



# Protect photovoltaic systems

Lightning and surge protection  
for rooftop and ground-mounted  
PV systems





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### Do you know the risks?

PV systems are installed outdoors, on roofs or in open fields. This exposes them to an increased risk of direct or indirect lightning strikes. The larger the area of the solar installation, the higher the risk.

The possible consequences include:

- Outbreaks of fire
- Destruction of or damage to system components, electrical installations and connected devices
- Shortened service life of components
- Energy supply downtimes
- Financial losses

The only reliable way to prevent this damage is a professionally planned and expertly coordinated lightning and surge protection concept.

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### → Make planning easy – with DEHN Engineering Services

Discover our unique range of services for planning your lightning and surge protection concept. Complete. Standard-compliant. Optimised to suit your budget. Find out more from page 4

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### Are you aware of all the specifications and requirements?

To ensure that the protection solution for your PV system effectively prevents failures or damage and fulfils all specifications, aspects such as ground conditions, corrosion and the positioning of air-termination rods must be taken into account. The following standards must also be observed:

- IEC 62305: comprehensive framework for lightning and surge protection of PV systems.
- IEC TR 63227:2020: technical report with recommendations for the installation of lightning and surge protection systems for PV systems on buildings.
- IEC 60364-4-44 section 443, IEC 60364-5-53 section 534: installation of surge protection measures.
- IEC 60364-7-712: protection against electric shock, surges and lightning protection for PV systems.
- IEC 61643-32: selection, installation and coordination of surge arresters (SPDs) for PV systems.

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### → DIY planning made easy – with digital tools from DEHN

With our software solutions, you always have an overview of the entire process during planning, coordinate everyone involved and manage data and documents centrally. Discover our digital applications on page 9

Protect your PV power

# Secure your electricity yield. With protection solutions from DEHN.

Photovoltaics are increasingly shaping the global energy landscape. The more that is invested in these systems, the more important it becomes to protect the optimum energy yield. A comprehensive lightning and surge protection system that prevents failures and maximizes the service life of the components is therefore essential. This guide explains the important aspects when planning and implementing your protection solution.

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### What does a complete protection solution need?

In principle, a complete protection system consists of the following elements:

- External lightning protection with separation distances, an air-termination and down-conductor system and an earthing system with equipotential bonding
- Internal lightning protection with lightning equipotential bonding and surge protection

For optimum effectiveness, the protective measures must be professionally coordinated and positioned in accordance with the lightning protection zone concept.

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### Which protection solution for which installation configuration?

When selecting protection measures for PV systems, a basic distinction is drawn between the following applications:

- Ground-mounted system with central inverter
- Ground-mounted system with string inverter
- Rooftop system with external lightning protection, separation distance not maintained
- Rooftop system with external lightning protection, separation distance maintained
- Rooftop system without external lightning protection system

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### → DEHN product highlights

From external lightning protection and earthing to surge arresters of all types, we have developed the right products for every protection requirement. Reliable. High-quality. Sophisticated. See page 10 to find out more

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### → Protection solutions for every system type

Whether it's a ground-mounted or rooftop system, our example protection solutions demonstrate the protective measures that should be used for the respective installation configuration and how they can be professionally coordinated. Find out more on page 12

Standard-compliant and efficient

# Expert planning. With DEHN Engineering Services.

Our expertise in lightning and surge protection makes us unique. With DEHN Engineering Services, we have drawn on this expertise to develop a comprehensive range of services to plan your protection or help you in the planning process.

From initial project consultation to planning protection concepts and calculations to the finished protection solution, you can commission our engineers anywhere in the world to handle part or all of your project as best suits you. Our plans are developed in accordance with IEC, UL, EN or DIN standards and are customised to your location.

You can rely on the technical expertise and international experience of DEHN engineers when planning and implementing your project. We ensure that your project planning is precise, economical and sustainable. You save time and resources – and get your standard-compliant, customised protection concept from a single source.

## What we offer:

- Risk analysis and assessment
- Designs and plans
- Simulations
- Arc fault risk assessment

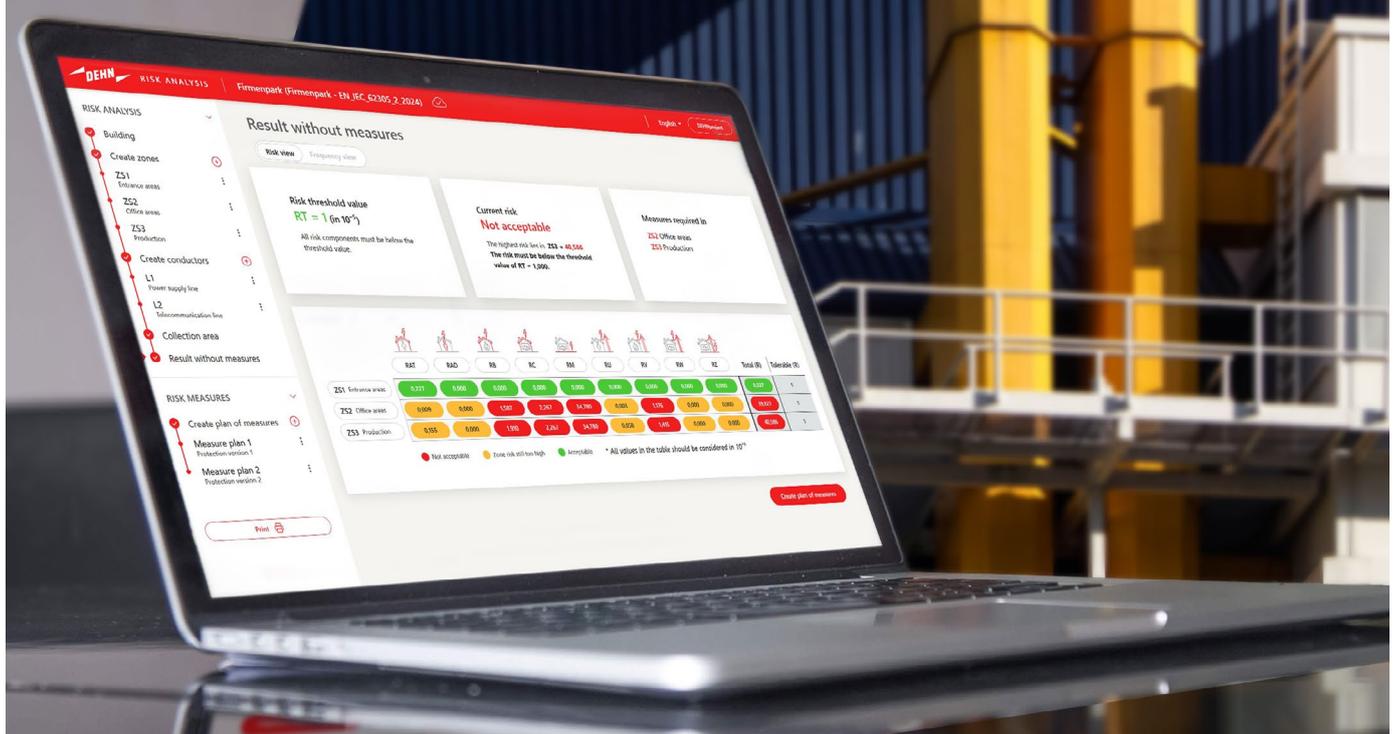
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**Get in touch with us**  
engineering.services@dehn.de

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**DEHN Engineering Services**  
Discover online:  
<http://de.hn/9mgNH>





## DEHN Engineering Services

# Risk analysis and assessment: essential for planning

Your protection planning starts with a risk analysis in accordance with IEC 62305-2, which includes determining the statistical probability of damage to your property caused by a lightning strike. Firstly, system and building parameters such as location and size are recorded. Lightning parameters, such as the number of strikes per year and square kilometre, and damage risks in terms of loss of human life, services or the economy are also included in the assessment.

The results show you:

- If you need a protection system.
- Which class of lightning protection system (LPS) applies for your building or installation (I-IV).
- On this basis, which measures are required for your LPS.

## Risk analysis and assessment with DEHN Engineering Services

Our experts carry out a full, professional risk assessment for you. To do this, we first determine the properties of your structure in consultation with you – which can include a visit to your site.

- Saves you time and resources
- Standard-compliant
- Maximum cost-effectiveness

### Our services:

- Determination of all types of damage to the structure and the associated damage risks R1 (loss of human life), R2 (loss of services to the public), R3 (loss of cultural heritage) and R4 (economic losses)
- Assessment of the risk of damage for each selected type of loss
- Assessment of the protection requirements by comparing the selected risks of damage (R1, R2 and R3) for a structure with the tolerable risk RT
- If R4 is selected, assessment of the economic efficiency of the protection by comparing the costs of a total loss with and without protection measures



DEHN Engineering Services

# Meeting all requirements when planning earthing systems

In order to minimise safety risks and ensure the long-term functionality of the PV system, it is essential to plan the earthing system in accordance with IEC 62305-3, IEC 60364-5-54, IEC 60364-7-712 and the recommendations of IEC TR 63227:2020. Omissions or errors cannot be corrected retrospectively or only at great expense. The standard distinguishes between individual vertical or horizontal earth electrodes, such as earth electrodes or flat conductors (type A) and closed ring earth electrodes or foundation earth electrodes for extensive connections (type B).

**Ground-mounted PV systems** require an earthing system that connects all supports at their base (type B). The type of earth electrode is selected depending on the earth resistance of the ground (earth rods for high resistance). High-alloy, corrosion-resistant materials should be used in aggressive soils. More on this from page 13.

**Rooftop systems** must be integrated into the building's existing earthing system and all metallic parts must be included in the functional equipotential bonding. More on this from page 20.

