Positive Attachment
Installation Guide
 Installer must read this manual before attempting installation. Failure to correctly establish the requirements of the proposed installation site is dangerous and can void the framing or roofing warranty. Please contact Shai Bergerfroind at 323-692-9264 Ext. 216 or at shai@permacity.com to verify latest revision of this manual.
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Handling & Installing

It is critically important to observe standard safety practices when installing Solar Strap™:

- Follow all OSHA safety guidelines for construction safety.
- Stop work during stormy weather. Solar modules, Solar Straps, and other components can be blown off the roof in high winds.
- Always secure solar modules, Solar Straps, and other components from unexpected high winds while under construction. Wind blown construction materials are a safety hazard.
- Never step or sit on the glass surface of a solar module. The glass may break, resulting in shock or bodily injury.
- Do not throw or roughly handle any Solar Strap™ components.
- Do not bring Solar Strap™ into contact with sharp or heavy objects.
- Do not modify Solar Strap™ components in any way. The exchange of bolts, drilling of holes, bending and any other physical changes not intended in standard installation procedure will void the warranty.
- Products should be installed and maintained by qualified personnel. Keep unauthorized personnel away from solar modules.
- It is the installer’s responsibility to verify the integrity of the structure to which Solar Strap™ is used. Roofs or structures with rotten/rusted bearers, undersized bearers, excessively spaced bearers or any other unsuitable substructure cannot be used with Solar Strap™. Installation on such structures could result in death or serious injury.
- Installation is to be periodically re-inspected for loose components, loose fasteners and any corrosion. Any affected components are to be immediately replaced.

Roof Loading Resistance, and Seismic Attachments

Roof loading calculation are based on code approved stress equations and allowable margins of safety. Roof loading calculations must be conservatively performed under wind loads, snow, and dead loads. Components have had full envelope forces applied to each component from engineered data sets approved by the Engineer Of Record (EOR). The EOR will review PermaCity wind data tables and choose the appropriate wind uplift values by boundary roof zones. The EOR will choose and compute the quantity and method of positive seismic attachments required based on roof type, roof substructure and seismic locations. This data is either provided as part of the project engineering or from a Solar Strap code compliant data set.

Features

- Aluminum 5052 - 6061
- Suitable for most buildings
- Suitable for roof slope range 0°<9.5°
- Panel array weight under (3) Lbs/sf
- High strength-to-weight ratio
- Spacing efficiency with integrated setback adjustments
- High corrosion resistant materials resulting in low lifetime maintenance and an extended product life
- Complies with ASCE 7-05 and ASCE 7-10 guidance for design criteria
- Complies with SEAOC PV-1 for seismic designs
- Complies with SEAOC PV-2 guidance for wind tunnel tested arrays
- Ballast only option under (5) Lbs/sf in most Western U.S. locations
- Tested to 120 MPH wind zones, calibrated to 150 MPH

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Diagram

The SolarStrap™ is fast and easy to install with minor field measurements required. The PanStrap option is available when used in conjunction with PermaCity’s wind tunnel test data in compliance with SEAOC PV-2 Guidelines.

Note: The SSSS4 or SSOP3 will need to be in every installation for that installation to retain Fire Rating. (UL2703 First Edition 20150128 §26.1)

Note: Marking plate will be stamped into each SSOP3 near the middle of the part, see location shown below under components.

Components

SolarStrap™ One Piece w/Marking Stamp SSOP3

SolarStrap™ Low Bracket (5°, 10°, 15°) SSLB

SolarStrap™ High Bracket (5°, 10°, 15°) SSHB

SolarStrap™ Attachment Plate/Heavy Duty SSAP/SSAPHD

Conductive Mid Clamp* A3004

Conductive End Clamp* A3003

Grounding Lug* SGB-4

Grounding Lug* SGB-5

Serrated Hex Flange Nut SSHWSFN

SolarStrap™ Bond Bar

Full Threaded Hex Bolt SSHWHB

Lock Washer SSHWLW

Frameless Module Clamp with Star Washer SSTFEC

*Note: For certain jurisdictions these items may be single use only. Please check with local AHJ for more information regarding single use bonding.
Required Tools and Safety Equipment

