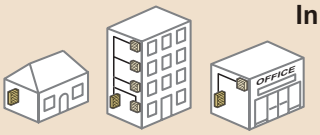
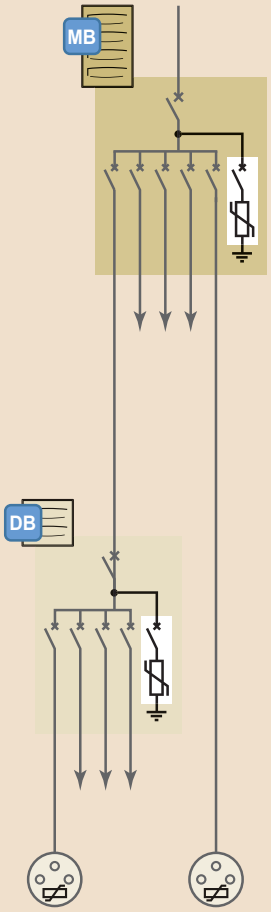
Selecting Surge Protective Devices (SPDs) and their associated protection

SPDs are compulsory [1]:
- In all areas (apart from specific cases):
  - With lightning protection of buildings (LPS): SPDs in the main distribution boards and distribution boards
  - With IEC/EN 62305 standards
  - Commercial installations
  - Public services, hospitals
- In AQ2 areas with overhead (or partially overhead) lines

Group or individual houses, small commercial buildings — **In ≤ 125 A**



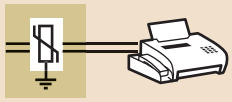
Low voltage installation



MB: Main Distribution Board
DB: Distribution Board

Main distribution board	Power network	Isc	SPD type	SPD (N left/right) + recommended overcurrent protection[2]
Very high risk  All areas	1P+N	≤ 10 kA	 T1+T2 / 12.5 kA	4 122 74/76 + 4 078 06
	3P			4 122 72 + 4 078 65
	3P+N			4 122 75/77 + 4 079 34
High risk  Non-urban areas, mountains, etc.	1P+N		 T1+T2 / 8 kA	4 122 54/56 + 4 078 04
	3P			4 122 52 + 4 078 63
	3P+N			4 122 55/57 + 4 079 32
Low risk  Urban areas, excluding mountains, etc.	1P+N		 T2 / 40 kA	4 122 44/46 + 4 078 02
	3P			4 122 42 + 4 078 61
	3P+N			4 122 45/47 + 4 079 30
Distribution board **All risks**	1P+N	≤ 6 kA	 T2 /12 kA	0 039 51 (integrated protection)
	3P			-
	3P+N			0 039 53 (integrated protection)
	1P+N		 T2 / 20 kA	4 122 24/26 + 4 078 01
	3P			-
	3P+N			4 122 25/27 + 4 079 29
Proximity protection of sensitive equipment		Multi-outlet extensions		6 946 14/48/51/56/64/66/70/71
		Mosaic		0 775 40

Communication lines



(See p. 14)

1: According to installation standards IEC/HD 60364 parts 443 and 534
2: Recommended protective device to be used according to the type of SPD and requirements of the installation (see opposite table and technical pages)
3: Standard modular SPD

SPDs Cat.Nos	T1 / 25 kA and 35 kA 4 122 80/81/82/83		T1+T2 / 12.5 kA 4 122 70/71/72/73/74/75/76/77			T1+T2 / 8 kA 4 122 50/51/52/53/54/55/56/57			T2 / 40 kA 4 122 30/32/33/40/41/42/43/44/45/46/47/64/65/66/67		
Network	3P	3P+N	1P+N	3P	3P+N	1P+N	3P	3P+N	1P+N	3P	3P+N
Circuit breaker	DPX³160 - 80 A		DX³ 63 A C curve			DX³ 40 A C curve			DX³ 25 A C curve		
	3P	4P	2P	3P	4P	2P	3P	4P	2P	3P	4P
Isc ≤ 10 kA	-	-	4 078 06	4 078 65	4 079 34	4 078 04	4 078 63	4 079 32	4 078 02	4 078 61	4 079 30
Isc ≤ 16 kA	4 200 04	4 200 14	4 092 08	4 092 60	4 093 42	4 092 06	4 092 58	4 093 40	4 092 04	4 092 56	4 093 38
Isc ≤ 25 kA	4 200 44	4 200 54	4 097 74	4 097 87	4 098 00	4 097 72	4 097 85	4 097 98	4 097 70	4 097 83	4 097 96
Isc ≤ 50 kA	4 201 24	4 201 34	4 101 54	4 101 67	4 101 80	4 101 52	4 101 65	4 101 78	4 101 50	4 101 63	4 101 76

