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SALTEK®
Overvoltage controlled. ANYWHERE.

SOLUTION

Railway stations and railways

Surge Protective Devices and Voltage Limiting Devices

Why to protect?
Protection of railway systems
Trains – metro – trams

Rail transportation in general, whether underground, ground or by trams, put great emphasis on the safety and reliability of traffic, especially on the unconditional protection of persons. For this reason all the sensitive, sophisticated electronic devices (e.g. control, signalling or information systems) require a high level of reliability to meet the needs for safe operation and protection of persons. For economic reasons, these systems do not have sufficient dielectric strength for all possible cases of effects from overvoltage and therefore optimal surge protection must be adapted to the specific requirements of rail transportation.

The cost of complex surge protection of the electric and electronic systems on the railways is only a fraction of the total cost of the protected technology and a small investment in relation to possible consequential damages caused by failure or destruction of equipment.

The damages can be caused by the effects of surge voltage in both direct or indirect lightning strikes, switching operations, failures or due high voltage induced to the metal parts of railway equipment.

The main principle of optimal surge protection design is the complexness and coordination of SPDs and equipotential bonding by direct or indirect connection. Complexness is ensured by installing surge protective devices on all inputs and outputs of the device and system, that all power lines, signal and communication interfaces are protected. The co-ordination of the protections is ensured by installing SPDs with different protective effects consecutively in the correct order so as to progressively limit the surge voltage pulses to the safe level for the protected device.

Voltage limiting devices are also an essential part of the comprehensive protection of electrified rail tracks. They serve to prevent impermissible high touch voltage on the metal parts of the railway equipment by establishing a temporary or permanent connection of the conductive parts with the return circuit of the traction system. By this function they protect primarily people who can get in touch with these exposed conductive parts.



What and how to protect?
Surge Protective Devices (SPD) for railway stations and railways

Power supply lines AC 230/400 V

The railway stations serves primarily to stop the train for the arrival and departure of passengers. In the premises there are important information, management, control and safety system for rail transportation, but also various facilities such as waiting rooms, restaurants, shops, etc., which are connected to the common power supply network and, due to their electrically proximate location, they may be at risk from a failure on the traction power supply circuit. To maintain trouble-free operation of these devices, three-level surge protection must be installed on the AC power supply lines. The recommended configuration of SALTEK surge protective devices is as follows:

- Main distribution board (substation, power line input) – SPD Type 1, e.g. **FLP-SG50 V/1**, or combined lightning current arrester and surge arrester Type 1+2, e.g. **FLP-B+C MAXI V/3**.
- Sub-distribution boards – second level protection, SPD Type 2, e.g. **SLP-275 V/3+1**.
- Technology / equipment – third level protection, SPD Type 3,
  - If the protected devices is located directly in or close to the distribution board, then it is advisable to use SPD Type 3 for the mounting on the DIN rail 35 mm, such as **DA-275 V/3+1**.
  - In cases of direct socket circuits protection into which IT devices such as copiers, computers, etc. can be connected, then it is suitable SPD for additional mounting into socket boxes, e.g. **DA-275-A**.
  - Most of the current measurement and control technology is controlled by microprocessors and computers. Therefore, in addition to overvoltage protection, it is also necessary to eliminate the effect of radio frequency interference that could disrupt the proper operation, e.g. by „freezing“ the processor, overwriting data or memory. For these applications SALTEK recommends **DA-275-DF16**. There are available also other variants according to the required load current.

Fig. 1 SPDs connected to LV power supply systems

FLP-SG50 V/1 | FLP-B+C MAXI V/3 | SLP-275 V/3+1 | DA-275 V/3+1 | DA-275-A | DA-275-DF16

In addition to its own railway buildings, the another important part of the whole infrastructure is the railway track with a wide range of control, monitoring and signalling systems (e.g. signal lights, electronic interlocking, crossing barriers, wagon wheel counters etc.). Their protection against the effects of surge voltages is very important in terms of ensuring trouble-free operation.

- To protect these devices it is suitable to install SPD Type 1 into power supply pillar, or even better product from the range **FLP-B+C MAXI V,** SPD Type 1+2 which, thanks to a lower protection level, better protects the equipment. The example of a real installation is shown in *Fig. 2*.

Fig. 2 Signalling system power supply pillar

- For railway equipment that are connected directly to or close to rails (for example, a wagon counting device), it is necessary to use the **BVL-25-120-R01**, the voltage limiting device, to compensate possible potential differences between the rails and the protective ground the equipment. It is designed for easy DIN rail 35 mm mounting.

