

# **hakel<sup>®</sup>**

**Hz in Hearts**

**Photovoltaic systems**



## Photovoltaic systems – solutions online:

### Family houses



### Outdoor areas



### Office and industrial buildings



## Link to products:

### SPD for PV systems



### SPD for AC side



### Data protection



### IMD for AC systems



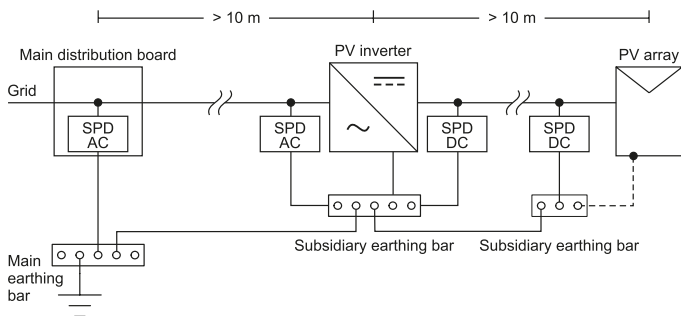
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## Selection of surge arresters for photovoltaic applications

There are many surge protection devices (SPD – Surge Protection Device) for photovoltaic (PV) systems. The HAKEL company from Hradec Králové offers a complete, integrated range for all possible applications, according to the latest international standards.

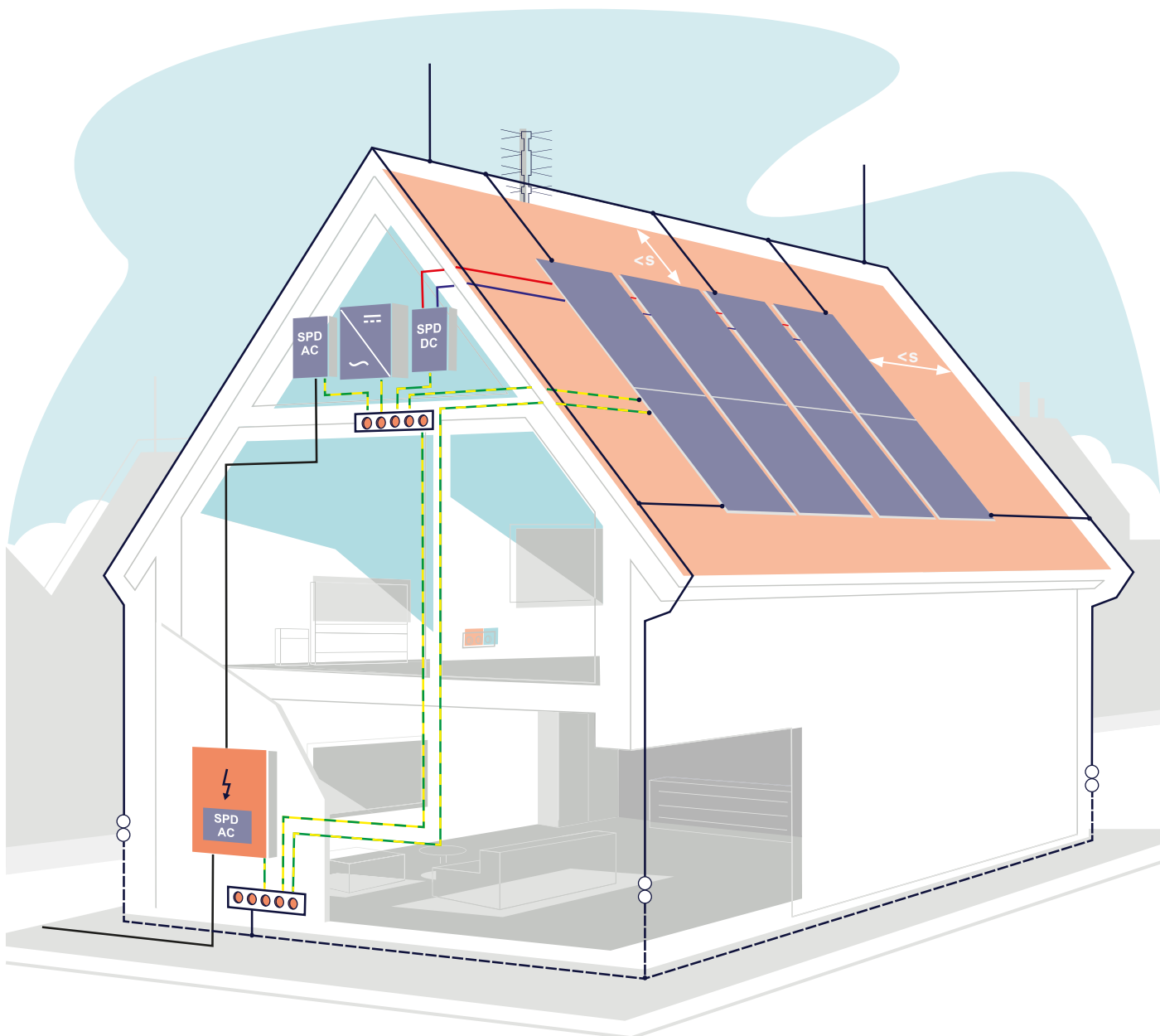
The principle of the PV system is shown in the diagram below. It consists of two parts – the AC side and the DC side. Between these parts, there is an inverter, which is the heart of the whole system and its function is to change the DC power generated by PV panels (modules) to AC power, which can be supplied to the distribution network or consumed within the autonomous system.