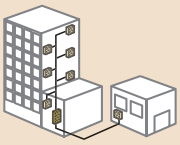
Risk levels:

- **Very high risk:** EN/IEC 62305 standards, installations with a LPS or metal structure (acting as a lightning conductor), installations that are isolated, or on a high mountain, or have a history of lightning strikes, etc.

- **High risk:** installations outside of urban areas, in mountainous areas, isolated, at the end of a line, near a body of water, trees or near installations equipped with lightning conductors, etc.

- **Low risk:** installations in urban areas (or grouped buildings), flat areas, or low and medium height mountains

Commercial buildings

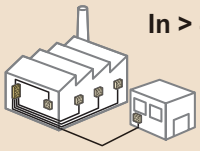


In ≤ 400 A

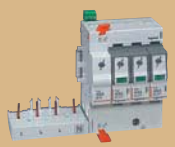
Isc	SPD type	SPD (N left/right) + recommended overcurrent protection[2]
≤ 25 kA	 T1 / 25 kA	-
		4 122 82 + 4 200 44
		4 122 83 + 4 200 54
	 T1+T2 / 12.5 kA	-
		4 122 72 + 4 097 87
		4 122 75/77 + 4 098 00
	 T1+T2 / 12.5 kA	-
		4 122 72 + 4 097 87
		4 122 75/77 + 4 098 00
≤ 10 kA	 T2 / 12 kA	0 039 71 (integrated protection)
		-
		0 039 73 (integrated protection)
≤ 16 kA	 T2/20 kA	4 122 60/62 + 4 092 03
		4 122 42[3] + 4 092 55
		4 122 61/63 + 4 093 37
Mosaic		0 775 40

Large commercial/ Industrial buildings

(IT earthing system: see below)



In > 400 A

Isc	SPD type	SPD (N left/right) + recommended overcurrent protection[2]
≤ 50 kA	 T1/25 kA	-
		4 122 82 + 4 201 24
		4 122 83 + 4 201 34
	 T1/25 kA	-
		4 122 82 + 4 201 24
		4 122 83 + 4 201 34
	 T1+T2/12.5 kA	-
		4 122 72 + 4 101 67
		4 122 75/77 + 4 101 80
≤ 25 kA	-	-
		-
		-
	 T2/40 kA	4 122 64/66 + 4 097 70
		4 122 42[3] + 4 097 83
		4 122 65/67 + 4 097 96
Mosaic		0 775 40

When low voltage SPDs are present, protection of all lines entering the building is recommended

	T2 / 20 kA 4 122 20/21/23/24/25/26/27/60/61/62/63		
	1P+N	3P	3P+N
	DX[3] 20 A C curve		
	2P	3P	4P
	4 078 01	4 078 60	4 079 29
	4 092 03	4 092 55	4 093 37
	4 097 69	4 097 82	4 097 95
	-	-	-

IT earthing system (all risks)

SPD type		Network	Icc	SPD + protective device[2]
MB	T1 50 kA/440 V	3P	50 kA	0 030 00 (x 3) + 4 201 24
		3P+N		0 030 00 (x 4) + 4 201 34
DB	T2 40 kA/440 V	1P+N	25 kA	4 122 30 (x 2) + 4 097 70
		3P		4 122 32 + 4 097 83
		3P+N		4 122 33 + 4 097 96

