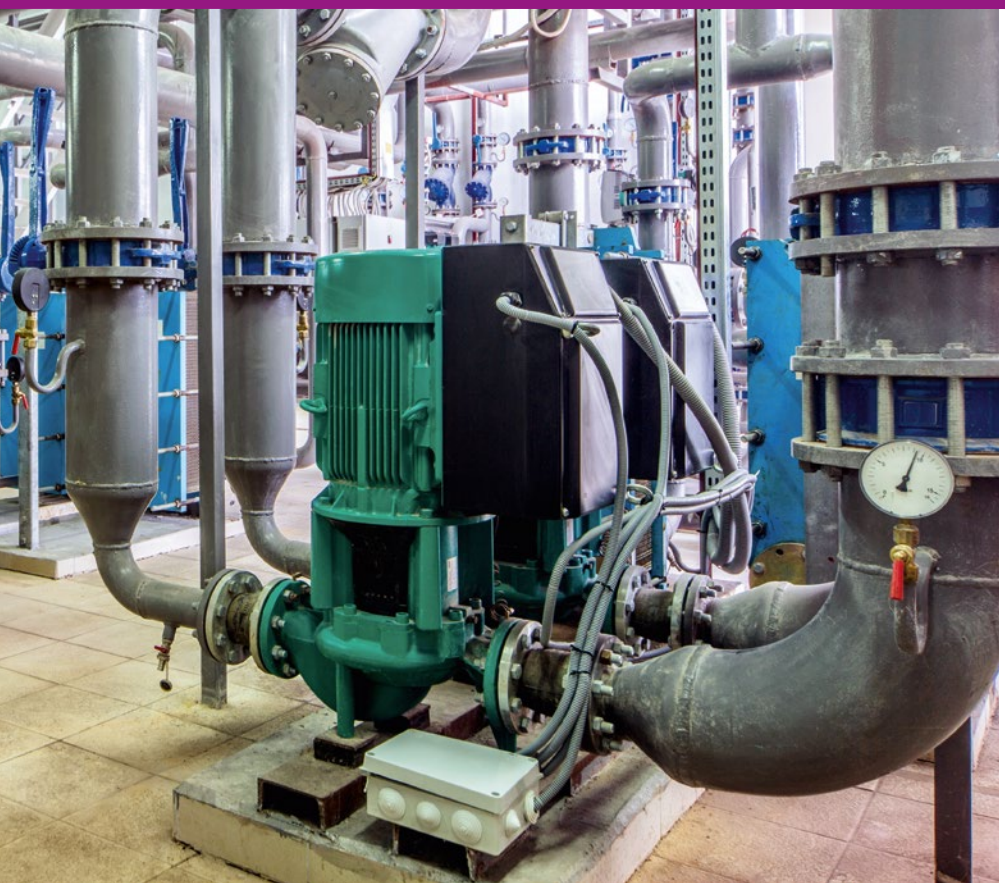
SALTEK®

Overvoltage controlled. ANYWHERE.

PRACTICAL GUIDE

Signal and Data lines

Surge Protection of low current systems



1. Overvoltage – Theory and protection

1.1. Legislation

Immunity of electronic systems to interference – EMC
In EU countries, the Electromagnetic Compatibility (EMC) Directive applies. The Directive requires that the operating equipment is not a source of interference and is immune to electromagnetic surrounding. EU Directive 30/2014.

Standards that apply to overvoltage and interference protection can be divided into:

Standards describing requirements for surge protective devices (SPD) – testing and categorization:
- EN 61643-21 Low-voltage surge protective devices – Part 21: Surge protective devices in telecommunication and signaling networks - Requirements on functional and test methods.

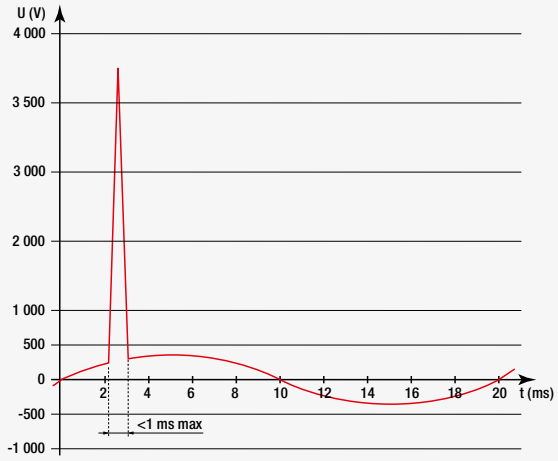
Standards describing protected device requirements – overvoltage immunity:
- EN 61000-6-1 Electromagnetic compatibility (EMC) – Immunity – Residential, commercial and light-industry environment;
- EN 61000-6-2 Electromagnetic compatibility (EMC) – Industrial environment immunity;
- Requirements on the immunity of protected equipment, given e.g. in EN 61000-4-4 and EN 61000-4-5, are divided into four test levels.

Standards specifying surge protective device applications – SPD installation, connection and grounding:
- IEC (CLC/TS) 61643-22 Low-voltage surge protective devices – Surge protective devices in telecommunication and signaling networks – selection and installation principles;
- EN 62305-4 Lightning protection – Electrical and electronic systems in buildings;
- EN 50174-2 Information technology – Cable distribution installation: Project preparation and construction in buildings;
- EN 50310 Use of a common interconnection and grounding system in buildings equipped with information technology devices;
- ITU-T K.xx recommendation – Protection against interference.

1.2. What does overvoltage mean?

Overvoltage = voltage that exceeds the maximum operating voltage of the „system". The transient (surge, impulse) overvoltage is considered being dangerous when achieving high amplitudes (kV and more) in a very short time (ns ÷ µs), SSŁ *(Fig. 1).*

Fig. 1 Transient overvoltage



Sources of transient overvoltage
- Lightning electromagnetic pulse (LEMP) overvoltage is classified according to the cause of the damage in terms of the mutual position of the lightning strike and the building *(Fig. 2)*.
- Switching electromagnetic pulses (SEMP) are caused by switching capacitance loads, by load variations in the distribution grid, by disconnecting inductive loads, by resonant circuits connected to switching elements (transistors, thyristors), and by network failures such as short circuits and ground connections (electric arc).
- Electrostatic Discharge (ESD)

Depending on the type of the interference source, transverse and longitudinal overvoltages are distinguished.

The transverse overvoltage can arise in electrical circuits when switching non-linear loads *(Fig. 3a)*. The longitudinal overvoltage is caused by atmospheric phenomena – lightning (*Fig. 3b*).

Fig. 2 Lightning electromagnetic pulses

S – a cause of the damage in terms of the mutual position of the lightning strike and the building
S1 – strike into the building
S2 – strike near the building
S3 – strike into the transmission line
S4 – strike near the transmission line

99 % of lightning strikes are below 200 kA.
Current pulses waveform:
- 10/350 lightning strike simulation
- 8/20 induction simulation

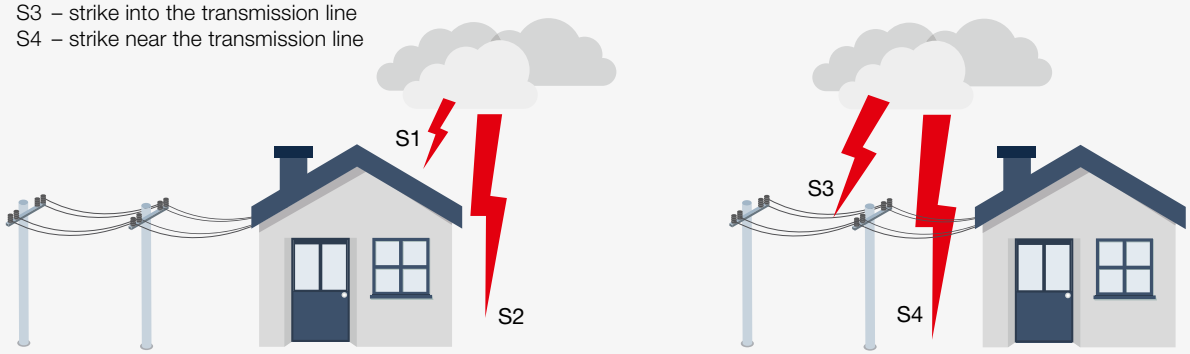


Fig. 3a Transverse overvoltage

– between cores (core–core)
– symmetric, common mode

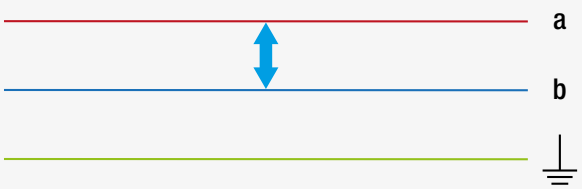
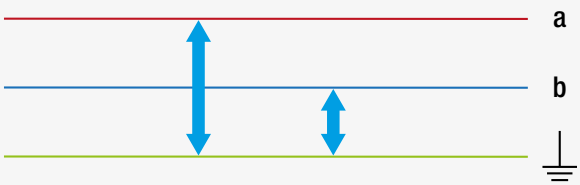


Fig. 3b Longitudinal overvoltage

– against ground (core–ground)
– asymmetric, differential mode

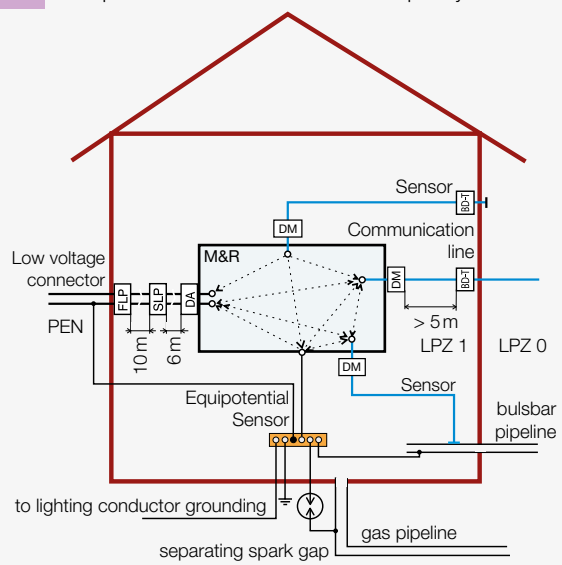


1.3. Ways of surge-pulse penetration into devices/systems and interaction of individual parts

The overvoltage is of a high-frequency nature, and can therefore penetrate to systems via low-voltage power supply, via power transformers and via circuitry of devices, via control, measuring, data and telecommunication lines of sensors if located outside buildings or on pipelines, on rail-yards, in lightning and grounding systems.

In case of an attack of an electronic system by a surge pulse, individual parts do not behave in isolation but interact mutually – even without a galvanic connection. An overvoltage always looks for a way towards grounded parts or other conductors representing the distant ground. Dashed lines in *Fig. 4* represent interactions of individual parts of systems. These interactions are called internal coupling of technology. This coupling is of a very low immunity, and this immunity cannot be defined since depending on the design of the technology equipment.

Fig. 4 Principle of SPD coordination and complexity of SPD



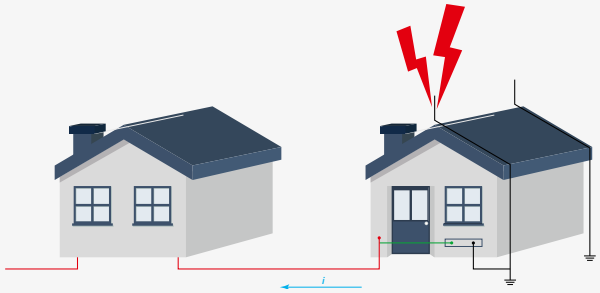
The overvoltage spreads in form of coupling among systems:

- by wire – i.e. galvanic coupling (*Fig. 5*)
- by induction – i.e. capacitive (*Fig. 6a*) or magnetic coupling (*Fig. 6b*)
- by air – i.e. by radiation, electromagnetic coupling (*Fig. 7*)

Galvanic coupling

A conductive path between the source of interference and the object of interference, either directly by line or by the puncture of insulation. This coupling is also referred to as a common impedance coupling.

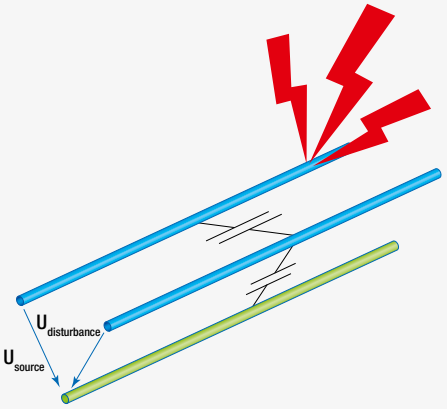
Fig. 5 Overvoltage propagation by galvanic coupling



Capacitive coupling

The influence of electric field induction among circuits with a capacitive coupling. This coupling can be suppressed by a sufficient grounding.

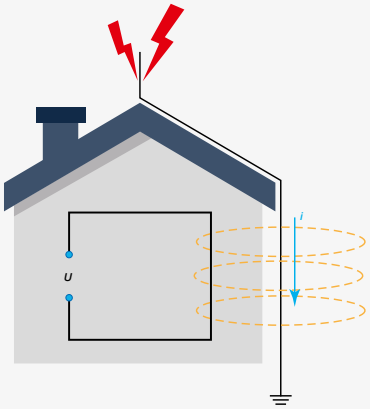
Fig. 6a Overvoltage spreading by capacitive coupling



Inductive (magnetic) coupling

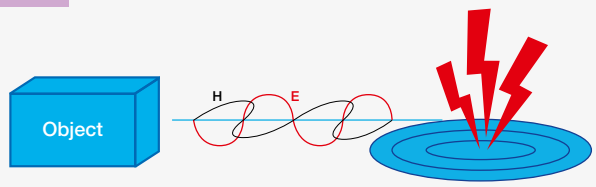
Circuits can influence mutually by magnetic field induction. This coupling can be described by the mutual inductance of circuits. In order to suppress this coupling a shielding is used.

Fig. 6b Overvoltage spreading by inductive coupling



Radiation coupling
Caused by electromagnetic waves spreading from a source (atmospheric discharge, industrial disturbance – switching, near transmitters) to a disturbed object (influence apparent in case of radio receivers). A overvoltage can be induced even off-grid systems, which are not connected to the environment. So, SPDs have to be used here too.

Fig. 7 Overvoltage spread by radiation (electromagnetic coupling)

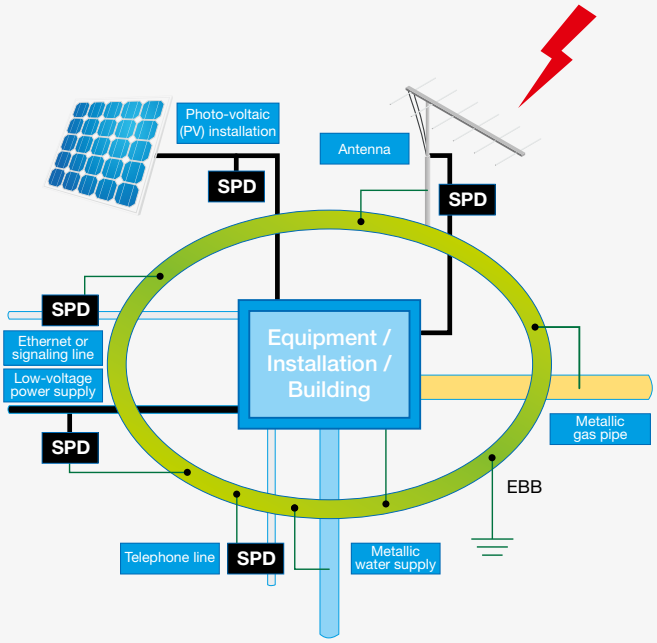


1.4. Principles of protection against pulse overvoltage

Shielding – suppression of electromagnetic field spread.

Potential equalization – suppressing current impulses on the conductive parts of an object *(Fig. 8)*.

Fig. 8 Suppressing current pulses on conductive parts of an object



1.4.1. Main principles of pulse overvoltage protection

External lightning protection (system of lightning conductors) – protection of buildings.
Internal lightning and surge protection (SPD) – protection of technology equipments.

Potential equalization on the main busbar by connecting all conductive parts:
- direct connections are established wherever possible – lightning conductor system, protective earth (PE), water supply, metal jacket covers, heating, etc.
- indirect connections by lightning arresters (SPD T1, SPD ST1) and surge protective devices of all live wires of power and communication lines (SPD T2, SPD ST2 + 3).

1.5. Classification of SPDs according to lightning protection zones (LPZ)

SPDs are installed at an boundary of individual LPZs where they are also connected to an appropriate potential equalization *(Fig. 9 and Fig. 10)*.

Fig. 9 SALTEK classification of SPDs

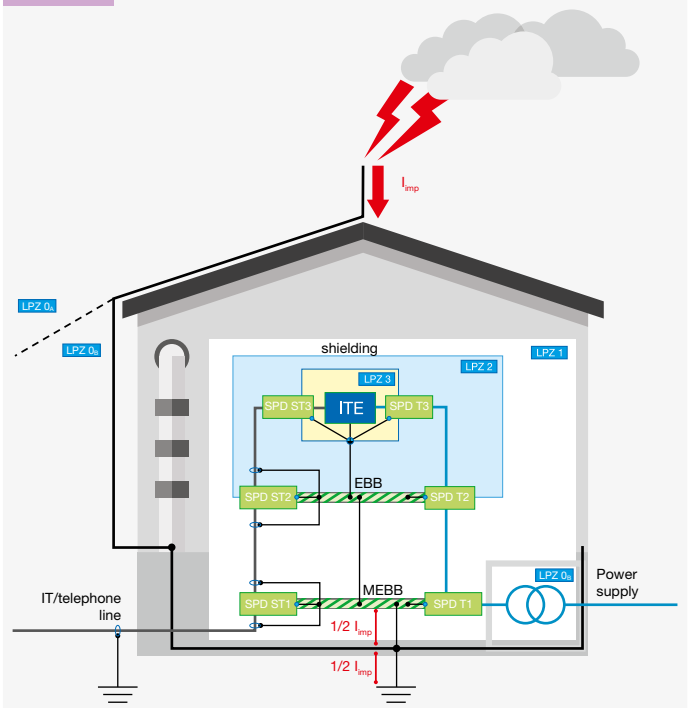


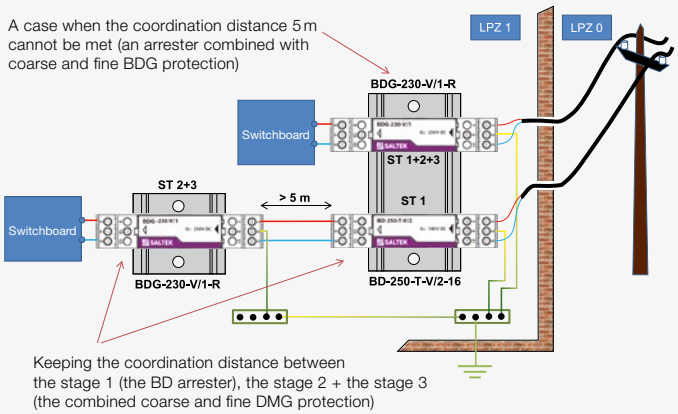
Fig. 10 SALTEK classification of SPDs

Saltek Classification	Installation			Test
	Boundary of zones	Location	For risks	
ST1	LPZ 0/1	To the building entrance	S1 or S3 with galvanic coupling	*i* (10/350)
ST2	LPZ 1/2		S1 or S2 and inductive coupling	*u* (1,2/50) *i* (8/20)
ST3	LPZ 2/3	Close to ITE		*u* (1 kV/µs)
ST2+3	LPZ 1/(2)3	Close to ITE	The combination of row 1 and 2	The combination of row 1 and 2
ST1+2+3	LPZ 0/(1, 2)3	To the building entrance and close to ITE	The combination of row 1, 2 and 3	The combination of row 1, 2 and 3

ITE = low current system equipment

The SPDs ST 2+3 or ST 1+2+3 are located directly at technology equipments because nothing like a sub-domain distribution board exists in low current systems. Where the SPDs type ST 2 would be placed. The SDP ST1 is placed at the communication line entrance to the building if the technology equipment is located far away from the entrance. If the technology equipment is close to the communication line entrance to the building the SPD ST 1+2+3 is used *(Fig. 11)*.

Fig. 11 An example of placing the SPDs on a telephone line

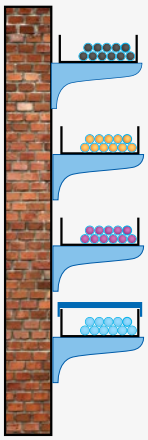


1.6. The SPD installation principles

1.6.1. Principles of installing cables to cable trays:

- The minimum separation between information technology cables and power supply cables has to include any additional deviations for the movement of the cables between their fixing points or other limitations (e.g. cable deflection).
- The requirement for minimum separation is applied in three dimensions. If the information technology cables and the power supply cables are required to cross the angle of their crossing must be 90° on each side Up to a distance longer than the required minimum separation distance.
- In accordance with requirements of the corresponding Article of the standard, power supply cables and information technology cables must not be in the same bundle and different bundles have to be isolated and shielded.

Fig. 12 Recommended storage of cables in cable trays



Power distribution cabling

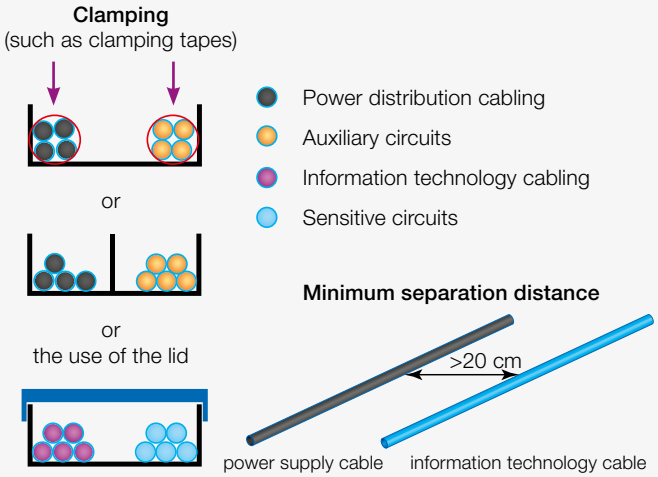
Auxiliary circuits
(e.g. fire alarm, door opener)

Information technology cabling

Sensitive circuits
(e.g. measurement ones or instrumentation ones) – the use of the lid recommended

Cable trays can be installed in a reverse order also

Fig. 13 Possible storage of harnesses



1.6.2. Wiring principles of SPD

Low current communication lines operate with low voltages in order of volts e. g. the RS-485 communication operates with a voltage of 5 V. Therefore, even a very small induced disturbance (e.g. 20 V) may have a damaging effect on the low current technology equipment. This is the reason why special care of possible couplings between input and output lines has to be taken in low current systems, especially (*Fig. 14a* and *14b)*.

If the switchboard of technology equipment consists of more communication lines then multi-row solutions have to be adopted with respect to coupling between input and output lines *(Fig. 15a* and *15b)*.

Fig. 14a

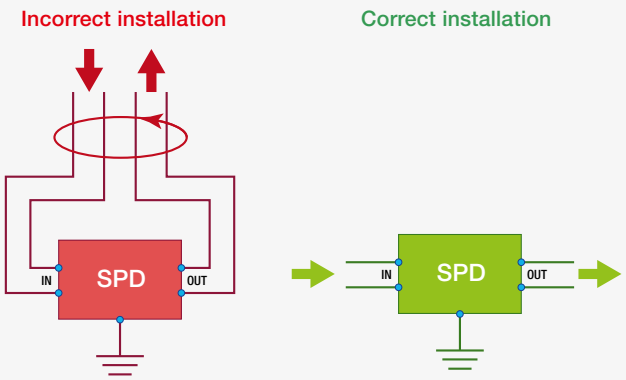


Fig. 14b

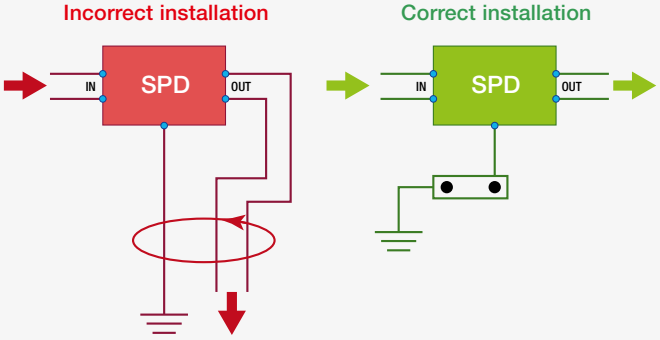
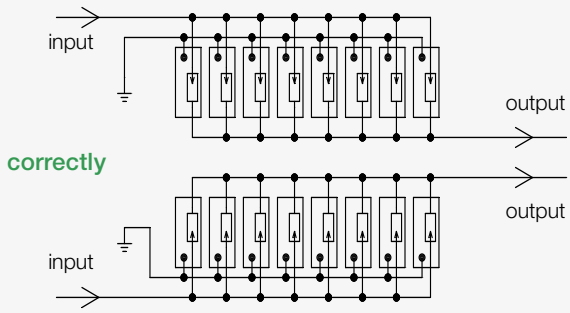


Fig. 15a Coupling between input and output lines and grounding

Principle

Isolated input and output



Implementation

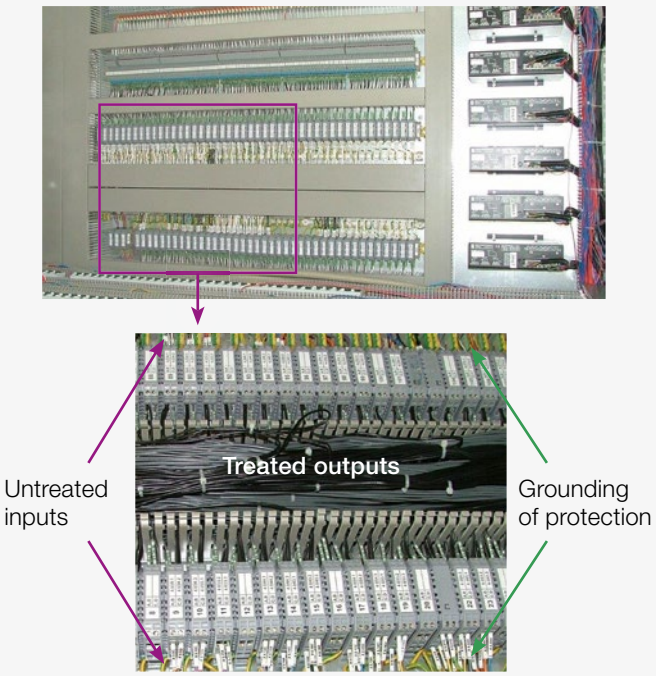
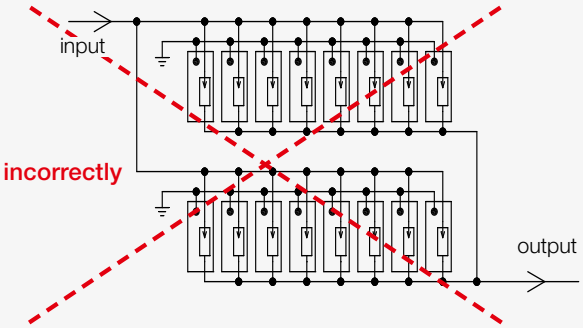


Fig. 15b Coupling between input and output lines and grounding

Principle

Coupling input – output



Implementation

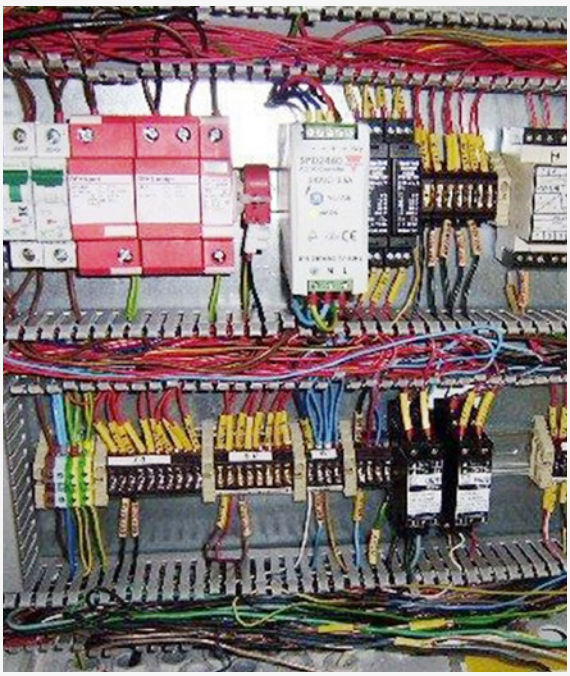
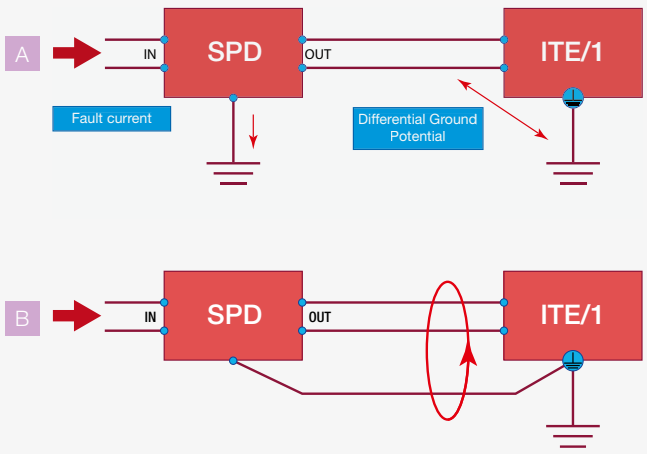
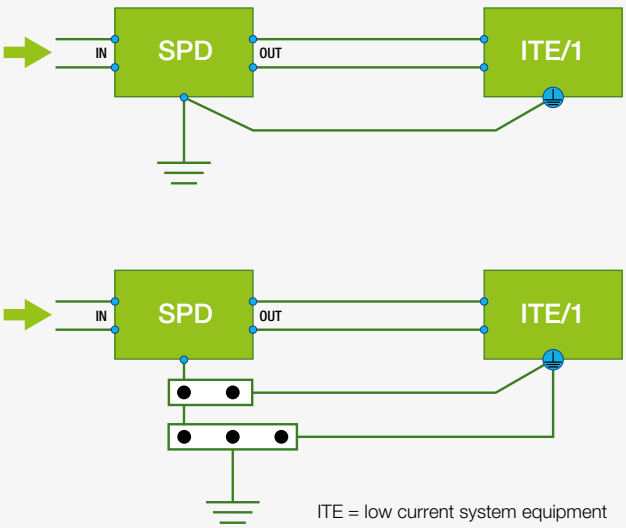


Fig. 16 Incorrect protective ground connection



ITE = low current system equipment

Fig. 17 Correct connection



ITE = low current system equipment

Connecting of protective ground to a surge protective device (SPD) is very important. In this case, it is necessary to take into account the internal couplings in the technology equipment *(Fig. 4*). The SPD has to be therefore connected to the same protection potential as the technology equipment. Typical faults of connecting protective grounds are in *Fig. 16*.

