LIGHTNING CURRENT ARRESTERS - STAGE 1 - TYPE 1 T1

- For protection of electric networks and equipment against overvoltage from direct or indirect lightning strokes in the arresting equipment of buildings, LV lines etc.
- For protection of electric networks and equipment in family houses, commercial and industrial buildings etc. (SJB*plus*. . .shall be used for two-wire power supply)
- They reduce voltage and "cut down" the overvoltage wave power caused by direct or indirect lightning stroke
- Application: as the first stage (coarse protection) in 3-stage overvoltage protection - **type 1** according to EN 61643-11
- SJB*pro* is mainly intended for **building applications**
- SJB*plus* is mainly intended for **industrial applications**
- **Standard solution** with SJB*pro*35 and SJB*plus*50 - it is recommended, if the length of the line between T1 and T2 (second stage of overvoltage protections) is higher than 10 m
- **Universal solution** with SJB*pro*35/1,5 and SJB*plus*50/1,5
  - their installation is independent of the length of the line between T1 and T2; therefore they can be installed irrespective of the length of the line
  - It is recommended to install them above all, if the length of the line between T1 and T2 is shorter than 10 m, or if the length of the line is not known and there is not time to check the length of the line
  - The arresters SJB*pro*35/1,5 and SJB*plus*50/1,5 eliminate the need of a separation inductance in cases, when the length of the line is shorter than 10 m, save space in switchboards, and increase the transferred power of the distribution system (I_n of the distribution system is not dependent of I_n of the separation inductances)
- Installation[1)] : in the main switchboard

SJB*pro*35 and **SJB*pro*35/1,5**

- Ideal arrester for most building and commercial applications
- Main component is a powerful arrester gap able to arrest lightning current and to quench the follow-current
- **Quenching takes place in the device – SJB*pro*… requires no exhaust space**
- Possibility of installation also in common plastic switchboards (e.g. type ORO, COMBI, ECO, ERA)
- In use of SJB*pro*35 (standard solution) it is necessary to observe the length of the line between T1 and T2 at least 10 m
- In use of SJB*pro*35/1,5 (universal solution) the length of the line between T1 and T2[2)] can be arbitrary. Recommended application is however at the length of the line shorter than 10 m
- Voltage protection level for SJB*pro*35/1,5 is **U_p = 1.5 kV**
- Width: 1 module per DIN rail
- Simple interconnection of the rails and with arresters of type 2

SJB*plus*50 and **SJB*plus*50/1,5**

- Arresters for demanding applications, industry, power engineering etc.
- Main component is a powerful arrester gap **able to arrest lightning current up to 50 kA**
- **Quenching of follow-current up to 50 kA**
- In use of SJB*plus*50 (standard solution) it is necessary to observe the length of the line between T1 and T2 at least 10 m
- In use of SJB*plus*50/1,5 (universal solution) the length of the line between T1 and T2[2)] can be arbitrary. Recommended application is however at the length of the line shorter than 10 m
- Voltage protection level for SJB*plus*50/1,5 is **U_p = 1.5 kV**
- In installation exhaust space shall be taken into account
- Width: 2 modules per DIN rail
- Simple interconnection of the rails

SJB100/NPE/1,5

- Application as a summary arrester gap between N and PE in TN-S or TT network (connection "3+1")
- **Quenching takes place inside the device - SJB100/NPE/1,5 requires no exhaust space**
- Possibility of installation also in common plastic switchboards (e.g. type ORO, COMBI, ECO, ERA)
- Width: 2 modules per DIN rail

[1)] see Recommendations to design, installation and measurement on page 45

[2)] If the length of the line between T1 and T2 < 10 m must be with T2 s U_N = 400 V e.g. SVM440-Z, see page 41

Lightning current arresters

I_{imp} (10/350) µs [kA]	Version	Type	Product code	Weight [kg]	Packing [pcs]
35	encapsulated arrester gap	**SJB*pro*35**	13019	0.16	1
	encapsulated arrester gap with electronic ignition release	**SJB*pro*35/1,5**	14122		1
50	arrester gap	**SJB*plus*50**	14424		1
	arrester gap with electronic ignition release	**SJB*plus*50/1,5**	14423		1
100	summary arrester gap with electronic ignition release	**SJB100/NPE/1,5**	14425		1

SJB accessories

Interconnecting busbars	**G..., S...**	page 93
Connecting adapters	**AS..., CS-FH000..., N3x10-FH000**	page 95

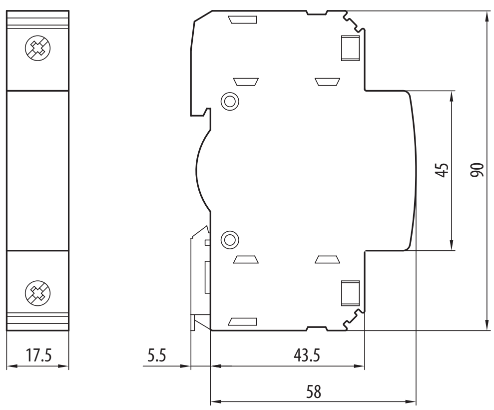
LIGHTNING CURRENT ARRESTERS - STAGE 1 - TYPE 1 T1

Specification

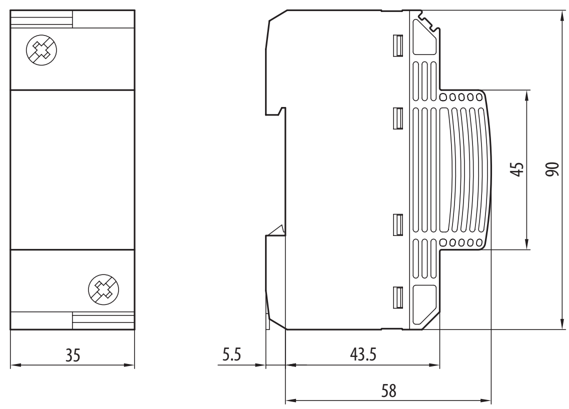
Type			SJB*pro*35	SJB*pro*35/1,5	SJB*plus*50	SJB*plus*50/1,5	SJB100/NPE/1,5
Standards			EN 61643-11 IEC 61643-1 VDE 0675-6	EN 61643-11 IEC 61643-1 VDE 0675-6	EN 61643-11 IEC 61643-1 VDE 0675-6	EN 61643-11 IEC 61643-1 VDE 0675-6	EN 61643-11 IEC 61643-1 VDE 0675-6
Approval marks							
Rated voltage		U_N	230 V a.c.	230 V a.c.	400 V a.c.	400 V a.c.	230 V a.c.
Maximum constant operating voltage		U_c	440 V a.c.	440 V a.c.	440 V a.c.	440 V a.c.	260 V a.c.
Lightning current (10/350 μs)	peak value	I_{imp}	35 kA	35 kA	50 kA	50 kA	100 kA
	impulse charge	Q	17.5 As	17.5 As	25 As	25 As	50 As
	specific energy	W/R	0.305 MJ/Ω	0.305 MJ/Ω	0.625 MJ/Ω	0.625 MJ/Ω	2.5 MJ/Ω
Rated discharge current (8/20 μs)		I_n	35 kA	35 kA	50 kA	50 kA	100 kA
Rated frequency		f_n	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
Voltage protection level		U_p	≤ 4 kV	≤ 1.5 kV	≤ 4 kV	≤ 1.5 kV	≤ 1.5 kV
Arrester classification	according to EN 61643-11		type 1 T1	type 1 T1	type 1 T1	type 1 T1	type 1 T1
	according to IEC 61643-1		class I	class I	class I	class I	class I
	according to VDE 0675-6		class B	class B	class B	class B	class B
Reaction time			≤ 100 ns	≤ 1000 ns	≤ 100 ns	≤ 1000 ns	≤ 100 ns
Quenching follow-current	at 260 V a.c.	I_{fi}	3 kA	3 kA	-	-	0.1 kA
	at 400 V a.c.	I_{fi}	-	-	50 kA	50 kA	-
	at 440 V a.c.	I_{fi}	1.5 kA	1.5 kA	-	-	-
Backup fuse gG/gL			≤ 125 A	≤ 125 A	≤ 250 A	≤ 250 A	-
Degree of protection			IP20	IP20	IP20	IP20	IP20
Mounting on the rail DIN EN 50 022	width		35 mm	35 mm	35 mm	35 mm	35 mm
Connection	rigid conductor		0.5 ÷ 35 mm^2	0.5 ÷ 35 mm^2	10 ÷ 50 mm^2	10 ÷ 50 mm^2	0.5 ÷ 35 mm^2
	flexible conductor		0.5 ÷ 25 mm^2	0.5 ÷ 25 mm^2	16 ÷ 25 mm^2	16 ÷ 25 mm^2	0.5 ÷ 25 mm^2
	interconnecting busbar		G-1L-1000/20 G-3L-1000/16C	G-1L-1000/20 G-3L-1000/16C	G-1L-1000/20	G-1L-1000/20	G-1L-1000/20
	tightening torque		4.5 Nm	4.5 Nm	8 Nm	8 Nm	4.5 Nm
Ambient temperature			-40 ÷ 85 °C	-40 ÷ 85 °C	-40 ÷ 85 °C	-40 ÷ 85 °C	-40 ÷ 85 °C
Seismic immunity (8 ÷ 50 Hz)			3 g	3 g	3 g	3 g	3 g

