



DEHN protects  
Photovoltaic Systems



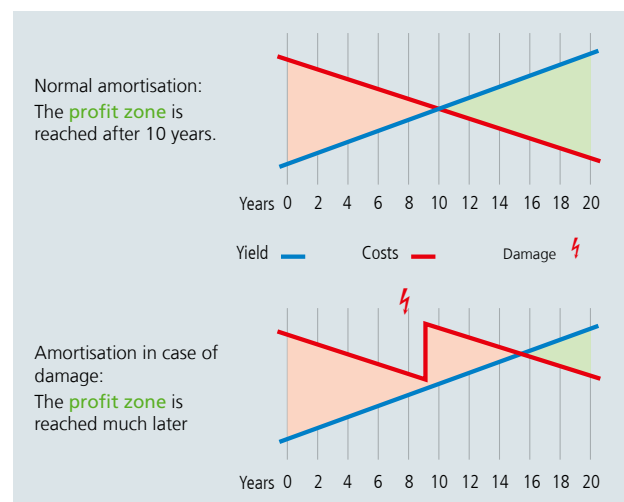




## This is why investors choose protection solutions by DEHN

Surges often cause considerable damage to photovoltaic systems. The resulting reinvestment costs can be high. This delays the return on investment and postpones the break-even-point. The worst case is a complete failure of the system.

A protection concept with lightning and surge protection from DEHN can prevent all of this and specifically protect the investment in a PV system.



## This is what is important to planning engineers

Whether a rooftop installation or a solar park – the topic of lightning and surge protection should be integrated in the planning right from the start. It is important for you as a planning engineer to have a manufacturer who supports you and proposes practical solutions. With DEHN, you have a strong partner at your side.

By using a coordinated protection concept with the right components, you can significantly contribute to a reliable power supply, high system availability and the long-term protection of your investment.









## The top priority for EPCs

General contractors (EPCs) <sup>1)</sup> plan and construct photovoltaic systems worldwide. With components from renowned, qualified manufacturers, they establish the preconditions for the plants to be connected to the grid quickly and to deliver as much electricity as possible. System availability is their top priority.

When it comes to lightning and surge protection, they rely on DEHN because they have confidence in our long experience and first-class service.

## This is what matters to solar park operators

Their objective is to achieve the highest possible system performance. This is only possible if system failures are avoided. Lightning and surge protection is hence an important feature for operators in terms of an efficient system.

High-quality and durable products from DEHN reduce service costs, as fewer components need to be replaced due to damage caused by lightning strikes and surges. This makes work easier for operators. They also rely on DEHN when it comes to personal protective equipment – to protect their employees.

<sup>1)</sup> EPC stands for Engineering - Procurement - Construction for project management in power plant or system construction.









# Lightning and surge protection for rooftop systems

Rooftop systems are extremely exposed and therefore particularly prone to damage caused by direct and indirect lightning effects. Since the PV system is directly connected to the electrical installation of the building, lightning effects can have severe consequences for the building itself, for the people inside it and for electrical devices.

According to the current state of scientific knowledge, PV modules do not increase the risk of a lightning strike which means that the need for lightning protection measures cannot be derived directly from that. The risk of damage due to lightning should therefore be assessed in compliance with IEC 62305-2 <sup>1)</sup>. National regulations, e.g., the state building code, should also be considered.

A professional lightning protection system consists of an

- external lightning protection including an air-termination system, a down conductor system and an earth-termination system
- internal lightning protection for lightning equipotential bonding and surge protection

The German national supplement 5 of DIN EN 62305-3 describes protective measures for external and internal lightning protection when using PV power supply systems <sup>2)</sup>. Implementation of the protective measures described there has also proven its worth on an international level. The DIN VDE 0100-712 standard for the installation of PV systems refers to Supplement 5 <sup>3)</sup> with regard to overvoltage protection.

In addition, IEC 61643-32 provides information on selecting and implementing surge protective devices in PV power supply systems <sup>4)</sup>. Both this standard and supplement 5 of DIN EN 62305-3 describe **three different applications for PV installations on buildings:**

- Buildings with PV systems, **without** external lightning protection
- Buildings with PV systems, **with** external lightning protection **and** sufficient separation distance
- Buildings with PV systems, **with** external lightning protection, **without** sufficient separation distance

<sup>1)</sup> IEC 62305-2: Protection against lightning Part 2: Risk management

<sup>2)</sup> DIN EN 62305-3 (VDE 0185-305-3) Supplement 5: Protection against lightning - Part 3: Physical damage to structures and life hazard – Supplement 5: Lightning and overvoltage protection for photovoltaic power supply systems

<sup>3)</sup> IEC 60364 Electrical installation of buildings – Part 7-712: Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems.