Surge Protective Devices (SPDs)
protection against transient overvoltages

Protection against lightning and overvoltages

Protection against the effects of lightning is essentially based on:
• Protecting buildings using a lightning protection system (LPS or lightning conductors) to catch lightning strikes and to drive the lightning current to earth.
• The use of surge protective devices (SPDs) to protect equipment.
• The design of the earthing system (passive protection of the installation).
Throughout the world, there are millions of lightning strikes each day in the summer (up to 1000 lightning strikes/second). Lightning is responsible for 25% to 40% of all damage to equipment. When added to industrial overvoltages (switching overvoltages due to the operation of internal equipment), they account for more than 60% of all electrical damages, which can be prevented by installing SPDs (according to the country and type of installation - source: insurance companies).
In some countries, and depending on the end use of the building, national regulations may always stipulate the installation of SPDs (for example, Germany, Austria, Norway, etc.). If there are no specific national regulations, SPDs are usually specified by national installation standards (based on HD/IEC 60364 international installation standards) and EN/IEC 62305 standards.

External lightning protection system (LPS) or lightning conductors: protection of buildings (EN/IEC 62305)

An external lightning protection system (LPS) protects buildings against direct lightning strikes. It is generally based on the use of lightning conductors (single rod, with sparkover device, meshed cage, etc.) and/or the metallic structure of the building.
If there is an LPS or if a lightning risk assessment has been carried out in accordance with EN/IEC 62305 standards, SPDs are generally required in the main distribution board (T1 SPDs) and distribution boards (T2 SPDs).
Determination of the SPDs in the main distribution board in accordance with EN/IEC 62305 and TS/IEC 61643-12 (if there is insufficient information available):

LPL[1]: Lightning protection level	Total lightning current of the LPS	Min. value of Imp current of the SPD (T1)	Usage practices
I	200 kA	25 kA/pole (IT: 35kA min.)	Power installations
II	150 kA	18.5 kA/pole	Rarely used
III/IV	100 kA	12.5 kA/pole	Small installations

1: LPL (Lightning Protection Level)

Surge protective device (SPD) (internal protection)

The SPD
• Protects sensitive devices against overvoltages caused by lightning and industrial overvoltages, by limiting the overvoltages to values that are tolerated by the equipment
• Limits the possible harmful consequences in terms of the safety of people (medical equipment installed in the home, security systems, environmental systems, etc.)
• Maximises the continuity of operation of equipment and limits production losses

SPDs and standards

Standards EN/IEC 61643-11

Type of SPD		Test waves
EN 61643-11	IEC 61643-11	
Type 1 (T1)	Class I (T1)	Iimp: 10/350 µs (discharge current) In: 8/20 µs (nominal current, 15 shocks)
Type 2 (T2)	Class II (T2)	Imax: 8/20 µs (discharge current) In: 8/20 µs (nominal current, 15 shocks)

T1+T2 SPDs: tested in accordance with both methods.
T1 or T1+T2 SPDs are being increasingly used at the supply origin of installations, even when there is no lightning conductor, as they enable higher energies to be discharged and increase the service life the SPD.

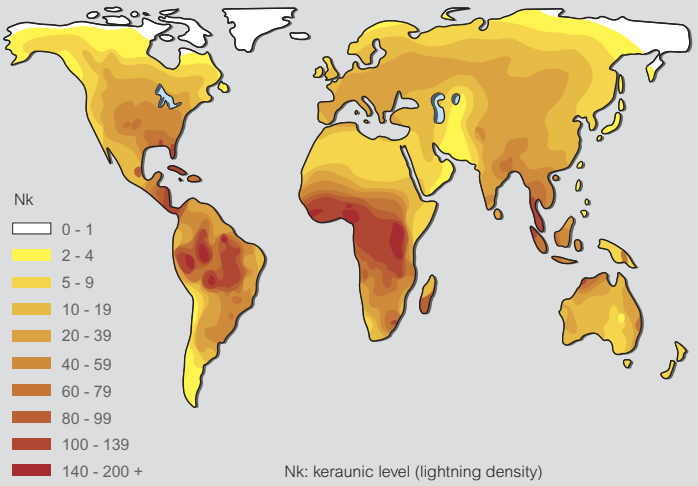
HD/IEC 60364 electrical installation standards

