



Inverter manufacturers

**66.22....x600,
66.22....x600S and
66.82....x600**

45.31

65.61.9xxx.x300S

Installations

**7P.26.9.420.1020
7P.23.9.700.1020
7P.23.9.000.1020**

7P.22.8.275.1020

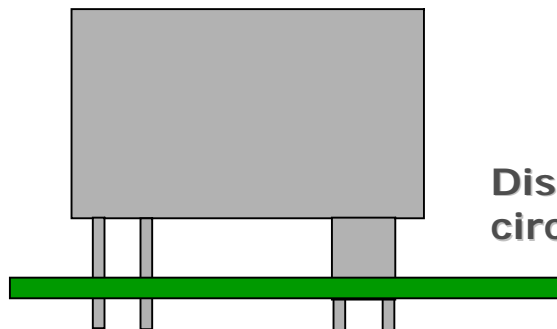
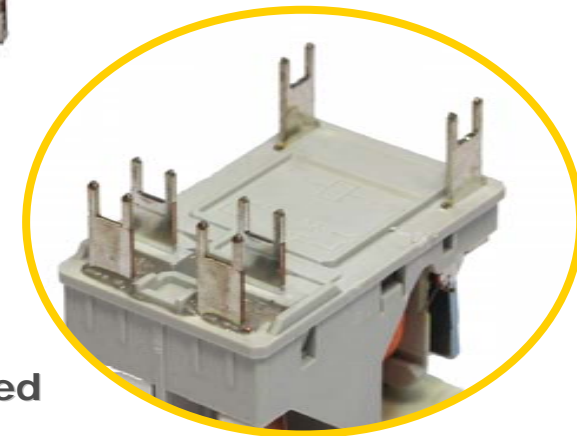
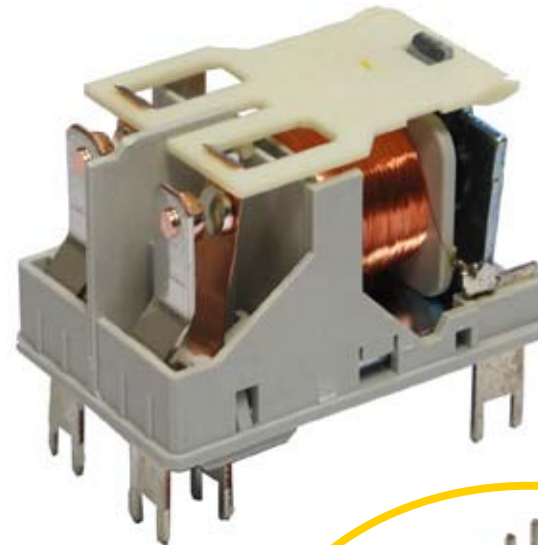


- As part of its strategy for growth in the rapidly expanding photovoltaic solar panel sector Finder has developed, in collaboration with a leading company in the field, special versions of existing relays (with a $> 1.5\text{mm}$ contact gap according to VDE 0126-1-1) targeted at producers of photovoltaic solar panel inverters.

Technical Characteristics:

- 2 contacts NO (DPST-NO),
≥ 1.5 mm contact gap
- DC coil only
- Type 66.22....x600S is
equipped with special
terminals that space the
relay body 5mm off the pcb
- to achieve improved relay
cooling.

contact gap $\geq 1.5 \text{ mm}$



**Distance above printed
circuit board, 5mm**

contact gap $\geq 3\text{mm}$

Technical Characteristics:

- 1 NO contact (SPST-NO),
 $\geq 3\text{mm}$ contact gap
- Maximum ambient
temperature $+105^{\circ}\text{C}$
- For pcb mounting

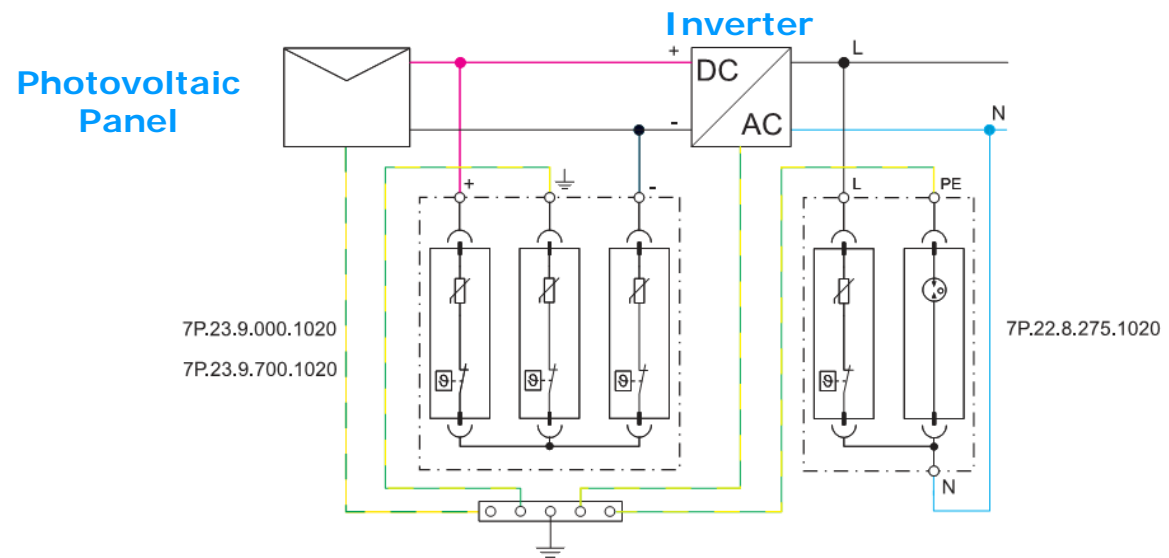
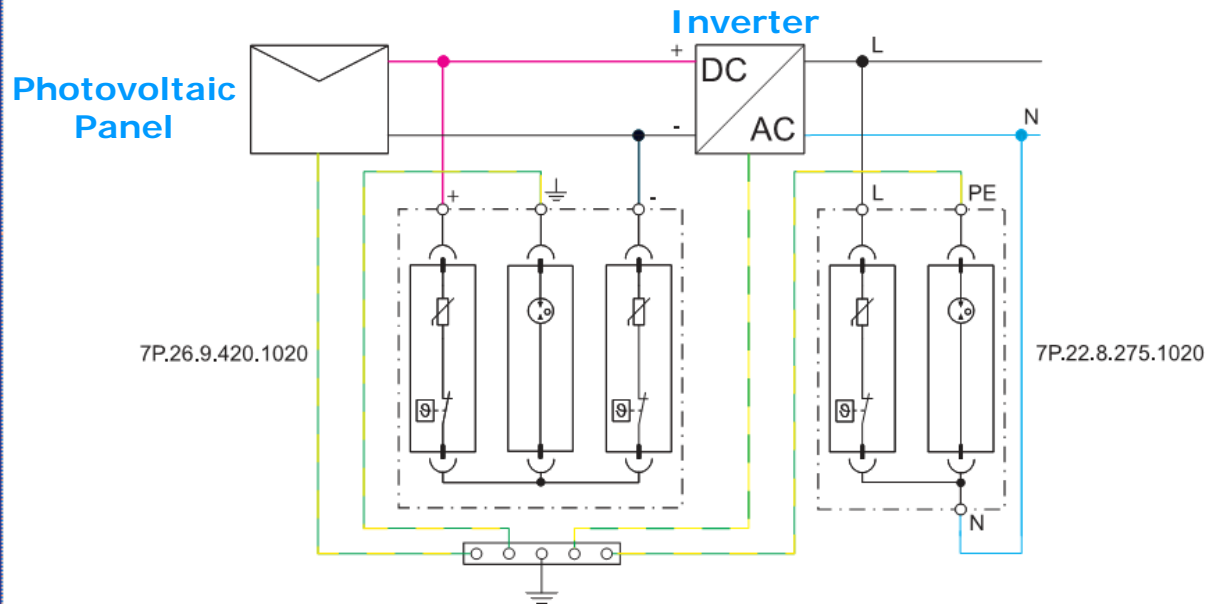


contact gap $\geq 3mm$



Technical characteristics:

- 1 NO contact (SPST-NO), $\geq 3mm$ opening
- IMQ approved (new approved rating of 35 A, AC7a)



Features

2 Pole Changeover (DPDT)

30 A Power relay

66.22 PCB connections & mount

66.82 Faston 250 connections

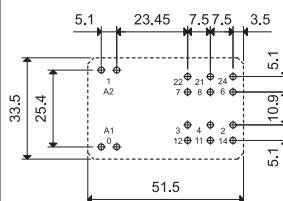
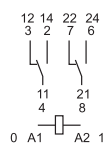
- Flange mount

- Reinforced insulation between coil and contacts according to EN 60335-1; 8 mm creepage and clearance distances
- AC coils & DC coils
- Cadmium Free option available

66.22



- 30 A rated contacts
- PCB mount - bifurcated terminals

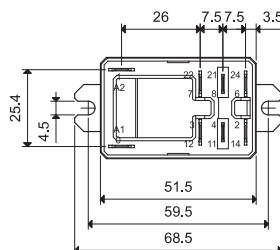
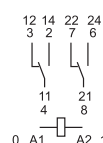


Copper side view

66.82



- 30 A rated contacts
- Flange mount
- Faston 250 connections



For outline drawing see page 6

FOR UL RATINGS SEE:

"General technical information" page V

Contact specification

Contact configuration		2 CO (DPDT)	2 CO (DPDT)
Rated current/Maximum peak current	A	30/50 (NO) - 10/20 (NC)	30/50 (NO) - 10/20 (NC)
Rated voltage/Maximum switching voltage V AC		250/440	250/440
Rated load AC1	VA	7,500 (NO) - 2,500 (NC)	7,500 (NO) - 2,500 (NC)
Rated load AC15 (230 V AC)	VA	1,200 (NO)	1,200 (NO)
Single phase motor rating (230 V AC)	kW	1.5 (NO)	1.5 (NO)
Breaking capacity DC1: 30/110/220 V	A	25/0.7/0.3 (NO)	25/0.7/0.3 (NO)
Minimum switching load	mW (V/mA)	1,000 (10/10)	1,000 (10/10)
Standard contact material		AgCdO	AgCdO

Coil specification

Nominal voltage (U _N)	V AC (50/60 Hz)	6 - 12 - 24 - 110/115 - 120/125 - 230 - 240	
	V DC	6 - 12 - 24 - 110 - 125	
Rated power AC/DC	VA (50 Hz)/W	3.6/1.7	3.6/1.7
Operating range	AC	(0.8...1.1)U _N	(0.8...1.1)U _N
	DC	(0.8...1.1)U _N	(0.8...1.1)U _N
Holding voltage	AC/DC	0.8 U _N /0.5 U _N	0.8 U _N /0.5 U _N
Must drop-out voltage	AC/DC	0.2 U _N /0.1 U _N	0.2 U _N /0.1 U _N

Technical data

Mechanical life AC/DC	cycles	10 · 10 ⁶	10 · 10 ⁶
Electrical life at rated load AC1	cycles	100 · 10 ³	100 · 10 ³
Operate/release time	ms	8/15	8/15
Insulation between coil and contacts (1.2/50 μs)	kV	6 (8 mm)	6 (8 mm)
Dielectric strength between open contacts	V AC	1,500	1,500
Ambient temperature range	°C	-40...+70	-40...+70
Environmental protection		RT II	RT II

Approvals (according to type)



Features

2 Pole NO (DPST-NO)

30 A Power relay

66.22-x300 PCB mount

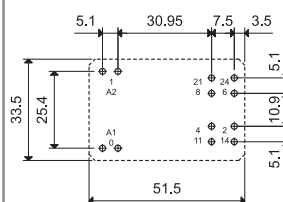
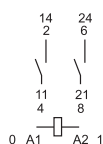
66.82-x300 Faston 250 connections
- Flange mount

- Reinforced insulation between coil and contacts according to EN 60335-1;
8 mm creepage and clearance distances
- AC coils & DC coils
- Cadmium Free option available

66.22-x300



- 30 A rated contacts
- PCB mount - bifurcated terminals

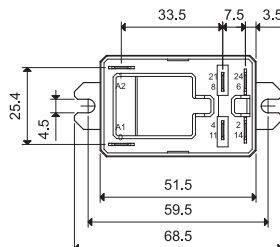
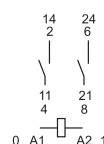


Copper side view

66.82-x300



- 30 A rated contacts
- Flange mount
- Faston 250 connections



For outline drawing see page 6

FOR UL RATINGS SEE:

"General technical information" page V

Contact specification			
Contact configuration		2 NO (DPST-NO)	2 NO (DPST-NO)
Rated current/Maximum peak current		A	30/50
Rated voltage/Maximum switching voltage V AC			250/440
Rated load AC1		VA	7,500
Rated load AC15 (230 V AC)		VA	1,200
Single phase motor rating (230 V AC)		kW	1.5
Breaking capacity DC1: 30/110/220 V		A	25/0.7/0.3
Minimum switching load		mW (V/mA)	1,000 (10/10)
Standard contact material			AgCdO
Coil specification			
Nominal voltage (U _N)	V AC (50/60 Hz)	6 - 12 - 24 - 110/115 - 120/125 - 230 - 240	
	V DC	6 - 12 - 24 - 110 - 125	
Rated power AC/DC	VA (50 Hz)/W	3.6/1.7	3.6/1.7
Operating range	AC	(0.8...1.1)U _N	(0.8...1.1)U _N
	DC	(0.8...1.1)U _N	(0.8...1.1)U _N
Holding voltage	AC/DC	0.8 U _N /0.5 U _N	0.8 U _N /0.5 U _N
Must drop-out voltage	AC/DC	0.2 U _N /0.1 U _N	0.2 U _N /0.1 U _N
Technical data			
Mechanical life AC/DC	cycles	10 · 10 ⁶	10 · 10 ⁶
Electrical life at rated load AC1	cycles	100 · 10 ³	100 · 10 ³
Operate/release time	ms	8/10	8/10
Insulation between coil and contacts (1.2/50 μs)	kV	6 (8 mm)	6 (8 mm)
Dielectric strength between open contacts	V AC	1,500	1,500
Ambient temperature range	°C	-40...+70	-40...+70
Environmental protection		RT II	RT II
Approvals (according to type)			

