Photovoltaic Distribution
Safe product solutions conforming to standards for photovoltaic plants

» Photovoltaic: Standards and Regulations

» PV Generator

» PV Generator Junction Box

» Inverter for PV plants

» Inverter Collector

» Power supply / Measuring
Safe product solutions conforming to standards for photovoltaic plants

» Photovoltaic: Standards and Regulations

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» Power Supply / Measuring
Standards is the label given to planned procedures and activities to create and implement regulations, which encompass identical or similar objectives for many different contexts at various locations from different groups of people.

The IEC 60364-7-712 standard for the construction of low voltage equipment dated May 2002 covers electrical equipment in solar photovoltaic (PV) power supply systems.

712.1 Scope
The particular requirements of this part of IEC 60364 apply to the electrical installations of PV power supply systems including systems with AC modules.

NOTE 2: Requirements for PV power supply systems which are intended for stand-alone operation are under consideration.

This standard is only applied to PV power supply systems for grid-connected operations.

A standard for off-grid-connection „isolated operation“ is being worked out.
In IEC 60364-7-712 the **schematic diagram** and concepts behind a PV power supply system are set down.

**712.3.14**
**PV installation**
erected equipment of a PV power supply system

**712.3.18**
**DC side**
part of a PV installation from a PV cell to the DC terminals of the PV inverter

**712.3.19**
**AC side**
part of a PV installation from the AC terminals of the PV inverter to the point of connection of the PV supply cable to the electrical installation
PV Diagram / IEC 60364-7-712
1. PV Generator  
*Power in kWp*
*Area approx. 10 m² / kWp*

2. PV Generator Junction Box

3. Inverter  
*(DC / AC)*  
*Output in kW (cos φ = 1)*  
*or in kVA (cos φ ≠ 1)*

4. PV Inverter Collector

5. Supply / Measuring  
*Work in kWh*  
*approx. 900 kWh / kWp / y*
Safe product solutions conforming to standards for photovoltaic plants

» Photovoltaic: Market, Standards and Regulations

» **PV Generator**

» PV Generator Junction Box

» Inverter for PV plants

» Inverter Collector

» Power supply / Measuring
PV Diagram

1. PV Generator

2. PV Generator Junction Box

3. Inverter (DC / AC)

4. PV Inverter Collector

5. Supply / Measuring
"Photovoltaic" (PV) is the direct conversion of light into electric energy. It is the release of electrons from a metallic surface, which is bombarded by electro magnetic radiation (e.g. light).

The photovoltaic effect was discovered in 1839. The first solar cell was built in 1954.

Two layers of a semi conductor are influenced by "targeted contamination" so that one partial layer is negatively charged and the other positively charged.

The barrier between the two semi-conductors is the p-n transfer, where the irradiation with light energy releases free charge carriers.

Connection to a consumer allows the electric current to be used.
712.3.1
PV cell
basic PV device which can generate electricity when exposed to light such as solar radiation

712.3.2
PV module
smallest completely environmentally protected assembly of interconnected PV cells

PV module output:
100 – 300 Wp.

712.3.3
PV string
circuit in which PV modules are connected in series, in order for a PV array to generate the required output voltage

PV modules have voltage of up to DC 1000 V using series connections.

Higher voltages (DC 1500 V) are in planning.

712.3.4
PV array
mechanically and electrically integrated assembly of PV modules, and other necessary components, to form a DC power supply unit

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The following information is required for dimensioning generator junction boxes:
- Voltage $U_{OC\ STC}$,
- String current $I_N$,
- Number of strings.

$OC = \text{Open Circuit}$

$STC = \text{Standard Test Conditions}$
Safe product solutions conforming to standards for photovoltaic plants

» Photovoltaic: Market, Standards and Regulations

» PV Generator

» **PV Generator Junction Box**

» Inverter for PV plants

» Inverter Collector

» Power supply / Measuring
PV Diagram

1. PV Generator
2. PV Generator Junction Box
3. Inverter (DC / AC)
4. PV Inverter Collector
5. Supply / Measuring
Protection Class II for DC Applications

**712.41 Protection against electric shock**
PV equipment on the DC side shall be considered to be energized, even when the system is disconnected from the AC side.

