Zep Solar

ZS Comp

Installation Manual for Composition Shingle Roofs - U.S.

Document #800-0351-001 Rev B

Notices

This manual contains safety, installation, configuration and troubleshooting instructions for ZS Comp. Zep Solar, Inc. recommends that you save this manual in a readily accessible location, should any questions arise regarding ZS Comp.

Copyright and Trademark Information

Warranty Notice

Warranty void if hardware not certified by Zep Solar, Inc. is attached to the Zep Groove of a Zep Compatible PV module frame.

Contents

1 Introduction

ZS Comp, from Zep Solar, Inc., is an integrated solution for installing PV arrays on composition shingle roofs. ZS Comp offers the following benefits: rapid installation, reduced roof penetrations, reduced parts count, low system weight, elimination of lengthy and cumbersome mounting rails and clip hardware, precision alignment, enhanced aesthetics, resistance to theft, redundant auto-grounding matrix, portrait and landscape options, and an easy-to-use design tool with array-level BOM calculations.

1.1 ZS Comp Overview

Figure 1.1 ZS Comp for Composition Shingle Roofs

1.2 General Safety Precautions

Follow all instructions in this manual and the PV module installation manual. The installer is ultimately responsible for ensuring that all installations are performed in compliance with applicable codes and standards, as well as industry best practices.

1.2.1 Installation Safety

- The installation process requires working on sloped and elevated building surfaces, in outdoor weather conditions, using tools and heavy components designed for the generation of electricity.
  - Use properly anchored fall protection equipment.
  - Use caution to prevent objects from falling or dropping off the roof area.
  - Cordon off ground areas directly beneath the roof work area when possible.
- Always use personal protection equipment such as safety glasses, gloves, etc. as necessary.
- Do not perform installations in excessively wet, windy, or inclement weather conditions.
- When working in hot weather, work crews should take care to prevent symptoms of overheating or deyhdration.
- Use proper lifting and carrying techniques when handling heavy components at the job site. If conditions are challenging for moving PV modules to the roof area, use a mechanical lift.
- Follow best practices when working around high-voltage electrical equipment.
- Do not anchor fall protection equipment to roof mounts, or any other inappropriate roof structure.
- The installer is responsible for:
  - Following all applicable regional and local codes, standards, and regulations
  - Ensuring that all personnel are properly trained, equipped, and licensed
  - Obtaining all required permits and inspections
  - Verifying that the roof structure can support the array under live load conditions.
  - Verifying that the system is installed over a properly rated fire-resistant roof covering
- Ensure that Zep Solar components are properly engaged with the PV modules.
- Do not subject the PV modules to excessive loads or deformation such as twisting or bending.

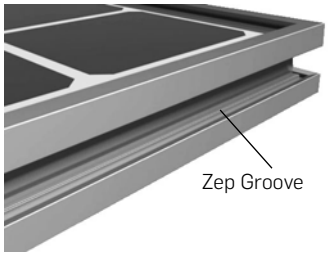
1.2.2 Electrical Specifications

- These instructions describe the correct installation of the Interlock, the Ground Zep, and other listed components into a PV module that has a Zep Compatible frame.
- Product listing information is shown for each component in the Components chapter and in the Requirements chapter. For the most up-to-date listing information, please refer to the product datasheets on the Zep Solar web site.
- Zep Solar components are only suitable for PV modules with a series fuse rating of 15 Amps or less.
- Each array of PV modules must be grounded with a solid copper wire that is connected between the Ground Zep and a suitable earth ground. The ground wire and torque specs are identified in "Ground the Array" on page 44.

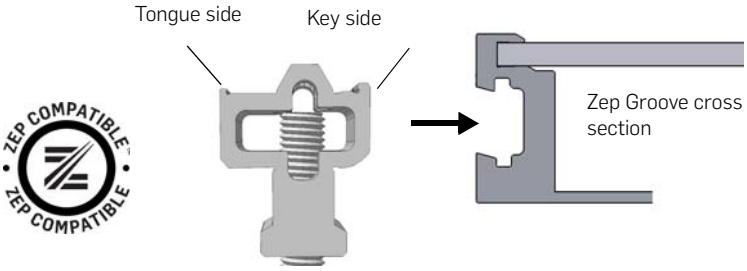
1.3 Zep Compatible

Zep Solar mounting solutions are based on the Zep Groove, a patented module frame profile designed to mate easily and precisely with Zep components. Module frames with the Zep Groove are considered "Zep Compatible", and are offered by PV module manufacturers who have established a licensing agreement with Zep Solar, Inc.

Figure 1.2 Zep Groove and Rockit



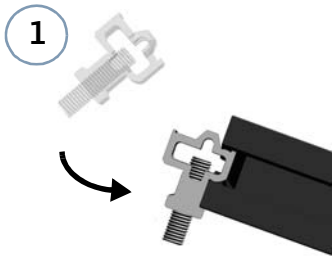
Zep Compatible PV module



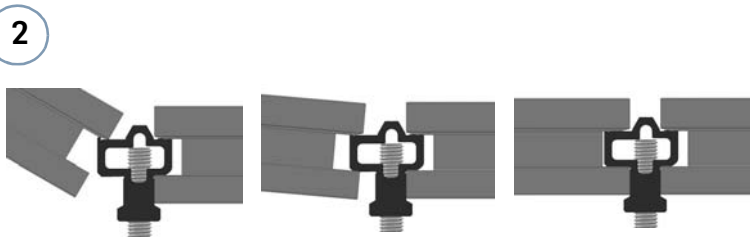
For example, the “Rockit” is a hardware feature used to secure PV modules to the roof attachments. The Rockit fits into the Zep Groove on both sides: The Key side inserts, while the Tongue side receives.

Key and Tongue. The Key and Tongue concept informs all Zep Compatible designs. The Key side inserts into the Zep Groove, similar to inserting a key into a lock. On the other side, the Zep Groove allows PV modules to “drop in” easily onto the Tongue of the Rockit.

Figure 1.3 Module Drop-In Example



First, the Key side of the Rockit is inserted into the Zep Groove.

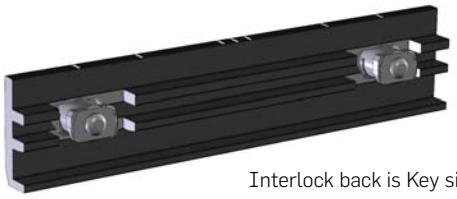


In the next row, modules are “dropped in” on the Tongue side (the receiving side).

Another example of the use of Key and Tongue in a Zep Compatible design is seen with the Interlock, a component that couples and bonds two modules together. Here, the Key and Tongue are differently shaped, but they still fit into the Zep Groove in the same manner as the Rockit.

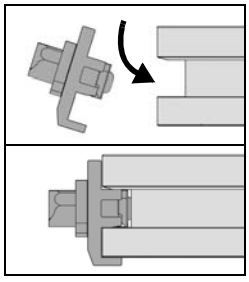
Figure 1.4 Zep Groove and Interlock

Interlock front is Tongue side

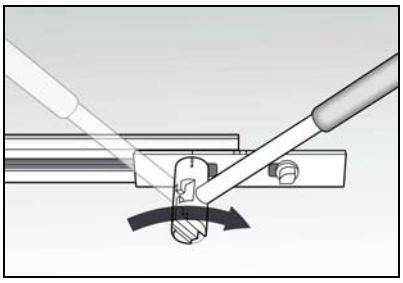


Interlock back is Key side

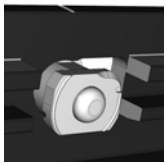
Other Zep Solar components such as the Interlock also use the Key and Tongue concept.



Key side is inserted into Zep Groove



The fasteners on the Interlock (the "Interlock Zeps") are tightened one-quarter turn to lock securely into the Zep Groove.



Open

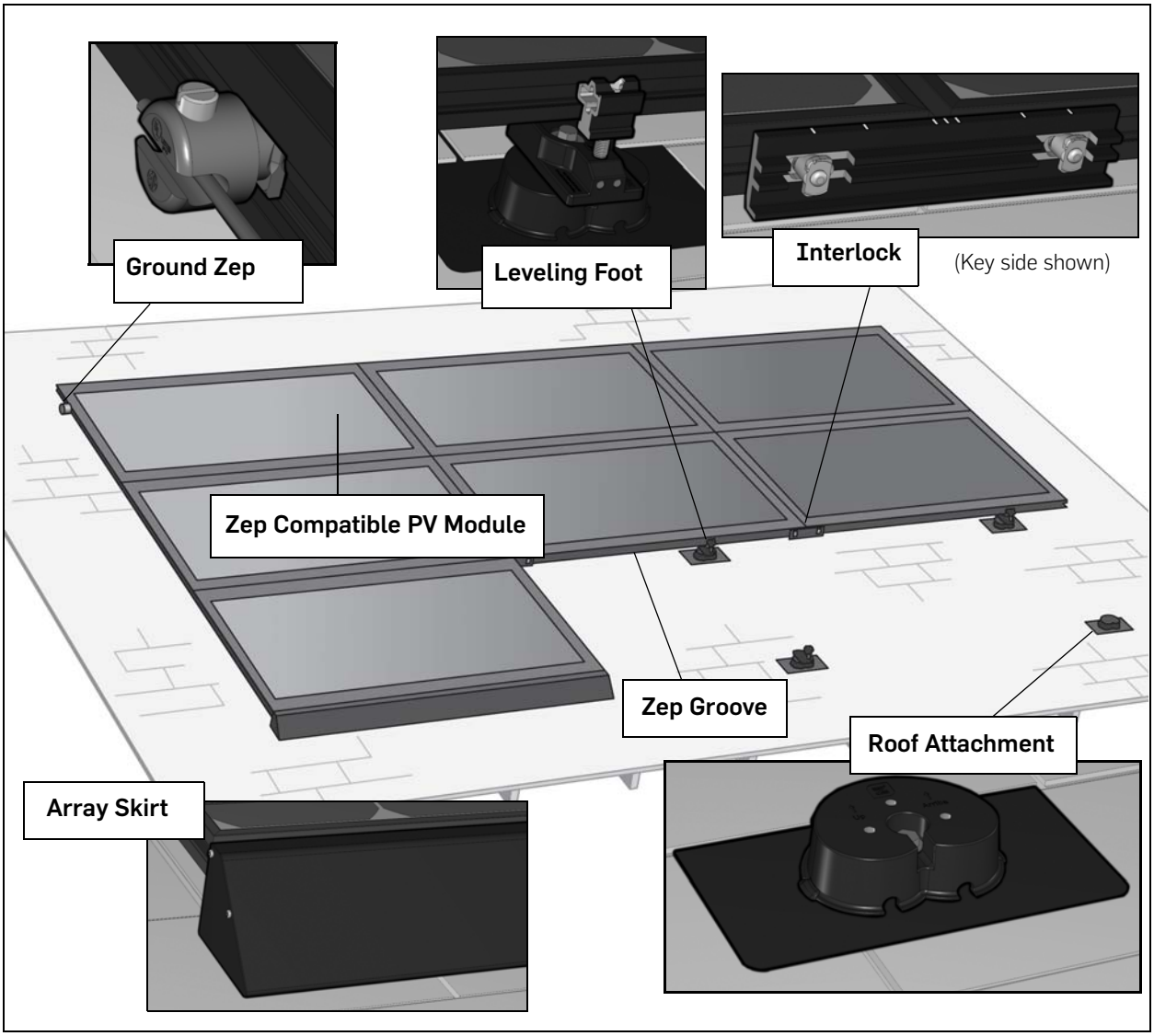
Closed

Rotation seen from Key side

See "Interlocks" on page 38 for more information on the Interlock.

2 ZS Comp Components

2.1 ZS Comp Cutaway View



2.2 ZS Comp Core Components

Part No. 850-1408

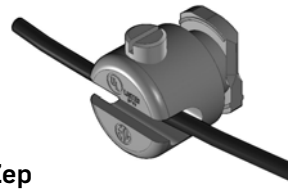
Leveling Foot

Secured PV Modules to the Comp Mount flashing and enables fine-tuned leveling.

Grounding version is listed by UL to UL 2703.

Comp Mount, Type C

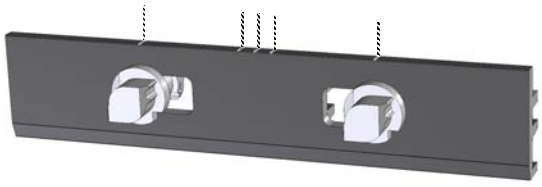
Provides a roof mounting attachment point for the array. Flashing and waterproofing measures included.



Ground Zep

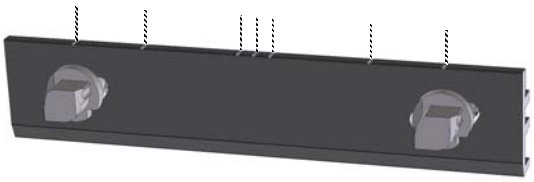
Provides a single point for grounding/earthing the PV Array. A single Ground Zep can ground up to 72 modules.

Listed by UL to UL 467 and UL 2703.
ETL listing conforms to UL STD 467.



Part No. 850-1178

- or -



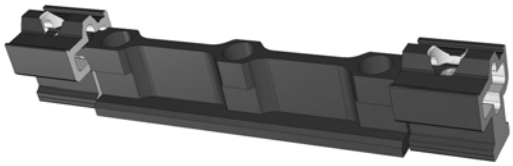
Part No. 850-1388

Interlock

Provides a structural and electrical bond between modules.

850-1178:
Listed by UL to UL 2703.
ETL listing conforms to ULC ORD STD C1703.

850-1388:
Listed by UL to UL2703.

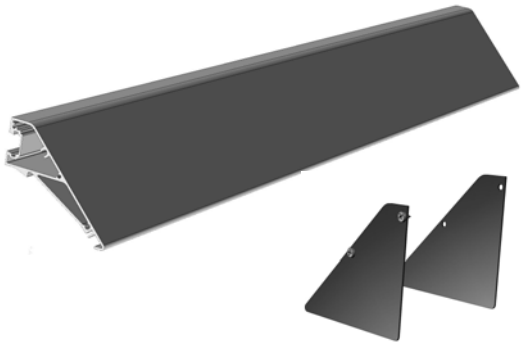


Hybrid Interlock

Used on Leveling Foot base where the Rockit conflicts with the installation of an Interlock.

Grounding version is listed by UL to UL 2703.

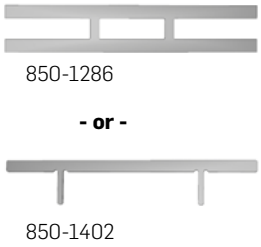
2.3 ZS Comp Accessory Components



Array Skirt and End Caps

Conceals hardware for an aesthetic appearance, and also serves as a jig during installation to keep the first row of modules straight. The Array Skirt comes with one Array Skirt Spacer and two Jams.

End caps sold separately.



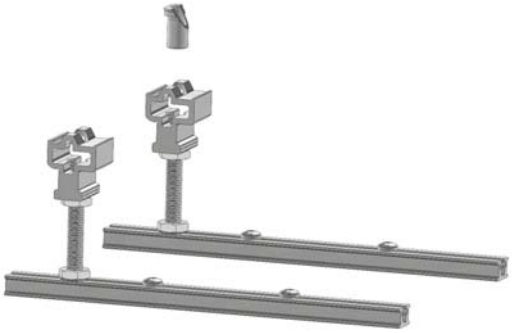
Array Skirt Spacer

Used with the Interlock when connecting sections of Array Skirt together.

Spacer 850-1402 is compatible with Interlock 850-1388.

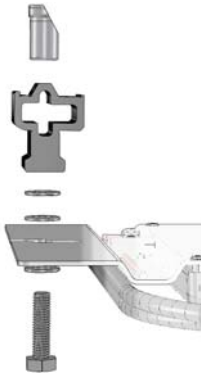
Jams

Used to secure Array Skirt after attaching the Array Skirt to the first row of Leveling Feet.



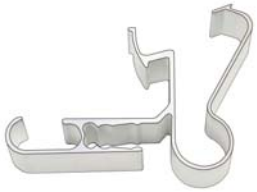
Universal Box Bracket

Allows attachment of electrical boxes to Zep Compatible PV module frame, thereby eliminating additional roof penetrations.



Groove Adapter Kit

Attaches to the bracket of a microinverter, DC optimizer, or other module-level electronic device in order to secure the device to a Zep Compatible PV module frame.



AC/DC Cable Clip

Snaps into the Zep Groove to secure array wiring, and to adjust wire tension.

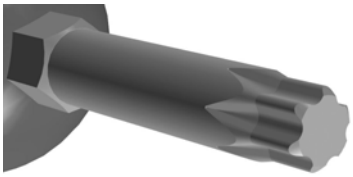
* Please visit the Zep Solar web site at **www.zepsolar.com** for additional accessories and information.

2.4 ZS Comp Tools

Zep Tool

The Zep Tool performs the following functions:

- Install and remove Interlock
- Attach and remove Leveling Foot, Hybrid Interlock, Universal Box Bracket, and Groove Adapter Kit from Zep Compatible PV module frame
- Install and remove Ground Zep
- Adjust height of Leveling Feet using #30 Torx Bit attachment
- Secure Leveling Foot base using 1/2" socket wrench attachment



#30 Torx Bit Attachment

Attaches to the end of the Zep Tool for raising and lowering of the array at the attachment points.

850-1199

850-1412

Flat Tool

The Flat Tool does everything that the Zep Tool can do, except for attaching the Leveling Foot and adjusting the Leveling Foot height. In addition, the Flat tool performs one additional function:

- Remove Interlock from between two modules

3 Array Design

Zep Solar, Inc. seeks to encourage efficient design of PV arrays by allowing users to design their own systems. The Zepulator online design tool and Span Tables are available on the Zep Solar web site to enable custom array designs. Additional information on fine-tuning array designs can be found in training videos, also available on the Zep Solar web site.

Step 1: Gather Project Data

Array design begins by identifying specific information that applies to the project, including:

- Site information such as wind speed/zones, snow load, and terrain characteristics
- Building characteristics such as rafter/truss spacing, roof pitch, and roof type
- PV array details such as PV module manufacturer, mounting area size, and desired orientation

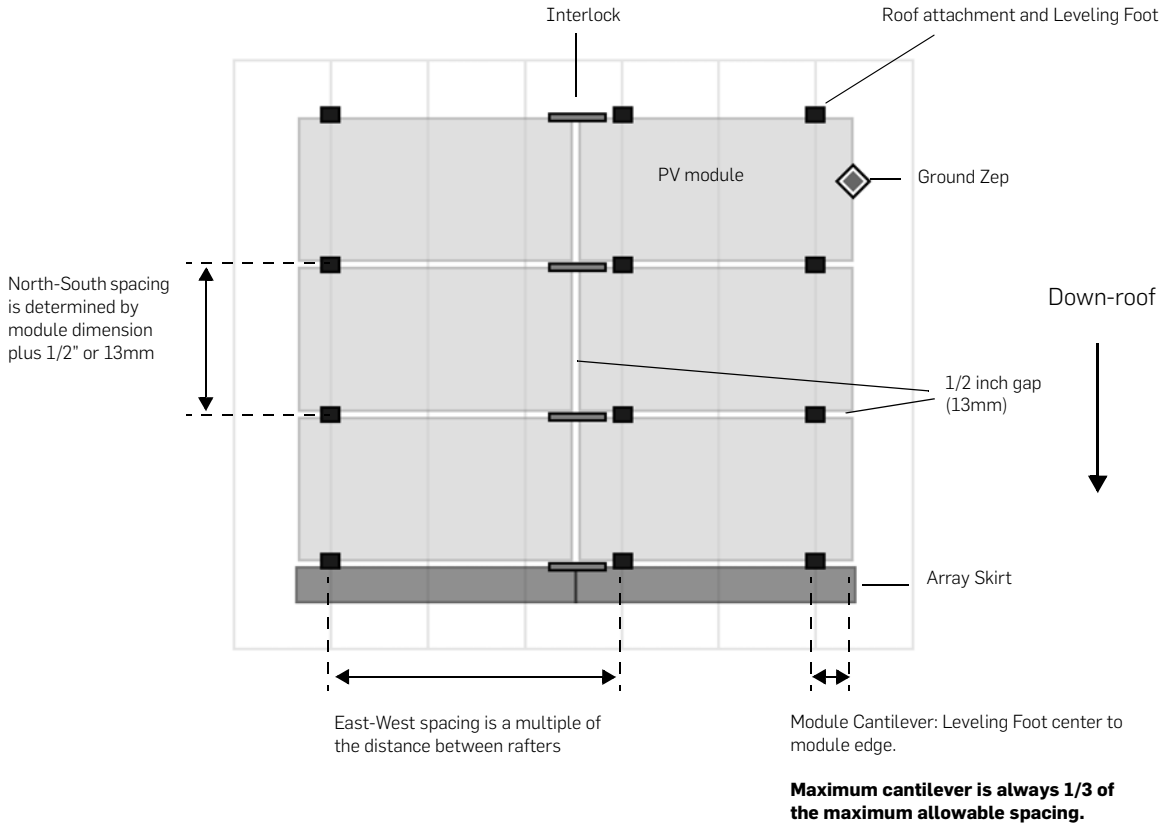
Within each specified roof type, users can select a preferred Zep Solar approved roof attachment when using the Zepulator. The Span Tables and Certification Letters are only valid for hardware specifically tested and approved by Zep Solar, Inc. for use within each country.