<sup>4)</sup> IEC 61643-32: Low-voltage surge protective devices – Part 32: Surge protective devices connected to the DC side of photovoltaic installations – Selection and application principles



## Buildings with PV installations Without external lightning protection

Surge protective devices should be installed even if there is no external lightning protection system.

With the publication of the amended IEC 60364-4-44 clause 443, IEC 60364-5-53 clause 534 and IEC 60364-7-712, the installation of surge protection measures became mandatory – even if there is no external lightning protection system! Due to the reference of IEC 60364-7-712 to supplement 5 of DIN EN 62305-3, the protective measures described therein must be observed for this application.

It is necessary to protect both the electrical components on the AC and DC side and any data interfaces.

The protective devices should be installed as closely as possible to the device to be protected, e.g., inverter. If the line between the surge protective device and, e.g., the inverter is longer than 10 metres, an additional type 2 surge protective device is required.

The same applies to battery storage systems: If the storage system is in the immediate proximity (less than 10 m) of the surge protective device, no further protective devices are required.



More information at:  
[de.hn/9BT5m](https://de.hn/9BT5m)



A Main distribution board		Part no.	Mandatory <sup>1)</sup>	Recommended
	<b>DEHNshield Basic</b> (depending on the system configuration) The combined arrester is mounted directly at the entrance point into the building. It protects the electrical installations in the immediate vicinity.	<b>941 306</b> (TNC) <b>941 406</b> (TNS) <b>941 316</b> (TT)	●	
	<b>alternatively: DEHNgard modular</b> (depending on the system configuration) This surge arrester protects against overvoltages from inductive couplings in case of distant lightning strikes and from switching overvoltages. It must be installed downstream of the electricity meter which means that it does not protect the Smart Meter and Smart Meter Gateway.	<b>952 400</b> (TNS) <b>952 381</b> (TT)	●	
B Internet / telephone / broadband		Part no.	Mandatory <sup>2)</sup>	Recommended
	<b>DEHNbox TC B 180</b> The combined arrester offers protection in the event of lightning strikes and overvoltages. It secures telephone and DSL connections. Its compact design makes it quick to install in new buildings and easy to retrofit in existing buildings.	<b>922 220</b>	●	
C PV installation		Part no.	Mandatory <sup>3)</sup>	Recommended
	<b>Generator junction box DEHNcube 2 YPV</b> Prewired system solution with integrated type 2 surge arrester for protecting PV systems from surges. The generator junction box is available for 1MPPT and 2MPPT applications and suitable for all commonly used inverter types. Push-in connection terminals and cable glands with multiple sealing inserts reduce the installation effort.	<b>900 913</b> (1 MPPT, 2 strings) <b>900 921</b> (2 MPPT, 1 string) <b>900 923</b> (2 MPPT, 2 strings)	<b>C1</b> ●	<b>C2</b> ●
 	<b>alternatively: DEHNcube YPV SCI 1000</b> Type 2 arrester DEHNcube YPV SCI provides comprehensive protection for a PV system in an enclosure. It is mounted directly upstream of the inverter and is available in two versions, 1 MPPT and 2 MPPT. If there is more than 10 metres of cable between the PV system and the inverter, a further arrester is necessary in the roof area. <b>Accessories: Y connecting cable</b> For easy wiring of the DEHNcube YPV	<b>900 910</b> (1 MPPT) <b>900 920</b> (2 MPPT)  <b>900 945</b>	<b>C1</b> ●	<b>C2</b> ●
D AC side inverter		Part no.	Mandatory	Recommended
	<b>DEHNgard MP 275</b> Modular, type 2 + 3 surge arrester with push-in double terminal; 230/400 V AC	<b>942 310</b> (TT) <b>942 400</b> (TNS)		●
E Equipotential bonding		Part no.	Mandatory	Recommended
	<b>UNI earthing / saddle clamp</b> The clamps are suitable for integrating the mounting systems of PV installations in the functional equipotential bonding / the functional earthing or the lightning equipotential bonding.	<b>540 250</b> <b>365 250</b>		●
	<b>Gutter Clamp</b> For lightning current carrying connection of the earthing system in buildings without external lightning protection.	<b>540 120</b>		●
F Equipotential bonding		Part no.	Mandatory	Recommended
	<b>Equipotential bonding bar</b> The equipotential bonding bars are installed at the service connection and, e.g., at the heating system. For connection with the foundation / ring earth electrode fixed earthing terminals are installed flush with the wall. Connection lugs are also possible.	<b>563 200</b>		●

<sup>1)</sup> acc. to IEC 60364-4-44 clause 443

<sup>2)</sup> In compliance with IEC 60364-4-44 clause 443 surge arresters should also be installed for data lines entering from the outside.