**712.413.2 Protection by use of class II or equivalent insulation** should preferably be adopted on the DC side.

**Attention:**
IEC 60670-22 the standard for cable junction boxes does not foresee any testing for protection class II, therefore cable junction boxes cannot be used, if protection class II is required (e.g. non-earth DC-grids).

In such a case empty boxes shall be used which are tested in accordance with IEC 60439-3 and fulfil the requirements of protection class II.
Protection Class II for DC Applications

Empty boxes in protection class II

<table>
<thead>
<tr>
<th>KF PV 0100</th>
<th>KF PV 0200</th>
<th>KF PV 0300</th>
<th>KF PV 0400</th>
<th>KF PV 0500</th>
<th>KF PV 0600</th>
<th>KF PV 0700</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photovoltaic</td>
<td>PV Generator</td>
<td>PV Junction Box</td>
<td>Inverter</td>
<td>Inverter Collector</td>
<td>Supply</td>
<td></td>
</tr>
</tbody>
</table>
712.511.1 PV modules shall comply with the requirements of the relevant equipment standard, e.g. IEC 61215 for crystalline PV modules.

IEC 60439-1 is the standard for type-tested switchgear and controlgear assembly (TTA) and determines the values for factors such as
- Temperature-rise test,
- Conductor cross-sections,
- Short circuit tests, etc.
in switchgear and controlgear assemblies (e.g. PV generator junction boxes).

712.512.1.1 Electrical equipment on the DC side shall be suitable for direct voltage and current.
Connections of the strings to the PV generator junction box are made by plugs, f.e. **MC4**.

A connection using screw connections to terminal blocks is also possible.

The **PE-connection** is carried out using a screw connection and is to be done by an **electrician**.

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**712.536.2.2.5.1** All junction boxes (PV generator and PV array boxes) shall carry a warning label indicating that active parts inside the boxes may still be live after isolation from the PV inverter.
PV generator junction boxes (DC) with surge protection

712.3.5
PV array junction box
enlosure where all PV strings of any PV array are electrically connected and where protection devices can be located if necessary

712.3.7
PV generator junction box
enclosure where all PV arrays are electrically connected and where protection devices can be located if necessary

Protection devices may include for example
• Surge Protection Device
When does a power plant need a surge protection?

1. If **external lightning protection facility** is available or is about to be installed.
When does a power plant need a surge protection?

2. If cables are crossing from one lightning protection zone to another (e.g. from the roof (outside) into the building (inside)).
When does a power plant need a surge protection?

3. The German Association of Casualty Insurers VdS "recommends" external lightning protection facility on roof arrays of > 10 kWp.
Surge (Overvoltage) protection in PV plants

Is a Surge Protection Device **type 1** or **type 2** required?

Can the separation distance between lightning protection facility and PV plant be maintained?

The separation distance \((s)\) is the distance between
- the lightning protection facility,
- conducting building parts and
- building installations.

The separation distance \((s)\) depends on;
- the selected lightning protection class \((ki)\),
- the number of surge arresters \((kc)\),
- the insulating material \((km)\)
- the length of parallel wiring \((l)\).

**Calculation:** \(s = ki \times kc/km \times l\)
Surge (Overvoltage) protection in PV plants

Is a **Surge Protection Device** **type 1** or **type 2** required?

Can the **separation distance** between lightning protection facility and PV plant **be maintained**?