Features

2 Pole NO (DPST-NO), ≥ 1.5 mm contact gap
30 A Power relay

- 66.22-x600 PCB mount
- 66.22-x600S PCB mount - 5 mm gap between PCB and relay base
- 66.82-x600 Faston 250 connections - Flange mount

- ≥ 1.5 mm contact gap (according to VDE 0126-1-1 for solar inverter applications)
- Reinforced insulation between coil and contacts according to EN 60335-1; 8 mm creepage and clearance distances
- Wash tight version (RT III) available
- DC coils
- Cadmium Free option available

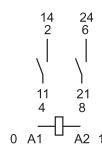
For outline drawing see page 6

FOR UL RATINGS SEE:
"General technical information" page V

NEW 66.22-x600



- PCB mount - bifurcated terminals

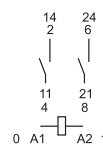


Copper side view

NEW 66.22-x600S



- PCB mount - bifurcated terminals
- 5 mm gap between PCB and relay base

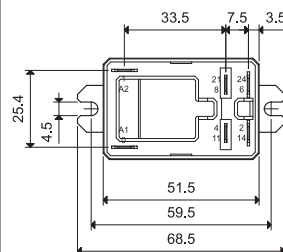
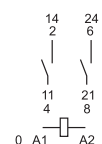


Copper side view

NEW 66.82-x600



- Flange mount
- Faston 250 connections



Contact specification					
Contact configuration		2 NO (DPST-NO)		2 NO (DPST-NO)	
Rated current/Maximum peak current	A	30/50		30/50	
Rated voltage/Maximum switching voltage	V AC	250/440		250/440	
Rated load AC1	VA	7,500		7,500	
Rated load AC15 (230 V AC)	VA	1,200		1,200	
Single phase motor rating (230 V AC)	kW	1.5		1.5	
Breaking capacity DC1: 30/110/220 V	A	30/1.2/0.5		30/1.2/0.5	
Minimum switching load	mW (V/mA)	1,000 (10/10)		1,000 (10/10)	
Standard contact material		AgCdO		AgCdO	
Coil specification					
Nominal voltage (U_N)	V AC (50/60 Hz)	—		—	
	V DC	6 - 12 - 24 - 110 - 125		6 - 12 - 24 - 110 - 125	
Rated power AC/DC	VA (50 Hz)/W	—/1.7		—/1.7	
Operating range	AC	—		—	
	DC	$(0.8 \dots 1.1) U_N$		$(0.7 \dots 1.1) U_N$	
Holding voltage	AC/DC	—/0.5 U_N		—/0.5 U_N	
Must drop-out voltage	AC/DC	—/0.1 U_N		—/0.1 U_N	
Technical data					
Mechanical life	cycles	$10 \cdot 10^6$		$10 \cdot 10^6$	
Electrical life at rated load AC1	cycles	$100 \cdot 10^3$		$100 \cdot 10^3$	
Operate/release time	ms	10/12		10/12	
Insulation between coil and contacts (1.2/50 μ s)	kV	6 (8 mm)		6 (8 mm)	
Dielectric strength between open contacts	V AC	2,500		2,500	
Ambient temperature range	°C	-40...+70		-40...+70	
Environmental protection		RT II		RT II	
Approvals (according to type)					

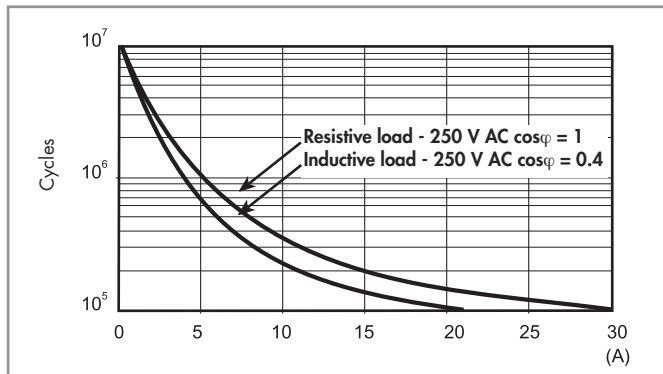
Ordering information

Example: 66 series relay, Faston 250 (6.3x0.8 mm) with top flange mount, 2 CO (DPDT) 30 A contacts, 24 V DC coil.

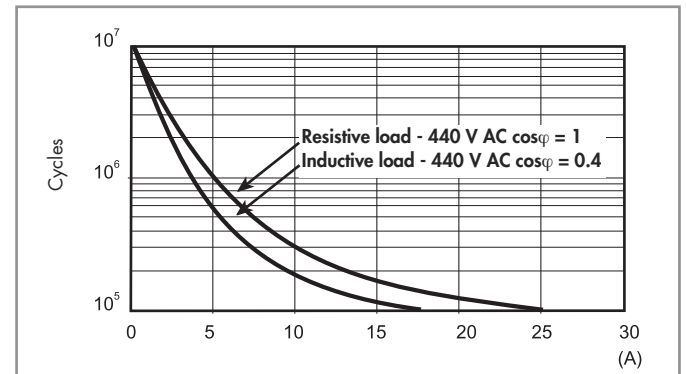
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Series			Type			No. of poles			Coil version			Coil voltage			A: Contact material			B: Contact circuit			C: Options			D: Special versions								
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Contact specification

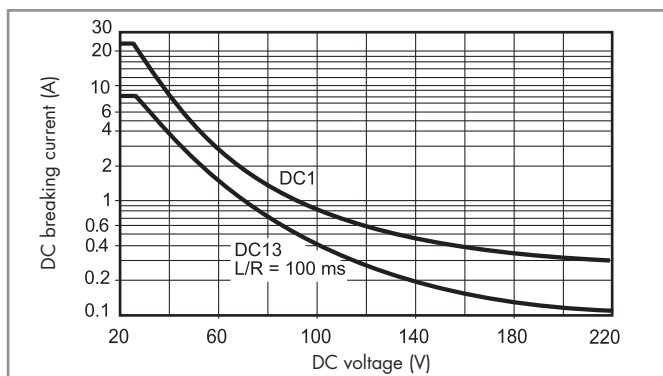
F 66 - Electrical life (AC) v contact current
250 V (normally open contact)



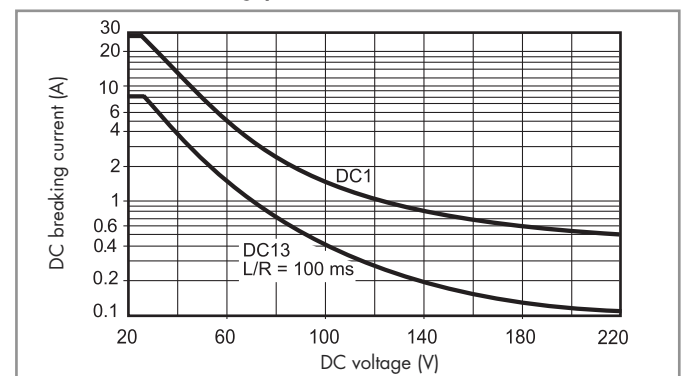
F 66 - Electrical life (AC) v contact current
440 V (normally open contact)



H 66 - Maximum DC breaking capacity



H 66 - Maximum DC breaking capacity, x600 versions
(>1.5mm contact gap)



- When switching a resistive load (DC1) having voltage and current values under the curve, an electrical life of $\geq 100 \cdot 10^3$ can be expected.
- In the case of DC13 loads, the connection of a diode in parallel with the load will permit a similar electrical life as for a DC1 load.
Note: the release time for the load will be increased.

Coil specifications

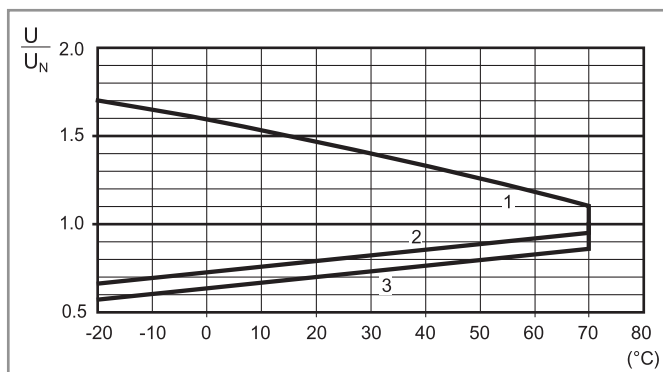
DC coil data

Nominal voltage U_N	Coil code	Operating range		Resistance	Rated coil consumption
V		U_{min} V	U_{max} V	R Ω	I at U_N mA
6	9.006	4.8	6.6	21	283
12	9.012	9.6	13.2	85	141
24	9.024	19.2	26.4	340	70.5
110	9.110	88	121	7,000	15.7
125	9.125	100	138	9,200	13.6

AC coil data

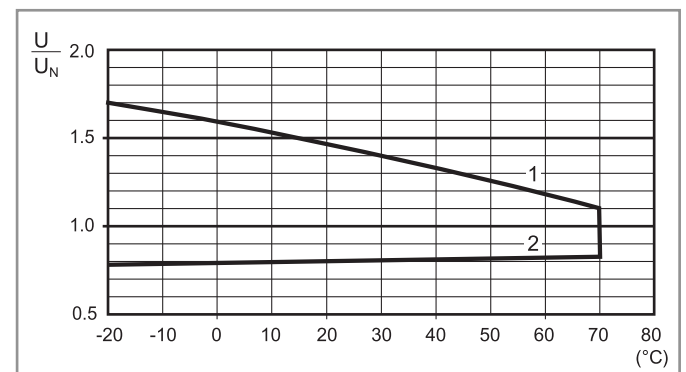
Nominal voltage U_N	Coil code	Operating range		Resistance	Rated coil consumption I at U_N (50Hz)
V		U_{min} V	U_{max} V	R Ω	mA
6	8.006	4.8	6.6	3	600
12	8.012	9.6	13.2	11	300
24	8.024	19.2	26.4	50	150
110/115	8.110	88	126	930	32.6
120/125	8.120	96	137	1,050	30
230	8.230	184	253	4,000	15.7
240	8.240	192	264	5,500	15

R 66 - DC coil operating range v ambient temperature



- 1 - Max. permitted coil voltage.
- 2 - Min. pick-up voltage with coil at ambient temperature.
- 3 - Min. pick-up voltage with coil at ambient temperature (66.22-x600S).

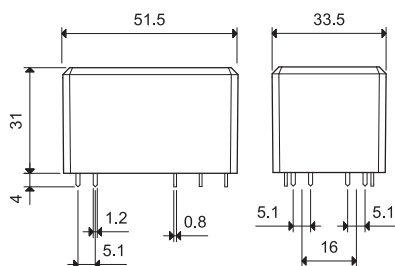
R 66 - AC coil operating range v ambient temperature



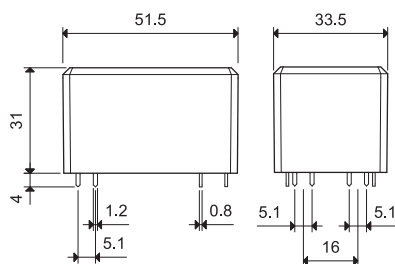
- 1 - Max. permitted coil voltage.
- 2 - Min. pick-up voltage with coil at ambient temperature.

Outline drawings

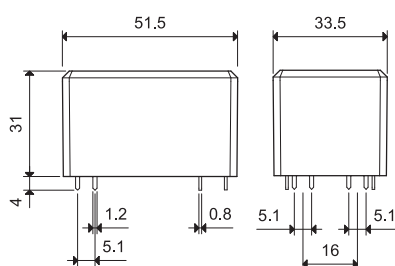
Type 66.22



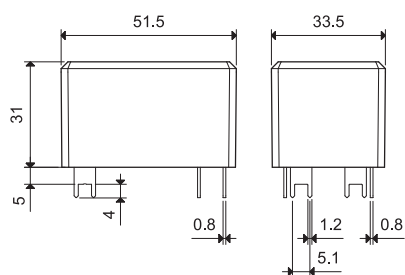
Type 66.22-0300



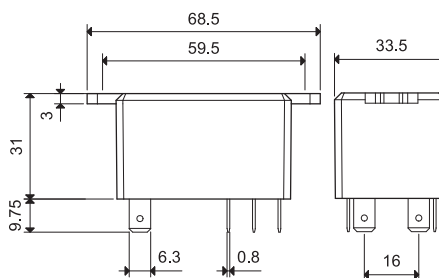
Type 66.22-0600



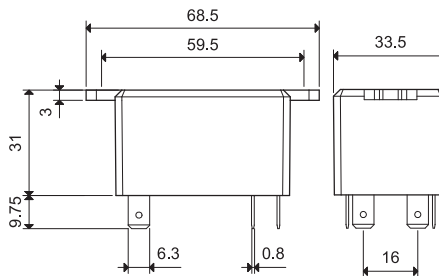
Type 66.22-0600S



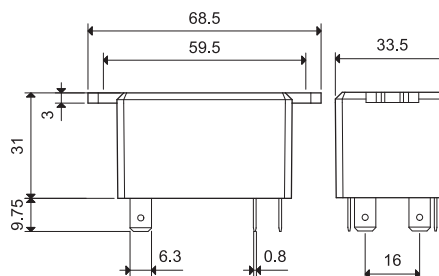
Type 66.82



Type 66.82-0300



Type 66.82-0600



Accessories



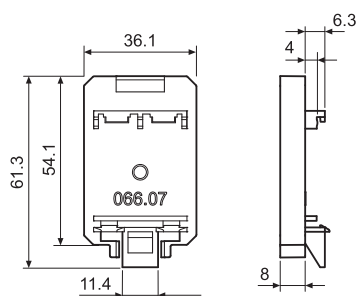
066.07



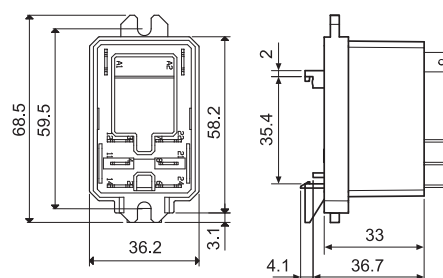
066.07 with relay

Top 35 mm rail (EN 60715) mount for types 66.82.xxxx.0x00

066.07



066.07



066.07 with relay

Features

Relay for +105 °C ambient use
PCB mount - direct for coil and contact terminals
- 45.31, 1 Pole normally open
(≥ 3 mm contact gap)

