Overvoltage Protection

OVR Range

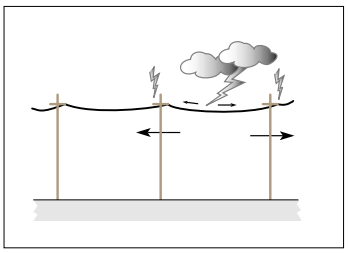
FRSOX 0101 03 GB

Main causes for transient overvoltages

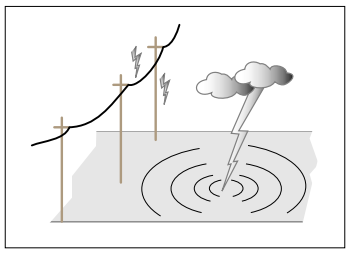
The solution:
ABB OVR Surge Protection Devices

Lightning strike

- A lightning strike can have a destructive or disturbing effect on electrical installations situated up to several kilometers away from the actual point of the strike.
- During a storm, underground cables can transmit the effect of a lightning strike to electrical equipment installed inside buildings.
- A lightning protection device (such as a lightning rod or a Faraday cage) installed on a building to protect it against the risk of a direct strike (fire) can increase the risk of damage to electrical equipment connected to the main supply near or inside the building.

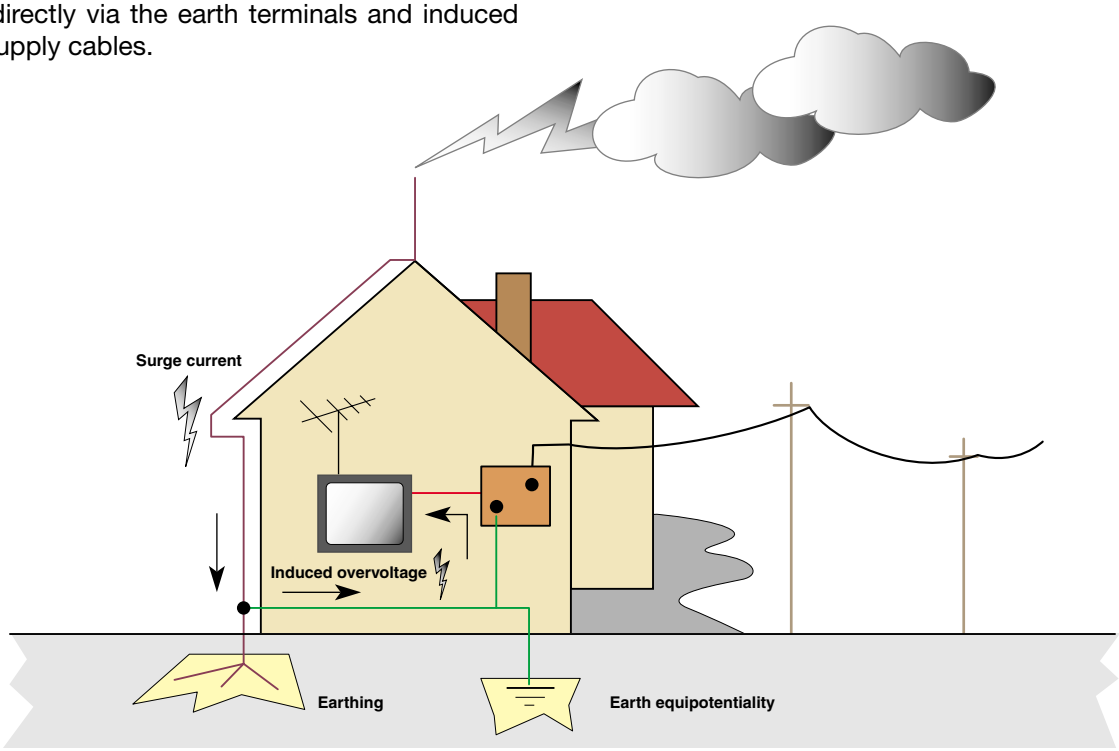


Direct strike on overhead line



Indirect lightning strike

The lightning protection device diverts the high strike current to earth, considerably raising the potential of the ground close to the building on which it is installed. This causes overvoltages on the electrical equipment directly via the earth terminals and induced via the underground supply cables.



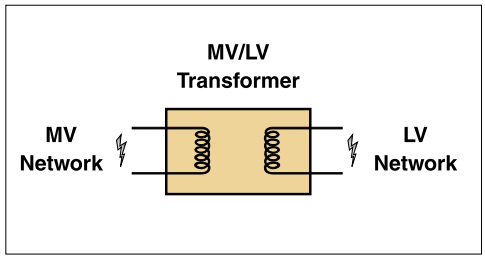
Strike on a lightning rod

Switching operation on the power distribution system

The switching of transformers, motors or inductances in general, sudden variation of load, disconnection of circuit breakers or cut outs (i.e in the distribution circuits) lead to overvoltages that penetrate the user's building.

Significantly, the closer the building is to a generating station or sub station, the higher the overvoltages may be.