**yes**

**SPD Type 2**
Examples:

- **DEHN DG M YPV SCI 1000**
- **OBO V20-C 3PH 1000**
- **Phoenix VAL-MS 1000DC/2+V**

» Multi-pole modular **SPD Type 2**
» Max. PV voltage $V_{OC\ STC} \leq DC\ 1000\ V$

**Y circuit** prevents damage to the surge protection in case of insulation faults in the generator circuit.
Surge (Overvoltage) protection in PV plants

Applications: DC SPD Type 2
Surge (Overvoltage) protection in PV plants

Is a Surge Protection Device **type 1** or **type 2** required?

Can the **separation distance** between lightning protection facility and PV plant **be maintained**?

**no**

**SPD Type 1**
Surge (Overvoltage) protection in PV plants

Examples:

**DEHN**
**DLM PV 1000**

**OBO**
**V25-B+C/3-PH 900**

- SPD Type 1 combination arrester, classification in accordance with EN 61 643-11
- max. PV voltage $U_c \leq \text{DC 1000 V}$
Surge (Overvoltage) protection in PV plants

Applications: DC SPD Type 1
PV generator junction boxes (DC)

A switch disconnector shall be provided on the DC side of the PV inverter.

**DC disconnect switches can be integrated in the inverter.**

When using **DC** disconnect switches special attention needs to the **voltage (Ue ≤ 1000 V)** and the current (Ie).

<table>
<thead>
<tr>
<th>Rated current (A)</th>
<th>80</th>
<th>80</th>
<th>80</th>
<th>80</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated operational voltage DC (Ue)</td>
<td>220 V</td>
<td>440 V</td>
<td>500 V</td>
<td>600 V</td>
<td>800 V</td>
</tr>
<tr>
<td>Utilisation category</td>
<td>DC-21B</td>
<td>DC-21B</td>
<td>DC-21B</td>
<td>DC-21B</td>
<td>DC-21B</td>
</tr>
<tr>
<td>Rated operational current (Ie)</td>
<td>40 A</td>
<td>40 A</td>
<td>40 A</td>
<td>40 A</td>
<td>40 A</td>
</tr>
<tr>
<td>Number of poles</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>
PV generator junction boxes ENYSUN

» in Hensel KV or Mi boxes
» protection class II (total insulated)
» IP 65
» UV-resistant (material = polycarbonate)
» with mounting plates or external mounting brackets from stainless steel
» Surge Protection Device type 2, DC 1000 V
» plug contacts, MC4 compatible (DC 1000 V)
» two variants:
  - 1 string on 1 inverter input
  - 2 strings on 1 inverter input
» optional: DC disconnect switch
PV generator junction box with SPD type 2 or DC generator disconnect switch.

Mounting plate for **wall** installation … … and **post** installation.
PV Generator junction box with SPD type 2
or DC generator disconnect switch

PV Junction Box

Photovoltaic | PV Generator | PV Junction Box | Inverter | Inverter Collector | Supply
--- | --- | --- | --- | --- | ---

KV PV 1211
with DC SPD

Connection KV PV 1211

KV PV 2211
with DC generator disconnect switch

Connection KV PV 1411

KV PV 1411
with DC/AC SPD
PV Accessories: KV small-type distribution boards, box walls without knockouts

KV PC 8104

KV BP 04
mounting plate for KV PC 8104

For wall and post installation

KV PC 8109

KV BP 04
mounting plate for KV PC 8104

For wall and post installation
Products for DC applications

PV generator junction box with DC SPD type 2

**Mi PV 1111**
1x PV string on 1x inverter input

**Mi PV 1121**
2x PV string on 1x inverter input

**Mi PV 1122**
2x PV string on 2x inverter input

**Mi PV 1242**
4x PV string on 2x inverter input

**Mi PV 1133**
3x PV string on 3x inverter input

**Mi PV 1263**
6x PV string on 3x inverter input
PV Generator junction box with DC SPD type 2 and DC generator disconnect switch.