<sup>3)</sup> If there is a surge arrester on the AC side in compliance with IEC 60364-4-44 clause 443, a surge protection on the DC side shall also be provided in compliance with IEC 60364-7-712 particularly to protect the inverter.





## Buildings with PV installations

### With external lighting protection **and** sufficient separation distance

The PV modules must be within in the protected volume of the isolated air-termination system – whilst also maintaining the separation distance “s”.

It is always advisable to favour a lightning protection system which, taking the required separation distance into account, has no direct connection with the PV power supply system. The HVI Conductor by DEHN comes into its own here. High-voltage-resistant insulated down conductors make it possible to maintain an equivalent separation distance of, e.g.,  $s \leq 0.75$  m (in air) and still make optimum use of the roof surface.









Type 2 arresters are used on the DC side to protect the module and the inverter. The AC side is protected by a combined arrester near the grid connection. On both the AC and DC sides, the protective devices are installed as closely as possible to the device to be protected.

If the cable is longer than 10 metres, e.g., between the grid connection point and the inverter, additional type 2 surge protective devices are required. Battery storage systems which are less than 10 m from the point where the surge protective device is installed are also protected.

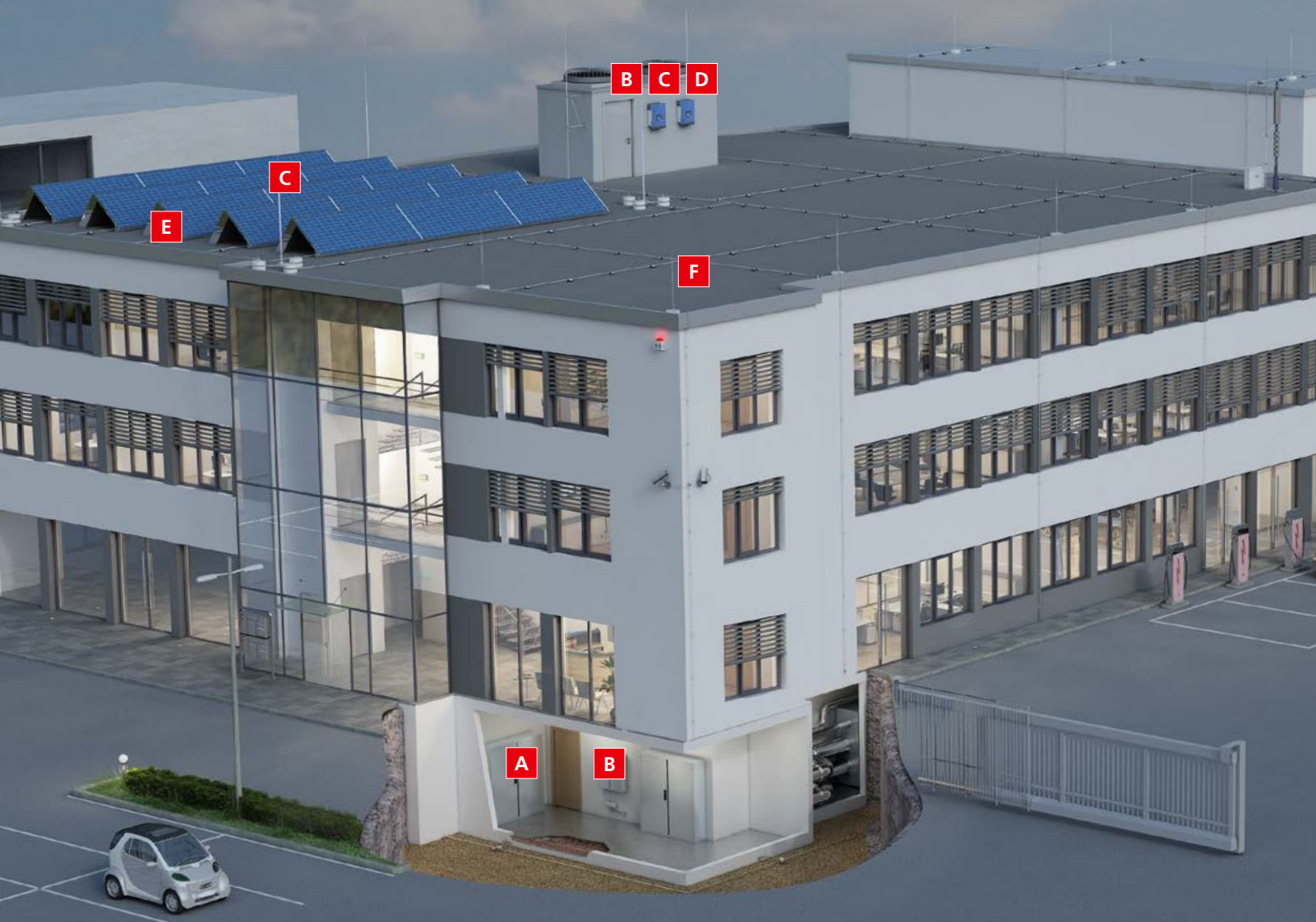


More information at:  
[de.hn/9GyPk](https://de.hn/9GyPk)



A	Main distribution board / MEB	Part no.
	<p><b>DEHNventil M2</b> (depending on the system configuration)            Multipole, modular combined arrester, type 1+2+3, as per EN 61643-11. Maximum system availability due to RAC spark gap technology. Capable of protecting terminal equipment. For installation in conformity with the lightning protection zone concept at the boundaries from <math>0_A - 2</math>. Energy coordination according to EN 61643-12.</p>	<p><b>954 315</b> (TT)  <b>954 405</b> (TNS)  <b>954 305</b> (TNC)</p>
B	Data interface	Part no.
	<p><b>BLITZDUCTORconnect ML2 BE 24</b> or  <b>BLITZDUCTORconnect ML2 BD HF 5</b>            Combined lightning current and surge arrester in compact and modular design Fast and easy installation due to push-in connection system Integrated status indication with optional remote signalling (break contact) via condition monitoring unit DRC IRCM</p>	<p><b>927 224</b>            or  <b>927 271</b></p>
