

Overvoltage Protection Devices

Configuration Manual · 10/2010



SENTRON

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SIEMENS

Overvoltage Protection Devices






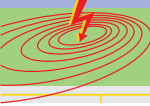



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9	Surge arresters type 2, 5SD7
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28	Surge arresters for measuring and control technology, 5SD7

Overvoltage Protection Devices

Introduction

Overview

Devices	Page	Application	Standards	Used in		
				Non-residential buildings	Residential buildings	Industry
	5	<p>With plug-in protective modules for TN-C, TN-S and TT systems Rated voltage 350 V AC for lightning currents from 25 kA to 100 kA. All versions with remote signaling contact.</p> <p>For installation in main distribution boards, upstream or downstream of the counter.</p>	EN 61643-11	✓	✓	✓
	7	<p>With plug-in protective modules for TN-C, TN-S and TT systems Rated voltage 350 V AC for lightning currents from 25 kA to 100 kA. All versions with remote signaling contact.</p> <p>For installation in main distribution boards downstream of the counter.</p>	EN 61643-11	✓	✓	✓
	9	<p>With plug-in protective modules for TN-C, TN-S and TT systems Rated voltage 350 V AC, rated discharge current 20 kA and discharge surge current 40 kA.</p> <p>For installation in sub-distribution boards.</p>	EN 61643-11	✓	✓	✓
	13	<p>With plug-in protective modules for single-phase and three-phase systems. Rated voltage, single-phase 24 V AC/DC, 60 V, 120 V, 230 V and three-phase 230/400 V AC.</p> <p>For installation as close as possible upstream from the terminal equipment.</p>	EN 61643-11	✓	✓	✓
	15	<p>Link rails provide the electrical interconnection of the N conductors, PE conductors or PEN conductors of 1-pole surge arresters, type 2.</p>	--	✓	✓	✓
	16	<p>Everything you need to know about overvoltage protection. Function, mounting and technical connections.</p>				
	28	<p>With plug-in protective modules for measuring and control technology for installation in signal circuits.</p>	EN 61643-21	✓	--	✓

Overview

Lightning arresters type 1 protect low-voltage systems against any overvoltage or high impulse currents that may be triggered by a direct or indirect lightning strike.

The protection level is lowered to 1.5 kV by the lightning arrester.

The lightning arresters are enclosed and are suitable for installation in the precounter area.

All spark gaps are tripped. For this reason, decoupling reactors are no longer required for the installation of overvoltage protection devices.

The lightning arresters are tested using a wave-shaped 25 kA to 100 kA lightning impulse current with waveform 10/350 μ s.

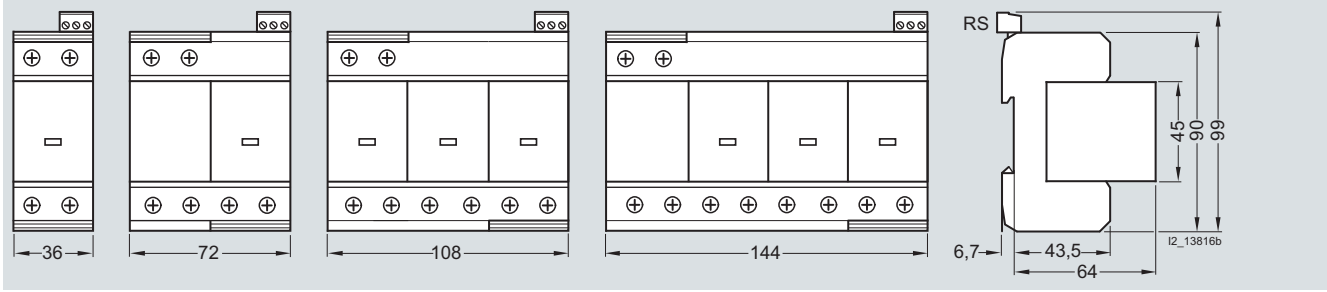
Technical specifications

		5SD7 411-1	5SD7 412-1	5SD7 413-1	5SD7 414-1
Standards		IEC 61643-11; DIN VDE 06754-6			
Approvals		--	UL/CUL	UL/CUL	UL/CUL
Rated voltage U_N	V AC	240		240/415	
Rated arrester voltage U_C		350			
• L/N, N/PE, L/PEN	V AC				
Lightning impulse current I_{imp} (10/350 μs)					
• L/N or L/PEN, 1P/3P	kA	25	25	25/75	25/75
• N/PE	kA	--	100	--	100
Rated discharge surge current I_n (8/20 μs)					
• L/N or L/PEN, 1P/3P	kA	25	25	25/75	25/75
• N/PE	kA	--	100	--	100
Protection level U_p		≤ 1.5			
• L/N, N/PE, L/PEN	kV				
Follow current discharge capacity I_{fi} (AC)					
• L/N or L/PEN	for 264 V/350 V	kA	50/25	50/25	50/25
• N/PE		A	--	100	--
Response time t_A					
• L/N or L/PEN		ns	≤ 100	≤ 100	≤ 100
• L-(N)-PE		ns	--	≤ 100	--
Max. back-up fuse	Acc. to IEC 61643-1				
• For parallel connection		A	315 gL/gG		
• For series connection		A	125 gL/gG		
Short-circuit strength with max. back-up fuse		kA _{rms}	50		
Temperature range		°C	-40 ... +80		
Degree of protection			IP20, with connected conductors		
Conductor cross-section					
• Finely stranded		mm ²	2.5 ... 25		
• Solid		mm ²	2.5 ... 35		
Mounting width	Acc. to DIN 43880	MW	2	4	6
Remote signaling (RS)			Yes		
• Contact type			Floating CO contact (plug-in)		
• Operational voltage, max.		V AC	250		
		V DC	125		
• Operational current, max.		A AC	1/1		
- Resistive/inductive load		mA DC	200/30		
• Conductor cross-section					
- Finely stranded		mm ²	1.5		
- Solid		mm ²	1.5		

Overvoltage Protection Devices

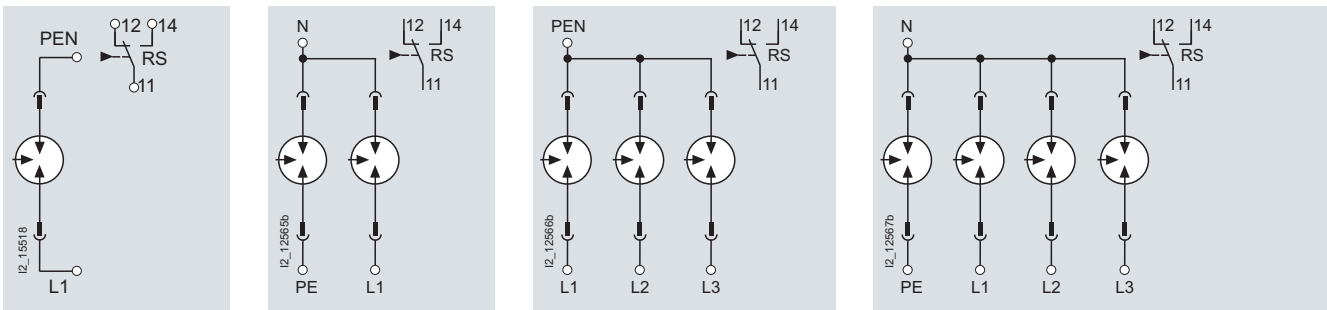
Lightning arresters type 1, 5SD7

Dimensional drawings



1P 2P 3P 4P
RS = remote signaling.

Schematics



1P 2P 3P 4P
RS = remote signaling.

Overview

Combination surge arresters type 1 and type 2 protect low-voltage systems against the overvoltages and high currents triggered by direct lightning strikes. They are tested by wave-shaped lightning impulse, 25 kA to 100 kA with waveform 10/350 μ s.

The protection level is lowered to 1.5 kV by the combination surge arresters.

A thermal isolating arrester disconnecter offers a high degree of protection against overload.

All spark gaps are tripped. For this reason, decoupling reactors are no longer required for the installation of overvoltage protection devices.

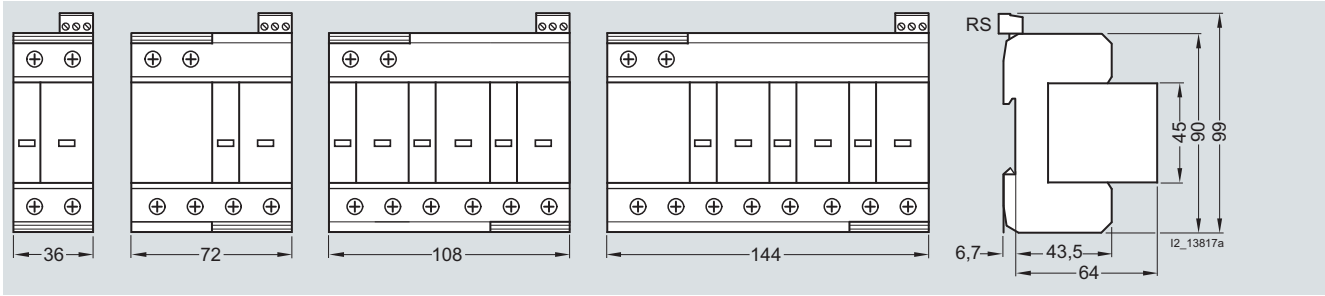
Technical specifications

		5SD7 441-1	5SD7 442-1	5SD7 443-1	5SD7 444-1
Standards		IEC 61643-11; EN 61643-11			
Approvals		--	KEMA, UL/CUL	KEMA, UL/CUL	KEMA, UL/CUL
Rated voltage U_N	V AC	240		240/415	
Rated arrester voltage U_C		350			
• L/N, N/PE, L/PEN	V AC	350			
Lightning impulse current I_{imp} (10/350 μs)					
• L/N or L/PEN, 1P/3P	kA	25	25	25/75	25/75
• N/PE	kA	--	100	--	100
Rated discharge surge current I_n (8/20 μs)					
• L/N or L/PEN, 1P/3P	kA	25	25	25/75	25/75
• N/PE	kA	--	100	--	100
Protection level U_p		≤ 1.5			
• L/N, N/PE, L/PEN	kV	≤ 1.5			
Follow current discharge capacity I_{ff} (AC)					
• L/N or L/PEN	kA	25	25	25	25
• N/PE	kA	--	100	--	100
Response time t_A					
• L/N or L/PEN	ns	≤ 25	≤ 100	≤ 100	≤ 100
• L-(N)-PE	ns	--	≤ 100	--	≤ 100
Max. back-up fuse	Acc. to IEC 61643-1				
• For parallel connection	A	315 gL/gG			
• For series connection	A	125 gL/gG			
Short-circuit strength with max. back-up fuse	kA _{rms}	25			
Temperature range	°C	-40 ... +80			
Degree of protection		IP20, with connected conductors			
Conductor cross-section					
• Finely stranded	mm ²	2.5 ... 25			
• Solid	mm ²	2.5 ... 35			
Mounting width	Acc. to DIN 43880 MW	2	4	6	8
Visual function/fault indication		Yes			
Remote signaling (RS)		Yes			
• Contact type		Floating CO contact (plug-in)			
• Operational voltage, max.	V AC	250			
	V DC	125			
• Operational current, max.					
- Resistive/inductive load	A AC	1/1			
- Resistive/inductive load	mA DC	200/30			
• Conductor cross-section					
- Finely stranded	mm ²	1.5			
- Solid	mm ²	1.5			

Overvoltage Protection Devices

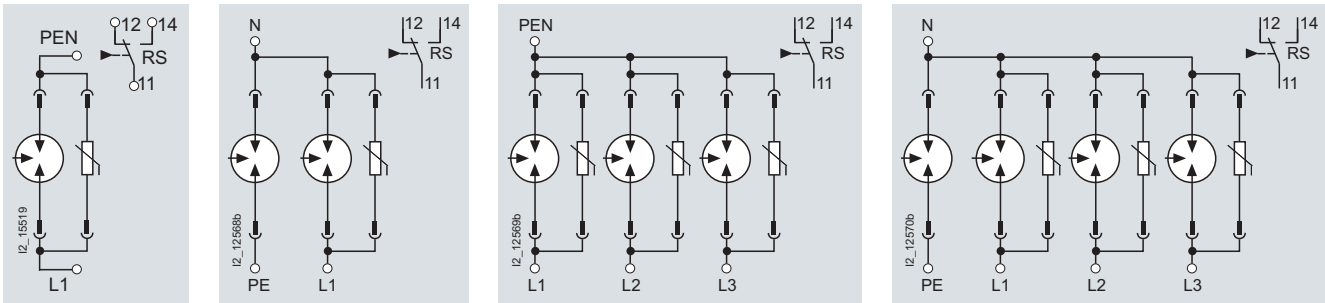
Combination surge arresters type 1 and type 2, 5SD7

Dimensional drawings



1P 2P 3P 4P
RS = remote signaling.

