Lightning and surge protection for rooftop photovoltaic systems

White Paper

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At present, well above a million PV systems are installed in Germany. Based on the fact that self-generated electricity is generally cheaper and provides a high degree of electrical independence from the grid, PV systems will become an integral part of electrical installations in the future. However, these systems are exposed to all weather conditions and must withstand them over decades.

The cables of PV systems frequently enter the building and extend over long distances until they reach the grid connection point.

Lightning discharges cause field-based and conducted electrical interference. This effect increases in relation to the length of the cables and the size of the conductor loops. Surges not only damage the PV modules, inverters and their monitoring electronics, but also devices in the building installation. In industrial buildings, production facilities may be damaged causing production to come to a standstill.

If surges are injected into systems that are far from the power grid, so-called stand-alone PV systems, the operation of equipment powered by solar electricity (e.g. medical equipment, water supply) may be disrupted.

Necessity of a rooftop lightning protection system

The energy released by a lightning discharge is one of the most frequent causes of fire. Therefore, personal and fire protection is of paramount importance in case of a direct lightning strike to the building.

At the design stage of a PV system, it is evident whether a lightning protection system is installed on a building. Building regulations in some countries require public buildings (e.g. places of public assembly, schools and hospitals) to be equipped with a lightning protection system. In case of industrial or private buildings, whether or not a lightning protection system needs to be installed depends on their location, the type of construction and utilisation. To this end, it must be determined whether lightning strikes are to be expected or could have severe consequences. Structures in need of protection should be provided with permanently effective lightning protection systems.

According to the current state of scientific and technical knowledge, the installation of PV modules does not increase the risk of a lightning strike. Therefore, the request for lightning protection measures cannot be derived directly from the mere existence of a PV system. However, substantial lightning interference may be injected into the building through these systems. Therefore, it is necessary to determine the risk resulting from a lightning strike as per IEC 62305-2 (EN 62305-2) and to take the results from this risk analysis into account when installing the PV system. The DEHNsupport Toolbox software is specially designed to calculate this risk and produce a clear, easily understandable analysis. It compares the risk with the technical expenditure and suggests economically optimised protection measures.

As a general rule, rooftop photovoltaic systems must not interfere with the existing lightning protection measures.

Necessity of surge protection for PV systems

In case of a lightning discharge, surges are induced on electrical conductors. Surge protective devices (SPDs) which must be installed upstream of the devices to be protected on the AC, DC and data side have proven very effective in protecting electrical systems from these destructive voltage peaks. Section 8 of IEC 61643-32 calls for the installation of surge protective devices unless a risk analysis demonstrates that SPDs are not required. According to IEC 60364-4-44 standard, surge protective devices must also be installed for buildings without an external lightning protection system such as commercial and industrial buildings, e.g. agricultural facilities. IEC 61643-32 and IEC TR 63227 ** provide a detailed description of the types of SPDs and their place of installation.

Cable routing of PV systems

Cables must be routed in such a way that large conductor loops are avoided. This must be observed when combining the DC circuits to form a string and when interconnecting several strings. Moreover, data or sensor lines must not be routed over several strings and form large conductor loops with the string lines. This must also be observed when connecting the inverter to the grid connection. The important thing is that the power (DC and AC) and data lines (e.g. radiation sensor, yield monitoring) are routed together with the equipotential bonding conductors along their entire route.

Earthing of PV systems

PV modules are typically fixed on metal mounting systems. The live PV components on the DC side feature double or reinforced insulation (comparable to the previous protective insulation) as required in the IEC 60364-4-41 standard. The combination of numerous technologies on the module and inverter sides (e.g. with or without galvanic isolation) results in different earthing requirements. Moreover, the insulation monitoring system integrated in the inverters is only permanently effective if the mounting system is connected to earth. Information on the practical implementation is provided in IEC TR 63227 standard. Functional earthing should be established if the PV system is located in the protected volume of the air-termination systems and the separation distance is maintained. Section 7 of IEC TR 63227 requires copper conductors with a cross-section of at least 6 mm^2 or equivalent for functional earthing (**Figure 1**). The mounting rails also have to be permanently interconnected by means of conductors of this cross-section. If the mounting system is directly connected to the external lightning protection system due to the fact that the separation distance s cannot be maintained, these conductors become

part of the lightning equipotential bonding system. Consequently, these elements must be capable of carrying lightning currents. The minimum requirement for a lightning protection system designed for class of LPS III is a copper conductor with a cross-section of 16 mm² or equivalent. Also in this case, the mounting rails must be permanently interconnected. The requirements on natural components according to IEC 62305-3 (EN 62305-3) apply here (**Figure 2**).
UNI earthing clamps (**Figure 3**) can be fixed on all common mounting systems. They connect, for example, copper conductors with a cross-section of 6 or 16 mm² and bare round wires with a diameter from 8 to 10 mm to the mounting system in such a way that they can carry lightning currents. The integrated stainless steel (V4A) contact plate ensures corrosion protection for the aluminium mounting systems.

Separation distance s as per IEC 62305-3 (EN 62305-3)

A certain separation distance s must be maintained between a lightning protection system and a PV system. It defines the distance required to avoid uncontrolled flashover to adjacent metal parts resulting from a lightning strike to the external lightning protection system. In the worst case, such an uncontrolled flashover can set a building on fire. In this case, damage to the PV system becomes irrelevant. Details on calculating the separation distance s can be found in chapter 5.6 and of our Lightning Protection Guide and are easily and quickly calculated using the DEHN Distance Tool software.

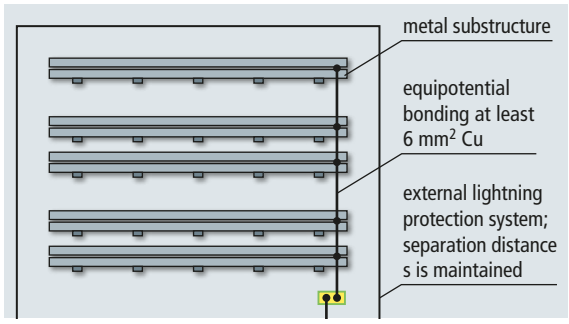

Figure 1 Functional earthing of the mounting systems if no external lightning protection system is installed or the separation distance is maintained (IEC TR 63227)

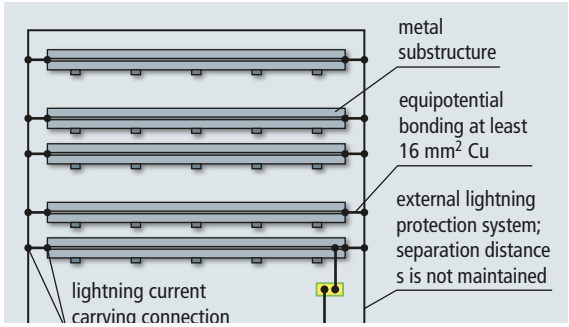

Figure 2 Lightning equipotential bonding for the mounting systems if the separation distance is not maintained

Figure 3 UNI earthing clamp: A stainless steel intermediate element prevents contact corrosion, thus establishing reliable long-term connections between different conductor materials

Core shadows on solar cells

The distance between the solar generator and the external lightning protection system is an important aspect to be considered in order to prevent excessive shading. Diffuse shadows cast by, for example overhead lines, do not significantly affect the PV system and the yield. However, in case of core shadows, a dark clearly outlined shadow is cast on the surface behind an object, changing the current flowing through the PV modules. For this reason, it should be ensured that solar cells and the associated bypass diodes are not influenced by core shadows. This can be achieved by maintaining sufficient distance. For example, if an air-termination rod with a diameter of 10 mm shades a module, the core shadow is steadily reduced as the distance from the module increases. After 1.08 m only a diffuse shadow is cast on the module (**Figure 4**). Annex A of IEC TR 63227 provides more detailed information on the calculation of core shadows.

Special surge protective devices for the DC side of photovoltaic systems

The U/I characteristics of photovoltaic current sources are very different from those of conventional DC sources: They have a non-linear characteristic (**Figure 5**) and cause long-term persistence of ignited arcs. This unique nature of PV current sources not only requires larger PV switches and PV fuses, but also a disconnector for the surge protective device which is specially designed for the purpose and capable of coping with PV currents. The selection of suitable SPDs is described in subsection 9.2 of IEC 61643-32 or in Section 5.6 of IEC TR 63227.

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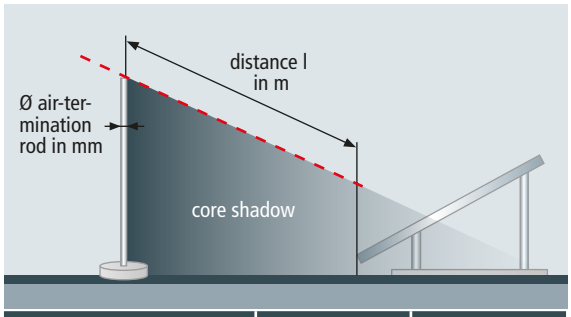

Ø air-termination rod	x factor	= distance l
10 mm	108	1.08 m
16 mm	108	1.73 m

Figure 4 Distance between the module and the air-termination rod required to prevent core shadows

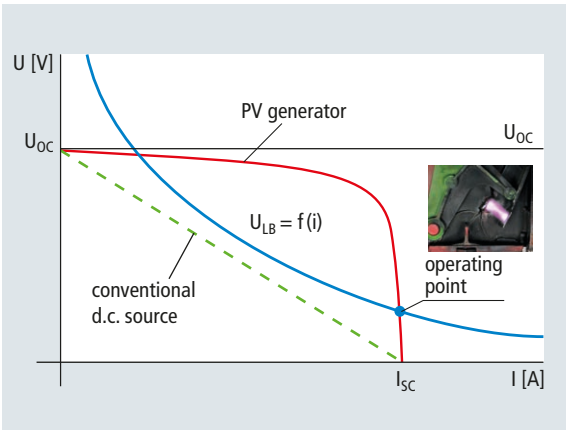

Figure 5 Source characteristic of a conventional DC source versus the source characteristic of a PV generator. When switching PV sources, the source characteristic of the PV generator crosses the arc voltage range

Class of LPS and max. lightning current (10/350 µs)		Number of down conductors of the external lightning protection system			
		< 4		≥ 4	
		Values for the voltage-limiting type 1 SPDs or type 1 combined SPDs (series connection) based on a selection of $I_{8/20}$ (8/20 µs) and $I_{10/350}$ (10/350 µs)			
		$I_{SPD1} = I_{SPD2}$ $I_{8/20}/I_{10/350}$	$I_{SPD3} = I_{SPD1} + I_{SPD2} = I_{total}$ $I_{8/20}/I_{10/350}$	$I_{SPD1} = I_{SPD2}$ $I_{8/20}/I_{10/350}$	$I_{SPD3} = I_{SPD1} + I_{SPD2} = I_{total}$ $I_{8/20}/I_{10/350}$
I or unknown	200 kA	17/10	34/20	10/5	20/10
II	150 kA	12.5/7.5	25/15	7.5/3.75	15/7.5
III and IV	100 kA	8.5/5	17/10	5/2.5	10/5

Table 1 Selection of the minimum discharge capacity of voltage-limiting type 1 SPDs (varistors) or type 1 combined SPDs (series connection of varistors and spark gaps); according to IEC 61643-32 (Table A.1) and IEC TR 63227 (Table 2)

To facilitate the selection of type 1 SPDs, **Table 1** shows the required lightning impulse current carrying capability I_{imp} depending on the class of LPS and the number of down conductors of the external lightning protection systems.