	<p><b>DEHNrecord IRCM</b>            Condition monitoring unit DEHNrecord, for DIN rail mounted devices with integrated visual transmitter/receiver and visual reverse unit for monitoring the condition of up to 50 BLITZDUCTORconnect arresters with LifeCheck. Visual arrester status indication via LED group display in combination with remote signalling contact (break contact).</p>	<p><b>910 710</b></p>
C	PV installation	Part no.
	<p><b>DEHNguard M YPV</b>            This type 2 arrester is specially designed for application in PV systems and protects the DC side of the inverter against surges from inductive couplings.            If there is more than 10 metres of cable between the PV system and the inverter, a further arrester is necessary in the roof area.</p>	<p><b>952 565</b> (1170 V)  <b>952 567</b> (1500 V)</p>
	<p><b>Generator junction box DEHNcube 2 YPV</b>            Prewired system solution with integrated type 2 surge arrester for protecting PV systems from surges. The generator junction box is available for 1MPPT and 2MPPT applications and suitable for all commonly used inverter types.            Push-in connection terminals and cable glands with multiple sealing inserts reduce the installation effort.</p>	<p><b>900 913</b> (1 MPPT, 2 strings)  <b>900 921</b> (2 MPPT, 1 string)  <b>900 923</b> (2 MPPT, 2 strings)</p>
D	AC side inverter	Part no.
	<p><b>DEHNguard M TNS</b> or <b>DEHNguard M TT</b>            If there is more than 10 metres of cable between the service entrance box and the inverter, a further type 2 surge arrester is required at the inverter.            This arrester protects against overvoltages from inductive couplings by distant lightning strikes and from switching overvoltages.</p>	<p><b>952 405</b> (TNS)  <b>952 315</b> (TT)</p>
E	Equipotential bonding	Part no.
	<p><b>UNI earthing / saddle clamp</b>            The clamps are suitable for integrating the mounting systems of PV installations in the functional equipotential bonding / the functional earthing or the lightning equipotential bonding.</p>	<p><b>540 250</b>  <b>365 250</b></p>
F	External lightning protection	
	<p><b>HVI Conductor</b>            With the high-voltage-resistant insulated down conductors it is possible to make optimum use of the roof surface whilst still maintaining the separation distance from conductive parts.</p>	





## Buildings with PV installations

### With external lightning protection, **without** sufficient separation distance

If the separation distance “s” cannot be maintained, lightning equipotential bonding is required.

If the separation distance calculated acc. to IEC 62305-2 cannot be maintained, e.g. on metal roofs, lightning equipotential bonding must be established <sup>1)</sup>.