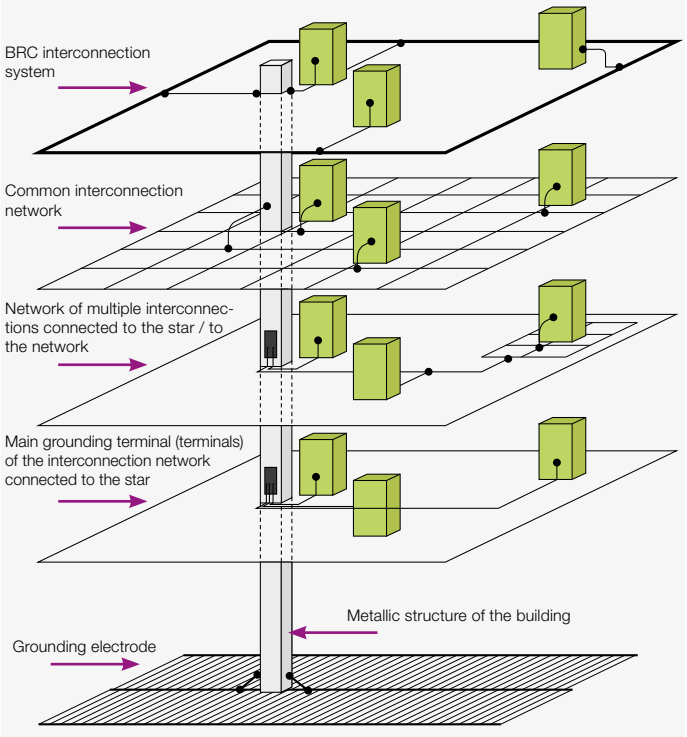
Fig. 16 part a shows the effect of internal coupling of the technology equipment when the protective grounds are connected improperly. *Fig. 16 part b* shows the superposition of the fault voltage on the technology equipment with a potential unwanted induction into the communication line and a potential damage of the given input.

The correct connection of the protective ground of the SPD and the technology is shown in *Fig. 17* where both grounds are connected to the same potential, and the fault current cannot be induced into the protected communication.

1.6.3. Principles of grounding and interconnection

In multistorey buildings the interconnection network is recommended to be installed on each floor (*Fig. 18*). Each floor is a specific type of a network. These interconnection systems on separate floors should be connected by wires in two points at least. The interconnection system on each floor should be connected to the common protective ground of the technology equipment and related SPDs in a way corresponding to the character of the technology equipment.

Fig. 18 Detail of multiple interconnections



1.6.4. Shielding installation rules for overvoltage and disturbance protection

If the shielded cable passes rooms complying with EN 50310, ed. 2 for spaces with information technology equipments, and interconnection is installed as a grid the shielding has to be installed according to *Fig. 19.* If these principles are not met and the shielding can not be connected to ET at the second end of the cable the shielding has to be connected via SPD according to *Fig. 20.*

Fig. 21 shows the way of linking two objects by a metal pipe so that the communication line does not need to pass through LPZ 0/1. This approach is called zone shaping and substitutes ST1 protections that are necessary otherwise. Next we show the correct connection of a shielding of a shielded cable between two objects when passing LPZ 0/1 and providing protection against atmospheric overvoltage at the same time.

Fig. 19 Connecting the shielding to the interconnection grid network

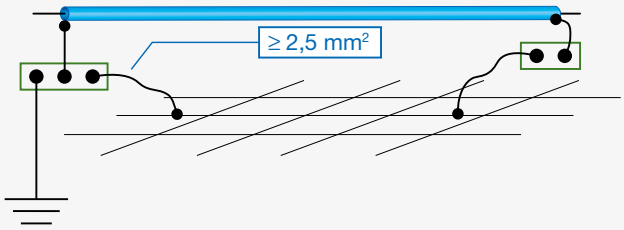


Fig. 20 Connecting the shielding via SPD

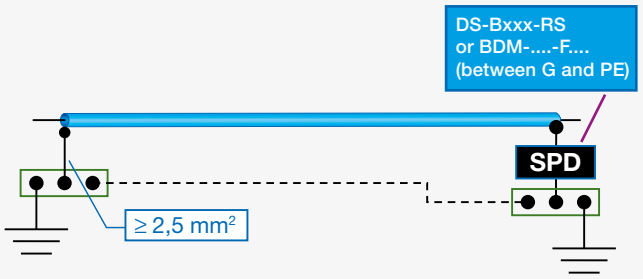
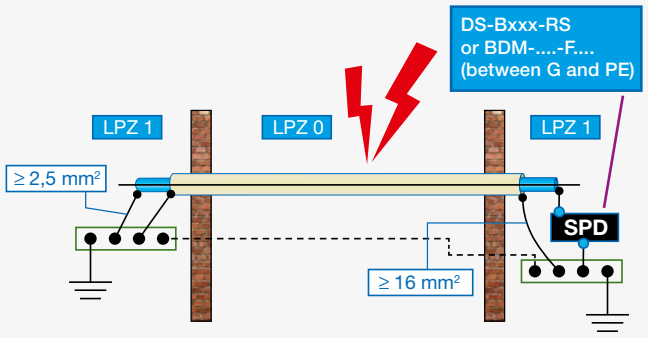


Fig. 21 Zone shaping by metal pipe



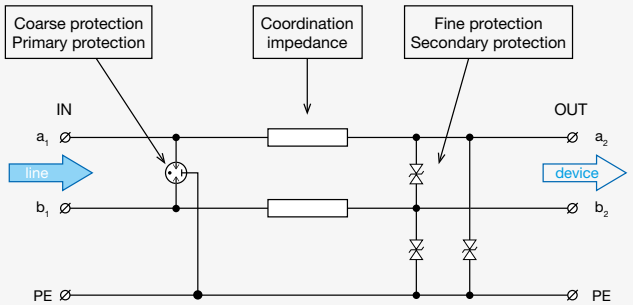
1.7. Components for protection of low current lines against overvoltage and their coordination

For the protection of low current communications components with different reaction times and different capabilities to collect are used. Consequently the SPD can either lead a huge amount of energy (but is slow) or a small amount of energy (and is very fast). E.g. gas lightning arresters or suppressors. If the surge protective device should be both efficient and fast, both types of components have to be combined. In order to ensure a proper common function of such heterogeneous components, their coordination has to be performed.

The requirement to reduce overvoltage in low current lines is very strict. The residual overvoltage has to be reduced to a nominal voltage level or its multiple most highly. Immunity of protective devices and the reaction rate have to be high. A sufficient surge protection cannot be achieved when using separate components those have been mentioned.

Usually, several protection components have to be arranged properly to achieve the desired function of surge protective device. Components those can handle large currents in a slow reaction are combined with very fast components those are unable to lead such an amount of energy. That way, overvoltage pulses are limited to a value that is not dangerous for the function of the protected equipment. As a coarse (primary) protection a gas lightning arrester is usually used. A fine (secondary) protection consists of a suppressor diode, a varistor or a Zener diode. *Fig. 22* shows the principle of coordination of these components.

Fig. 22



1.8. Design and installation of pulse overvoltage protection

1.8.1. Principles of protection design

When designing the overvoltage protection for low current systems, specific system layout has to be taken into account.

Power supply lines, data network inputs, communication line inputs, inputs for connection of measuring transducers and lines to actuators are the places for penetration of over voltage or disturbance to low current systems. The risk of penetration is higher if connecting lines are installed outside buildings with a risk of a lightning strike.

Another hazards are created by areas of strong electromagnetic fields which always contain undesired high-frequency components. In these situations appropriate high-frequency filters or a combination of a filter and a surge protective device have to be installed to power supply lines. Suppression of high-frequency disturbances in signal, measurement or communication lines is very difficult. Those phenomena usually indicate an incompetent designing or a low-quality assembly. Galvanic isolation of signal is considered to be a sufficient protection of lines. Let us emphasize that the galvanic isolation of the data line is primarily intended to isolate the line input from the common-mode voltage. However, used integrated circuits do not have a sufficient insulation resistance which can be even reduced by an improper design of the printed circuit board, by the residue of the soldering flux, by the parasitic capacitances among separate circuits, etc. In case of a high-energy pulse an arc can appear at the outlets and pulses can be superposed to other circuits.

1.8.2. Main rules of overvoltage protection design

- high-quality project preparation
- properly dimensioned interconnection with the equipotential busbar (attention has to be paid to potential inductive loops)
- line protection at the entry into the building by coarse protections – lightning arresters (immunity up to 5 kA in wave 10/350 μs)
- protection of measurement and regulation devices by installing the SPDs type 3 or ST3
- elimination of collisions of lines with power lines
- selection of a correct type of a lightning arrester and a surge protective device has to respect the nominal voltage, current and maximum signal frequency

Complexity and coordination of the SPDs is the fundamental principle for overvoltage protection. Thanks to complexity all inputs of the device (power, data and telecommunication interfaces) are protected. Thanks to coordination, protections with different protective effects are ranked along the line to protected equipment safely and systematically.

SALTEK data SPD ranges DM, DL and VL are two-stage protections with a nominal discharge current of 10 kA (8/20 μs). This value is sufficient for most applications. If the line is installed in outdoor environment (air, facade, etc.), or the line is a ground cable, the surge protective devices have to be completed by the ST1 protection – the lightning arrester – of the range BD-xx or FX-xx, rated for lightning current up to 5 kA (10/350 μs) or 20 kA (8/20 μs). These lightning current arresters are recommended to be installed just behind the entry of the outdoor line (cable) into the building.

Ranking BD or FXD range protections and DM, DL or VL range protections an alternative to the 3-stage low-voltage protection can be created.

- the 1st stage – SALTEK lightning arrester, range BD or FX for coaxial lines,
- the 2nd and the 3rd stage integrated into a one SALTEK arrester range DM-xx, VL-xx and DL-xx.

The minimum distance between the coarse protection (range BD-xx) and the combined medium and fine protection e.g. range DM, etc. should be 5 m. If this can not be ensured, the coordination of the protection has to be ensured in a different way for example by SPD ST 1+2+3.

The correct functioning of surge protective devices depends on a correct grounding. The PE terminal of SPD has to be connected to a suitable grounding point by a yellow-green wire with a cross-section of min. 2.5 mm^2 for ST 2+3 and a cross-section of min. 4 mm^2 for ST 1. The protective ground of the protected equipment in compliance with valid EN standards has to be used for grounding of protective devices (SPDs).

If the protected equipment is not connected to the low-voltage network, another grounding has to be used in compliance with valid EN standards. The grounding has to be connected to the frame (shielding, etc.) of the protected equipment. The grounding resistance of this grounding should not exceed 5 Ω but declared parameters of protective devices are met at values not exceeding 2 Ω.

Input and output terminals of SPDs can be used to connect wires of the cross-section 0.35 to 2.5 mm^2. The PE terminal should be connected to the protective ground of the protected equipment using a yellow-green conductor with the cross-section of at least 2.5 mm^2. For the ST 1 protection, the cross-section of the yellow-green wire is min. 4 mm^2. Correct and incorrect grounding of the SPD and the protected equipment is in *Fig. 16* and *17*.

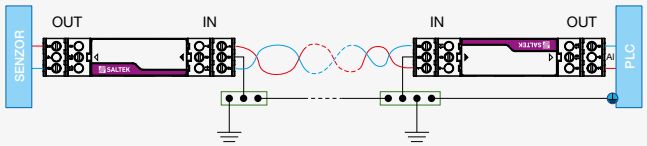
When installing, untreated input lines have to be ensured to be as far as possible from the treated (clean) output line. The way of grounding of shielding in shielded cable networks is not affected by the installation of protective devices. However, the unshielded end

of the shielding has to be protected against the effects of pulsed overvoltage by a lightning arrester, e.g. DS-B090-RS (RB), see *Fig. 20* and *21*. This protection is already done at SPDs with connection via connectors (range VL, DL, etc.) – the shielding is protected by a full surge protection against the protective ground.

SPDs have to be in principle placed such a way so that the output line to the protected equipment can be as short as possible. **Observe principally direction of SPD connecting: input – towards the line, output – towards the protected device. The direction of connecting is displayed on the body of the SPD by the full/empty arrow and the IN/OUT text.** If correct orientation of the surge protective device is not kept the protection does not meet declared parameters and can be destroyed.

The *Fig. 23* shows the connection of protective devices (SPDs) on the communication line.

Fig. 23 Input / Output of SPD



1.9. Selection of SPDs according to parameters of protected interface

Nominal voltage U_c. The amplitude of the transmitted signal must not exceed the nominal voltage of the protective device by more than approx. 10%, otherwise the useful signal may be reduced or the power supply may be damaged. The lowest nominal voltage should be therefore chosen which still does not reduce the useful signal. The minimum residual overvoltage at the input of the protected device can be ensured that way.

Nominal load current I_L. In the loop it must not permanently exceed the value given in the table of technical parameters.

Impulse current I_{imp}. At SPD type 1 or ST 1.

Limiting frequency f. If the frequency of the transmitted signal exceeds the limiting frequency of the used protective device, an excessive attenuation of the transmitted signal (> 2 dB) can occur.

Location in LPS. Definition of right LPZ.

Type of the line. The number of cores and if the common wire is connected or isolated to the ground.

1.10. SPD installation – safety rules

Installation of surge protective devices may be carried out by qualified personnel only. The valid technical standards must be complied during installation of SPDs.

The use of protective devices is permitted only within the scope of conditions given in the installation manual. If the use of the protective device does not respect specified conditions e.g. exceeded nominal voltage, current, etc., or the SPD is loaded above the specified conditions e.g. the direct lightning stroke to the line the SPD and the connected equipment can be destroyed.

Never install a mechanically damaged SPD. The damaged SPD should be sent to the manufacturer for inspection and repair. Never open the SPD. Any intervention may result in the destruction of the SPD. Any SPD intervention causes the loss of warranty.

1.11. Maintenance of the SPDs

Supplied devices are maintenance-free. During regular inspections equipment is checked from viewpoint of integrity and conductivity of grounding wires, and the type of operation, used conductors and tightening screws in terminal blocks. Damage of SPD during overload usually appears to be a short circuit or an interruption of line. Damaged protection is never repaired but replaced with a new one.

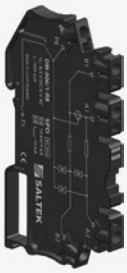
1.12. Ranges of SALTEK low current SPDs

- pluggable modules design
- compact design
- terminal block design
- LSA bars
- in a metal case with connectors (DL, VL, FX)
- in special metal case (HX, ZX)

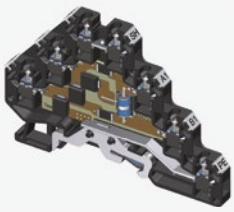
Examples of SALTEK low current SPDs

■ pluggable design

■ compact design



■ screwless terminal block



■ screw terminal block

■ into LSA disconnecting bars

■ in special metallic special case

■ in special metallic special case

■ in metallic case with connectors

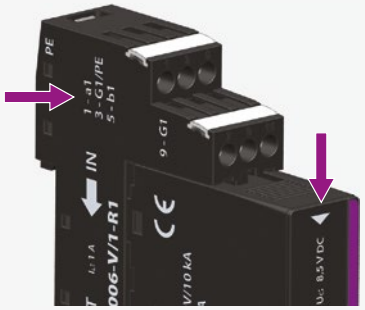
■ in metallic case with connectors

■ in metallic case with connectors

1.12.1. Marking INPUT – OUTPUT of SALTEK SPDs for low current systems

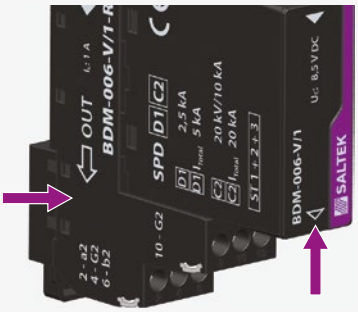
obr. 24a SPD input

- always in the direction towards the incoming line (cable)
- marking IN = INPUT
- terminals x1 (a1, b1,...)



obr. 24b SPD output

- always in the direction towards the protected device
- marking OUT = OUTPUT
- terminals y2 (a2, b2,...)



1.12.2. Code matrix of SALTEK SPDs for low current systems

Design with pluggable modules – ST 1

BD -xxx_ -V /n -F i

SPD for signalling lines at the interance of LPZ 0 and LPZ 1 zone

Maximum signal current

16 – ≤ 16 A

Signal ground
nothing – connected with the protective ground
F – separated from the protective ground by lighting arrester

In case of BD, the static starting voltage of lighting arrester
090-T – 90 V DC
250-T – 250 V DC

The number of two-core lines (1, 2)

With pluggable module

Design with pluggable modules – ST1+ST2+ST3

BD _ HF -xxx_ -V /n -x -F R i

SPD for signaling lines ST1+ST2+ST3

Connection
G – floating voltage line
M – ground with common reference potencial

Transmission rate
nothing – ≤ 20 MHz
HF – high transmission rate

Nominal voltage
006 – 6 V
012 – 12 V
024 – 24 V
048 – 48 V
110 – 110 V
230 – 230 V

Maximum signal current
nothing – ≤ 500 mA
1 – ≤ 1 A
2 – ≤ 2 A

Coordinating impedance
R – resistor

Signaling ground
nothing – connected with the progresive ground
F – separated from the protective ground by lightning arrester

The number of cores per line
J – 1
nothing – 2
4 – 4

The number of 2(1)-core lines (1, 2, 4)

With pluggable module

Design with pluggable modules – ST 2+3

DMP -xxx -V /n -x F R i

SPD for signaling lines (coarse and fine) – ST2+ST3

Connection
M – ground with common reference potential
P – feeding to I_n 16 A

Nominal voltage
012 – 12 V
024 – 24 V

With pluggable module

The number of 2(1)-core lines (1)

The number of cores per line
J – 1
nothing – 2

Signaling ground
nothing – connected with the protective ground
F – separated from the protective ground by lightning arrester

Coordinating impedance
R – resistor

Maximum signal current
1 – ≤ 1 A

Compact design – ST 2+3

DM -hf -xxx /1 n z DJ

SPD for signaling lines (coarse and fine) – ST2+ST3

Transmission rate

Nominal voltage
006 – 6 V
012 – 12 V
024 – 24 V
048 – 48 V
PROFIBUS types:
5V – 5 V
24 – 24 V

Number of lines (1)

The number of cores per line
nothing – 2
3 – 3
4 – 4

Coordinating impedance, max. signal current
R – resistor, ≤ 60 mA
L – choke, ≤ 380 mA
L2 – choke, ≤ 2 A

Terminal block design – ST 2+3

DM _ ff -xxx /n -R _

SPD for signaling lines (coarse and fine) – ST2+ST3

Connection
G – floating voltage line
nothing – ground with common reference potential
J – single-core line, the ground is common reference potential

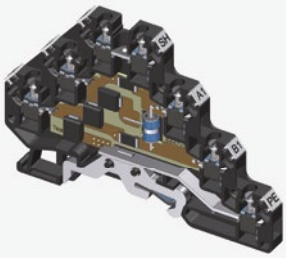
Transmission rate
nothing – ≤ 20 MHz
HF – high transmission rate
LF – ≤ 70 kHz, high-frequency filter

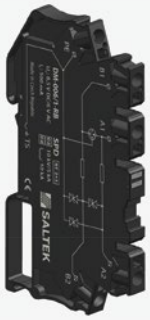
Nominal voltage
006 – 6 V
012 – 12 V
015 – 15 V
024 – 24 V
048 – 48 V
110 – 110 V

Number of lines (1, 2)

Overvoltage protection in terminal block

Design of contacts of terminal block
S – screwed
B – screwless



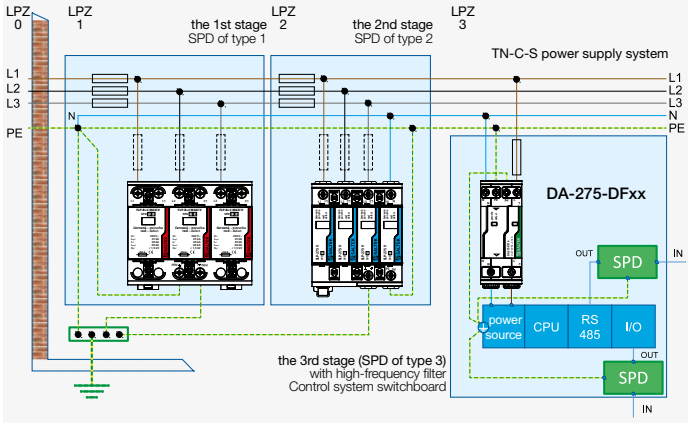


2. Examples of SPD Application – Power supply protection

2.1. Low Voltage power supply protection

For low current devices/equipments/systems which are supplied from the distribution network 230/400 V AC, a sufficiently low level of over-voltage has to be ensured that corresponds to the nominal pulse voltage U_W devices of the Class I, i.e. below the level of 1.5 kV reduced for 20%, i.e. to 1.2 kV. To have the protection sufficiently effective, a threestage cascade of particular types of SPDs has to be installed in appropriate switchboards. The last stage of power protection (SPD T3) must not be in a longer distance than 5 m from power supply terminals of the low current device (*Fig. 25*).

Fig. 25 Protection of control systems from side of LV power supply



For low current non-processor technologies, SPD of type 3 without RF filter is suitable, such as the DA-275-DJ25 type.

If a low current system is controlled by a processor (electronic security systems, electronic fire alarms, PLCs, access control systems, etc.), the SPD protection type 3 has to be equipped with a high-frequency filter aimed to eliminate the effects of undesired transient pulses in the power supply those can be caused, e.g. by a drilling machine with pure interference suppression. The SPD does not respond to these pulses due to their small amplitude (hundred volts). So, the pulses penetrate to the system, which is not destroyed, but the processor can freeze or can be damaged, and memory chips can be erased, resulting in malfunction of the system. In this situation, the SPD type 3 is therefore appropriate being used with a high-frequency filter, e.g. DA-275-DF16 which is capable to solve the problem. The principle of connection and filter function are in *Fig. 26*.

If a low current system is equipped with an additional power source e.g. switchboard of electronic security systems or electronic fire alarms, the SPDs type 3 with a high-frequency filter with a power interruption, e.g. type DA-275-DFi16 are recommended being used. If the SPD is damaged, the power supply is automatically disconnected and the system is switched to a emergency power source and reports a power failure. This prevents the system from being unprotected and the next pulse penetrating via the power supply will not destroy the system.

2.2. Small Voltage power supply protection

For low current systems those are powered by different DC or AC small-voltage sources, a sufficiently low level of surge over voltage has to be ensured that corresponds to the nominal value of the small voltage.

For this purpose, SALTEK offers SPD range DP (ST 2) for small voltages from 12 V to 60 V *(Fig. 27)*. If the processor of system equipment powered by small voltage needs to be prevented from freezing and the effect of RF disturbance needs to be eliminated then the power protection combined with the high-frequency filter is appropriate again, e.g. type DPF-024.

Obviously, the three-stage SPD cascade on the low voltage side is again assumed to be installed in front of the small-voltage power source.

Fig. 27 SPD, range DP

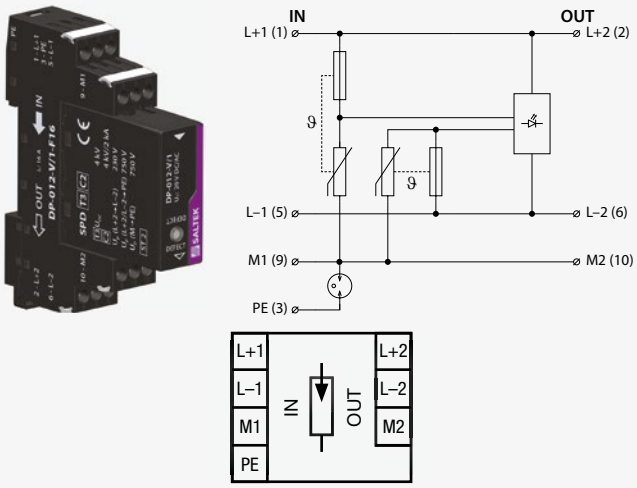
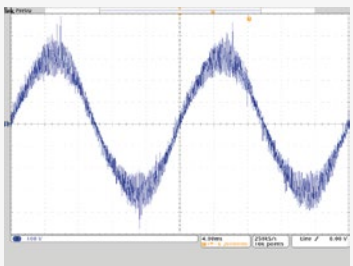
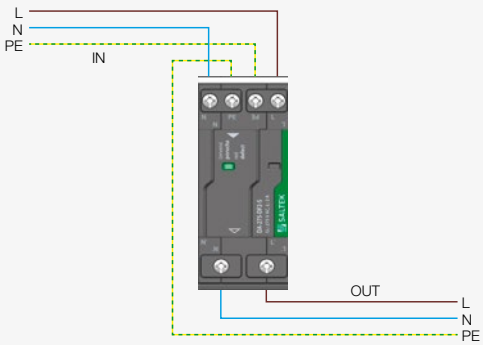
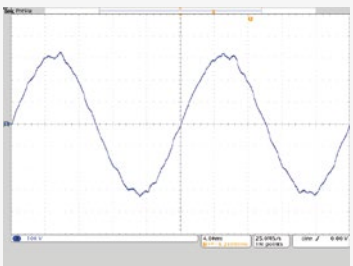


Fig. 26 An example of wiring the SPD of DF range in the TN-S (TT) network with the power supply response before and after protection.



Response of the disturbed power supply on the input side of SPD DF





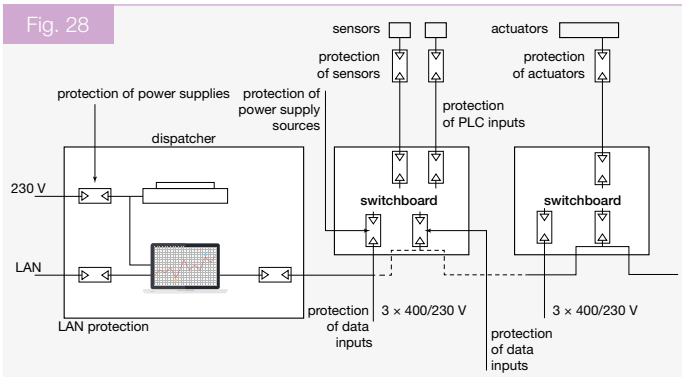
Response of the filtered power supply on the output side of SPD DF

3. Examples of SPD Applications – Measurement & Regulation

3.1. Protection of distributed M&R control systems

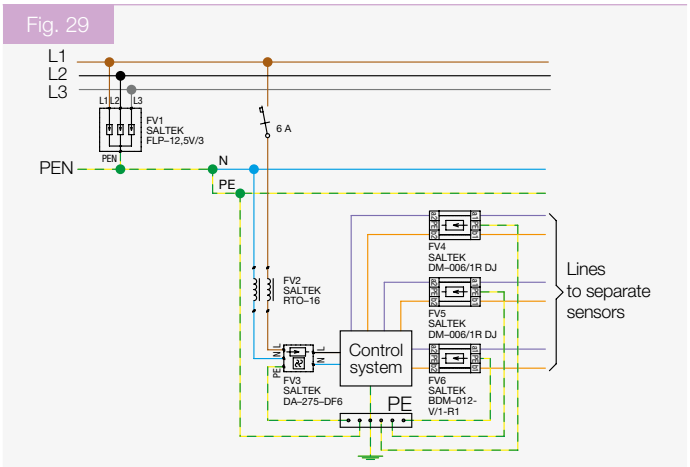
The effect of pulsed overvoltage or RF disturbance can cause the collapse of the information and control systems of the technology equipment. Damages and losses resulting from overvoltage or RF disturbance are becoming higher and higher. This is due to the continued miniaturization of these systems, and consequently, their lower immunity. Subsequent losses due to production outages, loss of data and information are often even higher than direct damage to the equipment. In addition, a serious manufacturing breakdown might occur in industry. Distributed systems are particularly prone to overvoltage failure. Separate parts of the system might have different potentials and might be powered from different power supply lines. These systems usually include long lines. An extensive M&R system in a power plant or data network (Ethernet) are typical examples of distributed systems. An example of such a system is shown in *Fig. 28*.

Fig. 28



In the control computer, power supply sources of all devices have to be protected against overvoltage peaks in the power supply network. If the system is connected to a LAN, the LAN input is recommended to be protected as well. In the switchboard of a distributed system, the one-phase supply of power supply sources of electronics is recommended to be protected at least. Additional stages of SPD are usually installed in the parent switchboard or the main switchboard. The inputs of the data bus are protected at the input of the switchboard. If remote sensors (current loop transducers, switches, etc.) are connected to the devices, measuring inputs connected to these sensors are necessary to be protected as well. Outputs to actuators e.g. proportional valves, inverters have to be protected the same way. If sensors or actuators include electronic circuits amplifiers and transducers for standardized signal, inputs and outputs of sensors are recommended to be protected too. This principle is shown in *Fig. 29*.

Fig. 29



If remote power supply of sensors is used (either DC or AC), the power supply sources and sensor stabilizers are recommended to be protected also.

