Raycap

Surge protection technology

Concepts, applications and products

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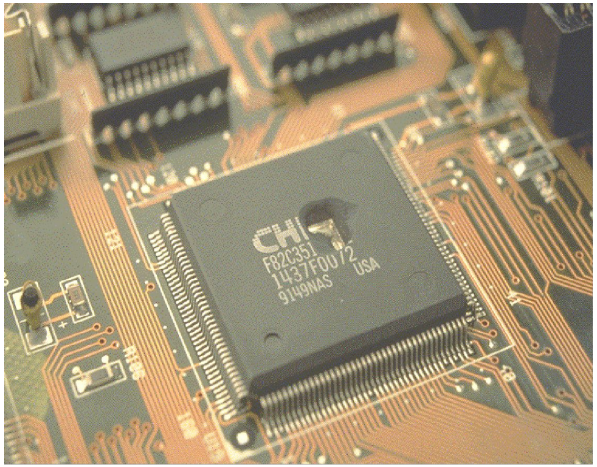
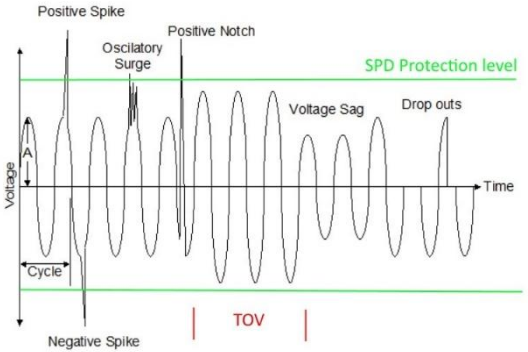
SPD Basics

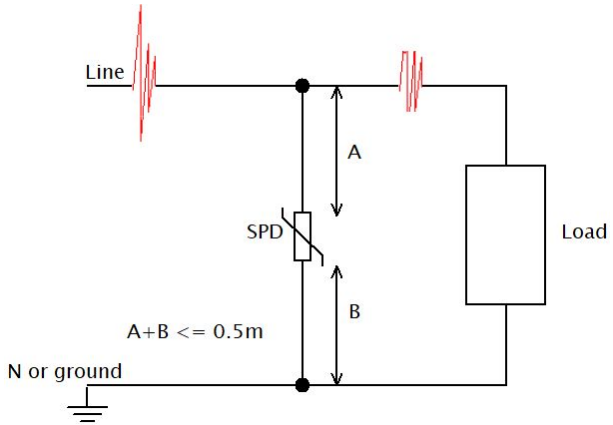
What is an electrical power surge?

- Surge is a sudden burst of energy that flows in a circuit and can be caused by various events:
  - Lightning strike
  - Power line switching
  - High power load switching manoeuvre
  - Arcing
  - Switching
- Power surge can manifest either as increased voltage, current or both
- High voltage causes dielectric breakdown of insulation
- High current causes overload of current paths



What is SPD and how does it work?





- SPD (**S**urge **P**rotective **D**evice) is installed in-line or in parallel path with the load
- When a voltage surge does come down the line, the SPD responds in nanoseconds by creating a low impedance path to neutral or ground
- Current flows through the path of least resistance
- There is always some voltage/current that will be pushed through the load (protection level)
- If the SPD is installed correctly and in the proper location, the remaining surge voltage seen by the equipment will be well below a level that could damage components

Applicable standards

- IEC 60664-1 - Insulation coordination for equipment within low-voltage systems
- IEC 60364-4-44 Edition 2.2 - Low-voltage electrical installations - Part 4-44: Protection for safety - Protection against voltage disturbances and electromagnetic disturbances
- IEC 60364-5-53, Electrical installations of buildings – Part 5-53: Selection and erection of electrical equipment – Isolation, switching and control
- IEC 61643-11 - Low-voltage surge protective devices - Part 11: Surge protective devices connected to low-voltage power systems - Requirements and test methods
- IEC 61643-12 - Low-voltage surge protective devices - Part 12: Surge protective devices connected to low-voltage power systems - Selection and application principles
- IEC 62305 series - Protection against lightning:
    - Part 1: General principles
    - Part 2: Risk management
    - Part 3: Physical damage to structures and life hazard
    - Part 4: Electrical and electronic systems within structures
- UL 1449, 5th Edition - UL Standard for Safety Surge Protective Devices

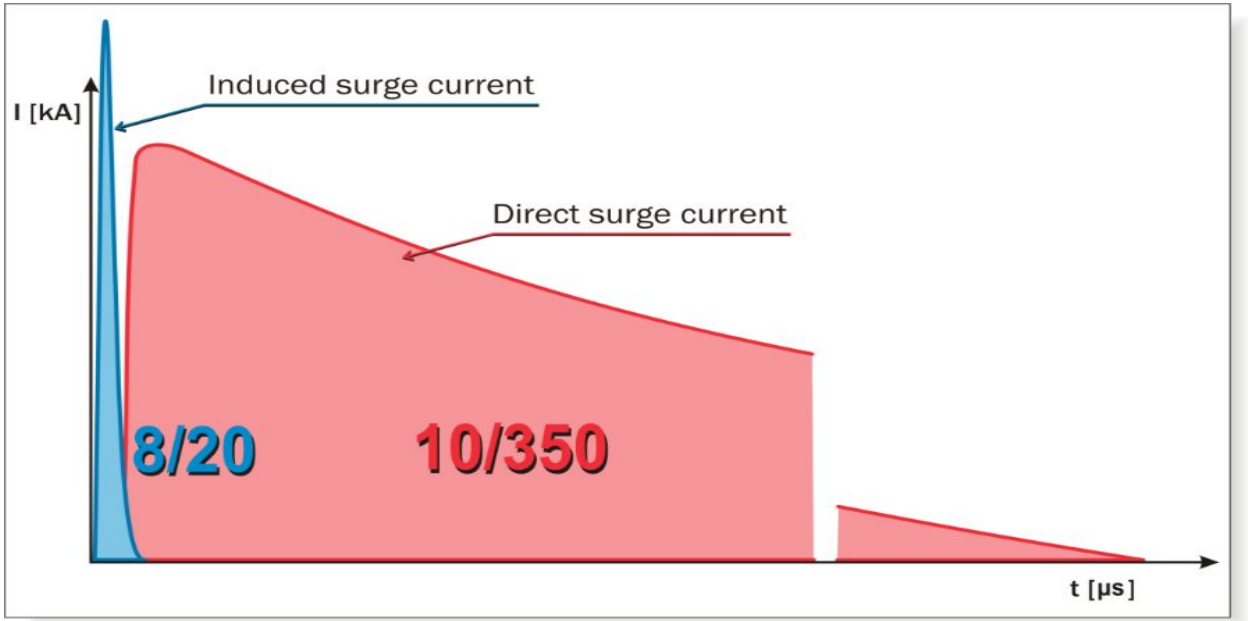
New IEC standard structure for SPD testing

- **Present situation:**
  - Independent standard covering AC SPDs testing methods (IEC/EN 61643-11:2011)
  - Independent standard for PV SPDs testing methods (IEC/EN 61643-31:2019 and EN 50539-11:2013 which became obsolete in May 2022)

- **New upcoming standards:**
  - Main standard IEC 61643-01:202X
  - Sub-standard IEC 61643-11:202X for AC SPDs
  - Sub-standard IEC 61643-21:202X for Data SPDs
  - Sub-standard IEC 61643-31:202X for PV SPDs (released in 2019 and will be adapted).
  - Sub-standard IEC 61643-41:202X for DC SPDs.

Expected release is delayed due to many comments. Currently updated Committee Draft (CD) status versions of standards are available. Next step is a committee draft for vote (CDV) version, and release of standards after voting

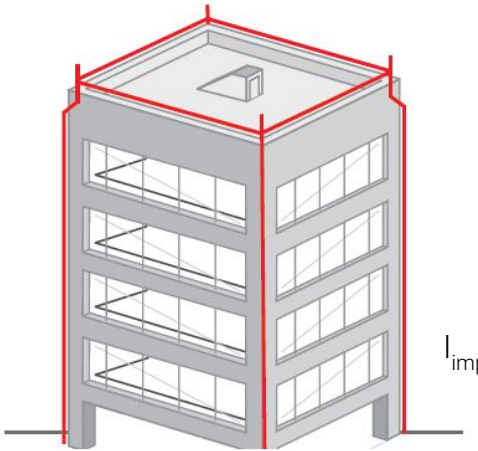
Type 1 and Type 2 impulse comparison



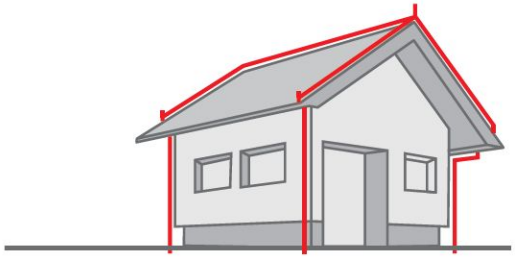
Due to longer duration Type 1 impulse (10/350) carries up to 20 times more energy at the same impulse amplitude as Type 2 impulse (8/20)

T1 applications

Buildings with External Lightning Protection

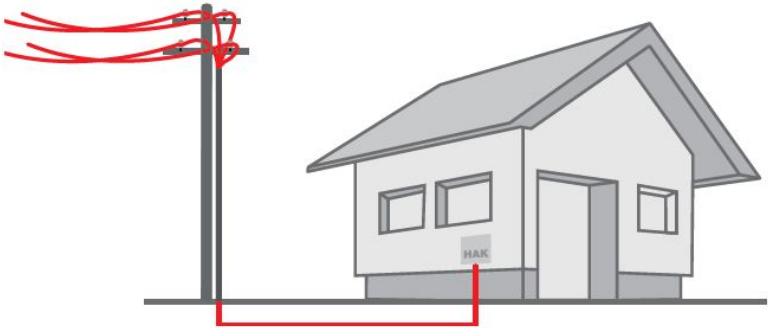


I_{imp} up to 25kA (LPL I)



I_{imp} up to 12,5kA (LPL III/IV)

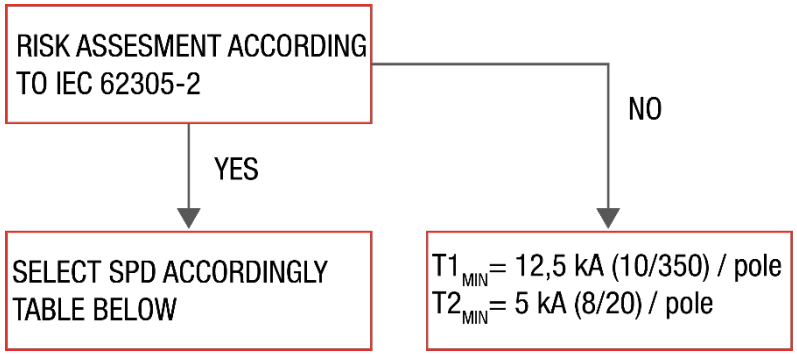
Buildings with Overhead Line Feed



I_{imp} up to 10kA (LPL I),
up to 5kA (LPL III/IV)

All values per conductor

SPD Parameter selection guide

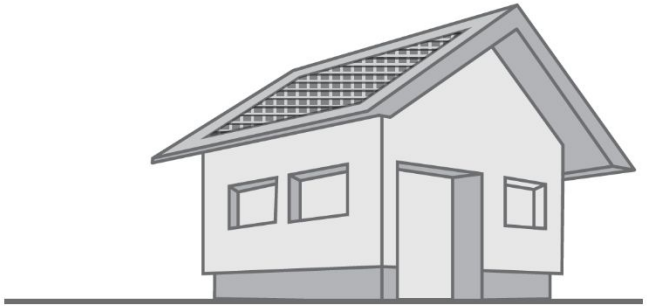


LPL	FLASH TO STRUCTURE		FLASH TO STRUCTURE		DIRECT AND INDIRECT FLASHES TO THE SERVICE		
	S1 (10/350)		S1 (8/20)	S2 (8/20)	S3 (10/350)		S4 (8/20)
	1phase	3phase	Inductive coupling	Induced current	1phase	3phase	Inductive coupling
I	50 kA	25 kA	10 kA	0,2 kA	20 kA	10 kA	5 kA
II	35 kA	17,5 kA	7,5 kA	0,15 kA	15 kA	7,5 kA	3,75 kA
III / IV	25 kA	12,5 kA	5 kA	0,1 kA	10 kA	5 kA	2,5 kA

