

SIEMENS



Overvoltage Protection Devices

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Overvoltage Protection Devices



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26	5SD7 surge arresters, for measuring and control technology

For further technical product information:

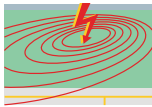
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Product note
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Technical data

Overvoltage Protection Devices

Introduction

Overview

Devices	Page	Application	Standards
	3	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. For installation in main distribution boards, upstream or downstream of the counter.	EN 61643-11
	5	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. For installation in main distribution boards downstream of the counter.	EN 61643-11
	7	With plug-in protective modules for TN-C, TN-S and TT systems. Rated voltage 335 V AC for lightning currents or discharge surge currents up to 50 kA. Versions with or without remote signaling.	EN 61643-11
	9	With plug-in protective modules for TN-C, TN-S and TT systems. Rated voltage 350 V AC, rated discharge surge current 20 kA and discharge surge current 40 kA. For installation in sub-distribution boards.	EN 61643-11
	12	With plug-in protective modules for single-phase and three-phase systems. Rated voltage, single-phase 24 V, 120 V, 230 V AC/DC and three-phase 230/400 V AC. For installation as close as possible upstream from the terminal equipment.	EN 61643-11
 I201_13815	14	Everything you need to know about overvoltage protection: Function, mounting and technical connections.	
	26	With plug-in protective modules for measuring and control technology for installation in signal circuits.	EN 61643-21

Overview

Type 1 lightning arresters are the most powerful overvoltage protection. They protect low-voltage systems against any overvoltage or high impulse currents that may be triggered by a direct or indirect lightning strike.

All lightning arresters are fitted with a mechanical fault indication, which does not require an extra power supply. For this

reason, the lightning conductors can also be used in the precounter area.

The protective modules are available as connectors. The majority of lightning arresters have a remote signaling contact, which signals if the device fails.

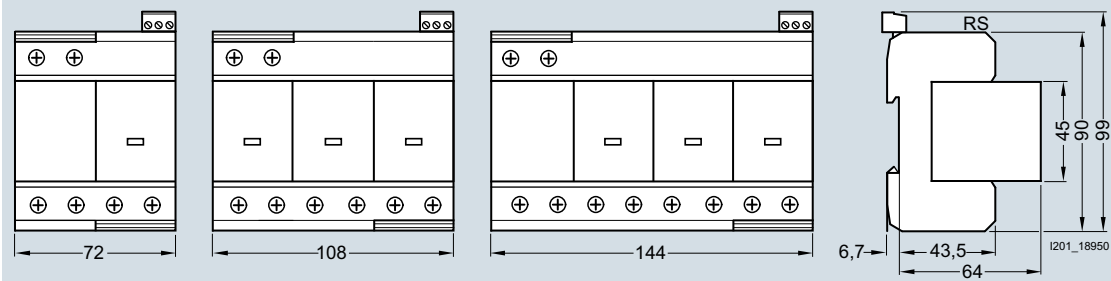
Technical specifications

		5SD7411-2	5SD7412-1	5SD7413-1	5SD7414-1
Standards		IEC 61643-11 (DIN VDE 06754-6)			
Approvals		KEMA, UL/cUL	UL/cUL		UL/cUL
Rated voltage U_N	V AC	690	240	240/415	
Rated arrester voltage U_C					
• L-N, N-PE, L-(PE)N	V AC	800	350	350	350
Lightning impulse current I_{imp} (10/350 μs)					
• L-N or L-(PE)N, 1P/3P	kA	35	25	25/75	25/75
• N-PE	kA	--	100	--	100
Rated discharge surge current I_n (8/20 μs)					
• L-N or L-(PE)N, 1P/3P	kA	35	25	25/75	25/75
• N-PE	kA	--	100	--	100
Protection level U_p					
• L-(PE)N	kV	≤ 4.50	≤ 1.50	≤ 1.50	≤ 1.50
• L-PE	kV	--	≤ 2.50	--	≤ 2.50
• N-PE	kV	--	≤ 1.50	--	≤ 1.50
Follow current discharge capacity I_{fi} (AC)					
• L-N or L-(PE)N for 264 V/350 V	kA	--	50/25	50/25	50/25
• N-PE	A	--	100	--	100
Response time t_A					
• L-N or L-(PE)N	ns	≤ 100	≤ 100	≤ 100	≤ 100
• L-(N)-PE	ns	--	≤ 100	--	≤ 100
Max. back-up fuse acc. to IEC 61643-1					
• For parallel connection	A	400 gL/gG	315 gL/gG	315 gL/gG	315 gL/gG
• For series connection	A	125 gL/gG	125 gL/gG	125 gL/gG	125 gL/gG
Short-circuit strength	kA _{rms}	50	50	50	50
With max. back-up fuse					
Temperature range	°C	-40 ... +80			
Degree of protection		IP20, with connected conductors			
Conductor cross-section					
• Finely stranded	mm ²	16 ... 50	2.5 ... 25	2.5 ... 25	2.5 ... 25
• Solid	mm ²	16 ... 50	2.5 ... 35	2.5 ... 35	2.5 ... 35

Overvoltage Protection Devices

5SD7 lightning arresters, type 1

Dimensional drawings



RS = remote signaling

2P

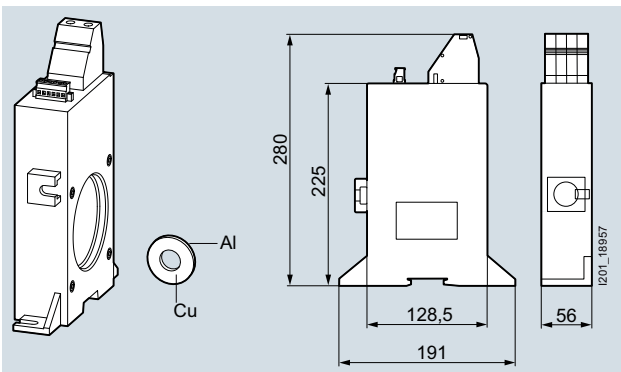
5SD7412-1

3P

5SD7413-1

4P

5SD7414-1



1P

5SD7411-2

5SD7 combination surge arresters, type 1 + type 2

Overview

Combination surge arresters type 1 + 2 are compact designs comprising lightning arresters (type 1) and surge arresters (type 2). They protect low-voltage systems against overvoltages triggered by lightning strikes or by switching operations in the network.

A thermal isolating arrester for the varistors offers a high degree of protection against overload. The protective modules are available as connectors. All combination surge arresters have a remote signaling contact, which signals if the device fails.

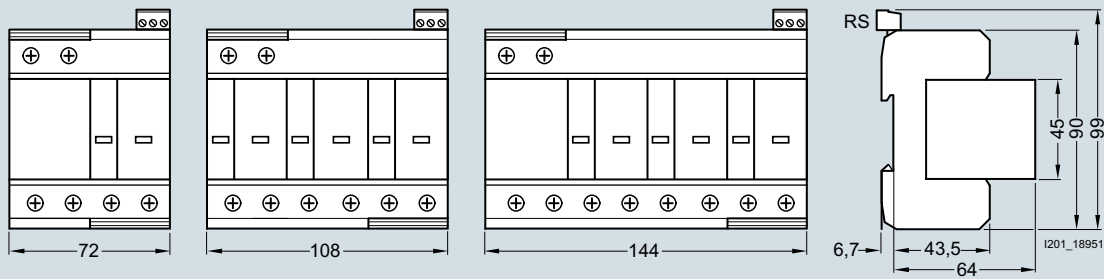
Technical specifications

		5SD7442-1	5SD7443-1	5SD7444-1
Standards Approvals		IEC 61643-11; EN 61643-11 KEMA, UL/cUL		
Rated voltage U_N	V AC	240	240/415	
Rated arrester voltage U_C				
• L-N, N-PE, L-(PE)N	V AC	350		
Lightning impulse current I_{imp} (10/350 μs)				
• L-N or L-(PE)N, 1P/3P	kA	25	25/75	25/75
• N-PE	kA	100	--	100
Rated discharge surge current I_n (8/20 μs)				
• L-N or L-(PE)N, 1P/3P	kA	25	25/75	25/75
• N-PE	kA	100	--	100
Protection level U_p				
• L-(PE)N	kV	≤ 1.50	≤ 1.50	≤ 1.50
• L-PE	kV	≤ 2.20	--	≤ 2.20
• N-PE	kV	≤ 1.50	--	≤ 1.50
Follow current discharge capacity I_{fi} (AC)				
• L-N or L-(PE)N	kA	25	25	25
• N-PE	kA	100	--	100
Response time t_A				
• L-N or L-(PE)N	ns	≤ 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	4	6
Visual function/fault indication			Yes	8

Overvoltage Protection Devices

5SD7 combination surge arresters, type 1 + type 2

Dimensional drawings



2P
5SD7442-1

3P
5SD7443-1

4P
5SD7444-1

Overview

Combination surge arresters type 1 / 2 are compact designs which can be used as both lightning arresters type 1 and surge arresters type 2.