Communication technology

An important part of rail transportation systems are also all communication technologies and their proper protection. There can be various digital and analogue communication lines working on classic metal cables or wirelessly. For the protection of the equipment connected to these circuits can be used for example these SALTEK surge arresters:

- Telephone line with ADSL or VDSL2 – e.g. **BDG-230-V/1-R** at the entrance to the building and **DL-TLF-HF** close to the protected equipment.
- Ethernet networks – universal protection for data networks and lines combined with PoE, for example **DL-1G-RJ45-PoE-AB**.
- Coaxial antenna line for wireless communication – e.g. **HX-090N50 F/F**.

Control and data signal lines

The lines of measuring and control equipment in the rail infrastructure must be, of course, also protected from the effects of surges and overvoltage in order to maintain the maximum possible reliability and operability. An example of the application of SALTEK protection for data and signal networks can be:

- Protection of the signal and measuring lines to railway equipment – surge arrester ST 1+2+3, e.g. **BDM-024-V/1-FR1**.

Fig. 3 SPDs for data/signalling/telecomunication networks

BDG-230-V/1-R | DL-TLF-HF | DL-1G-RJ45-PoE-AB | HX-090 N50 F/F | BDM-024-V/1-FR1

What and how to protect?
Voltage Limiting Devices (VLD) for railway stations and railways

During normal operation on the railways, due to voltage drop in the return circuit, or in relation with fault condition, there may occur impermissible high touch voltage on the accessible parts between return circuit and the earth potential, or on grounded exposed conductive parts (poles, handrails and other equipment). At the places accessible to people such as railway stations or tracks, it is necessary to limit this voltage to a safe value by installation of the **Voltage Limiting Devices** (VLD). Their function is to establish transient or permanent connection of exposed conductive parts with the return circuit in case when permissible value of touch voltage is exceeded. When choosing VLD it is necessary to consider whether function of VLD-F, VLD-O or both is required, as defined in EN 50122-1.

Exposed conductive parts of the overhead or traction lines are usually connected to the return circuit directly or through VLD-F type device. So, voltage limiting devices type VLD-F are intended for the protection in case of faults, for example short-circuit of the electric traction system with exposed conductive part.

Devices type VLD-O are used in normal operation, i.e. they limit increased touch voltage caused by the rail potential during the train operation.

The function of voltage limiting devices is not the protection against lightning and switching surges. This protection is provided by Surge Protective Devices (SPD).

The requirements on the VLDs have undergone considerable changes with the new version of standard EN 50526-2 and there are considerably higher technical demands on them now. According to this standard, VLD-F voltage limiters are classified as class 1 and VLD-O types as class 2.1 and class 2.2.

The SCG range of VLD class 1, type VLD-F

The **SCG** voltage limiting devices are used to restrict excessive high touch voltages arising on exposed conductive parts of a railway equipment in case of a disturbance (short circuit) in AC and DC railway electric traction systems. Thus they are ensuring protection to persons that may come into contact with the parts mentioned by establishing of a transient or permanent connection of conductive parts with the return circuit in case when permissible value of touch voltage is exceeded.

In the event of a failure connection between a live power supply part of the traction system and an exposed conductive part (e.g. due to the overhead power line fall) the **SCG** protects the parts affected by causing conductive itself, which results in turning off of the power supply.

In case of an overload caused by short-circuit or long-term withstand current, that may cause harm to the protective element, the internal patented (PV CZ2017248) short-circuiting device intervenes by establishing a permanent short circuit across the protective element. By this it also meets the requirement of the standard for the guaranteed protective function in such cases.

The integrated protective element also effectively eliminates high impulse overvoltage induced into the traction mains or railway equipment by a lightning strike.

The BVL range of VLD class 2.2, type VLD-O

Voltage limiting devices **BVL** provides the temporary connection between the return circuit and the earth of the railway electric traction system during the permissible value of touch voltage is exceeded. In such a way it protects persons that might enter into contact with the parts affected, against the excessive voltage caused by the rail potential during the operation and the short-circuit events.

The protective elements can handle and equalize the transient fault currents even for a long time, so they are suitable for potential equalizing at railway stations or switching stations.

Voltage limiting devices **BVL-50** and **BVL-100** meet requirements of the standard EN 50122-1 ed. 2, Annex F, for type VLD-F and VLD-O at the same time.