According to articles 443 and 534 of HD/IEC 60364 standards and the TS/IEC 61643-12 guides, the use of SPDs in new or renovated buildings is compulsory at the supply origin of the installation in the following cases:
• Buildings with lightning conductors (T1 SPDs, Iimp ≥ 12.5 kA)
• Buildings with totally or partially overhead power supplies in AQ2 geographical areas (article 443.3.2.1 - AQ2: Nk > 25, see map below) and based on a risk assessment taking into account the type of power supply to the building (article 443.3.2.2)

According to article 443.3.2.2, SPDs (Type 2) are also required in the following cases:
• Commercial/industrial buildings, public buildings and services, religious buildings, schools and large residential complexes, etc.
• Hospitals and buildings containing medical equipment and/or security systems for people and property (fire alarm, technical alarms, etc.)

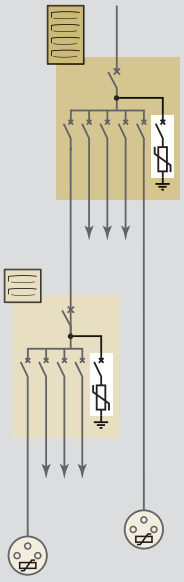
Important: it is advisable to install an SPD when the safety of people may depend on the continuity of service of equipment (even if this is not required by national standards). Although not compulsory according to the installation standards, an SPD should always be installed to protect the communication equipment when there is an SPD on the low voltage power network.

These rules should change in 2015. Please consult Legrand.



Nk: keraunic level (lightning density)

Protection of distribution boards and sensitive equipment (cascaded protection)



Effective protection against overvoltages cannot generally be assured with a single SPD if its protection level (Up) is greater than 1.2 kV (EN/IEC 62305 and TS/IEC 61643-12).
When there are overvoltages, an SPD protects equipment by limiting these overvoltages to values that can be tolerated by the equipment. Thus, depending on its discharge capacity (discharge current In, Imax, etc.) and its protection level (Up), an SPD will limit these overvoltages to varying values depending on the energy levels involved. The overvoltage values that may be transmitted downstream of the SPD may double over distances of more than 10 m due to resonances associated with the type of electrical installation and the type of equipment. Overvoltages greater than 2.5 kV may then occur and damage equipment if the residual energy is high enough (2.5 kV being the insulation level of most electrical and electronic equipment, or typically 1.5 kV for electrical domestic appliances).
SPDs should be installed in the distribution boards supplying equipment that is sensitive or critical for the activity being carried out (and/or near to equipment with proximity SPDs).

Surge Protective Devices (SPDs)
technical characteristics

Modular SPDs

230/400 V~ power network (50/60 Hz) - Degree of protection IP 20
Operating temperature: -10 to +40°C/Storage temperature: -20 to +70°C
1P+N (3P+N) SPDs: L-N and N-PE protection, also called 1+1 (3+1 resp.) or CT2 type protection depending on installation standards.

