1 Contents

SECTION 1 — INTRODUCTION ................................................................................................................. 4
   Abbreviations ................................................................................................................................. 4
   Symbol List .................................................................................................................................. 4
   Definitions .................................................................................................................................... 5
   General Safety Precautions ......................................................................................................... 6
   Electrical Safety Precautions ..................................................................................................... 7

SECTION 2 - GAF SOLAR ENERGY SYSTEM OVERVIEW .............................................................................. 9
   Main Components of the GAF Solar Energy System ................................................................... 9
   GAF Solar System Components ................................................................................................. 10
   Solar Array Configurations ........................................................................................................ 13

SECTION 3 — GAF SOLAR ENERGY SYSTEM CONSIDERATIONS AND REQUIREMENTS .............................. 14
   Design Considerations ................................................................................................................ 14
   Installation Requirements .......................................................................................................... 16
   Grounding ...................................................................................................................................... 17
   Recommended Tools .................................................................................................................... 21
   Prior to Installation ...................................................................................................................... 22

SECTION 4 — GAF SOLAR ENERGY SYSTEM INSTALLATION .................................................................... 23
   Step 1: Prep the Roof .................................................................................................................. 24
   Step 2: Build the Starter Bars and the Solar Module Assemblies ............................................ 28
   Step 3: Install the Starter Bar ................................................................................................... 34
   Step 4: Install the First Row of Solar Module Assemblies ....................................................... 36
   Step 5: Install the Remaining Rows of Solar Module Assemblies ........................................... 41
   Step 6: Install Side Flashing ....................................................................................................... 42
   Step 7: Install Top Flashing ....................................................................................................... 44
   Step 8: Install Top Flashing Underlayment and Complete Shingles ....................................... 49
   Completed GAF Solar Energy System ....................................................................................... 51

SECTION 5 — WIRE MANAGEMENT ...................................................................................................... 52
   DC Optimizer ............................................................................................................................... 52
   AC Microinverter ........................................................................................................................ 52

SECTION 6 — GAF SOLAR ENERGY SYSTEM MAINTENANCE .................................................................... 54

SECTION 7 — APPENDIX ....................................................................................................................... 55
   GAF Solar Module Technical Data .............................................................................................. 55
GAF Solar Energy System Codes and Standards................................................................. 58
Alternate Solar System Configurations.............................................................................. 59
Version Control................................................................................................................. 63
SECTION 1 — INTRODUCTION

The GAF Solar Energy System is designed by GAF, North America’s largest roofing manufacturer. The sleek, black, low-profile design delivers performance and curb appeal at an affordable price. The GAF Solar Energy System was developed with roofing best practices, simplicity of installation, performance, safety, and aesthetics in mind. Its deck-mounting technology coupled with GAF underlayment offers fast installation with high-performance water shedding and a Class A fire rating. Module Level Power Electronics (either AC or DC) is easily integrated in the field.

This Manual contains safety, installation, and troubleshooting instructions for the GAF Solar Energy System.

READ THESE INSTRUCTIONS ENTIRELY AND THOROUGHLY TO HELP ENSURE A PROBLEM-FREE INSTALLATION.

Save this Manual and keep it in a readily accessible location for future reference. As part of its continuing efforts to improve the performance of its products, GAF periodically makes changes to its products and application specifications. GAF reserves the right to change or modify, at its discretion, any of the information, requirements, specifications, or policies contained herein. Please be sure to check gaf.com/solar for the most up-to-date version of this Manual or any technical bulletins for this product.

Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>Alternating Current</td>
</tr>
<tr>
<td>AHJ</td>
<td>Authority Having Jurisdiction</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>AWG</td>
<td>American Wire Gage</td>
</tr>
<tr>
<td>DC</td>
<td>Direct Current</td>
</tr>
<tr>
<td>OCPD</td>
<td>Overcurrent Protection Device</td>
</tr>
<tr>
<td>OSB</td>
<td>Oriented Strand Board</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
</tr>
<tr>
<td>MLPE</td>
<td>Module Level Power Electronics</td>
</tr>
<tr>
<td>NEC</td>
<td>National Electrical Code</td>
</tr>
<tr>
<td>NFPA</td>
<td>National Fire Protection Association</td>
</tr>
<tr>
<td>MC</td>
<td>Multi-Contact</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
</tr>
<tr>
<td>PV</td>
<td>Photovoltaic</td>
</tr>
<tr>
<td>UL</td>
<td>Underwriters Laboratories</td>
</tr>
</tbody>
</table>

Symbol List

- **CAUTION:** Use caution and fully understand the instructions before proceeding.
- **DANGER:** Indicates a hazardous situation. Failure to follow these instructions could lead to serious injury or death.
- **NOTE:** Follow these instructions closely for optimal system operations and best installation practices.
- **MOVE:** Denotes direction of movement.
Definitions

**GAF Solar Module Assembly** – the GAF solar module combined with:
- Roof attachments (adjustable feet)
- MLPE bracket
- MLPE (either a DC optimizer or an AC Microinverter)
- Wire ties
- Grounding lug

The Module Assembly is built in the field with the provided hardware. Detailed instructions are in Section 4.