It is also necessary to take into account mutual induction effects between the high voltage power line and aerial sections of the low voltages lines as well as direct contact between lines of different voltages caused by accidental breaking of cables.



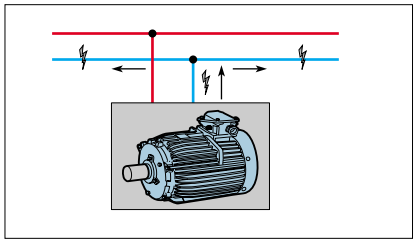
MV disturbances transmitted to LV

Parasitic interferences

These are interferences with indifferent amplitudes and frequencies that are re-injected into the electrical supply by the user himself or his environment.

The parasites can, for example, be due to:

- Light fittings with discharge lamps
- Arc furnaces
- Welding equipment
- Thyristors operation
- Contactors operation
- Opening circuit breakers
- Starting a motor
- Etc…



Disturbances generated by the user

These interferences have little energy but their short duration, their steep wave front and their peak value (that can reach several kilovolts) can have harmful effects on the proper functioning of sensitive equipment causing either disruption or complete destruction.

Surge Protection Device Selection and application principles

Definition of the parameters

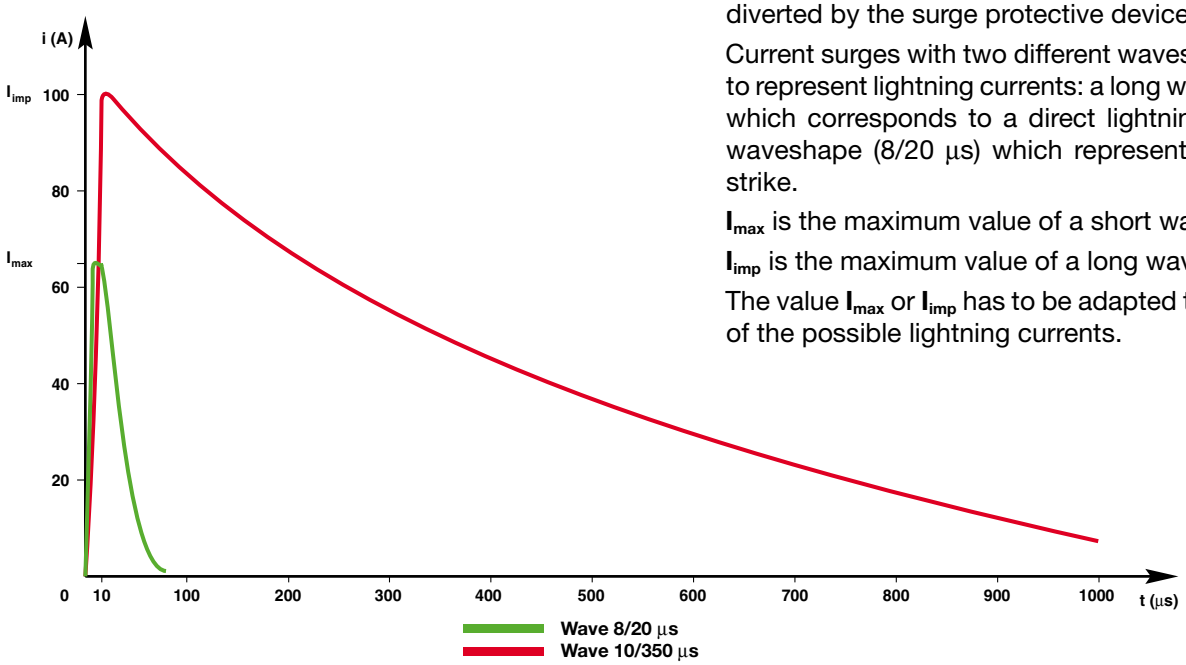
Aim of the protection

Protection devices are used to prevent current surges from flowing through the network by diverting them harmlessly to the ground. They also limit overvoltages to values compatible with the withstand of the equipment or devices connected.

Parameters of the protection

It can be easily understood from the above that the critical parameters of a surge protective device are its ability to divert high values of current to the ground (i.e. to dissipate large amount of energy) and to limit the voltage to the lowest possible level. Other parameters correspond to the fact that surge protective devices have to be adapted to the network they are connected to.

The applicable international standards give a precise definition of these parameters:



- **Maximum current I_{max} or I_{imp}**

  This is the maximum value of a surge current that can be diverted by the surge protective device.

  Current surges with two different waveshapes are necessary to represent lightning currents: a long waveshape (10/350 µs) which corresponds to a direct lightning strike and a short waveshape (8/20 µs) which represents a damped indirect strike.

  I_{max} is the maximum value of a short waveshape current.

  I_{imp} is the maximum value of a long waveshape current.

  The value **I_{max}** or **I_{imp}** has to be adapted to the expected value of the possible lightning currents.

- **Voltage protection level U_p**

  The voltage given by the surge protective device while diverting the surge current to the ground; **U_p** must not exceed the voltage withstand value of the equipment connected downstream.