The metal components must be connected to the lightning protection systems and the connections should be capable of carrying lightning current. At the same time, the lines leading into the building must be integrated in the lightning equipotential bonding. This is done using type 1 combined arresters on the AC, DC and data side.

If the lines between the arrester and the device to be protected are longer than 10 metres, e.g., on the DC side between the inverter and PV modules, additional protective devices should be installed. Supplement 5 of the German DIN EN 62305-3 standard describes further type 1 arresters for this purpose <sup>2)</sup>.

<sup>1)</sup> IEC 62305-3: Protection against lightning – Part 3: Physical damage to structures and life hazard

<sup>2)</sup> DIN EN 62305-3 (VDE 0185-305-3) Protection against lightning – Part 3: Physical damage to structures and life hazard – Supplement 5: Lightning and overvoltage protection for photovoltaic power supply systems



<b>A Main distribution board / MEB</b>		<b>Part no.</b>
	<b>DEHNventil M2</b> (depending on the system configuration) Multipole, modular combined arrester, type 1+2+3, as per EN 61643-11. Maximum system availability due to RAC spark gap technology. Capable of protecting terminal equipment. For installation in conformity with the lightning protection zone concept at the boundaries from 0 <sub>A</sub> – 2. Energy coordination according to EN 61643-12.	<b>954 315</b> (TT) <b>954 405</b> (TNS) <b>954 305</b> (TNC)
<b>B Data interface</b>		<b>Part no.</b>
	<b>BLITZDUCTORconnect ML2 BE 24</b> or <b>BLITZDUCTORconnect ML2 BD HF 5</b> Combined lightning current and surge arrester in compact and modular design Fast and easy installation due to push-in connection system Integrated status indication with optional remote signalling (break contact) via condition monitoring unit DRC IRCM	<b>927 224</b> or <b>927 271</b>
	<b>DEHNrecord IRCM</b> Condition monitoring unit DEHNrecord, for DIN rail mounted devices with integrated visual transmitter/receiver and visual reverse unit for monitoring the condition of up to 50 BLITZDUCTORconnect arresters with LifeCheck. Visual arrester status indication via LED group display in combination with remote signalling contact (break contact).	<b>910 710</b>
<b>C PV installation</b>		<b>Part no.</b>
	<b>DEHNcombo YPV</b> This combined arrester was specially developed for use in PV installations and protects the DC side of the inverter against partial lightning currents and surges. If there is more than 10 metres of cable between the PV system and the inverter, a further arrester is necessary in the roof area.	<b>900 075</b> (1200 V) <b>900 076</b> (1500 V)
<b>D AC side inverter</b>		<b>Part no.</b>
	<b>DEHNshield</b> (depending on the system configuration) If the cable length between the grid connection and the inverter is longer than 10 metres, an additional combined arrester is required at the inverter. This application-optimised combined lightning current and surge arrester fulfils the requirements LPS class III at the point of installation and thus protects the inverter against any partial lightning currents and surges.	<b>941 305</b> (TNC) <b>941 405</b> (TNS) <b>941 315</b> (TT)
<b>E Equipotential bonding</b>		<b>Part no.</b>
	<b>UNI earthing / saddle clamp</b> The clamps are suitable for integrating the mounting systems of PV installations in the functional equipotential bonding / the functional earthing or the lightning equipotential bonding.	<b>540 250</b> <b>365 250</b>
<b>F External lightning protection</b>		
	<b>Air-termination and down conductor system</b> Air termination rods and down conductors are required to protect the building and the PV installation and any additional components against the effects of direct lightning strikes.	









## Lightning and surge protection for solar parks

In many countries, large-scale PV power plants are becoming an important part of the power supply infrastructure. As a result, they must also meet requirements for stable network operation. The supply reliability and volume of investment make it necessary to assess the risk of damage due to lightning. Damage may be the result of direct lightning strikes or of inductive or capacitive coupled voltage. An integrated lightning protection system, consisting of external and internal lightning protection, is needed to prevent damage.

The German supplement 5 of DIN EN 62305-3 and IEC 61643-32 describe protective measures for free field PV systems <sup>1)</sup>. The basis for an effective lightning and surge protection system is a meshed earthing system. This produces a large equipotential surface which significantly reduces the voltage interference of electrical connecting cables in case of lightning interference. Mesh sizes between 20 x 20 metres and 40 x 40 metres have proven effective.