## Earthing planning with DEHN Engineering Services

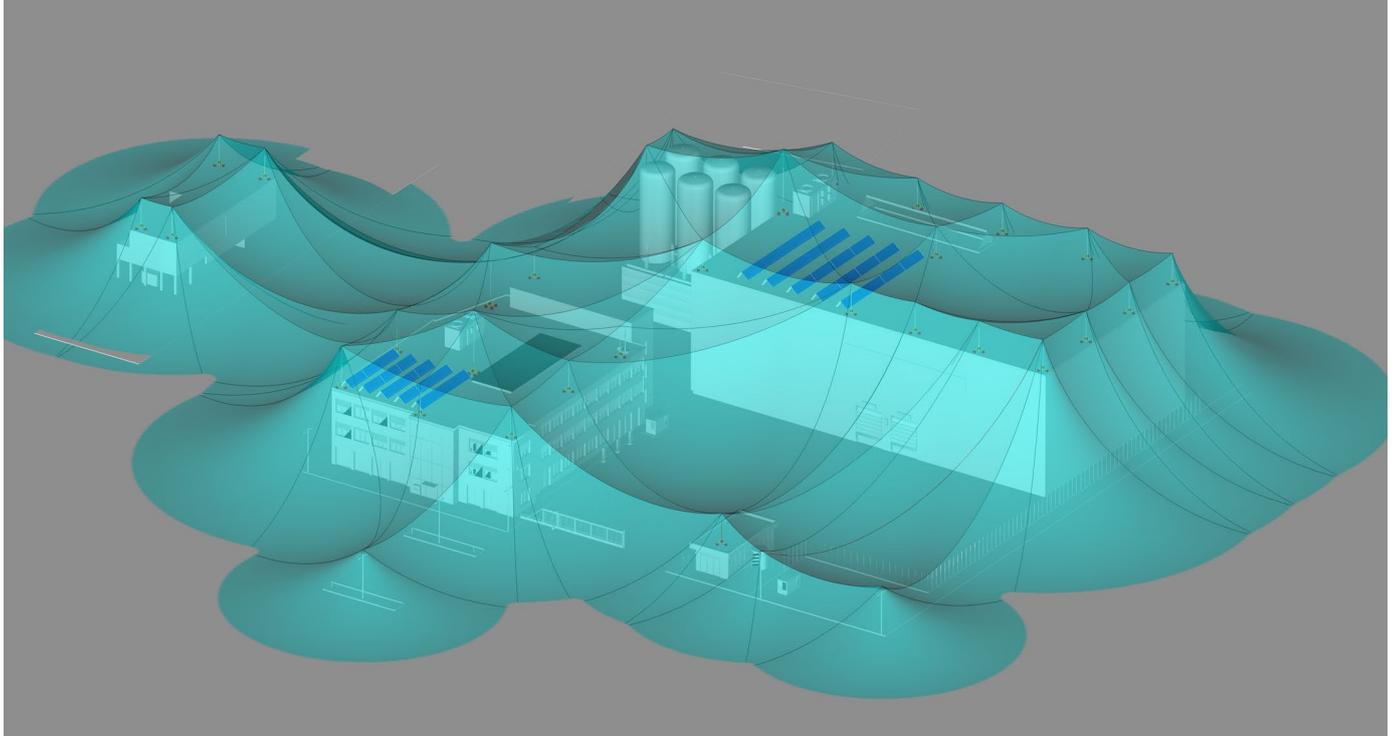
Our experts will ensure that the earthing for your PV system is planned professionally and in accordance with standards:

- Standard-compliant
- Cost-efficient
- Adapted to suit the conditions at your location

### Our services:

- Ground resistance measurement\*  
Physical testing of the ground at your site.
- Ground resistance analysis and report  
A representative soil model is created on the basis of the data from the physical measurement according to theoretical curves.
- Planning and dimensioning  
Simulation of step voltage under the influence of lightning or the short-circuit current. We design a safe earthing network based on the data obtained.
- Corrosion effect testing\*  
Inspection of risers and earthing mats for corrosion.

\*Availability depends on the region, please contact your local branch.



DEHN Engineering Services

# Lightning protection planning: safety in design

A lightning protection zone concept is created for planning an integrated protection solution. This shows where which measures are necessary. When positioning external lightning protection components, the separation distance to conductive metallic parts plays a particularly important role (see page 21).

To maximize output, care should also be taken to ensure that air-termination rods do not cast any shadows on the PV modules. Surge protection must be provided

on both the AC and DC sides as well as for data and communication lines.

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## Lightning protection zones explained

Find out how the subdivision into hazard zones works:  
<http://de.hn/adfnS>



## Lightning protection planning with DEHN Engineering Services

Find the right balance of ensuring protected volumes, maintaining separation distances, avoiding core shadows and coordinating protective measures with expert planning. Our experienced engineers are on hand to support you.

### Our services:

- 3D laser scanning  
High-precision laser scanning for as-built surveys of objects or installations, as well as processing and registering scans and point clouds.
- 3D modelling  
Drawing of the outer shell of the object or system to be protected in 3D CAD files.
- Enhanced lightning protection simulation  
The simulation analyses what would happen to a specific system in the event of a lightning strike.
- Protected volume check  
Inspection of existing lightning protection systems to determine whether the property or installation is completely within the protected volume.
- Lightning protection concept  
Creation of a complete external lightning protection system for your property or system with the help of our specialised software.
- Surge protection concept  
Recommendation for surge protection based on an analysis of low-voltage electrical or communication systems.



## DEHN Engineering Services

# Correctly assess arc fault hazards

It is mandatory for companies to protect their employees from arc fault hazards. An arc fault is an unwanted electric gas discharge between two electrodes. This creates an electric arc that can reach a temperature of up to 10,000 degrees Celsius and cause serious damage. This is why the requirements for protection against arc fault hazards in accordance with the OSHA must be met using NFPA 70E and IEEE 1584.

The extremely high temperatures of arc faults can cause materials to melt and even explode, posing a considerable risk to employees on site. The toxic vapours emitted by burnt plastic and metal parts can cause lung damage and the radiation emitted by the arc can cause serious eye injuries. The strong air expansion not only creates a high pressure effect, but also a dangerous sound blast of up to 140 dB.

## Arc flash risk assessment with DEHNarX

Get professional support to assess arc fault hazards correctly with DEHNarX – our service for risk assessment and designing protective measures according to the hierarchy of risk control.

- Meet the requirements of work safety legislation
- Save costs for staff training and equipment
- Guaranteed to meet all OSHA requirements

### Our services:

- Identifying arc fault protection objectives for employees and electrical installations.
- Checking existing protective measures and optimising them to the state of the art.
- Ensuring transparency across the company concerning the arc fault protection concept – from comprehensive documentation to arc flash labels.

Digital solutions

# DIY planning made easy. With tools from DEHN.



## DEHNrisk

### The easy way to assess risks

A professional risk analysis is the first step towards an efficiently, precisely and economically planned PV protection solution. To do this, use our web-based DEHNrisk application – our practical tool for anyone who wants to carry out their own risk assessment.

- Modern and intuitive interface – directly accessible via the customer portal.
- Efficient user navigation guides you through the process step by step.
- A quick and easy approach: DEHNrisk supports the determination and input of parameters that are necessary for the process.
- Complies with the latest IEC 62305-2:2024 and EN IEC 62305-2:2024 standards.



## DEHNplan

### Plan your lightning protection digitally

With the DEHNplan BIM-compatible software (Building Information Modelling), you can plan your own system. Your specialist knowledge of lightning protection and earthing, and your CAD skills, are enough to get started.

- 3D lightning protection and earthing planning according to IEC 62305
- BIM-compatible with IFC import and export
- Produce wind gust calculations
- Placement of air-termination systems and down conductors
- Access to the DEHN 3D component library
- Calculation and visual representation of the protected volume and separation distance
- Creation of an automatic bill of materials
- Centralised, web-based data storage, accessible from anywhere



## DEHNproject

### Everything on the screen. Everything on demand.

Bringing together the DEHNrisk and DEHNplan applications and all other project data:

DEHNproject gives you a comprehensive, cloud-based user interface for managing your protection concepts. On the web-based platform you can:

- Create different customers, projects or buildings with a customised structure.
- Assign concurrent user licences for simultaneous access by multiple users.
- Upload, download, copy, delete, etc. files such as measurement and analysis data.
- Export and import projects.
- Edit and manage templates for DEHNplan.

Discover  
DEHNrisk  
<http://de.hn/3A4Bi>



More about  
DEHNplan  
<http://de.hn/8W4NY>



All info about  
DEHNproject  
<http://de.hn/cmpvU>



Product highlights

# Build on safety. With quality from DEHN.



From surge protection, external lightning protection and earthing to occupational safety: We have the right solution for every type of system, every installation situation and every requirement.

- High-quality
- Reliable
- Standard-compliant

## Surge protection



**DEHNcombo  
YPV**

The Type 1 + 2 varistor-based combined arrester protects the DC side of the inverter, combiner box or PV modules. Suitable for small rooftop systems up to multi-megawatt systems. Optionally for system voltages up to 1,200 V and 1,500 V.



**DEHNguard  
MP YPV**

Type 2 multipole surge arrester to protect the DC side. The prewired complete unit has a practical push-in connection terminal to ensure easy installation, and the option of feed-through wiring saves you additional terminals. With a smaller housing for confined spaces.



Learn more:  
<http://de.hn/42QbG>



Learn more:  
<http://de.hn/bs65g>

## External lightning protection, earthing, equipotential bonding



**HVI - high-voltage-resistant  
insulated conductor**

Thanks to its special design, the high-voltage-resistant insulated conductor enables compliance with equivalent separation distances of 45 to 90 cm (air) to earthed metal building installations, depending on the HVI variant.



**Conductor material,  
round wires, strips**

Round wires, strips and cables of different materials and diameters. For use in lightning protection and earthing systems and in equipotential bonding.



Learn more:  
<http://de.hn/5F6A1>



Learn more:  
<http://de.hn/aE1Xg>



**DEHNcube  
PV**

Preassembled generator connection boxes for overvoltage protection of inverters and PV modules. Available in numerous versions: 1 MPP, 2 MPP and 3 MPP applications, as well as commonly used inverter types. The boxes can also be customised. Available with practical push-in technology or original MC4 plug-in connection.



**DEHNventil  
M2 880 FM**

As a tested Type 1 + 2 + 3 combined arrester in accordance with IEC 61643-11, it safeguards installations and terminal equipment within 10 metres of cable length from partial lightning currents and surges. DEHNventil combines lightning equipotential bonding, overvoltage protection and terminal equipment protection in just one device.



**DEHNcharge**

Prewired, two-pole combined arrester specially designed to protect large DC battery storage systems up to a system voltage of 1,500 V.



Learn more:  
<http://de.hn/7aLNc>



Learn more:  
<http://de.hn/96rhW>



Learn more:  
<http://de.hn/6i9un>



**Components for foundation  
earth electrodes**

Terminals for combining round and flat conductors and for connecting structural elements. Expansion, bridging and test joint components for connection to the earthing system.



**Components for  
earth rods**

Components for installing single earth electrodes in lightning protection and plant construction, including connection terminals.