The data line protection should be included into the switchboard input. At a higher transmission rate, the cable is necessary to be properly connected, which should not form stubs and should maintain linearity. For RS-232, DMG-012-V/1-4R1 is recommended. For RS-422 (two pairs), the protection DMG-012-V/1-4R1 or BDM-012-V/2-R1, and for RS-485 is BDM-006-V/1-R1 recommended. In case of shortage of space, DM-006/1-RS or DM- 006/1-RB are recommended. These SPDs are narrow terminal blocks (6 mm wide) with a screw terminals (RS) or a screwless terminals (RB), *(Fig. 30a* and *30b)*.

Fig. 30a Screw terminal block

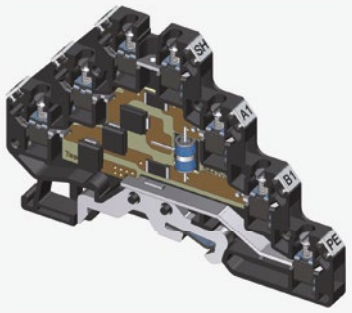


Fig. 30b Screwless terminal block

3.2. Protection of sensors and sensor inputs

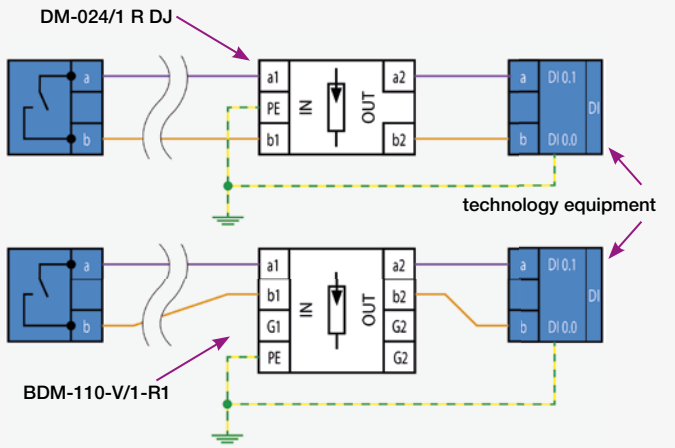
The protection of inputs and outputs of control units is as important as data line protection. Voltage peaks causing malfunctions or destruction of the device might appear on input lines of sensors as well. In many cases, sensors and actuators should be protected themselves, when containing electronic circuits especially. Again, the protection should be installed near the equipment to be protected. The protection must not affect the function of the sensor and should not affect the error of output data of the sensor. If this effect cannot be eliminated, the impact of protection on the total error of sensor data has to be known and has to be considered.

Protection of digital inputs

Sensors connected to digital inputs with a longer line are related to a different potential and powered from another source. Then, the digital inputs should be protected even if insulated in a galvanic way. In real life, protection of the input for a potential-free contact and input protection for the sensor output with open collector can be considered.

Fig. 31 shows an example of input protection for binary signals by a compact and pluggable version of SPD.

Fig. 31 Binary signals



For multiple binary signals with a single common non-grounded wire, the principle of protection is shown in *Fig. 32*: the protection of binary inputs and outputs of power elements with ungrounded common pole is shown here, including protection of the power supply source.

Fig. 33 shows the principle of wiring in case the common wire is grounded. The figure specifically shows wiring with the grounded positive pole of the source. If the negative pole of the source is grounded, then the plus and the minus have to be swapped in the schematics, and the colors of wires have to be exchanged – red to blue and vice versa.

Input protection for potential-free contact

Either the DM protection or the BDM protection can be used. The nominal voltage is selected according to the related voltage of the contact. The mechanical contact itself is quite resistant to overvoltage destruction. The protection of the contact is recommended by a lightning arrestor in a terminal block DS-B240-RS or DS-B240-RB only in case if contact failure e.g. by welding in case of an arc at surge tip could cause a serious failure.

Fig. 32 Binary input – output, common ungrounded conductor

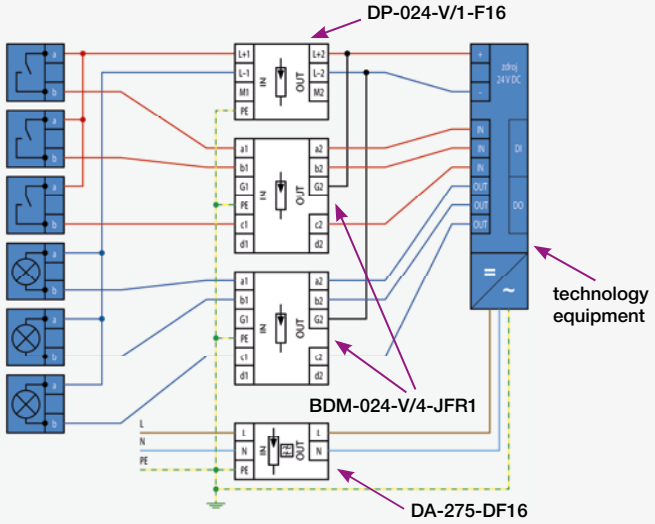
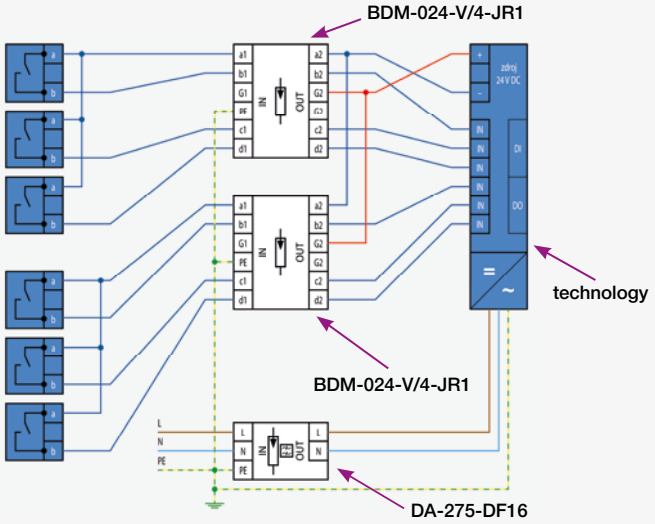
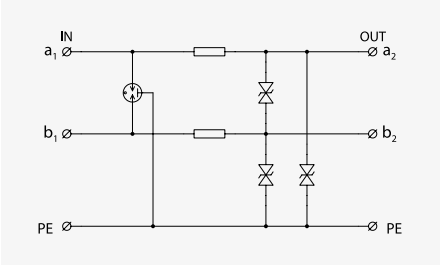


Fig. 33 Binary input – output, common grounded conductor

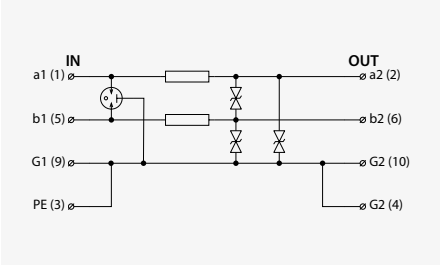


Connection diagrams

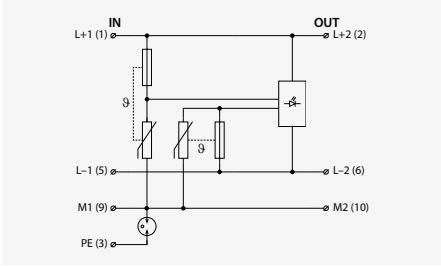
DM-024/1 R DJ (see *Fig. 31*)



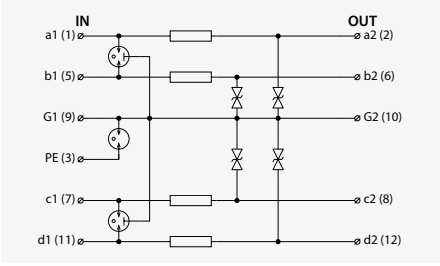
BDM-110-V/1-R1 (see *Fig. 31*)



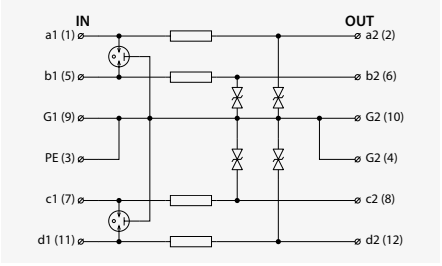
DP-024-V/1-F16 (see *Fig. 32*)



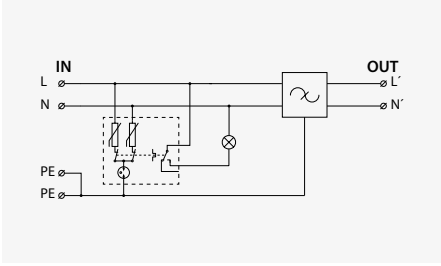
BDM-024-V/4-JFR1 (see *Fig. 32*)



BDM-024-V/4-JR1 (see *Fig. 33*)



DA-275-DF16 (see *Figures 32, 33*)



Protection of the sensor with the PNP output is in *Fig. 34.* The version uses a galvanically separate input, when a dual SPD is more suitable being used. The SPD range DM in the compact design is used in the wiring.

The wiring with SPD with the pluggable module is shown in *Fig. 35.*

Fig. 34 Ungrounded pole

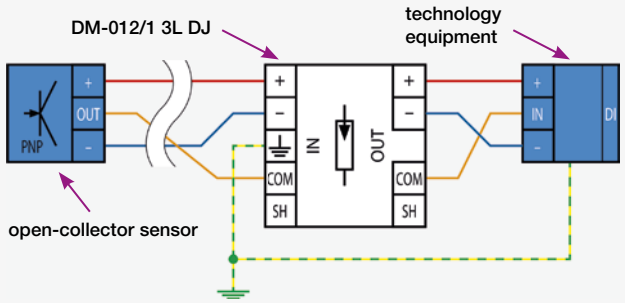
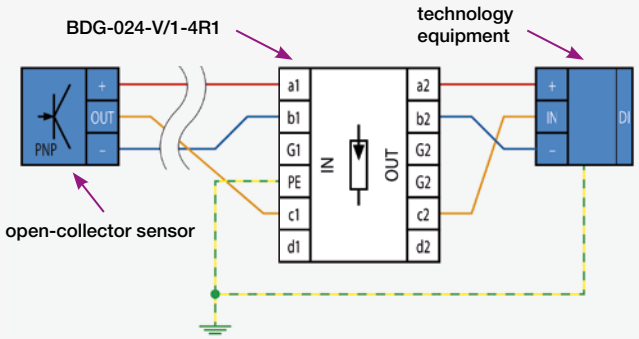


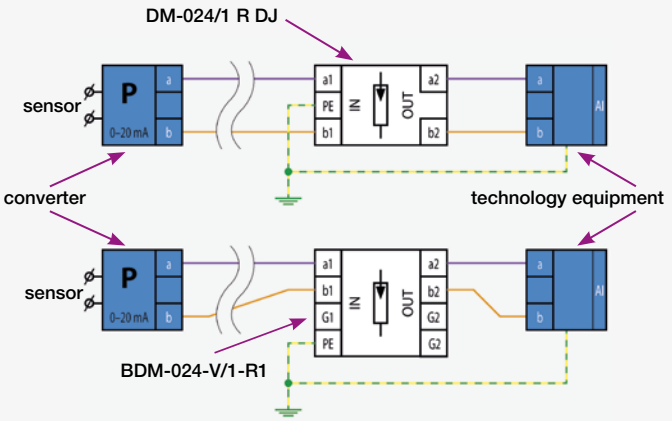
Fig. 35 Ungrounded pole



Protection of analog inputs

Analog inputs are more sensitive to the damage by overvoltage than digital inputs. In projects of industrial control systems, inputs for measuring temperature e.g. thermo-elements, resistive thermometers and inputs for universal signals (0-20 mA or 4-20 mA or 0-10 V) are the most common ones. Sensors are often located far from the control system, on different potentials and connected by long lines. In order to reach a sufficient immunity against disturbance, galvanic separation is often used. The breakdown voltage is usually low and even the design of the separator (circuit board) is not designed according to overvoltage protection rules. In any case, additional protection is recommended. An example of a current loop 0-20 mA (4-20 mA) protection is in *Fig. 36* in the compact design of SPD and the pluggable version.

Fig. 36 Overvoltage protection of current loop signal w/o external power supply (compact and pluggable design)

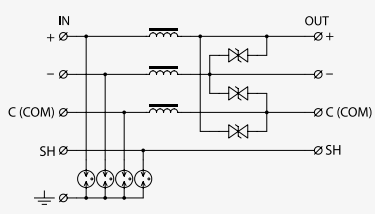


Protection of converters 0–20 mA, 4–20 mA

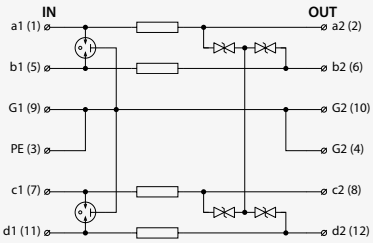
Due to disturbance immunity, converters with current loop output are often used for remote measurements. In most cases, converters themselves contain electronic circuits and that´s why they should be protected. If the device is powered separately from the power network then the internal power source should be protected by SPD type 3 with RFI filter.

Connection diagrams

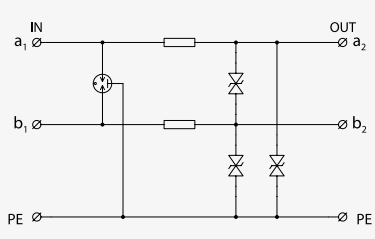
DM-012/1 3L DJ (see *Fig. 34*)



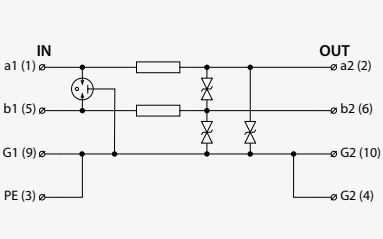
BDG-024-V/1-4R1 (see *Fig. 35*)



DM-024/1 R DJ (see *Fig. 36*)

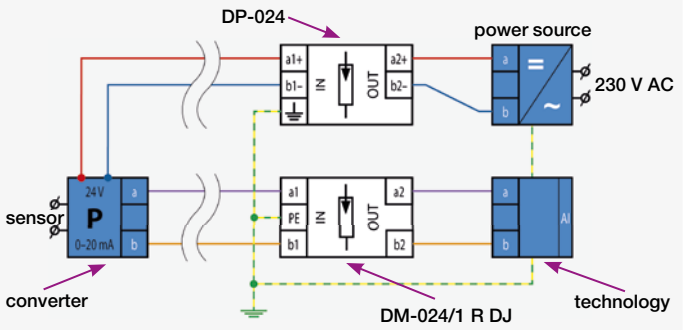


BDM-024-V/1-R1 (see *Fig. 36*)



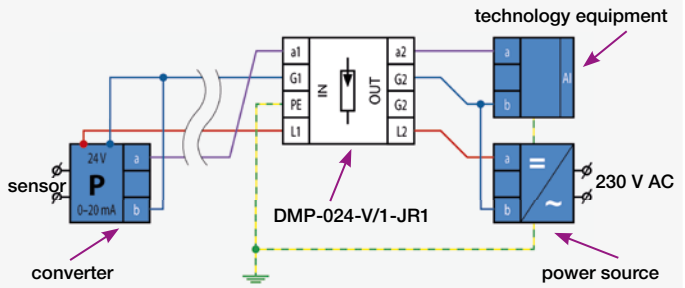
Protection of a current loop, which is supplied from external power source of 24 V DC, is in *Fig. 37*.

Fig. 37 With external power supply – not grounded pole



The current loop protection with external power supply and a common wire is in *Fig. 38*. The protecion is realized by a combined (coarse and fine) SPD with pluggable module range DMP.

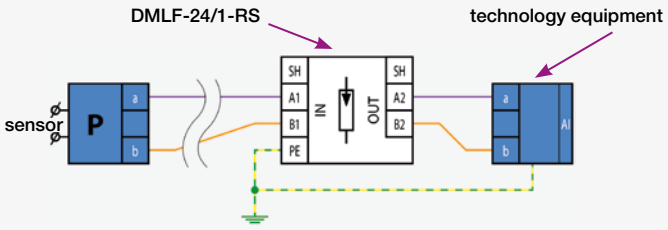
Fig. 38 With external power supply – grounded pole



If analog signal communication (0-20 mA, 0-10 V) is exposed to high-frequency e.g. electromagnetic field close to the welding machines then SPD for low current systems with a low-pass filter is recommended so that all high-frequency components can be filtered out.

For this purpose, special SPD range DMLF should be used. They are available in screw or screw-less design. Connection of these SPDs *Fig. 39*.

Fig. 39



Protection of the thermoelectric cell

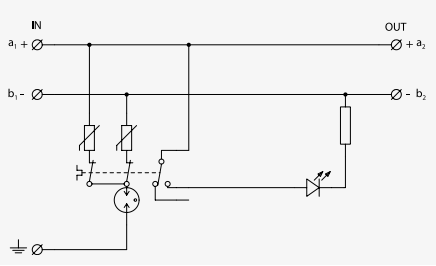
Protection of the input for thermoelectric cells is problematic due to the very low range of input voltage that is required for measuring of the thermo-element voltage. Leakage currents and thermoelectric voltage of the protection may negatively influence the measurements. In any case, the protection must be connected behind the terminal block representing the cold junction of the thermo-element. In case the thermo-element has to be protected e.g. due to long lines of the thermo-element near electric machines, an external isothermal terminal block is recommended to be used. The external isothermal terminal block provides the best results in terms of measuring errors. The terminal block should be connected as close as possible to the inputs of the measuring system and then behind it the protection device should be connected.

3.3. Communication bus protection

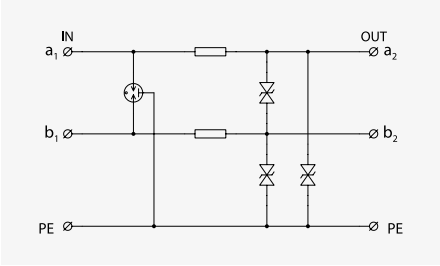
Communication buses are used to transmit data between different systems. There are many communication busses. *Fig. 40* shows the implementation of protection of separate devices on the most commonly used RS-485 addressable communication bus, using pluggable version of SPDs for low current systems.

Connection diagrams

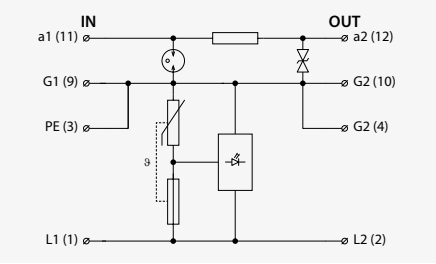
DP-024 (see *Fig. 37*)



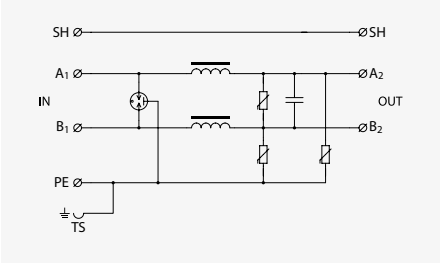
DM-024/1 R DJ (see *Fig. 37*)



DMP-024-V/1-JR1 (see *Fig. 38*)



DMLF-24/1-RS (see *Fig. 39*)



If the shielded communication cable is used, then the shielding on the side of the control system is connected directly to the ground (via the SPD BDM-006-V/1-R1) and the other devices connected to communication bus should be connected indirectly via the terminal DS-B090-RS or the SPD BDM-006-V/1-FR1 *(Fig. 40).*

In various systems, RS-485 communication is more often used in combination with the power supply of the technology equipment. Protection of RS-485 communication line + power line with common power conductor by SPD DMP range is shown in *Fig. 41*.

Fig. 40

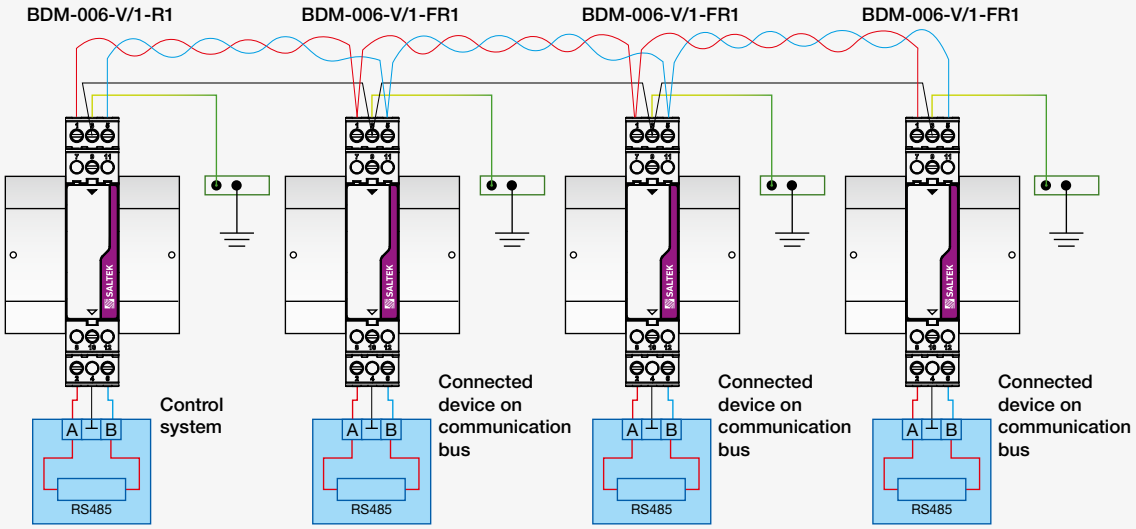
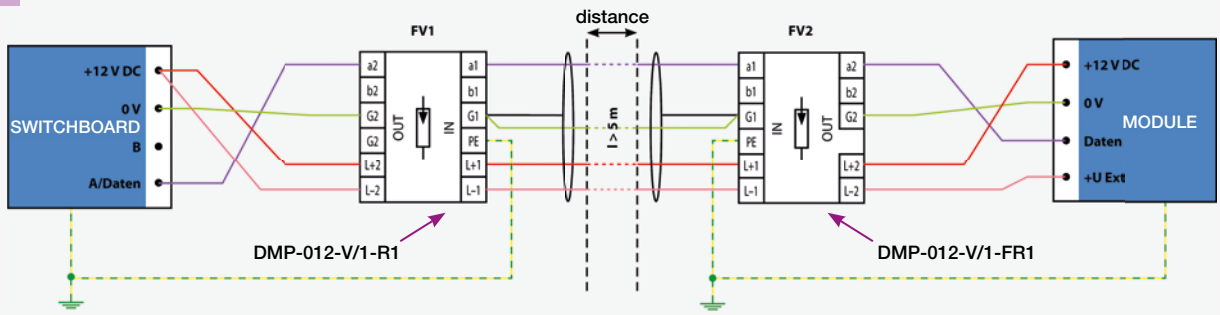
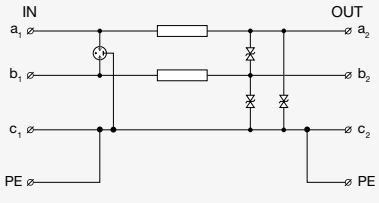


Fig. 41

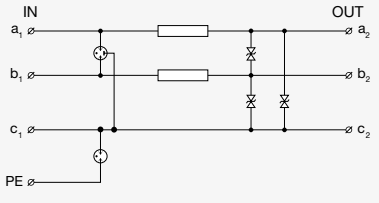


Connection diagrams

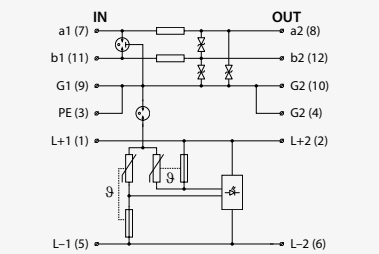
BDM-006-V/1-R1 (see *Fig. 40*)



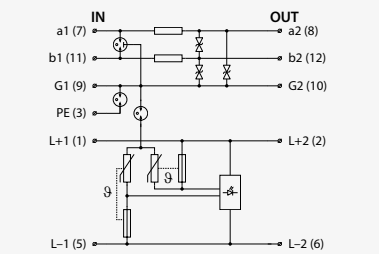
BDM-006-V/1-FR1 (see *Fig. 40*)



DMP-012-V/1-R1 (see *Fig. 41*)



DMP-012-V/1-FR1 (see *Fig. 41*)



3.4. Usage of SPDs in SELV and PELV circuits

SELV=separated or safety extra-low voltage
PELV=protected extra-low voltage

IEC defines a SELV system as "an electrical system in which the voltage cannot exceed ELV under normal conditions, and under single-fault conditions, including earth faults in other circuits".

IEC 61140 defines a PELV system as "an electrical system in which the voltage cannot exceed ELV under normal conditions, and under single-fault conditions, except earth faults in other circuits". In contrast to a SELV circuit, a PELV circuit can have a protective earth (ground) connection.

In special areas, where SELV is required and the protective shielding is used, the protective shielding (connected to e.g. a protective interconnection of the supply network) has to be insulated from each neighboring circuit by the basic insulation designed for the highest occuring voltage, see *Fig. 44*.

In SELV circuits, binary and analog signals are very common. Mainly a current loop of 0-20 mA (4-20 mA), *(Fig. 42)*.

Fig. 43 shows the connection of binary signals with SALTEK SELV SPDs.

To protect technology equipments and communication lines in SELV circuits, SALTEK produces special SPDs that meet the requirements for SELV circuits. These SPDs are DMG-024-V/1-4R1 or DMG-024-V/1-4FR1 which are able to provide the required electrical parameters for overvoltage protection as well as for SELV circuits application rules.

The standard SALTEK SPDs can be used without modifications in PELV circuits.

Fig. 42

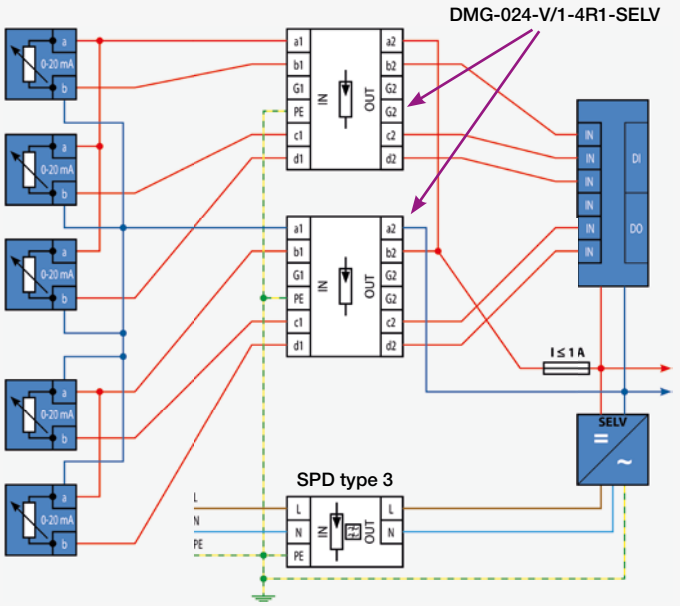


Fig. 43

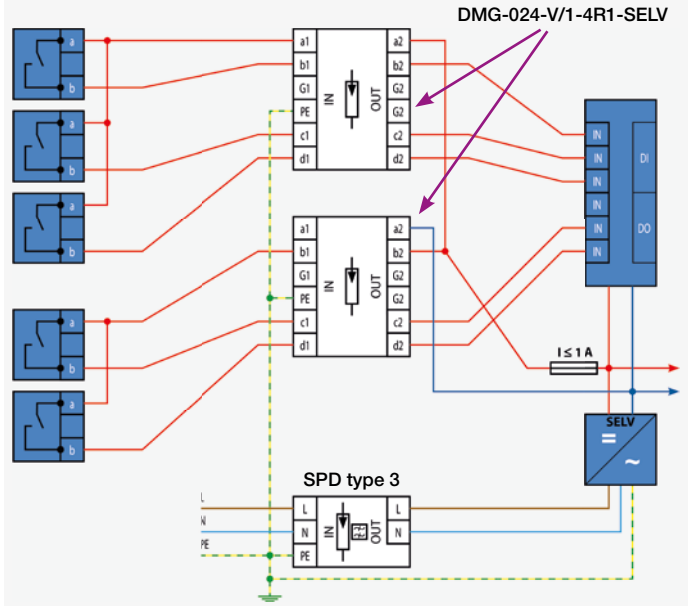
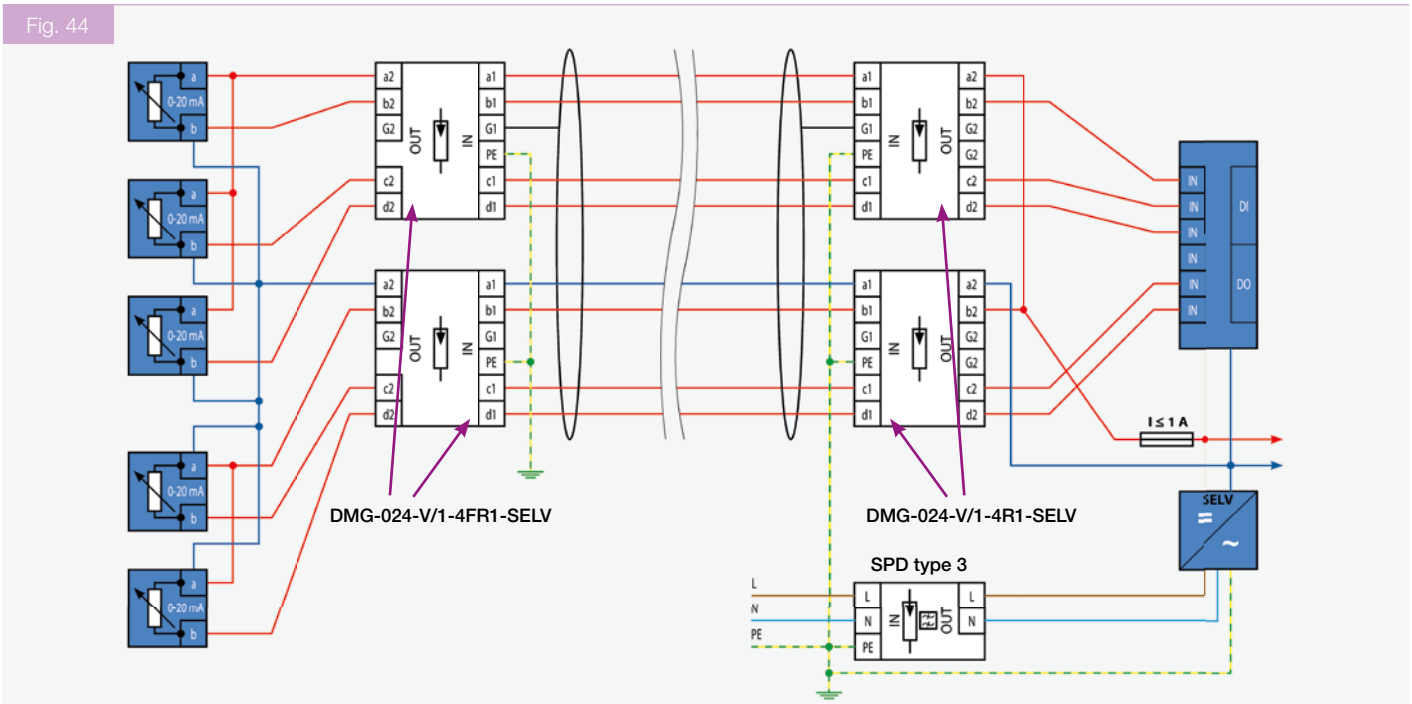


Fig. 44



3.5. SPD application in circuits with pulse overvoltage and overcurrents

In industrial environment very often occures the situations when due to the fault in the electronic circuit (typicaly it´s a shortcut) the power network voltage of 230 V AC can be present on the communication data lines. These lines operate normally only with extra low voltages. The shortcut loop has usually high resistivity which isn´t enough to trip the circuit breaker connected at the beginning of the power line from which the electronics is supplied. This is why the power line voltage (230 V AC) remains permanently on the electrical equipment impacted by the circuit fault and finally it´s dangerous for the human body as well as for the technology equipment itself.