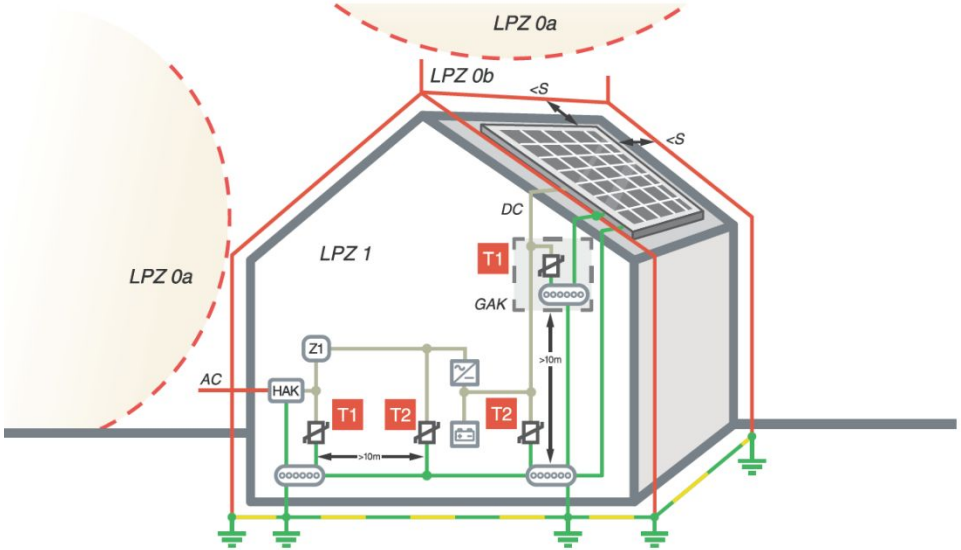
- Values per conductor

T2 applications

Buildings with no External Lightning Protection

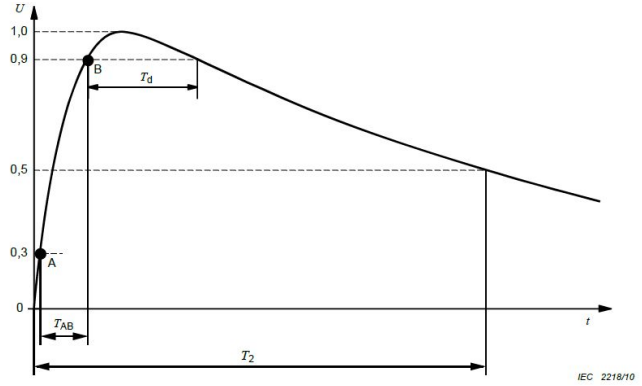


Buildings with External Lightning Protection but distance > 10m between T1 SPD and protected device

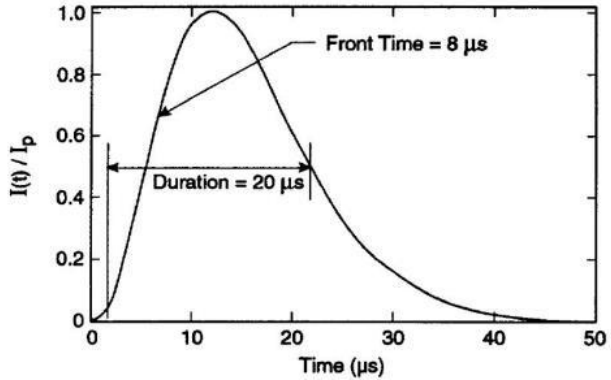


Types of SPDs and surges - Type 3

- Type 3 SPDs are used for fine protection against switching overvoltages, they provide low voltage protection level for devices rated for Overvoltage category 4
- Type 3 SPD must always be used in conjunction with Type 2 SPD upstream
- U_{oc} is the key parameter for SPD selection
- I_n is modeled as 1,2/50 pulse:
- Devices are tested with combined wave, consisting of 1,2/50 and 8/20 impulse (voltage and current)



1,2/50 us voltage impulse



8/20 us voltage impulse

SPD Type & location of installation

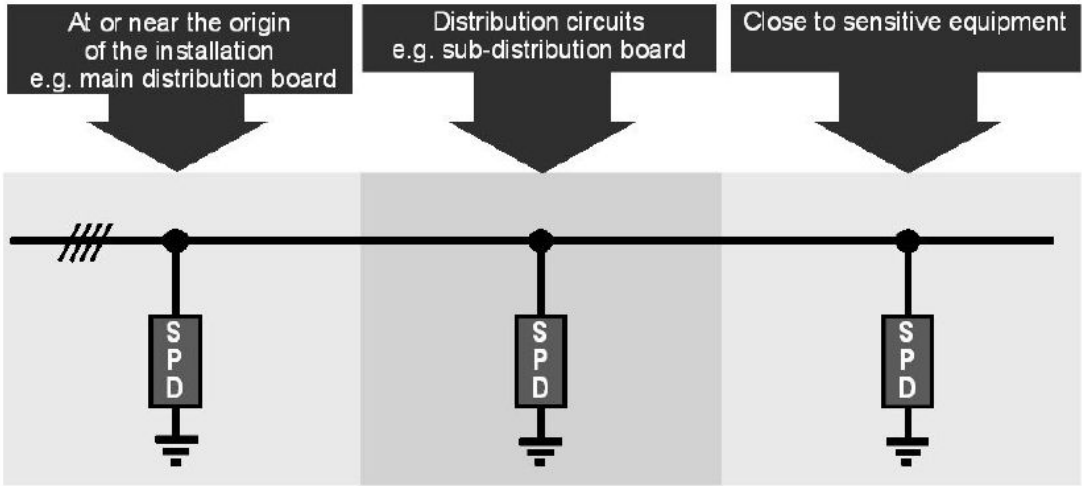


Figure 1 – Example of installation of class I, class II and class III tested SPDs

Impulse withstand voltage of equipment

Table 44.B – Required rated impulse withstand voltage of equipment

Nominal voltage of the installation [a] V		Required impulse withstand voltage for kV [c]			
Three-phase systems [b]	Single-phase systems with middle point	Equipment at the origin of the installation (overvoltage category IV)	Equipment of distribution and final circuits (overvoltage category III)	Appliances and current-using equipment (overvoltage category II)	Specially protected equipment (overvoltage category I)
–	120-240	4	2,5	1,5	0,8
230/400[b] 277/480[b]	–	6	4	2,5	1,5
400/690	–	8	6	4	2,5
1 000	–	12	8	6	4

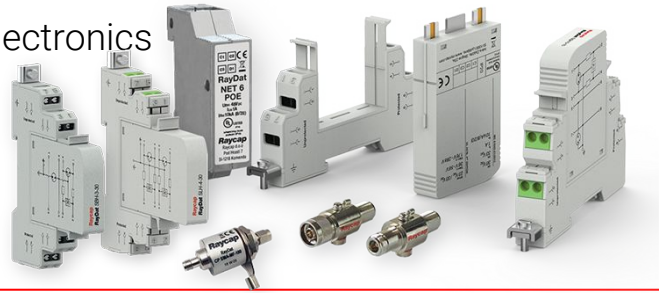
[a] According to IEC 60038.

[b] In Canada and USA, for voltages to earth higher than 300 V, the impulse withstand voltage corresponding to the next highest voltage in column one applies.

[c] This impulse withstand voltage is applied between live conductors and PE.

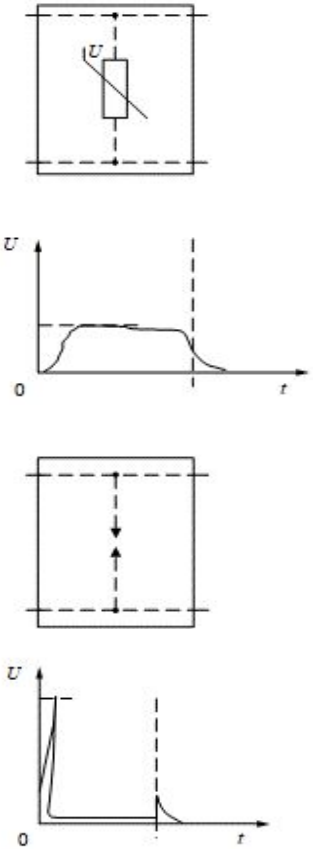
What kind of SPDs exist? (1/2)

- Surge protection devices can be divided per two general criteria:
  - What are they protecting?
    - **Power SPDs**
      - Protect power lines, supplies, etc
      - Capable of handling high power
    - **Signal line SPDs**
      - Protect low voltage lines, used for signal and data transmission
      - Provide very low protection levels, suitable for sensitive electronics



What kind of SPDs exist? (2/2)

- How they work?
  - **Voltage limiting SPDs**
    - SPD has a high impedance when no surge is present but will reduce it continuously with increased surge current and voltage – **linear operation**
    - Based on MOVs and TVS diodes
    - Most used in power SPDs
  - **Voltage switching SPDs**
    - SPD has a high impedance when no surge is present, but will suddenly change impedance to a low value in response to a voltage surge – **switch-like operation**
    - Based on gap devices (GDTs, PGDTs, spark gaps) and switches (thyristors)
    - Gap based devices are often used in applications where galvanic separation is required



SPD component technologies

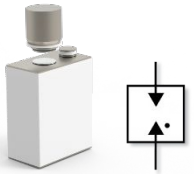
Most common

MOVs
[Metal Oxide Varistor]

GDTs
[Gas Discharge Tube]

SG
[Spark Gap]

PGDTs
[Phase GDT]



TVSs
[Transient Voltage Suppressor Diode]

Type	Limiting	Switching	Switching	Switching	Limiting
Usage	Power SPDs (L-N, N-PE)	Power SPDs - (N-PE) Signal line SPDs	Power SPDs (L-N, N-PE)	Power SPDs (L-N, N-PE)	Signal line SPDs
Pros	Low clamping voltage high current capability	High current capability Isolation (no leakage)	High current capability Isolation (no leakage)	High current capability Isolation (no leakage) Follow current handling	Lowest clamping voltage
Cons	Overheating during conduction Leakage current	Low follow current handling	Medium clamping voltage and follow current issues		Very low energy absorbing capability

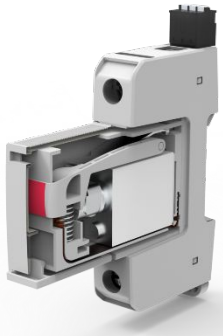
Din Rail SPDs for AC applications

- Light industry
- Commercial buildings
- Residential buildings

T1 SPDs for AC applications

ProTec T1S

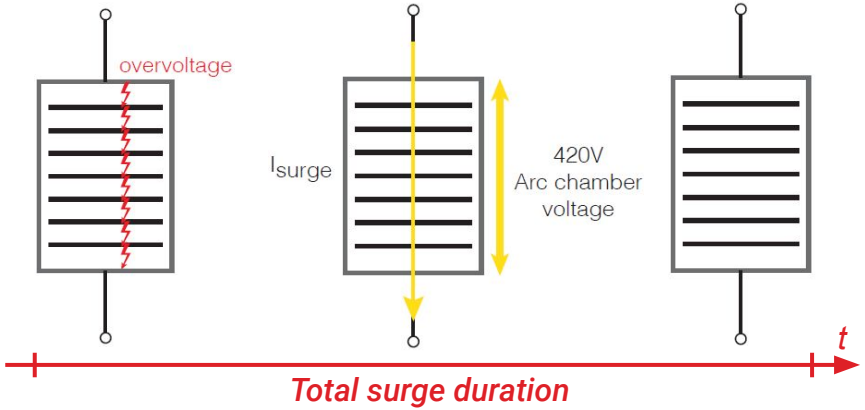
The T1S product achieves 100kA protection in a pluggable 4TE size.