**Equipotential bonding**

Pipe clamps, equipotential bonding bars and earthing busbars for equipotential bonding of external conductive parts and lightning equipotential bonding.



Learn more:  
<http://de.hn/3jDNr>



Learn more:  
<http://de.hn/7UHKs>



Learn more:  
<http://de.hn/2DPia>

# Maximum availability

## Protection for every PV system type. With solutions from DEHN.

- Ground-mounted PV systems:
  - Solar park with central inverter, from page 14
  - Solar park with string inverter, from page 16
  - Battery storage system, from page 18
  
- Commercial buildings:
  - Separation distance maintained, from page 22
  - Separation distance not maintained, from page 24
  - Metal roof and steel structure, from page 26
  
- Residential buildings, from page 28

Big numbers, big responsibility

# Protection for ground-mounted photovoltaic systems

Solar parks are an important pillar of renewable energy generation. For planning engineers or operators, ensuring the availability of the system and avoiding maintenance and repair costs are the top priority.

An integrated lightning and surge protection concept is essential. After all, as an integral part of the renewable energy mix, PV power plants must fulfil conditions for stable grid operation, often have a service life of at least 20 years and are measured by their annual performance ratio – i.e. their electricity yield. A lot depends on their reliability:

- Energy supply to the customer
- Profitability of the solar park
- Fulfilment of tender and funding criteria

Every failure jeopardises these basic requirements. Assessing the risk of damage from lightning strikes and designing protective measures are therefore an integral part of planning (see page 5). A distinction is made between systems with central inverters and systems with string inverters. The following section illustrates what a protection concept can look like for both versions.




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#### The best help for your planning:

Our DEHNrisk, DEHNplan and DEHN Engineering Services tools and services  
<http://de.hn/cmpvU>




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#### Protecting ground-mounted PV systems:

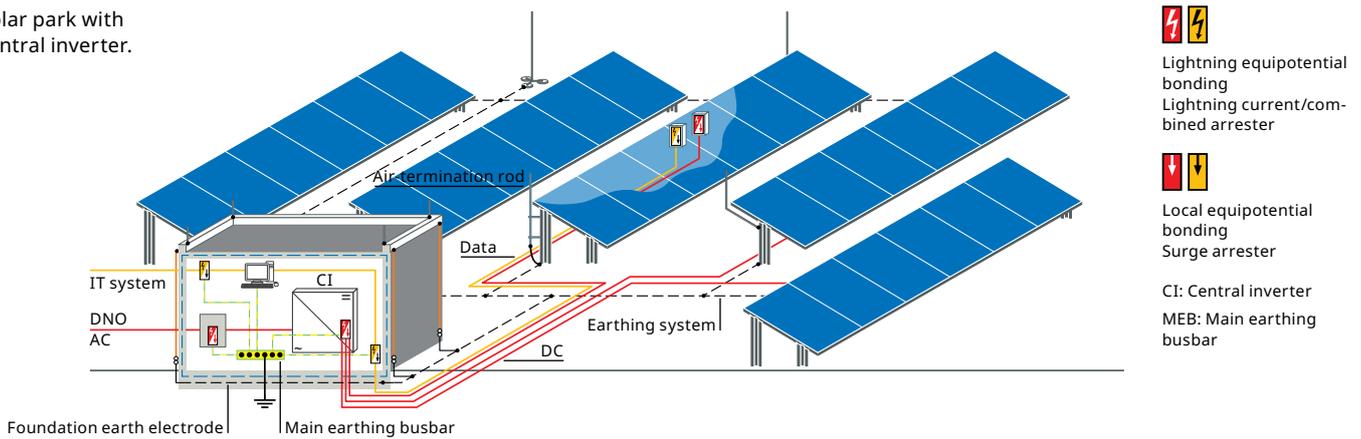
Concept and product selection online at  
<http://de.hn/9uRZR>



# Protection concept: Solar park with central inverter

These systems are usually set up with generator junction boxes or DC sub-distribution boards in the field and a central inverter near the transformer station. The generator junction boxes are usually located on the mounting system of the solar modules, where the respective strings are collected and routed to the central inverter.

Solar park with central inverter.



## Surge protection

In the event of a direct lightning strike on the air-termination system of the support frame, the DC cabling acts as an equipotential bonding conductor between the local earth potential of the module field and the "remote" equipotential surface of the central inverter. Partial lightning currents flow into the DC cabling with both low and high, specific earth resistance.

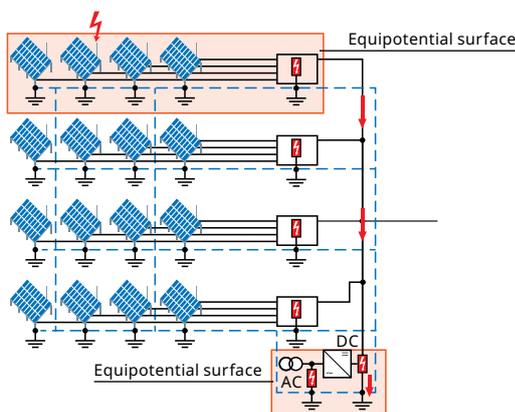
→ Due to the partial lightning currents to be expected, Type 1 + 2 combined arresters are also required to protect the DC system components in addition to the AC side.

## External lightning protection

Due to the arrangement of air-termination systems determined in the protection concept, these form a lightning-protected area above module fields and on system components such as inverters or battery storage systems. Planning is usually based on protective class III in accordance with IEC EN 62305.

→ Air-termination rods that are attached directly to the metal or mounting system of the PV modules in ground-mounted PV systems serve as air-termination systems. The mounting frame also serves as a down conductor and connection to the earthing system.

Intermeshed earthing system.



⚡ Type 1 AC SPDs  
↓ Partial lightning currents

## Earthing

An earthing system forms the basis of lightning and surge protection measures in PV power plants. The requirements are described in IEC 62305-3 and IEC TR 63227.

→ The metal module racks can be used as part of the mesh. We recommend interconnecting racks to create a large-scale meshed earthing system.

Frame constructions using pile-driven and screw-in foundation technology can also be used as earth electrodes, provided their material and wall thickness fulfil the specifications in Table 7 of IEC 62305-3. The IEC 61936-1 standard must be taken into account, especially for the earthing systems of operations buildings (including transformer stations).

The earthing systems of PV generators and the operations buildings must be connected to each other using a 30 x 3.5 mm flat strip or 10 mm round wire (V4A stainless steel material).

## Our protection solutions: System with central inverter

### DC side central inverter



**DEHNCombo  
YPV 1200 FM**

Part no. 900 075

Multipole, Type 1 + 2 combined arrester for photovoltaic generator circuits. For protecting photovoltaic inverters against surges and even direct lightning strikes.



**DEHNCombo  
YPV 1500 FM**

Part no. 900 076

Multipole, Type 1 + 2 combined arrester for photovoltaic generator circuits.

### AC side and data interface



**DEHNventil  
M2 880 FM**

Part no. 961 151

Set consisting of pluggable lightning and surge arresters, including insulated module wiring bar. For use in inverter systems with active anti-PID with maximum DC offset of 750 V DC. Wiring of the earthing systems in accordance with IEC 60364-4-44, Table 44.A1 – RE and Z as well as RE and RA connected.



**DEHNBloc Maxi  
1 CI 760 FM**

Part no. 961 176

Single-pole, coordinated, Type 1, spark-gap-based lightning current arrester and with integrated arrester backup fuse. High follow current extinguishing capability and follow current limitation due to RADAX Flow technology.



**DEHNpatch  
CL8 EA 4PPOE**

Part no. 929 161

Universal, space-saving combined arrester with RJ45 connection technology and status indication. For protecting Ethernet applications. With powerful gas discharge arrester and protective diodes, fully shielded adapter design, optional earth connection.



**BLITZDUCTORconnect  
ML2 BD HF 5**

Part no. 927 271

Space-saving, modular combined arrester with push-in connection terminal and status indication for protecting one pair of unearthed high-frequency bus systems and balanced interfaces. With signal disconnection for maintenance purposes.

### External lightning protection and earthing



**Earthing conductor**

Part no. 860 050

Stainless steel wire for use in lightning protection and earthing systems or equipotential bonding.



**MV clamp  
with locking lug**

Part no. 391 070

The locking lug is used to lock the MV clamp securely in a cross arrangement.



**UNI seam clamp**

Part no. 365 250

For integrating the mounting systems of PV systems into functional equipotential bonding, functional earthing and lightning equipotential bonding.



**Air-termination tip  
including seam clamp**

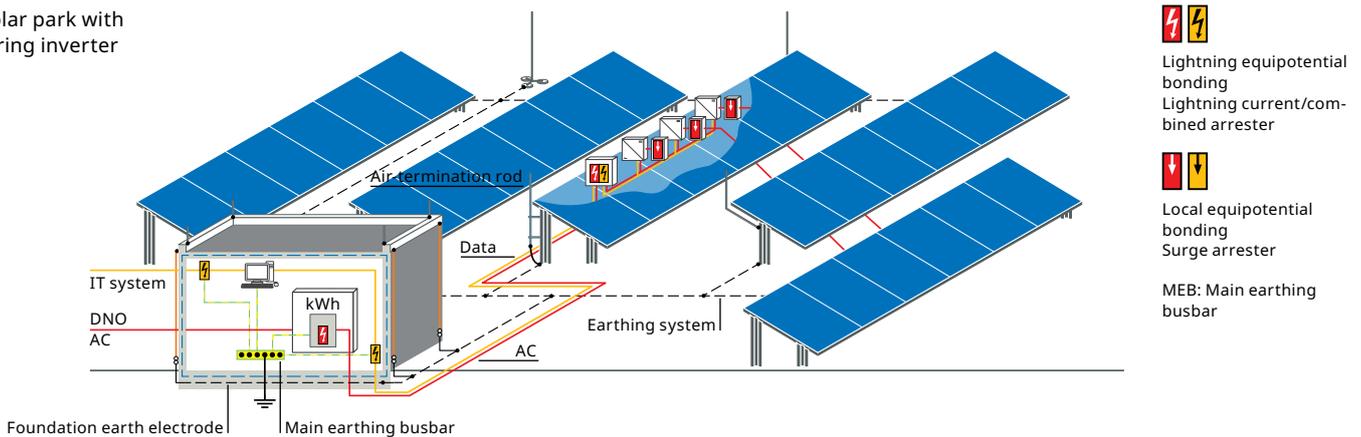
Part no. 101 110

Air-termination tip, including two seam clamps, for protecting free field photovoltaic systems or carports with a PV system against direct lightning strikes.