This can be avoided by specialized integrated SPD range DMS-xx. This SPD was designed for DIN rail mounting, and includes a powerful overvoltage protection that repeatedly protects the M&R interface against all types of overvoltage. In addition, the SPD is equipped with special which disconnect the technology equipment from the exposed line during the presence of the higher voltages than is allowed *Fig. 45*.

Fig. 45

After the fault has been cleered out (i.e. after removing the incoming voltage from line), the device returns automatically to the pass-through state and the measurement, or the data transfer, can be continued without the operator having to intervene.

This special SPD range DMS is mainly used in pipelines for M&R lines, in railways, mines, and other industries where bus lines and M&R lines run in parallel to low-voltage distribution networks, and where a dangerous voltage might be induced in case of a malfunction.

4. Examples of SPD applications – Electronic security/fire alarm systems

4.1. Protection of electronic security/fire alarm/monitoring and access control systems

Security and monitoring systems also include a communication interface. Control units can be equipped with a direct telephone line for automatic alarm reporting, a GSM modem or telephone, or an Ethernet interface for connection to a local area network or the Internet. This allows, for example, remote control and monitoring or CCTV video monitoring anywhere in the world.

The high risk of lightning current injection into the telephone line threatens due to the indirect lightning strike or the strike into the line. Therefore, the overvoltage protection on the telephone line should be designed for lightning currents, especially. According to the type of the line, the SALTEK SPDs in different design ranges CLSA, BD, DL can be used (*Fig. 46a, b, c*).

Fig. 46a SPD CLSA range

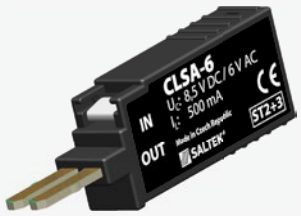


Fig. 46b SPD BD range

Fig. 46c SPD DL range

4.2. Zones wiring protection in electronic security/fire alarm systems

Input of low-voltage line into the building
A basic power-supply protection at the boundary of zones LPZ 0 and 1, i.e. SPD type 1 and 2. It would be in the main switchboard of the building (type FLP-B+C MAXI V/3). The application is in *Fig. 25*.

Protection of power supply in main control unit (MCU)
SPD type 3 with an integrated noisesuppressing high-frequency (RFI) filter installed in the switchboard of the security system – as much close as possible to the protected device. This protection reduces high-frequency disturbance in the network (type DA-275-DF6 or DA-275-DFi6).

In case of a power failure, the MCU is automatically switched to the backup power supply. Therefore, the use of the SPD DA-275-DFix is preferred rather than the standard DA-275-DFx. This type is able to disconnect the MCU from the power supply in case of a failure of the SPD. That way, the MCU is perfectly protected from the subsequent overvoltage pulses that could destroy it. High-frequency disturbance may be very harmful to electronic security/fire alarm systems, and can cause unpredictable system states. Therefore, the disturbance has to be removed if there is a risk of data loss, direct or indirect irreversible damage to property.

Protection of circular loop
The two-stage SPD (ST 2+3) for internal sensor zone loops e.g. motion IR sensors, door and window magnetic sensors, glass break detectors, flood detectors, emergency buttons, smoke and heat sensors, gas leakage detectors, CO sensors, etc. SPDs are installed as close as possible to the MCU e.g. type BDM-024-V/2-R1. When the zone loop passes from LPZ 0 to LPZ 1, the lightning current arresters (ST 1), e.g. type BD-090-T-V/2-16, should be installed at the entering point to the building. If the sensors or the MCU are located within the distance 5 m from the loop entering point to the building (from LPZ 0), then combined three-stage SPD (ST 1+2+3 e.g. type BDM-024-V/R1 and BDG-024-V/1-FR1 should be installed. Example of the protection of the zone loop inside the object is in *Fig. 47a* and *Fig. 47b*.

Fig. 47a Version for loop current up to 500 mA

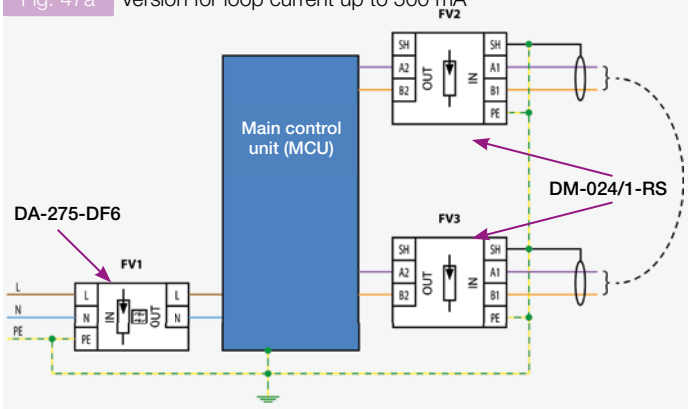
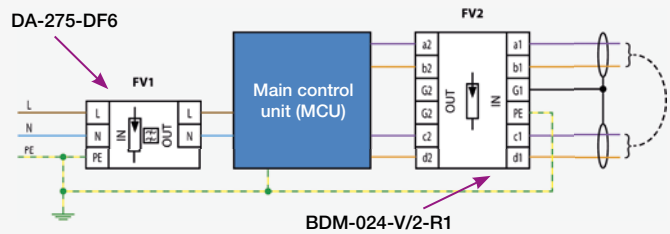


Fig. 47b Version for loop current up to 1 A
For version up to 2 A, two pieces of BDM-024-V/1-R2 have to be used



Protection of keyboard, tab, operator panel
A combined SPD e.g. the type DMP-012-V/1-(F)R1 is installed between the MCU and control interface (keyboard, tab, operator panel, etc.) to protect the RS-485 and power line (AUX output) together. The SPD should be installed as close as possible to the protected devices on both sides. Example in *Fig. 48*.

Protection of Ethernet communication line
SPD range DL-Cat. 6 is connected between the MCU and local data network/PC/router. The SPD should be installed as close as possible to the protected devices.

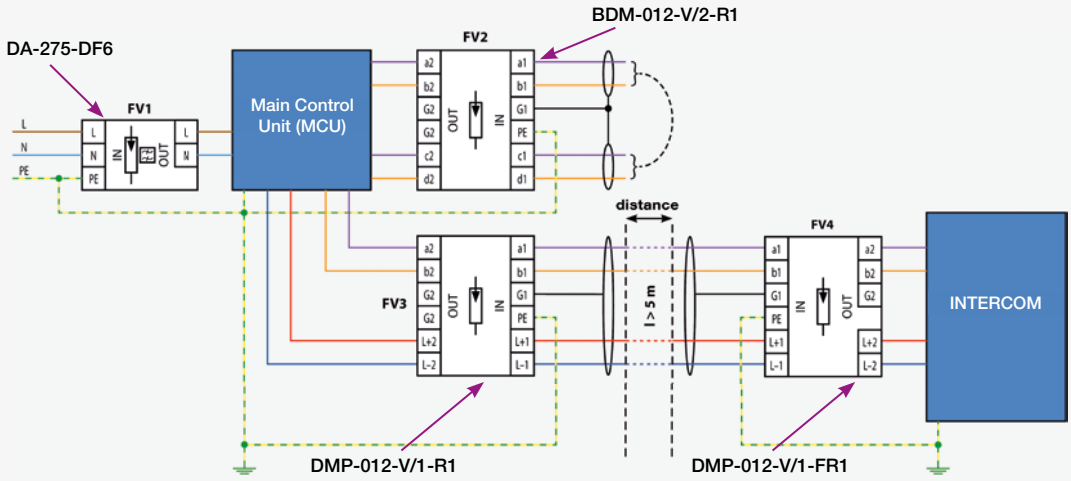
Protection of telephone line entering point to the building
A three-stage SPD (ST 1+2+3) to protect the telephone line installed at the building enterign point – type BDG-230-V/1-R, and a two-stage SPD (ST 2+3) for the telephone line connected into electronic security/fire alarm system. The SPD type DL-TLF-HF has parameters suitable for high-frequency xDSL lines and should be installed as close as possible to the protected device (MCU, phone-line communicator, etc.).

Protection of cameras (e.g. CCTV, IPTV, intercoms)
A three-stage SPD (ST 1+2+3) type DL-1G-RJ45-PoE-AB is installed for outdoor and indoor IP cameras with Ethernet line Cat.6 without or with PoE in A or B mode. The SPD should is installed at the entering point to the object.

For outdoor cameras with coaxial cable connection a lightning current arrester (ST 1) type FX-090 B75T F/F should be installed at the entering point of the line to the building. As the second stage of the overvoltage protection, the SPD (ST 2+3) the type VL-B75 F/F is installed just in front of the protected device. The same type VL-B75 F/F is used to protect indoor cameras with a coaxial line or their DVR recording equipment.
If the video signal is transmitted from the camera via a twisted pair, then the SPD VL-SV is required. All types of VL range are designed to prevent the distrubance of video signal, which is a common case of video signal failure in large systems.

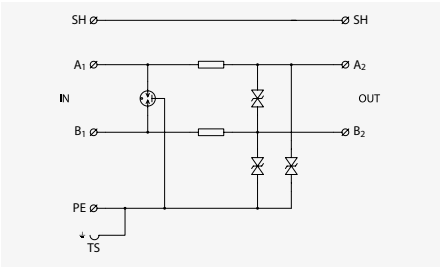
In case of cameras powered and controlled via the RS-485 communication line e.g. PTZ cameras, a combined SPD (ST 2+3) e.g. type DMP-xxx-V/1-(F)R1 should be installed as close as possible to the protected device for protection of the RS-485 communication line with power supply. For video signal transmission, the VL-B75 F/F can be used for a coaxial line. The DL-Cat.5e can be used for signal transmitted via a FTP cable. The DL-1G-RJ45-PoE-AB or DL-10G-RJ45-PoE-AB can be used for cameras with PoE.

Fig. 48 RS 485 communication and power supply protect via DMP range of SPD

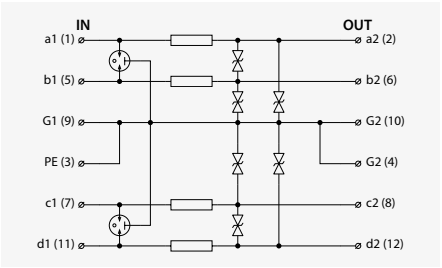


Connection diagrams

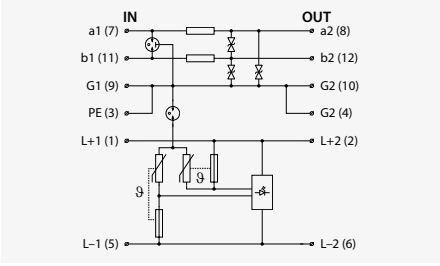
DM-024/1-RS (see *Fig. 47a*)



BDM-024-V/2-R1 (see *Fig. 47b*)



DMP-012-V/1-R1 (see *Fig. 48*)



DMP-012-V/1-FR1 (see *Fig. 48*)

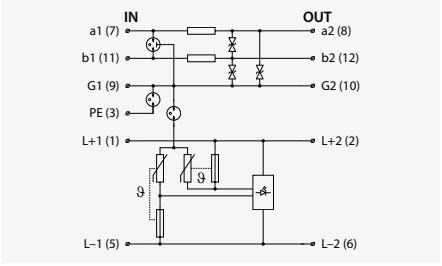
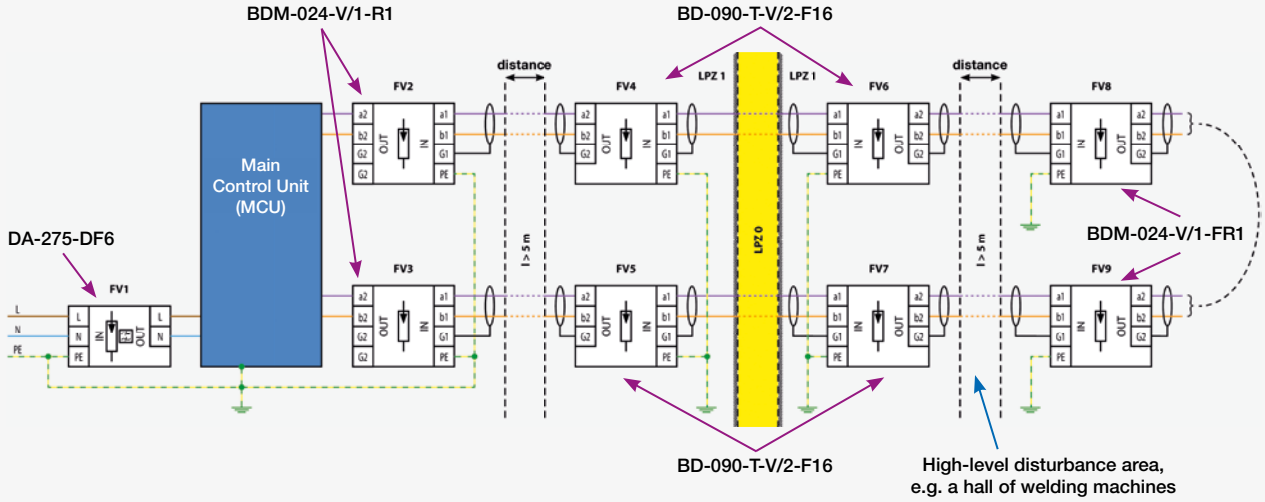


Fig. 49 Solution of protection for crossing between the zones LPZ 0 and LPZ 1
MCU and sensors with a long distance from LPZ 0-1, areas with high level of disturbance



4.3. Examples of protection of communication lines in electronic security systems

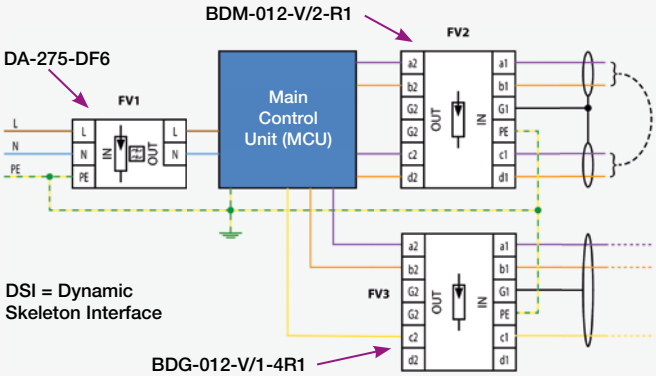
4.3.1. Protection of circle line – general case

If the distance of the main control unit from the crossing point of zones LPZ 0-1 is less than 5 m then the FV2 and FV4 protections can be changed to a single SPD BDM-024-V/1-R1 located at position FV2. The same is valid for FV3 and FV5 protections. If the the circle line does not cross a high-level distrubance area in the second building, FV8 and FV9 protections are not needed to be installed.

4.3.2. Protection of selected communication lines

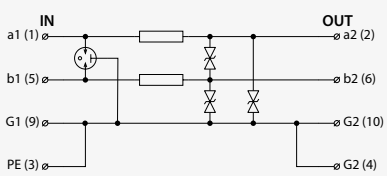
The *Fig. 51, 52, 53* clearly show that the communication lines are very similar each other, and the same type of protection (SPD) can still be used with simple variants in the wiring.

Fig. 50 RS-232 line protection (e.g., DSI programming)

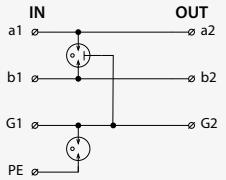


Connection diagrams

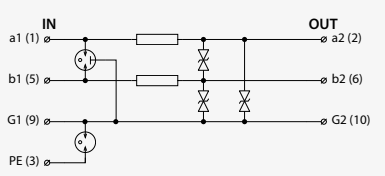
BDM-024-V/1-R1 (see *Fig. 49*)



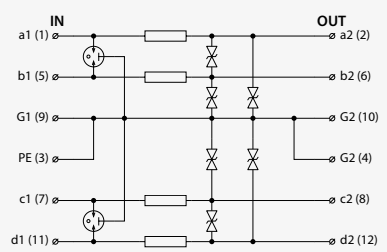
BD-090-T-V/1-F16 (see *Fig. 49*)



BDM-024-V/1-FR1 (see *Fig. 49*)



BDM-012-V/2-R1 (see *Fig. 50, 54*)



BDG-012-V/1-4R1 (see *Fig. 50*)

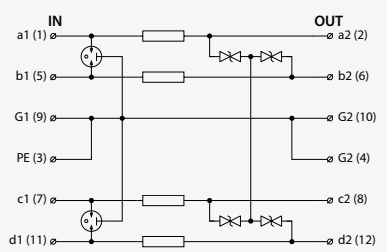


Fig. 51 Protection of BUS 2

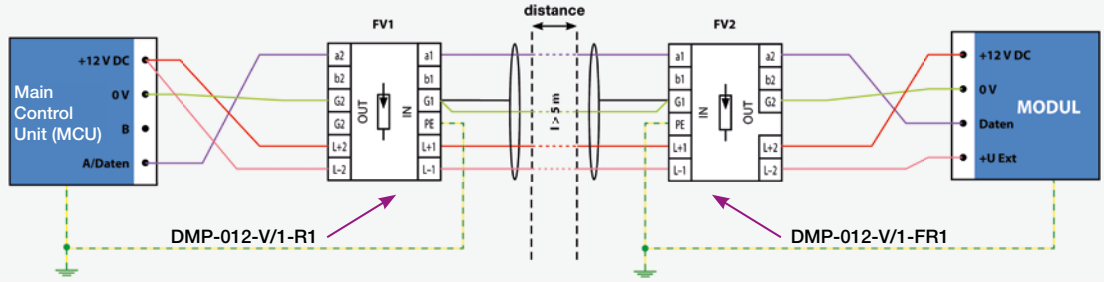


Fig. 52 Protection of Intellibus – designed to connect the Ethernet module and the module of PIR cameras

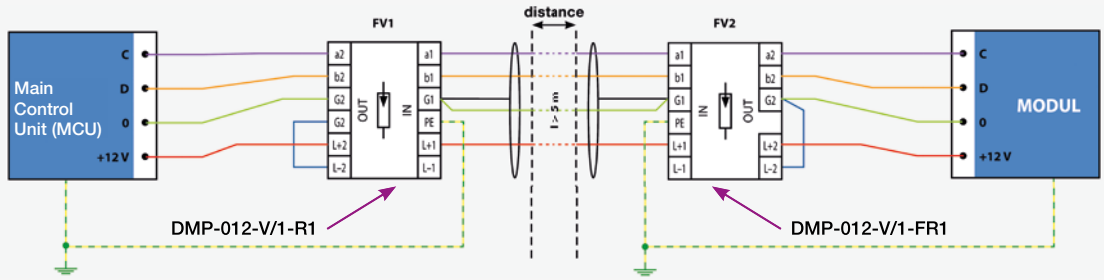


Fig. 53 Protection of RS-485, e.g. main control unit GALAXY

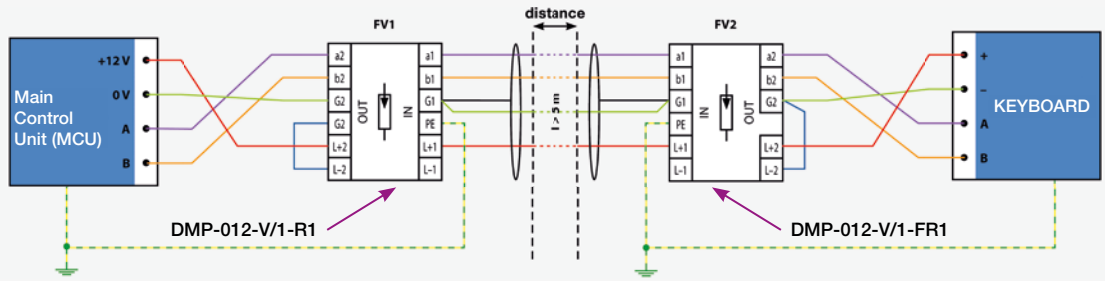
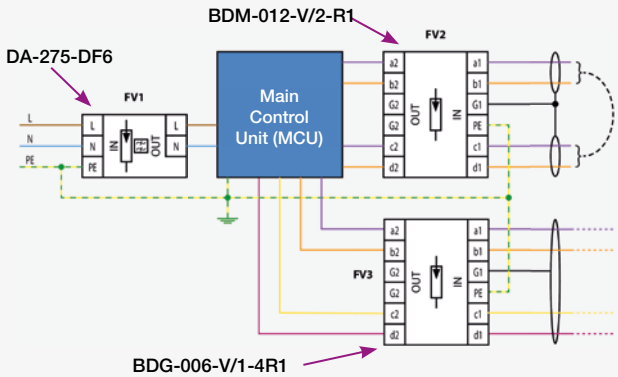
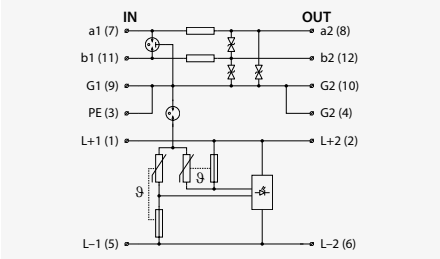


Fig. 54 Protection of IB 2 communication

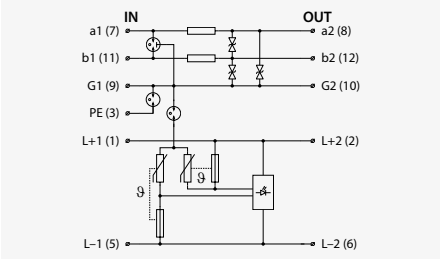


Connection diagrams

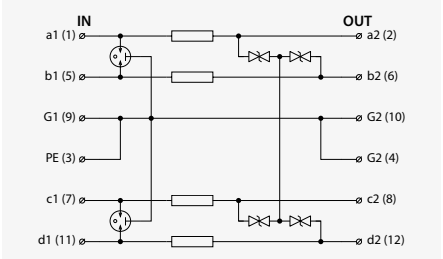
DMP-012-V/1-R1 (see *Figures 51, 52, 53*)



DMP-012-V/1-FR1 (see *Figures 51, 52, 53*)



BDG-006-V/1-4R1 (see *Fig. 54*)



5. Examples of SPD applications – Data networks

5.1. Protection of data networks and structured cabling

Ethernet connection, even when connected to a local area network, can be a frequent source of problems, and the impulse overvoltage could be induced there. Long distribution lines or paralleling with low voltage lines (i.e. induced overvoltage) can cause problems here. An extra attention should be paid to the Ethernet network if Ethernet lines pass from one to another building or to devices out of the building (LPZ 1 - LPZ 0).

Therefore, all the communication lines should be protected by overvoltage protection according to recommended design rules. Here, the SALTEK SPD range DL can be applied in various versions for analog lines, ISDN lines, high-frequency xDSL telephone lines, Ethernet networks Cat. 5e, 6 and 6A, incl. versions with combined powering PoE (which can be used e.g. to protect rotating digital cameras with Ethernet signal transmission), and incl. the design for 19" racks.

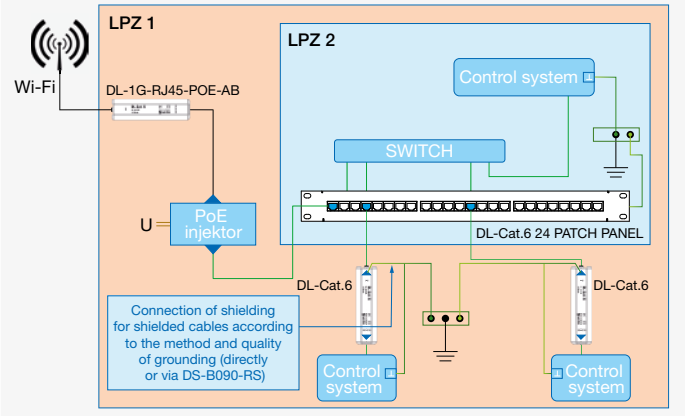
5.2. Protection of Ethernet data lines

Structured cabling protection is provided by SPD for Ethernet Cat.5e or Cat.6 lines (depending on the network type) between the data switchboard (RACK) and the PC/router connected in the data network. Protection is primarily installed in front of inputs to the RACK or in a switch with integrated overvoltage protection directly. On the opposite side, the SPD has to be located as close as possible to the protected device.

5.2.1. Design of data network protection

Fig. 55 shows an example of data network with a Wi-Fi antenna connection point. Instead of a Wi-Fi antenna, alternatively the ADSL or DSL telephone line, a GSM module or a FTP cable can be used.

obr. 55



5.2.2. Connection of SPD for Ethernet data network

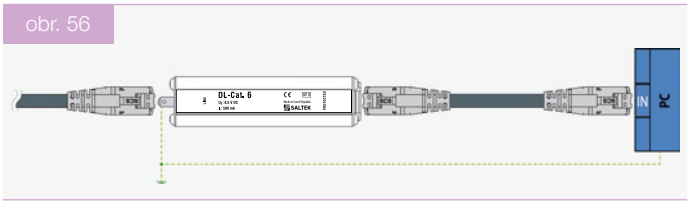
Depending on the type of the network, different SPDs are used. The Cat.5 or Cat.5e Ethernet network uses only two twisted pairs with a data rate of 100 Mbps for data transmission. The second two pairs can be used in FTP cable for powering. If there is no need for powering via FTP cable, the SPD DL-Cat.5e can be used as a protection for this type of network, as shown in *Fig. 56*.

The Cat.6 Ethernet network uses all 4 pairs of the FTP cable for data transmission, and the transmission rate is 1000 Mbps (one Gigabit per second, 1 Gbps). If the powering of connected devices is required together with data transmission over such FTP cable than it´s called Phantom power and a special SPD should be used in this case (e.g. DL-1G-RJ45-PoE-AB or DL-10G-RJ45-PoE-AB). If only data transmission over the FTP cable s required then, SPD DL-Cat.6 should be used.

The Cat.6A Ethernet network uses all 4 pairs, and power supply is also implemented as a phantom powering. The transmission rate is 4 x 500 Mbps in this case. This network is already in the category called 10G. For this network the DL-10G-RJ45-POE-AB was designed.

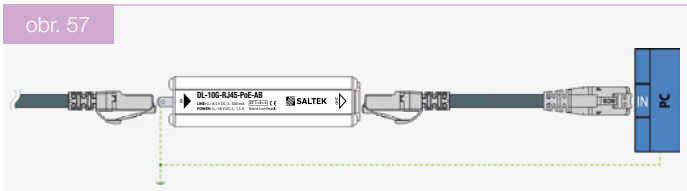
Fig. 56 shows the wiring for technology equipment protection. For Cat.5e, the type DL-Cat.5e and for Cat.6, the type DL-Cat.6 is used.

obr. 56



For network with transmission rate a higher than 1Gbps (category 10G) should be use type DL-10G-RJ45-POE-AB (*Fig. 57*).

obr. 57



5.2.3. Powering the technology via FTP cable

The transmission of both data and power via the FTP cable is called the Power over Ethernet, abbreviated PoE. The intention of PoE solution is to save additional cables and power sockets, to make the connection of devices easier, and to allows the network administrator remotely restart the device at the end of the cable by turning the power off and on simply via only the port command (LAN switch with powering ports).

Next to the advantages, this solution also has several limitations. It is the transmitted power (limited current and voltage) and the dependence on the distance. The higher the current is needed, the closer the device has to be connected to the source. In order to compensate these limitations in part at least, two possible solutions can be applied in principle.

The first solution, two unused pairs in a FTP data cable (mode B) can be used for powering. The pairs 4–5 and 7–8 are the powering ones.

The second solution, the phantom powering between the two of active pairs of wires with a simultaneous data transmission (mode A) can be used for powering. In that case, the pairs 1–2 and 3–6 are the powering ones.

