Overvoltage Protection Devices

Configuration

Overvoltage protection devices (SPD)

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

Overvoltage protection devices are categorized:

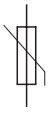
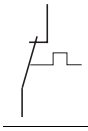
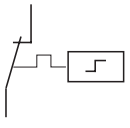
a) according to their application:

- Overvoltage protection devices for plants and devices in power systems in the voltage range up to 1000 V rated voltage
- Overvoltage protection devices for plants and devices in information systems for protecting modern electronic devices in telecommunication and signal processing systems, with rated voltages of up to 1000 V AC (r.m.s. value) and 1500 V DC, 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:

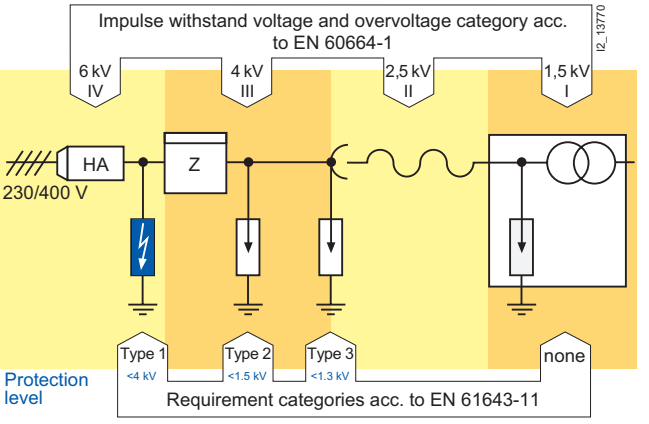
- Lightning arresters
  for influences as a result of direct or close-up strikes for the protection of installations and equipment
- Combination surge arresters
  for influences as a result of direct or close-up strikes for the protection of installations and terminal equipment
- Surge arresters
  for remote strikes, switching overvoltages, as well as electrostatic discharges for the protection of installations, equipment and terminal equipment

Symbols

Symbol	Description
	Lightning and surge arresters, general
	Lightning and surge arresters for atmospheric influences
	Varistors
	Measuring spark gaps
	Back-up fuse
	Thermal isolating arrester
	Thermodynamic isolating arrester

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 overvoltage protection devices.



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

Overvoltage categories		
Category	**Impulse withstand voltage**	**Description**
IV	6 kV	For devices connected upstream of the distribution board
III	4 kV	For devices that are an integral part of the plant (e.g. distribution boards)
II	2.5 kV	For normal devices (e.g. household appliances)
I	1.5 kV	For extremely sensitive devices (e.g. electronic devices)

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

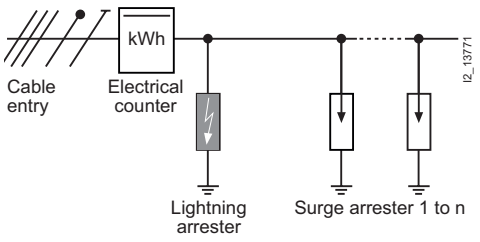
European Standard EN 61643-11	International Standard IEC 61643-1	Designation
Type 1	Class I	Lightning arresters
Type 2	Class II	Surge arresters for distribution boards
Type 3	Class III	Surge arresters for terminal equipment

The requirement categories were also referred to as Class B, C and D acc. to the withdrawn standard DIN VDE 0675-6-11.

Furthermore, the following country-specific product standards also apply (mostly equivalent to IEC 60364):

- Austria: ÖVE/ÖNORM E 8001.
- Germany: DIN VDE 0100

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 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". It must be established between arresters of type 1 (Class B) and type 2 (Class C) as well as between arresters of type 3 (Class D).

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.

SPD 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^2t_{max} of the SPD are not exceeded. This prevents damage to the SPD.

A distinction is generally made between 2 different connection types:

- 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.
- 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.

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

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-time 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.

Description	Requirement categories acc. to EN 61643-11	Product designation	Max. permissible energy value I^2t_{max}	Max. permissible peak current value $I_{p\,max}$	Comments
Lightning arresters	Type 1	5SD7 412-1, 5SD7 413-1, 5SD7 414-1	180 kA^2s	12 kA	No protection necessary up to 50 kA effective short-circuit current
Combination surge arresters	Type 1 and 2	5SD7 442-1, 5SD7 443-1, 5SD7 444-1	180 kA^2s	12 kA	No protection necessary up to 25 kA effective short-circuit current
Surge arresters	Type 2	5SD7 422-0, 5SD7 422-1, 5SD7 423-0, 5SD7 423-1, 5SD7 424-0, 5SD7 424-1, 5SD7 466-0, 5SD7 466-1, 5SD7 461-0, 5SD7 461-1, 5SD7 463-0, 5SD7 463-1, 5SD7 464-0, 5SD7 464-1, 5SD7 481-0	100 kA^2s	10 kA	No protection necessary up to 25 kA effective short-circuit current