Cat.Nos	Type	Poles	Earthing system	Max. voltage (Uc)	Protection mode	Nominal current In/pole (8/20)	Max. discharge current			Protection level		Max. short-circuit current Isc (Isccr)	Protective device to be used [1]	FS auxiliary (remote status monitoring)
							Imax/ pole (8/20)	Iimp/pole (10/350)	I total (10/350)	Up (L-N/L-PE/N-PE)	Up at 5 kA			
0 030 00 **4 122 80**	T1/50 kA T1/35 kA	1P	TT, TNC, TNS, IT	440 V~	CT1	50 kA 35 kA		50 kA 35 kA	50 kA 35 kA	2.5 kV		50 kA	DPX³160 80 A	no yes
4 122 81	T1/25 kA	1P+N	TT, TNS	350 V~	CT2	25/50 kA		25/50 kA	50 kA	1.5/2.5/1.5 kV				yes
4 122 82	T1/25 kA	3P	TNC	350 V~	CT1	25 kA		25 kA	75 kA	1.5 kV				yes
4 122 83	T1/25 kA	3P+N	TT, TNS	350 V~	CT2	25/100 kA		25/100 kA	100 kA	1.5/2.5/1.5 kV				yes
4 122 70	T1+T2/12.5 kA	1P	TT, TNC, TNS	320 V~	CT1	25 kA	60 kA	12.5 kA	12.5 kA	1.5 kV at 12.5 kA 1.9 kV at 25 kA	1 kV	50 kA	DX³ 63 A C curve	no
4 122 71	T1+T2/12.5 kA	2P	TT, TNS	320 V~	CT1	25 kA	60 kA	12.5 kA	25 kA					no
4 122 72	T1+T2/12.5 kA	3P	TNC	320 V~	CT1	25 kA	60 kA	12.5 kA	37.5 kA					yes
4 122 73	T1+T2/12.5 kA	4P	TT, TNS	320 V~	CT1	25 kA	60 kA	12.5 kA	50 kA					no
4 122 74/76	T1+T2/12.5 kA	1P+N	TT, TNS	320 V~	CT2	25/25 kA	60 kA	12.5/25 kA	25 kA	1.5/1.6/1.5 kV at 12.5 kA 1.9/2.1/1.5 kV at 25 kA	1 kV			yes
4 122 75/77	T1+T2/12.5 kA	3P+N	TT, TNS	320 V~	CT2	25/50 kA	60 kA	12.5/50 kA	50 kA					yes
4 122 50	T1+T2/8 kA	1P	TT, TNC, TNS	320 V~	CT1	20 kA	50 kA	8 kA	8 kA	1.2 kV at 8 kA 1.7 kV at 20 kA	1 kV	50 kA	DX³ 40 A C curve	no
4 122 51	T1+T2/8 kA	2P	TT, TNS	320 V~	CT1	20 kA	50 kA	8 kA	16 kA					no
4 122 52	T1+T2/8 kA	3P	TNC	320 V~	CT1	20 kA	50 kA	8 kA	25 kA					no
4 122 53	T1+T2/8 kA	4P	TT, TNS	320 V~	CT1	20 kA	50 kA	8 kA	32 kA					no
4 122 54/56	T1+T2/8 kA	1P+N	TT, TNS	320 V~	CT2	20 kA	50 kA	8 kA	16 kA	1.2/1.5/1.5 kV at 8 kA 1.7/2/1.5 kV at 20 kA	1 kV			no
4 122 55/57	T1+T2/8 kA	3P+N	TT, TNS	320 V~	CT2	20 kA	50 kA	8 kA	25 kA					no
4 122 40	T2/40 kA	1P	TT, TNC, TNS	320 V~	CT1	20 kA	40 kA			1.5 kV at 15 kA 1.7 kV at 20 kA	1 kV	50 kA	DX³ 25 A C curve	no
4 122 41	T2/40 kA	2P	TT, TNS	320 V~	CT1	20 kA	40 kA					50 kA		no
4 122 42	T2/40 kA	3P	TNC	320 V~	CT1	20 kA	40 kA					50 kA		yes
4 122 43	T2/40 kA	4P	TT, TNS	320 V~	CT1	20 kA	40 kA					50 kA		no
4 122 44/46 **4 122 64/66**	T2/40 kA	1P+N	TT, TNS	320 V~	CT2	20 kA	40 kA			1.5/1.6/1.4 kV at 15 kA 1.7/2/1.4 kV at 20 kA	1 kV	50 kA 25 kA		no yes
4 122 45/47 **4 122 65/67**	T2/40 kA	3P+N	TT, TNS	320 V~	CT2	20 kA	40 kA					50 kA 25 kA		no yes
4 122 30	T2/40 kA	1P	TT, TNC, TNS, IT	440 V~	CT1	20 kA	40 kA			1.8 kV at 15 kA 2.1 kV at 20 kA	1.3 kV	50 kA	DX³ 25 A C curve	no
4 122 32	T2/40 kA	3P	TNC, IT	440 V~	CT1	20 kA	40 kA							yes
4 122 33	T2/40 kA	4P	TT, TNS, IT	440 V~	CT1	20 kA	40 kA							yes
4 122 20	T2/20 kA	1P	TT, TNS	320 V~	CT1	10 kA	20 kA			1.2 kV at 5 kA 1.4 kV at 10 kA	1.2 kV	25 kA	DX³ 20 A C curve	no
4 122 21	T2/20 kA	2P	TT, TNS	320 V~	CT1	10 kA	20 kA							no
4 122 23	T2/20 kA	4P	TT, TNS	320 V~	CT1	10 kA	20 kA							no
4 122 24/26 **4 122 60/62**	T2/20 kA	1P+N	TT, TNS	320 V~	CT2	10/20 kA	20 kA			1.2/1.4/1.4 kV at 5 kA 1.4/1.4/1.4 kV at 10 kA	1.2 kV			no yes
4 122 25/27 **4 122 61/63**	T2/20 kA	3P+N	TT, TNS	320 V~	CT2	10/20 kA	20 kA							no yes
0 039 51 **0 039 71**	T2+T3/12 kA	1P+N	TT, TNS	275 V~	CT2	10/10 kA	12 kA			1.1/1.2/1.2 kV at 10 kA	1 kV	6 kA 10 kA	integrated protection	no
0 039 53 **0 039 73**	T2+T3/12 kA	3P+N	TT, TNS	275 V~	CT2	10/20 kA	20 kA					6 kA 10 kA		