If the calculation of risk management according to the standard EN 62305-2:2012 (IEC 62305:2010) does not state anything else, the surge protection devices (SPD) must be installed on both the AC side and the DC side. The reason is the threat to the PV system and the entire electrical installation, not only from the AC side, consequently over the distribution network, but especially by a direct lightning strike to the building or even to the particular PV system. If the SPDs are installed to protect the power line, we also recommend to protect the transmission of data and information signals.

Selection of the SPD's continuous operating voltage ( $U_{CPV}$ ) on the DC side is derived from the no-load voltage value of the PV generator (panel) at standard testing conditions ( $U_{OCSTC}$ ). In large systems, the  $U_{OCSTC}$  can reach values above 1000 V. The minimum  $U_{CPV}$  value must be higher or equal to 1.2 times the  $U_{OCSTC}$  value.

Hakel company comes up with a new range of G-line surge protection devices for PV installations, thus complements its basic range. Hakel offers SPD type T2 and type T1+T2 in both U-connection and Y-connection for all LPL levels, so that for all possible applications. All this for voltage levels from 200 V DC to 1500 V DC. The advantage of the Y connection versus the U connection is the resistance to the earth connection of the working conductors and guarantees zero leakage currents, which can activate the insulation monitoring device, that every IT power supply system must be equipped with.



## HLSA6,5 PV \* M (S) – Lightning and surge arresters T1+T2 for DC side



- HLSA6,5 PV \* M S are lightning and surge arresters type T1+T2 with exchangeable modules in U or Y connection.
- The advantage of the Y connection versus the U connection is the resistance to the earth connection of the working conductors.
- They are installed in PV applications with external LPS, where a sufficient distance „s“ is not observed.
- Suitable for level LPL III or IV.
- Ensure the equipotential bonding of positive and negative busbars of PV systems and the elimination of transient overvoltage that originates during the atmospheric discharges or switching processes.
- Particular varistor sectors, connected between the terminals L+, L- and PE are equipped with internal disconnectors, which are activated when the varistors fail (overheat) and they are able to interrupt the DC current.
- Their special construction allows installation without a back-up fuse.
- Operational status indication of these disconnectors is visual (discolouration of the signal field) and also optional remote via potential free change over contacts (S types only).
- In accordance with: EN 61643-31:2019 (IEC 61643-31:2018), which replaces EN 50539-11:2013; UL94 V-0
- Installation acc. to: CLC/TS 51643-32:2020 (IEC 61643-32:2017); EN 62305:2011 (IEC 62305:2010); HD 60364-7-712:2016