# Protection concept: Solar park with string inverter

PV system concepts with string inverters are usually set up in a decentralised structure. The inverters are mounted here in the field under the module racks of the respective solar generators and perform the typical functions of generator junction boxes. The AC side of the inverter is connected to a central feed transformer via a generally longer cable.

Solar park with string inverter



## Surge protection

In string inverters, the power cabling again acts as an equipotential bonding conductor between the "local" earth potential of the module field and the "remote" equipotential surface of the feed transformer.

→ **Difference to a system with a central inverter:**  
 In systems with string inverters, the partial lightning currents flow on the AC cables.

Accordingly, Type 1 + 2 combined arresters must be installed on the AC side and the low-voltage side of the in-feed transformer. With an appropriately designed earthing system, the string inverters and the module field connected to them form a local equipotential surface so that no lightning currents are to be expected on the DC cabling. That means Type 2 arresters are sufficient on the DC side.

## String inverter:

- Depending on the size, constructed as a 230/400 V system or as an IT system without a neutral conductor with higher voltages up to 800 V.

## For systems with 230/400 V:

- Type 1 + 2 combined arrester, for example DEHNventil M2, on the AC side of the inverter and on the low-voltage side of the transformer.

## For three-phase IT systems up to 800 V:

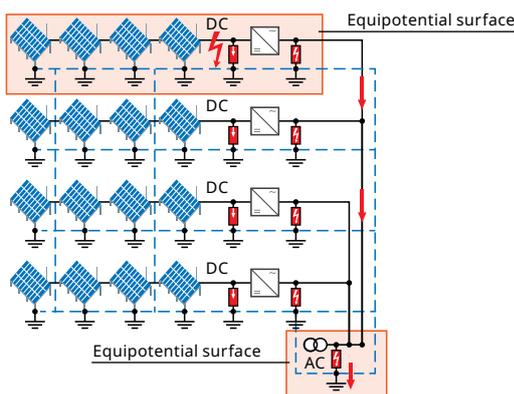
- On the AC side, the DEHNventil M2 880 FM can be used, even with active anti-PID measures.

## On the DC side of the string inverter:

- Type 2 SPDs (e.g. DEHNguard M YPV) are sufficient.

## Communication interfaces:

- Protect with suitable surge arresters.



Intermeshed earthing system.



## PID effect in PV modules

With transformerless string inverters, a direct earth connection of the negative pole of the PV generator cannot be made. This results in a high negative potential difference to earth at modules close to the negative pole, which can lead to potential-induced degradation (PID) and a reduction in yield. Inverters for 800 V IT systems often have an anti-PID function that equalises the potential difference with a DC offset. This offset, maximum UDC/2, also affects surge protection devices, which must be selected so that they do not respond.

## External lightning protection and earthing

Identical to systems with a central inverter – see page 14.

## Our protection solutions: System with string inverter

### DC side and auxiliary power supply



**DEHNguard  
M YPV 1500 FM**

Part no. 952 567

Multipole, Type 2 surge arrester, consisting of a base part and plug-in protection modules. High device reliability due to Thermo Dynamic Control arrester monitoring.



**DEHNguard  
MP YPV 1500 FM**

Part no. 942 567

Multipole, Type 2 surge arrester, consisting of a base part with plug-in protection modules and double-push-in connection clamp, suitable for stub wiring and feed-through wiring. High device reliability due to Thermo Dynamic Control arrester monitoring.



**DEHNcube  
2 YPV 1100 2M 2S**

Part no. 900 923

Generator junction box for PV systems with IP65 degree of protection. For protecting 2 MPP inputs and 2 strings each.



**DEHNcube  
2 YPV 1100 2M 1S MC4**

Part no. 900 924

Generator junction box for PV systems with IP65 degree of protection and original MC4 plug-in connection. For protecting 2 MPP inputs and 1 string each.

### AC side and data interface



**DEHNventil  
M2 880 FM**

Part no. 961 151

Set consisting of pluggable lightning and surge arresters including insulated modular wiring busbar. For use in inverter systems with active anti-PID with maximum DC offset of 750 V DC. Wiring of the earthing systems in accordance with IEC 60364-4-44, Table 44.A1 – RE and Z as well as RE and RA connected.



**DEHNventil  
M2 TNS 255 FM**

Part no. 956 405

Four-pole, spark-gap-based, Type 1 + 2 + 3 combined arrester. Consisting of a base part and a plug-in protection module. Maximum system availability due to rapid arc control (RAC) spark gaps. Enables the protection of terminal equipment.



**DEHNpatch  
CL8 EA 4PPOE**

Part no. 929 161

Universal, space-saving combined arrester with RJ45 connection technology and status indication. For protecting Ethernet applications. With powerful gas discharge arrester and protective diodes, fully shielded adapter design, optional earth connection.



**BLITZDUCTORconnect  
ML2 BD HF 5**

Part no. 927 271

Space-saving, modular combined arrester with push-in connection terminal and status indication for protecting one pair of unearthed high-frequency bus systems and balanced interfaces. With signal disconnection for maintenance purposes.

### External lightning protection and earthing



**Earthing conductor**

Part no. 860 050

Stainless steel wire for use in lightning protection and earthing systems or equipotential bonding.



**MV clamp  
with locking lug**

Part no. 391 070

The locking lug is used to lock the MV clamp securely in a cross arrangement.



**UNI seam clamp**

Part no. 365 250

For integrating the mounting systems of PV systems into functional equipotential bonding, functional earthing and lightning equipotential bonding.



**Air-termination tip  
including seam clamp**

Part no. 101 110

Air-termination tip, including two seam clamps, for protecting ground-mounted PV systems or carports with a PV system against direct lightning strikes.

# Protection concept: Battery storage systems

The energy revolution requires reliable storage solutions to balance out the fluctuating feed-in of renewable energies and ensure a stable energy supply.

Battery storage systems play a key role, as they are an efficient way to store surplus electricity and supply it to the grid or for intrinsic consumption when required. But even though these systems are highly efficient, they are also sensitive to external influences – especially lightning and surge damage.



Surges, direct lightning strikes and mains-induced voltage peaks jeopardise the sensitive electronics of battery storage systems.

## External lightning protection

The design of the lightning protection system depends on the results of the risk analysis in accordance with IEC 62305-2 and the specific site conditions of the storage facility.

→ Our high-voltage-resistant, insulated HVI Conductors are used to prevent lightning current from being conducted via the battery storage container.

Isolated lightning protection is installed using free-standing air-termination rods. If the container is to discharge the direct lightning strike directly into the ground via its metal enclosure, air-termination tips are installed as defined strike points.

The developed earthing system is installed with a flat strip measuring 30 x 3.5 mm or alternatively with a round wire with a diameter of 10 mm.

## Surge protection

On the AC side:

- Type 1 surge arresters, such as DEHNvenCI, DEHNbloc Maxi CI or DEHNventil, are used depending on the lightning protection system, the voltage magnitude, the maximum short-circuit current and the type of network.

On the DC side:

- Depending on the lightning protection concept, Type 1 DC arresters such as DEHNcharge or Type 2 arresters such as DEHNguard M DC ACI must be used.

Measuring and control system protection:

- Type 1 combined arresters from the BLITZDUCTORconnect product range are suitable for protecting measuring and control equipment, such as RS485 interfaces.
- The integrated LifeCheck function provides the opportunity to deliver a "predictive maintenance concept".
- The respective signal statuses can be communicated via the floating remote signalling contact.

Further information and communication interfaces:

- Ethernet is protected with DEHNpatch.

## Why protecting the battery modules is important:

The DEHNcharge and DEHNguard M DC ACI arresters are ideally suited for this purpose as they have been specially developed for use in battery storage systems. When selecting SPDs for specific use in DC systems, care must be taken to select and dimension the fuses correctly. DEHNcharge and DEHNguard M DC ACI are particularly suitable for high short-circuit currents due to the batteries. The DEHNcharge T1 BATT 1500 FM Type 1 + 2 arrester is suitable for protecting the connecting cables of the batteries and the inverter DC outputs when installed between different zones. If there is no zone transition, the DEHNguard M DC ACI 1250 FM Type 2 arrester is an excellent choice, as it means no additional DC fuses are required.

## Our protection solutions: Battery storage systems

### DC side and auxiliary power supply



**DEHNcharge  
T1 BATT 1500 FM**

Part no. 900 095

Type 1 + 2, multipole, for battery storage systems. With combined disconnection and short-circuiting device. For protecting battery storage systems, even against direct lightning strikes.



**DEHNguard  
M DC ACI 1250 FM**

Part no. 972 150

Modular, pluggable, Type 2 surge arrester with mechanical function/fault indication for DC charging equipment up to 1,250 V.



**DEHNshield Basic  
TNS FM 255 FM**

Part no. 941 406

Multipole, spark-gap-based, Type 1 + 2 combined arrester. Space-saving spark gap technology with a width of only 1 module/pole enables a compact design.

### AC side and data interface



**DEHNventil  
M2 880 FM**

Part no. 961 151

Set consisting of pluggable lightning and surge arresters including insulated modular wiring busbar. For use in inverter systems with active anti-PID with maximum DC offset of 750 V DC. Wiring of the earthing systems in accordance with IEC 60364-4-44, Table 44.A1 – RE and Z as well as RE and RA connected.



**DEHnbloc Maxi  
1 CI 760 FM**

Part no. 961 176

Single-pole, coordinated, Type 1, spark-gap-based lightning current arrester and with integrated arrester backup fuse. High follow current extinguishing capability and follow current limitation due to RADAX Flow technology.



**DEHNpatch  
CL8 EA 4PPOE**

Part no. 929 161

Universal, space-saving combined arrester with RJ45 connection technology and status indication. For protecting Ethernet applications. With powerful gas discharge arrester and protective diodes, fully shielded adapter design, optional earth connection.

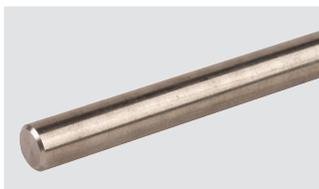


**BLITZDUCTORconnect  
ML2 BD HC5A 24**

Part no. 927 254

Space-saving, modular combined arrester with push-in connection terminal and status indication for protecting one pair of unearthed signal circuits with a high nominal current for IT systems and measuring and control circuits.

