



AC System Installation Guide

V2 60 Cell Modules

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Section I. Getting Started

1. Safety Precautions

- Before installing the Westinghouse Solar AC Module, read all instructions and cautionary markings in the Westinghouse Solar AC documentation.
- Perform all electrical installations in accordance with all local electrical codes, the National Electrical Code (NEC), ANSI/NFPA 70 and local utility requirements.

2. Parts and Tools



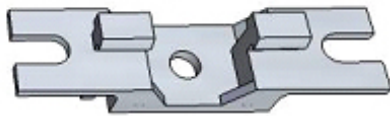
Splice



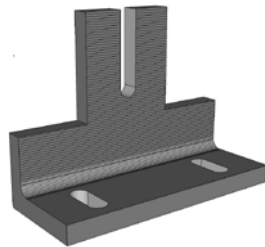
3/8"-1" Hex Bolt
and Flange Nut



L Bracket



North/ South Bracket



Offset Bracket



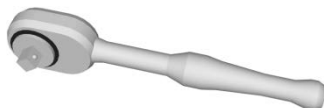
Grounding Washer

Required tools include:



Splice Driver

(Available from Westinghouse Solar)



1/4" Ratchet Wrench

(Available from any tool source)



9/16" Combination Wrench

(available from any tool source)

3. Solar Power Basics

Background

Rooftop solar power systems have come a long way, and Westinghouse Solar AC panels break new ground in both performance and safety. Westinghouse Solar AC panels are the first solar panel on the market to integrate racking, wiring, grounding and inverters directly into the panel. This section provides an overview of the installation and operation of your Westinghouse Solar Power System. Please note that the instructions herein are directed towards individuals and professionals with good knowledge of residential wiring and construction techniques. Do not undertake the wiring and installation of this product if you are not qualified to work with household AC voltages, if you are not knowledgeable about construction techniques, and if you are not experienced in working on rooftops and other dangerous locations.

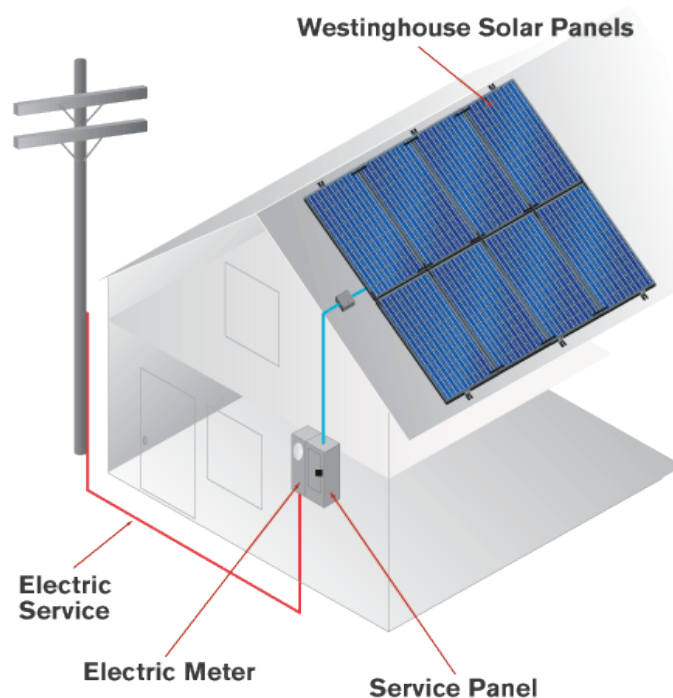


Figure 1 — Westinghouse Solar AC System

How Westinghouse Solar AC Works

Westinghouse Solar AC panels are installed on a sunny, generally south-facing rooftop or back yard area. AC output from the solar panels is wired into your home's electrical service panel via a dedicated 240 VAC branch circuit. When direct sunlight hits Westinghouse Solar panels, their built-in inverters produce AC power synchronized to the utility's grid. This power goes towards use in your home first. When you produce more electricity on your roof than your home needs, the excess flows to the grid, running your electric meter backwards. At night or on cloudy days you

still draw power from your utility. Your electric bill is reduced because you only pay for the net amount of electricity you use.

Westinghouse Solar AC Panel Design and Performance

Ordinary solar power systems use a centralized inverter, and require the installation of a separate racking system to mount the panels. These ordinary systems also require manual interconnection of high voltage DC wiring, and manual grounding of all panel and racking components. With the racking, wiring, grounding and inverters built into Westinghouse Solar panels, installation is much easier, reliability is greater and performance is 5 to 25% higher than ordinary systems.

The rating on each panel indicates the nominal DC power output in watts of a panel when it is in bright sunlight in 25 degree C conditions, and the sun's rays are perpendicular to the surface of the panel. Because the inverter operates at about 95% efficiency, the AC output of the system will be approximately 5% less than the peak DC output. So at peak conditions, a 235 watt Westinghouse Solar AC panel will produce up to about 223 watts of power. In real world conditions throughout the day, as the sun rises, moves across the sky, and then sets, the output of the panels will increase from essentially zero at dawn to a peak of about 175-214 watts (depending on season, sun angle, mounting angle and roof orientation), and then decline again to zero. Each panel operates independently, so if one is shaded or dirty the adjacent panels will still operate to maximize their energy output.

Westinghouse Solar AC panels use Enphase micro-inverters, which are mounted on the back of each panel. The easiest way to determine the output from your Westinghouse Solar AC panels is with the optional Energy Management Unit (EMU). The EMU communicates with Enphase's "Enlighten" website for real time reporting and analysis on the performance of each of your Westinghouse Solar panels. The EMU is installed by plugging it into any convenient 120 VAC wall socket and providing an Ethernet connection to your broadband router or modem. After installation of the EMU, the full network of Westinghouse Solar AC Panels automatically begins reporting to Enlighten. Alternatively, you may measure the voltage, current and power output of each branch circuit of Westinghouse Solar AC panels with conventional electrical instruments, taking the appropriate cautions when handling live electrical circuitry.

4. Using this Guide

This guide will familiarize you with the fundamentals of design and installation of your Westinghouse Solar Power System. The guide also serves to illustrate the simplicity and efficiency of solar design when equipment is developed in unison with each other. Westinghouse Solar Power Systems consist of hundreds of individual separate parts built into one integrated solar electric system delivering easier, faster design and installation over ordinary solar installations.

This guide contains three primary sections. The first section covers the physical properties of solar design specific to the Westinghouse Solar Power System, including how to layout your Westinghouse Solar Power System, how to choose components, and the structural requirements

involved in the installation process. The second section of this guide covers the creation of an electrical diagram, electrical site surveys, and elements of designing a solar system specific to Westinghouse Solar AC panels. Common requirements for solar electrical permit applications are also reviewed. The final section reviews Westinghouse Solar AC installation best practices and system commissioning. If you are familiar with residential construction techniques, AC wiring, and your local permitting requirements you will have the basic skills to install your Westinghouse Solar Power System. Please note that certain state incentive programs and utility interconnection regulations may require skills and instruments beyond those noted above, in which case the services of a professional solar installer may be needed.

The convention we use to describe the orientation of Westinghouse Solar layouts in this guide is that the north/ south direction describes rows of panels that are aligned vertically where north is the peak of the roof, and south refers to the gutter. An east / west row describes a horizontal grouping of panels from left to right. There are different functions that need to be considered when designing Westinghouse Solar in regards to the horizontal and vertical connection of panels.

Note:

This guide was created by summarizing common requirements of solar design. It serves to prepare system designers with a basic understanding of the solar design and planning process. Designers are encouraged to research the specific demands of the permitting jurisdiction and utility governing their region. Your installation should be performed in full compliance with OSHA safety standards and all relevant jurisdictional requirements, including if applicable, the U.S. National Electrical Code ("NEC").

Section II. Westinghouse Solar AC System Layout and Design

Westinghouse Solar AC systems require 80% fewer parts than ordinary solar systems; the simplicity of having fewer parts transfers directly into the ease of the design process. Along with the added efficiencies of Westinghouse Solar AC panels comes a set of unique parameters that need to be considered when laying out your design. Westinghouse Solar's racking system is built directly into the panel frame. When laying out a single row you should visualize the **perimeter** of the array for your roof attachment points. The top and bottom frames of Westinghouse Solar panels is where the "Groove" (Figure 2) is accessible and will serve as connection between the array and the chosen roof-mounting solution. The Groove provides full adjustability in the east-west direction of your roof, allowing you to adapt attachment spacing to nearly every rafter scenario.

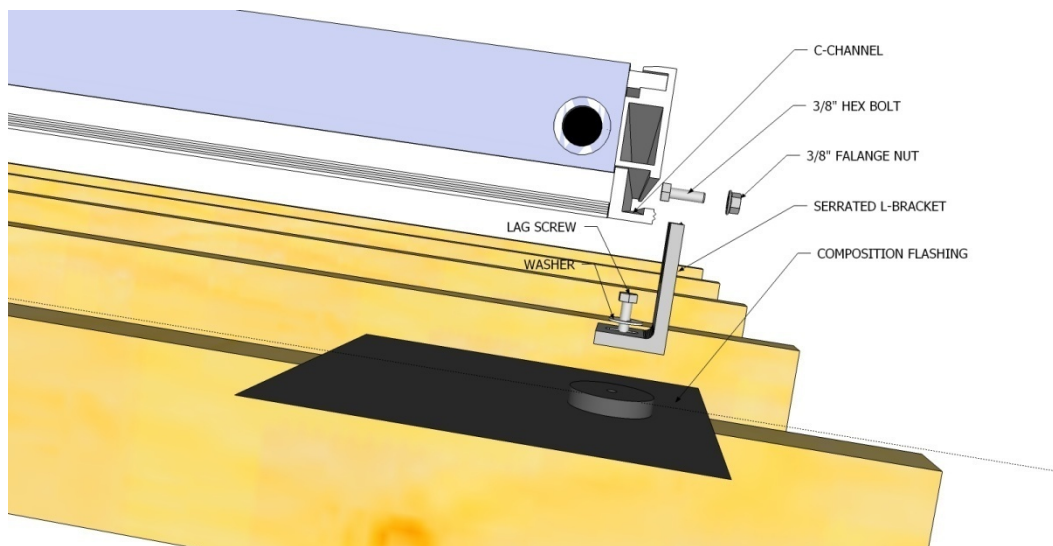


Figure 2 - Roof attachment components and panel Groove example for composition shingle roof

You may orient the Westinghouse Solar panels in either a "portrait mode" or a "landscape mode". Portrait mode minimizes roof penetrations and AC wiring, resulting in faster installation times. Landscape mode may also be used for added flexibility. The design of the Westinghouse Solar Power System also accommodates mixed portrait and landscape installations.

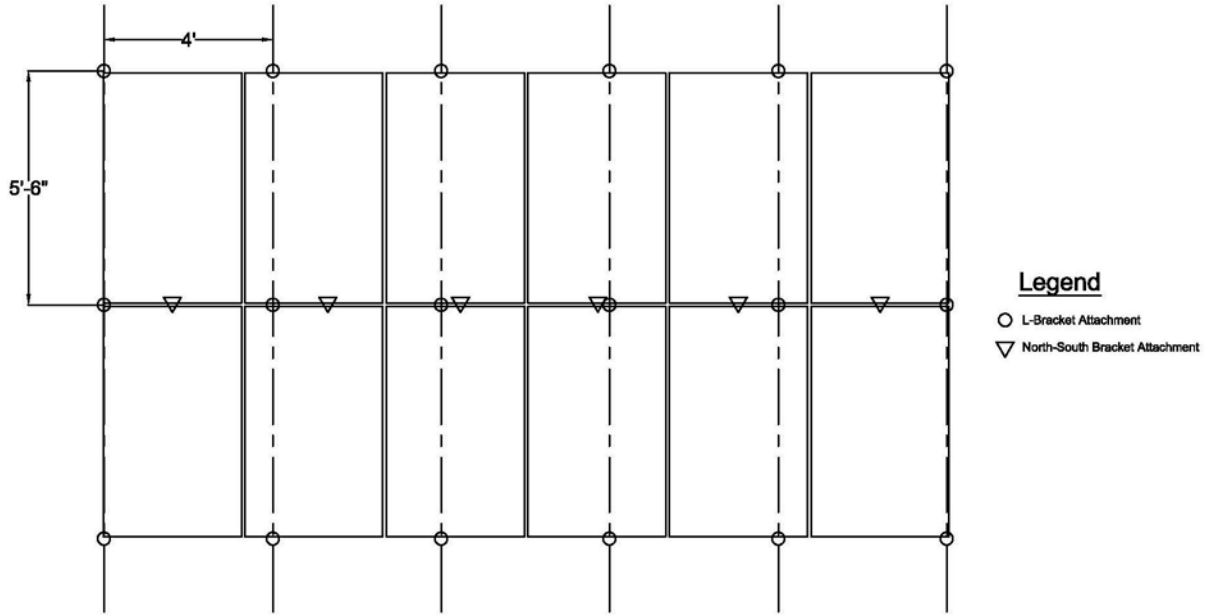


Figure 3 – Six by two array installed in portrait mode

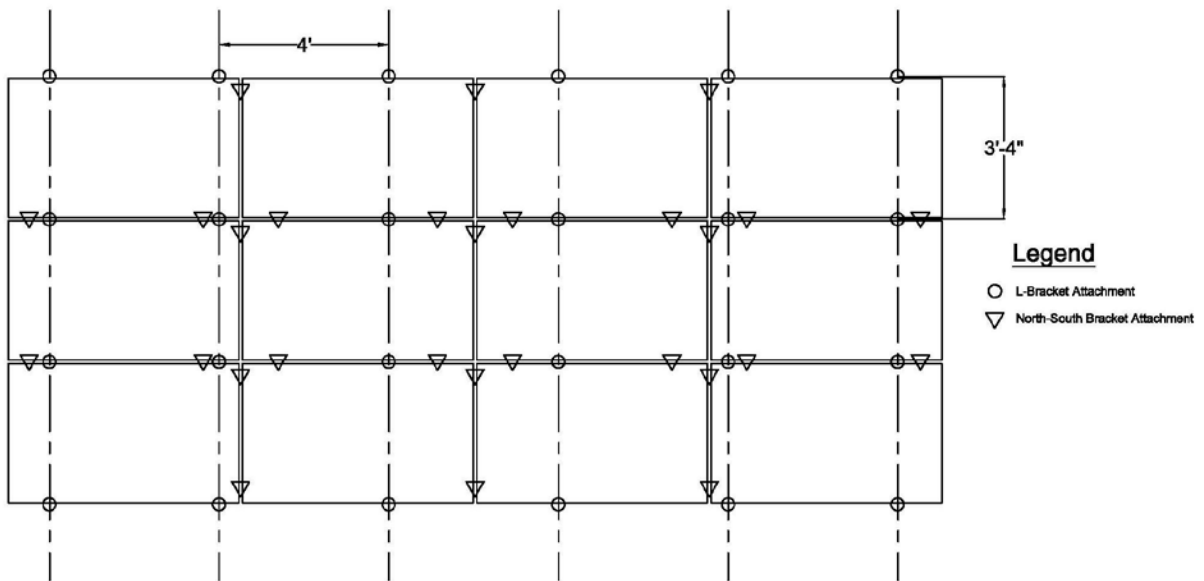


Figure 4 - Comparably sized four by three array in landscape mode

1. Westinghouse Solar Roof Layout Site Surveys

Prepare for the roof layout by surveying your roof to gather the following design information:

- A. Roof type.** The most common roof type is composition asphalt shingle. Flat Concrete tile and barrel tile roofs are also compatible with Westinghouse Solar AC panels. This information will determine your specific roofing kit needed. We have included roof attachment profiles that can be included in your plans in the appendix of this guide.
- B. Underlying structure.** Determine the dimension of rafters and the spacing of the rafters. For example, 2"x 8" @ 24" o.c. describes 2" by 8" rafters that are spaced 24" on center. This information will determine where you locate your attachment points on your roof layout. Also, planning departments typically will not ask you to draw individual rafters on your submitted layout, but they will need this information noted on the plans to confirm the structure meets code requirements.
- C. Roof Pitch.** Measure the pitch of your roof in degrees.
- D. Roof measurements.** Take accurate measurements that can easily be transferred onto a sheet of graph paper or into the CAD program you are working with to design the layout. Remember to include any obstacles that will interfere with your array design. When measuring the peak of the roof, exclude the roof cap in your measurements because this is an unusable area for solar attachments.
- E. Azimuth.** This information will help you choose the optimal solar roof surfaces, and is also crucial to include on documentation when applying for state rebates and incentives. Ideal orientation is south, but east and west facing roofs are OK with only a slight output penalty. Panels are designed for flush roof mounting at your existing roof slope.
- F. Shading.** Using a SunEye or Solar Pathfinder device, determine shading and design a layout that will maximize system output.