- **Maximum operating voltage U_c**

  The value of voltage that the surge protection device can be permanently connected to; it has to take into account the network nominal voltage **U_n** plus the possible tolerances.

Product selection

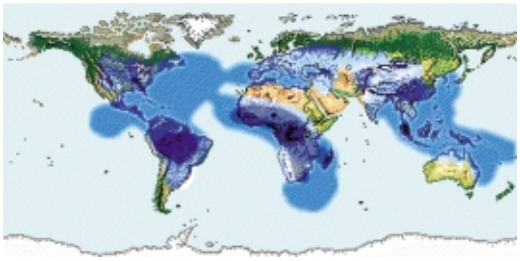
Determination of the current capability

The determination of the current capability for a surge protective device, and the energy dissipation capability of this device, are obtained by performing a risk analysis.

This analysis is based on three groups of parameters:

- Environmental parameters: frequency of lightning storms, represented by the number of lightning strikes per year and per square kilometre Ng.
- Installation and equipment parameters: existing lightning rod, power distribution to the installation (overhead or underground line), position of the equipment in the installation, ...
- Security parameters: replacement and unavailability cost of the equipment to be protected, risk for the environment or for human life (petrochemical sites, stadium, ...).

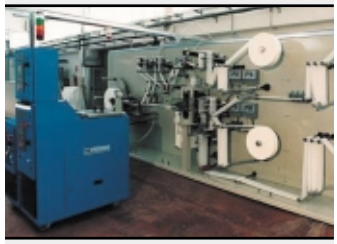
Keraunic map



Dark blue areas cover regions with a Keraunic level of 80 to 180
Light blue areas cover regions with a Keraunic level of 20 to 80

Determination of the voltage protection level (U_p)

Surge protection devices must provide a level of protection compatible with the withstand voltage of the equipment.
This withstand voltage depends on the type of equipment and its sensitivity.

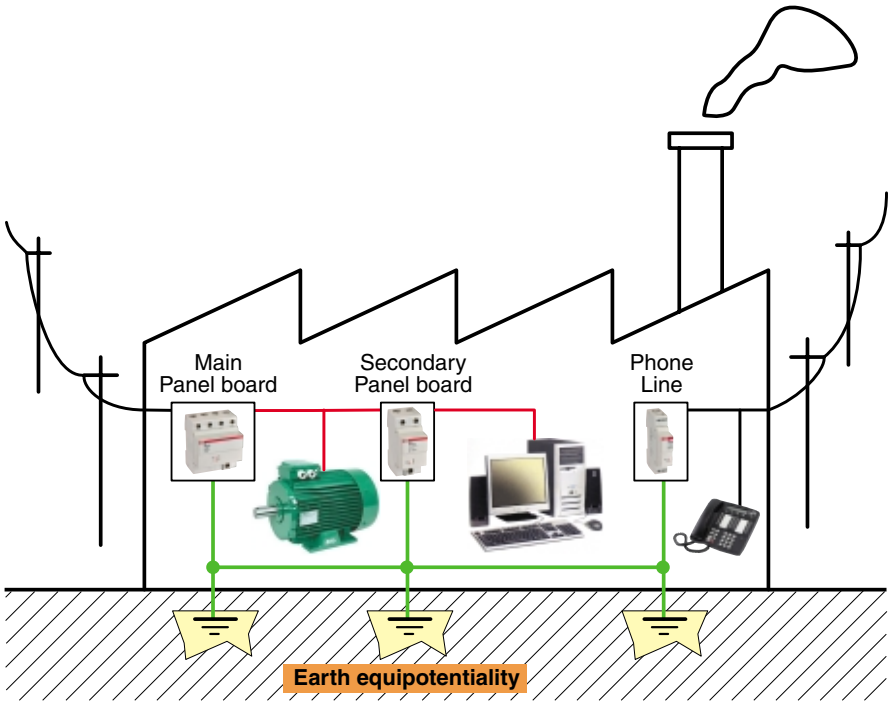
Electrotechnical equipment	Electrical equipment containing slightly sensitive electronics	Sensitive electronic equipment	Highly sensitive equipment
			
Required protection level U_p 1.8 to 2.5 kV	Required protection level U_p 1.5 to 1.8 kV	Required protection level U_p 1 to 1.5 kV	Required protection level U_p 0.5 to 1 kV

Type of equipment to be protected

Need for multi-level protection

Sometimes it is not possible to find a device which provides both the required current capability and protection level. In this case, the protection system has to have two or more levels, with a first device at the entrance of the installation (i.e. as close as possible to the point of entrance of the lightning surge), which handles the current capability, and a second device as close as possible to the protected equipment, which gives the required voltage protection level.

Telecommunication lines entering the installation must be protected as well; Grounding connections for all arresters must be equipotentially bonded.