### External lightning protection and earthing



**Earthing conductor**

Part no. 860 050

Stainless steel wire for use in lightning protection and earthing systems or equipotential bonding.



**MV clamp  
with locking lug**

Part no. 391 070

The locking lug is used to lock the MV clamp securely in a cross arrangement.



**UNI seam clamp**

Part no. 365 250

For integrating the mounting systems of PV systems into functional equipotential bonding, functional earthing and lightning equipotential bonding.



**HVI light plus  
Conductor**

Part no. 819 609

High-voltage-resistant, insulated down conductor, for maintaining the separation distance to live parts. For on-site assembly. Equivalent separation distance  $s \leq 60$  cm (in air);  $s \leq 120$  cm (solid material).

Reliability comes first

# Protection for PV systems on commercial buildings

Buildings used for commercial and industrial purposes pose particular challenges for lightning protection. Limited space, shading problems or architectural specifications make planning difficult. This is how to deal with it.



PV systems are also increasingly being installed on the roofs of industrial and commercial buildings. They enable greater independence from electricity suppliers, and the effects of price fluctuations and peak loads can be mitigated. The requirements for the use of photovoltaics are:

- Stability of the power supply
- Economic efficiency of the system

Lightning and surge protection measures are therefore an integral part of the installation of PV systems in the commercial sector – and are mandatory in many places in relation to public buildings or parts of critical infrastructure. Lightning protection is often already in place in these locations before the PV system is installed. As a general rule, PV systems on buildings must not impair existing lightning protection measures.

Mistakes in the planning and implementation of your protection concept can have serious consequences. So we are at your side as a reliable partner, with sophisticated protection solutions and an all-round service that protects you in all areas.

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**The best help for your planning:**  
Our DEHNrisk, DEHNplan and DEHN Engineering Services tools and services  
<http://de.hn/cmpvU>



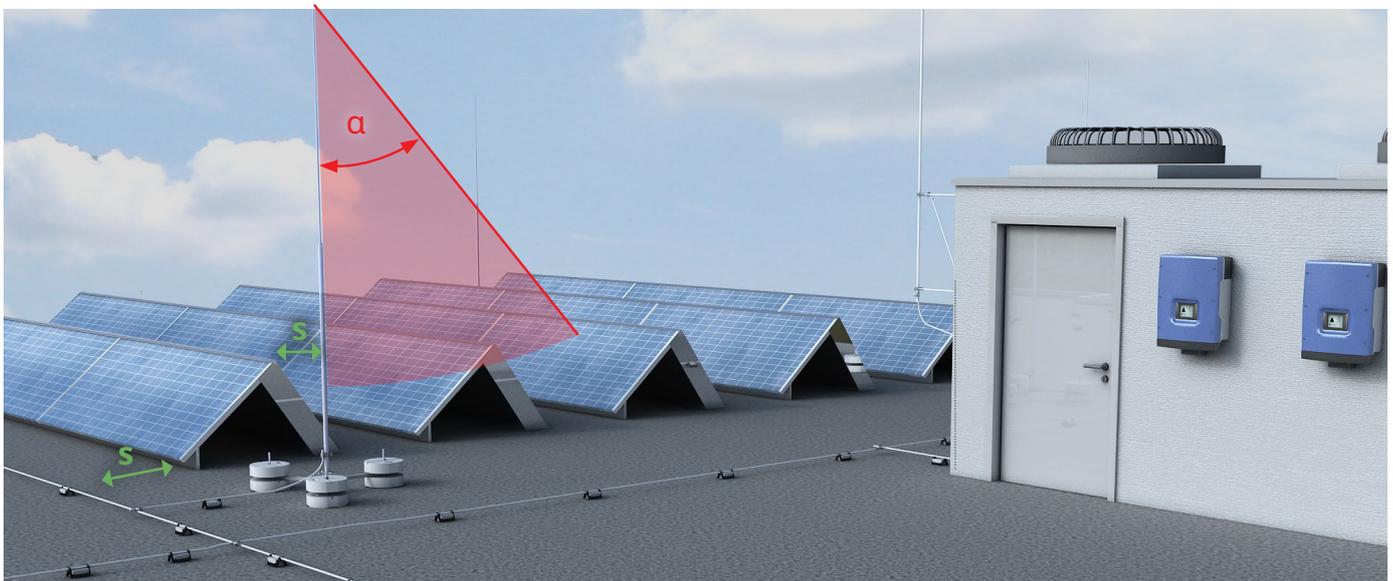
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**Protecting PV systems on commercial buildings:**  
Concept and product selection online at  
<http://de.hn/9u5H2>



# Protection concept: Rooftop solar system with external lightning protection

When planning protective measures for buildings with external lightning protection, compliance with the separation distance "s" is an important aspect. This prevents dangerous flashovers between metal parts of the PV structure (e.g. the PV mounting system) and the lightning-current-carrying components of the lightning protection system (air-termination systems, down conductors, etc.). In the worst-case scenario, these flashovers can lead to fires.



Compliance with the separation distance "s" and design of the protected volume for PV systems.

## External lightning protection

In accordance with IEC 62305, an external lightning protection system consists of an air-termination system installed on the roof, which is connected to the earth-termination system via down conductors.

→ As it is often difficult to maintain the required separation distances in practice, we at DEHN have developed a high-voltage-resistant insulated lightning protection system – HVI for short. Thanks to their unique design with a special sheath, HVI Conductors allow an equivalent separation distance to be maintained, even in complicated, cramped installation situations on the roof.

## Surge protection

Surges as a result of thunderstorms often lead to the destruction of system parts such as the inverter or components that are central to energy management control.

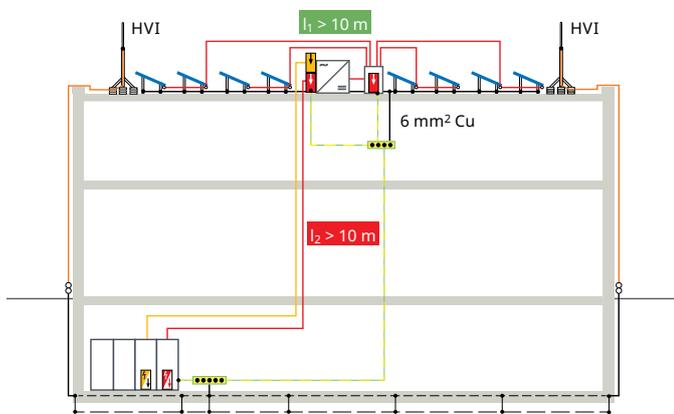
→ Lightning and surge arresters prevent this cost-intensive damage to electrical and electronic components of the PV system.

In order to select the appropriate arrester, a distinction is made when creating the protection concept as to whether the separation distance is maintained ( $\geq s$ ) or not maintained ( $\leq s$ ) (see following pages).

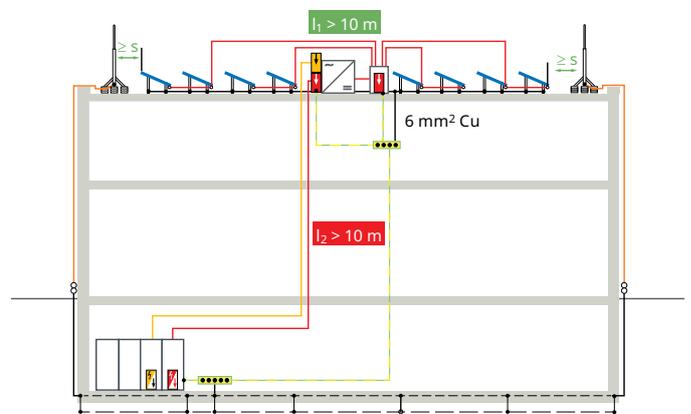
# Building with external lightning protection system: Separation distance maintained

On the roofs of industrial buildings in particular, ventilation or air conditioning shafts often restrict the available space even further, making it difficult to maintain the separation distance. With our HVI Conductors, you can create an equivalent separation distance of e.g.  $s \leq 0.60$  m (air).

Building with HVI Lightning Protection:  
Separation distance maintained (optimum utilisation of the available roof surface for the PV system).



Building with a conventional lightning protection system:  
Separation distance maintained



In addition, for buildings with an external lightning protection system and maintained separation distance in accordance with IEC 60364-7-712, the metal mounting system of the PV system must be integrated into the functional equipotential bonding with at least 6 mm<sup>2</sup> copper (Cu).

### Surge protection

In addition to the external lightning protection, the lightning equipotential bonding or internal lightning protection in accordance with IEC 62305-3 must also be provided.

### Establishing lightning equipotential bonding in the main distribution board/LVMDB:

Type 1 + 2 combined arresters, e.g. DEHNventil M2 255 FM and BLITZDUCTORconnect ML2 BD HF 5, are installed in the building's electrical supply and data lines.

### Protecting the AC side of the inverter:

For cable lengths greater than 10 m (e.g. inverters on the roof), a Type 2 surge protective device for the AC side, e.g. DEHNguard M TNS 275 FM, is also installed as close as possible to the inverter.

### Protecting the DC side of the inverter:

For special protection of the inverter, a type 2 surge protector, e.g. the prewired DEHNCube 2 YPV system solution for 1 MPPT and 2 MPPT applications, must be installed as close as possible to the MPP inputs.

## Our protection solutions: Rooftop installations with separation distance maintained

### Surge protection



**DEHNventil  
M2 TNS 255 FM**

Part no. 956 405

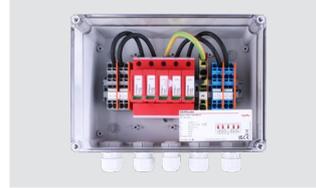
Four-pole, modular combined arrester for Type 1 + 2 + 3 TN-S systems. Spark-gap-based, with plug-in protection module and Rapid Arc Control (RAC) for maximum system availability.



**DEHNcube  
2 YPV 1100 2M 1S MC4**

Part no. 900 924

Generator junction box for PV systems with IP65 degree of protection and original MC4 plug-in connection. For protecting 2 MPP inputs and 1 string each.



**DEHNcube  
2 YPV 1100 2M 2S**

Part no. 900 923

Generator junction box for PV systems with IP65 degree of protection. For protecting 2 MPP inputs and 2 strings each.



**DEHNguard  
M TNS 275 FM**

Part no. 952 405

Four-pole, Type 2 surge arrester, consisting of a base part and plug-in protection modules. High device reliability due to Thermo Dynamic Control arrester monitoring.



