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1. General Information

1.1. Short Description

The system FS Uno is a one-support substructure for the mounting of photovoltaic modules in ground mount plants. The supporting structure and the module-bearing rails are made of hot-dip galvanized steel, the fastening elements and screws/bolts are made of steel or stainless steel. By means of the leveling holes, it is possible to adjust the system to the result of the pile-driving process and even out tolerances. FS Uno allows to use framed as well as unframed modules that can be mounted either in portrait or in landscape, or with the Schletter combined clamping system. It is also possible to mount additional accessories for the cable management or components for the internal potential equalization.

1.2. Intended Use

FS Uno is a substructure for the mounting of photovoltaic modules. Any kind of different use that is not mentioned in these Mounting Instructions or an incorrect mounting (e.g. the utilization of components made by other producers or non-observance of tolerances specified here and/or exceeding the indicated loads) are considered as non-intended use and, thus, exclude any liability of the manufacturer.

The manufacturer accepts no liability for damage caused by failure to observe these Mounting Instructions.

1.3. Copyright and Intellectual Property Rights

The entire content of these Mounting Instructions is the intellectual property of Schletter GmbH and is subject to the German copyright law.

Any reproduction, editing, distribution, transfer to third parties - in whole or in part - and any kind of utilization beyond the limits of the copyright law must be approved in writing by Schletter GmbH.

Schletter reserves the right to take legal action in case of infringements.

These Mounting Instructions are subject to change without notice.

All names of products stated in these Mounting Instructions are trademarks of Schletter GmbH and are herewith recognized and acknowledged.

Schletter GmbH is not liable for any damage of the product or subsequential damage caused by the product that are due to improper handling.

First and foremost, Schletter GmbH is not responsible or liable for failures and faults that are caused by modifications made by the customer or other persons.

There is no claim for availability of previous designs and for the ability to retrofit delivered components to the respective latest state of the series.

\[\text{Schletter Solar GmbH has made considerable efforts to make sure that these Mounting Instructions are free of errors and omissions.} \]
\[\text{Schletter Solar GmbH does not assume any responsibility or liability for possible errors included in these Mounting Instructions and/or incidental, concrete or consequential damages arising from the publication of these Mounting Instructions.} \]
1.4. Safety Precautions

Please read these Mounting Instructions carefully before starting the assembly and keep it in a safe place for further reference. Please observe and adhere to the regional and national applicable standards, building regulations and accident prevention regulations.

Read and make sure you understand the safety and warning notes in these Mounting Instructions and always apply them according to the relevant conditions and type of operation!

This instruction manual contains guidelines and notices you have to observe in order to ensure your personal safety and to prevent physical injuries or damage to property. Such safety and warning notes are marked with a warning triangle. Depending on the kind and degree of danger, warning notices are displayed as follows:

**DANGER**
indicates that death or severe personal injury will result, if proper safety precautions are not taken.

**WARNING**
indicates that death or severe personal injury may result, if proper safety precautions are not taken.

**CAUTION**
indicates that minor personal injury can result, if proper safety precautions are not taken.

**DANGER**
due to operations with electricity. Electric power can lead to serious accidents and can cause severe injuries. Appropriate safety precautions are to be taken by all means.

Securing of the working area
Before the start of construction, the building site must be inspected by a supervising person by sight check or using plans showing all supply lines (water, electricity, gas) in the relevant area. For this purpose, the position of all supply lines (water, gas electricity, etc.) must be marked using marking paint and unstable ground and areas that are landslide-prone must be sealed off with stable barriers or warning signs.
We absolutely recommend to observe the following protective measures when mounting of FS Uno:

- **Remember to wear reflective vests and safety shoes all the time**
- **Always wear ear protection when carrying out noisy work**
- **Always wear a hard hat when there might be falling objects or if you could hurt your head in some other way**
- **Wear protective gloves when working with sharp-edged components**
- **When carrying out dusty work, always wear breathing protection**
- **Wear safety glasses when carrying out grinding and abrasive operations in order to avoid any danger to your eyes caused by flying liquids or parts (sparks, splinters)**

Apart from that, please consider the applicable rules and regulations on accident prevention and environmental protection that apply at the respective installation site as well as the work instructions and directives by the plant owner/operating company or at the place of operation.
1.5. Obligation of the Plant Owner / Operating Company

The plant owner ensures that all parts of these Mounting Instructions are stored readily available and handy at the plant.

The plant owner/operating company undertakes to only let people work at and in the striking distance of the plant who
• have read and understood the parts of the mounting instruction that are relevant for the respective operations,
• are familiar with the fundamental regulations on work safety, accident prevention and protection of the environment
• and have been instructed in the safe handling of the plant (training course).

Before starting any mounting works, the plant owner/operating company designates
• a supervising person and ensures that
• the construction site is inspected using plans showing all supply lines (water, electricity, gas) and thus
• the position of all underground supply lines and unstable ground without sufficient load-bearing capacities are marked properly or sealed off with barriers.