NOTE: Input variables may vary from one country to the next. To see variables for other countries supported in the Zepulator, select another country for the project on the Project page.

Step 2: Obtain Spacing and Cantilever Allowances

After gathering the project data, the designer can either look up the allowances in the Span Tables, or s/he can enter the project information into the Zepulator in order to obtain the spacing and cantilever allowances. (The terms “spacing” and “span” are interchangeable.)

Figure 3.1 Spacing and Cantilever: Composition Shingle Roof With Vertical Rafters



Note the following points:

- Interlocks are always aligned perpendicular to the module drop-in direction.
- Leveling Foot minimum distance from module corner is 2 inches or 50 mm to center of threaded Leveling Foot stud.
- Allow a gap between modules of 1/2 inch or 13 mm, in both North-South and East-West directions; actual tolerance is 1/4”-3/4”.

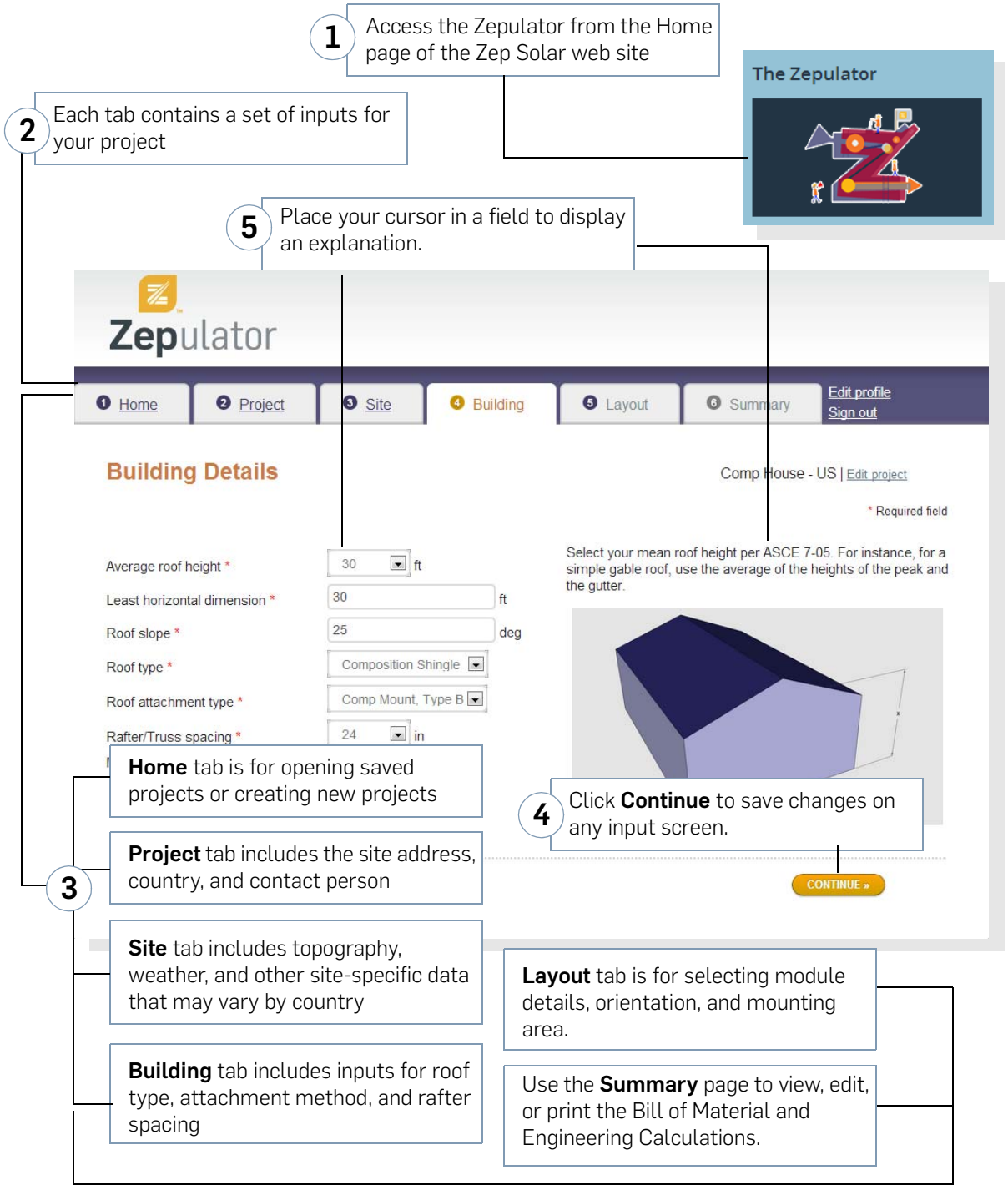
Step 3: Create Array Layout and Bill of Material

Array Layouts and a Bill of Material can be created using the Zepulator online design tool or using a CAD program. The designer may also choose to generate an initial layout in the Zepulator and then further refine the design using another program. Zep Solar, Inc. provides downloadable CAD blocks on the Zep Solar web site for Zep Solar components. Note that the Bill of Material created by the Zepulator does not include hardware pricing, since that may depend on the distribution channel and other factors.

3.1 Using the Zepulator Online Design Tool

The Zepulator online design tool is available from the Zep Solar web site, or directly at **www.zepulator.com**.

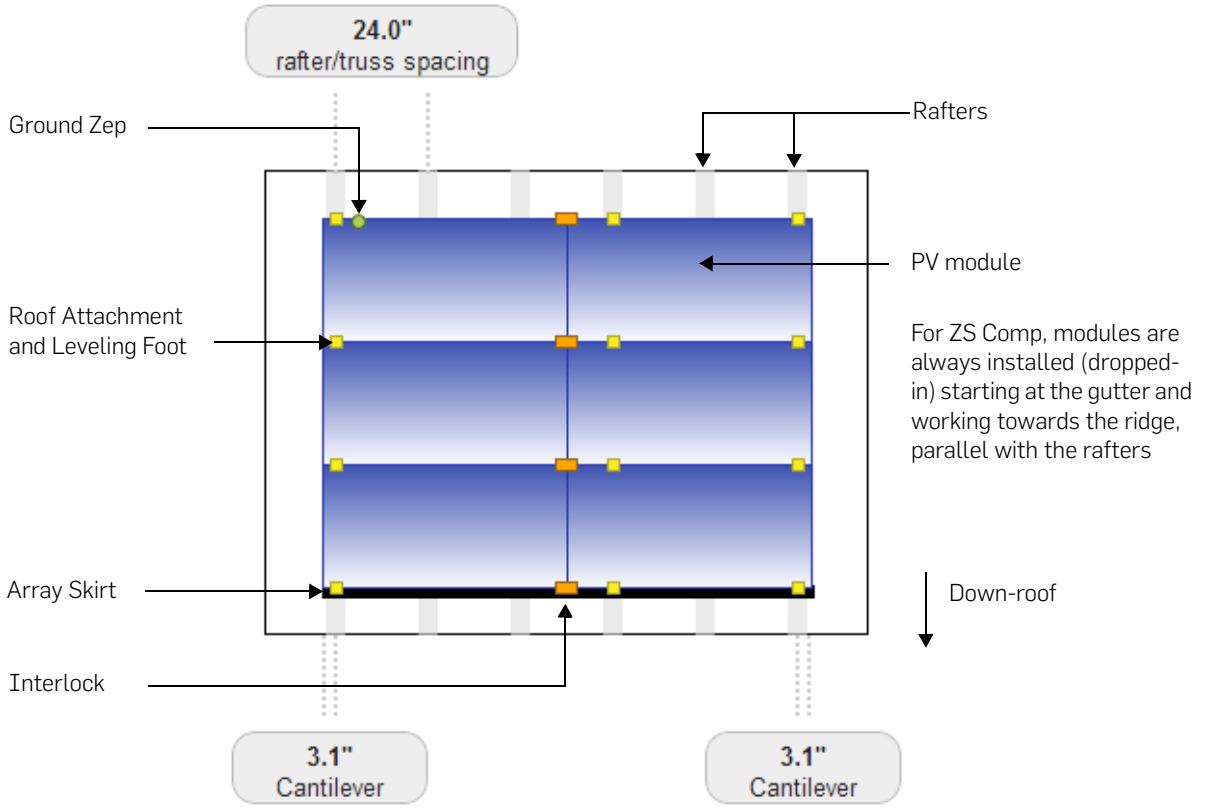
Figure 3.2 Zepulator Online Design Tool



3.1.1 Zepulator Layout Example

After all information is entered or selected, click the **Update** button on the **Layout** tab to see a suggested layout similar to the one shown below. Note that the Zepulator optimizes the layout to minimize the number of roof penetrations.

Figure 3.3 Example Zepulator Array Layout (ZS Comp, U.S.)



The Zepulator centers the array in the specified roof mounting area.

The array layout accounts for each ZS Comp component listed on the Bill of Material.

NOTE: In cases where a Leveling Foot coincides with an Interlock location, you may need to substitute a Hybrid Interlock. However, shifting the array to the east or west may eliminate the need for Hybrid Interlocks altogether, especially when using the Comp Mount C flashing. The Zepulator does not show Hybrid Interlocks on the layout, although it will include Hybrid Interlocks in Additional Truck Stock to ensure adequate hardware supply if needed.

3.2 Using the Span Tables

In addition to the Zepulator online design tool, Zep Solar, Inc. provides complete Span Tables that are included with the Engineering Certification Letters for each country. These tables represent tested structural values for every combination of hardware that is approved for use with Zep Compatible roof mounted PV arrays. The Engineering Certification Letter may also be provided to building officials when submitting for a permit, or for use by independent engineering consultants.

Figure 3.4 Span Table Example (ZS Comp - U.S.)

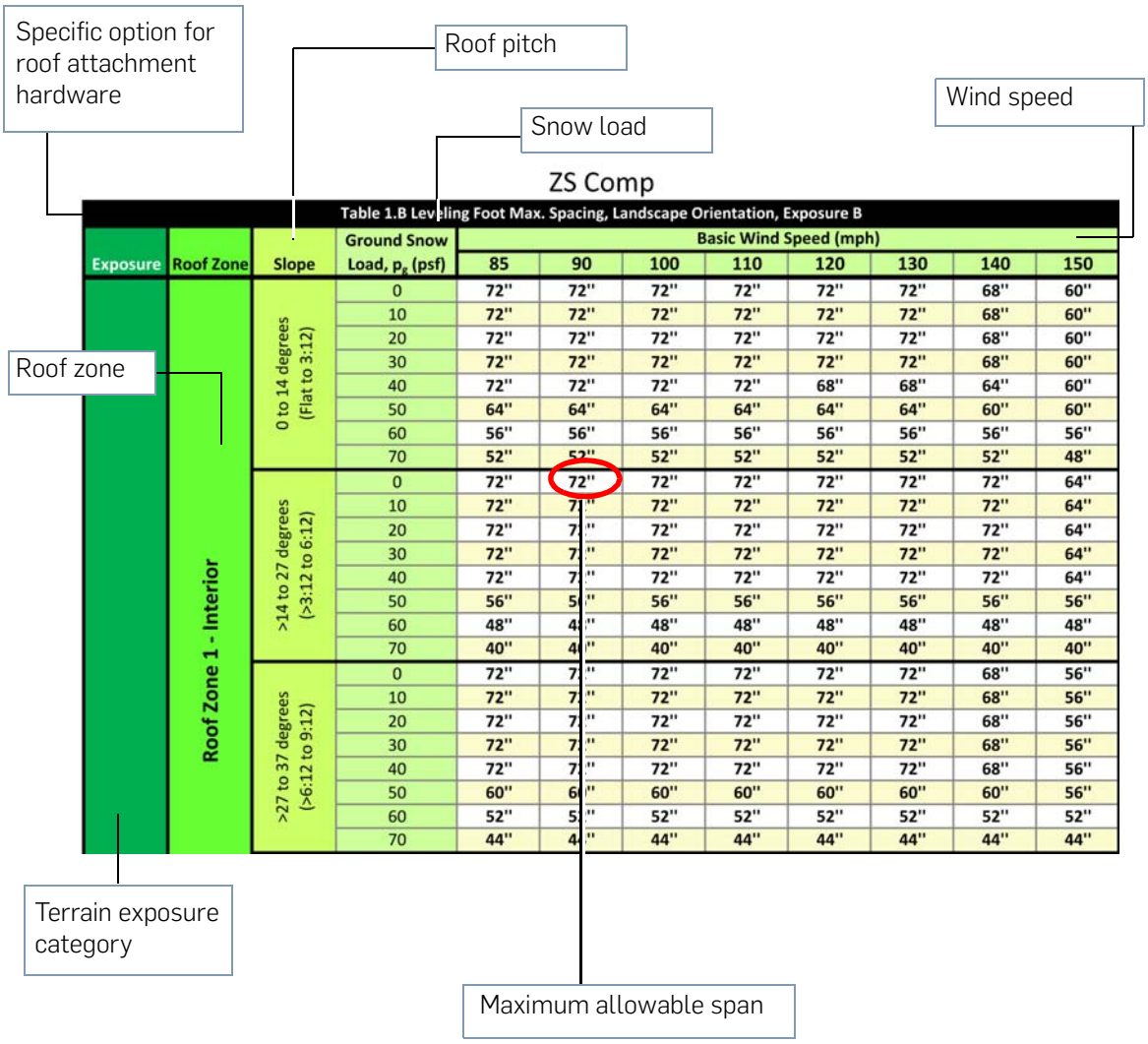


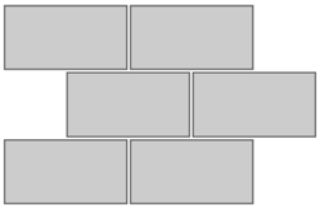
Table 1.B Leveling Foot Max. Spacing, Landscape Orientation, Exposure B

Exposure	Roof Zone	Slope	Ground Snow Load, p_g (psf)	Basic Wind Speed (mph) 85	90	100	110	120	130	140	150
		0 to 14 degrees (Flat to 3:12)	0	72"	72"	72"	72"	72"	72"	68"	60"
			10	72"	72"	72"	72"	72"	72"	68"	60"
			20	72"	72"	72"	72"	72"	72"	68"	60"
			30	72"	72"	72"	72"	72"	72"	68"	60"
			40	72"	72"	72"	72"	68"	68"	64"	60"
			50	64"	64"	64"	64"	64"	64"	60"	60"
			60	56"	56"	56"	56"	56"	56"	56"	56"
			70	52"	52"	52"	52"	52"	52"	52"	48"
		>14 to 27 degrees (>3:12 to 6:12)	0	72"	72"	72"	72"	72"	72"	72"	64"
			10	72"	72"	72"	72"	72"	72"	72"	64"
			20	72"	72"	72"	72"	72"	72"	72"	64"
			30	72"	72"	72"	72"	72"	72"	72"	64"
			40	72"	72"	72"	72"	72"	72"	72"	64"
			50	56"	56"	56"	56"	56"	56"	56"	56"
			60	48"	48"	48"	48"	48"	48"	48"	48"
			70	40"	40"	40"	40"	40"	40"	40"	40"
		>27 to 37 degrees (>6:12 to 9:12)	0	72"	72"	72"	72"	72"	72"	68"	56"
			10	72"	72"	72"	72"	72"	72"	68"	56"
			20	72"	72"	72"	72"	72"	72"	68"	56"
			30	72"	72"	72"	72"	72"	72"	68"	56"
			40	72"	72"	72"	72"	72"	72"	68"	56"
			50	60"	60"	60"	60"	60"	60"	60"	56"
			60	52"	52"	52"	52"	52"	52"	52"	52"
			70	44"	44"	44"	44"	44"	44"	44"	44"
	Roof Zone 1 - Interior										

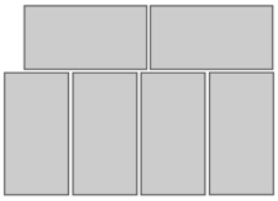
3.3 Alternative Layout Possibilities

The layouts shown thus far have been simple examples for the purposes of illustration. In the real world, things are rarely as straightforward: roof obstacles, shading, and multiple roof planes may require an adaptive approach. The following examples show a few of the array designs that are possible with ZS Comp for composition shingle roofs. Please contact Zep Solar Support if you need assistance in creating a complex array layout design for a specific project or field condition.

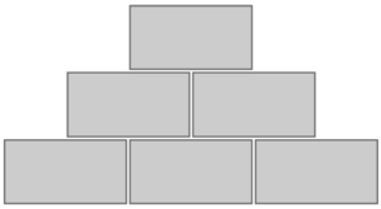
Figure 3.5 Alternative Layouts Possible in ZS Comp



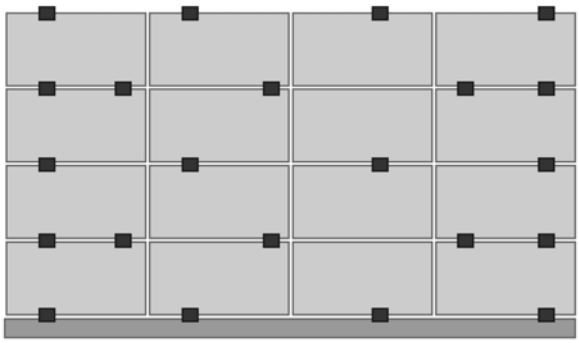
Staggered Modules



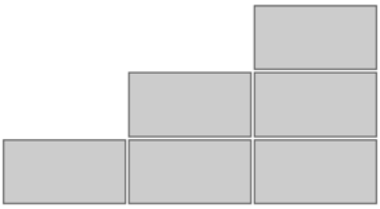
Hybrid Orientation



Pyramid Array



Staggered Attachment Points



Stair-Step Array

3.3.1 Site Assessment Form

Please contact Zep Solar Support for design assistance with unusual array configurations or special site conditions. Zep Solar Support will ask you to complete a Site Assessment Form, which lists all the site information required to create a custom layout. This is the same information shown in the Zepulator.

4 Layout Concepts

This chapter contains important information on the rules governing Zep Compatible array layouts.

4.1 Drop-In Direction

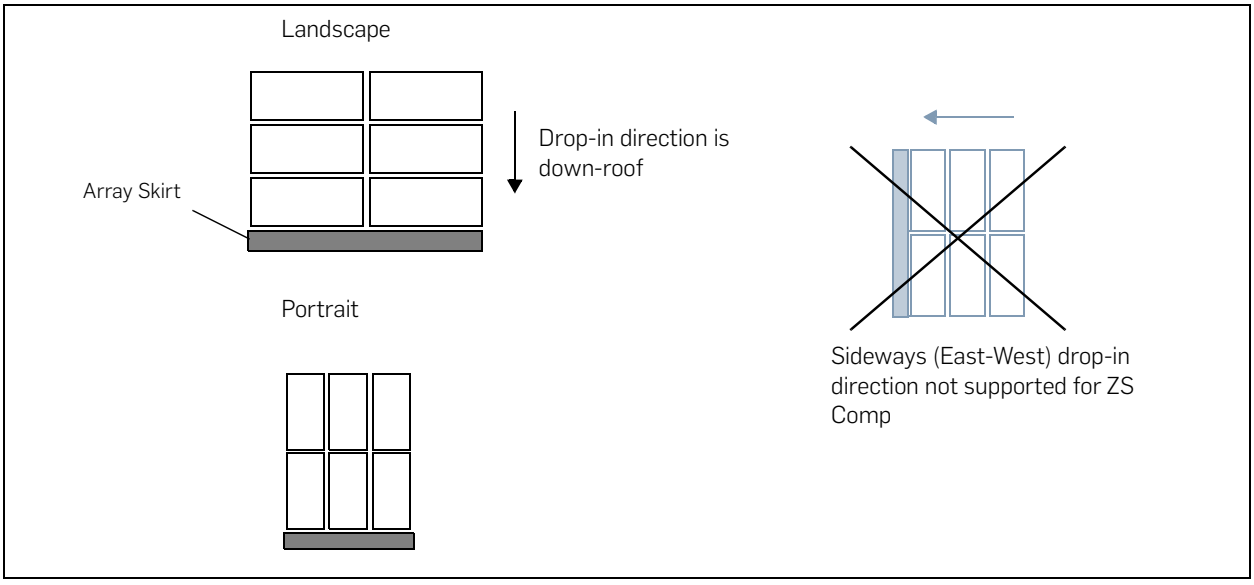
The PV module drop-in process is specific to Zep Solar hardware designs.