- **Raycap's innovative technology "PhaseGDT" is at the core of a wide range of T1 25kA high performance and highly compact products for various voltage and applications**
- **100kA total lightning capacity** (10/350µs) in **4TE** size only (25kA / pole) for sensitive LPL I & LPL II zones
- **Follow current limitation** capability which results to:
  - **No overcurrent protection tripping** during conduction
  - **Long lifetime** due to no follow current conduction.
- Applicable in networks with **high short-circuit currents (up to 50 kA)**
- **Universal energy coordination** with any Type 2 and Type 3 SPD regardless of cable length
- **Leakage current free** technology
- **VDE certified**
- **Pluggable** product with anti-vibration lock

Principle and benefits of revolutionary “Phase GDT” technology

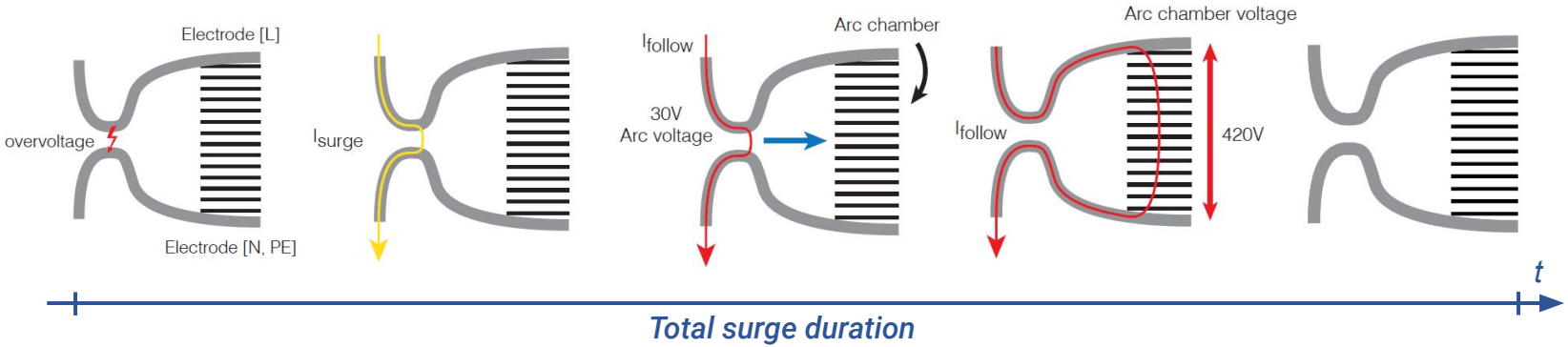
PGDT



Faster reaction time benefits:

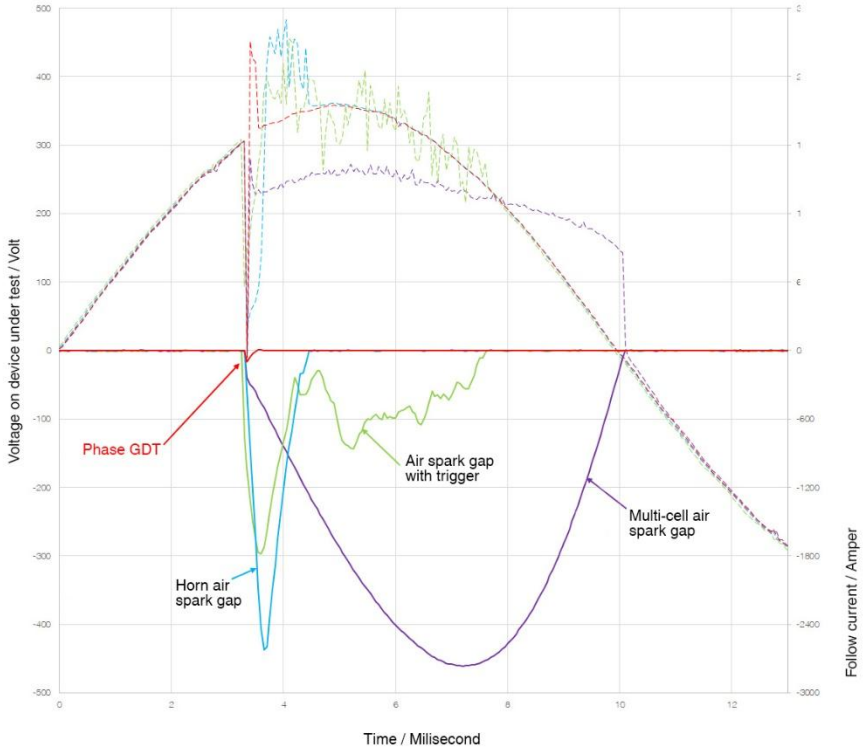
- Lower follow current – no tripping of overcurrent protection
- Easy coordination with downstream SPDs
- Less stress on the installation
- Longer lifetime of the SPD
- No catastrophic failures

SPARK GAP



Follow current comparative test results

Below comparison shows behavior of several different voltage switching technologies (solid lines are currents and dotted lines are voltages). It is clear that the follow-current of Phase GDT technology is significantly lower than that of conventional devices, and below the point where it can damage or age its internal components.



Technology	Phase GDT	Horn air SG	Air SG with trigger	Multi-cell air SG
Peak amplitude [A]	**92**	2600	1800	2700
Specific energy [A^2s]	**39**	3080	2297	19602

ProTec T1S

Unique product features:

- High discharge capacity - I_{imp} 25kA
- U_c 275V or 440V
- Modular SPD in 1TE/pole
- For use in TN and TT systems
- Leakage current free

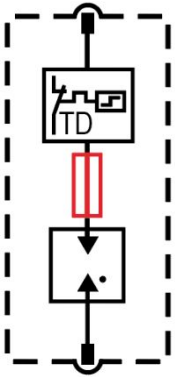
Applications:

- High risk buildings
- TN / TT 400V/690V systems
- IT 400V system LPL II installations
-

ProTec T1SF – Fuse integrated T1 product

Unique product features:

- No back-up fuse required!
- High discharge capacity - I_{imp} 25 kA
- Status indication for all scenarios
- Phase GDT based
- U_c 275V
- Short circuit current rating 75 kA
- Low voltage protection level
- 16 mm^2 wiring can be always used*
- Smallest in class solution on the market!



Applications:

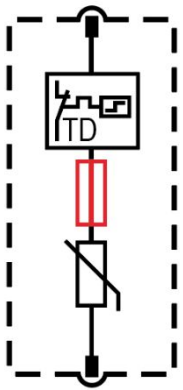
- Industry installations
- Transformer stations

**Installation of live conductors must be proof to internal short-circuit between phases or between phase and earth*

ProTec T2F – Fuse integrated T2 product

Unique product features:

- No back-up fuse required!
- High discharge capacity - I_{max} up to 40 kA
- U_c 300V
- Short circuit current rating up to 50 kA_{rms}
- Low voltage protection level
- 6 mm^2 can be always used*



Applications:

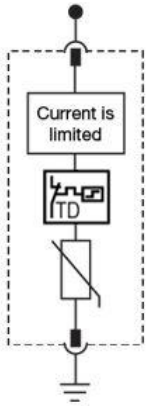
- Transformer stations
- Industrial sites with big fuses / breakers

**Installation of live conductors must be proof to internal short-circuit between phases or between phase and earth*

SafeTec T2 Technology for AC

Unique product features:

- TOV immunity due to current limiting function
- Available in a wide variety of operating voltages (75V to 880V)
- VDE-IEC (Type 2) and UL (Type 1CA) certificate
- Pluggability
- Vibration and shock withstand capability
- Sensitive and reliable state of the art disconnector
- High Surge Current capability, Imax = 50kA
- Backup fuse up to 315 A gG
- Short circuit current rating up to 50kA



AC SPDs - Basic line T1, T2, T3

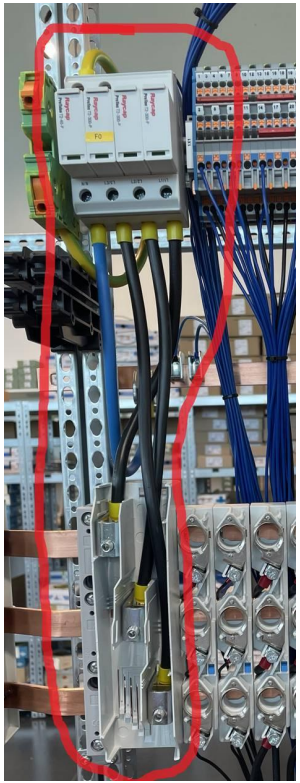
ProTec, ProBloc, SafeBloc, DMDR, MPE-Mini

- Modular or pluggable
- T1 line up to Imax=25kA (10/350µs) per pole
- wide variety of operating voltages (75V to 880V)
- Leakage current free product line available
- TN and TT (3+1) support

Special applications

60mm busbar systems
ProTec 60 SPD

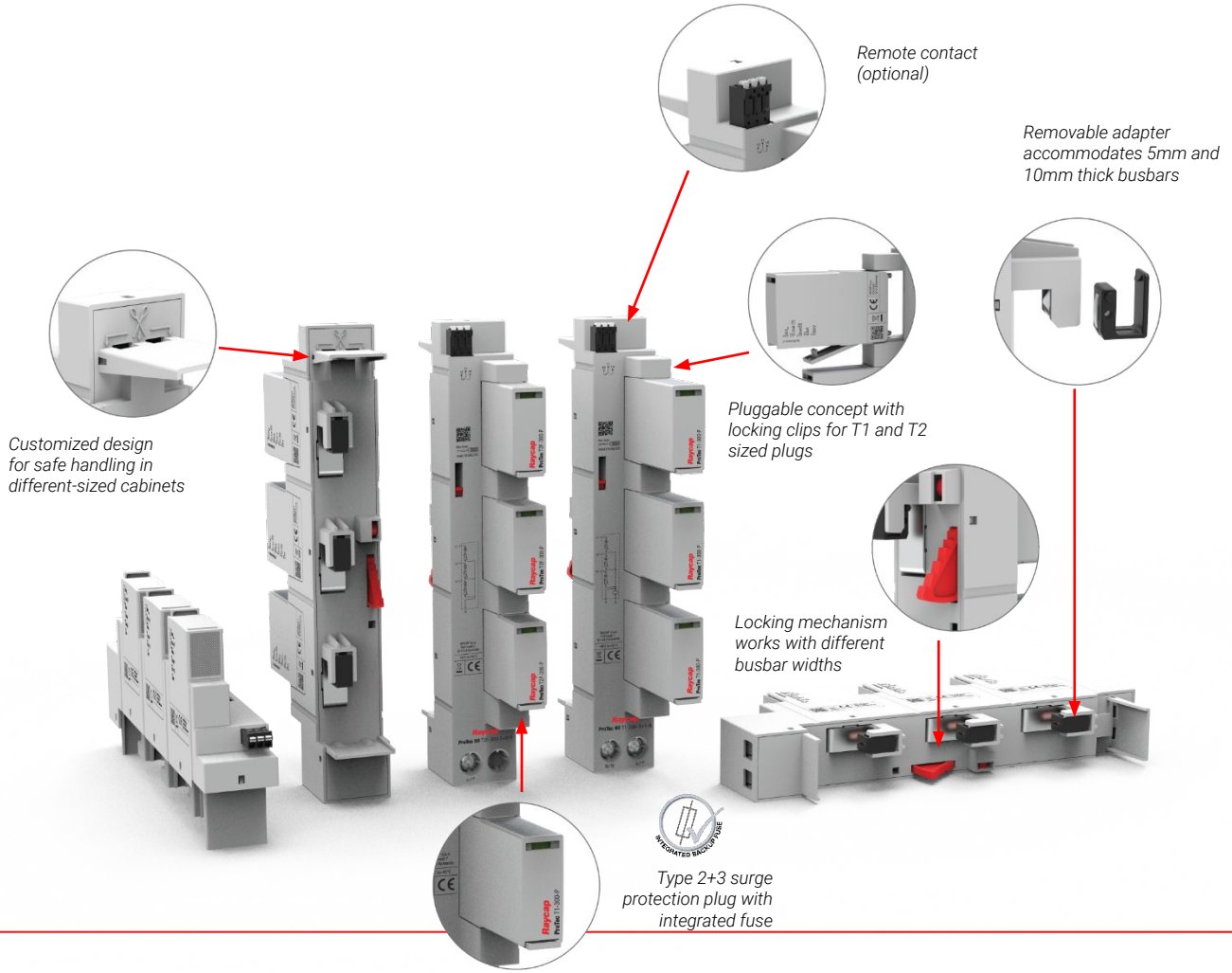
Application examples & competition



ProTec 60 – 60mm busbar system SPD

Overview:

- SPD adapter for 60mm busbar system for standard DIN rail plugs
- Base with integrated GDT for TN-S & TT models
- Modular solution that allows usage of T1 and T2 SPDs
- Expected high runner is T2F as it does not require additional backup fuse
- 3 phases are connected via busbars, neutral and ground via cables for highest application flexibility
- Pluggable concept allows for fast & simplified installation


Remote contact
(optional)
Removable adapter
accommodates 5mm and
10mm thick busbars
Customized design
for safe handling in
different-sized cabinets
Pluggable concept with
locking clips for T1 and T2
sized plugs
Locking mechanism
works with different
busbar widths
Type 2+3 surge
protection plug with
integrated fuse