Relays for +125 °C ambient use
PCB mount - Faston 250 contact connections
- 45.71, 1 Pole normally open or normally closed
- 45.91, 1 Pole normally open
(≥ 3 mm contact gap)

- Contact gap ≥ 3 mm according to EN 60730-1 (45.31 and 45.91 type)
- Sensitive DC coil - 360 mW
- Cadmium Free option available
- Reinforced insulation between coil and contacts according to EN 60335-1 (VDE 0700), with safe separation and 8 mm clearance and creepage distance
- 6 kV (1.2/50 μs) isolation, coil-contacts
- Flux proof: RT II standard, (RT III option)

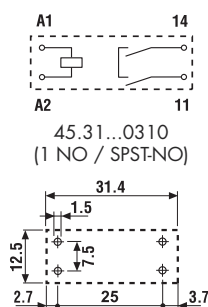
For outline drawing see page 3

FOR UL RATINGS SEE:
"General technical information" page V

NEW 45.31



- 1 NO (SPST-NO), ≥ 3 mm gap
- Max ambient temperature +105°C
- PCB mounting

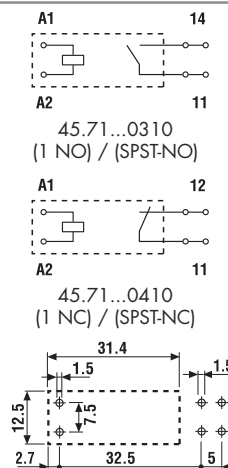


Copper side view

45.71



- 1 NO or 1 NC (SPST-NO or SPST-NC)
- Max ambient temperature +125°C
- PCB mounting + Faston 250

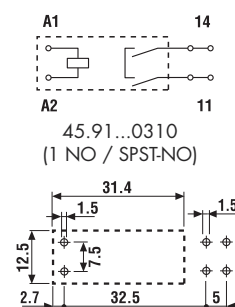


Copper side view

45.91



- 1 NO (SPST-NO), ≥ 3 mm gap
- Max ambient temperature +125°C
- PCB mounting + Faston 250



Copper side view

Contact specification

Contact configuration	1NO (SPST-NO) ≥ 3 mm gap	1NO or 1NC (SPST-NO or SPST-NC)	1NO (SPST-NO) ≥ 3 mm gap
Rated current/Maximum peak current A	16/30	16/30	16/30
Rated voltage/Maximum switching voltage V AC	250/400	250/400	250/400
Rated load AC1 VA	4,000	4,000	4,000
Rated load AC15 (230 V AC) VA	750	750	750
Single phase motor rating (230 V AC) kW	0.55	0.55	0.55
Breaking capacity DC1: 30/110/220 V A	16/4/1	16/0.3/0.13	16/4/1
Minimum switching load mW (V/mA)	500 (10/5)	500 (10/5)	500 (10/5)
Standard contact material	AgNi	AgCdO	AgNi

Coil specification

Nominal voltage (U _N)	V AC (50/60 Hz)	—	—	—
	V DC	6 - 12 - 24 - 48 - 60	6 - 12 - 24 - 48 - 60	6 - 12 - 24 - 48 - 60
Rated power AC/DC	VA (50 Hz)/W	—/0.36	—/0.36	—/0.36
Operating range	AC	—	—	—
	DC	(0.7...1.2)U _N	(0.7...1.2)U _N	(0.7...1.2)U _N
Holding voltage	AC/DC	—/0.4 U _N	—/0.4 U _N	—/0.4 U _N
Must drop-out voltage	AC/DC	—/0.1 U _N	—/0.1 U _N	—/0.1 U _N

Technical data

Mechanical life AC/DC cycles	—/10 · 10 ⁶	—/10 · 10 ⁶	—/10 · 10 ⁶
Electrical life at rated load AC1 cycles	30 · 10 ³	100 · 10 ³	30 · 10 ³
Operate/release time ms	12/2	10/2	12/2
Insulation between coil and contacts (1.2/50 μs) kV	6 (8 mm)	6 (8 mm)	6 (8 mm)
Dielectric strength between open contacts V AC	2,500	1,000	2,500
Ambient temperature range °C	−40...+105	−40...+125	−40...+125
Environmental protection	RT II	RT II	RT II

Approvals (according to type)



Ordering information

Example: 45 series for PCB relay + Faston 250, 1 NO (SPST-NO), 12 V DC coil.

	4	5	.	7	.	1	.	7	.	0	1	2	.	A	B	C	D
Series	45					17				012							
Type	3 = PCB mount, ≥ 3 mm contact gap					7 = PCB + Faston 250 mount				9 = PCB + Faston 250 mount, ≥ 3 mm contact gap							
No. of poles	1 = 1 pole, 16 A																
Coil version	7 = Sensitive DC																
Coil voltage	See coil specifications																
A: Contact material														0 = Standard AgCdO for 45.71, Standard AgNi for 45.31 and 45.91			
														1 = AgNi			
														2 = AgCdO			
B: Contact circuit														3 = NO (SPST)			
														4 = NC (SPST) 45.71 only			
D: Special versions														0 = Flux proof (RT II)			
														1 = Wash tight (RT III) 45.71 and 45.91 only			
C: Options														1 = None			

Selecting features and options: only combinations in the same row are possible.

Type	Coil version	A	B	C	D
45.31	sensitive DC	0 - 2	3	1	0
45.71	sensitive DC	0 - 1	3 - 4	1	0 - 1
45.91	sensitive DC	0 - 2	3	1	0 - 1

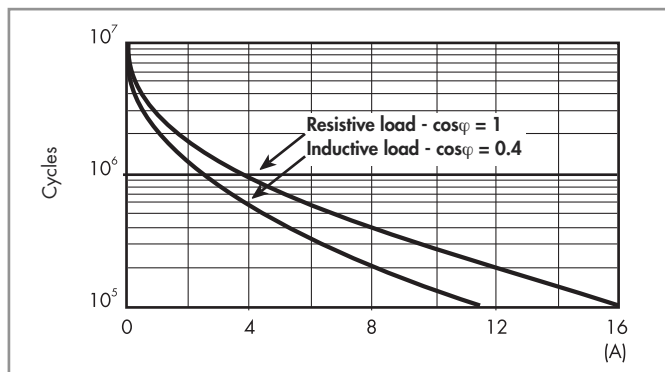
Technical data

Insulation according to EN 61810-1

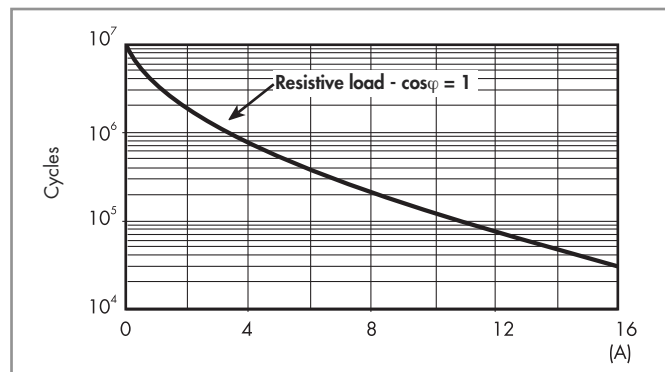
			45.71		45.31 / 45.91	
Nominal voltage of supply system		V AC	230/400		230/400	
Rated insulation voltage		V AC	250	400	250	400
Pollution degree			3	2	3	2
Insulation between coil and contact set						
Type of insulation			Reinforced (8 mm)		Reinforced (8 mm)	
Overvoltage category			III		III	
Rated impulse voltage		kV (1.2/50 μs)	6		6	
Dielectric strength		V AC	4,000		4,000	
Insulation between open contacts						
Type of disconnection			Micro-disconnection		Full-disconnection	
Overvoltage category			—		III	
Rated impulse voltage		kV (1.2/50 μs)	—		4	
Dielectric strength		V AC/kV (1.2/50 μs)	1,000/1.5		2,500/4	
Conducted disturbance immunity						
Burst (5...50)ns, 5 kHz, on A1 - A2			EN 61000-4-4		level 4 (4 kV)	
Surge (1.2/50 μs) on A1 - A2 (differential mode)			EN 61000-4-5		level 3 (2 kV)	
Other data			45.71		45.31 / 45.91	
Bounce time: NO/NC		ms	3/3		2/—	
Vibration resistance (10...150)Hz: NO/NC		g	20/10		20/—	
Shock resistance		g	20			
Power lost to the environment		without contact current	W	0.4		
		with rated current	W	1.8		
Recommended distance between relays mounted on PCB		mm	≥ 5			

Contact specification

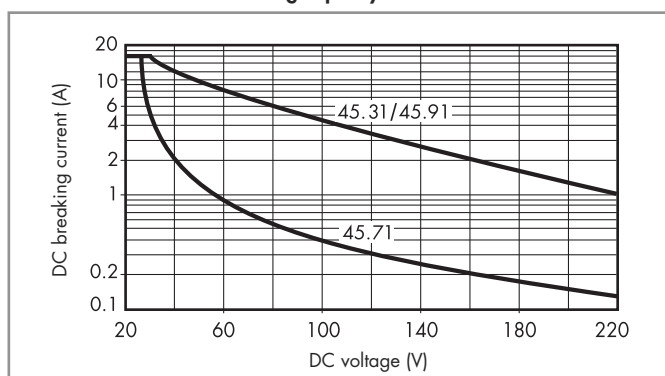
F 45 - Electrical life (AC) v contact current
Type 45.71



F 45 - Electrical life (AC) v contact current
Type 45.31 / 45.91



H 45 - Maximum DC1 breaking capacity



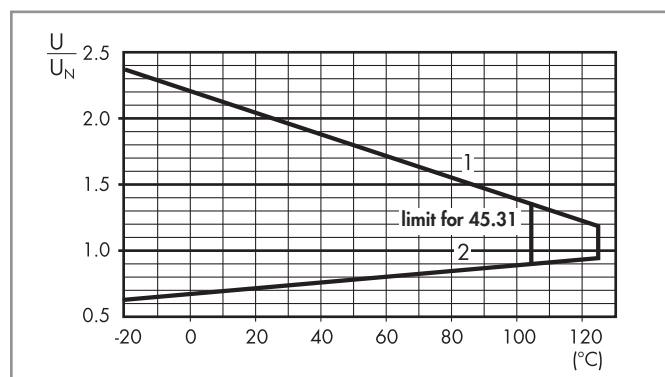
- When switching a resistive load (DC1) having voltage and current values under the curve, an electrical life of $\geq 100 \cdot 10^3$ cycles (45.71) and $\geq 30 \cdot 10^3$ cycles (45.31, 45.91) can be expected.
- In the case of DC13 loads, the connection of a diode in parallel with the load will permit a similar electrical life as for a DC1 load.
Note: the release time for the load will be increased.

Coil specifications

DC coil data - 0.36 W sensitive

Nominal voltage U_N V	Coil code	Operating range		Resistance R Ω	Rated coil consumption I at U_N mA
		U_{min} V	U_{max} V		
6	7.006	4.2	7.2	100	60
12	7.012	8.4	14.4	400	30
24	7.024	16.8	28.8	1,600	15
48	7.048	33.6	57.6	6,400	7.5
60	7.060	42	72	10,000	6

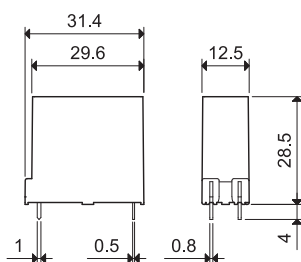
R 45 - DC coil operating range v ambient temperature



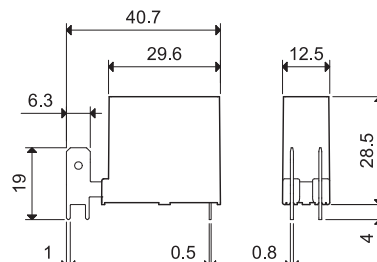
- 1 - Max. permitted coil voltage.
- 2 - Min. pick-up voltage with coil at ambient temperature.

Outline drawings

Type 45.31



Type 45.71 / 91



Features

SPD Type 1+2 Surge arrester range - single phase system / three phase system

- Surge arresters suitable in low-voltage applications in order to protect equipment against overvoltage by direct lightning strike, induction overvoltage and switching overvoltage.
- To be installed at the boundary of LPZ 0_A - LPZ 1 zones or higher
- Versions with combination of varistor and encapsulated spark gap which eliminates leakage current and ensures high discharge current
- Remote status signalling contact for each varistor module. Connector 07P.01 included
- Visual fault signalling
- According to EN 61 643-11
- 35 mm rail EN 60715 mounting, 35mm each pole

7P.09.1.255.0100 SPD Type 1, GDT protection for N-PE application only

7P.01.8.260.1025 SPD Type 1+2, varistor unipolar protection suitable to realize single phase or three phase systems (230/400 V) with the GDT protection (7P.09)

7P.02.8.260.1025 SPD Type 1+2 for single phase system. Varistor protection L-N + spark gap protection N-PE

7P.09 / 7P.01 / 7P.02
Screw terminal

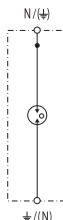


For outline drawing see page 10

NEW 7P.09.1.255.0100



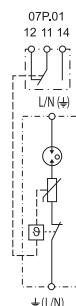
- SPD Type 1
- Spark gap module for N-PE application



NEW 7P.01.8.260.1025



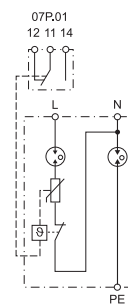
- SPD Type 1+2
- Combination of varistor and encapsulated spark gap
- Visual fault signalling varistor status



NEW 7P.02.8.260.1025



- SPD Type 1+2
- Combination of varistor and encapsulated spark gap + spark gap
- Visual fault signalling for each varistor module