- Chalk Line Reel
- Drill with Impact Driver
- Measuring Tape
- Torque Screw Driver
- Footwear
- Gloves
- Hard Hat
- Safety Glasses
- Safety Harness
- Safety Vest
Setting Up The Roof

• Identify interlock set point on SolarStrap™ (y2). Verify plan set to check correct slot to inter-lock.
  \[ x^1 = \text{Length of the center of the module to the center of strap} \]
  \[ x^2 = \text{Length of the strap to the center of the strap} \]
  \[ x^1 = \text{Space in-between modules 3/4” per Sunpreme installation manual} \]
  \[ y^1 = \text{Module width 38.98” per Sunpreme module spec sheet} \]
  \[ y^2 = \text{Identify inter-lock set point on SolarStrap™} \]

• Spans for inter-row spacing vary between different module tilt angles.
• Modules are mounted in Landscape orientation unless otherwise specified in the plans.
• Snap horizontal and vertical lines or chalk-mark the position of each assembly support bracket for a quick and easy layout. For large open roofs only edge straps and horizontal module edges may need lines identified.

<table>
<thead>
<tr>
<th>CAUTION</th>
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<tbody>
<tr>
<td>• AHJ may request seismic attachment for certain zones. Verify with your local department of building and safety.</td>
</tr>
<tr>
<td>• Be careful to follow final design/layout.</td>
</tr>
<tr>
<td>• Installer must verify that PV Module manufacturer’s attachment points for clamps are met to avoid damage, injuries and module warranty being voided.</td>
</tr>
<tr>
<td>• Installers must verify that all building requirements specific to installation site are met, including city, fire department, and other jurisdictions responsible for Residential/Commercial roof inspections.</td>
</tr>
<tr>
<td>• Installer must follow all OSHA CFR1926 rules and regulations regarding Job-site safety, fall protection and PPE. For more info visit: <a href="http://www.osha.gov">www.osha.gov</a></td>
</tr>
</tbody>
</table>
Roof Layout

NOTE:
ONCE THE CORRECT INTERLOCK SETTING HAS BEEN ESTABLISHED BY PERRMACITY AND/OR APPROVED PLANS BY AHJ/BUILDING DEPARTMENT. INTERLOCK ALL SSOP3 - SOLARSTRAP TO THE ESTABLISHED SETTING. THIS WILL MAKE THE INSTALLATION AND MOUNTING OF SOLARSTRAP COMPONENTS AND SOLAR EQUIPMENT FAST AND EASY.

Laydown Straps

NOTE:
TO MAKE THIS INSTALLATION FAST, EASY, AND ACCURATE, YOU CAN DO THE FOLLOWING TO LOCATE AND PLACE THE SSOP3 - SOLARSTRAP AND SSAP - ATTACHMENT PLATES. USE A JIG (2 x 4 WOOD/STUD OR ALUMINUM BAR, CUT TO THE CORRECT SIZE. THIS CAN BE PROVIDED BY PERRMACITY OR CAN BE ACQUIRED ONCE YOU MARK THE ROOF.

For framed modules the jig should = Length of module - 2 1/4"
For frameless modules you will need 2 jigs based on the manufacturer's recommendation on module clamping:
1. double first clamping position - 2 1/4"
2. distance between clamping positions - 3"
Add Brackets

After SolarStraps are laid down, simply place brackets with top flanges facing inwards. The low bracket is for the sun-facing side and the high bracket for the shade-facing side. Fasten the Serrated Hex Flange Nuts to secure brackets to a torque of 78 in.-lbs.