Dimensions

SJB*pro*35, SJB*pro*35/1,5

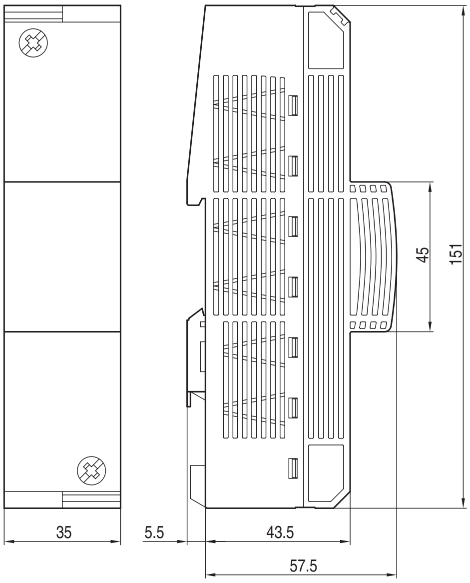


SJB100/NPE/1,5

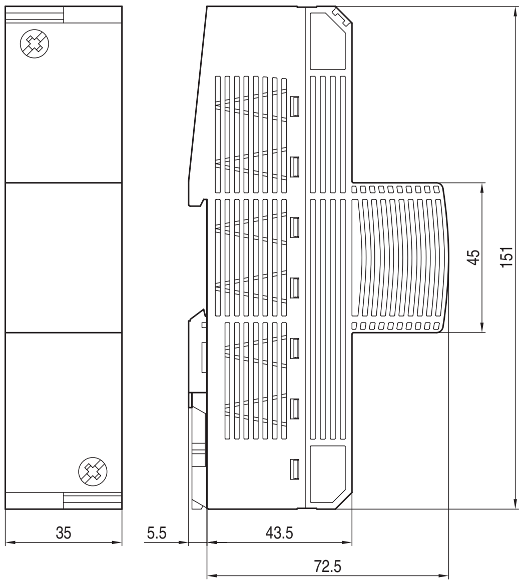


LIGHTNING CURRENT ARRESTERS - STAGE 1 - TYPE 1 T1

SJB*plus*50

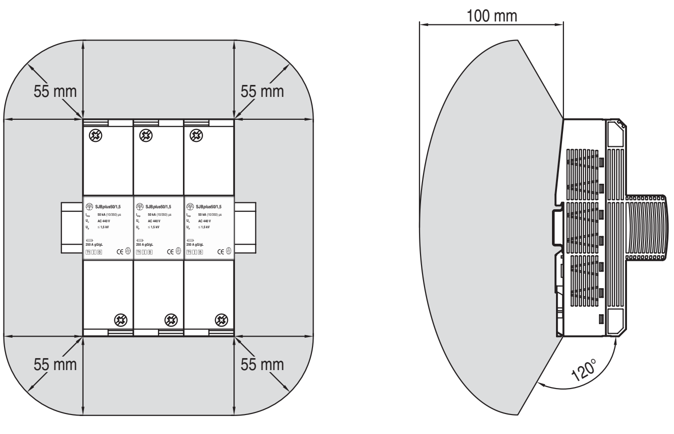


SJB*plus*50/1,5

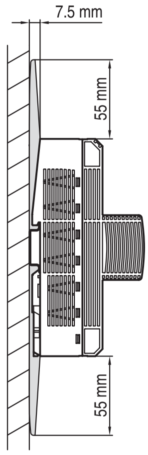


Exhaust space of SJB*plus*...

1)



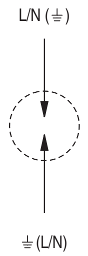
2)



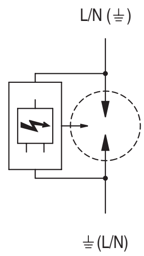
In action of the arrester the ionized gas is exhausted from the rear part of the arrester. The exhaust space is defined in Fig. 1. In the exhaust space there must not be any highly or medium combustible material or live bare conductive parts. Minimum distance from materials combustible with difficulty or non-combustible materials (grade C1, B, A) is defined in Fig. 2).

Diagram

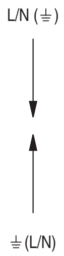
SJB*pro*35



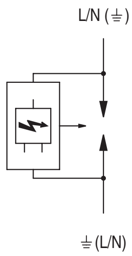
SJB*pro*35/1,5



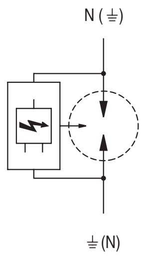
SJB*plus*50



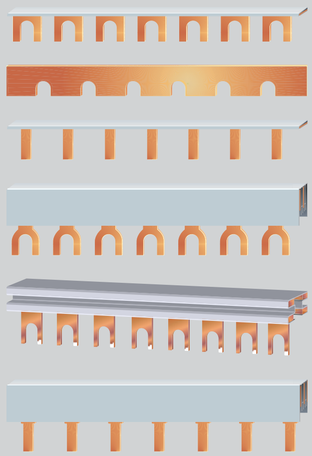
SJB*plus*50/1,5

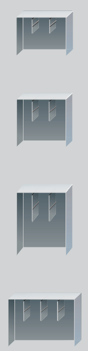


SJB100/NPE/1,5



INTERCONNECTING BUSBARS AND END CAPS





Interconnecting busbars

- For interconnection of 1 to 4-pole circuit breakers, tumbler power switches, residual current circuit breakers, lightning current arresters and surge voltage arresters
- For interconnection of a series of single-phase or three-phase circuit breakers and tumbler power switches, on which an auxiliary switch is mounted
- Busbars G-. . . with forks into the head part of the device
  Busbars S-. . . with pins into the clip part of the device