**BLITZDUCTORconnect  
ML2 BD HF 5**

Part no. 927 271

Space-saving, modular combined arrester with push-in connection terminal and status indication for protecting one pair of unearthed high-frequency bus systems and balanced interfaces. With signal disconnection for maintenance purposes.



**DEHNpatch  
CL8 EA 4PPOE**

Part no. 929 161

Universal, space-saving combined arrester with RJ45 connection technology and status indication. For protecting Ethernet applications. With powerful gas discharge arrester and protective diodes, fully shielded adapter design, optional earth connection.



**DEHNrecord  
IRCM**

Part no. 910 710

DIN-rail-mounted device set with integrated visual transmitter/receiver and reverse unit for condition monitoring of BLITZDUCTORconnect and DEHNpatch arresters. Indication via LED group display combined with remote signalling.

### External lightning protection / equipotential bonding



**HVI light plus**

Part no. 819 674

High-voltage-resistant, insulated down conductor (copper) in the supporting tube, for maintaining the separation distance to live parts. With interior sealing end, EB spring element, air-termination tip and earth connection element.



**Hinged tripod**

Part no. 107 390

Hinged, for supporting tubes with side outlet or air-termination rod with adapter set (part no. 107 399). With double clamp for connection and base holder set for adjusting to the roof pitch.



**Equipotential bonding bar**

Part no. 472 207

For industrial applications, with six connections for functional equipotential bonding and lightning equipotential bonding. With UP insulator and thread, UV-stabilised, halogen-free. Suitable for use in hazardous areas.



**UNI earthing clamp**

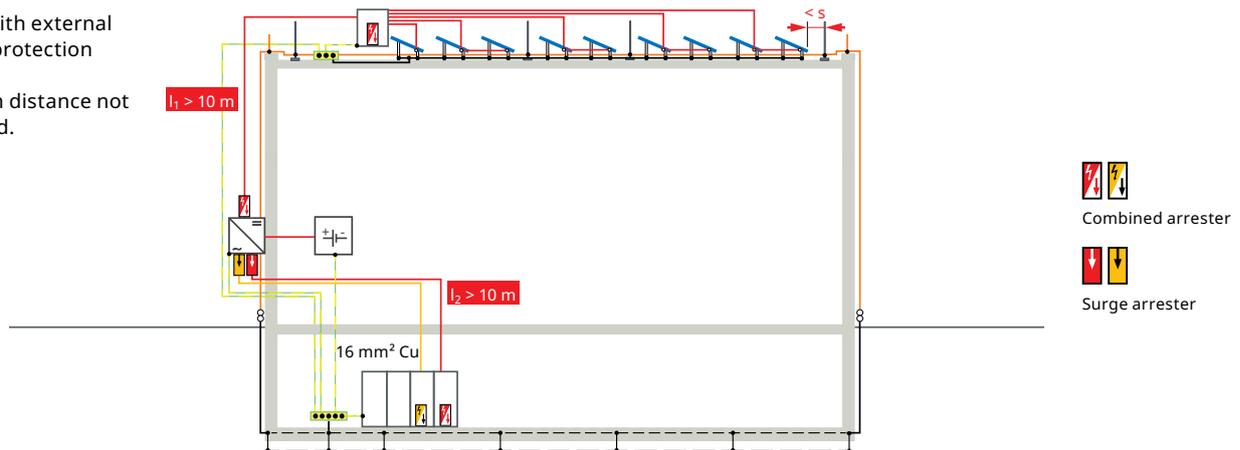
Part no. 540 249

UNI earth clamp for integrating the mounting systems of PV systems in functional equipotential bonding/functional earthing and lightning equipotential bonding.

# Building with external lightning protection system: Separation distance not maintained

The external lightning protection system is designed conventionally with air-termination rods, air-termination tips and a meshed network (e.g. 15x15 m for lightning protection class III) in accordance with the rolling sphere method or a meshed network in accordance with IEC 62305-3.

Building with external lightning protection system:  
Separation distance not maintained.



## Lightning equipotential bonding

If the separation distance "s" calculated in accordance with IEC 62305-3 cannot be maintained, local lightning equipotential bonding is required to prevent dangerous sparkovers and fires. This means that the PV system, in particular the mounting system, must be connected directly and with lightning current carrying capacity (at least 16 mm<sup>2</sup> Cu, 8 mm round Al or Cu or equivalent) to the external lightning protection system.

→ When connected to the external lightning protection, lightning currents are conducted into the interior of the building, which means lightning equipotential bonding of the electrical supply and data lines of the PV system is required.

## Lightning and surge protection

Compared to when the separation distance is maintained, the main difference is that all SPDs used in this concept must demonstrate a lightning-current-carrying capacity with test currents of the 10/350 μs waveform. This is done using (Type 1 + 2) combined arresters on the AC, DC and data side.

## Establishing lightning equipotential bonding in the main distribution board/LVMDB:

Type 1 + 2 combined arresters, e.g. DEHNventil M2 255 FM and BLITZDUCTORconnect ML2 BD HF 5, are installed in the building's electrical supply and data lines.

## Protecting the DC side of the inverter:

For special protection of the inverter, a combined Type 1 + 2 arrester, e.g. DEHNcombo YPV 1200 FM, must be installed as close as possible to the MPP inputs.

## Protecting the AC side of the inverter:

For cable lengths greater than 10 m (e.g. inverters on the roof), a Type 1 surge protective device for the AC side, e.g. DEHNventil M2 TNS 255 FM, is also installed as close as possible to the inverter.

→ If the cable length between the arrester or generator junction box and the device to be protected is more than 10 metres, additional Type 1 protective devices must also be used.

The lightning-current-carrying cables can jeopardise other electrical and safety technology installations in the building. The following measures should therefore be taken for the PV lines:

- Installation outside the building
- Additional shielding measures, e.g. closed metal cable ducts

## Our protection solutions: Rooftop installations without separation distance maintained

### Surge protection



**DEHNCombo  
YPV 1200 FM**

Part no. 900 075

Multipole, Type 1 + 2 combined arrester for photovoltaic generator circuits. For protecting photovoltaic inverters against surges and even direct lightning strikes.



**DEHNCube  
2 YPV 1 + 2 1000 2M 2S FM**

Part no. 900 976

Generator junction box for PV systems with IP65 degree of protection. For protecting 2 MPP inputs and 2 strings each.



**DEHNCube  
2 YPV 1 + 2 1200 2M 1S MC4**

Part no. 900 986

Generator junction box for PV systems with IP65 degree of protection and original MC4 plug-in connection. For protecting 2 MPP inputs and 1 string each.



**DEHNventil  
M2 TNS 255 FM**

Part no. 956 405

Four-pole, modular combined arrester for Type 1 + 2 + 3 TN-S systems. Spark-gap-based, with plug-in protection module and Rapid Arc Control (RAC) for maximum system availability.



**BLITZDUCTORconnect  
ML2 BD HF 5**

Part no. 927 271

Space-saving, modular combined arrester with push-in connection terminal and status indication for protecting one pair of unearthed high-frequency bus systems and balanced interfaces. With signal disconnection for maintenance purposes.



**DEHNpatch  
CL8 EA 4PPOE**

Part no. 929 161

Universal, space-saving combined arrester with RJ45 connection technology and status indication. For protecting Ethernet applications. With powerful gas discharge arrester and protective diodes, fully shielded adapter design, optional earth connection.



**DEHNrecord  
IRCM**

Part no. 910 710

DIN-rail-mounted device set with integrated visual transmitter/receiver and reverse unit for condition monitoring of BLITZDUCTORconnect and DEHNpatch arresters. Indication via LED group display combined with remote signalling.

### External lightning protection / equipotential bonding



**Air-termination rod**

Part no. 105 525

Self-supporting air-termination rods with tripod for protecting roof-mounted structures, adjustable to a roof pitch up to max. 10°. The concrete base (part no. 102 075 or 102 010) and the plastic base plate (part no. 102 060 or 102 050) have to be ordered separately.



**UNI earthing clamp**

Part no. 540 249

UNI earth clamp for integrating the mounting systems of PV systems in functional equipotential bonding/functional earthing and lightning equipotential bonding.



**UNI seam clamp**

Part no. 365 250

For integrating the mounting systems of PV systems into functional equipotential bonding, functional earthing and lightning equipotential bonding.



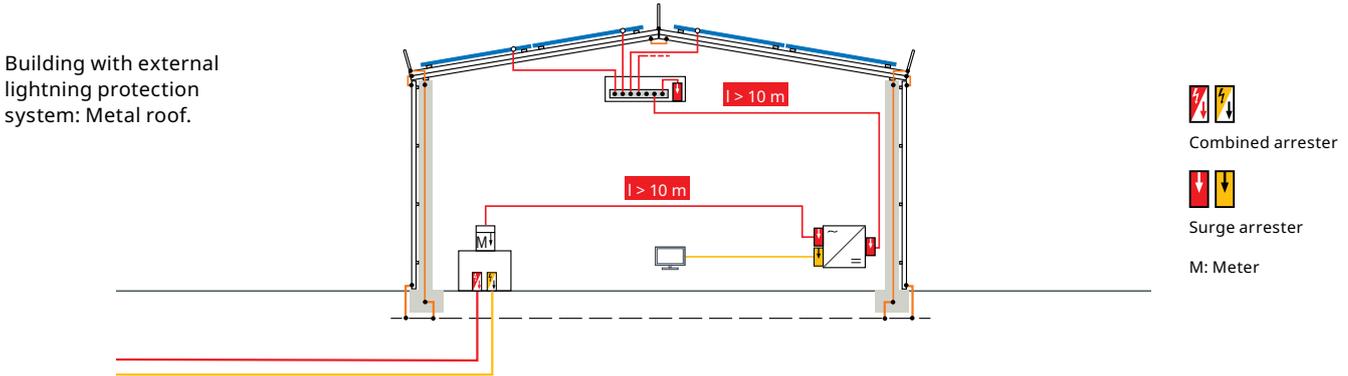
**DEHNalu  
round wire**

Part no. 840 018

Soft, twistable aluminium wire, for use in lightning protection systems as an air-termination system, down conductor or equipotential bonding.

# Building with external lightning protection system: Metal roof and steel structure

For functional buildings or halls with a steel frame construction and sheet metal roof, you can utilise the conductive elements of the existing building structure as an effective component of your lightning protection system.