Fig. 58a Wiring standard T568A

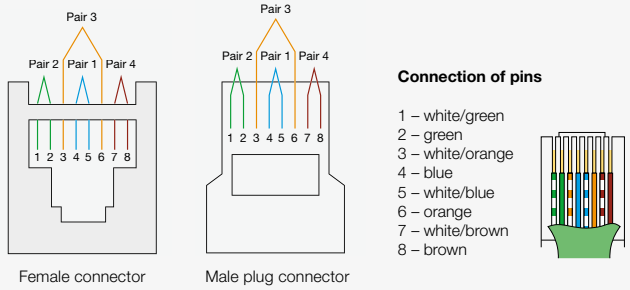
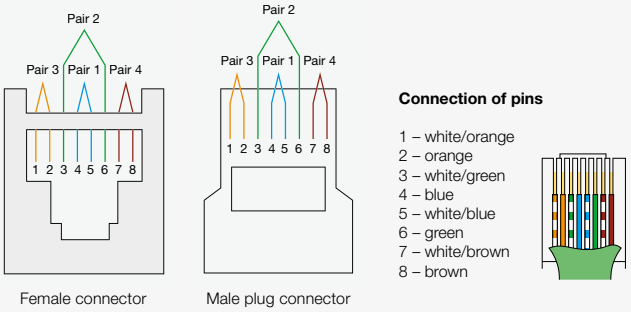


Fig. 58b Wiring standard T568B



5.2.4. Connection of RJ-45 connectors

Fig. 58a , 58b show different ways of RJ-45 pinouts.As shown in figures, there are two ways of connecting RJ-45 connectors, according to T568A or T568B wiring standards. Via different connection of connectors, two different types of interconnection cables can be created. In case of so-called direct cable, both RJ connectors have the same connection, e.g. T568B-T568B. This type of cable is used to connect a PC-switch or a PC-router. If the cable is of a different connection of RJ connectors (T568A-T568B), then socalled crossed cable is created. The crossed cable is used to make connections PC-PC, switch-switch or router-router. New modern devices no longer require the appropriate type of cable – they can internally reconnect the pins as needed.

Eight wires in the cable are divided into the following pairs, which are twisted separately.

- Pair 1–2 .....A
- Pair 3–6 .....A´
- Pair 4–5 .....B
- Pair 7–8 .....B´

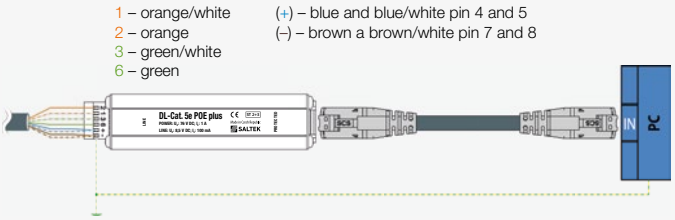
The numbers also indicate the order of contacts on the RJ-45 connector.

Fig. 59a DL-Cat.5e POE plus

Fig. 59b DL-100 POE-048

If two free (unused) pairs are available in the cable (pairs 4-5 and 7-8), then these pairs can be used for powering. In this case, this is PoE in Mode B called PoE B. A typical representative of the data SPD with PoE in B mode is DL-Cat.5e POE plus or a stronger version DL-100 POE-048. These SPDs are in *Fig. 59a , 59b*.

Fig. 60 PoE – connection



Connection of DL-Cat.5e PoE plus, including the connection of individual colors in the FTP cable to the terminal block, is in *Fig. 60*. This SPD was designed for the version in the B, called PoE mode B.

In PoE B, the positive voltage plus (+) is connected to the pair 4–5, and the negative voltage minus (-) is connected to the pair 7–8.

If no pairs are available in the data cable, i.e. all pairs are used for data transfer, and the cable has to be used for powering, then powering by the “phantom” voltage has to be used. This powering is usually managed via pairs 1-2 and 3-6. In this case, this is PoE in Mode A called PoE A.

In PoE A, the positive voltage plus (+) is connected to the pair 1–2 usually, but may also be minus (-), and the negative voltage minus (-) is connected to the pair 3-6 usually, but may also be plus (+). There is no standard for PoE A specifying the type of voltage on pairs.

For some high-power technologies, all four pairs are used for powering. If the technology uses two pairs for the data only, and the remaining two pairs are without a signal, and all four pairs should be used for the powering, then PoE A has to be combined with PoE B. If the technology uses all four pairs for data transmission, and all pairs are needed to be used for powering also, then PoE A should be used for each of two pairs.

Fig. 61 DL-1G-RJ45-POE-AB/DL-10G-RJ45-POE-AB

All those versions of powering solves the DL-1G-RJ45-POE-AB for gigabit networks, or the SPD type DL-10G-RJ45-POE-AB for 10G networks. These SPDs are in *Fig. 61*.

These SPDs are also tested for lightning current and are therefore suitable for communication data lines operating in the environment where LPZ 0 and LPZ 1 zones crossing is observed.

PoE Mode B connection of pins
4,5 (+) power supply
7,8 (–) power supply

PoE Mode A connection of pins
1,2 (+/–) power supply
3,6 (–/+) power supply

PoE Modes A and B
connected all 4 pairs, i.e. pins 1,2–3,6 and 4,5–7,8, whereas data are on pairs 1,2–3,6 only.

PoE Mode A and A´
connected all 4 pairs, i.e. pins 1,2–3,6 and 4,5–7,8, whereas data are on all pairs.

5.3. SALTEK SPDs overview – Ethernet Data Network

All SALTEK surge protective devices for Ethernet lines up to the 10G bit rate are shown in *Table 1*.

5.4 Protection in Optical data networks

Even if optical cables are used in backbone networks of structured cabling, implementation of the surge protection is necessary.

Optical fibers are immune to overvoltage, but optical cables have to be completed by a mechanical protection because of low mechanical resistance of fibers. The mechanical protection is built from flexible metallic tubes, the fibers are placed into, or the optical cable contains a metallic conductor. And these are the elements the pulsed lightning current can be induced into the device through. That is why the overvoltage protection has to be provided on these metallic elements. These metallic elements have to be connected to the EBB directly. If this is not possible, elements have to be connected via SPD, which has to be dimensioned sufficiently. Converters between metal lines and optical ones or active elements and servers, which such converters contain already, can be threatened by overvoltage from the powering side as well as from metallic data network. For these reasons, sufficient surge protection is needed. On side of powering, the SPD type 3 DA range is recommended, e.g. DA-275-DJ25 or DA-275-DFxx with the RF filter, if the converter is powered by 230 V AC, or the SPDs range DP for small-voltage solution e.g. DP-xxx-V / 1-F16, or with a RF filter – range (DPF). In metallic cabling, the induced overvoltage is dominant. According to these assumptions, SPDs of a specific category Cat.5e, Cat.6, Cat.6A. has to be designed and sized. If the converter is powered via a data cable, then the SPD for PoE solution should be used, e.g., DL-1G-RJ45-POE-AB or DL-10G-RJ45-POE-AB.

Table 1

SPD SALTEK	Type SPD	Bit rate Mbit/s	For cabling	Input/Output	Figure
DL-100 POE-048	ST 2+3	10/100	into Cat. 5	Screw terminals / RJ45	
DL-Cat. 5e POE plus			into Cat. 5e	Screwless terminals / RJ45	
DL-Cat.5e	ST 3	10/100>1 000		RJ45 / RJ45	
DL-Cat.5e 8 RACK PANEL					
DL-Cat.5e 16 RACK PANEL					
DL-Cat.5e 24 RACK PANEL					
DL-Cat.6 8 PATCH PANEL			into Cat. 6	LSA / RJ45	
DL-Cat.6 16 PATCH PANEL					
DL-Cat.6 24 PATCH PANEL					
DL-Cat.6				RJ45 / RJ45	
DL-Cat.6-60 V					
DL-1G-RJ45-POE-AB	ST 1+2+3				
DL-1G-RJ45-60V					
DL-10G-RJ45-PoE-AB			into Cat. 6A		
DL-10G-RJ45-60V					

6. Examples of SPD applications – Antennas

6.1 Antenna Systems – Introduction

As regards the principle of functioning, antenna systems are devices that are, with a few exceptions, placed at sites exposed to atmospheric disturbances (storms). Therefore they automatically turn into devices that are at risk of thunderstorm activities and are exposed to adverse potentials arising from lightning, induction of nearby lightning strikes or from faults on medium voltage or high voltage power lines.

Antenna systems are electrically connected to a transmitter or receiver and these electronic devices are sensitive to various electromagnetic disturbances. Therefore, if we want to make these devices working reliably, it is necessary to ensure their maximum resistance to atmospheric disturbances and possibly disturbances arising at low and high voltage lines situated in the vicinity of antenna systems. From this it follows that it is necessary to secure these systems against lightning as well as against the induced voltage. This issue is addressed by a set of EN 62305 standards in accordance with the EN 60728-11 standard, ed. 2.

The EN 60728-11 standard ed. 2 shows in detail the basic principles of placing the antenna systems on building objects (buildings) and their protection against direct lightning strike, protection against induced surges, including the solution of bonding and grounding issues. The basic rule to protect antenna systems is their location which is to be situated in an area protected by LPS (the LPZ 0_B zone) while maintaining adequate distance. This separation (isolation) distance „s“, which is between the antenna system and a trap (ATS – air terminal system) system or LPS (lightning rod) or any associated portions of the LPS, must meet or exceed values required by EN 62305-3. Antenna systems are not allowed to be installed on buildings having a roof covered with easily flammable materials such as reed, thatch, bitumen board etc. Antenna down leads (coaxial cables, etc.) and grounding conductors must not be routed through areas where flammable materials such as oil , straw, hay and similar materials are stored, or through the spaces in which explosive gases may arise or accumulate (e.g. carpentry workshop).

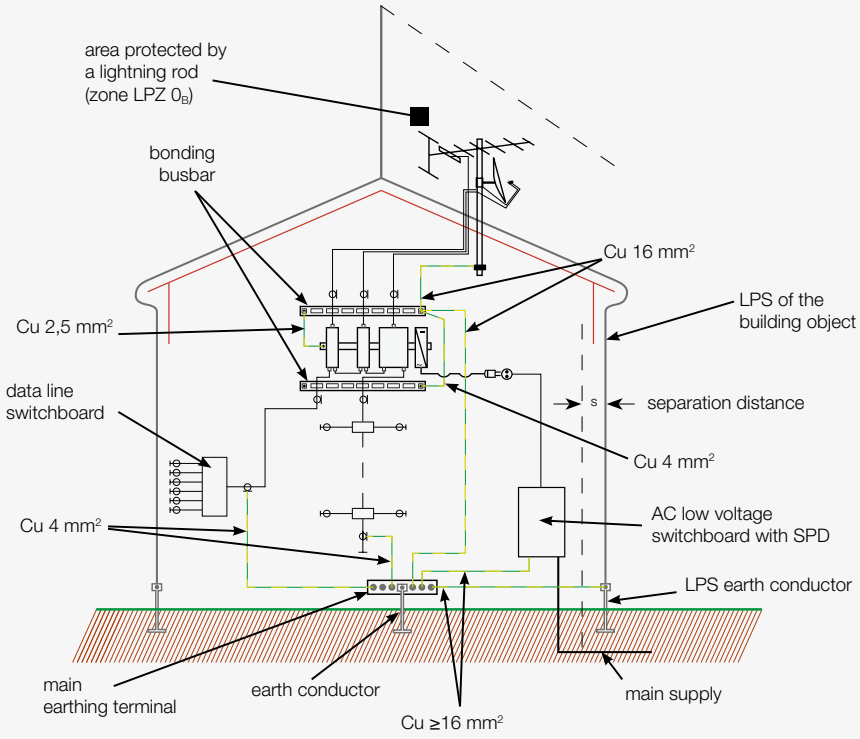
6.2 Principle of protection of antenna network

The risk of atmospheric overvoltage entering via the antenna transmission line of the antenna system mounted on a roof is a high danger for electrical installation in the building. In points of passing cables into a building (i.e. from LPZ 0_B to LPZ 1), a potential atmospheric overvoltage has to be prevented from penetrating into the building. In a point of entering the antenna leads into the building, the leads have to be grounded (their metal shielding). For grounding, a grounding kit can be used which is waterproof and weatherproof. Basic versions of the solution are shown in the following figures.

6.2.1 Protection of antenna system in space protected by lightning rod

If a building is equipped with the LPS system (lightning rod), which corresponds to EN 62305-3, it is necessary to install the antenna system in the protected area of the LPS (LPZ 0_B zone). This variant is in *Fig. 62*, where also bonding and grounding is being addressed, while observing a separation distance according to EN 62305-3.

Fig. 62



6.2.2. Protection of antenna system with remote lightning rod

In case the existing LPS does not allow to place the antenna system in a space protected by LPS (the LPZ 0_B zone) the situation can be resolved as per *Fig. 63*, where the existing LPS is completed with an ATS in a way for the antenna system to be situated in the LPZ 0_B zone.

6.2.3. Protection of antenna system non protected by lightning rod

If the antenna system is located outside of the LPZ 0_B zone, it-means that it is now situated in an area no more protected by the LPS (LPZ 0A zone). Mounting example of such antenna system isshown in *Fig. 64*. It can be seen that the ground conductors and bonding wires may not have a cross section less than 16 mm^2.

Fig.63

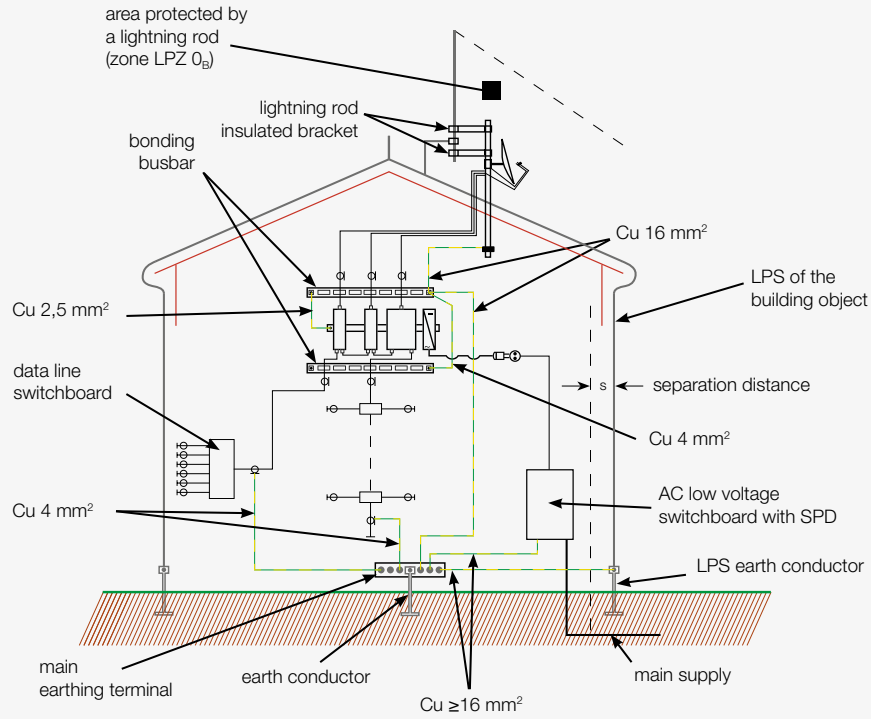
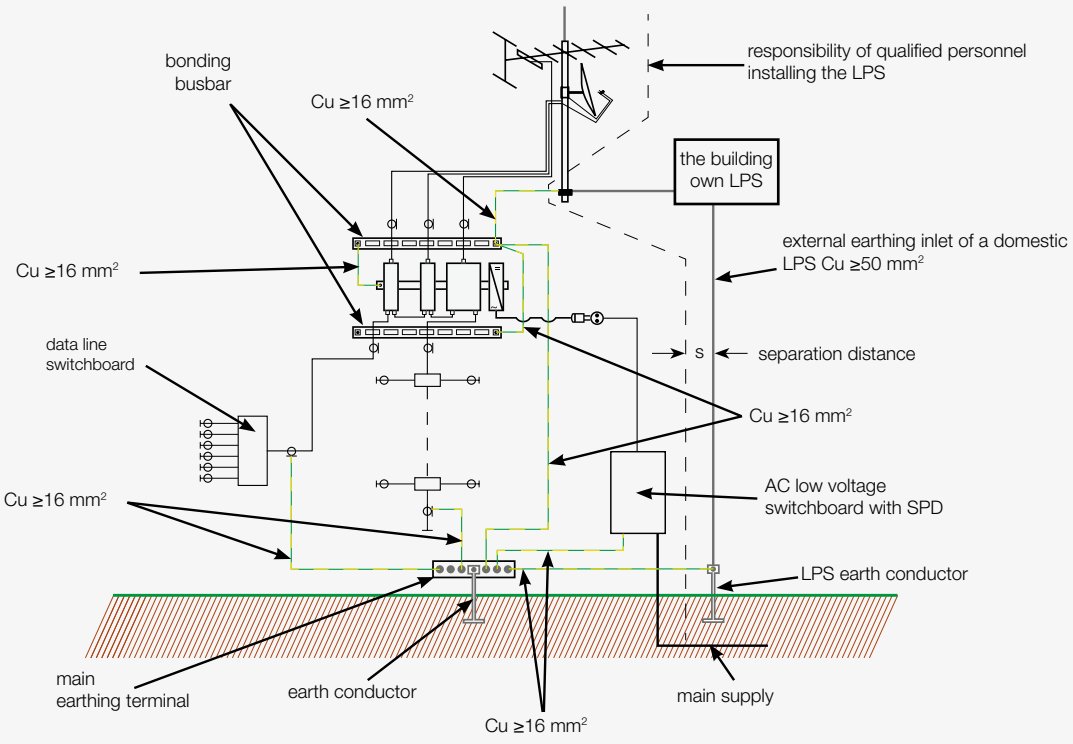


Fig. 64



6.3. Protection of technology equipments in antenna networks

Present-day technological equipment is threatened by electromagnetic fields originating from distant lightning strikes or disturbances at the MV and HV and is becoming more sensitive to unwelcome induced voltages induced on antenna systems and coaxial lines. At transfer points, system outlets, cable network stations or subscriber device inputs (e.g. at a satellite receiver, TV etc.), high voltages may appear which can destroy this technology. Protection of engineering equipment from induced voltages is performed by equipotential bonding using surge protective devices (SPD) which provide for temporary equalization of potentials between the middle conductor and shielding (coaxial cable), or in web-based systems in which case an equipotential cable is placed in between the UTP (STP) antenna system and the respective cable cores for voltage balancing purposes.

The coaxial SPDs range FX, SX, HX are used for the protection of a coaxial lines In case of Wi-Fi antennas, SPDs enabling power supply by an FTP cable are used ror the protection of a coaxial lines e.g., DL-Cat. 5e POE plus or DL-1G-RJ45-POE-AB or DL-10G-RJ45-POE-AB), which are tested for lightning current. The protection of such a large system is in *Fig. 65*.

Fig. 66 shows the way of surge protection of separate technology equipments which are connected to the antenna network inside the object. For efficient protection of the technology equipment, it is necessary to do protection of power supply via SPD type 3 both and also protection of signal sides.

Fig. 67 shows an example of an antenna overvoltage protection from the signal side, including satellite and terrestrial transmission.

Fig. 65

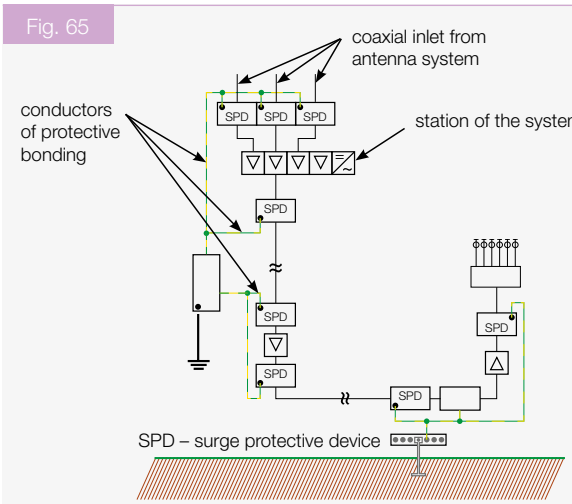


Fig. 66

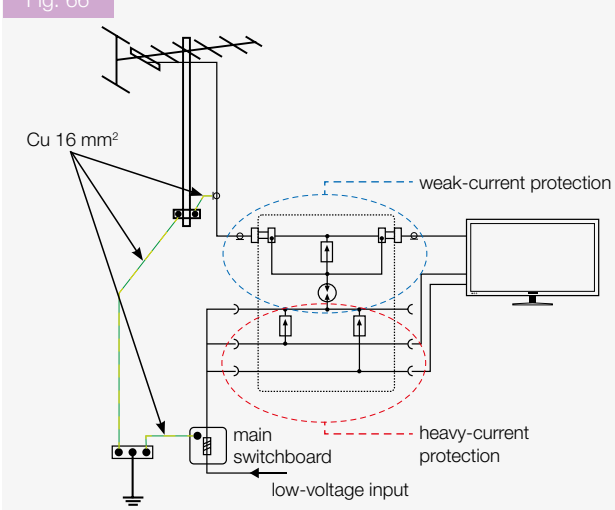
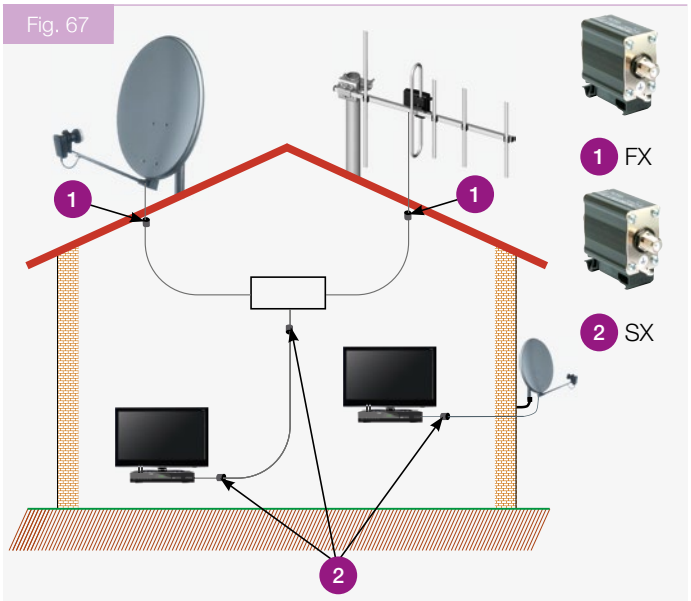


Fig. 67

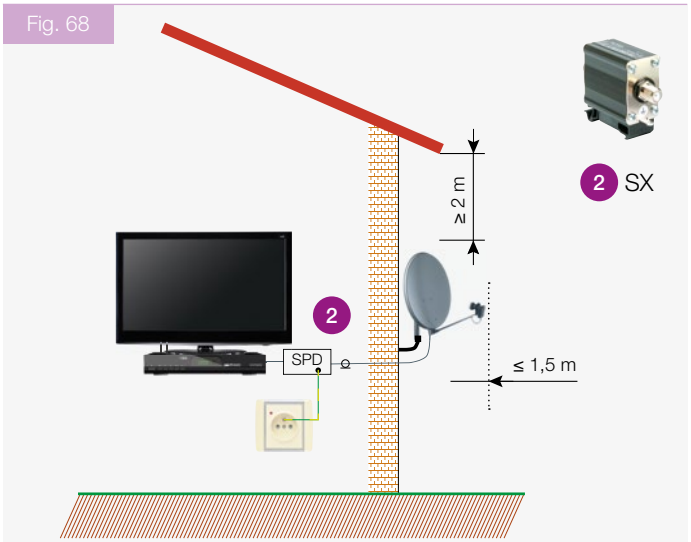


1 lightning arresters (ST 1) – FX with F connectors, BNC – a coarse protection of the antenna lead

2 surge arresters (ST 2+3) – SX with F connectors, BNC – a fine protection at the input of the device. We can also use a SPD combined with the protection of the 230 V power supply – type SAT-OVERDRIVE F6, which is a suitable solution for in-house technology equipment, because grounding of the protection of the antenna lead is not necessary to be solved.

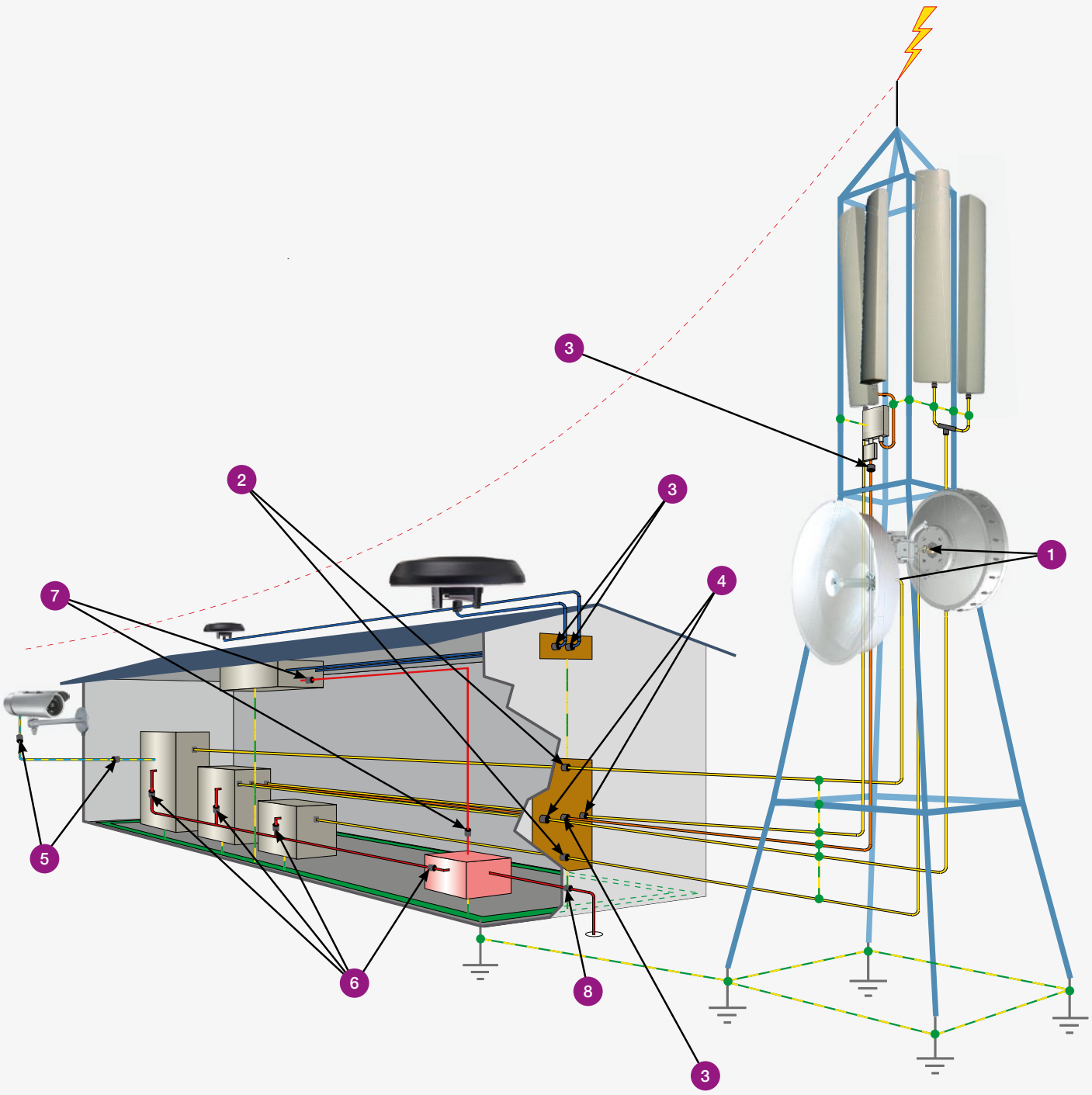
Fig. 68 shows a typical example of the protection of the antenna network in residential buildings up to a height of max. 45 m, but conditions shown in the figure have to be met.

Fig. 68



6.4 Protection of a large industrial antenna system

Fig. 69 Protection of a large industrial antenna system



Products overview in Fig. 67,68, 69

1

FX – lightning arrester for coaxial cables with a frequency range from 0 to 2.15 GHz, with powering by a coaxial cable (BNC or F connectors). The lightning arrester is installed at the boundary of LPZ 0 and LPZ 1 zones. The application is typical for satellite reception, terrestrial reception or microwave links.

2

SX – fine surge protection designed for TV and SAT inputs of technology equipments located inside buildings, with the possibility of provision of power supply or control voltages up to 28 V DC via coaxial cable.

3

HX – lightning arrester designed to protect coaxial inputs/outputs of telecommunication devices in the frequency band from 0 to 3.5 GHz, enabling powering via the cable and tuning in the whole band.

4

ZX – highly efficient lightning arrester with the technology λ/4 or λ/8 designed to protect telecommunication devices. The lightning arrester was designed for telecommunication technology equipments with a fixed frequency, and a narrow frequency band around the fixed frequency. It is not suitable for combined distributions of RF signal and power supply or control voltages. This is a protection that protects from overvoltage (lightning) and prevents the generation of static electricity at the inputs of the technology equipment.

5

VL – combined coarse and fine protection designed to protect analog coaxial lines of CCTV camera systems. This protection in the VL-SV version is designed to protect the video twisted--pair networks.

6

DL-Cat. 5e a DL-Cat. 6 – protection designed for different data transmissions via the FTP cable, which can be used for radio transmission systems and Ethernet.

7

DL-Cat. 5e POE plus a DL-100 POE 48 protections designed for simultaneous data transfer and powering via an FTP cable.

8

DL-1G-RJ45-POE-AB a DL-10G-RJ45-POE-AB – a universal data protection that is designed to the installation at the boundary of LPZ 0_B and LPZ 1 zones. The protection allows data communication Cat.5e or Cat.6, or versions 10G also Cat.6A. At the same time, the protection allows powering via the FTP cable both in the A mode or the B mode, and in a combination.

7. Examples of SPD applications – Camera systems

7.1 Conditions for cameras installing

Closed camera systems have a wide variety of uses. These camera systems can be used in transport, surveillance systems, etc. and can be operated both indoors and outdoors. In the open space, these systems can be installed on the facade of objects, masts or portals.

On the market exist analog systems interconnected by coaxial lines or twisted pairs, or digital IP camera systems, which use FTP cabling for the transmission of data only, or data with powering.