Type 1 DC arrester for use in PV systems: Multipole type 1 + type 2 combined DC arrester, DEHNcombo YPV

With their proven fault-resistant Y circuit, DEHNcombo YPV (FM) combined arresters (**Figure 6**) fulfil the above mentioned requirements. PV generators with up to 10,000 A can be protected by DEHNcombo YPV (FM) without an additional backup fuse. This arrester combines a lightning current arrester and a surge arrester in a single device, thus ensuring efficient protection of terminal equipment. With its discharge capacity I_{total} of 12.5 kA (10/350 µs), it is very flexible and can even be used for the highest classes of LPS. DEHNcombo YPV (FM) is available for

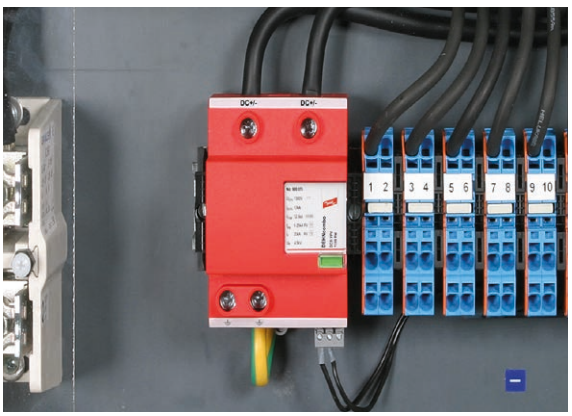

Figure 6 DEHNcombo YPV type 1 combined arrester for protecting photovoltaic systems from surges and partial lightning currents

voltages U_{CPV} of ≤1200V and ≤1500V and has a width of only 4 modules. It is therefore the ideal type 1 combined arrester for use in photovoltaic power supply systems.

Type 2 DC arrester for use in PV systems: DEHNguard M YPV and DEHNcube YPV

Reliable operation of SPDs in DC PV circuits is also indispensable when using type 2 surge protective devices. To this end, the DEHNguard M YPV SCI … (FM) and DEHNcube YPV SCI … surge arresters also feature a fault-resistant Y protective circuit (**Figures 7 and 8**).

Selection of SPDs according to the voltage protection level U_p

The operating voltage on the DC side of PV systems differs from system to system. At present, values up to 1500 V DC are possible. Consequently, the dielectric strength of terminal equipment also differs. To ensure that the PV system is reliably protected, the voltage protection level U_p of the SPD must be lower than the dielectric strength of the PV system it is supposed to protect. The IEC 61643-32 standard requires that U_p is at least 20 % lower than the dielectric strength of the PV system. Type 1 or type 2 SPDs must be energy-coordinated with the input of terminal equipment. If SPDs are already integrated in terminal equipment, coordination between the type 2 SPD and the input circuit of terminal equipment is ensured by the manufacturer (**Figure 9**).

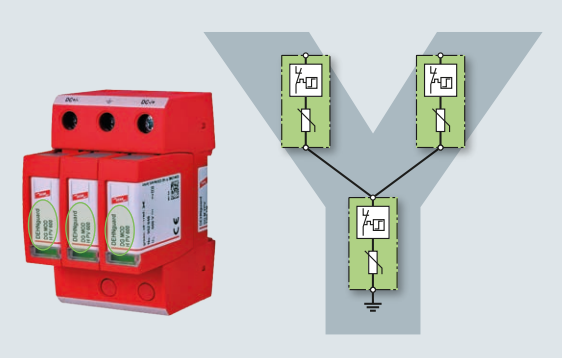

Figure 7 Modular DEHNguard M YPV … (FM) type 2 surge arrester with fault-resistant Y circuit

Figure 8 Ready-to-install type 2 DEHNcube YPV SCI 1000 1M surge arrester

Application examples:

Building without an external lightning protection system (situation A)

Figure 10 shows the surge protection concept for a PV system installed on a building without an external lightning protection system. Dangerous surges enter the PV system due to inductive coupling resulting from nearby lightning strikes or travel from the power supply system through the service entrance to the consumer's installation. The SPDs can be installed at the following locations:

- DC side of the modules and inverters
- AC output of the inverter
- Main low-voltage distribution board
- Wired communication interfaces

Figure 9 DEHNguard type 2 SPD integrated in the inverter for the DC side

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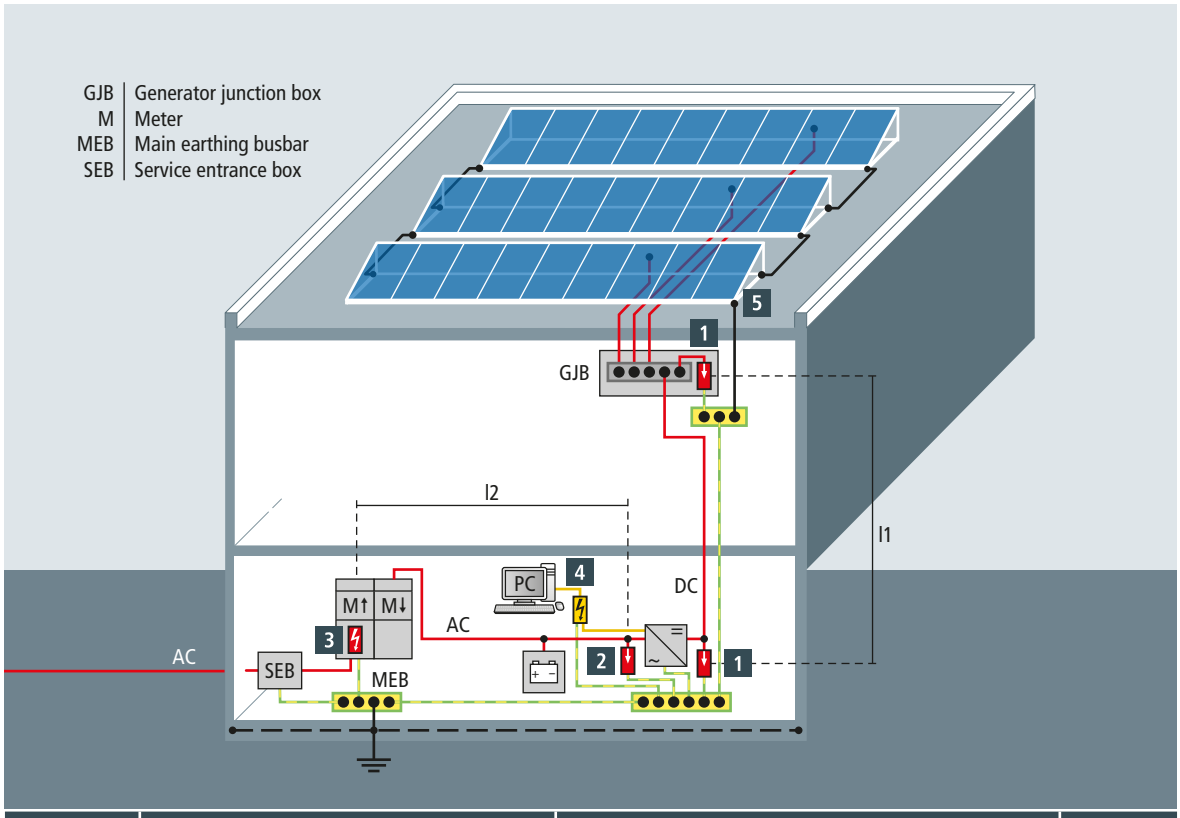

		SPD * FM = Floating remote signalling contact	Part No.
DC input of the inverter (if l1 > 10 m, additional SPD required for the PV generator)			
1	For 1 MPPT	DEHNguard DG M YPV 1200 FM*	952 565
		DEHNcube DCU YPV SCI 1000 1M	900 910
	For 2 MPPTs	DEHNguard DG M PV2 SCI 1000 FM*	952 519
		DEHNcube DCU YPV SCI 1000 2M	900 920
AC output of the inverter (required, if l2 > 10 m)			
2	TN-S system	DEHNguard DG M TNS 275 FM*	952 405
Low-voltage input			
3	TN-C system	DEHNshield Basic TNC 255 FM	941 306
	TT system	DEHNshield Basic TT 255 FM	941 316
	TN-S system	DEHNshield Basic TNS 255 FM	941 406
Data interface			
4	Two pairs, even with different operating voltages up to 180 V	BLITZDUCTOR BXTU ML4 BD 0-180 + BXT BAS base part	920 349 + 920 300
Functional earthing			
5	Functional equipotential bonding	UNI earthing clamp	540 250

Figure 10 PV system installed on a building without external LPS

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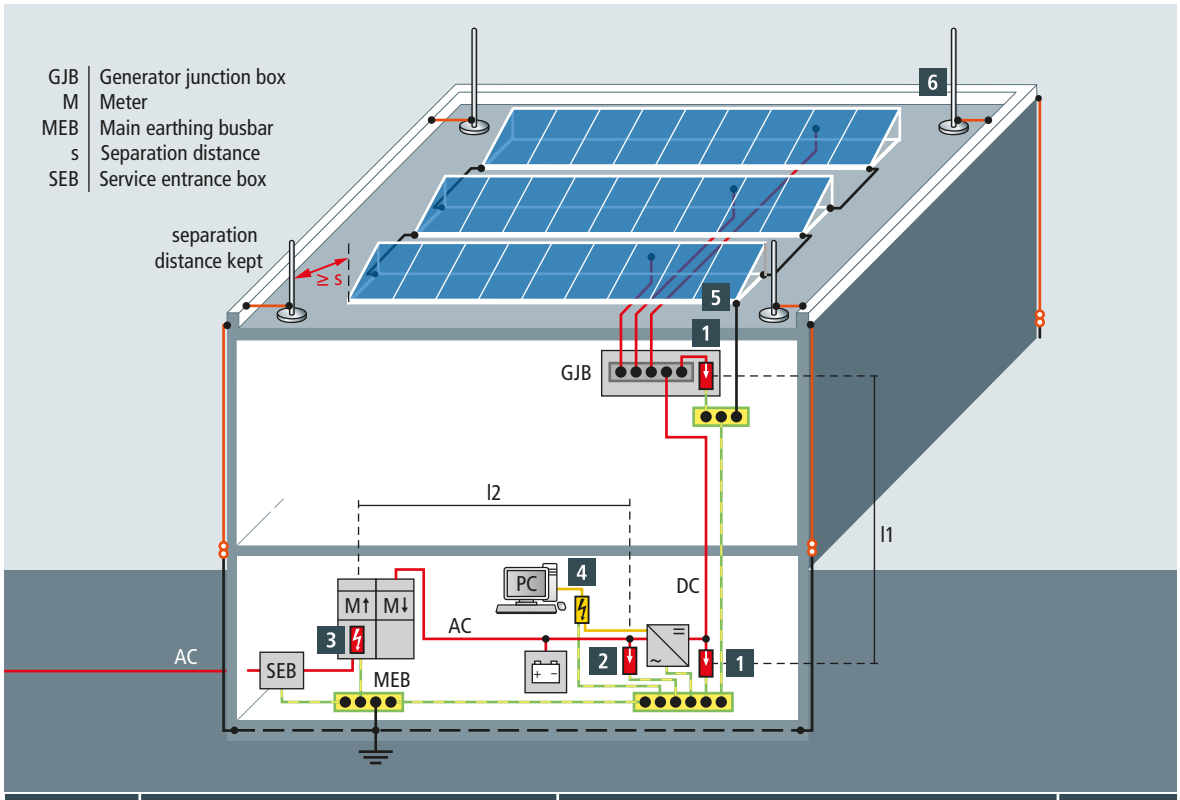

