Features

SPD Type 2 Surge arrester range for single / three phase AC systems

- Surge arrester suitable for AC systems to protect equipment against induced overvoltage or switching transients
- To be installed at the boundary of LPZ 1-LPZ 2 zones or higher
- Visual indication of status of SPD - Healthy/Replace
- Contact for remote signalling of SPD status. Connector (06P.01) included
- Replaceable varistor and spark gap modules with colour code: white for varistor and green for spark gap
- Complies with EN 61643-11:2012
- 17.5 mm rail EN 60715 mounting for each module

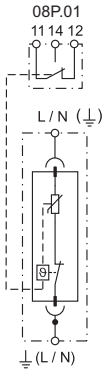
6P.21.8.320.1020 SPD Type 2, unipolar protection suitable to realize single phase or three phase systems (230/400 V)
- Varistor protection L/N(GND)-GND/(L/N)
- Replaceable module

6P.22.8.320.1020 SPD Type 2 for single phase system with Neutral
- Varistor protection L-N + spark gap protection N-PE
- Replaceable varistor and spark gap modules

6P.21 / 6P.22
Screw terminal

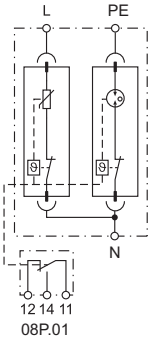
6P.21.8.320.1020

- SPD Type 2 (1 varistor)
- Replaceable varistor module with colour code
- Visual and remote signalling of varistor status



6P.22.8.320.1020

- SPD Type 2 (1 varistor + 1 spark-gap)
- Combination of replaceable varistor and encapsulated spark gap modules with colour code
- Visual and remote signalling of varistor and GDT status



For outline drawing see page 5

SPD specification			L-N	N-PE
Maximum continous operating voltage (U_C)	V AC/DC	320/—	320/—	255/—
Nominal discharge current (8/20 µs) (I_n)	kA	20	20	20
Maximum discharge current (8/20 µs) (I_{max})	kA	40	40	40
Voltage protection level at I_n(U_P)	kV	1.5	1.5	1.5
Response time (t_a)	ns	25	25	100
Short-circuit proof at maximum overcurrent protection	kA_{rms}	50	50	—
Maximum overcurrent protection (fuse rating gL/gG)		125 A	125 A	—
Replacement module code		6P.20.8.320.0020	6P.20.8.320.0020	6P.20.1.000.0020
Other technical data				
Ambient temperature range	°C	–40...+80		
Protection degree		IP20		
Wire size		solid cable	stranded cable	
	mm^2	1x2.5...1x35	1x2.5...1x25	
	AWG	1x13...1x2	1x13...1x4	
Wire strip length	mm	10		
Screw torque	Nm	4		
Remote status signalling contact specification				
Contact configuration		1 CO (SPDT)		
Rated current	A AC/DC	0.5/0.1		
Rated voltage	V AC/DC	250/250		
Wire size (06P.01)		solid cable/stranded cable		
	mm^2	1.5		
	AWG	16		
Approvals (according to type)		CE		

Features

SPD Type 2 Surge arrester range - three phase systems

- Surge arrester suitable for 230/400 V system applications to protect equipments against induced overvoltage or switching transients
- To be installed at the boundary of LPZ 1-LPZ 2 zones or higher
- Visual indication of status of SPD - Healthy/Replace
- Contact for remote signalling of SPD status. Connector (06P.01) included
- Replaceable varistor and spark gap modules with colour code: white for varistor and green for spark gap
- Complies with EN 61643-11:2012
- 35 mm rail (EN 60715) mounting

6P.23.8.320.1020 SPD Type 2 for three phase system without Neutral (PEN conductor)
- Varistor protection L1, L2, L3-PEN
- Replaceable varistor module

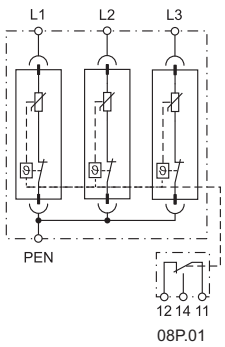
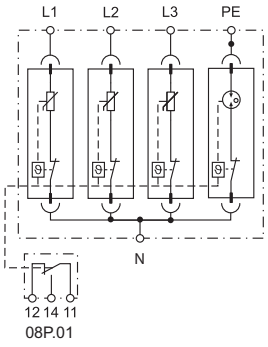
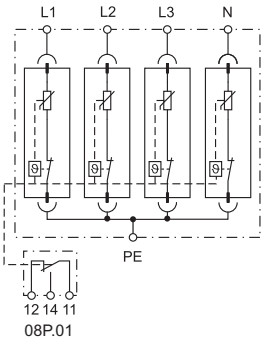
6P.24.8.320.1020 SPD Type 2 for three phase system with Neutral
- Varistor protection L1, L2, L3 + Spark gap protection N-PE
- Replaceable varistor and spark gap modules

6P.25.8.320.1020 SPD Type 2 for three phase system with Neutral.
- Varistor protection L1, L2, L3, N-PE
- Replaceable varistor module

6P.23.8 / 6P.24 / 6P.25
Screw terminal

For outline drawing see page 5

E

	6P.23.8.320.1020	6P.24.8.320.1020	6P.25.8.320.1020
			
	• SPD Type 2 (3 varistors) • Replaceable varistor module, 3 pole, with colour code • Visual and remote signalling of varistor status	• SPD Type 2 (3 varistors + 1 spark-gap) • Combination of replaceable varistor and encapsulated spark gap modules with colour code • Visual and remote signalling of varistor and GDT status	• SPD Type 2 (4 varistors) • Replaceable varistor module, 4 pole, with colour code • Visual and remote signalling of varistor status
			

SPD specification		L, N-PEN	L-N	N-PE	L, N-PE
Maximum continous operating voltage (U_C) V AC/DC		320	320/—	255/—	320
Nominal discharge current (8/20 µs) (I_n)	kA	20	20	20	20
Maximum discharge current (8/20 µs) (I_{max})	kA	40	40	40	40
Voltage protection level at I_n(U_P)	kV	1.5	1.5	1.5	1.5
Response time (t_a)	ns	25	25	100	25
Short-circuit proof at maximum overcurrent protection	kA_{rms}	—	50	—	50
Maximum overcurrent protection (fuse rating gL/gG)		125 A	125 A	—	125
Replacement module code		6P.20.8.320.0020	6P.20.8.320.0020	6P.20.1.000.0020	6P.20.8.320.0020
Other technical data					
Ambient temperature range	°C	–40...+80			
Protection degree		IP20			
Wire size		solid cable		stranded cable	
	mm^2	1x2.5...1x35		1x2.5...1x25	
	AWG	1x13...1x2		1x13...1x4	
Wire strip length	mm	10			
Screw torque	Nm	4			
Remote status signalling contact specification					
Contact configuration		1 CO (SPDT)			
Rated current	A AC/DC	0.5/0.1			
Rated voltage	V AC/DC	250/250			
Wire size (06P.01)		solid cable/stranded cable			
	mm^2	1.5			
	AWG	16			
Approvals (according to type)		CE			

Features

SPD Type 2 Surge arrester range for Photovoltaic applications

- Surge arrester for protection of DC side (600 V to 1,020 V) of systems in photovoltaic applications
- Protects equipment against inducedovervoltage caused by lightning strikes or switching transients