SPD specification		N-PE		L-N		N-PE	
Nominal voltage (U _N)	V AC	—		230		230	—
Maximum operating voltage (U _C)	V AC	255		260		260	255
Lightning impulse current (10/350 μs) (I _{imp})	kA	100		25		25	50
Nominal discharge current (8/20 μs) (I _n)	kA	100		30		30	50
Maximum discharge current (8/20 μs) (I _{max})	kA	100		60		60	100
Voltage protection level (U _P)	kV	1.5		1.5		1.5	1.5
Ability to independently switch off the following current (I _{fi})	A	100 (@255 V AC)		No following current		No following current	100
Response time (t _a)	ns	100		100		100	100
Shortcircuit proof at maximum overcurrent protection	kA _{rms}	—		35		35	—
Maximum overcurrent protection		—		160 A gL/gG		160 A gL/gG	—
Other technical data							
Ambient temperature range	°C	-40...+80					
Protection degree		IP20					
Wire size		solid cable			stranded cable		
	mm ²	1x1...1x50			1x1...1x35		
	AWG	1x 17...1x1			1x 17...1x2		
Wire strip length	mm	14					
Screw torque	Nm	4					
Remote status signalling contact specification							
Contact configuration		—		1 CO (SPDT)		1 CO (SPDT)	
Rated current	A AC/DC	—		0.5 - 0.1		0.5 - 0.1	
Rated voltage	V AC/DC	—		250		250	
Wire size (07P.01)		—		solid cable	stranded cable	solid cable	stranded cable
	mm ²	—		1.5	1.5	1.5	1.5
	AWG	—		16	16	16	16
Approvals (according to type)		CE					

Features

SPD Type 1+2 Surge arrester range - three phase system (230/400 V)

- Surge arresters suitable in low-voltage applications in order to protect equipment against overvoltage by direct lightning strike, induction overvoltage and switching overvoltage.
- To be installed at the boundary of LPZ 0_A - LPZ 1 zones or higher
- Versions with combination of varistor and encapsulated spark gap which eliminates leakage current and ensures high discharge current
- Remote status signalling contact for each varistor module. Connector 07P.01 included
- Visual fault signalling
- According to EN 61 643-11
- 35 mm rail EN 60715 mounting, 35mm each pole

7P.03.8.260.1025 SPD Type 1+2 for three phase system without Neutral (PEN conductor). Varistor protection L1, L2, L3-PEN

7P.04.8.260.1025 SPD Type 1+2 for three phase system with Neutral. Varistor protection L1, L2, L3-N + spark gap protection N-PE

7P.05.8.260.1025 SPD Type 1+2 for three phase system with Neutral (varistor N-PE). Varistor protection L1, L2, L3-N + varistor protection N-PE

7P.03 / 7P.04 / 7P.05
Screw terminal

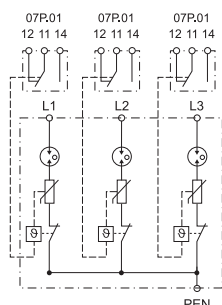


For outline drawing see page 10, 11

NEW 7P.03.8.260.1025



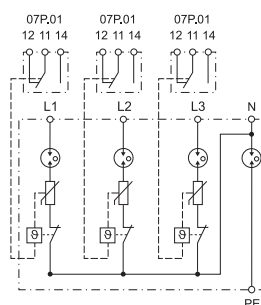
- SPD Type 1+2
- 3 x combination of varistor and encapsulated spark gap
- Visual fault signalling for each varistor module



NEW 7P.04.8.260.1025



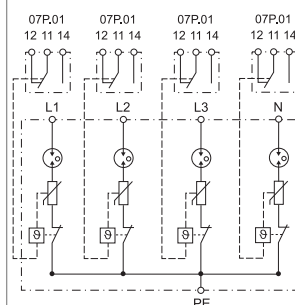
- SPD Type 1+2
- 3 x combination of varistor and encapsulated spark gap + 1 encapsulated spark gap
- Visual fault signalling for each varistor module



NEW 7P.05.8.260.1025



- SPD Type 1+2
- 4 x combination of varistor and encapsulated spark gap
- Visual fault signalling for each varistor module



SPD specification		L-PEN		L-N	N-PE		
Nominal voltage (U _N)	V AC	230		230	—	230	
Maximum operating voltage (U _C)	V AC	260		260	255	260	
Lightning impulse current (10/350 μs) (I _{imp})	kA	25		25	100	25	
Nominal discharge current (8/20 μs) (I _n)	kA	30		30	100	30	
Maximum discharge current (8/20 μs) (I _{max})	kA	60		60	100	60	
Voltage protection level (U _p)	kV	1.5		1.5	1.5	1.5	
Ability to independently switch off the following current (I _{fi})	A	No following current		No following current	100	No following current	
Response time (t _a)	ns	100		100	100	100	
Shortcircuit proof at maximum overcurrent protection	kA _{rms}	35		35	—	—	
Maximum overcurrent protection		160 A gL/gG		160 A gL/gG	—	160 A gL/gG	
Other technical data							
Ambient temperature range	°C	−40...+80					
Protection degree		IP20					
Wire size		solid cable			stranded cable		
	mm ²	1x1...1x50			1x1...1x35		
	AWG	1x 17...1x1			1x 17...1x2		
Wire strip length	mm	14					
Screw torque	Nm	4					
Remote status signalling contact specification							
Contact configuration		1 CO (SPDT)		1 CO (SPDT)		1 CO (SPDT)	
Rated current	A AC/DC	0.5 - 0.1		0.5 - 0.1		0.5 - 0.1	
Rated voltage	V AC/DC	250		250		250	
Wire size (07P.01)		solid cable	stranded cable	solid cable	stranded cable	solid cable	stranded cable
	mm ²	1.5	1.5	1.5	1.5	1.5	1.5
	AWG	16	16	16	16	16	16
Approvals (according to type)		CE					

Features

SPD Type 1 Surge arrester range with "Low U_p -System" – Single phase / three phase system

- Surge arrester suitable for 230/400 V system/ applications to prevent overvoltage effects caused by direct or indirect lightning strikes.
- To be installed at the boundary of LPZ O_A and LPZ 1 zones
- "Low U_p System" guarantees low U_p values as if it has a built-in SPD Type 2
- Visual indication of varistor status - Healthy/Replace
- Remote signalling contact, of varistor status. Connector 07P.01 included
- Replaceable varistor and Spark Gap modules
- Complies with EN 61 643-11
- 17.5 mm rail EN 60715 mounting for each module

7P.12.8.275.1012

- Varistor protection L-N + spark gap protection N-PE

- Replaceable Spark Gap and varistor modules

7P.13.8.275.1012

- Varistor protection L1, L2, L3-PEN
- Replaceable varistor modules

7P.21 / 7P.22

Screw terminal

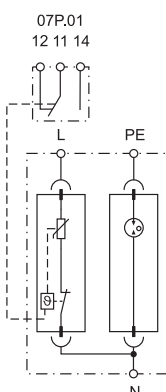


For outline drawing see page 11

NEW 7P.12.8.275.1012



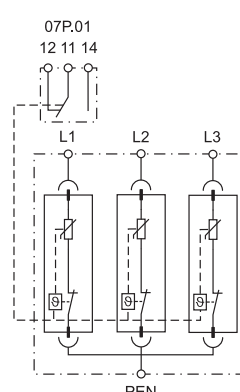
- SPD Type 1
- Replaceable Spark Gap and varistor modules
- Visual and remote signalling of varistor status



NEW 7P.13.8.275.1012



- SPD Type 1
- Replaceable varistor modules
- Visual and remote signalling of varistor status



SPD specification		L-N		N-PE	L-PEN	
Nominal voltage (U _N)	V AC	230		—	230	
Maximum continous operating voltage (U _C)	V AC/DC	275 / 350		255 / —	275 / 350	
Lightning impulse current (10/350 μs) (I _{imp})	kA	12.5		25	12.5	
Nominal discharge current (8/20 μs) (I _n)	kA	30		40	30	
Maximum discharge current (8/20 μs) (I _{max})	kA	60		60	60	
Voltage protection level (U _p)	kV	1.2		1.5	1.2	
Ability to independently switch off the following current (I _{fi})	A	No following current		100	No following current	
Response time (t _a)	ns	25		100	25	
Shortcircuit proof at maximum overcurrent protection	kA _{rms}	35		—	35	
Maximum overcurrent protection - fuse rating		160 A gL/gG		—	160 A gL/gG	
Replacement modules code		7P.10.8.275.0012		7P.10.1.000.0025	7P.10.8.275.0012	
Other technical data						
Ambient temperature range	°C	-40...+80				
Protection degree		IP20				
Wire size		solid cable			stranded cable	
	mm ²	1x1...1x50			1x1...1x35	
	AWG	1x 17...1x1			1x 17...1x2	
Wire strip length	mm	14				
Screw torque	Nm	4				
Remote status signalling contact specification						
Contact configuration		1 CO (SPDT)		—	1 CO (SPDT)	
Rated current	A AC/DC	0.5 - 0.1		—	0.5 - 0.1	
Rated voltage	V AC/DC	250		—	250	
Wire size (07P.01)		solid cable	stranded cable		solid cable	stranded cable
	mm ²	1.5	1.5	—	1.5	1.5
	AWG	16	16	—	16	16
Approvals (according to type)		CE				

Features

SPD Type 1 Surge arrester range with "Low U_p -System" – three phase system

- Surge arrester suitable for 230/400 V system/ applications to prevent overvoltage effects caused by direct or indirect lightning strikes.
- To be installed at the boundary of LPZ O_A and LPZ 1 zones
- "Low U_p System" guarantees low U_p values as if it has a built-in SPD Type 2
- Visual indication of varistor status - Healthy/Replace
- Remote signalling contact, of varistor status. Connector 07P.01 included
- Replaceable varistor and Spark Gap modules
- Complies with EN 61 643-11
- 17.5 mm rail EN 60715 mounting for each module

7P.14.8.275.1012

- Varistor protection L1, L2, L3+N+Spark Gap protection N-PE
- Replaceable varistor modules
- Not replaceable high discharge current spark gap

7P.15.8.275.1012

- Varistor protection L1, L2, L3, N-PE
- Replaceable varistor modules

7P.21 / 7P.22
Screw terminal

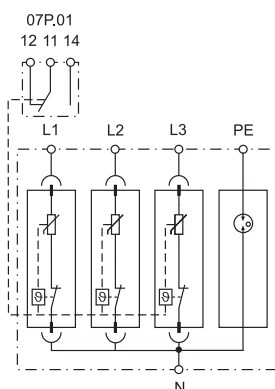


For outline drawing see page 11

NEW 7P.14.8.275.1012



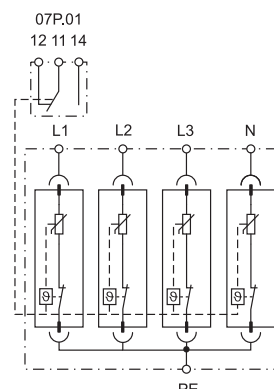
- SPD Type 1
- Replaceable varistor module
- Visual and remote signalling of varistor status



NEW 7P.15.8.275.1012



- SPD Type 1
- Replaceable varistor module
- Visual and remote signalling of varistor status



SPD specification		L-N		N-PE	L, N-PE	
Nominal voltage (U _N)	V AC	230		—	230	
Maximum continous operating voltage (U _C)	V AC/DC	275/ 350		255 / —	275 / 350	
Lightning impulse current (10/350 μs) (I _{imp})	kA	12.5		50	12.5	
Nominal discharge current (8/20 μs) (I _n)	kA	30		50	30	
Maximum discharge current (8/20 μs) (I _{max})	kA	60		100	60	
Voltage protection level (U _p)	kV	1.2		1.5	1.2	
Ability to independently switch off the following current (I _{fi})	A	No following current		100	No following current	
Response time (t _a)	ns	25		100	25	
Shortcircuit proof at maximum overcurrent protection	kA _{rms}	35		—	35	
Maximum overcurrent protection - fuse rating		160 A gL/gG		—	160 A gL/gG	
Replacement modules code		7P.10.8.275.0012		—	7P.10.8.275.0012	
Other technical data						
Ambient temperature range	°C	–40...+80				
Protection degree		IP20				
Wire size		solid cable			stranded cable	
	mm ²	1x1...1x50			1x1...1x35	
	AWG	1x 17...1x1			1x 17...1x2	
Wire strip length	mm	14				
Screw torque	Nm	4				
Remote status signalling contact specification						
Contact configuration		1 CO (SPDT)		—	1 CO (SPDT)	
Rated current	A AC/DC	0.5 - 0.1		—	0.5 - 0.1	
Rated voltage	V AC/DC	250		—	250	
Wire size (07P.01)		solid cable	stranded cable		solid cable	stranded cable
	mm ²	1.5	1.5	—	1.5	1.5
	AWG	16	16	—	16	16
Approvals (according to type)		CE				

Features

SPD Type 2 Surge arrester range - single phase systems

- Surge arrester suitable for 230V system/ applications
- Protects equipment against overvoltage caused by lightning strikes or switching transients
- To be installed at the boundary of LPZ 1-LPZ 2 zones or higher

7P.21.8.275.1020 Varistor protection L - N

7P.22.8.275.1020 Varistor protection L - N + spark-gap protection N - PE

Spark-gap protection N - PE avoids earth leakage current

- Visual indication of varistor status - Healthy/Replace
- Remote signalling contact of varistor status Connector (07P.01) included
- Replaceable modules
- Complies with EN 61643-11
- 35 mm rail (EN 60715) mounting

7P.21 / 7P.22
Screw terminal

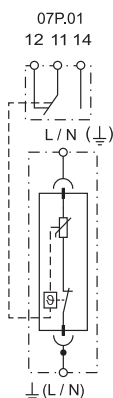


For outline drawing see page 12

7P.21.8.275.1020



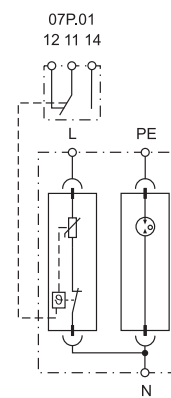
- SPD Type 2 (1 varistor)
- Replaceable varistor module
- Visual and remote signalling of varistor status