2. Drafting a Roof Layout

This portion of the process can be done using a graph paper or in a more detailed tool such as a CAD program. Before submitting your layout to your local permitting jurisdiction, request information from your local building permit office on special requirements for PV design in your area. These requirements may include roof setbacks and clearances that need to be included in your design.

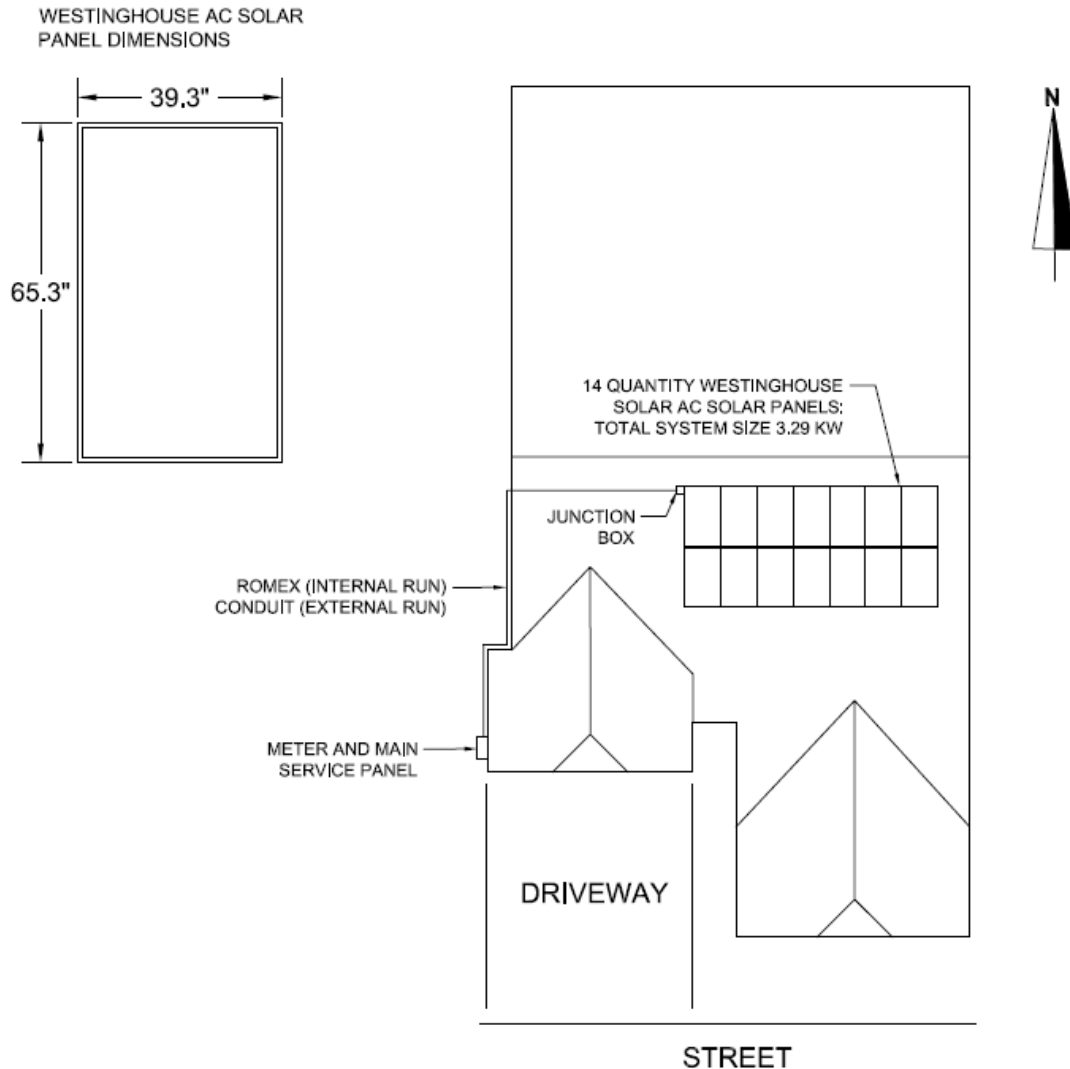


Figure 5 - Sample roof layout and panel dimensions

3. Elements of Designing a Solar System Specific to Westinghouse Solar AC Panels

Before you add the solar array to your roof layout design become familiar with the basic design principles specific to Westinghouse Solar AC. You should understand the spacing requirements, mounting methods, and wiring basics that are a part of the Westinghouse Solar AC design. You will need to follow the equipment specific rules below in order to create a safe and efficient Westinghouse Solar AC system.

-Westinghouse Solar AC Branch Circuits. -When Westinghouse Solar AC panels are arranged on a roof layout, they are wired in parallel, and operate independently on a per panel basis. For this reason, panels can be placed on roofs of varying pitches, orientations, and shading levels.

Unlike with ordinary DC solar panels, the performance of Westinghouse Solar panels will not be compromised by adjacent lower producing panels in the same branch circuit.

-Include Buffer Space Around the Array in your Design. Consider the necessary buffer room needed around the array for the roof mount to be sufficiently “flushed.” To be flashed is a roofing term for professionally sealing a penetration by installing a separate metal flashing underneath the row of shingles above the penetration, as illustrated below. Concrete tile and barrel tile dimensions are shown in the Appendix.

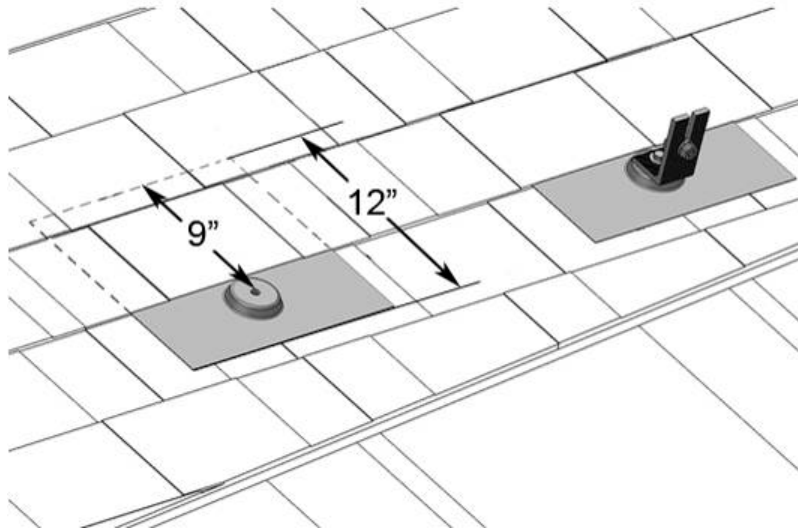


Figure 6 - Roof top buffer room example on composition shingle roof

Use an Offset L Bracket when modules connect over an attachment point. The Offset L Brackets allow you to secure two modules together with a splice over an attachment point. Use the Offset L Bracket instead of a regular L Bracket for an additional 2 inches of mounting flexibility.

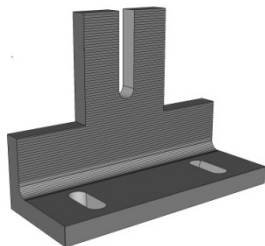


Figure 7 - Offset L Bracket

4. Westinghouse Solar Mounting and Structural Requirements

To satisfy Westinghouse Solar's minimal structural requirements there are two simple design rules that usually dictate the minimum mounting requirements. As Westinghouse Solar AC panels are connected together they form a rigid structure. The span of the panels between roof attachments is generally 48". As per the Technical Engineering Report (available on WestinghouseSolar.com, greater spans can be used in sheltered wind condition areas, and shorter spans may be necessary under high wind conditions. These roof attachments are located on both the top and bottom of your single row array. The second rule requires that panels which overhang the last footing in a row may stick out no more than a maximum of 16" from that footing. **Before finalizing your roof drawing, check with your local building department to identify any unique wind or snow load requirements that pertain to your jurisdiction. A combination of shortening the maximum span between roof attachments and increasing the length of your lags will enhance the wind load rating of Westinghouse Solar AC panels. Refer to the *Technical Engineering Report* on www.westinghousesolar.com to determine maximum allowable anchor spacing.**

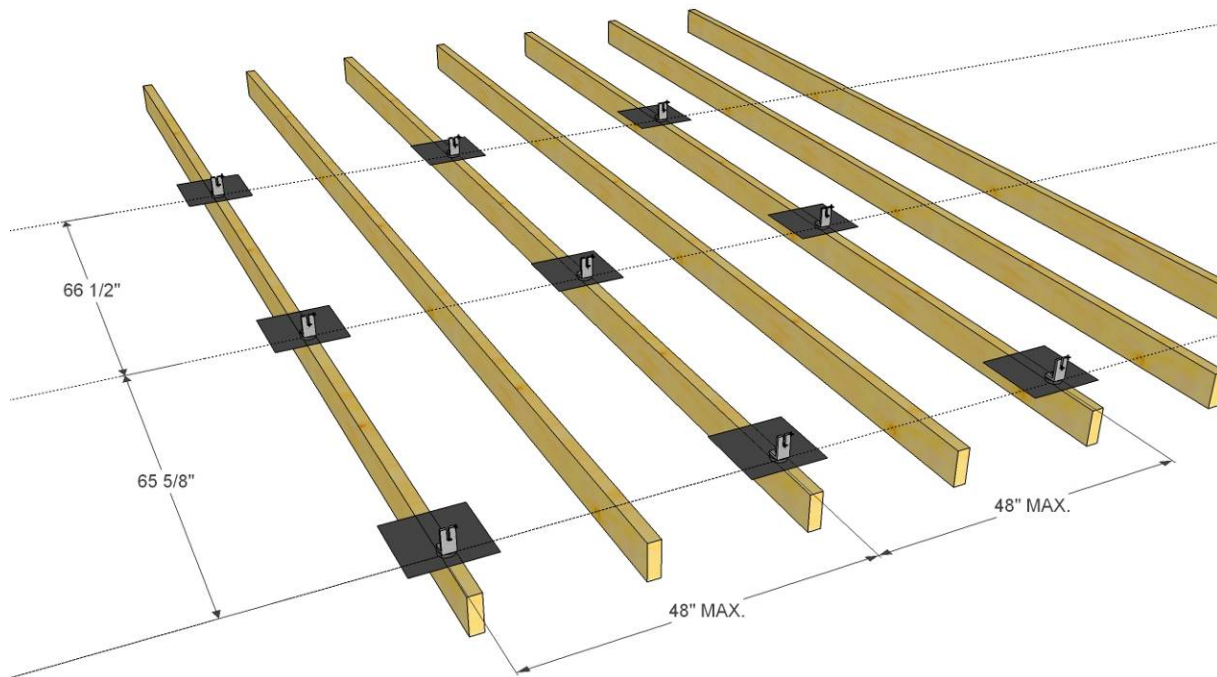


Figure 8 - Basic Westinghouse Solar attachment point layout

(Refer to Technical Engineering Report on www.westinghousesolar.com)

Warning: *The Westinghouse Solar AC Solar Panel System must be mounted over a fire resistant roof covering rated for the application. Attachment points must be properly located relative to the panel so the brackets do not exert lateral pressure on the frame. Care should be taken to ensure the mounting points are positioned in accordance with the Westinghouse Solar AC panel requirements. The measurements in the following diagrams represent distance between lag bolt penetrations. Westinghouse Solar L-brackets feature an adjustable oblong base slot that is adjusted to exact panel dimensions as the system is installed. **Failure to adjust the L-Brackets and associated hardware to the exact panel dimensions may cause the hardware to exert lateral pressure on the Westinghouse Solar Frame voiding the warranty.***

Shared Attachment Points

Westinghouse Solar roof layouts that include multiple rows of panels leverage the installation efficiencies of panel-integrated racking. The stainless steel Westinghouse Solar splices (Connectors) that ground and connect panels in the east-west direction serve as structural components. The North-South Bracket serves as a structural connection and enables sharing of footings between the first and second rows (and all consecutive rows until the top of array). The Westinghouse Solar North-South Bracket allows the upper row to share the lower rows upper footing. The Westinghouse Solar AC Solar Power System has been tested and certified at an accredited laboratory as an integrated system. When designing a multiple row array with Westinghouse Solar AC, the entire array can be seen as a unified structure, and not single rows of panels on independent racking systems as with ordinary solar panels.