		SPD * FM = Floating remote signalling contact	Part No.
DC input of the inverter (if l1 > 10 m, additional SPD required for the PV generator)			
1	For 1 MPPT	DEHNguard DG M YPV 1200 FM*	952 565
		DEHNcube DCU YPV SCI 1000 1M	900 910
	For 2 MPPT	DEHNguard DG M PV2 SCI 1000 FM*	952 519
		DEHNcube DCU YPV SCI 1000 2M	900 920
AC output of the inverter (required, if l2 > 10 m)			
2	TN-S system	DEHNguard DG M TNS 275 FM*	952 405
Low-voltage input			
3	TN-C system	DEHNventil DV M TNC 255 FM*	951 305
	TN-S system	DEHNventil DV M TNS 255 FM*	951 405
	TT system	DEHNventil DV M TT 255 FM*	951 315
Data interface			
4	Two pairs, even with different operating voltages up to 180 V	BLITZDUCTOR BXTU ML4 BD 0-180 + BXT BAS base part	920 349 + 920 300
Functional earthing / External lightning protection system			
5	Functional equipotential bonding	UNI earthing clamp	540 250
6	Air-termination system	Air-termination rod with concrete base (8.5 kg)	101 000 + 102 075

Figure 11 PV system installed on a building with external LPS and sufficient separation distance

Every DC input (MPPT) of the inverter must be protected by a type 2 surge protective device, for example DEHNguard M YPV 1200 FM, that reliably protects the DC side of PV systems. The IEC 61643-32 and the IEC TR 63277 standards require an additional type 2 DC arrester to be installed on the module side if the distance between the inverter input and the PV generator exceeds 10 m.

If PV inverters and further electronic components like, for example, AC coupled battery storage systems, are situated no further than 10 m away from where the arrester is installed at the grid connection point (low-voltage infeed), they are sufficiently protected. In case of greater cable lengths, an additional type 2 surge protective device must be installed.

For the grid connection point we recommend installing the combined type 1 + 2 arrester DEHNventil Basic. Reliable spark gap technology means that it can be used upstream of the meter.

If inverters are connected to data and sensor lines to monitor the yield, suitable surge protective devices are required. BLITZDUCTOR XTU, which features terminals for two pairs, for example for incoming and outgoing data lines, can be used for data systems based on RS 485.

Figure 12 Determination of the protected volume using the protective angle method

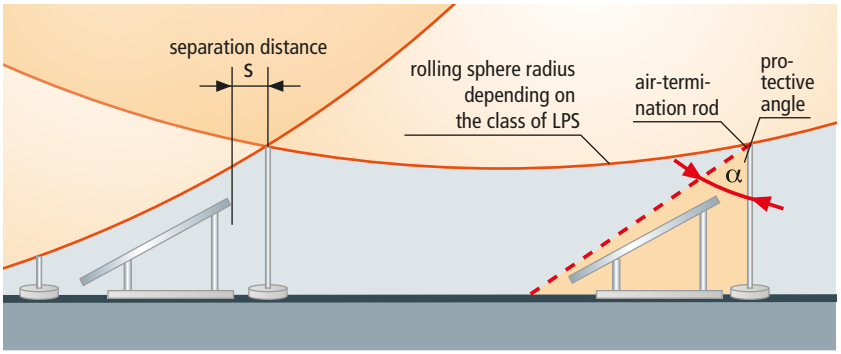

Figure 13 Rolling sphere method versus protective angle method for determining the protected volume

Building with external lightning protection and sufficient separation distance s (situation B)

Figure 11 shows the surge protection concept for a PV system with an external lightning protection system and sufficient separation distance s between the PV system and the external lightning protection system.

The primary protection goal is to avoid damage to people and property (fire) resulting from a lightning strike. In this context, it is important that the PV system does not interfere with the external lightning protection system. Moreover, the PV system itself must be protected from direct lightning strikes. This means that the PV system must be installed within the protected volume of the external lightning protection system. This protected volume is formed by air-termination systems (e.g. air-termination rods) which prevent direct lightning strikes to the PV modules and cables. The protective angle method (**Figure 12**) or rolling sphere method (**Figure 13**) as described in subsection 5.2.2 of the IEC 62305-3 (EN 62305-3) standard may be used to determine this protected volume. A certain separation distance s must be maintained between all conductive parts of the PV system and the lightning protection system. In this context, core shad-

Figure 14 DEHNcube YPV SCI 1000 1M type 2 arrester for protecting inverters (1 MPPT)

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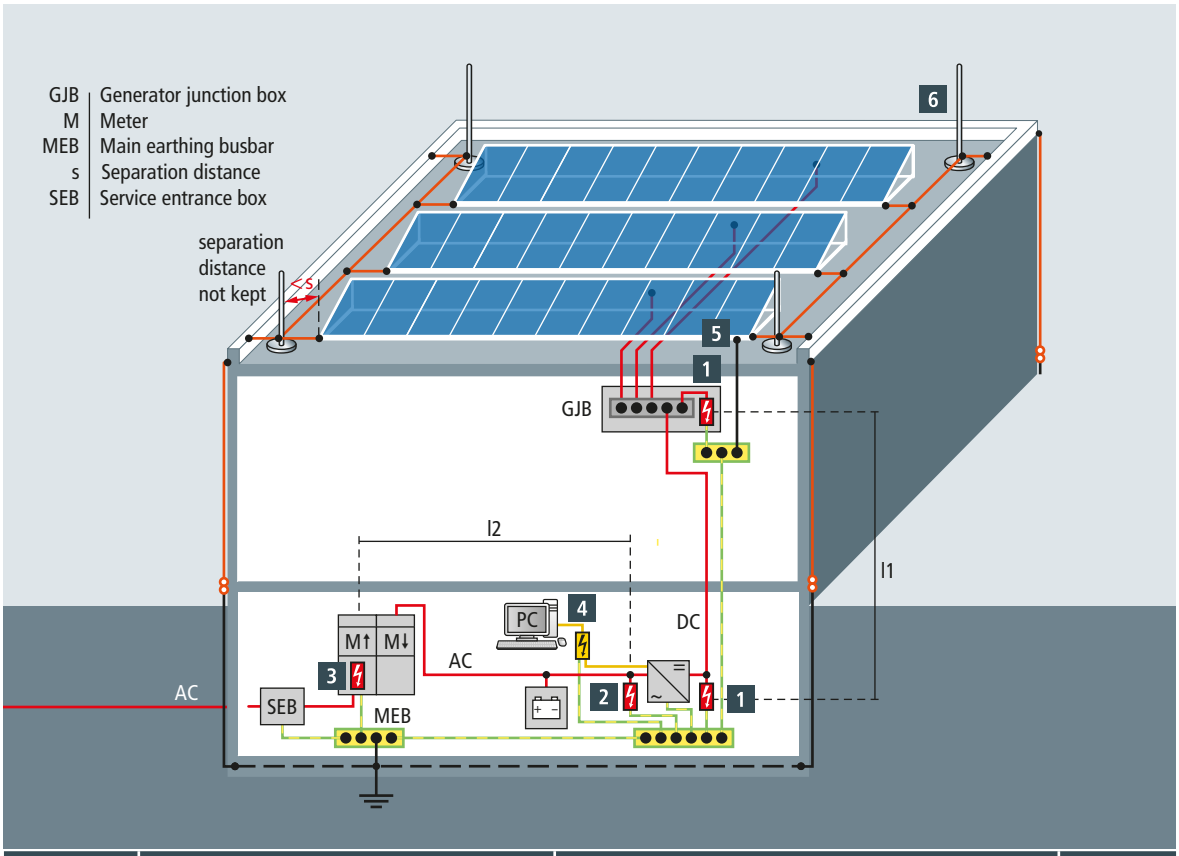


		SPD * FM = Floating remote signalling contact	Part No.
PV generator at the entrance point of the building (if l1 > 10 m, an additional SPD must be installed at the inverter)			
1	Per MPPT	DEHNcombo DCB YPV 1200 FM*	900 075
AC output of the inverter (required, if l2 > 10 m)			
2	TN-S system	DEHNshield DSH TNS 255	941 400
Low-voltage input			
3	TN-C system	DEHNventil DV M TNC 255 FM*	951 305
	TN-S system	DEHNventil DV M TNS 255 FM*	951 405
	TT system	DEHNventil DV M TT 255 FM*	951 315
Data interface			
4	Two pairs, even with different operating voltages up to 180 V	BLITZDUCTOR BXTU ML4 BD 0-180 + BXT BAS base part	920 349 + 920 300
Functional earthing / External lightning protection system			
5	Functional equipotential bonding	UNI earthing clamp	540 250
6	Air-termination system	Air-termination rod with concrete base (8.5 kg)	101 000 + 102 075

Figure 15 PV system installed on a building with external LPS and insufficient separation distance

ows must be prevented by, for example, maintaining a sufficient distance between the air-termination rods and the PV module.
Lightning equipotential bonding is an integral part of a lightning protection system. It must be implemented for all conductive systems and lines entering the building which may carry lightning currents. This is achieved by directly connecting all metal systems and indirectly connecting all energised systems via type 1 lightning current arresters to the earth-termination system. Lightning equipotential bonding should be implemented as close as possible to the entrance point into the building to prevent partial lightning currents from entering the building. The grid connection point must be protected by a multipole type 1 SPD, for example a spark-gap-based DEHNventil combined arrester. This arrester combines a lightning current arrester and a surge arrester in a single device. If the length of the cables between the arrester, the inverter and further electronic components like, for example, AC coupled battery storage systems is less than 10 m, sufficient protection is provided. In case of longer cables, additional type 2 DEHNguard M surge protective devices must be installed upstream of the devices to be protected.
The DC side of the inverter must be protected by a type 2 PV arrester, for example DEHNcube YPV SCI … (**Figure 14**). If the inverters are connected to data lines, for example to monitor the yield, surge protective devices must be installed to protect data transmission. BLITZDUCTOR XTU with actiVsense technology can be used here to protect both lines with an analogue signal and data bus systems such as RS485. It automatically detects the operating voltage of the useful signal and adjusts the voltage protection level to this operating voltage.