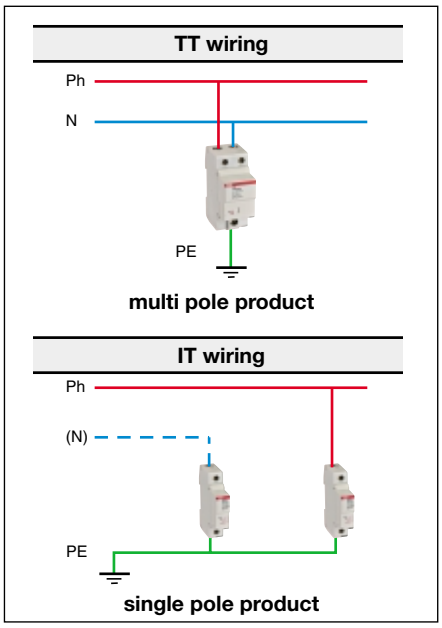


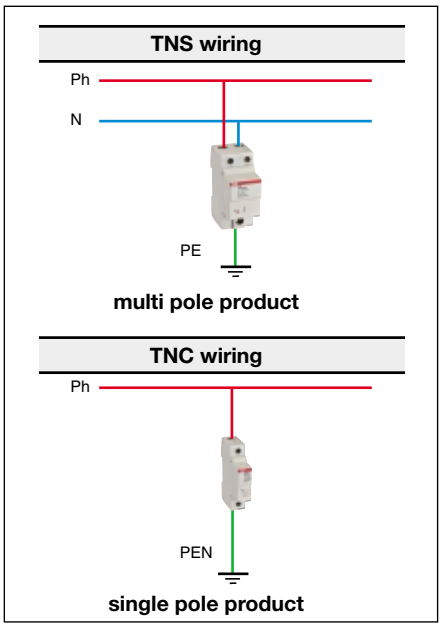
Installation rules

• Identification of the network

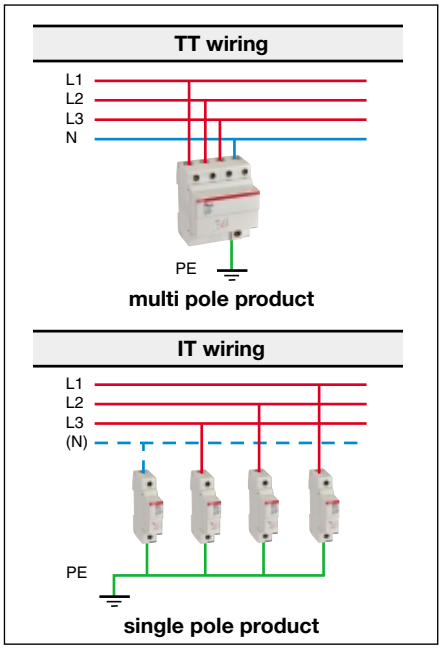
The type of product (single pole or multi pole) and the connection depend on the network, as follows:

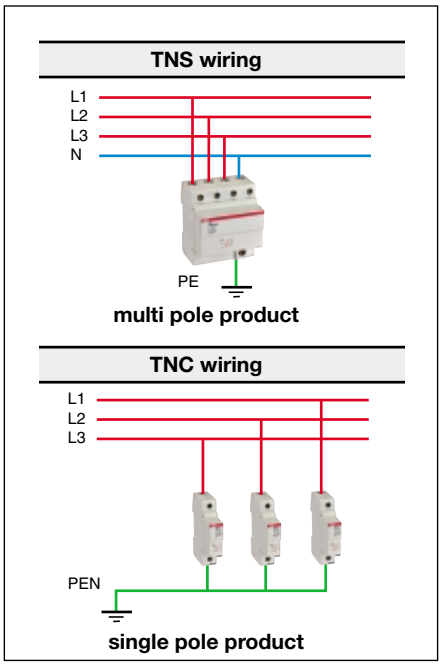
1 - phase networks





3 - phase networks





• Additional information

– **TT wiring:** the power supply neutral point is connected to earth.
The installation grounds are connected to an electrical earth terminal which is different from the neutral earthing point.

– **IT wiring:** the neutral point is not connected to earth or is earthed via an impedance (1.000 to 2.000 Ω).

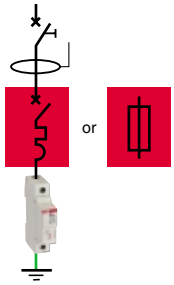
– **TNC wiring:** the neutral conductor and the protective conductor merge into one (PEN) conductor.

– **TNS wiring:** the neutral conductor and the earth conductor are separated.

• Associated switching element

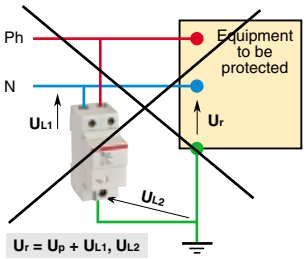
Even if all lightning arresters are provided with a built-in thermal disconnector, they must be associated with an upstream protection element for protection against permanent circuit currents.

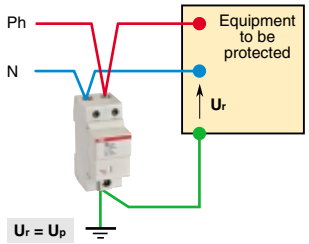
For some types of networks (TT for example), protection from indirect contact has to be provided by a residual current device.