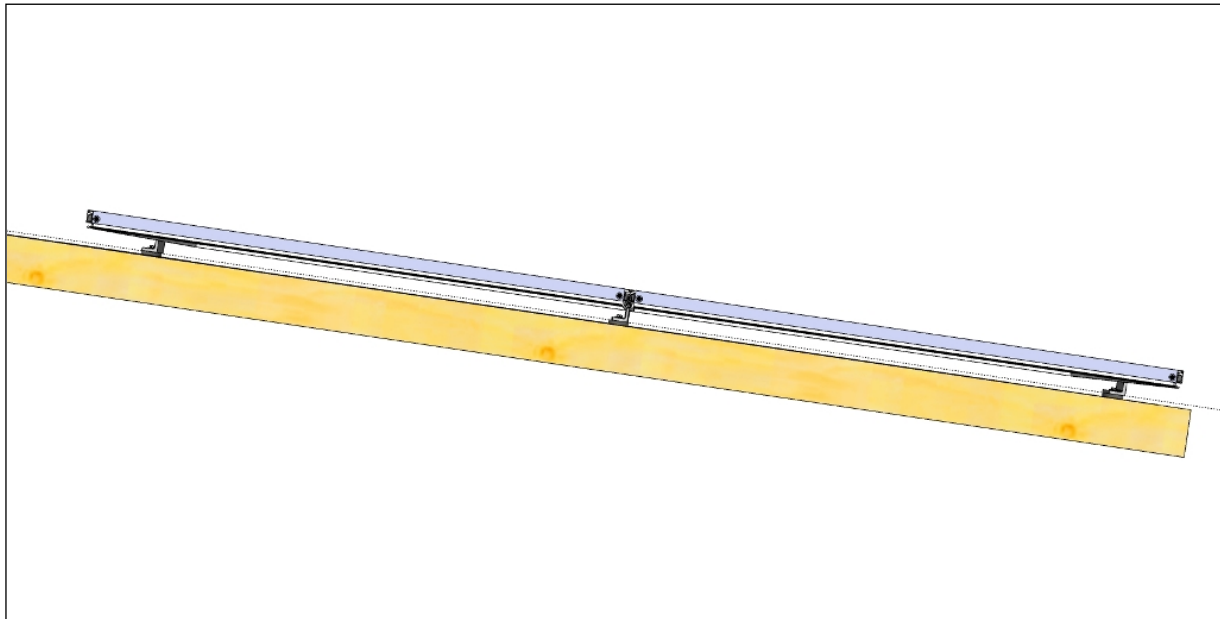


Figure 9 - Profile of roof attachments with shared center attachment point across two panel rows

5. Drafting a Solar Array

Begin drawing Westinghouse Solar panels on the predetermined solar roofs considering the above mentioned design parameters. Westinghouse Solar AC panels measure 65.3" long by 39.3" wide. Include a 1" gap between rows in the north/ south direction to accommodate the installation of the Westinghouse Solar North-South Bracket. To allow for thermal expansion in large arrays, include a one inch expansion gap for every 12 Westinghouse Solar panels in a continuous row.

Take time to review how the Westinghouse Solar components you are working with are developed and organized in the included roof layout. The default roof attachment profiles included in the Appendices may be attached to your plans for review by local planning and permitting jurisdictions.

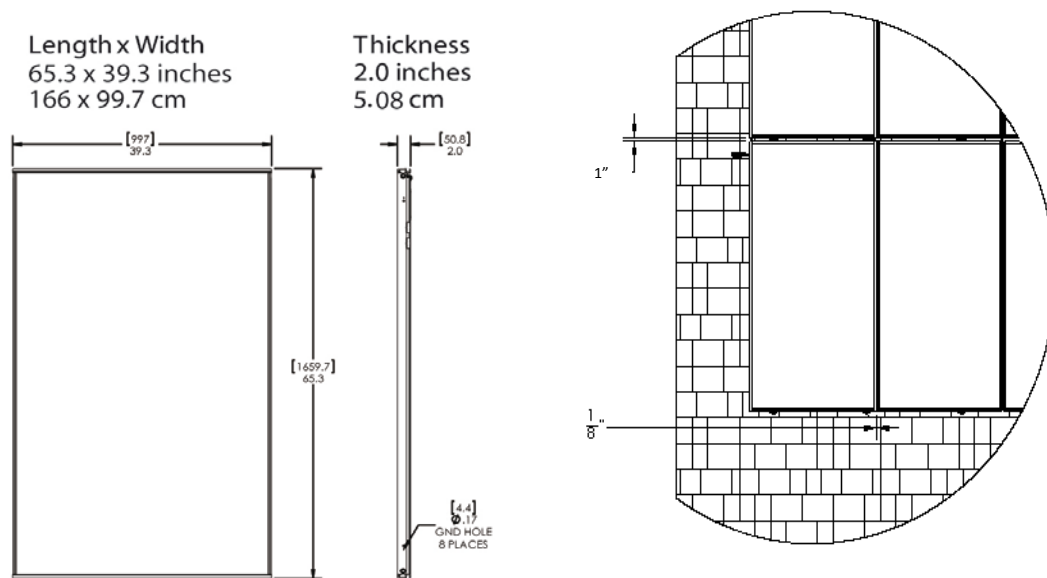


Figure 10 - Westinghouse Solar inter-panel spacing and panel dimensions

Adding Additional Equipment to the Roof Layout

Westinghouse Solar AC Wire Runs

After the roof layout is complete with Westinghouse Solar AC panel locations and the existing electrical service, identify where conduit or Romex will be run to route the arrays conductors to the associated equipment on the ground. This can be done by simply drawing a line across your site map and labeling the material as is seen in the sample roof layout.

Conductors

Conductors will either be run as Romex internally or through an approved conduit externally. If an external disconnect is required in your jurisdiction, include this location on the roof layout. Label all equipment and conduit sizes on the roof layout.

Other Electrical Equipment

Include junction boxes and disconnects on your roof layout as needed. The conduit will connect all of this equipment in the same sequence as your electric diagram. For this reason it may be helpful to finalize the electrical line diagram before finalizing equipment placement on the roof layout.

Section III. Creating an Electrical Diagram

It is important to understand the electrical design principles specific to Westinghouse Solar technology before you begin your electric line diagram. Sample designs for 15 panels (or fewer), 30 panels and 45 panels are provided in an Appendix. Below are some important concepts to consider as you create your roof layout and electric line diagrams:

1. Westinghouse Solar AC Electrical Requirements

- A.** Westinghouse Solar AC Panels may be arranged in branch circuits of up to 15 when working with 240V single phase electrical systems. Each branch circuit will need to be isolated using NEC compliant circuit protection
- B.** When Westinghouse Solar AC panels are arranged on a roof layout, they are wired in parallel, and invert DC power on a per panel basis. For this reason, panels can be placed on roofs of varying pitches, orientations, and shading scenarios. Their performance will not be hindered by adjacent panels in the same branch circuit.
- C.** Westinghouse Solar AC branch circuits require three proprietary components to complete a multi row branch circuit. An AC branch circuit is ended with an “end cap,” which is a plastic fitting that protects the last inverter in a circuit from moisture and exterior elements. Because the wiring harnesses come built into the inverters at a preset length, a 6' extension cable is necessary to wire branch circuits in the north /south direction, and also to route the inverters past obstructions (such as a vent pipe). Finally, Westinghouse Solar AC circuits are completed with a “Pigtail” connector; the Pigtail transitions the inverter's conductors from the UV rated insulation to four color-coded conductors that can be utilized inside a junction box on the edge of an array. Each Westinghouse Solar AC kit includes one Pigtail and one end cap.
- D.** Inverters mounted on Westinghouse Solar AC panels work most conveniently when the wiring harnesses are aimed towards the junction box, or final destination for a circuit on a rooftop. By carefully planning the direction and orientation of Westinghouse Solar AC Panels, your wire management will be simplified and system will be installed with fewer extra components.
- E.** Westinghouse Solar AC inverters are attached to the panel frame using an UL-approved bonding method. These attachments utilize thread-forming bolts in addition to star washers to ensure a solid and redundant bonding path between the frame and inverter.

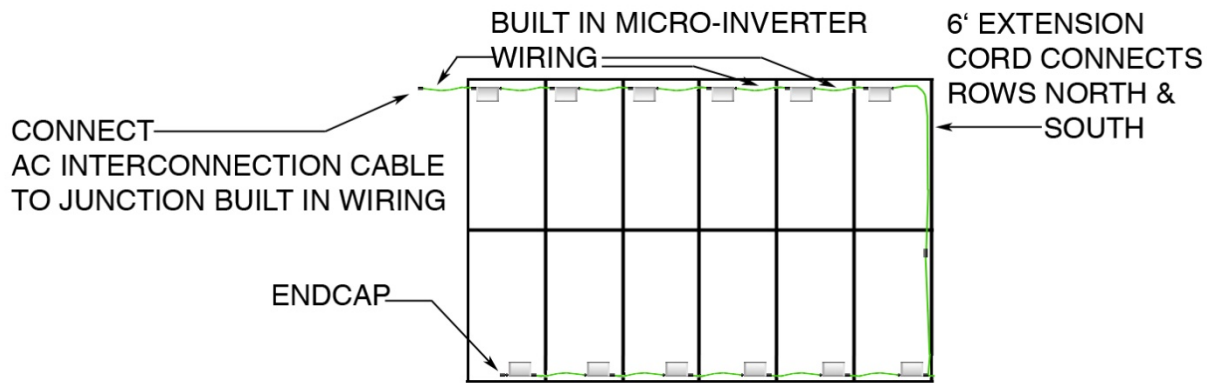


Figure 11 - Inverter components in a two row array

2. Single line diagram preparation

Prior to drafting the diagram it is necessary to identify the size and capacity of the existing electrical system components. You will also need to research the additional equipment you may need to include based on special local utility and building department requirements.

Electrical Site Survey List:

- A. **Main Panel bus rating-** This information can be found inside the electrical service door on a sticker label, common residential bus ratings are 100A, 125A, and 200A.
- B. **Main Disconnect Rating-** The main disconnect rating is printed directly on the main breaker. It is common for the main breaker's rating to match that of the main panel bus. The main breaker should not exceed the rating of the main panel.
- C. **Available breaker space-** The most straightforward method to back feed a residential grid-tied electrical service is by utilizing a double pole breaker to interconnect your circuit (up to 15 panels) or circuits (if more than 15 panels) to the main panel. Survey how many breaker spaces are available; a double pole breaker will require approx. two inches of space in your average residential service panel.
- D. **Grounding-** Check that a ground rod is present, serving as a grounding electrode to the main electrical service. If you cannot identify a grounding electrode, per section 250 of the NEC, a new one will need to be installed to assure a safe grounding path for your solar equipment. The grounding electrode, new or existing needs to be included in your electrical line Diagram.
- E. **Wiring Location-** Is there a clear pathway through crawl spaces and attics to route your Westinghouse Solar AC system conductors? Will the wire run be external to the structure? How long is the wire run? This information will be a factor in sizing your

conductors and what types of materials you will need to use in reference to the U.S. NEC, if applicable.

3. Electrical Line Diagram

The sample Electrical Line Drawings in the appendix are provided as a starting point. Three drawings (15 panels, 30 panels and 40 panels) are provided that include multiples of 15 Westinghouse Solar AC Panels in branch circuits. Use the sample drawings as a template, and identify the exact number of panels in your system. Completing your electrical line diagram circuit can be as simple as labeling the equipment rating and defining whether you are wiring the system with Romex or using a conduit with individual conductors. The following details should be provided:

- Type of utility meter, voltage rating, and phase (bi-directional utility meter, 240 VAC, 1 Phase).
- Main panel manufacturer, main panel bus rating, main disconnect rating (Square D, 200 A rated main panel, 200 A main disconnect).
- The grounding electrode and an appropriately sized conductor grounding the main panel.
- The voltage, number of poles, and circuit protection rating of the breaker used to interconnect with the main service, (240 V, double pole, 30 amp breaker).

Conductor sizing, overcurrent protection, load centers, disconnect switches, and other equipment must be sized according to the National Electrical Code, in addition to any special requirements of the local permit jurisdiction. Special considerations for solar include, but are not limited to, the following:

- Conductors and connectors used on the roof must be rated for 90 degrees C
- Conductors on the roof should have their ampacity de-rated for a temperature of at least 70 degrees C.
- Voltage drop between the array and the main panel should not exceed 1.5%.
- The sum of the overcurrent protection of all power sources (line + PV) feeding a bus bar or conductor must not exceed 120% of the current rating of that equipment.
- Warning labels as required by your local jurisdiction.

4. Grounding

Rows of Westinghouse Solar AC panels spliced in the East-West direction are bonded by the same stainless steel splices that connect the panels structurally. The North-South bracket provides grounding when used with grounding washers for columns of Westinghouse Solar panels. Westinghouse Solar splices are a UL listed grounding component. At the end of each row in the east-west orientation there is a factory designated bonding location for attaching a lug.

SAMPLE WIRE DIAGRAM (15 WESTINGHOUSE AC MODULES)

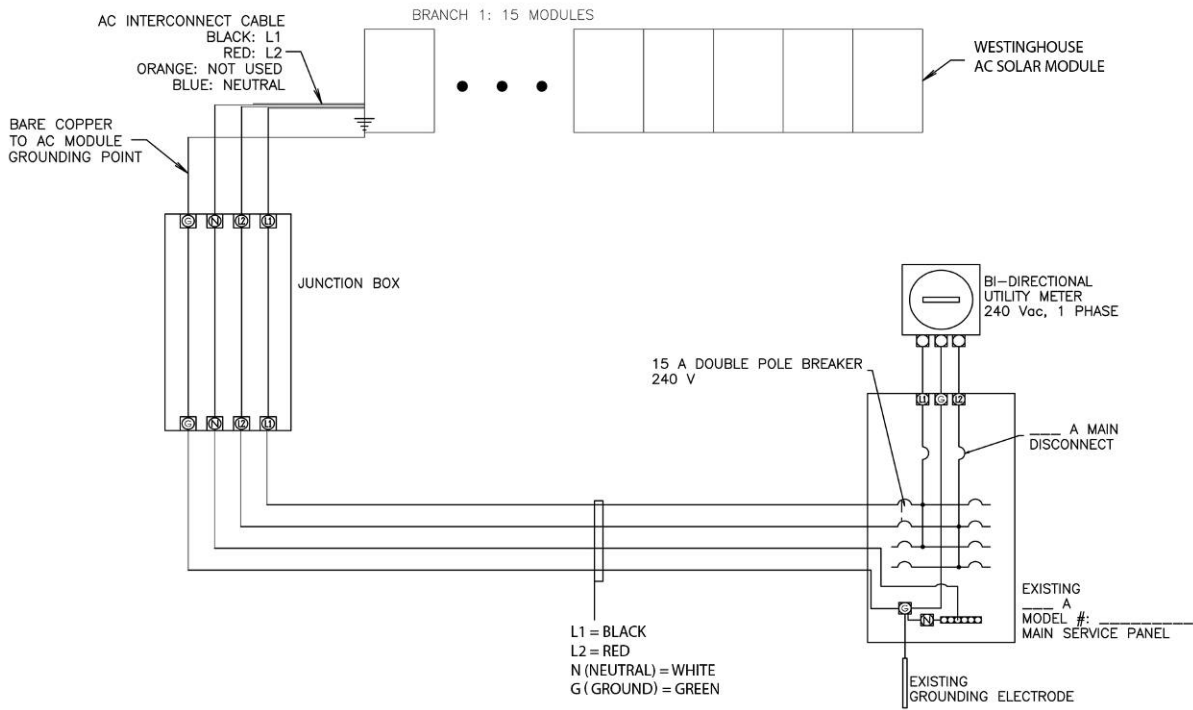


Figure 12 - Single Branch Circuit Westinghouse Solar AC Wire Diagram

Section IV. Installation

1. Safety Warnings

- Before installing the Westinghouse Solar AC Panel, read all instructions and cautionary markings in the Westinghouse Solar AC documentation
- Perform all electrical installations in accordance with all local electrical codes, the National Electrical Code (NEC), ANSI/NFPA 70 and local utility requirements.
- Be aware that installation of this equipment includes risk of electric shock. Normally grounded conductors may be ungrounded and energized when a ground fault is indicated.
- Do not wear metallic jewelry, which may become a cause of electric shock during installation.
- Do not expose solar panel to sunlight concentrated with mirrors, lenses or similar means.
- Do not walk on or drop tools or hard objects on the glass of the solar panel.
- Do not scratch the back sheet (behind the glass) of the solar panel.
- Use approved glass cleaning products on panels
- Do not connect the panels directly to power loads such as a motor since the variation of output power depends on solar irradiation which may cause damage to the connected load.
- Do not block frame drain holes.