7P.22.8.275.1020



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



SPD specification				L-N	N-PE
Nominal voltage (U _N)	V AC	230		230	—
Maximum continous operating voltage (U _C)	V AC/DC	275 / 350		275 / 350	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 5kA (U _{p5})	kV	0.9		0.9	—
Voltage protection level at I _n (U _p)	kV	1.2		1.2	1.5
Response time (t _a)	ns	25		25	100
Shortcircuit proof at maximum overcurrent protection kA _{rms}		35		35	—
Maximum overcurrent protection - fuse rating		160 A gL/gG		160 A gL/gG	—
Replacement modules code		7P.20.8.275.0020		7P.20.8.275.0020	7P.20.1.000.0020
Other technical data					
Ambient temperature range	°C	–40...+80			
Protection degree		IP20			
Wire size		solid cable		stranded cable	
	mm ²	1x1...1x50		1x1...1x35	
	AWG	1x 17...1x1		1x 17...1x2	
Wire strip length	mm	14			
Screw torque	Nm	4			
Remote status signalling contact specification					
Contact configuration		1 CO (SPDT)		1 CO (SPDT)	
Rated current	A AC/DC	0.5 - 0.1		0.5 - 0.1	
Rated voltage	V AC/DC	250		250	
Wire size (07P.01)		solid cable	stranded cable	solid cable	stranded cable
	mm ²	1.5	1.5	1.5	1.5
	AWG	16	16	16	16
Approvals (according to type)		CE			

Features

SPD Type 2 Surge arrester range - three-phase systems

- Surge arrester suitable for 230/400V system/applications
- Protects equipment against overvoltage caused by lightning strikes or switching transients
- To be installed at the boundary of LPZ 1-LPZ 2 zones or higher

7P.23.8.275.1020 Varistor protection L1, L2, L3

7P.24.8.275.1020 Varistor protection L1, L2, L3 - N, + spark-gap protection N - PE

7P.25.8.275.1020 Varistor protection L1, L2, L3 - N, + varistor protection N - PE

Spark-gap protection N - PE avoids earth leakage current

- Visual indication of varistor status - Healthy/Replace
- Remote signalling contact of varistor status Connector (07P.01) included
- Replaceable modules
- Complies with EN 61643-11
- 35 mm rail (EN 60715) mounting

7P.23.8 / 7P.24 / 7P.25

Screw terminal

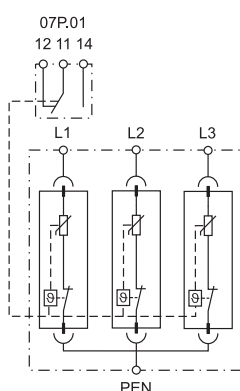


For outline drawing see page 12

7P.23.8.275.1020



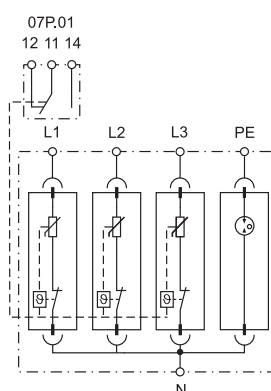
- SPD Type 2 (3 varistors)
- Replaceable varistor module, 3 pole
- Visual and remote signalling of varistor status



7P.24.8.275.1020



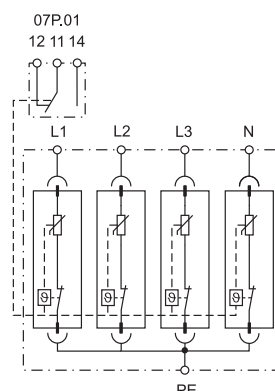
- SPD Type 2 (3 varistors + 1 spark-gap)
- Combination of replaceable varistor and encapsulated spark gap modules
- Visual and remote signalling of varistor status



7P.25.8.275.1020



- SPD Type 2 (4 varistors)
- Replaceable varistor module, 4 pole
- Visual and remote signalling of varistor status



SPD specification				L-N	N-PE	L, N-PE	
Nominal voltage (U _N)	V AC	230		230	—	230	
Maximum continous operating voltage (U _C)	V AC/DC	275 / 350		275 /350	255 / —	275 / 350	
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 5kA (U _{P5})	kV	0.9		0.9	—	0.9	
Voltage protection level at I _n (U _P)	kV	1.2		1.2	1.5	1.2	
Response time (t _a)	ns	25		25	100	25	
Short-circuit proof at maximum overcurrent protection	kA _{rms}	35		35	—	35	
Maximum overcurrent protection - fuse rating		160 A gL/gG		160 A gL/gG	—	160 A gL/gG	
Replacement modules code		7P.20.8.275.0020		7P.20.8.275.0020	7P.20.1.000.0020	7P.20.8.275.0020	
Other technical data							
Ambient temperature range	°C	−40...+80					
Protection degree		IP20					
Wire size		solid cable			stranded cable		
	mm ²	1x1...1x50			1x1...1x35		
	AWG	1x 17...1x1			1x 17...1x2		
Wire strip length	mm	14					
Screw torque	Nm	4					
Remote status signalling contact specification							
Contact configuration		1 CO (SPDT)		1 CO (SPDT)		1 CO (SPDT)	
Rated current	A AC/DC	0.5 - 0.1		0.5 - 0.1		0.5 - 0.1	
Rated voltage	V AC/DC	250		250		250	
Wire size (07P.01)		solid cable	stranded cable	solid cable	stranded cable	solid cable	stranded cable
	mm ²	1.5	1.5	1.5	1.5	1.5	1.5
	AWG	16	16	16	16	16	16
Approvals (according to type)		CE					

Features

SPD Type 2 Surge arrester range for Photovoltaic applications

- Surge arrester for protection on DC side (420 to 1000 V) of systems in photovoltaic applications
- Protects equipment against overvoltage caused by lightning strikes or switching transients
- To be installed at the boundary of the LPZ 0 - LPZ 1 zones, or higher

7P.26.9.420.1020 420 V DC

7P.23.9.700.1020 700 V DC

7P.23.9.000.1020 1000 V DC

- Visual indication of varistor status - Healthy/Replace
- Remote signalling contact of varistor status Connector (07P.01) included
- Replaceable modules
- Complies with EN 61643-11
- 35 mm rail (EN 60715) mounting

7P.23.9 / 7P.26
Screw terminal

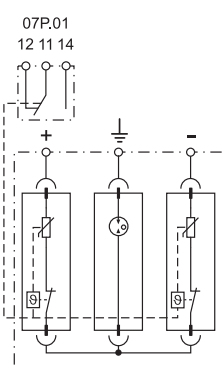


For outline drawing see page 12

7P.26.9.420.1020



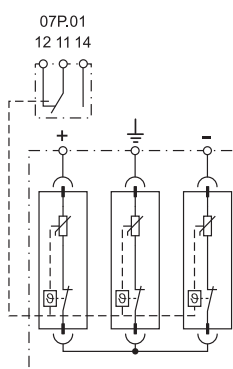
- SPD Type 2 (2 varistors + 1 spark-gap) for 420 V DC photovoltaic systems
- Combination of replaceable varistor and encapsulated spark gap modules
- Visual and remote signalling of varistor status



7P.23.9.700.1020



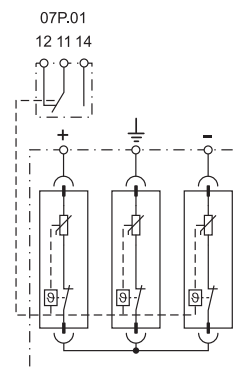
- SPD Type 2 (3 varistors) for 700 V DC photovoltaic systems
- Replaceable varistor modules
- Visual and remote signalling of varistor status



7P.23.9.000.1020



- SPD Type 2 (3 varistors) for 1000 V DC photovoltaic systems
- Replaceable varistor modules
- Visual and remote signalling of varistor status



SPD specification		Varistor module		Spark-gap module		Varistor module		Varistor module	
PV voltage mid central earthing (U _{OC STC}) V DC		600				700		1,000	
PV voltage earth free systems (U _{OC STC}) V DC		420				700		1,000	
Maximum operating voltage /per module (U _{CPV}) V DC		350		420		350		500	
Nominal discharge current (8/20 μs) /per module (I _n) kA		20		20		20		20	
Maximum discharge current (8/20 μs) /per module (I _{max}) kA		40		40		40		40	
Voltage protection level /per module (U _p) kV		1.2		1.5		1.2		1.8	
Voltage protection level of the system (U _p) kV		< 2.7				2.4		3.6	
Response time (t _a) ns		25		100		25		25	
Short-circuit withstand capability		100 A 200 V DC		—		100 A 200 V DC		100 A 200 V DC	
Maximum overcurrent protection - fuse rating		160 A gL/gG		—		160 A gL/gG		160 A gL/gG	
Replacement modules code		7P.20.9.350.0020		7P.20.1.000.9020		7P.20.9.350.0020		7P.20.9.500.0020	
Other technical data									
Ambient temperature range °C		−40...+80							
Protection degree		IP20							
Wire size		solid cable				stranded cable			
mm ²		1x1...1x50				1x1...1x35			
AWG		1x 17...1x1				1x 17...1x2			
Wire strip length mm		14							
Screw torque Nm		4							
Remote status signalling contact specification									
Contact configuration		1 CO (SPDT)				1 CO (SPDT)		1 CO (SPDT)	
Rated current A AC/DC		0.5 - 0.1				0.5 - 0.1		0.5 - 0.1	
Rated voltage V AC/DC		250				250		250	
Wire size (07P.01)		solid cable		stranded cable		solid cable		stranded cable	
mm ²		1.5		1.5		1.5		1.5	
AWG		16		16		16		16	
Approvals (according to type)		CE							

Features

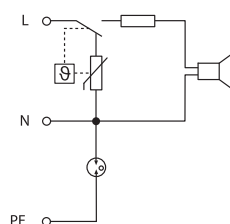
SPD Type 3 Surge arrester for incorporation within socket outlets

- Provides easy additional surge protection for existing 230 V sockets
- Protects electric and electronic equipment against pulse overvoltage
- Combined varistor + spark-gap protection (avoiding earth leakage current)
- Acoustical indication of varistor status (Replace)
- Complies with EN 61 643-11
- 3 wires, 150 mm long, for connection to socket terminals

7P.32.8.275.2003



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



For outline drawing see page 12

SPD specification		
Nominal voltage (U_N)	V AC	230
Maximum continuous operating voltage (U_C)	V AC	275
Nominal discharge current (8/20 μ s) L-N, L(N)-PE (I_n)	kA	3 / 3
Test voltage of the combined generator L-N, L(N)-PE (U_{OC})	kV	6 / 6
Voltage protection level L-N, L(N)-PE (U_P)	kV	1 / 1.5
Response time L-N, L(N)-PE (t_d)	ns	25 / 100
Shortcircuit proof at maximum overcurrent protection	kA_{rms}	6
Maximum overcurrent protection		16A gL/gG or C16 A
Transient OverVoltage 5s L-N (U_{TOV})	V	335
Transient OverVoltage 5s L-PE (U_{TOV})	V	400
Transient OverVoltage 200 ms L-PE (U_{TOV})	V	1430
Other technical data		
Ambient temperature range	$^{\circ}C$	-25...+40
Protection degree		IP 20
Wire length	mm	150
Approvals (according to type)		CE

Ordering information

Example: 7P series, surge protection device, Type 2, single phase ($U_c = 275$ V), 1 varistor + 1 encapsulated spark gap, with remote status signalling contact, $I_n = 20$ kA

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

Series

Type

0 = Combined type 1 + 2 arresters
1 = Type 1 surge arresters
2 = Type 2 surge arresters
3 = Type 3 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)
6 = 2 varistor + 1 spark-gap
9 = N-PE spark-gap
0 = Spare module

Supply version

1 = N+PE connection
(only for single spark gap replaceable module and 7P.09)
8 = AC (50/60 Hz)
9 = DC (PV application)

Supply voltage

000 = 1.000 V DC Max (or N+PE connection for spark gap modules)
700 = 700 V DC Max
420 = 420 V DC Max
275 = 275 V Max for SPD Type 1 "Low Up", Type 2 (U_d) (for $U_N = 230-240$ V AC) and Type 3
260 = 260 V Max (U_d) for SPD Type 1 + 2 (for $U_N = 230-240$ V AC)
255 = 255 V Max (U_d) for SPD Type 1, N+PE (7P.09)

Nominal discharge current

100 = 100 kA (I_{imp} Type 1) only for 7P.09
050 = 50 kA (I_{imp} Type 1) only for 7P.14
012 = 12.5 kA (I_{imp} Type 1)
020 = 20 kA (I_n Type 2)
025 = 25 kA (I_{imp} Type 1+2)
003 = 3 kA (I_n @ U_{oc} only for 7P.32)

Remote status signalling contact

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

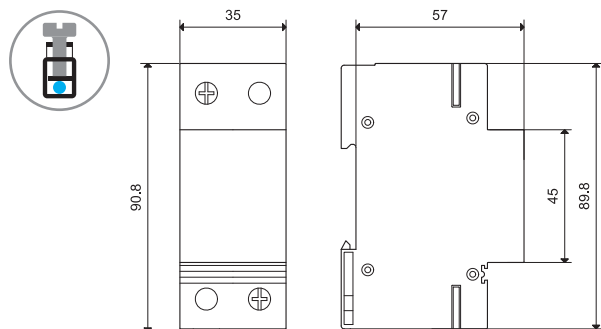
Replaceable modules



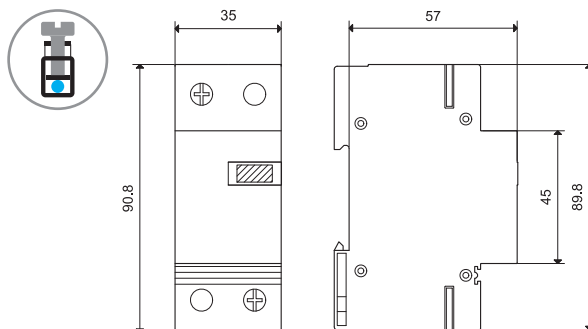
Replacement varistor and Spark-Gap modules	7P.10.8.275.0012			7P.10.1.000.0025	
	Varistor			Spark-Gap	
Maximum operating voltage (U_c) V AC	275			255	
Impulse current (10/350 μ s) (I_{imp}) kA	12.5			25	
Nominal discharge current (8/20 μ s) (I_n) kA	30			30	
Maximum discharge current (8/20 μ s) (I_{max}) kA	60			60	
Voltage protection level (U_p) kV	1.2			1.5	
Response time (t_a) ns	25			100	
Maximum overcurrent protection	160 A gL/gG			—	
Replacement varistor and Spark-Gap modules	7P.20.8.275.0020	7P.20.9.350.0020	7P.20.9.500.0020	7P.20.1.000.0020	7P.20.1.000.9020
	Varistor	Varistor	Varistor	Spark-Gap	Spark-Gap
Maximum operating voltage (U_c) V AC/DC	275 / —	— / 350	— / 500	255 / —	— / 420
Nominal discharge current (8/20 μ s) (I_n) kA	20	20	20	20	20
Maximum discharge current (8/20 μ s) (I_{max}) kA	40	40	40	40	40
Voltage protection level (U_p) kV	1.2	1.2	1.8	1.5	1.5
Response time (t_a) ns	25	25	25	100	100
Maximum overcurrent protection	160 A gL/gG	160 A gL/gG	160 A gL/gG	—	—