North-South. Roof attachments run along the vertical rafters. Modules are "dropped in" row by row going upwards, beginning at the Array Skirt, which is nearest to the eave.

NOTE: East-West drop-ins, with the Array Skirt to one side, are not supported for ZS Comp, except in the rare case where the roof is supported by horizontal purlins instead of vertical rafters.

Is There a Preferred Portait or Landscape Orientation? ZS Comp can be installed in either Landscape or Portrait orientation. A Landscape orientation will generally maximize spans in the East-West direction.

Figure 4.1 Drop-In and Orientation Supported for ZS Comp



4.2 Fixed Rules

The rules and guidelines described in this section, together with the Span Tables, are important factors in array design and must be considered when adjusting or customizing array designs. Installers must be aware of these rules when making field adjustments during installation.

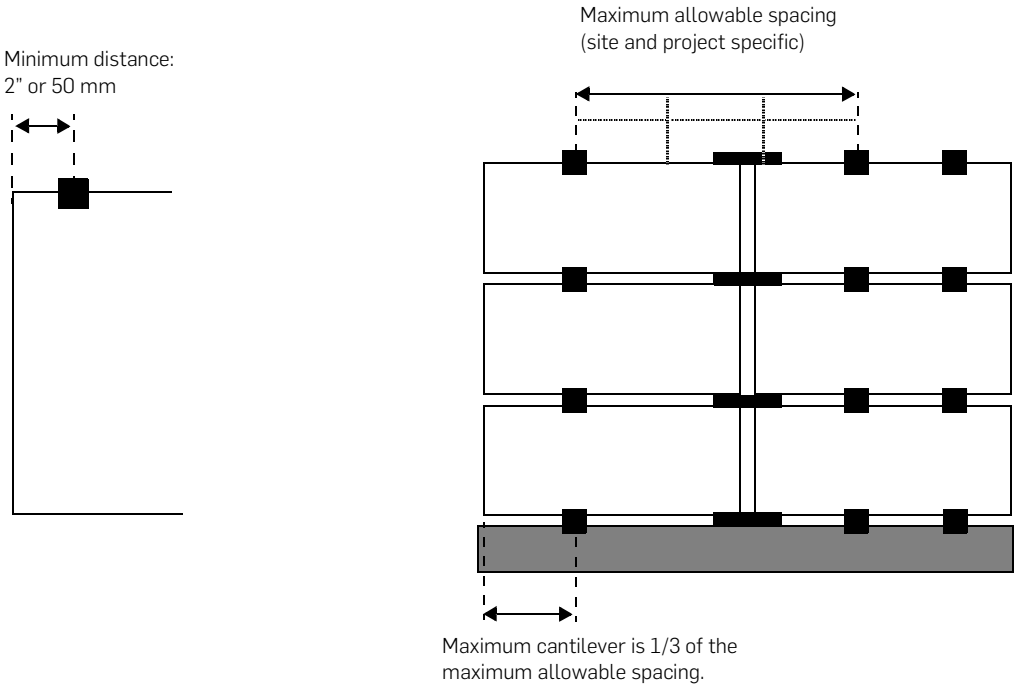
4.2.1 Laws of Spacing and Distance

Maximum Allowable Spacing. The maximum allowable spacing between roof attachment points is determined by various site-specific and building inputs, which are captured in the Zepulator and/or the Span Tables.

Maximum Cantilever. The maximum module cantilever distance is always 1/3 of the maximum allowable spacing.

Module Corner Minimum Distance. Zep Solar hardware such as Leveling Feet and Ground Zeps must be installed a minimum distance of 2 inches or 50mm from module corners, measured from the center of the Leveling Foot Rockit.

Figure 4.2 Maximum Spacing, Cantilever, and Corner Distance



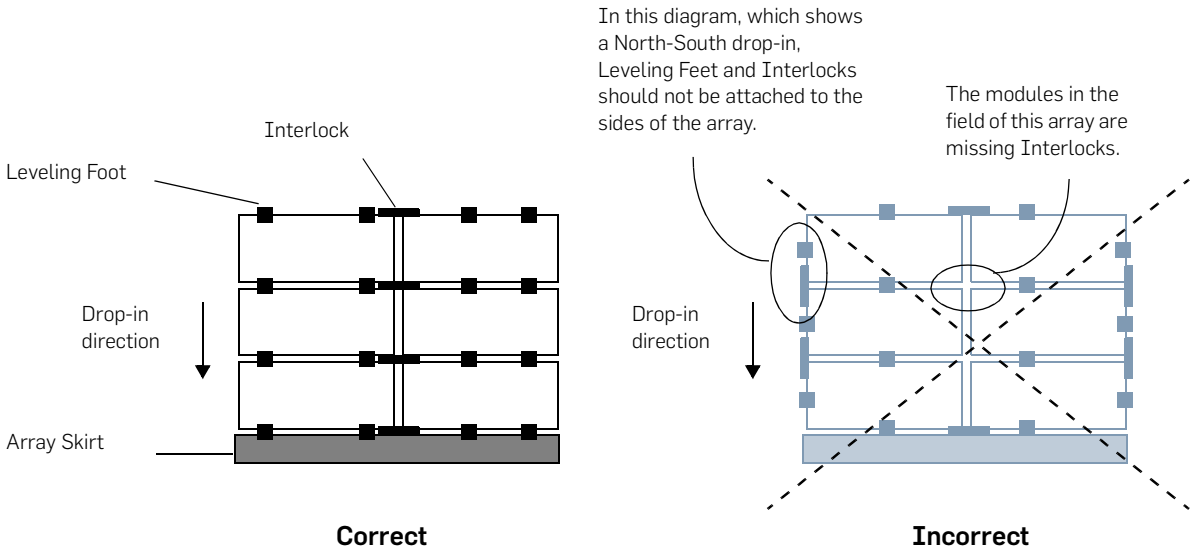
4.2.2 Law of Perpendicularity

Perpendicularity is a general principle that informs Zep Compatible array designs.

Interlocks Must be Perpendicular to Drop-In Direction. For ZS Comp, module drop-in direction is always North-South to match the direction of the vertical rafters, and Interlocks almost always run perpendicular to the module drop-in direction. In this case, the Interlocks should be attached along the upper edge of each module row.

Feet Attach on Opposing Sides of Module. Leveling Feet must always attach on opposite sides of the module, with the Tongue and Groove facing along the drop-in direction. Leveling Feet should never be installed along the drop-in direction.

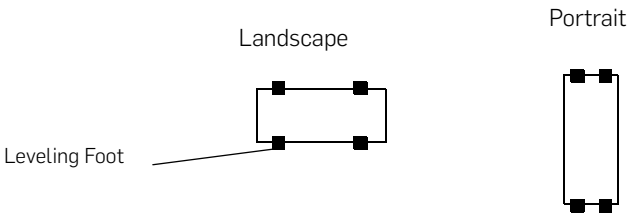
Figure 4.3 Law of Perpendicularity



4.2.3 Single Module Installation

A standalone module requires two Leveling Feet on each side, for a total of 4 Leveling Feet. This remains true regardless of module orientation.

Figure 4.4 Standalone Module Installation



4.3 Grounding/Earthing

The Zep Compatible design concept allows the installer to build a hyper-bonded array with a single ground bond connection. In a hyper-bonded array, every module is structurally and electrically bonded to the surrounding modules, on all sides. This eliminates the need for extensive lengths of copper wire run to every module in order to ground the array.

In some situations, portions of the array may require additional ground bond connections. The illustrations on the following pages show when additional Equipment Grounding Conductors or jumpers are required.

4.3.1 Grounding Path Examples

The following examples show how a Zep Compatible PV array is hyper-bonded using Interlocks.

Figure 4.5 Grounding Path - Simple Array

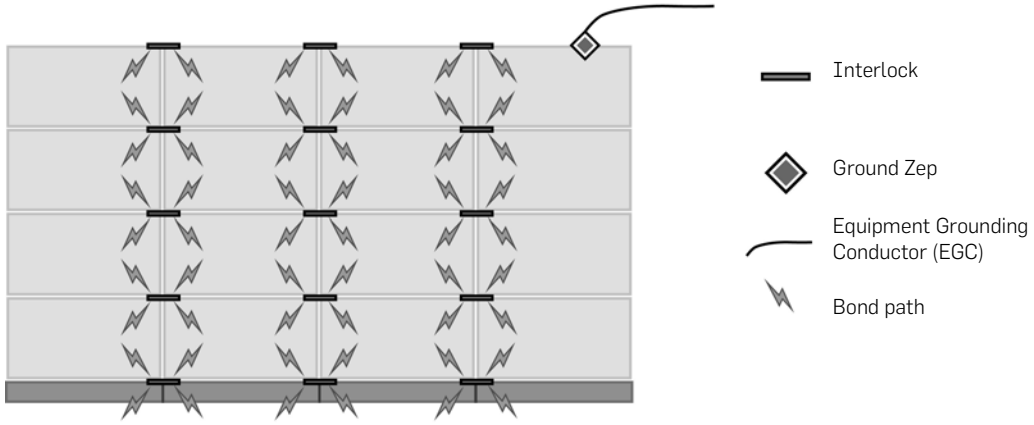
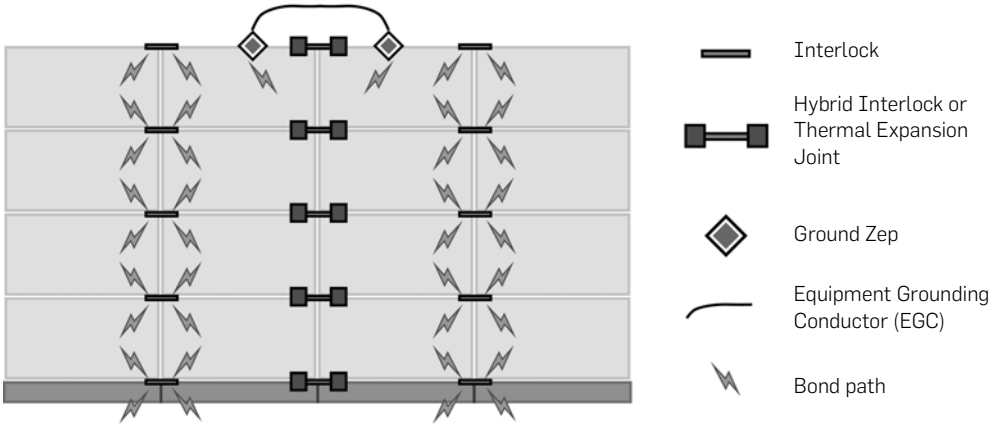


Figure 4.6 Grounding Path - Hybrid Interlocks or Thermal Expansion Joints



An array with a continuous column of Hybrid Interlocks (or a Thermal Expansion Joint) must be installed with a Ground Zep on either side of the column and a copper conductor wire between the two, in order to bond the two electrically isolated sub-array sections.

4.3.2 Special Grounding Component Options

Zep Solar, Inc. offers grounded versions of some components (Hybrid Interlock, Leveling Foot, Groove Adapter Kit) in selected markets as required by national codes and standards. All of these components are built around a "Grounding Rockit" which is a Rockit with a grounding feature on the Key side.

Hybrid Interlocks and Grounding. Zep Solar, Inc. offers two versions of the Hybrid Interlock. National code requirements determine which component is available within each country. If an installed layout has a continuous column of Hybrid Interlocks, and the grounded version is not available, a Ground Zep must be installed on either side of that column.

Ground Zep Module Limit. A single Ground Zep can ground up to 72 modules

4.4 Thermal Expansion

There are two methods to address thermal expansion and contraction within Zep Compatible arrays: Thermal Expansion Joints and physical gaps or breaks between sub-arrays.

Thermal Expansion Joints consist of Interlocks that are installed in a manner that allows modules to slide back and forth as they expand and contract in response to daily temperature swings on the roof. This allows the modules some added flexibility to expand in the direction that the Interlocks are running. In the other direction (North-South in the case of ZS Comp), a physical gap is required to allow for thermal expansion of the modules. Generally, a gap of at least 12" between sub-arrays is recommended, both for thermal expansion and to allow access by work crews for module servicing.

4.4.1 When Are Thermal Expansion Joints Needed?

Thermal expansion must be addressed under the following conditions:

- Array sizes larger than 10 meters or approximately 33 feet in either direction.
- After two consecutive Thermal Expansion Joints, a physical gap is required.

For example, a typical 60-cell polycrystalline module would require thermal expansion every 6 module lengths or 10 module widths, or approximately every 60 modules assuming a square array.

4.4.2 Installing Thermal Expansion Joints

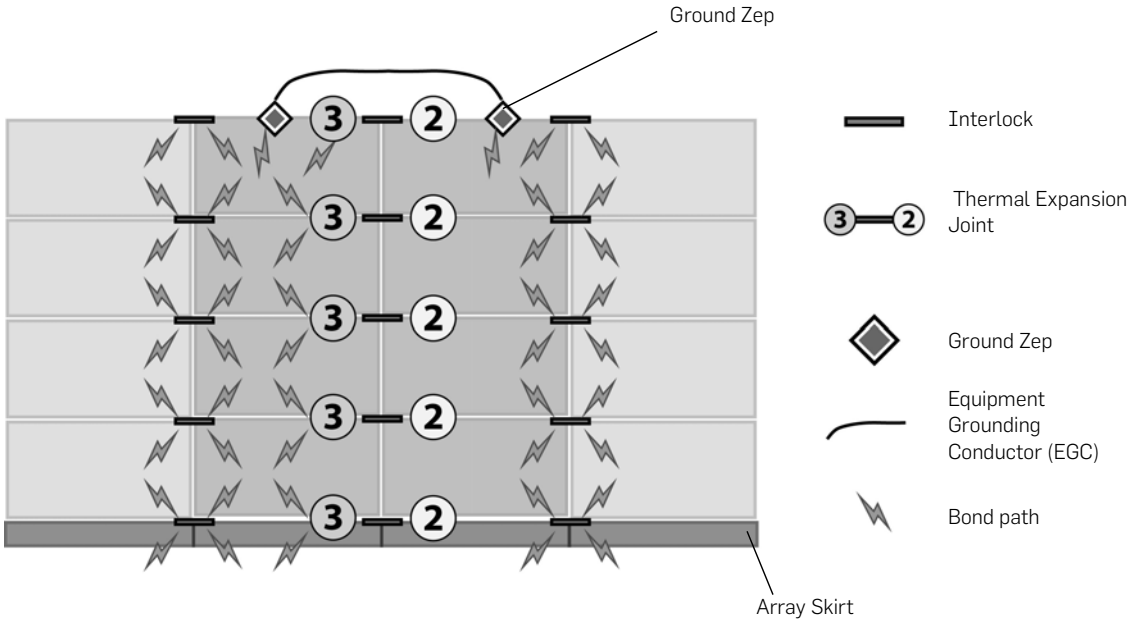
Thermal Expansion Joints use the Interlock component, which is used to connect and bond two modules together. To create a Thermal Expansion Joint between two modules, rotate the Interlock Zep on one side to Position 3 (locked position) using the Zep Tool. Rotate the Interlock Zep on the other side to Position 2. Position 2 provides a structural connection, but does not establish an electrical bond.This allows the module on the side of Position 2 to slide back and forth as the modules expand and contract in changing temperatures.

NOTE: Thermal Expansion Joints require that a Ground Zep be installed on both sides of the break.

4.4.3 Thermal Expansion Joints and Module Columns

When there is a continuous column of Interlocks all serving as a thermal expansion joint, **all Interlocks must be tightened consistently going up the column**. In most cases, one side is turned to Position 3, and the other side to Position 2, the exception being a staggered array. For example, a North-South drop-in with thermal expansions that run East-West could be installed as follows:

Figure 4.7 Thermal Expansion Joint: Interlock Tightening Positions, North-South Drop-In



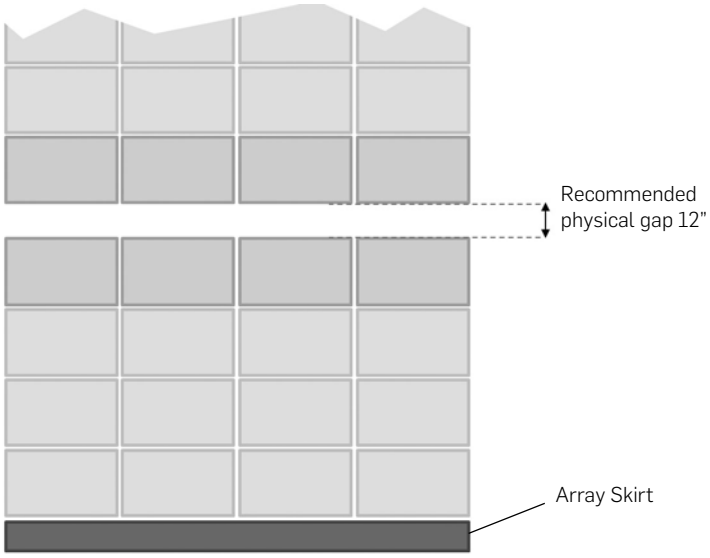
Note that the Interlock Position 3 also locks in the Tongue side modules (up-roof side) as well.

4.4.4 Physical Gaps Between Sub-Arrays

Thermal Expansion Joints only work along the axis of the Interlock. Thermal expansions running along the other axis (parallel to the module drop-in direction) require a physical break between the sub-arrays. For example, a vertical North-South drop-in may require physical breaks between rows.

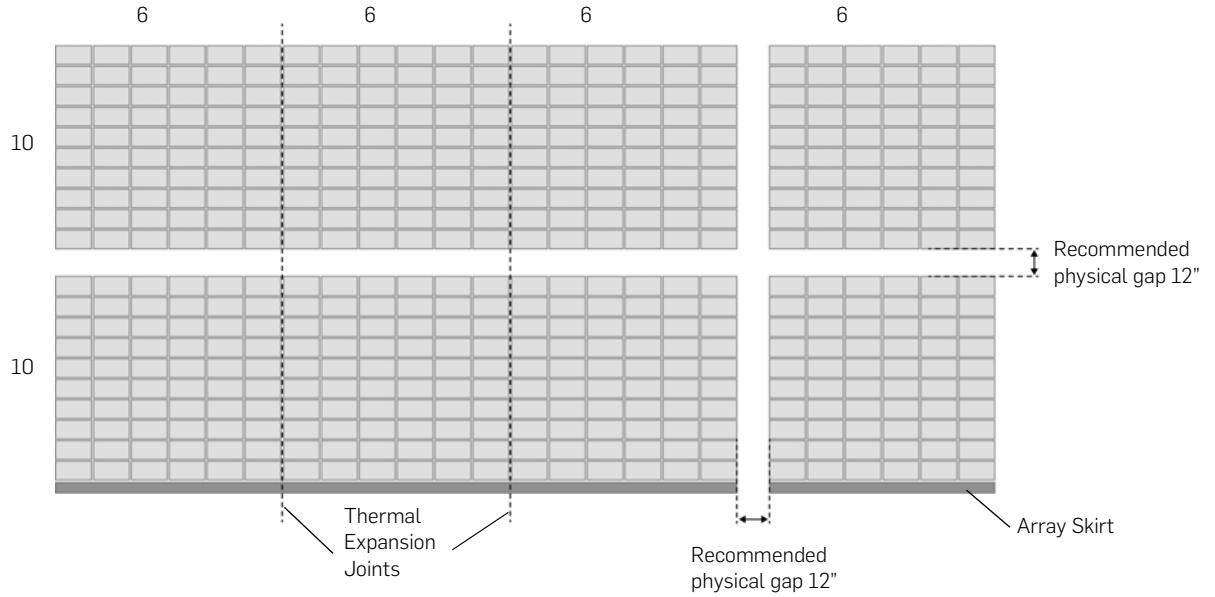
At a minimum, the gap should be at least 4 inches or 100 mm. However, a gap of 12 inches or 300 mm is recommended for ease of servicing.