2. Layout

Laying out an Array

Following the roof layout created by the engineer of record, use the provided dimensions to draw out the corners of a solar array. Adjust your array in the east/ west direction so that the edge of the solar module frame starts within 16" of the closest rafter to the interior of the array. Westinghouse Solar AC modules may not overhang the last array attachment point by more than 16" or 40% of the module's width. Remember to include 7/8" of space between modules in the north-south direction. This gap accommodates the serrated L along with the Westinghouse Solar North-South Bracket.

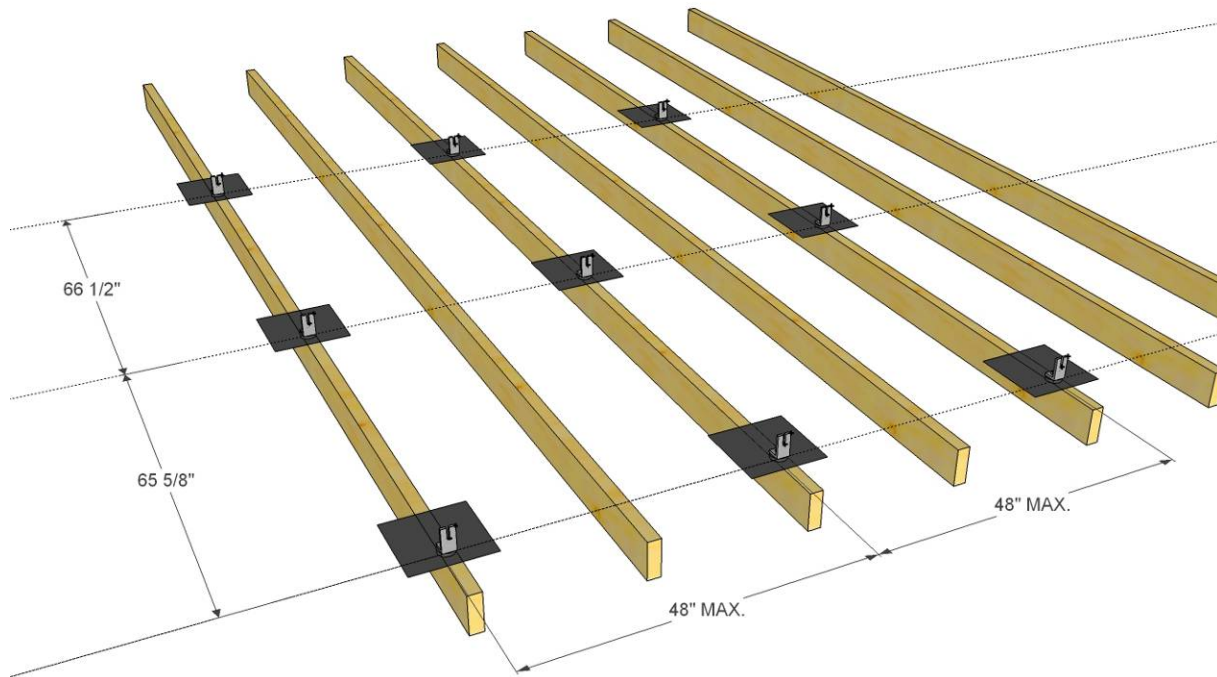


Figure 13 – Laying out attachment points for Westinghouse Solar Modules

(See Engineering Supplement on www.WestinghouseSolar.com for required spacing)

Multiple Module Rows

After defining the corners of the array on the roof using chalk or a wax crayon, snap chalk lines representing rows of attachment points required for your array. In the following sample array there are three rows of attachment points to accommodate two rows of Westinghouse Solar modules. The first row of attachment points starts at the bottom horizontal perimeter of the Array. Snap a chalk line across the bottom two corners of the array to define the first row of attachment points. The second row of attachment points is created by measuring 65-5/8" up the pitch of the roof from the first chalk line; snap a second line at this interval. The spacing interval for the next row of attachment points up the pitch of the roof is 66-1/2". This larger distance represents the necessary three quarter inch gap between all rows in the north/ south direction. If a third row of modules were to be installed there would also be 66-1/2" space between the third and fourth row of attachment points. Note that all L-Brackets are oriented in the same direction; this allows access to secure the Lag bolts once modules are put in place. **The measurements in the Figure above represents distance between lag bolt penetrations; Westinghouse Solar L-brackets feature an adjustable oblong base slot that is adjusted to exact module dimensions as the system is installed.**

Marking Attachment Points

Using the chalk lines snapped create marks on the roof surface where these horizontal chalk lines intercept the rafters. Attachment points are located at this junction. If your rafter locations are unknown, follow the rafter locating tips below. The illustration above shows attachment points spaced at 48" on center in the east-west direction. Carefully review the engineering set of plans provided, attachment points may be spaced at longer and shorter spans depending on wind conditions.

Tips for finding rafters on a composition shingle roof

- A. Look for exposed rafters under the eaves of the building. Mark these locations with chalk at the gutter for reference on the roof.
- B. Tap hammer repetitively, gently moving from left to right across the assumed rafter location. You should be able to detect the firmest spot by paying attention to the sound and bounce of the roof surface. The more the hammer bounces the further your hammer is from the rafter location. Mark the firmest location with piece of chalk prior to pre-drilling. This technique also works on concrete tile roofs when a tile is removed exposing the roof sheathing.
- C. If there is attic access, identify where rafters are located in proximity to roof vents, roof hips, or other objects visible from above and below the roof surface. Rafter spacing may be inconsistent, creating a map of specific rafter spacing that is visible from the attic will help installers on the roof.
- D. When probing for the first rafter location, use a pry bar to loosen the composition shingle. By bending back the course of shingles where you are penetrating, you will be able to easily seal and cover any misses.



Figure 14 - Tapping across assumed rafter location to find firmest point

3. Mounting

The examples that follow illustrate how to install Westinghouse Solar Power Systems mounting components on composition a shingle roof.

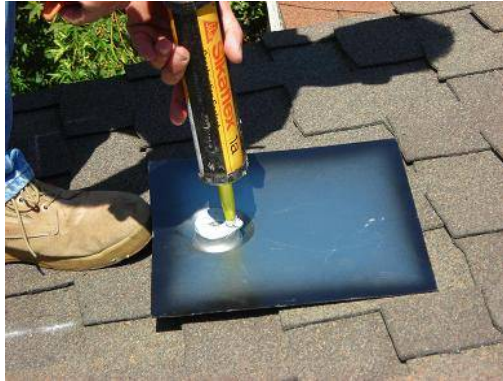
Step 1A. Pre-drill at the pre-determined roof penetration chalk markings established in step 2 of this section. The drill bit is held perpendicularly to the roof surface, this will ensure maximum strength at the attachment point by securing through the most solid point of the underlying rafter. **The roof attachment points will require a minimum of 2-1/2" of rafter penetration.**



Step 1B. Loosen the composition shingles directly above the pre-drilled roof penetration, make sure to loosen and remove any nails or staples that will interfere with the Composition mount flashing. The Composition mount flashing will extend 9" above the pre-drilled hole. Test that the shingles are adequately loosened by "dry fitting" the comp mount flashing. Line up the hole in the flashing with the pre-drilled hole in the roof.



Step 1C. Apply Roofing sealant. Using a caulk gun, backfill the roof penetration and apply a liberal amount of sealant to the immediate area. Apply a circle of sealant to the puck on the unfinished side of the Composition mount flashing. Finally, applying a horse shoe shape of sealant above the puck will act as redundant protection if roof conditions up the slope are compromised.



Step 1D. Installing Hardware - Place the Composition mount flashing in its final location prior to installing the lag bolt. Holding the lag bolt and fender washer, thread this hardware through the oblong hole at the base of the serrated L-Bracket. With all of these components assembled, place the tip of the lag bolt through the 5/16" hole in the raised area of the Composition mount flashing. Before tightening, the lag bolt must be seated in the pre-drilled hole; this will ensure that the lag bolt does not damage the underlying rafter, achieving maximum attachment strength.



Step 1E. Tightening Lag Bolts-Using socket wrench or impact driver with a 1/2" socket, slowly torque down lag bolts until the head of the lag bolt is 1/8" from seating on the Fender washer. This 1/8" of space will allow the installer to line up and adjust the L brackets before tightening them down to their final position. Excess caulk should squeeze out of the hole and surround the head of the lag bolt.

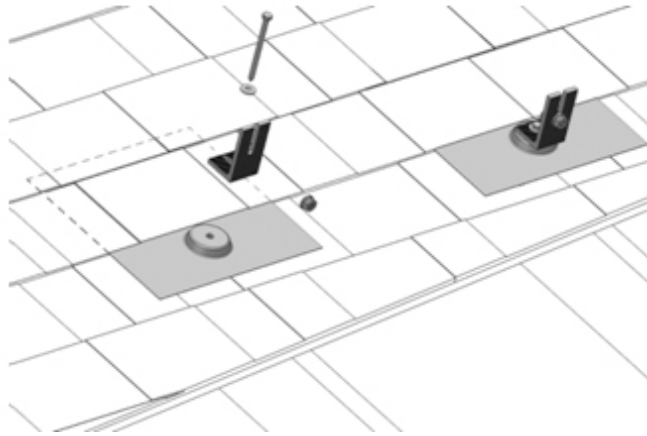


Figure 15 - Detail of Composition mount components pre and post installation

Step 1F. Finalizing the First Row of Attachments - Following the installation the first row of attachments, tighten the lag bolts furthest to the East and West, The Lag Bolt must be centered within the L Brackets oblong hole to ensure good fit for rows of modules up the roofs slope. Once the two end attachments are tight, the L brackets between them are tightened to 15-20 ft. /lbs. Use a string pulled taught from end to end to align all the interior brackets in a straight line. The L brackets in the second row up the slope of the roof remain loose until the first of modules are installed. Leaving the upper L-brackets loose allows the module frames to be installed without interference.

4. Module Installation

The figure below illustrates the thread patterns of a Westinghouse Solar Splice. Notice that the threads on either end are opposite. This design feature allows the splice to connect two Westinghouse Solar module frames together when rotated. Observe that one end of the splice is marked with three small circles. This marking identifies a left hand thread at that end of the splice. Use this marking to quickly identify which end of the Westinghouse Solar splice you are holding. Splice Channels are either marked with three small circles to identify a left hand thread fit or are blank to identify a right hand thread pattern. If a splice does not thread with ease, try the other end, do not force the Westinghouse Solar splice.

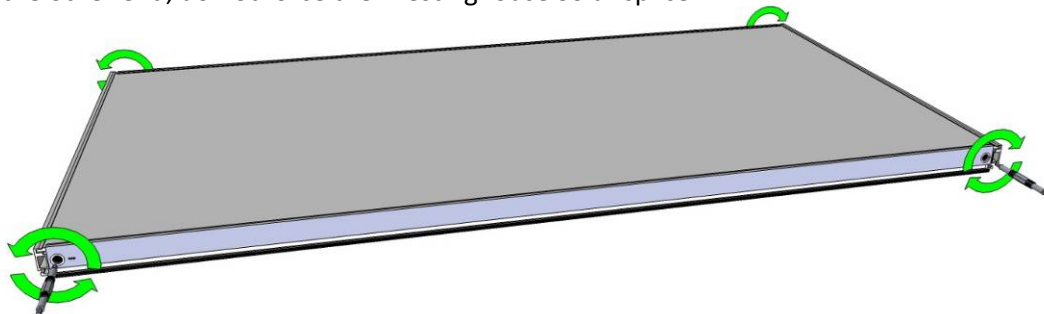


Figure 16 - Westinghouse Solar Splice thread direction
(Tightening)