1.6. Commitment of the Staff

Only people who give reason to expect that they will reliably do their job are allowed. Persons whose ability to react is affected, for example by drugs, alcohol or medication, are NOT allowed.
• Every person that is involved in the mounting of FS Uno must have read and understood these Mounting Instructions, especially chapter “1.4 Safety Precautions”, as well as all relevant chapters regarding the corresponding operations.
• These Mounting Instructions should always be kept available and easily accessible for all persons involved.
• Only trained and instructed qualified personnel are allowed to execute the operations mentioned in this instruction manual.
• Staff that still is to be trained may only mount the FS Uno system under the supervision of an experienced person.

We recommend the operator to insist on a confirmation in writing in each case.

1.7. Training of the Staff

These Mounting Instructions are addressed to personnel qualified in the areas of transportation and loading, mounting, disassembly and disposal, having the following qualifications:
• The professional staff members must be capable of fulfilling the tasks they have been assigned with and must be able to realize and avoid dangers on the basis of their professional formation, experience, expertise and their specific knowledge of the relevant regulations.
• The qualified staff members must have the required knowledge of the guidelines regarding safety, accident prevention and environmental protection, as well as of loading and unloading regulations that apply at the respective construction site.
• The qualified personnel have the driving licenses required at the specific construction site to be able to drive site vehicles and operate construction machines.
1.8. Additional documents relevant for the mounting

In addition to these Mounting Instructions, the following documents are required for the mounting of FS Uno:

- Pile-driving plan
- Blueprint drawing / general layout drawing
- Bill of materials / parts list
- Delivery note
- DIS unloading guidelines for transport in maritime containers
- General Terms and Conditions of Sale and Supply of Schletter GmbH
- Data sheet and instructions of the module manufacturer

2. Transportation, Loading and Unloading

**WARNING**
- Always wear protective equipment (safety shoes, hard hat, safety glasses, protective gloves and reflective vest) when unloading the FS Uno components.
- Besides also wear the personal protective equipment that is specified in your intra-company regulations for the respective activity.
- It is compulsory to monitor and supervise the complete unloading process.
- Do not step under suspended loads!
- Please make sure that there are no unauthorized persons in the danger area.

**Please observe all country-specific regulations and standards of the country of destination and its work instructions!**

2.1. Delivery of the components

The delivery of the components for FS Uno is carried out with an appropriate vehicle, for example
- trucks/lorries or
- overseas containers

2.2. Preparing the delivery

- Provide a stable and drivable surface for the delivery.
- Please make sure that all access roads, manoeuvring and unloading areas are suitable for trucks (up to 40 tons) and can be used by forklift trucks and hoisting equipments.
- Please exclusively provide trained professionals for the loading and transportation activities.
2.3. Provide forklift trucks and hoisting equipment

- Organize suitable forklift trucks and hoisting equipment to be available at the moment of delivery.
- Choose the suitable forklift trucks and hoisting equipment in cooperation with the site manager in charge.
- Make sure that the components, pallets and long items can properly be unloaded.
- Provide forklifts and hoisting equipment with different fork intervals or with adjustable forks.

2.4. Check the scope of delivery (for completeness)

The following shipping documents need to be verified on delivery:

- Delivery note
- Packing list

We recommend to observe the following points on receiving the goods:

- Visual inspection of the delivered goods
- Check whether the supplied goods correspond to the delivery order
- Delivered quantity / comparison with packing lists and delivery note
- General condition of the goods
- Damages of the delivery
- Delivery documents

Claims as to defects by the customer shall require that he has complied with his duties of examination and notification of complaint contained in Sections 377, 381 of the German Commercial Code [HGB]. Defects discovered during incoming goods inspection or later shall be notified to Schletter GmbH in writing without undue delay. A notification shall not be unduly delayed if it has been made within two weeks; the timely dispatch of this notification shall be deemed sufficient to meet the deadline. Regardless of the obligation to inspect and notify, the customer shall notify Schletter of obvious defects (including delivery of the wrong product or in not enough quantity) within two weeks of delivery in writing; the timely dispatch of this notification shall also be deemed sufficient in this case to meet the deadline. A general right to return purchased goods is not granted.

Extract from the General Terms and Conditions of Sale and Supply of Schletter GmbH - download available at www.schletter.de/AGB_en

2.5. Storage of the components

The components will also be delivered in cardboard boxes on pallets. And there also are fragile and sensitive items among those components.

- Unload the items on firm and stable ground only.
- Protect all components against rain, snow, moisture and other weather conditions.
- Store the items in dry and well-ventilated storage buildings or tents.
- Never store components outdoors or covered by a plastic sheet only.