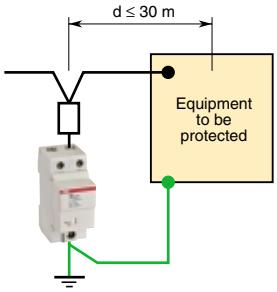
• Wiring rules

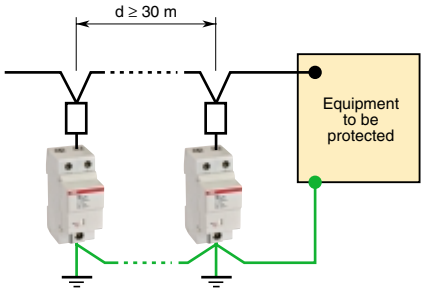
The impedance of the cables increases the voltage across the connected equipment, i.e. the protection level. Therefore, the length of cable between the surge protector and the equipment should be minimized, and the wiring should be done as follows:





The surge protection device should also be installed as close as possible to the equipment to be protected. If this is not possible (e.g. the equipment is too far away from the entrance panel), then a second protector has to be installed.





• Energy coordination

When it is necessary to use a multi-level protection, the energy coordination between the various levels should be studied carefully. It consists of ensuring that when the maximum discharge current is flowing through the first level surge protector, the remaining current flowing through the remaining level(s) arrester(s) does not exceed its (their) capacity.

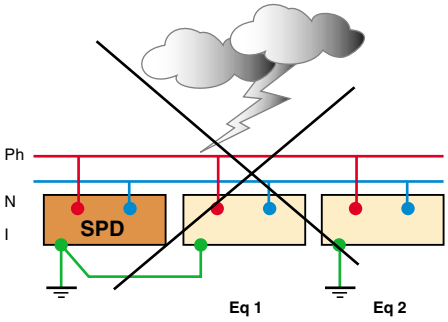
• Wire size of cables

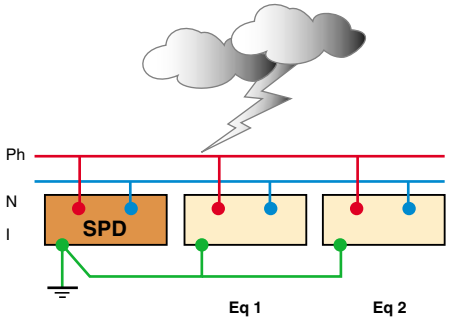
The wire size of cables depends on the short-circuit capability that can be delivered by the network to the installation.

The wire size of cables must be at least equal to the cross section of the rest of the cables in the installation.

• Earth equipotential bonding

The earth conductors of all surge arresters and equipment connected together have to be equipotentially bonded, in order to avoid any difference of potential between local earthing points that would lead to annihilate the protection level provided by the surge arresters.





Product overview

Mono Block Units

Single Pole Unit

Multi Pole Unit

Single pole surge arresters are used mainly in IT and TNC wiring.
These products offer common mode protection.

On the other hand, multi pole surge protective devices are used in TT and TNS wiring, either in 1-phase (two pole SPD) or 3-phase networks (four pole SPD).
These products can offer common mode and differential mode protection.

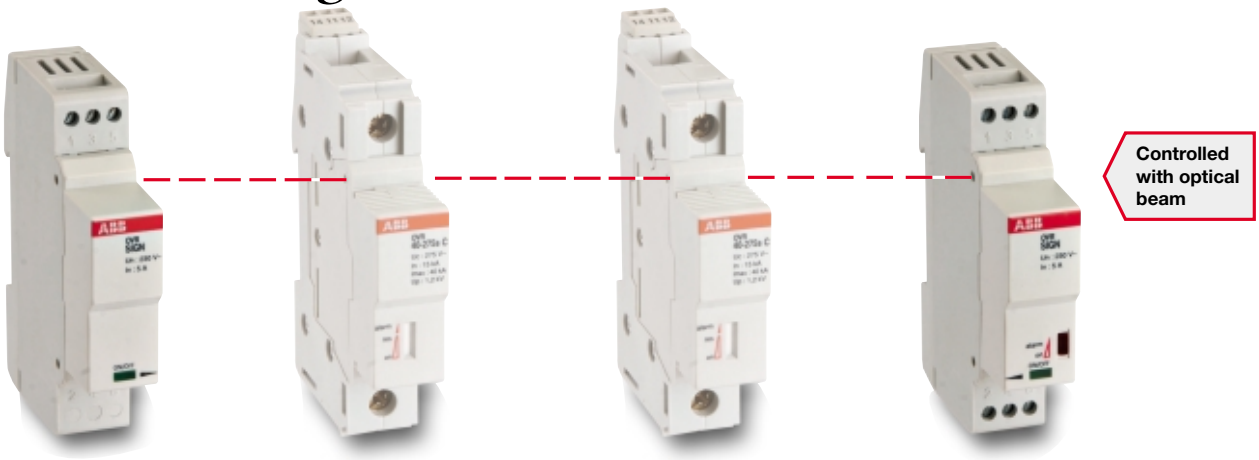
Pluggable Units

Single Pole Unit

Multi Pole Unit

The pluggable functionality is one of the main advantages of this range of surge arresters, because of their replacement made easy (no tools needed) by a system of cartridges with pins connection.
Each pluggable SPD is equipped with the safety reserve(s) system of ABB and/or with an integrated contact (TS) for the remote status indication.