Schematics



1P 2P 3P 4P
RS = remote signaling.

Overview

Surge arresters type 2 are used downstream of lightning arresters type 1 in main distribution boards or sub-distribution boards. They protect low-voltage systems against transient overvoltages.

The type 2 surge arrester lowers the protection level to 1.4 / 1.5 kV. A remote signaling contact signals whether a protective module has been disconnected from the network by the thermal arrester disconnecter or whether it is just not plugged in.

All spark gaps are tripped. For this reason, decoupling reactors are no longer required for the installation of overvoltage protection devices.

To ensure fault-free operation of photovoltaic systems, it is essential to have standardized protection against lightning and overvoltages. SPDs (5SD7 483-.) on the DC side protect the photovoltaic generator and the inverter against overvoltages.

The SPDs 5SD7 473- . and 5SD7 485- . are especially available for protecting IT systems.

Technical specifications

	Surge arresters, standard design							
	N/PE	Single-pole	Multipole		3P	4P	3P	
	Plug-in	Plug-in	3P	4P	3P	4P	3P	
	5SD7 481-0	5SD7 461-.	5SD7 463-.	5SD7 464-.	5SD7 473-.	5SD7 485-.	5SD7 483-.	
Standards	IEC 61643-11; EN 61643-11							
Approvals	KEMA --							
Rated voltage U_N	V AC	240	240	240/415	240/415	500	240/415	--
Rated arrester voltage U_C								
• L/N	V AC	--	350	--	--	--	--	--
• L/N or L/PEN	V	--	--	350 AC	350 AC	580 AC	440 AC	1000 DC
• N/PE	V AC	260	--	--	260	--	--	--
Rated discharge surge current I_n (8/20 μs)								
• L/N	kA	--	20	--	--	--	--	--
• L/N or L/PEN, 1P	kA	--	--	20	20	15	20	15
• N/PE	kA	20	--	--	20	--	--	--
Max. discharge surge current I_{max} (8/20 μs)								
• L/N	kA	--	40	--	--	--	--	--
• L/N or L/PEN, 1P	kA	--	--	40	40	--	--	30
• L/N or L/PEN, 1P/multipole	kA	--	--	--	--	30	40	--
• N/PE	kA	40	--	--	40	--	--	--
Lightning impulse current I_{imp} (10/350 μs)	kA	12	--					
Protection level U_p								
• L/N or L/PEN	kV	--	≤ 1.4	≤ 1.4	≤ 1.4	≤ 2.5	≤ 2.2	≤ 5
• N/PE	kV	≤ 1.5	--	--	≤ 1.5	--	--	--
Response time t_A								
• L/N or L/PEN	ns	--	≤ 25	≤ 25	≤ 25	≤ 25	≤ 25	≤ 25
• N/PE	ns	≤ 100	--	--	≤ 100	--	--	--
Max. back-up fuse	Acc. to IEC 61643-1							
• For parallel connection	A	125	gL/gG					
• For series connection	A	63	gL/gG					
Short-circuit strength	kA _{rms}	25						
with max. back-up fuse								
Temperature range	°C	-40 ... +80						
Degree of protection		IP20, with connected conductors						
Conductor cross-section								
• Finely stranded	mm ²	1.5 ... 25						
• Solid	mm ²	1.5 ... 35						
Mounting width according to DIN 43880	MW	1	1	3	4	3	4	3
Visual function/fault indication		Yes						

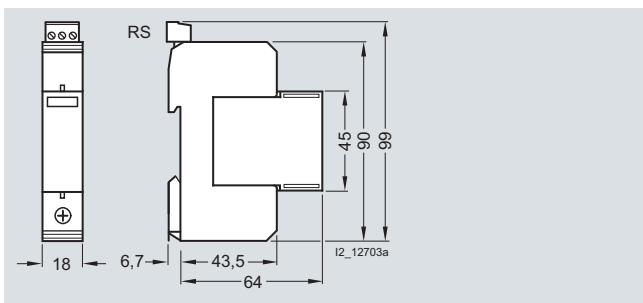
Overvoltage Protection Devices

Surge arresters type 2, 5SD7

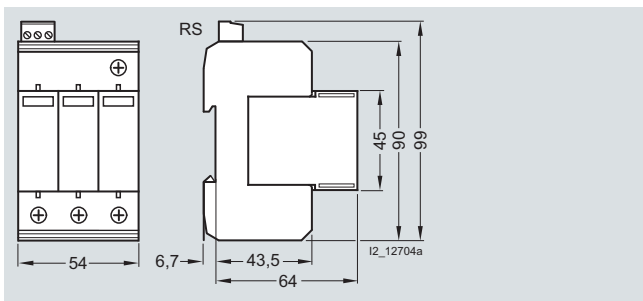
		Multipole surge arresters, narrow design					
		5SD7 422-0	5SD7 422-1	5SD7 423-0	5SD7 423-1	5SD7 424-0	5SD7 424-1
Standards Approvals		IEC 61643-11; DIN VDE 06754-6 KEMA KEMA/UL/CUL KEMA KEMA/UL/CUL KEMA KEMA/UL/CUL					
Rated voltage U_N	V AC	240		240/415		240/415	
Rated arrester voltage U_C							
• L/N or L/PEN	V AC	350		350		350	
• N/PE	V AC	264		--		264	
Rated discharge surge current I_n (8/20 μs)							
• L/N or L/PEN, 1P/3P	kA	20		20		20	
• N/PE	kA	20		--		20	
Max. discharge surge current I_{max} (8/20 μs)							
• L/N or L/PEN, 1P/3P	kA	40		40		40	
• N/PE	kA	40		--		40	
Protection level U_p							
• L/N or L/PEN	kV	≤ 1.4		≤ 1.4		≤ 1.4	
• N/PE	kV	≤ 1.5		--		≤ 1.5	
Response time t_A							
• L/N	ns	≤ 25		≤ 25		≤ 25	
• N/PE	ns	≤ 100		--		≤ 100	
Max. back-up fuse	Acc. to IEC 61643-1						
• For parallel connection	A	125 gL/gG					
• For series connection	A	63 gL/gG					
Short-circuit strength with max. back-up fuse	kA _{rms}	25		25		25	
Temperature range	°C	-40 ... +80					
Degree of protection		IP20, with connected conductors					
Conductor cross-section							
• Finely stranded	mm ²	1.5 ... 16					
• Solid	mm ²	1.5 ... 25					
Mounting width	Acc. to DIN 43880	mm	26	38		50	
Visual function/fault indication		Yes					
		Remote signaling contact					
Remote signaling (RS)		Yes					
Contact type		Floating CO contact (plug-in)					
Operational voltage, max.	V AC	250					
	V DC	125					
Operational current, max.							
• Resistive/inductive load	A AC	1/1					
• Resistive/inductive load	mA DC	200/30					
Conductor cross-section							
• Finely stranded	mm ²	1.5					
• Solid	mm ²	1.5					

Dimensional drawings

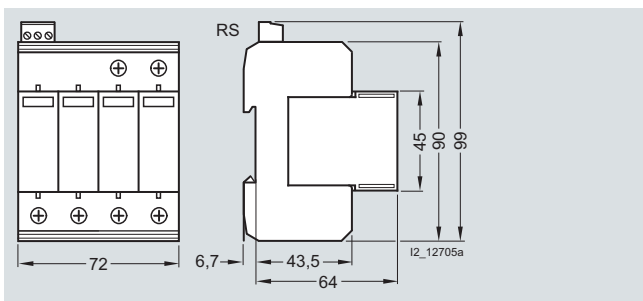
Surge arresters, standard design



1P
5SD7 461-0, 5SD7 481-0 without RS¹⁾
5SD7 461-1 with RS¹⁾

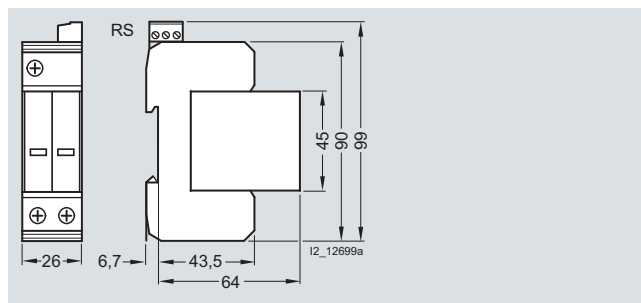


3P
5SD7 463-0, 5SD7 473-0, 5SD7 483-0 without RS¹⁾
5SD7 463-1, 5SD7 473-1, 5SD7 483-1 with RS¹⁾

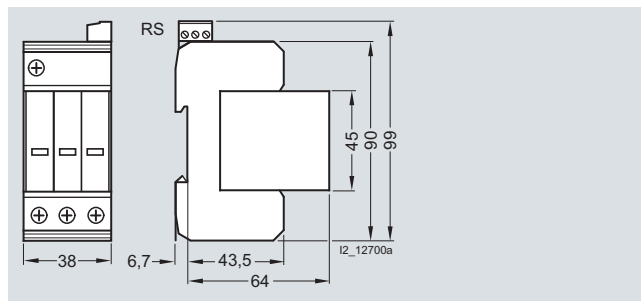


4P
5SD7 464-0, 5SD7 485-0 without RS¹⁾
5SD7 464-1, 5SD7 485-1 with RS¹⁾

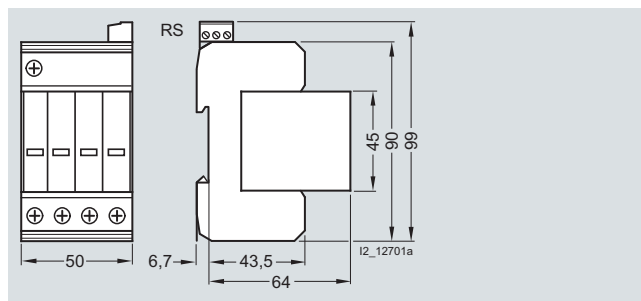
Surge arresters, narrow design



2P
5SD7 422-0 without RS¹⁾
5SD7 422-1 with RS¹⁾



3P
5SD7 423-0 without RS¹⁾
5SD7 423-1 with RS¹⁾



4P
5SD7 424-0 without RS¹⁾
5SD7 424-1 with RS¹⁾

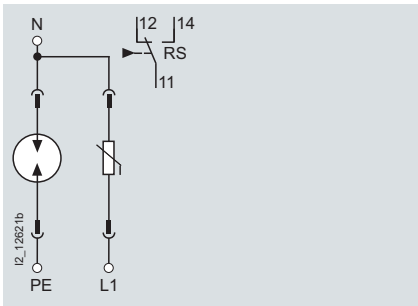
¹⁾ RS = remote signaling.