CT1: L(N)-PE protection modes.
CT2: L-N and N-PE protection modes.
1: DPX³ (with T1 SPDs), DX³ or similar type circuit breakers (with T2 and T1+T2 SPDs). For fuse protection or values other than those indicated in the table: please consult Legrand.

Characteristics of proximity SPDs

230 V~ protection: Type 3 (T3) SPDs

Cat.Nos	0 775 40	6 946 64/66/70	6 946 14/48/51/56/71
Protection mode	LN/NPE	LN/LPE/NPE	LN
Up	1/1.2 kV	1 kV	1 kV
Imax	6 kA	-	-
In	1.5 kA	2 kA	2 kA
Uoc	3 kV	4 kV	4 kV

TT earthing system: Installation downstream of a residual current device (HPI type recommended).

RJ 45/RJ 11 protection

Cat. No.	6 946 64	6 946 70
Uc	200 V	
Up	600 V	
Imax	1.5 kA	
In	1 kA	
Uoc	3 kV	

TV protection (9.5 mm coax.)

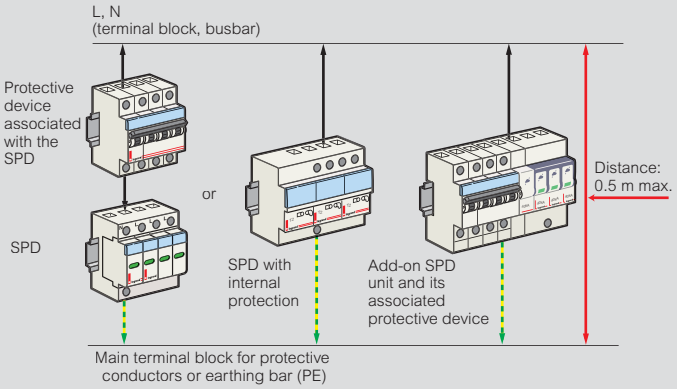
Cat. No.	6 946 66
Uc	50 V
Up	900 V
Imax	5 kA
In	1 kA
Uoc	3 kV

Installation

Associated overcurrent protection

SPDs must be protected by a circuit breaker (or fuses), to provide protection in the event of an overload, which may make the SPD reach its end of life (see selection table p. 10-11). This protective device will be defined to be coordinated or discriminating with regard to upstream protective devices.