End cap EK-C-3:

- To cover end of busbar G-3L-1000/10C

End cap EK-C-2+3:

- To cover end of busbar G-2L-1000/16, G-3L-1000/16C, S-3L-27-1000/16

End cap EK-C-3/36:

- To cover end of busbar S-3L-27-1000/25

End cap EK-C-4/16:

- To cover end of busbar G-4L-1000/16

Interconnecting busbars

Phase	Cross - section [mm²]	Max. current at power supply of [A/phase] end	middle	Length [mm]	Type	Product code	Accessories to	Weight [kg]	Packing [pcs]
1	12	65	110	1000	**G-1L-1000/12**	00171	LSN, LSE, ASN	0. 22	50
					G-1L-1000/12g [1]	00170	LSN, LSE, ASN	0.1	50
	16	80	130	210	**S-1L-210/16iso**	13012	LSN, LSE, SVL, SJL, ASN	0.045	50
	20	90	150	1000	**G-1L-1000/20**	00172	LSN, LSE, SJB, SVM, ASN	0.36	50
	24	100	180	1000	**G-1L-27-1000/24** [2]	11001	LSN, LSE, ASN	0.3	50
2	16	80	130	1000	**G-2L-1000/16**	11179	LSN, LSE, LFI, LFE, OFI, OFE, ASN	0.46	20
3	10	63	100	1000	**G-3L-1000/10C**	00173	LSN, LSE, ASN	0.44	20
	16	80	130	1000	**G-3L-1000/16C**	00174	LSN, LSE, OFI, OFE, SJB, SVM, ASN	0.72	20
					G-3L+9-1000/16 [2]	11002	LSN, LSE, ASN	0.66	10
					S-3L-27-1000/16 [3]	11864	LSN, LST, LSE, ASN, AST	0.52	20
	25	100	180	1000	**S-3L-27-1000/25** [3]	11865	LSN, LST, LSE, ASN, AST	0.96	10
4	16	80	130	1000	**G-4L-1000/16**	11180	LSN, LSE, OFI, OFE, ASN	0.96	15

[1] The busbar is uninsulated
[2] For 1-pole or 3-pole devices with an auxiliary switch
[3] For 3-pole LST; for 1-pole LSN, LSE, ASN with an auxiliary switch

End caps

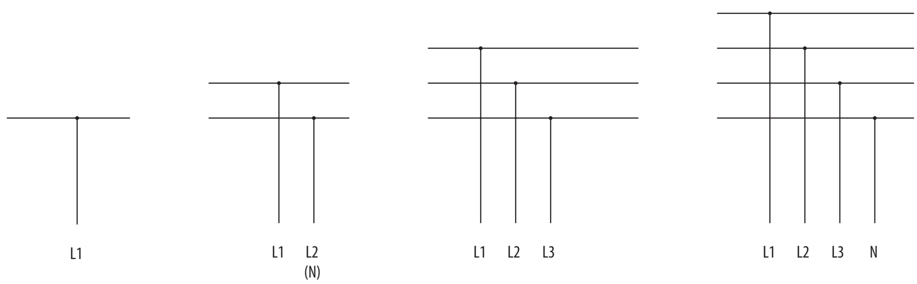
Type	Product code	Accessories to	Weight [kg]	Packing [pcs]
EK-C-3	00178	G-3L-100/10C	0.001	10
EK-C-2+3	00181	G-2L-1000/16, G-3L-1000/16C, S-3L-27-1000/16	0.001	10
EK-C-3/36	11176	S-3L-1000/25	0.002	10
EK-C-4/16	11181	G-4L-1000/16	0.002	10

Specification

Type		G-1L, G-2L, G-3L, G-4L, S-1L, S-3L
Rated operating voltage	U_e	230/400 V a.c., 220/440 V d.c.
Load current		63 ÷ 180 A
Length		210, 1000 mm
Cross-section		10 ÷ 25 mm²

Diagram

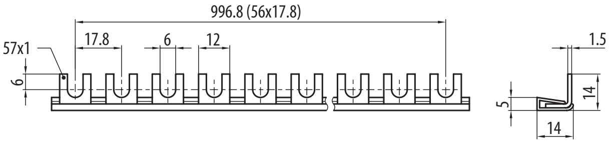
G-1L, S-1L **G-2L** **G-3L, S-3L** **G-4L**



