SALTEK®
Overvoltage controlled. ANYWHERE.

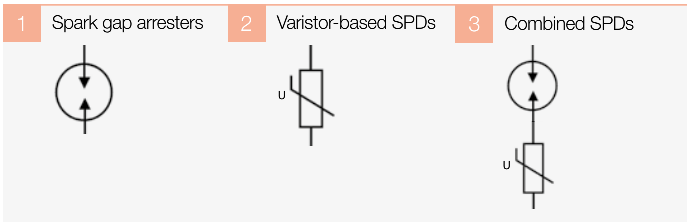
PRACTICAL GUIDE

Inspection

Surge protection in low-voltage power system

Introduction

SPD – disconnection – state indication – maintenance – service life. All SALTEK® surge protective devices (SPDs) are tested as per the requirements of Czech and European safety standards which apply to LV power distributions. If used according to instructions (inclusive of highest back-up protection, connection conductors and operated in appropriate environment), the SPDs are totally safe and do not require any special maintenance, i.e. they are completely maintenance-free. The only thing the user is required to do is to retighten the screw terminals, depending on the inlet conductors used.



In case of using prescribed back-up protection the **spark gap arresters** 1 (FLP-SG50 V/1 FLP-A60, FLP-A35, FLP-A100N, etc.) feature basically unlimited service life. They can be damaged only by high follow-on currents resulting from defective or improper back-up protection, or by increased conductivity when operated in improper environment. They do not contain any state indication. Only if the back-up protection is initiated (blown), it is necessary to check their appearance and insulation resistance with testing voltage of up to 250 V DC, at the highest.

Varistor-based SPDs 2 (FLP-12,5 V, SLP-275 V, the DA-275 types, etc.) are equipped with thermodynamic disconnector, of a type required by standard, which disconnects the varistor from the power mains in case of thermal overload (overheating) or by overload impulse currents. The overtemperature may be caused by increased quiescent current flowing through the varistor as a consequence of its ageing (due to the increased voltage of the varistor voltage beyond the corresponding tolerance band – see further), or by using the varistor in a power distribution system the voltage of which is higher than the highest permitted one (e.g. by connecting phase-to-phase voltage or disconnecting the zero conductor under voltage, by operating the varistor in an environment with high percentage of harmonics and improper or inadequate compensation, by voltage increase over 280 V AC with a sudden grid unloading, etc.). The overload by impulse current comes into question in particular in cases of inappropriate protection of the power distributions or, exceptionally, in case of direct strike of excessive lightning. The disconnection of varistor is indicated visually and acoustically, depending on the type of protection.

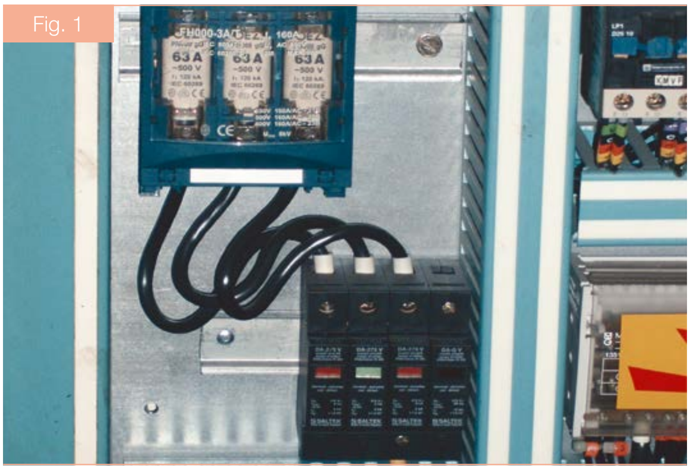
Combined SPDs 3 (FLP-B+C GE, FLP-B+C MAXI, SLP-330 GE V, FLP-B+C MAXI V, FLP-25-T1-V, SLP-275 VB, etc.) combine the advantages of both the previous types, i.e. the spark gap arresters and the varistor-type SPDs. In idle condition they behave in the power network as a spark gap, i.e. with no ageing since no quiescent current is flowing through the varistor. The advantages brought by this combination are: zero follow-on current (as against the spark gap), which means that the equipment nor the installation are exposed to excessive loads during the activation of the protection, and zero leakage current (as against protection based on varistors) which does not increase even after exposure to lightning currents. The combined SPDs are provided with state indications.

After the SPD becomes disconnected the power line or the equipment is no more protected and the SPD must immediately be replaced. Except for a few combined types of SPDs with RFi filter the SALTEK SPDs the power supply to the power line or power consumer is maintained after the disconnection of the SPD. In combined SPDs with RFi filter type DA-275-DFi the disconnection of the SPD is followed with disconnecting the power consumer from the mains (the letter “i” in the SPD designation means interruption).

SALTEK® recommends to visually check the protection devices (concerning the indication state – see Fig. 1) connected in 230/400 V AC power mains, in particular after a storm, in which events such as a lightning strike in a close vicinity, failure in the distribution network (short circuits, harmonics, long-term overvoltage events, disconnection or interruption of zero conductor etc.) prior and after the thunderstorm period have been registered. Of course, the SPDs have to be checked during periodical inspections.

The service life of SALTEK® SPDs depends on their construction and load conditions. If designed and installed properly, their service life usually exceeds 10 years.

Fig. 1



Inspection

Inspection – approach

The new approaches during the performance of works of inspection technicians result from EU directives and consist in searching potential risks and their minimization to a level acceptable for the user and the environment, on the responsibility of suppliers.

In addition, the organization is obliged to search for potential risks and to adopt technical measures for their acceptable minimization. In this respect the following new terminology and new procedures are being introduced:

- danger – a possibility that a damage or injury would happen, resulting from the properties of an equipment, environment or activity,
- risk – a probability that the above possibility will really happen.

The inspection technician or a person who will be assigned the tasks of an inspection technician in an organization should not be one-off event but a continuous and systematic activity. The inspection technician shall be responsible for continuous assessment of potential dangers and risks, and be obliged to propose measures for their elimination. If, for example, following the installation of a PC network, the risk of large material damages caused by lightning strike and overvoltage disproportionately increases, the inspection technician is required to implement measures for elimination of such risks to an acceptable minimum and to install a system of SPDs as a part of internal protection from lightning strike.

The work of an inspection technician will from now on become much more demanding, with much more responsibilities since he/she would now be responsible not only for adherence to the valid standards, but also for the elimination of risks to an acceptable level.

However, now but also in the future the activities of a inspection technician will stem from actual standards. Since the LV power distributions with built-in SPDs have only been introduced recently, the inspection of such distributions has some specifics we describe in detail in the following text.

Inspection – procedure

During the performance of **inspections on a power network with built-in SALTEK SPDs** it is necessary to proceed in accordance with the provisions of HD 60364-6 standard, Low-voltage electrical installations - Part 6: Verification.

The verification includes: inspection of the installation – testing – compilation of a report.

Inspection of the installation

During the inspection the correspondence with HD 60364-5-534 is being verified. According HD 60364-5-534 and HD 60364-4-443, the SPDs have to be installed near the starting point of the installation or near the main switchboard, as close as possible to the entry point of the installation in the building (*see Fig. 2a and 2b*).

The length of the connecting conductors should not be in excess of 0.5 m (*see Fig. 3*).The EN (IEC) 62305-4 standard and the CLC/TS 61643-12 document describe the correct selection of SPDs in terms of the concept of lightning strike protection ones (hereinafter only LPZ). The LPZ concept describes the installation and location of SPDs of type 1, 2 or 3.