type	article number	connection type	U <sub>CPV</sub>		I <sub>SCPV</sub>	I <sub>n</sub>	I <sub>imp</sub>	I <sub>Total</sub> (10/350)	U <sub>p</sub>		design dimension
			L+/L-	L±/PE					L+/L-	L±/PE	
HLSA6,5 PV 200 M S	16 381	Y	200 V DC		10 kA	20 kA	6.5 kA	12.5 kA	< 1.1 kV	< 1.9 kV	3TE
HLSA6,5 PV 200/2 M S	16 383	U	200 V DC	100 V DC					< 1.1 kV	< 0.55 kV	2TE
HLSA6,5 PV 400 M S	16 385	Y	400 V DC						< 1.6 kV	< 1.9 kV	3TE
HLSA6,5 PV 400/2 M S	16 387	U	400 V DC	200 V DC					< 1.6 kV	< 0.8 kV	2TE
HLSA6,5 PV 600 M S	16 363	Y	600 V DC						< 2.5 kV	< 2.1 kV	3TE
HLSA6,5 PV 600/2 M S	16 365	U	600 V DC	300 V DC					< 2.5 kV	< 1.25 kV	2TE
HLSA6,5 PV 800 M S	16 367	Y	800 V DC						< 3.4 kV	< 2.1 kV	3TE
HLSA6,5 PV 800/2 M S	16 369	U	800 V DC	400 V DC					< 3.4 kV	< 1.7 kV	2TE
HLSA6,5 PV 1000 M S	16 371	Y	1000 V DC						< 3.6 kV	< 2.3 kV	3TE
HLSA6,5 PV 1000/2 M S	16 373	U	1000 V DC	500 V DC					< 3.6 kV	< 1.8 kV	2TE

## HLSA12,5 PV \* (S) – Lightning and surge arresters T1+T2 for DC side



- HLSA12,5 PV \* S are lightning and surge arresters type T1+T2 in U or Y connection.
- The advantage of the Y connection versus the U connection is the resistance to the earth connection of the working conductors.
- They are installed in PV applications with external LPS, where a sufficient distance „s“ is not observed.
- Suitable for level LPL I or II.
- Ensure the equipotential bonding of positive and negative busbars of PV systems and the elimination of transient overvoltage that originates during the atmospheric discharges or switching processes.
- Particular varistor sectors, connected between the terminals L+, L- and PE are equipped with internal disconnectors, which are activated when the varistors fail (overheat).
- Operational status indication of these disconnectors is visual (discolouration of the signal field) and also optional remote via potential free change over contacts (S types only).
- In accordance with: EN 61643-31:2019 (IEC 61643-31:2018), which replaces EN 50539-11:2013; UL94 V-0
- Installation acc. to: CLC/TS 51643-32:2020 (IEC 61643-32:2017); EN 62305:2011 (IEC 62305:2010); HD 60364-7-712:2016

type	article number	connection type	U <sub>CPV</sub>		I <sub>SCPV</sub>	I <sub>n</sub>	I <sub>imp</sub>	I <sub>Total</sub> (10/350)	U <sub>p</sub>		design dimension
			L+/L-	L±/PE					L+/L-	L±/PE	
HLSA12,5 PV 1000 S	10 474	Y	1000 V DC		10 kA	20 kA	12,5 kA	25 kA	< 3.4 kV	< 2 kV	5TE
HLSA12,5 PV 1000/2 S	10 476	U	1000 V DC	500 V DC					< 3.4 kV	< 1.7 kV	4TE
HLSA12,5 PV 1500 S	10 478	Y	1500 V DC						< 4.8 kV	< 2.6 kV	5TE
HLSA12,5 PV 1500/2 S	10 480	U	1500 V DC	750 V DC					< 4.8 kV	< 2.4 kV	4TE