BVL incorporates by two antiparallel-connected high-performance thyristors and electronic detection circuit (EDC) together forming the voltage limiting device (VLD) and the parallel varistor surge protection device (SPD), which are connected between two main terminals. The VLD reacts to every type of impulse, both the slow and fast ones, short and long, DC and AC. The varistor (MOV) reacts to the occurrence of the impulse surge always first and protects other components against surge effects. Long-term impulse would lead to the destruction of the MOV – in this case one of both thyristors will be activated with approximately 1 ms delay. Electronic detection circuit monitors the occurrence of impermissible voltage on main electrodes continuously. If this current falls down below thyristors holding current, the limiter will switch-off and it will recover its high-impedance state.

Some selected typical applications for VLD use:

- Connection of the trolley poles to return circuit – VLD class 1, type **SCG-250-500-R01**. The principle is indicated in *Fig. 4*.
- Protection of the persons by connecting of the exposed conductive parts (grounded) to the return circuit in the railway and switching stations – VLD class 2.2, type **BVL-100-120-R01**, and VLD class 1, type **SCG-250-75-R01**. Example of possible use in *Fig. 5*.
- Connection of return circuit to equipotential bounding bar of the measurement technology – VLD class 2.2, type **BVL-25-120-R01**. Application is shown on the *Fig. 6*.

Fig. 4 Indirect connection of exposed conductive parts with a return circuit by VLD class 1

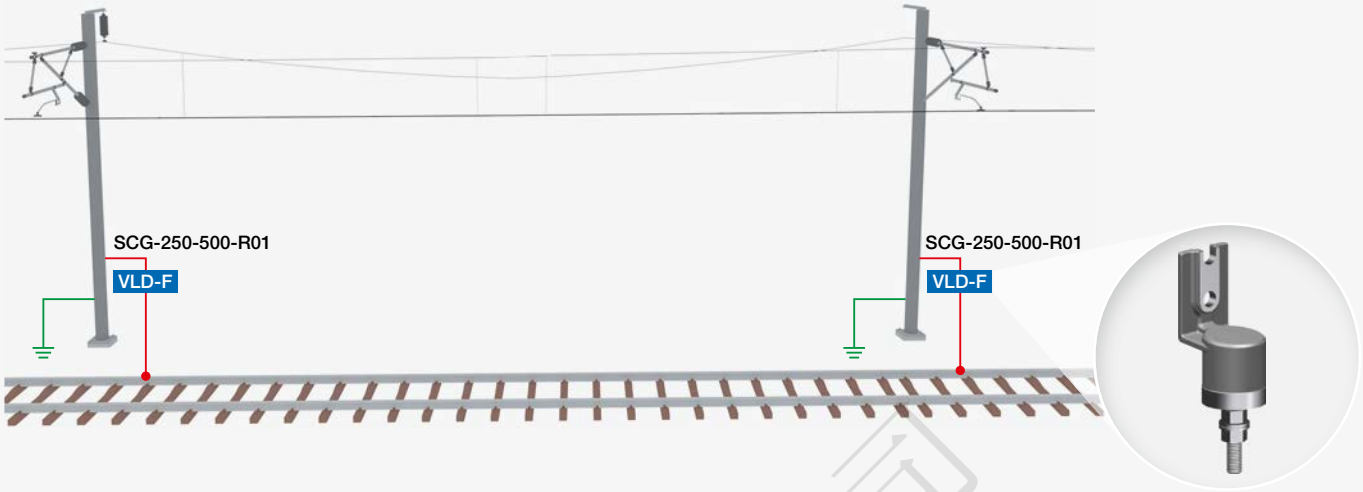


Fig. 5 Installation of VLD class 2.2 and VLD class 1 at railway and switching station according to EN 50526-3