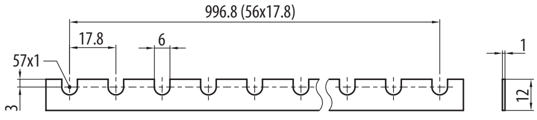
INTERCONNECTING BUSBARS AND END CAPS

Dimensions

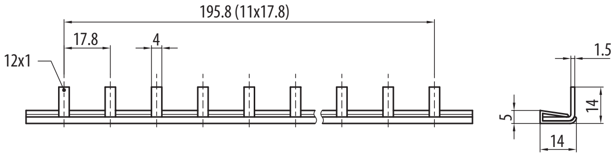
G-1L-1000/12



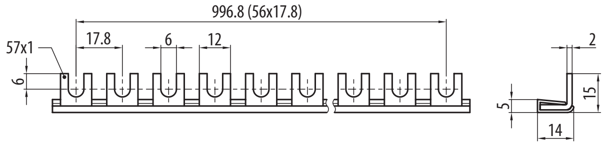
G-1L-1000/12g



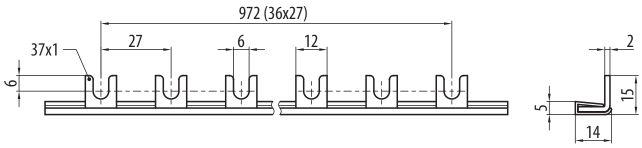
S-1L-210/16iso



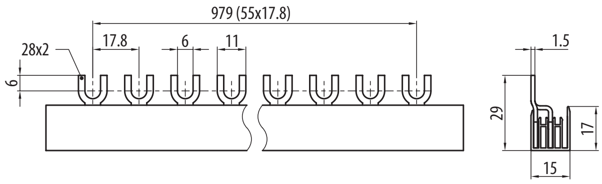
G-1L-1000/20



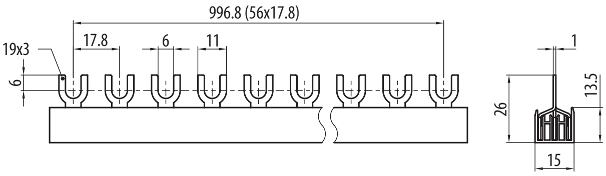
G-1L-27-1000/24



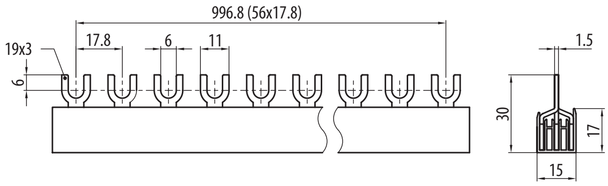
G-2L-1000/16



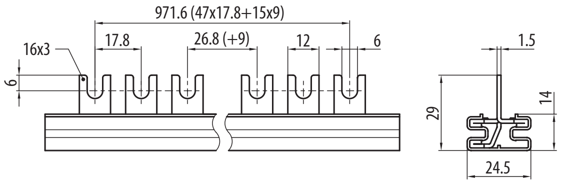
G-3L-1000/10C



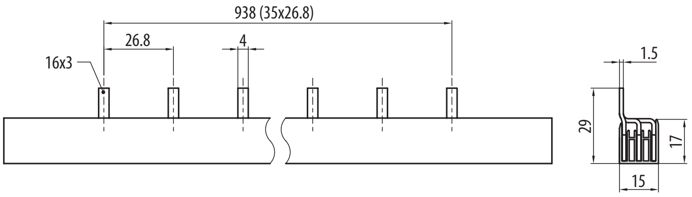
G-3L-1000/16C



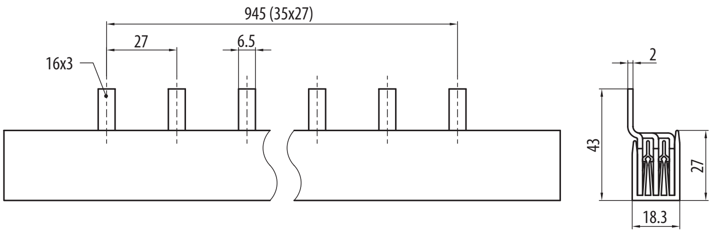
G-3L+9-1000/16C



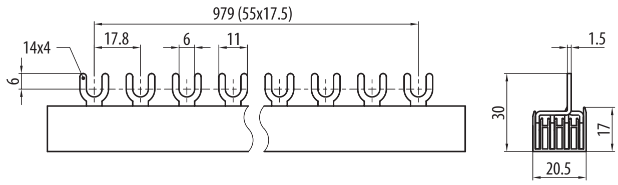
S-3L-27-1000/16



S-3L-27-1000/25



G-4L-1000/16



CONNECTING ADAPTERS AND BLOCKS

Connecting adapter AS/25-GN

- Accessories to: LSN, LSE, LFI, LFE, OFI, OFE, SJB, SVM, ASN
- For connection of another conductor to the head part of the terminal of a circuit breaker or tumbler power switch
- For example, it the best solution is to connect a conductor for power supply of an electric meter in the clip part of the circuit breaker terminal, and another conductor through the connecting adapter AS/25-GN in the head part of the circuit breaker terminal
- Conductor cross-section: 6 ÷ 25 mm^2

Connecting adapter AS/25-SN

- Accessories to: OFI20, OFE20, SVL, SJL, RP1
- For connection of conductor to the clip part of the terminal of a circuit breaker or tumbler power switch
- Conductor cross-section: 6 ÷ 25 mm^2

Connecting adapter AS-AL/Cu-16-50

- Accessories to: LSN, LST, LSE, LFI, LFE, SJB*plus*, ASN, AST
- For connection of Al or Cu conductors
- Cross-section of Cu conductors: 2.5 ÷ 50 mm^2
- Cross-section of Al conductors: 16 ÷ 50 mm^2

Connecting adapter CS-FH000-...NP95

- Accessories to: LST, SJB*plus*, SJB100/NPE/1,5, AST
- For connection of Cu/Al conductors of cross-section 35 ÷ 95 mm^2
- Connecting adapter with straight terminal

Connecting adapter CS-FH000-3NV95

- Accessories to: LST, SJB*plus*, SJB100/NPE/1,5, AST
- For connection of Cu/Al conductors of cross-section 35 ÷ 95 mm^2
- Connecting adapter with outbowed terminal

Connecting adapter N3x10-FH000

- Accessories to: LST, SJB, SVM, AST
- For connection of 3 conductors/pole of the device of cross-section 10 mm^2

Connection block ES/35S/G

- Accessories to: G-1L, G-2L, G-3L, G4-L, S-1L, S-3L
- It enables power supply of interconnecting busbars of conductors of section up to 35 mm^2
- The blocks can be installed in series to create a multiple-pole connection block
- Degree of protection IP20

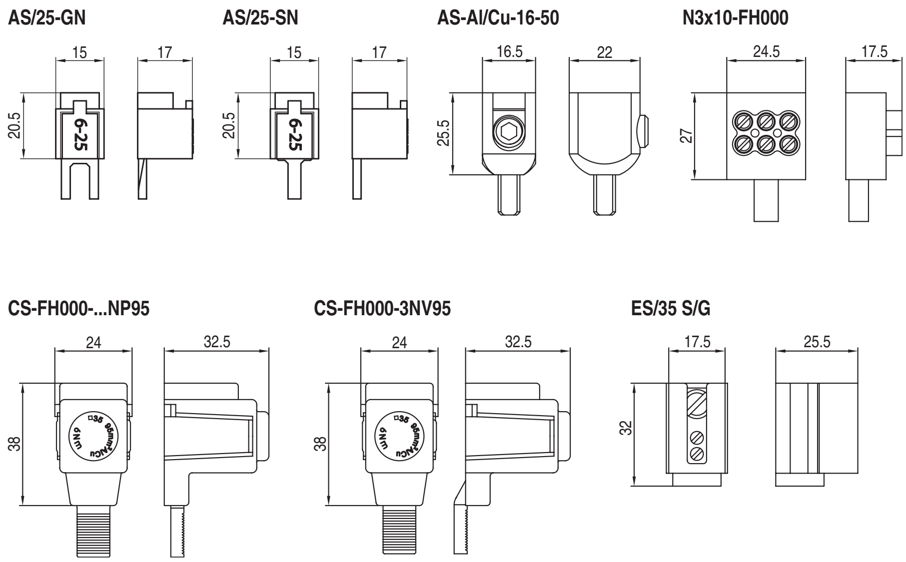
Connecting adapters

Type	Product code	Weight [kg]	Accessories to	Set [pcs]	Packing [pcs]
AS/25-GN	00177	0.012	LSN, LSE, LFI, LFE, OFI, OFE, SJB, SVM, ASN	1	10
AS/25-SN	00176	0.013	OFI20, OFE20, SVL, SJL, RP1	1	10
AS-AL/Cu-16-50	18351	0.016	LSN, LST, LSE, LFI, LFE, SJB*plus*, ASN, AST	1	15
CS-FH000-3NP95	13740	0.1	LST, SJB*plus*, SJB100/NPE/1,5, AST	3	1
CS-FH000-1NP95	14378	0.1	LST, SJB*plus*, SJB100/NPE/1,5, AST	1	1
CS-FH000-3NV95	13742	0.1	LST, SJB*plus*, SJB100/NPE/1,5, AST	3	1
N3x10-FH000	14127	0.02	LST, SJB, SVM, AST	3	1

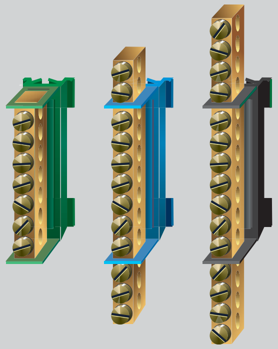
Connection block

Type	Product code	Weight [kg]	Packing [pcs]
ES/35 S/G	00175	0.03	10

Dimensions



TERMINAL STRIPS



- For branching or connection of conductors PEN, PE, N and L
- They are used in switchboards, which are not delivered with terminal blocks
- Mounting: on the rail DIN EN 50 022 - width 35 mm
- Colour: green, blue, black