NOTE:
PLACE SSLB - LOW BRACKET AND SSHB - HIGH BRACKET OVER INTEGRATED PEM STUDS STICKING UP THE SSOF3 - SOLARSTRAP TO SECURE THE BRACKETS USE SSHWSFN - 1/4" SERRATED FLANGE NUT AND FASTENED TO 78 IN-LBS.
Place Modules

After brackets are secured, simply place modules on brackets. Install mid and end clamps and torque to 78 in.-lbs or manufactures recommendation. See Mid and End Clamp instruction on page 11.

Note: For Sunpreme module torque to 78 in.-lbs or manufactures recommendations.

SolarStraps must be secured to the modules by using the “Conductive Mid-Clamps and End-Clamps” (for framed modules) or the “Frameless End Clamps” for the frameless modules, such as Sunpreme.

CAUTION

Never leave unsecured modules on the roof unattended.
CAUTION

Over torqueing could result in module damage and voiding of warranty. Never torque more than 78 in.-lbs. Clamps must be in proper location with the bolt center at the least 2.5” from the frame edge.
Wire Management and Grounding

The SolarStap™ is certified by UL2703 to be used for integrated grounding in two directions. (1) primary from module to module bonded by the Conductive Mid Clamp A3003 and (2) Through the SolarStrap connected to Mid Clamp A3004 or End Clamp A3003. For frameless modules the SolarStrap Bond Bar (SSBB) is used to connect SolarStraps together to maintain a continuous bond. The Maximum number of adjacent bonded PV modules or Straps from the “Grounding Lug” (SGB-4 or SGB-5) attached to the first supporting bracket is limited by the inverter DC ground conductor size or 360 modules, no more than 40 modules across from the SolarStrap connected to the grounding lug. For installations where some of the modules cannot be installed adjacent to each other the following methods may apply.

a. A bare solid #6 AWG copper conductor or A #6 AWG stranded with XHHW-2 90°c insulation with a maximum length of 30 feet bonded using approved grounding lug (SGB-4 or SGB-5)

b. Use of SSBB to bond gaps; including walkways

c. The use of SSBB to bond frameless modules straps together is required since bonding not available though a module frame

Simply attach ground wire to the provided Grounding Lug (SGB-4 or SGB-5) fastened to the wing of the low or high bracket and connect the ground wire to the pull box that is mounted on the back of the high bracket. From the pull box run ground wire all the way to the inverter or combiner box per the electrical engineering drawing.

PVC Schedule 80, EMT, IMT, or Rigid conduit may be secured to any part of the brackets and should be six inches or more above the roof to minimize heat gain and wire heat losses. Conduit may pass under the array to take the most direct path to inverters or combiner boxes. For wire management use EMT or Schedule 80 PVC conduit supported by a one-hole strap and one self tapping screw to attach your conduit to the side of the wing. Use plastic end protection if using EMT. EMT should be avoided for inter row crossings if the local AHJ requires bonding of EMT at these locations.

Note: A SSBB is only required on frameless modules, to bond the rows to columns. One per bonded 40 modules.

Note: This racking system may be used to ground and/or mount a PV module complying with UL 1703 only when the specific module has been evaluated for grounding and/or Mounting in compliance with the included instructions.
Grounding the Array Example