6P.27.9.600.1020, U_{CPV} = 600 V DC
6P.23.9.000.1020, U_{CPV} = 1,020 V DC

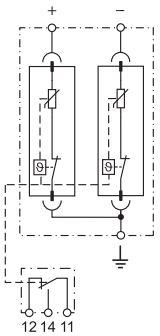
- Visual indication of varistor status - Healthy/Replace
- Contact for remote signalling of varistor status. Connector (06P.01) included
- Replaceable modules with colour code: white for varistor
- Complies with EN 50539-11:2010
- 35 mm rail (EN 60715) mounting

6P.27 / 6P.23
Screw terminal

For outline drawing see page 5

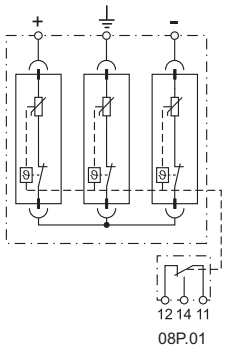
6P.27.9.600.1020

- SPD Type 2 (2 varistors) for 600 V DC photovoltaic systems
- Replaceable varistor modules with colour code
- Visual and remote signalling of varistor status



6P.23.9.000.1020

- SPD Type 2 (3 varistors) for 1,020 V DC photovoltaic systems
- Replaceable varistor modules with colour code
- Visual and remote signalling of varistor status



SPD specification		Varistor module	Varistor module
Maximum operating voltage (U_{CPV})	V DC	600	1,020
Maximum operating voltage /per module (U_{CPV})	V DC	600	500
Nominal discharge current (8/20 µs) /per module (I_n)	kA	20	20
Maximum discharge current (8/20 µs) /per module (I_{max})	kA	40	40
Voltage protection level per module (U_P)	kV	2.2	2.1
Voltage protection level of the system U_P (+ → –)/(+/– → PE)	kV	4.4/2.2	4.2/4.2
Voltage protection level VPR	kV	< 3.2	< 3.2
Response time (t_a)	ns	25	25
Short circuit current withstand I_{SCPV}	A	125	125
Replacement module code		6P.20.9.600.0020	6P.20.9.500.0020
Other technical data			
Ambient temperature range	°C	–40...+80	
Protection degree		IP20	
Wire size		solid cable	stranded cable
	mm^2	1x2.5...1x35	1x2.5...1x25
	AWG	1x13...1x2	1x13...1x4
Wire strip length	mm	10	
Screw torque	Nm	4	
Remote status signalling contact specification			
Contact configuration		1 CO (SPDT)	
Rated current	A AC/DC	0.5/0.1	
Rated voltage	V AC/DC	250/250	
Wire size (06P.01)		solid cable/stranded cable	
	mm^2	1.5	
	AWG	16	
Approvals (according to type)		CE	

Ordering information

Example: 6P series, surge protection device, Type 2, single phase (Uc = 320 V), 1 varistor + 1 encapsulated spark gap, with remote status signalling contact, In = 20 kA

6	P	.	2	2	.	8	.	3	2	0	.	1	0	2	0

Series

Type
2 = Type 2 surge arresters

Circuit
1 = Single phase (1 varistor)
2 = Single phase (1 varistor + 1 spark-gap)
3 = Three-phase (3 varistors)
4 = Three-phase (3 varistors + 1 spark-gap)
5 = Three-phase (4 varistors)
7 = Single phase (2 varistors) Type 2 SPD
0 = Spare module

Supply version
1 = N+PE connection
(only for single spark gap replaceable module)
8 = AC (50/60 Hz)
9 = DC (PV application)

Supply voltage
000 = 1,000 V DC Max (U_{cpv} for Type 2) or N+PE connection for spark gap modules
320 = 320 V Max (U_c for Type 2)
600 = 600 V DC Max (U_{cpv} for Type 2)

Nominal discharge current
020 = 20 kA (I_n Type 2)

Remote status signalling contact
1 = Built-in remote status signalling contact

E

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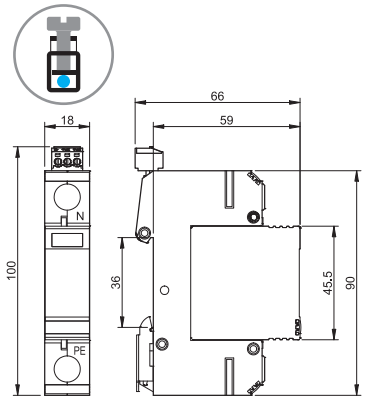
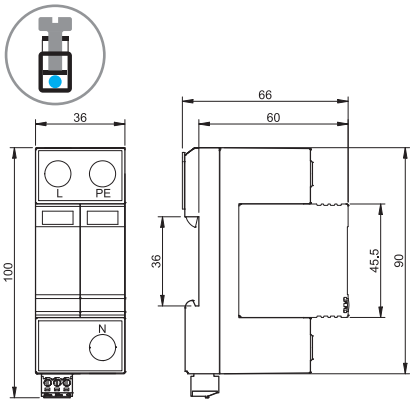
Outline drawings

