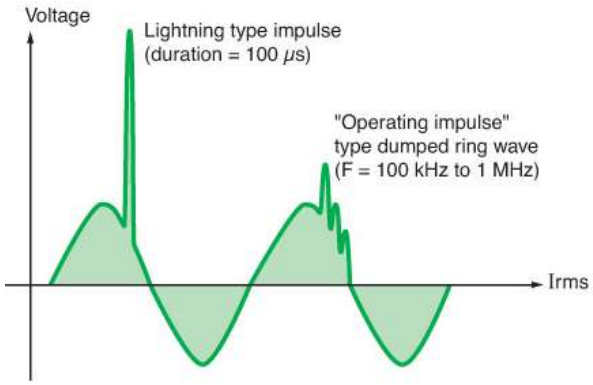
What is a Surge?

Overvoltage Definitions

Overvoltage in any system occurs when any voltage between one phase conductor and earth or between phase conductors has a peak value exceeding the corresponding peak of the highest voltage rating of the equipment.

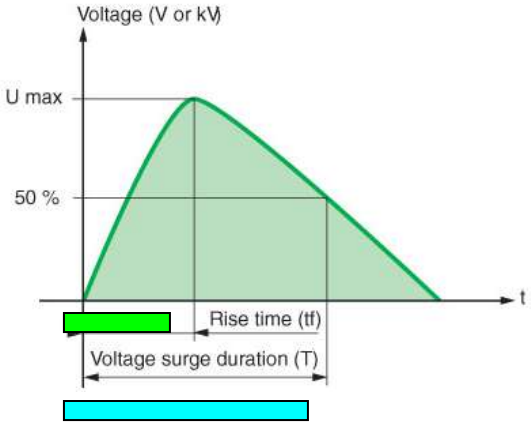


Examples of overvoltages are shown above.
This type of overvoltage is characterised by;

- The rise time tf (in µs)
- The gradient S (in kV/ µs)
- The duration of the overvoltage T

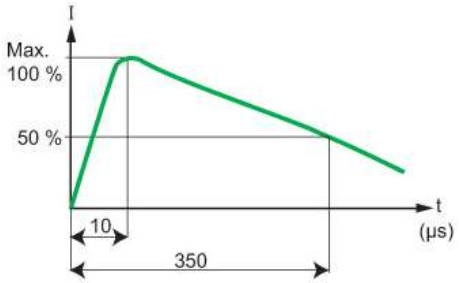
Characterisation of the lightning wave

A graphical representation of rise time (tf) and voltage surge duration (T) are shown below.



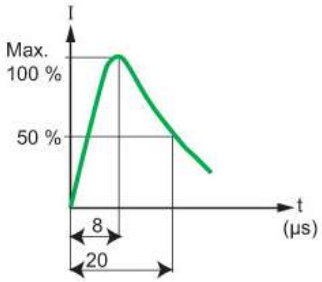
Two types of current wave are considered by IEC standards.

(1) 10/350 µs wave to characterise current wave from a direct lightning strike (i.e. 10µs rise time and 350 µs voltage surge duration).



10/30 µs current wave

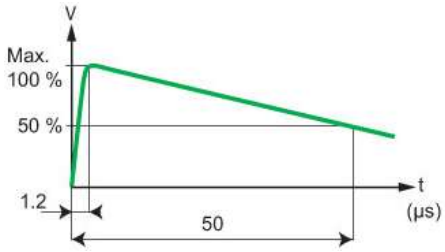
(2) 8/120 µs wave to characterise current waves from an indirect lightning strike (i.e. 8µs rise time and 120 µs voltage surge duration).



8/20 µs current wave

These two types of current wave are used to define tests on Surge Protection Devices (SPD) (IEC Standard 61643-11) and equipment immunity to lightning currents. The peak value of current wave characterises the intensity of the lightning strike.

The overvoltages created by lightning strikes are characterised by a 1.2/50 µs voltage wave