If you adhere to the hints above, you can prevent the goods from being damaged already before mounting.
3. Technical data

3.1. System description and properties

<table>
<thead>
<tr>
<th>System description</th>
<th>FS Uno - one-support ground mount system by Schletter</th>
</tr>
</thead>
</table>

**Material**
- Pile-driven foundation posts: Steel, hot-dip galvanized
- Profiles (rails): Steel, strip-galvanized
- Fastening elements and screws: Steel, hot-dip galvanized or high-grade steel (fastening device, bolts)

**Structural dimensioning**
- Customized structural analysis of the respective terrain based upon a geological survey
- Individual system structural analysis based on local data
- Load assumptions according to DIN1055, part 4 (03/2006), part 5 (06/2005), part 100 (03/2001), Eurocode 1 (06/2002), DIN4113, DIN18800, Eurocode 9 and further resp. corresponding national standards.
- Structural verification of all construction components based on FEM-calculation

**Characteristics of the structure**
- Quick and easy assembly
- Highly efficient and material-saving rail geometries
- Available in individual parts or highly pre-assembled if desired

**Delivery and services**
- Ground survey and structural analysis
- Site-specific structural analysis based on local data
- Ramming (pile-driving) of foundation posts and delivery of the complete mounting material
- Optional: Rack mounting
- Optional: Complete module assembly

**Module types**
- Framed modules with a frame thickness of up to 50 mm
- Unframed modules on request

3.2. Rack tolerances

FS Uno is always configured specifically for the wind and snow loads at the respective installation site. In the interest of economic efficiency, usually the maximum load-bearing capacity of the individual component is exploited. To achieve this, however, the racks must be mounted with the utmost precision. If there are significant deviations from the mounting plans, this can lead to structural overstress which in turn can lead to damage cases. Schletter GmbH will not assume any liability for such damages nor for any consequences thereof. Adherence to the specified tolerances is therefore essential to the structural safety of the rack.

![Field span and Lateral cantilever](image1)

<table>
<thead>
<tr>
<th>Tolerance</th>
<th>± 150 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support width</td>
<td>± 150 mm</td>
</tr>
<tr>
<td>Lateral cantilever of purlins</td>
<td>± 100 mm</td>
</tr>
<tr>
<td>Lower girder connection</td>
<td>± 100 mm</td>
</tr>
<tr>
<td>Upper girder connection</td>
<td>± 100 mm</td>
</tr>
<tr>
<td>Clearance between module and clamp</td>
<td>0.5 to 2 mm</td>
</tr>
</tbody>
</table>

![Girder connections](image2)
### 3.3. Systems overview

![Diagram of SRF foundation posts and girder assembly](image)

#### Components

1. SRF foundation post
2. Girder assembly
3. Module-bearing rail
4. Module clamp adapter
5. Strut assembly

#### Connection elements / fasteners

1. Hexagon bolt M12x30 DIN933, flange nut M12 DIN6923 and washer M12 DIN9021
2. Fastening device
3. Drill screw

---

**Fig. 3.3-1 (system visualisation)**

**Components**

- SRF foundation post
- Girder assembly
- Module-bearing rail
- Module clamp adapter
- Strut assembly

**Connection elements / fasteners**

- Hexagon bolt M12x30 DIN933, flange nut M12 DIN6923 and washer M12 DIN9021
- Fastening device
- Drill screw

**Detail**

**Fig. 3.3-2 (detail)**
### 3.4. Components

#### 3.4.1. Foundation posts

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>143006-200</td>
<td>Steel foundation post SRF6</td>
</tr>
<tr>
<td>143007-200</td>
<td>Steel foundation post SRF7</td>
</tr>
<tr>
<td>143008-200</td>
<td>Steel foundation post SRF8</td>
</tr>
</tbody>
</table>

#### 3.4.2. Module-bearing rails and connection elements

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>144901-001</td>
<td>FS Uno / Duo purlin</td>
</tr>
<tr>
<td>144999-003</td>
<td>FS Uno / Duo fastening device</td>
</tr>
<tr>
<td>144999-008</td>
<td>FS Uno / Duo purlin connector Gen2 kit</td>
</tr>
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</table>

#### 3.4.3. Strut assembly

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>144970-099</td>
<td>Strut assembly SRF</td>
</tr>
<tr>
<td>000022-235</td>
<td>Strut element SRF</td>
</tr>
<tr>
<td>000016-673</td>
<td>FS steel locking plate</td>
</tr>
<tr>
<td>943612-030</td>
<td>Hexagon head bolt M12x30 DIN933 A2 GMB</td>
</tr>
<tr>
<td>943912-012</td>
<td>Flange nut M12 serrated DIN923 A4</td>
</tr>
<tr>
<td>943921-012</td>
<td>Washer 12 DIN125 A2</td>
</tr>
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### 3.4.4. Girder assemblies and components