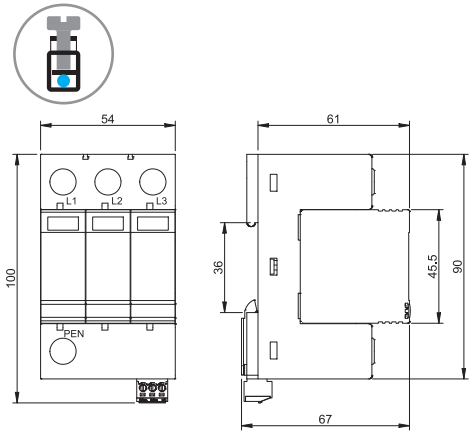
Type 6P.21.8.320.1020
Screw terminal



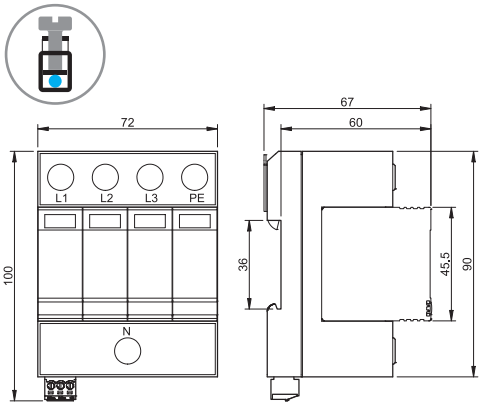
Type 6P.22.8.320.1020
Screw terminal



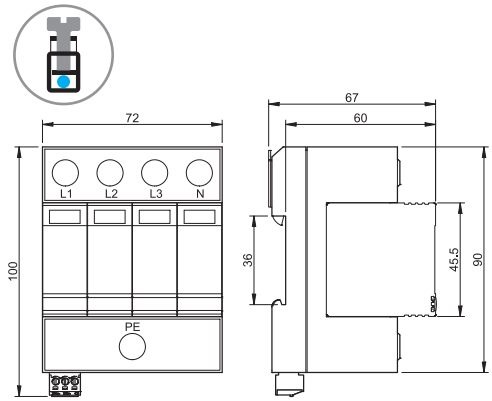
Type 6P.23.8.320.1020
Screw terminal



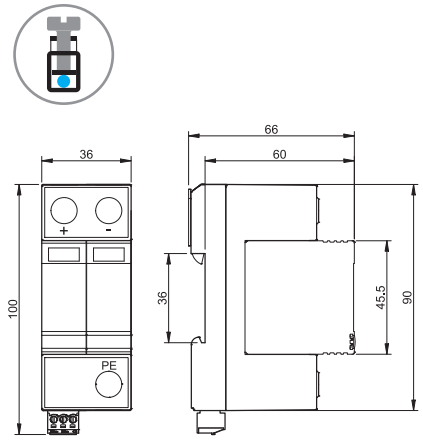
Type 6P.24.8.320.1020
Screw terminal



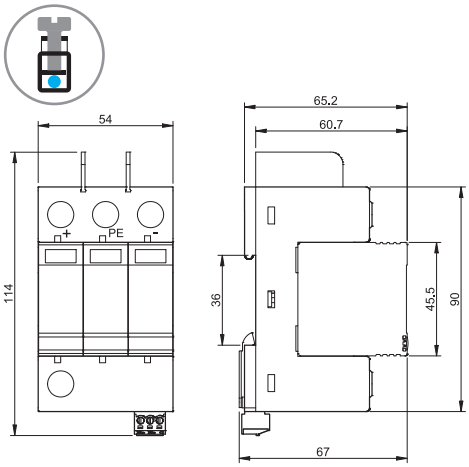
Type 6P.25.8.320.1020
Screw terminal



Type 6P.27.9.600.1020
Screw terminal



Type 6P.23.9.000.1020
Screw terminal



E

Features

SPD Type 3, Surge arrester for TT and TN-S system (with Neutral)
Single phase applications within socket outlets and 35 mm rail mounting

- Protects electrical and electronic equipment sensitive to impulse overvoltage
- "1+1" configuration: varistor + spark gap protection (avoiding earth leakage current)
- Conforms to EN 61643-11

7P.32.8.275.2003
- Provides easy additional surge protection for 230 V sockets
- Acoustic indication of need to replace varistor
- 3-wires, 150 mm long, for connection to socket terminals

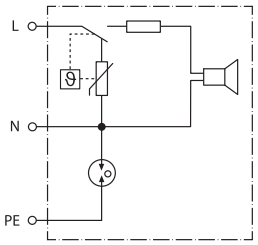
7P.37.8.275.1003
- Permits serial connection for optimized load protection up to 16 A
- Integrated remote signalling contact of varistor status
- Relay with gold change-over contact for reliable low level switching
- 17.5 mm L-N/N-PE protection
- Mounting on 35mm DIN rail (EN60715)

E

* see diagram L7P page 12
For outline drawing see page 9

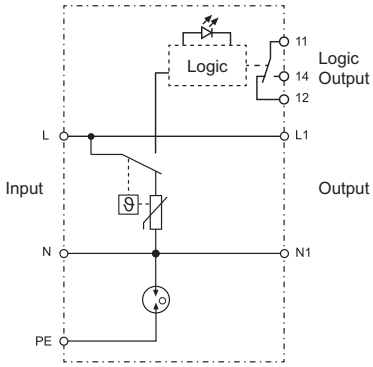
7P.32.8.275.2003

- SPD Type 3
- Acoustic (buzzing) signalling of varistor fault



7P.37.8.275.1003

- SPD Type 3
- Series connection for protection of loads up to 16 A
- Remote signaling of varistor status by integral change-over relay contact



SPD specification				
Nominal voltage (U_N)	V AC	230	230	
Maximum continuous operating voltage (U_C)	V AC	275	275	
Rated load current I_L	A	–	16	
Nominal discharge current (8/20 µs) L-N, L(N)-PE (I_n)	kA	3/3	3/3	
Test voltage of the combined generator L-N, L(N)-PE (U_{OC})	kV	6/6	6/6	
Voltage protection level L-N, L(N)-PE (U_P)	kV	1/1.5	1/1.5	
Response time L-N, L(N)-PE (t_a)	ns	25/100	25/100	
Short-circuit proof at maximum overcurrent protection	kA_{rms}	6	5	
Maximum overcurrent protection		16A gL/gG, C16 A	16A gL/gG, B16A, C16A	
Other technical data				
Ambient temperature range	°C	–25...+80	–25...+70*	
Protection degree		IP 20	IP 20	
Wire size		–	solid cable	stranded cable
	mm^2	–	0.5...6	0.5...4
	AWG	–	20...10	20...12
Wire strip length	mm	–	9	
Screw torque	Nm	–	0.8	
Remote status signalling contact specification				
Contact configuration		–	1 CO (SPDT)	
Rated current	A AC	–	0.5	
Rated voltage	V AC	–	230	
Breaking capacity DC1: 30/110	A	–	2/0.3	
Minimum switching load	mW (V/mA)	–	10 (5/5)	
Contact material		–	AgNi + Au	
Approvals (according to type)		CE EAC PG	CE EAC ESC PG	

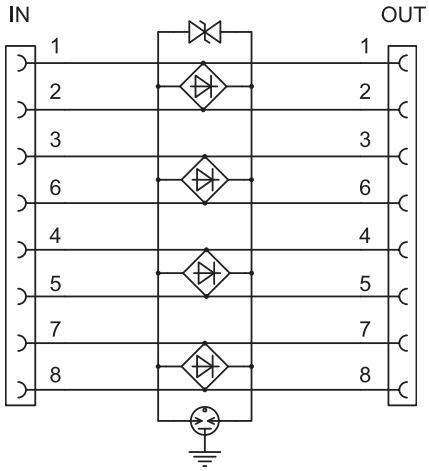
Features

Data line SPD for Ethernet Cat. 6

- Suitable for Ethernet, POE (Power over Ethernet) and dataline transmission system up to 250 MHz
- Protection of all pairs of conductors with minimum attenuation
- Aluminum chassis and RJ45 in metal screens
- Included accessories for simple installation near the equipment to be protected, LPZ boundary 2-3 (Type 3)
- Complies to EN 61643-21
- Mounting on 35mm DIN rail

7P.68.9.060.0600

- Ethernet Cat 6 - 60 V
- Shielded RJ45 connectors



For outline drawing see page 9

SPD specification		
Nominal voltage of system (U_N)	V DC	48
Maximum operating voltage (U_C)	V DC	60
Nominal current I_L	mA	500
C2 total nominal discharge current (8/20 µs) line - PG (I_n)	kA	1.6
C2 nominal discharge current (8/20 µs) line-line (I_n)	A	200
Voltage protection level line-line @ In (C2) - (Up)	V	40
Voltage protection level line-PG @ In (C2) - (Up)	V	350
Voltage protection level line-line @ 1kV/µs (C3) - (Up)	V	65
Insertion attenuation @ 250 MHz	dB	<2
Response time	ns	1
Other technical data		
Ambient temperature	°C	–40...+80
Degree of protection		IP 20
Input-Output connection		RJ45/RJ45 shielded
Approvals (according to type)		CE

Ordering information

Example: 7P series, surge protection device, Type 3, single phase (Uc = 275 V), 1 varistor + 1 encapsulated spark gap, with remote status signalling relay, In = 3 kA

7	P	.	3	7	.	8	.	2	7	5	.	1	0	0	3

Series

Type
3 = Type 3 surge arresters
6 = Data line SPD

Circuit
2 = Single phase (1 varistor + 1 spark-gap)
7 = Single phase (1 varistor + 1 spark gap) Type 3, DIN rail mounting
8 = Protected poles (Data line SPD)