## Air-termination system

In principle, the metal roof coverings must be connected to each other so that they can carry lightning currents and the minimum dimensions / sheet thicknesses must comply with IEC 62305-3. As metal sheets or panels are usually 0.7–1.2 mm thick, in most cases they cannot be used as air-termination systems (direct lightning strikes can melt or perforate the metal roof). In this case, you need standard-compliant external lightning protection with air-termination rods, air-termination conductors, etc.

## Down conductors

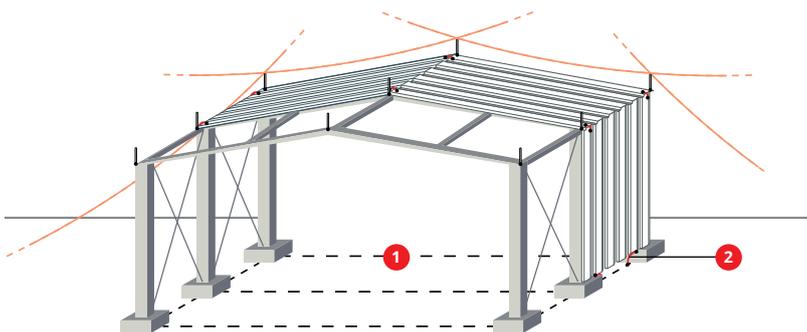
Steel supports that serve as down conductors must be connected to the earthing system at the base point (regardless of the distance between supports). The metal façade serves as a down conductor and must be connected to the earthing system at regular intervals if it is not already connected to the steel supports. For support spacings > 5 m, additional connections of the metal façade to the earthing system are recommended.

## Surge protection

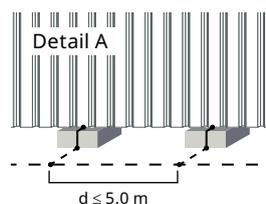
The PV mounting system is installed directly on the metal roof and is therefore directly and electrically conductively connected to the external lightning protection system. A separation distance cannot be maintained here due to the design. In combination with steel girders, however, a metal roof like this can form what is known as a reference plane or equipotential surface for the separation distance calculation. In the event of a direct lightning strike, the lightning current is distributed over a large area and is safely discharged via many parallel paths. The calculated separation distance is practically zero due to this design across the entire outer shell of the hall.

As a result, only very low partial (lightning) currents are to be expected on the individual PV supply lines, which can be managed with Type 2 surge protective devices.

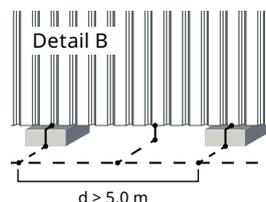
→ If the cable length between the arrester and the device to be protected is more than 10 m, additional Type 2 surge arresters must be used.



Steel hall with continuous metal cladding and PV system.



1 Mesh size of ring earth electrode according to IEC 62305-3 max. 10 x 10 m



2 The foot of each steel support must be connected to the earthing system. The metal cladding should be connected at a distance ≤ 5.0 m

## Our protection solutions: Buildings with metal roofs

### Surge protection



**DEHNventil  
M2 TNS 255 FM**

Part no. 956 405

Four-pole, modular combined arrester for Type 1 + 2 + 3 TN-S systems. Spark-gap-based, with plug-in protection module and Rapid Arc Control (RAC) for maximum system availability.



**DEHNcube  
2 YPV 1100 1M 1S MC4 FM**

Part no. 900 911

Prewired system solution with integrated Type 2 arrester; for 1 MPPT / 1 string with original MC4 plug connection.



**DEHNguard  
M TNS 275 FM**

Part no. 952 405

Four-pole, Type 2 surge arrester, consisting of a base part and plug-in protection modules. High device reliability due to Thermo Dynamic Control arrester monitoring.



**BLITZDUCTORconnect  
ML2 B 180**

Part no. 927 210

Space-saving, modular lightning current arrester with push-in connection technology and status display. For protecting two single cores for lightning equipotential bonding and indirect earthing of shielded cables. With signal disconnection for maintenance purposes.



**BLITZDUCTORconnect  
ML2 BD HF 5**

Part no. 927 271

Space-saving, modular combined arrester with push-in connection terminal and status indication for protecting one pair of unearthed high-frequency bus systems and balanced interfaces. With signal disconnection for maintenance purposes.



**DEHNpatch  
CL8 EA 4PPOE**

Part no. 929 161

Universal, space-saving combined arrester with RJ45 connection technology and status indication. For protecting Ethernet applications. With powerful gas discharge arrester and protective diodes, fully shielded adapter design, optional earth connection.



**DEHNrecord  
IRCM**

Part no. 910 710

DIN-rail-mounted device set with integrated visual transmitter/receiver and reverse unit for condition monitoring of BLITZDUCTORconnect and DEHNpatch arresters. Indication via LED group display combined with remote signalling.

### External lightning protection / equipotential bonding



**Air-termination rod for  
metal roofs**

Part no. 123 021

For protecting domelights or roof superstructures on metal roofs, dimensioned in accordance with Eurocode 1 for a maximum gust wind speed up to 184 km/h. Total length (Ø16 / 10 mm): 2,000 mm. Material of braces: stainless steel, air-termination rod: aluminium.



**Metal roof bracket**

Part no. 105 241

For vertical installation of HVI air-termination systems or air-termination rods. Material: stainless steel, adjustable range: 550 – 900 mm, roof slope: 5 – 53°.



**Fixing for metal roof  
bracket**

Part no. 123 040

Material: stainless steel, clamping range of round standing seam: 20 – 25 mm, Screw: M8 x 25 mm, Connection: 4 – 50 mm.



**UNI seam clamp**

Part no. 365 250

For integrating the mounting systems of PV systems into functional equipotential bonding, functional earthing and lightning equipotential bonding.

All about self-sufficiency

# Protection for PV systems in residential buildings

Many property owners want to generate their own electricity in an environmentally friendly way. This section explains how a professional protection concept secures your investment and prevents failures.

"Prosumer" is the keyword, referring to consumers who also act as producers. In terms of energy, it means a building that generates and then consumes its own electricity, or selling it to building tenants to boost income from rents. This is where PV systems come into their own, because they guarantee:

- Cheap electricity for private consumption
- Income from feeding energy back into the grid
- Independence from expensive electricity from the utility company

Whether it's a wallbox, heat pump or various terminal equipment, many devices depend on a functioning PV system. It is particularly annoying if an outage is caused by surge damage that could easily have been avoided with protective measures. This section explains how our solutions help you provide effective lightning and surge protection.

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**The best help for your planning:**  
Our DEHNrisk, DEHNplan and DEHN Engineering Services tools and services  
<http://de.hn/cmpvU>



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**Protecting PV systems in residential buildings:**  
Concept and product selection online at  
<http://de.hn/knZbr>

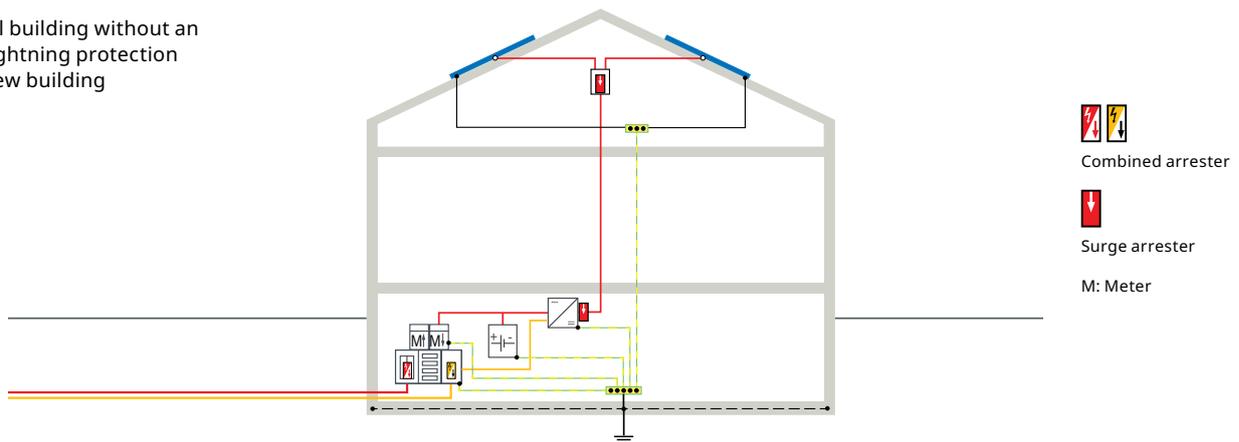




# Protection concept: Rooftop system without external lightning protection

Residential buildings often do not have an external lightning protection system. You should still take measures for overvoltage protection – both on the AC and DC side. Another particularly important factor for safe operation of the PV system is its integration into the earthing and equipotential bonding system of the building.

Residential building without an external lightning protection system: New building



## Surge protection

- To protect the AC side, in the meter cabinet or directly at the AC output of the inverter
- To protect the DC side directly upstream of the inverter
- Secure the power and data supply with arresters

In general, the arresters should be placed as close as possible to the device to be protected (e.g. the inverter). If the cable length between the surge arrester and the inverter is more than 10 m, another type 2 surge protective device is required.

## Earthing and equipotential bonding

The earthing system forms the basis of every electrotechnical system. You must earth the following components in your PV system:

- **Mounting system / substructure:**  
To be included in the functional equipotential bonding (connect with at least 6 mm<sup>2</sup> Cu)
- **Frame of the solar modules:**  
Not necessary for lightning protection reasons. However, please note that certain module types require earthing. The module manufacturer's specifications must be observed.
- **Metal cable trays and cable conduits:**  
All metal parts connected to the cabling of the system should be included in the equipotential bonding.
- **Inverter housing:**  
If the inverter housing is made of metal (protection class I), it should also be earthed and connected directly to the surge protection on the earth side.

## Our protection solutions: Building without an external lightning protection system

### Lightning and surge protection on the AC side and communication technology



**DEHNGuard  
MP TT 275**

Part no. 942 310

Type 2 + 3 four-pole surge arrester for TT and TN-S systems. With plug-in protection modules, double push-in connection terminal and Thermo Dynamic Control.



**DEHNbox  
TC B 180**

Part no. 922 220

Lightning current arrester for protecting information technology interfaces. Tool-free connection of one pair with integrated strain relief. Connection of a pair or patch cable with RJ45 plug at the outlet.



**DEHNpatch  
CL8 EA 4PPOE**

Part no. 929 161

Universal, space-saving combined arrester with RJ45 connection technology and status indication. For protecting Ethernet applications. With powerful gas discharge arrester and protective diodes, fully shielded adapter design, optional earth connection.