Figure 4.8 North-South Drop-in, North-South Thermal Expansion Gap



Along the axis of the Interlock, large arrays also need a physical gap after two Thermal Expansion Joints. For example, a North-South drop-in, Landscape orientation, might require a physical gap approximately every 30 meters or 100 feet. This would be approximately every 18 module lengths, depending on the module.

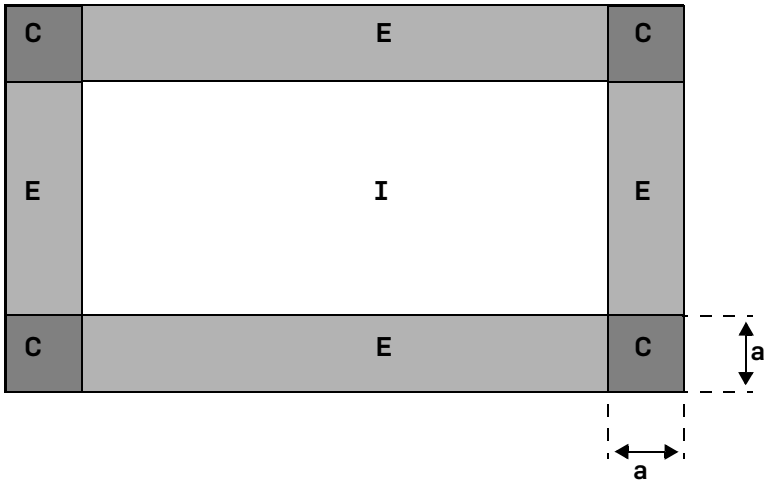
Figure 4.9 North-South Drop-In, Thermal Expansion East-West



4.5 Roof Zones

Roof zones identify the interior, edge and corner regions of each designated roof plane. This is to take into account varying wind pressures as the wind passes over different areas of the roof. The maximum allowable Leveling Foot spacing may be smaller in edge and corner roof zones.

Figure 4.10 Roof Zone Example (U.S.)



I Interior zone

E Edge zone

C Corner zone

a The determination of the edge and corner zone dimensions is country-specific, as described in the Engineering Certification Letters for each country.

NOTE: When generating array layouts, the Zepulator assumes that the entire mounting area is within an Interior roof zone. For detailed examples showing applications of array layouts within edge and corner roof zones, and how to determine the dimensions of these zones, please refer to the Engineering Certification Letter and Span Tables document that is appropriate for the project location.

5 Installation Process

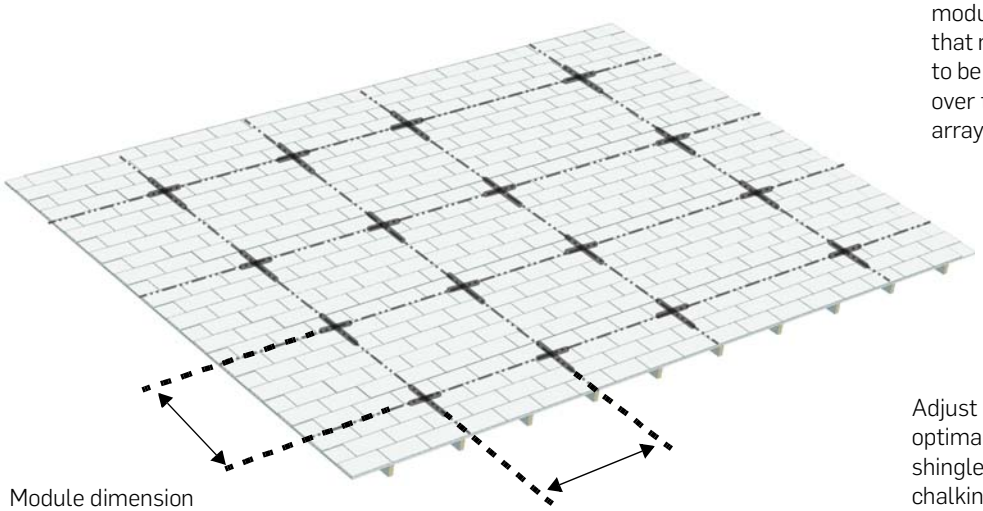
ZS Comp for Composition Shingle Roofs

Mounting Solution for Solar Arrays

Step 1: Mark Out Array Layout on Roof

1a Identify Attachment Locations Using Chalk Line

Consider the installation sequence when staging modules on the roof so that modules do not need to be transported directly over the partially built array.

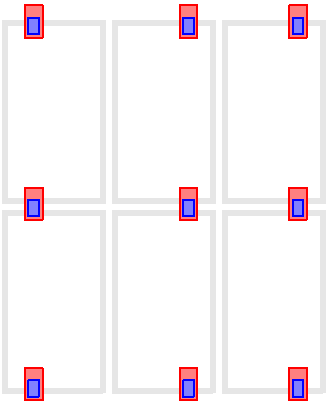


Module dimension + 1/2 inch

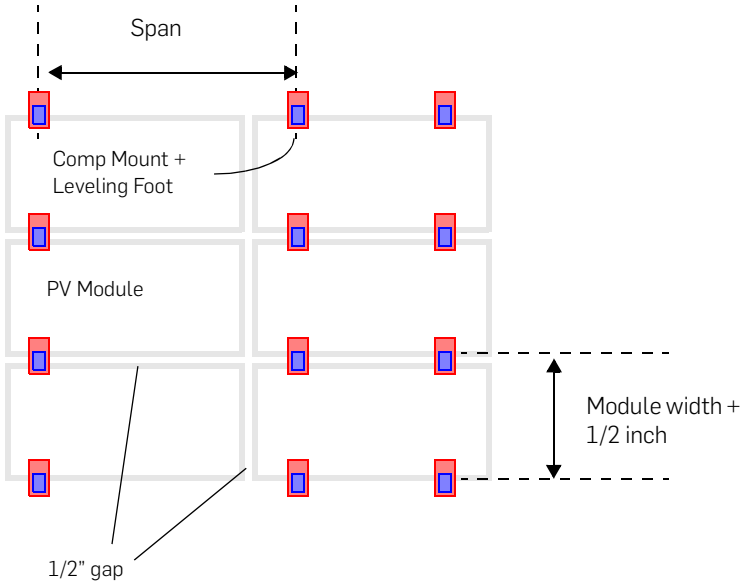
Maximum span (multiple of distance between rafters)

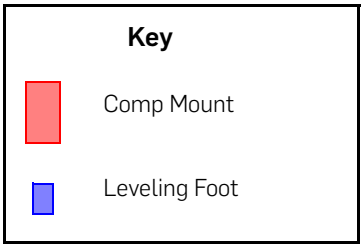
Adjust front row marks for optimal placement in the shingle course before chalking the rest.

Alternate: Portrait Orientation



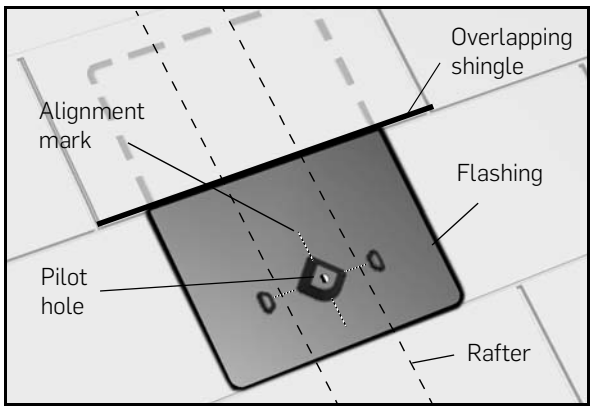
Array Layout Example: Landscape Orientation





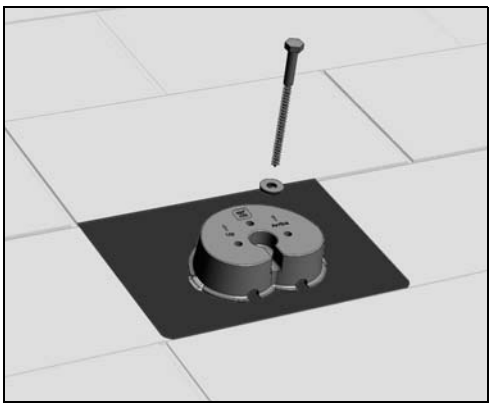
Step 2: Install Roof Attachments

2a Align Comp Mount with Layout mark



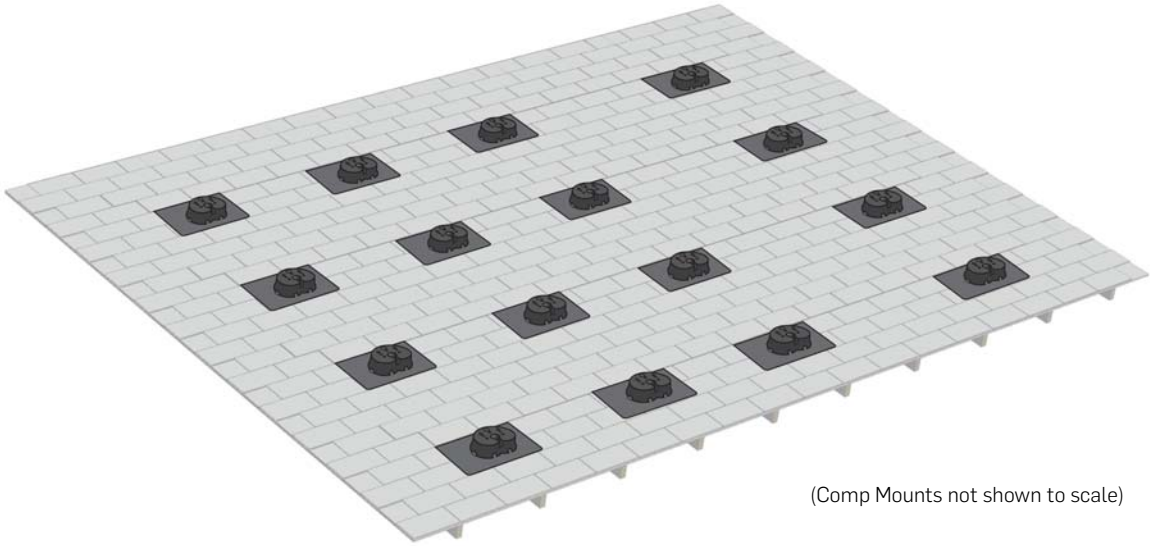
Drill pilot hole at layout mark, centered on rafter. Slide flashing into position, referring to the Comp Mount Installation Manual for details on placement of the flashing and correct up-roof orientation of the flashing block.

Ensure proper waterproofing measures and use of properly rated sealant.



Secure Comp Mount to rafter using lag screw provided.

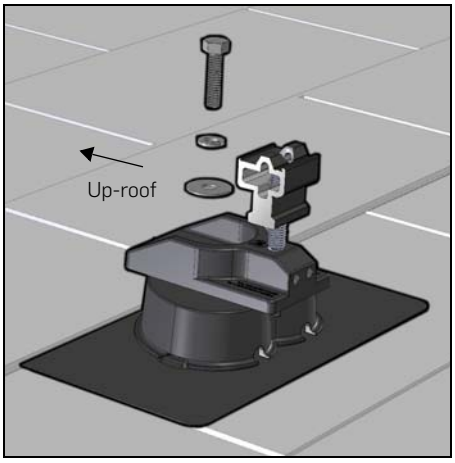
CHECKPOINT: Roof Attachments



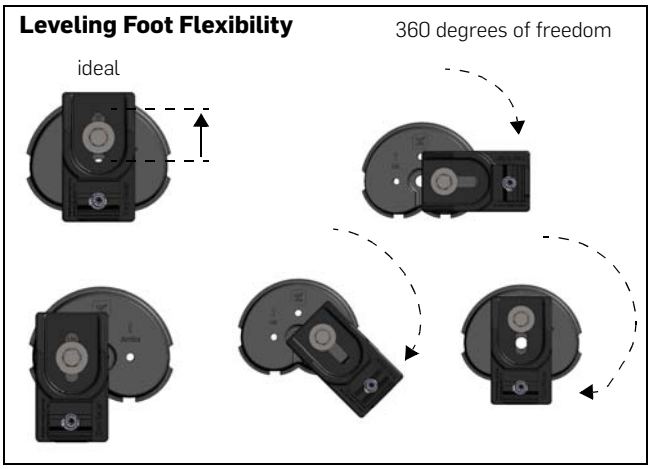
(Comp Mounts not shown to scale)

Step 3: Secure and Align Front-Row Leveling Feet

3a Secure Leveling Foot to Comp Mount



Secure the Leveling Foot to the Comp Mount using machine screw provided.

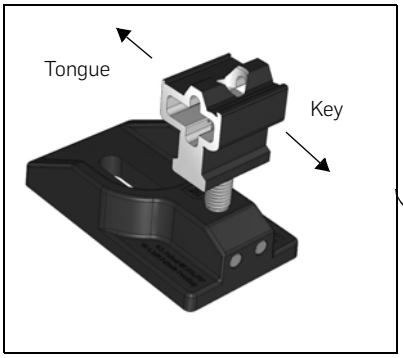


Leveling Foot position can be adjusted in several ways:

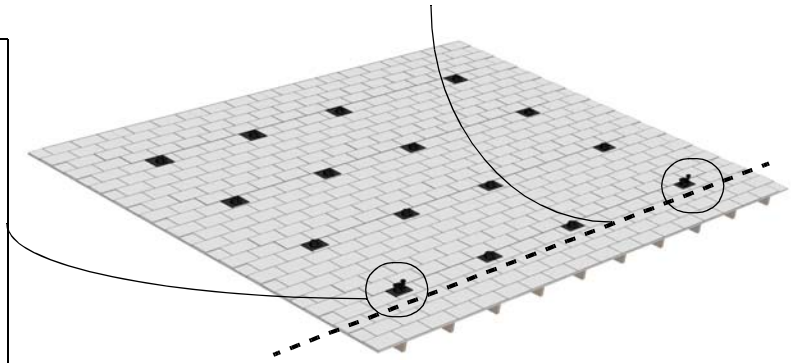
- Alternate mounting hole on Comp Mount
- Slotted bolt hole on Leveling foot base
- Leveling Foot base can be angled to avoid an Interlock or other hardware.

Refer to the Engineering Certification Letter for details. (Ideally, front-row Leveling Feet should aim for the up-roof center hole, center the slot over the hole, and use a straight alignment.)

3b Attach String Line to Outer Leveling Feet



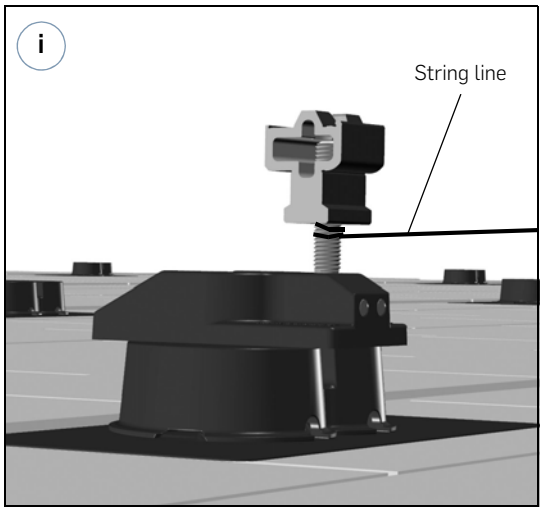
Ensure proper orientation of the Rockit. The Tongue side should face up-roof.



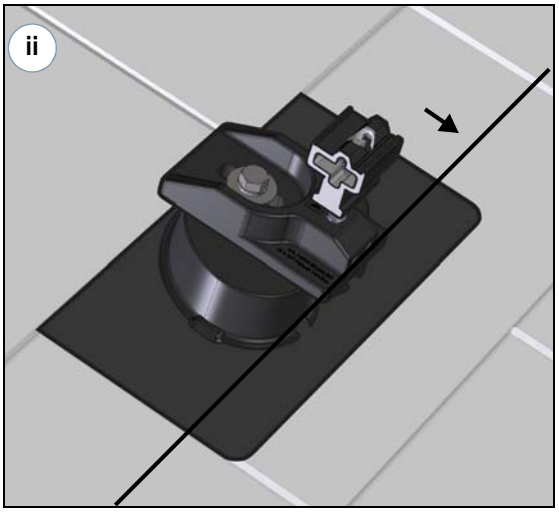
Secure outer Leveling Feet first.

Secure Front-Row Leveling Feet, Continued

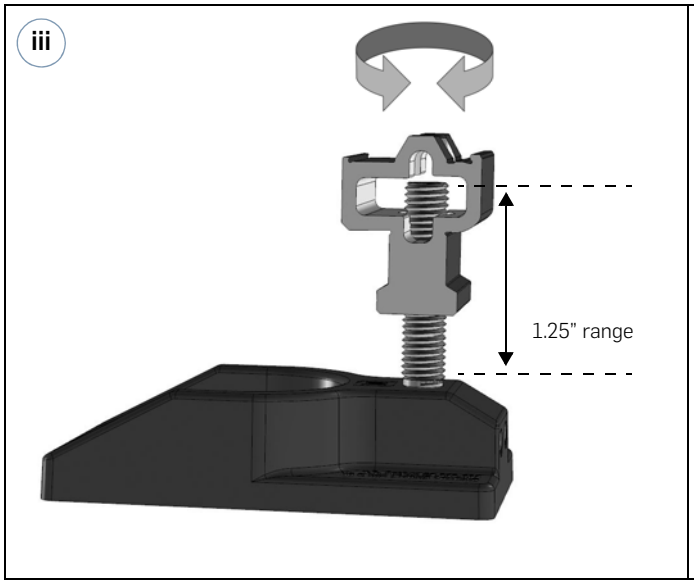
3c Adjust Leveling Feet to String Line



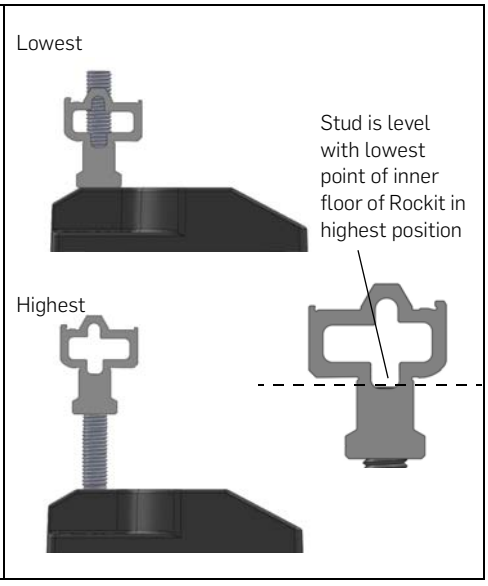
Place string line directly beneath the Rockit and on the front side of the Leveling Foot stud of the two outermost Leveling Feet.



Align the middle Leveling Feet to string line.



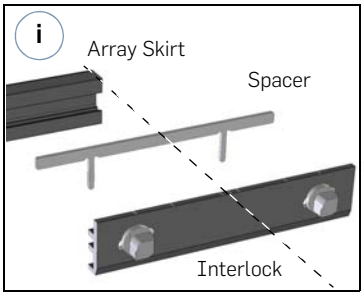
Spin the Rockit to adjust Leveling Foot height up or down within the allowable range.



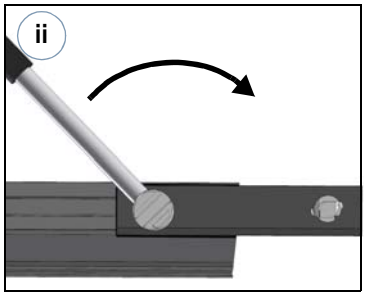
Allowable range is as shown.

Step 4: Install Array Skirt

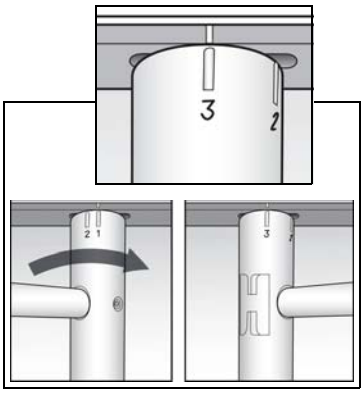
4a Connect First Two Array Skirt Sections Together



Place Array Skirt Spacer on the Key side of an Interlock, aligning the end of the Array Skirt with the center mark on the Interlock.