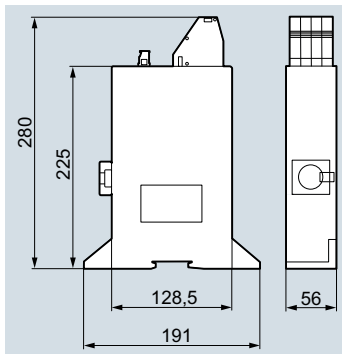
They protect low-voltage systems against overvoltages triggered by lightning strikes or by switching operations in the network.

A thermal isolating arrester for the varistors offers a high degree of protection against overload. The protective modules are available as connectors. The combination surge arresters can be fitted either with or without a remote signaling contact, which signals if the device fails.

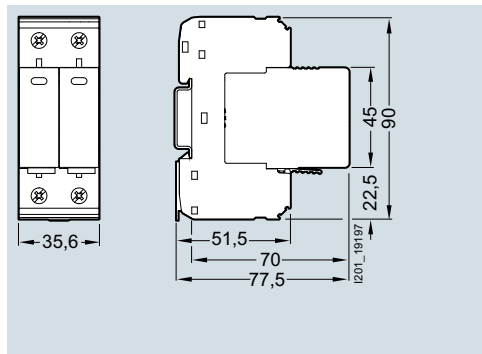
Technical specifications

		5SD7411-2	5SD7412-2 5SD7412-3	5SD7413-2 5SD7413-3	5SD7414-2 5SD7414-3	5SD7483-6 5SD7483-7
Standards		IEC 61643-11 KEMA, UL/cUL				EN 50539
Approvals		KEMA				
Rated voltage U_N	V AC	690	240	240/415		--
Rated arrester voltage U_C						
• L-N, N-PE, L-(PE)N	V	800 AC	335 AC			1000 DC
Lightning impulse current I_{imp} (10/350 μs)						
• L-N or L-(PE)N, 1P/3P	kA	35	12.5	12.5/37.5	12.5	≤ 5
• N-PE	kA	--	50	--	50	--
Rated discharge surge current I_n (8/20 μs)						
• L-N or L-(PE)N, 1P/3P	kA	35	12.5	12.5/37.5	12.5/50	15
• N-PE	kA	--	50	--	--	--
Max. discharge surge current I_n (8/20 μs)						
• L-N	kA	100	12.5	50/150	50	40
• N-PE	kA	--	50	--	50	--
Protection level U_p						
• L-(PE)N	kV	≤ 4.50	≤ 1.20	≤ 1.20	≤ 1.20	≤ 3.50
• L-PE	kV	--	--	--	--	--
• N-PE	kV	--	≤ 1.70	--	≤ 1.70	--
Response time t_A						
• L-N or L-(PE)N	ns	≤ 100	≤ 25			
• L-(N)-PE	ns	--	≤ 100	--	≤ 100	≤ 25
Max. back-up fuse acc. to IEC 61643-1						
• For parallel connection	A	400 gL/gG	160 gL/gG			--
• For series connection	A	125 gL/gG	80 gL/gG			--
Short-circuit strength						
With max. back-up fuse	kA _{rms}	50	25			
Temperature range	°C	-40 ... +80				
Degree of protection		IP20, with connected conductors				
Conductor cross-section						
• Finely stranded	mm ²	16 ... 50	1.5 ... 25			
• Solid	mm ²	16 ... 50	1.5 ... 35			

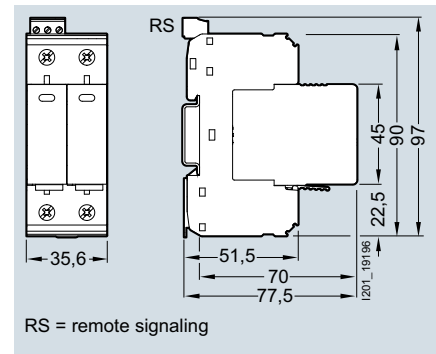
Dimensional drawings



1P
5SD7411-2



2P
5SD7412-2

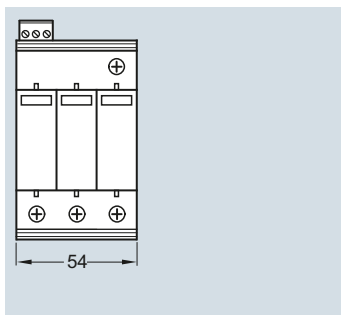


2P
5SD7412-3

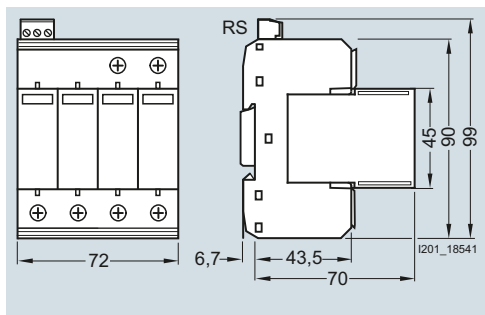
RS = remote signaling

Overvoltage Protection Devices

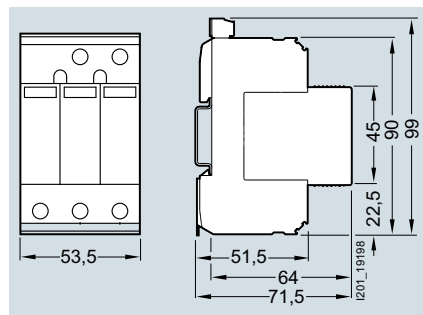
5SD7 combination surge arresters, type 1 / type 2



3P
5SD7413-2
5SD7413-3

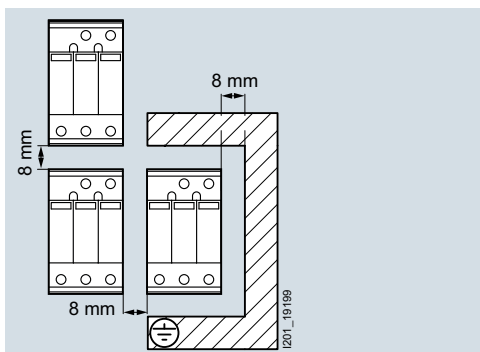


4P
5SD7414-2
5SD7414-3



3P
5SD7483-6
5SD7483-7

Installation distance between adjacent products



Only valid for 5SD7483-6 and 5SD7483-7

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, such as those triggered by switching operations.

A thermal isolating arrester for the varistors offers a high degree of protection against overload. The protective modules are available as connectors. The surge arresters have an optional remote signaling contact, which signals if the device fails.

Technical specifications

		Standard design						
		N-PE						
		5SD7481-0	5SD7461-0 5SD7461-1	5SD7481-1	5SD7463-0 5SD7463-1	5SD7464-0 5SD7464-1	5SD7473-1	5SD7483-5
Standards Approvals		IEC 61643-11; EN 61643-11 KEMA						-- KEMA, UL/cUL
Rated voltage U_N		V AC	240	240	690	240/415	240/415	500 554/960
Rated arrester voltage U_C								
• L-N		V AC	--	350	800	--	--	760
• L-N or L-(PE)N		V AC	--	--	350	350	580	--
• N-PE		V AC	260	--	--	260	--	--
Rated discharge surge current I_n (8/20 μ s)								
• L-N		kA	--	20	15	--	--	15
• L-N or L-(PE)N, 1P		kA	--	--	20	20	15	--
• N-PE		kA	20	--	--	20	--	--
Max. discharge surge current I_n (8/20 μ s)								
• L-N		kA	--	40	30	--	--	30
• L-N or L-(PE)N, 1P		kA	--	--	40	40	--	--
• L-N or L-(PE)N, 1P/multi-pole		kA	--	--	--	--	30	--
• N-PE		kA	40	--	--	40	--	--
Lightning impulse current I_{imp} (10/350 μ s)		kA	12	--				
Protection level U_p								
• L-(PE)N		kV	--	≤ 1.50	≤ 5	≤ 1.50	≤ 1.60	≤ 2.90
• L-PE		kV	--	--	≤ 5	--	≤ 1.90	--
• N-PE		kV	≤ 1.50	--	--	--	≤ 1.50	--
Response time t_A								
• L-N or L-(PE)N		ns	--	≤ 25	≤ 100	≤ 25	≤ 25	≤ 25
• N-PE		ns	≤ 100	--	--	≤ 100	--	--
Max. back-up fuse acc. to IEC 61643-1								
• For parallel connection		A	--	125 gL/gG	100 gL/gG	125 gL/gG		100 gL/gG
• For series connection		A	--	--	80 gL/gG	80 gL/gG		80 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	1.5 ... 25					
• Solid		mm ²	1.5 ... 35					
Mounting width according to DIN 43880		MW	1	1	2	3	4	3
Visual function/fault indication		Yes						