The camera, which is installed on the facade of an object, must be located in a sufficient separation distance "s" from the air-termination system, i.e. the LPS system (see EN 62 305), eaves and all metallic parts connected to the earthing system. If this condition is met and the cable immediately passes through the enclosure wall inside the building (LPZ 0_B and LPZ 1), the effect of the lightning strike is negligible and only induced overvoltages should be considered. The SPDs ST 2+3 are used then.

If the condition of a sufficient separation distance "s" is not met or a cable is installed on the facade of an object, the lightning strike problem has to be solved using lightning arresters. In this case, SPDs ST 1 or ST 1+2+3 have to be used.

The camera placed on a mast or a portal has to be installed in the protected angle area of the air-termination system (LPZ 0_B). In this case, a lightning arrester has to be installed on the lines. For coaxial cables, the ST 1 protection has to be used, and for IP cameras, the ST 1+2+3 protection has to be installed.

7.2 Protection of camera systems

7.2.1 Analog systems

The protection of analog systems those are interconnected by co-axial cables is assured by SDP range FX and VL. If the camera system is installed inside an the VL-B75 F/F devices should be used to protect quadrature encoder inputs and which should be grounded.

If the camera is located outside an object, the coaxial line should be equipped with the SPD type FX-090-B75T F/F, which is installed at the boundary of LPZ 0 and LPZ 1 zones.

If the camera system is installed inside an object and twisted pair is used then the SPD type VL-SV should be used.

If the camera is installed on the mast then the SPD type FX-090-B75T F/F should be used. The SPD should be connected to the same earthing point with the camera. If the camera is insulated, i.e. it is not connected to the ground at the installation site, then the overvoltage protection should be connected to the any other appropriate ground at the installation site, e.g. the metal grounded mast.

If the camera is not fixed but rotary, then the appropriate protection has to be installed on the control line as well. In case of cameras supplied by a small voltage and controlled via the RS-485 communication line, the combined SPD type DMP-xx-V/1-R1 should be used (xx is the power supply voltage).

7.2.2 Digital IP camera systems

IP cameras trasmit the signal via Ethernet line and that´s why the same protective devices like for data lines should be used also here (see Chapter 5).

If the IP camera uses a data network installed inside a object to transmit a video signal only, then the SPD type DL-Cat.5e or DL-Cat.6 can be used. If the camera uses the data network also for powering, then the type DL-Cat.5e POE plus has to be used. If the data network goes out the object, then the type DL-1G-RJ45-POE-AB has to be installed at the boundary LPZ 0-1. The same type of protection should be installed in front of the camera if protection of the camera is important for some reason, for example, to ensure a reliable operation. In terms of grounding, the same rules should be applied as for analog systems.

8. Examples of SPD applications – Telecommunications

8.1 Protection of telecommunication devices

8.1.1 Protection of power supply

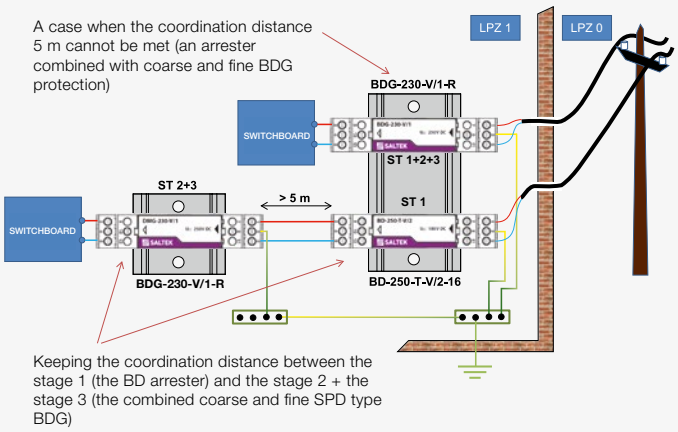
To protect the device from the side of the low-voltage supply, we have to establish a complete so-called 3-step protection (FLP = the 1st stage, SLP = the 2nd stage, DA = the 3rd stage). The third stage is recommended as a surge arrester installed in a socket outlet, in a box for a thrunking systems, for an additional installation below the socket outlet or a plug adapter (PA-OVERDRIVE X16, or combined FAX-OVERDRIVE X16) or for a DIN rail (DA-275-DJ25). For switchboards, and active elements of LAN and WAN networks, SPD combined with a high-frequency filter are recommended:

- DA-275-DF..
- PA-OVERDRIVE F6 or F16 (plug adapters)

8.1.2 Protection of telecommunication systems

Telecommunication lines pass from the outdoor to the building towards a switchboard (telephone exchange) or a PC. These telecommunication lines are very long and are threatened by overvoltage caused by lightning strikes or by induction generated by various switching or disturbance phenomena. The basic principle of protection is in *Fig. 70*.

Fig. 70



8.1.3 Protection of telecommunication lines

An appropriate solution has to be optimized according to the number of lines and the kind of connection:

- for separate lines and small switchboards the type DL-TLF-HF (ST 2+3) for analog telephone and VDSL lines or generally the type BDG-230-V/1-R1 (ST 1+2+3);
- for switchboards the type BDG-230-V/1-R1 for the DIN rail mounting, and CLSA-TLF, CLSA-DSL types for LSA PLUS bars (the Krone bar);
- combined SPDs of power supply 230 V / 50 Hz and 1 FAX-OVERDRIVE for telephone line for faxes, fax-modems, and PCs with an external modem or an internal one;
- for ISDN lines, types DL-ISDN SV and DL-ISDN RJ45 with a cut-off frequency higher than 50 MHz or SPD type CLSA-ISDN for the LSA PLUS (Krone) bars for transmission rates of up to 16 MHz.

8.2 IP telephony

IP telephony is one of the ways how to use the Internet and make phone calls through it. IP telephony is voice transmission over data networks. Voice information is transmitted via communication networks based on the data transmission with the IP protocol. The same rules apply to the protection of communication lines as in the Internet data network.

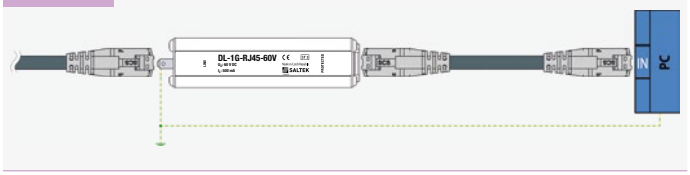
Usually a data network with a data rate of 100 Mbps is sufficient for IP telephony, i.e. a data network of Cat.5e or higher.

8.2.1. Protection of IP telephony lines

The principle of protecting communication lines of IP telephony with ring signal in *Fig. 71*.

In case of a conventional IP communication line, a standard Ethernet SPD (ST 2+3), the types DL-Cat.5e, DL-Cat.6 can be used. If the communication line goes out the building and passes the zone LPZ 0/1, the SPD (ST 1+2+3), the type DL-1G-RJ45-POE-AB should be used.

Fig. 71



SPDs for data / signalling / telecommunication networks
Devices with pluggable module

BD-…-T-V/2-(F)16 range

Lightning current arrester. To protect two-core communication, data and other lines at the zone boundaries LPZ 0 and LPZ 1.

- Variants BD-250 for protection of telecommunication lines
- Installation at the line entry into building
- In "F" version is the line separated from protective earth via GDT

Type	Location	Number of lines	U_C	I_L	I_{imp} (D1)	I_n (C2)	U_p (C3)	Floating	Ordering number
BD-090-T-V/2-16	ST 1	2	70 V DC	16 A	2.5 kA	10 kA	550 V	No	8595090555506
BD-250-T-V/2-16	ST 1	2	180 V DC	16 A	2.5 kA	10 kA	550 V	No	8595090555513
BD-090-T-V/2-F16	ST 1	2	70 V DC	16 A	2.5 kA	10 kA	550 V	Yes	8595090555544
BD-250-T-V/2-F16	ST 1	2	180 V DC	16 A	2.5 kA	10 kA	550 V	Yes	8595090555551

BDM-…-V/1-(F)R… range

Lightning current arrester. It is specified for the protection of two-core communication, data and other lines and the communication interface of control I&C, electronic security and fire alarm systems, etc., at the boundaries of LPZ 0 and LPZ 1 or higher.

- Installation at the line entry into building, close to protected equipment
- In "F" version is the line separated from protective earth via GDT

Type	Location	Number of lines	U_C	I_L	I_{imp} (D1)	I_n (C2)	U_p (C3) core-core	Floating	Ordering number
BDM-006-V/1-R1	ST 1+2+3	1	8.5 V DC	1 A	2.5 kA	10 kA	12 V	No	8595090554240
BDM-012-V/1-R1	ST 1+2+3	1	16 V DC	1 A	2.5 kA	10 kA	22 V	No	8595090554257
BDM-024-V/1-R1	ST 1+2+3	1	36 V DC	1 A	2.5 kA	10 kA	46 V	No	8595090554264
BDM-048-V/1-R1	ST 1+2+3	1	51 V DC	1 A	2.5 kA	10 kA	65 V	No	8595090554271
BDM-060-V/1-R1	ST 1+2+3	1	64 V DC	1 A	2.5 kA	10 kA	85 V	No	8595090555988
BDM-110-V/1-R1	ST 1+2+3	1	120 V DC	1 A	2.5 kA	10 kA	170 V	No	8595090564492
BDM-230-V/1-R1	ST 1+2+3	1	250 V DC	1 A	2.5 kA	10 kA	350 V	No	8595090564621
BDM-110-V/1-R	ST 1+2+3	1	120 V DC	0.5 A	2.5 kA	10 kA	170 V	No	8595090564485
BDM-230-V/1-R	ST 1+2+3	1	250 V DC	0.5 A	2.5 kA	10 kA	350 V	No	8595090554288
BDM-006-V/1-FR1	ST 1+2+3	1	8.5 V DC	1 A	2.5 kA	10 kA	12 V	Yes	8595090557098
BDM-012-V/1-FR1	ST 1+2+3	1	16 V DC	1 A	2.5 kA	10 kA	22 V	Yes	8595090557104
BDM-024-V/1-FR1	ST 1+2+3	1	36 V DC	1 A	2.5 kA	10 kA	46 V	Yes	8595090557111
BDM-048-V/1-FR1	ST 1+2+3	1	51 V DC	1 A	2.5 kA	10 kA	65 V	Yes	8595090557128
BDM-060-V/1-FR1	ST 1+2+3	1	64 V DC	1 A	2.5 kA	10 kA	85 V	Yes	8595090556053
BDM-110-V/1-FR1	ST 1+2+3	1	120 V DC	1 A	2.5 kA	10 kA	170 V	Yes	8595090564478
BDM-230-V/1-FR1	ST 1+2+3	1	250 V DC	1 A	2.5 kA	10 kA	350 V	Yes	8595090564614
BDM-110-V/1-FR	ST 1+2+3	1	120 V DC	0.5 A	2.5 kA	10 kA	170 V	Yes	8595090564461
BDM-230-V/1-FR	ST 1+2+3	1	250 V DC	0.5 A	2.5 kA	10 kA	350 V	Yes	8595090557135
BDM-006-V/1-R2	ST 1+2+3	1	8.5 V DC	2 A	2.5 kA	10 kA	12 V	No	8595090563860
BDM-012-V/1-R2	ST 1+2+3	1	16 V DC	2 A	2.5 kA	10 kA	22 V	No	8595090563990
BDM-024-V/1-R2	ST 1+2+3	1	36 V DC	2 A	2.5 kA	10 kA	46 V	No	8595090564126
BDM-048-V/1-R2	ST 1+2+3	1	51 V DC	2 A	2.5 kA	10 kA	65 V	No	8595090564256
BDM-060-V/1-R2	ST 1+2+3	1	64 V DC	2 A	2.5 kA	10 kA	85 V	No	8595090564416
BDM-006-V/1-FR2	ST 1+2+3	1	8.5 V DC	2 A	2.5 kA	10 kA	12 V	Yes	8595090563853
BDM-012-V/1-FR2	ST 1+2+3	1	16 V DC	2 A	2.5 kA	10 kA	22 V	Yes	8595090563983
BDM-024-V/1-FR2	ST 1+2+3	1	36 V DC	2 A	2.5 kA	10 kA	46 V	Yes	8595090564119
BDM-048-V/1-FR2	ST 1+2+3	1	51 V DC	2 A	2.5 kA	10 kA	65 V	Yes	8595090564249
BDM-060-V/1-FR2	ST 1+2+3	1	64 V DC	2 A	2.5 kA	10 kA	85 V	Yes	8595090564393

Continued on page 35.

BDM-…-V/1-(F)R… range

Type	Location	Number of lines	U_c	I_L	I_{imp} (D1)	I_n (C2)	U_p (C3) core-core	Floating	Ordering number
BDM-006-V/2-R1	ST 1+2+3	2	8.5 V DC	1 A	2.5 kA	10 kA	12 V	No	8595090563945
BDM-012-V/2-R1	ST 1+2+3	2	16 V DC	1 A	2.5 kA	10 kA	22 V	No	8595090564072
BDM-024-V/2-R1	ST 1+2+3	2	36 V DC	1 A	2.5 kA	10 kA	46 V	No	8595090564201
BDM-048-V/2-R1	ST 1+2+3	2	51 V DC	1 A	2.5 kA	10 kA	65 V	No	8595090564331
BDM-060-V/2-R1	ST 1+2+3	2	64 V DC	1 A	2.5 kA	10 kA	85 V	No	8595090564447
BDM-110-V/2-R	ST 1+2+3	2	120 V DC	0.5 A	2.5 kA	10 kA	170 V	No	8595090564577
BDM-230-V/2-R	ST 1+2+3	2	250 V DC	0.5 A	2.5 kA	10 kA	350 V	No	8595090564652
BDM-006-V/2-FR1	ST 1+2+3	2	8.5 V DC	1 A	2.5 kA	10 kA	12 V	Yes	8595090563884
BDM-012-V/2-FR1	ST 1+2+3	2	16 V DC	1 A	2.5 kA	10 kA	22 V	Yes	8595090564010
BDM-024-V/2-FR1	ST 1+2+3	2	36 V DC	1 A	2.5 kA	10 kA	46 V	Yes	8595090564140
BDM-048-V/2-FR1	ST 1+2+3	2	51 V DC	1 A	2.5 kA	10 kA	65 V	Yes	8595090564270
BDM-060-V/2-FR1	ST 1+2+3	2	64 V DC	1 A	2.5 kA	10 kA	85 V	Yes	8595090564430
BDM-110-V/2-FR	ST 1+2+3	2	120 V DC	0.5 A	2.5 kA	10 kA	170 V	Yes	8595090564515
BDM-230-V/2-FR	ST 1+2+3	2	250 V DC	0.5 A	2.5 kA	10 kA	350 V	Yes	8595090564645

BDM-…-V/…-J(F)R… range

Lightning current arrester with coarse and fine protection. It is specified for the protection of single-core lines of communication, data and other lines with common neutral and protective earth against pulse overvoltage. Suitable for potential free contacts of the communication interface in I&C, electronic security and fire alarm systems, etc., at the boundaries of LPZ 0 and LPZ 1 or higher.

- Installation at the line entry into building, close to protected equipment
- In "F" version is the line separated from protective earth via GDT

Type	Location	Number of lines	U_c	I_L	I_{imp} (D1)	I_n (C2)	U_p (C3) core-PE/ GND	Floating	Ordering number
BDM-006-V/2-JR1	ST 1+2+3	2	8.5 V DC	1 A	2.5 kA	10 kA	12 V	No	8595090563921
BDM-006-V/2-JR2	ST 1+2+3	2	8.5 V DC	2 A	2.5 kA	10 kA	12 V	No	8595090563938
BDM-012-V/2-JR1	ST 1+2+3	2	16 V DC	1 A	2.5 kA	10 kA	22 V	No	8595090564058
BDM-012-V/2-JR2	ST 1+2+3	2	16 V DC	2 A	2.5 kA	10 kA	22 V	No	8595090564065
BDM-024-V/2-JR1	ST 1+2+3	2	36 V DC	1 A	2.5 kA	10 kA	46 V	No	8595090564188
BDM-024-V/2-JR2	ST 1+2+3	2	36 V DC	2 A	2.5 kA	10 kA	46 V	No	8595090564195
BDM-048-V/2-JR1	ST 1+2+3	2	51 V DC	1 A	2.5 kA	10 kA	65 V	No	8595090564317
BDM-048-V/2-JR2	ST 1+2+3	2	51 V DC	2 A	2.5 kA	10 kA	65 V	No	8595090564324
BDM-110-V/2-JR1	ST 1+2+3	2	120 V DC	1 A	2.5 kA	10 kA	170 V	No	8595090564560
BDM-110-V/2-JR	ST 1+2+3	2	120 V DC	0.5 A	2.5 kA	10 kA	170 V	No	8595090564553
BDM-006-V/2-JFR1	ST 1+2+3	2	8.5 V DC	1 A	2.5 kA	10 kA	12 V	Yes	8595090563907
BDM-006-V/2-JFR2	ST 1+2+3	2	8.5 V DC	2 A	2.5 kA	10 kA	12 V	Yes	8595090563914
BDM-012-V/2-JFR1	ST 1+2+3	2	16 V DC	1 A	2.5 kA	10 kA	22 V	Yes	8595090564034
BDM-012-V/2-JFR2	ST 1+2+3	2	16 V DC	2 A	2.5 kA	10 kA	22 V	Yes	8595090564041
BDM-024-V/2-JFR1	ST 1+2+3	2	36 V DC	1 A	2.5 kA	10 kA	46 V	Yes	8595090564164
BDM-024-V/2-JFR2	ST 1+2+3	2	36 V DC	2 A	2.5 kA	10 kA	46 V	Yes	8595090564171
BDM-048-V/2-JFR1	ST 1+2+3	2	51 V DC	1 A	2.5 kA	10 kA	65 V	Yes	8595090564294
BDM-048-V/2-JFR2	ST 1+2+3	2	51 V DC	2 A	2.5 kA	10 kA	65 V	Yes	8595090564300
BDM-110-V/2-JFR1	ST 1+2+3	2	120 V DC	1 A	2.5 kA	10 kA	170 V	Yes	8595090564546
BDM-110-V/2-JFR	ST 1+2+3	2	120 V DC	0.5 A	2.5 kA	10 kA	170 V	Yes	8595090564539
BDM-006-V/4-JR1	ST 1+2+3	4	8.5 V DC	1 A	2.5 kA	10 kA	12 V	No	8595090563976
BDM-012-V/4-JR1	ST 1+2+3	4	16 V DC	1 A	2.5 kA	10 kA	22 V	No	8595090564102
BDM-024-V/4-JR1	ST 1+2+3	4	36 V DC	1 A	2.5 kA	10 kA	46 V	No	8595090564232
BDM-048-V/4-JR1	ST 1+2+3	4	51 V DC	1 A	2.5 kA	10 kA	65 V	No	8595090564362
BDM-110-V/4-JR	ST 1+2+3	4	120 V DC	0.5 A	2.5 kA	10 kA	170 V	No	8595090564607
BDM-006-V/4-JFR1	ST 1+2+3	4	8.5 V DC	1 A	2.5 kA	10 kA	12 V	Yes	8595090563969
BDM-012-V/4-JFR1	ST 1+2+3	4	16 V DC	1 A	2.5 kA	10 kA	22 V	Yes	8595090564096
BDM-024-V/4-JFR1	ST 1+2+3	4	36 V DC	1 A	2.5 kA	10 kA	46 V	Yes	8595090564225
BDM-048-V/4-JFR1	ST 1+2+3	4	51 V DC	1 A	2.5 kA	10 kA	65 V	Yes	8595090564355
BDM-110-V/4-JFR	ST 1+2+3	4	120 V DC	0.5 A	2.5 kA	10 kA	170 V	Yes	8595090564591

SPDs for data / signalling / telecommunication networks
Devices with pluggable module

BDMHF-…-V/1-(F)R1 range

Lightning current arrester with coarse and fine protection for industrial interfaces. For the protection of high-speed two-/four-core signal lines against pulse overvoltage. Suitable for the communication interface of I&C, electronic security and fire alarm systems, etc., RS485 and PROFIBUS mainly.

- Suitable for high-speed signalling lines
- Installation at the line entry into building, close to protected equipment
- In "F" version is the line separated from protective earth via GDT

Type	Location	Number of lines	U_c	I_L	I_{imp} (D1)	I_n (C2)	U_p (C3) core--PE/GND	Floating	Ordering number
BDMHF-006-V/1-R1	ST 1+2+3	1	8.5 V DC	1 A	2.5 kA	10 kA	12 V	No	8595090565482
BDMHF-024-V/1-R1	ST 1+2+3	1	36 V DC	1 A	2.5 kA	10 kA	46 V	No	8595090565543
BDMHF-006-V/1-4R1	ST 1+2+3	1 four-core	8.5 V DC	1 A	2.5 kA	10 kA	12 V	No	8595090565468
BDMHF-024-V/1-4R1	ST 1+2+3	1 four-core	36 V DC	1 A	2.5 kA	10 kA	46 V	No	8595090565529
BDMHF-006-V/1-FR1	ST 1+2+3	1	8.5 V DC	2 A	2.5 kA	10 kA	12 V	Yes	8595090565475
BDMHF-024-V/1-FR1	ST 1+2+3	1	36 V DC	1 A	2.5 kA	10 kA	46 V	Yes	8595090565536
BDMHF-006-V/1-4FR1	ST 1+2+3	1 four-core	8.5 V DC	2 A	2.5 kA	10 kA	12 V	Yes	8595090565451
BDMHF-024-V/1-4FR1	ST 1+2+3	1 four-core	36 V DC	1 A	2.5 kA	10 kA	46 V	Yes	8595090565512

BDG-…-V/…-(F)R… range

Lightning current arrester with coarse and fine protection. For the protection of up to four-core lines of communication, data and other lines against pulse overvoltage. Suitable for the telecommunication lines and communication interface of I&C, electronic security and fire alarm systems, etc., RS485, RS422 and RS232 mainly.

- Installation at the line entry into building, close to protected equipment
- In "F" version is the line separated from protective earth via GDT

Type	Location	Number of lines	U_c	I_L	I_{imp} (D1)	I_n (C2)	U_p (C3) core-core	Floating	Ordering number
BDG-006-V/1-R1	ST 1+2+3	1	8.5 V DC	1 A	2.5 kA	10 kA	12 V	No	8595090554196
BDG-012-V/1-R1	ST 1+2+3	1	16 V DC	1 A	2.5 kA	10 kA	22 V	No	8595090554202
BDG-024-V/1-R1	ST 1+2+3	1	36 V DC	1 A	2.5 kA	10 kA	46 V	No	8595090554219
BDG-048-V/1-R1	ST 1+2+3	1	51 V DC	1 A	2.5 kA	10 kA	65 V	No	8595090554226
BDG-060-V/1-R1	ST 1+2+3	1	64 V DC	1 A	2.5 kA	10 kA	85 V	No	8595090555742
BDG-110-V/1-R1	ST 1+2+3	1	120 V DC	1 A	2.5 kA	10 kA	170 V	No	8595090565109
BDG-230-V/1-R1	ST 1+2+3	1	250 V DC	1 A	2.5 kA	10 kA	350 V	No	8595090565154
BDG-110-V/1-R	ST 1+2+3	1	120 V DC	0.5 A	2.5 kA	10 kA	170 V	No	8595090565093
BDG-230-V/1-R	ST 1+2+3	1	250 V DC	0.5 A	2.5 kA	10 kA	350 V	No	8595090554233
BDG-006-V/1-FR1	ST 1+2+3	1	8.5 V DC	1 A	2.5 kA	10 kA	12 V	Yes	8595090557043
BDG-012-V/1-FR1	ST 1+2+3	1	16 V DC	1 A	2.5 kA	10 kA	22 V	Yes	8595090557050
BDG-024-V/1-FR1	ST 1+2+3	1	36 V DC	1 A	2.5 kA	10 kA	46 V	Yes	8595090557067
BDG-048-V/1-FR1	ST 1+2+3	1	51 V DC	1 A	2.5 kA	10 kA	65 V	Yes	8595090557074
BDG-060-V/1-FR1	ST 1+2+3	1	64 V DC	1 A	2.5 kA	10 kA	85 V	Yes	8595090555810
BDG-110-V/1-FR1	ST 1+2+3	1	120 V DC	0.5 A	2.5 kA	10 kA	170 V	Yes	8595090565086
BDG-230-V/1-FR1	ST 1+2+3	1	250 V DC	1 A	2.5 kA	10 kA	350 V	Yes	8595090565147
BDG-110-V/1-FR	ST 1+2+3	1	120 V DC	1 A	2.5 kA	10 kA	170 V	Yes	8595090565079
BDG-230-V/1-FR	ST 1+2+3	1	250 V DC	0.5 A	2.5 kA	10 kA	350 V	Yes	8595090557081
BDG-006-V/1-R2	ST 1+2+3	1	8.5 V DC	2 A	2.5 kA	10 kA	12 V	No	8595090564706
BDG-012-V/1-R2	ST 1+2+3	1	16 V DC	2 A	2.5 kA	10 kA	22 V	No	8595090564782
BDG-024-V/1-R2	ST 1+2+3	1	36 V DC	2 A	2.5 kA	10 kA	46 V	No	8595090564867
BDG-048-V/1-R2	ST 1+2+3	1	51 V DC	2 A	2.5 kA	10 kA	65 V	No	8595090564942
BDG-060-V/1-R2	ST 1+2+3	1	64 V DC	2 A	2.5 kA	10 kA	85 V	No	8595090565024
BDG-006-V/1-FR2	ST 1+2+3	1	8.5 V DC	2 A	2.5 kA	10 kA	12 V	Yes	8595090564690
BDG-012-V/1-FR2	ST 1+2+3	1	16 V DC	2 A	2.5 kA	10 kA	22 V	Yes	8595090564775
BDG-024-V/1-FR2	ST 1+2+3	1	36 V DC	2 A	2.5 kA	10 kA	46 V	Yes	8595090564850

Continued on page 37.

BDG-…-V/…-(F)R… range

Type	Location	Number of lines	U_C	I_L	I_{imp} (D1)	I_n (C2)	U_p (C3) core-core	Floating	Ordering number
BDG-048-V/1-FR2	ST 1+2+3	1	51 V DC	2 A	2.5 kA	10 kA	65 V	Yes	8595090564935
BDG-060-V/1-FR2	ST 1+2+3	1	64 V DC	2 A	2.5 kA	10 kA	85 V	Yes	8595090565000
BDG-006-V/2-R1	ST 1+2+3	2	8.5 V DC	1 A	2.5 kA	10 kA	12 V	No	8595090564737
BDG-012-V/2-R1	ST 1+2+3	2	16 V DC	1 A	2.5 kA	10 kA	22 V	No	8595090564812
BDG-024-V/2-R1	ST 1+2+3	2	36 V DC	1 A	2.5 kA	10 kA	46 V	No	8595090564898
BDG-048-V/2-R1	ST 1+2+3	2	51 V DC	1 A	2.5 kA	10 kA	65 V	No	8595090564973
BDG-060-V/2-R1	ST 1+2+3	2	64 V DC	1 A	2.5 kA	10 kA	85 V	No	8595090565055
BDG-110-V/2-R	ST 1+2+3	2	120 V DC	0.5 A	2.5 kA	10 kA	170 V	No	8595090565130
BDG-230-V/2-R	ST 1+2+3	2	250 V DC	0.5 A	2.5 kA	10 kA	350 V	No	8595090565185
BDG-006-V/2-FR1	ST 1+2+3	2	8.5 V DC	1 A	2.5 kA	10 kA	12 V	Yes	8595090564720
BDG-012-V/2-FR1	ST 1+2+3	2	16 V DC	1 A	2.5 kA	10 kA	22 V	Yes	8595090564805
BDG-024-V/2-FR1	ST 1+2+3	2	36 V DC	1 A	2.5 kA	10 kA	46 V	Yes	8595090564881
BDG-048-V/2-FR1	ST 1+2+3	2	51 V DC	1 A	2.5 kA	10 kA	65 V	Yes	8595090564966
BDG-060-V/2-FR1	ST 1+2+3	2	64 V DC	1 A	2.5 kA	10 kA	85 V	Yes	8595090565048
BDG-110-V/2-FR	ST 1+2+3	2	120 V DC	0.5 A	2.5 kA	10 kA	170 V	Yes	8595090565123
BDG-230-V/2-FR	ST 1+2+3	2	250 V DC	0.5 A	2.5 kA	10 kA	350 V	Yes	8595090565178
BDG-006-V/1-4R1	ST 1+2+3	4 (2x2)	8.5 V DC	1 A	2.5 kA	10 kA	12 V	No	8595090564683
BDG-012-V/1-4R1	ST 1+2+3	4 (2x2)	16 V DC	1 A	2.5 kA	10 kA	22 V	No	8595090564768
BDG-024-V/1-4R1	ST 1+2+3	4 (2x2)	36 V DC	1 A	2.5 kA	10 kA	46 V	No	8595090564843
BDG-048-V/1-4R1	ST 1+2+3	4 (2x2)	51 V DC	1 A	2.5 kA	10 kA	65 V	No	8595090564928
BDG-006-V/1-4FR1	ST 1+2+3	4 (2x2)	8.5 V DC	1 A	2.5 kA	10 kA	12 V	Yes	8595090564676
BDG-012-V/1-4FR1	ST 1+2+3	4 (2x2)	16 V DC	1 A	2.5 kA	10 kA	22 V	Yes	8595090564751
BDG-024-V/1-4FR1	ST 1+2+3	4 (2x2)	36 V DC	1 A	2.5 kA	10 kA	46 V	Yes	8595090564836
BDG-048-V/1-4FR1	ST 1+2+3	4 (2x2)	51 V DC	1 A	2.5 kA	10 kA	65 V	Yes	8595090564911

BDGHF-…-V/…-(F)R… range

Lightning current arrester with coarse and fine protection for industrial interfaces. For the protection of high-speed two-core signal lines against pulse overvoltage. Suitable for the telecommunication lines and communication interface of I&C, electronic security and fire alarm systems, etc., RS485 and PROFIBUS mainly.