Terminal strips

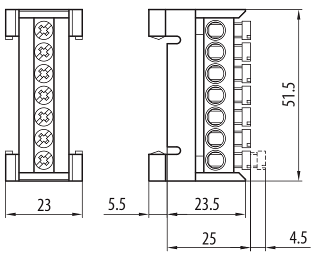
Colour	Number x maximum terminal range [pcs x mm²]	Type	Product code	Weight [kg]	Packing [pcs]
■ (green)	7 x 16	**PE7**	11124	0.026	10
	12 x 16	**PE12**	11125	0.042	10
	15 x 16	**PE15**	11126	0.048	10
■ (blue)	7 x 16	**N7**	11121	0.026	10
	12 x 16	**N12**	11122	0.042	10
	15 x 16	**N15**	11123	0.048	10
■ (black)	7 x 16	**L7**	11127	0.026	10
	12 x 16	**L12**	11128	0.042	10
	15 x 16	**L15**	11129	0.048	10

Specification

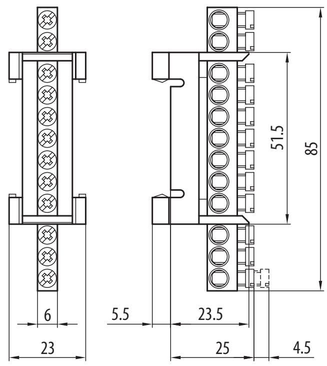
Type	**PE, N, L**
Standards	EN 60 947-1
Approval marks	
Mounting on the rail DIN EN 50 022 - width	35 mm
Connection	1 ÷ 16 mm², 2x (1 ÷ 4) mm²
Seismic immunity (8 ÷ 50 Hz)	1.5 g

Dimensions

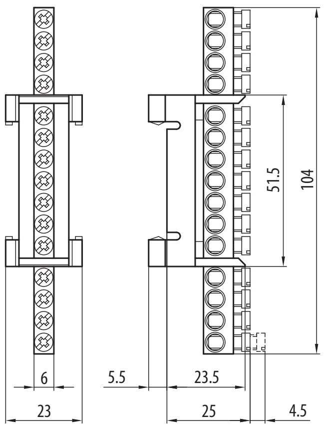
PE7, N7, L7



PE12, N12, L12



PE15, N15, L15



RECOMMENDATIONS TO DESIGN, INSTALLATION AND MEASUREMENT

General

- Protection of buildings and electrical equipment against lightning effects and overvoltage is carried out both outside and inside the building. External protection devices include lightning traps, conductor arresters, earthing systems, discharge arresters etc. Internal protection measures include equipotential bonding, screening etc.
- The basis of internal protection against lightning effects and overvoltage is protective equipotential bonding i.e. connection of all metallic wiring to an equipotential EP busbar (EP – equipotential point). This eliminates potential differences in the wiring over a permissible limit with subsequent damaging discharge.
- Lightning current arresters and surge voltage arresters are the elements of internal protection. They connect power cables to the EP busbar indirectly through arrester gaps and varistors and thus reduce overvoltage. The overvoltage reduction is normally carried out in 3 stages. Each stage shall reduce overvoltage to a level defined by IEC 664-1 for overvoltage categories. The arresters of stages 1 to 3 are installed on the interface of individual overvoltage categories – *see Fig. 1.*

■ Stage 1 – coarse protection – type 1 T1

This protection is provided lightning current arresters SJB, which arrest the biggest part of the overvoltage wave, and must be able without damage to divert lightning currents or their substantial parts. It is possible to deduct from IEC 61312-1 and IEC 61024-1 that in the most adverse case with 2 or 4-wire power lead the lightning current arresters must arrest 50 kA per pole or 25 kA per pole of impulse current with the waveform 10/350 µs. Such parameters can only be achieved with the devices designed on the arrester gap basis.

■ Stage 2 – medium protection – type 2 T2

This protection is provided by varistor-based surge voltage arresters SVL, SJL, SVM, which must be able to divert without damage atmospheric surges or overvoltage from switching processes in the network with waveform 8/20 µs.

Under corresponding conditions they can be installed without the front-end 1st stage e.g. in the main switchboard, see the table *Selection of the number of protection stages and types*. However in most cases they are installed after the lightning current arresters, which reduce overvoltage and "cut down" the energy of the overvoltage wave. See *Fig. 2* for visual comparison of the energies diverted by the lightning current arrester 50 kA and surge voltage arrester 15 kA.

Surge voltage arresters are rated at a specific heat output. If there is high power or too frequent overvoltage in the network, the heat output can be exceeded and the surge voltage arrester is disconnected by its disconnecting device. After disconnection the surge voltage arresters are nonfunctional and must be replaced. The disconnection is indicated both optically and remotely.

In insulation measurement it is necessary to disconnect the arresters from the earth to get undistorted results.

■ Stage 3 – fine protection – type 3 T3

To ensure really reliable protection it is necessary to complement the above types 1 and 2 by the last one – type 3. The basic elements of the fine protection are varistors and suppressor diodes able to divert the overvoltage with waveform 8/20 µs. It is recommended to install this protection directly at the protected appliance, without a long cable between the arrester and the appliance. Otherwise, when a long cable is installed between the last stage and the appliance, voltage may rise in the conductors over a permissible level (e.g. due to induction).

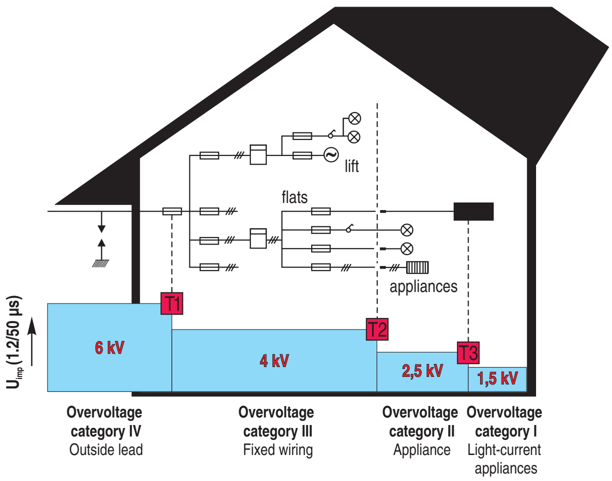


Fig. 1. Overvoltage categories and impulse withstand voltage U_{imp} (1,2/50 µs) for individual parts of a building and for mains voltage 230/400 V a.c. – according to IEC 664-1.

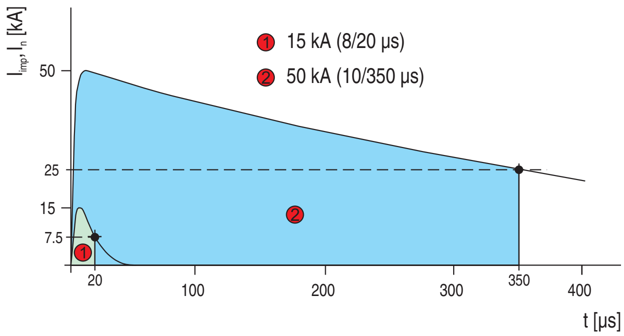


Fig. 2. Wave form and energy 8/20 µs and 10/350 µs (the arrested energy corresponds to the area below the curve)

RECOMMENDATIONS TO DESIGN, INSTALLATION AND MEASUREMENT

Recommended procedure of design of overvoltage protection in low-voltage distribution system

The design of overvoltage protection in a low-voltage distribution system consists in two steps, in particular:

1) Selection of the number of protection stages and types
2) Selection of overvoltage protections

Note: Recommended procedure does not include all cases and circumstances

1) Selection of the number of protection stages and types – This is one of the main and the first decisive criterion in designing overvoltage protection. First of all, in the table *Selection of the number of protection stages and types,* it is necessary to find corresponding exposure (big, medium or small) of the building to be protected, and, after it, to determine corresponding sensitivity (big, medium or small) to overvoltage of appliances, which are installed in the building. The number of protection stages and types is determined at the intersection. Note that the best and safest solution is installation of all three protection stages.

