Professional Solar Mounting Systems
Ground Mount Systems

Schletter
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Schletter’s **FS System™** is designed to be the most cost-effective system that allows for quick and easy installation on virtually any terrain. It uses state-of-the-art production procedures and equipment to ensure quick turnaround of all standard components, as well as fast and flexible designs of custom systems.

Arriving on-site virtually pre-assembled, the FS System utilizes driven-pile, hot-dipp galvanized steel posts. This installation technique eliminates the need for concrete foundations, reducing material and installation costs.

When working with Schletter on project planning and design, site characteristics are analyzed to ensure the system meets all code requirements. Soil analysis, wind and snow loads, terrain considerations, and national code standards all play a part in the final design. The end result is an installation designed for the long term — with unquestionable durability — at a great price.

Alternatively, the **PvMax™** utilizes concrete pads as a ballast, and allows for system installation without digging, boring, or geotechnical testing. The PvMax is ideal for small to mid-size installations and on terrains with rocky or unstable soils, such as covered Landfill sites.

Producing quality products is a central pillar of Schletter’s manufacturing philosophy. To further this goal, Schletter follows the ISO 9001:2008 quality and safety standards and undergoes yearly audits by outside inspectors to verify ISO compliance.
**Project Checklist**

In order to provide accurate quotes quickly, Schletter has developed an easy-to-complete project checklist that can be found online, at the web address listed below, or obtained from any technical sales representative.

While some off-the-shelf projects may not require it, the checklist is essential for custom-designed projects in order to ensure that the designs meet both code and customer expectations.

Download the project checklist on-line: www.schletter.us/brochures.

**Ordering Process**

Schletter offers design services for mounting systems at no charge*. When working with our sales and engineering departments, projects are generally handled as outlined below:

1. Complete project checklist
2. Soft offer is created and initial design is reviewed and approved by the engineer.
3. A formal offer or quote is sent to the customer. Any applicable geotechnical testing will be conducted once signed offer is received.
4. Initial offer will be modified, if necessary, based on the geotechnical testing results.
5. Drawings are created and sealed by professional engineers.
6. Project is manufactured and pre-assembled to exact specifications, and a delivery schedule is coordinated with the customer.
7. Delivery of material.

**Off-the-Shelf Solutions**

Because not all projects require a high level of custom design, Schletter offers several easy-to-order options that, in most cases, can ship the same day.

Off-the-shelf mounting solutions can be ordered conveniently on-line. Current customers can access the online store in the customer log-in section of our website.

For more information on this new service, please e-mail mail@schletter.us or call (888) 608-0234 (for locations in the United States, Central and South America). If located in Canada, please e-mail mail@schletter.ca or call (519) 946-3800.

*In unusual cases requiring a significant number of drawing modifications by the customer, a $50/hr drafting fee and/or $95/hr engineering design fee may be assessed.
Important Characteristics
Driven-Pile Post

Load-Bearing Profile, Roll-Formed
Developed by Schletter GmbH, safe and economical.

- High bending stiffness, economic material utilization
- Regarding soil friction, both inner and outer sides are relevant
- Reliable soil anchoring — even in cases of problematic soil conditions
- Avoidance of interfaces (welding joints, contact points, and different material combinations)

Comparison: aluminum and steel girders

Prices of aluminum and steel change independently of each other, making cost comparison a moving target. Generally speaking, however, aluminum is of higher value (no corrosion, stable value, etc.), and can be somewhat more expensive.

Structures made of hot-dip galvanized steel are of high value, but are also as expensive as aluminum in most cases. For hot-dip galvanizing, the steel posts must have a minimum wall thickness, because otherwise they will deform in the hot-dip galvanizing process.

Thus, structures are often built using thin, rolled profiles. Those are only electrolytically galvanized (limited durability in the exterior area) and sometimes even only strip-galvanized (thus, they have bare cutting edges).

Summary

Selecting the best post shape is a critical component in the design of a safe and efficient soil anchoring system.

When compared to the other common post shapes available, Schletter’s proprietary hat-channel design is superior. It offers the greatest bearing capacity, longest life span in harsh corrosive soils, and best dollar value.
The characteristics of the module bearing rails determine the economic efficiency of the complete load-bearing system. Optimum material utilization and adaption of the rail shape to the application are of utmost importance.