SPD type 1 is installed at the transition point between the LPZ 0 and LPZ 1 zones, i.e. the outer side of the building structure, or it may also be installed in the main switchboard cabinet, providing that its connection line is not laid in parallel to the power installations in the inside of the building.

SPD type 2 is installed at the transition point between the LPZ 1 and LPZ 2 zones – i.e. typically in an auxiliary switchboard or upper floor switchboard cabinet possibly near a protected facility.

Fig. 2a

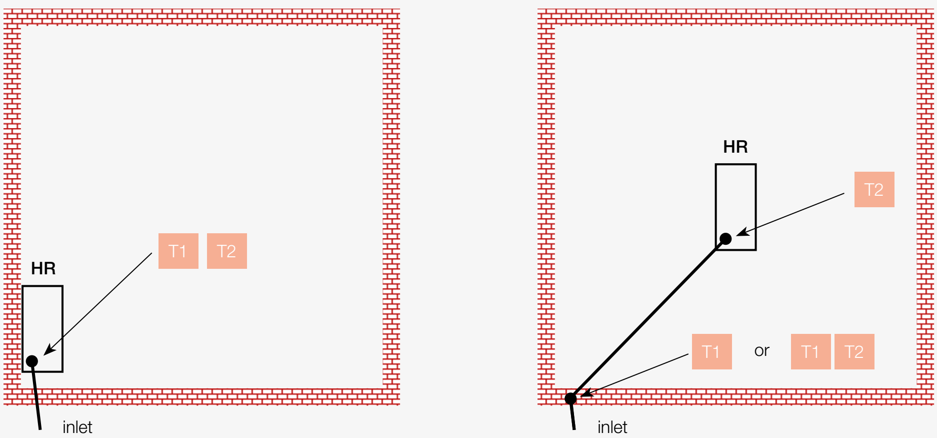
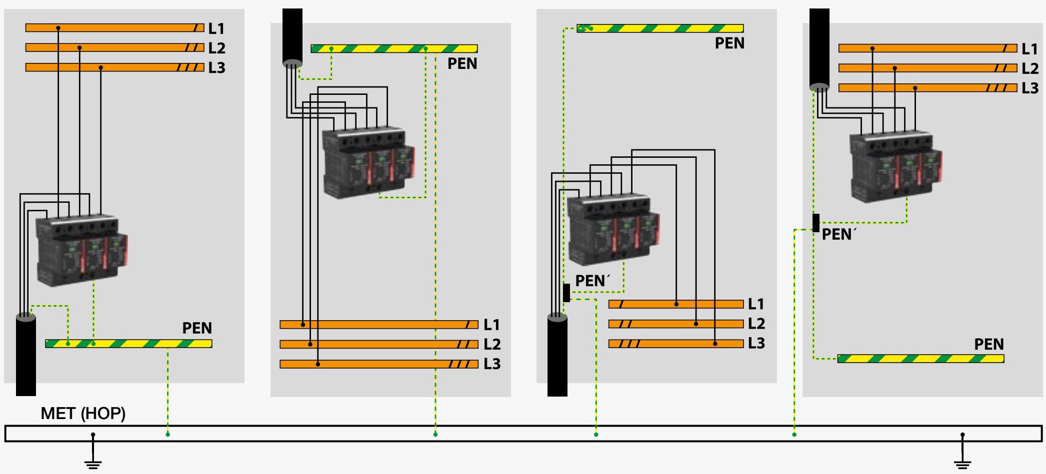


Fig. 2b



SPD type 3 is installed at the transition point between the LPZ 2 and LPZ 3 zones, i.e. closed to the protected equipment.

Stipulates that the verification is to be carried out there where it is appropriate, and that it must include at least the following:

a) checking the location of SPD – in particular the distance of terminals from the covers, and adherence to safe distance requirements of open spark gaps from other devices and installations. As regards the open spark gaps SALTEK FLP-A60, FLP-A25, FLP-A50-1,5, FLP-A50-2,5 and their installation conditions (*see Fig. 4)*,

b) check of the connection conductor dimensioning – as per the backup protection and terminals, with reference to the SPD type; for SDP type 1 – 16 mm^2 at minimum to PE and 6 mm^2 at minimum for live conductors, conductor type required Cu; for SPD type 2 the conductor size should be 6 mm^2 at minimum to PE and 2.5 mm^2 at minimum for live conductors, with conductor type Cu,

c) checking the highest level of backup protection and the indication state of the SPD,

d) checking the SPD dimensioning as regards the classification of the building in terms of protection level against lightning strike (LPL) – see Table 1 in the CLC/TS 61643-12 document,

e) checking the inscriptions on the switchboard cabinet, stating that an SPD has been installed in the fixed part of the installation,

f) check of the SPD marking,

g) checking the accessibility to the indication elements and possibilities of replacement, in particular as regards the pluggable modules such as FLP-12.5 V, SLP-275 V, FLP-B+C MAXI VS.