Up to 360 modules in an array requires one grounding lug (SGB-4 or SGB-5/Torque to 55 in. lbs) secured to one bracket. A bare #6 AWG solid copper or stranded wire with XHHW-2 90°C insulation may be used to bond each grounding lug (SGB-4 or SGB-5/Torques to 55 in. lbs) to the Earth Ground. The grounding lug must be placed on a continuous strap. Stranded rows of modules may ground through straps to the adjoining row. For islands of modules a bare #6 AWG solid copper or stranded wire with XHHW-2 90°C insulation jumper ground wire connects islands of modules together through grounding lugs (SGB-4 or SGB-5/Torque to 55 in.lbs) secured to one bracket per section. A SolarStrap™ Bond Bar (SSBB) can also be used to connect islands of modules. All bonding/grounding hardware is to be used in accordance with the National Electric code, ANSI/NFPA70.
PermaCity SolarStrap™ is uniquely suited for installation of rooftop mounted PV solar systems in seismically active areas and on buildings with limited roof structural capacity. Due to its light weight and flexible mounting options, the PermaCity SolarStrap™ is a viable option for a wide range of rooftops. Our design allows the PermaCity SolarStrap™ to be mounted to the roof using one of three mounting options: structurally attached; ballasted; and a hybrid option that uses both ballasted and structural attachments. Calculations have been performed in accordance with the 2013 California Building Code (CBC), the governing building code in California, which references the 2012 International Building Code (IBC). The 2012 IBC references the 2010 Minimum Design Loads for Buildings and Other Structures, including Supplement No. 1, No. 2, and Errata, by the American Society of Civil Engineers (ASCE), referred to as ASCE 7-10. The anchorage designs have been designed to withstand code-prescribed seismic forces due to the self-weight of the racking system, the self-weight of the solar panels and the system’s ballast, if present.

Our structural analysis and design of the PermaCity SolarStrap™ and its method of attachment (ballasted, structurally attached and the hybrid ballasted with structural attachment) complies with Section 13.4 of ASCE 7-10, which states that all components shall be positively fastened to the structure without consideration of frictional resistance. The intent of our design is to provide a solution for various design parameters for seismic anchorage in a variety of site-specific conditions. Since there are many different possible seismic conditions, we can provide a site-specific seismic anchorage configuration with calculations to assure a safe installation and to obtain building permits. The seismic forces used in our calculations assume Site Class D and utilize short- period spectral accelerations as provided in ASCE 7-10. The design parameters may also be customized by roof material type.

Limitations
For certain projects, site-specific engineering may be recommended to help determine a very efficient custom installation cost. These various building-specific issues must be evaluated by the appropriate registered professional(s) prior to the addition of the photovoltaic and racking systems. A licensed structural engineer shall be consulted for building-specific structural evaluation.
Builtup or Asphalt Roof

Note: EOR required to review suggested site plans. EOR shall review/recommend proper roof attachments that are commercially available.
<table>
<thead>
<tr>
<th>Product</th>
<th>Product Number</th>
<th>Quantity</th>
<th>Note</th>
</tr>
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<tr>
<td>SolarStrap™ One Piece</td>
<td>SSOP3</td>
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<td>SolarStrap™ Bond Bar</td>
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<td>SolarStrap™ Universal Connect Strap</td>
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<td>Grounding Lug</td>
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<td>Grounding Lug</td>
<td>SGB-5</td>
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<td>Serrated Hex Flange Nut</td>
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<td>Thin Film End Clamp with Star Washer</td>
<td>SSTFEC</td>
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CERTIFICATIONS AND APPROVED MODULES

TÜV UL2703 - Conformance

Fire Conformance
TÜV Rheinland Reference File: R1-PMC150609
L2-PMC150609

Mechanical Conformance
TÜV Rheinland Reference File: L1-PMC151112
L4-PMC150609

Electrical Conformance
TÜV Rheinland Reference File: L1-PMC161026
L1-PMC170505
L1-PMC170615
L3-PMC150609
L1-PMC180123

TÜV UL2703 - Approved Modules

Testing Approval

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<td>Sunpreme GX-Series</td>
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Design Load Rating

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<th>Upward Design Load (PSF)</th>
<th>Down-Slope Design Load (PSF)</th>
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<td>Hyundai 310W</td>
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SolarStrap™ Limited Warranty Statement