### Important Characteristics

#### Comparison of Load-Bearing Rail Shapes

<table>
<thead>
<tr>
<th>Rail Type</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extruded Aluminum Rails</td>
<td>Highly corrosion resistant without additional treatment</td>
</tr>
<tr>
<td></td>
<td>High scrap value for end-of-life recycling</td>
</tr>
<tr>
<td></td>
<td>Exact structural designs possible through extrusion process</td>
</tr>
<tr>
<td></td>
<td>Closed cross sections for greatest strength</td>
</tr>
<tr>
<td></td>
<td>Variety of extrusion variations available to maximize material efficiency</td>
</tr>
<tr>
<td></td>
<td>Lightweight for easy handling on-site</td>
</tr>
<tr>
<td>Rolled Steel Rail, Thick Wall</td>
<td>Must be galvanized for corrosion protection</td>
</tr>
<tr>
<td></td>
<td>Minimal recycling value</td>
</tr>
<tr>
<td></td>
<td>Limited shapes available</td>
</tr>
<tr>
<td></td>
<td>Closed cross-sections impossible to produce</td>
</tr>
<tr>
<td></td>
<td>Limited number of designs lead to inefficient use of material</td>
</tr>
<tr>
<td></td>
<td>Very heavy; requires power equipment to lift</td>
</tr>
<tr>
<td>Rolled Steel Rail, Thin Wall</td>
<td>Cannot be galvanized, paint needed for corrosion protection</td>
</tr>
<tr>
<td></td>
<td>Minimal recycling value</td>
</tr>
<tr>
<td></td>
<td>Limited shapes available</td>
</tr>
<tr>
<td></td>
<td>Closed cross-sections impossible to produce</td>
</tr>
<tr>
<td></td>
<td>Limited number of designs lead to inefficient use of material</td>
</tr>
<tr>
<td></td>
<td>Heavy; requires more manpower to maneuver on site</td>
</tr>
</tbody>
</table>
GAYK Ram
Hydraulic Pile-Driving Machine

Key Advantages

• Finely-tuned, intuitive controls
• Two boom lengths available, 13 or 18 feet for powerful ramming
• Rubber tracked for accurate and straight installations with minimal ground disturbance
• Exceptionally quiet engine for minimal environmental impact
• Operation by walking alongside the machine
• Engineered for easy maintenance
• Auto-leveling systems available
• Drilling and customized heads available

Versatility

The GAYK™ hydraulic ram makes installation fast and accurate in a variety of terrain conditions; even difficult gravel or loose stones, and on slopes (north-south) with up to 20 degree inclination.

FS System and the GAYK — An Unbeatable Combination

When installing large scale PV fields, the combination of the GAYK ram and the FS System’s hot-dipped galvanized foundation posts give the assurance that the installation is secure and on schedule. Per-post installation times measured in fractions of a minute allow significant savings in time and money.

Schletter is the exclusive distributor of the GAYK in North and South America.
**Key Advantages**

- Quick and simple mounting
- Cable protection
- UV resistance
- Perfect edge protection
- High impact resistance

**Cable Management**

Unsightly cables can make an otherwise attractive photovoltaic array seem poorly assembled and less likely to garner repeat business. Be sure to ask about our simple and affordable cable management products on your next order. We can offer:

- Cable clips for rails
- Cable clips for girders
- Conduit clamps for posts
- Cable Tray
- Combiner box mount

Can be installed directly to the purlin, the **cable tray** is the ideal solution to support multiple cable runs. It provides clean and professional cable routing for your solar mounting installation.

Each **combiner box mount** kit includes a set of top and bottom brackets to secure combiner box onto FS post.
In-house Geotechnical Team

Schletter offers geological analysis with an in-house team of geotechnicians. When using the steel posts that make up the FS System, geological testing of the soil is required to determine the necessary post embedment depth. Based on the testing results, the appropriate post length and any potential corrosion-resistance measures are determined. When on-site, Schletter geotechnicians conduct:

- Vertical pull-out load testing
- Lateral load testing
- Soil type analysis
- Sampling for laboratory testing of corrosion potential

Evaluation

Schletter’s Geotechnical Services provide a comprehensive report of the project site which may include (depending on site requirements):

- Description of site conditions
- Visual laboratory classification of selected soil samples
- Description of subsurface soil conditions
- Vertical pull-out capacity test results
- Lateral load capacity test results
- Assessment of corrosion potential

Mechanics of Vertical Pull-out Tests

Wind tests have shown that wind forces do not follow constant paths or act in strictly vertical or horizontal directions.

Instead, wind force on panels combines vertical and horizontal components to create a net force acting perpendicular to the face of the panel. By pull-testing posts in both vertical and horizontal directions, Schletter can accurately model how posts on any given site will react to wind forces. This allows for optimum embedment depth and material use.
Cross Beams

The cross rail, also known as the module-bearing rail, is designed according to profile geometry to match the natural forces created in a PV mounting system. Schletter has two decades of experience developing rail profiles with exact strength characteristics.