High-voltage-resistant, insulated HVI Conductor

Another technical solution for keeping the separation distance s is to use high-voltage-resistant, insulated HVI Conductors which make it possible to maintain a separation distance s up to 0.9 m in air. HVI Conductors may come into direct contact with the PV system downstream of the sealing end range. More detailed information on the application and installation of HVI Conductors is provided in our Lightning Protection Guide or in the relevant installation instructions.

Building with external lightning protection and insufficient separation distance s (situation C)

If the roofing is made of metal or is formed by the PV system itself, the separation distance s cannot be maintained. The metal components of the PV mounting system must be connected to the external lightning protection system in such a way that they can carry lightning currents (copper conductor with a cross-section of at least 16 mm^2 or equivalent). This means that lightning equipotential bonding must also be implemented for the PV lines entering the building from the outside (**Figure 15**). According to IEC 61643-32 and IEC TR 63227, DC lines must be protected by a type 1 SPD for PV systems.
For this purpose, a type 1 and type 2 DEHNcombo YPV (FM) combined arrester is used. Lightning equipotential bonding must also be implemented in the low-voltage infeed. If the inverter and, for example, the battery storage system, are situated more than 10 m from the type 1 SPD installed at the grid connection point, an additional type 1 SPD must be installed (e.g. type 1 + type 2 DEHNshield … 255 combined arrester). Suitable surge protective devices must also be installed to protect the relevant data lines for yield monitoring. BLITZDUCTOR XTU surge protective devices are used to protect data systems, for example based on RS 485.

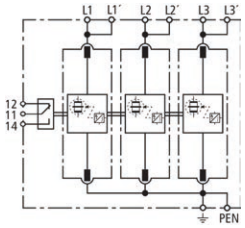
** IEC TR 63227 ED1 „Lightning and surge voltage protection for photovoltaic (PV) power supply systems“ has been approved by TC 82 „Solar photovoltaic energy systems“ and will be published within 2019.

DEHNventil

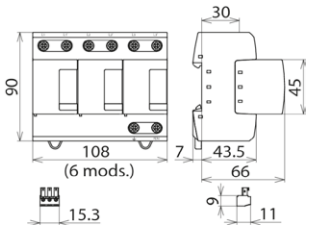
DV M TNC 255 FM (951 305)

- Prewired combined type 1 and type 2 spark-gap-based lightning current and surge arrester consisting of a base part and plug-in protection modules
- Maximum system availability due to RADAX Flow follow current limitation
- Capable of protecting terminal equipment

Figure without obligation



Basic circuit diagram DV M TNC 255 FM



Dimension drawing DV M TNC 255 FM

Modular combined lightning current and surge arrester for TN-C systems.

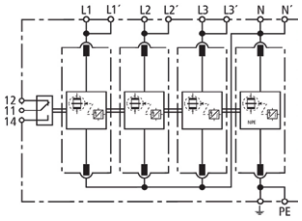
Type Part No.	DV M TNC 255 FM 951 305
SPD according to EN 61643-11 / IEC 61643-11	type 1 + type 2 / class I + class II
Energy coordination with terminal equipment (≤ 10 m)	type 1 + type 2 + type 3
Nominal voltage (a.c.) (U_N)	230 / 400 V (50 / 60 Hz)
Max. continuous operating voltage (a.c.) (U_C)	264 V (50 / 60 Hz)
Lightning impulse current (10/350 µs) [L1+L2+L3-PEN] (I_{total})	75 kA
Specific energy [L1+L2+L3-PEN] (W/R)	1.40 MJ/ohms
Lightning impulse current (10/350 µs) [L-PEN] (I_{imp})	25 kA
Specific energy [L-PEN] (W/R)	156.25 kJ/ohms
Nominal discharge current (8/20 µs) [L-PEN]/[L1+L2+L3-PEN] (I_n)	25 / 75 kA
Voltage protection level (U_P)	≤ 1.5 kV
Follow current extinguishing capability (a.c.) (I_{fi})	50 kA_{rms}
Follow current limitation / Selectivity	no tripping of a 20 A gG fuse up to 50 kA_{rms} (prosp.)
Response time (t_A)	≤ 100 ns
Max. backup fuse (L) up to I_K = 50 kA_{rms}	315 A gG
Max. backup fuse (L-L')	125 A gG
Temporary overvoltage (TOV) (U_T) – Characteristic	440 V / 120 min. – withstand
Operating temperature range [parallel] / [series] (T_U)	-40 °C ... +80 °C / -40 °C ... +60 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (L1, L1', L2, L2', L3, L3', PEN, ⏚) (min.)	10 mm^2 solid / flexible
Cross-sectional area (L1, L2, L3, PEN) (max.)	50 mm^2 stranded / 35 mm^2 flexible
Cross-sectional area (L1', L2', L3', ⏚) (max.)	35 mm^2 stranded / 25 mm^2 flexible
For mounting on	35 mm DIN rails acc. to EN 60715
Enclosure material	thermoplastic, red, UL 94 V-0
Place of installation	indoor installation
Degree of protection	IP 20
Capacity	6 module(s), DIN 43880
Approvals	KEMA, VDE, UL
Type of remote signalling contact	changeover contact
Switching capacity (a.c.)	250 V / 0.5 A
Switching capacity (d.c.)	250 V / 0.1 A; 125 V / 0.2 A; 75 V / 0.5 A
Cross-sectional area for remote signalling terminals	max. 1.5 mm^2 solid / flexible
Extended technical data:	For use in switchgear installations with prospective short-circuit currents of more than 50 kA_{rms} (tested by the German VDE)
– Max. prospective short-circuit current	100 kA_{rms} (220 kA_{peak})
– Limitation / Extinction of mains follow currents	up to 100 kA_{rms} (220 kA_{peak})
– Max. backup fuse (L) up to I_K = 100 kA_{rms}	315 A gG
Weight	962 g
Customs tariff number (Comb. Nomenclature EU)	85363090
GTIN	4013364108141
PU	1 pc(s)

DEHNventil

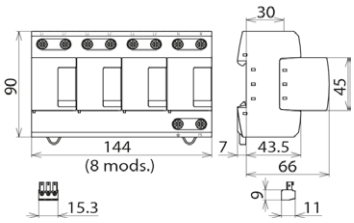
DV M TT 255 FM (951 315)

- Prewired spark-gap-based type 1 and type 2 combined lightning current and surge arrester consisting of a base part and plug-in protection modules
- Maximum system availability due to RADAX Flow follow current limitation, Capable of protecting terminal equipment

Figure without obligation



Basic circuit diagram DV M TT 255 FM



Dimension drawing DV M TT 255 FM

Modular combined lightning current and surge arrester for TT and TN-S systems (3+1 configuration).

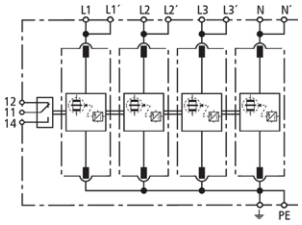
Type Part No.	DV M TT 255 FM 951 315
SPD according to EN 61643-11 / IEC 61643-11	type 1 + type 2 / class I + class II
Energy coordination with terminal equipment (≤ 10 m)	type 1 + type 2 + type 3
Nominal voltage (a.c.) (U_N)	230 / 400 V (50 / 60 Hz)
Max. continuous operating voltage (a.c.) [L-N] (U_C)	264 V (50 / 60 Hz)
Max. continuous operating voltage (a.c.) [N-PE] ($U_{C\ (N-PE)}$)	255 V (50 / 60 Hz)
Lightning impulse current (10/350 µs) [L1+L2+L3+N-PE] (I_{total})	100 kA
Specific energy [L1+L2+L3+N-PE] (W/R)	2.50 MJ/ohms
Lightning impulse current (10/350 µs) [L-N]/[N-PE] (I_{imp})	25 / 100 kA
Specific energy [L-N]/[N-PE] (W/R)	156.25 kJ/ohms / 2.50 MJ/ohms
Nominal discharge current (8/20 µs) [L-N]/[N-PE] (I_n)	25 / 100 kA
Voltage protection level [L-N]/[N-PE] (U_P)	≤ 1.5 / ≤ 1.5 kV
Follow current extinguishing capability [L-N]/[N-PE] (I_{fi})	50 kA_{rms} / 100 A_{rms}
Follow current limitation / Selectivity	no tripping of a 20 A gG fuse up to 50 kA_{rms} (prosp.)
Response time (t_A)	≤ 100 ns
Max. backup fuse (L) up to I_K = 50 kA_{rms}	315 A gG
Max. backup fuse (L-L')	125 A gG
Temporary overvoltage (TOV) [L-N] (U_T) – Characteristic	440 V / 120 min. – withstand
Temporary overvoltage (TOV) [N-PE] (U_T) – Characteristic	1200 V / 200 ms – withstand
Operating temperature range [parallel] / [series] (T_U)	-40 °C ... +80 °C / -40 °C ... +60 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (L1, L1', L2, L2', L3, L3', N, N', PE, ⏚) (min.)	10 mm^2 solid / flexible
Cross-sectional area (L1, L2, L3, N, PE) (max.)	50 mm^2 stranded / 35 mm^2 flexible
Cross-sectional area (L1', L2', L3', N', ⏚) (max.)	35 mm^2 stranded / 25 mm^2 flexible
For mounting on	35 mm DIN rails acc. to EN 60715
Enclosure material	thermoplastic, red, UL 94 V-0
Place of installation / Degree of protection	indoors / IP 20
Capacity	8 module(s), DIN 43880
Approvals	KEMA, VDE, UL
Type of remote signalling contact	changeover contact
Switching capacity (a.c.)	250 V / 0.5 A
Switching capacity (d.c.)	250 V / 0.1 A; 125 V / 0.2 A; 75 V / 0.5 A
Cross-sectional area for remote signalling terminals	max. 1.5 mm^2 solid / flexible
Extended technical data:	----------
Voltage protection level [L-PE] (U_P)	2.2 kV
For use in switchgear installations with prospective short-circuit currents of more than 50 kA_{rms} (tested by the German VDE)	----------
– Max. prospective short-circuit current	100 kA_{rms} (220 kA_{peak})
– Limitation / Extinction of mains follow currents	up to 100 kA_{rms} (220 kA_{peak})
– Max. backup fuse (L) up to I_K = 100 kA_{rms}	315 A gG
Weight	1,28 kg
Customs tariff number (Comb. Nomenclature EU)	85363090
GTIN	4013364108189
PU	1 pc(s)

DEHNventil

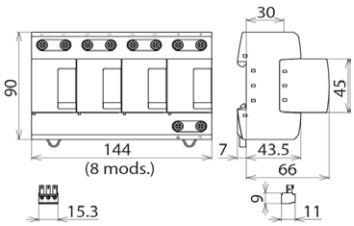
DV M TNS 255 FM (951 405)

- Prewired spark-gap-based type 1 and type 2 combined lightning current and surge arrester consisting of a base part and plug-in protection modules
- Maximum system availability due to RADAX Flow follow current limitation
- Capable of protecting terminal equipment

Figure without obligation



Basic circuit diagram DV M TNS 255 FM



Dimension drawing DV M TNS 255 FM

Modular combined lightning current and surge arrester for TN-S systems.