Fig. 3a a + b ≤ 0,5m

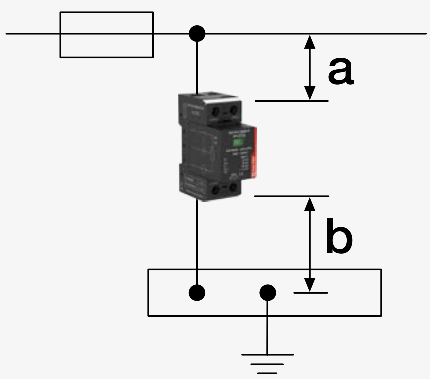


Fig. 3b c ≤ 0,5m

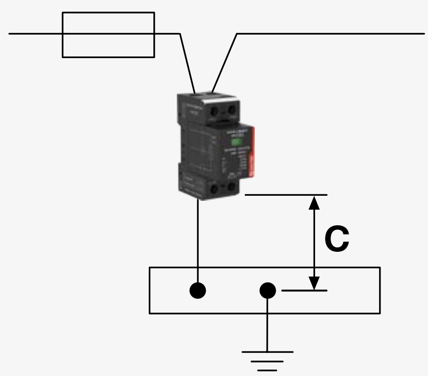


Fig. 4a FLP-A60, FLP-A25

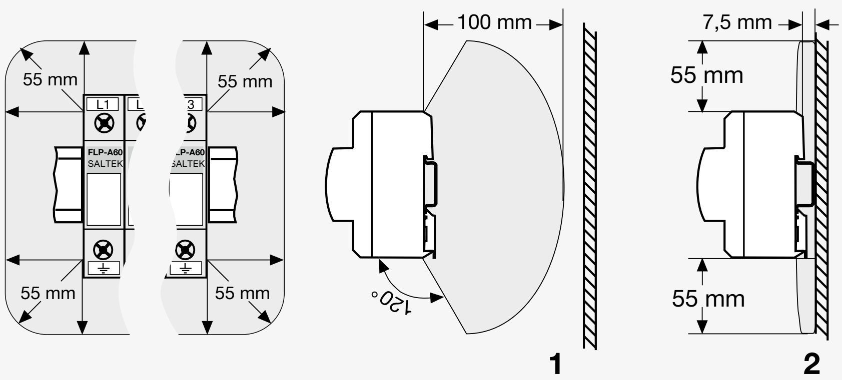


Fig. 4b FLP-A50-1,5, FLP-A50-2,5

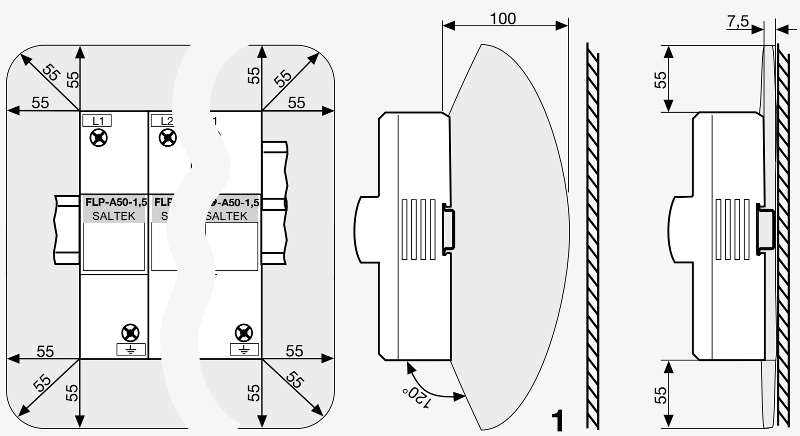
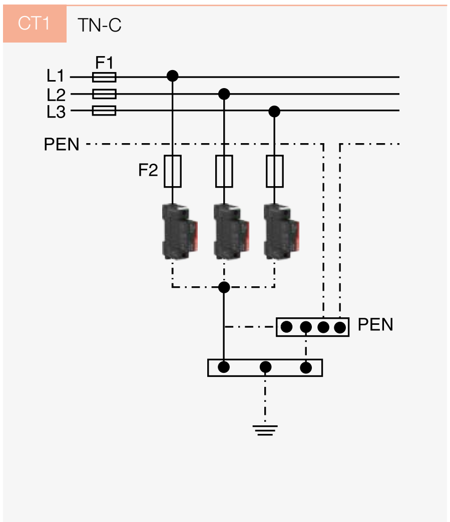
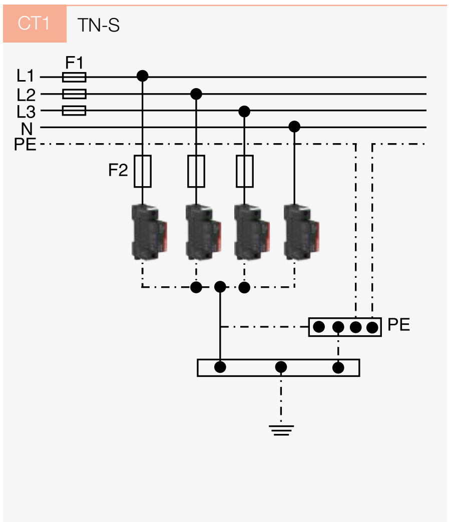


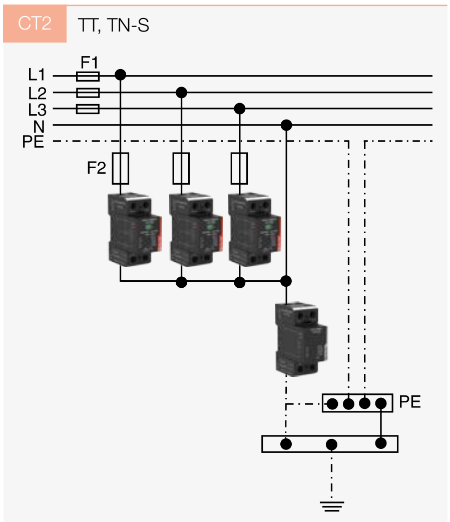
Table 1. Determination of impulse current value (10/350) for SPD type 1

If the LPL value is not known, the worse scenario is anticipated			Low voltage networks									
LPL	Maximum current corresponding to LPL	Number of conductors (n)	TT			TN-C	TN-S			IT without neutral conductor	IT with neutral conductor	
			Connection mode				Connection mode			Connection mode		
			CT1	CT2			CT1	CT2		CT1	CT2	
			L-PE N-PE	L-N	N-PE	L-PEN	L-PE N-PE	L-N	N-PE	L-PE	L-N	N-PE
I or unknown	200 kA		I_{imp} (kA)									
		5	N/A	N/A	N/A	N/A	20.0	20.0	80.0	N/A	N/A	N/A
		4	25.0	25.0	100.0	25.0	N/A	N/A	N/A	N/A	25.0	100.0
		3	N/A	N/A	N/A	N/A	33.3	33.3	66.7	33.3	N/A	N/A
		2	50.0	50.0	100.0	50.0	N/A	N/A	N/A	N/A	50.0	100.0
II	150 kA		I_{imp} (kA)									
		5	N/A	N/A	N/A	N/A	15.0	15.0	60.0	N/A	N/A	N/A
		4	18.8	18.8	75.0	18.8	N/A	N/A	N/A	N/A	18.8	75.0
		3	N/A	N/A	N/A	N/A	25.0	25.0	50.0	25.0	N/A	N/A
		2	37.5	37.5	75.0	37.5	N/A	N/A	N/A	N/A	37.5	75.0
III or IV	100 kA		I_{imp} (kA)									
		5	N/A	N/A	N/A	N/A	10.0	10.0	40.0	N/A	N/A	N/A
		4	12.5	12.5	50.0	12.5	N/A	N/A	N/A	N/A	12.5	50.0
		3	N/A	N/A	N/A	N/A	16.7	16.7	33.3	16.7	N/A	N/A
		2	25.0	25.0	50.0	25.0	N/A	N/A	N/A	N/A	25.0	50.0

Note: CT1 – SPD connected in the x+0 mode; **CT2** – SPD connected in the x+1 mode







Testing

General requirements

a) **IMPORTANT!** Check of the continuity of protective conductors and their equipotential bonding

b) with the SALTEK SPDs function tests are not being carried out

Continuity of conductors

Continuity of protective conductors and equipotential bonding conductors – the fulfilment of this requirement is important because of the necessity to have the whole overvoltage protection system to be operative. It can be implemented with the SPDs already connected.

Insulation resistance of electrical installation

The measurement of insulation resistance of the electrical equipment, and measurement of cable resistance for rated circuit voltages up to 500 V DC, can be done prior the installation of SPDs, or upon their disconnection.

If it is to be assumed that the measurement results will be affected with a high probability by the SPDs or other instruments, or that the instruments as such may by damaged by the measurement process, these should be disconnected prior starting the measurement.

If, however, such a disconnection is not being practically feasible (e.g. if hard coded sockets with already integrated SPDs are used), the testing voltage in such a case may be reduced to 250 V DC, but also in this case the circuits have to feature a resistance value of 1 MΩ, at the minimum.

Remarks

- To further clarify the prescribed testing voltage we copy here the table from HD 60364-6 standard:

Rated voltage of circuit	Testing DC voltage	Insulation resistance
SELV and PELV	250 V	= 0.5 MΩ
up to 500 V incl. (to apply also for FELV)	500 V	= 1.0 MΩ
nad 500 V	1 000 V	= 1.0 MΩ

- When measuring the insulation resistance of LV power distributions with integrated SALTEK SPDs, the procedure is as follows:

  a) in spark gaps FLP-A60, FLP-A25, FLP-A35, FLP-A50 types, the measurement can be done using 500 V DC, without the necessity of disconnecting the SPDs,
  b) with SPD removable modules such as the FLP-275 V, FLP-12,5V, FLP-B+C VE, FLP-B+C MAXI VS, SLP-275 V, DA-275 V types, the varistor-based modules should first be removed and then the resistance measurement using 500 V DC can take place,
  c) with SPD without the removable modules (fixed execution) e.g. of FLP-B+C, FLP-B+C MAXI, FLP-A35-0,9, SLP-275, DA-275-DJ types, the SPDs must either be disconnected, or the insulation resistance be measured using reduced testing voltage of 250 V DC,
  d) with socket circuits equipped with SALTEK SPDs the circuits need to be measured with reduced testing voltage of 250 V DC,
  e) with the SPDs with RFi filter, such as that of DA-275-DF, DA-275-DFi, DA-275 BFG types, the leakage current of the capacitors installed in the RFi filter have to be considered, and it is advisable to disconnect these prior stating the measurement,
  f) during the initial verification it is recommended to perform the insulation resistance measurement prior the installation of SPDs.