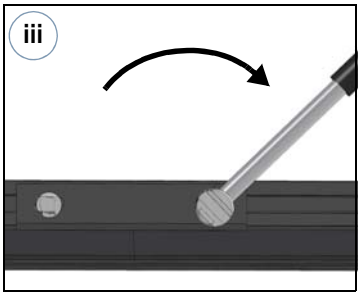
Use the Zep Tool to secure the Interlock on one side.



Rotate the Zep Tool from Position 1 to Position 3.

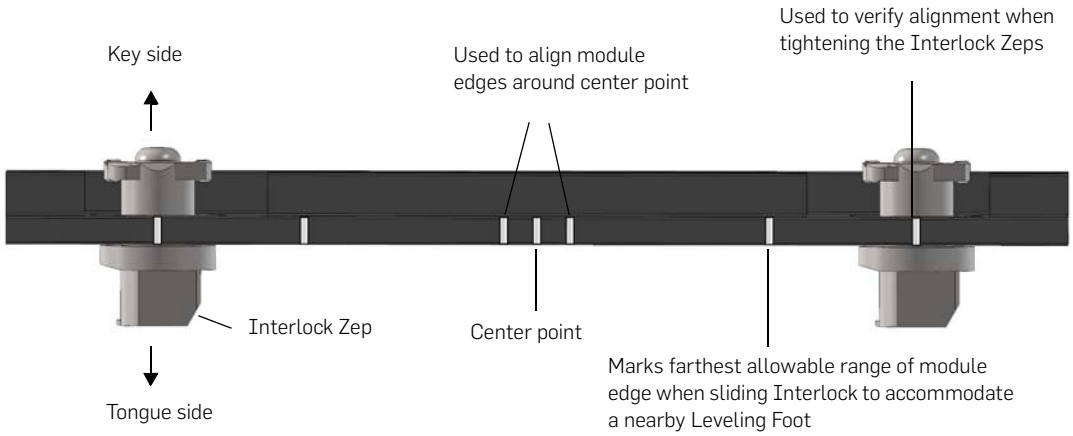
Do not over-turn.

Note: Pre-assemble the first two Array Skirt sections when the Leveling Foot spacing on the roof is greater than the length of a single Array Skirt.



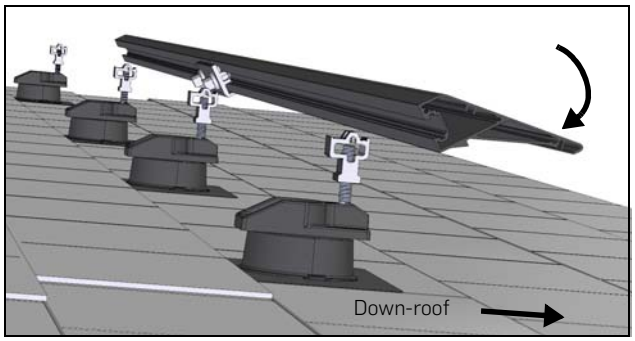
Attach the second Array Skirt section, and tighten the Interlock on the second side.

iv Interlock Alignment Marks

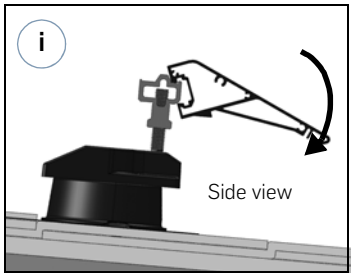


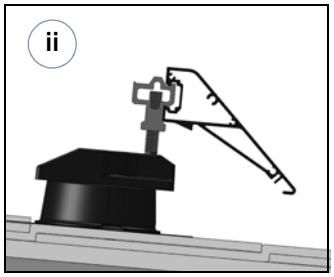
Array Skirt, Continued

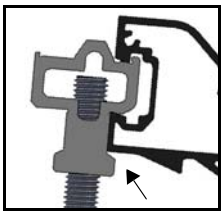
4b Rotate First Array Skirt Sections onto Key Side of Leveling Feet



Slide first Array Skirt sections to the right or to the left, to identify the East-West edges of the array. Adjust as needed to avoid conflicts between Interlocks and Leveling Feet, to reduce the need for Hybrid Interlocks where possible.

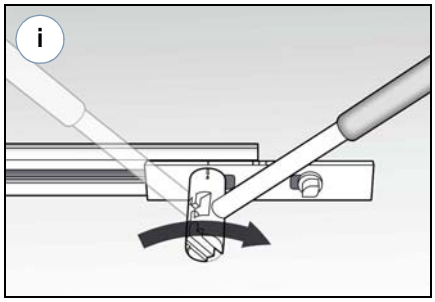




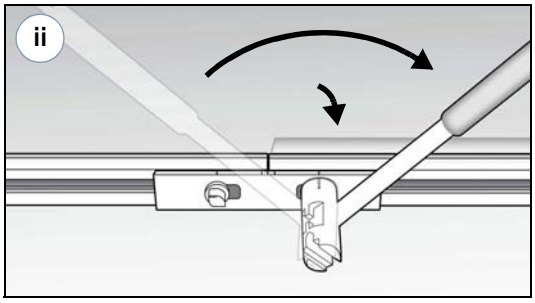


Bottom edge of Array Skirt should be flush against Leveling Foot Rockit.

4c Install Remaining Sections of Array Skirt



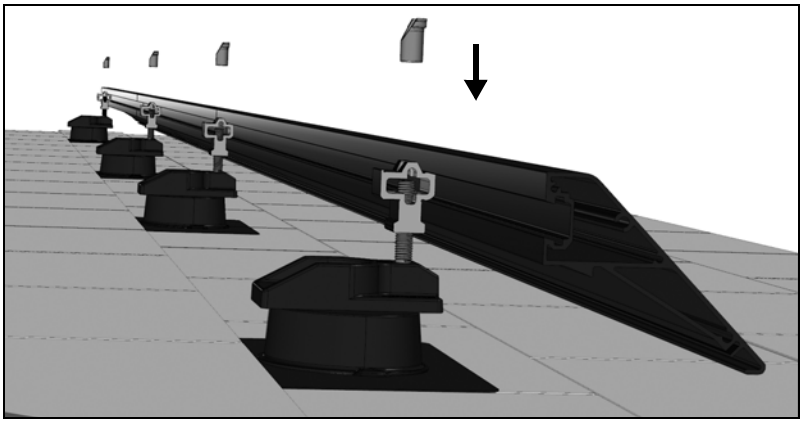
Install next Interlock with an Array Skirt Spacer.



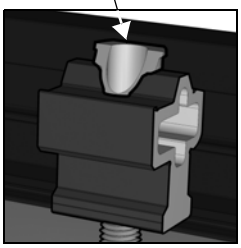
Simultaneously tighten Interlock to Position 3 (closed) while rotating next section of Array Skirt into place on the front-row Leveling Feet.

Array Skirt, Continued

4d Insert Jams into Leveling Feet



To completely secure the Array Skirt, a Jam is required in the Rockit of **every** front row Leveling Foot.

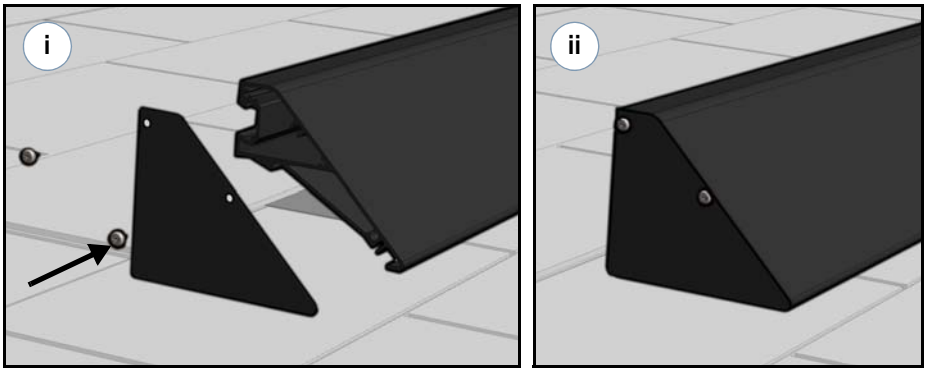


If the respective locations of a Leveling Foot and an Interlock overlap with one another, there are several possible options, depending on which version of the Interlock is available.

For more information see the following sections:

- "Interlocks" on page 38
- "Flexible Positioning" on page 40
- "Interlock Versions and Functionality" on page 50
- "Hybrid Interlocks" on page 52

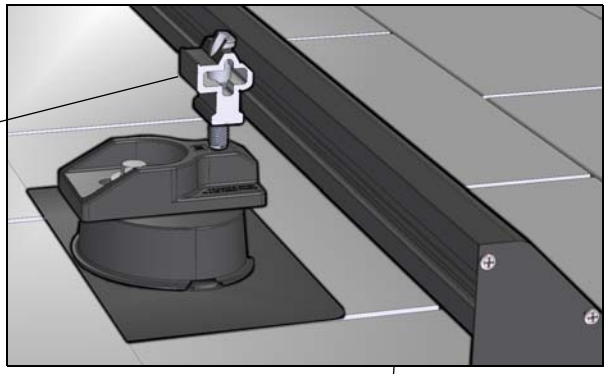
4e Attach Array Skirt End Caps



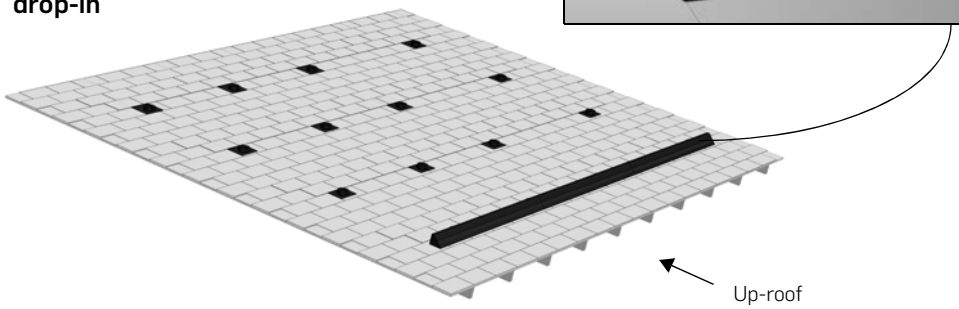
Array Skirt End Caps attach on either end of the completed Array Skirt.
(The End Caps are optional accessory components.)

Array Skirt, Continued

CHECKPOINT: Array Skirt

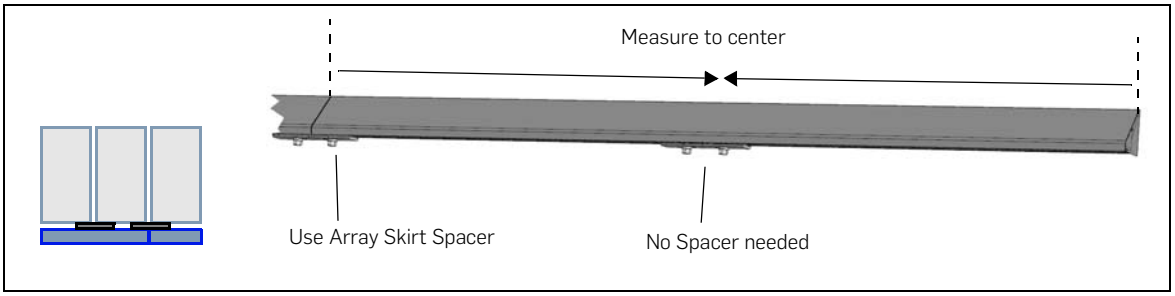


North-South drop-in



NOTE: The Array Skirt serves several functions: to mark the outside edges of the array, identify any potential Interlock and Leveling Foot conflicts, ensure that the first row of modules is straight and level, and as an aesthetic feature to blend the array into the roof while concealing all the hardware. If desired, the Array Skirt can be removed after installation is complete.

Portrait Exception

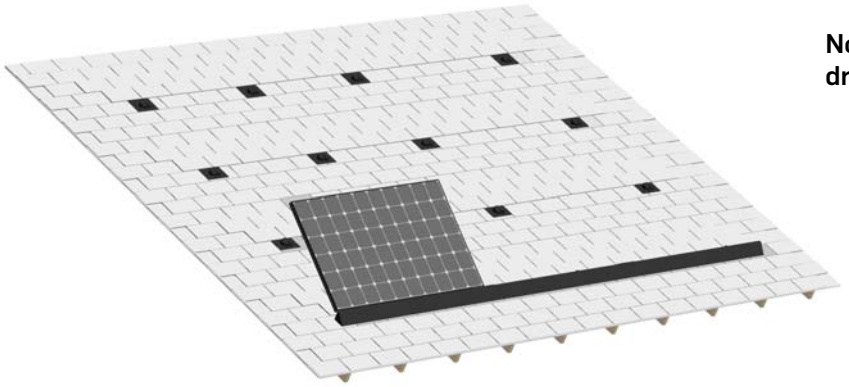


For Portrait orientation, add a second Interlock in the middle of each Array Skirt section. Do not use an Array Skirt Spacer for the mid-section Interlock. If there are an uneven number of modules in the first row, one Array Skirt section must be cut to match the front edge of the array.

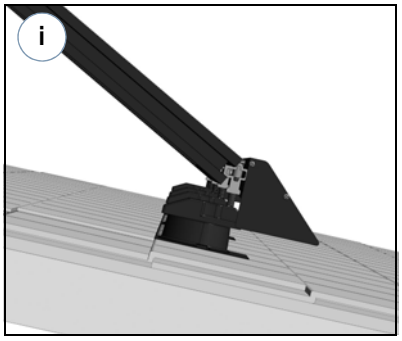
Step 5: Install First Row of Modules

5a Drop In First Module

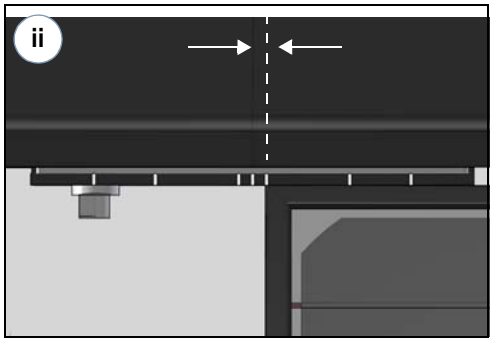
Up-roof



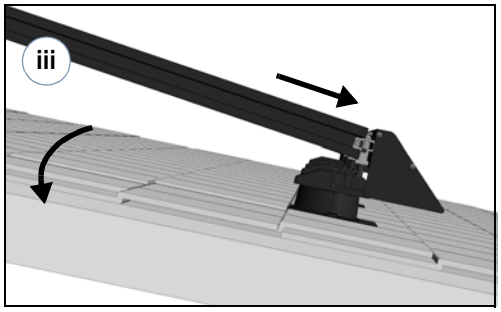
North-South drop-in



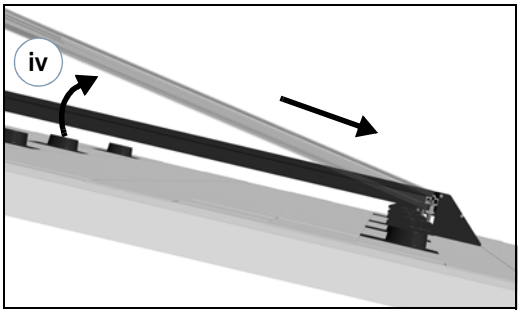
Place first module on Tongue side of Leveling Feet and Interlocks at a steep angle.



Adjust module edge alignment using Interlock timing marks.



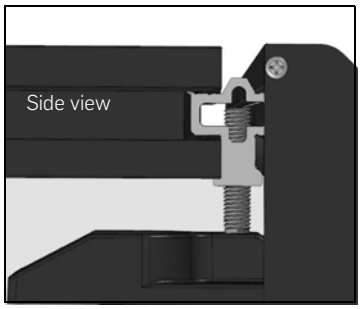
Rotate module downward almost flat, while pushing module onto tongues of Leveling Feet and Interlocks. Frame engages at 15 degrees.

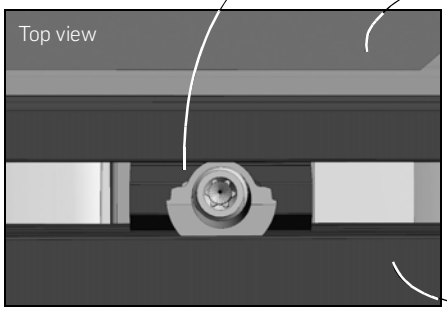


If needed, lift module up slightly, and apply force towards Leveling Feet to seat the module completely.

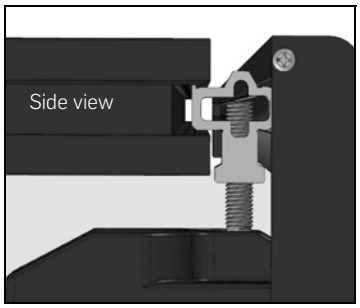
First Module Row, Continued

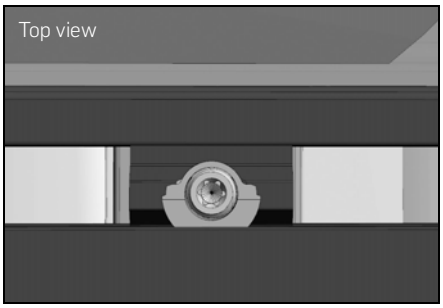
5b Adjust Module on Tongues





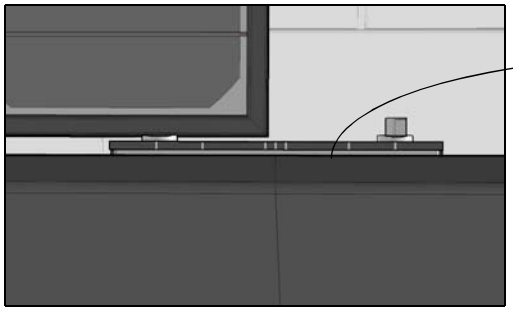
Fully Seated (Optimal)





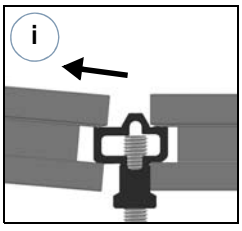
Acceptable

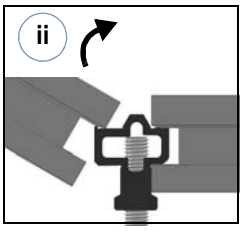
Visually check the first row of modules. Ideally, Rockit of Leveling Foot should be flush with module edge. Remove and re-seat if needed.

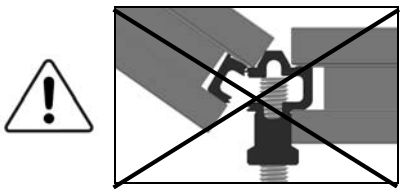


When module is fully seated, tongue side of Interlock is fully concealed inside module frame.

CAUTION: When removing a module from a Leveling Foot, first pull the module out of seat and then lift module upwards. See "Installation Supplement" on page 47.