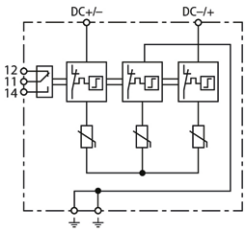
Type Part No.	DV M TNS 255 FM 951 405
SPD according to EN 61643-11 / IEC 61643-11	type 1 + type 2 / class I + class II
Energy coordination with terminal equipment (≤ 10 m)	type 1 + type 2 + type 3
Nominal voltage (a.c.) (U_N)	230 / 400 V (50 / 60 Hz)
Max. continuous operating voltage (a.c.) (U_C)	264 V (50 / 60 Hz)
Lightning impulse current (10/350 µs) [L1+L2+L3+N-PE] (I_{total})	100 kA
Specific energy [L1+L2+L3+N-PE] (W/R)	2.50 MJ/ohms
Lightning impulse current (10/350 µs) [L, N-PE] (I_{imp})	25 kA
Specific energy [L,N-PE] (W/R)	156.25 kJ/ohms
Nominal discharge current (8/20 µs) [L/N-PE]/[L1+L2+L3+N-PE] (I_n)	25 / 100 kA
Voltage protection level [L-PE]/[N-PE] (U_P)	≤ 1.5 / ≤ 1.5 kV
Follow current extinguishing capability (a.c.) (I_{fi})	50 kA_{rms}
Follow current limitation / Selectivity	no tripping of a 20 A gG fuse up to 50 kA_{rms} (prosp.)
Response time (t_A)	≤ 100 ns
Max. backup fuse (L) up to I_K = 50 kA_{rms}	315 A gG
Max. backup fuse (L-L')	125 A gG
Temporary overvoltage (TOV) [L-N] (U_T) – Characteristic	440 V / 120 min. – withstand
Operating temperature range [parallel] / [series] (T_U)	-40 °C ... +80 °C / -40 °C ... +60 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (L1, L1', L2, L2', L3, L3', N, N', PE, ⏚) (min.)	10 mm^2 solid / flexible
Cross-sectional area (L1, L2, L3, N, PE) (max.)	50 mm^2 stranded / 35 mm^2 flexible
Cross-sectional area (L1', L2', L3', N', ⏚) (max.)	35 mm^2 stranded / 25 mm^2 flexible
For mounting on	35 mm DIN rails acc. to EN 60715
Enclosure material	thermoplastic, red, UL 94 V-0
Place of installation	indoor installation
Degree of protection	IP 20
Capacity	8 module(s), DIN 43880
Approvals	KEMA, VDE, UL
Type of remote signalling contact	changeover contact
Switching capacity (a.c.)	250 V / 0.5 A
Switching capacity (d.c.)	250 V / 0.1 A; 125 V / 0.2 A; 75 V / 0.5 A
Cross-sectional area for remote signalling terminals	max. 1.5 mm^2 solid / flexible
Extended technical data:	For use in switchgear installations with prospective short-circuit currents of more than 50 kA_{rms} (tested by the German VDE)
– Max. prospective short-circuit current	100 kA_{rms} (220 kA_{peak})
– Limitation / Extinction of mains follow currents	up to 100 kA_{rms} (220 kA_{peak})
– Max. backup fuse (L) up to I_K = 100 kA_{rms}	315 A gG
Weight	1,36 kg
Customs tariff number (Comb. Nomenclature EU)	85363090
GTIN	4013364108165
PU	1 pc(s)

DEHNcombo

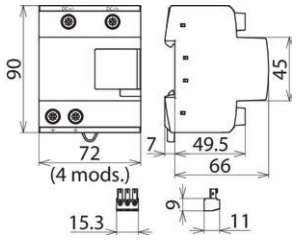
DCB YPV 1200 FM (900 075)

- Applicable in PV systems in accordance with IEC 60364-7-712 / DIN VDE 0100-712
- Universally applicable in earthed and unearthed PV systems
- Prewired type 1 and type 2 combined lightning current and surge arrester for use in photovoltaic generator circuits
- Fault-resistant Y circuit prevents damage to the surge protective device in case of insulation faults in the generator circuit

Figure without obligation



Basic circuit diagram DCB YPV 1200 FM



Dimension drawing DCB YPV 1200 FM

Combined lightning current and surge arrester for use in photovoltaic power supply systems up to 1200 V d.c.; with remote signalling contact.

Expected to be available as of July 2019!

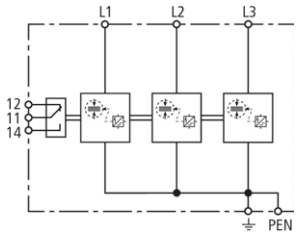
Type Part No.	DCB YPV 1200 FM 900 075
SPD according to EN 50539-11	type 1 + type 2
Max. PV voltage [DC+ -> DC-] (U_{CPV})	≤ 1200 V
Max. PV voltage [DC+/DC- -> PE] (U_{CPV})	≤ 1200 V
Short-circuit current rating (I_{SCPV})	10 kA
Nominal discharge current (8/20 µs) (I_n)	20 kA
Max. discharge current (8/20 µs) (I_{max})	40 kA
Total discharge current (8/20 µs) [DC+/DC- -> PE] (I_{total})	40 kA
Total discharge current (10/350 µs) [DC+/DC- -> PE] (I_{total})	12.5 kA
Lightning impulse current (10/350 µs) [DC+ -> PE/DC- -> PE] (I_{imp})	6.25 kA
Voltage protection level [(DC+/DC-) -> PE] (U_P)	< 3.8 kV
Voltage protection level [DC+ -> DC-] (U_P)	< 3.8 kV
Response time (t_A)	≤ 25 ns
Operating temperature range (T_U)	-40 °C ... +80 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (min.)	1.5 mm² solid / flexible
Cross-sectional area (max.)	35 mm² stranded / 25 mm² flexible
For mounting on	35 mm DIN rails acc. to EN 60715
Enclosure material	thermoplastic, red, UL 94 V-0
Place of installation	indoor installation
Degree of protection	IP 20
Dimensions	4 module(s), DIN 43880
Type of remote signalling contact	Changeover contact
Switching capacity (a.c.)	250 V / 0.5 A
Switching capacity (d.c.)	250 V / 0.1 A; 125 V / 0.2 A; 75 V / 0.5 A
Cross-sectional area for remote signalling terminals	max. 1.5 mm² solid / flexible
Weight	506 g
Customs tariff number (Comb. Nomenclature EU)	85363030
GTIN	6942299504538
PU	1 pc(s)

DEHNshield Basic

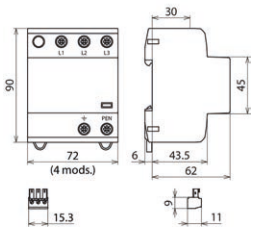
DSH B TNC 255 FM (941 306)

- Application-optimised and prewired spark-gap-based type 1 and type 2 combined lightning current and surge arrester
- Compact design due to space-saving spark gap technology with a width of only 1 module / pole
- Meets the minimum requirements according to IEC 60364-5-53 concerning the nominal discharge capacity I_n and the lightning current discharge capacity I_{imp} in case of overhead line supply

Figure without obligation



Basic circuit diagram DSH B TNC 255 FM



Dimension drawing DSH B TNC 255 FM

Application-optimised and prewired combined lightning current and surge arrester for TN-C systems; with floating remote signalling contact.

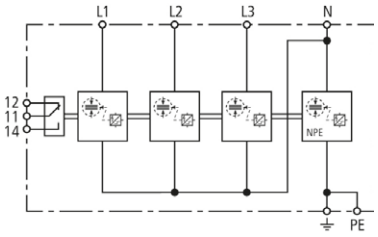
Type Part No.	DSH B TNC 255 FM 941 306
SPD according to EN 61643-11 / IEC 61643-11	type 1 + type 2 / class I + class II
Energy coordination with terminal equipment (≤ 10 m)	type 1 + type 2 + type 3
Nominal voltage (a.c.) (U_N)	230 / 400 V (50 / 60 Hz)
Max. continuous operating voltage (a.c.) (U_C)	255 V (50 / 60 Hz)
Lightning impulse current (10/350 µs) [L1+L2+L3-PEN] (I_{total})	22.5 kA
Lightning impulse current (10/350 µs) [L-PEN] (I_{imp})	7.5 kA
Nominal discharge current (8/20 µs) [L-PEN]/[L1+L2+L3-PEN] (I_n)	12.5 / 37.5 kA
Voltage protection level (U_P)	≤ 1.5 kV
Follow current extinguishing capability (a.c.) (I_{fi})	25 kA_{rms}
Follow current limitation / Selectivity	no tripping of a 32 A gG fuse up to 25 kA_{rms} (prosp.)
Response time (t_A)	≤ 100 ns
Max. mains-side overcurrent protection	160 A gG
Temporary overvoltage (TOV) [L-N] (U_T) – Characteristic	440 V / 120 min. – withstand
Operating temperature range (T_U)	-40 °C ... +80 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (L1, L2, L3, PEN) (min.)	1.5 mm^2 solid / flexible
Cross-sectional area (L1, L2, L3, PEN) (max.)	35 mm^2 stranded / 25 mm^2 flexible
For mounting on	35 mm DIN rails acc. to EN 60715
Enclosure material	thermoplastic, red, UL 94 V-0
Place of installation	indoor installation
Degree of protection	IP 20
Capacity	4 module(s), DIN 43880
Approvals	VDE
Type of remote signalling contact	changeover contact
Switching capacity (a.c.)	250 V / 0.5 A
Switching capacity (d.c.)	250 V / 0.1 A; 125 V / 0.2 A; 75 V / 0.5 A
Cross-sectional area for remote signalling terminals	max. 1.5 mm² solid / flexible
Weight	362 g
Customs tariff number (Comb. Nomenclature EU)	85363090
GTIN	4013364328068
PU	1 pc(s)

DEHNshield Basic

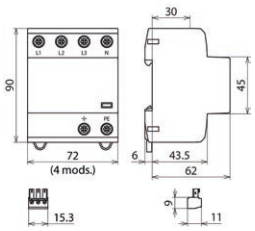
DSH B TT 255 FM (941 316)

- Application-optimised and prewired spark-gap-based type 1 and type 2 combined lightning current and surge arrester
- Compact design due to space-saving spark gap technology with a width of only 1 module / pole
- Meets the minimum requirements according to IEC 60364-5-53 concerning the nominal discharge capacity I_n and the lightning current discharge capacity I_{imp} in case of overhead line supply

Figure without obligation



Basic circuit diagram DSH B TT 255 FM



Dimension drawing DSH B TT 255 FM

Application-optimised and prewired combined lightning current and surge arrester for TT and TN-S systems (3+1 configuration); with floating remote signalling contact.

