

Spice Solar® Built-In Racking™, Series 300 Installation Guide



L-FOOT MOUNTING SYSTEM

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1. INTRODUCTION

Spice Solar® technology makes installing rooftop solar modules faster and cheaper by integrating the racking directly into the module frames. No more racking, mid and end clamps, grounding clips, transporting 20' rails, sawing, or splicing – not to mention all the purchasing and logistics hassles that go along with this blizzard of rooftop parts. Based on decades of rooftop solar installation experience, Spice Solar offers a family of easy-to-use installation components that work on all residential roof types and are optimized to work with Spice Solar Certified PV modules.

The Spice Solar Built-In Racking, Series 300 System conforms to UL-2703 standards for grounding, mounting and fire rating of solar mounting systems. The Spice Solar mounting 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 indicated instructions. The system has achieved a Class A fire rating when used with **Type 1 and** Type 2 solar modules. The system has been tested to 45 psf in both positive load and negative load configurations. A label identifying the Spice Solar Built-in Racking, Series 300 System is attached on the inside of the frame of each Spice Certified module.

The Spice Solar Installation Manual is applicable to Spice Solar Certified PV modules that are installed using Spice Solar Certified components. Although Spice Solar Certified PV modules can be installed using ordinary racking, that type of installation is outside the scope of this document.

The installation methodologies described in this manual are generalized to apply to any Spice Solar module using a Spice Solar L-Foot. Spice Solar L-Feet can then be attached to many industry standard roof mounts (including flashings, standoffs, hooks and specialty fasteners) that meet the engineering requirements for a particular application.

1.1. Spice Solar Overview

The key to Spice Solar technology is the use of a specially designed, highly-rigid module frame that enables the modules to be attached directly to the roof at the perimeter of the frame. Modules are connected together in the east-west direction with E-W Splices, and share roof mounts between rows with N-S Brackets. As shown in the figure below, an array of 6 modules composed of two rows of three modules would have 9 roof mounts (assuming rafter spacing of 16" and roof attachment spacing of 48"). Note that 20 modules is a more typical array size; however, for clarity a very small array is shown.

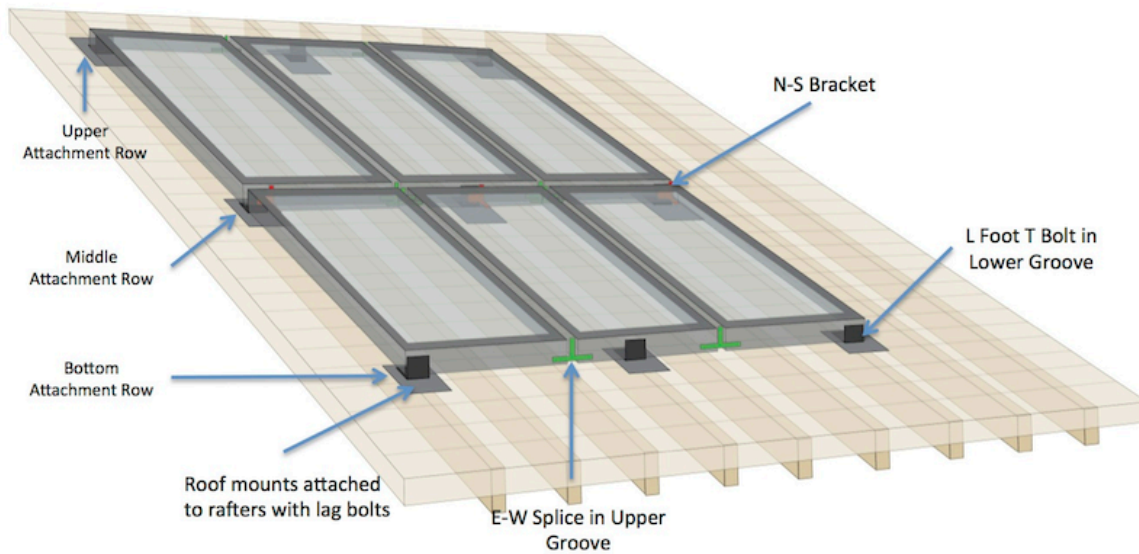


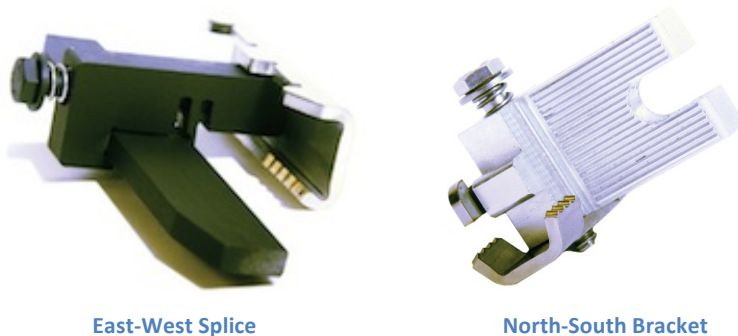
Figure 1-1 Spice Solar System

When using Spice Solar Certified PV modules, installers gain several important advantages:

- Modules can be installed on all roof types and in all wind/snow zones in the U.S.
- Modules are directly attached to roof mounts, thereby eliminating the cost, time and hassle of racking
- 25% fewer roof mounts are typically required compared to rackless or ordinary racking
- Installations only require two special components: East-West Splices and North-South Brackets
- The Spice System has integrated grounding, requiring only one grounding point per array
- No special tools are required

1.2. Spice Solar Components

The two primary Spice Solar components are shown below:



East-West Splice

North-South Bracket

Figure 1-2 Spice Solar Components

1.3. Other Installation Components

As shown in Appendix B, additional components are often necessary to complete an installation, including grounding lugs, L-Feet, Offset L-Feet (to avoid moving panels slightly when roof mounts are directly below the center of a E-W Splice), Flat Tile Hooks, **Tilt Legs**, and Inverter/optimizer brackets.

1.4. Roof Mounts

Spice Solar L-Feet can be attached to a wide variety of roof mounts, including composition roof flashings, single and double lag standoffs, flat tile hooks, barrel tile mounts, standing seam metal roof clamps, and tilt-up arrays.



Figure 1-3 Sample Roof Mounts

1.5. Tools

Spice Solar Certified modules are designed for easy installation using standard tools, including a torque wrench, ratchet wrench, drill, and impact driver. Other tools may be necessary depending on the type of roof mount to which the L-Foot is attached.

1.6. Torque Settings and Fasteners

Refer to the following table for torque settings required for the fasteners used in the Spice Solar system.

Spice Component	Torque Setting	Fastener	Tool
E-W Splice and N-S Bracket	7 ft-lbs	Hex Head on 1/4"-20 Bolt	7/16" deep socket
L-Foot, Offset L-Foot, Tile Hook	25 ft-lbs	Flange Nut on 3/8"-16 T-Bolts	9/16" socket
Grounding Lug	5 ft-lbs	Hex Head on 8-32 Bolt	5/16" socket
Grounding Lug	2.5 ft-lbs or 18 in-lbs	Set Screw	Flat head screwdriver
Comp Flashing, Tile Hook	See Roof Mount instructions	Hex Head 5/16" Lag Bolt	1/2" socket

1.7. Additional Considerations

Depending on the location and type of roof, other components may be required, including roof sealant, anti-seize lubricants, rodent/pigeon screening and specialty wiring components.