Special notice

For SALTEK SPDs with movable inlet conductor the prescribed insulation testing voltage is 250 V DC.

Prior disconnecting the zero conductor during the insulation resistance measurement on circuits with built-in SALTEK SPDs the main power switch (circuit breaker) in the corresponding switchboard has to be switched off.

ATTENTION! After finishing the insulation resistance measurement don´t forget to reconnect the zero conductor! **YOU MUST NOT FORGET THIS CHECK!**

Residual current circuit breakers

In the course of performing the inspections on residual current device (RCD), while measuring the tripping current of the RCD coil, you should not forget that there are SPDs connected in the RCD circuit.

If there are SPDs connected in the RCD protective circuit, through which a quiescent current is flowing through (see 2), it is to be realized that the quiescent current decreases the value of RCD tripping current and the installation in such a case is being switched off by the RCD sooner than this would be in normal situation. Still bigger problem is encountered with SPDs type 3, equipped with RFi filter (such as DA-275-DFxx, DA-275-DFixx, DA-275 BFG), where the quiescent current of varistor is summed up with the leakage current from the RFi filter capacitors, or from the indication devices. Due to the above it is advisable to always disconnect the SPDs when checking the RCD.

From the operational point of view of the SPD system it is of importance to establish a thorough and operative main and auxiliary equipotential bonding, in line with the provisions of HD 60364-4-41 standard and further documents, and to ensure that the external lightning protection as per the EN 62305-3 standard will be established and dimensioned acc. to the corresponding lightning protection classification level of the building object. Some of the important provisions of the standards concerning the functionality of the overvoltage protection system are set out below.

HD 60364-4-41
Provisions the observance of which is of importance from the view of functionality of the SALTEK SPDs:
411.3.1.1. Protective earthing
411.3.1.2. Protective equipotential bonding
411.4. TN system

EN 62305-4
Provisions the observance of which is of importance from the view of functionality of SALTEK SPDs: Equipotential bonding of electrical power equipment, electrical telecommunication equipment and piping.

Service life and testing of SPDs

The service life of surge protection devices depends on their design and load exposure.

Spark gap arresters 1 – types FLP-A60; FLP-A35; FLP-A25; FLP-A35-0,9; FLP-A50-1,5; FLP-A50-2,5 a FLP-SG50 V(S) feature a virtually unlimited service life.

The above are high performance spark gap arresters which can only be destroyed by a direct lightning strike of above standard value. They are not provided with state indication (damage), except for the FLP-SG50 V(S) type, and if their backup protection trips, then you should check the appearance and measure the insulation resistance of the SPD (it is to be in the order of megaohms - *see Fig. 5*).

The same applies also for spark gap arresters intended to be connected between the N and PE conductors, i.e. the FLP-A100N, FLP-A100N VS, FLP-A50N VS, FLP-G and FLP-GV types, and for NPE modules of SPDs of the FLP, SLP and DA series, in design versions of 3+1 and 1+1.

Varistor-based SPDs 2 – types FLP-B+C, FLP-B+C VE and SPD series of FLP-12,5 V, FLP-275, FLP-275 V, SLP-275, SLP-275 V and DA. These contain varistors with thermodynamic disconnector and are equipped with state indications.

Varistors built-in into these SPDs are permanently under load, being continuously flown through by the quiescent current.

This current increases with the SPD ageing and the temperature of the SPD increases. If the temperature exceeds a defined limit value, the thermodynamic disconnector trips and disconnects the SPD from the power mains. The proper condition of the varistor-based SPD can also be identified by measuring the varistor voltage (*see Fig. 6*).

The varistor voltage of the respective SPD types are shown in Tables 2 to 4.

SPDs 3, with varistor and surge arrester connected in series, i.e. the types FLP-B+C GE, FLP-B+C MAXI, FLP-B+C MAXI V, FLP-25-T1-V, SLP-330 GE, SLP-275 VB and FLP-25-T1-V, have also integrated thermodynamic disconnector and are equipped with state indication. Varistors in these SPDs are not permanently under load and are not flown through by quiescent current, i.e. they are not exposed to ageing.

In these types of SPDs the varistor voltage cannot be measured, except for the FLP-B+C MAXI V(S) and SLP-xxx VB(S) series, manufactured since 2013. The checking of these SPDs takes place visually, i.e. by watching the colour of the inspection window, which must be green. The insulation resistance of the SPDs can be measured and this value ranges in the order of megaohms (*see Fig. 5*).

The picture 7 shows the arrangement when measuring the varistor voltagewith the FLP-B+C MAXI V(S), FLP-25-T1-V(S) and also SLP-xxx VB(S) series of SPDs. The measurement can take place only on the removable module, with one tip of the probe touching the measuring point on the rear side of the module, and the other tip of probe touching the contact situated more closely to the measuring point.

Some of the inspection instruments make it possible to measure the varistor voltage of varistor-based SPDs. If there is a need for measuring the condition of varistor-based SPDs, you should contact the company SALTEK and discuss the measurement procedure with specialists, in relation to the particular measuring instrument used. You can skip this step if you are using the measuring instruments shown below.

Measuring instrument of **PU 187.2** (see Fig. 8), made by Metra Blansko. This device is capable of measuring the varistor voltage. It was tested at SALTEK and the measured mA values correspond with laboratory measurements shown in the following table. The **GIGATESTpro** insulation resistance meter (ordering no. B00010) has the varistor voltage for the respective SALTEK SPD types already defined and stored.

Fig. 5

Fig. 6

Measurement result
defective protection module

Fig. 7

Fig. 8

Table 2. Varistor voltage of the SALTEK SPDs type 1 and type 2

Product (removable module)	Varistor voltage	DC spark-over voltage	Note
Combined SPDs (varistor + surge arrester)			
FLP-B+C MAXI, FLP-B+C GE	cannot be measured		no measuring point available
SLP-330 GE	cannot be measured		
SLP-xxx VB(S)	cannot be measured (production until 2013)		
SLP-075 VB(S)	105–135 V	116–174 V	
SLP-130 VB(S)	185–230 V	195–285 V	
SLP-275 VB(S)	385–475 V	400–600 V	
FLP-B+C MAXI150 V	225–280 V	600–990 V	
FLP-B+C MAXI V(S)	284–347 V	600–990 V	The values for the N/PE mode and „x+1“ – see line 20,21
FLP-25-T1-V(S)	284–347 V	600–990 V	
SPD type 1			
FLP-12,5 V	385–475 V		
FLP-275 V	385–475 V		
FLP-B+C	385–475 V		
FLP-B+C VE, FLP-275 VE	385–475 V		
FLP-NPE 25 V		600–1000 V	only spark gap
FLP-A50N V		600–990 V	
FLP-A100N V		600–990 V	
SPD type 2			
SLP-075 V	105–135 V		
SLP-130 V	185–230 V		
SLP-150 V	216–264 V		
SLP-275 V	385–475 V		
SLP-320 V	459–561 V		
SLP-385 V	558–685 V		
SLP-440 V	645–790 V		
SLP-550 V	819–1 001 V		
SLP-600 V	1 285–1 575 V		
SLP-880 V	1 285–1 575 V		
SLP-NPE V		600–1 000 V	only spark gap
SLP-275 V/3+1, SLP-275 V/1+1	385–475 V L/N mode	600–1 000 V N/PE mode	