- Suitable for high-speed signalling lines
- Installation at the line entry into building, close to protected equipment
- In "F" version is the line separated from protective earth via GDT

Type	Location	Number of lines	U_C	I_L	I_{imp} (D1)	I_n (C2)	U_p (C3) core-PE/GND	Floating	Ordering number
BDGHF-006-V/1-R1	ST 1+2+3	1	8.5 V DC	1 A	2.5 kA	10 kA	14 V	No	8595090565215
BDGHF-012-V/1-R1	ST 1+2+3	1	16 V DC	1 A	2.5 kA	10 kA	24 V	No	8595090565277
BDGHF-024-V/1-R1	ST 1+2+3	1	24 V DC	1 A	2.5 kA	10 kA	48 V	No	8595090565338
BDGHF-230-V/1-R	ST 1+2+3	1	250 V DC	0.5 A	2.5 kA	10 kA	550 V	No	8595090565390
BDGHF-006-V/1-FR1	ST 1+2+3	1	8.5 V DC	1 A	2.5 kA	10 kA	14 V	Yes	8595090565208
BDGHF-012-V/1-FR1	ST 1+2+3	1	16 V DC	1 A	2.5 kA	10 kA	24 V	Yes	8595090565260
BDGHF-024-V/1-FR1	ST 1+2+3	1	24 V DC	1 A	2.5 kA	10 kA	48 V	Yes	8595090565321
BDGHF-230-V/1-FR	ST 1+2+3	1	250 V DC	0.5 A	2.5 kA	10 kA	550 V	Yes	8595090565383
BDGHF-006-V/2-R1	ST 1+2+3	2	8.5 V DC	1 A	2.5 kA	10 kA	14 V	No	8595090565246
BDGHF-012-V/2-R1	ST 1+2+3	2	16 V DC	1 A	2.5 kA	10 kA	24 V	No	8595090565307
BDGHF-024-V/2-R1	ST 1+2+3	2	24 V DC	1 A	2.5 kA	10 kA	48 V	No	8595090565369
BDGHF-230-V/2-R	ST 1+2+3	2	250 V DC	0.5 A	2.5 kA	10 kA	550 V	No	8595090565420
BDGHF-006-V/2-FR1	ST 1+2+3	2	8.5 V DC	1 A	2.5 kA	10 kA	14 V	Yes	8595090565239
BDGHF-012-V/2-FR1	ST 1+2+3	2	16 V DC	1 A	2.5 kA	10 kA	24 V	Yes	8595090565291
BDGHF-024-V/2-FR1	ST 1+2+3	2	24 V DC	1 A	2.5 kA	10 kA	48 V	Yes	8595090565352
BDGHF-230-V/2-FR	ST 1+2+3	2	250 V DC	0.5 A	2.5 kA	10 kA	550 V	Yes	8595090565413

SPDs for data / signalling / telecommunication networks
Devices with pluggable module

DMP-…-V/1-…(F)R1 range

Combined coarse and fine protection in data part and surge protection for ELV in power supply part. For protection of the communication interfaces of I&C, electronic security and fire alarm systems, etc., mainly for measuring circuits and sensors, where signal and power supply are transmitted in one cable, against surge voltage.

- For circuits where signal and power supply are transmitted in one cable
- Installation close to protected equipment
- Visual fault signalling
- In "F" version is the line separated from protective earth via GDT

Type	Location	Number of lines	U_c	I_L	I_n (C2)	U_p (C3) core-PE/GND	Floating	Ordering number
DMP-012-V/1-R1	ST 2+3	1 two-core	16 V DC	1 A	10 kA	22 V	No	8595090557968
DMP-024-V/1-R1	ST 2+3	1 two-core	36 V DC	1 A	10 kA	46 V	No	8595090557975
DMP-012-V/1-FR1	ST 2+3	1 two-core	16 V DC	1 A	10 kA	22 V	Yes	8595090557982
DMP-024-V/1-FR1	ST 2+3	1 two-core	36 V DC	1 A	10 kA	46 V	Yes	8595090557999
DMP-012-V/1-JR1	ST 2+3	1 single-core	16 V DC	1 A	10 kA	22 V	No	8595090558002
DMP-024-V/1-JR1	ST 2+3	1 single-core	36 V DC	1 A	10 kA	46 V	No	8595090558019
DMP-012-V/1-JFR1	ST 2+3	1 single-core	16 V DC	1 A	10 kA	22 V	Yes	8595090558026
DMP-024-V/1-JFR1	ST 2+3	1 single-core	36 V DC	1 A	10 kA	46 V	Yes	8595090558033

DP-…-V/1-(F)16 range

Universal overvoltage protection specified for the protection of direct or alternating low voltage distribution against pulse overvoltage.

- Installation close to protected equipment
- Visual fault signalling
- In "F" version is the line separated from protective earth via GDT

Type	Location	Number of lines	U_c	I_L	I_n (C2)	U_p (C3) core-PE	Floating	Ordering number
DP-012-V/1-16	ST 2	1	20 V AC/DC	16 A	2 kA	110 V	No	8595090554479
DP-024-V/1-16	ST 2	1	34 V AC/DC	16 A	2 kA	150 V	No	8595090554486
DP-048-V/1-16	ST 2	1	60 V AC/DC	16 A	2 kA	200 V	No	8595090554493
DP-060-V/1-16	ST 2	1	75 V AC/DC	16 A	2 kA	210 V	No	8595090554509
DP-012-V/1-F16	ST 2	1	20 V AC/DC	16 A	2 kA	750 V	Yes	8595090556640
DP-024-V/1-F16	ST 2	1	34 V AC/DC	16 A	2 kA	750 V	Yes	8595090556657
DP-048-V/1-F16	ST 2	1	60 V AC/DC	16 A	2 kA	750 V	Yes	8595090556664
DP-060-V/1-F16	ST 2	1	75 V AC/DC	16 A	2 kA	750 V	Yes	8595090556671

SPDs for data / signalling / telecommunication networks Compact devices

BD-…-T range

Lightning current arrester. To protect two-core communication, data and other lines at the zone boundaries LPZ 0 and LPZ 1, against pulse overvoltage.

- Variant BD-250 for protection of telecommunication lines
- Installation at the line entry into building
- Coarse protection between lines and protective earth

Type	Location	Number of lines	U_C	I_L	I_{imp} (D1) per core	I_n (C2) per core	U_p (C3) core-PE	Floating	Ordering number
BD-090-T	ST 1	1	70 V DC	1.6 A	2.5 kA	10 kA	550 V	Yes	8595090558217
BD-250-T	ST 1	1	180 V DC	1.6 A	2.5 kA	10 kA	550 V	Yes	8595090558224

DM-…/1 … DJ range

Combined coarse and fine protection. For the protection of up to four-core communication, data and other lines with common earth, against pulse overvoltage. Suitable for the communication interface of I&C, electronic security and fire alarm systems.

- Installation close to protected equipment
- Variants with resistive (R) or inductive (L) coupling impedance
- In "F" version is the line separated from protective earth via GDT

Type	Location	Number of lines	U_C	I_L	I_n (C2)	U_p (C3) core-PE	Floating	Ordering number
DM-006/1 R DJ	ST 2+3	1	8.1 V DC	0.06 A	10 kA	20 V	No	8595090509301
DM-012/1 R DJ	ST 2+3	1	14.5 V DC	0.06 A	10 kA	35 V	No	8595090509318
DM-024/1 R DJ	ST 2+3	1	29.1 V DC	0.06 A	10 kA	50 V	No	8595090509325
DM-048/1 R DJ	ST 2+3	1	50.2 V DC	0.06 A	10 kA	80 V	No	8595090509332
DM-006/1 L DJ	ST 2+3	1	8.1 V DC	0.37 A	10 kA	20 V	No	8595090515579
DM-012/1 L DJ	ST 2+3	1	14.5 V DC	0.37 A	10 kA	35 V	No	8595090513520
DM-024/1 L DJ	ST 2+3	1	29.1 V DC	0.37 A	10 kA	50 V	No	8595090512370
DM-048/1 L DJ	ST 2+3	1	50.2 V DC	0.37 A	10 kA	80 V	No	8595090513537
DM-006/1 L2 DJ	ST 2+3	1	8.1 V DC	2 A	10 kA	20 V	No	8595090513322
DM-012/1 L2 DJ	ST 2+3	1	14.5 V DC	2 A	10 kA	35 V	No	8595090513315
DM-024/1 L2 DJ	ST 2+3	1	29.1 V DC	2 A	10 kA	50 V	No	8595090513339
DM-048/1 L2 DJ	ST 2+3	1	50.2 V DC	2 A	10 kA	80 V	No	8595090513346
DM-006/1 3R DJ	ST 2+3	1 three-core	8.1 V DC	0.06 A	10 kA	350 V	Yes	8595090513506
DM-012/1 3R DJ	ST 2+3	1 three-core	14.5 V DC	0.06 A	10 kA	350 V	Yes	8595090513490
DM-024/1 3R DJ	ST 2+3	1 three-core	29.1 V DC	0.06 A	10 kA	350 V	Yes	8595090512349
DM-048/1 3R DJ	ST 2+3	1 three-core	50.2 V DC	0.06 A	10 kA	350 V	Yes	8595090513483
DM-006/1 3L DJ	ST 2+3	1 three-core	8.1 V DC	0.37 A	10 kA	350 V	Yes	8595090514022
DM-012/1 3L DJ	ST 2+3	1 three-core	14.5 V DC	0.37 A	10 kA	350 V	Yes	8595090520948
DM-024/1 3L DJ	ST 2+3	1 three-core	29.1 V DC	0.37 A	10 kA	350 V	Yes	8595090515197
DM-048/1 3L DJ	ST 2+3	1 three-core	50.2 V DC	0.37 A	10 kA	350 V	Yes	8595090516484
DM-006/1 4R DJ	ST 2+3	1 four-core	8.1 V DC	0.06 A	10 kA	350 V	Yes	8595090516750
DM-012/1 4R DJ	ST 2+3	1 four-core	14.5 V DC	0.06 A	10 kA	350 V	Yes	8595090516897
DM-024/1 4R DJ	ST 2+3	1 four-core	29.1 V DC	0.06 A	10 kA	350 V	Yes	8595090513575
DM-048/1 4R DJ	ST 2+3	1 four-core	50.2 V DC	0.06 A	10 kA	350 V	Yes	8595090519775

SPDs for data / signalling / telecommunication networks
Compact devices

DM-PROFIBUS ... range

Combined coarse and fine overvoltage protection. It is specified for the protection of signal lines and communication interfaces of high-speed industrial bus PROFIBUS. Cable shielding is also protected. NOTE: For a two-core bus-bar with shielded common conductor (COM), the shielding is connected simultaneously to the COM and SH terminals.

- Installation close to protected equipment
- Line separated from protective earth via GDT

Type	Location	Number of lines	U_C	I_L	I_n (C2)	U_p (C3) core-COM	Floating	Ordering number
DM-PROFIBUS 5 V	ST 2+3	1 three-core	8.1 V DC	0.06 A	10 kA	150 V	Yes	8595090515319
DM-PROFIBUS 24 V	ST 2+3	1 three-core	29.1 V DC	0.06 A	10 kA	300 V	Yes	8595090516736

DMS-... range

Special coarse and fine overvoltage protection with resistance to incoming AC voltage and current limiting. For protection of communication interface, mainly the measuring loops of I&C, electronic security and fire alarm systems, etc., against transient overvoltage where are long parallel lines with power network.

- Installation close to protected equipment
- Line separated from protective earth via GDT

Type	Location	Number of lines	U_C	I_L	I_n (C2)	U_p (C3) core-PE	Floating	Ordering number
DMS-24	ST 2+3	1	33 V DC	0.06 A	5 kA	450 V	Yes	8595090541189
DMS-48	ST 2+3	1	56 V DC	0.06 A	5 kA	450 V	Yes	8595090555452

DP...-... range

Universal overvoltage protection specified for the protection of direct or alternating low voltage distribution against pulse overvoltage.

- Variant DPF-024 with integrated RFI filter
- Installation close to protected equipment
- Visual fault signalling

Type	Location	VF filter	U_C	I_L	I_n (C2)	U_p (C3) core-PE	Fault signalling	Ordering number
DP-012	ST 2	No	28 V DC	16 A	2 kA	530 V	Visual	8595090521877
DP-024	ST 2	No	44 V DC	16 A	2 kA	530 V	Visual	8595090516040
DP-048	ST 2	No	90 V DC	16 A	2 kA	550 V	Visual	8595090521884
DP-060	ST 2	No	112 V DC	16 A	2 kA	550 V	Visual	8595090521907
DPF-024	ST 2	Yes	50 V DC	6 A	0.5 kA	550 V	Visual	8595090530503

SPDs for data / signalling / telecommunication networks
Terminal blocks with screw terminals

DM, DMG, DMJ, DMHF, DMLF, DS range

Surge protections for single- and two-core lines. Suitable for protection of telecommunication, measuring, signal lines and communication interfaces of I&C, electronic security and fire alarm systems, etc. against effects of surge voltage. Installation close to protected equipment.

- Multiple core lines significantly save the space
- Screw terminals
- Side cover in the scope of delivery for each piece

Type	Location	U_C	I_L	I_n (C2) (8/20 µs)	U_p (C3) core-core	U_p (C3) core-PE	Treshold frequency	Ordering number
DM-006/1-RS	ST 2+3	8.5 V DC	0.5 A	5 kA	18 V	30 V	1 MHz	8595090551409
DM-012/1-RS	ST 2+3	16 V DC	0.5 A	5 kA	28 V	40 V	2 MHz	8595090551416
DM-024/1-RS	ST 2+3	36 V DC	0.5 A	5 kA	50 V	65 V	4 MHz	8595090551423
DM-048/1-RS	ST 2+3	51 V DC	0.5 A	5 kA	80 V	95 V	5 MHz	8595090551430
DM-060/1-RS	ST 2+3	64 V DC	0.5 A	5 kA	100 V	120 V	6.5 MHz	8595090551294
DM-110/1-RS	ST 2+3	120 V DC	0.5 A	5 kA	210 V	230 V	10 MHz	8595090551300
DMG-006/1-RS	ST 2+3	8.5 V DC	0.5 A	5 kA	18 V	350 V	1 MHz	8595090551324
DMG-012/1-RS	ST 2+3	16 V DC	0.5 A	5 kA	28 V	350 V	2 MHz	8595090551331
DMG-024/1-RS	ST 2+3	36 V DC	0.5 A	5 kA	50 V	350 V	4 MHz	8595090551348
DMG-048/1-RS	ST 2+3	51 V DC	0.5 A	5 kA	80 V	350 V	5 MHz	8595090551355
DMG-060/1-RS	ST 2+3	64 V DC	0.5 A	5 kA	100 V	350 V	6.5 MHz	8595090551362
DMG-110/1-RS	ST 2+3	120 V DC	0.5 A	5 kA	210 V	350 V	10 MHz	8595090551379
DMJ-012/2-RS	ST 2+3	16 V DC	0.5 A	5 kA	-	40 V	2 MHz	8595090551447
DMJ-024/2-RS	ST 2+3	36 V DC	0.5 A	5 kA	-	65 V	4 MHz	8595090551454
DMJ-048/2-RS	ST 2+3	51 V DC	0.5 A	5 kA	-	95 V	5 MHz	8595090551317
DMJ-060/2-RS	ST 2+3	64 V DC	0.5 A	5 kA	-	120 V	6.5 MHz	8595090551461
DMJ-110/2-RS	ST 2+3	120 V DC	0.5 A	5 kA	-	230 V	10 MHz	8595090551478
DMHF-006/1-RS	ST 2+3	8.5 V DC	0.5 A	5 kA	26 V	350 V	70 MHz	8595090551386
DMHF-015/1-RS	ST 2+3	22 V DC	0.5 A	5 kA	36 V	350 V	70 MHz	8595090551393
DMLF-024/1-RS	ST 2	31 V DC	0.1 A	5 kA	65 V	80 V	0.07 MHz	8595090553335
DS-B090-RS	ST 2	70 V DC	16 A	10 kA	-	550 V	-	8595090551485
DS-B240-RS	ST 2	180 V DC	16 A	10 kA	-	600 V	-	8595090551492
DS-D024-RS	ST 3	29.1 V DC	16 A	0.3 kA	48 V	48 V	-	8595090551539
DS-V130-RS	ST 2	180 V DC	16 A	6 kA	530 V	530 V	-	8595090551515

SPDs for data / signalling / telecommunication networks Terminal blocks with screwless terminals

DM, DMG, DMJ, DMHF, DMLF, DS range

Surge protections for single- and two-core lines. Suitable for protection of telecommunication, measuring, signal lines and communication interfaces of I&C, electronic security and fire alarm systems, etc. against effects of surge voltage. Installation close to protected equipment.

- Multiple core lines significantly save the space
- Screwless terminals for easy connection
- Side cover in the scope of delivery for each piece

Type	Location	U_C	I_L	I_n (C2) (8/20 µs)	U_p (C3) core-core	U_p (C3) core-PE	Treshold frequency	Ordering number
DM-006/1-RB	ST 2+3	8.5 V DC	0.5 A	5 kA	18 V	30 V	1 MHz	8595090560579
DM-012/1-RB	ST 2+3	16 V DC	0.5 A	5 kA	28 V	40 V	2 MHz	8595090560586
DM-024/1-RB	ST 2+3	36 V DC	0.5 A	5 kA	50 V	65 V	4 MHz	8595090560593
DM-048/1-RB	ST 2+3	51 V DC	0.5 A	5 kA	80 V	95 V	5 MHz	8595090560609
DMG-006/1-RB	ST 2+3	8.5 V DC	0.5 A	5 kA	18 V	350 V	1 MHz	8595090560616
DMG-024/1-RB	ST 2+3	36 V DC	0.5 A	5 kA	50 V	350 V	4 MHz	8595090560623
DMG-048/1-RB	ST 2+3	51 V DC	0.5 A	5 kA	80 V	350 V	5 MHz	8595090560630
DMJ-012/2-RB	ST 2+3	16 V DC	0.5 A	5 kA	-	40 V	2 MHz	8595090560654
DMJ-024/2-RB	ST 2+3	36 V DC	0.5 A	5 kA	-	65 V	4 MHz	8595090560661
DMJ-048/2-RB	ST 2+3	51 V DC	0.5 A	5 kA	-	95 V	5 MHz	8595090560678
DMHF-006/1-RB	ST 2+3	8.5 V DC	0.5 A	5 kA	26 V	350 V	70 MHz	8595090560647
DMHF-015/1-RB	ST 2+3	22 V DC	0.5 A	5 kA	36 V	350 V	70 MHz	8595090562900
DMLF-024/1-RB	ST 2	31 V DC	0.1 A	5 kA	65 V	80 V	0.07 MHz	8595090560692
DS-B090-RB	ST 2	70 V DC	10 A	10 kA	-	550 V	-	8595090560708

For LSA-PLUS strips

CLSA-... range

Combination of coarse and fine protection of data, I&C and telecommunication lines against effects of surge voltage.

- For LSA-PLUS separating strips
- Accessories: comb earthing rail

Type	Location	U_C	I_L	I_n (C2) (8/20 µs)	U_p (C3) core-core	U_p (C3) core-PE	Treshold frequency	Ordering number
CLSA-6	ST 2+3	8.5 V DC	0.5 A	5 kA	13 V	350 V	1.5 MHz	8595090551690
CLSA-12	ST 2+3	16 V DC	0.5 A	5 kA	21 V	350 V	2.5 MHz	8595090551706
CLSA-24	ST 2+3	36 V DC	0.5 A	5 kA	48 V	350 V	4 MHz	8595090551713
CLSA-48	ST 2+3	51 V DC	0.5 A	5 kA	65 V	350 V	6.5 MHz	8595090551720
CLSA-HF6	ST 2+3	8.5 V DC	0.5 A	5 kA	15 V	350 V	55 MHz	8595090551751
CLSA-DSL	ST 2+3	170 V DC	0.5 A	5 kA	230 V	400 V	65 MHz	8595090551768
CLSA-TLF	ST 2+3	170 V DC	0.5 A	5 kA	230 V	350 V	14 MHz	8595090551737
CLSA-ISDN	ST 2+3	120 V DC	0.5 A	5 kA	170 V	350 V	16 MHz	8595090551744

SPDs for Ethernet, phone and serial lines

Surge arresters for phone lines

Combination of coarse and fine surge protection for one pair of telecommunication lines. Suitable also for high-speed lines e.g. ISDN, ADSL or VDSL2.

DL-TLF-HF

- RJ11 connectors
- Suitable also for VDSL2 lines
- Universal plastic adapter for mounting on DIN rail in the scope of delivery

DL-ISDN …

- RJ45 connectors or terminals
- Universal plastic adapter for mounting on DIN rail in the scope of delivery

Type	Location	U_C	I_L	I_n (C2) (8/20 µs)	U_p (C3) core-core	U_p (C3) core-PE	f	Ordering number
DL-TLF-HF	ST 2+3	162 V DC	0.06 A	2.5 kA	240 V	400 V	45 MHz	8595090561507
DL-ISDN SV	ST 2+3	120 V DC	0.06 A	10 kA	180 V	500 V	50 MHz	8595090533818
DL-ISDN RJ45	ST 2+3	121 V DC	0.06 A	2.5 kA	180 V	400 V	80 MHz	8595090533825

Surge arresters for Ethernet Cat. 5e

Fine surge protection suitable for Ethernet Cat. 5 or Cat. 5e lines. Installation close to protected equipment. RJ45 connectors.

DL-Cat. 5e

- RJ45 connectors
- Universal plastic adapter for mounting on DIN rail in the scope of delivery

DL-Cat. 5e … RACK PANEL

- RJ45 connectors
- For 19" RACK

Type	Location	Number of lines	U_C	I_L	I_n (C2) (8/20 µs)	U_p (C3) core-core	U_p (C3) core-PE	Ordering number
DL-Cat. 5e	ST 3	1	8.5 V DC	0.5 A	1.6 kA	65 V	350 V	8595090533757
DL-Cat. 5e 8 RACK PANEL	ST 3	8	8.5 V DC	0.1 A	1.6 kA	65 V	350 V	8595090529309
DL-Cat. 5e 16 RACK PANEL	ST 3	16	8.5 V DC	0.1 A	1.6 kA	65 V	350 V	8595090529316
DL-Cat. 5e 24 RACK PANEL	ST 3	24	8.5 V DC	0.1 A	1.6 kA	65 V	350 V	8595090529323

Surge arresters for Ethernet Cat. 5e PoE

Combined coarse and fine protection of Ethernet line and the PoE part. Connection to the terminals and RJ45 connectors.

DL-100 POE-048

- Panel mounting
- Terminals/RJ45 connector

Line part

- Wires 1, 2, 3, 6

Power part (PoE)

- U_C = 76 V DC
- I_L = 1 A
- Wires 4, 5, 7, 8

DL-Cat. 5e POE plus

- Universal plastic adapter for mounting on DIN rail in the scope of delivery
- Terminals/RJ45 connector

Line part

- Wires 1, 2, 3, 6

Power part (PoE)

- U_C = 76 V DC
- I_L = 1 A
- Wires 4, 5, 7, 8

Type	Location	Number of lines	U_C	I_L	I_n (C2) (8/20 µs)	U_p (C3) core-core	U_p (C3) core-PE	Ordering number
DL-100 POE-048	ST 2+3	1	8.5 V DC	0.1 A	1.5 kA	60 V	560 V	8595090531357
DL-Cat. 5e POE plus	ST 2+3	1	8.1 V DC	0.1 A	5 kA	55 V	530 V	8595090538066

SPDs for Ethernet, telecommunication and serial lines

Surge arresters for Ethernet Cat. 6

Fine protection for Ethernet Cat. 6 lines with or without power supply. Installation close to protected equipment.

DL-Cat.6…

- DL-Cat.6 for lines without power
- DL-...-RJ45-60V for lines with power or IP phones
- RJ45 connectors
- Universal plastic adapter for mounting on DIN rail in the scope of delivery

DL-Cat.6 … PATCH PANEL

- Input – LSA connectors
- Output – RJ45 connectors
- For 19" RACKs

Type	Location	Number of lines	U_c	I_L	I_n (C2) (8/20 µs)	U_p (C3) core-core	U_p (C3) core-PE	Ordering number
DL-Cat.6	ST 3	1	8.5 V DC	0.5 A	1.6 kA	65 V	350 V	8595090536031
DL-1G-RJ45-60V	ST 1+2+3	1 (1G)	60 V DC	0.5 A	0.15 kA	100 V	500 V	8595090562207
DL-10G-RJ45-60V	ST 1+2+3	1 (10G)	60 V DC	0.5 A	0.15 kA	100 V	500 V	8595090562214
DL-Cat.6 8 PATCH PANEL	ST 3	8	8.5 V DC	0.1 A	1.6 kA	65 V	350 V	8595090536048
DL-Cat.6 16 PATCH PANEL	ST 3	16	8.5 V DC	0.1 A	1.6 kA	65 V	350 V	8595090536055
DL-Cat.6 24 PATCH PANEL	ST 3	24	8.5 V DC	0.1 A	1.6 kA	65 V	350 V	8595090536062

Surge arresters for Ethernet Cat. 6(A) PoE

Combination of coarse and fine protection of single Ethernet Cat. 6 or 6A line with possibility of PoE (Power over Ethernet) Mode A, B, against surge voltage. Installation at the boundary of LPZ 0 and LPZ 1 or higher, close to protected equipment.

DL-…-RJ45-PoE-AB

- RJ45 connectors
- Universal plastic adapter for mounting on DIN rail in the scope of delivery

Type	Location	Network type	U_c line/PoE	I_L line/PoE	I_n (C2) (8/20 µs)	U_p (C3) core-core	U_p (C3) core-PE	Ordering number
DL-1G-RJ45-PoE-AB	ST 1+2+3	1G	8.5 / 58 V DC	0.5 / 1.5 A	0.15 kA	60 / 90 V	500 V	8595090561484
DL-10G-RJ45-PoE-AB	ST 1+2+3	10G	8.5 / 58 V DC	0.5 / 1.5 A	0.15 kA	60 / 90 V	500 V	8595090561491

Surge arrester for RS interface

Fine protection for protection of serial ports of computers and control systems against effects of surge voltage.

DL-RS DD9

- DSUB 9 F/M connectors

Type	Location	U_c	I_L	I_n (C2) (8/20 µs)	U_p (C3) core-core	U_p (C3) core-PE	f	Ordering number
DL-RS DD9	ST 2+3	18 V DC	0.06 A	0.15 kA	50 V	980 V	55 MHz	8595090509684

SPDs for video and coaxial lines

Surge arresters for video circuits

Combination of coarse and fine protection for video systems, CCTV, etc. against surge voltage. Installation close to protected equipment.

VL-…

- BNC 75 Ω connectors or terminals
- Universal plastic adapter for mounting on DIN rail in the scope of delivery

Type	Location	U_C	I_L	I_n (C2) (8/20 µs)	U_p (C3) core-SH	U_p (C3) SH-PE	f	Ordering number
VL-B75 F/F	ST 2+3	6 V AC / 8.5 V DC	0.06 A	5 kA	35 V	350 V	150 MHz	8595090533764
VL-SV	ST 2+3	6 V AC / 8.5 V DC	0.06 A	5 kA	35 V	350 V	150 MHz	8595090533795

Lightning current arresters for coaxial lines

Suitable for coaxial lines of telecommunication equipment against effects of direct or indirect lightning strike. Installation at the boundary of LPZ 0 and LPZ 1 zones at the line entry into building. Suitable for the combined signal and power supply installations. FX devices can be used as the 1st level of surge for protection in coordination with the SX type.

HX-… N50 F/…

- N 50 Ω connectors
- Suitable for the combined signal and power supply installations
- f = 0 – 3.5 GHz

FX-… …75 T F/F

- BNC or F 75 Ω connectors
- Universal plastic adapter for mounting on DIN rail in the scope of delivery
- f = 0 – 2.15 GHz

ZX-0,44 N50 F/...

- N 50 Ω connectors
- For narrowband transmitters/receivers it used 1/8-wave technology
- f = 0.44 GHz

Type	Location	U_C	I_L	I_{imp} (D1) (10/350 µs)	I_n (C2) (8/20 µs)	U_p (C3)	f_{max}	Ordering number
HX-090 N50 F/F	ST 1+2	70 V DC	6 A	2.5 kA	10 kA	600 V	3 500 MHz	8595090534051
HX-090 N50 F/M	ST 1+2	70 V DC	6 A	2.5 kA	10 kA	600 V	3 500 MHz	8595090533467
HX-230 N50 F/F	ST 1+2	180 V DC	6 A	2.5 kA	10 kA	650 V	3 500 MHz	8595090535119
HX-230 N50 F/M	ST 1+2	180 V DC	6 A	2.5 kA	10 kA	650 V	3 500 MHz	8595090535102
HX-470-N50-F/F	ST 1+2	360 V DC	6 A	2.5 kA	10 kA	980 V	1 800 MHz	8595090565567
HX-470-N50-F/M	ST 1+2	360 V DC	6 A	2.5 kA	10 kA	980 V	1 800 MHz	8595090565550
ZX-0.44 N50 F/F	ST 1+2+3	-	-	5 kA	20 kA	250 V	f = 440 MHz	8595090562078
ZX-0.44 N50 F/M	ST 1+2+3	-	-	5 kA	20 kA	250 V	f = 440 MHz	8595090562887
FX-090 B75 T F/F	ST 1	70 V	4 A	2.5 kA	10 kA	600 V	2 150 MHz	8595090533856
FX-230 B75 T F/F	ST 1	180 V	4 A	2.5 kA	10 kA	660 V	2 150 MHz	8595090533900
FX-090 F75 T F/F	ST 1	70 V	4 A	2.5 kA	10 kA	600 V	2 150 MHz	8595090533870
FX-230 F75 T F/F	ST 1	180 V	4 A	2.5 kA	10 kA	660 V	2 150 MHz	8595090533924

Surge arrester for coaxial lines

Fine surge protection of coaxial inputs of TV and CCTV systems against surge voltage. Suitable as the 2nd level of surge protection in coordination with the FX type. Installation close to protected equipment.