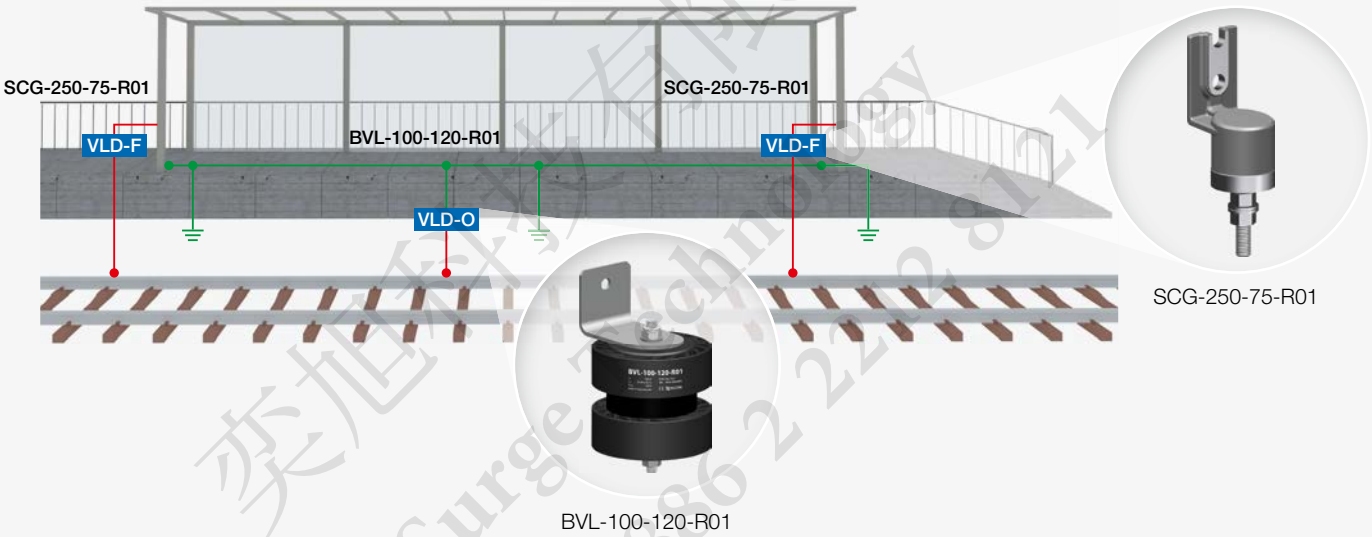


Fig. 6 Installation of VLD class 2.2 for potential equalizing between return circuit and technology's equipotential bounding bar