1.8. Safety Precautions

This Spice Solar Installation Manual is no substitute for comprehensive solar installation safety guidelines or training. Nevertheless, it is worth emphasizing the following precautions that should be followed for all solar installations:

- Ensure that all installation staff are properly trained for the work being done, including use of hand and power tools, ladders and materials handling equipment.
- Use appropriate fall protection equipment, and verify that this equipment is operated correctly.
- Use approved roof anchors (never solar roof mounts).
- Wear protective clothing including gloves, headgear (including hard hats where appropriate) and footwear.
- Maintain a neat work area, and prevent slipping and falling hazards from debris, tools or packaging.
- Follow appropriate electrical safety procedures. Note that solar power systems may produce dangerous shocks, even when exposed to weak sunlight.
- Be aware that weather conditions may create rooftop slipping hazards, and even light winds may make it difficult to carry solar modules.
- There are sharp stainless steel teeth on E-W Splices and N-S Brackets, as well as sharp exposed aluminum corners of Spice Modules in which E-W Brackets and T-Bolts are inserted. Where protective clothing, including gloves, when handling these components.

1.9. System Level Fire Classification

Spice Solar's Built-In Racking, Series 300 solar mounting system has been tested to the UL Subject 2703 with references from UL 1703 rev. May 2014 standard. It has achieved Class A system level performance for low (<2/12 pitch) and steep (>2/12 pitch) sloped roofs when used in conjunction with Type 1 and Type 2 module constructions. Class A system level fire performance is inherent in the system design, and no additional mitigation measures are required. There is no required minimum or maximum height limitation above the roof deck to maintain the Class A fire rating. The system fire class rating is only valid when the installation is conducted in accordance with the assembly instructions contained in this manual. Refer to Appendix B for the components covered under the certification. Refer to Appendix C for the relevant certifications.

1.10. UL 2703 Certification

Spice Solar's Built-In Racking, Series 300 solar mounting system has been tested to the UL 2703 standards for grounding, mounting and fire rating of solar mounting systems. The system

has been tested to 45 psf in both positive load and negative load configurations. Refer to Appendix B for the components covered under the certification. Refer to Appendix C for the relevant certifications.

1.11. References

Additional information, certifications, warranties, documentation, references, Technical Engineering Reports (TERs), regulatory information, certified modules and certified components may be found on the Spice Solar website at www.spicesolar.com.

2. Array Design and Planning

Spice Solar Certified modules can be installed in portrait, landscape and mixed orientations. The general process is to gather relevant data about the project site, determine the roof mount spacing, lay the array out, identify grounding points, consider thermal expansion, and then finalize the Bill of Materials as well as possible spare parts and accessories.

2.1. Project Data

The following information is necessary in order to determine the array design:

- Location Characteristics: Risk Category (1 or 2), Exposure/Terrain Category (A, B, C or D), Ground Snow Load, and Design Wind Speed. These location characteristics are usually similar for installations within a small geographic area.
- Building Characteristics: Roof Type, Roof Pitch, Rafter Type, and Rafter Spacing.
- Array Characteristics: Roof Zones (Interior, Exterior, Corner), Fire Setbacks, Roof Obstructions and Shading.

2.2. Determine Roof Mount Spacing

Spice Solar has developed Technical Engineering Reports (TERs) that provide lookup tables to determine roof mount spacing and roof mount cantilever allowances. TERs may vary by country. Using the applicable TER, and with the project data collected above look up the roof mount spacing and cantilever allowance. The maximum roof mount spacing is 72" (48" is typical) and the maximum cantilever allowance is 15.5".

2.3. Array Layout

Based on the roof mount spacing and cantilever allowance, lay out each array section, identifying:

- The number of roof mounts needed that is appropriate for the actual rafter spacing and cantilever allowance at the end of each module
- The number of L-Feet (same as the number of roof mounts)
- The number of E-W Splices (two required between adjacent modules)
- The number of N-S Brackets (one bracket at each shared roof mount between rows)

Spice Certified modules can be installed in portrait, landscape and mixed orientations. To minimize wiring lengths and number of roof mounts, portrait orientations are the most common.

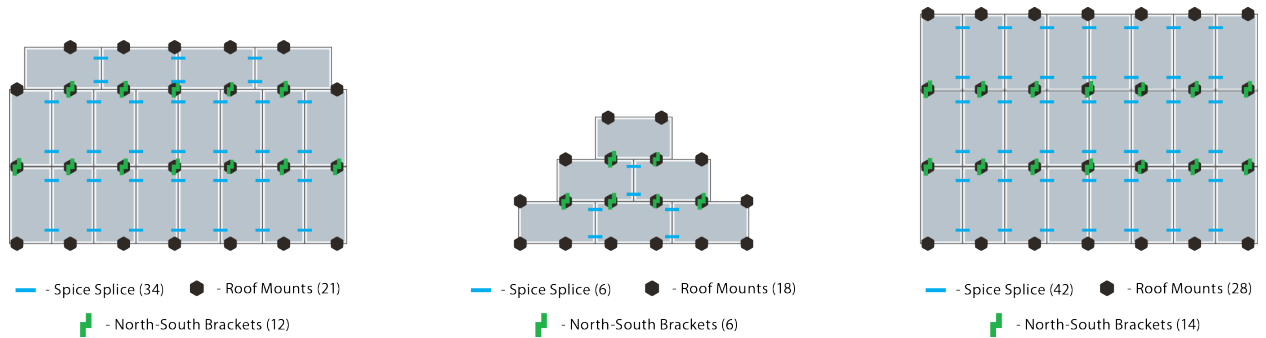


Figure 2-1 Portrait, Landscape and Mixed Orientations

2.4. Grounding

E-W Splices provide a grounding connection between adjacent modules in the east-west direction, and N-S Brackets provide a grounding connection between adjacent modules in the north-south direction. Grounding connections to Spice modules must be made at the identified grounding point. There are four grounding points per module. Only one grounding connection is needed per array segment (two array segments would require a grounding connection to each array segment). Grounding connections can also be made between two nearby array segments. Grounding connections, lugs and wiring must comply with applicable codes.

The maximum array size is 12 modules x 12 modules based on the grounding and bond path testing conducted for UL 2703 certification.

The Spice E-W Splice and N-S Bracket have been tested for multiple use even when installed in the same location on a module frame.

As shown with the blue and green symbols in the following illustration, E-W Splices and N-S Brackets provide redundant grounding paths to all connected modules. Although bonded, the Roof Mounts are not part of the system grounding path. To ground this array, only one Spice Ground Lug needs to be installed on any convenient module.