Mi PV 2111
1x PV string on 1x inverter input

Mi PV 1121
2 x PV string on 1 x inverter input

Mi PV 1122
2x PV string on 2x inverter input

Mi PV 1242
4x PV string on 2x inverter input

Mi PV 1133
3x PV string on 3x inverter input

Mi PV 1263
6x PV string on 3x inverter input
PV generator junction boxes (DC)

712.3.5
PV Partial Generator Connection boxes
Boxes where all PV strings for a PV partial generator are electrically bound together and where protection devices are required should they be necessary.

712.3.7
PV Generator Connection boxes
Boxes where all PV partial generators are electrically bound together and where protection devices are required should they be necessary.

Protection devices may include for example
• SPD
• Blocking diodes
In **thin film modules** several strings are switched parallel to create a greater current.

The module manufacturers will disclose the maximum number of strings, that can form a circuit without requiring a protective circuit.

Should the number be exceeded, => **Blocking diodes** (String diodes) will be installed.

In normal operations such string diodes cause a drop in voltage and an **output reduction** in the magnitude of up to 2%.

*Blocking diodes are not necessary for crystalline modules, because they are resistant against return current.*
In cases where the blocking diodes are used, the blocking voltage for the photovoltaic (PV) generator needs to be measured. The blocking diodes need to be connected in series with the PV strings.

**712.3.16 Voltage of non-load circuit under standard testing conditions $U_{OC\ STC}$**

Voltage under standard testing conditions in a non-load open circuit PV-module, PV string, PV-partial generator, PV-generator or on the direct voltage side of the PV inverter.

$$2 \times U_{OC\ STC} = 2 \times 1000 \text{ V} = 2000 \text{ V}$$

The diode was especially developed for photovoltaic plants and is in accordance with the extended standard IEC 62548.

<table>
<thead>
<tr>
<th>Diode parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{RRM}$</td>
<td>2200</td>
</tr>
<tr>
<td>$I_{FAMM\ Total}$</td>
<td>30</td>
</tr>
<tr>
<td>Rated current per diode</td>
<td>2.5*</td>
</tr>
</tbody>
</table>

**Type of dissipated power during operations:**

- at approx. 1.0 A (W): approx. 1.44
- at approx. 1.4 A (Isc) (W): approx. 1.82
- *At approx. 2.5 A (W): approx. 3.30

* Diode currents higher than 2.5A should be avoided due to their high dissipated power (above average heat creation). Requirements for higher loads include expanded cooling measures and can be implemented upon request.
PV Generator junction box with blocking diodes.

» in Mi boxes
» **protection class II** (total insulated)
» **IP 65**
» UV-resistant (material = polycarbonate)
» with external mounting brackets from stainless steel
» **including blocking diodes**
» **DC disconnect switch**
» cable entry with cable glands
» two variants:
  - 12 strings on 1 inverter input
  - 24 strings on 1 inverter input
» optional: Surge Protection Device **type 2, DC 1000 V**
PV Generator junction box with blocking diodes and DC generator disconnect switch

**Mi PV 4311**
12x PV string on 1x inverter input

**Mi PV 4321**
12x PV string on 1x inverter input, SPD type 2

**Mi PV 4631**
24x PV string on 1x inverter input

**Mi PV 4641**
24x PV string on 1x inverter input, SPD type 2
Protection devices may include for example
- SPD
- Blocking diodes
- Fuses

### 712.3.5
**PV Partial Generator Connection boxes**
Boxes where all PV strings for a PV partial generator are electrically bound together and where protection devices are required should they be necessary.

### 712.3.7
**PV Generator Connection boxes**
Boxes where all PV partial generators are electrically bound together and where protection devices are required should they be necessary.
Protection against overload is not required under certain conditions in accordance with standards.

712.433.1
The overload protection for PV string and PV partial generator cables / conductors can be waived, if the continuous current rating for the cable or conductor is equal to or greater than 1.25 times the value of $I_{SC \ STC}$ at each location.