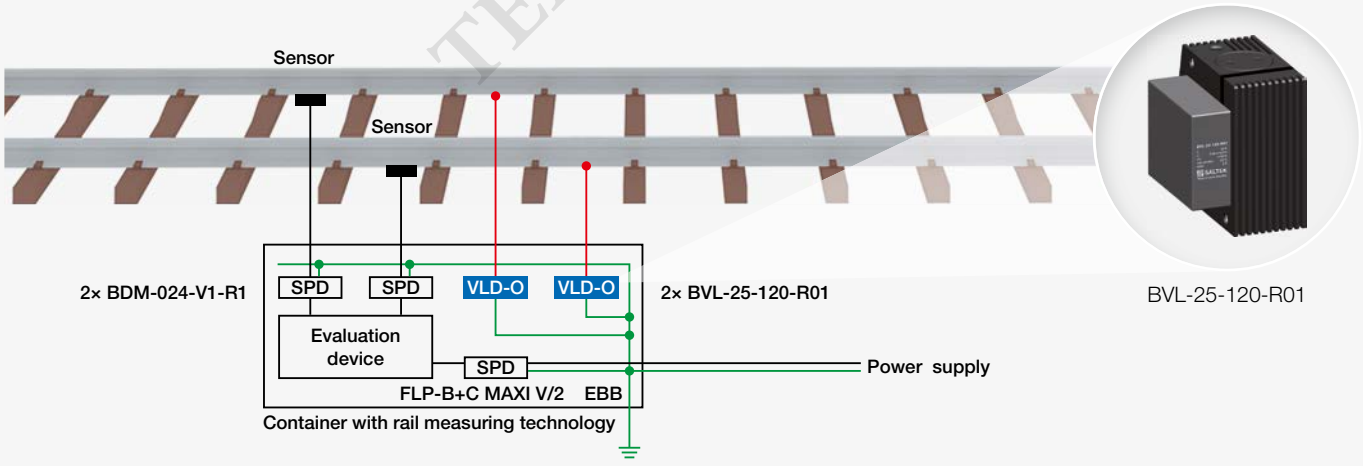


Fig. 7 Example of SPDs and LVDs installation in the model railway application

1 3× FLP-SG50 V/1

2 FLP-B+C MAXI V/…

3 SLP-275 V/…

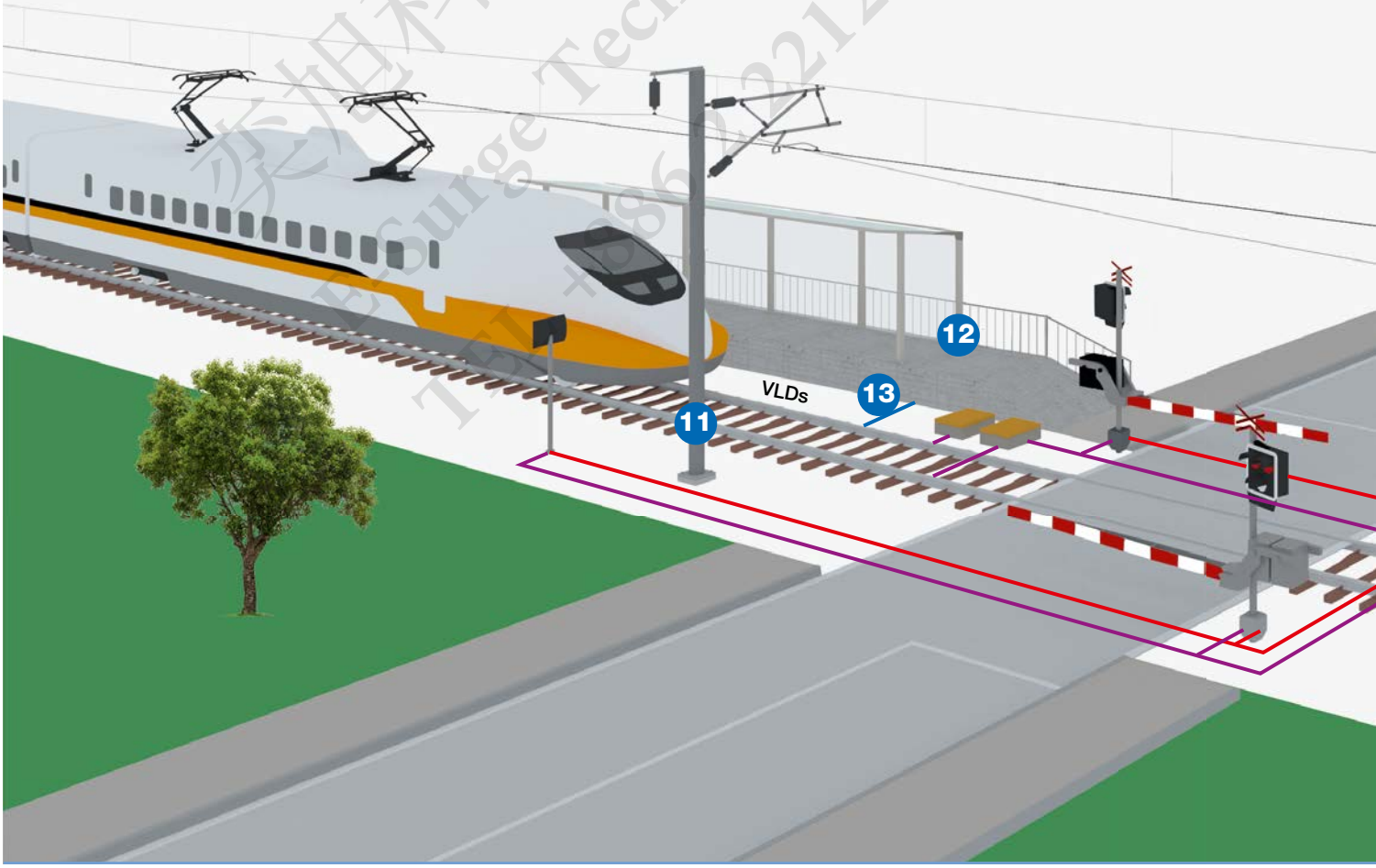
4 DA-275-A

9 HX-090 N50 F/F

10 BDM-024-V/1-FR1

11 SCG-250-500-R01

12 SCG-250-75-R01



5 DA-275-DF16

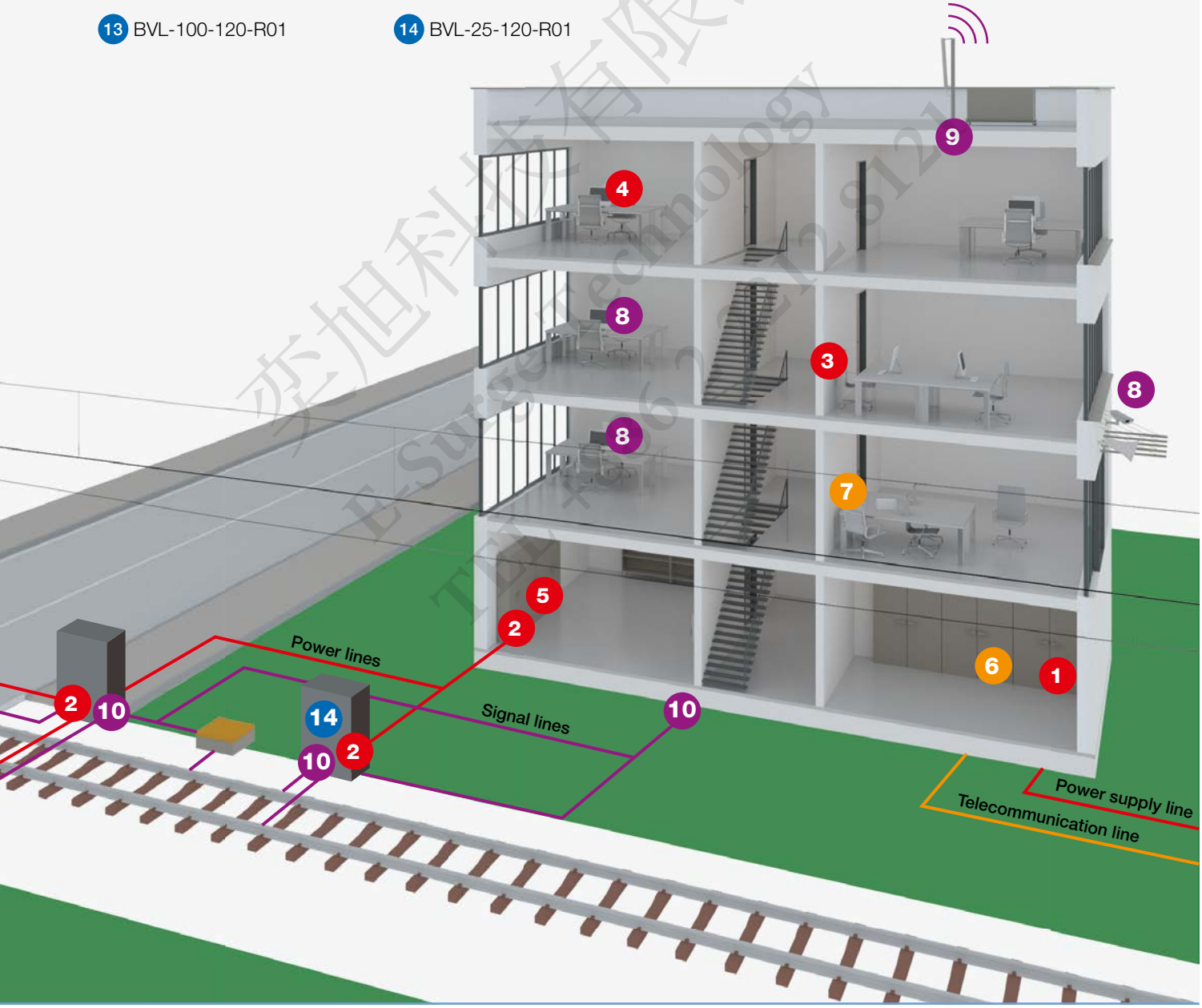
6 BDG-230-V/1-R

7 DL-TLF-HF

8 DL-1G-RJ45-PoE-AB

13 BVL-100-120-R01

14 BVL-25-120-R01



Recommended SPDs and VLDs for railway applications

Lightning current arresters (SPD Type 1), spark-gap based

A high-performance spark gap specified for using in LV installations at the boundary of the LPZ 0 and LPZ 1 zones. Surge protection in direct as well as indirect lightning strikes in the hardest application in heavy, chemical and energy industry. Coordination with SPD Type 2 (SLP-275 V) without coupling impedances.

FLP-SG50 V(S)/1

- Pluggable module
- Visual fault signalling
- Module locking
- Optional remote fault signalling (S)
- $U_p \leq 2{,}5$ kV

Type	Connection	Suitable networks	U_c	I_{imp} (10/350 µs)	I_n (8/20 µs)	I_{fi}	Remote signalling	Ordering number
FLP-SG50 V/1	1+0	TN, TT	255 V AC	50 kA	50 kA	50 kA	No	8595090540540
FLP-SG50 VS/1	1+0	TN, TT	255 V AC	50 kA	50 kA	50 kA	Yes	8595090540533

Lightning current arresters and surge arresters (SPD Type 1 and 2), serial combination MOV+GDT

Very high-performance lightning current arresters for LV installations at the boundary of the LPZ 0 and LPZ 1 zones or higher. For protection in direct as well as indirect lightning strikes. For using in a variety of installations, for family houses, office and industrial buildings, or in sub-distribution boards of large builings. No leakage current. No follow-on current.

FLP-B+C MAXI V(S)/...