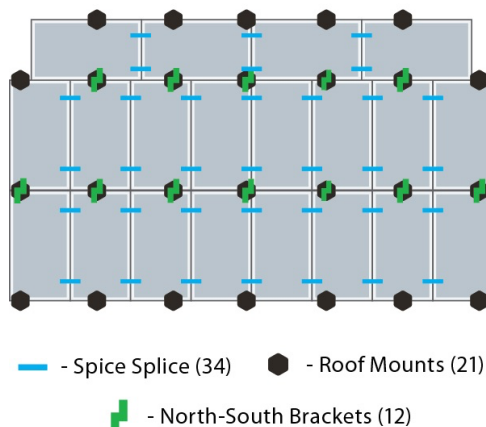


Figure 2-2 Grounding Paths Through E-W Splices and N-S Brackets

2.5. Maintaining Bonding Path During Maintenance

If a module must be removed for maintenance and that module is in the bonding path, a temporary jumper must be installed between adjacent modules to maintain the bonding path for the rest of the array. Since the Spice System has redundant column-row bonding, this circumstance only happens when there is a single row of modules and the module being removed is in the middle of the row. This jumper must be bare copper wire AWG 4-10, and must be connected to two Spice grounding lugs spanning the removed module. Once the removed module is replaced and re-connected with E-W Splices the grounding jumper can be removed.

2.6. Thermal Expansion

For large arrays, thermal expansion gaps are necessary to prevent excessive stress on module frames and roof mounts. A gap of 1" is required along any contiguous array distance over 33 feet, or 10 modules. An array composed of 16 modules arranged in a single row would require a 1" gap, ideally between modules 8 and 9 to balance the expansion of each array section. An array of 7 or more modules arranged in a single column would require a 1" gap between modules 3 and 4. Since there is no grounding connection across this thermal expansion gap, grounding connections must be made to each of the array sections.

2.7. Bill of Materials, Extra Parts and Supplemental Components

Summarize the number of L-Feet, E-W Splices, N-S Brackets needed for the array sections in the system. Keep in mind the following considerations for extra parts and supplemental components:

- Additional components may be necessary if roof attachment locations are different on the roof than originally planned, or if array segments must be separated due to vent pipes or other obstructions. It is prudent to plan for several extra roof mounts, L-Feet, E-W Splices, N-S Brackets and grounding lugs.
- When the center of E-W Splices align with the location of a roof mount and L-Foot, there may be a gap in the lower groove, making it difficult to attach the L-Foot to the side of the module. In this case it may be possible to shift the array by about 1" to either side. Alternatively, an Offset L-Foot can be used. For this reason, it is prudent to bring several Offset L-Feet to each project.
- The BOM should also include the wiring components needed for AC and/or DC wiring of the system. These components include wire management clips, and inverter/optimizer brackets.
- In addition to the Spice Solar mounting components described herein, wiring components, module electronics, inverters and electrical components should be included.

3. Installation Process

Spice Solar systems are installed in the same general manner as ordinary rack mounted systems – except there are many fewer parts. With the roof layout in hand and all components identified on the BOM available on site, the system is ready to be installed.

SAFETY NOTE: To prevent burned, pinched or cut fingers, we recommend wearing work gloves when installing modules, E-W Splices, brackets and roof mounts.

3.1. Mark Layout on Roof

Determine the exact external dimensions of the Spice Solar module being installed. For these examples we will be using a Spice Solar module that is 64.75" high and 39.25" wide on a roof that can accommodate two rows of modules in portrait orientation with a 36" spacing between the top of the modules and the ridgeline of the roof. In locations in which ridge fire setbacks are required, measurements usually begin from the top of the roof down so that unshaded roof space and gutter area access is maximized, as described below.

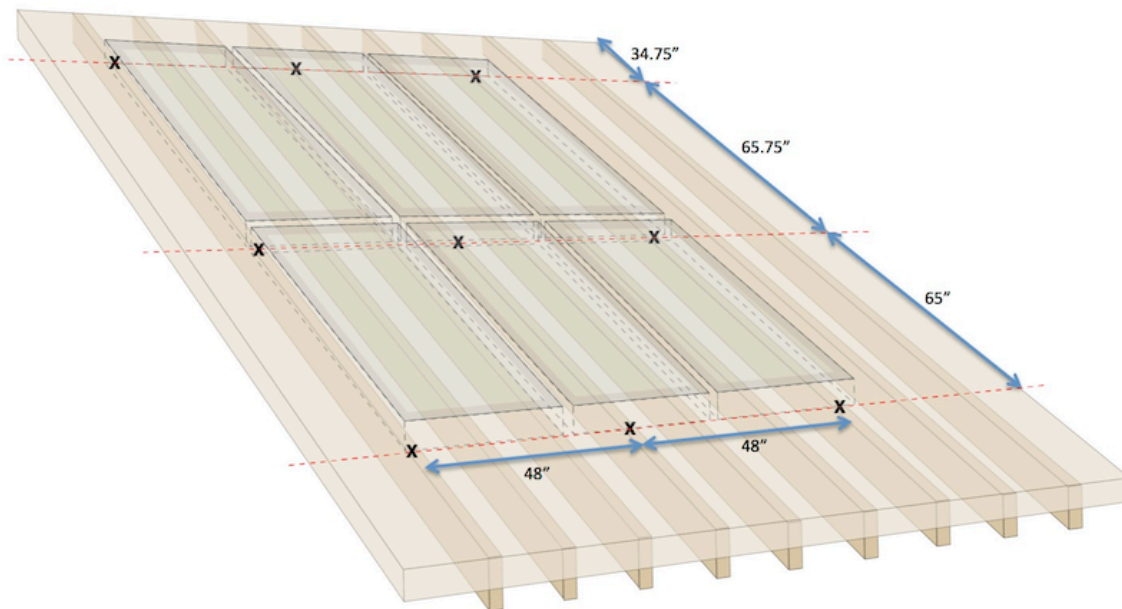


Figure 3-1 Roof Mount Locations

Formula for Horizontal Chalk Lines for Roof Mounts (portrait, L-Feet pointing upwards):

Distance between lower two chalk lines is height of module plus 0.25". Distance between second and subsequent chalk lines is height of module plus 1".

Formula for Horizontal Chalk Lines for Roof Mounts (landscape, L-Feet pointing upwards):

Distance between lower two chalk lines is width of module plus 0.25". Distance between second and subsequent chalk lines is width of module plus 1".

Location of Rafters

From the TERs in this example, roof mount spacing is 48" and the cantilever allowance is 15.5". Starting at the east or west edge of the array, locate the nearest rafter underneath the array that is within the cantilever allowance (less than 15.5" from the edge of the array). This rafter will be the starting point of the roof mounts. Snap a chalk line along this rafter between the top and bottom horizontal lines. Find the next rafter 48" over and snap a line along this rafter. Repeat at 48" intervals until the last rafter is within the cantilever allowance at the other end of the array.

3.2. Install Roof Mounts

Mark each intersecting line with a circle or X. Roof mounts will be installed so that each L-Foot installed on the mount will be centered on this mark with about 1" of adjustability in the bottom slot of each L-Foot.