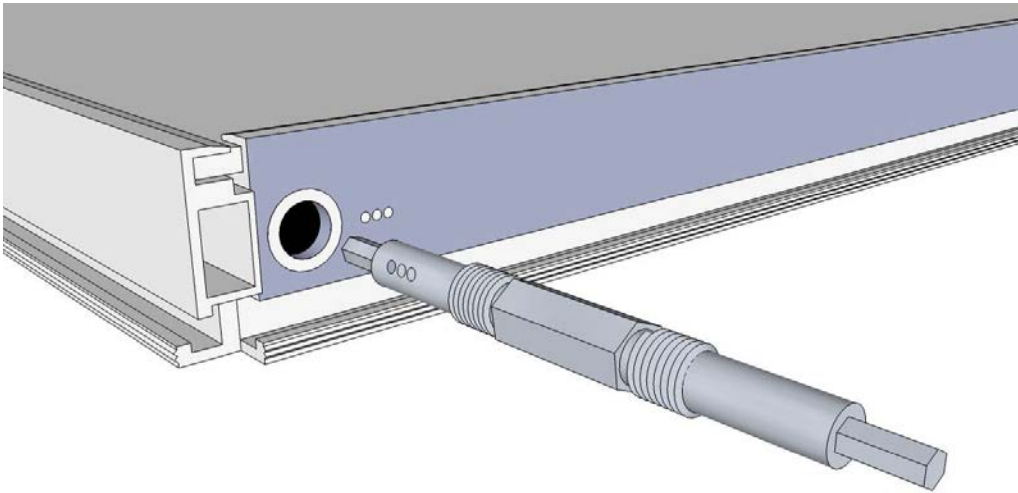


Figure 17 - Westinghouse Solar Splice thread direction

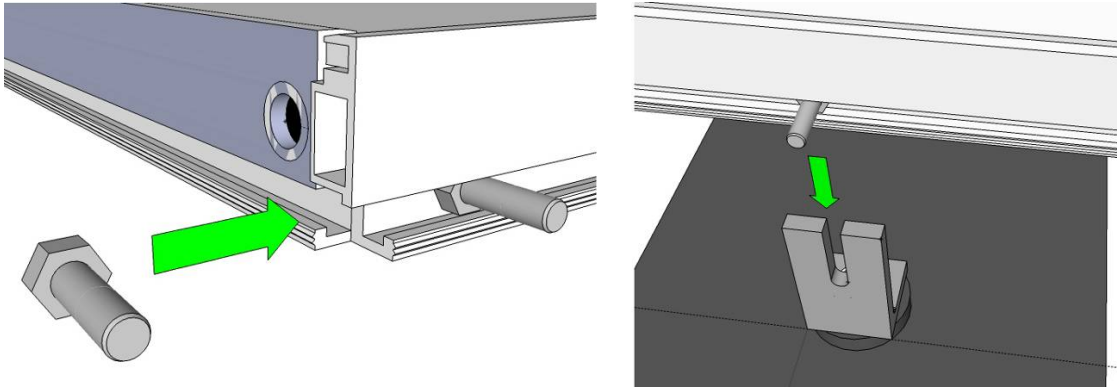
(Tightening Westinghouse Solar Splice and frame left hand thread marking pattern)

Westinghouse Solar Module Torque Specifications

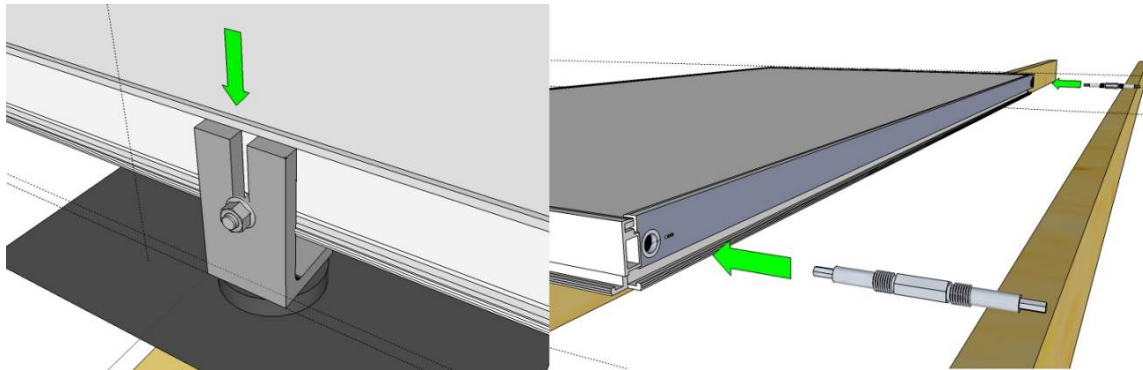
Westinghouse Solar Splices require 5-7 ft/ lbs of torque to fully engage in the east/ west direction. As an approximation, once you feel the Westinghouse Solar splice fully seated, turn the Westinghouse Solar wrench 1/8 of a turn, this will create the appropriate amount of torque for the connection of modules in the east/ west direction.

Installing the First Row

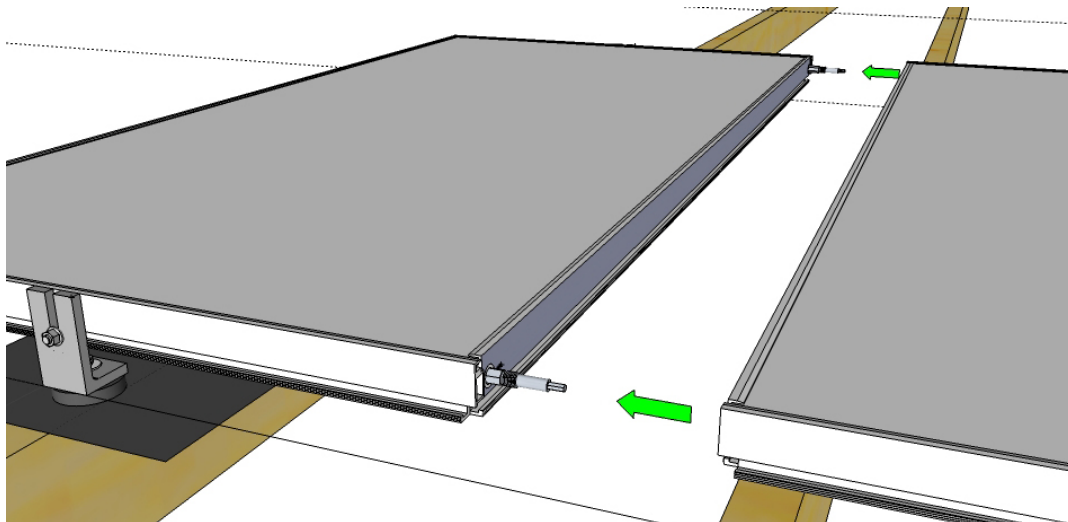
Prepare the module by inserting 3/8" hex bolts into the top and bottom Groove of the module frame. Position the first module above the first and second row of L Brackets using two people to carefully lower the module into place. 3/8" hex bolts are adjusted inside the Groove to line up with the L Bracket fork. 3/8" Flange Nuts are threaded onto the 3/8" hex bolts loosely, to allow height adjustment and array leveling. The module will temporarily rest on with the 3/8" hardware left loose. Prepare for the installation of a second module by threading two splices into the splice channels at both the top and bottom of the frames longer edge. The splices are used to interconnect the neighboring modules in the east/ west direction. When tightened simultaneously, the two splices will draw two modules together. Leave the inverter wiring harness on the roof surface where it will be accessible after a second module is installed.



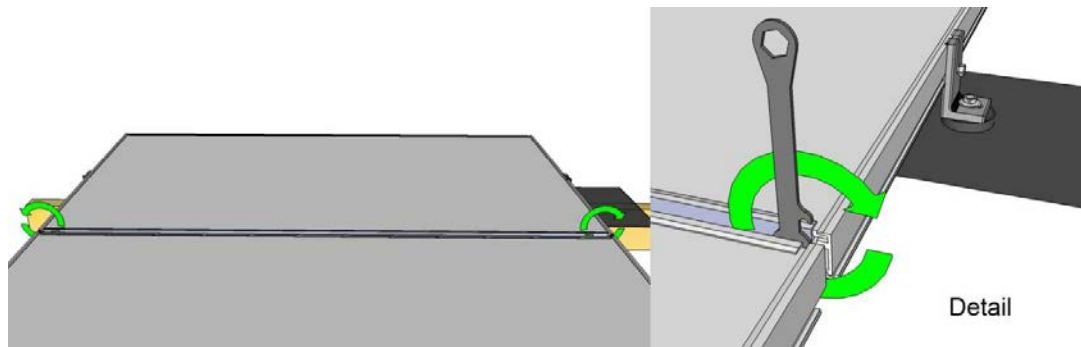
Step 1 - Westinghouse Solar module lowered on to L bracket using 3/8" hex bolts as a resting point. Repeat this step at both the upper and lower short edges of the module.



Step 2 - Loosely thread 3/8" Flange nut onto Hex bolt, prepare for second module by inserting upper and lower Westinghouse Solar Splices.



Step 3 - Slide the second module over the Splices installed in Step 2 until bottomed out on the splice channel.



Step 4 - Rotate Westinghouse Solar splices within the frame to draw two modules together. This can be done using the V2 wrench or with the V2 hex splice driver and a 1/4" drive ratchet. Green arrows indicate splice rotation. **Tip: Apply light pressure pushing the two modules together to ensure the splice threads engage on the first turn.**

5. Connecting Westinghouse Solar AC Wiring Harnesses

Begin to connect the built in wiring harnesses from inverter to inverter while additional modules are lowered into place. V2 modules require the wiring harnesses to be connected before adjacent modules are spliced together. The wiring harness and bulkhead connections are oppositely sexed, so that multiple inverters can be connected to form one continuous AC branch circuit. Wire connectors are keyed and slotted and will not fully engage unless the keyed connector is correctly rotated to match the male and female connector patterns. Once the first row of Westinghouse Solar V2 modules is complete secure the wiring harnesses to the module frame by preloading the wire management clip with the AC wiring then clipping the plastic wire management clip to the modules C- Channel.

Completing a single row of Modules

Repeating Steps 1-4, continue to loosely assemble the 3/8" hex bolts with their associated 3/8" Flange Nuts in the Groove of the module. Once all modules in a single row have been connected using Westinghouse Solar splices in the east-west direction the installer can flush up and secure the upper row of L Brackets. Torque down the lag bolts while L Brackets are flush against the module frame, following this step the array will be resting on the 3/8" hex bolts.

If the roof surface has any undulations, causing the array to appear warped, corrective adjustment is done at this time. A brightly colored string pulled taught across the entire array creates a straight line reference for array leveling. Using assistance, adjust the height of the 3/8" hex bolt within the L Bracket until the module surface is flush with the leveling string. Finalize module position by

tightening down the 3/8" Flange nut against the L Bracket. Once the array has been leveled, double check all flange nuts and lags are properly secured.

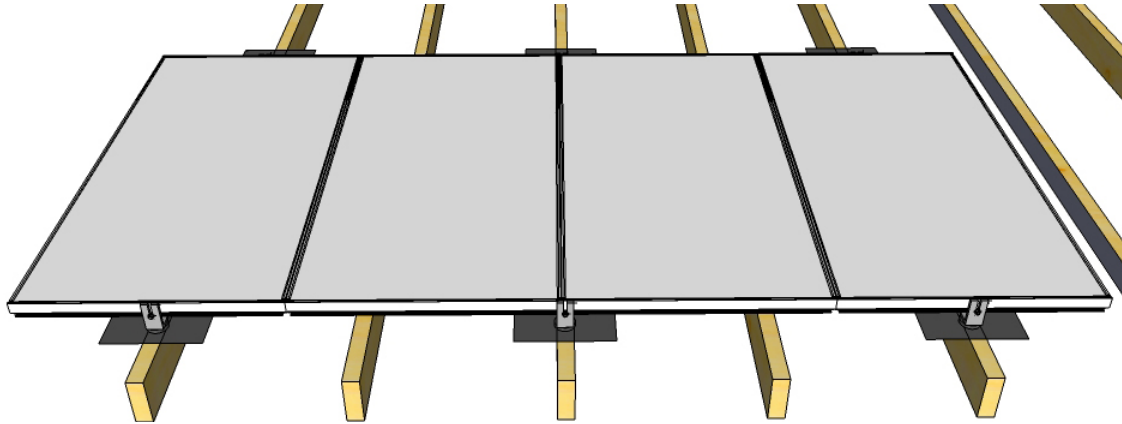


Figure 18 - Single row of Westinghouse Solar modules installed

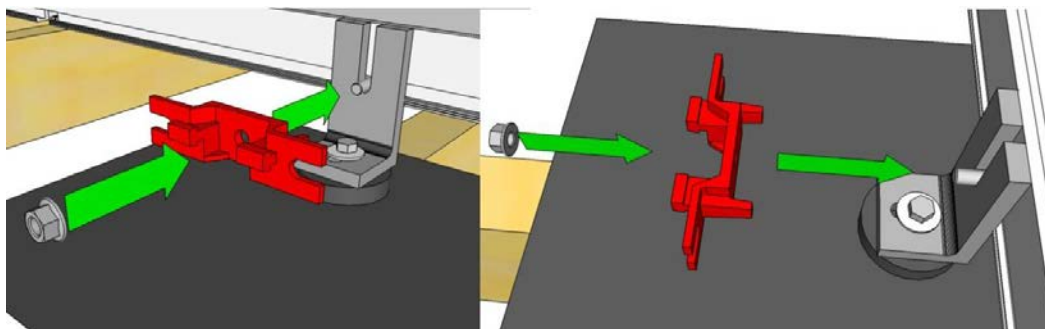
Considerations for Wiring Westinghouse Solar AC Arrays with multiple rows

If your array is continuing to an upper row, prepare the last wiring harness connector in the first row with an Extension Cable that will reach the upper row modules bulkhead connection. Westinghouse Solar AC Extension Cables are available in a length of 6', 12' and 20'.

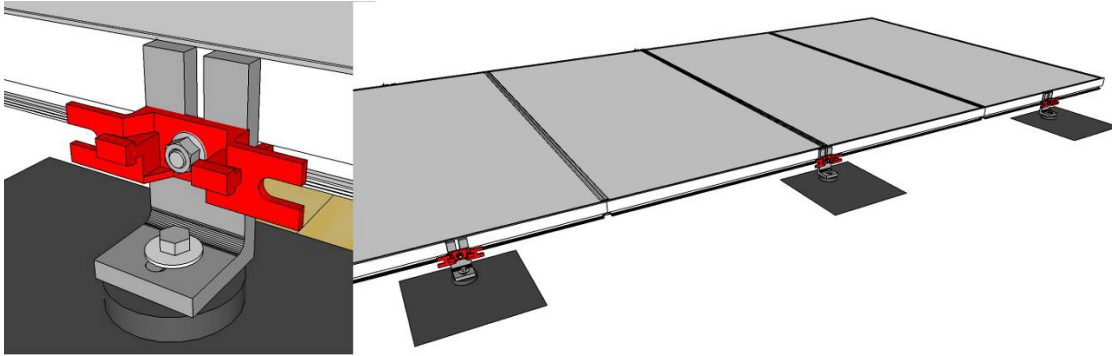
Tip: Careful planning of wiring layouts will create a quick installation without interruptions or the need to purchase additional equipment.

Installing a Second Row of Modules

To install a second row of modules in the north-south direction, Westinghouse Solar North-South Brackets are used as a structural component to connect module frames in adjacent rows. North-South Brackets balance the load of both rows on a shared attachment point in the center of the array.