712.3.17
Short-circuit current under standard testing conditions $I_{SC \ STC}$
Short-circuit current of a PV module, PV string, PV partial generator, PV generator under standard testing conditions.

If the cable can experience thermal overload should a fault occur, then such cable conductors need to be protected with (string) fuses.

In non-earthed net (IT system) these fuses need to be installed in + and - strings (VDE 0100).
PV generator junction boxes (DC)

There are special DC fuse holders for PV applications. These devices have to be disconnected in currentless condition only.

The short circuit current from a string is max. $1.2 \times I_N$ rated current.

The needed rated current has to be produced from the parallel connected strings.

The short circuit current for tripping is $1.45 \times I_N$.

So you need at least three strings to be connected in parallel.
PV generator junction boxes (DC)

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The short circuit current for tripping is $1.45 \times I_N$.

So you need **at least three strings** to be connected in parallel.
PV Generator junction box with string fuses.

» in Mi boxes
» protection class II (total insulated)
» IP 65
» UV-resistant (material = polycarbonate)
» with external mounting brackets from stainless steel
» including fuse holders without fuses
» DC disconnect switch
» cable entry with cable glands
» two variants:
  - 12 strings on 1 inverter input
  - 24 strings on 1 inverter input
» optional: Surge Protection Device type 2, DC 1000 V
PV Generator junction box with string fuses and DC generator disconnect switch

**Mi PV 3611**
12x PV string on 1x inverter input

**Mi PV 3621**
12x PV string on 1x inverter input, SPD type 2

**Mi PV 3931**
24x PV string on 1x inverter input

**Mi PV 3941**
24x PV string on 1x inverter input, SPD type 2
PV generator junction boxes (DC)

How to choose the correct overload protection for PV generator junction boxes:

<table>
<thead>
<tr>
<th>PV panel technology</th>
<th>Blocking diode</th>
<th>String overload protection</th>
<th>DC generator disconnect switch</th>
<th>DC surge arrester for PV plants (SPD)</th>
<th>Required protection device in PV generator junction boxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystaline panels</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>Generator junction box with terminals</td>
</tr>
<tr>
<td>Thin-film panels</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>Generator junction box with DC surge arrester for PV plants</td>
</tr>
</tbody>
</table>

- **Manufacturer's instructions must be checked**
- **Please check, if overload protection is needed, see the requirements of IEC 60364-7-710 Part 710.450.1**
- **Please check, if additionally a DC generator disconnect switch must be used. This can be integrated already in the initial current limiting circuit if the requirements of IEC 60364-7-710 Part 710.238.2.3.8 are met.**
- **Please check, if a surge protection device (SPD) is necessary.**
  - IEC 60364-7-710
  - Part 710.238.2.3.8: A switch disconnecting device shall be provided on the DC side of the PV Inverter.
  - IEC 60364-7-710
  - Part 710.238.2.3.5: A switch disconnecting device shall be provided on the DC side of the PV Inverter.
# PV generator junction boxes (DC)

**Customised solutions? Contact us!**

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## Hensel

Gustav Hensel GmbH & Co. KG | Product Management

### PV generator junction box check list

<table>
<thead>
<tr>
<th>Request/offer</th>
<th>Order</th>
</tr>
</thead>
</table>

**Projects**

- PV generator junction boxes (DC)

**PV Junction Box**

- PV generator junction boxes
  - DC 600 V
  - DC 1,000 V

### Specifications

- Number of boxes: ________
- Number of strings per box: ________
- Current per string: ________ A
- Outputs to inverter: ________
- Connection strings: ________
- Overvoltage protection: ________
- Manufacturer: ________
- DC generator disconnect switch: ________
- Cable type and diameter: ________ mm
- Cable entry: ________

**Notes:**

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### Footer

Foil 50
PV generator junction boxes (DC)
Safe product solutions conforming to standards for photovoltaic plants