- Pluggable module
- Visual fault signalling
- Module locking
- Optional remote fault signalling (S)
- $U_p \leq 1{,}5$ kV

Type	Connection	Suitable networks	U_c	I_{imp} (10/350 µs)	I_n (8/20 µs)	I_{max} (8/20 µs)	Remote signalling	Ordering number
FLP-B+C MAXI V/1+1	1+1	TT	275 V AC	25 kA	30 kA	60 kA	No	8595090550952
FLP-B+C MAXI VS/1+1	1+1	TT	275 V AC	25 kA	30 kA	60 kA	Yes	8595090537830
FLP-B+C MAXI V/2	2+0	TN-S	275 V AC	25 kA	30 kA	60 kA	No	8595090550921
FLP-B+C MAXI VS/2	2+0	TN-S	275 V AC	25 kA	30 kA	60 kA	Yes	8595090537847
FLP-B+C MAXI V/3	3+0	TN-C	275 V AC	25 kA	30 kA	60 kA	No	8595090550938
FLP-B+C MAXI VS/3	3+0	TN-C	275 V AC	25 kA	30 kA	60 kA	Yes	8595090535706
FLP-B+C MAXI V/3+1	3+1	TT	275 V AC	25 kA	30 kA	60 kA	No	8595090550969
FLP-B+C MAXI VS/3+1	3+1	TT	275 V AC	25 kA	30 kA	60 kA	Yes	8595090535720
FLP-B+C MAXI V/4	4+0	TN-S	275 V AC	25 kA	30 kA	60 kA	No	8595090550945
FLP-B+C MAXI VS/4	4+0	TN-S	275 V AC	25 kA	30 kA	60 kA	Yes	8595090535713

Surge arresters (SPD Type 2), MOV based

For LV installations, especially to sub-distribution boards. Protection of installation and devices against impact of induced surge during a lightning strike or switching surges.

SLP-… V/… (S)

- Pluggable module
- Visual fault signalling
- Module locking
- Optional remote fault signalling (S)

Type	Connection	Suitable networks	U_c	I_n (8/20 µs)	I_{max} (8/20 µs)	Remote signalling	Ordering number
SLP-275 V/1+1	1+1	TT	275 V AC	20 kA	40 kA	No	8595090519485
SLP-275 V/1S+1	1+1	TT	275 V AC	20 kA	40 kA	Yes	8595090524915

Type	Connection	Suitable networks	U_c	I_n (8/20 µs)	I_{max} (8/20 µs)	Remote signalling	Ordering number
SLP-275 V/2	2+0	TN-S	275 V AC	20 kA	40 kA	No	8595090516194
SLP-275 V/2 S	2+0	TN-S	275 V AC	20 kA	40 kA	Yes	8595090551836
SLP-275 V/3+1	3+1	TT	275 V AC	20 kA	40 kA	No	8595090519461
SLP-275 V/3S+1	3+1	TT	275 V AC	20 kA	40 kA	Yes	8595090520023
SLP-275 V/4	4+0	TN-S	275 V AC	20 kA	40 kA	No	8595090517221
SLP-275 V/4 S	4+0	TN-S	275 V AC	20 kA	40 kA	Yes	8595090517634

Surge protections (SPD Type 3) on the DIN rail, parallel connection

A combination of varistor surge protection and an encapsulated spark gap connected in the 1+1 (3+1) mode. For LV installations at the boundary of the LPZ 2 and LPZ 3 zones. For protection installations and devices against the impact of induced overvoltage in lightning strikes and against switching overvoltage. Location as close as possible to the protected device.

DA-275 V/… (S)

- Pluggable module
- Visual fault signalling
- Module locking
- Optional remote fault signalling (S)
- $U_p \leq 1,5$ kV

Type	Connection	Suitable networks	U_c	I_n (8/20 µs)	U_{oc}	Remote signalling	Ordering number
DA-275 V/1+1	1+1	TN-S, TT	275 V AC	5 kA	10 kV	No	8595090518723
DA-275 V/1S+1	1+1	TN-S, TT	275 V AC	5 kA	10 kV	Yes	8595090519751
DA-275 V/3+1	3+1	TN-S, TT	275 V AC	5 kA	10 kV	No	8595090518488
DA-275 V/3S+1	3+1	TN-S, TT	275 V AC	5 kA	10 kV	Yes	8595090518495

Surge protections (SPD Type 3) for additional mounting

Surge arresters for additional mounting to devices, machines, equipment, etc. For protection of all types LV electrical and electronic devices against transient overvoltage. Location as close as possible to the protected device.