When selecting surge protective devices, you must differentiate between systems with central inverters and systems with string inverters. The German supplement 5 of DIN EN 62305-3 and IEC 61643-32 both point out the minimum discharge capacity of the arresters to be implemented in solar parks, making selection easier.

You will find the following protection concepts on the next few pages:

- Solar parks, configuration with central inverter
- Solar parks, configuration with string inverter



More information at:  
[de.hn/cZ6BX](https://de.hn/cZ6BX)



<sup>1)</sup> DIN EN 62305-3 (VDE 0185-305-3) Supplement 5: Protection against lightning - Part 3: Physical damage to structures and life hazard – Supplement 5: Lightning and overvoltage protection for photovoltaic power supply systems

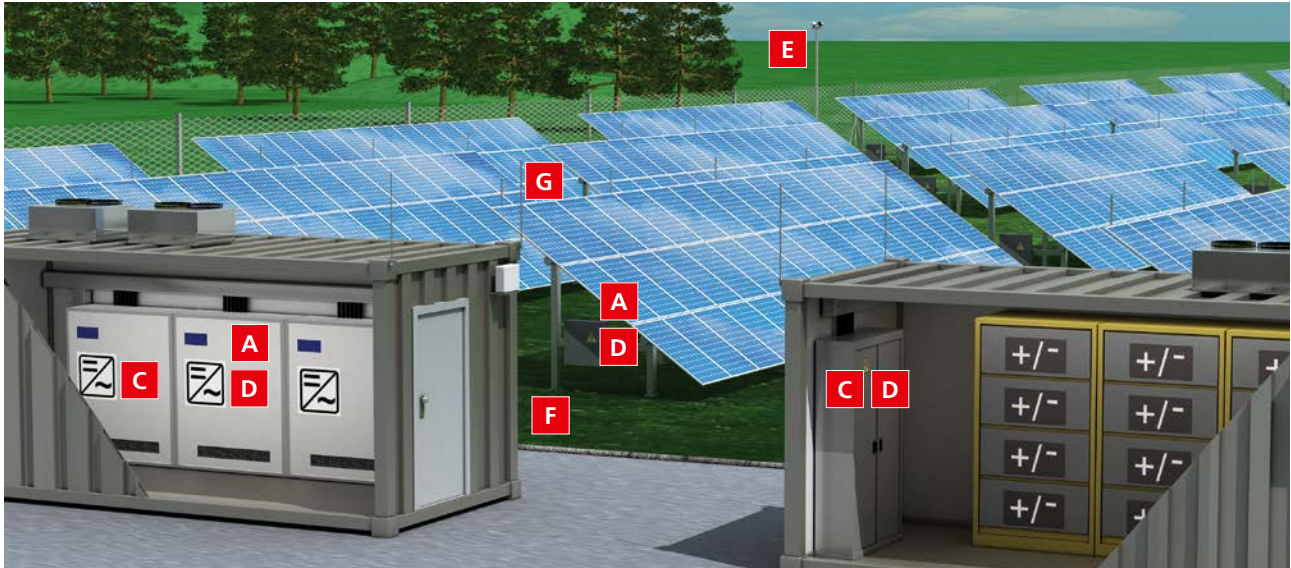
IEC 61643-32: Low-voltage surge protective devices – Part 32: Surge protective devices connected to the DC side of photovoltaic installations – Selection and application principles



## Solar parks – configuration with central inverter

System concepts with central inverter technology lead to extensive direct current cabling in the field. If lightning directly strikes the air-termination rod on the mounting frame, the extensive DC cabling acts as an equipotential bonding conductor between the “local” earth potential of the module field and the “distant” equipotential surface of the feed transformer/central inverter. Due to the partial