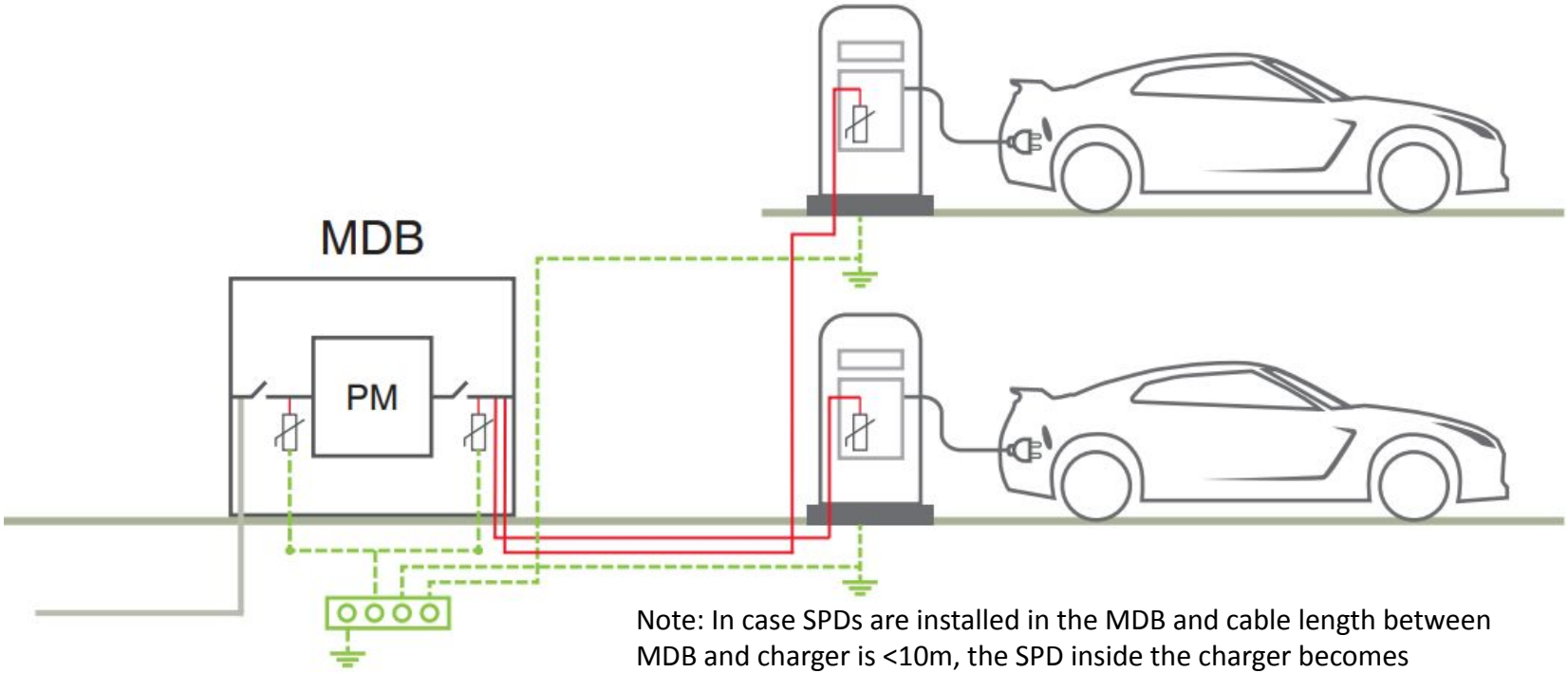
Din-Rail SPDs for EV

Scenario: EV charger connected to public network

IEC 60364-7-722 (DIN VDE 0100-722:2019-06)
Low-voltage electrical installations – Part 7-722: Requirements for special installations or locations – Supplies for electrical vehicles.

A connecting point accessible to the public is considered as part of a public service and therefore shall be protected against transient overvoltages.

Application example – AC charging stations on the street

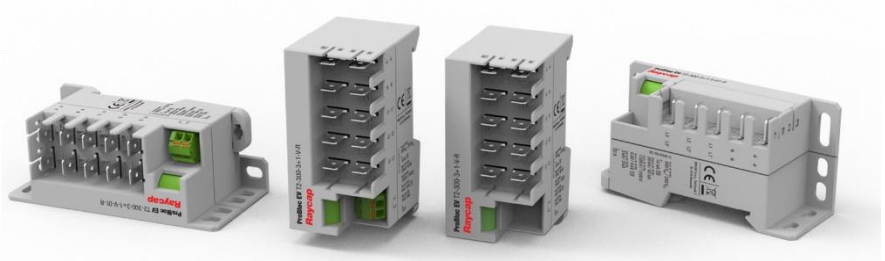


Note: In case SPDs are installed in the MDB and cable length between MDB and charger is <10m, the SPD inside the charger becomes optionally.

ProBloc EV T2

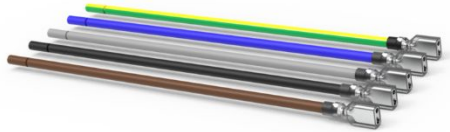
Overview:

- Enables V connectivity for in-line installation
- Ensures most space optimized SPD installation
- Updated mounting geometry for better application fit
- Optional version without mounting ears
- Single and 3 – phase version available

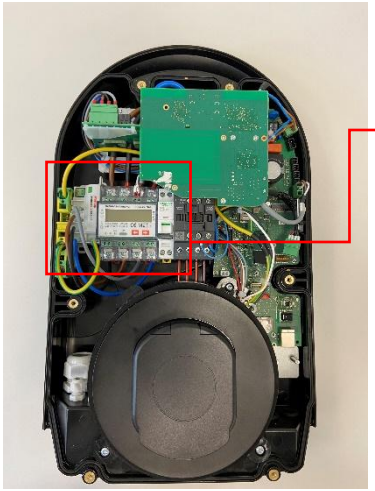


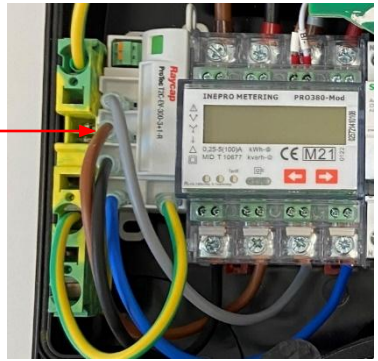
Product features & benefits:

- Compact design for installation in small AC wall box chargers
- Connection via faston connectors
- Dual mounting – DIN rail and backplate
- Type 2 SPD with increased ratings – I_n 10kA
- 3-phase (TN-S or TT) SPD in only 2TE



EV charger SPD – ProBloc EV T2

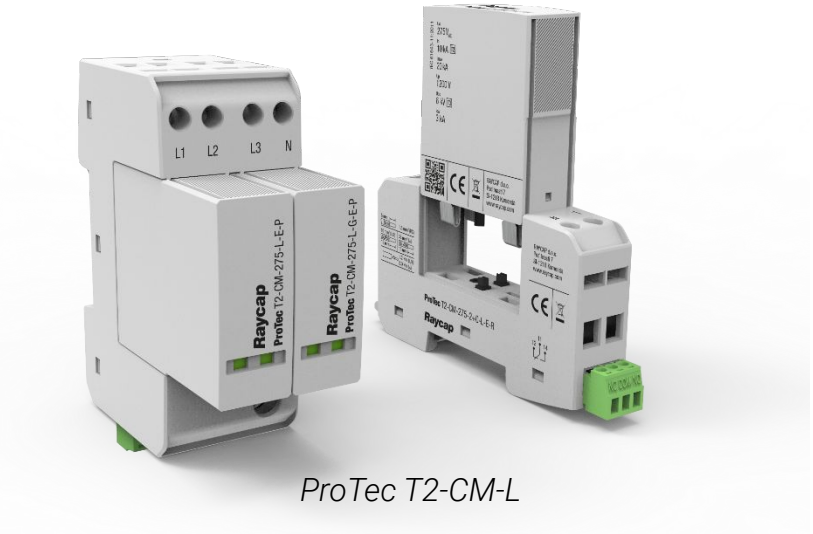




EV charging SPDs for AC chargers - ProTec T2-CM-L

Unique product features:

- **Compact design with 9mm / pole**
- **Type 2 + 3 SPD**
- U_c 275V and 440V
- Discharge capacity - I_{max} up to 40 kA
- Short circuit current rating up to 25 kA_{rms}



ProTec T2-CM-L

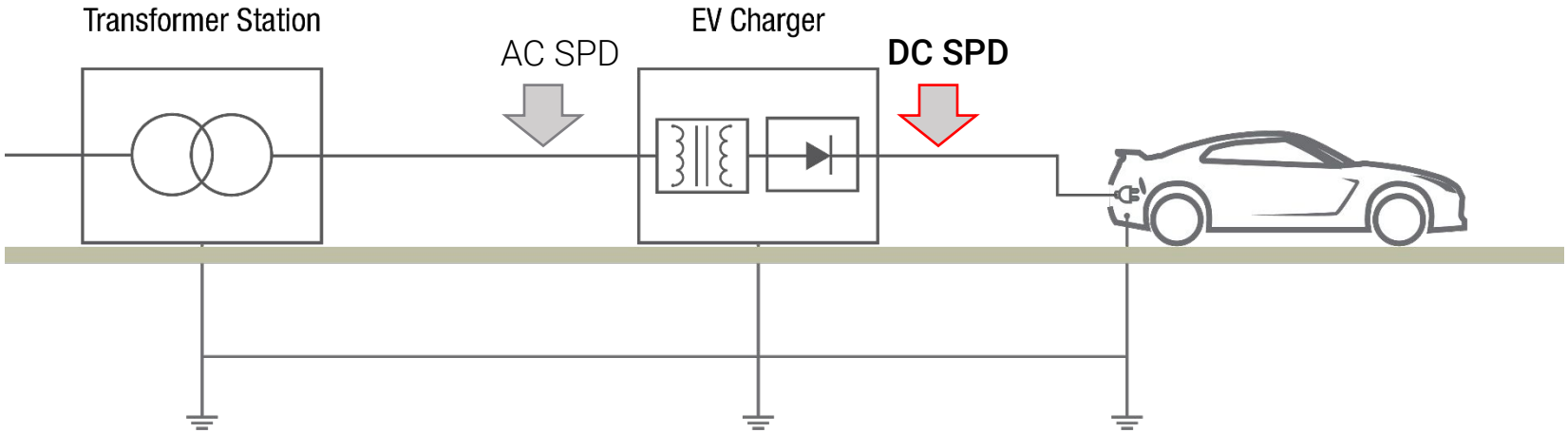
Application:

- Residential AC charger wall boxes
- Public AC charger pillars and boxes
- Sub-distribution boards
- Additional protection as high performance T3 SPD

Dimension	1TE	2TE
Configuration	2+0, 1+1	3+0, 4+0, 3+1

Scenario – EV DC chargers

- In DC charging stations transformers provide galvanic isolation of battery and supply network
- As cars are grounded but supply is isolated, the SPD on the AC side will not limit the overvoltage to low enough levels, potentially resulting in dielectric breakdown (flashover) on the DC side
- As a solution, special SPDs are installed on the DC side of chargers
- In addition, **IEC/EN 61851-23** states that the DC charging station must reduce the overvoltage to the electrical vehicle to a pulse rated voltage of 2500V or less. This is a safety measure to protect the car and the person using the charger. This shall be considered regarding SPD selection.



EV charging SPDs for DC chargers

Key facts:

- IEC/EN 61851-23 conform
- MOV and GDT based
- Type 1 and Type 2
- $I_{total\ (10/350)}$ up to 12.5kA
- UL certified

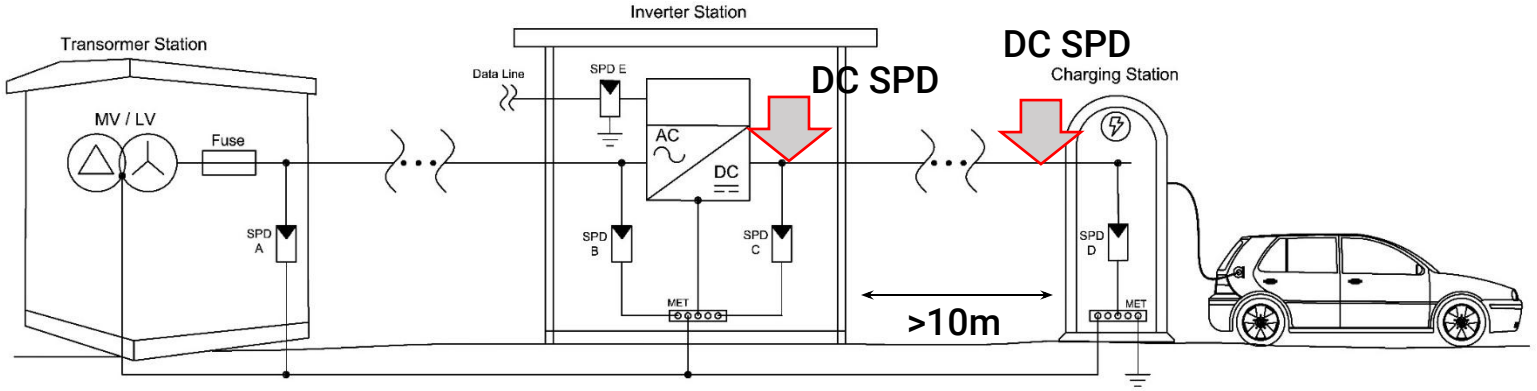
ProBloc B 1000 DC

SafeTec T2-1000DC-3+0

Application:

- *DC fast chargers*
- *Charging stations with DC bus*

DC fast charging with separate Converter-User unit



DC SPDs required because of

- IEC/EN 61851-23
- IEC 62305-2 – Risk assessment, considering induced currents.