2) Selection of overvoltage protections

Selection of T1 and T2

From the previous paragraph, the number of stages and types of protection are known, and now it is necessary to determine specific products. If both T1 and T2 are selected for protection, use the table *Selection of overvoltage protections T1 and T2, which is divided by other important criteria such as length of the line between* T1 and T2, network type etc. If protection T1 is not chosen, it is possible to select the protection T2 arbitrarily, depending on utilization properties of individual offered types (SVL, SJL, SVM).

Selection of T3

Protection T3 (if selected) is chosen from SVD205M-ZS (on the DIN rail) and SVD250-ZS (in wiring box, raceway, etc.). The arresters of the last stage are installed as close as possible to the end device. Otherwise, should a long cable be between the last stage and the appliance, voltage could have risen over a permissible level (e.g. due to induction) in conductors. On the other hand, if the protected device is in the distance shorter than 5 m from the second stage, it is not necessary to install the third stage. The second stage will provide sufficient protection. The surge voltage arresters T3 must always be installed after the surge voltage arrester T2.

Selection of the number of protection stages and types

	BUILDING EXPOSURE		
	BIG	**MEDIUM**	**SMALL**
	- power plants, hospitals, industrial buildings, public buildings with high number of visitors etc. **or** - buildings in mountain regions, free-standing buildings, buildings close to HV and EHV lines etc. **or** - buildings with external lightning protection (lightning conductor), with outdoor power supply, grounded roof superstructure (aerial) etc..	- individual housing units, family houses in high-density development etc. **and at the same time** - buildings in high-density development comparable with or not exceeding the other buildings **and at the same time** - buildings with connection by a short overhead line from power supply transformer (tens of meters)	- individual housing units, family houses in high-density development etc. **and at the same time** - buildings in high-density development enclosed by many higher buildings **and at the same time** - buildings in high-density development with buried cable supply lead
Appliance sensitivity to overvoltage – **BIG** - PC, TV, Hi-Fi system etc.	T1 + T2 + T3	T2 + T3	T2 + T3
MEDIUM – washing machines, refrigerators etc.	T1 + T2 + T3	T2	T2
SMALL – motors, fans etc.	T1 +T 2	T2	T2

Selection of overvoltage protections T1 and T2

Solution	Length of the line between T1 and T2	Application	Network [1]	Protection type	Recommended arrester type
Standard	> 10 m	Building	TN-C	T1	3x SJB*pro*35
				T2	3x SVL275(S) nebo 3x SJL275(S) nebo 3x SVM275-Z(S)
			TN-C-S	T1	3x SJB*pro*35
				T2	3x SVM275-Z(S) + 1x SVM260/NPE-Z
			TN-S	T1	3x SJB*pro*35 + 1x SJB100/NPE/1,5
				T2	3x SVM275-Z(S) + 1x SVM260/NPE-Z
		Industrial	TN-C	T1	3x SJB*plus*50
				T2	3x SVL275(S) nebo 3x SJL275(S) nebo 3x SVM275-Z(S)
			TN-C-S	T1	3x SJB*plus*50
				T2	3x SVM275-Z(S) + 1x SVM260/NPE-Z
			TN-S	T1	3x SJB*plus*50 + 1x SJB100/NPE/1,5
				T2	3x SVM275-Z(S) + 1x SVM260/NPE-Z
Universal	arbitrary (recommended solution at the length of the line <10 m)	Building	TN-C (TN-C-S)	T1+T2	3x SJB*pro*35/1,5
					3x SVM440-Z(S)
			TN-S	T1+T2	3x SJB*pro*35/1,5 + 1x SJB100/NPE/1,5
					3x SVM440-Z(S) + 1x SVM260/NPE-Z
		Industrial	TN-C (TN-C-S)	T1+T2	3x SJB*plus*50/1,5
					3x SVM440-Z(S)
			TN-S	T1+T2	3x SJB*plus*50/1,5 + 1x SJB100/NPE/1,5
					3x SVM440-Z(S) + 1x SVM260/NPE-Z

[1] For individual networks, connection is assumed as shown on pages 48 and 49.

Example

Situation

Administrative building of an industrial plant is supplied with 3x230/400 V AC (network TN-C) by a buried cable, and has a lightning conductor. It is equipped with PC, TV, refrigerators, microwave ovens etc. The system is divided into TN-C-S in the main switchboard. The length of the line between the main and subdistribution switchboard is 17 m. It is assumed that T1 and T2 will be installed in the main and subdistribution switchboards respectively. T3 protection is assumed in the raceway.

Solution

From the first table: building exposure – big, sensitivity of installed appliances to overvoltage – big. The result is the recommended installation of T1 + T2 + T3.

From the second table: standard solution chosen for building applications in the system TN-C-S; therefore the result are these arresters – 3x SJB*pro*35 and 3x SVM275-Z(S) + 1x SVM260/NPE-Z.

This solution has been chosen for the following reasons:

- buried supply cable, which eliminates the hazard of direct lightning stroke into the line
- length of the line between T1 and T2 is higher than 10 metres
- T1 does not require an exhaust space

According to the paragraph "Selection of T3", select appropriate number of protection units SVD250-ZS.

RECOMMENDATIONS TO DESIGN, INSTALLATION AND MEASUREMENT

INSTALLATION OF OVERVOLTAGE PROTECTIONS

1. Installation of lightning current arresters – T1 T1

Lightning current arresters, i.e. the arresters of type 1, are installed above all in the main switchboard on the DIN rail. Installation of the lightning current arresters in metering switchboards shall be approved by relevant power distribution companies. In not measured area, use lightning current arresters SJB*plus*50 or SJB*pro*35.

2. Installation of surge voltage arresters – T2 T2

Surge voltage arresters T2 are installed on the DIN in:

- subdistribution switchboard after the lightning current arrester **at the length of the line between T1 and T2 ≥ 10 m: it is possible to use any surge voltage arrester of type 2**
- main switchboard together with the lightning current arrester or in the subdistribution switchboard after the lightning current arrester; **at the length of the line between T1 and T2 < 10 m, it is necessary to use either the combination (SJB*pro*35/1,5 + SVM440-Z) or (SJB*plus*50/1,5 + SVM440-Z)**
- main switchboard separately under corresponding conditions (without backup lightning current arrester)

3. Installation of surge voltage arresters – T3 T3

The arresters are installed either on the DIN rail (SVM250M-ZS) or in a wiring box or raceway (SVD250-ZS). If the length of the line between T2 and T3 < 5 m, it is not necessary to use T3 – protection is sufficiently provided by the surge voltage arrester T2. Surge voltage arresters of 3rd stage can be connected to the line both continuously (see wiring diagram example 3b) and transversely (see wiring diagram example 3a). Transverse connection to the line is advantageous in particular if the current flowing through the line is higher than the permitted loading current I_L of the surge voltage arrester T3.