![Figure 1 GAF Solar Module Assembly](image1)

**GAF Solar Energy System** — The combination of GAF underlayment, Module Assemblies, Starter Bars, and Flashing make up the GAF Solar Energy System as shown in Figure 2.

![Figure 2 GAF Solar Energy System](image2)
General Safety Precautions

- **Must be installed by a qualified person**... The GAF Solar Energy System must be installed by a **PROPERLY TRAINED and QUALIFIED INSTALLER**. It is the responsibility of every installer to know and follow local code requirements.

- **Follow OSHA**... GAF recommends compliance with OSHA guidelines for Residential Fall Protection.

- **Wear Personal Protective Equipment (PPE)**... Use proper PPE (Figure 3) and follow safety policies and procedures. Proper PPE when dealing with rooftop solar systems includes, but is not limited to, the following:
  - **Hard hats**... For falling objects, as well as risk of contact with energized conductors. An ANSI Z89 Class A helmet will satisfy this OSHA requirement.
  - **Work gloves**... For slip, abrasion, and thermal resistance. Solar modules tend to get very hot when exposed directly to the sun.
  - **Electrically insulated gloves**... When working on energized circuits.
  - **Appropriate footwear**... Footwear with extra traction and/or heat-resistant soles.
  - **Personal fall arrest system (PFAS)**... Consists of an OSHA-approved anchor point, a full-body harness approved for electrical workers, rope or cable, and specific connecting hardware.
  - **Eye protection**... For site-specific hazards.

- **Work only in dry conditions**... Use dry equipment and dry tools. Protect all electrical equipment against weather elements.

- **Eliminate trip and fall hazards**... Keep work areas on the roof and ground staging areas organized and clean.

- **Beware of “in-between” roof slopes**... A “walkable” roof may not be walkable once the shingles are stripped off. A slope of 6:12 and higher generally becomes unsafe to walk on after being stripped.

- **No stacking of Module Assemblies**... Do not stack or store Module Assemblies on the roof. For general safety of roofing materials, use roof jacks, toe boards, or storage platforms secured to the underlying roof deck to prevent slippage of stored roofing materials.

---

Figure 3 personal Protective Equipment
• **Inspect for damage**... Do not use GAF Solar Energy System components if there are visible signs of damage from transport or handling.

• **Handling the Module Assembly**... Always have two people carry the product by its frame. Do not support the solar modules on your head as a hard hat may damage the PV back sheet.

• **Working Safely with PV systems**... Be aware of the hazards at the jobsite as well as the hazards of working on PV systems. Be alert at all times. Never work alone on PV systems. Always have at least two people installing solar systems on the roof.

---

**Electrical Safety Precautions**

• **Must be competent with electrical safety work practices**... The GAF Solar Energy System is an electric-powered generation system. The installer must be qualified according to state and local requirements.

• **De-energize**... All work must be performed on DC or AC circuits **only after** the circuits have been de-energized.

• **Use proper wire management techniques**... Ensure that none of the AC or DC wires are pinched or damaged during installation. Secure all loose cables with wire ties to the GAF Solar Module Assembly. Do not exceed the minimum bend radius of the cables.

• **Do not modify factory-applied connectors, terminals, or jumper cables**... Do not customize or modify the provided DC or AC cables or connectors in the field.

• **Do not repair**... The GAF Solar Energy System does not contain any user-serviceable parts. Replacement products should be obtained through GAF. Tampering with the GAF Solar Energy System will void the warranty.

• **Thermal and voltage hazard**... Certain parts of the GAF Solar Energy System may become extremely hot due to continued exposure to the sun. It should be installed in a location where it is protected against casual contact. It may also represent an electrical hazard while servicing the system immediately following shutdown.

• **Follow codes**... Perform all electrical installations in accordance with all local codes and the NEC (National Electrical Code) ANSI/NFPA 70 for U.S. installations.