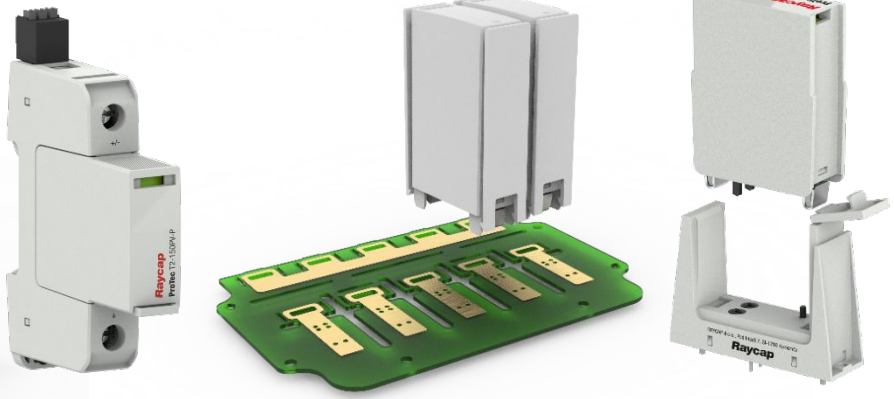
Din-Rail SPDs for PV applications

- PV String Inverter protection
- Commercial buildings
- Residential buildings

PV SPDs

Key Facts:

- MOV based, MOV + GDT available
- Type 1 and Type 2
- Voltages from 600V to 1500V in Type 1
- Voltages from 150V to 1500V in Type 2
- I_{total} (10/350) up to 12.5kA
- VDE and UL certified
- Compliant to new IEC/EN 61641-31 PV standard (replaced old EN 50539-11)

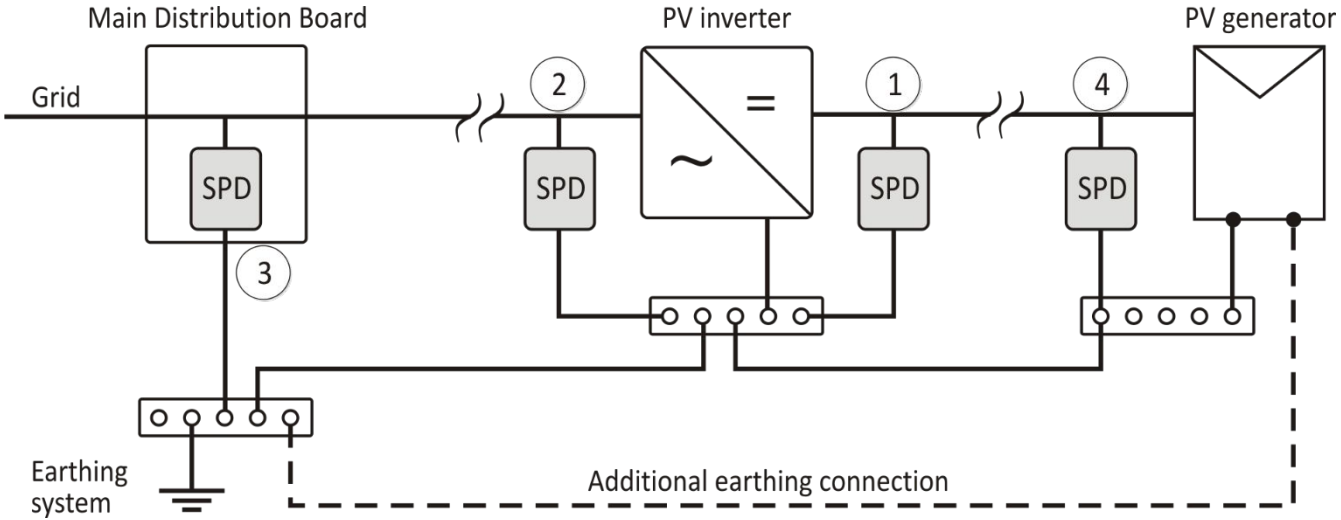


Application – Type 1 or Type 2 SPD?

Key criteria – Lightening Protection System:

- No LPS – **ProTec T2 PV**
- External LPS with separation distance – **ProTec T2 PV**
- External LPS with no separation distance – **ProTec T1 PV**

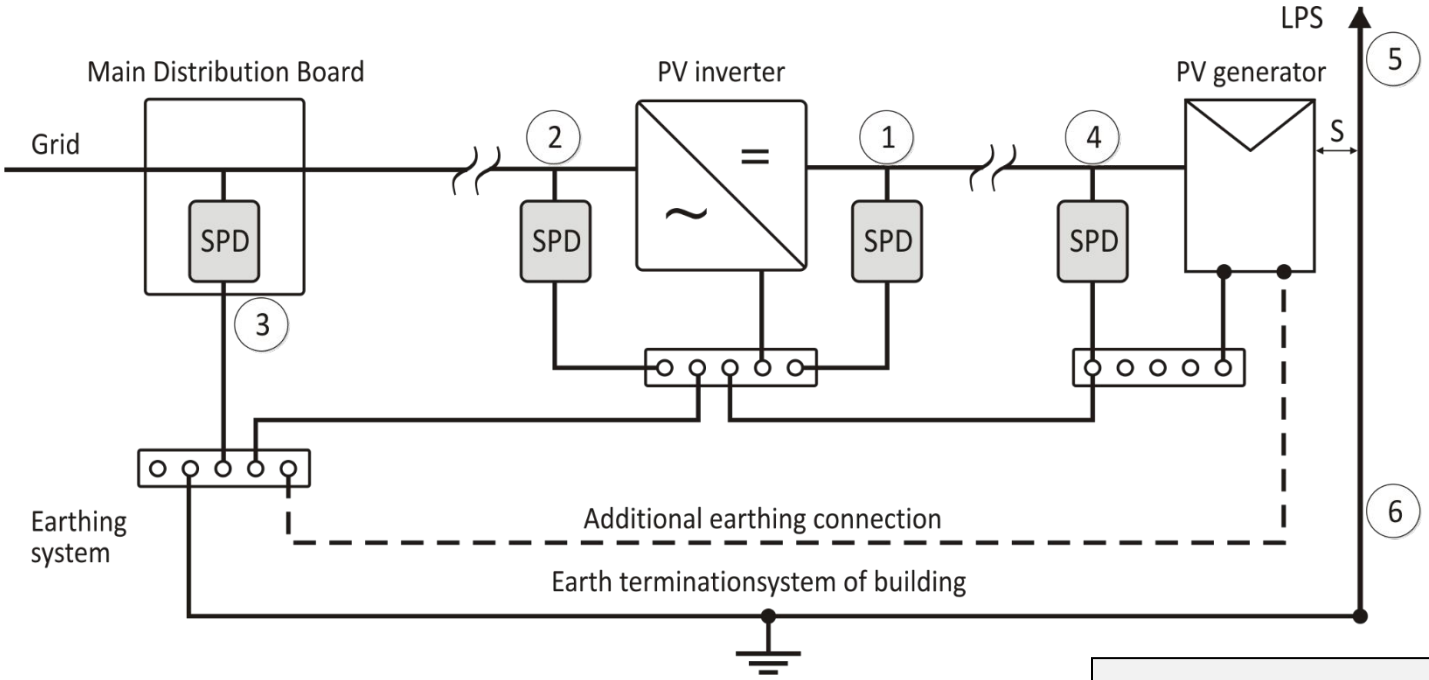
Application – No LPS



SPD 1, 4 – Type 2
SPD 2, 3 – Type 2

*SPD 4 not needed if cable length between 1 and 4 < 10m

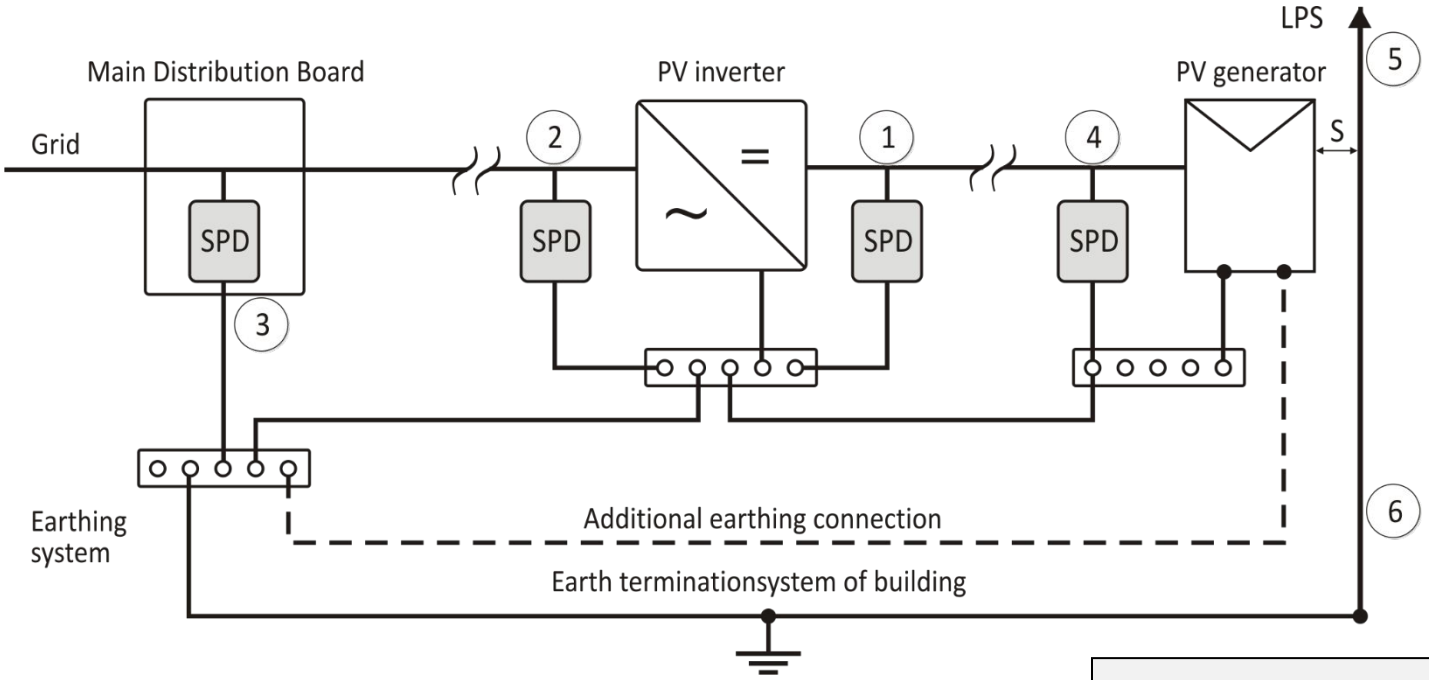
Application – External LPS with separation distance



*SPD 4 not needed if cable length between 1 and 4 < 10m

SPD 1, 4 – Type 2
SPD 2, 3 – Type 1

Application – External LPS with no separation distance



*SPD 4 not needed if cable length between 1 and 4 < 10m

SPD 1, 4 – Type 1
SPD 2, 3 – Type 1

Application – Which Type 1 SPD?

- Key parameter for selection is **I_{total}** – total discharge current which flows through the earth conductor of a multipole SPD
- Scenarios to select Type 1 SPDs:

1. According to IEC/EN 61643-32/50539-12:

a. If **no risk assessment** is calculated, the minimum partial lightning current for Type 1 SPD is **12,5kA** (10/350)

b. Green field PV installations

LPL Lightning protection level 10/350		Voltage limiting SPD	
		I_{imp}	I_{total}
III or IV	100 kA	5 kA	10 kA

c. Roof PV installations

LPL Lightning protection level 10/350		Number of external down-conductors			
		< 4		≥ 4	
		I_{imp}	I_{total}	I_{imp}	I_{total}
I	200 kA	10 kA	20 kA	5 kA	10 kA
II	150 kA	7,5 kA	15 kA	3,75 kA	7,5 kA
III	100 kA	5 kA	10 kA	2,5 kA	5 kA

Down-conductor – LPS conductor carrying direct lightning discharge current

PV ProTec T1 portfolio

Unique product features:

- **Type 1 and Type 2 PV SPD**
- MOV based
- $I_{total\ (10/350)}$ 12.5 kA
- U_{cpv} 600V*, 1100V and 1500V
- **VDE Certified to EN 61643-31**
- **UL 1449 5th edition**
- **Leakage current free version available (PVG)**

ProTec T1-1100PV-3+0-R

ProTec T1-1500PV-3+0-S-R

**compliant to IEC/EN 61643-31 PV standard and UL 1449 only*

PV ProTec T2 extended portfolio – below 1000V

Unique product features:

- MOV based
- I_n 20 kA and I_{max} up to 40kA
- I, V and Y configurations
- U_{cpv} 125V, 250V and 600V
- Compliant to **EN 50539-11** and new **IEC/EN 61643-31** PV standard
- **Leakage current free version available (PVG)**

ProTec T2-125PV-1+0-R

ProTec T2-600PV-2+0-R

ProTec T2-250PV-3+0-R

PV ProTec 5Y

Unique product features:

- **Type 1 and Type 2 PV SPD**
- **For 2 or 3 PV strings**
- Low height modules (78mm)
- $I_{total\ (10/350)}$ up to 10 kA
- U_{cpv} 1100V
- Compliant to IEC 61643-31 PV surge protection device standard and UL 1449 5th edition as Type 1CA PV SPD

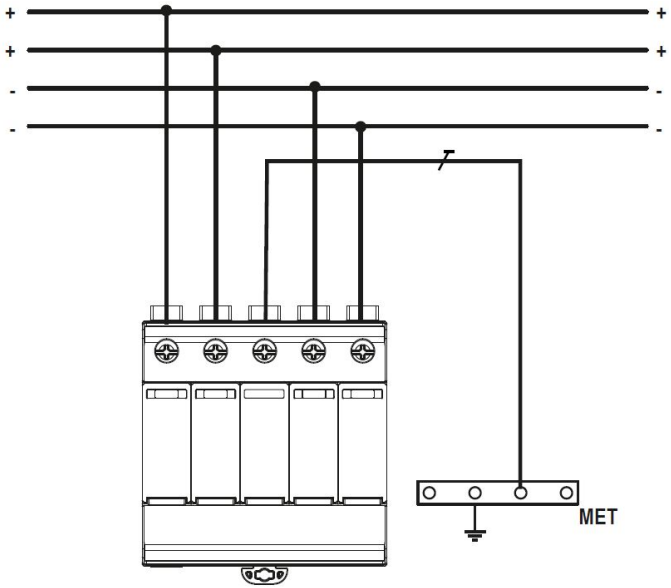
Application:

- String combiner boxes
- PV inverters

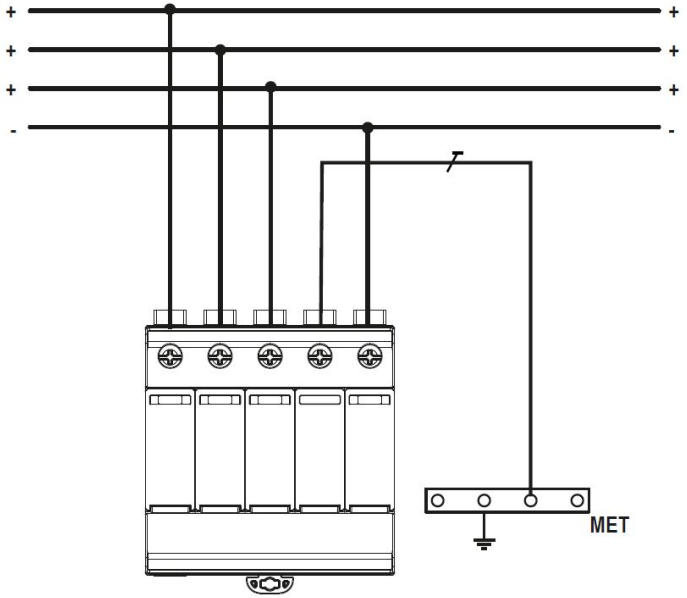
ProTec T1-1100P-5Y-00-R

ProTec T2-1100P-5Y-L-R

PV ProTec 5Y - 2 or 3 string protection



2 string protection
ProTec PV-5Y-00

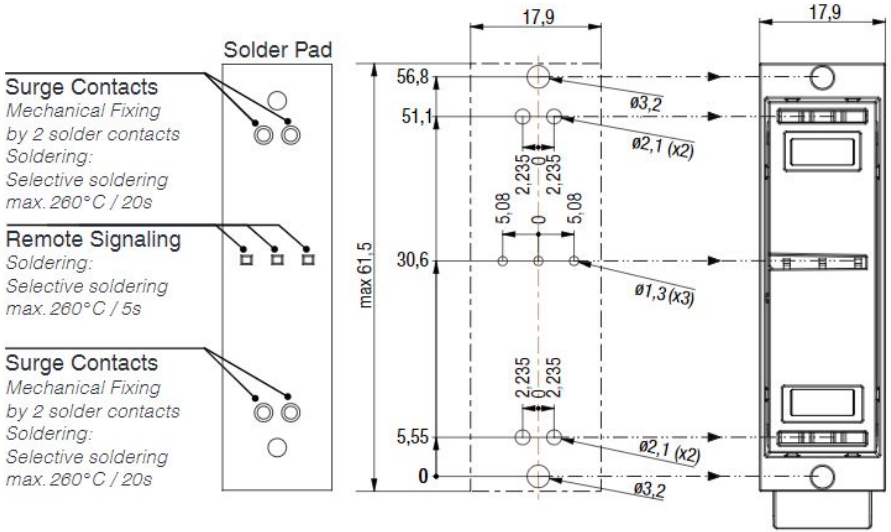


3 string protection
ProTec PV-5Y-01

PCB socket + DIN rail plug

Solderable PCB socket + DIN rail plug

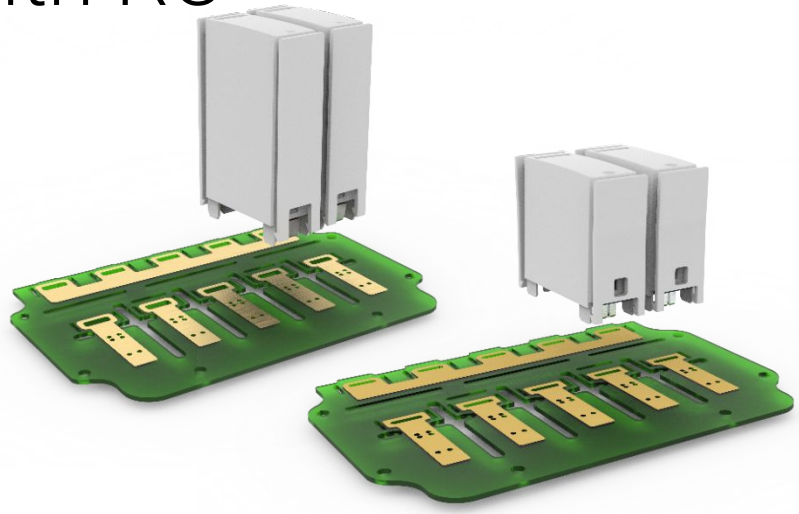
- Sockets are always soldered onto PCB, plugs are populated per request
- Standard DIN rail plugs are used
- Plugs can be replaced by in the field

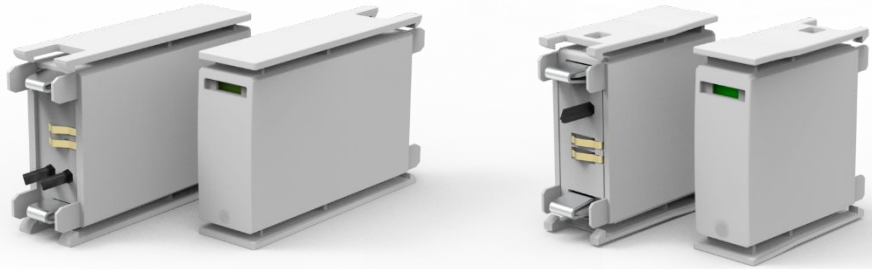


Direct PCB mount plugs with RC

Unique product features:

- Direct mounting on PCB
- Type 1 and Type 2 SPD
- Compliant to IEC 61643-31 PV surge protection device standard
- **Remote signalization** in NC
- Available for 600, 1000V and 1500V systems
- I_{total} (10/350) up to 12.5kA in all voltages





Application:

- Custom string combiner boxes
- PV inverters

Box with Multi-Pole SPD for Photovoltaic Systems

Main features:

- Pre-assembled connection box with Class I & II / EN Type 1 & 2 arrester
- Available for 1100V and 1500V PV systems
- 3Y and 5Y configuration for 1 and 2 string systems
- Push-in connectors on PCB for cable gland and rubber grommet version
- MC4 connector version available
- Compact UV-stable housing with protection class up to IP 67
- Transparent cover with failure status indicator on plugs
- Compliant to IEC 61643-31 PV surge protection device standard

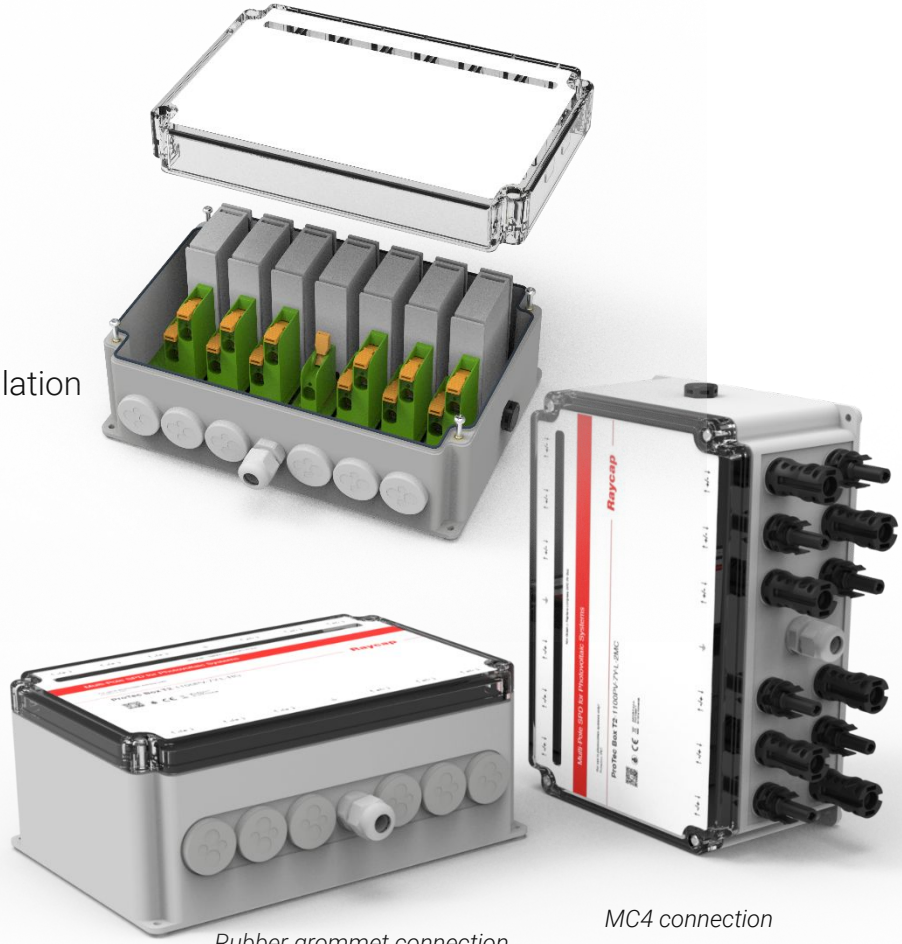
Key advantages:

- Easily installed inside the string box using the cable gland or a rubber grommet
- Fast connection of the strings using push-in connectors or MC4 connectors
- Wide range of uses - for indoor and outdoor installations

PV box – new products

Overview:

- High market demands for protection of more strings
- Additional features for even easier installation requested by installers:
  - Double connection terminals for rubber grommet installation (no double ferrule needed anymore)
  - Usage of Staubli MC4 connectors for best compatibility with products on the market
- New solutions:
  - 5Y – 2 MPPT (2 strings, 2 MPPT outputs)
  - 7Y – 3 MPPT (3 strings, 3 MPPT outputs)
- Various connectivity options:
  - 2xMC4 (in & out)
  - Rubber grommet (in & out)



Rubber grommet connection

MC4 connection

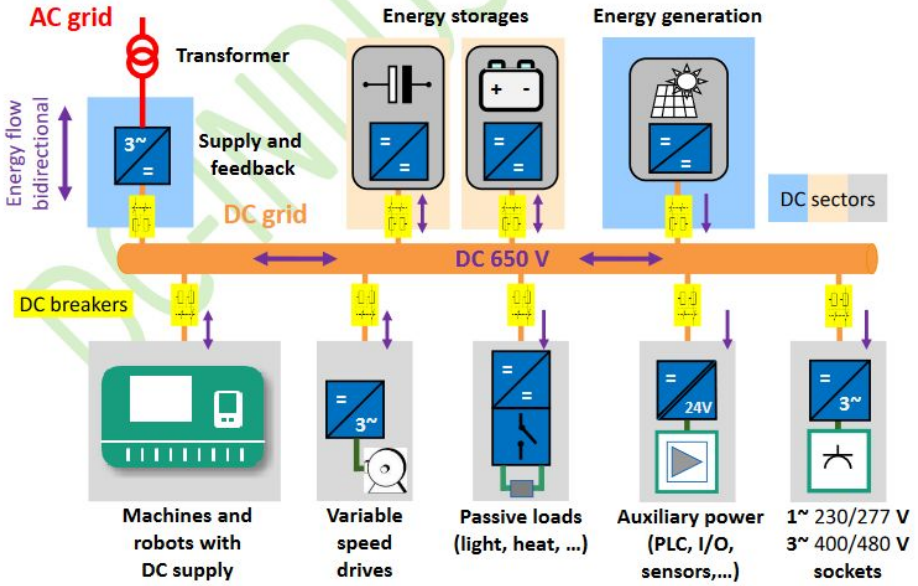
Din-Rail SPDs for high voltage/currents DC applications