Optical monitoring kit

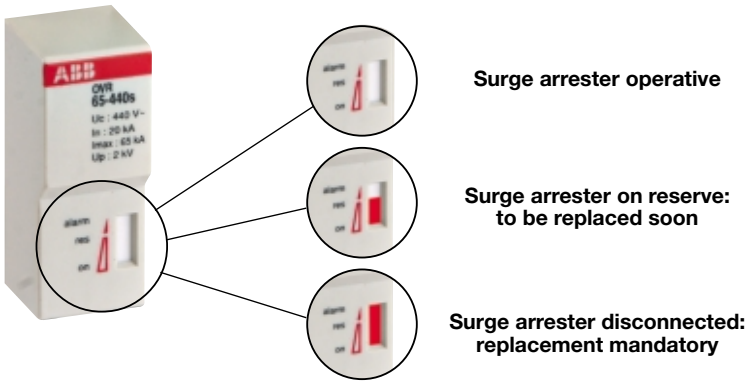


The optical monitoring kit (OVR SIGN) allows the easy status monitoring of all the modular surge arresters. The optical link between the transmitter module and the receiver module coupled to a dry 5 A contact allows remote alarm indication in addition to the visual status on each arrester.

Telecommunication line SPD

Telecommunication line surge arresters (OVR TC) protect the equipment connected to telephone lines, computer communication or data links and current loops.

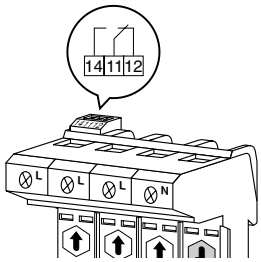
Safety reserve (s)



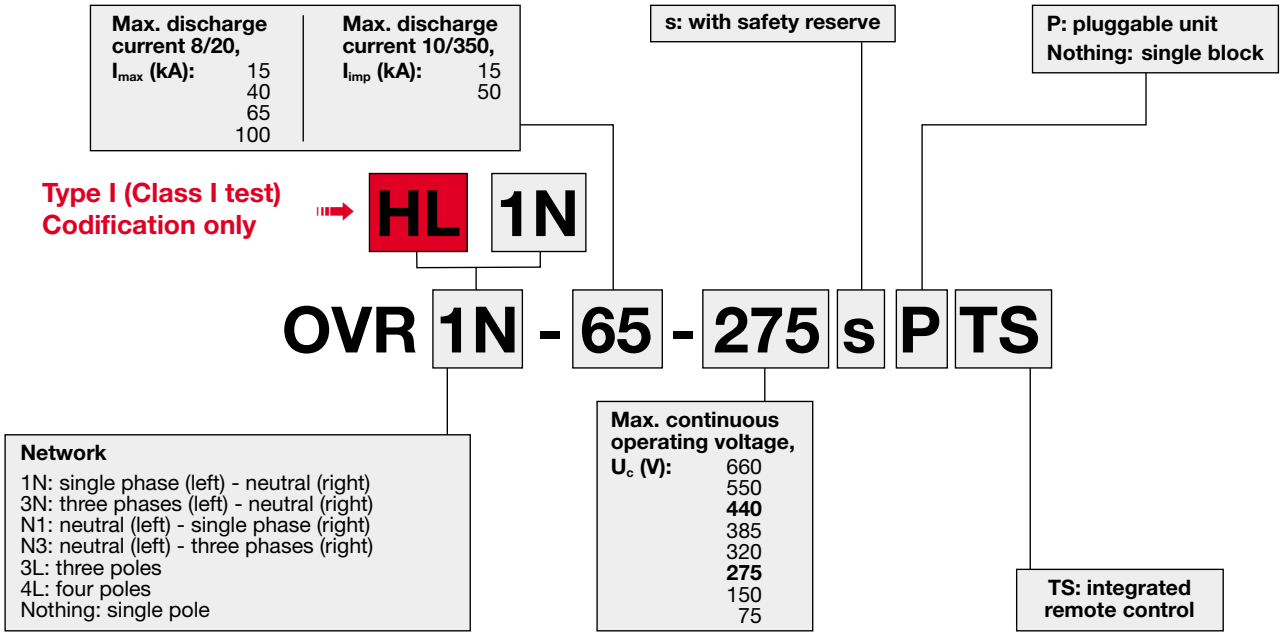
The safety reserve allows a preventive maintenance of the surge arrester.

Remote indication (TS)

The contact TS allows a remote control of the status of the protection.