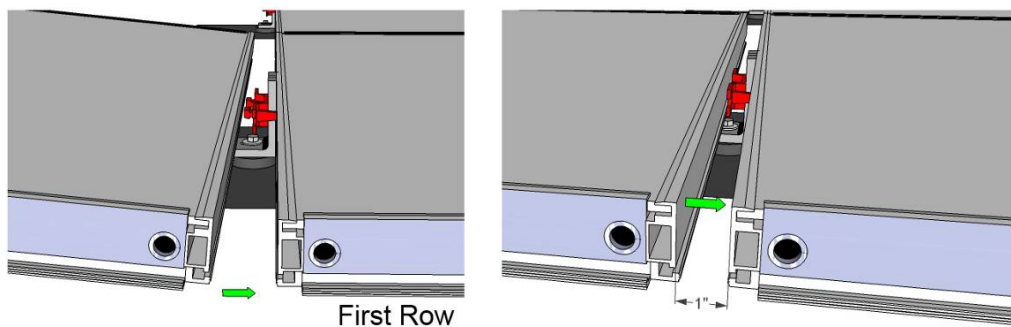
Step 5 - Assemble the north/ South Bracket to the second row of L brackets using the 3/8" hardware. The feeler prongs are inserted into the lower modules Groove to properly align the bracket.

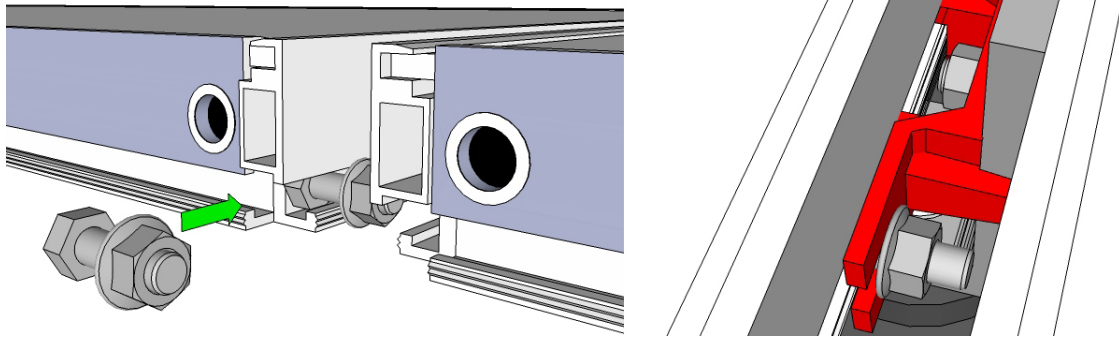


Step 6 - North-South brackets are secured to the L Bracket at the top of the lower row using 3/8" Flange nuts. North/ South Brackets are installed at all inter row L Bracket locations in preparation for the second row of modules.

Tip: If a module is left out of the array to make room for a roof vent, an additional North /South bracket may be required to support the second row and maintain Westinghouse Solar structural requirements.

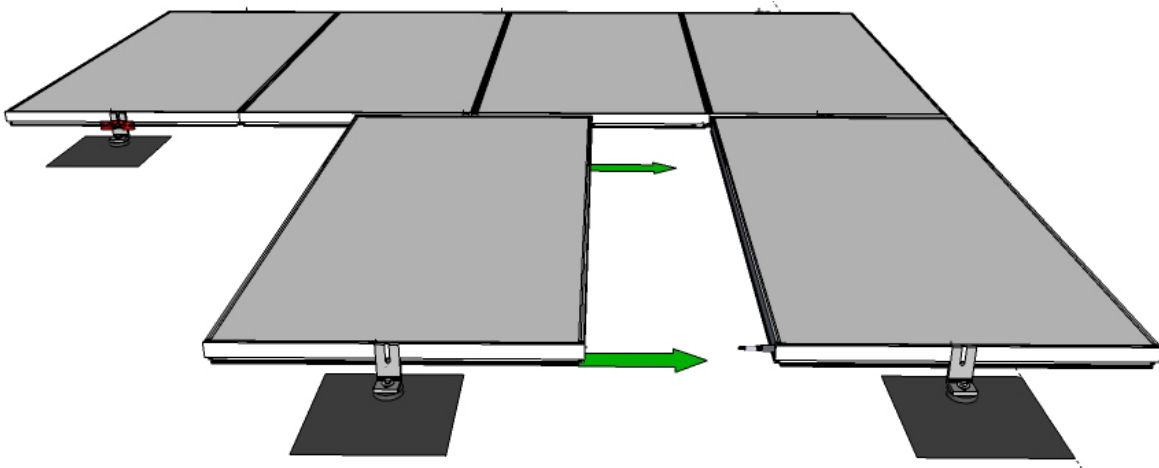
Step 7 - Lower the first module of the upper row into place until the module surface is level with the lower row. Rest the module on the two North/ South Bracket fingers to hold the module in place while 3/8" hardware is installed in the modules Groove closest to the roofs peak.





Step 8 - Slide 3/8" Hardware into the lower Groove of the second row module. Slide the hardware through the Groove into the open end of the North/ South Bracket. Secure this hardware with the V2 Westinghouse Solar wrench once the outer edges of the two rows are flush. By tightening this hardware in this step you will avoid the module sliding out of alignment when the next module is spliced in the east/ west direction.

Tip: By pre-threading the 3/8" flange nut onto the 1" hex bolt it will take fewer wrench rotations to complete the assembly in step 8.



Step 9 - Connect Modules in the east/ west direction only after securing the North/ South Bracket hardware and installing the 3/8" hardware at the top of the array. After each additional modules North/ South bracket and hardware are secure follow the East/ West assembly process described in steps 1-4.

6. Grounding

Splices and North/South brackets provide contiguous grounding between panels and across rows. Proper grounding is achieved by assembling the module frame(s) contiguously using two bonding

splices in the east-west direction and contiguously with the north-south direction using grounding washers on specific North/South Brackets such that each module is electrically grounded one in a continuous path to the grounding electrode for the array.

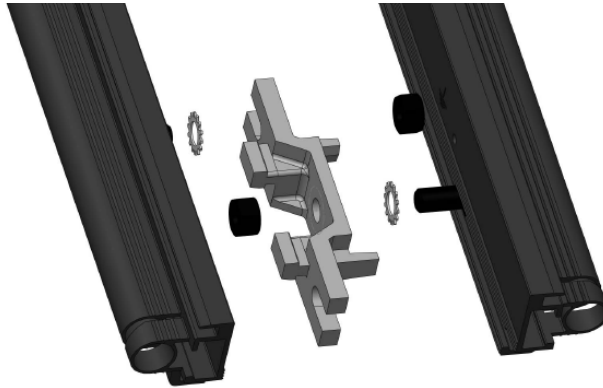


Figure 19 - Ground washers on the North/South Bracket ensure ground continuity across rows

Each contiguous array of module frames is then attached to the grounding electrode, in accordance with Section 690 of the National Electrical Code (NEC) using one method as follows. Ensure positive electrical contact through the anodizing on the module's frame by attaching the grounding conductor to one of the 0.173" diameter (4.4 mm) holes on the frame marked 'ground' using an ILSCO GBL-4DB lug, star-washer and thread-rolling 10-32 X 1/2" Taptite II stainless steel screw and torque to a value of 20 Lbf-inch. Attach a solid copper (gauge AWG 4-12) to the lug to enable array grounding.

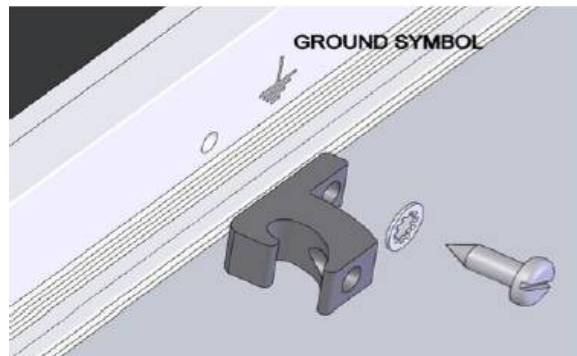


Figure 20 - Ground conductor applied to enable array grounding

7. Adding AC Interconnect Parts

The Interconnection cable is connected to the last inverter in a Branch Circuit. **Branch circuits must never exceed a total quantity of 15 inverters at 240VAC.** Wiring patterns and direction are planned out before the array is installed so that the final destination of the built-in wire harness and AC interconnection cable is in proximity to the junction box. The junction box is the location where conductors from the array transition to conductors that will run down to the main

electrical service. The unused bulkhead connector at the other end of the circuit is sealed with the End Cap. If your array consists of multiple rows, additional wiring components may be necessary. If continuing a branch circuit into an upper row, the AC interconnection cable is left out until the end of the branch circuit.

Westinghouse Solar AC Panel to Junction Box wiring – On the end of a row of panels, attach a grounding lug to the frame at one of the designated grounding attachment points of one panel using the thread forming grounding screw. Then, connect the grounding lug to the appropriately sized grounding conductor inside the Westinghouse Solar Junction Box.

8. Commissioning Westinghouse Solar AC Systems

Step 1 - Install the AC Branch Circuit Junction Box

Use electrical system components approved for wet locations only. Connect the open wire end of the AC Interconnection Cable into the junction box using an appropriate gland or strain relief fitting. **Do not connect the connector end to the Westinghouse Solar AC panels at this time, as this is to be done during the commissioning step.**

Step 2 – Verify the connections of the Inverter Wiring Harnesses

Each inverter comes with one 4-pin bulkhead receptacle and one 70-inch AC wire harness with multi-pin connectors. The AC connectors are oppositely sexed, so that multiple inverters can be connected to form one continuous AC branch circuit. Please verify that you performed this properly in Section I, Step 6.

- Connect the first Micro-inverter to the AC interconnection cable (pigtail). All AC interconnection cables have four conductors. Do not exceed the maximum number of Micro-inverters in an AC branch circuit, as displayed on the unit-rating label. Each Micro-inverter AC branch circuit must be sourced from a dedicated branch circuit protected by a 15A maximum breaker.
- Install a protective end cap on the open AC connector of the last Micro-inverter in the AC branch circuit. Make sure protective end caps have been installed on all unused AC connectors. Unused AC Micro-inverter wire harness connectors may be live when the system is energized by the utility system.

NOTE: *Be sure to size the AC wire gauge to account for voltage drop between the AC branch circuit junction box and the point of utility inter-connection. (See the wire sizing guide in the appendix of this document).*

Step 3 – Complete the Inverter Installation Map

The Inverter Installation Map is a diagrammatic representation of the physical location of each inverter in your Westinghouse Solar AC installation. If you have purchased an EMU, follow the included Monitoring Quickstart Guide to complete the Inverter Installation Map.

Step 4 - Commissioning

Ensure that all AC wiring is correct. Ensure that none of the AC and DC wires are pinched or damaged. Ensure that all junction boxes are properly closed.

The Status LED of each Micro-inverter will blink green six times to indicate normal start-up operation once DC power is applied.

To commission the Westinghouse Solar AC system:

1. Turn ON the AC disconnect or circuit breaker on each inverter AC branch circuit. Check the voltages on the AC Interconnection Cable (Pigtail) to ensure proper wiring. **Please verify proper AC cable voltage and neutral conductors prior to connecting to live voltage or connecting the harness to the Westinghouse Solar AC string. Failure to properly connecting the wires can result in severe damage and void the warranty.**
2. Turn OFF the AC disconnect or circuit breaker and connect the AC Interconnection Cable (Pigtail) to the string/branch.
3. Repeat for each string/branch until each one is complete.
4. Turn ON the main utility-grid AC circuit breaker. Your system will start producing power after a five-minute wait time.
5. The Westinghouse Solar AC inverters will start to send performance data over household wiring to the EMU. The time required for all the inverters in the system to report to the EMU will vary with the number of inverters in the system. The first units should be detected within 15 minutes but the entire system could take hours to detect. Please refer to the *EMU Installation and Operation Manual* for information on the EMU.

Section V. Westinghouse Solar Operations

The inverter is powered on when sufficient sunlight hits the solar panel. The status LED will flash green six times indicating proper start-up.

In the event of a GFDI failure, the status LED will display continuous red after the fault occurs. This will persist until AC power is cycled to the Micro-inverter.

You can verify proper operation of the inverters via the EMU. See the *EMU Installation and Operation Manual* for more information.

1. Troubleshooting

Adhere to all the safety measures described throughout this document. Qualified personnel can use the following troubleshooting steps if the solar system does not operate correctly:

WARNING: Do not attempt to repair the inverter; it contains no user-serviceable parts. If it fails, please contact Enphase customer service to obtain an RMA number and start the replacement process.

Inverter Status LED Indications and Error Reporting

Startup LED Operation:

- Six short green blinks when DC power is first applied to the inverter indicates a successful inverter startup sequence.
- Six short red blinks when DC power is first applied to the inverter indicates a failure during inverter startup.

Post-Startup LED Operations:

- **Flashing Green** - Producing power and communicating with EMU
- **Flashing Orange** – Producing power and not communicating with EMU
- **Flashing Red** – Not producing power

GFDI Fault:

A solid red status LED when DC power has been cycled, indicates the inverter has detected a ground fault (GFDI) error. The LED will remain red and the fault will continue to be reported by the EMU until the error has been cleared. The error can only be cleared via the EMU after the ground fault condition has been remedied. Contact Enphase Customer Support for assistance.

Other Faults:

All other faults are reported to the EMU. Refer to the *EMU Installation and Operation Manual* for a list of additional faults and troubleshooting procedures.

WARNING: Always disconnect AC power before disconnecting the PV panel wires from the inverter. The AC connector of the first inverter in a branch circuit is suitable as a disconnecting means once the AC branch circuit breaker in the load center has been opened.

2. Troubleshooting an Inoperable Inverter (For Experienced Installers)

To troubleshoot an inoperable inverter, follow the steps in the order shown:

1. Check the connection to the utility grid. Verify the utility voltage and frequency is within allowable ranges shown in the Technical Data section on page of this document. Verify utility power is present at the inverter in question by removing AC, then DC power. **Never disconnect the DC wires while the inverter is producing power.** Re-connect the DC panel connectors and watch for six short LED flashes.
2. Check the AC branch circuit interconnection harness between all the inverters. Verify each inverter is energized by the utility grid as described in the previous step.
3. Make sure that any AC disconnects are functioning properly and are closed.
4. Verify the PV panel DC voltage is within the allowable range shown in the Technical Data page of this document.
5. Check the DC connections between the inverter and the PV panel.
6. If the problem persists, please call customer support at Westinghouse Solar.