Refer to the Installation Instructions for the type of roof mount being installed. Since Spice Solar Certified modules use L-Feet that are attached at the top and bottom of the module (which is a defined dimension), the final location of each L-Foot must be precisely the same as the height of the module – otherwise the frame of the module would be stretched or compressed, voiding the module warranty. L-Feet have approximately 1" of north-south adjustability so that they can be properly located on top of roof mounts. However, some roof mounts (such as tile hooks) may not have sufficient north-south adjustability to accommodate the precise dimensions of the module (roof mount locations may be constrained by tile course dimensions).

3.3. Install L-Feet on Roof Mounts

Attach L-Feet to all roof mounts, with the base of the L-Foot facing up the roof. Do not tighten the L-Feet yet to the roof mounts.

Follow the installation instructions for the type of roof mount being installed, paying particular attention to the integrity of the water seal between the roof and the roof mount. Spice Certified modules are designed to be mounted with Spice Certified L-Feet since there are matching friction ridges in the L-Feet and modules.

3.4. Align L-Feet on Bottom and Middle Rows of Roof Mounts

Attach a plumb line to the far east (left) and far west (right) L-Feet in the bottom row of roof mounts. Adjust all L-Feet so that they are aligned evenly across the roof. Tighten bottom row of L-Feet to recommended torque for roof mounts. These L-Feet will define the final layout of the modules across the roof.

Attach a plumb line to the far east (left) and far west (right) L-Feet in the middle row of roof mounts. Adjust the far east and far west L-Feet so that the distance between the bottom and middle rows of L-Feet is 65". This distance provides 0.25" of spacing to simplify the installation of the first row of modules. Adjust all middle row L-Feet so that they are aligned evenly across the roof. Loosely tighten middle row of L-Feet (these L-Feet will be re-adjusted and tightened once the first row of modules is installed).



Figure 3-2 Align L-Feet on Bottom Row of Roof Mounts

3.5. Pre-assemble First Two Modules

On an open area of the roof, install two E-W Splices in the first module. E-W Splices are inserted in upper T-slot of module by grasping splice with hand and depressing hex bolt with thumb. This action releases the bottom clamp so that splice can easily slide into upper T-slot. Install one E-W Splice at the top and one E-W Splice at the bottom of the first module. Jagged grounding teeth are positioned to be at the outer frame edge of the module.

Snap the second module into the first module by pushing down on the hex bolt on the top of the E-W Splice. Tighten hex bolts on top of the two E-W Splices.



Figure 3-3 Pre-assemble First Two Modules

3.6. Install First Two Pre-assembled Modules

Insert T Bolts with flange nuts in each of the top and bottom lower T slots of the two pre-assembled modules, aligning bolts with open slots of top and bottom L-Feet. Lower modules into slots on L-Feet.

Level modules to roof surface and temporarily prop at the unsupported corners. L-Foot, N-S Bracket or E-W Splice boxes are handy props. Align modules so that subsequent modules will be planar to the roof surface.

Tighten flange nuts on bottom row of L-Feet, leaving flange nuts on middle row of L-Feet loose.

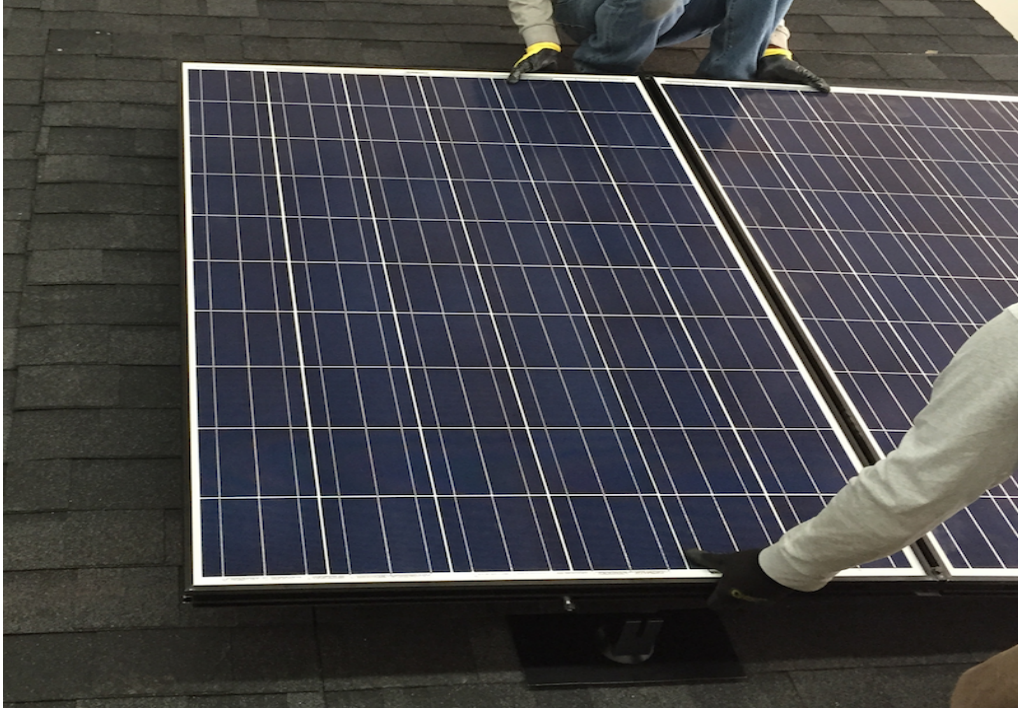


Figure 3-4 Install First Two Pre-assembled Modules

3.7. Install Modules in Balance of First Row and Align Modules

Install E-W Splices in upper T-slot of second module. Position third module so that exposed ends of E-W Splice are inserted into the upper T-slot of the second module. Insert T-Bolt with flange nut in each of top and bottom lower T-slots of third module. Slide the third module towards the second module until the two E-W Splices engage with a “click.” Be careful to keep the two modules parallel as they slide together. It may be helpful to “rock” the module as you slide the module along the N-S Bracket and T Bolt to the first module.

As the module is being installed, connect wiring to adjacent module, and install appropriate wire management clips or brackets.

Tighten the hex bolts at the top of each E-W Splice.

Tighten flange nuts on bottom row of L-Feet, leaving flange nuts on middle row of L-Feet loose.



Figure 3-5 Installation of E-W Splices and Third Module

Adjust the height and planar angle of the third module so that it is properly aligned with the first two modules. L-Feet have 1-1/2" of vertical adjustability to account for uneven roof surfaces. Note that the maximum height of a module on an L-Foot is the point at which the ridges on the L-Foot engage with the lower two ridge sections on the side of the module.

NOTE: If a second row of modules is to be installed above the first row, add an N-S Bracket to each top L-Foot as described in the section below.

Tighten flange nuts on the top and bottom L-Feet to secure the L-Feet to the third module.

Repeat process for subsequent modules in first row.

Once all modules are installed in the first row, it is necessary to re-align the middle row of L-Feet so that the open distance between the ridges in the L-Feet is exactly the height of the module. Starting from either end, loosen the lag bolt securing the L-Foot to the underlying roof mount and allow the L-Foot to slide down about 1/4". Then tighten the L-Foot to the recommended torque for the roof mount.