All Schletter rails have integrated channels for easy module clamp installation for both standard framed and frameless thin-film modules.

Module Clamps

Regardless of the module type, Schletter has several options available for safe, secure module clamping. All module clamps are tested for durability and most are ETL listed as grounding and bonding components.

Framed Modules

Framed modules, mounted in either portrait or landscape orientation, are securely held in place by Schletter’s proprietary Rapid5K™ module clamp. Pre-assembled for fast installation and featuring integrated grounding, the Rapid5K clamp can save valuable time during installation.

When ordering, specify module orientation and thickness for the right Rapid5K clamp. The Rapid5K clamps are ETL Listed to UL 467, CAN/CSA-C22.2 No. 41 for module grounding requirements.

Thin-Film Frameless Modules

Fragile thin-film modules are handled with care using Schletter’s Eco Series™ module clamps. Supportive rubber pads hold the modules in place without potential for damage — even in high wind.
Installed in some of the world’s largest, most robust solar fields, the FS System is the figure-head of Schletter’s ground mount solutions.

Projects like Mesquite Valley (150 MW), Brandis (40 MW) or San Alberto & Alfonsine (70 MW) demonstrate that verified structural safety, high-value materials and low prices are not conflicting targets!

FS System™
Driven-Pile Ground Mount Solution

Key Advantages

- Conforms to UL SUB 2703
- Certified to UL/ORD STD C1703
- No soil sealing required
- High durability and top-quality materials
- Industry-leading installation times
- All systems include certified engineering by professional engineers licensed in the state of the project
- Up to 70% pre-assembled for faster field installation
- Fully adjustable for a perfectly straight installation
- Fully integrated grounding and bonding (ETL listed)
- 20-year limited warranty

Ground Mount FS System

Few others can offer the engineering expertise, experience, and overall material optimization that Schletter puts behind its products every day. Built to install quickly and affordably, the FS System is ideally suited for mid to large-scale photovoltaic installations using any kind of module on the market.

Each post that makes up the FS System is hot-dipped galvanized using ASTM standard A123 grade 75, with a galvanized coating of G235. This is several times thicker than the industry standard. This thickness significantly extends the life of the steel and can aid in fighting the effects of corrosive soils. Adding to this robust process is a scientifically optimized post design which offers maximum soil anchoring strength, surpassing I-beams or round poles.

The module bearing portion of the FS System arrives partially pre-assembled for quick installation. Installers simply attach the head assembly to the foundation post, place the girder/strut assembly on the head, and secure with the included hardware.

Delivery schedules can be arranged in order to have the necessary material delivered continuously as installation progresses, or deliver all material in a single batch.
FS System™
Technical Data

Structural Analysis

• PE stamped drawings and calculations
• Individual system structural calculations based on geotechnical report
• Individual system design calculations based on regional load values
• Design loads according to IBC 2006, 2009, or 2012
• Patented profile geometries with optimum material utilization
• Verification of all construction components based on FEM-calculation
• Earthquake simulation, optional

Material

• Fastening elements, bolts: Stainless steel 304 & 316
• Profile (rails): Aluminum alloy 6105 T5
• High life expectancy, high residual value, no disposal cost
• Pile driven support posts: Steel, galvanized, ASTM A123 Grade 75

Construction

• Can be installed on uneven terrain
• Simple adjustment options
• Cost optimized configurations for framed and frameless modules
• Installation manual available online at www.schletter.us

Logistics

• Maximum level of prefabrication prior to shipment
• Industry leading installation time of 330 manhours per megawatt

Recommended Maintenance

• Every two years, check for exposed wiring in contact with aluminum or steel, correct exposed wiring
• If concrete foundations are used, check for sink holes or scour around foundations every two years
### FS System™ Reference Examples

<table>
<thead>
<tr>
<th>Location</th>
<th>Power</th>
<th>Rack configuration</th>
<th>Modules</th>
<th>Customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Sankusky, Ohio</td>
<td>12 MW</td>
<td>2 vertical</td>
<td>First Solar</td>
<td>Juwi Solar</td>
</tr>
<tr>
<td>Paulsboro, New Jersey</td>
<td>6 MW</td>
<td>2 vertical</td>
<td>Yingli</td>
<td>Americal Capital Energy</td>
</tr>
<tr>
<td>Hanover, Pennsylvania</td>
<td>3 MW</td>
<td>2 vertical</td>
<td>Schott</td>
<td>KPS Contracting / Kline Process Systems</td>
</tr>
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</table>
An attractive system installed quickly, efficiently, and with the durability to last.