Table 3. Varistor voltage of SALTEK SPDs for photovoltaics

Product	Replacement module	Varistor voltage
SLP-100 PH V/2	SLP-100 PH V/0	108–132 V
SLP-170 PH V/2	SLP-170 PH V/0	185–230 V
SLP-500 PH V/2	SLP-500 PH V/0	558–682 V
SLP-550 PH V/2	SLP-550 PH V/0	643–787 V
SLP-600 PH V/2	SLP-600 PH V/0	675–825 V
SLP-700 PH V/3	SLP-350 PH V/0	387–473 V
SLP-800 PH V/3	SLP-400 PH V/0	459–561 V
SLP-1000 PH V/3	SLP-500 PH V/0	558–682 V
SLP-PV170 V/I	SLP-PV170 V/0	184–230 V
SLP-PV170 V/U	SLP-PV170 V/0	184–230 V
	SLP-PV170U V/0	184–230 V
SLP-PV500 V/I	SLP-PV500 V/0	558–682 V
SLP-PV500 V/U	SLP-PV500 V/0	558–682 V
	SLP-PV500U V/0	558–682 V
SLP-PV600 V/I	SLP-PV600 V/0	675–825 V
SLP-PV600 V/U	SLP-PV600 V/0	675–825 V
	SLP-PV600U V/0	675–825 V
SLP-PV700 V/Y	SLP-PV350 V/0	387–473 V
	SLP-PV350Y V/0	558–682 V
SLP-PV1000 V/Y	SLP-PV500 V/0	558–682 V
	SLP-PV500Y V/0	734–905 V
SLP-PV 1500 V/Y	SLP-PV750Y V/0	1 285–1 575 V
FLP-500 PH V/2	FLP-250PH V/0	260–297 V
FLP-1000 PH V/3	FLP-250PH V/0	260–297 V
FLP-PV500 V/U	FLP-PV250 V/0	260–297 V
	FLP-PV250U V/0	260–297 V
FLP-550V/U	FLP-PV275U V/0	285–475 V
FLP-PV700 V/U	FLP-PV350 V/0	387–473 V
	FLP-PV350U V/0	387–473 V
FLP-PV700 V/Y	FLP-PV350 V/0	387–473 V
FLP-PV720 V/Y	FLP-PV180 V/0	243–297 V
FLP-PV1000 V/Y	FLP-PV250 V/0	387–473 V
	FLP-PV250Y V/0	387–473 V
FLP-PV1000 V(S)/Y MAXI design	FLP-PV500Y V/0	738–902 V
FLP-PV1000 Y		1 468–1 810 V

Note: the varistor voltage values have been measured on removable module, except for the FLP-PV1000 Y SPD which is of integral design. The measurement takes place on terminals.

Table 4. Varistor voltage of SALTEK SPDs type 3

Product (removable module)	Varistor voltage	DC spark-over voltage	Note
DA-075 DJ	120-150 V L/N mode	cannot be measured	symmetrical connection
DA-130 DJ	215-265 V L/N mode	cannot be measured	symmetrical connection
DA-275 DJ	485-595 V L/N mode	cannot be measured	symmetrical connection
DA-275 IT DJ	385-475 V L/N mode	cannot be measured	symmetrical connection

Continuation Table 4 on next page

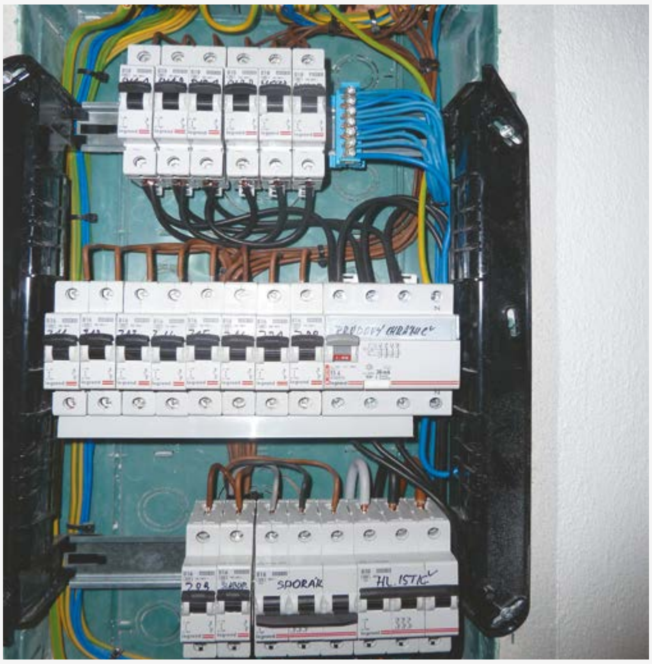
Table 4. Varistor voltage of SALTEK SPDs type 3

Product (removable module)	Varistor voltage	DC spark-over voltage	Note
DA-275-DJ25(S)	576–704 V L/N mode	cannot be measured	symmetrical connection
DA-275 V/1+1, DA-275 V/3+1	385–475 V L/N mode	500-1000 V N/PE mode	
DA-275 V/0	385–475 V		replacement module
DA-NPE V/0		500–1 000 V	replacement module
CZ-275 A, sockets with SPD (1 varistor)	385–475 V L/N mode	cannot be measured L(N)/PE mode	
CZ-275-A, sockets with SPD (1 varistor) since 2016	558–682 V L/N mode	680–920 V N/PE mode	
DA-275 C, CZ, DD	385–475 V L/N mode	cannot be measured L(N)/PE mode	
DA-275 NM, NMA, NMS, NM2	385–475 V L/N mode	cannot be measured L(N)/PE mode	
DA-275 CZS	385–475 V L/N mode	cannot be measured L(N)/PE mode	
DA-275 A, DA-275 S	594–726 V L/N mode	cannot be measured	symmetrical connection
DA-320-LED	594–726 V L/N mode	cannot be measured	symmetrical connection
DA-275 DF10, DA-275 DF16	cannot be measured		RFi filter
DA-48 DF16	cannot be measured		RFi filter
DA-400 DF16	cannot be measured		RFi filter
DA-275 DF2, DA-275 DF6	cannot be measured		RFi filter
DA-275 DFIx	cannot be measured		RFi filter
CZ-275 S, sockets with SPD (2 varistors)	cannot be measured		signalling
DA-275 DFxS, DA-400 DF16S	cannot be measured		RFi filter
DA-275-DF(x)	cannot be measured		RFi filter
DA-275-DF(x)-S	cannot be measured		RFi filter
DA-275-DFi(x)	cannot be measured		RFi filter
DA-400/3 IT DJ	cannot be measured		
DA-400/4 IT DJ	cannot be measured		
DA-500/3 IT DJ	cannot be measured		
PC-OVERDRIVE 6	cannot be measured		
PC-OVERDRIVE 10	cannot be measured		
P-PROTECTOR F6	cannot be measured		RFi filter
RACK PROTECTOR	cannot be measured		
P-PROTECTOR X	cannot be measured		
P-PROTECTOR V	cannot be measured		
P-PROTECTOR VF	cannot be measured		RFi filter
P-PROTECTOR ABX	cannot be measured		
DA-275 BF	cannot be measured		RFi filter
DA-275 BFG	cannot be measured		RFi filter
DA-275 BFI	cannot be measured		RFi filter
DA-275 BFGI	cannot be measured		RFi filter
DA-275 DFEI	cannot be measured		RFi filter
DA-275 LF	cannot be measured		RFi filter
DA-275 PF	cannot be measured		RFi filter
RACK-PROTECTOR-X8-1U	576–704 V L/N mode	cannot be measured L(N)/PE mode	symmetrical connection
RACK-PROTECTOR-VX7-1U	576–704 V L/N mode	cannot be measured L(N)/PE mode	symmetrical connection
RACK-PROTECTOR-F6-1U	cannot be measured		RFi filter
RACK-PROTECTOR-VF5-1U	cannot be measured		RFi filter
RACK-PROTECTOR-EURO-X12-1U	576–704 V L/N mode	cannot be measured L(N)/PE mode	symmetrical connection
SP-T2-T3-320/Y-CLT-LED	486–594 V L/N mode	cannot be measured L(N)/PE mode	symmetrical connection

Note: the practical guide also lists SPD SALTEK types that are no longer for sale but can be installed in installations.