- DC Industry

- Energy storage (BESS)

DC Industry

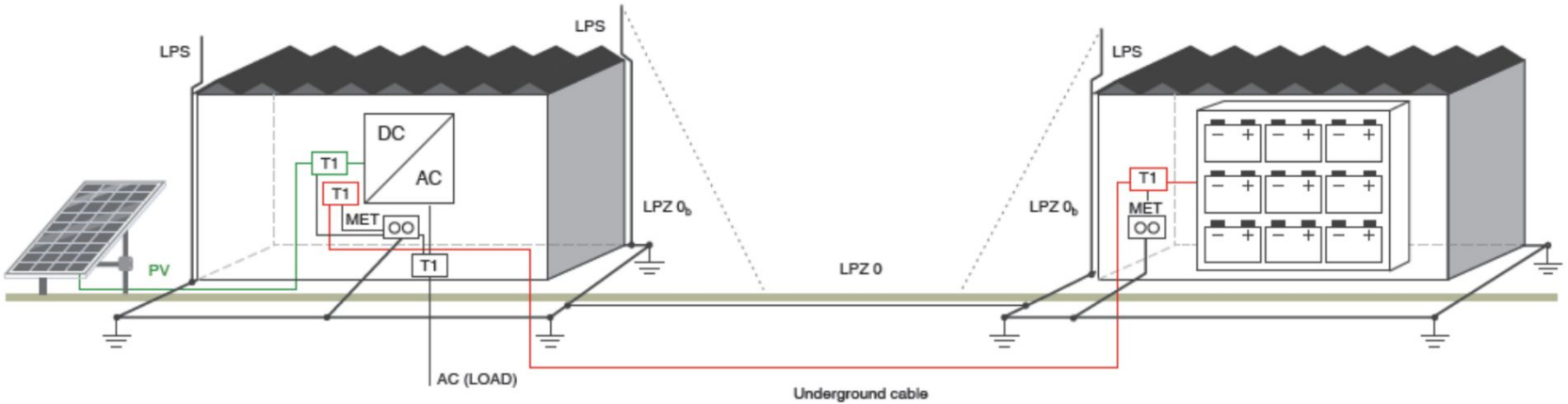
- Consortium projects DC-INDUSTRIE and DC-INDUSTRIE2 Germany
- funded by the German Federal Ministry for Economic Affairs and Climate Action (BMWK)



BESS

- Battery Energy storage (BESS) in size of 100kWh - 10MWh+ contain AC/DC converters and battery banks, implemented in concrete constructions or in metallic containers.
- DC or AC coupling solutions, additional PV integration possible
- Especially large-scale systems with large footprint are at potential risk of lightning impacts
- AC/DC converters have sensitive electronics; and high-capacity batteries with low dielectric strength pose a risk of explosion in case of arcing.
- Need for optimized and reliable electrical protection against the influence of lightning and surge events becomes mandatory

BESS



- BESS with separate concrete or metal structures for AC/DC converter and the battery located nearby.
- The separation distance between the LPS and the BESS equipment is maintained. Common or separated grounding.
- DC cable is routed above ground or underground in a cable trench in the LPZ 0 area.
- T1 DC SPDs are required, T1/2 is recommended.
- If the DC cable length is <10m, only one DC SPD, either at the inverter or the battery.

Unique technical challenges of DC protection

- DC current
- High voltage (1000 or 1500 Vdc)
- Potential high available SCC (Short Circuit Current)
- High linear or capacitive behaving SCC sources
- Pending IEC/EN standardization, currently only prIEC 61643-41 is available
- UL standard UL 1449 5th edition, Supplement SB – Direct Current (DC) SPDs shall be fulfilled, challenge at high voltage and high available SCC.

Attention: PV products are tested according to Supplement SA- Photovoltaic(PV SPDs) with simplified

test procedure

Unique technical challenges of DC protection

Key application differences:

- **Main difference between AC and DC SPDs is arcing during disconnection**
  - There is no zero crossing in DC, so SPD disconnection in case of failure is done under load

- **Main difference between PV and DC SPDs is different power source behaviour**
  - Due to specific U-I characteristic of solar panel short-circuit current is low and most SPDs can disconnect it without need for external disconnectors
  - General DC applications have higher short-circuit currents – either because of AC supply behind (network) or due to high short-circuit capability (batteries)

- For safe operation most upcoming SPDs (and solutions with existing PV SPDs) will rely on operation of external disconnector in case of failure

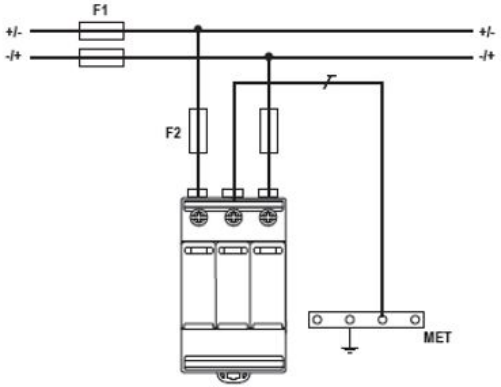
DC protection T2

ProTec T2 DC 3Y (Unipolar)

Available from 500V to 1500V

Location of Use:	DC Systems, EV Chargers
Network Systems:	Unipolar grounded / ungrounded
Mode of Protection:	(L+)-PE/M/G, (L-)-PE/M/G, (L+)-(L-)
IEC/UL Category:	Type 1, Type 2 DC SPD Type 1, DC SPD Type 2
Housing:	Pluggable Design
Compliance:	IEC CD 61643-41 Edition 1 UL 1449 5th Edition

Installation method:



F2: ETI gBat fuse 160A/100kA

Advantage:

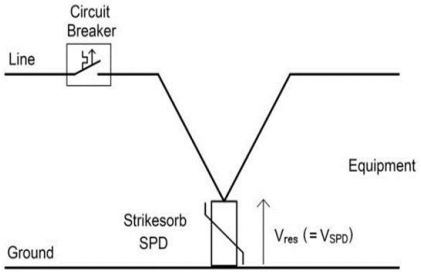
- Coverage of BESS and industrial applications
- IEC CD 61641-41 compliant
- UL 1449 DC (supplement SB) certification

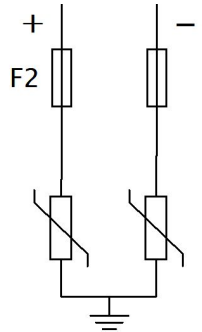
DC protection T1/2

Strikesorb 35 Specialized DC

Maximum DC Voltage	Strikesorb 35
650 V	Strikesorb 35-D-HV
800 V	Strikesorb 35-E-HV
1100 V	Strikesorb 35-F-HV
1500 V	Strikesorb 35-G-HV
1500 V	Strikesorb 35-G-HG (leakage current free)

Installation method:





2x Strikesorb 35

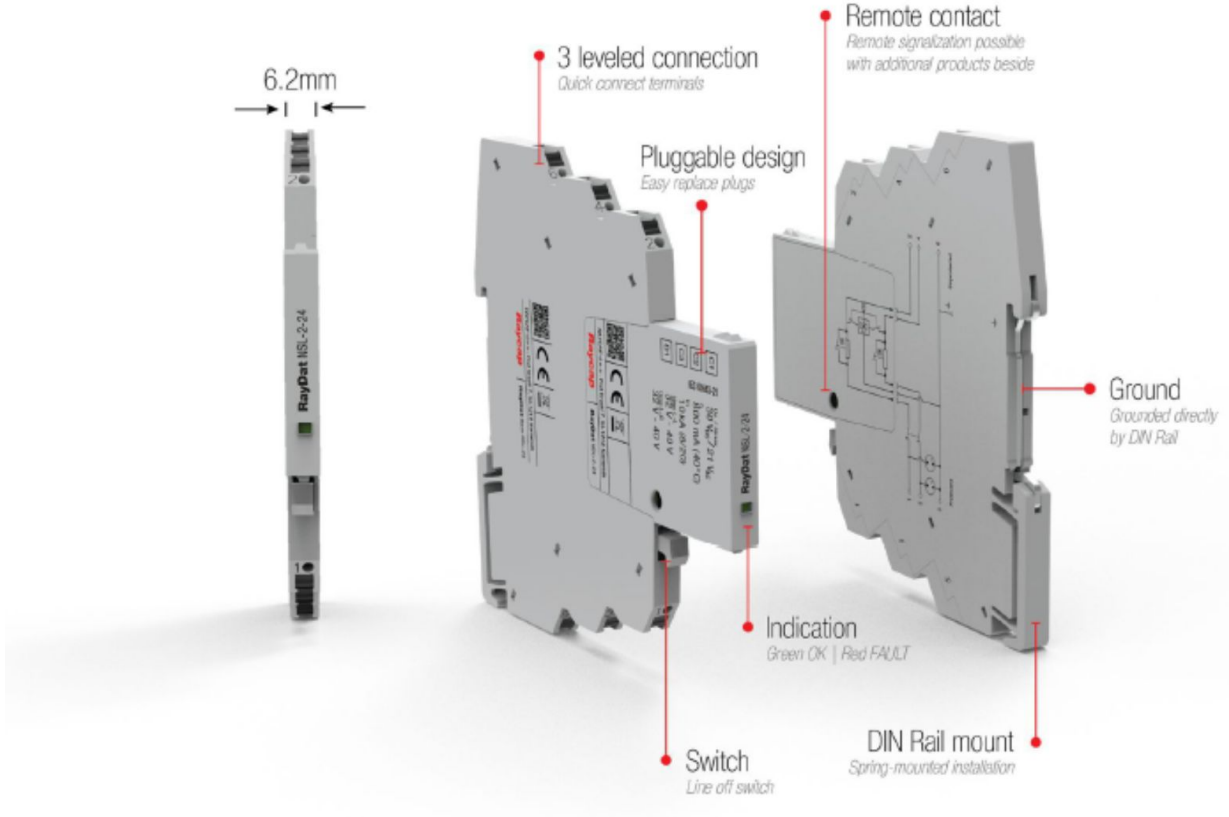
F2: Siba Surge fuse SF35/100kA

Advantage:

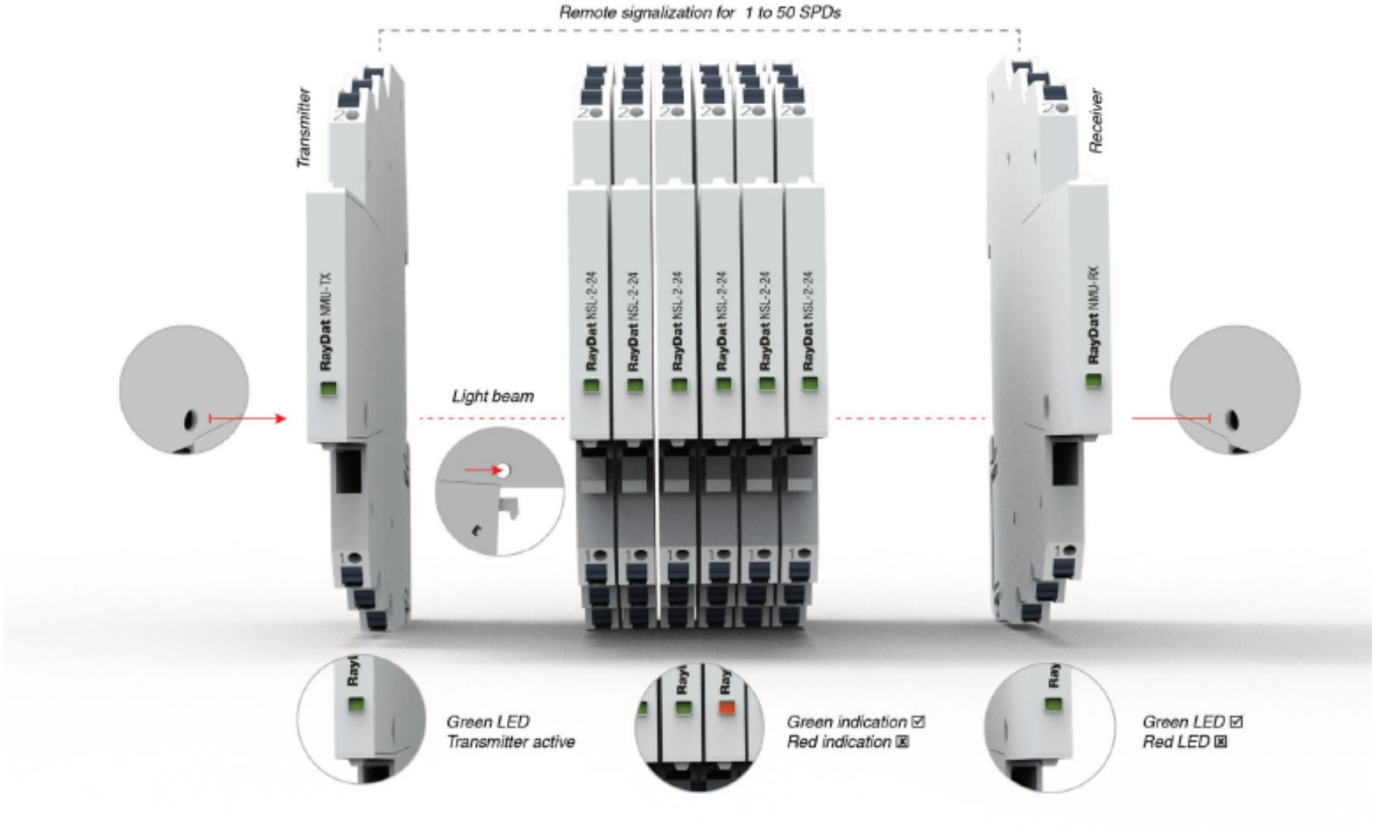
- Coverage of BESS and industrial applications
- IEC CD 61641-41 compliant
- UL 1449 DC (supplement SB) certification
- Direct (V) connection possible in most of applications - no need for a bulky and expensive branch fuse