Egg Harbor Township, New Jersey
- Power: 2.5 MW
- Rack configuration: 3 horizontal
- Modules: Yingli
- Customer: DCO Energy

Bolder, Colorado
- Power: 2 MW
- Rack configuration: 2 vertical
- Modules: Solon
- Customer: Solon

Dayton, Ohio
- Power: 750 kW
- Rack configuration: 2 vertical
- Modules: Sharp
- Customer: Inovateus

A production capacity of 125 MW/month and state-of-the-art manufacturing equipment enables Schletter to deliver on time.
FS Uno™ and FS Duo™

Affordable All Steel Options

Key Advantages

- 100% galvanized steel mounting system going beyond industry standard in steel fabrication
- Mounting superstructure made of galvanized steel up to G90 specifications
- High level of pre-assembly for faster field installations
- Increased distances between foundation supports further aids in cost reduction
- Driven galvanized steel posts with durable zinc coating for extended product longevity
- Single post (FS Uno) and double post (FS Duo) options

Based on the proven FS System™, installed in the world’s largest PV power plants, Schletter introduces an all steel option for ground mount photovoltaic systems, the FS Uno and FS Duo.

FS Uno Single Post System

Through extensive analysis and design, Schletter engineers developed a single post system which can install in the traditional south facing orientation or with a unique east-west orientation for difficult layout situations.

Mounting Options

FS Uno-100 (East-West Facing)

FS Duo Double Post System

Excellent for maximizing module installations, the Duo is the choice for reducing material costs for large-scale installations. The Duo uses a two post design extending the mountable area on the system.

Mounting Options

FS Uno (South Facing)

FS Duo
All of Schletter’s solar mounting systems are built to withstand years of relentless environmental conditions. In order to meet such expectations, the FS Uno™ and FS Duo™ product lines use only high quality galvanized steel with no exposed edges. The result is a steel solar mounting system designed to outlast the competition.

**FS Uno and FS Duo Material**
- Fastening elements, bolts: Stainless steel, grade 304
- Rails: Steel, hot-dip galvanized, up to G90 coating
- Driven-pile foundations (posts): Steel, hot-dip galvanized with G210 coating

**Logistics**
- Delivery of single components as well as a maximum level of pre-assembly are possible.
- Transport to construction site for efficient installation

**Construction**
- See installation manual at www.schletter.us/brochures.html

**Delivery and Services**
- Geotechnical investigation
- Structural analysis of the individual rack based on local wind, snow and seismic data

**Structural Analysis**
- Structural analysis based on a geotechnical investigation for local terrain condition
- Individual systems analysis based on local load values
- Design loads according to current IBC, ASCE, NBCC, and OBC standards.
- Highly efficient, material-saving profile geometries

- Verification of all construction components based on FEM-calculation

**System Grounding**
- The FS Uno and Uno-100 are ETL Certified to UL Subject 2703

**Warranty**
- 5-year limited warranty
# FS Uno™ and FS Duo™ Reference Examples

<table>
<thead>
<tr>
<th>Project</th>
<th>Rack configuration:</th>
<th>Size:</th>
<th>Location:</th>
<th>Customer:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>xxx</td>
<td>xxkW</td>
<td>xx</td>
<td>xxx</td>
</tr>
</tbody>
</table>

**Stonehill College**

- Rack configuration: FS Uno 2V x 11 30°
- Size: 2.7 MW
- Location: Easton, MA
- Customer: Solect Energy Development
Project
Rack configuration: xx
Size: xxkW
Location: xx
Customer: xx

Project
Rack configuration: xx
Size: xxkW
Location: xx
Customer: xx

Project
Rack configuration: xx
Size: xxkW
Location: xx
Customer: xx
Key Advantages

- Concrete ballast ground mount system
- Suitable for landfill sites, rocky terrain, and residential locations
- Complete structural analysis provided, including sizing of concrete ballast
- Short mounting time with partially pre-assembled support frames and no heavy machinery required
- Proprietary S-Series rail allows for long spans, reducing the required number of support frames and concrete foundations
- Corrosion resistant, all-aluminum construction
- Compatible with ground screws as alternative foundation type
- 20-year limited warranty

Standard Option or Individual Solutions Available

The PvMax is a ballasted ground mount system which offers an attractive design with long-lasting and durable system components. The system offers mounting solutions in areas where pile-driven posts are not possible, as is the case in most residential locations, on landfill sites or very rocky terrain. The PvMax also works with ground mount screws as an alternative foundation to concrete footings.

The core strength of the PvMax lies in the uniquely designed S-Series rail. This proprietary rail enables long spans, resulting in a lower number of required supports, thereby reducing the number of concrete foundations. Made entirely of aluminum, the PvMax is easily installed requiring no heavy machinery and able to resist decades of exposure without corrosion.