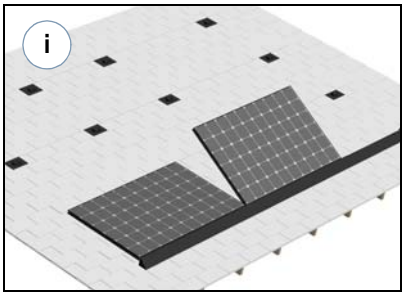




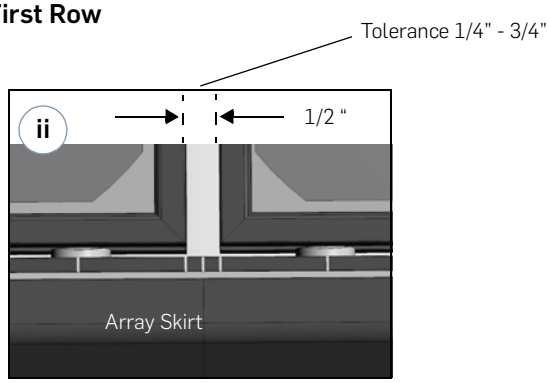


First Module Row, Continued

5c Drop In Remaining Modules In First Row

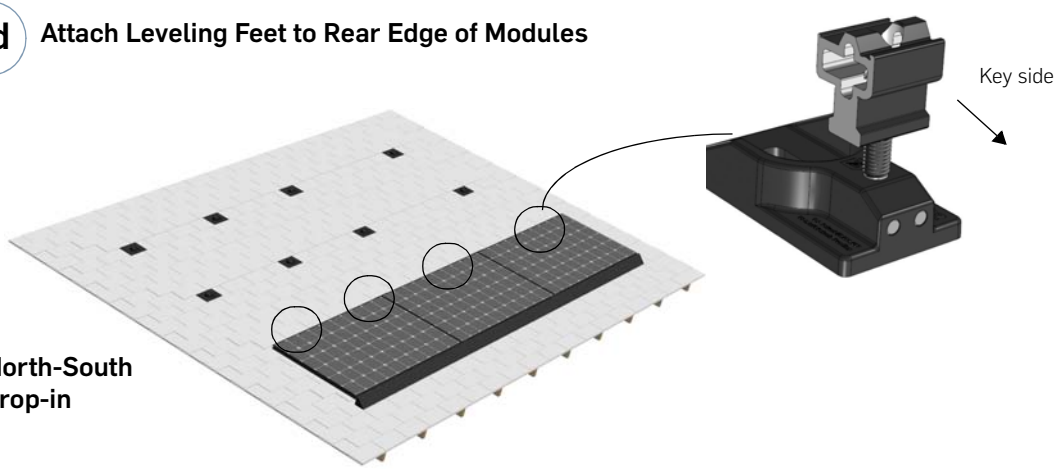


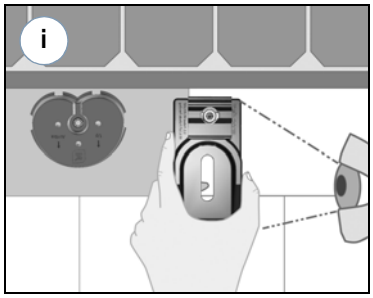
Place the second module on Tongue side of first row Leveling Feet and Interlocks.



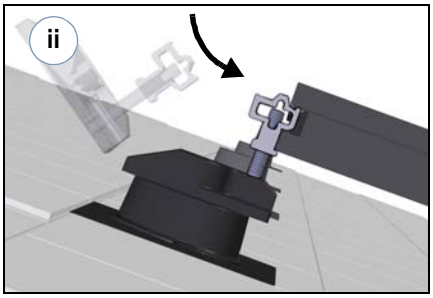
Align module with Interlock timing marks. Allow 1/2 inch gap between modules.

5d Attach Leveling Feet to Rear Edge of Modules



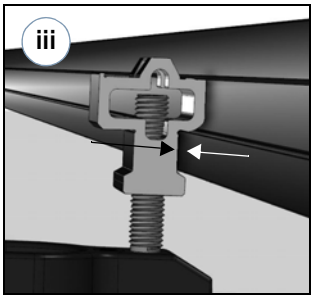


Position the Leveling Foot above the Comp Mount by eye.



Manually insert the Key side of the Leveling Foot into Zep Groove.

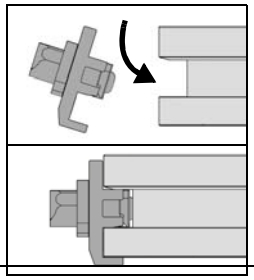
Do not attach the Leveling Foot base until the next step.



Flat face of Rockit should be flush with module frame.

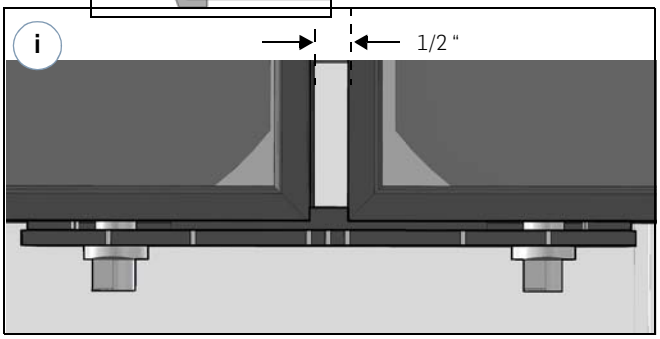
First Module Row, Continued

5e Attach Interlocks to Rear Edge of Modules

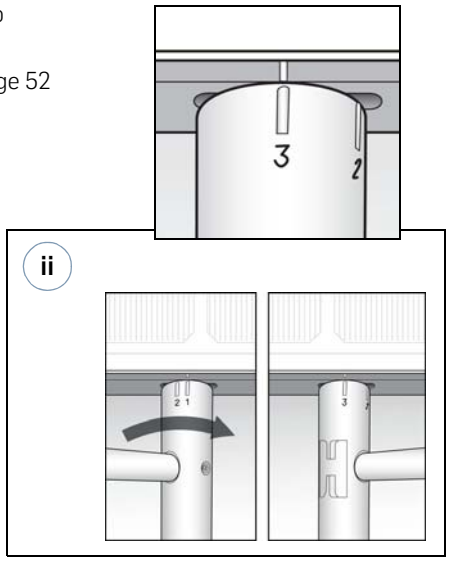


If a nearby Leveling Foot is too close to the Interlock, refer to these sections:

- "Hybrid Interlocks" on page 52
- "Flexible Positioning" on page 40

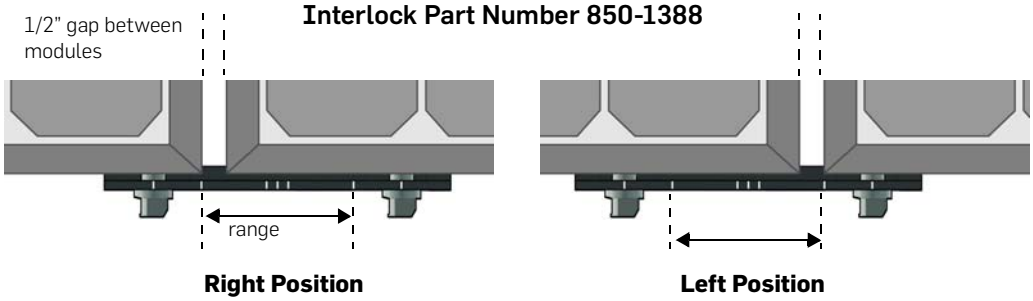


Align Interlocks with module corners using timing marks. Attach Interlocks to connect the back corners of the modules, using the Zep Tool.



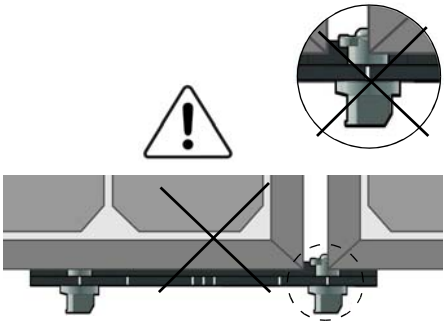
Rotate the Zep Tool from Position 1 to Position 3. **Do not over-turn.** Over-turning may prevent next row of modules from seating properly.

Interlock Part Number 850-1388



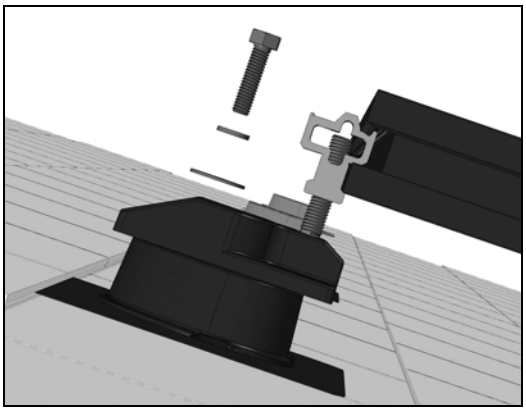
Interlock 850-1388, shown above, has two timing marks that allow for off-center placement anywhere between the marks indicated, or 1.5" in either direction.

Note: If the Interlock Zeps are showing, the Interlock is positioned too far to one side.



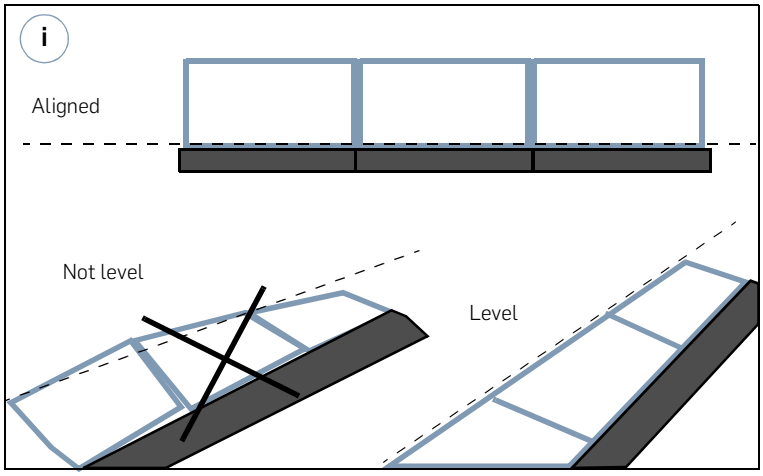
First Module Row, Continued

5f Secure Leveling Foot Base

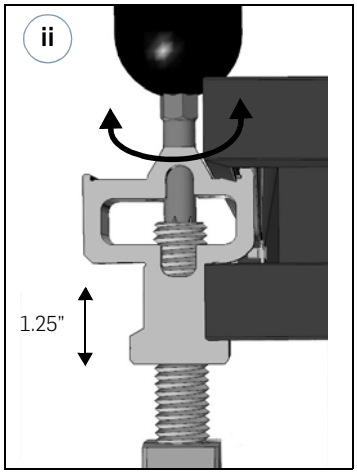


Secure Leveling Feet to Comp Mounts using machine screw provided. Note that there is flexibility in the positioning of the Leveling Foot on the Comp Mount, as well as in the positioning of the Interlock, as described in "Flexible Positioning" on page 40.

5g Adjust Leveling Foot Height



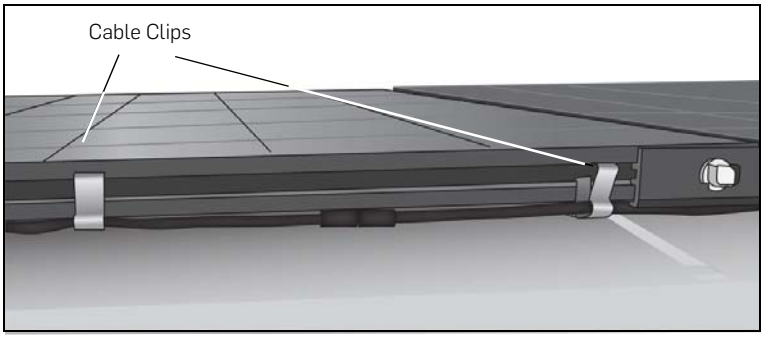
Ensure that first row is level and aligned. This will aid in keeping the rest of the array true.



Use the Zep Tool with #30 torx bit to raise or lower the Leveling Feet as needed.

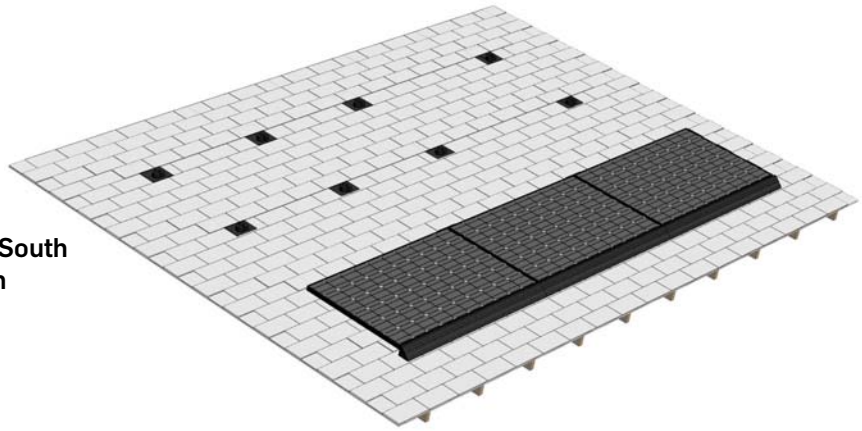
First Module Row, Continued

5h Manage Wires Using Cable Clips



See "Wire Management" on page 41.

CHECKPOINT: First Module Row

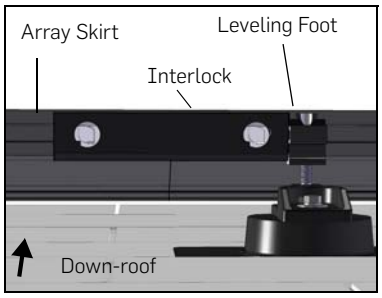


North-South drop-in

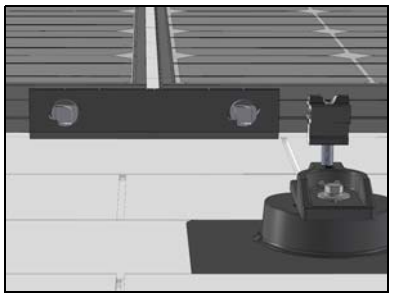
Special Inset: Interlocks

How Interlocks Are Used

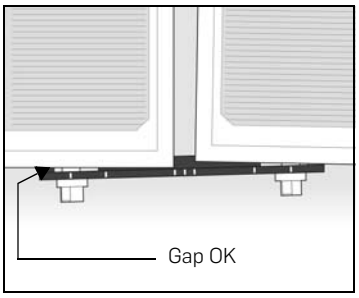
The Interlock creates a simultaneous structural and electrical bond on both Key and Tongue sides.



Connect Array Skirt

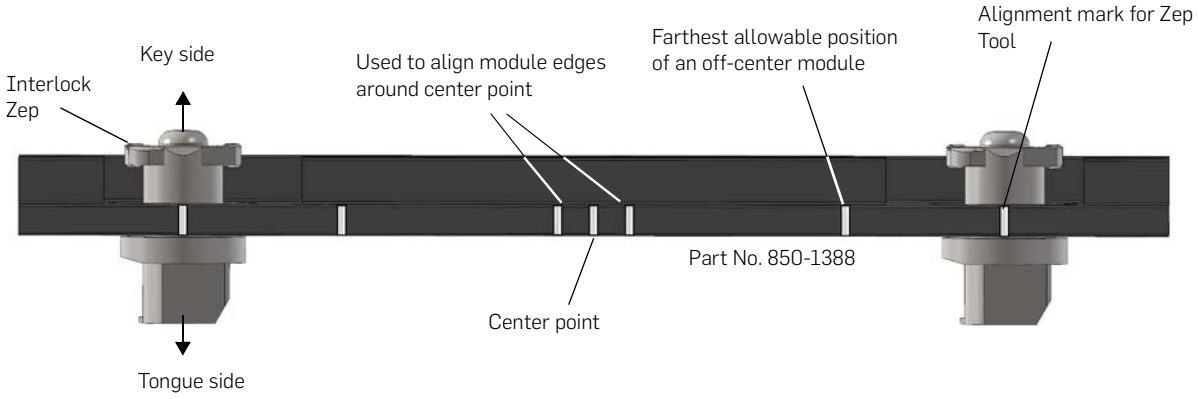


Connect PV modules



Built-in tolerance for module size variations

Interlock Timing Marks



Placement Between Modules

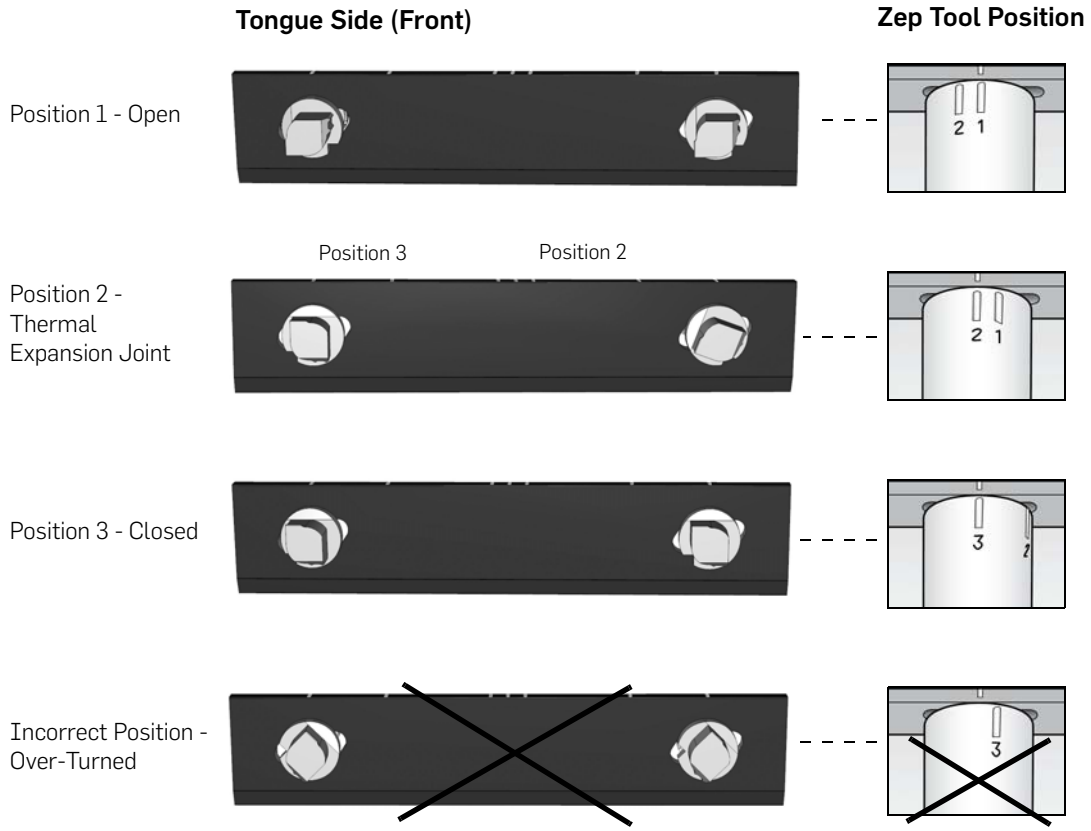
Centered

Shifted right

Shifted left

Interlocks, Continued

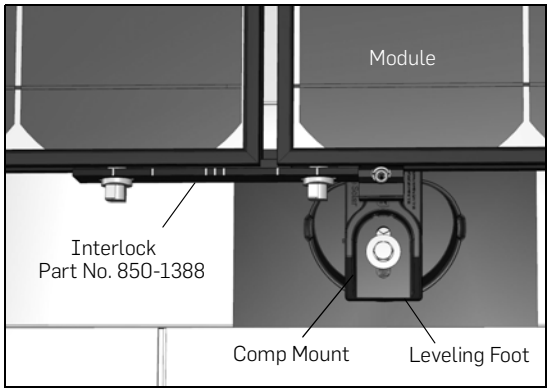
Closed and Open Positions



NOTE: An over-turned Interlock Zep will interfere with the drop-in of the next row of modules.

Special Inset: Flexible Positioning

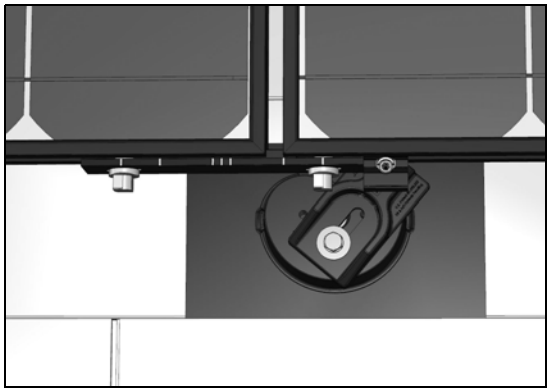
Scenario 1: Minor Shift



The Interlock can slide up to 1.5" in either direction to avoid Leveling Foot conflicts.

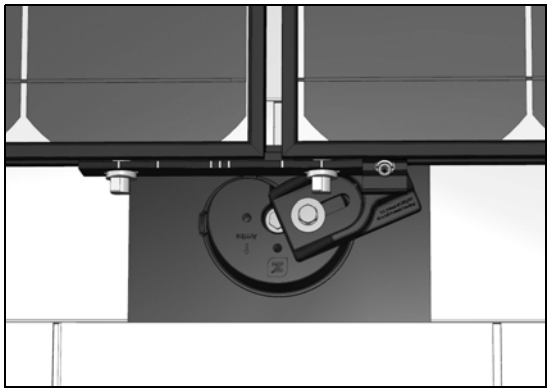
(In this example, the Interlock is shifted to the left.)