## HSA PV \* M (S) – Surge arresters T2 for DC side



- HSA PV \* M S are surge arresters type T2 with exchangeable modules in U or Y connection.
- The advantage of the Y connection versus the U connection is the resistance to the earth connection of the working conductors.
- They are installed in PV applications with external LPS, where a sufficient distance „s“ is not observed.
- Suitable for all LPL levels.
- Ensure the equipotential bonding of positive and negative busbars of PV systems and the elimination of transient overvoltage that originates during the atmospheric discharges or switching processes.
- Particular varistor sectors, connected between the terminals L+, L- and PE are equipped with internal disconnectors, which are activated when the varistors fail (overheat) and they are able to interrupt the DC current.
- Their special construction allows installation without a back-up fuse.
- Operational status indication of these disconnectors is visual (discolouration of the signal field) and also optional remote via potential free change over contacts (S types only).
- In accordance with: EN 61643-31:2019 (IEC 61643-31:2018), which replaces EN 50539-11:2013; UL94 V-0
- Installation acc. to: CLC/TS 51643-32:2020 (IEC 61643-32:2017); EN 62305:2011 (IEC 62305:2010); HD 60364-7-712:2016

type	article number	connection type	U <sub>CPV</sub>		I <sub>SCPV</sub>	I <sub>n</sub>	I <sub>Total</sub> (8/20)	U <sub>p</sub>		design dimension
			L+/L-	L±/PE				L+/L-	L±/PE	
HSA PV 200 M S	27 225	Y	200 V DC		10 kA	20 kA	40 kA	< 1.1 kV	< 1.9 kV	3TE
HSA PV 200/2 M S	27 227	U	200 V DC	100 V DC				< 1 kV	< 0.5 kV	2TE
HSA PV 400 M S	27 229	Y	400 V DC					< 1.6 kV	< 1.9 kV	3TE
HSA PV 400/2 M S	27 231	U	400 V DC	200 V DC				< 1.6 kV	< 0.8 kV	2TE
HSA PV 600 M S	27 233	Y	600 V DC					< 2.5 kV	< 2.1 kV	3TE
HSA PV 600/2 M S	27 235	U	600 V DC	300 V DC				< 2.5 kV	< 1.25 kV	2TE
HSA PV 800 M S	27 255	Y	800 V DC					< 3.3 kV	< 2.1 kV	3TE
HSA PV 800/2 M S	27 257	U	800 V DC	400 V DC				< 3.3 kV	< 1.65 kV	2TE
HSA PV 1000 M S	27 237	Y	1000 V DC					< 3.8 kV	< 2.6 kV	3TE
HSA PV 1000/2 M S	27 239	U	1000 V DC	500 V DC				< 3.8 kV	< 1.9 kV	2TE
HSA PV 1500 M S	27 241	Y	1500 V DC					< 4.8 kV	< 2.6 kV	3TE
HSA PV 1500/2 M S	27 243	U	1500 V DC	750 V DC				< 4.8 kV	< 2.4 kV	2TE

## Surge protection devices for AC side



- HLSA\*/HSA\* are designed to limit the impulse surge and discharge the impulse currents.
- The products consist of high power varistors MOV for big discharge ability. In 1+1, 3+1 and HLSA25G configurations they are additionally combined with a gas discharge tube, which ensures zero leakage current through the PE conductor.
- They are installed in the main switchboards and possibly also as close as possible to the output of the voltage inverter.
- Available in versions with remote monitoring (S type).
- In accordance with: EN 61643-11:2012 (IEC 61643-11:2011); UL94 V-0
- Installation acc. to: EN 62305:2011 (IEC 62305:2010); HD 60364-5-53:2022 (IEC 60364-5-53:2019); HD 60364-7-712:2016

type	SPD type	U <sub>c</sub>	I <sub>n</sub>	I <sub>imp</sub>	U <sub>p</sub>	recommended cross-section				design dimension
						T1		T2		
						L. N	PE. PEN	L. N	PE. PEN	
HLSA25G-255 (S)	T1+T2+T3	255 V AC	25 kA	25 kA	< 1.2 kV	6 mm <sup>2</sup>	16 mm <sup>2</sup>	2.5 mm <sup>2</sup>	6 mm <sup>2</sup>	from 1TE to 8TE acc. to chosen configuration
HLSA25-275 (S)	T1+T2+T3									
HLSA12,5-275 M (S)	T1+T2+T3	275 V AC	20 kA	12.5 kA	< 1.25 kV	N/A	N/A	N/A		
HSA-275 M (S)	T2+T3			N/A						

We offer the main products listed in the table in versions according to the application in single-pole to four-pole design. You can find more information at [www.hakel.com](http://www.hakel.com).