Figure 3-6 First Row of Modules Complete (With N-S Brackets)

3.8. Install N-S Brackets for Second Row of Modules

If there is a second row of modules above the first row, attach a N-S bracket to each L-Foot that is securing the top of the first row of modules. Ridges on N-S bracket must engage with ridges of L-Foot. The clamp on the bottom of the N-S Bracket can be reversed if the N-S Bracket is located at the edge of a module. Reverse the clamp by removing the spring and bolt in the N-S Bracket, connecting the clamp to the other side of the N-S Bracket, and re-attaching the spring and bolt.

Tighten flange nuts securing each N-S Bracket/L-Foot combination.

Hex bolts on top of N-S Brackets should be loose so that clamp can be depressed by pushing down on top of hex bolt.

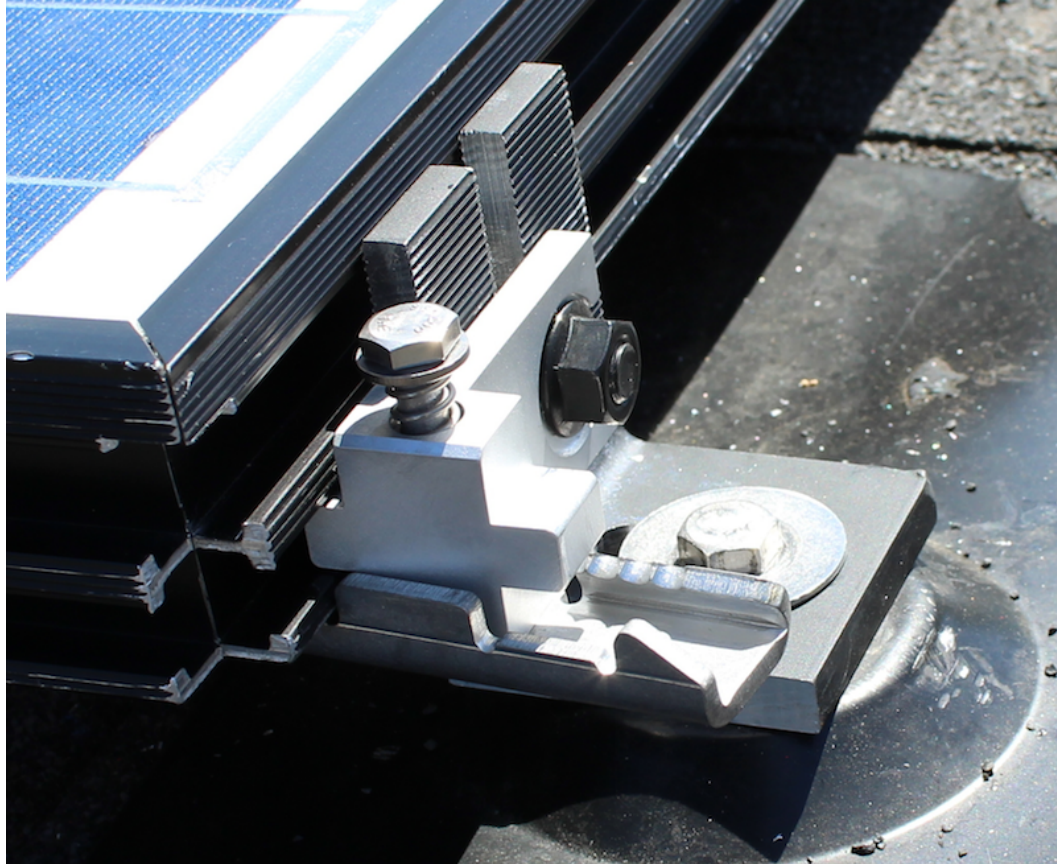


Figure 3-7 N-S Bracket Installed on L-Foot

3.9. Install Second Row of Modules

N-S Brackets should already be installed along top row of L-Feet.

To simplify start of second row, pre-fabricate the first two modules together. On an open section of roof, install two E-W Splices in upper T-slots of first module. Slide second module into position until the two E-W Splices are fully engaged. Tighten hex bolts at the top of each E-W Splice.

Slide pre-fabricated pair of modules into bottom clamps of N-S Brackets. There should be two (or more) N-S Brackets already in place on the first row of modules to support this pair of modules. Slide two (or three if there are three L-Feet along the top row) with flange nuts into lower T-slot at the top of the pair of modules so that T Bolts align with open slots of L-Feet. Position modules so that they are fully inserted in N-S Brackets and aligned with the first row. It may be helpful to insert pair of modules at an angle and lower into place so that the lower edge of the pair of modules engages in the clamp in the N-S Bracket.

As the pair of modules is being installed, connect wiring to adjacent module, and install appropriate wire management clips or brackets.

Align pair of modules so that they are horizontal to roof surface and first row of modules.

Tighten the hex bolts at the top of each N-S Bracket.



Figure 3-8 Installation of Second Row of Modules

3.10. Install Third Module in Second Row and Align Top L-Feet

Install E-W Splices in upper T-slot of second module.

Position third module so that exposed ends of Splice are inserted into the upper T-slot of the second module. Insert T-Bolt with flange nut into the top lower T-slot of third module.

Position the bolt so that it is aligned with the initial positions of the open slots of the L-Foot. Lower the third module into position until the shaft of the T-Bolt slides into open top slot of the top L-Foot. Slide the third module towards the second module until the two E-W Splices engage with a “click.” Be careful to keep the modules parallel as they slide together, and depress the hex bolt on top of the E-W splice so that the bottom bracket more easily engages with the lower lip of the adjacent module. It may be helpful to “rock” the third module as you slide the third module along the N-S Bracket and T-Bolt.

As the module is being installed, connect wiring to adjacent module, and install appropriate wire management clips or brackets.

Tighten hex bolts at the top of each E-W Splice.

Tighten hex bolts at the top of each N-S Bracket.



Figure 3-9 Installation of Third Module in Second Row

Repeat process for subsequent modules in second row.

Once all modules are installed in the second row, it is necessary to re-align the L-Feet so that the open distance between the ridges in the L-Feet is exactly the height of the module. Starting from either end, loosen the L-Foot attachment to the underlying roof mount and allow the L-Foot to slide down about 1/4". Then tighten the L-Foot to the recommended torque for the roof mount.

Repeat process as needed for third and subsequent rows until the array is complete, the array is sufficiently level, the hex bolts on top of E-W Splices and N-S Brackets have been properly tightened, the flange nuts securing L-Feet to modules have been properly tightened, and L-Feet have been secured to roof mounts as per the roof mount instructions.

3.11. Complete Array

Grounding, wire management, module electronics and array alignment steps are necessary before an installation is completed.