<table>
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<th>Part Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>144301-000</td>
<td>FS Uno girder assembly 1V custom cut</td>
</tr>
<tr>
<td>144302-200</td>
<td>FS Uno girder assembly 2V custom cut</td>
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<tr>
<td>144303-200</td>
<td>FS Uno girder assembly 3V custom cut</td>
</tr>
<tr>
<td>144304-200</td>
<td>FS Uno girder assembly 4V custom cut</td>
</tr>
<tr>
<td>144305-200</td>
<td>FS Uno girder assembly 5V custom cut</td>
</tr>
<tr>
<td>144306-200</td>
<td>FS Uno girder assembly 6V custom cut</td>
</tr>
<tr>
<td>144307-200</td>
<td>FS Uno girder assembly 7V custom cut</td>
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<tr>
<td>144308-200</td>
<td>FS Uno girder assembly 8V custom cut</td>
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<tr>
<td>144301-000</td>
<td>FS Uno girder assembly 1H custom cut</td>
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<tr>
<td>144302-100</td>
<td>FS Uno girder assembly 2H custom cut</td>
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<tr>
<td>144303-100</td>
<td>FS Uno girder assembly 3H custom cut</td>
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<tr>
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<td>144307-100</td>
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<tr>
<td>144308-100</td>
<td>FS Uno girder assembly 8H custom cut</td>
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<td>144999-006</td>
<td>FS Uno / Duo fastening plate galvanized</td>
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<td>Hexagon head screw M12x30 DIN933 A2 GMB</td>
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<td>943912-012</td>
<td>Flange nut M12 serrated DIN6923 A4</td>
</tr>
<tr>
<td>943922-012</td>
<td>Large washer M12 DIN9021 A2</td>
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### 3.4.5. Module clamps for vertical module mounting

<table>
<thead>
<tr>
<th>Module height</th>
<th>End clamp left</th>
<th>Middle clamp</th>
<th>End clamp right</th>
<th>End clamp</th>
<th>Middle clamp</th>
<th>End clamp</th>
<th>Middle clamp</th>
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<tbody>
<tr>
<td>20 mm</td>
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<td>---</td>
<td>---</td>
<td>---</td>
<td>130001-020</td>
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<td>24 mm</td>
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<td>---</td>
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<td>28 mm</td>
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<td>131001-030</td>
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<tr>
<td>31 mm</td>
<td>144912-031</td>
<td>144910-001</td>
<td>144911-031</td>
<td>131001-031</td>
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<td>32 mm</td>
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<td>144910-001</td>
<td>144911-032</td>
<td>131001-032</td>
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<td>33 mm</td>
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<td>144911-037</td>
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<tr>
<td>38 mm</td>
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<td>39 mm</td>
<td>144912-039</td>
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<td>144911-039</td>
<td>131001-039</td>
<td>131002-000</td>
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<tr>
<td>40 mm</td>
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<td>41 mm</td>
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<td>42 mm</td>
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<td>131001-042</td>
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</tr>
<tr>
<td>43 mm</td>
<td>144912-043</td>
<td>144910-004</td>
<td>144911-043</td>
<td>131001-043</td>
<td>131002-001</td>
<td>130001-043</td>
<td>130002-001</td>
</tr>
<tr>
<td>44 mm</td>
<td>144912-044</td>
<td>144910-004</td>
<td>144911-044</td>
<td>131001-044</td>
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<td>130002-001</td>
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<tr>
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<td>144910-004</td>
<td>144911-045</td>
<td>131001-045</td>
<td>131002-001</td>
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<tr>
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<td>130001-050</td>
<td>130002-001</td>
</tr>
<tr>
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<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>130001-051</td>
<td>130002-001</td>
</tr>
</tbody>
</table>

* in combination with module clamp adapter

---

Fig. 3.4.4.-1 (144912-030)  
Fig. 3.4.4.-2 (131001-030)  
Fig. 3.4.4.-3 (130001-030)
### 3.4.6. Module clamps for horizontal module mounting

<table>
<thead>
<tr>
<th>Module height</th>
<th>Rapid clamp*</th>
<th>Standard clamp*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>End clamp</td>
<td>Middle clamp</td>
</tr>
<tr>
<td>20 mm</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>24 mm</td>
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<tr>
<td>28 mm</td>
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<td>---</td>
</tr>
<tr>
<td>30 mm</td>
<td>131001-030</td>
<td>131002-000</td>
</tr>
<tr>
<td>31 mm</td>
<td>131001-031</td>
<td>131002-000</td>
</tr>
<tr>
<td>32 mm</td>
<td>131001-032</td>
<td>131002-000</td>
</tr>
<tr>
<td>33 mm</td>
<td>131001-033</td>
<td>131002-000</td>
</tr>
<tr>
<td>34 mm</td>
<td>131001-034</td>
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<td>35 mm</td>
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<tr>
<td>50 mm</td>
<td>131001-050</td>
<td>131002-001</td>
</tr>
<tr>
<td>51 mm</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

* in combination with module clamp adapter

### 3.4.7. Module clamp adapter and connection elements for module clamps

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>144919-050</td>
<td>FS Steel Module clamp adapter KIT</td>
</tr>
<tr>
<td>129010-008</td>
<td>KlickIn click component for nut M8</td>
</tr>
<tr>
<td>943914-008</td>
<td>Square nut M8 DIN557 A4</td>
</tr>
</tbody>
</table>
The nuts and bolts of the Standard clamps are not included in the scope of delivery and must be ordered separately.

