Application note

Overcurrent protection for surge protection devices (SPD)

Installation instructions and requirements / protection of SPDs

A surge protective device (SPD) and its connecting cables must be protected against the effects of an overcurrent, just like any other piece of electrical equipment. A suitably dimensioned overcurrent protection device is provided for this purpose during system planning.

In normal operation, SPDs behave like passive, non-conductive components and are installed in parallel with the device/system to be protected.

A current flow only occurs in the event of an overvoltage or at the end of the life of the protective components.

For protection SPDs are protected against short circuits or overloads by means of an overcurrent protection element (F2; Fig. 1.1), which is designed for the type of installation and the cross-section of the connected cable.

The protective elements must be selected taking into account the rated currents specified by the SPDs manufacturer in the installation instructions. It must be ensured that the branch fuse (F2) is actually capable of carrying lightning currents. F2 must not be selected too small so that the SPD is not ineffective in the event of an overvoltage.

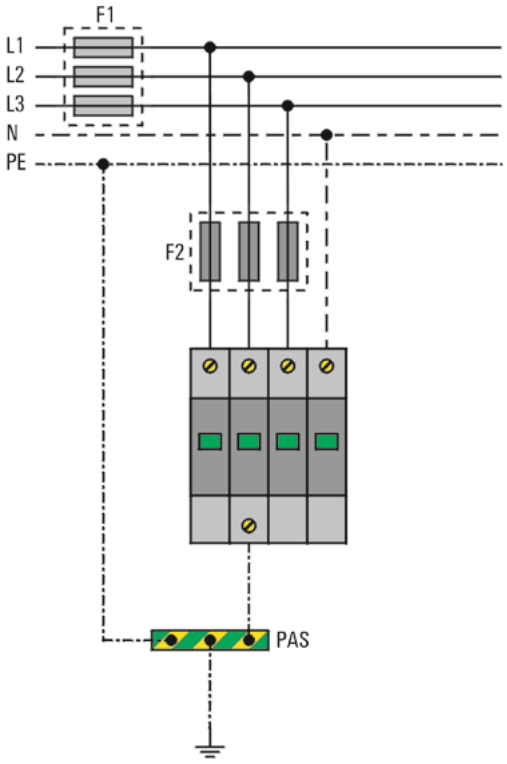


Fig. 1.1 Schematic representation of the protective elements

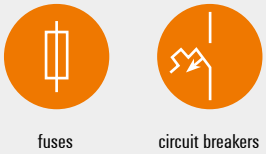
- An additional fuse F2 is required if the nominal value of the system-side fuse F1 is greater than the maximum rating of the fuse, specified by SPD manufacturer
- The maximum fuse rating is described in the data sheet
- Note the selectivity: F2 / F1 = 1 : 1,6
- F2 must be able to carry the pulse current

If the fuse is incorrectly selected, the back-up fuse would limit the capacity of the arrester. This would result in the fuse element tripping even with small surge currents and the system would no longer be protected.

Fuses & circuit breakers

Fuses and circuit breakers are overcurrent protection devices that protect cables and devices (such as SPDs in our case) from overloading and short circuits.

The rated current indicates the amperage for which a fuse or circuit breaker is designed. If the rated current is exceeded, a tripping characteristic can be used to determine the time range in which the protective device trips.



Functionality

Fusible links (commonly known as fuses) are triggered when a fusible wire or strip heats up in the event of an overcurrent and then melts. This interrupts the circuit. After blowing, the fuses must be replaced as they are disposable components.

Circuit-breakers offer overload protection through the thermal release (bimetal) and protection against short circuits through electromagnetic tripping.

Thermal release: When tripped by overcurrent, the metal heats up and bends. This mechanically separates the contact and interrupts the circuit.

Electromagnetic tripping: In the event of a short circuit, a very high current flows briefly through a coil. The resulting magnetic field pushes an iron armature out of the coil. This mechanically interrupts the contact of the circuit. A circuit breaker is reusable and can be easily reset after tripping.

Fuses for the protection of an SPD

Behavior of NH fuses with lightning impulse current (10/350 µs)
When dimensioning the fuse, it is important to use the maximum back-up fuse if possible. Figure 1.2 clearly shows that the lightning current carrying capacity of small fuses is severely limited. Only dimensioning according to the maximum value offers unrestricted protection of the system by an SPD!