Overvoltage Protection Devices

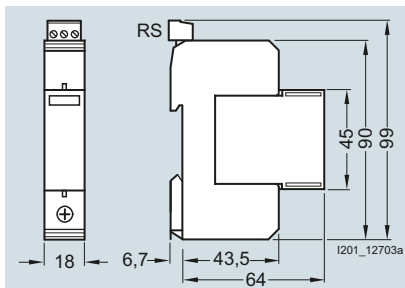
5SD7 surge arresters, type 2

		Narrow design	
		5SD7422-0 5SD7422-1	5SD7424-0 5SD7424-1
Standards		IEC 61643-11 (DIN VDE 06754-6)	
Approvals		KEMA/UL/cUL	
Rated voltage U_N	V AC	240	240/415
Rated arrester voltage U_C			
• L-N or L-(PE)N	V AC	350	350
• N-PE	V AC	264	264
Rated discharge surge current I_n (8/20 μs)			
• L-N or L-(PE)N, 1P/3P	kA	20	20
• N-PE	kA	20	20
Max. discharge surge current I_n (8/20 μs)			
• L-N or L-(PE)N, 1P/3P	kA	40	40
• N-PE	kA	40	40
Protection level U_p			
• L-(PE)N	kV	≤ 1.50	≤ 1.50
• L-PE	kV	--	--
• N-PE	kV	≤ 1.50	≤ 1.50
Response time t_A			
• L-N	ns	≤ 25	≤ 25
• 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	63 gL/gG	
Short-circuit strength with max. back-up fuse	kA _{rms}	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 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 V DC	250 125	
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

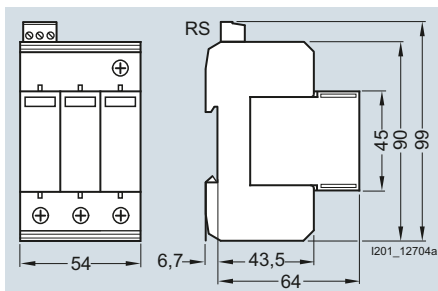


RS = remote signaling

1P

5SD7461-0, 5SD7481-0 without RS

5SD7461-1 with RS

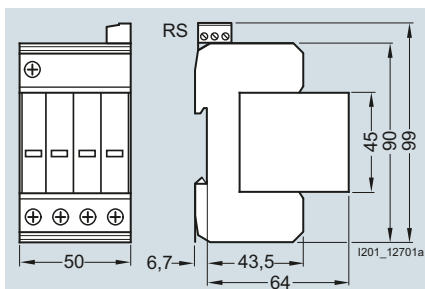


RS = remote signaling

3P

5SD7463-0

5SD7463-1, 5SD7473-1



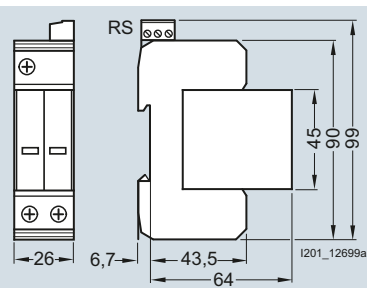
RS = remote signaling

4P

5SD7424-0 without RS

5SD7424-1 with RS

Surge arresters, narrow design

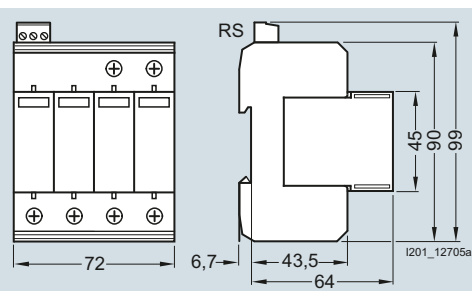


RS = remote signaling

2P

5SD7422-0 without RS

5SD7422-1 with RS



RS = remote signaling

4P

5SD7464-0

5SD7464-1

Overvoltage Protection Devices

5SD7 surge arresters, type 3

Overview

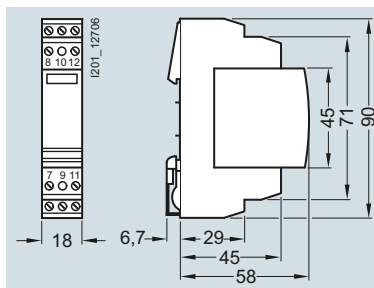
Type 3 surge arresters are installed downstream of type 2 surge arresters in sub-distribution boards as close as possible to the load. The protective modules are available as connectors.

In the event of a power failure, a remote signaling is output over an optocoupler with open collector output.

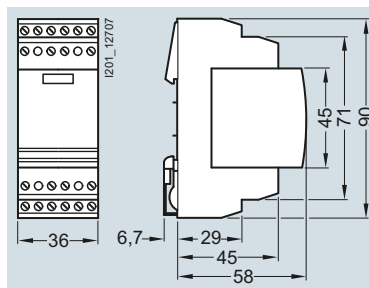
Technical specifications

			2-pole 5SD7432-1	5SD7432-2	5SD7432-4	4-pole 5SD7434-1
Standards			IEC 61643-11; EN 61643-11			
Approvals			KEMA/UL/cUL			KEMA
Rated voltage U_N	V AC		230	120	24	230/400
Rated load current I_L (at 30 °C)	A		26	26	26	3 × 26
Rated arrester voltage U_C	V AC		264	150	34	335
Rated discharge surge current I_n (8/20 μs)	kA		3	3	1	1.5
Combined surge U_{oc}	kV		6	6	2	4
Protection level U_p	L-N / L-PE, N-PE	V	≤ 1350/≤ 1500	≤ 850/≤ 950	≤ 250/≤ 650	≤ 1200/≤ 1500
Response time t_A	ns		≤ 100	≤ 100	≤ 100	≤ 100
Required back-up fuse, max.	A (gG/B/C)		25	25	25	25
Temperature range	°C		-40 ... +80			
Degree of protection			IP20, with connected conductors			
Conductor cross-section						
• Finely stranded			mm ²			
• Solid			mm ²			
			0.2 ... 2.5			
			0.2 ... 4			
Mounting width	Acc. to DIN 43880	MW	1	1	1	2
Visual function/fault indication			Yes			

Dimensional drawings



2P
5SD7432-.



4P
5SD7434-1

Using the plug-in parts in the various overvoltage protection devices

Replacement plug	5SD7428-1	5SD7428-0	5SD7468-1	5SD7488-0	5SD7488-1	5SD7488-2	5SD7488-4	5SD7498-1	5SD7498-3
Surge arresters, type 2	5SD7424-1	5SD7424-1	5SD7461-0	5SD7481-0	5SD7485-0	5SD7481-1	5SD7481-1	5SD7473-0	5SD7483-6
	5SD7424-0	5SD7424-0	5SD7461-1	5SD7464-0	5SD7485-1	5SD7483-5		5SD7473-1	5SD7483-7
	5SD7423-1	5SD7422-1	5SD7463-0	5SD7464-1				5SD7483-0	
	5SD7423-0	5SD7422-0	5SD7463-1					5SD7483-1	
	5SD7422-1		5SD7464-0						
	5SD7422-0		5SD7464-1						

Replacement plug	5SD7437-1	5SD7437-2	5SD7437-3	5SD7437-4	5SD7438-1
Surge arresters, type 3	5SD7432-1	5SD7432-2	5SD7432-3	5SD7432-4	5SD7434-1

Replacement plug	5SD7428-1	5SD7448-1	5SD7418-0	5SD7418-1	5SD7418-2	5SD7418-3
Lightning arresters, type 1 and combination surge arresters type 1+2	5SD7444-1	5SD7444-1	5SD7414-1	5SD7414-1	5SD7412-2	5SD7412-2
	5SD7443-1	5SD7443-1	5SD7412-1	5SD7413-1	5SD7412-3	5SD7412-3
	5SD7442-1	5SD7442-1	5SD7444-1	5SD7412-1	5SD7414-2	5SD7413-2
	5SD7441-1	5SD7441-1	5SD7442-1	5SD7411-1	5SD7414-3	5SD7413-3
						5SD7414-2
						5SD7414-3

Overvoltage Protection Devices

Configuration

Overview

Surge protection devices (SPD)

Surge protection devices are devices whose main components comprise spark gaps (discharge paths) and/or voltage-dependent 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:

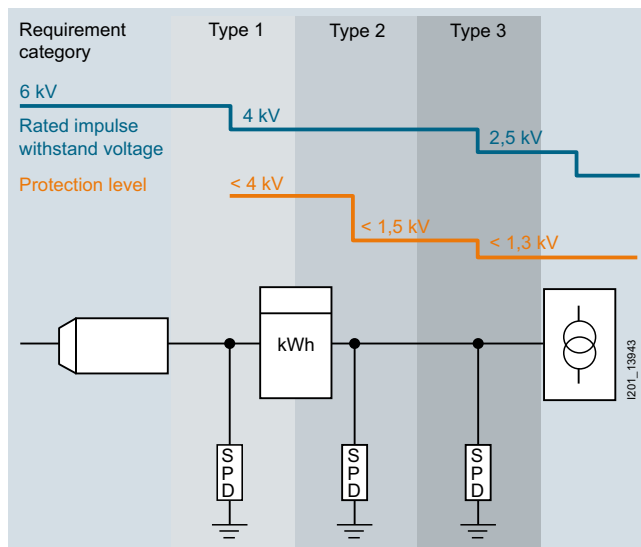
- Surge protection devices for systems and devices in power systems
- Surge protection devices for plants and devices in information systems for protecting modern electronic devices in telecommunication and signal processing systems against the indirect and direct effects of lightning strikes and other 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 + 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:

Voltage surges		
Category	Impulse withstand voltage	Description
IV	6 kV	Devices at the infeed of the installation, e.g. main distribution boards, E-counters, overcurrent protection devices, ...
III	4 kV	Devices that are part of the permanent installation, e.g. distribution boards, protective equipment, ...
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:

- Italy: 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/lowvoltage/infomaterial

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 + 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 perform the following tasks:

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

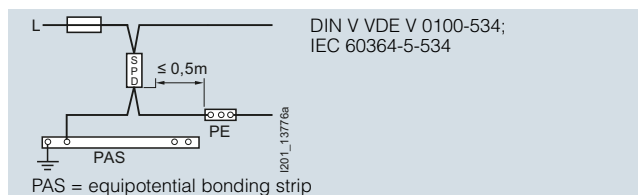
Fuses or miniature circuit breakers therefore ensure that the max. permissible peak current $I_{p \max}$ and the maximum permissible energy value $I^2 t_{\max}$ of the SPD are not exceeded. This prevents damage to the SPD.

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:

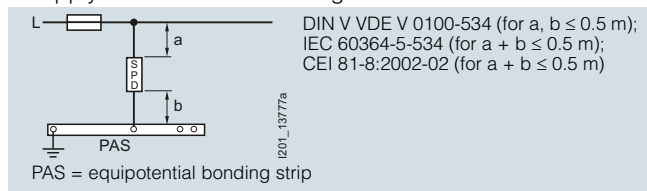
The installation is protected via the protective device that is fitted in the power distribution as standard. The SPD is protected over the plant fuse installed in the system. If this fuse is tripped because the SPD is overloaded, the plant is disconnected from the supply by the fuse or miniature circuit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

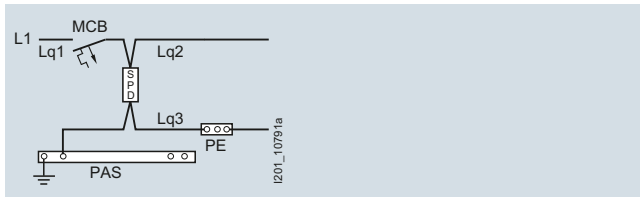
Overvoltage Protection Devices

Configuration

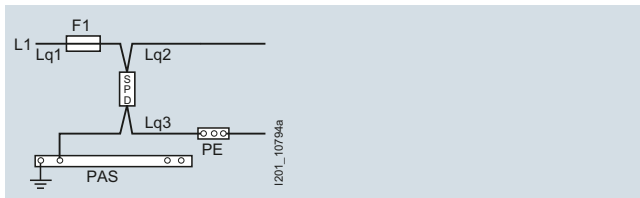
Dimensioning of conductor cross-sections

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 using miniature circuit breakers



b) Protection of the SPD using fuses

PAS = equipotential bonding strip

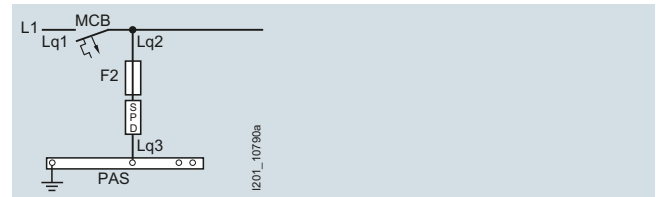
Conductor cross-sections for lightning arresters (type 1) and combination surge arresters (type 1 + type 2) for series connection

MCB/fuse (F1) upstream [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

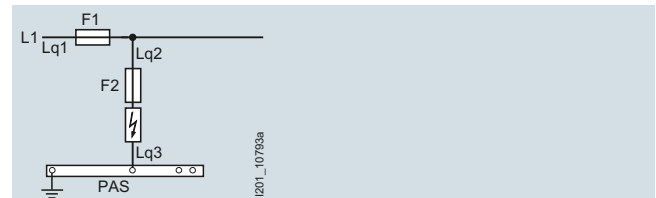
Conductor cross-sections for surge arresters (type 2) for series connection

MCB/fuse (F1) upstream [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

Parallel connection



a) Protection of the SPD using miniature circuit breakers



b) Protection of the SPD using fuses

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

MCB/fuse (F1) upstream [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 [A gL/gG]	Lq 2 [mm ²]	Lq 3 [mm ²]	F2 fuse [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

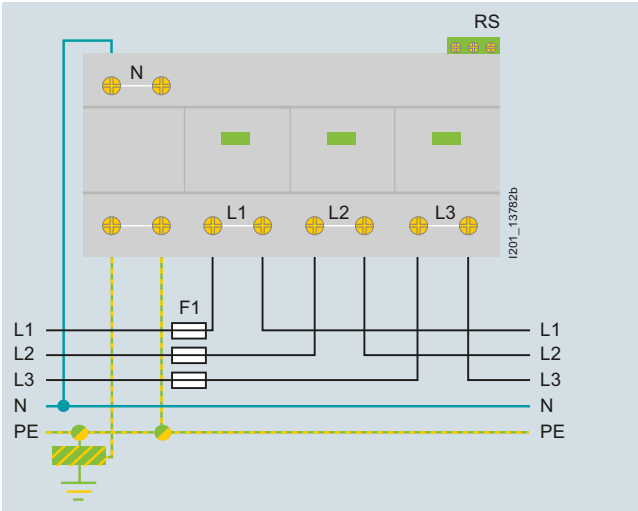
In the case of surge arresters type 3, the following conductor cross-sections are generally used:

- Rigid: up to 4 mm²
- Flexible: up to 2.5 mm²

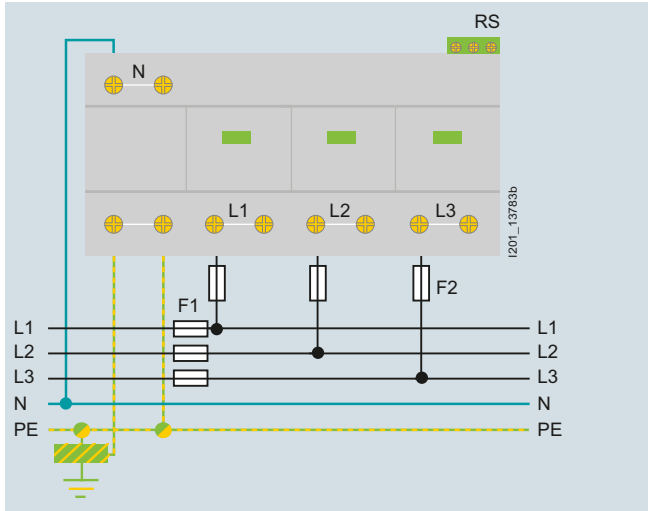
Circuit diagrams

Examples

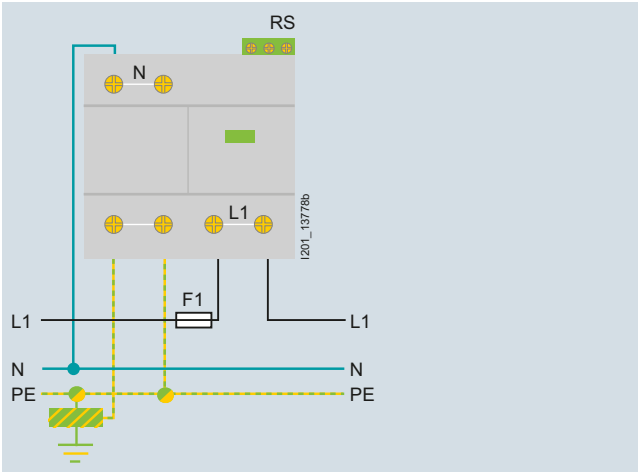
Series connection



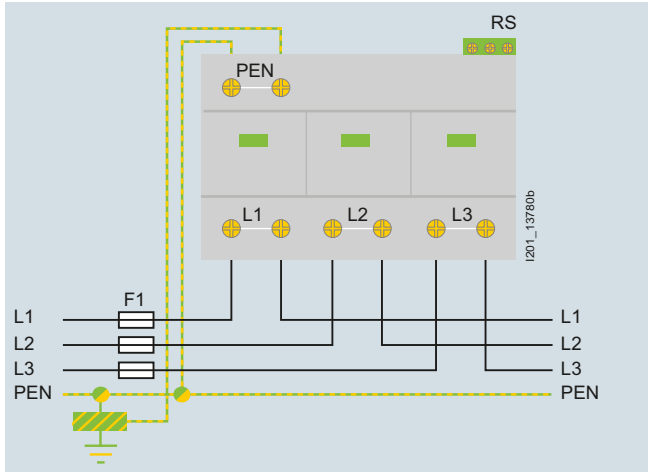
Parallel connection



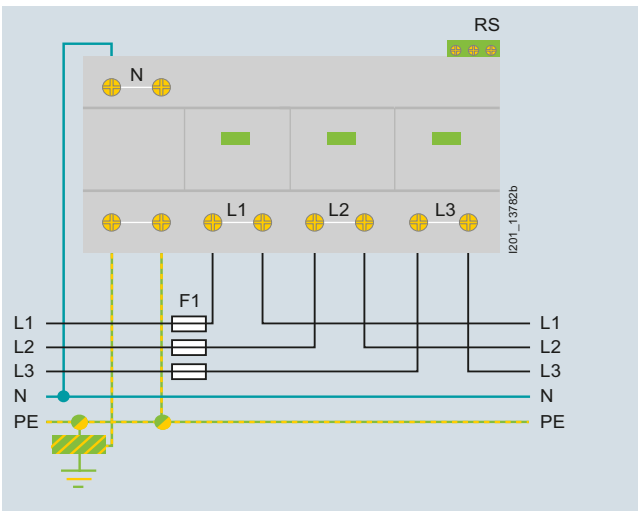
Lightning arresters, type 1



5SD7412-1 for TN-S/TT systems



5SD7413-1 for TN-C systems



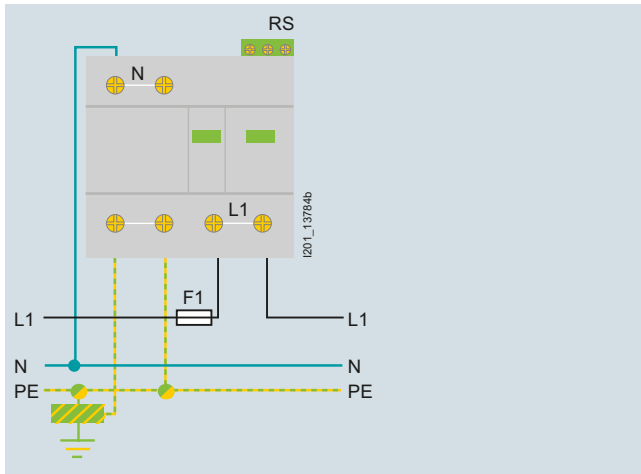
5SD7414-1 for TN-S/TT systems

RS = Remote signaling

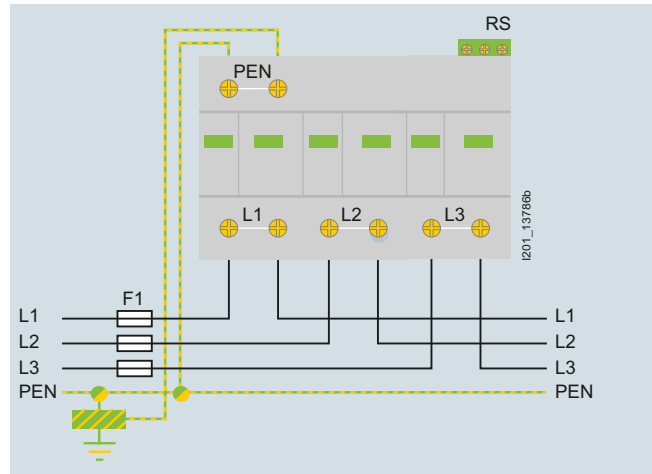
Overvoltage Protection Devices

Configuration

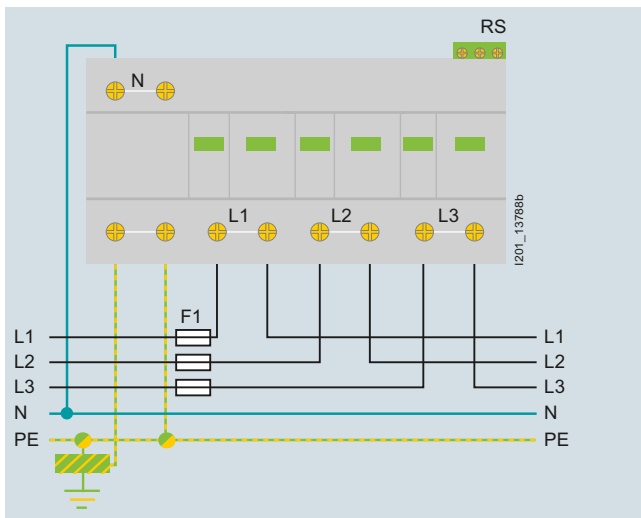
Combination surge arresters, type 1 + type 2