Outline drawings

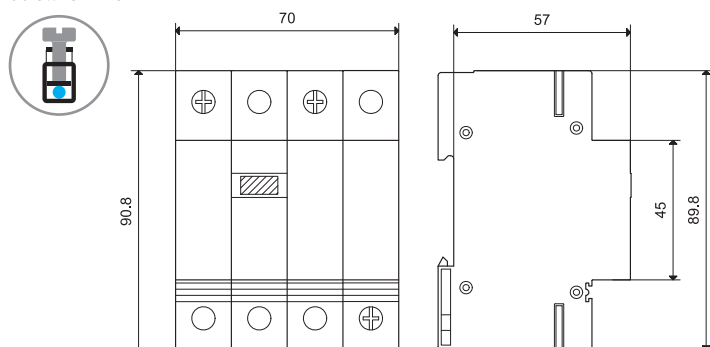
Type 7P.09
Screw terminal



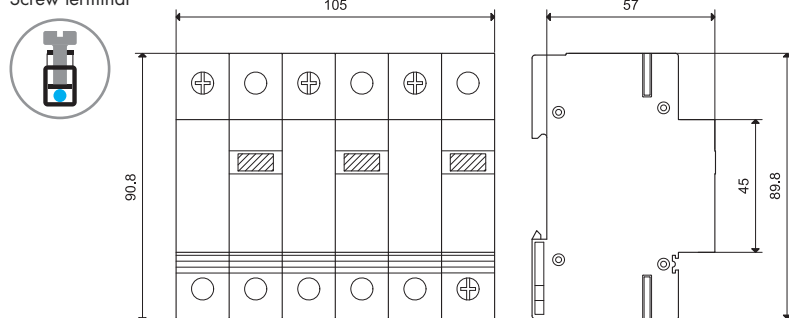
Type 7P.01
Screw terminal



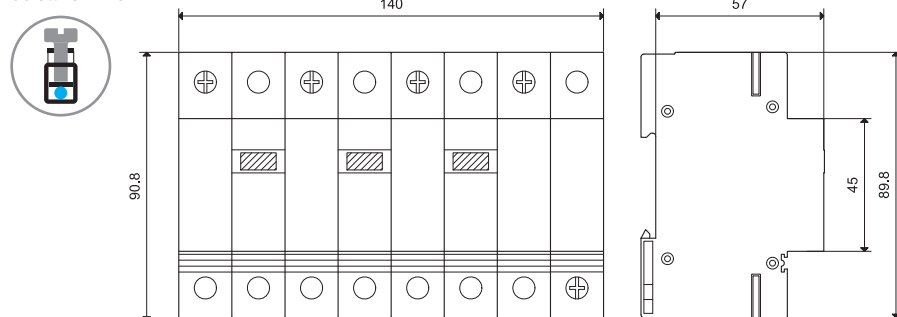
Type 7P.02
Screw terminal



Type 7P.03
Screw terminal

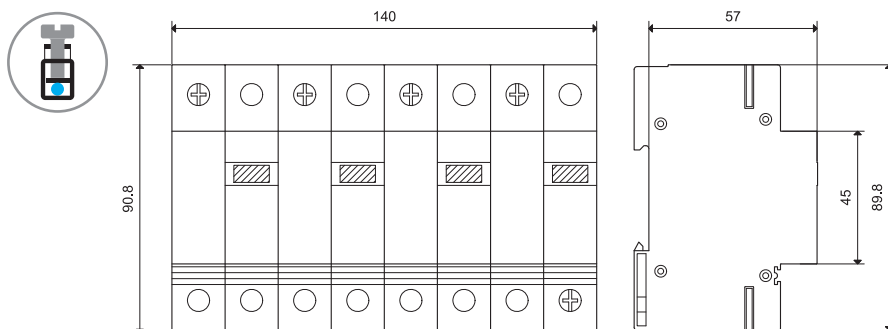


Type 7P.04
Screw terminal

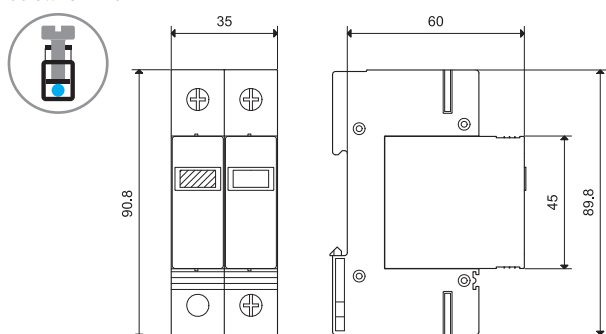


Outline drawings

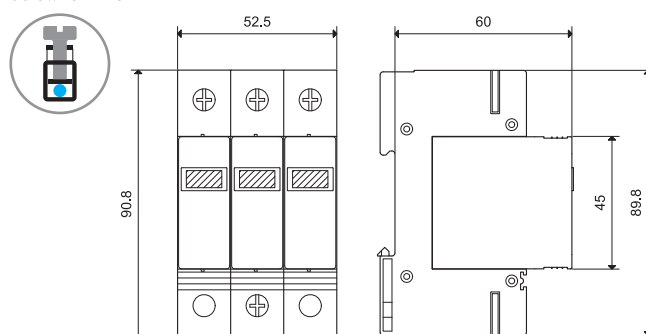
Type 7P.05
Screw terminal



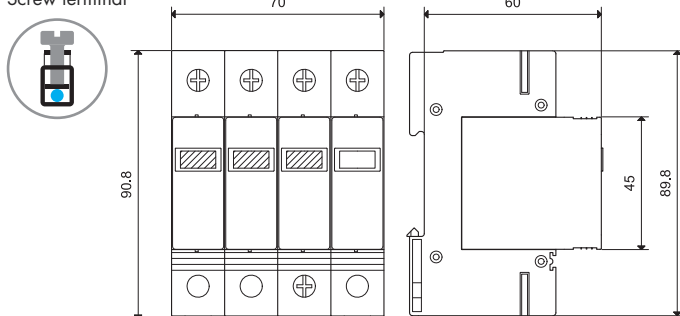
Type 7P.12
Screw terminal



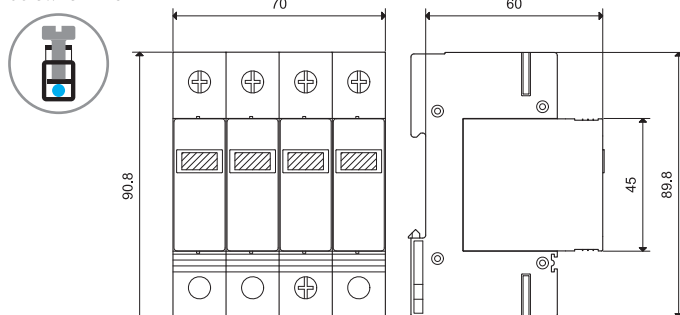
Type 7P.13
Screw terminal



Type 7P.14
Screw terminal

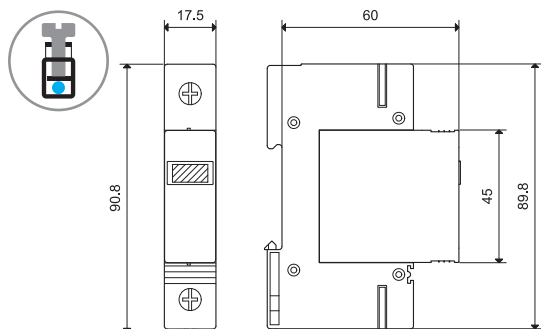


Type 7P.15
Screw terminal

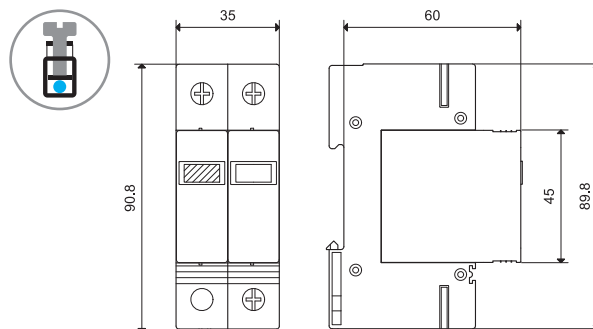


Outline drawings

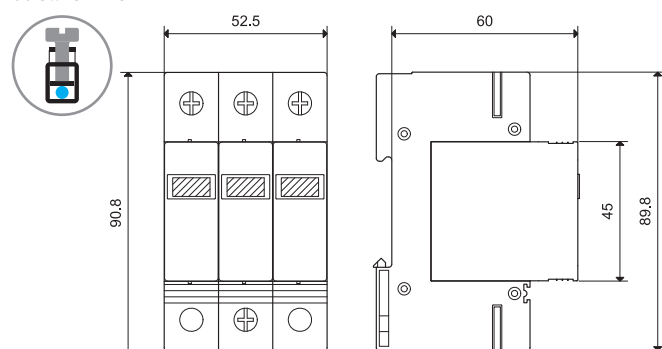
Type 7P.21
Screw terminal



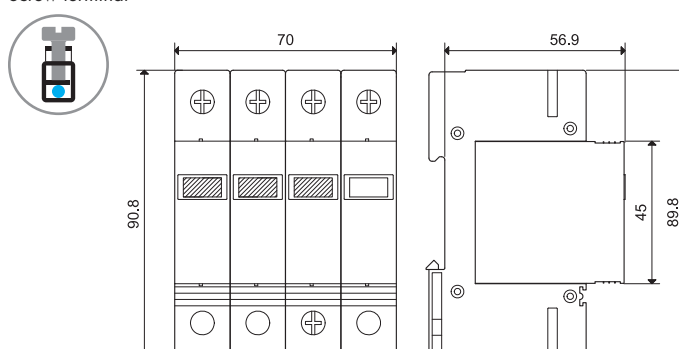
Type 7P.22
Screw terminal



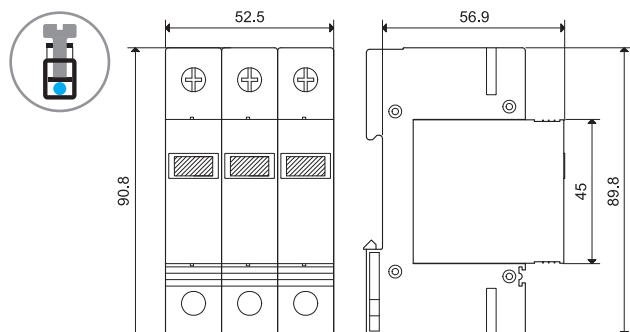
Type 7P.23.8
Screw terminal



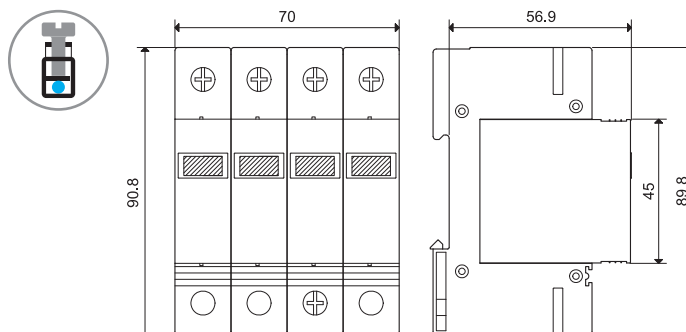
Type 7P.24
Screw terminal



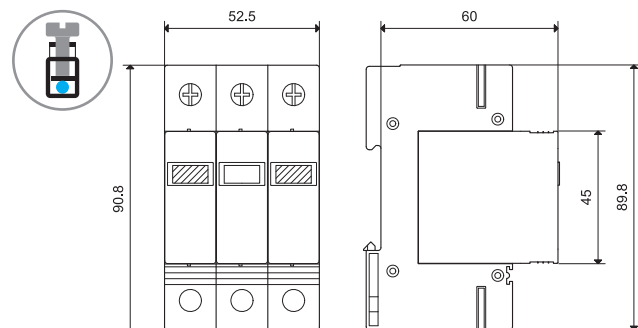
Type 7P.23.9
Screw terminal



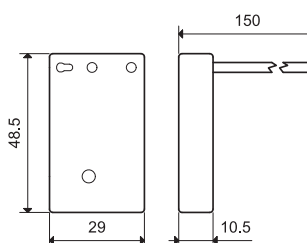
Type 7P.25
Screw terminal



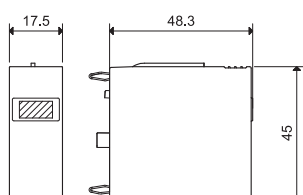
Type 7P.26
Screw terminal



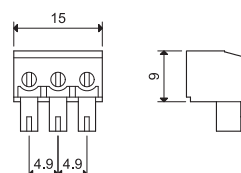
Type 7P.32



Type 7P.20