With big order quantities, clamps for other module thicknesses can be manufactured on request!

The Standard clamps are not pre-assembled when they are delivered. These clamps are combined with a hexagon socket head screw, a KlickIn click component and a square nut. The screws listed below can be used for that purpose:

### 3.4.8. Screws for standard module clamps

<table>
<thead>
<tr>
<th>Frame height in mm</th>
<th>Hexagon socket screw in mm</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>943308-125</td>
<td>20</td>
<td>Hexagon socket screw M8x25 serrated DIN912 A3</td>
</tr>
<tr>
<td>943308-130</td>
<td>24</td>
<td>Hexagon socket screw M8x30 serrated DIN912 A3</td>
</tr>
<tr>
<td>943308-135</td>
<td>28 - 30</td>
<td>Hexagon socket screw M8x35 serrated DIN912 A3</td>
</tr>
<tr>
<td>943308-120</td>
<td>31 - 35</td>
<td>Hexagon socket screw M8x20 serrated DIN912 A3</td>
</tr>
<tr>
<td>943308-125</td>
<td>36 - 40</td>
<td>Hexagon socket screw M8x25 serrated DIN912 A3</td>
</tr>
<tr>
<td>943308-130</td>
<td>41 - 45</td>
<td>Hexagon socket screw M8x30 serrated DIN912 A3</td>
</tr>
<tr>
<td>943308-135</td>
<td>46 - 51</td>
<td>Hexagon socket screw M8x35 serrated DIN912 A3</td>
</tr>
</tbody>
</table>

### 3.4.9. Auxiliary equipment / accessories

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>964000-176</td>
<td>Paint zinc dust silver gray satin-gloss</td>
</tr>
<tr>
<td>149023-001</td>
<td>Cable fastening retainer 1.0-3.0mm, guidance at the top</td>
</tr>
<tr>
<td>149023-002</td>
<td>Cable fastening retainer 1.0-3.0mm, guidance at the side</td>
</tr>
<tr>
<td>149023-003</td>
<td>Cable fastening retainer 3.0 - 6.0 mm</td>
</tr>
<tr>
<td>144999-009</td>
<td>FS Uno / Duo cable fastener purlin</td>
</tr>
<tr>
<td>144999-010</td>
<td>Empty cable conduit</td>
</tr>
</tbody>
</table>
4. Mounting information

The FS Uno system is customized for the respective installation site. The following indications are already needed during the planning process:

- Site boundaries
- Rights of way / easements (the building site must be accessible for vehicles at any time)
- Obstacles in the subsoil (pipes, subterranean cables, etc.)
- Weather conditions (wind, rain, snow, etc.)
- Conditions that may influence the building ground (seismic activities, erosion, etc.)
- Geo-technical reports about the topology of the site and the composition of the soil

When mounting the ground-mount system, we recommend:

- Keeping a clearly laid out and detailed daily construction report (site journal), where all daily work steps, employment of staff and assembled components are exactly specified.
- Accurately checking and comparing the delivery notes with the delivered goods on the site.

4.1. Terrain

When planning the ground-mounted system, make sure that the ground slope is within the tolerances. In the following, the guiding values for a structurally safe solar plant are specified.

**Maximum admissible ground slope**

East-West: 3°

Regarding the structural calculations, additional measures may be required (for example reinforcements)

North-South: 35°

(depending on the condition of the slope, soil composition, rocks, etc.)

The Schletter ground mount plants within one rack are always parallel to the terrain topography beneath them. Height differences of the subsoil under a rack can be equalized with the foundation posts. Please already align the piles with a cord when pile-driving. The tolerance of the anchoring depth is ±100 mm.
4.2. Foundation

4.2.1. Ramming (pile-driving) tolerances

Pile-driving operations must be undertaken by specialist companies. Special pile-driving plans are created on the basis of a digital terrain model with exactly specified contour lines. These plans must be available at least one week before the start of the pile-driving operations and must include the positions of the foundation posts and their corresponding dimensions. The position of the first and last pile in each row must be marked on the terrain with a wooden stake. If a row length exceeds 50 meters, additional markings (wooden stakes) must be used within the row.

Extraordinary foundation posts must be clearly identified and documented in a pile-driving plan. Inconsistencies during the pile-driving procedure which could affect the adhesive force of the piles must be documented, (e.g. slant position, deceleration and subsequent, sudden acceleration of the penetration speed, swift penetration of the foundation pile while pile-driving etc.). All pile-driving procedures deviating from the specifications as to the ramming of the foundation posts must be approved by Schletter GmbH.