» Photovoltaic: Market, Standards and Regulations

» PV Generator

» **PV Generator Junction Box**

» Inverter for PV plants

» Inverter Collector

» Power supply / Measuring
1. PV Generator

2. PV Generator Junction Box

3. Inverter (DC / AC)

4. PV Inverter Collector

5. Supply / Measuring
PV Inverter

Solar inverter

- Island inverter (off-grid power supply)
- Mains-connected inverter
  - String inverter
  - Central inverter
PV Inverter

- Ambient conditions
- Control / Display
- Communication
- Direct current (DC)
- Alternating current (AC)

Direct current (DC) \(=\) Alternating current (AC)

Photovoltaic PV Generator PV Junction Box Inverter Inverter Collector Supply
=> Inverter with various inputs / MPP trackers:

» Inverter with an input and an MPP tracker
» Inverter with several inputs and an MPP tracker
» Inverter with several inputs and several MPP trackers
PV inverters are available for **various grid connection**:
» 1~ Inverter for three-pole connection (L, N, PE)
» 1~ Inverter for five-pole connection (L1, L2, L3, N, PE)
» 2~ Inverter for four-pole connection (L1, L2, N, PE)
» 2~ Inverter for five-pole connection (L1, L2, L3, N, PE)
» 3~ Inverter for five-pole connection (L1, L2, L3, N, PE)
» 1~ Inverter with output of 11 kW (48 A).

**the connection can lead to an extreme asymmetric load** (max. 4.6 kVA permitted).

**Symmetric** three phase power feed offers:
» Continuous power flow
» Preferred by power suppliers
» Simple adaptation to existing mains
» Problem-free grid operation
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- Inverter Collector
- Power supply / Measuring
1. PV Generator

2. PV Generator Junction Box

3. Inverter
   (DC / AC)

4. PV Inverter Collector

5. Supply / Measuring
712.536.2.2.1 In the selection and erection of devices for isolation and switching to be installed between the PV installation and the public supply, the public supply shall be considered the source and the PV installation shall be considered the load.

712.434.1 Overload protection may be omitted to PV string and PV array cables when the continuous current-carrying capacity of the cable is equal to or greater than 1.25 times ISC STC at any location.

712.413.1.1.1.1 On the AC side, the PV supply cable shall be connected to the supply side of the protective device for automatic disconnection of circuits supplying current-using equipment.
What is an Inverter collector?
An Inverter collector is a distribution board with reversed functions => the power from several devices is gathered and conducted to measuring equipment.

Difference between inverter collector and distribution boards:

In distribution boards simulataniety factor is between 0.3 and 0.6, at a power production plant the simulataniety factor = 1!

The high level of dissipated power can lead to the equipment exceeding its maximum temperature, meaning that the protective equipment will trip at levels below the rated current.
Thermal aspects of components

Influence of ambient temperature on the rated current of **fuse links**

Operating current for **63 A fuse links**: 63 A x 0.8 => 50 A
Thermal aspects of components

Influence of ambient temperature on the rated current of MCB

In addition to determining the discount factor for ambient temperature the corrective factor for accumulation of switches needs be taken into consideration when installing several cable protection switches adjacent to one another.

The temperature in the distribution board is the ambient temperature for the MCB.

Corrective factor at 50°C => 0.8

Corrective factor for 6 MCB connected in series => 0.8

Operating current for MCB B 25 A: 25 A x 0.8 x 0.8 => 16 A
Inverter collector (AC)

Thermal aspect

Inverter collector with circuit-breaker box, including consideration of thermal aspects.

1. **Consideration of simultaneity** and load capacity
   - Devices set at a **distance** allow for better radiation of dissipated power.
   - Additional **ventilation slots** provide improved air circulation in the box.
   - The **larger box** increases the amount of dissipated power that can be emitted.