Supply version
8 = AC (50/60 Hz)
9 = DC (PV application and data line SPD)

Supply voltage
275 = 275 V Max

Nominal discharge current
003 = 3 kA (In @ U_{oc} only for 7P.32 and 7P.37)
600 = Ethernet Cat 6 (Data line SPD)

Remote status signalling contact
0 = Without remote status signalling contact
1 = Built-in remote status signalling contact
2 = Acoustic fault signalling

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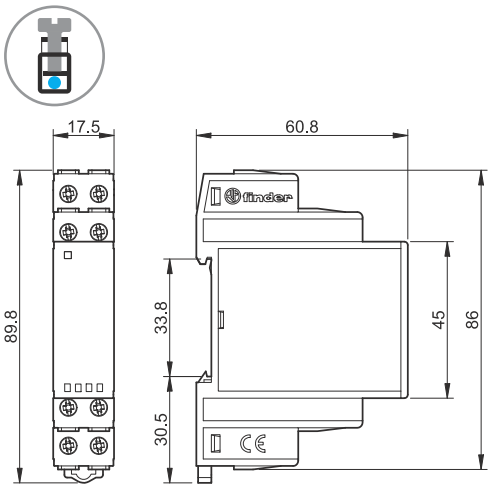
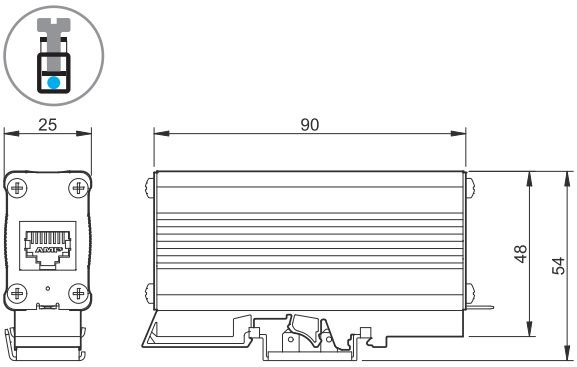
Outline drawings

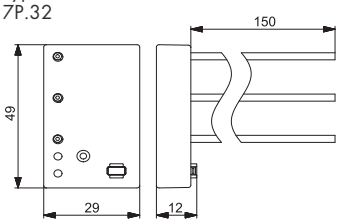
Tipo 7P.37.8.275.1003
Screw terminal



Type 7P.68.9.060.0600
Screw terminal



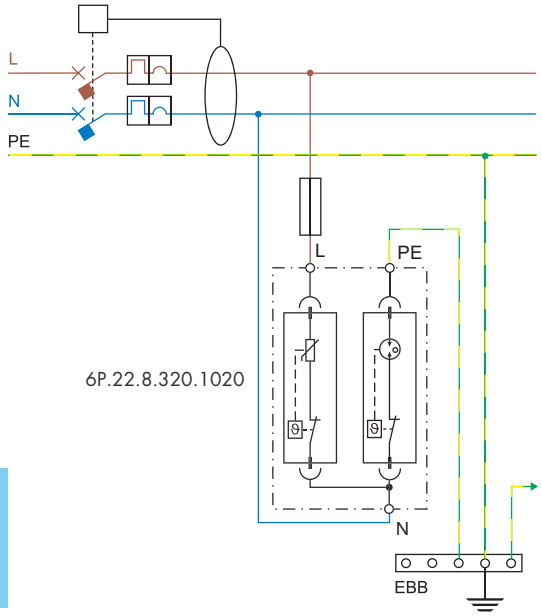
Type
7P.32



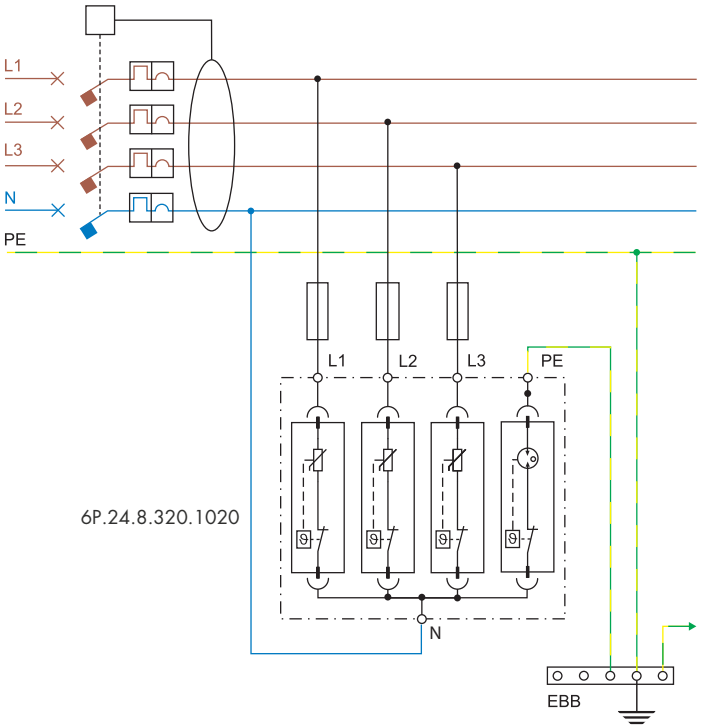
E

Installation example - SPD Type 2

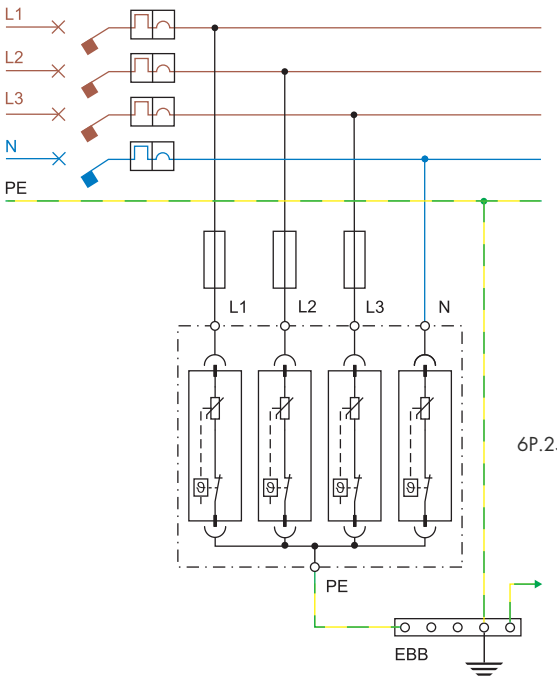
TT or TN-S SINGLE PHASE SYSTEM - SPD DOWN-STREAM OF RCD