5SD7442-1 for TN-S/TT systems

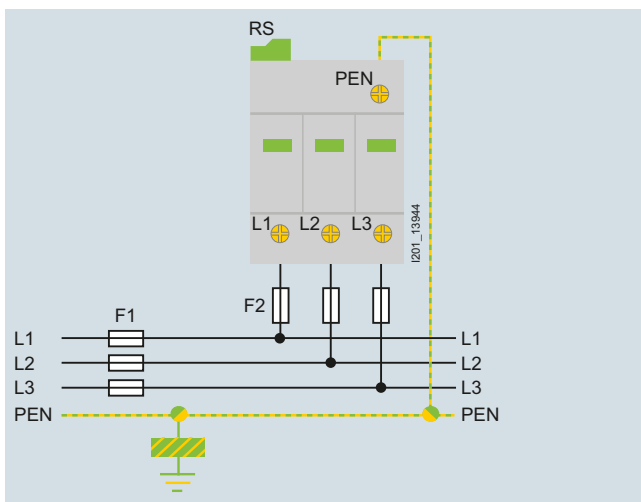


5SD7443-1 for TN-C systems

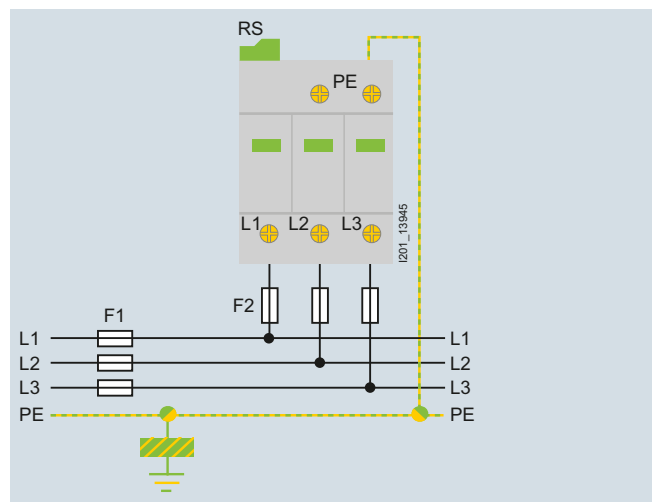


5SD7444-1 for TN-S/TT systems

Surge arresters, type 2

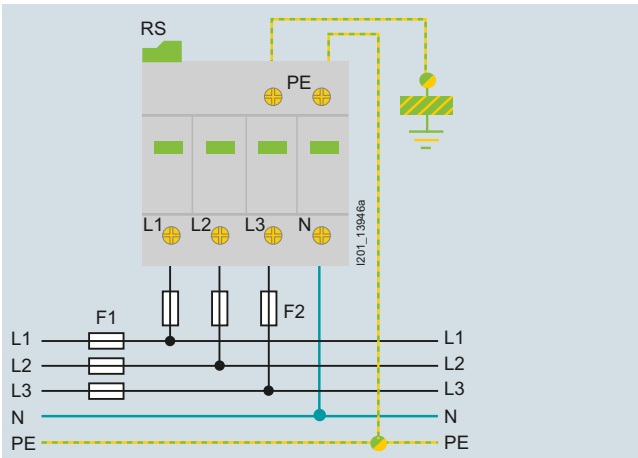


5SD7463-0/1 for TN-C systems

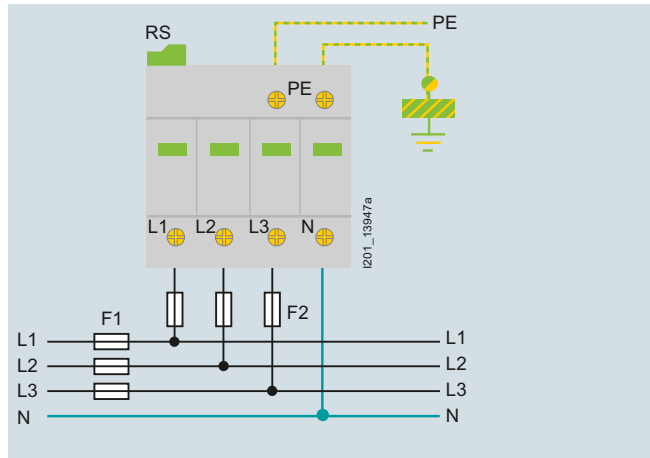


5SD7473-1 for IT systems

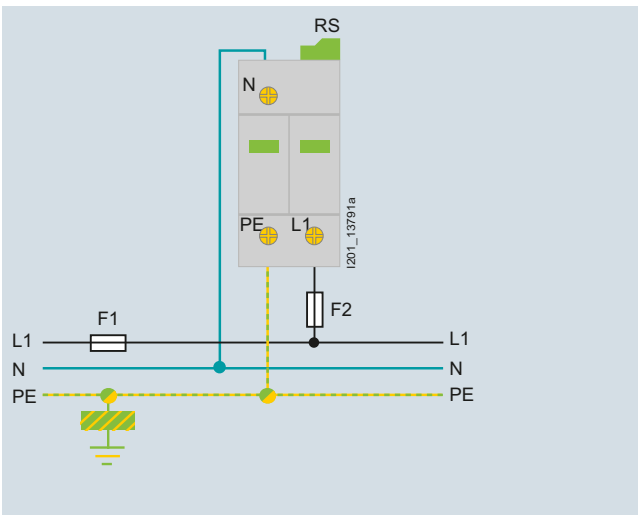
RS = Remote signaling



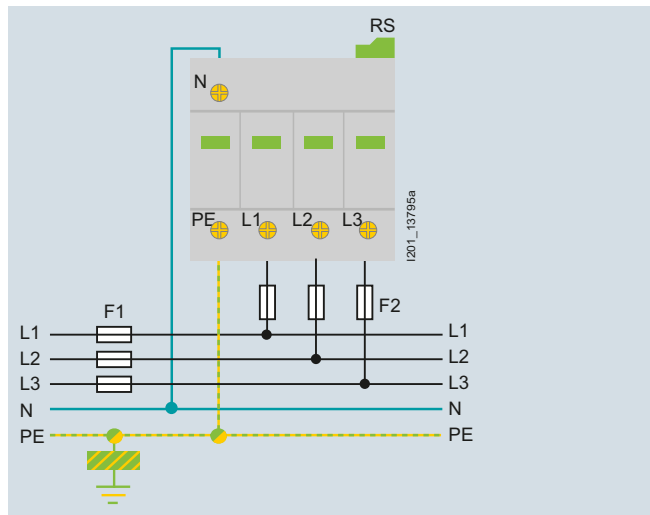
5SD7464-0/1 for TN-S systems



5SD7464-0/1 for TN-S/TT systems



5SD7422-0/1 for TN-S/TT systems



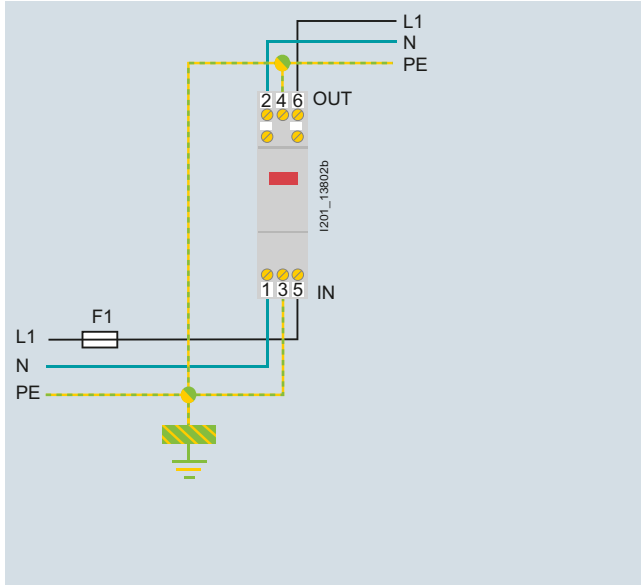
5SD7424-0/1 for TN-S/TT systems

RS = Remote signaling

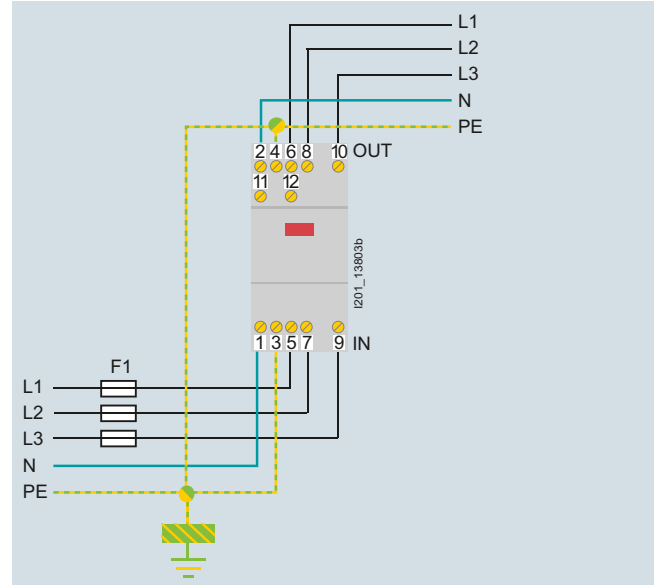
Overvoltage Protection Devices

Configuration

Surge arresters, type 3

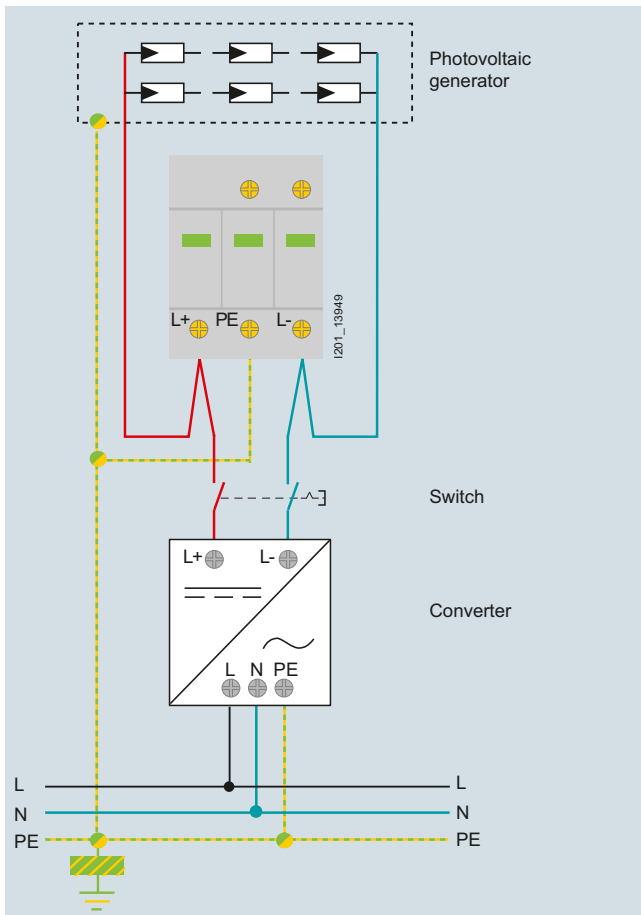


5SD7432-1/2/4 for TN-S/TT systems



5SD7434-1 for TN-S/TT systems

Surge arresters, photovoltaic type



5SD7483-6/7

Due to the combination of three power varistors, the overvoltage protection required for the inverters is implemented on the DC side.

On the AC side, the overvoltage protection can be ensured using surge arresters type 2 (5SD7422-. or 5SD7424-.).

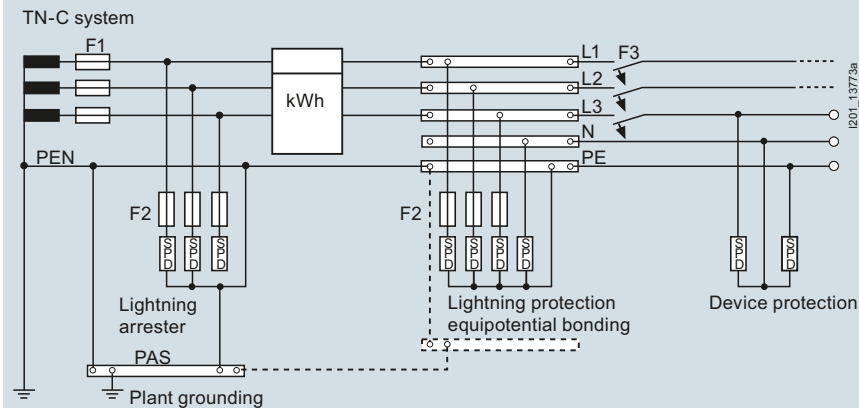
Scope when installing overvoltage protection systems

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.