2. **Standard installation assistance**
   - Installed equipment is **properly mounted** with the positioning aids on the DIN rail.
   - Simultaneously the MCB are placed in the **proper position** for the protection cover.
**Thermal aspect**

Documents show how great a load the switchgear and and the busbars may bear. For inverter collectors with circuit-breaker boxes, the installation of 32 A-miniature circuit breakers for 28 A of operating current for example is possible, i.e. for a 1~ inverter up to 6.4 kW.
### Thermal aspect

Inverter collector with circuit-breaker box  
=> Tables where the number of MCB per series and their ratings and operational data can be found.

<table>
<thead>
<tr>
<th>Table: Rating of solar inverter collector</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1- solar inverter</strong></td>
</tr>
<tr>
<td>maximum power output:</td>
</tr>
<tr>
<td>Rated current</td>
</tr>
<tr>
<td>2.8 kW</td>
</tr>
<tr>
<td>3.7 kW</td>
</tr>
<tr>
<td>4.8 kW</td>
</tr>
<tr>
<td>6.4 kW</td>
</tr>
</tbody>
</table>

| **3- solar inverter**                     |
| maximum power output:  | Miniature circuit breaker | cable | glands | flange |
| Rated current | max. operating current | max. quantity | minimum cable cross section | minimum outside diameter |
| 8.4 kW | 16 A | 12 A | 6 per row | 5 x 2.5 mm² | 13.5 mm | M 25 | Mi FM 32 |
| 11.1 kW | 20 A | 16 A | 5 per row | 5 x 2.5 mm² | 13.5 mm | M 25 | Mi FM 32 |
| 14.4 kW | 25 A | 21 A | 4 per row | 5 x 4 mm² | 15.5 mm | M 32 | Mi FM 32 |
| 19.3 kW | 32 A | 28 A | 3 per row | 5 x 6 mm² | 18 mm | M 32 | Mi FM 32 |

Values are valid for max. ambient temperature of 35°C.
Feed-in via screw-type fuse element for 1~ inverter up to 7 kW e.g. 50 A fuse for 30 A operational current.

Should solar inverter collector be connected to the public mains using screw-type fuses (D02), the power feed shall **not be carried out via the foot contact**.

In Germany a self activating switch for PV plants in accordance with DIN V VDE V 0126-1-1 (VDE V 0126–1–1) shall be used to prevent island network formation when inverting, i.e. should a plant be operating parallel to the public low voltage mains, the feed will be stopped when mains voltage is missing.

Should the solar inverter be cut off from the mains (AC side), it can re-activate within approx. 20 ms. After removing the fuse, the mains voltage is active only in the foot contact and does not present any danger.
Thermal aspect

For the connection of inverters with higher capacity for 1~ inverter up to 11 kW switch disconnectors with an operating current of maximum 48 A for each 63 A fuse element.
Surge (Overvoltage) protection in PV plants

External lightning protection and **observance** the separation distance

» Should a surge arrester be installed on the **DC** side, a surge arrester is required on the **AC**-side as well. => **Increasing PE potential**
Inverter collector

» Set (not installed) from Mi boxes
» **IP 65**
» UV resistant
» with external stainless steel mounting brackets
» Power from several solar inverters is "collected" and "discharged" once

» optional:
  - surge protection device

» optional:
  - 1~ inverter requires several N-PE terminals => separate box
Inverter collector

» Set (not installed) from Mi boxes
Inverter collector for 70 kW for circuit breaker (MCB)

Mi PV 6111
1~ inverter with 1 x 28 A

Mi PV 6311
3~ inverter with 3 x 28 A

Mi PV 6211
1~ inverter with 1 x 28 A, SPD type 2

Mi PV 6411
3~ inverter with 3 x 28 A, SPD type 2
Inverter collector for **140 kW** for circuit breaker (MCB)