• **Re-inspection**... Regularly re-inspect the solar system to ensure that all fasteners are securely tightened and corrosion free; that wiring is securely connected and free of corrosion; and that cables are free of damage. This is important especially after storms and in areas prone to hail and high winds. Any damaged parts should be replaced immediately.

• **Be aware of ground faults**... Functionally grounded conductors may become ungrounded and energized when a ground fault is indicated, resulting in risk of electric shock. Prior to touching any part of the
product, use care to ensure surfaces and equipment are at touch-safe temperatures and voltage potentials (by testing with a multimeter) before proceeding. Anytime the MLPE has been disconnected from the power network, use extreme caution as some components can retain a charge sufficient to create a shock hazard.

- **Licensed Electrician**... Installing AC or DC circuits, switches, tie-in to the PV point of connection, OCPDs, and initial startup of the PV system must be performed by a licensed electrician. Make all electrical connections (e.g., conductor termination, fuses, potential earth connection, etc.) in accordance with the electrical standards prescribed by the applicable NEC wiring methods and/or by other local regulations and codes.
SECTION 2 - GAF SOLAR ENERGY SYSTEM OVERVIEW

Main Components of the GAF Solar Energy System

The three main components of the GAF Solar Energy System are:

- **GAF Underlayment System**
  - Attaches to the deck and is installed underneath the Solar Array
  - Provides a Class A fire rating
  - Provides secondary leak protection

- **Module Assembly**
  - Deck-mounted Solar Module integrated with power electronics and grounding lug

- **Flashing**
  - Starter Bar and Flashing provides primary leak protection and module ventilation
  - Presents an aesthetically-pleasing finished look

The Balance Of System components that make up the remainder of the solar installation are outside the scope of this manual. Typical components are: rooftop junction box, conduit and cables, disconnect switch, meter, monitoring system, and inverter. See the Project Installation Drawings for more information.

Figure 4 Main Components of Solar Installation
GAF Solar System Components

Figure 5 shows all of the hardware components that comprise GAF Solar Energy System.

Figure 5 GAF Solar Energy System Components
The SKU Numbers for GAF components are shown in Table 1 below.

### Table 1 GAF SKU Numbers

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>SILFAB</th>
<th>SOLARIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module</td>
<td>2947401</td>
<td>2947452</td>
</tr>
<tr>
<td>Starter Bar</td>
<td>2947405</td>
<td>2947441</td>
</tr>
<tr>
<td>Adjustable Foot Base</td>
<td>2947402</td>
<td>2947434</td>
</tr>
<tr>
<td>Starter Bar Cover-Left</td>
<td>2947412</td>
<td>2947446</td>
</tr>
<tr>
<td>Starter Bar Cover-Right</td>
<td>2947413</td>
<td>2947446*</td>
</tr>
<tr>
<td>Step Flashing</td>
<td>2947411</td>
<td>2947447</td>
</tr>
<tr>
<td>Counter flashing-Left</td>
<td>2947406</td>
<td>2947448</td>
</tr>
<tr>
<td>Counter flashing-Right</td>
<td>2947407</td>
<td>2947449</td>
</tr>
<tr>
<td>MLPE Bracket</td>
<td>2947404</td>
<td>2947436</td>
</tr>
<tr>
<td>Adjustable Foot</td>
<td>2947403</td>
<td>2947435</td>
</tr>
<tr>
<td>Top Flashing Frame Insert</td>
<td>2947415</td>
<td>2947445</td>
</tr>
<tr>
<td>Top Flashing Support</td>
<td>2947414</td>
<td>2947444</td>
</tr>
<tr>
<td>Top Flashing</td>
<td>2947408</td>
<td>2947450</td>
</tr>
<tr>
<td>Top Corner Flashing-Left</td>
<td>2947409</td>
<td>2947442</td>
</tr>
<tr>
<td>Top Corner Flashing-Right</td>
<td>2947410</td>
<td>2947443</td>
</tr>
</tbody>
</table>

* Left and Right Covers are the same.

### Table 2 Non-GAF Components

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>MANUF</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEEB Grounding Lug</td>
<td>Wiley</td>
<td>WEEB-LUG-8.0</td>
</tr>
<tr>
<td>DynoBond™ Grounding Jumper-38&quot;</td>
<td>DynoRaxx</td>
<td>DynoBond-38</td>
</tr>
<tr>
<td>DynoBond™ Grounding Jumper-76&quot;</td>
<td>DynoRaxx</td>
<td>DynoBond-76</td>
</tr>
<tr>
<td>MLPE</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

The required GAF underlayment is listed in Table 3.