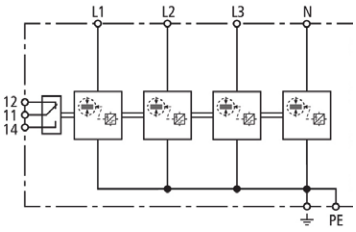
Type Part No.	DSH B TT 255 FM 941 316
SPD according to EN 61643-11 / IEC 61643-11	type 1 + type 2 / class I + class II
Energy coordination with terminal equipment (≤ 10 m)	type 1 + type 2 + type 3
Nominal voltage (a.c.) (U_N)	230 / 400 V (50 / 60 Hz)
Max. continuous operating voltage (a.c.) (U_C)	255 V (50 / 60 Hz)
Lightning impulse current (10/350 µs) [L1+L2+L3+N-PE] (I_{total})	30 kA
Lightning impulse current (10/350 µs) [L-N]/[N-PE] (I_{imp})	7.5 / 30 kA
Nominal discharge current (8/20 µs) [L-N]/[N-PE] (I_n)	12.5 / 50 kA
Voltage protection level [L-N]/[N-PE] (U_P)	≤ 1.5 / ≤ 1.5 kV
Follow current extinguishing capability [L-N]/[N-PE] (I_{fi})	25 kA_{rms} / 100 A_{rms}
Follow current limitation / Selectivity	no tripping of a 32 A gG fuse up to 25 kA_{rms} (prosp.)
Response time (t_A)	≤ 100 ns
Max. mains-side overcurrent protection	160 A gG
Temporary overvoltage (TOV) [L-N] (U_T) – Characteristic	440 V / 120 min. – withstand
Temporary overvoltage (TOV) [N-PE] (U_T) – Characteristic	1200 V / 200 ms – withstand
Operating temperature range (T_U)	-40 °C ... +80 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (L1, L2, L3, N, PE, ⏚) (min.)	1.5 mm^2 solid / flexible
Cross-sectional area (L1, L2, L3, N, PE, ⏚) (max.)	35 mm^2 stranded / 25 mm^2 flexible
For mounting on	35 mm DIN rails acc. to EN 60715
Enclosure material	thermoplastic, red, UL 94 V-0
Place of installation	indoor installation
Degree of protection	IP 20
Capacity	4 module(s), DIN 43880
Approvals	VDE
Type of remote signalling contact	changeover contact
Switching capacity (a.c.)	250 V / 0.5 A
Switching capacity (d.c.)	250 V / 0.1 A; 125 V / 0.2 A; 75 V / 0.5 A
Cross-sectional area for remote signalling terminals	max. 1.5 mm^2 solid / flexible
Extended technical data:	----------
Voltage protection level [L-PE] (U_P)	2.0 kV
Weight	450 g
Customs tariff number (Comb. Nomenclature EU)	85363090
GTIN	4013364328075
PU	1 pc(s)

DEHNshield Basic

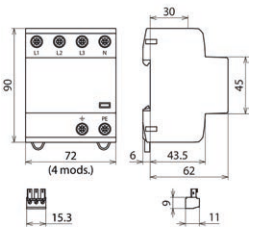
DSH B TNS 255 FM (941 406)

- Application-optimised and prewired spark-gap-based type 1 and type 2 combined lightning current and surge arrester
- Compact design due to space-saving spark gap technology with a width of only 1 module / pole
- Meets the minimum requirements according to IEC 60364-5-53 concerning the nominal discharge capacity I_n and the lightning current discharge capacity I_{imp} in case of overhead line supply

Figure without obligation



Basic circuit diagram DSH B TNS 255 FM



Dimension drawing DSH B TNS 255 FM

Application-optimised and prewired combined lightning current and surge arrester for TN-S systems; with floating remote signalling contact.

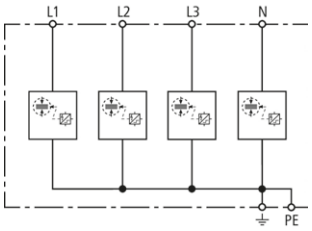
Type Part No.	DSH B TNS 255 FM 941 406
SPD according to EN 61643-11 / IEC 61643-11	type 1 + type 2 / class I + class II
Energy coordination with terminal equipment (≤ 10 m)	type 1 + type 2 + type 3
Nominal voltage (a.c.) (U_N)	230 / 400 V (50 / 60 Hz)
Max. continuous operating voltage (a.c.) (U_C)	255 V (50 / 60 Hz)
Lightning impulse current (10/350 µs) [L1+L2+L3+N-PE] (I_{total})	30 kA
Lightning impulse current (10/350 µs) [L, N-PE] (I_{imp})	7.5 kA
Nominal discharge current (8/20 µs) [L/N-PE]/[L1+L2+L3+N-PE] (I_n)	12.5 / 50 kA
Voltage protection level [L-PE]/[N-PE] (U_P)	≤ 1.5 / ≤ 1.5 kV
Follow current extinguishing capability (a.c.) (I_{fi})	25 kA_{rms}
Follow current limitation / Selectivity	no tripping of a 32 A gG fuse up to 25 kA_{rms} (prosp.)
Response time (t_A)	≤ 100 ns
Max. mains-side overcurrent protection	160 A gG
Temporary overvoltage (TOV) [L-N] (U_T) – Characteristic	440 V / 120 min. – withstand
Operating temperature range (T_U)	-40 °C ... +80 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (L1, L2, L3, N, PE, ⏚) (min.)	1.5 mm^2 solid / flexible
Cross-sectional area (L1, L2, L3, N, PE, ⏚) (max.)	35 mm^2 stranded / 25 mm^2 flexible
For mounting on	35 mm DIN rails acc. to EN 60715
Enclosure material	thermoplastic, red, UL 94 V-0
Place of installation	indoor installation
Degree of protection	IP 20
Capacity	4 module(s), DIN 43880
Approvals	VDE
Type of remote signalling contact	changeover contact
Switching capacity (a.c.)	250 V / 0.5 A
Switching capacity (d.c.)	250 V / 0.1 A; 125 V / 0.2 A; 75 V / 0.5 A
Cross-sectional area for remote signalling terminals	max. 1.5 mm^2 solid / flexible
Weight	429 g
Customs tariff number (Comb. Nomenclature EU)	85363090
GTIN	4013364328082
PU	1 pc(s)

DEHNshield

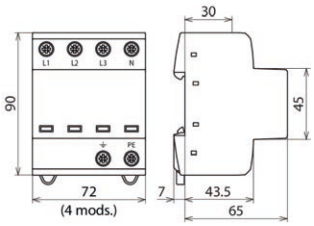
DSH TNS 255 (941 400)

- Application-optimised and prewired spark-gap-based type 1 and type 2 combined lightning current and surge arrester
- Compact design due to space-saving spark gap technology with a width of only 1 module / pole
- Allows compact lightning equipotential bonding including protection of terminal equipment

Figure without obligation



Basic circuit diagram DSH TNS 255



Dimension drawing DSH TNS 255

Application-optimised and prewired combined lightning current and surge arrester for TN-S systems.

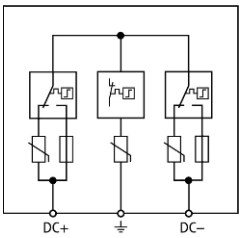
Type Part No.	DSH TNS 255 941 400
SPD according to EN 61643-11 / IEC 61643-11	type 1 + type 2 / class I + class II
Energy coordination with terminal equipment (≤ 10 m)	type 1 + type 2 + type 3
Nominal voltage (a.c.) (U_N)	230 / 400 V (50 / 60 Hz)
Max. continuous operating voltage (a.c.) (U_C)	255 V (50 / 60 Hz)
Lightning impulse current (10/350 µs) [L1+L2+L3+N-PE] (I_{total})	50 kA
Specific energy [L1+L2+L3+N-PE] (W/R)	625.00 kJ/ohms
Lightning impulse current (10/350 µs) [L, N-PE] (I_{imp})	12.5 kA
Specific energy [L,N-PE] (W/R)	39.06 kJ/ohms
Nominal discharge current (8/20 µs) [L/N-PE]/[L1+L2+L3+N-PE] (I_n)	12.5 / 50 kA
Voltage protection level [L-PE]/[N-PE] (U_P)	≤ 1.5 / ≤ 1.5 kV
Follow current extinguishing capability (a.c.) (I_{fi})	25 kA_{rms}
Follow current limitation / Selectivity	no tripping of a 32 A gG fuse up to 25 kA_{rms} (prosp.)
Response time (t_A)	≤ 100 ns
Max. mains-side overcurrent protection	160 A gG
Temporary overvoltage (TOV) [L-N] (U_T) – Characteristic	440 V / 120 min. – withstand
Operating temperature range (T_U)	-40 °C ... +80 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (L1, L2, L3, N, PE, ⏚) (min.)	1.5 mm^2 solid / flexible
Cross-sectional area (L1, L2, L3, N, PE, ⏚) (max.)	35 mm^2 stranded / 25 mm^2 flexible
For mounting on	35 mm DIN rails acc. to EN 60715
Enclosure material	thermoplastic, red, UL 94 V-0
Place of installation	indoor installation
Degree of protection	IP 20
Capacity	4 module(s), DIN 43880
Approvals	KEMA, VDE, UL
Weight	525 g
Customs tariff number (Comb. Nomenclature EU)	85363090
GTIN	4013364133563
PU	1 pc(s)

DEHNcube

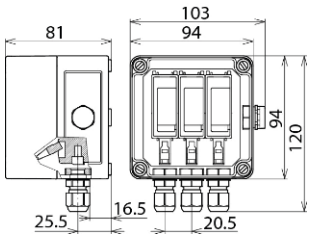
DCU YPV SCI 1000 1M (900 910)

- Prewired multipole surge arrester with IP 65 degree of protection for photovoltaic systems
- Combined disconnection and short-circuiting device with safe electrical isolation in each protective path (patented SCI principle)
- Easy and fast implementation of surge protection measures since no space is required in a separate insulating enclosure

Figure without obligation



Basic circuit diagram DCU YPV SCI 1000 1M



Dimension drawing DCU YPV SCI 1000 1M

Two-pole surge arrester with IP65 degree of protection and three-step d.c. switching device for PV inverters for protecting one MPP input.