### Surge protection on the DC side



**DEHNcube  
YPV SCI 1000 1M**

Part no. 900 910

Multipole, Type 2 surge arrester with IP65 degree of protection. For protecting 1 MPP input. Three-stage DC switching device with combined disconnection and short-circuiting device with safe electrical isolation.



**DEHNGuard  
MP YPV 1200 FM**

Part no. 942 565

Multipole, Type 2 surge arrester. Consisting of a base part with plug-in protection modules and double-push-in connection clamp, for stub wiring and feed-through wiring. High device reliability due to Thermo Dynamic Control arrester monitoring.

### Earthing and equipotential bonding



**DEHN earthing kit**

Part no. 690 001

Earthing kit for buildings with up to 120 m<sup>2</sup> of ground area. For a complete earthing system for the construction of residential buildings, consisting of round material, earth rod and installation accessories.



**UNI earthing clamp**

Part no. 540 249

UNI earth clamp for integrating the mounting systems of PV systems in functional equipotential bonding/functional earthing and lightning equipotential bonding.



**UNI seam clamp**

Part no. 365 250

For integrating the mounting systems of PV systems into functional equipotential bonding, functional earthing and lightning equipotential bonding.



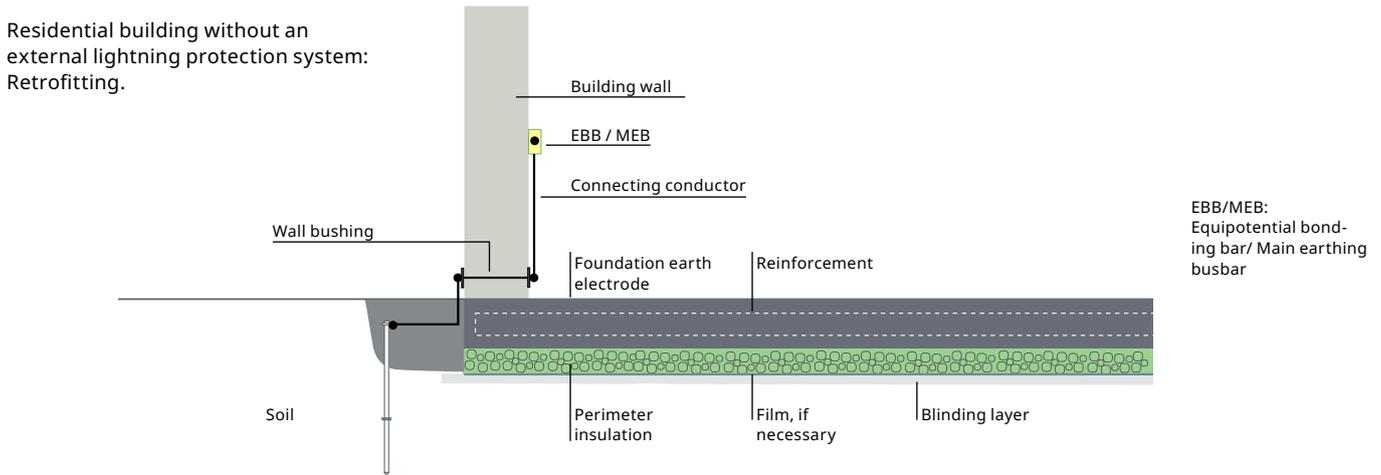
**DEHNalu  
round wire**

Part no. 840 008

For use in lightning protection systems as an air-termination system, down conductor or equipotential bonding.

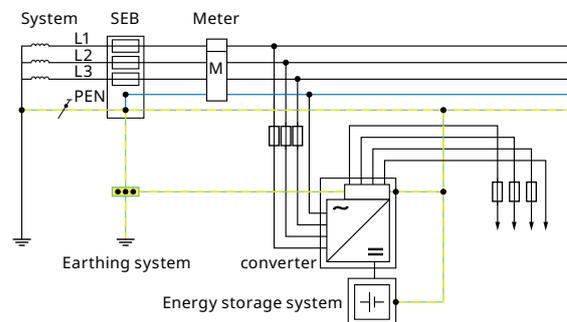
# Retrofitting and modernising earthing in buildings without an external lightning protection system

Existing buildings often lack evidence of a functioning earthing system. Metal water pipe networks were frequently used for earthing, but replacing steel pipes with plastic pipes means this option is no longer possible. A qualified electrician must take these aspects into account when retrofitting a PV system.



The earthing system must be retrofitted, particularly in TT system configurations where only the external and neutral conductors are provided by the power utility. Earthing of storage systems in stand-alone operation also requires special attention, as the grid operator's PEN conductor must not be used for protection purposes.

→ We recommend retrofitting an earthing system to safely integrate all components of the PV system into the earthing system or equipotential bonding. The ideal choice for retrofitting: **earth rods**.

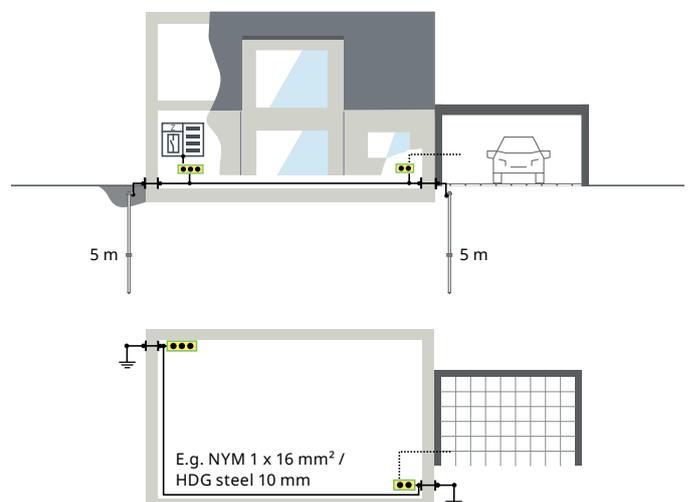


Design of a functional earthing system for stand-alone operation of a PV system with battery storage application.\*

Depending on the conditions on site, two 5 m or four 3 m long earth rods (length: 1 m or 1.5 m) are usually installed at the diagonal corners of the building. These can be installed either outside (our recommendation) or inside the building by drilling holes in the floor slab or the foundation. In the latter case, care must be taken to ensure that the sealing of the floor slab is not adversely affected. It is important that a cable connects the earth rods with lightning-current-carrying capability. Regardless of the positioning of the earth rods themselves, this connecting cable can be laid inside or outside the building. That means the earth rods can also be laid outside and the connecting cable inside.

**Benefits of this option:**

- Renovation with minimal shaft work
- Excavation only required at two points and sides of the building



Retrofitting of an earthing system with two earth rods (5 m long) outside and corresponding connecting cable inside the building.

\*The requirements of the protective measures in the island network apply in the island network path.

## Our protection solutions: Earthing

### Conductor materials and earth rods



**Earth rod**

Part no. 620 903

For setting up earthing systems for down conductors or transformer stations. With self-closing coupling, without thickening of the cross-section at the coupling joint, with offset knurled pin. Made of stainless steel (V4A).



**Driving spike**

Part no. 620 001

Driving spike for driving in the first earth rod.



**Round wire**

Part no. 860 050

Stainless steel wire for use in lightning protection and earthing systems or equipotential bonding.



**Connection lug**

Part no. 860 129

Made of corrosion-resistant stainless steel (V4A), for connecting down conductors to the earth-termination system.

### Clamps and connectors



**Connection bracket for earth rods**

Part no. 620 915

For connecting round conductors, cables and flat strips to earth rods. Material: stainless steel (V4A).



**Connection clamp for earth rods**

Part no. 540 121

For cross and parallel connection of round conductors or cables to earth rods. With double clamp and four M8 screws.



**KS connector**

Part no. 301 099

For connection to flat profiles. Material of clamping screw and clamp: stainless steel (V4A), clamping range Rd. 6 - 10 mm.



**MV clamp with locking lug**

Part no. 391 079

Multi-purpose connecting clamp, with anti-rotation protection. For universal use as a cross clamp, T clamp and parallel clamp for round conductors. Two-part version with hexagon screw and threaded base part.

### Equipotential bonding and accessories



**Anti-corrosion tape**

Part no. 557 125

For protecting underground connections, such as clamp and screw connections. The permanently plastic anti-corrosion tape, petrolatum-coated on both sides, effectively prevents the penetration of dirt and moisture.



**Z-shaped end piece**

Part no. 390 499

Connector for connecting the equipotential bonding bar to the wall bushing or fixed earthing point.



**Equipotential bonding bar K12**

Part no. 563 200

Standard version, for functional and lightning equipotential bonding. With CE mark, St/gal Zn snap-on terminals, fixing frames and plastic cover. Halogen-free, cover can be sealed and labelled.



**Earth electrode seal and wall bushing**

Part no. 478 410

For water-pressure-tight feed-through of walls, max. 300 mm

Your protection solutions specialist

# Full service for your safety. With DEHN worldwide.

## Safety equipment

Do you install and maintain PV systems in addition to planning them? Our expertise can help you ensure that your staff are reliably protected. We have a comprehensive range of safe equipment for working on electrical systems:

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### DEHNcare protective equipment

Discover our range of personal protective equipment:  
<http://de.hn/3H6dL>



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### DEHNshort – active arc fault protection

Protects system availability. Protects human life. Our protection system for the low-voltage main distribution board quenches fault arcs in just a few milliseconds, making it one of the fastest on the market:  
<http://de.hn/XdNGp>



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### 5 safety rules – information and products

Working on electrical systems can be life-threatening. Compliance with the 5 safety rules is essential for qualified electricians. We can help:  
<http://de.hn/7XQVb>



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### DEHNarX – arc fault protection

Commission our DEHNarX risk assessment to identify the arc fault hazards in your system and determine which protective measures are required:  
<http://de.hn/4XHcZ>



## DEHNacademy

Would you like to learn the basics of lightning and surge protection, delve into special aspects or deepen your existing knowledge?

Take advantage of the DEHNacademy:

- In-person seminars
- Online seminars
- E-learning

Register online, choose the topic you want to explore and the learning format, and log in. We look forward to hearing from you!

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### Take a look at our courses

<http://de.hn/bXL6P>







<http://de.hn/chv4K>

**Surge protection  
Lightning Protection / Earthing  
Safety Equipment**

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