Examples of Mounting Variations

- PvMax 2V: 2 vertical modules
- PvMax 3V: 3 vertical modules
- PvMax 4V: 4 vertical modules
- PvMax 3H: 3 horizontal modules
- PvMax 4H: 4 horizontal modules
- PvMax 5H: 5 horizontal modules
- PvMax 6H: 6 horizontal modules
**PvMini™**

**Concrete Ballasted Ground Mount System**

**Key Advantages**

- Concrete ballast ground mount system
- Designed for mid- to large-scale PV applications including closed landfills, rocky terrain, and residential locations
- Complete structural analysis provided, including sizing of concrete ballast
- Light-weight and durable system with quick installation
- ProfiPlus XT™ rail enables longer spans, reducing the number of concrete foundations needed
- Corrosion resistant, all-aluminum construction
- 20-year limited warranty

**Cost Effective, Light-Weight Ground Mount Solution**

Based on the proven PvMax™, the PvMini is a non-penetrating ground mount system designed for one portrait or two landscape module configurations. This solution is ideal for mid to large-scale applications, including closed landfills and areas with rocky terrain.

The PvMini utilizes the proprietary ProfiPlus XT rails which enable longer spans and allow for more efficient use of other components within the system, thereby reducing the number of concrete foundations needed. Light-weight and quick to install, the system is an easy and cost-effective way to transform landfills into clean energy generators.
### Reference Examples

<table>
<thead>
<tr>
<th>Location</th>
<th>Power</th>
<th>Rack configuration</th>
<th>Modules</th>
<th>Customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perth, Ontario</td>
<td>10 KW</td>
<td>2 vertical</td>
<td>Day4 Energy</td>
<td>Blaze Power</td>
</tr>
<tr>
<td>Hudson, New York</td>
<td>150 KW</td>
<td>1 vertical</td>
<td>Aleo Solar AG</td>
<td>Hudson Solar</td>
</tr>
<tr>
<td>Logan Township, New Jersey</td>
<td>1.5 MW</td>
<td>2 vertical</td>
<td>Astronergy</td>
<td>groSolar</td>
</tr>
<tr>
<td>Dinuba, California</td>
<td>1.1 MW</td>
<td>2 vertical</td>
<td>SolarWorld</td>
<td>Chevron Energy Solutions</td>
</tr>
</tbody>
</table>
**Material**
- Fastening elements, bolts: Stainless steel 304 and 316
- Rails: Aluminum alloy 6105 T5
- High life-expectancy, high residual value, no disposal costs

**Logistics**
- Quick and simple mounting
- Maximum level of pre-assembly prior to shipment

**Delivery and Services**
- Soil survey and soil structural analysis (FS System, ground screw foundations)
- Individual structural analysis of site based on project characteristics
- Complete construction drawings and permitting package

**Structural Calculations**
- 100% code compliant designs for any locality
- Structural PE stamped drawings and calculations available for most states
- Geotechnical reporting for driven post and ground screw foundations
- Individual system design calculations based on site-specific load values and layout
- Design loads according to current IBC, ASCE, NBCC, and OBC standards.
- Patented rail geometries with optimum material utilization

**Foundation Options**
- Driven posts (FS System)
- Ballasted concrete (PvMax/PvMini)
- Ground screws (PvMax/PvMini)

**Accessories**
- Cable trays for clean installation
- Cable clips for easy wire management
- Grounding-integrated module clamps

**System Grounding**
- The FS System is ETL Certified to UL Subject 2703. A guide to proper grounding procedures of the system is available on the Schletter website.
- The Rapid5K Module Clamp allows for integrated grounding

**Warranty**
- 20-year limited warranty
Park@Sol
Technical Data

Material
- Hardware, bolts: Quality steel 1.4301;
- Profiles: Aluminum (EN AW 6063, EN AW 6005)

Logistics
- Quick and simple mounting
- Maximum level of pre-assembly
- Direct delivery to construction site

Accessories
- Cable channels, cable ducts
- Lightning protection system (FS Protect System)
- Module clamps with integrated grounding.

Delivery and Services
- Project planning assistance
- Complete system drawings
- Production and delivery of the complete carport system

Optional
- Vibration simulation of wind loads on request
- Earth quake simulation

Lightning and Grounding
- Extension with outward lightning protection system is possible
- Components for grounding system
- Potential equillization certified according to VDE 0100, part 712

Construction
- For framed and unframed modules
- Minimum sealing of the soil surface
- Optional waterproof substructure