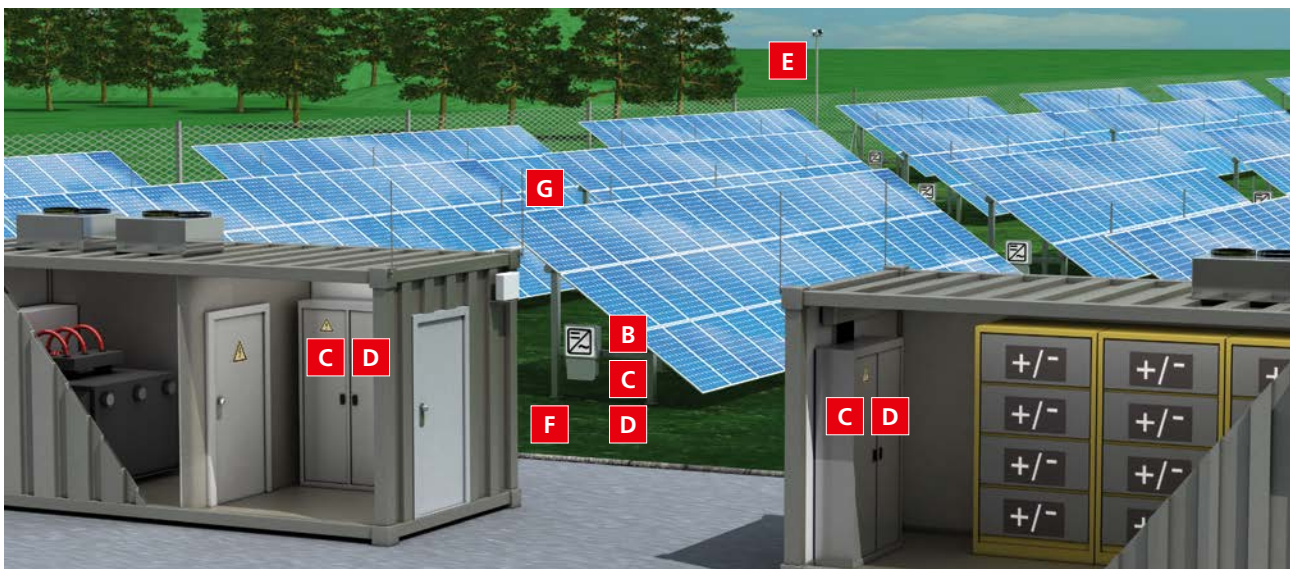
lightning currents anticipated on the DC cables, type 1 arresters are used to protect the electrical systems within the PV power plant. Any battery storage systems must also be protected against lightning and surges. This is done by protecting the electrical cables entering the building or container with combined arresters.













## Solar parks – configuration with string inverter

If the PV power plants are designed with decentralised string inverters, a large portion of the cabling is shifted from the DC to the AC side. In case of a direct lightning strike, the AC cabling acts as an equipotential bonding conductor between the “local” earth potential of the module field and the “distant” equipotential surface of the feed transformer. For this reason, type 1 arresters are used on the AC side.

On the DC side, type 2 SPDs suffice to essentially limit induced interference impulses. Any battery storage systems must also be protected against lightning and surges. This is done by protecting the electrical cables entering the building or container with combined arresters.



A DC side central inverter		Part no.
	<p><b>DEHNcombo YPV</b></p> <p>This combined arrester was specially developed for use in PV installations and protects the DC side of the inverter against partial lightning currents and surges.</p>	<p><b>900 075</b> (1200 V)</p> <p><b>900 076</b> (1500 V)</p>
B DC side string inverter		Part no.
	<p><b>DEHNgard M YPV</b></p> <p>This type 2 arrester is specially designed for application in PV systems and protects the DC side of the inverter against surges from inductive couplings.</p> <p>If there is more than 10 metres of cable between the PV system and the inverter, a further arrester is necessary in the roof area.</p>	<p><b>952 565</b> (1170 V)</p> <p><b>952 567</b> (1500 V)</p>
	<p><b>Generator junction box DEHNCube 2 YPV</b></p> <p>Prewired system solution with integrated type 2 surge arrester for protecting PV systems from surges. The generator junction box is available for 1MPPT and 2MPPT applications and suitable for all commonly used inverter types.</p> <p>Push-in connection terminals and cable glands with multiple sealing inserts reduce the installation effort.</p>	<p><b>900 913</b> (1 MPPT, 2 strings)</p> <p><b>900 921</b> (2 MPPT, 1 string)</p> <p><b>900 923</b> (2 MPPT, 2 strings)</p>
C AC side		Part no.
	<p><b>DEHNshield</b> (depending on the system configuration)</p> <p>The application-optimised combined lightning current and surge arrester can be installed to protect the AC side of central and string inverters or AC-coupled battery storage systems.</p>	<p><b>941 305</b> (TNC)</p> <p><b>941 405</b> (TNS)</p> <p><b>941 315</b> (TT)</p>
D Data interface		Part no.
	<p><b>BLITZDUCTORconnect ML2 BE 24</b> or <b>BLITZDUCTORconnect ML2 BD HF 5</b></p> <p>Combined lightning current and surge arrester in compact and modular design</p> <p>Fast and easy installation due to push-in connection system.</p> <p>Integrated status indication with optional remote signalling (break contact) via condition monitoring unit DRC IRCM</p>	<p><b>927 224</b> or <b>927 271</b></p>
	<p><b>DEHNrecord IRCM</b></p> <p>Condition monitoring unit DEHNrecord, for DIN rail mounted devices with integrated visual transmitter/receiver and visual reverse unit for monitoring the condition of up to 50 BLITZDUCTORconnect arresters with LifeCheck.</p> <p>Visual arrester status indication via LED group display in combination with remote signalling contact (break contact).</p>	<p><b>910 710</b></p>
E Surveillance camera		Part no.
	<p><b>DEHNpatch CLE IP 66</b></p> <p>The complete unit consisting of surge protection and outdoor enclosure (IP 66) protects, e.g. IP camera systems.</p>	<p><b>929 221</b></p>
F Equipotential bonding / earthing		Part no.
	<p><b>UNI earthing / saddle clamp</b></p> <p>The clamps are suitable for integrating the mounting systems of PV installations in the functional equipotential bonding / the functional earthing or the lightning equipotential bonding.</p>	<p><b>540 250</b></p> <p><b>365 250</b></p>
	<p><b>Earth-termination system</b></p> <p>Highly durable round wires or strips should be used to set up a meshed earth-termination system.</p>	
G External lightning protection		Part no.
	<p><b>Angled air-termination rod</b></p> <p>The 10 mm air-termination rod is fixed to the metal support structure of PV modules to protect them from direct lightning strikes.</p> <p>Total length 1 m.</p>	<p><b>101 010</b></p>
	<p>Air-termination rod (including two saddle clamps)</p>	<p><b>101 110</b></p>