Examples of correct installation

Fig. 9a

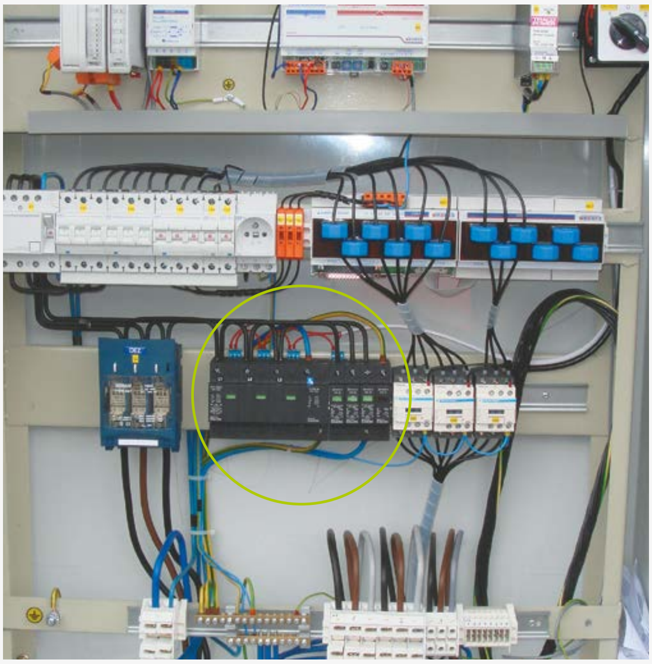


Switchboard cabinet prior the installation of SPD

Fig. 9b

Switchboard cabinet after the the SPD is correctly installed.

Fig. 10



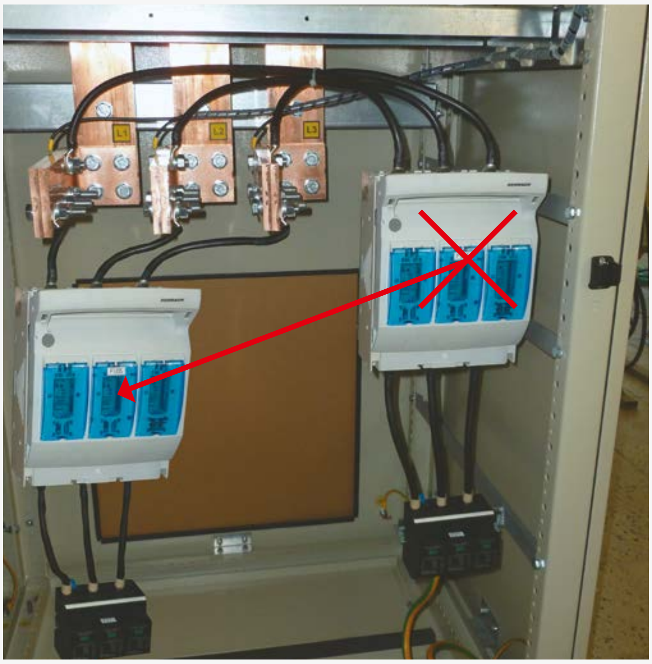
SPDs installed with connecting wires of correct length, corresponding to HD 60364-5-534 requirements. Due to potential dynamic effects acting on the connecting wires the use of sharp bends on the conductors should rather be avoided.

Examples of incorrect installation vs. correct solution

Fig. 11a

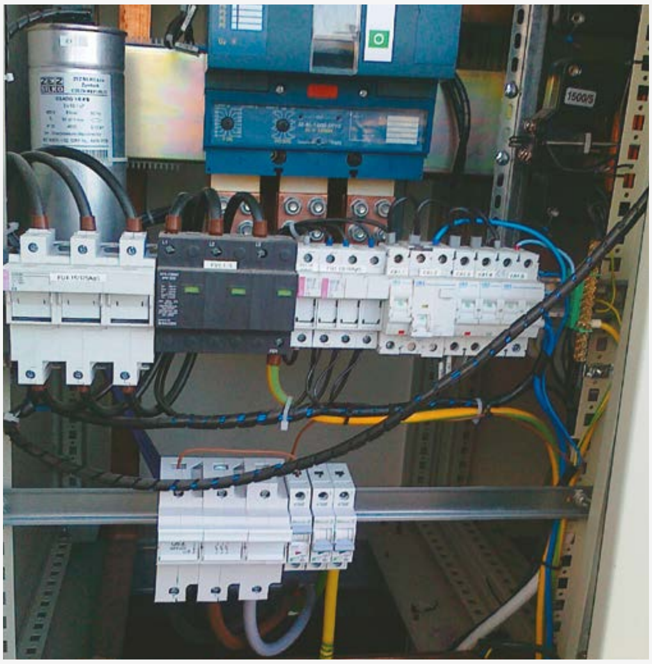
Incorrect

Fig. 11b



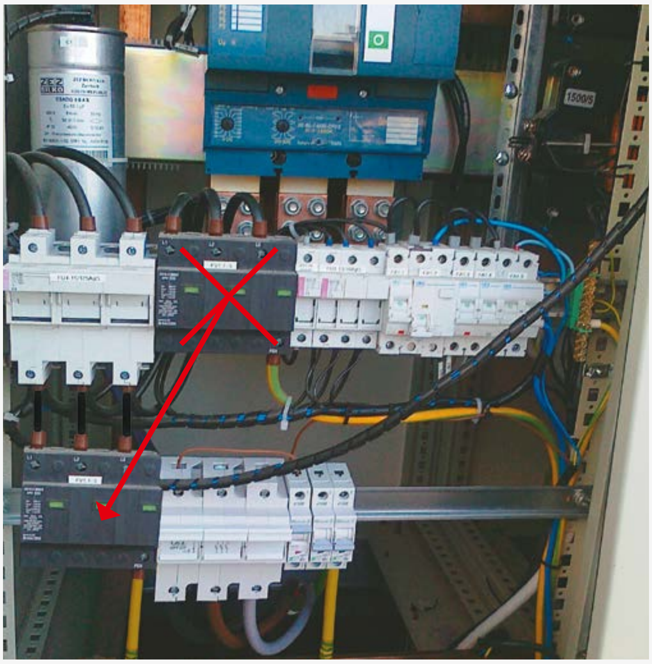
Correct: the condition from HD 60364-5-534 (connecting wire lengths) in *Fig. 11a* is met, but by placing the SPDs at the opposite side in the cabinet (*Fig. 11b*) the wires become much shorter and the U_p protective level is still increased.