TT or TN-S SINGLE PHASE SYSTEM - SPD DOWN-STREAM OF RCD

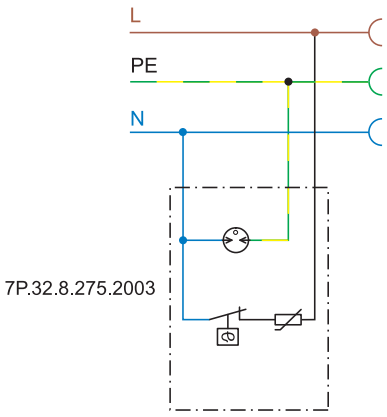


TN-S-THREE PHASE SYSTEM - SPD DOWN-STREAM OF MCB



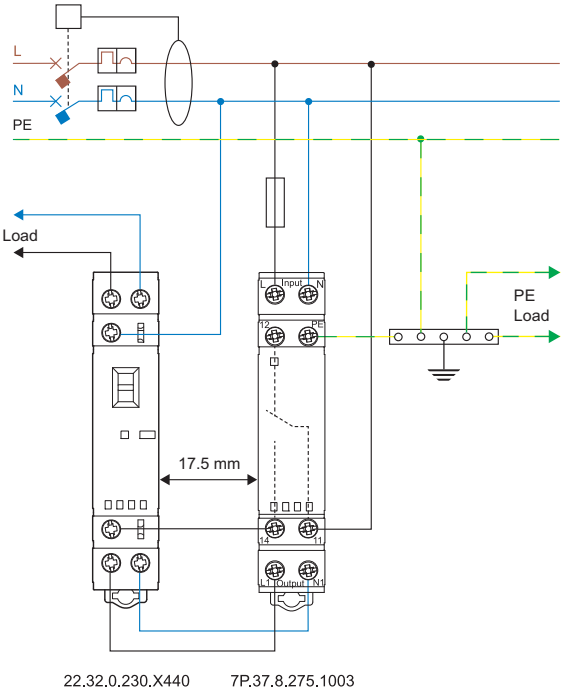
Installation example for SPD Type 3

TT or TN-S SINGLE PHASE SYSTEM - INCORPORATED IN SOCKET OUTLET

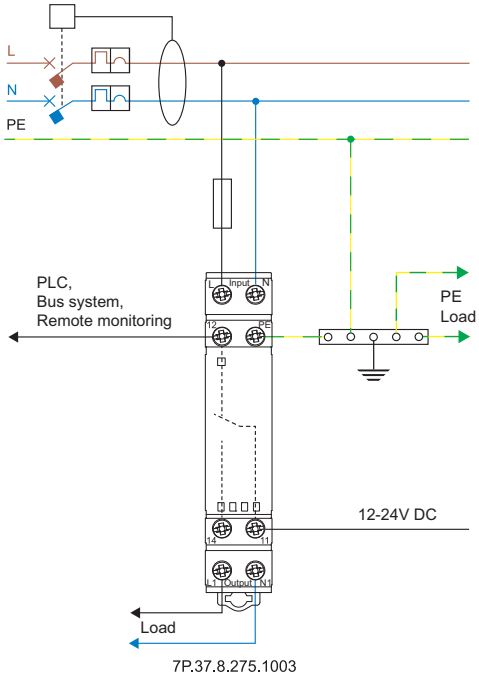


Installation example for SPD Type 3 - Single phase

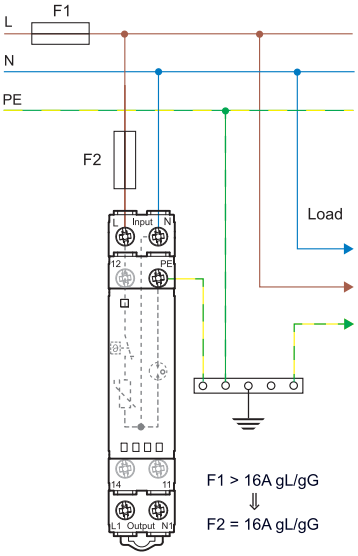
TT or TN-S SINGLE PHASE SYSTEM - SPD DOWN-STREAM OF RCD
Serial connection



TT or TN-S SINGLE PHASE SYSTEM - SPD DOWN-STREAM OF RCD
Serial connection + BUS line

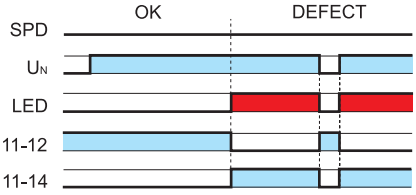


TT, TN-S SINGLE PHASE: parallel connection

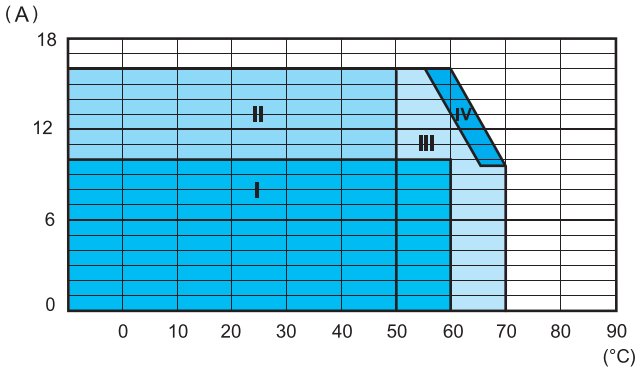


Function

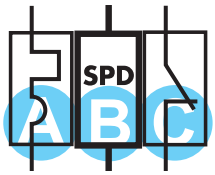
Visual local LED signalling and remote signalling of varistor status



L7P Temperature/Current diagram for model 7P.37

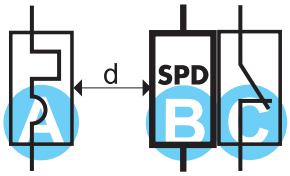


Zone I: SPD and other devices installed as a group (without gap)



- A MCB = B10A, C10A
- B 7P.37.8.275.1003
- C 22.32.0.xxx.x4x0

Zone II: SPD spaced, at least from one side, from components that generate heat during their operation (17.5 mm gap)

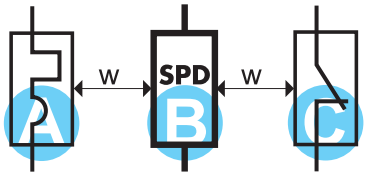


- A MCB = B16A, C16A
- B 7P.37.8.275.1003
- C 22.32.0.xxx.x4x0
- d 17.5 mm

- A MCB = B16A, C16A
- B 7P.37.8.275.1003

- B 7P.37.8.275.1003
- D 22.32.0.xxx.x3x0
  22.32.0.xxx.x4x0

Zone III: SPD spaced, on both side, from components that generate heat during their operation (20 mm gap)



- A MCB = B16A, C16A
- B 7P.37.8.275.1003
- C 22.32.0.xxx.x4x0
- W 20 mm

Zone IV: SPD installed individually in free air (without significant influence from nearby components)