Overvoltage Protection Devices

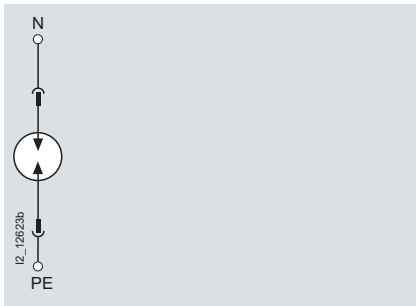
Surge arresters type 2, 5SD7

Schematics

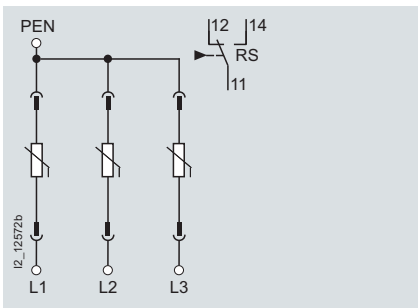
Surge arresters, standard design



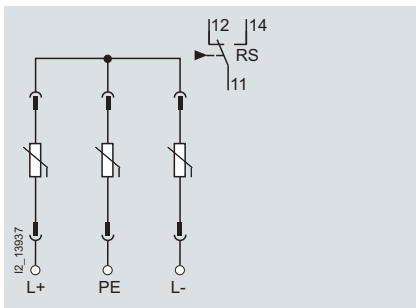
5SD7 461-0 without RS¹⁾
5SD7 461-1 with RS¹⁾



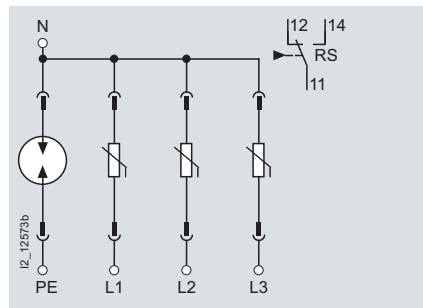
5SD7 481-0 without RS¹⁾



5SD7 463-0, 5SD7 473-0 without RS¹⁾
5SD7 463-1, 5SD7 473-1 with RS¹⁾



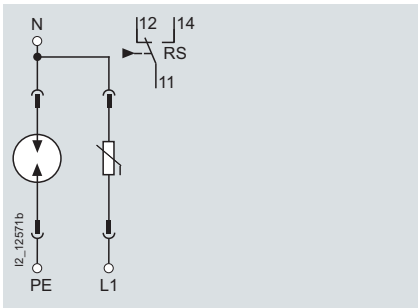
5SD7 483-0 without RS¹⁾
5SD7 483-1 with RS¹⁾



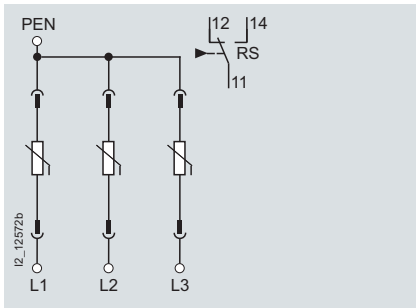
5SD7 464-0, 5SD7 485-0 without RS¹⁾
5SD7 464-1, 5SD7 485-1 with RS¹⁾

¹⁾ RS = remote signaling.

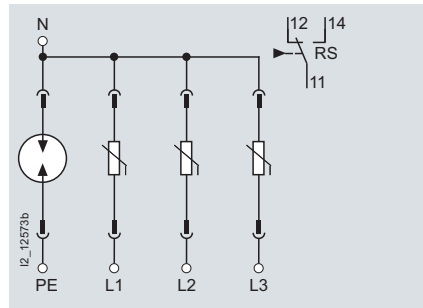
Surge arresters, narrow design



2P
5SD7 422-0 without RS¹⁾
5SD7 422-1 with RS¹⁾



3P
5SD7 423-0 without RS¹⁾
5SD7 423-1 with RS¹⁾



4P
5SD7 424-0 without RS¹⁾
5SD7 424-1 with RS¹⁾

¹⁾ RS = remote signaling.

Overview

Type 3 surge arresters are installed after the type 2 surge arresters in sub-distribution boards close to the loads in single or

multiphase systems and further limit the overvoltage in order to protect the connected loads.

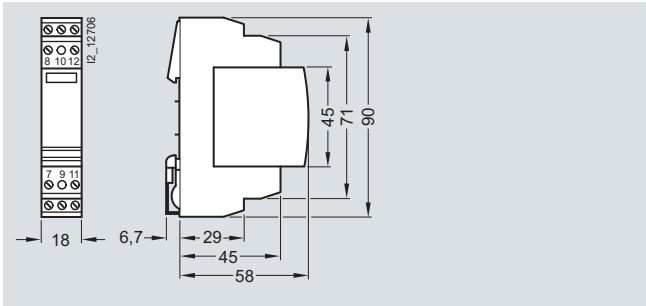
Technical specifications

	Multipole surge arresters, plug-in					
	2P					4P
		5SD7 432-1	5SD7 432-2	5SD7 432-3	5SD7 432-4	5SD7 434-1
Standards		IEC 61643-11; EN 61643-11				
Approvals		KEMA				
Rated voltage U_N	V AC	230	120	60	24	230/400
Rated load current I_L (at 30 °C)	A	26	26	26	26	3 × 26
Rated arrester voltage U_C	V AC	253	150	100	34	335
Rated discharge surge current I_n (8/20 μs)	kA	3	2.5	2.5	1	1.5
Max. discharge surge current I_{max} (8/20 μs)	kA	10	10	6.5	2	4.5
Combined surge U_{oc}	kV	6	6	4	2	4
Protection level U_p	L-N/L(N)-PE	V ≤ 1500/≤ 600	≤ 850/≤ 350	≤ 700/≤ 250	≤ 550/≤ 100	≤ 1200
Response time t_A	ns	≤ 100	≤ 100	≤ 100	≤ 100	≤ 100
Required back-up fuse, max.	A	25 gL/gG	25 gL/gG	25 gL/gG	25 gL/gG	25 gL/gG
Temperature range	°C	-40 ... +85				
Degree of protection		IP20, with connected conductors				
Conductor cross-section						
• Finely stranded	mm ²	0.2 ... 4				
• Solid	mm ²	0.2 ... 2.5				
Mounting width	Acc. to DIN 43880	MW	1	1	1	2
Visual function/fault indication		Yes				
Remote signaling (RS)		Yes				
• Contact type		NC contacts				
• Operational voltage, max.	V AC	250				
• Operational current, max.		3				

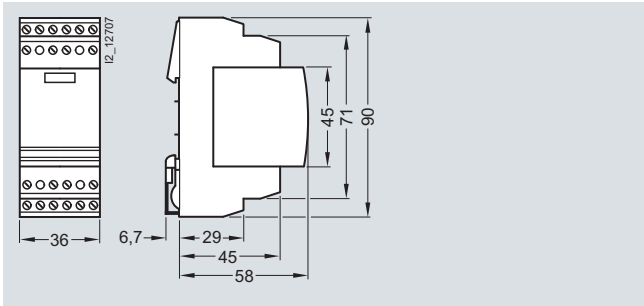
Overvoltage Protection Devices

Surge arresters type 3, 5SD7

Dimensional drawings

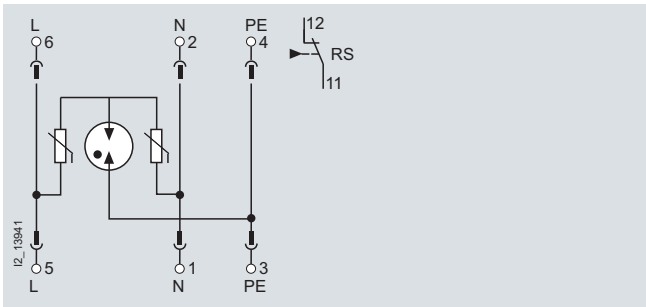


2P
5SD7 432-

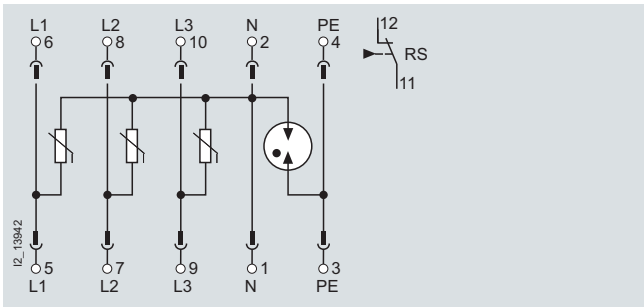


4P
5SD7 434-1

Schematics



2P
5SD7 432-



4P
5SD7 434-1

RS = remote signaling.

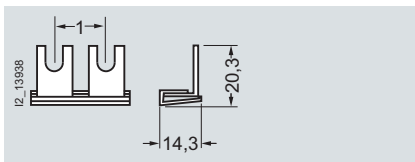
Overview

Link rails let you combine 1-pole surge arresters to create complete solutions for multiphase systems.

Technical specifications

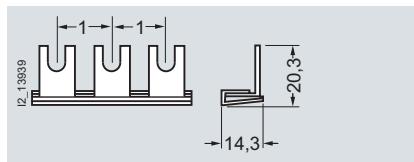
		Link rails 5SD7 490-2, 5SD7 490-3, 5SD7 490-4
Standards		EN 60439-1 (VDE 0660-500:2005-01)
Busbar material		SF-Cu F 24
Partition material		Plastic, cycolor 3600 heat-resistant ≥ 90 °C
Busbar cross-section	mm ²	16
Rated operational voltage U_c	V AC	400
Rated current I_n		
• Cross-section 16 mm ²	A	80
Rated impulse withstand voltage U_{imp}	kV	4
Test pulse voltage (1.2/50)	kV	6.2
Rated conditional short-circuit current I_{cc}	kA	25
Resistance to climate		
• Constant atmosphere acc. to DIN 50015		23/83; 40/92; 55/20
• Humid heat (acc. to IEC 68, Part 2-30)		28 cycles
Insulation coordination according to VDE 0110-1 April 1997 (IEC 664)		
• Overvoltage category		III
• Pollution degree		2
Maximum busbar current I_S/phase		
• Cross-section 16 mm ²	A	80
Maximum current in the arm I_E/phase		
• Cross-section 16 mm ²	A	130

Dimensional drawings

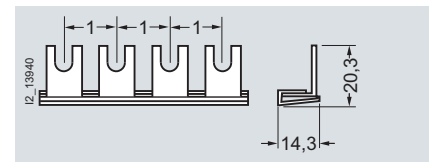


5SD7 490-2

Pin spacing in MW.
Dimensions of side views in mm.



5SD7 490-3



5SD7 490-4

Overvoltage Protection Devices

Configuration

Overview

Surge protection devices

Surge protection devices equipment whose main components comprise spark gaps (discharge paths) and/or voltage-independent resistors (varistors, suppressor diodes). Surge protection devices serve to protect other electrical equipment and electrical systems against unacceptably high overvoltages and to establish equipotential bonding.