Fig. 12a



Incorrect: the installation procedure of SPD contravenes the conditions specified by HD 60364-5-534 standard, length of connecting wires

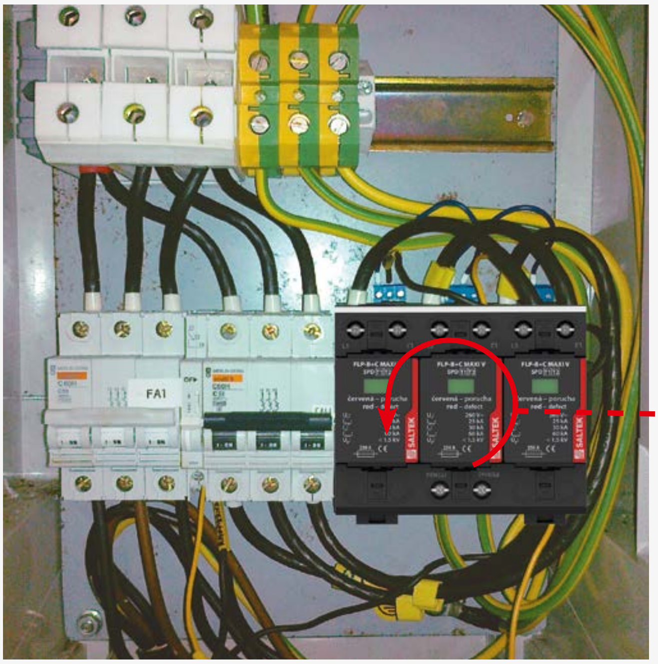
Fig. 12b



Correct: by changing the location of SPD the conditions specified by HD 60364-5-534 standard are complied with.

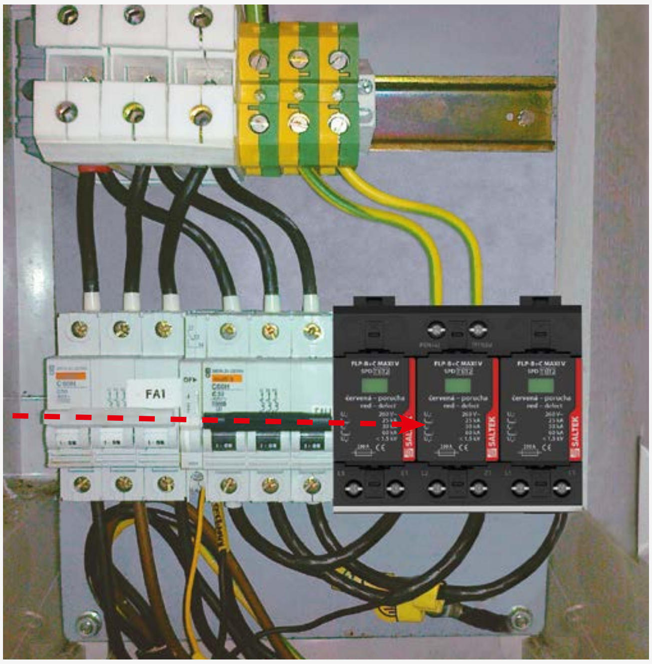
Examples of incorrect installation vs. correct solution

Fig. 13a



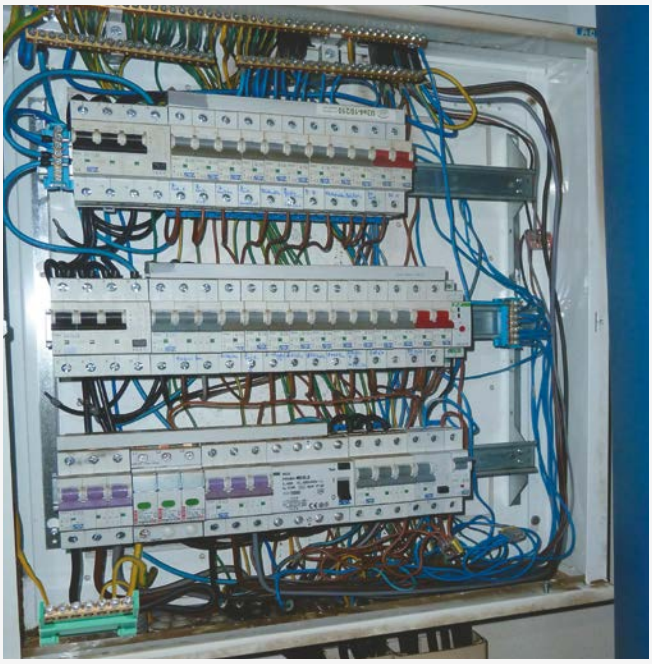
Incorrect

Fig. 13b



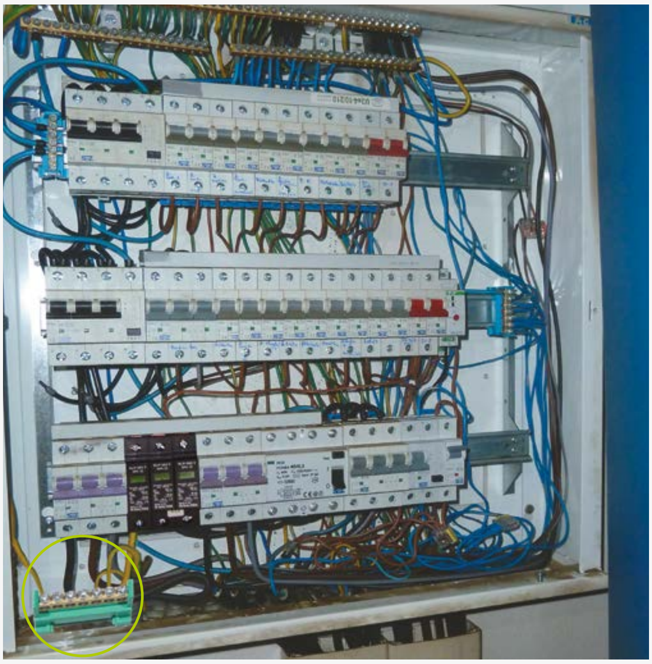
Correct: by turning round the SPD (*Fig. 13b*) the wiring in the inside of the cabinet becomes better arranged and, at the same time, the condition from IEC 61643-12 (CLC/TS 61643-12) concerning the loops is met.

Fig. 14a



Incorrect: the arrangement of SPDs does not meet the conditions of HD 60364-5-534, concerning the lengths of connecting wires.

Fig. 14b



Correct: by adding terminal boards (*Fig. 14b*) into the cabinet and connecting the PEN conductors to the terminal board the conditions of HD 60364-5-534 are complied with.

Fig. 15a

Incorrect: the arrangement of SPDs does not meet the conditions of HD 60364-5-534, concerning the lengths of connecting wires.

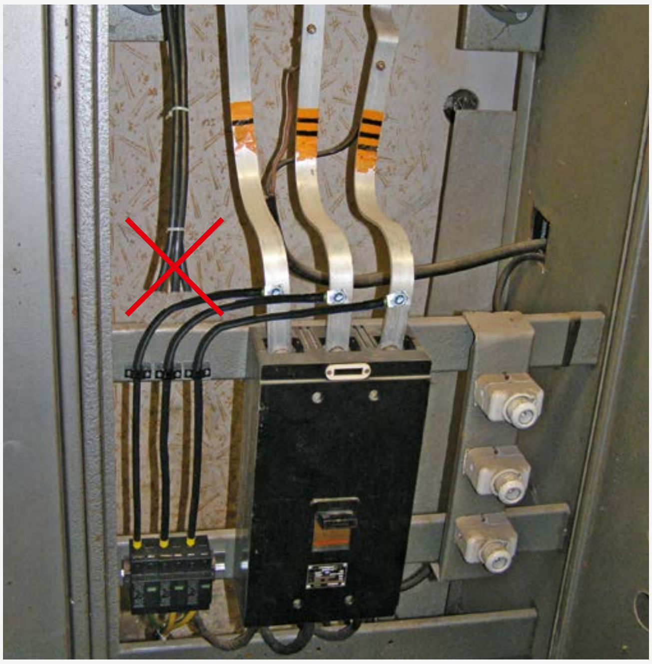
Fig. 15b

Correct: by relocating the SPD the conditions of HD 60364-5-534 are complied with.