SX-090 …75 F/F

- Shielding connected to protective grounding
- BNC or F 75 Ω connectors
- Universal plastic adapter for mounting on DIN rail in the scope of delivery

Type	Location	U_C	I_L	I_n (C2) (8/20 µs)	U_p (C3) core-PE	f_{min}	f_{max}	Ordering number
SX-090 B75 F/F	ST 2+3	29.1 V DC	4 A	1.5 kA	80 V	1 MHz	2 150 MHz	8595090533955
SX-090 F75 F/F	ST 2+3	29.1 V DC	4 A	1.5 kA	80 V	1 MHz	2 150 MHz	8595090533979

SALTEK® SPD applications in data / signalling / telecommunication systems

MEASURING AND CONTROL TECHNOLOGY AND BUS SYSTEMS								
Interface / Signal		**Protected cores**	**U (DC) (V)**	**Discharge current per core**		**SPD xx – corresponding voltage**	**For mounting on**	**Notes**
				10/350 µs	**8/20 µs**			
Current loop 0 ÷ 20mA. 4 ÷ 20mA		2	12/24	x	10 kA	DM-xx/1R DJ	DIN 35	
				x	5 kA	DM-xx/1-Ry*	DIN 35	
		2	12/24	x	5 kA	CLSA-xx	LSA plus	disconnection
		4	12/24	2.5 kA	10 kA	BDM-xx-V/2-R1	DIN 35	
				2.5 kA	10 kA	BDM-xx-V/2-FR1	DIN 35	floating ground
				x	10 kA	2ks DM-xx/1 R DJ	DIN 35	
		2	12/24	x	5 kA	DMG-xx/1-Ry*	DIN 35	isolated signal ground
		2	12/24	x	10 kA	DMG-xx/1R DJ	DIN 35	isolated signal ground
		2	12/24	2.5 kA	10 kA	BDG-xx-V/1-R1	DIN 35	isolated signal ground
		2	24	x	5 kA	DMLF-024/1-Ry*	DIN 35	
Binary signals		2	6 ÷ 230	2.5 kA	10 kA	BDM-xx-V/1-R1	DIN 35	
				2.5 kA	10 kA	BDM-xx-V/1-FR1	DIN 35	floating ground
				x	5 kA	CLSA-xx	LSA plus	disconnection
				x	10 kA	DM-xx/1R DJ	DIN 35	
BLN Building Level Network		2	15/48	2.5 kA	10 kA	BDM-xx-V/1-R1	DIN 35	
				2.5 kA	10 kA	BDM-xx-V/1-FR1	DIN 35	floating ground
				x	10 kA	DM-xx/1R DJ	DIN 35	
TTL		2	12	2.5 kA	10 kA	BDM-012-V/1-R1	DIN 35	
				2.5 kA	10 kA	BDM-012-V/1-FR1	DIN 35	floating ground
				x	10 kA	DM-012/1R DJ	DIN 35	
RS-485 up to 1.5 Mbit/s		2	5	2.5 kA	10 kA	BDM-006-V/1-R1	DIN 35	
				2.5 kA	10 kA	BDM-006-V/1-FR1	DIN 35	floating ground
				x	10 kA	DM-006/1R DJ	DIN 35	
		3	5	x	10 kA	DM-006/3R DJ	DIN 35	
		3/4	5	2.5 kA	10 kA	BDG-006-V/1-4R1	DIN 35	isolated signal ground
		3/4	5	2.5 kA	10 kA	BDG-006-V/1-4FR1	DIN 35	floating ground
		4	5	x	10 kA	DM-006/4R DJ	DIN 35	
RS 485 combined with power line (e.g. security and fire alarm system)		2	12	x	10 kA	DMP-012-V/1-R1	DIN 35	
			12	x	10 kA	DMP-012-V/1-FR1	DIN 35	floating ground
			24	x	10 kA	DMP-024-V/1-R1	DIN 35	
			24	x	10 kA	DMP-024-V/1-FR1	DIN 35	floating ground
RS-422		2	5	2.5 kA	10 kA	BDM-006-V/1-R1	DIN 35	
				2.5 kA	10 kA	BDM-006-V/1-FR1	DIN 35	floating ground
				x	10 kA	DM-006/1R DJ	DIN 35	
		4	5	2.5 kA	10 kA	BDG-006-V/1-4R1	DIN 35	isolated signal ground
				2.5 kA	10 kA	BDG-006-V/1-4FR1	DIN 35	floating ground
				x	10 kA	DM-006/4R DJ	DIN 35	
Analog signals	I = 0.06A	2	6 ÷ 48	x	10 kA	DM-xx/1- R DJ	DIN 35	
	I = 0.37A	2	6 ÷ 48	x	10 kA	DM-xx/1- L DJ	DIN 35	
	I = 0.5A	2	6 ÷ 48	x	5 kA	CLSA-xx	LSA plus	disconnection
			6 ÷ 110	x	5 kA	DM-xx/1-Ry*	DIN 35	
			6 ÷ 110	x	5 kA	DMG-xx/1-Ry*	DIN 35	
			24	x	5 kA	DMLF-024/1-Ry*	DIN 35	
	I = 1A	2	6 ÷ 230	2.5 kA	10 kA	BDM-xx-V/1-R1	DIN 35	
				2.5 kA	10 kA	BDG-xx-V/1-R1	DIN 35	isolated signal ground
				2.5 kA	10 kA	BDM-xx-V/1-FR1	DIN 35	floating ground
				2.5 kA	10 kA	BDG-xx-V/1-FR1	DIN 35	floating ground
	I = 2A	2	6 ÷ 48	x	10 kA	DM-xx/1- L2 DJ	DIN 35	
			6 ÷ 60	2.5 kA	10 kA	BDM-xx-V/1-R2	DIN 35	
				2.5 kA	10 kA	BDM-xx-V/1-FR2	DIN 35	floating ground
				2.5 kA	10 kA	BDG-xx-V/1-R2	DIN 35	isolated signal ground
				2.5 kA	10 kA	BDG-xx-V/1-FR2	DIN 35	floating ground
Multipurpose coarse protection		2	70	2.5 kA	x	BD-090-T-V/1-16	DIN 35	
				2.5 kA	x	BD-090-T-V/1-F16	DIN 35	floating ground
RS-232		2	15	2.5 kA	10 kA	BDM-012-V/1-R1	DIN 35	
				2.5 kA	10 kA	BDM-012-V/1-FR1	DIN 35	floating ground
				x	10 kA	DM-012/1R DJ	DIN 35	
Measurement of temperature Pt-100. Pt-1000 Ni-1000. NTC. PTC		2	up to 6	x	5 kA	CLSA-006	LSA plus	disconnection
				2.5 kA	10 kA	BDM-006-V/1-R1	DIN 35	
				2.5 kA	10 kA	BDM-006-V/1-FR1	DIN 35	floating ground
				x	10 kA	DM-006/1R DJ	DIN 35	
		3	up to 6	x	10 kA	DM-006/3R DJ	DIN 35	
		3/4	up to 6	2.5 kA	10 kA	BDG-006-V/1-4R1	DIN 35	isolated signal ground
		3/4	up to 6	2.5 kA	10 kA	BDG-006-V/1-4FR1	DIN 35	floating ground
		4	up to 6	x	10 kA	DM-006/4R DJ	DIN 35	
Optron protocol		2	6 ÷ 24	2.5 kA	10 kA	BDM-006-V/1-R1	DIN 35	
				2.5 kA	10 kA	BDM-006-V/1-FR1	DIN 35	floating ground
				x	10 kA	DM-xx/1R DJ	DIN 35	

Ry means version of the terminal: RS – screw, RB – screwless

SALTEK® SPD applications in data / signalling / telecommunication systems

MEASURING AND CONTROL TECHNOLOGY AND BUS SYSTEMS								
Interface / Signal		Protected cores	U (DC) (V)	Discharge current per core		SPD xx – corresponding voltage	For mounting on	Notes
				10/350 µs	8/20 µs			
DC power supply	I = 2 A	2	6 ÷ 60	2.5 kA	10 kA	BDM-xx-V/1-R2	DIN 35	
				2.5 kA	10 kA	BDM-xx-V/1-FR2	DIN 35	floating ground
				x	10 kA	DM-xx/1 L2 DJ	DIN 35	
	I =16 A	2	12 ÷ 60	x	2 kA	DP-xx	DIN 35	
				x	2 kA	DP-xx-V/1-16	DIN 35	
				x	2 kA	DP-xx-V/1-F16	DIN 35	floating ground
	I = 2 A	2	6 ÷ 60	2.5 kA	10 kA	BDG-xx-V/1-R2	DIN 35	isolated signal ground
				2.5 kA	10 kA	BDG-xx-V/1-FR2	DIN 35	floating ground
	I = 1 A	2	6 ÷ 60	2.5 kA	10 kA	BDM-xx-V/1-R1	DIN 35	
						BDM-xx-V/1-FR1	DIN 35	floating ground
	I = 1 A	2	6 ÷ 60	2.5 kA	10 kA	BDG-xx-V/1-R1	DIN 35	isolated signal ground
				2.5 kA	10 kA	BDG-xx-V/1-FR1	DIN 35	floating ground
	I = 6 A	2	24	x	1 kA	DPF-24	DIN 35	RFI filter
EIB		2	24	2.5 kA	10 kA	BDM-024-V/1-R1	DIN 35	
				2.5 kA	10 kA	BDM-024-V/1-FR1	DIN 35	floating ground
				x	10 kA	DM-024/1R DJ	DIN 35	
M-Bus		2	48	2.5 kA	10 kA	BDM-048-V/1-R1	DIN 35	
				2.5 kA	10 kA	BDM-048/1R DJ	DIN 35	
CAN-Bus		2	6	x	10 kA	DM-006/1R DJ	DIN 35	
communication max. 1.5 Mbit/s		2	6	2.5 kA	10 kA	BDM-006-V/1-R1	DIN 35	
Device Net communication 500 kbit/s	I = 2 A	2	24	2.5 kA	10 kA	BDM-024-V/1-R2	DIN 35	
				x	10 kA	DM-024/1 L2 DJ	DIN 35	
	I = 2 A	2	5	2.5 kA	10 kA	BDM-006-V/1-R2	DIN 35	
				x	10 kA	DM-006/1L2 DJ	DIN 35	
	I = 1 A	2	24	2.5 kA	10 kA	BDM-024-V/1-R1	DIN 35	
			5	2.5 kA	10 kA	BDM-006-V/1-R1	DIN 35	
C-Bus		2	5	x	10 kA	DM-006/1R DJ	DIN 35	
Honeywell communication max. 0.9 Mbit/s		2	5	2.5 kA	10 kA	BDM-006-V/1-R1	DIN 35	
Dupline		2	15	2.5 kA	10 kA	BDG-012-V/1-R1	DIN 35	isolated signal ground
E-Bus (Honeywel)		2	48	2.5 kA	10 kA	BDG-048-V/1-R1	DIN 35	isolated signal ground
Fieldbus Foundation		2	30	2.5 kA	10 kA	BDG-048-V/1-R1	DIN 35	isolated signal ground
Genius I/O Bus		2	12	2.5 kA	10 kA	BDG-012-V/1-R1	DIN 35	isolated signal ground
FIPIO/FIPWAY		2	30	2.5 kA	10 kA	BDG-048-V/1-R1	DIN 35	isolated signal ground
INTERBUS INLINE		2	48	2.5 kA	10 kA	BDG-048-V/1-R1	DIN 35	isolated signal ground
K-Bus		2	24	2.5 kA	10 kA	BDG-024-V/1-R1	DIN 35	isolated signal ground
LUXMATE-Bus		2	24	2.5 kA	10 kA	BDG-024-V/1-R1	DIN 35	isolated signal ground
Procontic CS31 (RS-232)		2	15	2.5 kA	10 kA	BDM-024-V/1-R1	DIN 35	isolated signal ground
Profibus-DP/FMS high-speed lines	up to 1.5 Mbit/s	2	9	x	10 kA	DM-006/1R DJ	DIN 35	
		2	6	2.5 kA	10 kA	BDM-006-V/1-R1	DIN 35	
	up to 20 Mbit/s	9	18	x	150 A	DL-RS DD9	Canon	
	up to 50 Mbit/s	2	6	x	10 kA	DM-PROFIBUS 5V	DIN 35	
		2	6/15	x	5 kA	DMHF-xx/1-Ry*	DIN 35	
		3/4	6/24	2.5 kA	10 kA	BDMHF-xx-V/1-4R1	DIN 35	
		3/4	6/24	2.5 kA	10 kA	BDMHF-xx-V/1-4FR1	DIN 35	floating ground
		2	6/24	2.5 kA	10 kA	BDMHF-xx-V/1-R1	DIN 35	
			6/24	2.5 kA	10 kA	BDMHF-xx-V/1-FR1	DIN 35	floating ground
		2	6 ÷ 24	2.5 kA	10 kA	BDGHF-xx-V/1-R1	DIN 35	isolated signal ground
			6 ÷ 24	2.5 kA	10 kA	BDGHF-xx-V/1-FR1	DIN 35	floating ground
		2+2	6 ÷ 24	2.5 kA	10 kA	BDGHF-xx-V/2-R1	DIN 35	isolated signal ground
			6 ÷ 24	2.5 kA	10 kA	BDGHF-xx-V/2-FR1	DIN 35	floating ground
R-Bus		2	6	2.5 kA	10 kA	BDG-006-V/1-R1	DIN 35	isolated signal ground
SDLS		2	6	x	5 kA	CLSA-6	Krone LSA+	
Securilan-LON-Bus		2	6	2.5 kA	10 kA	BDG-006-V/1-R1	DIN 35	isolated signal ground
SIGMA SYS		2	48	2.5 kA	10 kA	BDG-048-V/1-R1	DIN 35	isolated signal ground
(Siemens EPS)		2	48	2.5 kA	10 kA	BDM-048-V/1-R1	DIN 35	
SS97 SINIS (RS-232)		2	15	2.5 kA	10 kA	BDM-024-V/1-R1	DIN 35	
SUCONET		2	6	2.5 kA	10 kA	BDG-006-V/1-R1	DIN 35	isolated signal ground
TELEPERM M analog input		2	12	2.5 kA	10 kA	BDM-012-V/1-R1	DIN 35	
		2	24	2.5 kA	10 kA	BDM-024-V/1-R1	DIN 35	
		2	12	x	5 kA	CLSA-12	Krone LSA+	
		2	24	x	5 kA	CLSA-24	Krone LSA+	
TELEPERM M binary I/O		2	48	x	10 kA	DM-048/1L DJ	DIN 35	
		2	48	2.5 kA	10 kA	BDM-048-V/1-R1	DIN 35	
		2	12	x	10 kA	DM-012/1L DJ	DIN 35	
		2	12	2.5 kA	10 kA	BDM-012-V/1-R1	DIN 35	
TELEPERM MFM100		2	12	2.5 kA	10 kA	BDG-012-V/1-R1	DIN 35	isolated signal ground
				2.5 kA	10 kA	BDG-012-V/1-FR1	DIN 35	floating ground
TTY		2	6 ÷ 24	x	10 kA	DM-xxx/1R DJ	DIN 35	
		2	6 ÷ 24	2.5 kA	10 kA	BDM-xxx-V/1-R1	DIN 35	
Potential-free (isolated) contacts		1	6 ÷ 110	x	10 kA	DMJ-xx/2-Ry*	DIN 35	
				2.5 kA	10 kA	BDM-xx-V/2-JR1	DIN 35	
				2.5 kA	10 kA	BDM-xx-V/2-JR2	DIN 35	
				2.5 kA	10 kA	BDM-xx-V/2-JFR1	DIN 35	floating ground
				2.5 kA	10 kA	BDM-xx-V/2-JFR2	DIN 35	floating ground
				2.5 kA	10 kA	BDM-xx-V/4-JFR1	DIN 35	
				2.5 kA	10 kA	BDM-xx-V/4-JFR1	DIN 35	floating ground
Protection against power crossing of lines up to 400 V		2	24/48	x	5 kA	DMS-xx	DIN 35	

SALTEK® SPD applications in data / signalling / telecommunication systems

TELECOMMUNICATIONS. TELEPHONE SYSTEMS							
Interface / Signal	Protected cores	U (DC) (V)	Discharge current per core		SPD xx – corresponding voltage	For mounting on	Notes
			10/350 µs	8/20 µs			
ADSL analog line	2	170	x	5 kA	CLSA-TLF	LSA plus	disconnection
			x	5 kA	CLSA-DSL	LSA plus	disconnection
			x	2.5 kA	DL-TLF-HF	DIN 35	RJ11
			2.5 kA	10 kA	BDG-230-V/1-R	DIN 35	isolated signal ground
			2.5 kA	10 kA	BDG-230-V/1-FR	DIN 35	floating ground
			2.5 kA	x	BD-250-T-V/1-16	DIN 35	
Analog telephone line	2	170	x	5 kA	CLSA-TLF	LSA plus	disconnection
			x	2.5 kA	DL-TLF-HF	DIN 35	RJ11
			2.5 kA	10 kA	BDG-230-V/1-R	DIN 35	isolated signal ground
			2.5 kA	10 kA	BDG-230-V/1-FR	DIN 35	floating ground
			2.5 kA	x	BD-250-T-V/1-16	DIN 35	
DATEX-P	2	24	x	5 kA	CLSA-24	LSA plus	disconnection
			x	5 kA	DMG-024/1-Ry*	DIN 35	
			2.5 kA	10 kA	BDG-024-V/1-R1	DIN 35	isolated signal ground
			2.5 kA	10 kA	BDG-024-V/1-FR1	DIN 35	floating ground
ISDN U_{K0}	2	120	x	2.5 kA	DL-ISDN RJ45	DIN 35	
			x	10 kA	DL-ISDN SV	DIN 35	
			x	5 kA	CLSA-ISDN	LSA plus	disconnection
Modem M1	2	15	x	5 kA	CLSL-24	LSA plus	disconnection
			x	5 kA	DMG-024/1R-Ry*	DIN 35	isolated signal ground
			2.5 kA	10 kA	BDG-024-V/1-R1	DIN 35	isolated signal ground
			2.5 kA	10 kA	BDG-024-V/1-FR1	DIN 35	floating ground
			2.5 kA	10 kA	BDM-24-V/1-R1	DIN 35	
			2.5 kA	10 kA	BDM-24-V/1-FR1	DIN 35	floating ground
Telephony systems (eg. Siemens, HICOM, ALCATEL)	2	170	x	5 kA	CLSA-TLF	LSA plus	disconnection
			x	2.5 kA	DL-TLF-HF	DIN 35	RJ11
			2.5 kA	x	BD-250-T-V/1-16	DIN 35	
T-DSL	2	170	x	5 kA	CLSA-DSL	LSA plus	disconnection
			x	5 kA	CLSA-TLF	LSA plus	disconnection
			x	2.5 kA	DL-TLF-HF	DIN 35	RJ11
			2.5 kA	10 kA	BDGHF-230-V/1-R	DIN 35	
			2.5 kA	10 kA	BDGHF-230-V/1-FR	DIN 35	floating ground
	2+2		2.5 kA	10 kA	BDGHF-230-V/2-R	DIN 35	
			2.5 kA	10 kA	BDGHF-230-V/2-FR	DIN 35	floating ground
	2		2.5 kA	x	BD-250-T-V/1-16	DIN 35	
Multipurpose coarse protection	2	180	2.5 kA	x	BD-250-T-V/1-16	DIN 35	
				x	BD-250-T-V/1-F16	DIN 35	floating ground
		70	2.5 kA	x	BD-090-T-V/1-16	DIN 35	
				x	BD-090-T-V/1-F16	DIN 35	floating ground
		180	2.5 kA	x	BD-250-T	DIN 35	
		70	2.5 kA	x	BD-090-T	DIN 35	
VDSL/VDSL2	2	170	x	2.5 kA	FAX-OVERDRIVE ...		
			x	5 kA	CLSA-DSL	LSA plus	disconnection
			x	2.5 kA	DL-TLF-HF	DIN 35	
			2.5 kA	x	BD-250-T-V/1-16	DIN 35	

* Ry means version of the terminal: RS – screw, RB – screwless

SALTEK® SPD applications in data / signalling / telecommunication systems

DATA LINES NETWORK							
Interface / Signal	Protected cores	U (DC) (V)	Discharge current per core		SPD xx – corresponding voltage	For mounting on	Notes
			10/350 µs	8/20 µs			
ETHERNET 10/100/1000 Base T	8	6	2 kA	150 A	DL-10G-RJ45-PoE-AB	DIN 35	RJ45
			2 kA	150 A	DL-1G-RJ45-PoE-AB	DIN 35	RJ45
			x	200 A	DL-Cat. 5e	DIN 35	RJ45
			x	200 A	DL-Cat. 6	DIN 35	RJ45
FDDI. CDDI	8	6	2 kA	150 A	DL-10G-RJ45-PoE-AB	DIN 35	RJ45
			2 kA	150 A	DL-1G-RJ45-PoE-AB	DIN 35	RJ45
			x	200 A	DL-Cat. 5e	DIN 35	RJ45
			x	200 A	DL-Cat. 6	DIN 35	RJ45
	2	6	x	5k A	CLSA-6	LSA plus	disconnection
Industrial Ethernet	8	6	2 kA	150 A	DL-1G-RJ45-PoE-AB	DIN 35	RJ45
			x	200 A	DL-Cat. 5e	DIN 35	RJ45
			x	200 A	DL-Cat. 6	DIN 35	RJ45
	8 x 8	6	x	200 A	DL-Cat. 5e 8 PATCH PANEL	19" RACK	LSA/RJ45
	16 x 8		x	200 A	DL-Cat. 5e 16 PATCH PANEL	19" RACK	LSA/RJ45
	24 x 8		x	200 A	DL-Cat. 5e 24 PATCH PANEL	19" RACK	LSA/RJ45
	8 x 8	6	x	200 A	DL-Cat. 5e 8 RACK PANEL	19" RACK	RJ45
	16 x 8		x	200 A	DL-Cat. 5e 16 RACK PANEL	19" RACK	RJ45
	24 x 8		x	200 A	DL-Cat. 5e 24 RACK PANEL	19" RACK	RJ45
Token Ring	8	6	2 kA	150 A	DL-1G-RJ45-PoE-AB	DIN 35	RJ45
			x	200 A	DL-Cat. 5e	DIN 35	RJ45
			x	200 A	DL-Cat. 6	DIN 35	RJ45
	8 x 8	6	x	200 A	DL-Cat. 6 8 PATCH PANEL	19" RACK	LSA/RJ45
	16 x 8		x	200 A	DL-Cat. 6 16 PATCH PANEL	19" RACK	LSA/RJ45
	24 x 8		x	200 A	DL-Cat. 6 24 PATCH PANEL	19" RACK	LSA/RJ45
	8 x 8	6	x	200 A	DL-Cat. 5e 8 RACK PANEL	19" RACK	RJ45
	16 x 8		x	200 A	DL-Cat. 5e 16 RACK PANEL	19" RACK	RJ45
	24 x 8		x	200 A	DL-Cat. 5e 24 RACK PANEL	19" RACK	RJ45
VG-Any LAN	8	6	2 kA	150 A	DL-1G-RJ45-PoE-AB	DIN 35	RJ45
			x	200 A	DL-Cat. 5e	DIN 35	RJ45
			x	200 A	DL-Cat. 6	DIN 35	RJ45
	8 x 8	6	x	200 A	DL-Cat. 6 8 PATCH PANEL	19" RACK	LSA/RJ45
	16 x 8		x	200 A	DL-Cat. 6 16 PATCH PANEL	19" RACK	LSA/RJ45
	24 x 8		x	200 A	DL-Cat. 6 24 PATCH PANEL	19" RACK	LSA/RJ45
	8 x 8	6	x	200 A	DL-Cat. 5e 8 RACK PANEL	19" RACK	RJ45
	16 x 8		x	200 A	DL-Cat. 5e 16 RACK PANEL	19" RACK	RJ45
	24 x 8		x	200 A	DL-Cat. 5e 24 RACK PANEL	19" RACK	RJ45
VoIP (Voice over IP)	8	60	2 kA	150 A	DL-1G-RJ45-60V	DIN 35	RJ45
POE (power over ethernet)	4	6/48	x	5/1 kA	DL-100 POE-048	box	screw terminals/RJ45
	4	6/48	x	1.5/1 kA	DL-Cat. 5e POE plus	DIN 35	screw terminals/RJ45
	8	6/60	2 kA	150 A	DL-1G-RJ45-PoE-AB	DIN 35	RJ45
		6/60	2 kA	150 A	DL-10G-RJ45-PoE-AB	DIN 35	RJ45

SALTEK® SPD applications in data / signalling / telecommunication systems

ANTENNAS. TRANSMITTERS. RECIEVERS. BROADBAND SYSTEM. CCTV								
Interface / Signal		Protected cores	U (DC) (V)	Discharge current per core		SPD xx – corresponding voltage	For mounting on	Notes
				10/350 µs	8/20 µs			
AMPS. NADAC 824 ÷ 894 MHz		1	70	2.5 kA	10 kA	HX-090 N50 F/F	N50	I_N = 6A 3.5 GHz
			70	2.5 kA	10 kA	HX-090 N50 F/M	N50	I_N = 6A 3.5 GHz
			180	2.5 kA	10 kA	HX-230 N50 F/F	N50	I_N = 6A 3.5 GHz
			180	2.5 kA	10 kA	HX-230 N50 F/M	N50	I_N = 6A 3.5 GHz
DCS 1800 B162 1710 ÷ 1880 MHz		1	70	2.5 kA	10 kA	HX-090 N50 F/F	N50	I_N = 6A 3.5 GHz
			180	2.5 kA	10 kA	HX-230 N50 F/F	N50	I_N = 6A 3.5 GHz
Transmitters			70	2.5 kA	20 kA	HX-090 N50 F/F	N50	I_N = 6A 3.5 GHz
			70	2.5 kA	20 kA	HX-090 N50 F/M	N50	I_N = 6A 3.5 GHz
			180	2.5 kA	20 kA	HX-230 N50 F/F	N50	I_N = 6A 3.5 GHz
			180	2.5 kA	20 kA	HX-230 N50 F/M	N50	I_N = 6A 3.5 GHz
GSM 900. GSMR		1	70	2.5 kA	10 kA	HX-090 N50 F/F	N50	I_N = 6A 3.5 GHz
			70	2.5 kA	10 kA	HX-090 N50 F/M	N50	I_N = 6A 3.5 GHz
			180	2.5 kA	10 kA	HX-230 N50 F/F	N50	I_N = 6A 3.5 GHz
			180	2.5 kA	10 kA	HX-230 N50 F/M	N50	I_N = 6A 3.5 GHz
GPS 1565 ÷ 1585 MHz		1	70	2.5 kA	10 kA	HX-090 N50 F/F	N50	I_N = 6A 3.5 GHz
			70	2.5 kA	10 kA	HX-090 N50 F/M	N50	I_N = 6A 3.5 GHz
			180	2.5 kA	10 kA	HX-230 N50 F/F	N50	I_N = 6A 3.5 GHz
			180	2.5 kA	10 kA	HX-230 N50 F/M	N50	I_N = 6A 3.5 GHz
GSM 1800		1	70	2.5 kA	10 kA	HX-090 N50 F/F (F/M)	N50	I_N = 6A 3.5 GHz
			180	2.5 kA	10 kA	HX-230 N50 F/F (F/M)	N50	I_N = 6A 3.5 GHz
PCS 1900 1850 ÷ 1990 MHz		1	70	2.5 kA	10 kA	HX-090 N50 F/F (F/M)	N50	I_N = 6A 3.5 GHz
			180	2.5 kA	10 kA	HX-230 N50 F/F (F/M)	N50	I_N = 6A 3.5 GHz
TETRA. NMT 450 380 ÷ 512 MHz		1	70	2.5 kA	10 kA	HX-090 N50 F/F (F/M)	N50	I_N = 6A 3.5 GHz
			180	2.5 kA	10 kA	HX-230 N50 F/F (F/M)	N50	I_N = 6A 3.5 GHz
Terrestrial TV		1	29	x	1.5 kA	SX-090 F75 F/F	F connector	I_N = 4A 2 GHz
			29	x	1.5 kA	SX-090 B75 F/F	BNC	I_N = 4A 2 GHz
			70	2.5 kA	10 kA	FX-090 F75 F/F	F connector	I_N = 4A 2 GHz
			70	2.5 kA	10 kA	FX-090 B75 F/F	BNC	I_N = 4A 2 GHz
UMTS		1	70	2.5 kA	10 kA	HX-090 N50 F/F (F/M)	N50	I_N = 6A 3.5 GHz
			180	2.5 kA	10 kA	HX-230 N50 F/F (F/M)	N50	I_N = 6A 3.5 GHz
WLAN band 2.4 GHz		1	70	2.5 kA	10 kA	HX-090 N50 F/F (F/M)	N50	I_N = 6A 3.5 GHz
			180	2.5 kA	10 kA	HX-230 N50 F/F (F/M)	N50	I_N = 6A 3.5 GHz
VIDEO	coax	1	6	x	10 kA	VL-B75 F/F	DIN 35	BNC
	2-wire	2	6	x	10 kA	VL-SV	DIN 35	screw terminals
	IP	8	6	x	200	DL-Cat. 5e	DIN 35	RJ45
		8	6	x	200	DL-Cat. 6	DIN 35	RJ45
		4	6/76	x	1	DL-100 POE-048	box	screw terminals/RJ45
		4	6/76	x	1	DL-Cat. 5e POE plus	DIN 35	RJ45
		8	6/60	2 kA	150	DL-1G-RJ45-PoE-AB	DIN 35	RJ45
		8	6/60	2 kA	150	DL-10G-RJ45-PoE-AB	DIN 35	RJ45
WLAN Twist Pair		2	6	x	10 kA	VL-SV	DIN 35	screw terminals

Sales and technical support:

SALTEK TRADE s.r.o.
Vodňanská 1419/226
198 00 Praha 9 - Kyje
Czech Republic
Phone: +420 272 942 470
Fax: +420 267 913 411
E-mail: trade@saltek.cz
www.saltek.eu/en

Manufacture and headquarter:

SALTEK s.r.o.
Drážďanská 85
400 07 Ústí nad Labem
Czech Republic
Phone: +420 475 655 511
Fax: +420 475 622 213
E-mail: info@saltek.cz
www.saltek.eu

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