## HT-NET PoE+ 6cat 802.3at Xseries – Data protection, ETHERNET, PoE+



- HT-NET PoE+ 6cat 802.3at Xseries is a surge protection device designed for computer networks category 6 with the possibility of transmitting PoE+ 802.3at – power supply for IP cameras.
- It protects the input of the electrical circuit of network cards against damage caused by surge effects.
- For installation on the interface of **LPZ 1-2-3**.
- It is recommended to use these protection devices at the input of protected equipment.
- In accordance with: EN 61643-21:2001 (IEC 61643-21:2000)
- Installation acc. to: EN 62305:2011 (IEC 62305:2010)

type	article number	connection input / output	$U_c$ (DC / AC)	$I_L$	$U_p$	$I_n$ (C1)	category	transmission speed	operating temperature
HT-NET PoE+ 6cat 802.3at Xseries	57 102	RJ45 / RJ45	58 V / 41 V	1 A	< 150 V	150 A	C1, C2, C3	max. 500 Mbit/s	-40 °C ÷ +70 °C

## HDT1/24B – Data protection



- HDT is a basic range of surge protection devices (for voltage levels 6-48 V DC) designed for protecting data, communication, measuring and control lines against surge effects.
- The replaceable design of the module is adapted so that the communication busbar is not interrupted when the module is changed and the continuous operation of the system is ensured.
- The whole system is adapted so that it is possible to make the protection tailored to the specific needs of the user.
- The connection interface is solved via screw terminals.
- For installation on the interface of **LPZ 1-2-3**.
- In accordance with: EN 61643-21:2001 (IEC 61643-21:2000)
- Installation acc. to: EN 62305:2011 (IEC 62305:2010)

type	article number	$U_n$	$I_L$	$I_n$ (C1)	$U_p$ (C1)	category	transmission speed	operating temperature
HDT1/24B	56 004	24 V DC	0.1 A	1 kA	< 65 V	C1, C2, C3, D1	1 Mbit/s	-40 °C ÷ +70 °C

You will find the whole HDT range for voltage levels of 6-48 V DC in single-pair and double-pair versions in our [overview catalogue of Data and Coaxial Protection](#) and also at [www.hakel.com](http://www.hakel.com).

## HDSP – Hakel data slim protection



- The special HDSP series is designed primarily for industrial applications, especially for the MaR sector, but will certainly find its use in PV applications.
- The individual products are designed directly for typical applications with the possibility of variable connection according to the specific solution.
- You will find here special versions for various communication buses, but also for analog systems such as sensors, current loop, etc.
- The HDSP series use appropriately selected breakdown voltage and low capacitance protection diodes to achieve full communication speed and maximum protection of the data devices.
- In accordance with: EN 61643-21:2001 (IEC 61643-21:2000)
- Installation acc. to: EN 62305:2011 (IEC 62305:2010)

You can find more information including the parameters of each protection device at [www.hakel.com](http://www.hakel.com).

Note: For larger PV systems, where there are isolated grids on the AC side, an **Insulation Monitoring Device** (IMD) must also be installed. IMD monitors the insulation resistance of this part of the system. Our [technical support](#) will be happy to help you with the selection of the correct type.

## Why HAKEL?



more than 25 years  
of experience



own testing laboratory



support  
within 24 hours



made in  
Czech Republic



certified ISO 9001



worldwide export

## Assortment of Hakel products:

Surge protection devices (SPD)

Surge protection devices + EMI filters (SPD+EMI)

Surge protection devices for photovoltaic applications (SPD PV)

Surge protection devices for IT power supply systems (SPD IT)

Voltage limiting devices (VLD)

Gas discharge tubes for equipotential bonding (GDT)

Insulation monitoring devices (IMD)



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