**Mi PV 6123**
1~ inverter with 1 x 28 A

**Mi PV 6323**
3~ inverter with 3 x 28 A

**Mi PV 6223**
1~ inverter with 1 x 28 A, SPD type 2

**Mi PV 6423**
3~ inverter with 3 x 28 A, SPD type 2
Inverter collector for **70 kW** for fuse elements (D02)

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mi PV 5112</td>
<td>1~ inverter with 1 x 30 A</td>
</tr>
<tr>
<td>Mi PV 5312</td>
<td>3~ inverter with 3 x 30 A</td>
</tr>
<tr>
<td>Mi PV 5212</td>
<td>1~ inverter with 1 x 30 A, SPD type 2</td>
</tr>
<tr>
<td>Mi PV 5412</td>
<td>3~ inverter with 3 x 30 A, SPD type 2</td>
</tr>
</tbody>
</table>
Products for AC applications

Inverter collector for **140 kW** for fuse elements (D02)

- **Mi PV 5124**
  - 1~ inverter with 1 x 30 A

- **Mi PV 5324**
  - 3~ inverter with 3 x 30 A

- **Mi PV 5224**
  - 1~ inverter with 1 x 30 A, SPD type 2

- **Mi PV 5424**
  - 3~ inverter with 3 x 30 A, SPD type 2
Inverter collector for 140 kW for switch disconnector (Powerliner)

**Mi PV 5123**
1~ inverter with 1 x 48 A

**Mi PV 5323**
3~ inverter with 3 x 48 A

**Mi PV 5223**
1~ inverter with 1 x 48 A, SPD type 2

**Mi PV 5424**
3~ inverter with 3 x 48 A, SPD type 2
PV Accessories: Extension box

Mi PV 5511
PV terminal (N, PE) box

Mi PV 5611
Surge protection device (SPD) box

Mi PV 1318
Circuit breaker (MCB) box

Mi PV 3266
switch disconnector for fuses box
Connection technology

Due to some of the long conductors, large cross-sections are often connected and the conductors are often made from Aluminium.

The documentation contains entries regarding cable cross sections and conductor material.
Connection technology

Extending wiring area

Enlargement of the wiring area using the empty box for extension: **Mi 0101**

Connection with aluminum conductor

Connection from aluminum cable using terminals for direct connection: **DA 240**
Inverter collector (AC)

Customised solutions? Contact us!
### Inverter Collector

**PV Solar inverter collector check list**

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inverter manufacturer/type:</td>
<td></td>
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</tr>
<tr>
<td>Quantity: (items)</td>
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</tr>
<tr>
<td>Output: (W)</td>
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<tr>
<td>Current: (A)</td>
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<tr>
<td>Inverter type:</td>
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<tr>
<td>Cable to inverter:</td>
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<td>Cable type:</td>
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<tr>
<td>Cable quantity:</td>
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<tr>
<td>Cross-section:</td>
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<tr>
<td>Conductor material:</td>
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<tr>
<td>Cable to distribution board:</td>
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<td>Installation location:</td>
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<td>Degree of protection:</td>
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<tr>
<td>Notes:</td>
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</tr>
</tbody>
</table>

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**Customised solutions? Contact us!**

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**Foil 81**

**Gustav Hensel GmbH & Co. KG | Product Management**
Safe product solutions conforming to standards for photovoltaic plants

» Photovoltaic: Market, Standards and Regulations

» PV Generator

» PV Generator Junction Box

» Inverter for PV plants

» Inverter Collector

» Power supply / Measuring
PV Diagram

1. PV Generator

2. PV Generator Junction Box

3. Inverter (DC / AC)

4. PV Inverter Collector

5. Supply / Measuring
Power distribution with measuring devices is HENSEL's core business since 1931.
You can find this information

» in the internet at www.ENYSUN.eu
» in the HENSEL Main catalog
» In the ENYSUN Product information.
The *geographic* variations, the PV components installed and the power suppliers requirements for photovoltaics make "off the rack" solutions are impossible!

For customized solutions please contact the Hensel specialist close to you.
Thank you for your attention!