Replaceable module

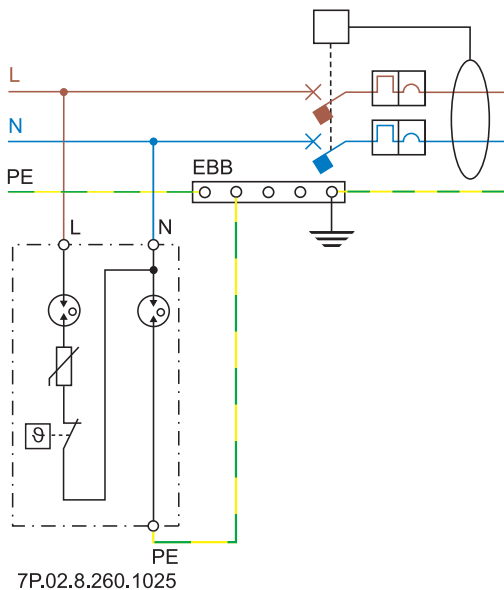


07P.01
Connector

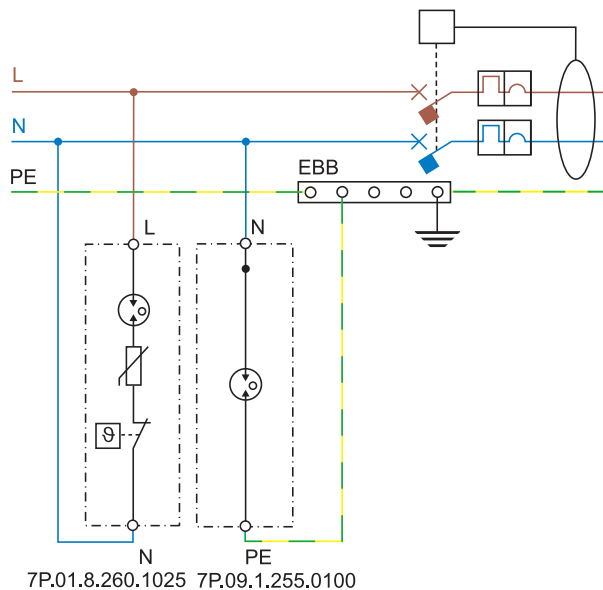


Installation example - SPD Type 1 + 2

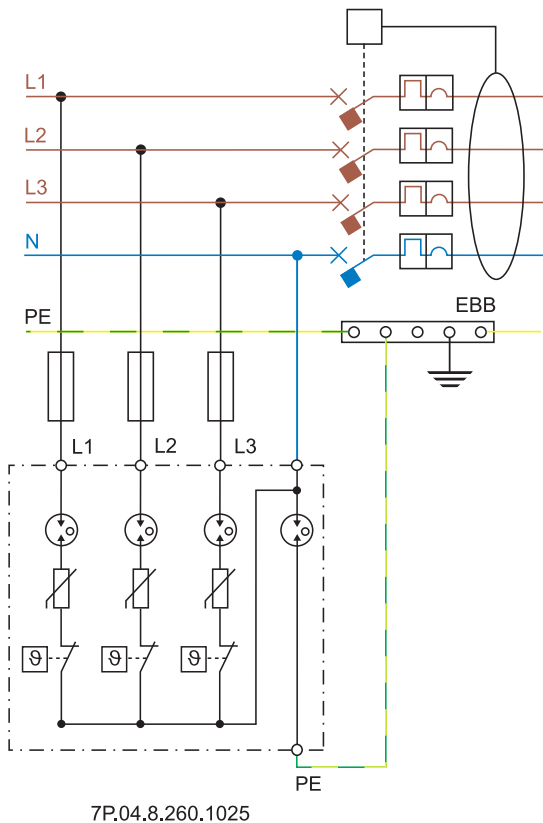
TT-SINGLE PHASE SYSTEM - SPD UP-STREAM OF RCD



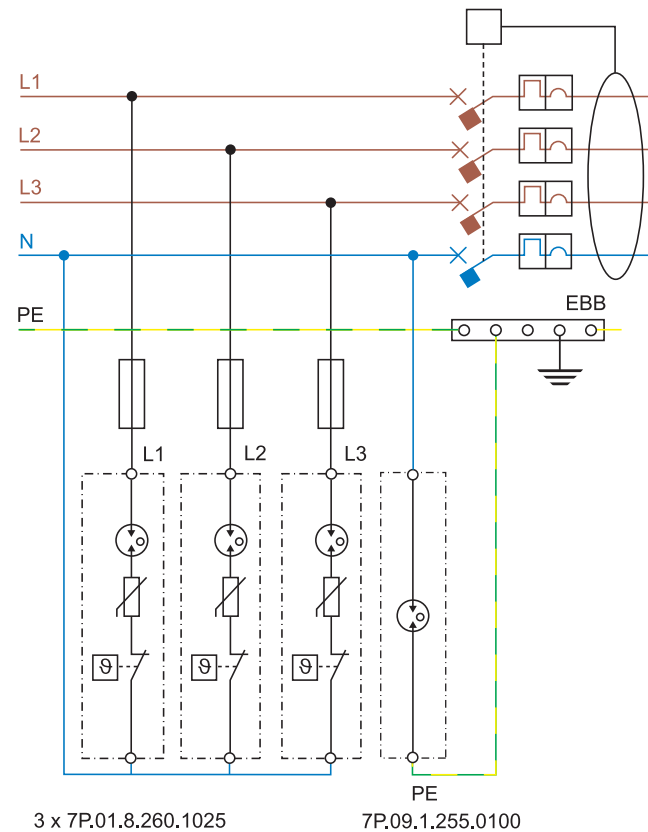
TT-SINGLE PHASE SYSTEM - SPD UP-STREAM OF RCD



TT-THREE PHASE SYSTEM - SPD UP-STREAM OF RCD

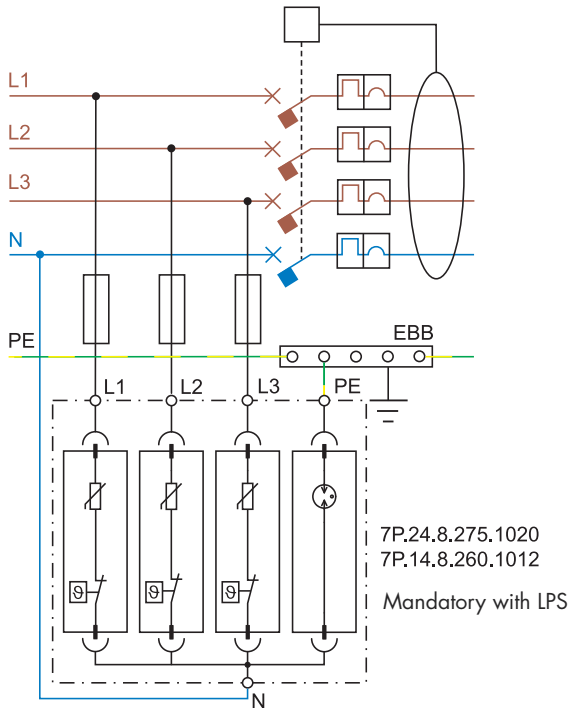


TT THREE PHASE SYSTEM - SPD UP-STREAM OF RCD

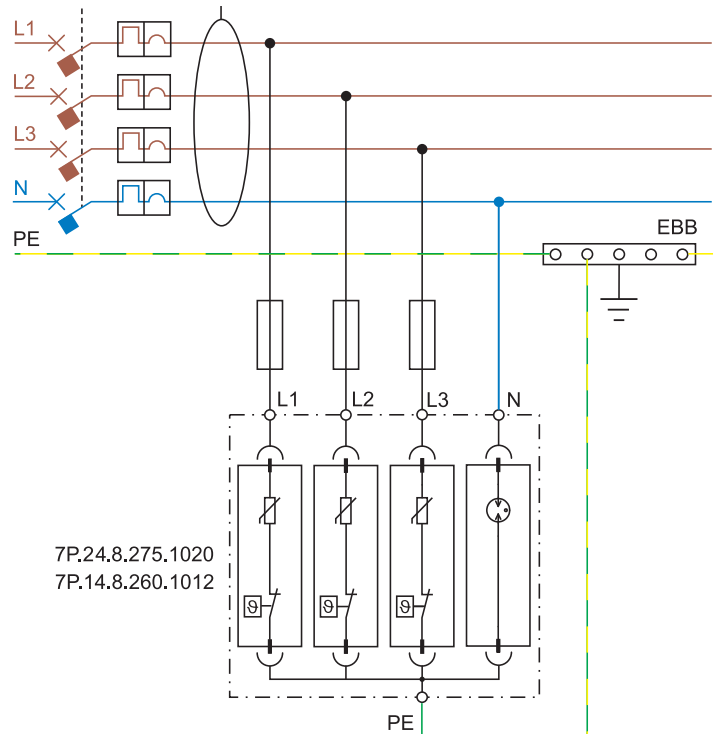


Installation example for SPD Type 1 and Type 2 - Three phase

TT-THREE PHASE SYSTEM - SPD UP-STREAM OF RCD

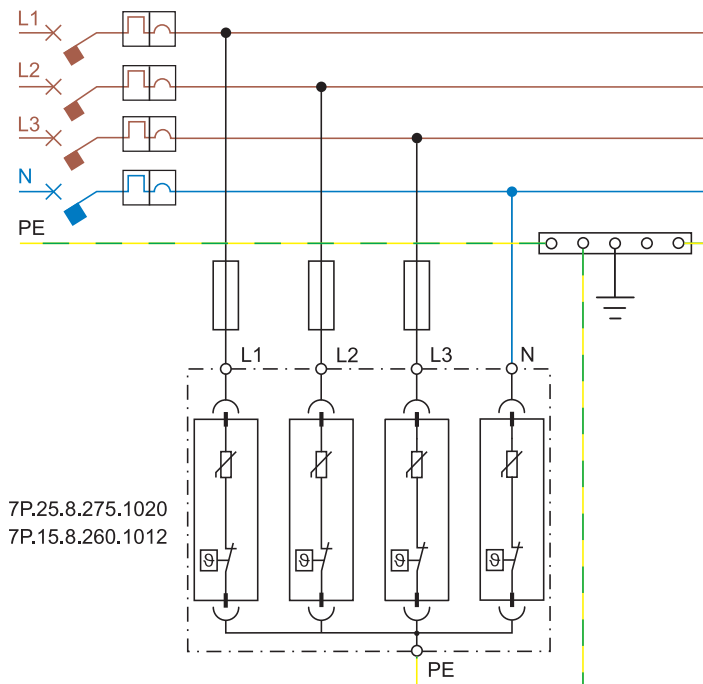


TT or TN-S THREE PHASE SYSTEM - SPD DOWN-STREAM OF RCD

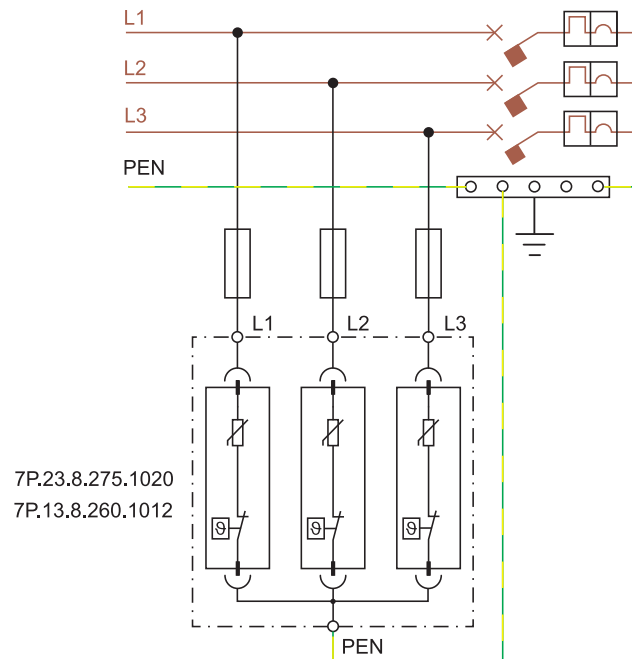


Note: suggested RCD type S

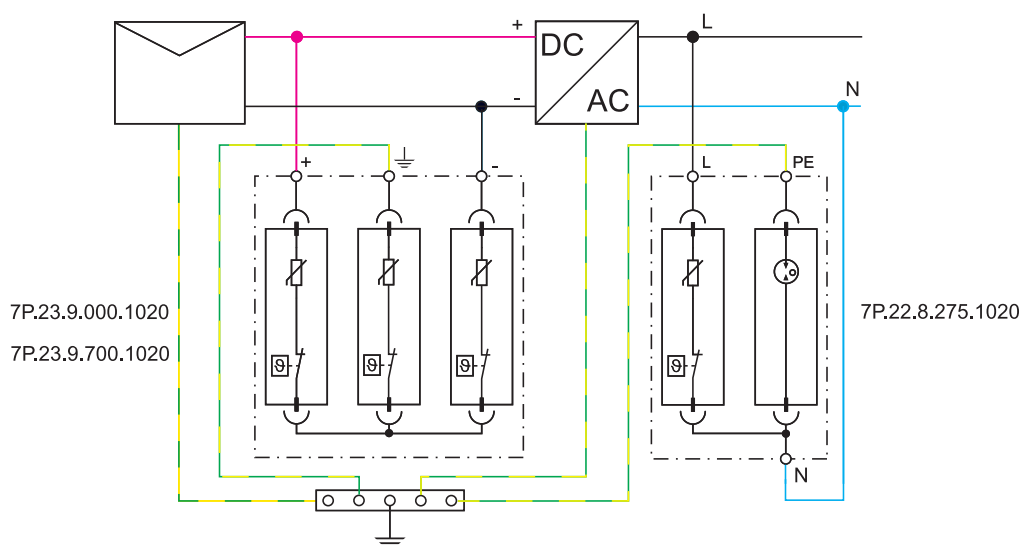
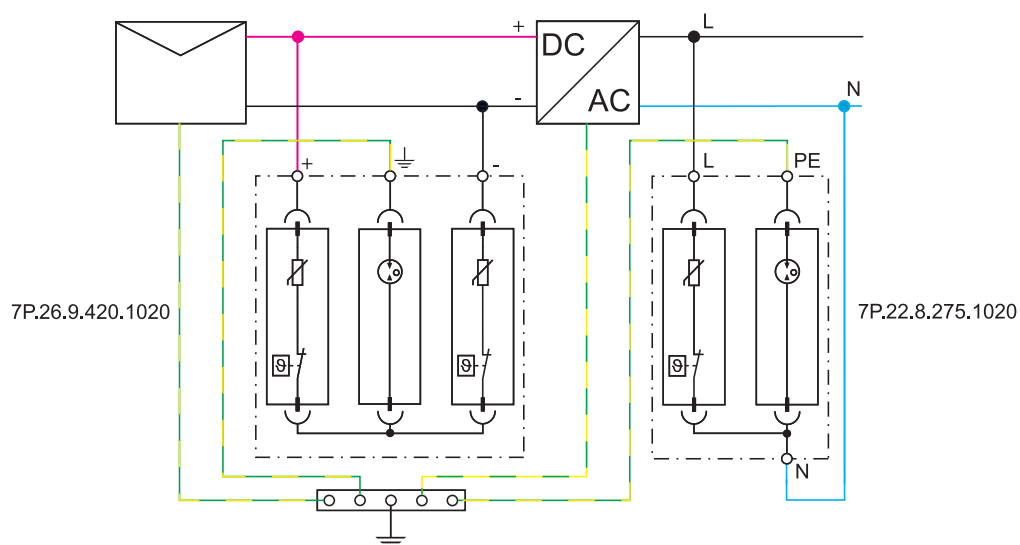
TN-S THREE PHASE SYSTEM - SPD DOWN-STREAM OF OVERCURRENT PROTECTION



TN-C THREE PHASE SYSTEM - SPD UP-STREAM OF OVERCURRENT PROTECTION



Installation examples - photovoltaic



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 0Ω . 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 SPD are installed. When the overvoltage has passed, the SPD impedance rises rapidly and resumes the state of an open switch again.