Surge protection devices are categorized:

a) According to their application:

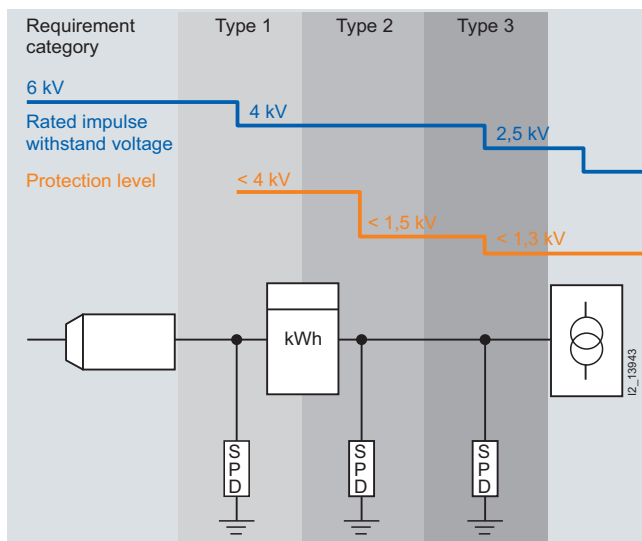
- Surge protection devices for systems and devices in power systems
- Surge protection devices for plants and devices in information systems for protecting modern electronic devices in telecommunication and signal processing systems against the indirect and direct effects of lightning strikes and other transient overvoltages
- Spark gaps for grounding systems or for equipotential bonding

b) According to their surge current discharge capacity and their protective action:

- Type 1 lightning arresters for influences as a result of direct or close-up strikes for the protection of installations and equipment
- Type 1 and type 2 combination surge arresters in one device for influences as a result of direct or close-up strikes for the protection of installations, equipment and terminal equipment
- Type 1 and type 2 surge arresters for remote strikes, switching overvoltages, as well as electrostatic discharges for the protection of installations, equipment and terminal equipment

Requirement categories of arresters

Lightning current and overvoltage protection is only effective if the pertinent insulation resistance of plant sections is also taken into account. To do this, the impulse withstand voltage of the different overvoltage categories is adapted to suit the protection level U_p of the different surge protection devices.



The international standard IEC 60664-1 (EN 60664-1) distinguishes between four chopped-wave withstand voltage categories for low-voltage devices. For low-voltage systems with a rated voltage of 230/400 V in particular, the following categories apply:

Surge voltages		
Category	Impulse withstand voltage	Description
IV	6 kV	Devices at the infeed of the installation, e.g. main distribution boards, E-counters, overcurrent circuit breakers, ...
III	4 kV	Devices that are part of the permanent installation are: e.g. distribution boards, protective devices, ...
II	2.5 kV	Devices for connection to the permanent installation, e.g. household appliances
I	1.5 kV	Extremely sensitive devices e.g. electronic devices

The following table shows the breakdown of lightning and surge arresters into requirement categories.

German Product Standard EN 61643-11	International Standard IEC 61643-1	Designation
Type 1	Class I	Lightning arresters
Type 2	Class II	Surge arresters for distribution boards
Type 3	Class III	Surge arresters for terminal equipment

Furthermore, the following country-specific product standards also apply:

- Italian: CEI EN 61643-11
- Austria: ÖVE/ÖNORM E 8001.

Note:

You can download the technical primer, "Lightning current and overvoltage protection" on the Internet at: www.siemens.com/beta or obtain a copy from your local Siemens representative.

Coordinated use of lightning and surge arresters

In practice, arresters of the different requirement categories are switched in parallel. Due to their different operating characteristics, discharge capacity and protection tasks, the different arrester types must be installed in the system so that the nominal values of the individual devices are not exceeded, thus ensuring consistent protection.

In order to enable subsequent coupling, we recommend inserting an additional type 2 surge arrester every 10 m.

In order to ensure that a surge current always switches to the nearest upstream arrester - if there is a risk that the surge current could overload the respective arrester - it is necessary to take energetic considerations into account.

This is called "energetic coordination" and must be established between type 1 and type 2 arresters, as well as between type 3 arresters.

In the past, this was achieved through the laborious and costly installation of decoupling reactors or sufficiently long cable lengths. However, thanks to modern tripping technology, this is no longer necessary.

Follow current discharge capacity

The data for the follow current discharge capacity of lightning arresters indicates the maximum line current that the arrester is capable of interrupting by itself without needing help to extinguish the fault from an upstream protective device, such as a fuse or miniature circuit breaker. The follow current is a result of the short circuit produced briefly by the lightning arrester to discharge the lightning current. The follow current is therefore a short-circuit current and has a frequency of 50 Hz.

If the maximum permissible short-circuit current of the plant is smaller than the maximum follow current that can be extinguished by the SPD, no upstream protective device is required. If this is not the case, a fuse or miniature circuit breaker is required.

Devices	Maximum permissible energy value $I^2 t_{\max}$ kA ² s	Maximum permissible peak current value $I_{p \max}$ kA	No protection necessary if $I_{cc \text{ eff}}$ kA
Lightning arresters, type 1	180	12	Up to 50
Combination surge arresters, type 1 and type 2	180	12	Up to 25
Surge arresters, type 2	180	12	Up to 25

SPDs with miniature circuit breakers and fuses

Miniature circuit breakers or fuses should perform the following tasks:

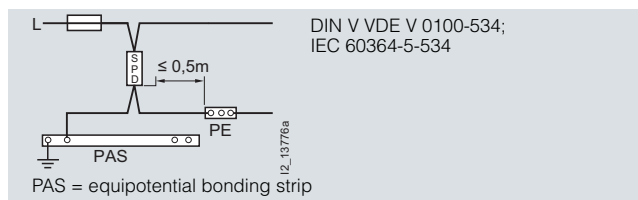
- Protect the SPD from overload in the event of overcurrent
- Ensure plant availability
- Help suppress system follow currents

Fuses or miniature circuit breakers therefore ensure that the max. permissible peak current $I_{p \max}$ and the maximum permissible energy value $I^2 t_{\max}$ of the SPD are not exceeded. This prevents damage to the SPD.

We recommend using fuses rather than miniature circuit breakers as they have a smaller voltage drop and ensure better protection.

A distinction is generally made between 2 different connection types:

- **Series connection:**
The installation is protected over the protective device that is fitted in the power distribution as standard. The SPD is protected over the plant fuse installed in the system. If this fuse is tripped because the SPD is overloaded, the plant is disconnected from the supply by the fuse or miniature circuit breakers.



Recommended max. cable length for series connection

- **Parallel connection:**
The protective device is located in the connecting cable of the SPD. If the miniature circuit breaker or fuse is tripped, the power supply of the plant is maintained. In this case, we recommend using a signaling device to signal that the overvoltage protection function has been disconnected from the supply and is therefore no longer effective.



Recommended max. cable lengths for parallel connections

Your configuration should take into account the values for the maximum permissible arrester back-up fuses stipulated in the technical specifications.

Generally speaking, a series connection is always preferable to a parallel connection. This connection is particularly suitable for reducing additional voltages on surge current cables.

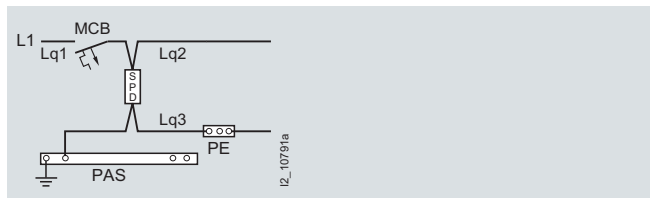
Overvoltage Protection Devices

Configuration

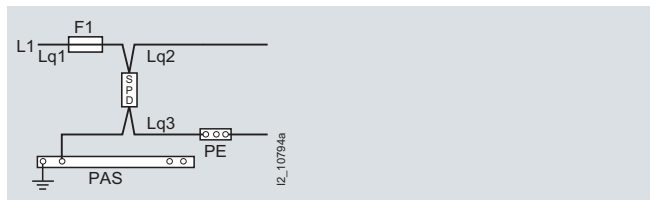
Dimensioning of conductor cross-sections

The different conductor cross-sections (Lq 1 to Lq 3) must be dimensioned according to the rated current of the miniature circuit breaker or of the fuse.

Series connection



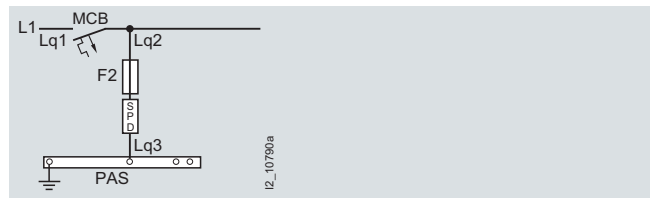
a) Protection of the SPD over miniature circuit breakers



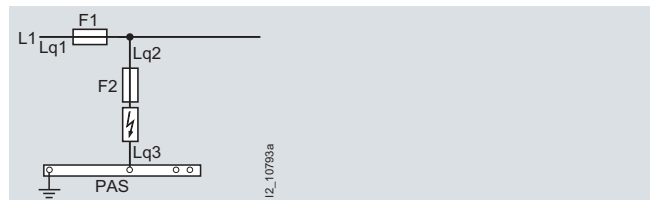
b) Protection of the SPD over fuses

PAS = equipotential bonding strip

Parallel connection



a) Protection of the SPD over miniature circuit breakers



b) Protection of the SPD over fuses

Conductor cross-sections for lightning arresters (type 1) and combination surge arresters (type 1 and type 2) for series connection

MCB/fuse (F1) upstream connected [A gL/gG]	Lq 2 [mm ²]	Lq 3 [mm ²]
25	10	16
35	10	16
40	10	16
50	10	16
63	10	16
80	16	16
100	25	16
125	35	16

Conductor cross-sections for surge arresters (type 2) for series connection

MCB/fuse (F1) upstream connected [A gL/gG]	Lq 2 [mm ²]	Lq 3 [mm ²]
25	6	6
35	6	6
40	6	6
50	10	10
63	10	10

Conductor cross-sections for lightning arresters (type 1) and combination surge arresters (type 1 and type 2) for parallel connection

MCB/fuse (F1) upstream connected [A gL/gG]	Lq 2 [mm ²]	Lq 3 [mm ²]	F2 fuse [A gL/gG]
25	6	16	/
35	10	16	/
40	10	16	/
50	10	16	/
63	10	16	/
80	10	16	/
100	16	16	/
125	16	16	/
160	25	25	/
200	35	35	160 ¹⁾
250	35	35	160 ¹⁾
315	50	50	160 ¹⁾
> 315	50	50	160 ¹⁾

1) Recommended fuse.