Connection principles



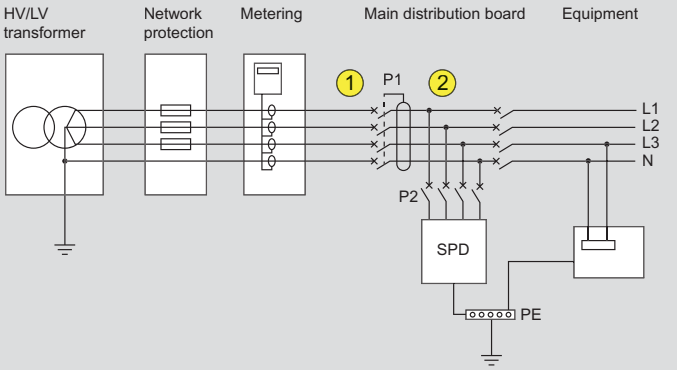
Connection lengths: as short as possible (< 50 cm if possible).

EMC (Electromagnetic Compatibility) rules: avoid loops, fix the cables firmly against the exposed metal conductive parts of the enlcosure.

SPD types and earthing systems

When possible (according to local rules), the SPD and its associated overcurrent protection (P2) should be installed upstream of the main protection (P1) as shown below (according to standards HD/IEC 60364).

SPDs and TT earthing system

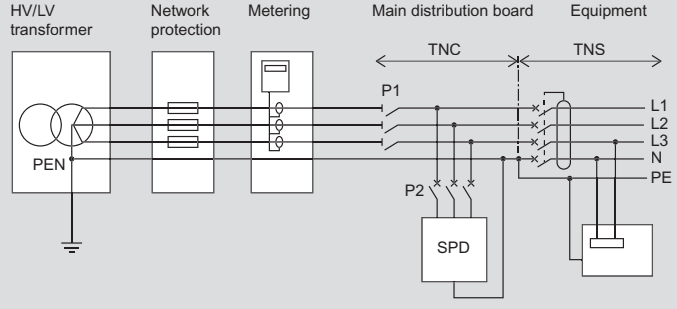


P1: main protection of the installation
SPD: surge protective device with Uc 275 or 320 V recommended

(1) (upstream of P1): 1P+N/3P+N SPDs only (except for Cat.Nos 0 039 51/53/71/73).
1P/2P/3P/4P SPDs and Cat.Nos 0 039 51/53/71/73 must always be installed downstream of a residual current device (discriminating or delayed, at the supply end of the installation).

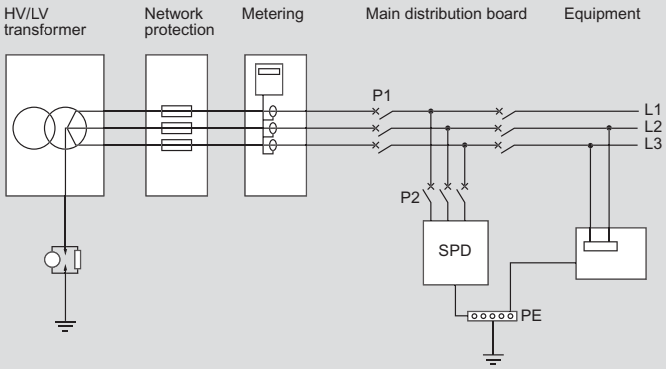
(2) (downstream of P2): any SPD.

SPDs and TN (TNC, TNS and TNC-S) earthing systems



P1: main protection of the installation
SPD: surge protective device with Uc 275 or 320 V recommended

SPDs and IT earthing system



P1: main protection of the installation
SPD: surge protective device with Uc 440 V (Uc < 440 V prohibited)

Coordinating upstream/downstream SPDs

Consists of ensuring that any downstream SPD (in distribution enclosures or proximity SPDs) is correctly coordinated in energy terms with any SPD located upstream (TS 61643-12).

Minimum distances between SPDs

Upstream SPD	Downstream SPD	Min. distance (m)
T1/50 and T1/25	**T2/40**	10
T1/12.5 and T1/8	**T2/40**	6
	T2/20, T2/12	8
T2/40	**T2/20**	4
	T2/12	6
T2/20 and T2/12	**Proximity SPD**	2

If it is not possible to comply with these distances, insert decoupling inductors on each phase and neutral conductor.