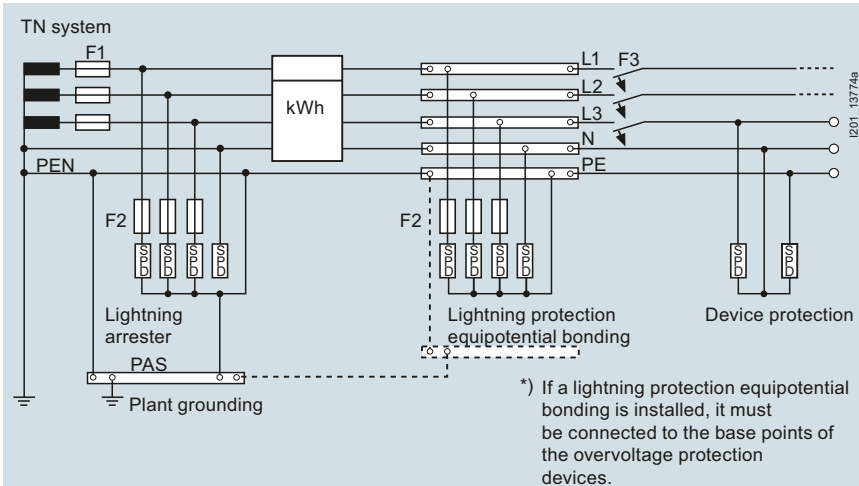
The scope of IEC 61024-1 – Protection of structures against lightning – and IEC 61312-1 – Protection against lightning

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

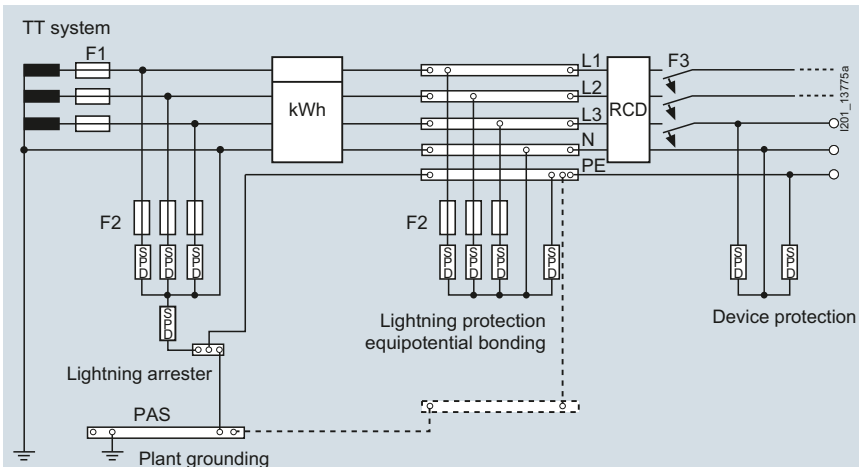
If a lightning protection equipotential bonding is installed, it must be connected to the base points of the overvoltage protection devices.



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

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 to be protected and the specifications of the installation regulations (DIN VDE 0100-534).

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.

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 di/dt of the surge current, response times may change within specific limits.

Versions for Austria

The standard ÖVE/ÖNORM E 8001-1 is generally applied in Austria – with relevant supplements. 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).

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.

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.

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.

Insertion loss a_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.

Frequency range

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

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 (a_E) of 3 dB (see EN 61643-21). Unless otherwise specified, this is based on a 50 Ω system.

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.

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.

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.

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.

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.

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.

Screening attenuation

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

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.

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 current

The protection level characterizes the capability of an overvoltage protection device to limit overvoltages to a residual 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 to be protected (EN 61000-4-5, -12).

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.

Series impedance

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

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".

Symbols

Circuit symbol	Description
	Surge protection device (SPD)
	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 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  - No external lightning protection - Power supply via ground conductor	TN-S and TT system	Surge arresters, type 2 5SD7424-0, 5SD7424-1, 5SD7464-0, 5SD7464-1 Combination surge arresters, type 1 / type 2 5SD7414-2, 5SD7414-3 
	TN-C system	Surge arresters, type 2 5SD7423-0, 5SD7423-1, 5SD7463-0, 5SD7463-1 Combination surge arresters, type 1 / type 2 5SD7413-2, 5SD7413-3 
High-risk buildings  - External lightning protection system	TN-S and TT system	Lightning arresters, type 1 5SD7414-2, 5SD7414-3, 5SD7414-1 
 - Power supply via overhead lines	TN-C system	Lightning arresters, type 1 5SD7413-2, 5SD7413-3, 5SD7413-1 
 - Grounded antenna structures	TN-S and TT system	Combination surge arresters, type 1 + type 2 5SD7444-1 
	TN-C system	Combination surge arresters, type 1 + type 2 5SD7443-1, 5SD7441-1 
	IT systems without N conductor incorporated in the cable	Typically, IT systems are only installed in special building sections. In the area of the main distribution board, TN-C-, TN-S or TT systems are generally still used. 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

5SD7424-0, 5SD7424-1,
5SD7464-0, 5SD7464-1



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

Surge arresters, type 2

5SD7463-0, 5SD7463-1



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

Surge arresters, type 2

5SD7424-0, 5SD7424-1,
5SD7464-0, 5SD7464-1

**Surge arresters, type 2**

5SD7463-0, 5SD7463-1

**Surge arresters, type 2**

5SD7424-0, 5SD7424-1,
5SD7464-0, 5SD7464-1



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

Surge arresters, type 2

5SD7463-0, 5SD7463-1



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

Surge arresters, type 2

5SD7473-1
3-pole, (3+0 circuit)
 $U_c = 580 \text{ V AC}$

**Fine protection**

For installation directly upstream of the terminal equipment

Surge arresters, type 3

For installation in sub-distribution boards
or control cabinets

5SD7432-x and 5SD7434-1
With remote signaling



Overvoltage Protection Devices

5SD7 surge arresters for measuring and control technology

Overview

The surge arresters for measuring and control technology are overvoltage protection modules that comprise two parts, a basic element and a plug-in part. 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 arresters 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.

The arresters are made up of two parts (plug-in part and base element).

A mechanical encoding ensures protection against reverse polarity.

Technical specifications

		5SD7502-0KB	5SD7522-7KA 5SD7522-7KB	5SD7530-4KA 5SD7530-4KB	5SD7540-6KB	5SD7541-7KB	5SD7550-4KA 5SD7550-4KB
IEC category/EN type		C1/C2/C3/D1	C1/C2/C3/D1	C1/C2/C3/D1	C1/C2/C3/D1	C1/C2/C3/D1	C1/C2/C3/D1
Maximum continuous voltage U_C							
• Direct voltage	V DC	68	40	14	27	40	14
• AC voltage	V AC	48	28	8.3	18.6	28	9.8
Rated current I_N	mA	2000	450	450	2000	300	450
Lightning test current I_{imp}	Per path						
10/350 μ s	kA	5	2.5	2.5	2.5	2.5	2.5
Rated discharge surge current I_n	8/20 μ s						
• Core – Core	kA	--	10	10	0.365	--	10
• Core – Ground	kA	20	10	10	0.365	10	10
Total surge current I_N	8/20 μ s	kA	40	20	20	20	20
Output voltage limit at 1 kV/μs							
• Core – Core	V	--	≤ 55	25	25	--	≤ 25
• Core – Ground	V	≤ 600	≤ 450	40	40	≤ 55	≤ 25
Residual voltage at I_n							
• Core – Core	V	--	≤ 55	--	--	--	≤ 25
• Core – Ground	V	--	--	--	--	≤ 55	≤ 40
Response time t_A							
• Core – Core	ns	--	≤ 1	≤ 500	≤ 1	--	≤ 500
• Core – Ground	ns	≤ 100	≤ 100	≤ 500	≤ 100	≤ 1	≤ 500
Insertion loss a_E							
• Symmetrical in the 50- Ω system	dB	--	Type 0.5 (1.5 MHz)	--	0.1 dB to 1 MHz	--	--
• Asymmetrical in the 50- Ω system	dB	0.1 (1 MHz)	--	--	--	0.5 (1.5 MHz)	--
• Symmetrical in the 100- Ω system	dB	--	--	0.2 (5 MHz)	--	--	0.2 (5 MHz)
Limit frequency f_G (3 dB)							
• Symmetrical in the 50- Ω system	MHz	--	typ. 8	--	6 MHz (typ.)	--	--
• Asymmetrical in the 50- Ω system	MHz	--	--	--	--	typ. 8	--
• Symmetrical in the 100- Ω system	MHz	--	--	typ. 70	--	--	typ. 70
Resistance per path	Ω	--	2.2	--	--	4.7	2.2
Temperature range	$^{\circ}$ C	-40 ... +85					
Degree of protection according to IEC 60529/EN 60529		IP20					
Flammability class acc. to UL 94		V0					
Test standards		EN 61643-21/ EN 61643-21	EN 61643-21/ EN 61643-21	IEC_61643-21/ EN 61643-21	IEC_61643-21/ EN 61643-21	EN 61643-21/ EN 61643-21	IEC 61643-21