- B 7P.37.8.275.1003

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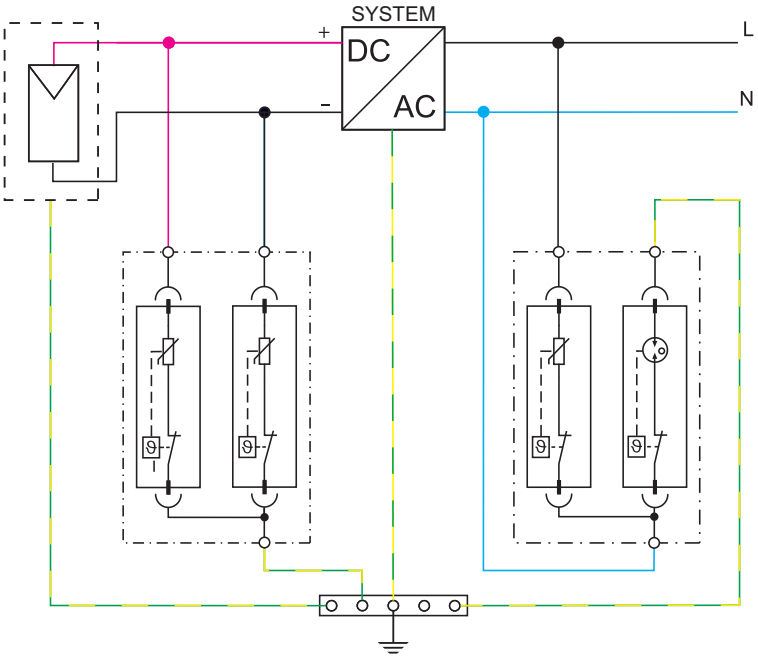
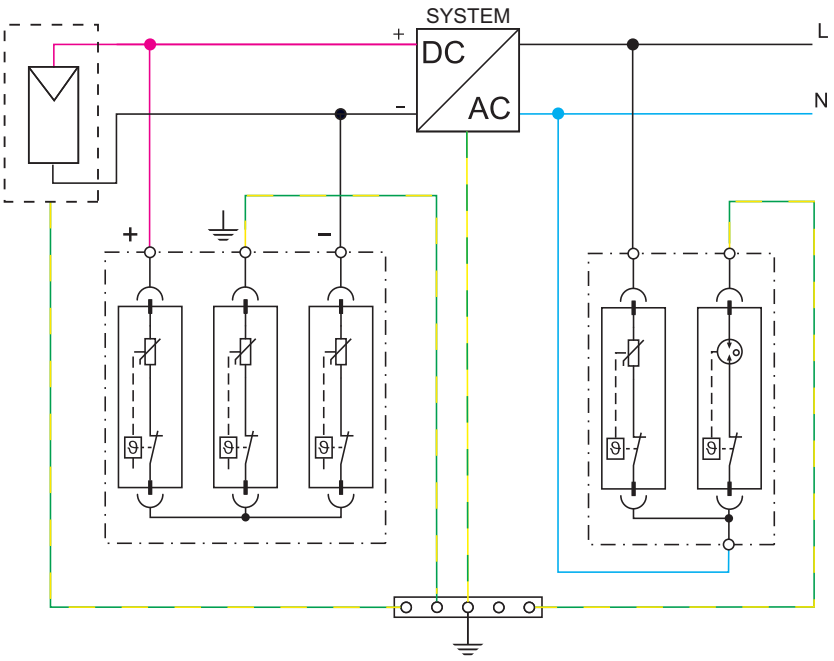
Installation examples - photovoltaic system



6P.27.9.600.1020 6P.22.8.320.1020



6P.23.9.000.1020 6P.22.8.320.1020

E

SURGE VOLTAGE PROTECTORS

Surge voltage protectors (such as Finder's Surge Protection Devices, SPD) are intended to be installed in electrical systems, to protect people and machines from surge voltages that can occur on the electrical supply line and which would otherwise have disastrous consequences. These surge voltages can be atmospheric (lightning) or can originate on the electrical system due to, for example: the opening and closing of large loads, short circuits, or the switching of large power factor correction capacitors. The SPD can be described as a switch that is in parallel with the electrical system's supply line - which it is protecting. At the nominal network voltage (e.g. 230 V) the SPD appears as an open switch, having a very high impedance (almost infinite). But, under an overvoltage condition its impedance rapidly falls to near 0 Ω. This effectively applies a short circuit across the supply lines and immediately "drains" the overvoltage to earth. In this way the supply line is protected wherever an SPD is installed. When the overvoltage has passed, the SPD impedance rises rapidly and resumes the state of an open switch again.

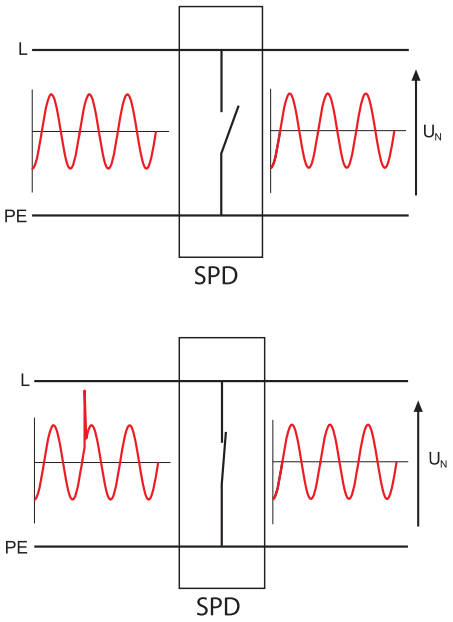


Figure 1: Ideal operation of an SPD

SPD technologies

Finder surge voltage protectors use either varistors or spark gaps.

Varistor: This can be considered as a variable resistance that at nominal voltage has a very high ohmic value. But the resistance rapidly falls to near zero as the voltage surges. In this way the varistor applies a near short circuit which clamps the surge voltage. The varistor is however subject to progressive degradation due to the small leakage current that occurs at the nominal voltage, and with the number of interventions. With every overvoltage that occurs the leakage current rises and accelerates the end of life for the device - which is ultimately indicated by the change from green to red in the signal-window.

Spark gap: This comprises two electrodes separated by air, or a gas. When a surge voltage occurs an electrical arc bridges the gap and a surge current flows to limit the surge voltage to a low and constant level. The arc extinguishes only when the surge current falls below about 10 ampere. The gas guarantees a constant level of breakdown voltage since the arc is struck in a protected environment; not exposed to pressure or humidity variations or impurities as would happen if it had occurred in air. There is however, a delay before the device arcs and the surge current is diverted, and this is dependent on the magnitude of the original voltage surge and on its rate of rise. Therefore, the voltage protection level can vary, although it is guaranteed to be less than U_p.

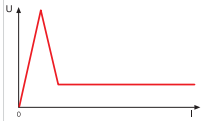
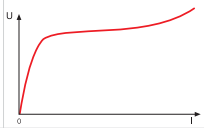
Component	Symbol	Leakage current	Energy dissipated	Response time	Voltage/Current characteristic
Ideal		0	High	Fast	
Spark gap		0	High	Medium	
Varistor		Very Low	Medium	Fast	

Figure 2: SPD component characteristics.

Installation (Overvoltage) categories

Choosing the SPD requires matching the Rated Impulse Voltage of the SPD with that of the equipment to be protected. This in turn relates to the Installation category (Overvoltage category). Installation categories are described within IEC 60664-1, which for a 230/400 V installation prescribes as follows:

- **Installation category I:** 1.5 kV for "particularly sensitive" equipment (e.g. electronic devices like PC or TV set);
- **Installation category II:** 2.5 kV for "user" equipment subject to "normal" impulse voltages (e.g. household electrical appliances, mobile items);
- **Installation category III:** 4 kV for equipment that are part of a fixed installation (e.g. switchboards, switches)
- **Installation category IV:** 6 kV for equipment installed at or near the origin of main incoming supply mains (e.g. energy meters).

Lightning Protection Zones and installation considerations

International standards refer to the various Lightning Protection Zones by the letters LPZ followed by an appropriate number.

LPZ 0A: An external area, where a direct lightning strike is possible and where there is total exposure to the electromagnetic field induced by the lightning.

LPZ 0B: An external area, but below a lightning conductor providing direct lightening strike protection. There remains total exposure to the electromagnetic field.