If pile-driving operations are impeded by unexpected obstacles (blocks, solid rock on the site), the following procedure must be implemented:
1. Pre-drill down to the intended target depth.
2. If possible, vacuum the drill cuttings out of the borehole. Otherwise, the drill cuttings that remain in the borehole have to be compacted.
3. The borehole must be filled in layers with compressed concrete of strength C16/20 and compacted.
4. After that, ram (pile-drive) the pile without delay.

4.2.2. Pile-driving obstacles and concreting

Fig 4.2.1.-1 (pile-driving tolerances - depth)  Fig 4.2.1.-2 (pile-driving tolerances - E/W tilt)  Fig 4.2.1.-3 (pile-driving tolerances - N/S tilt)
Fig 4.2.1.-4 (pile-driving tolerances - twist / distortion)  Fig 4.2.1.-5 (pile-driving tolerances - difference in height)
4.3. Tools

In the following, the tools that are usually required for the mounting of FS Uno are listed. Additional tools that are required for special cases (for example encasing the foundation posts in concrete) are not listed here.

NOTICE
Please exclusively use the tools recommended for the assembly of FS Uno.
If you use tools that are not intended for this purpose, the rack can be damaged and the structural safety of the plant could thus be endangered!

We recommend using torque wrenches for all bolted connections. With fast rotary motions, there is an increased danger of "bolt blocking"!

4.3.1. Defining the positions of the foundation posts and marking these positions (staking)

- Measuring tapes (100 m)
- Line pins (about 20 pieces)
- Mason's lacing cord
- Club hammer
- Wooden stakes
- Color spray (for ground marking etc.)
- Permanent marker
- Zinc dust primer
- Brush

4.3.2. Pile-driving (ramming)

- Pile-driver with suitable ram
- Spirit level

4.3.3. Rack mounting

- Torque wrench (30 Nm to 60 Nm)
- Wrench socket size 17
- Wrench socket size 19
- Hammer
- Club hammer (to hold against the connector hook)
- Plastic tip hammer
- Angle meter (goniometer) - spirit level
- Mason's lacing cord
- Cordless screw driver
4.3.4. Module mounting

- Mason’s lacing cord
- Measuring tape
- Possibly distance template for distances between the modules
- Cordless screw driver
- Size 8 socket for cordless screwdriver
- Size 6 hexagon socket wrench / 40TX key
- Torque wrench (< 8 Nm)
- Size 6 hexagon socket wrench / 40TX bit for torque wrench

4.4. Torque specifications

4.4.1. Bolted connections in the substructure

<table>
<thead>
<tr>
<th>Name</th>
<th>Tightening torque (MA-Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hexagon head bolt DIN933 M12x30 A2 GMB</td>
<td>56 Nm</td>
</tr>
<tr>
<td>Hexagon nut DIN6923 M12 A4</td>
<td></td>
</tr>
<tr>
<td>Washer, large DIN9021 M12 A2</td>
<td></td>
</tr>
</tbody>
</table>

4.4.2. Fastening of the module clamps

<table>
<thead>
<tr>
<th>Name</th>
<th>Tightening torque (MA-Nm)</th>
<th>Module arrangement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hexagon socket screw DIN4762 M8 (20 - 35 mm) KlickIn click component for nut M8 Square nut DIN557 M8 A4</td>
<td>15 Nm</td>
<td>H and V in combination with module clamp adapter</td>
</tr>
<tr>
<td>Hexagon socket screw DIN912 M8 A2 (25 - 45 mm)</td>
<td>8 Nm</td>
<td>V</td>
</tr>
<tr>
<td>TX stud screw M8 A2 GMB (42.5 - 55 mm)</td>
<td>15 Nm</td>
<td>H and V in combination with module clamp adapter</td>
</tr>
</tbody>
</table>

Always fasten the bolted connection by turning the bolt head! When checking the pre-stress of the bolts, it has to be considered that constraints and frictional forces can lead to a loss of clamping force. This was taken into consideration when the tightening torques were determined. When a bolted connection is checked, it must not loosen when 50% of the specified tightening torque is applied.
5. Assembly steps

5.1. Pile-driving of foundation posts and applying corrosion protection

WARNING

- Wear adequate protective equipment during the pile-driving operations, especially ear protection and protective gloves, reflective vest and safety shoes!
- Always keep looking on the machine and the surrounding area.
- Please especially pay attention to mechanically moving parts in the danger area of the ramming machine to avoid crushing injuries.
- Prevent the ramming machine from toppling over by exclusively driving on adequate, stable ground!

Check the stability and firm embedment of the pile-driven foundations before mounting the racks!

Only a special paint (zinc dust primer) will give the required protection and is approved according to the standards. Basic zinc spray coatings do not provide long-term protection.

The tolerances specified here must not be exceeded!