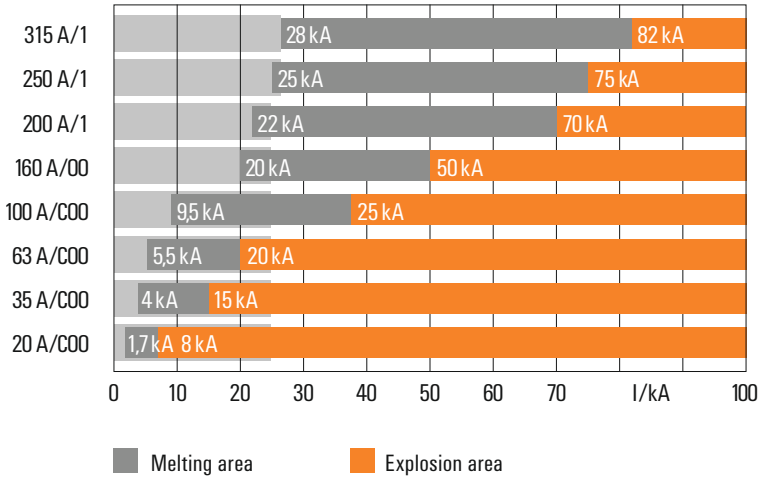


Fig. 1.2 Melting and explosion range of NH fuses

Use of SPD and fuse (according to IEC 61643-12):

- A back-up fuse of 160A gG is the minimum fuse value for SPD type 1 (12.5kA)
- A back-up fuse of 80A gG is the minimum fuse value for SPD type 2 (20 kA)

Circuit breaker to protect an SPD

If circuit breakers are used as overcurrent protection components, they should comply with IEC/EN 60947-2, DIN EN 60947-2 (VDE 0660-101). The rated limit short-circuit breaking capacity (I_{cu}) and rated short-circuit breaking capacity (I_{cn}), which are specified in IEC 60947-2 (VDE 0660-101).

The rated value I_{cu} (industrial circuit breakers) and I_{cn} (circuit breakers for domestic installations) is specified in kArms.

I_{cu} or I_{cn} correspond to the maximum short circuit current that a circuit breaker can interrupt without damage.

Under normal operating conditions, the short circuit current are much smaller than the rated limit short-circuit breaking capacity (I_{cu}) of the circuit breaker. Nevertheless, it is important that high short circuit current can be interrupted properly without impairing the function of the circuit breaker.

When selecting the short circuit current device, the data such as rated breaking capacity and rated limit short-circuit breaking capacity are specified in the data sheet or in online configurators.

System	$50\ V < U_0 \leq 120\ V$	$120\ V < U_0 \leq 230\ V$	$230\ V < U_0 \leq 400\ V$	$U_0 > 400\ V$
	AC	AC	AC	AC
TN	0,8 s	0,4 s	0,2 s	0,1 s
TT	0,3 s	0,2 s	0,07 s	0,04 s

Fig. 1.3
Maximum permissible switch-off times for final circuits according to application standard DIN VDE 0100-410:2018-10 / IEC 60364-4-41

The maximum permissible switch-off times for final circuits (Fig. 1.3) define the switch-off time that a miniature circuit breaker must be able to carry the applied short circuit current (a few milliseconds). This ensures that the circuit breakers are not damaged by a lightning impulse.

If circuit breakers are used, the values (I_{cu}) or (I_{cn}) must be large enough to carry the lightning / leakage current (like gG fuses), i.e. greater than I_{imp}!

Conclusion

- Fuses and circuit breakers are overcurrent protection devices that protect against overloads and short circuits.
- **Fuses** always have a melting device that disconnects the connection in the event of an overload. Fuses are disposable components.
- **Circuit breakers** protect against overloads caused by overcurrent or short circuits. They can be used several times and can be switched on again after tripping.
- **The basic recommendation is to use a fuse gG. It guarantees absolutely safe disconnection by destroying the fuse, even if the power is too high. Nevertheless, the use of MCBs is an alternative, taking into account the parameters described above.**

What other options are available?

An additional fuse F2 (Fig. 1.1) always requires additional space and can lead to longer connection cables (0.5 m rule - see VARITECTOR Guide installation instructions).

An SPD with integrated fuse can be the perfect alternative. This ensures that even lightning currents with 25 kA per pole can be handled by the integrated fuse. The particular advantage of such a solution is the significantly smaller space requirement compared to a conventional size 2 external fuse. At the same time, it simplifies the possibility of optimizing the length of the connecting cables.

Product name	Type	Mains voltage	Version	Order No.
VPU AC I F 1 275/25	I + II	230 V / 400 V	Without remote contact	2859330000
VPU AC I F 1 R 275/25	I + II	230 V / 400 V	With remote contact	2859340000
VPU AC I 1 N-PE 305/100 S	I + II	230 V / 400 V	Without remote contact	2726800000
VPU AC I F 3+0	I + II	230 V / 400 V	Without remote contact	3022890000
VPU AC I F 3+0 R	I + II	230 V / 400 V	With remote contact	3022900000
VPU AC I F 3+1	I + II	230 V / 400 V	Without remote contact	3022910000
VPU AC I F 3+1 R	I + II	230 V / 400 V	With remote contact	3022920000
VPU AC II F 1+1 300/40	II + III	230 V / 400 V	Without remote contact	2827620000
VPU AC II F 1+1 R 300/40	II + III	230 V / 400 V	With remote contact	2807430000
VPU AC II F 3+1 300/40	II + III	230 V / 400 V	Without remote contact	2827630000
VPU AC II F 3+1 R 300/40	II + III	230 V / 400 V	With remote contact	2807440000

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