3.11.1. Grounding

Spice Solar arrays are properly grounded when all E-W Splices and N-S Brackets are installed. The only remaining step is to install a grounding lug in one of the identified grounding holes on one module. Use the Spice Solar grounding assembly by sliding the star washer on the steel bolt, inserting the bolt through the front of the grounding lug, sliding the spacer onto the bolt, inserting the bolt through the grounding hole on the module, and securing the bolt with the star washer/nut from the back side of the module. A solid gauge copper wire, AWG 4-10, is attached under the set screw of the grounding lug. The copper wire is then connected to an approved grounding location for the system. To prevent corrosion and deterioration of the grounding path, keep the copper wire at least ¼” from the side of the module frame or any other aluminum component.

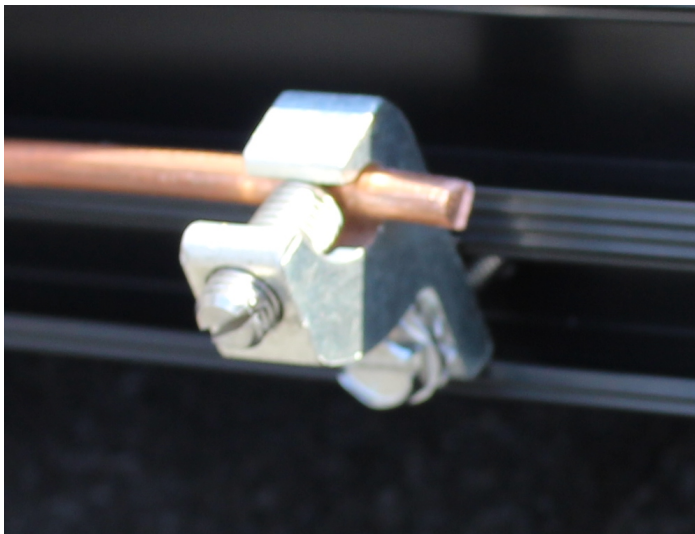


Figure 3-10 Grounding Lug Attached to Module

If there are two or more arrays, each array must be grounded as described above. Alternatively, a grounding connection may be made from the grounded array to the ungrounded array using one grounding lug installed on a module in each array and connected with an approved grounding conductor.

3.11.2. Wire Management

Proper wire management is required to prevent mechanical or sunlight damage to PV system wiring. Both DC wiring and trunk cable wiring must be properly supported so that the wires do not dangle below the module and rest on the roof.

Spice Solar Wire Management Clips are used to support both DC wiring and trunk cable wiring. Wire management clips are inserted in the upper T-slot of the module, and can then support a variety of wire types underneath the module. Insert the clip in the upper T-slot of the module as shown in the picture below with the clip on the left. Then stretch the clip around the bottom of the module until the clip snaps in place as shown with the clip on the right. Attach the PV wire or trunk cable to the open hook under the module.



Figure 3-11 Wire Management Clips

Install sufficient clips along the bottom frame of the module so that wires are properly supported. Wires can be tightened by sliding two adjacent clips apart to apply tension, thereby elevating the wires off the surface of the roof.

4. Supplemental Components

Spice Solar systems may require installation of supplemental components for unusual roof layouts, as well as module electronics (such as micro inverters and DC optimizers) and trunk cable wiring. Installation of these supplemental components is described below.

4.1. Offset L-Foot

When the center of an E-W Splice aligns with the location of a roof mount and L-Foot, there may not be enough space to attach the standard L-Foot to the side of the module. If it is not easy to shift the array by about 1" to either side, an Offset L-Foot can be used on the top and bottom of each module. Remove the L-Feet that may already be in place on the roof mounts and replace them with Offset L-Feet. Tighten the Offset L-Feet to the roof mount as per the roof mount installation instructions. With these Offset L-Feet in place, the modules can be secured with the standard T-Bolts with the attachment points offset to one side or the other by approximately 1". Since it is generally not possible to anticipate the need for Offset L-Feet, it is prudent to bring several pairs to each project.

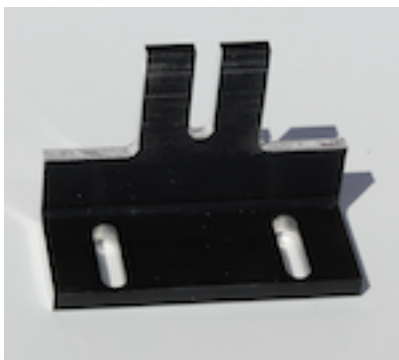


Figure 4-1 Offset L-Foot

4.2. Inverter/Optimizer Bracket

Module electronics, such as micro inverters and DC optimizers, are secured to the back of each module using the Spice Inverter-Optimizer Bracket, as shown in the pictures below. The Bracket is be grounded to the frame of the module with the T-Bolt. If the inverter/optimizer is internally grounded, then no additional grounding is necessary. If the inverter/optimizer must be grounded, a grounding star washer (single use), weeb (single use) or separate grounding lug may be used according to the inverter/optimizer mounting instructions. Wire management clips are used to secure the DC and/or AC trunk cable wires to the side of the module. **The Spice Inverter-Optimizer Bracket has been tested to UL-2703 to provide a grounding path for SolarEdge and Tigo Optimizers.**

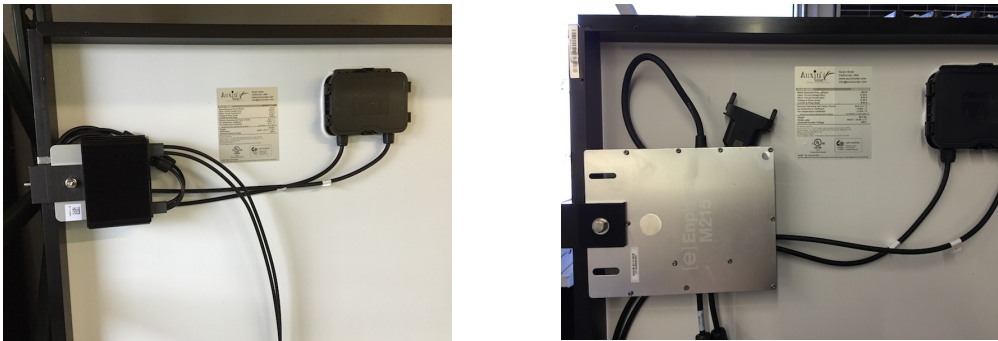


Figure 4-2 Inverter/Optimizer Bracket

5. Alternative Roof Types

Spice Solar systems with L-Feet are designed to be installed on a variety of roof types, as described below. Unless specifically noted, E-W Splices, N-S Brackets, L-Feet, grounding, torque settings, wire management and accessory installation is the same as on composition shingle roofs.

5.1. Reverse Tilt

To maximize the available roof space, it is sometimes necessary to install modules on north-facing rooftops. When these modules are tilted up (facing south), performance can be significantly improved. The picture and drawing below shows how a single row of Spice Solar modules is installed. E-W Splices are used between modules, two L-Feet are connected together with T-Bolts at the ridge side of the roof to create the desired tilt angle on the upper (ridge) roof mount, one L-Foot is attached at the back side of the module so that L-Foot ridges are at 90 degrees to module ridges, a section of ¼"x2" aluminum angle is cut to length and used to elevate the back side of the module to the desired tilt angle, the lower section of the aluminum angle is attached to another L-Foot, and this lower L-Foot is then attached to a roof mount. T-Bolts ground L-Feet **and aluminum angle**. Holes drilled in the aluminum angle for T-Bolts must be deburred. Use of reverse tilt aluminum angle is not covered in the Spice TER; local engineering approval is necessary for this installation method.