PROTECTION OF OVERVOLTAGE PROTECTIONS

1. Protection of lightning current arresters – T1 T1

Protection can be implemented in two ways:

- Protection only by fuses F1 in service box, if F1 correspond to the values stated in the table of technical parameters of given type. However if in such wiring there are leakages and follow short-circuit currents, though the SJB arresters are able to quench the follow short-circuit current, F1 may blow with subsequent interruption of the power supply in the building.
- Use of fuses F2 in addition to F1 if the latter are too big or if you do not want to interrupt the power supply so frequently. In this case selectivity must be ensured between F1 and F2 i.e. $I_{nF1} \geq 1.6xI_{nF2}$
  In these ratios of rated currents the fuse F2 will cut out sooner than F1, and the power supply will not be interrupted so frequently. However the values I_{nF2} may be low, and F2 will blow more frequently. For this reason it is recommended to equip the fuse F2 with a signalling device.

2. Protection of surge voltage arresters – T2 T2

The previous paragraph applies also to the protection of surge voltage arresters, however in *Wiring diagram examples* these fuses are designated F3. The surge voltage arresters however do not quench the follow current; the varistor increases its resistance after the conduction of the current impulse into the earth until earth-leakage current ceases to flow through the surge voltage arrester due to big resistance of the varistor.

3. Protection of surge voltage arresters – T3 T3

Surge voltage arresters SVD250M and SVD250 shall be protected by circuit breakers or fuses gG/gL max. 20 A and 16 A respectively.

4. Protection of arresters for connection "3+1"

Arresters for connection between N and PE conductors, i.e. the arrester SJB100/NPE/1,5 for the first stage and SVM260/NPE-Z for the second stage are not protected separately, because their protection is already provided by the fuses F1, F2 and F3, see the wiring diagram examples.

LIGHTNING CURRENT ARRESTERS WITH ELECTRONIC IGNITION RELEASE

Till lately it was necessary to use the separation inductance for power control between the lightning current arresters and surge voltage arresters, i.e. between 1st and 2nd stage (between T1 and T2) of overvoltage protections, if the length of the line between T1 and T2 was shorter than 10 m.

Now it is possible to use new lightning current arresters **SJB*pro*35/1,5** and **SJB*plus*50/1,5**, which are equipped with an electronic ignition release. Thanks to it, these lightning current arresters in combination with a surge voltage arrester[1] can be installed directly side-by-side or in a distance shorter than 10 m without the need of installation of the separation inductance (*see the figure*). This principle of overvoltage protection is suitable for both:

- **building applications** (SJB*pro*35/1,5) and
- **industrial applications** (SJB*plus*50/1,5)

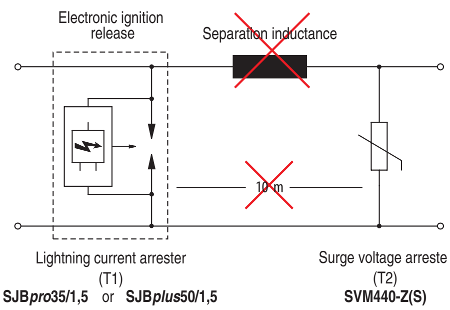
where it is not possible to install T1 and T2 separately. Another undisputable advantage of the new functional principle is the value of the voltage protection level $U_p = 1.5$ kV. In addition SJB*pro*35/1,5 has been designed in such a way that it requires no exhaust space and thus can be installed even in common plastic switchboards. SJB*plus*50/1,5 can quench the follow current up to 50 kA without backup fuse, and saves protective elements in many applications.

Advantages of these lightning current arresters can be summarized as follows

- **no separation inductance is needed**
- **lany distance between arresters T1 and T2 - universal solution**[2]
- **saving of space in the switchboard**
- **substantial increase in transferred power** - I_n of the distribution system does not depend on I_n of the separation inductance
- **lower loading of the installation** – voltage protection level $U_p = 1.5$ kV
- **possibility of installation in common plastic switchboards** - quenching takes place inside the device (SJB*pro*35/1,5)
- **saving of protective elements** – ability of quenching of follow current up to 50 kA without backup fuse (SJB*plus*50/1,5)

Function principle

Beside the lightning current arrester (SJB*pro*35/1,5 or SJB*plus*50/1,5) there is a varistor-base surge voltage arrester[1]. If overvoltage wave comes to these arresters, it is first diverted by T2 i.e. the surge voltage arrester. As soon as the value of the overvoltage wave reaches the voltage protection level of the lightning current arrester $U_p = 1.5$ kV, during the protection process, the arrester gap is ignited by means of the ignition release. The overvoltage wave is now limited by the lightning current arrester, which also relieves the surge voltage arrester T2. Thus the electronic ignition release monitors continuously the level of overvoltage in the line, and ignites the arrester gap of the lightning current arrester at a suitable moment, and eliminates destruction of the surge voltage arrester T2.



[1] T2 must be with $U_N = 400$V, i.e. SVM440-Z(S)

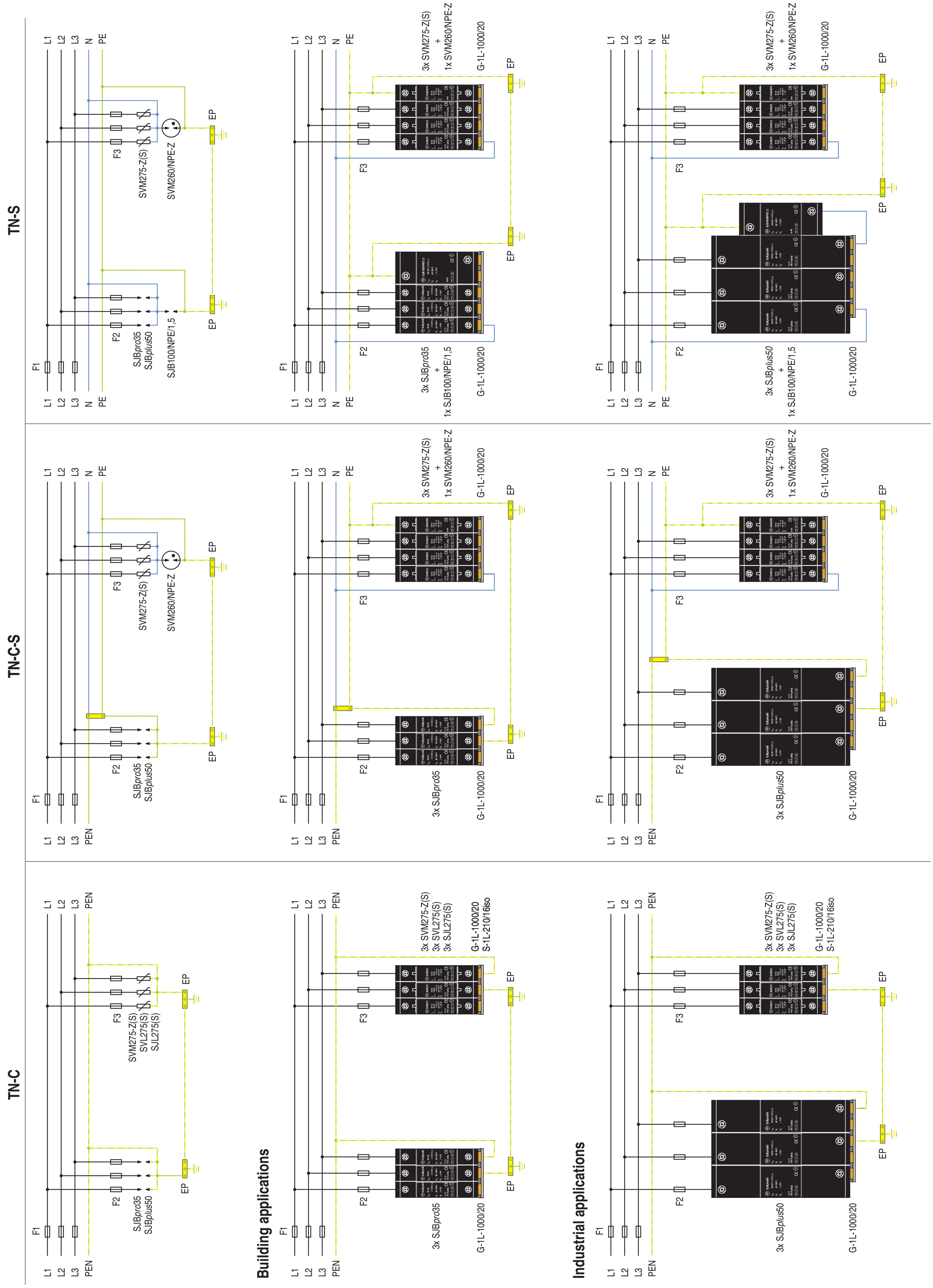
[2] Installation is independent of the length of the line between T1 and T2; therefore they can be installed irrespective of the length of the line. It is recommended to install them above all, if the length of the line between T1 and T2 is shorter than 10 m, or if the length of the line is not known and there is not time to check the length of the line (universal solution).