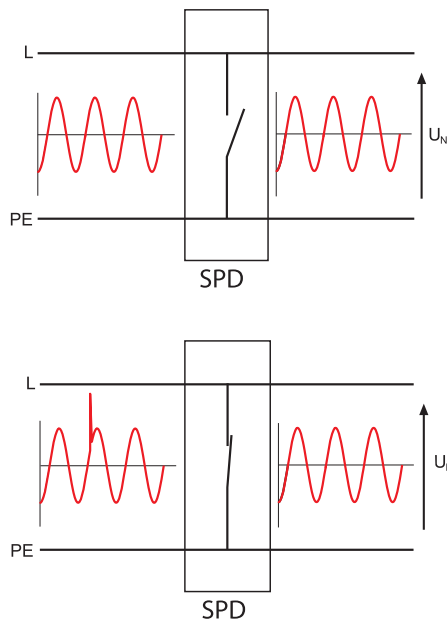


Figure 1: Ideal operation of an SPD

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 the 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 OA: 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 OB: An external area, but below a lightning conductor providing direct lightning 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 OA or OB 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) is shown that the transition from a protection zone to the next is through the installation of SPD. SPD Type 1 must be connected upstream the system, at the point of delivery connection. As alternative is possible to use SPD Type 1+2. The grounding conductor must have a minimum section of 6 mm² for SPD Type 1, of 4 mm² for SPD Type 2, and 1.5 mm² for SPD Type 3 (If the building has an LPS, reference should be made to CEI 81-10/4 for the correct dimension of the cable).

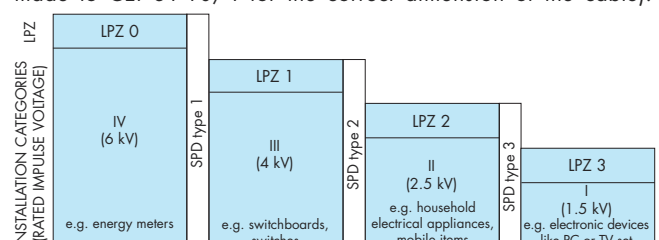


Figure 3: Typical relationship between Lightning Protection Zones, Installation Categories and SPD types

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 is 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 up 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 ($V = R \times I$), and will be limited to $< U_p$.

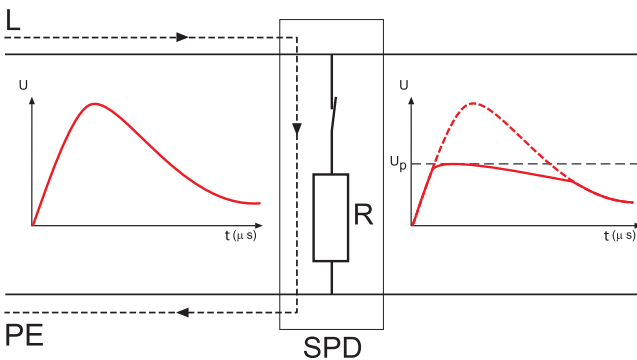


Figure 4: Overvoltage limiting

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. Consequently the maximum prospective short-circuit current of the system at the point of installation of the SPD must not exceed this value.

Rated values 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.

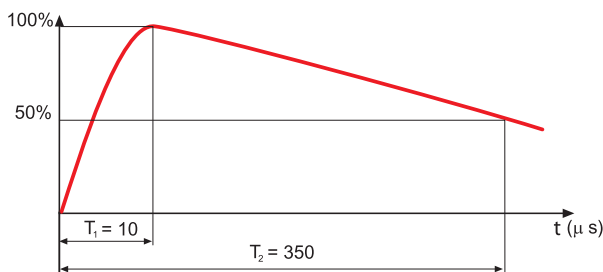


Figure 5: 10/350 μs current waveform

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.

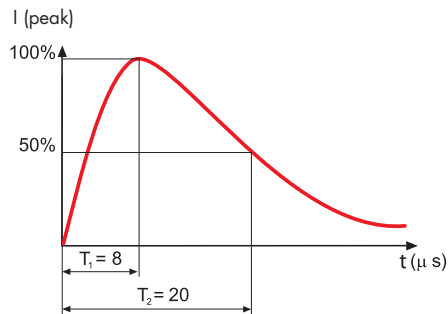


Figure 6: 8/20 μs current waveform

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 grid 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 8/20 μs 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).

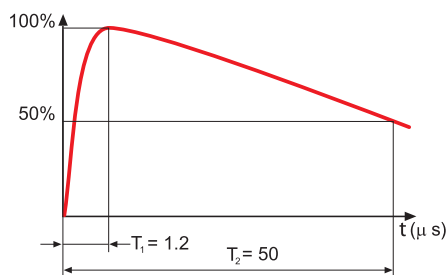
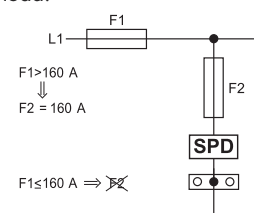


Figure 7: 1.2/50 μs voltage waveform

Suggestion for the connection

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



Protection against SPD's short circuits is provided by the overcurrent protective devices (fuses type gL/gG) recommended.

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 F2 (back up fuse), then F2 can be omitted.

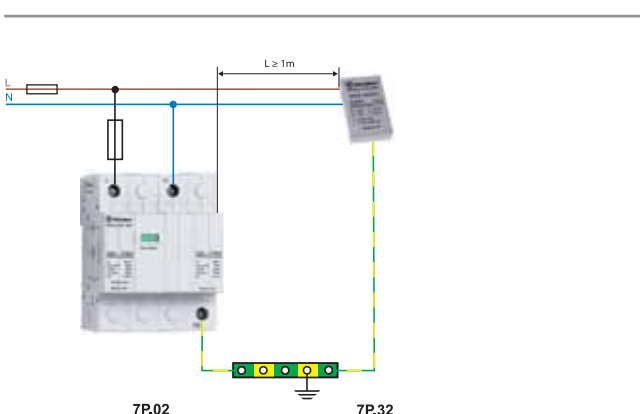
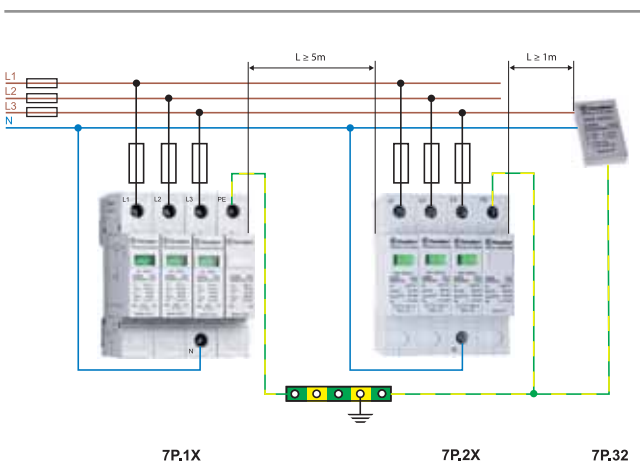
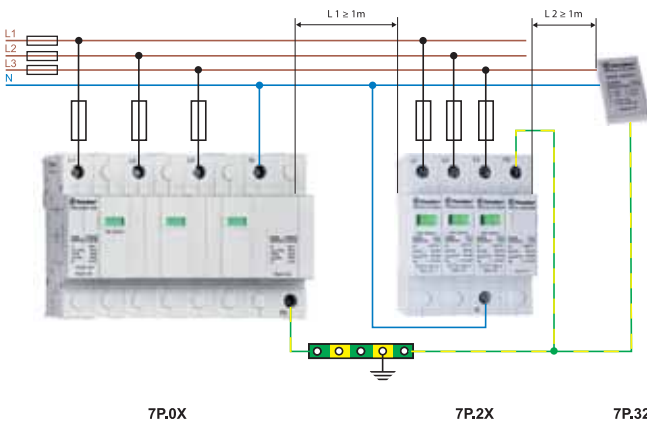
If $F1 > 160 \text{ A}$, then $F2 = 160 \text{ A}$ ($F2_{\min} = 125 \text{ A}$ only for SPD Type 2)

If $F1 \leq 160 \text{ A}$, then F2 can be omitted

The use of 125 A fuse gL/gG, instead of fuse rated 160 A gL/gG, as short circuit overcurrent protection is permitted and does not compromise the efficiency and the safety function of the SPD.

Coordination of SPD

Optimal protection from surges requires more cascaded SPD coordinated. Coordination has the purpose of splitting the energy associated with voltage across the SPD and it is obtained by introducing between them an impedance of appropriate value or, alternatively, by connecting them using wires having the minimum length indicated in the figures below, in order to use the impedance of its own conductor.



PROTECTING PHOTOVOLTAIC (PV) SYSTEMS AGAINST LIGHTNING

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.

Installation characteristics

[$U_{OC \text{ STC}}$] PV voltage: corresponds to the SPD maximum operating voltage and must be greater or equal to the maximum no-load voltage of the PV system - depending on the configuration: earth free or mid central earthing.

It is suggested that the maximum no-load voltage of the PV system is calculated on the basis $1.2 \times N \times U_{OC(\text{module})}$, where $U_{OC(\text{module})}$ is the no-load voltage of the single PV module in standard conditions and N is the number of modules connected in series in each array of the PV system (TS 50539-12).

Earth free system

An earth free system installation, typical of smaller systems, is characterized by the DC side floating, without connection to the ground. $U_{OC \text{ STC}}$ refers to the voltage between positive and negative poles. Class II photovoltaic panels are normally used in earth free system. However, if Class I panels are used, their metallic frames have to be earthed for safety reasons.

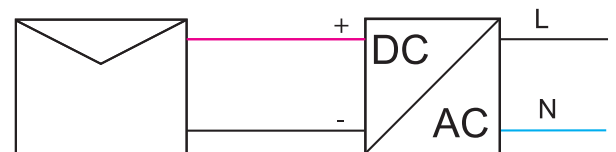


Figure 8: Earth free system installation

Mid central earthing

This system is used in larger installations, with high voltages: the ground connection to the mid point reduces by half the maximum voltage with respect to the ground. In this case $U_{OC \text{ STC}}$ is the voltage between the pole connected to the SPD and the ground.

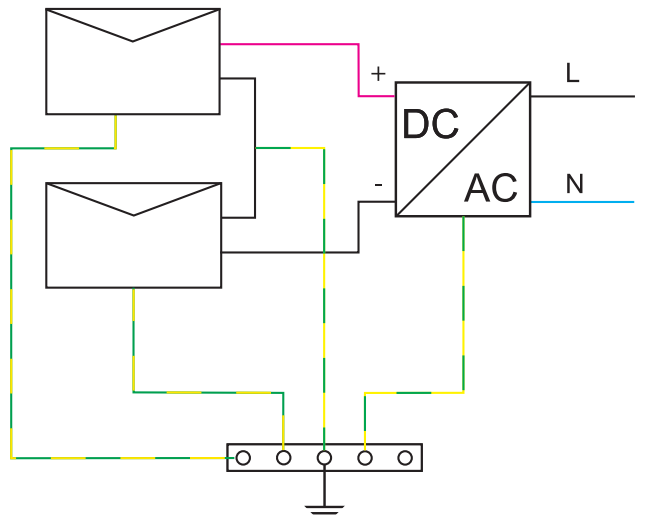


Figure 9: Mid central earthing installation

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

As an example, Figure 10 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. For example; if the PV panels are more that 10m from the inverter: fit one set of SPD as close as possible to the panels and one close to the inverter. At the point of delivery of energy, must be connected an SPD Type 1 or combined (1+2).

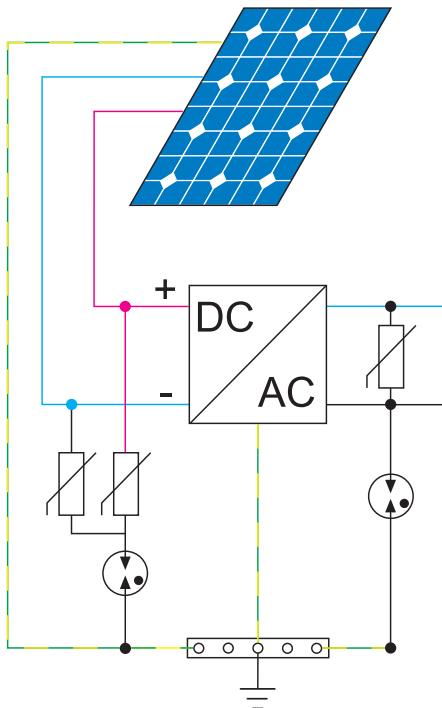


Figure 10: example of a photovoltaic system located on a building without LPS, protected on the DC side by an SPD with $U_{OC\ STC} = 420\ V$, and on the AC side by a 7P.22, specific for TT systems.

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 side is the same as for systems without LPS, consequently an arrester for PV systems of a suitable voltage ($U_{OC\ STC}$) should be used.

An appropriate Type 2 SPD should protect the AC side of the inverter, assuming a Type 1 SPD is already installed upstream.

However, if the inverter is sited in the field, for example; below the structure that supports the panels, then we recommend installing a Type 1 SPD to the AC side, instead of Type 2. Note that under EN 62305 installation of a Type 1 SPD is mandatory at the point of delivery of electricity, if the building has LPS (with or without solar panels).

SPD fuse protection

SPD Finder can break a 100 A DC (@200 V DC) current. This means that for nominal current of string (I_s) is lower than 100 A, is not necessary to install a back up fuse.