1. Pile-drive the foundation post according to the indicated tolerances

   Height tolerance of the piles to each other: ± 30 mm

   Tolerance of pile tilt in N-S and E-W direction: ± 3°

   Tolerance of the pile height according to terrain topography: ± 100 mm

2. A zinc dust primer is to be used to coat the top 30 mm of the foundation post, inside and outside.

   The exact positions of the foundation posts can be referenced in the corresponding pile-driving plan.
3. Check whether the individual foundation posts are aligned to each other and verify the posts regarding their corresponding tolerances (see item 5.1.- step 1)

Fig. 5.1.-3 (flush alignment of the foundation posts)

Fig. 5.1.-4 (detailed view of the foundation post - from above)

Detail
5.2. Mounting the girder assembly

CAUTION

- Wear adequate protective equipment, especially a hard hat, when mounting the girder assembly!
- Secure all parts that need to be fastened against slipping!
- Use appropriate auxiliary devices to handle heavy loads and ask your co-workers for help!
- Keep the work area clean to avoid falls!
- Never walk under suspended loads and secure objects and tools against falling down.

Fasten the bolted connection by turning the bolt head! Do not turn the nut, just hold it!

1. Fold out the strut.

Fasten the girder assembly to the top of the foundation post using a hexagon head bolt M12x30 DIN933, a washer 12 DIN9021, a locking plate and a flange nut M12 DIN6923.

Fasten the strut assembly to the lower part of the foundation post using a hexagon head bolt M12x30 DIN933, a washer 12 DIN9021 and a flange nut M12 DIN6923.

Fig. 5.3.-1 (mounting the girder assembly)
5.3. Mounting the module-bearing rail (purlin)

**CAUTION**
- Wear adequate protective equipment, especially a hard hat, when mounting the module-bearing rails!
- Secure all parts that need to be fastened against slipping!
- Use appropriate auxiliary devices to handle heavy loads and ask your co-workers for help!
- Keep the work area clean to avoid falls!
- Never walk under suspended loads and secure objects and tools against falling down.

**NOTICE**
Please note that the module-bearing rail must be mounted at a 90° angle to the girder assembly to safeguard that the modules are correctly supported. In the case of an imprecise mounting, the modules could fall down in the worst case.

1. Swivel the module-bearing rail into the pre-assembled fastening plates on the girder assembly.

2. Hammer in the fastening device using a plastic tip hammer. Hold a hammer against the other side of the fastening plate for stabilization reasons.

3. Use a zinc dust primer to coat the top 3 cm of the module-bearing rails.

**ATTENTION**
The fastening plates have slotted holes for fine adjustment and have to be readjusted, if required.
5.4. Mounting the purlin connectors (optional)

When mounting the purlin connectors, please use the designated drilled holes on the module-bearing rails!

1. Fasten each purlin connector with four hexagon head bolts M12x30 DIN933, washers DIN9021 and flange nuts M12 DIN6923 to the module-bearing rail.

5.5. Mounting the module clamp adapter (optional)

The module clamp adapter must be used in the case of a horizontal bearing of the modules or when using a combined clamping. Moreover, the module clamp adapter is used when the modules are mounted vertically (in portrait), in combination with Rapid 2+ or Standard clamps.

The exact positions of the module clamp adapters can be referenced in the technical general layout drawing.

NOTICE
Please ensure that no drilling chips are left in the module-bearing rails after screwing the self-drilling screws to avoid contact corrosion!
After positioning the module clamp adapter, please clean the module-bearing rails with a hand brush or cover the module-bearing rail during the screwing process (e.g. with a cardboard).
1. Clip the module clamp adapter onto the Z-purlin at the indicated points.

2. Screw the module clamp adapter in the designated hollow space (notch) with a self-drilling screw to the module-bearing rail.
6. Module mounting and module clamping

Solar modules are third party components that are not included in the scope of delivery of the FS Uno substructure. Schletter GmbH thus points out that the safety notices and mounting instructions of the module manufacturer are to be observed. And please also note the notices given in these Mounting Instructions when mounting the photovoltaic modules!

The following points must be taken into consideration at any event:

- Photovoltaic modules are electric devices. They must be treated carefully!
- Impacts, kicks, shocks or vibrations must be avoided.
- It is not allowed to put loads on the modules (trespassing, storing of items, etc.).
- Scratches or dirt on the module surface must be avoided.
- It is not allowed to pull or tear at the module cables. Do not heavily bend the module cables.

The module clamping is carried out according to the project planning (vertical, horizontal or combined module arrangement). The distance between modules can deviate from the standard value.

Standard value:
- clamped side 23 mm
- side without clamping 5 - 10 mm

(according to the specifications in the technical drawing; specifications by the module manufacturer are considered)

Clearance (= distance between module and module clamp) of
- min. 0.5 mm
- max. 2 mm

must be observed (module abuts on the spacer notches).

Observe the clamping points specified by the module manufacturer!