<table>
<thead>
<tr>
<th>Product</th>
<th>Product Number</th>
<th>Duration of Limited Warranty</th>
</tr>
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<tbody>
<tr>
<td>SolarStrap™ One Piece</td>
<td>SSOP3</td>
<td>20 Years</td>
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<tr>
<td>SolarStrap™ Solar Strap</td>
<td>SSSS4</td>
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<td>SSPS4</td>
<td>20 Years</td>
</tr>
<tr>
<td>SolarStrap™ High Bracket (5°, 10°, 15°)</td>
<td>SSHB</td>
<td>20 Years</td>
</tr>
<tr>
<td>SolarStrap™ Double High Bracket (5°, 10°, 15°)</td>
<td>SSHBEW</td>
<td>20 Years</td>
</tr>
<tr>
<td>SolarStrap™ Low Bracket (5°, 10°, 15°)</td>
<td>SSLB</td>
<td>20 Years</td>
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<tr>
<td>SolarStrap™ Double Low Bracket (5°, 10°, 15°)</td>
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<td>Conductive Mid Clamp</td>
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<tr>
<td>Conductive End Clamp</td>
<td>A3003</td>
<td>20 Years</td>
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</table>

A. Extent of Limited Warranty
1. PermaCity warrants to the end-user customer that the PermaCity products specified above will be free from defects in materials and workmanship for the duration specified above, which duration begins on the date of purchase by the customer.
2. PermaCity’s limited warranty covers only those defects that arise as a result of normal use of the product, and does not cover any other problems, including those that arise as a result of:
   a. Improper maintenance or modification;
   b. Parts or supplies not provided or supported by PermaCity;
   c. Operation outside the design specifications or engineering;
   d. Unauthorized modification or misuse.
3. If PermaCity receives, during the applicable warranty period, notice of a defect in any product which is covered by PermaCity’s warranty, PermaCity shall either repair or replace the product, at PermaCity’s option.
4. If PermaCity is unable to repair or replace, as applicable, a defective product which is covered by PermaCity’s warranty, PermaCity shall, within a reasonable time after being notified of the defect, refund the purchase price for the product.
5. PermaCity shall have no obligation to repair, replace, or refund until the customer returns the defective product to PermaCity.
6. Any replacement product may be either new or like-new, provided that it has functionality at least equal to that of the product being replaced.
7. PermaCity products may contain remanufactured parts, components, or materials equivalent to new in performance.
8. PermaCity’s Limited Warranty Statement is valid in any country where the covered PermaCity product is distributed by PermaCity. Contracts for additional warranty services, such as on-site service, may be available from any authorized PermaCity service company in countries where the product is distributed by PermaCity or by an authorized importer.

B. Limitations of Warranty
To the extent allowed by local law, neither PermaCity nor its third party suppliers makes any other warranty or condition of any kind, whether express or implied warranties or conditions of merchantability, satisfactory quality, and fitness for a particular purpose.

C. Limitations of Liability
1. To the extent allowed by local law, the remedies provided in this Warranty Statement are the customer’s sole and exclusive remedies.
2. To the extent allowed by local law, except for the obligations specifically set forth in this warranty statement, in no event shall PermaCity or its third party suppliers be liable for direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory and whether advised of the possibility of such damages.

D. Projects located within 2.5 miles of the ocean must use marine grade option, using either coated stainless steel serrated hex flange nut, pem studs, and pem nuts or these items mare inaluminum.

The only warranties for PermaCity products and services are set forth in the express warranty statements accompanying such products and services. Nothing herein should be construed as constituting an additional warranty. PermaCity shall not be liable for technical or editorial errors or omissions contained herein. In order to keep full warranty, please design and build per installation manual guidelines.

SolarStrap™ Installation Manual
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www.solarstrap.com
# Log of changes to install manual

<table>
<thead>
<tr>
<th>Revision Number</th>
<th>Date</th>
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<td>First Draft</td>
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<td>SSIM REV 091917</td>
<td>09/19/2017</td>
<td>Submittal to TUV for Certification</td>
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<td>01/24/2018</td>
<td>Updated per TUV review comments</td>
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<tr>
<td>SSIM REV 013018</td>
<td>01/30/2018</td>
<td>Minor Format changes/Added Hansol HSXXXTD to approved list</td>
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<tr>
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<td>Clarify SSTFEC installation. Certified by TUV Cert. (# XXXX to be updated)</td>
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