KA: Basic element grounded via gas arrester

KB: Basic element directly grounded

Overvoltage Protection Devices

5SD7 surge arresters for measuring and control technology

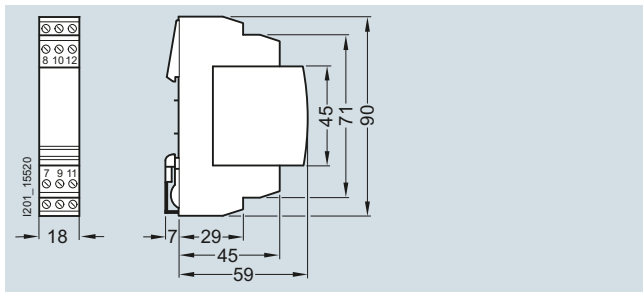
			5SD7581-2	5SD7581-3	5SD7581-5	5SD7581-6
IEC category/EN type			B2/C1/C2/C3/D1	B2/C1/C2/C3/D1	B2/C1/C2/C3/D1	B2/C1/C2/C3/D1
Maximum continuous voltage U_C						
• Direct voltage	V DC		185	3.3	12	15
• AC voltage	V AC		128	2.3	8.3	10.4
Rated current I_N			mA	380	1500	380
Rated discharge surge current I_n 8/20 μ s						
• Core – Core	kA		5	0.10	5	0.25
• Core – Ground	kA		5	2	5	0.25
Total surge current I_N 8/20 μ s			kA	10	10	10
Output voltage limit at 1 kV/ μ s						
• Core – Core	V		≤ 250	≤ 9	≤ 25	≤ 25
• Core – Ground	V		≤ 250	≤ 700	≤ 700	≤ 650
Residual voltage at I_n						
• Core – Core	V		≤ 120	≤ 15	≤ 25	≤ 55
• Core – Ground	V		≤ 120	≤ 700	≤ 55	≤ 700
Response time t_A						
• Core – Core	ns		≤ 100	≤ 1	≤ 100	≤ 1
• Core – Ground	ns		≤ 100	≤ 100	≤ 100	≤ 100
Insertion loss a_E						
• Symmetrical in the 50- Ω system	dB		--	--	--	--
• Asymmetrical in the 50- Ω system	dB		--	--	--	--
• Symmetrical in the 100- Ω system	dB		--	≤ 1	0.3	--
Temperature range			°C	-40 ... +85		
Degree of protection according to IEC 60529/EN 60529				IP20		
Test standards			EN 61643-21	EN 61643-21	EN 61643-21	EN 61643-21

Plug-in part	5SD7502-0	5SD7522-7	5SD7530-4	5SD7540-6	5SD7550-4	5SD7541-7
Surge arresters	5SD7502-0KB	5SD7522-7KA 5SD7522-7KB	5SD7530-4KA 5SD7530-4KB	5SD7540-6KB	5SD7550-4KA 5SD7550-4KB	5SD7541-7KB

Overvoltage Protection Devices

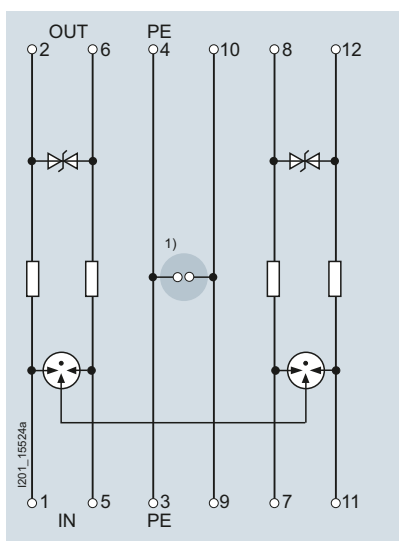
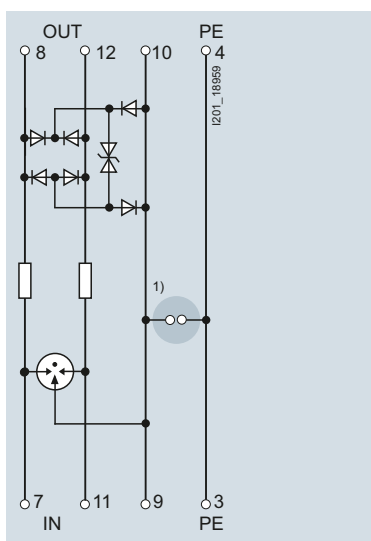
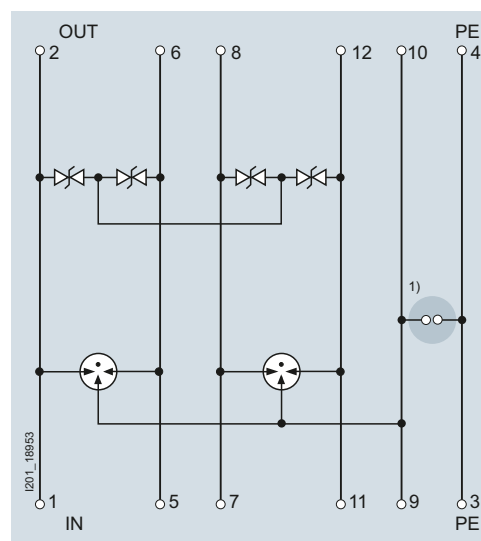
5SD7 surge arresters for measuring and control technology

Dimensional drawings

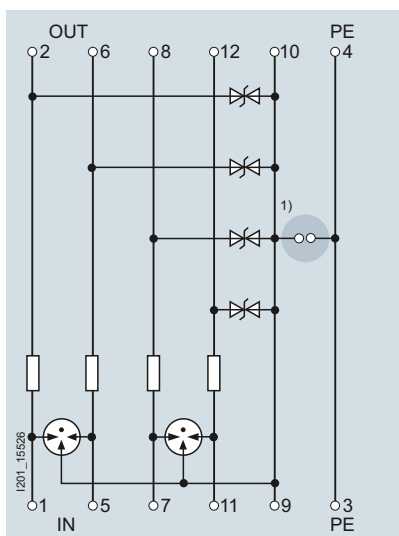


5SD75..

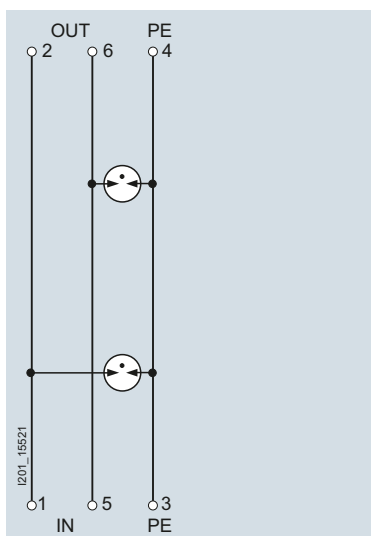
Circuit diagrams

5SD7522-7KA
5SD7522-7KB5SD7530-4KA
5SD7530-4KBS

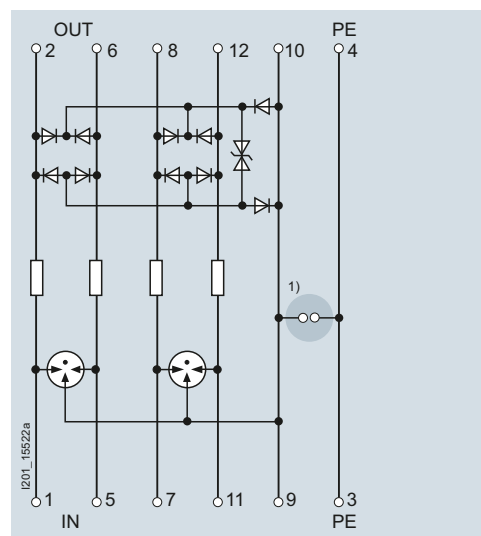
5SD7540-6KB



5SD7541-7KB



5SD7502-0KB

5SD7550-4KA
5SD7550-4KB

¹⁾ With the 5SD7512-1, 5SD7522-1, 5SD7541-1 and 5SD7500-0 basic elements, the terminals 9 and 10 (GND) are directly connected to the standard mounting rail over the metallic mounting foot.

KA: Basic element grounded via gas arrester
KB: Basic element directly grounded

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