OVR Range Codification



SPD Main features

Type of protector	Main features
Type 1 SPD according to EN 61643-11 (= Class I SPD according to IEC 61643-1) 	- high energy capability to handle direct lightning strike - electronically pre-triggered spark gap • low protection level (U_p = 1.8 kV) • no need for decoupling coil (combined I+II arrester) - high follow current extinction capability - safety open concept : no expelling of molten or burning material, therefore no need for a separate enclosure - compact design (down to 17.5 mm per pole) - single and multi pole versions
Type 2 SPD according to EN 61643-11 (= Class II SPD according to IEC 61643-1) 	- high energy capability (up to 100 kA 8/20) - adapted to all types of networks (IT, TT, TNC, TNS, TNC-S) - adapted to all network voltages (57 to 600 V) - local status indicator on front side - possible remote indicator (integrated in the product or with optical monitoring kit) - possibility of Safety reserve - single block and pluggable versions - single and multi pole versions
Type 3 SPD according to EN 61643-11 (= Class III SPD according to IEC 61643-1) 	- low protection level (U_p = 1.2 kV) - local status indicator on front side - possible remote indicator with optical monitoring kit - adapted to all types of 230/400 V networks - multi-pole versions
Telecom and dataline SPD: adapted to analog and digital transmision lines 	- compact design (17.5 mm width) - local status indicator on front side - possible remote indicator with optical monitoring kit

Part Numbers List of SPD's

Pluggable - Type II (Class II test)

	U_c	kA	Description	Part number
Single pole	275 V	15	OVR 15 275 P	2 CTB 8138 51 R 24 00
			OVR 15 275 s P	2 CTB 8138 51 R 21 00
			OVR 15 275 P TS	2 CTB 8138 51 R 18 00
			OVR 15 275 s P TS	2 CTB 8138 51 R 15 00
		40	OVR 40 275 P	2 CTB 8138 51 R 23 00
			OVR 40 275 s P	2 CTB 8138 51 R 20 00
			OVR 40 275 P TS	2 CTB 8138 51 R 17 00
			OVR 40 275 s P TS	2 CTB 8138 51 R 14 00
		65	OVR 65 275 P	2 CTB 8138 51 R 22 00
			OVR 65 275 s P	2 CTB 8138 51 R 19 00
			OVR 65 275 P TS	2 CTB 8138 51 R 16 00
			OVR 65 275 s P TS	2 CTB 8138 51 R 13 00
		100	OVR 100 275 s P TS	2 CTB 8138 50 R 02 00
Single phase + Neutral	275 V	15	OVR 1N 15 275 P	2 CTB 8139 52 R 12 00
			OVR 1N 15 275 s P	2 CTB 8139 52 R 09 00
			OVR 1N 15 275 s P TS	2 CTB 8139 52 R 03 00
			OVR 1N 15 275 P TS	2 CTB 8139 52 R 06 00
		40	OVR 1N 40 275 P	2 CTB 8139 52 R 11 00
			OVR 1N 40 275 s P	2 CTB 8139 52 R 08 00
			OVR 1N 40 275 s P TS	2 CTB 8139 52 R 02 00
			OVR 1N 40 275 P TS	2 CTB 8139 52 R 05 00
		65	OVR 1N 65 275 P	2 CTB 8139 52 R 10 00
			OVR 1N 65 275 s P	2 CTB 8139 52 R 07 00
			OVR 1N 65 275 s P TS	2 CTB 8139 52 R 01 00
			OVR 1N 65 275 P TS	2 CTB 8139 52 R 04 00
Three phases + Neutral	275 V	15	OVR 3N 15 275 P	2 CTB 8139 53 R 12 00
			OVR 3N 15 275 s P	2 CTB 8139 53 R 09 00
			OVR 3N 15 275 s P TS	2 CTB 8139 53 R 03 00
			OVR 3N 15 275 P TS	2 CTB 8139 53 R 06 00
		40	OVR 3N 40 275 P	2 CTB 8139 53 R 11 00
			OVR 3N 40 275 s P	2 CTB 8139 53 R 08 00
			OVR 3N 40 275 s P TS	2 CTB 8139 53 R 02 00
			OVR 3N 40 275 P TS	2 CTB 8139 53 R 05 00
		65	OVR 3N 65 275 P	2 CTB 8139 53 R 10 00
			OVR 3N 65 275 s P	2 CTB 8139 53 R 07 00
			OVR 3N 65 275 s P TS	2 CTB 8139 53 R 01 00
			OVR 3N 65 275 P TS	2 CTB 8139 53 R 04 00
Single pole	440 V	15	OVR 15 440 P	2 CTB 8138 51 R 12 00
			OVR 15 440 s P	2 CTB 8138 51 R 09 00
			OVR 15 440 P TS	2 CTB 8138 51 R 06 00
			OVR 15 440 s P TS	2 CTB 8138 51 R 03 00
		40	OVR 40 440 P	2 CTB 8138 51 R 11 00
			OVR 40 440 s P	2 CTB 8138 51 R 08 00
			OVR 40 440 P TS	2 CTB 8138 51 R 05 00
			OVR 40 440 s P TS	2 CTB 8138 51 R 02 00
		65	OVR 65 440 P	2 CTB 8138 51 R 10 00
			OVR 65 440 s P	2 CTB 8138 51 R 07 00
			OVR 65 440 P TS	2 CTB 8138 51 R 04 00
			OVR 65 440 s P TS	2 CTB 8138 51 R 01 00
		100	OVR 100 440 s P TS	2 CTB 8138 50 R 01 00
Single pole		65	OVR 65 N P	2 CTB 8139 51 R 01 00
		100	OVR 100 N P	2 CTB 8138 50 R 03 00