Scenario 2: Mounting Angle and Slot Range



The Leveling Foot slotted bolt hole and mounting angle provides additional range and flexibility.

Scenario 3: Alternate Mounting Hole

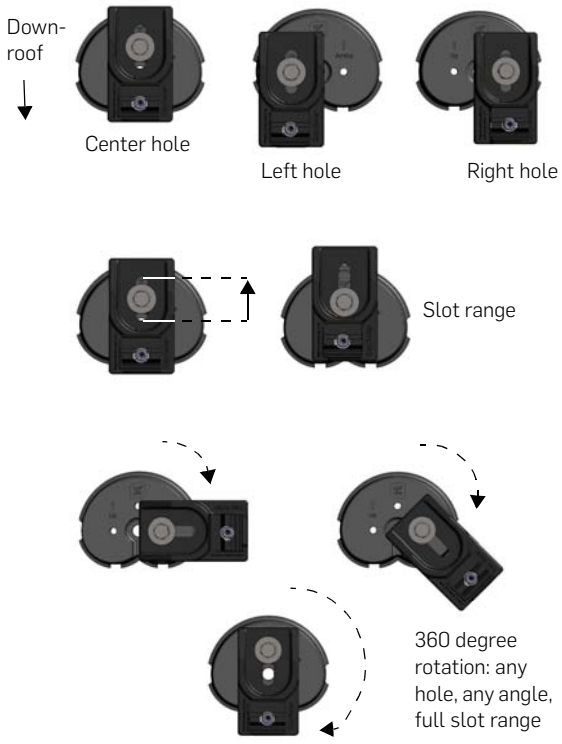


In this example, the Leveling Foot is mounted in one of the alternate mounting holes on the Comp Mount flashing block.

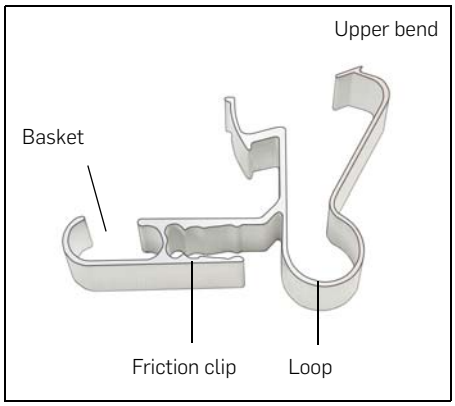
Note: These options may be used in any combination as needed for the installation.

Note: Options may vary by Comp Mount Type. Examples shown here are for Comp Mount Type C. Please refer to the Zep Solar Engineering Certification Letter for full details.

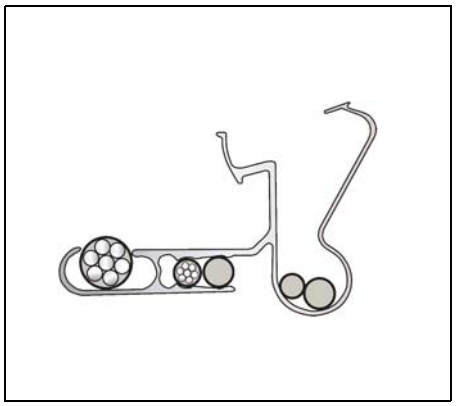
Examples: Leveling Foot Positioning



Special Inset: Wire Management

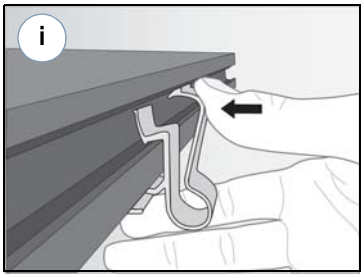


The AC/DC Cable Clip snaps into the Zep Groove and slides back and forth to secure array wiring.

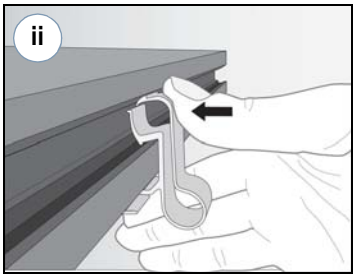


The AC/DC Cable Clip can accommodate many sizes of wire and cable.

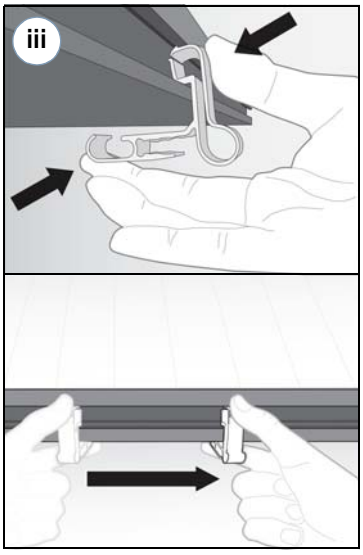
Attaching the AC/DC Cable Clip



Place the AC/DC Cable Clip into the Zep Groove.

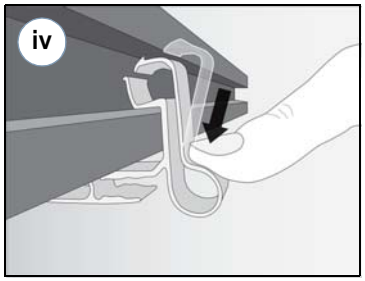


Press the upper bend to snap it into place.



To keep cables taut, squeeze the top and the basket to slide the AC/DC Cable Clip back and forth.

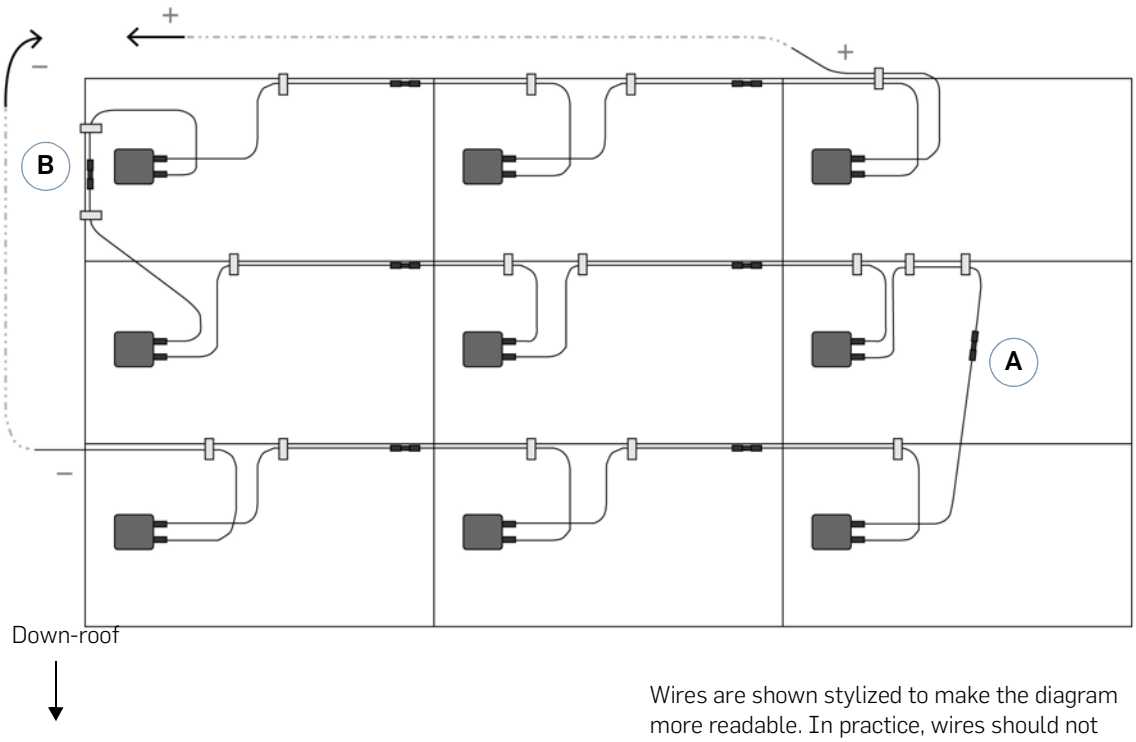
Releasing the AC/DC Cable Clip



To release, press the top of the loop.

Wire Management, Continued

Example: Array Wiring Using 2 Clips Per Module

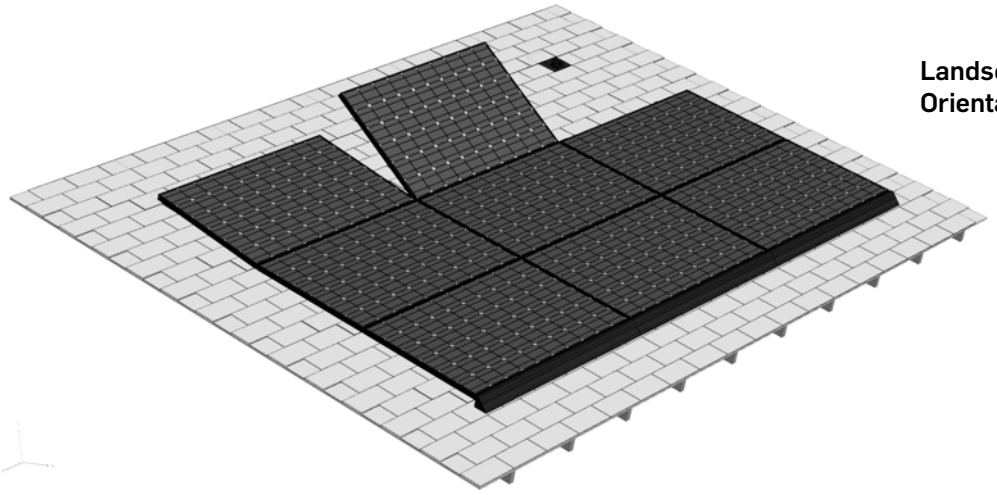


Wires are shown stylized to make the diagram more readable. In practice, wires should not have slack between clipping points.

NOTE: Two variants for row-to-row wire management are shown. Method A is to clip wires to the upper edge of the module as shown on lower right, rather than clipping along the side as shown in Method B.

Step 6: Complete the Array

6a Install Remaining Modules



Landscape Orientation

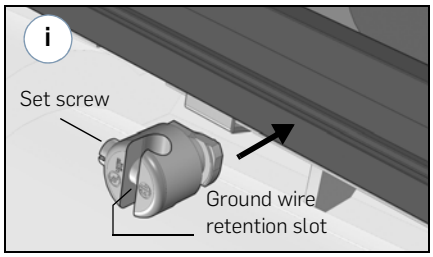
Install remaining modules, row by row. True and level the array as you go. Attach Leveling Feet and Interlocks as before. Clip and secure wires for each row before moving on to the next row.

For large arrays, Thermal Expansion Joints may be needed. See "Thermal Expansion" on page 19, and "Interlocks" on page 38 for details.

NOTE: Portrait orientation is also supported for ZS Comp.

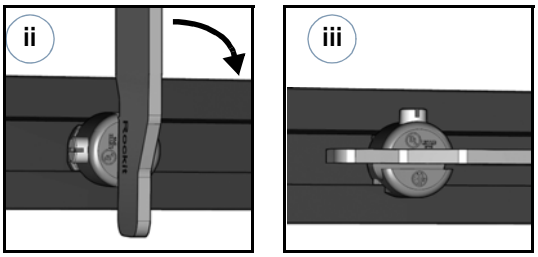
Step 7: Ground the Array

7a Insert a Ground Zep Into Module



Insert a Ground Zep in the Zep Groove of any module around the array perimeter.

Start with the set screw at 9 o'clock position (pointing left).



Using either the Zep Tool or the Flat Tool (shown), lock the Ground Zep into place by turning 1/4 turn clockwise. After the Ground Zep is turned 90 degrees, the set screw should be pointing straight up.

This locks the Ground Zep into the Zep Groove and creates a solid ground bond with the module frame.

7b Connect Ground Zep to Building Ground/Earth.

Insert solid copper ground wire into the ground wire retention slot and turn the set screw wtih a flat-bladed screwdriver until the ground wire is captured by the set screw. To fully secure, torque the set screw as follows:

- 14-10 AWG: 40 inch-lbs
- 8 AWG: 45 inch-lbs
- 6 AWG: 50 inch-lbs

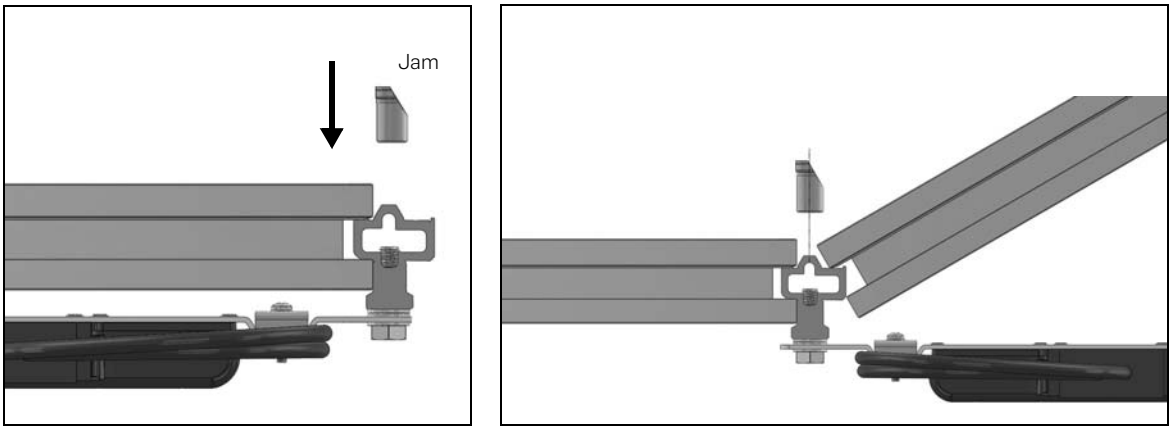
NOTE: If the array contains an unbroken row or column of Hybrid Interlocks or Thermal Expansion Joints, a Ground Zep is required on both sides of the break. See "Thermal Expansion" on page 19.

Special Inset: Universal Box Brackets and Other Accessories

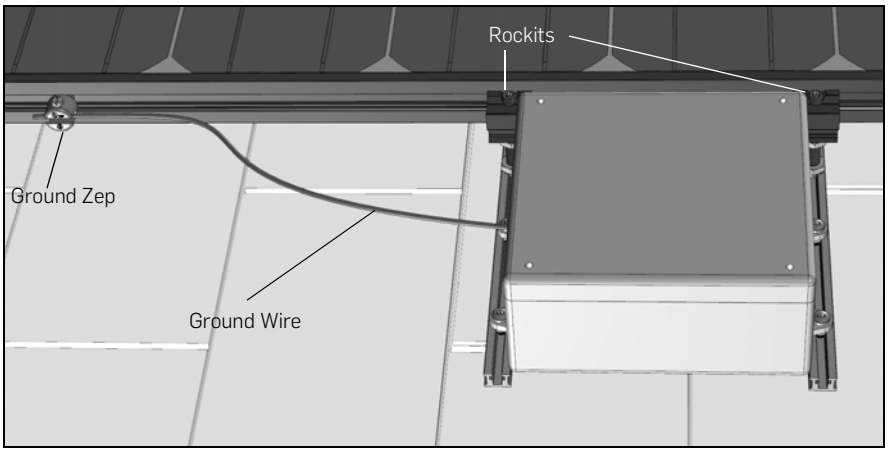
Zep Solar, Inc. offers accessories for installing third-party products:

- The **Universal Box Bracket** is for PV electronic devices such as electrical boxes that are typically bottom mounted and attached on the perimeter of the array.
- The **Groove Adapter Kit** is for items such as microinverters or DC-to-DC optimizers that are side mounted and may be attached either on the perimeter or underneath each module.
- The **Groove Adapter Bracket** works with selected third-party microinverters to provide a ground bond path as well as a mechanical connection to the PV module frame.

Each of the above components includes installation details on the Component Level Instruction sheets that are shipped with the component. For some third-party Zep Compatible items, additional manual supplements are available. Contact Zep Solar Support for more information.



Groove Adapter Kit (examples)



Universal Box Bracket

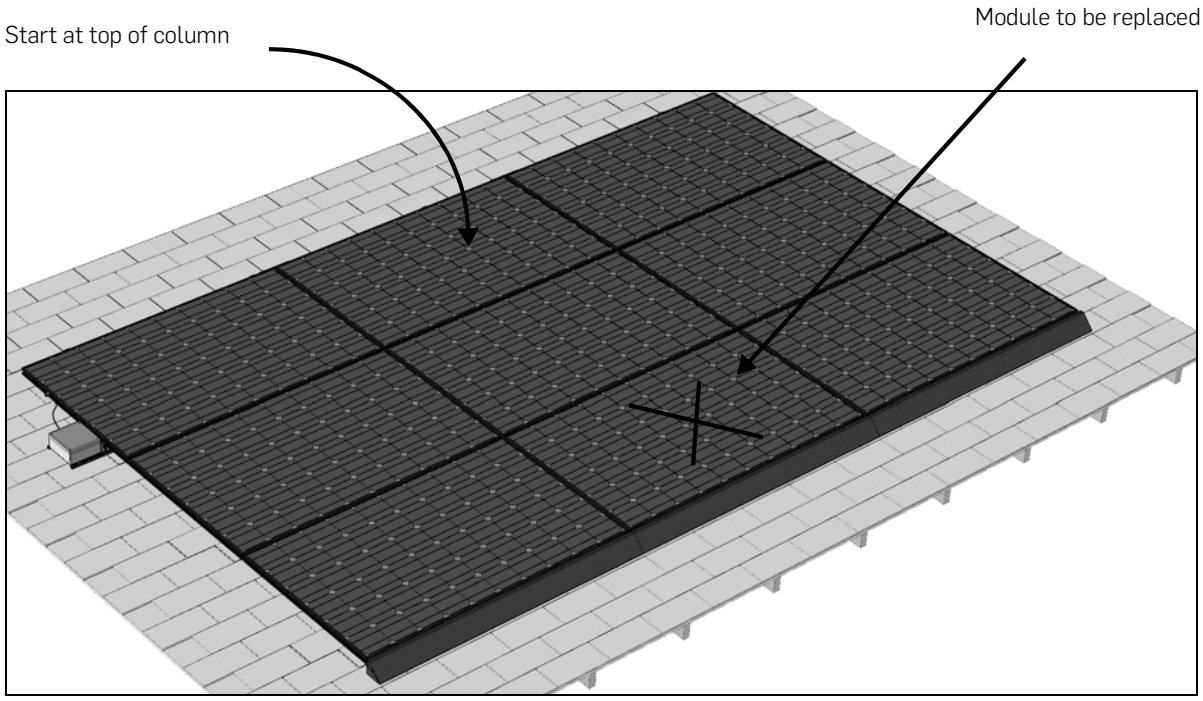
* See the Zep Solar web site for additional information and accessories.

6 Installation Supplement

6.1 Servicing an Array

Servicing an array usually means identifying and replacing a malfunctioning PV module.

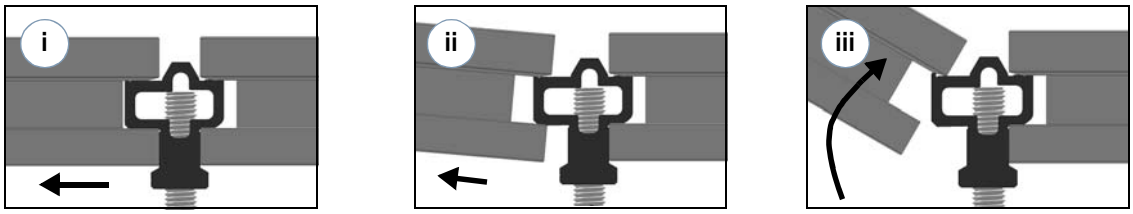
1. **Start at the top of the column with the faulty module.**



2. **Remove the top row Interlocks.**
   Remove the two Interlocks on either side of the module column to be removed. Rotate the Zep Tool counterclockwise to Position 1. Do not over-turn.
3. **Detach Leveling Foot base.**
4. **Remove Leveling Foot from module frame.**
5. **Disconnect wires from module to be removed.**

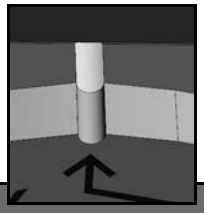
6. Remove the first module.