Conductor cross-sections for surge arresters (type 2) for parallel connection

MCB/fuse (F1) upstream connected [A gL/gG]	Lq 2 [mm ²]	Lq 3 [mm ²]	Fuse F2 [A gL/gG]
25	6	6	/
32	6	6	/
40	6	6	/
50	6	6	/
63	10	10	/
80	10	10	/
100	16	16	/
125	16	16	/
> 125	16	16	125

In the case of surge arresters type 3, the following conductor cross-sections are generally used:

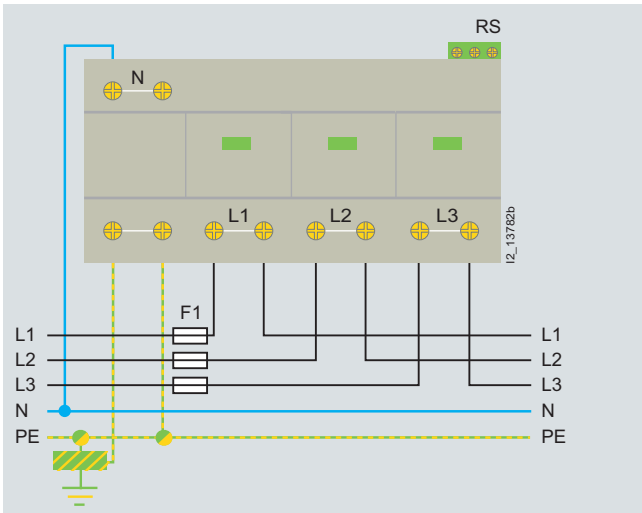
- rigid: up to 4 mm²
- flexible: up to 2.5 mm².

Configuration

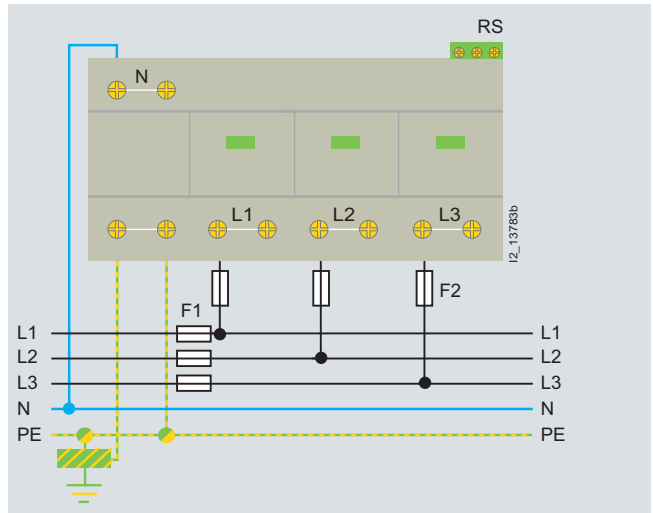
Schematics

Examples

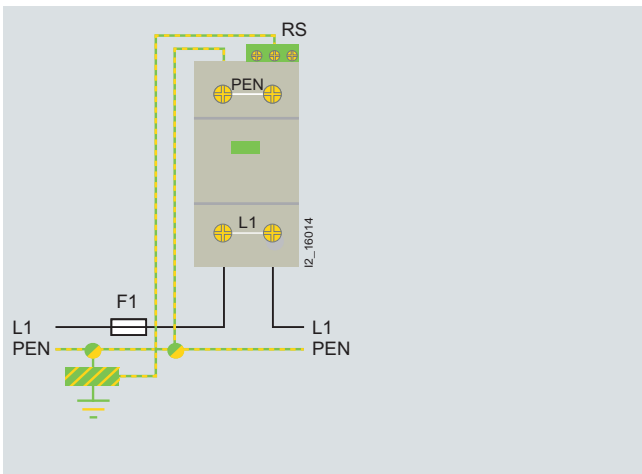
Series connection



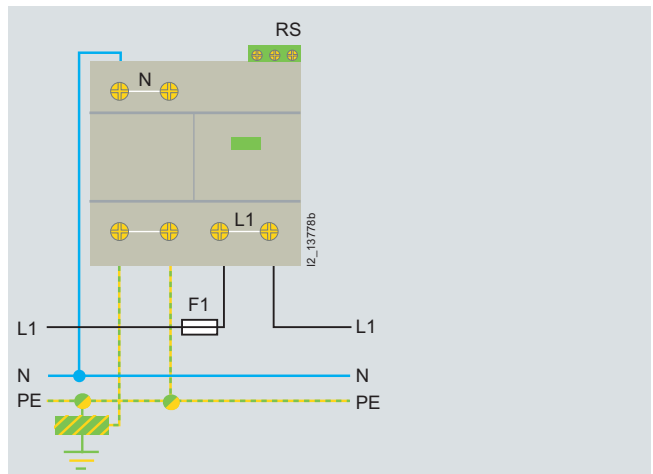
Parallel connection



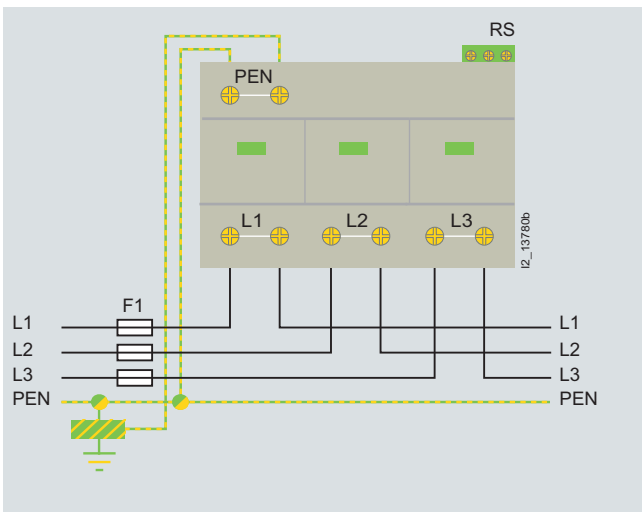
Lightning arresters, type 1



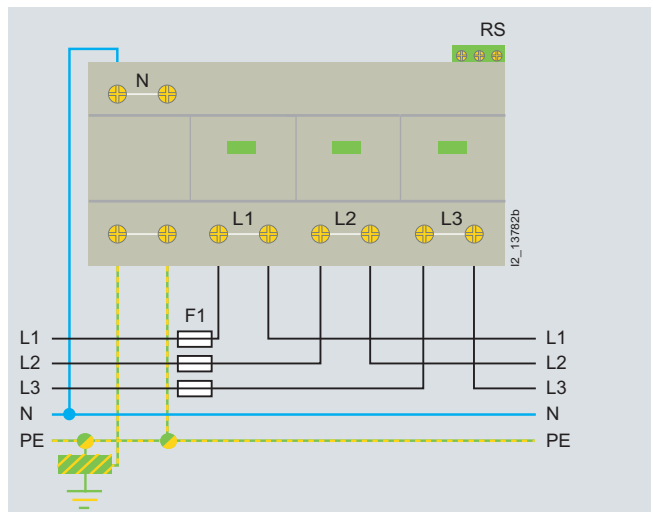
5SD7 411-1 for 1-wire systems



5SD7 412-1 for TN-S/TT systems



5SD7 413-1 for TN-C systems



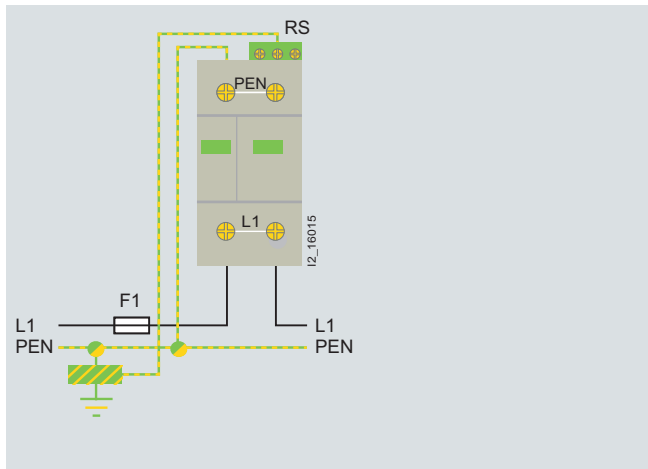
5SD7 414-1 for TN-S/TT systems

RS = remote signaling.

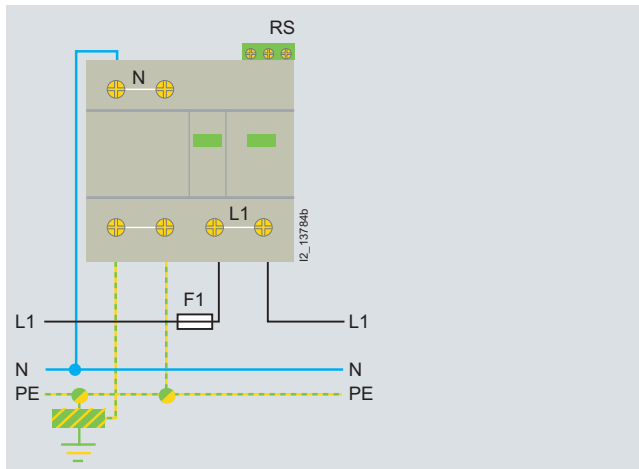
Overtoltage Protection Devices

Configuration

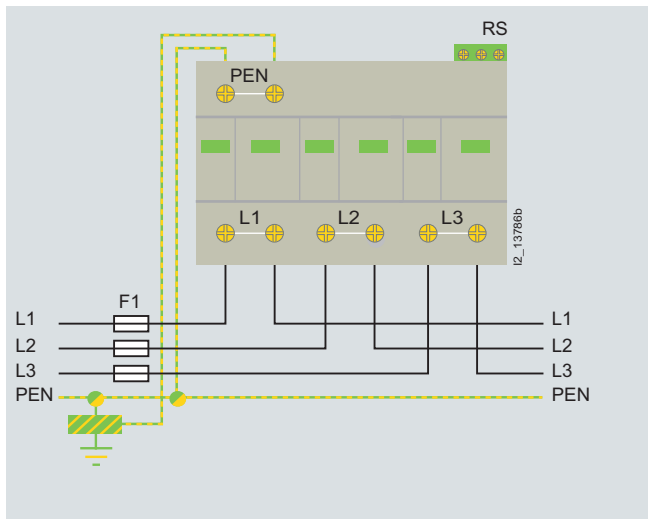
Combination surge arresters, type 1 and type 2