DA-275-…

- Acoustic or remote status signalling
- $U_p \leq 1,5$ kV

Type	Connection	Suitable networks	U_c	I_n (L+N-PE) (8/20 µs)	U_{oc} (L+N-PE)	Status signalling	Ordering number
DA-275-A	Symmetric	TN, TT	275 V AC	2 kA	4 kV	Acoustic	8595090559580
DA-275-S	Symmetric	TN, TT	275 V AC	2 kA	4 kV	Remote	8595090559597

Surge protections (SPD Type 3) on the DIN rail, with RFI filter

A surge arrester with an integrated RFI filter to protect the supply of control systems such as I&C, electronic security and fire alarm systems, etc., against transient overvoltage and RF disturbance. Variants “i” with remote fault signalling by interruption of power supply. Location as close as possible to the protected device.

DA-275-DF…(-S), DA-… DF … (S)

- Visual fault signalling
- Optional remote fault signalling (S)
- Filter attenuation range ca. 150 kHz ÷ 30 MHz
- $U_p \leq 1,5$ kV

Type	Connection	Suitable networks	U_c	I_L	I_n (L+N-PE) (8/20 µs)	U_{oc} (L+N-PE)	Remote signalling	Ordering number
DA-275-DF16	Symmetric	TN, TT	275 V AC	16 A	5 kA	10 kV	No	8595090557210
DA-275-DF16-S	Symmetric	TN, TT	275 V AC	16 A	5 kA	10 kV	Yes	8595090557227
DA-275-DFi16	Symmetric	TN, TT	275 V AC	16 A	5 kA	10 kV	Interruption	8595090557258

Lightning current arrester BDG-…-V/1-(F)R… range

Lightning current arrester. It is specified for the protection of two-core floating 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
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-230-V/1-FR	ST 1+2+3	1	250 V DC	0,5 A	2,5 kA	10 kA	350 V	Yes	8595090557081

Lightning current arrester 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-024-V/1-R1	ST 1+2+3	1	36 V DC	1 A	2,5 kA	10 kA	46 V	No	8595090554264
BDM-024-V/1-FR1	ST 1+2+3	1	36 V DC	1 A	2,5 kA	10 kA	46 V	Yes	8595090557111

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

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

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

Lightning current arresters for coaxial lines

Suitable for coaxial lines of telecommunication equipment against impact 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

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

Voltage limiting devices (VLD) class 1

The VLD is used to restrict excessive high contact voltages arising on exposed conductive parts of a railway equipment in case of a disturbance (short circuit). The integrated surge arrester also effectively eliminates induced high impulse overvoltages from a lightning strike.

SCG-250-…-R01

- For AC and DC traction systems
- Easy mounting
- According to standard EN 50526-2
- Other voltages on demand

Type	Type (EN 50122-1)	U_{Tn}	I_r @ 60 min	I_W @ 100 ms	I_{SCC} @ 300 ms	I_{imp-n}	T_t	Ordering number
SCG-250-75-R01	VLD-F	75 V	250 A	5 kA	5 kA	100 kA	< 100 ns	8595090561538
SCG-250-250-R01	VLD-F	250 V	250 A	5 kA	5 kA	100 kA	< 100 ns	8595090561545
SCG-250-500-R01	VLD-F	480 V	250 A	5 kA	5 kA	100 kA	< 100 ns	8595090561552

Voltage limiting devices (VLD) class 2.2

Provides the temporary connection between the return circuit and the earth of the railway electric traction system during the permissible value of touch voltage is exceeded. Protects equipment and persons that might enter into contact with the parts affected, against the excessive voltage caused by the rail potential during the operation and the short-circuit events.

BVL-…-120-R01

- For AC and DC traction systems
- Easy mounting
- According to standard EN 50526-2
- Other voltages on demand

Type	Type (EN 50122-1)	U_{Tn}	I_r @ 60 min	I_W @ 50 ms	I_{SCC} @ 50 ms	I_{imp-n}	T_t	Ordering number
BVL-25-120-R01	VLD-O	120 V	25 A	3.5 kA (@ 100 ms)	1 kA (@ 100 ms)	25 kA	< 1.5 ms	8595090561002
BVL-50-120-R01	VLD-O-F	120 V	50 A	15 kA	20 kA	50 kA	< 1.5 ms	8595090561019
BVL-100-120-R01	VLD-O-F	120 V	100 A	15 kA	20 kA	50 kA	< 1.5 ms	8595090561026