Please note the data sheet of the photovoltaic module provided by the manufacturer to verify the clamping points.
6.1. Module mounting and clamping in the case of vertical module bearing

The modules are fastened with special steel clamps in the case of vertical module arrangements:

1. Attach the module clamp on the rail of the Z-purlin.

2. Push the module towards the clamp (observe the clearance!)

3. Fasten hex socket screw with a torque of 8 Nm
6.2. Module mounting and clamping in the case of horizontal module bearing

The horizontal module clamping is carried out with a module clamp adapter in combination with Rapid 2+ clamps or Standard clamps:

1. Insert the module clamp into the rail of the module clamp adapter

![Fig. 6.2.-1 (clicking in the module clamp)](image1)

2. Push the module towards the clamp (observe the clearance!)

![Fig. 6.2.-2 (pushing/sliding the module towards the clamp)](image2)

3. Fasten hex socket screw with a torque of 15 Nm

![Fig. 6.2.-3 (fastening the hex socket screw)](image3)
6.3. Module mounting and clamping in the case of combined module bearing

The combined module clamping is carried out with a module clamp adapter in combination with Rapid 2+ clamps or Standard clamps:

1. Clamping at the long side of the module to the upper and lower module-bearing rail.

2. Clamping to the inner module-bearing rails at the short module side (comparable to clamping in the case of horizontal module arrangement)

Fig. 6.3.-1 (combined module clamping)

Fig. 6.3.-2 (upper and lower module clamping)

Fig. 6.3.-3 (module clamping at the inner side)

Fig. 6.3.-4 (clamping of the upper module)

Fig. 6.3.-5 (clamping of the inner module)

Fig. 6.3.-6 (clamping of the lower module)
7. Disassembly and disposal

**DANGER**
- The plant operates with high voltage.
- Please note all tutorials and safety guidelines provided by the manufacturer of the modules or electrical components before shutting down the plant.
- The plant may only be disconnected from the power supply provided on site by a qualified electrical technician.

**WARNING**
- Always wear protective equipment (safety shoes, hard hat, safety glasses, protective gloves and reflective vest) when disassembling the FS Uno components.
- Make sure that no unauthorized persons can enter the danger area.
- Do not step under suspended loads!

- We recommend to wait for the confirmation by a qualified electrical technician regarding the correct decommissioning of the plant before starting the disassembly of the FS Uno.
- Have an accordingly trained professional disassemble the plant in transportable units.
- Observe all information and instructions provided in these Mounting Instructions.
- Also make these Mounting Instructions available to the staff that is in charge of the disassembling operations.
- Ensure that the disassembling operations are performed exactly in reverse order of the mounting steps.

Faulty waste disposal can lead to environmental damage. With regard to the environment it is recommended to dispose of recyclable materials in an appropriate manner.

Properly dispose of components
- Separate the materials steel, plastics, electric scrap, aluminium, stainless steel, copper, brass, etc.
- Dispose of the components in accordance with the local regulations

Fig. 7.-1 (general recycling symbol)
8. Maintenance and care

We recommend as follows:

**INSPECTION OF THE PLANT**
- after exceptional weather conditions (storm, heavy snowfall or rain, etc.)
- after natural convulsions (earthquake, landslip, settlements, etc.)

**MAINTENANCE OF THE PLANT**
- Cleaning of the modules
- Verification of the bolted connections
- Check of the plant regarding corrosion
- Maintenance of the access roads and walkways

**REMEDIAL MAINTENANCE OF THE PLANT**
- after detecting damages on the racks or earth movements (for example removing corrosion, replacement of faulty components, detection of unfastened bolted connections, etc.)

9. Warranty and liability

Generally, the customer is responsible for the proper mounting and installation of the FS Uno.

**Exclusions**

Guarantee, warranty and liability claims against the manufacturer Schletter GmbH in case of injury to persons or material damage shall be excluded if they result from one or several of the causes listed below:

- Non-observance of the Mounting Instructions and/or maintenance instructions in combination with a warranty extension
- Any use other than the intended use of the FS Uno or faulty operation
- Incorrect mounting, maintenance or repair
- Operation with spare or equipment parts that are faulty or have not been approved by the manufacturer
- Arbitrary constructional modifications or manipulation of the FS Uno or its equipment or components
- Utilization of components made by other manufacturers (third party components)
- Neglect or non-observance of the prescribed maintenance and/or testing and inspection intervals

The customer exclusively shall bear the costs for damage or consequential damage that is due to one or several of the causes mentioned above.

The Mounting Instructions as well as the maintenance instructions in combination with a warranty extension refer exclusively to the mechanical metal structure supplied by Schletter GmbH.

Components of the solar plant like modules, cables and plug connectors, inverters or electric switch boxes are not part of these parts of the manual and thus are exempt from warranty and liability by Schletter GmbH.

Material damage to objects that are not included in the scope of delivery are generally excluded from any liability.