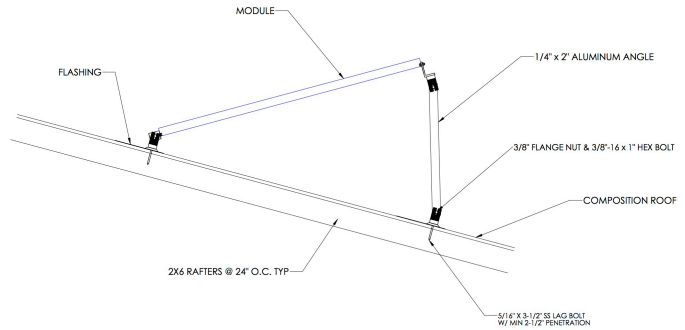


Figure 5-1 Reverse Tilt Picture and Schematic



Figure 5-2 Reverse Tilt Ridge L-Foot Angle Adjustment, Bottom Back Leg, Top Back Leg

5.2. Low Slope Roof

Spice Solar systems can be installed on low slope or flat roofs. The picture and drawing below shows how two rows of Spice Solar modules are installed using three rows of roof mounts. E-W Splices are used between modules and N-S Brackets are installed between rows at the roof mount points.

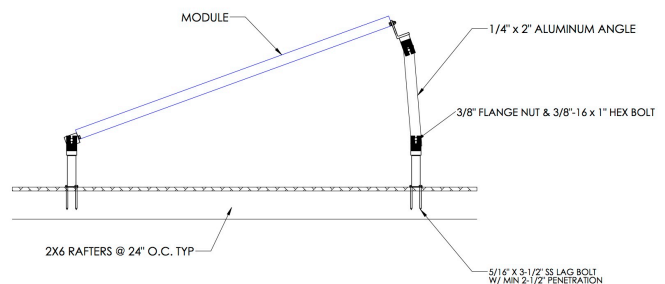


Figure 5-3 Low Slope Roof

For low relative array slopes (<5 degrees), the L-Foot can be attached directly to the front of the lower module and then to the underlying standoff. For higher relative array slopes (>5 degrees), two L-Feet are connected together with T-Bolts to create the desired tilt angle (as with the reverse tilt method described above). Between on the rows of modules a section of ¼"x2" aluminum angle is cut to length and used to elevate the center of the array to the desired height. The top of this aluminum angle is notched and drilled so that the ¼" aluminum angle fits between one module and a N-S Bracket; no L-Foot is necessary at the top of this center support. The bottom of the center supporting ¼" aluminum angle is drilled and attached to an L-Foot, which is then attached to a standoff. Another section of ¼"x2" aluminum angle is cut to length and used to elevate the back side of the module to the desired tilt angle, the lower section of the aluminum angle is attached to an L-Foot, and this lower L-Foot is then attached to a standoff. T-Bolts ground L-Feet and aluminum angle. Holes drilled for T-Bolts and notches cut in the aluminum angle must be deburred. Use of reverse tilt aluminum angle is not covered in the Spice TER; local engineering approval is necessary for this installation method.

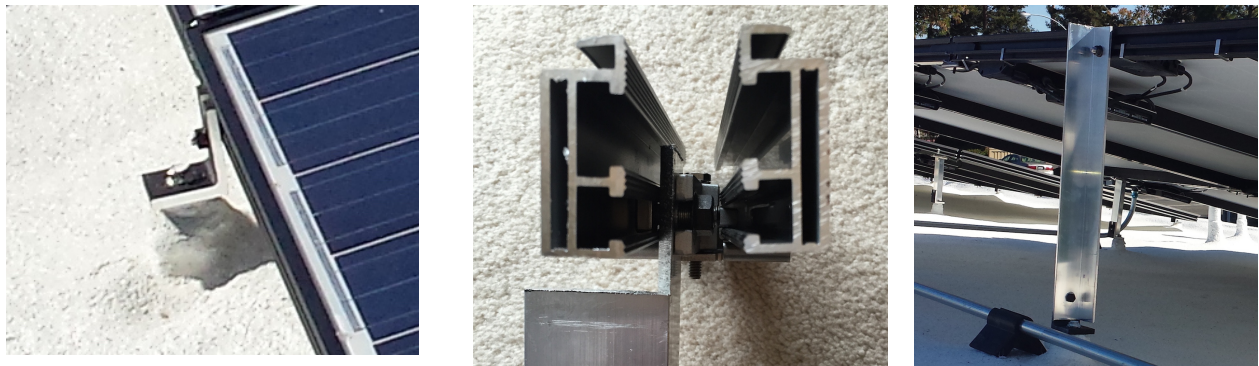


Figure 5-4 Low Slope Roof Front L-Foot, Center Aluminum Angle Support, and Rear Aluminum Angle Support

5.3. Standing Seam Metal Roof

Spice Solar systems can be installed on standing seam metal roofs. The drawing and picture below show how an installation in which two rows of Spice Solar modules are installed using three rows of roof mounts. E-W Splices are installed between each module, and N-S Brackets are installed between rows at the roof mount points. S-5 clamps (or equivalent) are installed on the roof, and L-Feet are attached to these clamps. Metal roofs must be grounded per instructions provided by the roofing manufacturer.

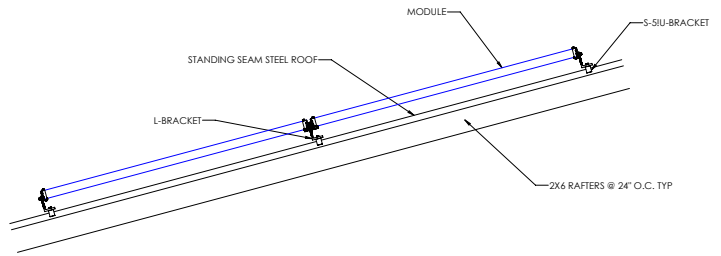


Figure 5-5 Standing Seam Metal Roof

5.4.Flat Tile Roof

The Spice Flat Tile Hook is used on flat tiles, which attaches directly to the side of the module without an L-Foot. The Splice Flat Tile Bracket is grounded with T-Bolts. Refer to the detailed instructions for the Spice Flat Tile Bracket.