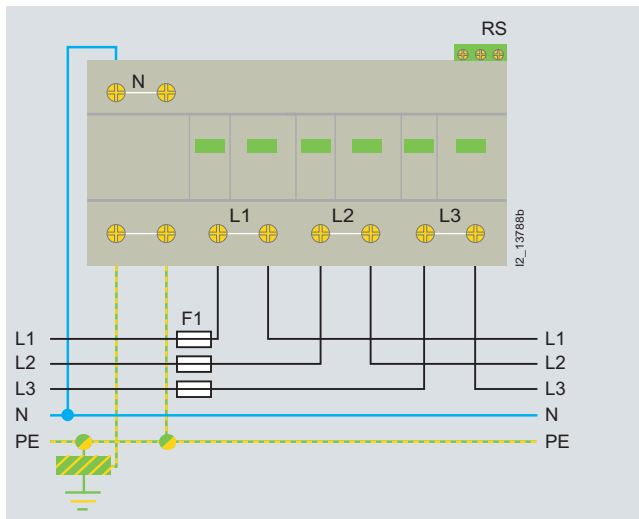
5SD7 441-1 for 1-wire systems



5SD7 442-1 for TN-S/TT systems

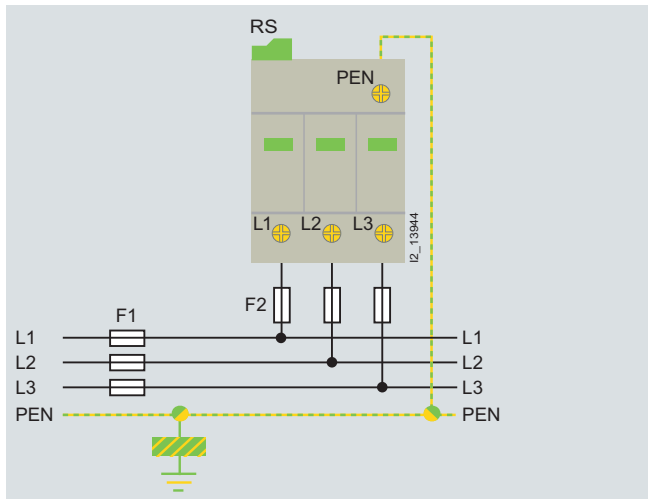


5SD7 443-1 for TN-C systems

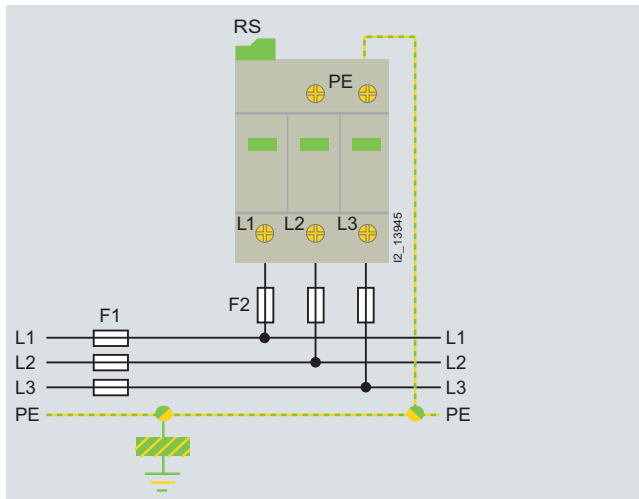


5SD7 444-1 for TN-S/TT systems

Surge arresters, type 2



5SD7 463- for TN-C systems

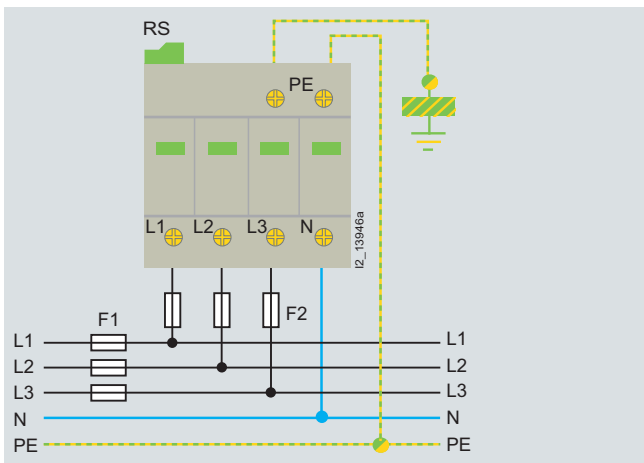


5SD7 473- for IT systems

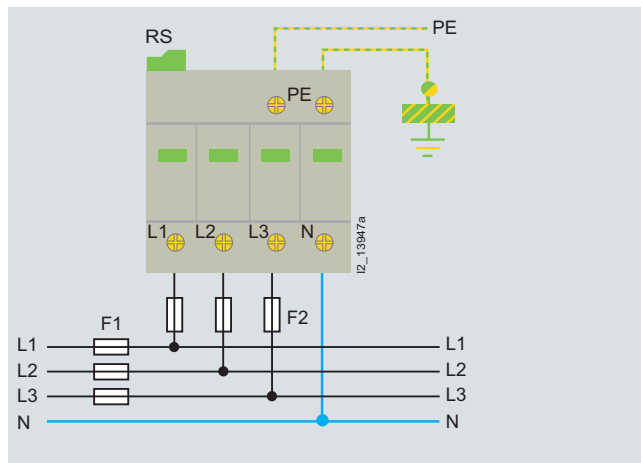
RS = remote signaling.

Overvoltage Protection Devices

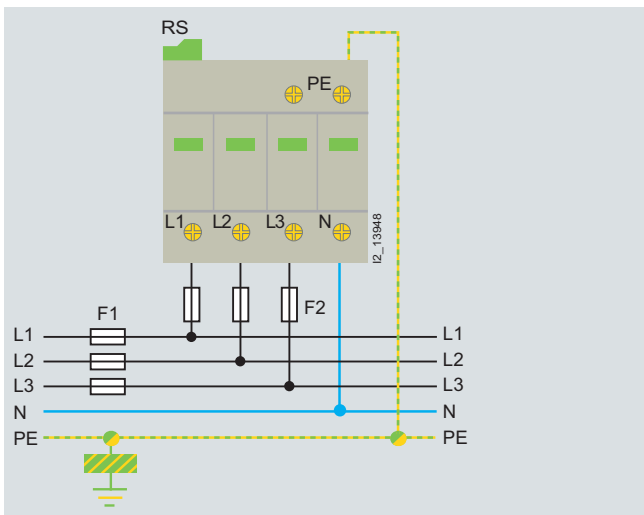
Configuration



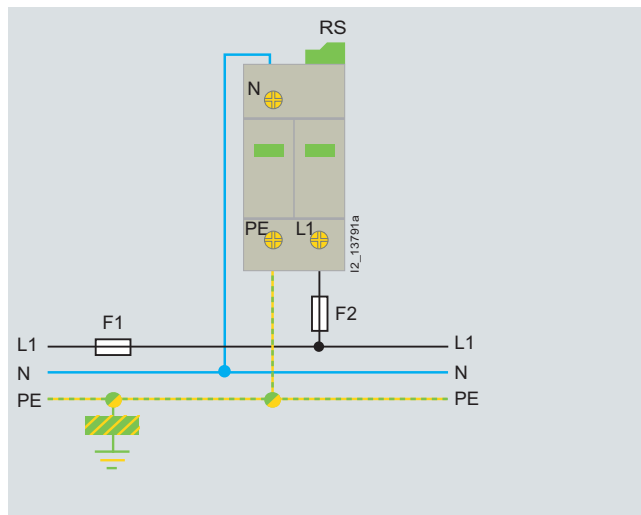
5SD7 464-. for TN-S systems



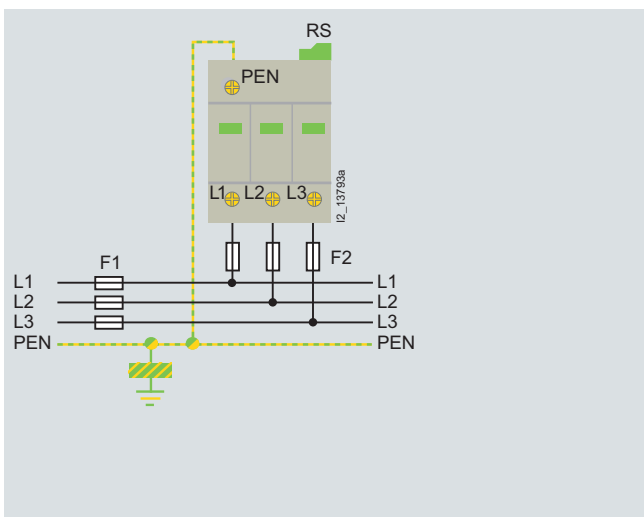
5SD7 464-. for TN-S/TT systems



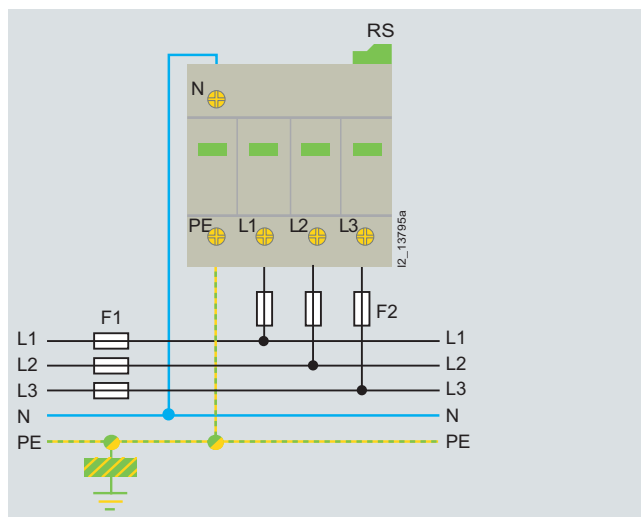
5SD7 485-. for IT systems



5SD7 422-. for TN-S/TT systems



5SD7 423-. for TN-C systems



5SD7 424-. for TN-S/TT systems

RS = remote signaling.

Configuration

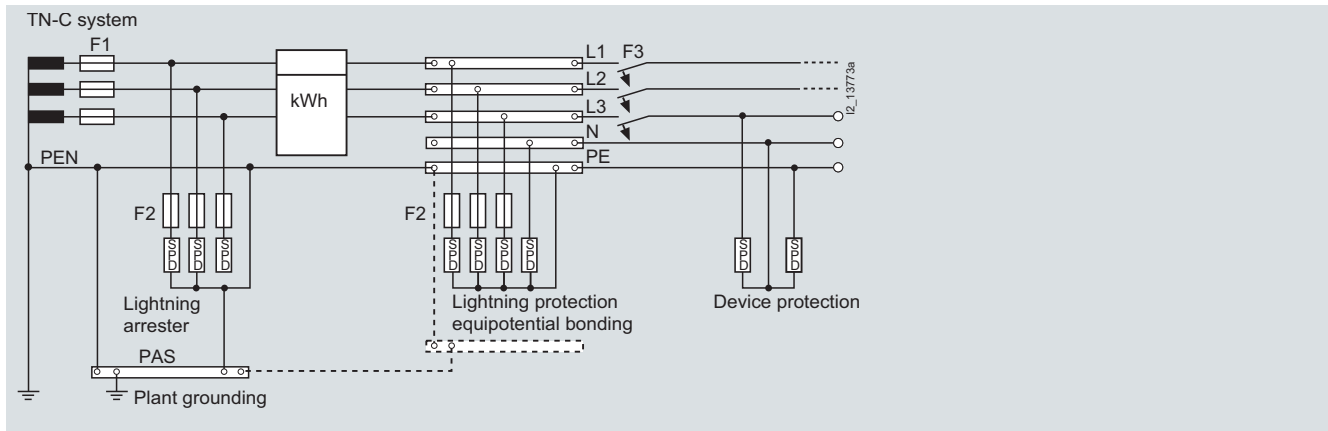
Scope when installing overvoltage protection systems

The scope of IEC 60364-4-443 – Electrical installations of buildings, Protection for safety; Protection against voltage disturbances and electromagnetic disturbances – extends from the protective device over the counter, through to the socket outlet.