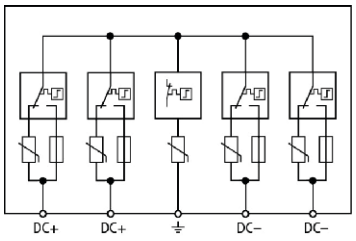
Type Part No.	DCU YPV SCI 1000 1M 900 910
SPD according to EN 50539-11	type 2
Energy coordination with terminal equipment (≤ 10 m)	type 2 + type 3
Max. PV voltage (U_{CPV})	1000 V
Short-circuit withstand capability (I_{SCPV})	1000 A
Total discharge current (8/20 µs) (I_{total})	40 kA
Nominal discharge current (8/20 µs) [(DC+/DC-) --> PE] (I_n)	12.5 kA
Max. discharge current (8/20 µs) [(DC+/DC-) --> PE] (I_{max})	25 kA
Voltage protection level (U_P)	≤ 4 kV
Voltage protection level at 5 kA (U_P)	≤ 3.5 kV
Response time (t_A)	≤ 25 ns
Operating temperature range (T_U)	-35 °C ... +80 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (min.)	2.5 mm^2 solid / flexible
Cross-sectional area (max.)	6 mm^2 solid / flexible
Place of installation	outdoor
Degree of protection	IP 65
Type	with pressure compensating element
Cover	transparent cover with product label
Colour of enclosure	grey
Number of cable entries	3x Ø3-7 mm
Enclosure dimensions (W x H x D)	94 x 94 x 81 mm
Approvals	KEMA
Weight	426 g
Customs tariff number (Comb. Nomenclature EU)	85363030
GTIN	4013364155046
PU	1 pc(s)

DEHNcube

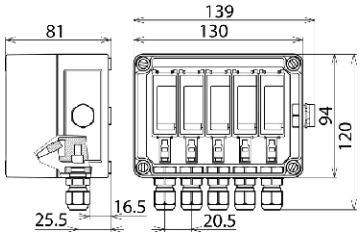
DCU YPV SCI 1000 2M (900 920)

- Prewired multipole surge arrester with IP 65 degree of protection for photovoltaic systems
- Combined disconnection and short-circuiting device with safe electrical isolation in each protective path (patented SCI principle)
- Easy and fast implementation of surge protection measures since no space is required in a separate insulating enclosure

Figure without obligation



Basic circuit diagram DCU YPV SCI 1000 2M



Dimension drawing DCU YPV SCI 1000 2M

Four-pole surge arrester with IP 65 degree of protection and three-step d.c. switching device for PV inverters for protecting two MPP inputs.

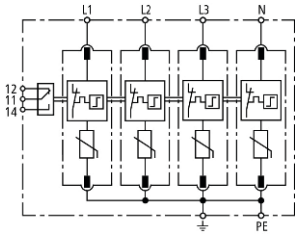
Type Part No.	DCU YPV SCI 1000 2M 900 920
SPD according to EN 50539-11	type 2
Energy coordination with terminal equipment (≤ 10 m)	type 2 + type 3
Max. PV voltage (U_{CPV})	1000 V
Short-circuit withstand capability (I_{SCPV})	1000 A
Total discharge current (8/20 µs) (I_{total})	40 kA
Nominal discharge current (8/20 µs) [(DC+/DC-) --> PE] (I_n)	12.5 kA
Max. discharge current (8/20 µs) [(DC+/DC-) --> PE] (I_{max})	25 kA
Voltage protection level (U_P)	≤ 4 kV
Voltage protection level at 5 kA (U_P)	≤ 3.5 kV
Response time (t_A)	≤ 25 ns
Operating temperature range (T_U)	-35 °C ... +80 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (min.)	2.5 mm^2 solid / flexible
Cross-sectional area (max.)	6 mm^2 solid / flexible
Place of installation	outdoor
Degree of protection	IP 65
Type	with pressure compensating element
Cover	transparent cover with product label
Colour of enclosure	grey
Number of cable entries	5x Ø3-7 mm
Enclosure dimensions (W x H x D)	130 x 94 x 81 mm
Approvals	KEMA
Weight	617 g
Customs tariff number (Comb. Nomenclature EU)	85363030
GTIN	4013364155053
PU	1 pc(s)

DEHNguard

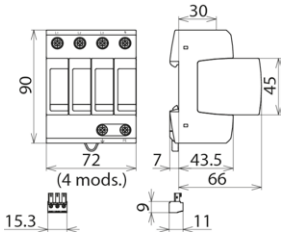
DG M TNS 275 FM (952 405)

- Prewired complete unit consisting of a base part and plug-in protection modules
- High discharge capacity due to heavy-duty zinc oxide varistors / spark gaps
- High reliability due to "Thermo Dynamic Control" SPD monitoring device

Figure without obligation



Basic circuit diagram DG M TNS 275 FM



Dimension drawing DG M TNS 275 FM

Modular surge arrester for use in TN-S systems; with floating remote signalling contact.

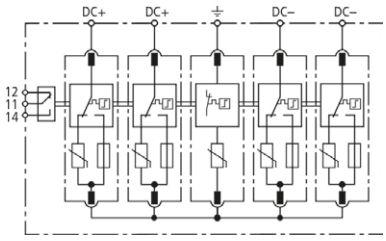
Type Part No.	DG M TNS 275 FM 952 405
SPD according to EN 61643-11 / IEC 61643-11	type 2 / class II
Energy coordination with terminal equipment (≤ 10 m)	type 2 + type 3
Nominal voltage (a.c.) (U_N)	230 / 400 V (50 / 60 Hz)
Max. continuous operating voltage (a.c.) (U_C)	275 V (50 / 60 Hz)
Nominal discharge current (8/20 µs) (I_n)	20 kA
Max. discharge current (8/20 µs) (I_{max})	40 kA
Voltage protection level [L-PE]/[N-PE] (U_P)	≤ 1.5 / ≤ 1.5 kV
Voltage protection level [L-PE] / [N-PE] at 5 kA (U_P)	≤ 1 / ≤ 1 kV
Response time (t_A)	≤ 25 ns
Max. mains-side overcurrent protection	125 A gG
Short-circuit withstand capability for max. mains-side overcurrent protection (I_{SCCR})	50 kA_{rms}
Temporary overvoltage (TOV) (U_T) – Characteristic	335 V / 5 sec. – withstand
Temporary overvoltage (TOV) (U_T) – Characteristic	440 V / 120 min. – safe failure
Operating temperature range (T_U)	-40 °C ... +80 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (min.)	1.5 mm^2 solid / flexible
Cross-sectional area (max.)	35 mm^2 stranded / 25 mm^2 flexible
For mounting on	35 mm DIN rails acc. to EN 60715
Enclosure material	thermoplastic, red, UL 94 V-0
Place of installation	indoor installation
Degree of protection	IP 20
Capacity	4 module(s), DIN 43880
Approvals	KEMA, VDE, UL
Type of remote signalling contact	changeover contact
Switching capacity (a.c.)	250 V / 0.5 A
Switching capacity (d.c.)	250 V / 0.1 A; 125 V / 0.2 A; 75 V / 0.5 A
Cross-sectional area for remote signalling terminals	max. 1.5 mm^2 solid / flexible
Weight	453 g
Customs tariff number (Comb. Nomenclature EU)	85363030
GTIN	4013364108462
PU	1 pc(s)

DEHNguard

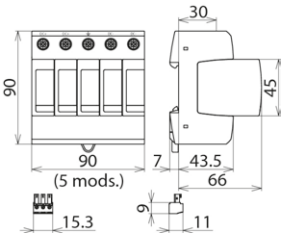
DG M PV2 SCI 1000 FM (952 519)

- Prewired modular complete unit for use in photovoltaic systems consisting of a base part and plug-in protection modules for protecting of two MPP-systems
- Combined disconnection and short-circuiting device with safe electrical isolation in the protection module (patented SCI principle)
- Tried and tested fault-resistant Y circuit

Figure without obligation



Basic circuit diagram DG M PV2 SCI 1000 FM



Dimension drawing DG M PV2 SCI 1000 FM

Modular multipole surge arrester with three-step d.c. switching device for use in PV systems with remote signalling contact (floating changeover contact).

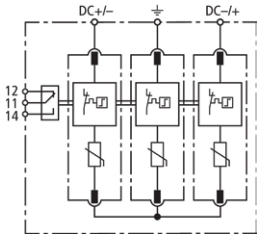
Type Part No.	DG M PV2 SCI 1000 FM 952 519
SPD according to EN 50539-11	type 2
Energy coordination with terminal equipment (≤ 10 m)	type 2 + type 3
Max. PV voltage (U_{CPV})	1000 V
Short-circuit current rating (I_{SCPV})	10 kA
Total discharge current (8/20 µs) (I_{total})	40 kA
Nominal discharge current (8/20 µs) [(DC+/DC-) --> PE] (I_n)	12.5 kA
Max. discharge current (8/20 µs) [(DC+/DC-) --> PE] (I_{max})	25 kA
Voltage protection level (U_P)	≤ 4 kV
Voltage protection level at 5 kA (U_P)	≤ 3.5 kV
Response time (t_A)	≤ 25 ns
Operating temperature range (T_U)	-40 °C ... +80 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (min.)	1.5 mm^2 solid / flexible
Cross-sectional area (max.)	35 mm^2 stranded / 25 mm^2 flexible
For mounting on	35 mm DIN rails acc. to EN 60715
Enclosure material	thermoplastic, red, UL 94 V-0
Place of installation	indoor installation
Degree of protection	IP 20
Capacity	5 module(s), DIN 43880
Approvals	UL, KEMA
Type of remote signalling contact	changeover contact
Switching capacity (a.c.)	250 V / 0.5 A
Switching capacity (d.c.)	250 V / 0.1 A; 125 V / 0.2 A; 75 V / 0.5 A
Cross-sectional area for remote signalling terminals	max. 1.5 mm^2 solid / flexible
Weight	509 g
Customs tariff number (Comb. Nomenclature EU)	85363030
GTIN	4013364224971
PU	1 pc(s)

DEHNguard

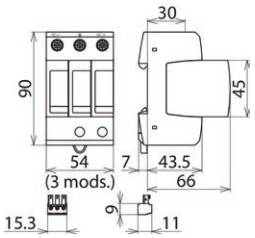
DG M YPV 1200 FM (952 565)

- Modular prewired complete unit for use in photovoltaic systems consisting of a base part and plug-in protection modules
- High reliability due to "Thermo Dynamic Control" SPD monitoring device
- Tried and tested fault-resistant Y circuit

Figure without obligation



Basic circuit diagram DG M YPV 1200 FM



Dimension drawing DG M YPV 1200 FM

Multipole modular surge arrester for use in PV systems; with remote signalling contact for monitoring unit (floating changeover contact).