## DEHN protection of people and systems

With DEHN safety equipment for installation and maintenance, the safety of your employees is paramount. Protect your service personnel when working on roof-top systems and solar parks.

### In the DEHN portfolio you will find:

#### DEHNcare PPE

Do you require personal protective equipment which reliably protects your employees? With DEHNcare, you have all the components from one source.

#### DEHNshort Arc Fault Protection System

Reliable protection for switchgear installs up to 110 kA/690V. The modular system is individually configured for the respective installation. With arc fault extinguishing times of a few milliseconds, it is one of the fastest protection systems on the market.

#### Safe work – 5 safety rules

Work in and on electrical installations can be life-threatening. To avoid electrical accidents, follow the 5 safety rules.

#### Safety services

Electricians with special training according to DIN VDE 0105-100 and BGR A3 will do the job for you, professionally and on time.



More information at:  
[de.hn/4DJZV](https://de.hn/4DJZV)

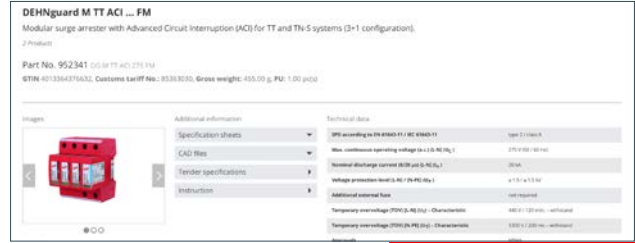
# Services and information

Whether support with planning or specific help with a query – take advantages of DEHN’s range of services.

## Online product data base and configurators

You will find further information, data sheets, planning documents for our products online.

Simply enter the part number or description in the search field.



More information at: [de.hn/aQac5](https://de.hn/aQac5)



## More detailed information

Specific concepts can be found in numerous white papers alongside industry and practical solutions. Or, in our LIGHTNING PROTECTION GUIDE, a lightning and surge protection planning manual. This means that you quickly have all relevant information and solutions at your fingertips.



More information at: [de.hn/cNayk](https://de.hn/cNayk)



## Expert pages

Have you already seen our expert pages?

Concisely compiled for you, you will find current and relevant information at a click.



More information at: [de.hn/3p81F](https://de.hn/3p81F)



## Answering questions

If you have commercial or specific technical questions, please contact our commercial customer services or our experts for lightning protection, earthing, surge protection, safety equipment and arc fault protection:



### Commercial Customer Service

Phone +49 9181 906-1462

Fax +49 9181 906-1444

[sales@dehn.de](mailto:sales@dehn.de)

### Technical Support

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Fax +49 9181 906-1444

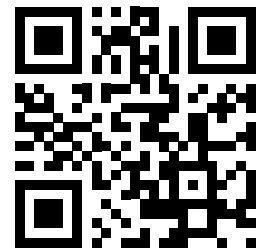
[itss@dehn.de](mailto:itss@dehn.de)



Surge Protection  
Lightning Protection  
Safety Equipment  
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