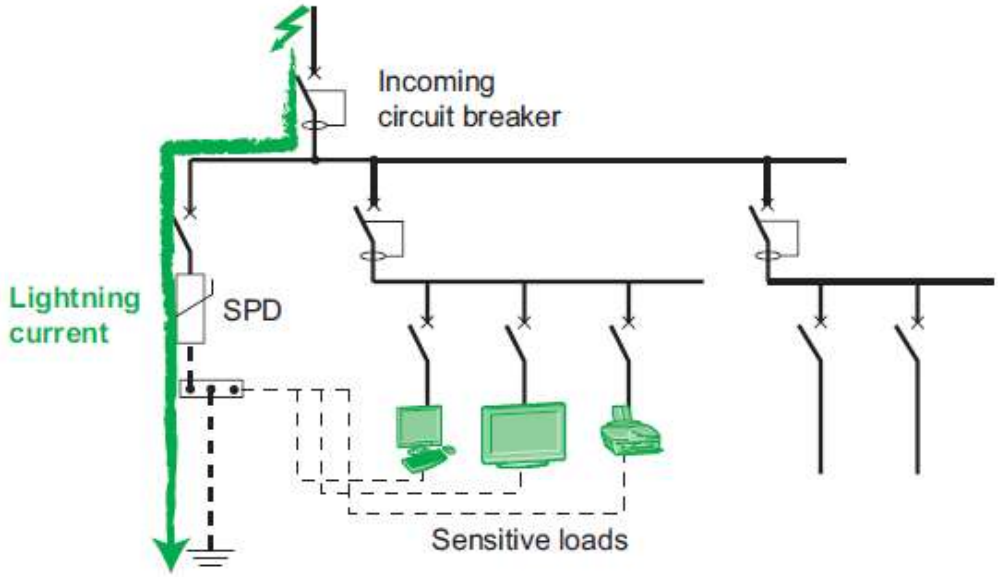


1.2/50 µs voltage wave

This type of voltage wave is used to verify equipments ability to withstand voltages of an atmospheric origin.

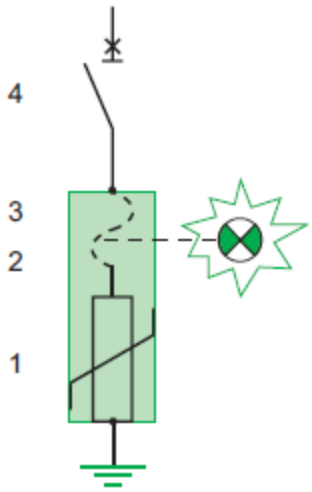
What is a Surge Protection Device?

The Surge Protection Device (SPD) is a component of the electrical installation protection system. This device is connected in parallel on the power supply circuit of the loads that it is to protect. It can also be used at all levels of the power supply network. This is the most commonly used and most efficient type of overvoltage protection.



The SPD is designed to limit transient overvoltages and divert current waves to earth, so as to limit the amplitude of this overvoltage to a value that is not hazardous for the electrical installation and switchgear.

Components of a SPD



The SPD consists of

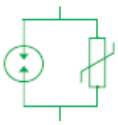
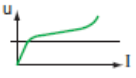
(1) One or more non-linear “live parts”. These are a varistor, gas discharge tube etc.
(2) A thermal protective device (internal disconnector) which protects the SPD from thermal runaway at the end of its life.
(3) An indicator which indicates end of life of the SPD. Some SPDs allow remote monitoring of this status via an auxiliary contact.
(4) An external short circuit protection device.

Technology of the ‘Live Part’

Several technologies are available to implement the live part. They each have advantages and disadvantages.

- Zener diodes;
- Gas discharge tube
- Varistor

The table below shows the characteristics of three commonly used technologies. Please note that two technologies can be used in the same SPD.

Component	Gas Discharge Tube (GDT)	Encapsulated spark gap	Zinc oxide varistor	GDT and varistor in series	Encapsulated spark gap and varistor in parallel
Characteristics					
					
Operating mode	Voltage switching	Voltage switching	Voltage limiting	Voltage-switching and -limiting in series	Voltage-switching and -limiting in parallel
Operating curves					
Application	■ Telecom network ■ LV network (associated with varistor)	LV network	LV network	LV network	LV network
SPD Type	Type 2	Type 1	Type 1 ou Type 2	Type 1+ Type 2	Type 1+ Type 2

End of life Indication

External indication of the state of the internal disconnector in the SPD can be provided either via a visual indicator and/or auxiliary contact built into the SPD. The protecting circuit breaker status can also be monitored via auxiliary contact.

When the SPD internal indicator indicates end of life, the offending cartridge needs to be replaced. The visual indication on the SPD assists with identification of the correct cartridge to be replaced.

Selection of a Type 1 SPD

Where there are no national regulations or specific regulations for the type of building to be protected (as per AS/NZS3000:2007), it is recommended to use a SPD with an impulse current rating (I_{IMP}) of at least 12.5kA (10/350µs wave) per branch in accordance with IEC 60354-5-534.

Selection of Type a 2 SPD

The maximum discharge current (Imax) is defined according to the estimated exposure level relative to a buildings location. The table below (from Schneider Electric – Electrical Installation guide 2015) provides a guideline for selection of this value which is based purely on the geographic location of the building(s).

	Exposure level		
	Low	**Medium**	**High**
Building environment	Building located in an urban or suburban area of grouped housing	Building located in a plain	Building where there is a specific risk: pylon, tree, mountainous region, wet area or pond, etc.
Recommended Imax value (kÂ)	20	40	65

Fig. J32 : Recommended maximum discharge current Imax according to the exposure level

To determine how to select a suitable “Type 1 + Type 2” Surge Protection device, please refer to separate FAQ “How do I select a suitable Type 1 + Type 2 Surge Protection Device”