3. Disconnecting the Inverter from the PV Panel

To ensure the inverter is not disconnected from the PV panels under load, adhere to the following disconnection steps in the order shown:

1. Disconnect the AC by opening the branch circuit breaker.
2. Disconnect the first AC connector in the branch circuit.
3. Cover the panel with an opaque cover.
4. Using a DC current probe, verify there is no current flowing in the DC wires between the Westinghouse Solar panel and the inverter.
5. Care should be taken when measuring DC currents, most clamp-on meters must be zeroed first and tend to drift with time.
6. Disconnect the Westinghouse Solar panel DC wire connectors from the inverter.
7. Remove the inverter from the Westinghouse Solar AC frame.

Section VI. Definitions

NEMA6 rating- Indoor or outdoor use primarily to provide a degree of protection against hose-directed water, and the entry of water during occasional temporary submersion at a limited depth, and damage from external ice formation.

Panel- The technical term for Solar Panels or Modules.

Splices- Splices refer to the stainless steel rods with forward and reverse threading used to combine Westinghouse Solar AC Panels.

Romex- A name brand of nonmetallic-sheathed electrical cable that is used for indoor wiring.

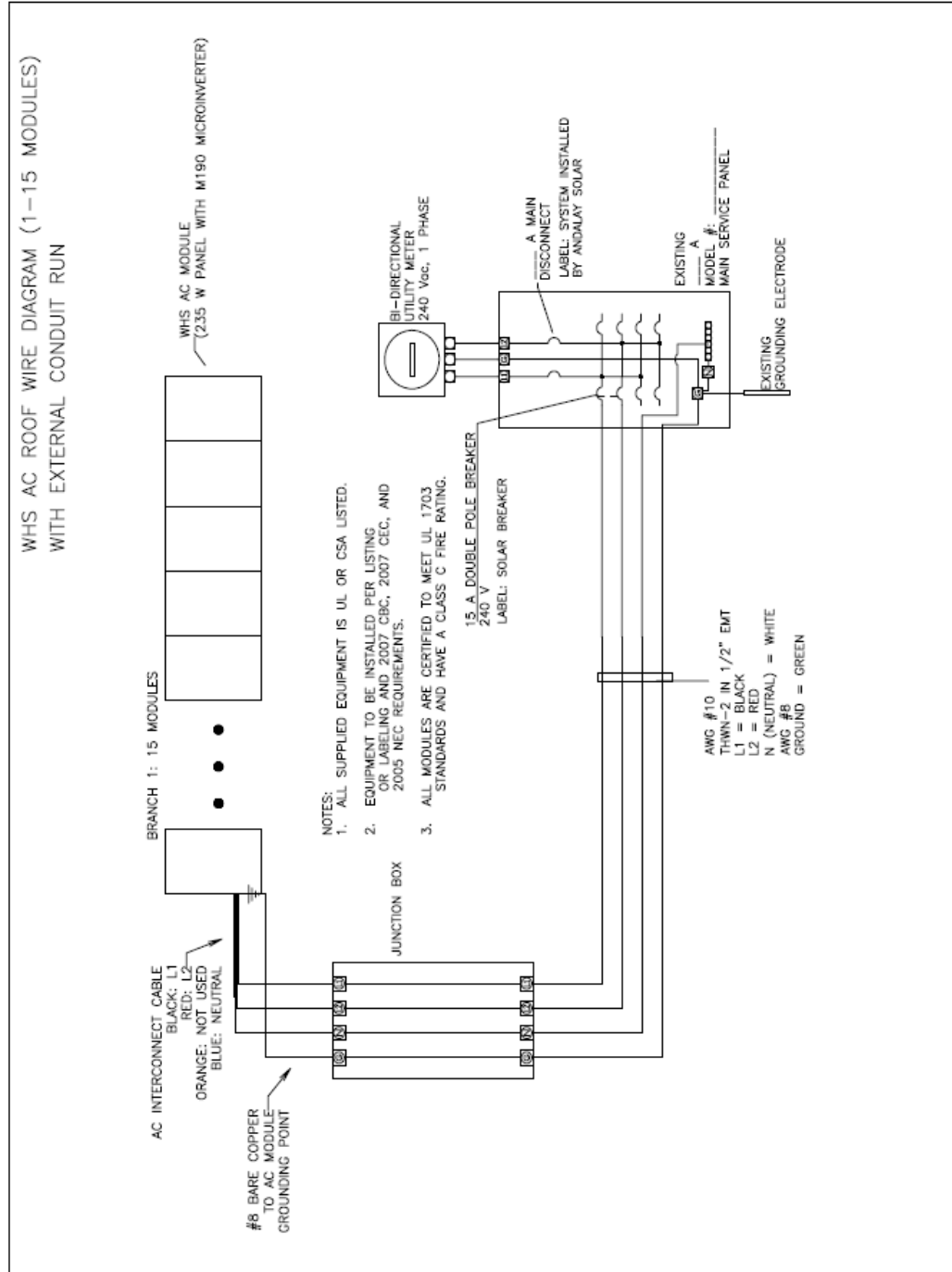
NEC- U.S. National Electric Code is a safety code regarding the use of electricity. The NEC is sponsored by the National Fire Protection Institute. It is also used by insurance inspectors and by many government bodies regulating building codes.

North-South Bracket - The North-South Bracket serves as a structural connection for V2 60 Cell Westinghouse Solar Power Systems and enables sharing of footings between the first and second rows (and all consecutive rows until the top of array).

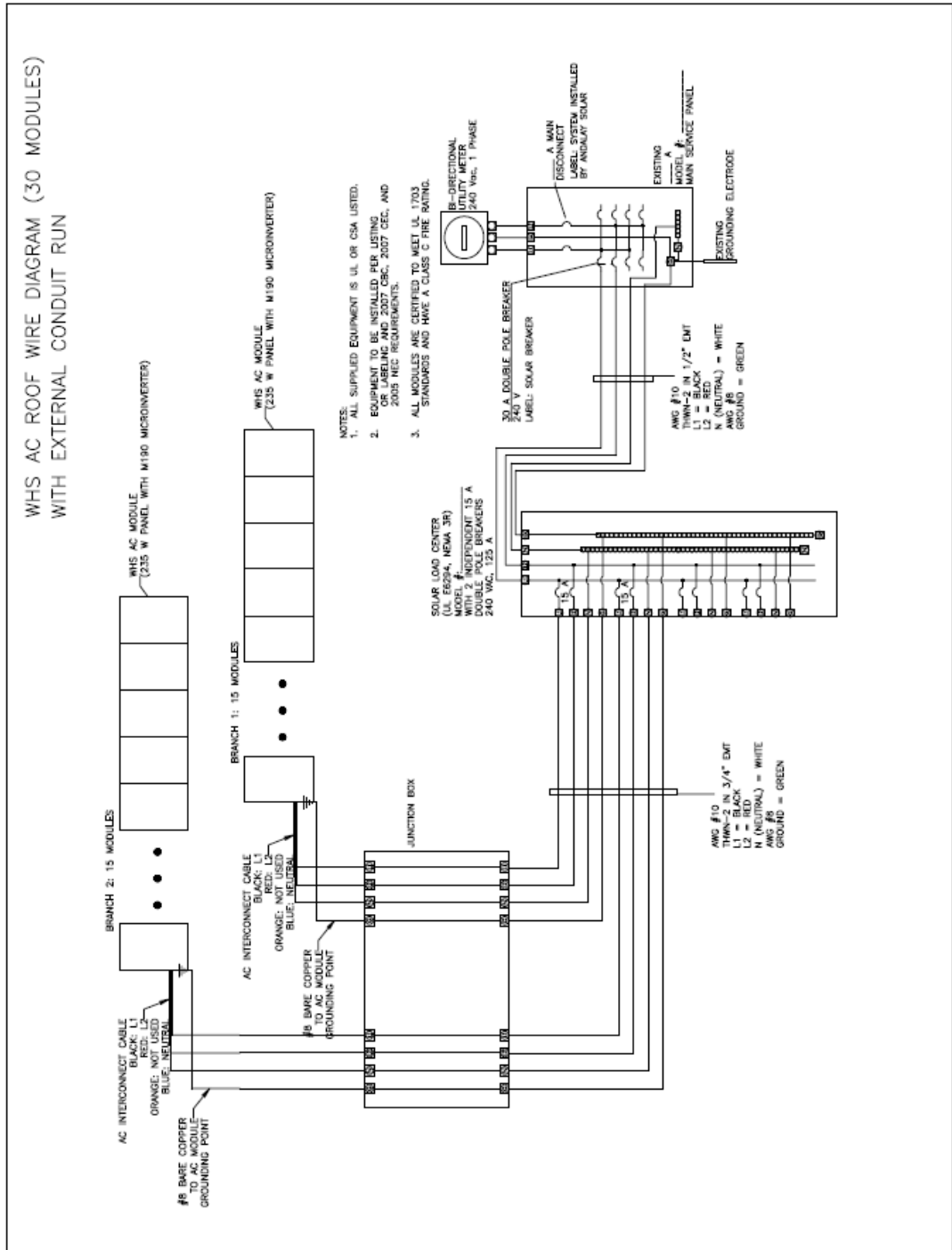
Micro-inverter- A micro-inverter is a device that converts the DC output of a single solar panel into grid-compliant AC power. AC power then travels upstream through an ordinary branch circuit to the service panel.

Pigtail- Transitions built-in microinverter wiring harnesses to color coded wires for utility interconnection.