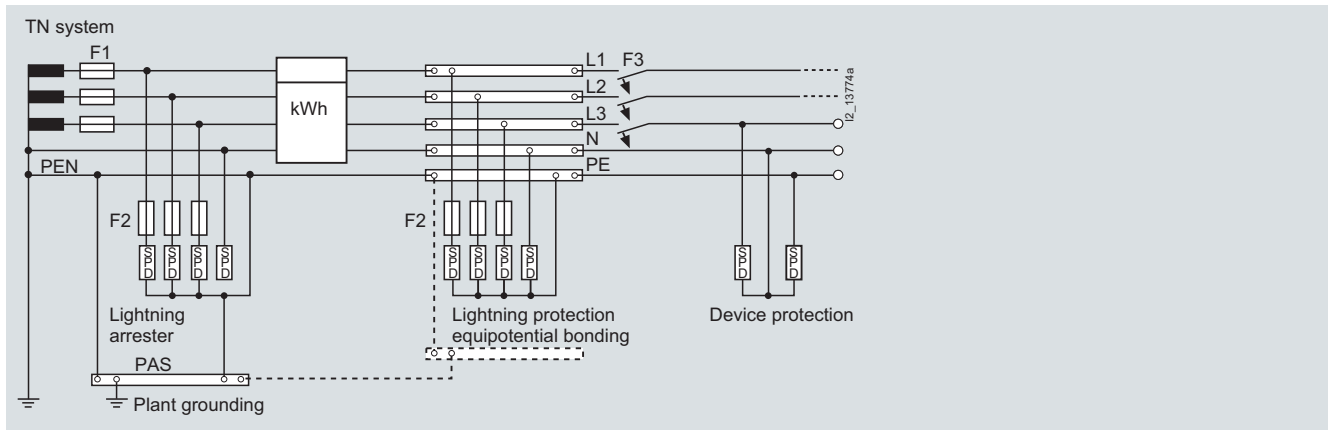
The scope of IEC 61024-1 – Protection of structures against lightning - and IEC 61312-1 - Protection against lightning

electromagnetic impulse – extends from the incoming main feeder box through to the socket outlet and includes grounding measures for SPDs.

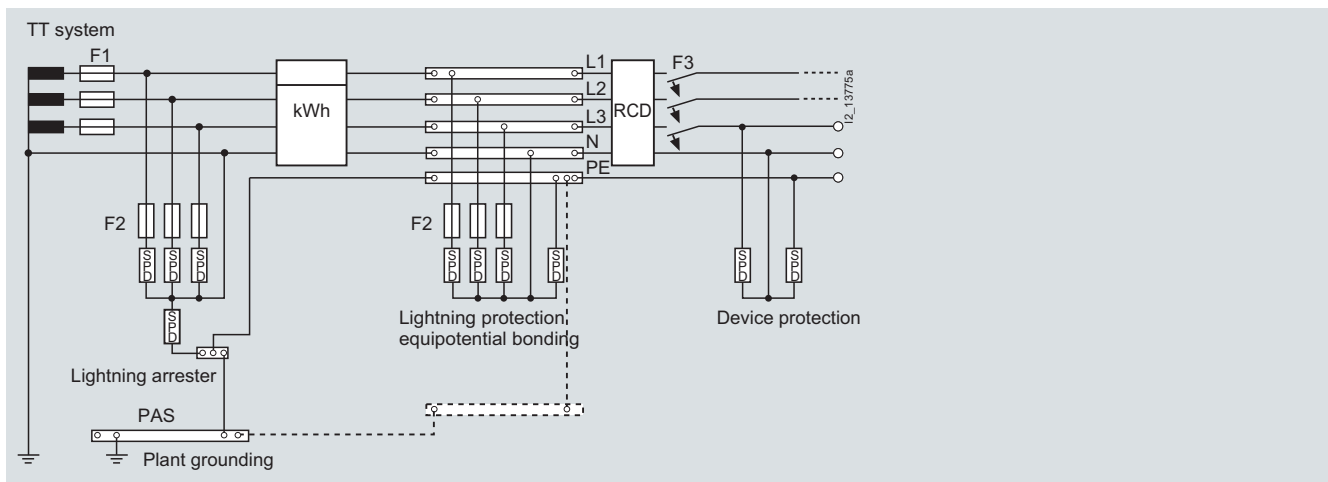
If a lightning protection equipotential bonding is installed, it must be connected to the base points of the overvoltage protection devices.



TN-C systems



TN-S system



TT system

PAS = equipotential bonding strip
 RCD (Residual Current Device): Residual current-operated circuit breakers

Overvoltage Protection Devices

Configuration

More information

Break time t_a

The break time is the time required to automatically switch off the power supply in the event of a fault in the electrical circuit or equipment being protected. The break time is an application-specific value, which is derived from the level of fault current flowing and the characteristic of the protective device.

Breaking capacity, follow current discharge capacity I_{ff}

The breaking capacity is the prospective r.m.s. value of the follow current that can be extinguished by the overvoltage protection device on its own when U_C is applied. This is proven in the operating duty test according to EN 61643-11.

Categories according to IEC 61643-21 (DIN VDE 0845-3-1)

In order to test the current carrying capacity and the voltage limitation during pulse interference, the standard IEC 61643-21 (DIN 0845-3-1) describes a range of surge voltage and surge current impulses. All Siemens overvoltage protection devices exceed these values in the depicted categories. For this reason, the explicit value for the surge current carrying capacity is derived from the specified rated discharge surge current (8/20) and lightning impulse current (10/350).

Combined surge U_{oc}

The combined surge is produced by a hybrid generator (1.2/50 μ s, 8/20 μ s) with a fictitious impedance of 2 Ω . The no-load voltage of this generator is indicated as U_{oc} . The specification of U_{oc} is primarily achieved with arresters of type 3.

Frequency ranges

The frequency range characterizes the transmission band or let-through frequency of the arrester, depending on the described damping characteristics.

Insertion loss α_E

At a specified frequency, the insertion loss of an overvoltage protection device is described by the ratio of the voltage value at the installation site before and after insertion of the overvoltage protection device. Unless otherwise specified, this is based on a 50 Ω system.

Lightning impulse current I_{imp}

The lightning impulse current is a standardized surge current curve with waveform 10/350 μ s. With its parameters (peak value, load, specific energy) it simulates the load of natural lightning currents. Lightning and combination surge arresters must be capable of repeatedly discharging these types of lightning impulse currents.

Limit frequency f_G

The limit frequency describes the frequency-dependent behavior of an arrester. The limit frequency is the respective frequency that produces an insertion loss under specific test conditions (α_E) of 3 dB (see EN 61643-21). Unless otherwise specified, this is based on a 50 Ω system.

Line-side overcurrent protection/discharge back-up fuses

An overcurrent protection device (e.g. fuse or miniature circuit breaker) that is located outside the arrester on the infeed side and serves to interrupt the line-frequency follow current if the breaking capacity of the overvoltage protection device is exceeded.

Maximum discharge surge current I_{max}

The maximum peak value of the surge current with the waveform 8/20 μ s that the device can safely discharge.

N-PE arrester

Protective devices that are intended solely for installation between the N and PE conductor.

Operating loss

In high-frequency applications, the operating loss indicates how many parts of the "advancing" wave are reflected at the protective device ("transition point"). This is a direct benchmark for how well suited a protective device is to the surge impedance of the system.

Operating temperature range

The operating temperature range specifies the range within which the devices can be used. In the case of devices without self-heating, this is identical to the ambient temperature range. The temperature rise in devices with self-heating must not exceed the specified maximum value.

Protection circuit

Protection circuits are multi-step cascading protective devices. The individual protection steps can be made up of discharge paths, varistors and/or semiconductor devices. The energetic coordination of the individual protection steps is achieved using decoupling elements.

Protection level U_p

The protection level of a surge protective device is the highest instantaneous value of the voltage at the terminals of an overvoltage protection device, determined from standardized individual tests:

- Lightning impulse sparkover voltage 1.2/50 μ s (100 %)
- Operational voltage at a rate of rise 1 kV/ μ s
- Residual voltage U_{res} for rated discharge surge current

The protection level characterizes the capability of an overvoltage protection device to limit overvoltages to a remainder level. When used in power systems, the protection level determines the mounting location with regard to overvoltage category acc. to DIN VDE 0110-1, -11.

In the case of overvoltage protection devices used in information systems, the protection level must be adapted to the immunity to interference of the equipment being protected (EN 61000-4-5, -12).

Protective conductor current I_{PE}

The current that flows through the PE terminal connection when the overvoltage protection device is connected to the rated arrester voltage U_C without any load-side consumers.

Rated arrester voltage U_C

The highest continuous voltage (maximum permissible operational voltage) is the r.m.s. value of the maximum voltage that can be applied under field conditions to the terminals of the overvoltage protection device as specified on the respective terminal. It is the maximum voltage that can be applied to the arrester in a defined, non-conductive state that, after it has tripped and discharged, still ensures that this state can be restored. The value of U_C is based on the rated voltage of the system being protected and the specifications of the installation regulations (DIN VDE 0100-534).

Rated discharge surge current I_n

The rated discharge surge current is the peak value of a surge current of the waveform 8/20 μ s for which the overvoltage protection device is designed in accordance with a specified test program.

Rated load current (rated current) I_L

The rated load current is the highest permissible operational current that can be continuously routed over the terminals with this specification.

Rated voltage U_N

This corresponds to the rated voltage of the system to be protected. In the case of information systems, the rated voltage usually serves as the type rating. In the case of AC voltage, it is specified as the r.m.s. value.

Response time t_A

Response times largely characterize the response behavior of the individual protective elements used in arresters. Depending on the rate of rise du/dt of the surge voltage or the di/dt of the surge current, response times may change within specific limits.

Screening attenuation

Ratio of feeding power of a coaxial cable to that of the radiated power of the cable supplied by the outer conductor

Series impedance

The impedance in signal flow direction between the input and output of an arrester.

Short-circuit strength

The value of the prospective short-circuit current that can be controlled by the overvoltage protection device if the respective back-up fuse is connected.










Thermal isolating arrester

Overvoltage protection devices for power systems that are equipped with voltage-dependent resistors (varistors) have an integral isolating arrester, which disconnects the overvoltage protection device from the mains in the event of an overload and displays this operating state. The isolating arrester reacts to "joule heat" generated by an overloaded varistor and disconnects the overvoltage protection device from the mains if a specific temperature is exceeded. The isolating arrester disconnects the overloaded overvoltage protection device from the mains so fast that any risk of fire is prevented. However, it is not the task of an isolating arrester to ensure "protection against indirect contact".

Versions for Austria

The standard ÖVE/ÖNORM E 8001-1 is generally applied in Austria - with pertinent additions.
The key difference for implementation of devices of type 2 is that these have to have a higher rated voltage (335 V AC, 440 V AC).










Symbols

Switching symbol	Description
	Overvoltage protection device (SPD: Surge Protection Device)
	Lightning arresters, type 1
	Surge arresters type 2 or type 3
	Tripped spark gap
	Varistor
	Spark gap
	Gas-filled surge arrester
	Plug-in contact
	Suppressor diode

Overvoltage Protection Devices

Configuration

Selection of overvoltage protection devices

Situation Which type of building do you want to protect? Generally speaking, all our devices are suitable for residential buildings, office buildings, industrial and commercial buildings.	Systems	Basic protection For installation upstream of counters in main distribution boards or in combined main/sub-distribution boards
Low risk buildings  <ul style="list-style-type: none"> - No outer lightning protection - Power supply over ground conductor 	TN-S and TT systems	Surge arresters, type 2 Narrow design 5SD7 424-0, 5SD7 424-1 Wide design 5SD7 464-0, 5SD7 464-1 With or without remote signaling 
High-risk buildings  <ul style="list-style-type: none"> - Outer lightning protection system 	TN-S and TT systems	Lightning arresters, type 1 5SD7 414-1 With remote signaling 
 <ul style="list-style-type: none"> - Power supply over overhead lines 	TN-C systems	Lightning arresters, type 1 5SD7 413-1 With remote signaling 5SD7411-1 
 <ul style="list-style-type: none"> - Grounded aerial structures 	TN-S and TT systems	Combination surge arresters, type 1 and type 2 5SD7 444-1 With remote signaling 
IT systems without N conductor incorporated in the cable	TN-C systems	Combination surge arresters, type 1 and type 2 5SD7 443-1 With remote signaling 5SD7441-1 
IT systems with N conductor incorporated in the cable		Typically, IT systems are only installed in special building sections. There are generally still TN-C, TN-S or TT systems in the area of the main distribution board. In this case, the protective devices shown above must be installed.