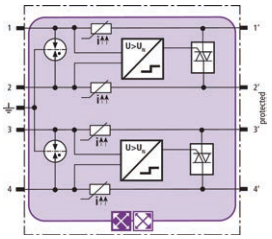
Type Part No.	DG M YPV 1200 FM 952 565
SPD according to EN 50539-11	type 2
Energy coordination with terminal equipment (≤ 10 m)	type 2 + type 3
Max. PV voltage (U_{CPV})	1170 V
Short-circuit current rating (I_{SCPV})	10 kA
Total discharge current (8/20 µs) (I_{total})	40 kA
Nominal discharge current (8/20 µs) [(DC+/DC-) --> PE] (I_n)	20 kA
Max. discharge current (8/20 µs) [(DC+/DC-) --> PE] (I_{max})	40 kA
Voltage protection level (U_P)	≤ 4 kV
Response time (t_A)	≤ 25 ns
Operating temperature range (T_U)	-40 °C ... +80 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (min.)	1.5 mm^2 solid / flexible
Cross-sectional area (max.)	35 mm^2 stranded / 25 mm^2 flexible
For mounting on	35 mm DIN rails acc. to EN 60715
Enclosure material	thermoplastic, red, UL 94 V-0
Place of installation	indoor installation
Degree of protection	IP 20
Capacity	3 module(s), DIN 43880
Approvals	UL, KEMA
Type of remote signalling contact	changeover contact
Switching capacity (a.c.)	250 V / 0.5 A
Switching capacity (d.c.)	250 V / 0.1 A; 125 V / 0.2 A; 75 V / 0.5 A
Cross-sectional area for remote signalling terminals	max. 1.5 mm^2 solid / flexible
Weight	300 g
Customs tariff number (Comb. Nomenclature EU)	85363030
GTIN	4013364327719
PU	1 pc(s)

BLITZDUCTOR XTU

BXTU ML4 BD 0-180 (920 349)

- Universal voltage type with actiVsense technology
- For installation in conformity with the lightning protection zone concept at the boundaries from 0_A – 2 and higher
- With integrated LifeCheck monitoring

Figure without obligation



Basic circuit diagram BXTU ML4 BD 0-180

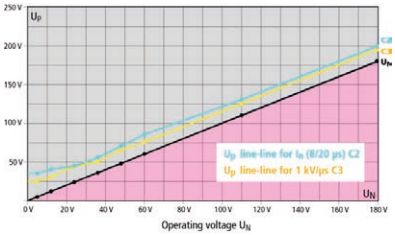


Diagram of the voltage protection level BXTU

Space-saving combined lightning current and surge arrester module with actiVsense and LifeCheck technology for protecting two pairs (same or different operating voltage) of balanced interfaces with galvanic isolation. Automatically detects the operating voltage of the useful signal and optimally adapts the voltage protection level to it.

Type Part No.	BXTU ML4 BD 0-180 920 349
SPD class	TYPE 1 P1
SPD monitoring system	LifeCheck
Operating voltage (U_N)	0-180 V
Frequency of the operating voltage (f_{UN})	0-400 Hz
Max. continuous operating voltage (d.c.) (U_C)	180 V
Max. continuous operating voltage (a.c.) (U_C)	127 V
Permissible superimposed signal voltage (U_{signal})	≤ +/- 5 V
Cut-off frequency line-line (U_{signal}, balanced 100 ohms) (f_G)	50 MHz
Nominal current at 80 °C (equal to max. short-circuit current) (I_L)	100 mA
D1 Total lightning impulse current (10/350 µs) (I_{imp})	10 kA
D1 Lightning impulse current (10/350 µs) per line (I_{imp})	2.5 kA
C2 Total nominal discharge current (8/20 µs) (I_n)	20 kA
C2 Nominal discharge current (8/20 µs) per line (I_n)	10 kA
Voltage protection level line-line for I_n C2 (U_p)	see diagram, line C2
Voltage protection level line-line at 1 kV/µs C3 (U_p)	see diagram, line C3
Voltage protection level line-line for I_{imp} D1 (U_p)	≤ U_N + 53 V
Voltage protection level line-PG for C2/C3/D1	≤ 550 V
Series resistance per line	≤ 10 ohms; typically 7.5 ohms
Capacitance line-line (C)	≤ 80 pF
Capacitance line-PG (C)	≤ 16 pF
Operating temperature range (T_U)	-40 °C ... +80 °C
Degree of protection (plugged-in)	IP 20
Pluggable into	BXT BAS / BSP BAS 4 base part
Earthing via	BXT BAS / BSP BAS 4 base part
Enclosure material	polyamide PA 6.6
Colour	yellow
Test standards	IEC 61643-21 / EN 61643-21, UL 497B
Approvals	CSA, UL, EAC, SIL
SIL classification	up to SIL3 *)
Weight	25 g
Customs tariff number (Comb. Nomenclature EU)	85363010
GTIN	4013364126404
PU	1 pc(s)

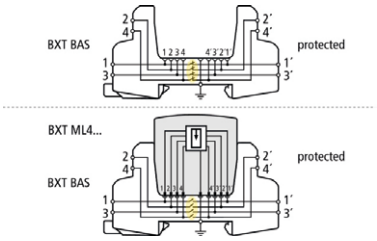
*) For more detailed information, please visit www.dehn-international.com.

BLITZDUCTOR

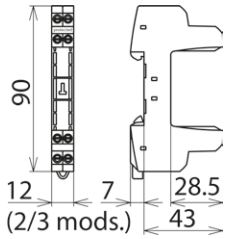
BXT BAS (920 300)

- Four-pole version for universal use with all types of BSP and BXT / BXTU protection modules
- No signal interruption if the protection module is removed
- Universal design without protection elements

Figure without obligation



Basic circuit diagram with and without plugged-in module



Dimension drawing BXT BAS

The BLITZDUCTOR XT base part is an extremely space-saving and universal four-pole feed-through terminal for the insertion of a protection module without signal disconnection if the protection module is removed. The snap-in mechanism at the supporting foot of the base part allows the protection module to be safely earthed via the DIN rail. Since no components of the protective circuit are situated in the base part, maintenance is only required for the protection modules.

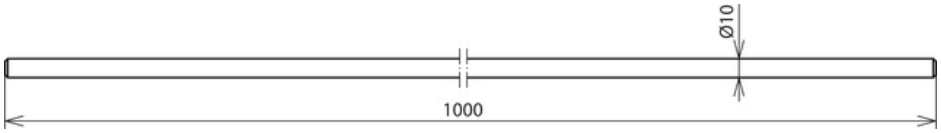
Type Part No.	BXT BAS 920 300
Operating temperature range (T_U)	-40 °C ... +80 °C
Degree of protection	IP 20
For mounting on	35 mm DIN rails acc. to EN 60715
Connection (input / output)	screw / screw
Signal disconnection	no
Cross-sectional area, solid	0.08-4 mm^2
Cross-sectional area, flexible	0.08-2.5 mm^2
Tightening torque (terminals)	0.4 Nm
Earthing via	35 mm DIN rails acc. to EN 60715
Enclosure material	polyamide PA 6.6
Colour	yellow
ATEX approvals	DEKRA 11ATEX0089 X: II 3 G Ex nA IIC T4 Gc *)
IECEx approvals	DEK 11.0032X: Ex nA IIC T4 Gc *)
Approvals	CSA, UL, EAC, ATEX, IECEx *)
Weight	34 g
Customs tariff number (Comb. Nomenclature EU)	85369010
GTIN	4013364109179
PU	1 pc(s)

*) only in connection with an approved protection module

Air-termination rod

FS 10 1000 AL (101 000)

Figure without obligation



Air-termination rod chamfered on both sides, for protecting roof-mounted structures, chimneys etc., also for erection with concrete base (8.5 kg) for wedge mounting or for fixing with rod holders / spacers.

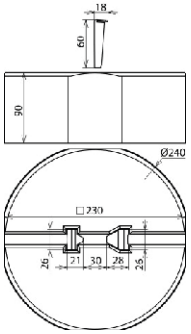
Type Part No.	FS 10 1000 AL 101 000
Total length (l1)	1000 mm
Material	Al
Diameter Ø	10 mm
Standard	EN 62561-2
Weight	212 g
Customs tariff number (Comb. Nomenclature EU)	85389099
GTIN	4013364094505
PU	20 pc(s)

Concrete base

BES 8.5KG KT10 16 D240 SET (102 075)

For wedge mounting, for air-termination rods Ø10, length 1000 mm or DEHNiso spacers Ø16 mm, length up to 675 mm (distance 0.8 m) or conductor holder (Part No. 253 279).

Type Part No.	BES 8.5KG KT10 16 D240 SET 102 075
Total weight	8.5 kg
Diameter Ø	240 mm
Material	concrete (C45/55)
Material of wedge / adapter	StSt
Weight	8,46 kg
Customs tariff number (Comb. Nomenclature EU)	68109100
GTIN	4013364094215
PU	120 pc(s)



Earthing Clamp

UEK 8.10 AQ4 50 HKSM8 V2A (540 250)

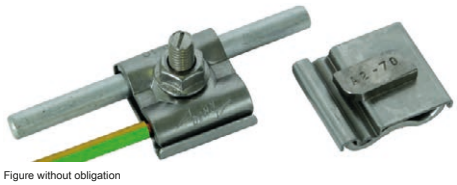
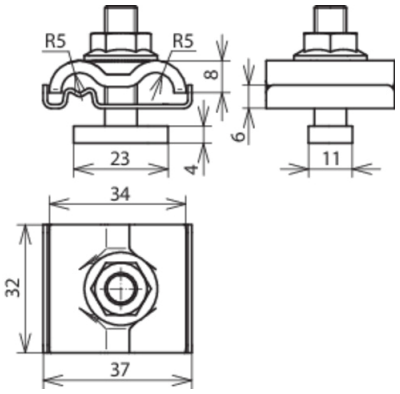


Figure without obligation



Earthing clamps for integrating mounting systems e.g. of PV installations into the functional equipotential bonding/functional earthing (optionally black conductor) and lightning equipotential bonding according to IEC/EN 62305-3.

The StSt contact plate (intermediate element) allows for different materials of conductors (Cu, Al, St/tZn and StSt) to be connected to the usual mounting systems, e.g. to aluminium, without the risk of contact corrosion.
The double cleat design allows for easy and quick interconnection of the profiles, e.g. by feed-through wiring.

Type Part No.	UEK 8.10 AQ4 50 HKSM8 V2A 540 250
Material of clamp	StSt
Clamping range Rd	8-10 mm
Connection (solid / stranded)	4-50 mm^2
Screw	hammer-head bolt M8 x 30 mm
Self-locking nut	width across flats 13 mm
Material of screw / nut	StSt
Standard	EN 62561-1
Weight	60 g
Customs tariff number (Comb. Nomenclature EU)	85389099
GTIN	4013364138650
PU	50 pc(s)

www.dehn-international.com/partners

Surge Protection
Lightning Protection
Safety Equipment
DEHN protects.

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