Data and signal line protection

New generation

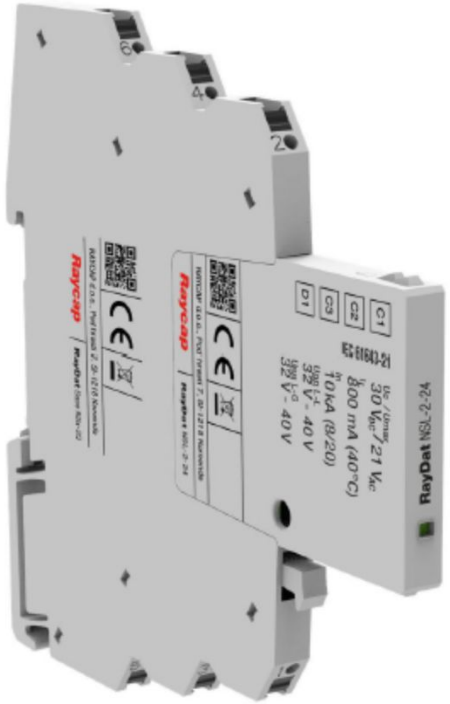


New generation – features



New generation

Features	Benefits
• Increased surge current rating	• Increased reliability/lifetime
• Maximum transmitting frequency 120MHz for HF versions	• More applications covered • Less signal loss enables longer lines
• Increased load current rating up to 12A	• Higher maximum transmitted power
• Risk free solution - fault detection per individual line (TVS diodes and resistors)	• Status of SPD is always known • Low Ohmic re-connection of the line after disconnection of resistors • Basic protection is provided by GDTs even if diodes are damaged and disconnected



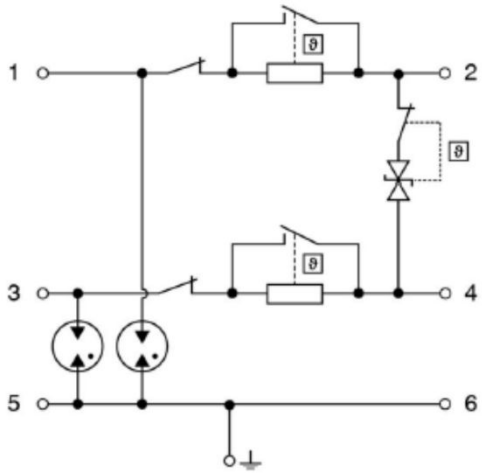
UL certified

New generation

Features	Benefits
• Disconnection of lines is provided with lever	• Fast and easy disconnection of the line when needed
• Specially designed contacts on the plug	• Interruption-free while pushing or pulling the plug • Antivibration locks are not needed
• User friendly terminals	• Easier installation
• Slim and compact design	• Less space needed comparable to previous RayDat series
• One product can protect various applications	• Less portfolio needed, simplified logistics

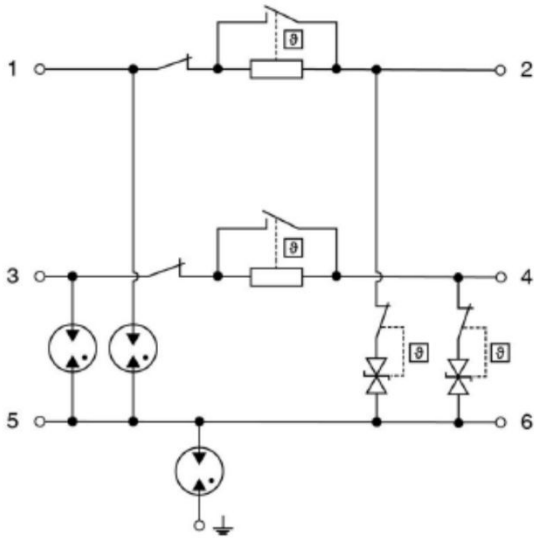
LF and PF series

RayDat NSP-2-xx LF

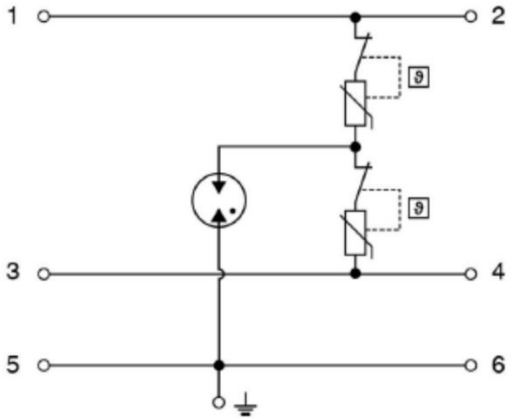


Temperature sensor

RayDat NSB-3-xx LF



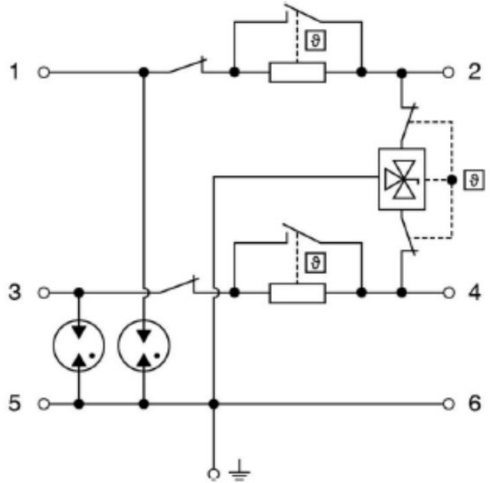
RayDat NPS-2-xx



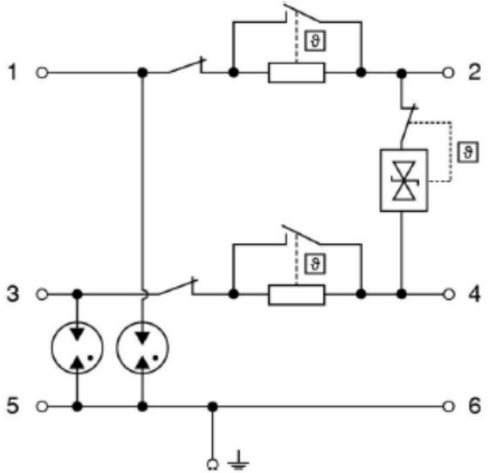
Power supply protection 12A

HF Series – 120MHz

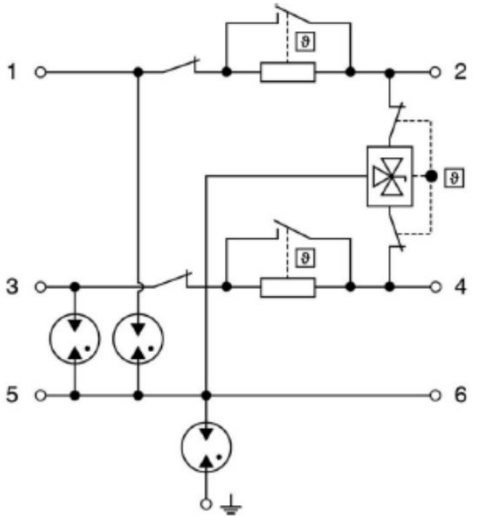
RayDat NSL-2-xxx



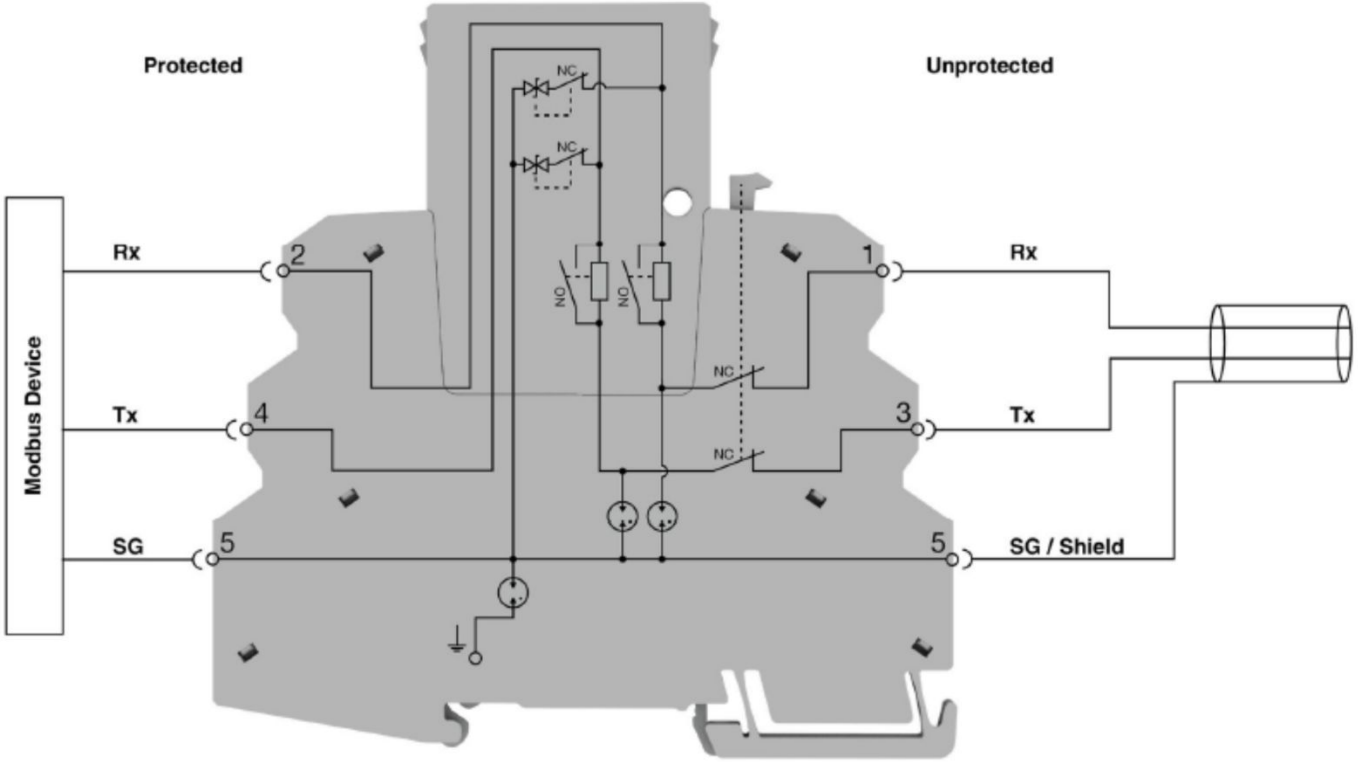
RayDat NSP-2-xx



RayDat NSB-3-xx



Typical application: Modbus



KNX/Ethernet

SPD with Terminal Connection for Bus Systems

RayDat KNX

D1 • C1 • C2 • C3

IEC/EN Category: D1/C1/C2/C3
Voltages: 110 V DC
Max. Operating Voltage: 180 V DC
Surge Discharge Ratings: I_n: 5 kA, I_{max}: 10 kA
Series Load Current: 7 A
Housing: Compact Design
Compliance: IEC/EN 61643-21

SPD for LAN Category 6 Networks

RayDat NET 6 POE

UL Listed

D1 • C1 • C2 • C3

IEC/EN Category: D1/C1/C2/C3
Surge Discharge Ratings: I_n: 10 kA, I_{imp}: 1 kA
Voltages: 48 V DC
Max. Operating Voltage: 50 V
Frequency Range: 250 MHz, up to Cat 6, up to PoE++ Compatible
Housing: Compact Design
Compliance: IEC/EN 61643-21
UL 497B 4th Edition

Thank You for Your Attention!