Fig. 16a

Incorrect: the arrangement of SPDs does not meet the conditions of HD 60364-5-534, concerning the lengths of connecting wires.

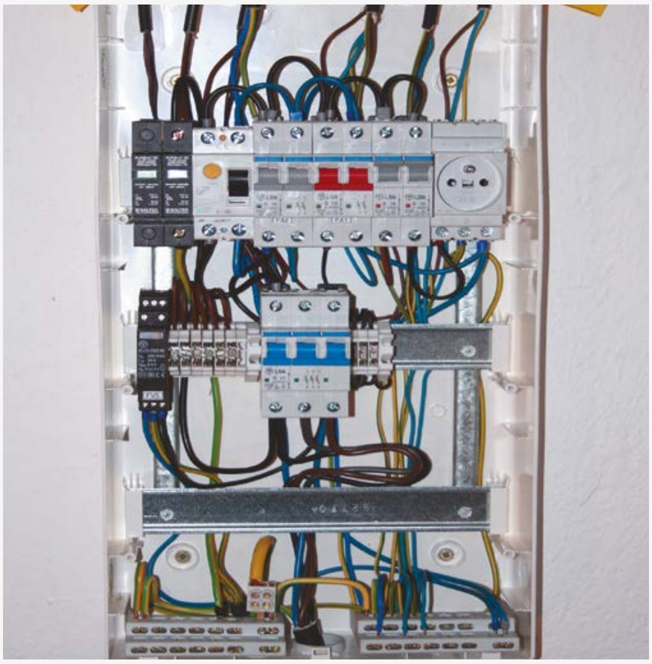
Fig. 16b



Correct: by properly connecting the SPD the length of the connecting wires reduces significantly.

Examples of incorrect installation vs. correct solution

Fig. 17a

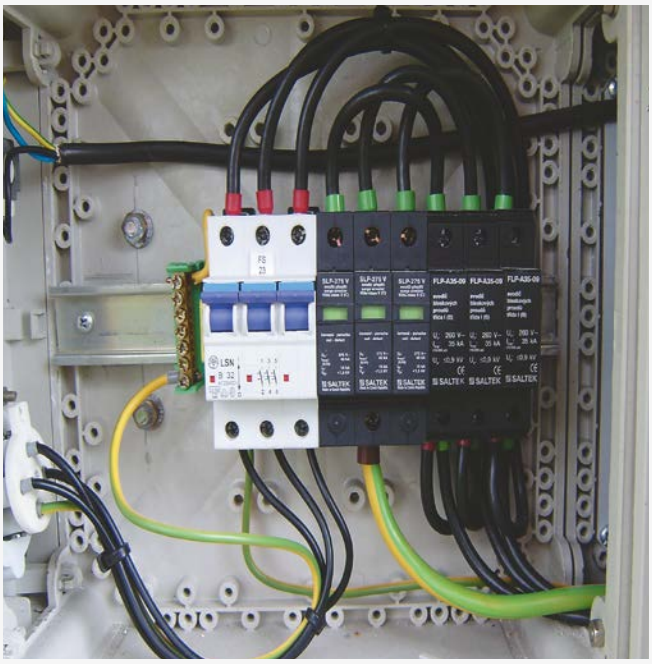


Incorrect: the installation of SPD does not meet the conditions of HD 60364-5-534, concerning the lenths of connecting wires, and also the provisions for connecting the SPDs in TN-S power mains.

Fig. 17b

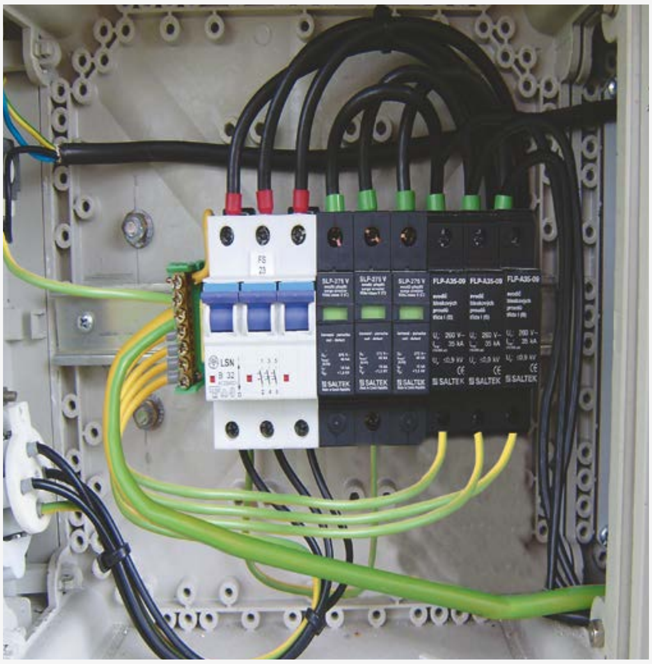
Correct: by relocating the circuit breaker and the SPD (*Fig. 17b*) the conditions of HD 60364-5-534 are complied with. By adding another SPD the N conductor can also be protected.

Fig. 18a



Incorrect: the arrangement of SPDs does not meet the condition for equal potential for SPD type 1 and type 2. Also the connection of the coordinated SPD type 1 and type 2 is defective.

Fig. 18b

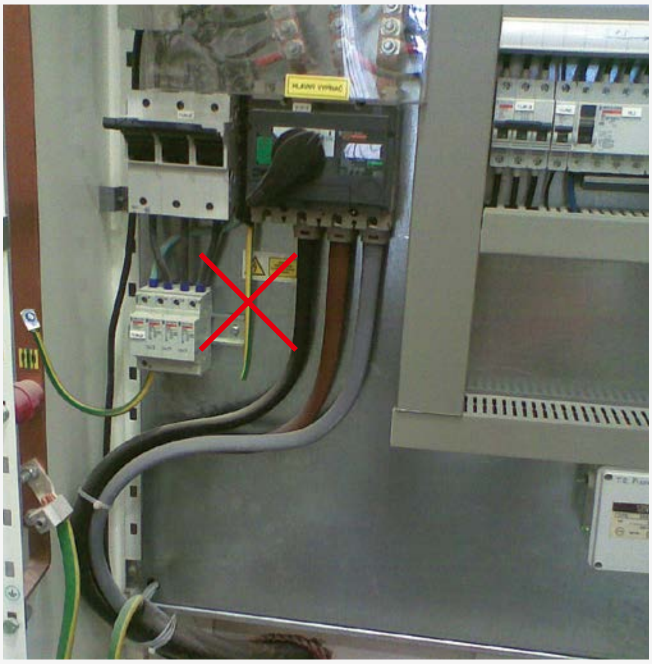


Correct: after reconnecting the conductors the equipotential bonding is properly established, and the coordinated SPD type 1 and type 2 are properly connected.

Fig. 19a

Incorrect: the installation procedure of SPD does not meet the conditions of HD 60364-5-534, concerning the lenths of connecting wires.

Fig. 19b



Correct: by properly connecting the SPD the length of connecting wires becomes significantly reduced.

Fig. 20a

Incorrect

Fig. 20b

Correct: by relocating the SPD the wiring in the inside of the cabinet becomes better arranged. The conditions of IEC 61643-12 (CLC/TS 61643-12) concerning the loops are satisfied with and, at the same time, the conditions of HD 60364-5-534, concerning the conductor lengths are also met.

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