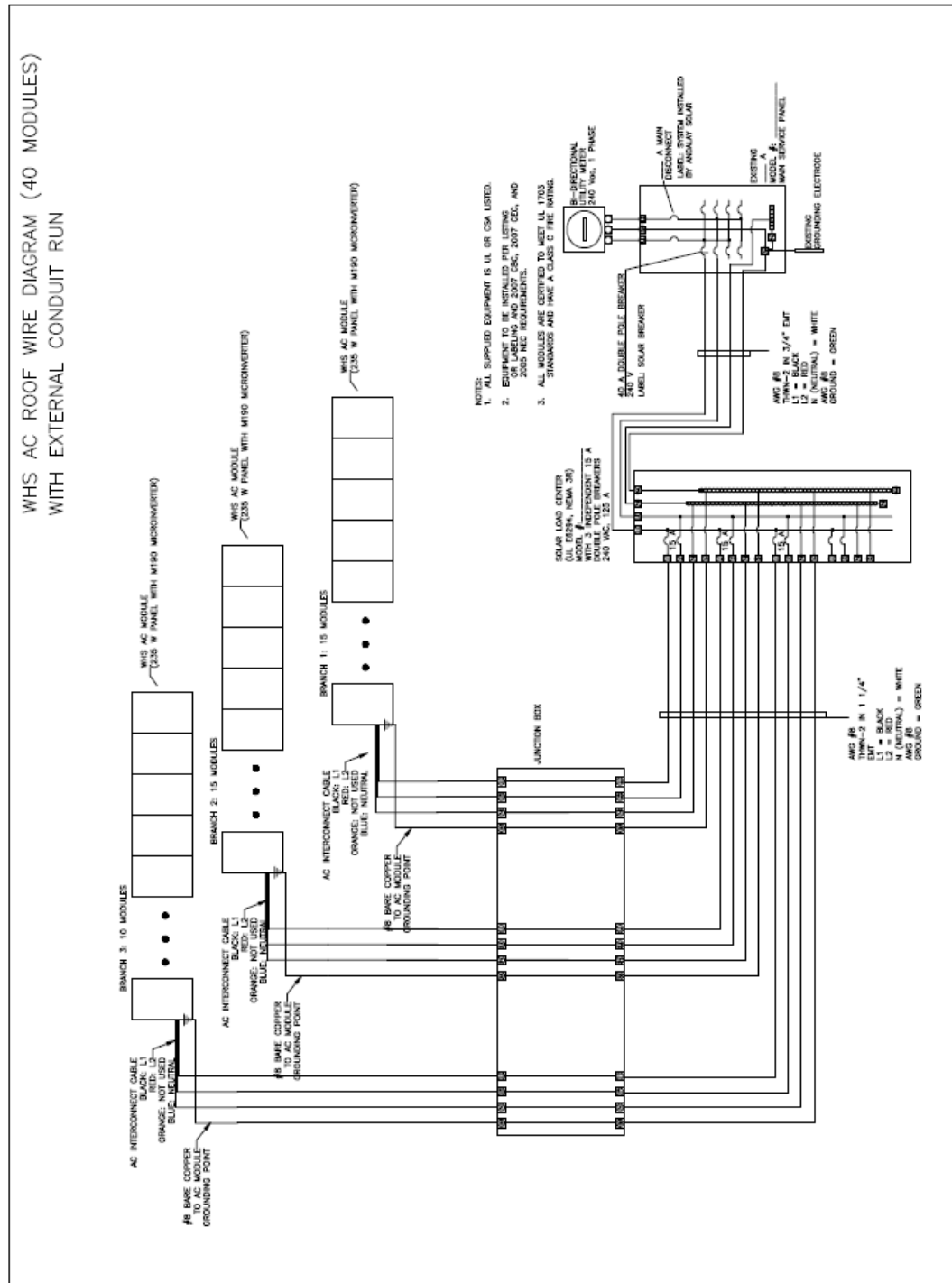
Section VII. Appendix

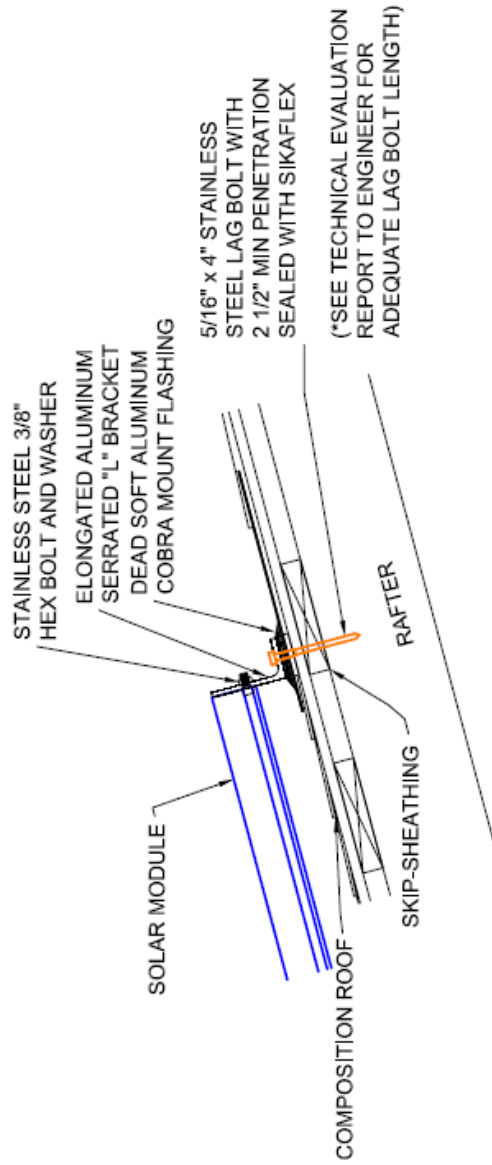


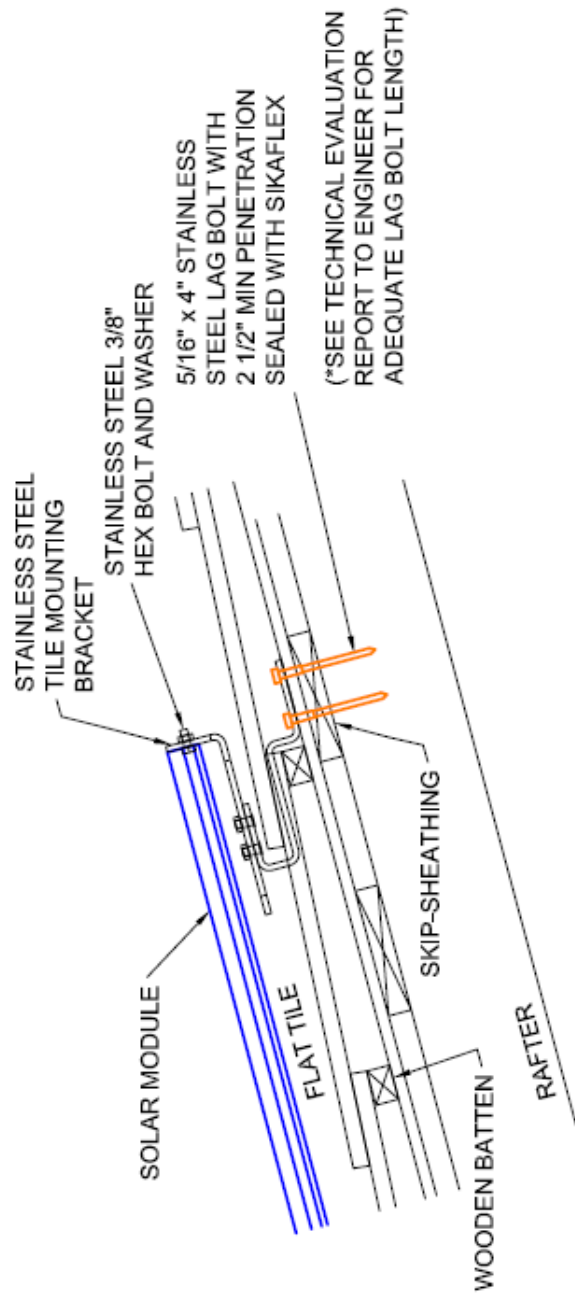
WHS AC ROOF WIRE DIAGRAM (30 MODULES)
WITH EXTERNAL CONDUIT RUN

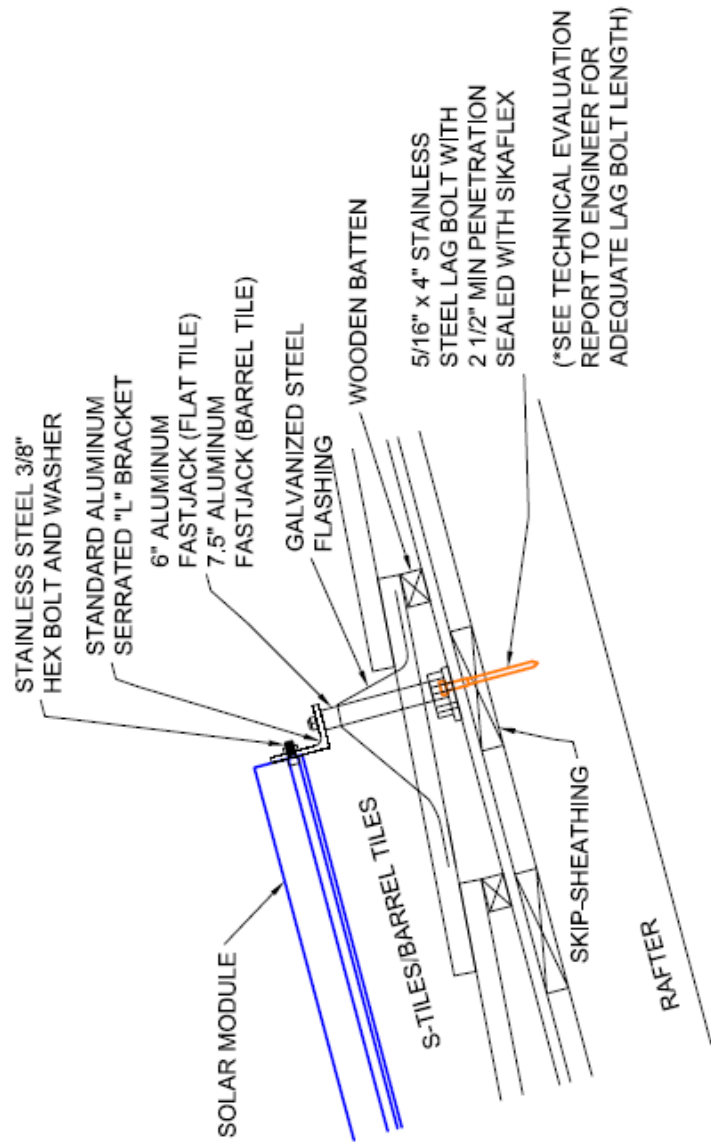


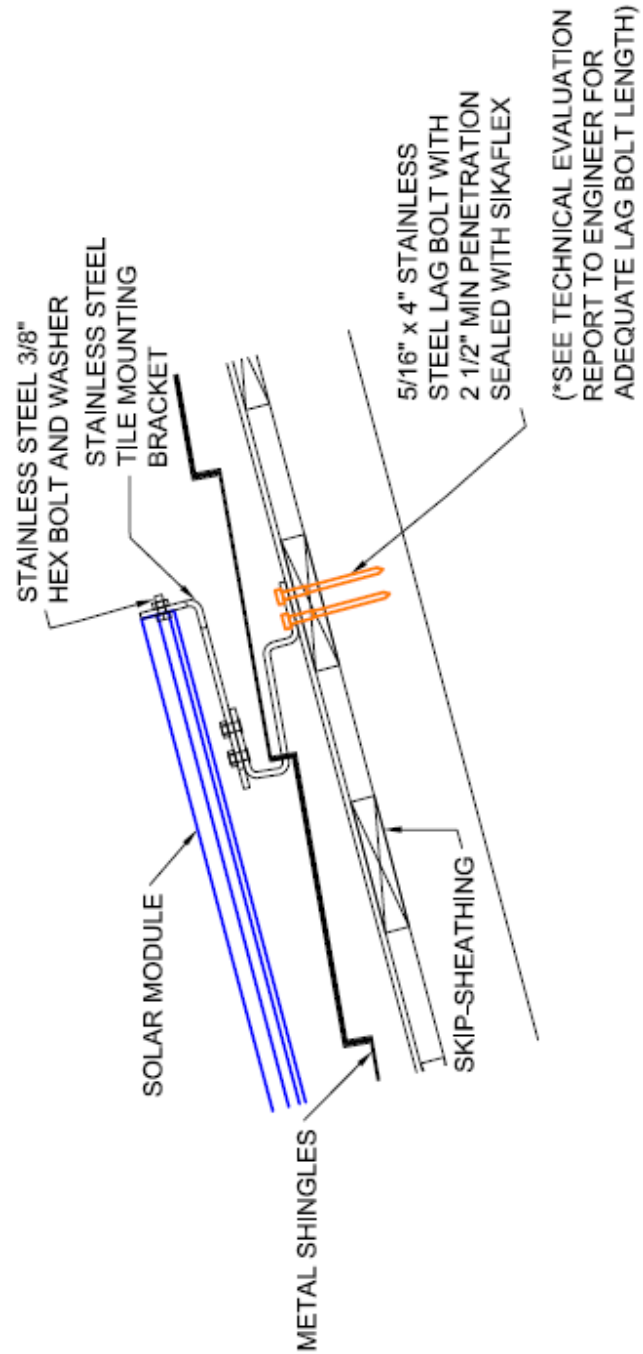
WHS AC ROOF WIRE DIAGRAM (40 MODULES) WITH EXTERNAL CONDUIT RUN

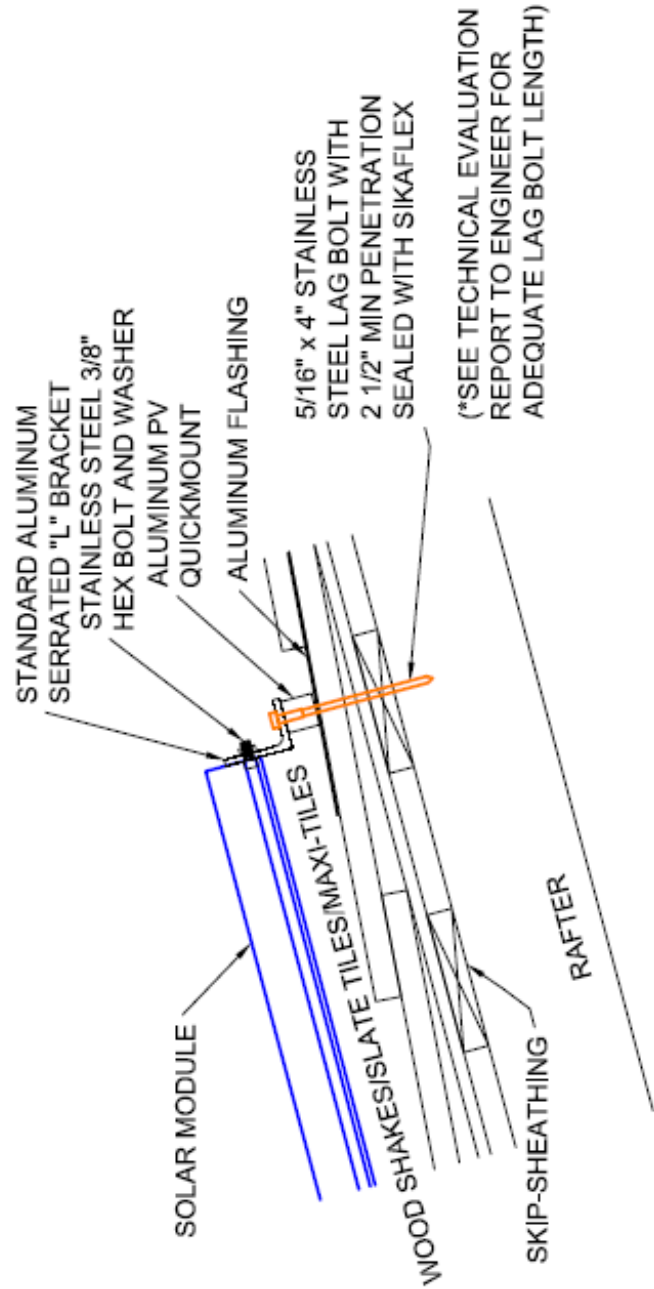


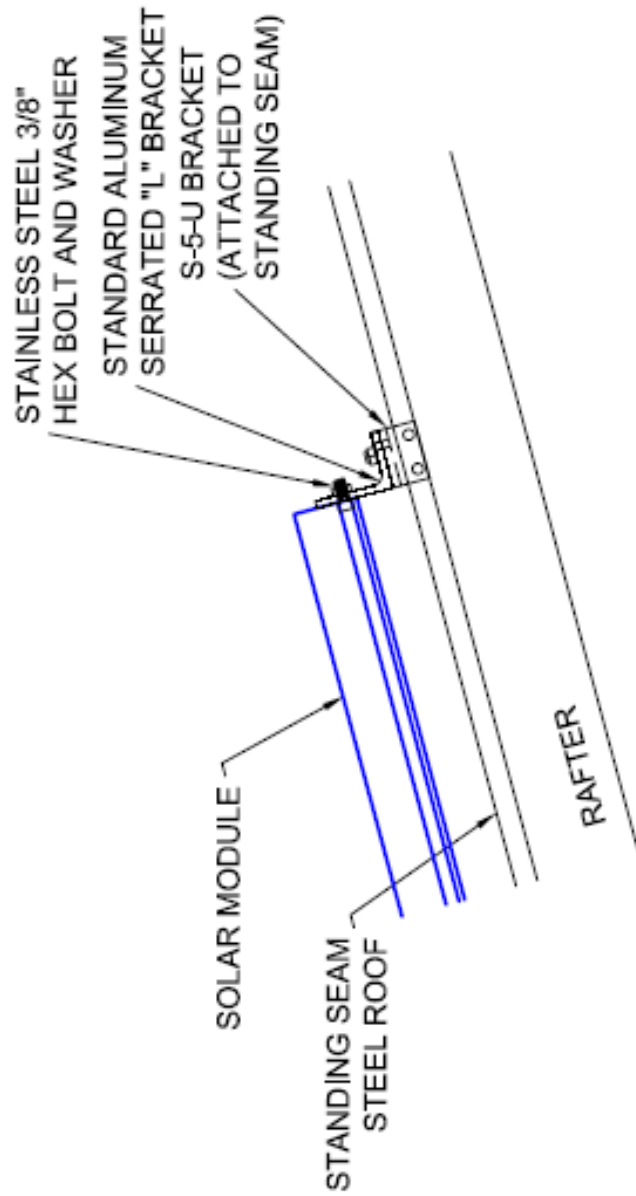












Installing flat concrete/ cement roof tile hardware

Step 1. Remove a tile at roof attachment location.



Step 2. Predrill using flat tile bracket as a template at rafter location.



Step 3. Apply roofing sealant to roof penetration area.



Step 4. Install Lag Bolts and washers to secure bracket in place.



Step 5. Replace previously removed tile at attachment location.



Installing "S" or Barrel Tile Roof Attachment hardware

Step 1. Remove tile at attachment location.



Step 2. predrill at rafter attachment location.



Step 3. Apply sealant to attachment location.



Step 4. Place standoff base over pre-drilled hole.



Step 5. Using lag Bolt with included washer, attach standoff base to roof surface using an impact driver.



Step 6. Mold Flashing material to the profile of existing tiles. Install aluminum standoff into base once flashing is in place.



Step 7. Seal flashing with vinyl roofing tape and loosely assemble associated attachment hardware.



Section VIII. Technical Support

The following contact options are available for support of questions regarding product, installation, operation or warranty of your Westinghouse Solar AC system:

Phone: 1.888.395.2248 (option 2)

Email: tech@westinghousesolar.com

Fax: Westinghouse Solar Tech Support - (408) 395-7979

Mail: Attention Westinghouse Solar Tech Support, 1475 South Bascom Ave. Suite 101, Campbell, CA, USA, 95008

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