LPZ 1: Area within a building – therefore protected from direct lightning strike. The electromagnetic field will be attenuated, depending on the degree of shielding. This zone has to be protected by SPD type 1 device(s) at its boundary with the LPZ 0A or 0B zone.

LPZ 2: An area, typically a room, where the lightning current has been limited by preceding surge protectors. This zone has to be protected by SPD type 2 device(s) at its boundary with the LPZ 1 zone.

LPZ 3: An area within a room where the lightning current has been limited by preceding surge protectors (typically the wiring after a socket or an area within a metal enclosure). This zone has to be protected by SPD type 3 device(s) at its boundary with the LPZ 2 zone.

On the following picture (Figure 3, representation is not binding) it is shown that the transition from a protection zone to the next is through the installtion of SPD. SPD Type 1 must be connected upstream the system, at the point of delivery connection. As an alternative it is possible to use SPD Type 1+2.

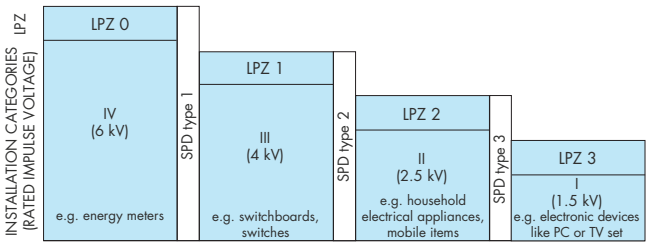


Figure 3: Typical relationship between Lightning Protection Zones, Installation Categories and SPD types

Rated values and marking common to all SPD

[U_c] Maximum continuous operating voltage: Under this voltage the SPD is guaranteed to appear as an "open switch". This voltage is normally at least equal to the nominal supply voltage (U_N) + 10%. For the Finder SPD, U_c is specified as 275 V.

[U_p] Voltage protection level: This is the highest voltage level seen across the SPD during its intervention. For example, for Finder SPD Type 2, this means that a 4kV overvoltage would be limited by the SPD to a maximum 1.2 kV. Consequently, electronic devices such as PC, TV, stereo, etc. are protected - as their own internal protection will handle overvoltages U_p to 1.5 kV.
To better understand this concept; imagine that the SPD is a switch in series a low resistance. In the case of an overvoltage the switch closes and all the current goes through the resistance. According to Ohm's law the voltage developed across the resistance will be this resistance x the current (V = R x I), and will be limited to < U_p.

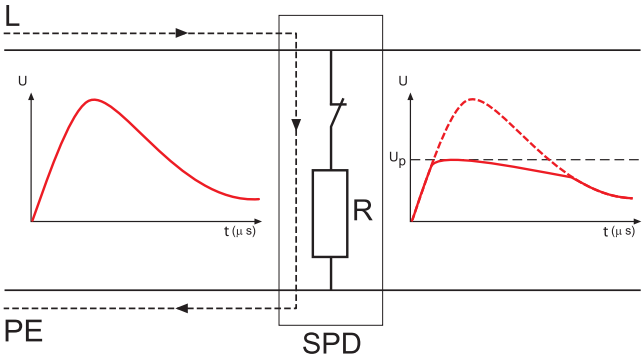


Figure 4: Overvoltage limiting

Short circuit proof: A further characteristic, not normally marked on the product but important for its correct installation, is the Short circuit proof at maximum overcurrent protection. This is the maximum short-circuit current that the SPD is able to withstand when it is installed with additional maximum overcurrent protection - such as a fuse rated in accordance with the value stated under the SPD specification. Consequentely the maximum prospective short-circuit current of the system at the point of installation of the SPD must not exceed this value.

Rated vaules and marking of SPD Type 1

SPD Type 1 must be connected upstream the system, at the point of delivery of power energy. SPD protects building and people from the risk of direct lightning (fire and death) and are characterized by:

[I_{imp}10/350] Impulse current: I_{imp} corresponds to the peak value of a 10/350 µs current impulse waveform. This waveform represents a direct lightning strike and is used in tests to prove the performance of SPD type 1 devices.

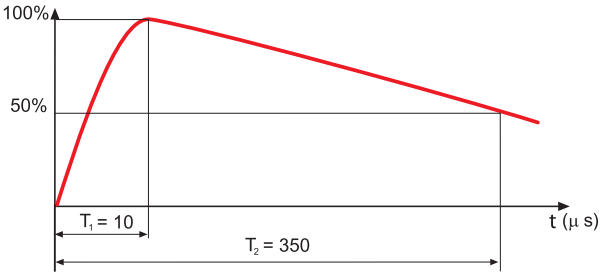


Figure 5: 10/350 µs current waveform

Comparison of the waveforms in figures 5 and 6 shows the much higher energy content controlled by the type 1 SPD.

[I_n8/20] Nominal discharge current: The peak current (and waveform shape) through the SPD under conditions prescribed by EN 62305 to represent the surge current as a consequence of a lightning strike to the electric supply line.

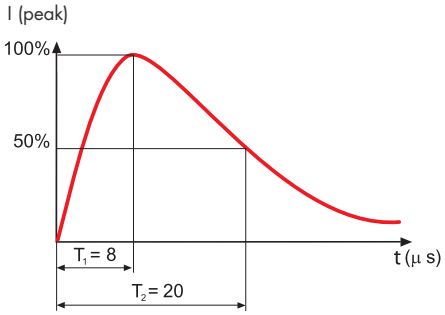


Figure 6: 8/20 µs current waveform

Rated values and marking of SPD Type 2

SPD Type 2 devices are designed to remove all the overvoltage from supply circuits that are not likely to be directly hit by lightning. SPD Type 2 are connected downstream SPD Type 1 or SPD Type 1+2, (minimum distance 1 m) and they protect machine and tools connected to the ground and reduce the risk of economic loss.
SPD Type 2 are characterized by:

[I_n8/20] Nominal discharge current: The peak current (and waveform shape) through the SPD under conditions prescribed by EN 62305 to represent the surge current as a consequence of a lightning strike to the electric supply line.

[I_{max}8/20] Maximum discharge current: Peak value of the highest current of a 8/20µs waveform that an SPD can discharge at least once without breaking.

Rated values and marking of SPD Type 3

SPD type 3 devices are used to protect the end user from overvoltage. They may be installed in supply networks where SDP types 1 and/or 2 already exist. They can be installed in fixed or mobile sockets and have the following characteristic parameters.

U_{oc}: test voltage. This is the peak value of the no load voltage of the combined test-generator; this has a waveform of 1.2/50 µs (figure 7) and can supply at the same time current with waveform 8/20 µs (figure 6).

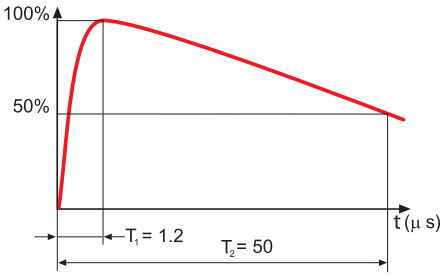
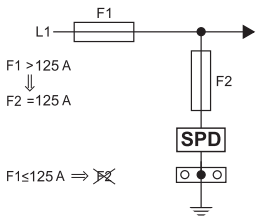


Figure 7: 1.2/50 µs voltage waveform

Suggestion for the connection

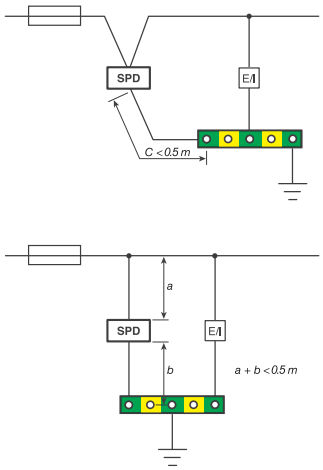
The correct connection of SPD requires a shortest as possible connection to the local equipotential bar, to which are connected PE cables of the equipment to be protected. From the local equipotential bar there is a connection to the EBB. The phase wiring remains appropriate to the load.