RECOMMENDATIONS TO DESIGN, INSTALLATION AND MEASUREMENT

Wiring diagram examples

1. Standard solution

Recommended connection at the length of the line between T1 and T2 ≥ 10 m

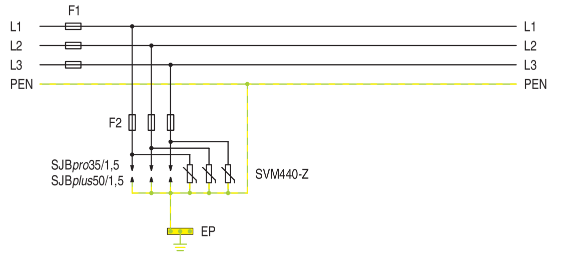


RECOMMENDATIONS TO DESIGN, INSTALLATION AND MEASUREMENT

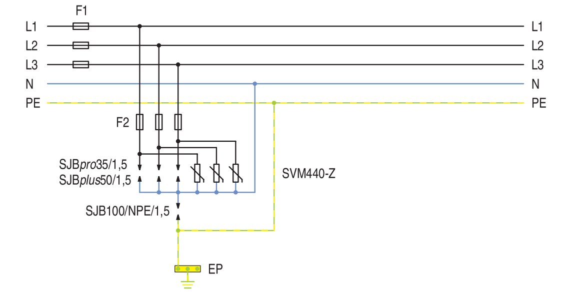
2. Universal solution

Independent of the length of the line; recommended connection in the length of the line between T1 and T2 < 10 m (below are examples with zero length of the line - arresters are next to each other)

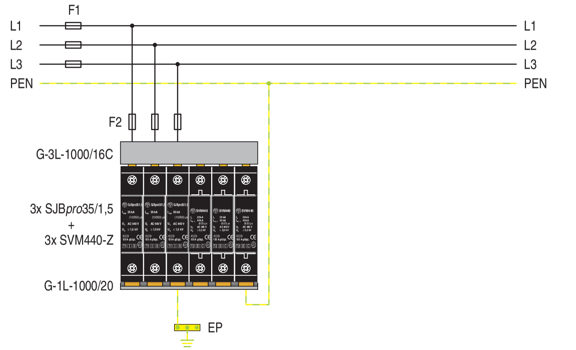
TN-C (TN-C-S)[1)]

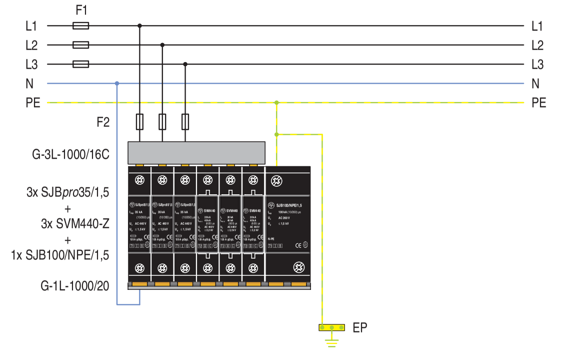


TN-S

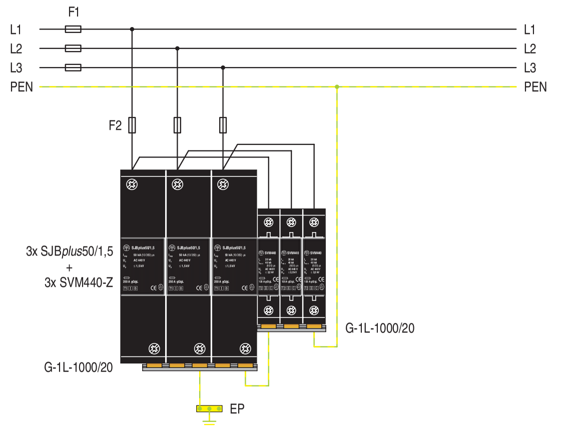


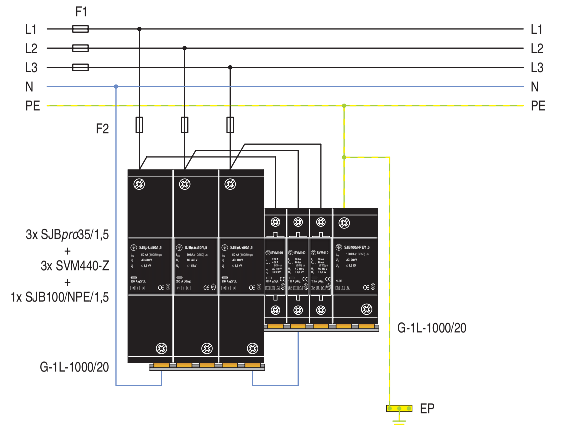
Building applications





Industrial applications





TT, IT networks – wiring diagram can be provided on request from Technical Support

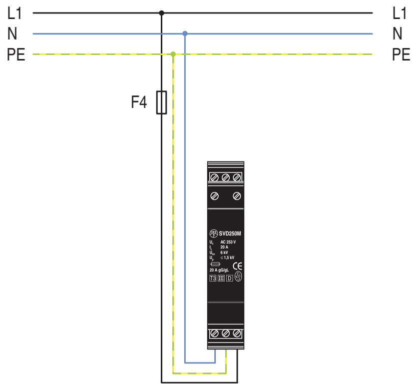
[1)] The installation of the arresters and the point of division into PE and N conductors are assumed in the main switchboard. For this reason the wiring diagram of the arresters is the same as that for TN-C network.

RECOMMENDATIONS TO DESIGN, INSTALLATION AND MEASUREMENT

Wiring diagram examples

3. Surge voltage arresters T3

a) transversal connection



b) continuous connection