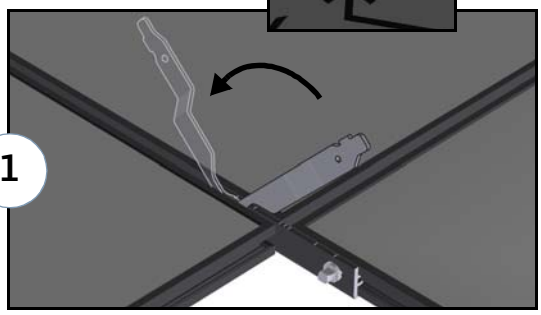
First, lift module very slightly and pull module back out of seat. After module is out of seat, rotate up 15 degrees. If needed, pull module back once more to ensure that it is completely pulled out, and then rotate module up and out of the array.



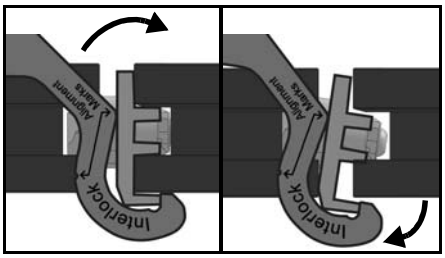
7. Remove mid-array Interlocks from next row of modules, using Flat Tool.

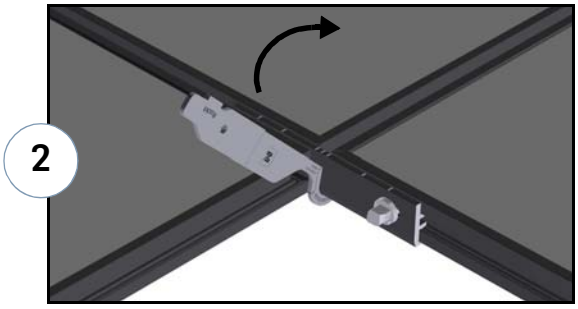
Line up alignment mark on Flat Tool with mark on Interlock.



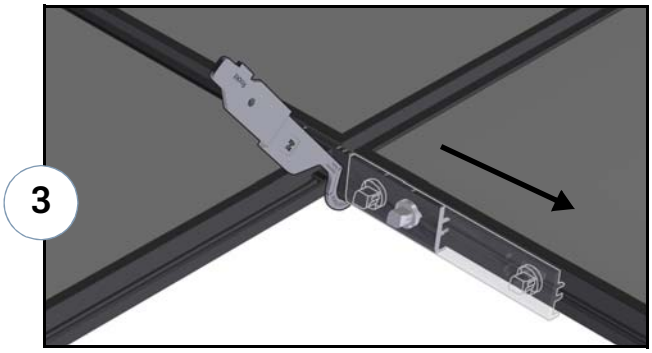


Rotate Flat Tool from Position 3 to Position 1 to open both Interlock Zeps. Note that Flat Tool is reversed.





Use the Flat Tool to rotate the Interlock out of the Zep Groove.



Slide the Interlock out from between modules. Tap gently with the Flat Tool if needed.

For a Hybrid Interlock, remove the exposed Rockit using #30 Torx Bit. Leave the rest of the Hybrid Interlock in place.

8. **Remove remaining mid-array modules.**
9. **Replace faulty module.**
10. **Re-connect wires.**
11. **Replace and secure mid-array Interlocks using Flat Tool.**
12. **Replace up-roof modules in column.**

NOTE: A ground/earth path must be maintained while modules are being serviced. When removing an entire module column or otherwise isolating modules, use additional Ground Zeps and jumpers during maintenance work.

6.2 Removing the Array Skirt

The Array Skirt serves as a jig during installation to mark the outside edges of the array, to identify any potential conflicts between Interlocks and Leveling Feet, and to ensure that the first row of modules is straight and level. However, the Array Skirt is not required for structural integrity, only for convenience and aesthetic appearance. Therefore, installers may choose to remove the Array Skirt subsequent to module installation.

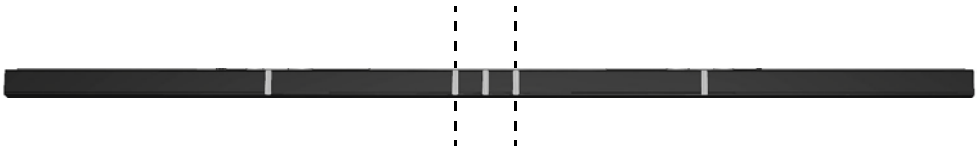
1. **Remove all Jams from front-row Leveling Feet.**
2. **Use the Flat Tool to open Interlock Zeps on Array Skirt from Position 3 to Position 1.**
3. **Remove Array Skirt sections by rotating them up and off the front row Leveling Feet.**
4. **The Interlocks are revealed with the Key side showing.**
5. **After both sections of Array Skirt are removed, the Interlocks and Array Skirt Spacers will be loose for removal. (Hybrid Interlocks can remain, and do not need to be removed.)**
6. **Re-install and secure the Interlock with the Key side facing inwards. Do not use the Array Skirt Spacer.**

6.3 Product Notes

Special Inset: Interlock Versions and Functionality

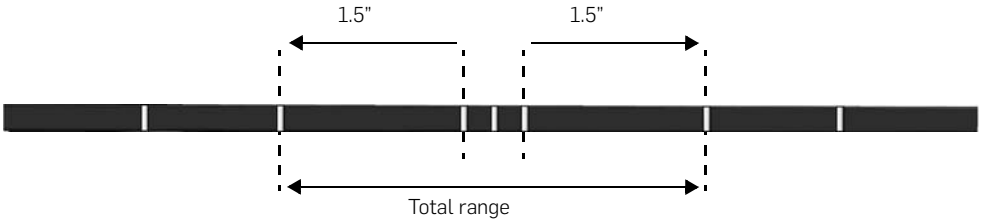
Timing Marks

Part No. 850-1178

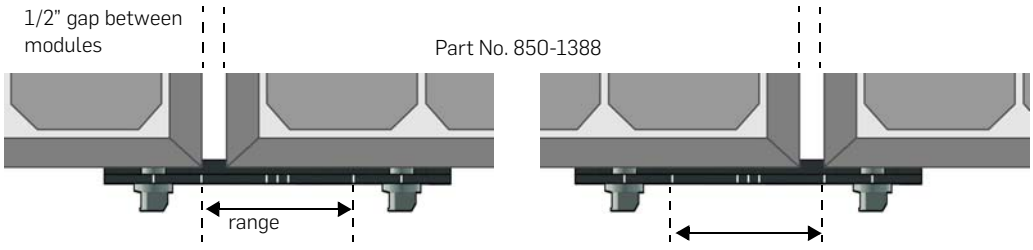


The Interlock with 5 timing marks must be centered with 1/2" gap between the PV modules using the three center marks.

Part No. 850-1388



The Interlock with 7 timing marks can be 1.5" off-center between the PV modules, up to marks as shown. Maintain the same 1/2" gap between modules.



Special Inset: Interlock Versions and Spacers Used

Either version of the Interlock is compatible with the Array Skirt, using a compatible Spacer.

Profile No. 500-0104

Part No. 850-1178

Part No. 850-1286

- or -

Part No. 850-1402

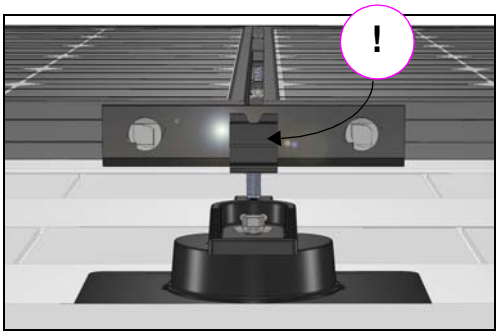
Profile No. 500-0104

Part No. 850-1388

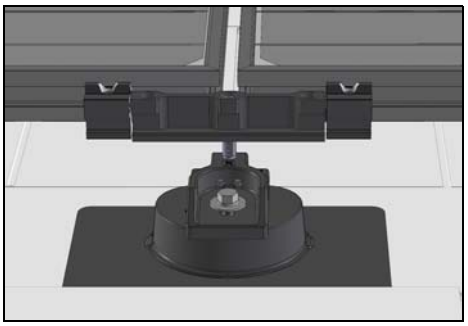
Part No. 850-1402

only

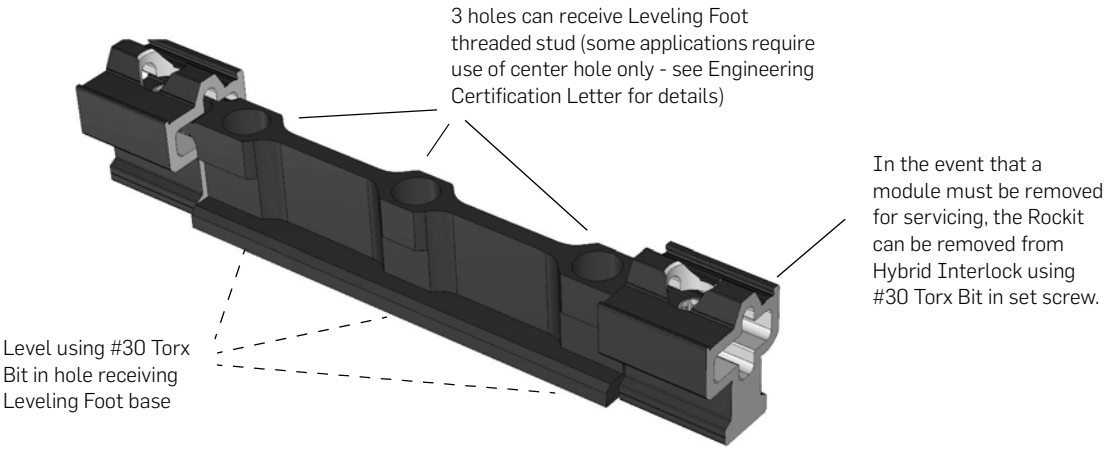
Special Inset: Hybrid Interlocks



A Leveling Foot-Interlock conflict occurs when the location of a Leveling Foot coincides with the location of an Interlock.



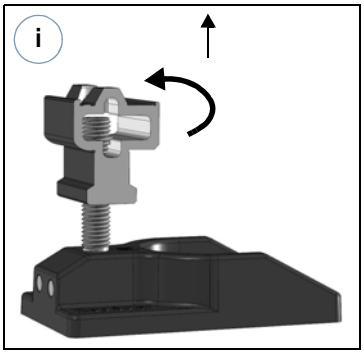
The Hybrid Interlock has a dual function: attachment to the Comp Mount and structural connection between modules.



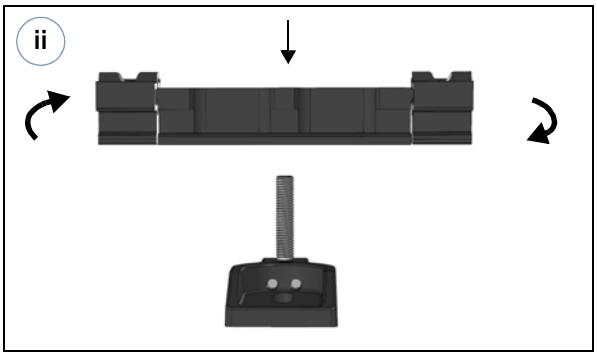
NOTE: The ungrounded Hybrid Interlock does not create a bonding path across modules. An array containing an unbroken column or row of Hybrid Interlocks requires a Ground Zep on both sides of the break. (A grounding version of the Hybrid Interlock is available in selected regions, and the Grounding Hybrid Interlock does create a bonding path across modules.)

Hybrid Interlocks, Continued

Connecting the Hybrid Interlock to the Leveling Foot Base

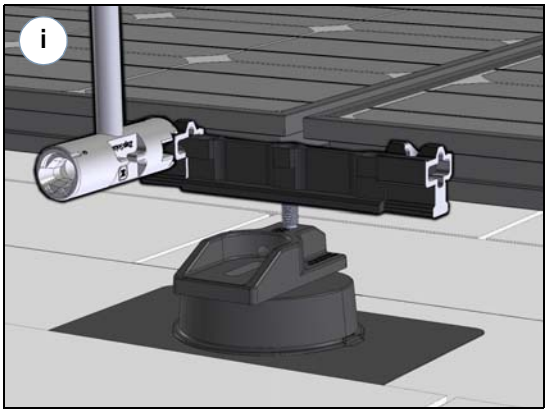


Spin the Rockit to remove it from the threaded stud and the Leveling Foot base.

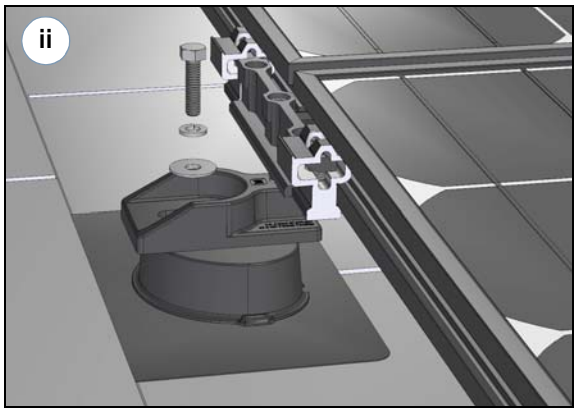


Insert the Leveling Foot stud into one of the holes on the Hybrid Interlock, and spin the Hybrid Interlock to attach it.

Installing the Hybrid Interlock



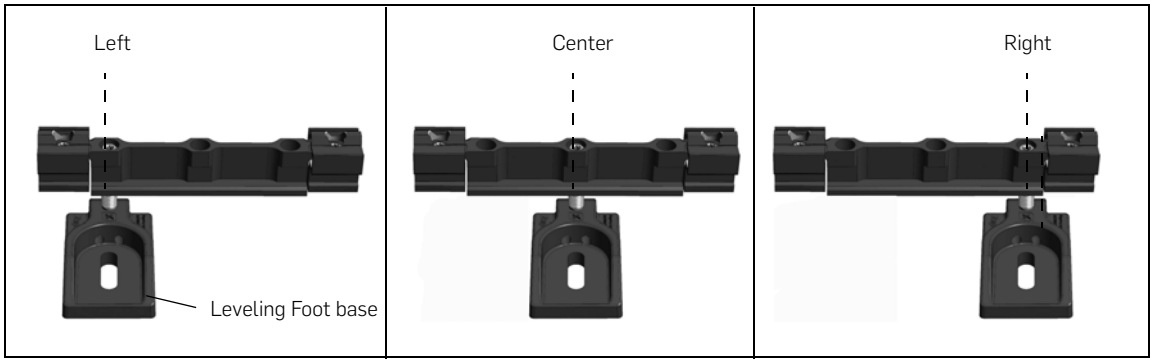
Using the Zep Tool to provide leverage as needed, attach the Hybrid Interlock to the PV module frame or Array Skirt.



Secure Leveling Foot base to Comp Mount using machine screw provided. Keep the center of each Rockit minimum 2 inches from module corner.

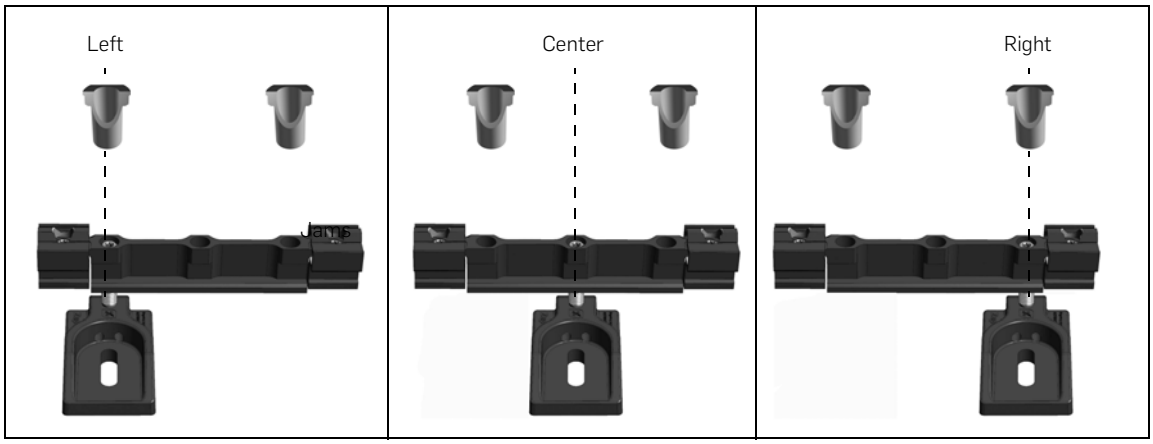
Hybrid Interlocks, Continued

Centering the Hybrid Interlock



When threading the Leveling Foot base for a Hybrid Interlock that connects two Array Skirt sections, choose the hole that best centers the Hybrid Interlock between Array Skirt sections. For Interlocks connect PV modules within the field of the array, only the center hole may be used.

Use Jams With Array Skirt



When attaching to an Array Skirt, insert 2 Jams into the holes so that each Jam touches one of the Array Skirt sections. Do not use Jams when attaching to modules.

7 Regulatory Information

The following electrical and safety information regarding Zep Solar hardware products is for use by building inspectors having jurisdiction as well as national listing agencies. Additional specifications may be provided for use by both regulatory agencies and field installers.

NOTE: Structural testing and related requirements are contained within the Engineering Certification Letters, available on the Zep Solar web site.

7.1 UL and ETL Listings

Selected Zep Solar products have been tested for ground/earth bond functionality, and have been approved by the following testing agencies:

- **Underwriters Laboratories, Inc. (UL)** - These listings appear as “Listed by UL to...” followed by the UL standard.
- **Intertek Testing Services (ETL)** - These listings appear as “ETL listing conforms to...” followed by the UL standard.
- **Canadian Standards Association (CSA)** - These items appear as “Certified to ULC ORD STD...” or “Certified to CSA STD...”

Table 7.1 Zep Solar Product Listing and Torque Specifications

Product Name and Number *	UL and ETL Listings	Listing Notification, Full Text Version	Additional Specifications
Ground Zep 850-1172	UL Listings: • UL 2703 • UL 467 ETL Listings: • UL 467 • CSA STD C22.2 NO 41	Listed by UL to UL 467 and UL 2703. ETL listing conforms to UL STD 467. Certified to CSA STD C22.2 NO 41.	Installation of Ground Zep into Zep Groove requires precise quarter-turn connections using the Zep Tool or the Flat Tool. See Installation chapter for further details. US torque specifications and ground wire gauges: • 14-10 AWG: 40 inch-lbs. • 8 AWG: 45 inch-lbs. • 6 AWG: 50 inch-lbs.
Interlock 850-1178	UL Listings: • 2703 ETL Listings: • UL 1703 • ULC ORD STD C1703	Listed by UL to UL 2703. ETL listing conforms to UL STD 1703. Certified to ULC ORD STD C1703.	Installation requires precise quarter-turn connections according to alignment marks provided, using the Zep Tool or Flat Tool. See the Installation chapter for further details.
Interlock 850-1388	UL Listings: • 2703	Listed by UL to UL 2703.	Installation requires precise quarter-turn connections according to alignment marks provided, using the Zep Tool or Flat Tool. See the Installation chapter for further details.
Leveling Foot (Grounding) 850-1408	UL Listings: • 2703	Listed by UL to UL 2703.	Insertion of Leveling Foot Rockit into Zep Groove is self-grounding. See the Installation chapter for details. Recommended torque value for attaching Leveling Foot to Comp Mount is 16.9 ft-lbs. **
Hybrid Interlock (Grounding) 850-1281 850-1283	UL Listings: • 2703	Listed by UL to UL 2703.	Installation of Grounding Hybrid Interlock Rockits into Zep Groove is self-grounding. See Installation chapter for details.

* Part numbers beginning with 850 refer to top-level SKUs as shown on shipping labels and sales catalogs. Part numbers beginning with 301 or other numbers refer to common parts or profiles that may have many top-level SKUs. Items shown in this table by profile number also display this number on shipping labels, and for listed parts, the listings explicitly reference the profile number rather than the top-level SKU.

**UL 2703 certification testing was performed for Grounding Leveling Foot with a torque value of 25.5 ft-lbs.

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