Short-circuit protection for the SPD is provided by the overcurrent protective devices (fuses type gL/gG) recomended.

If the overcurrent protective devices F1 (which are part of the installation) have a rating smaller than or equal to the maximum recommended rating for the overcurrent protective devices for the SPD, then F2 (back up fuse), can be omitted.

Connecting cable
Depending on the type of connection, serial (V-shape) or parallel (T-shape), ensure that both the maximum cable lengths and minimum cross section of the connecting wires are respected in accordance with the information below (IEC 60634-5-534):



The section of the connecting wires (copper) must not be less than:
SPD Tipo 1: 16 mm^2 if it is subject to discharge a significant lightning current, 6 mm^2 otherwise
SPD Type 2: 6 mm^2
SPD Type 3: 1.5 mm^2

PROTECTING PHOTOVOLTAIC (PV) SYSTEMS AGAINST LIGHTNING

Installation characteristics

[U_{OCSTC}] PV voltage: Open circuit voltage, measured under standardized test conditions, of the PV module, panel, array, or the DC side of the photovoltaic inverter. EN50539-12.

[I_{SCSTC}]: Short-circuit current: Short-circuit current, measured under standardized test conditions, of the PV module, panel, array, or photovoltaic inverter. EN50539-12.

[U_{CPV}] SPD Maximum continuous operating voltage: Must be equal or greater than to 1.2 times Uocstc in all conditions of radiation and temperature. EN50539-11, EN50539-12.

[I_{SCPV}]: Maximum prospective short-circuit current from the power system for which the SPD, in conjunction with the disconnectors specified, is rated. EN50539-11.

System installation

Photovoltaic systems are generally located external to a building and can be subjected to the direct or indirect effects of lightning.
Whilst the installation of photovoltaic panels on the roof does not, in itself, increase the risk of direct lightning, the only practical way to protect against the effects of a direct lightning strike would be the use of a lightning protection system (LPS).
The indirect effects of lightning can however, be mitigated by the appropriate use of Surge Protection Devices (SPD). These indirect effects occur when lightning strikes in proximity to the structure and where magnetic induction creates an overvoltage in the conductors – a danger to both people and equipment. In particular, the DC cables of a PV system would be exposed to the high conducted and radiated disturbances caused as a result of the lightning currents. In addition, overvoltages in PV systems are not only of atmospheric origin. It is also necessary to consider overvoltages due to switching on electrical networks connected to them. These overvoltages can also damage both the inverter and the PV panels, and this explains the need to protect the inverter on both DC and AC sides.

Photovoltaic system on a building without a lightning protection system (LPS)

As an example, Figure 8 represents a simplified photovoltaic system placed on a building without lightning rod. In such a system, the protection against lightning must be considered at the following points of installation:

- DC input of the inverter
- AC output of the inverter
- Low voltage supply network

At the DC input to the inverter SPDs specific for photovoltaic systems must be installed, according to the PV system voltage. At the inverter AC output, type 2 surge arresters must be installed suitable for the type of system. At the point of connection to the LV supply network, install type 2 surge arresters suitable to the type of system (TT, TN). In more complex systems, it might be necessary to introduce additional SPDs. DC side: if the distance between the inverter and PV modules exceeds 10 m, it is necessary to replicate and install the SPD as close as possible to the PV modules.

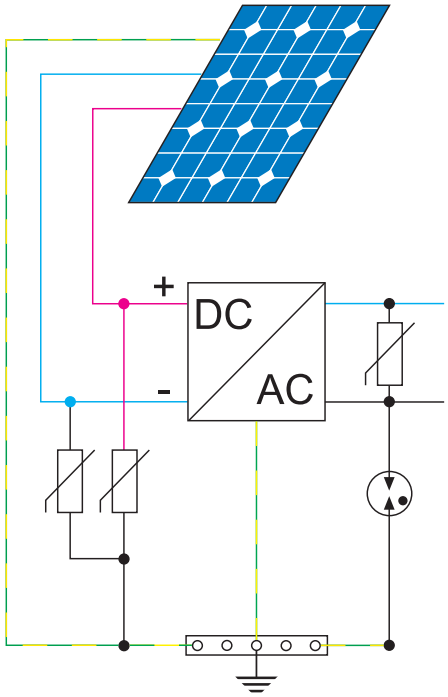


Figure 8: example of a photovoltaic system located on a building without LPS, protected on the DC side by an SPD with U_{OCSTC} = 500 V, and on the AC side by a 6P.22, specific for TT systems.

Photovoltaic system on a building with a lightning protection system (LPS)

Where an LPS exists it is good practice to install the photovoltaic panels in the area protected by the lightning rod.
In addition it is necessary to realize a good equipotential bonding system, which must be positioned as close as possible to the entry point of LV supply into the structure. The LPS, the SPD and all metal parts have to be connected to this equipotential system.
SPD protection on the DC depends on the safety distance (referred in EN50539-12:12-2012).
Note that under EN 62305 installation of a Type 1 SPD is mandatory at the point of delivery of the AC electricity supply, whether or not the building has LPS (with or without solar panels).

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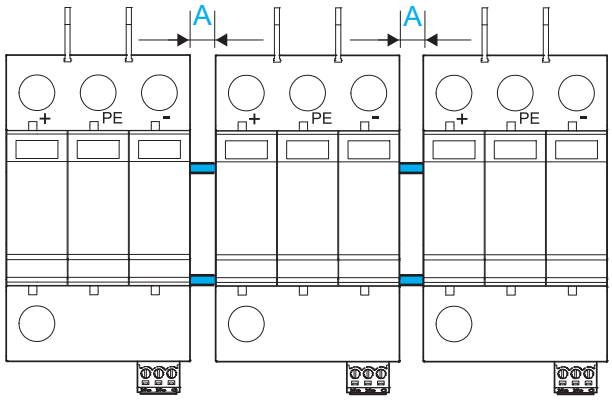
SPD fuse protection

Conforming to prEN50539-11: 2010, Finder SPDs are equipped with a thermal disconnector able to safely disconnect a worn or damaged varistor up to a value of short-circuit current equal to the short-circuit current withstand value (I_{scpv}), as specified in the technical data. Ensure that the PV short circuit current $I_{sc}<I_{scpv}$.
Ensure that the PV short circuit current Isc<Iscpv or increase the number of the strings.

Insulation distances and wiring

To conform with EN50539-11 insulation distances and minimum wiring cross section must be respected.



Insulation distances		Minimum Wiring [mm²]	
U_{CPV}(SPD)≥ 1.2xU_{OCSTC}	A [mm]	+/– Poles	Ground
600 V DC	5	4	6
1,000 V DC	5	4	6
1,200 V DC	7	4	6

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