Telecom and Dataline SPD

	kA	Description	Part number
	10	OVR TC 06 V	2 CTB 8138 14 R 01 00
		OVR TC 12 V	2 CTB 8138 14 R 02 00
		OVR TC 24 V	2 CTB 8138 14 R 03 00
		OVR TC 48 V	2 CTB 8138 14 R 04 00
		OVR TC 200 V	2 CTB 8138 14 R 05 00
		OVR TC 200 FR	2 CTB 8138 14 R 00 00

Optical monitoring kit

	U_c	Description	Part number
	230 V	OVR SIGN	2 CTB 8138 15 R 00 00

Mono block - Type I (Class I test)

	U_c	kA	Description	Part number
Single pole	275 V	15	OVR HL 15 275	2 CTB 8152 01 R 00 00
Single phase + Neutral	275 V	15	OVR HL 1N 15 275	2 CTB 8153 01 R 00 00
Three poles	275 V	15	OVR HL 3L 15 275	2 CTB 8154 01 R 00 00
Three phases + Neutral	275 V	15	OVR HL 3N 15 275	2 CTB 8155 01 R 00 00
Four poles	275 V	15	OVR HL 4L 15 275	2 CTB 8156 01 R 00 00
Neutral		50	OVR HL 50N	2 CTB 8152 04 R 00 00
Single phase + Neutral	275 V	50	OVR HL 1N 50 275	2 CTB 8153 02 R 00 00

Mono block - Type II (Class II test)

	U_c	kA	Description	Part number
Single pole	275 V	15	OVR 15 275	2 CTB 8138 11 R 08 00
		40	OVR 40 275	2 CTB 8138 11 R 07 00
			OVR 40 275 s	2 CTB 8138 11 R 10 00
		65	OVR 65 275	2 CTB 8138 11 R 06 00
			OVR 65 275 s	2 CTB 8138 11 R 05 00
		100	OVR 100 275 s	2 CTB 8138 11 R 12 00
Single phase + Neutral	275 V	15	OVR 1N 15 275	2 CTB 8139 12 R 04 00
		40	OVR 1N 40 275	2 CTB 8139 12 R 03 00
		65	OVR 1N 65 275	2 CTB 8139 12 R 06 00
			OVR 1N 65 275 s	2 CTB 8139 12 R 07 00
Three phases + Neutral	275 V	15	OVR 3N 15 275	2 CTB 8139 13 R 04 00
		40	OVR 3N 40 275	2 CTB 8139 13 R 03 00
		65	OVR 3N 65 275	2 CTB 8139 13 R 06 00
			OVR 3N 65 275 s	2 CTB 8139 13 R 07 00
Single pole	440 V	15	OVR 15 440	2 CTB 8138 11 R 04 00
		40	OVR 40 440	2 CTB 8138 11 R 03 00
			OVR 40 440 s	2 CTB 8138 11 R 09 00
		65	OVR 65 440	2 CTB 8138 11 R 02 00
			OVR 65 440 s	2 CTB 8138 11 R 01 00
		100	OVR 100 440 s	2 CTB 8138 11 R 11 00

Mono block - Type III (Class III test)

	U_c	kA	Description	Part number
Single phase + Neutral	275 V	10	OVR 1N 10 275	2 CTB 8139 12 R 10 00
Three phases + Neutral	275 V	10	OVR 3N 10 275	2 CTB 8139 13 R 10 00

Replacement Cartridge

	U_c	kA	Description	Part number
	275 V	15	OVR 15 275 C	2 CTB 8138 54 R 12 00
			OVR 15 275 s C	2 CTB 8138 54 R 11 00
		40	OVR 40 275 C	2 CTB 8138 54 R 10 00
			OVR 40 275 s C	2 CTB 8138 54 R 09 00
		65	OVR 65 275 C	2 CTB 8138 54 R 08 00
			OVR 65 275 s C	2 CTB 8138 54 R 07 00
	440 V	15	OVR 15 440 C	2 CTB 8138 54 R 06 00
			OVR 15 440 s C	2 CTB 8138 54 R 05 00
		40	OVR 40 440 C	2 CTB 8138 54 R 04 00
			OVR 40 440 s C	2 CTB 8138 54 R 03 00
		65	OVR 65 440 C	2 CTB 8138 54 R 02 00
			OVR 65 440 s C	2 CTB 8138 54 R 01 00
Neutral			OVR 65 N C	2 CTB 8138 54 R 00 00

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