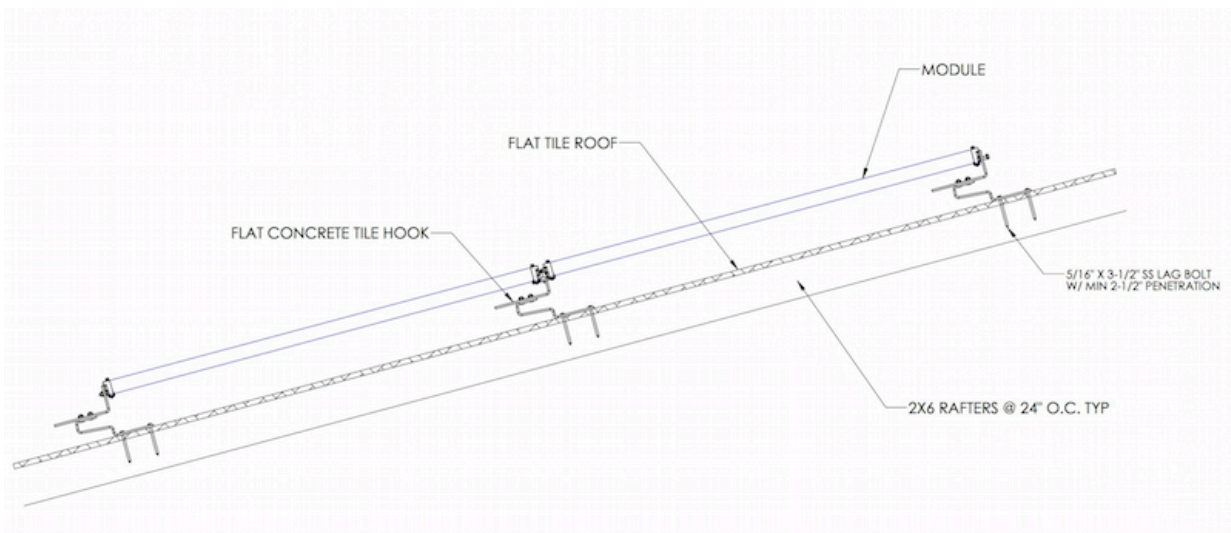


Figure 5-6 Flat Tile Roofs

5.5.Barrel Tile Roof

A standard flashed tile standoff is used on barrel tile roofs, to which an L-Foot is attached at the top of the standoff. Refer to the manufacturer's instructions for standard flashed tile standoffs.

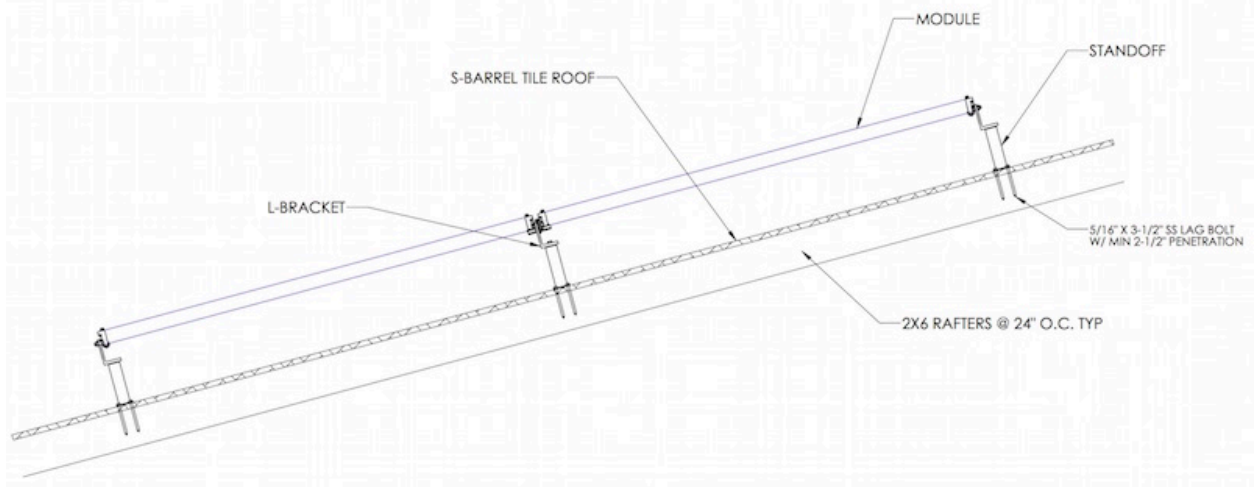




Figure 5-7 Barrel Tile Roofs

6. Appendix A – Spice Certified Modules

Auxin Solar	AXN6P610TXXX
Auxin Solar	AXN6M610TXXX

7. Appendix B – Part Numbers

Photo #	Part #	Item	Material	Finish
	0240-1001-A	East-West Splice	Stainless steel and aluminum	Black oxide splice bar and bolt, anodized bracket clamp, mill finish bottom clamp
	0240-1002-A	North-South Bracket	Stainless steel and aluminum	Mill finish
	0240-1013-A	L-Foot Kit	Aluminum with stainless steel fasteners	Anodized aluminum L-Foot, mill finished rectangular bolt, black oxide flange nut
	0240-1014-A	Offset L-Foot Kit	Aluminum with stainless steel fasteners	Anodized aluminum L-Foot, mill finish rectangular bolt, black oxide flange nut
	0240-1005-A	Microinverter-Optimizer Bracket Kit	Aluminum with stainless steel fasteners	Anodized aluminum bracket, mill finish rectangular bolt, flange nut and bolt; black oxide flange nut
	0240-1015-A	Spice Frame	Aluminum	Anodized aluminum
	0240-1017-A	Flat Tile Hook	Stainless steel	Mill finish and powder coated black paint Cardinal #P008-BK06

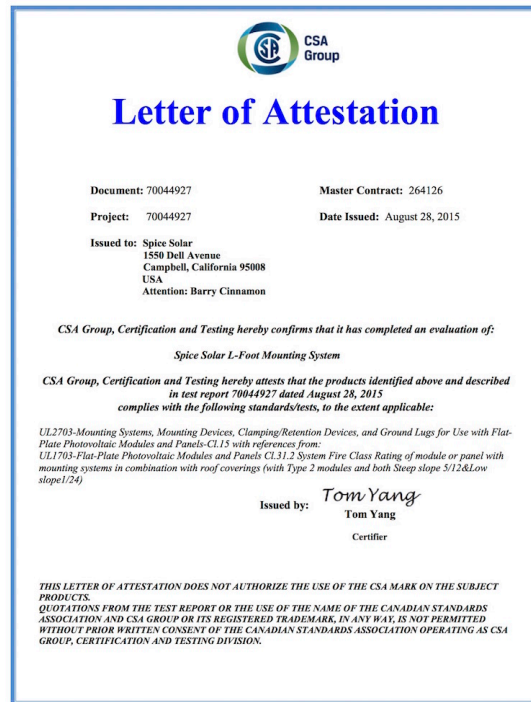
Photo #	Part #	Item	Material	Finish
	0240-1006-A	Grounding Lug Kit	Tin-plated copper lug, aluminum spacer, Stainless steel bolt, washer and nut	Mill finish
	TBD	Tilt-Up Leg	1/4" thick aluminum 2" angle, varying lengths	Mill Finish

8. Appendix C – Certifications

Additional Certification letters for the Spice System and Components are available at <http://www.spicesolar.com/resources/>



UL-2703 PV Racking and Clamping Systems



UL-2703 Class A Fire Rating Steep and Low Slope Roofs