Medium protection

For installation upstream of counters in main distribution boards or in combined main/sub-distribution boards

Surge arresters, type 2

Narrow design
5SD7 424-0, 5SD7 424-1

Standard design
5SD7 464-0, 5SD7 464-1

With or without remote signaling

Only required if the distance between the main and sub-distribution boards is > 10 m



Fine protection

For installation directly upstream of the terminal equipment

Surge arresters, type 3

For installation in sub-distribution boards or control cabinets

5SD7 432-x and 5SD7 434-1

With remote signaling



Surge arresters, type 2

Narrow design
5SD7 423-0, 5SD7 423-1

Standard design
5SD7 463-0, 5SD7 463-1

With or without remote signaling

Only required if the distance between the main and sub-distribution boards is > 10 m



Surge arresters, type 2

Narrow design
5SD7 424-0, 5SD7 424-1

Standard design
5SD7 464-0, 5SD7 464-1

With or without remote signaling



Surge arresters, type 2

Narrow design
5SD7 423-0, 5SD7 423-1

Standard design
5SD7 463-0, 5SD7 463-1

With or without remote signaling



Surge arresters, type 2

Narrow design
5SD7 424-0, 5SD7 424-1

Standard design
5SD7 464-0, 5SD7 464-1

With or without remote signaling

Only required if the distance between the main and sub-distribution boards is > 10 m



Surge arresters, type 2

Narrow design
5SD7 423-0, 5SD7 423-1

Standard design
5SD7 463-0, 5SD7 463-1

With or without remote signaling

Only required if the distance between the main and sub-distribution boards is > 10 m



Surge arresters, type 2

5SD7 473-0, 5SD7 473-1

3-pole (3+0 circuit)

$U_c = AC 580 V$

with or without remote signaling



Surge arresters, type 2

5SD7 485-0, 5SD7 485-1

4-pole (4+0 circuit)

$U_c = AC 440 V$

with or without remote signaling



Overvoltage Protection Devices

Surge arresters for measuring and control technology, 5SD7

Overview

The surge arresters for measuring and control technology are overvoltage protection modules that comprise two parts, a base element and a male connector. Their application area is the protection of signal circuits.

The cable shields of basic elements can be either directly or indirectly grounded.

The mounting width of the new surge arrester is 1 MW.

Through the number of integrated paths, it is possible to protect up to four signal cores or two double cores against overvoltages.

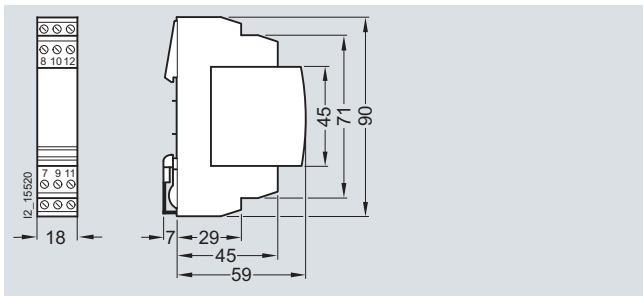
Technical specifications

	5SD7 502-0	5SD7 520-1	5SD7 522-7	5SD7 530-3	5SD7 541-7	5SD7 550-4	
IEC category/EN type	C1/C2/C3/D1	C1/C2/C3/D1/B2	C1/C2/C3/D1	C1/C2/C3/D1	C1/C2/C3/D1	C1/C2/C3/D1	
Max. continuous voltage U_C							
• Direct voltage	V DC	68	185	40	5.2	40	14
• AC voltage	V AC	48	130	28	3.6	28	9.8
Rated current I_N	mA	2000	450	450	450	300	450
Lightning test current I_{imp} 10/350 μ s Per path	kA	5	--	2.5	2.5	2.5	2.5
Rated discharge current I_n 8/20 μ s							
• Core - Core	kA	--	10	10	10	--	10
• Core - Ground	kA	20	10	10	10	10	10
Total surge current I_N 8/20 μ s	kA	40	10	20	20	20	20
Output voltage limit at 1 kV/μs							
• Core - Core	V	--	≤ 300	≤ 55	≤ 15	--	≤ 25
• Core - Ground	V	≤ 600	≤ 300	≤ 450	≤ 15	≤ 55	≤ 25
Residual voltage at I_n							
• Core - Core	V	--	≤ 160 (C2/5 kA)	≤ 55	≤ 15	--	≤ 25
• Core - Ground	V	--	≤ 160 (C2/5 kA)	--	≤ 30	≤ 55	≤ 40
Response time t_A							
• Core - Core	ns	--	≤ 500	≤ 1	≤ 500	--	≤ 500
• Core - Ground	ns	≤ 100	≤ 500	≤ 100	≤ 500	≤ 1	≤ 500
Insertion loss a_E							
• Symmetrical in the 50- Ω system	dB	--	--	typ. 0.5 (1.5 MHz)	--	--	--
• Asymmetrical in the 50- Ω system	dB	0.1 (1 MHz)	--	--	--	0.5 (1.5 MHz)	--
• Symmetrical in the 100- Ω system	dB	--	typ. 0.2 (5 MHz)	--	0.2 (5 MHz)	--	0.2 (5 MHz)
Limit frequency f_G (3 dB)							
• Symmetrical in the 50- Ω system	MHz	--	--	Typ. 8	--	--	--
• Asymmetrical in the 50- Ω system	MHz	--	--	--	--	Typ. 8	--
• Symmetrical in the 100- Ω system	MHz	--	Typ. 70	--	Typ. 70	--	Typ. 70
Resistor per path	Ω	--	--	2.2	2.2	4.7	2.2
Temperature range	$^{\circ}$ C	-40 ... +85					
Degree of protection acc. to IEC 60529/EN 60529		IP20					
Flammability class acc. to UL 94		V0					
Test standards		EN 61643-21	IEC 61643-21	EN 61643-21	IEC 61643-21	EN 61643-21	IEC 61643-21

Combination options for basic elements and plug-in parts

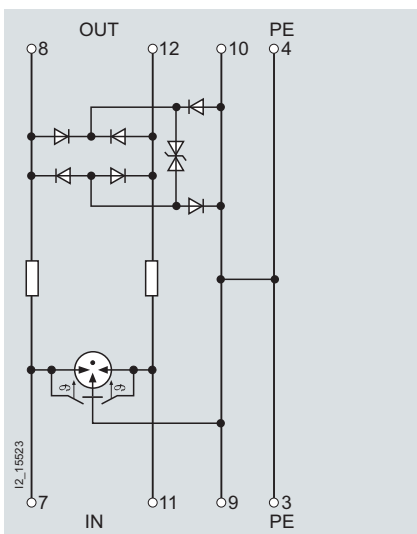
Basic element	Plug-in parts					
	5SD7 502-0	5SD7 520-1	5SD7 522-7	5SD7 530-3	5SD7 541-7	5SD7 550-4
5SD7 500-0	✓	--	--	--	--	--
5SD7 512-1	--	✓	--	✓	--	--
5SD7 522-0	--	--	✓	--	--	✓
5SD7 522-1	--	--	✓	--	--	✓
5SD7 541-1	--	--	--	--	✓	--

Dimensional drawings

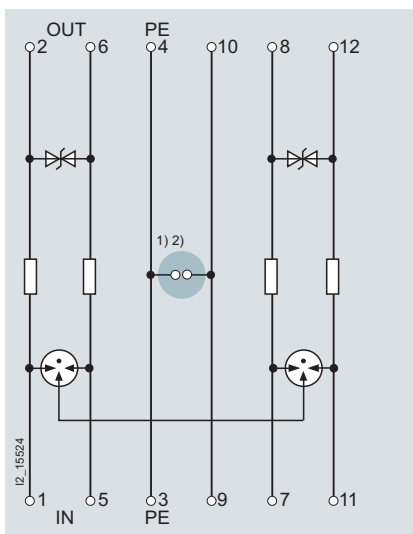


5SD7 5..

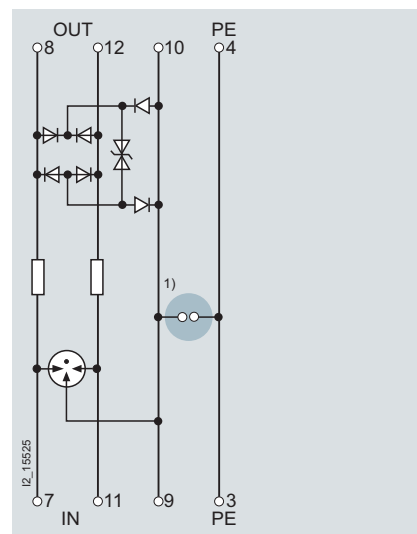
Schematics



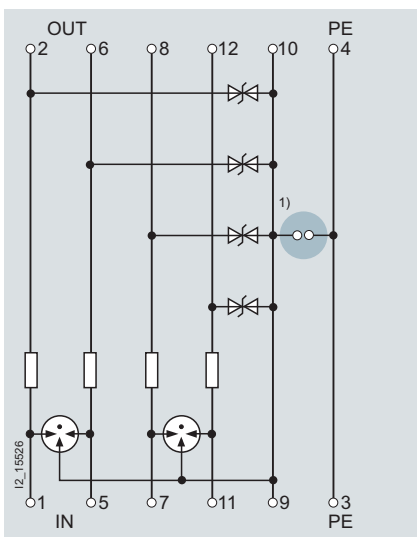
5SD7 520-1



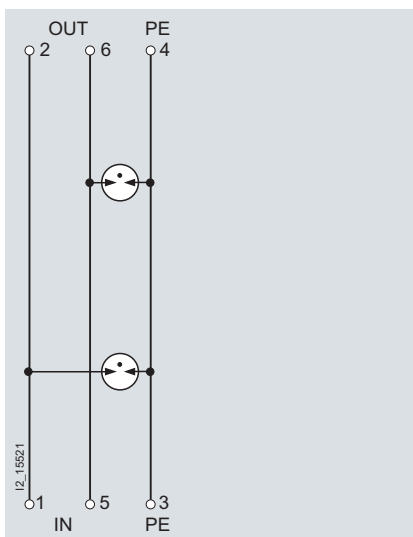
5SD7 522-7



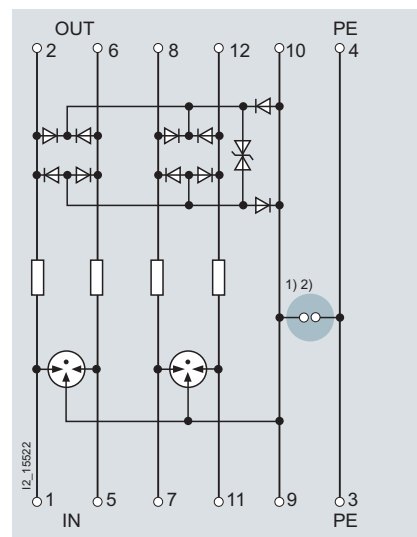
5SD7 530-3



5SD7 541-7



5SD7 502-0



5SD7 550-4

- 1) With the 5SD7 512-1, 5SD7 522-1, 5SD7 541-1 and 5SD7 500-0 basic elements, the terminals 9 and 10 (GND) are directly linked to the standard mounting rail over the metallic mounting foot.
- 2) With the 5SD7 522-0 basic element, the terminals 9 and 10 (GND) are linked with the metallic mounting foot over a gas arrester.

Overvoltage Protection Devices

Notes

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