### Table 3 GAF Underlayment

<table>
<thead>
<tr>
<th>ITEM</th>
<th>GAF SKU #</th>
</tr>
</thead>
<tbody>
<tr>
<td>VersaShield® SOLO™ Fire-Resistant Slip Sheet (Note: 3 foot wide roll)</td>
<td>905500</td>
</tr>
<tr>
<td>QuickStart® Peel &amp; Stick Starter Roll</td>
<td>1122000ST</td>
</tr>
<tr>
<td>StormGuard® Film-Surfaced Leak Barrier</td>
<td>092500MV</td>
</tr>
</tbody>
</table>
In addition to the above, the installer will need to provide the following typical Balance of System items:

- Bare solid copper grounding wire
- PV wire/jumpers
- Wire and conduit for homeruns
- Junction box
- AC/DC Disconnect
- Meter
- Inverter
- Roofing materials
  - Shingles
  - Shingle Underlayment
  - Drip edge
  - Shims
  - Triangle Fastener Panel-Tite™ #14 – 1-1/2" (37.5 mm) heavy-duty roofing fasteners
  - Cap nails/staples

**Notes**

- Do not mix Solaria and Silfab GAF components.
- The System can be designed with either a DC power optimizer or an AC Microinverter. Follow the MLPE manufacturer’s installation instructions. Additional components may be required.
- GAF recommends the use of factory-certified PV cables instead of field-crimping PV wire and connectors.
- If the installer wishes to use his or her own non-corrosive metal step flashing, the flashing must have a vertical height of 2 inches (51 mm) up the side of the modules, be a minimum of 2 inches (51 mm) longer up the roof than the exposure of the asphalt shingle being installed, and must extend horizontally over the shingle on the roof a minimum of 5 inches (127 mm).
- Except as noted, no substitutions are allowed without prior written approval from GAF.
Solar Array Configurations

The solar array can be laid out in various shapes. The available configurations are shown in Figure 6. The assembly instructions in Section 4 assume a rectangular Configuration “A” layout. Installation instructions for the other configurations can be found in the Appendix (Page 59).

![Figure 6 Solar Array Configurations](image-url)
SECTION 3 — GAF SOLAR ENERGY SYSTEM CONSIDERATIONS AND REQUIREMENTS

Design Considerations

- **Slope limitations**... The GAF Solar Energy System is intended for use solely on roofs having a slope between 4:12 and 12:12.

- **Deck mounting**... The GAF Solar Energy System is installed directly to the roof deck without engaging rafters and requires underlayment as specified in these instructions. It cannot be installed over shingles.

- **Deck thickness and fastening**... The roof deck must be a minimum of 15/32 inches (11.9 mm) thick plywood or 7/16 inches (11.1 mm) OSB decking as recommended by APA – The Engineered Wood Association. Wood plank decking must be well-seasoned and supported having a maximum 1/8 inch (3 mm) spacing at the ends and sides using minimum nominal thickness 1 inch (25 mm) x maximum 6 inches (152 mm) lumber. The decking must have adequate nail-holding capacity and a smooth surface. Boards with a nominal thickness of 1 inch (25 mm) and a maximum width of 6 inches (152 mm) are also acceptable. Installers should ensure that the deck is properly fastened per local building code requirements.

- **Landscape orientation**... The GAF Solar Energy System is designed for landscape orientation only.

- **Solar Array wiring**... Refer to the Permit Design Drawings for the system wiring details. The system electrical design is outside the scope of this manual.

- **Operating temperature**... The GAF Solar Energy System has an operating temperature range of -40°F to +185°F (-40°C to +85°C).

- **DC electrical output**... Under certain environmental conditions, the GAF Solar Array may produce more current and/or voltage than reported at standard test conditions (irradiance of 1000 W/m², AM 1.5 spectrum, and a cell temperature of 25°C [77°F]). The solar designer should account for these conditions when designing the solar array.

- **Suitable ambient conditions**... Artificially concentrated sunlight shall not be directed on the Solar Array. The modules must neither be immersed in water nor be exposed to continuous wetting (e.g. by fountains). Exposure to salt or sulfur (sulfur sources, volcanoes) implies a risk of corrosion. The system must not be used for maritime (e.g. boats) or automotive (vehicles) purposes. The system must not be exposed to extraordinary chemical loads (e.g. emissions from manufacturing plants). The GAF Solar Energy System should not be installed on stables.

- **Paint**... Do not apply paint to any part of the GAF Solar Energy System.

- **Roof Setbacks**... The GAF Solar Energy System requires the installation of a minimum of two full rows of shingles at the eave and the ridge. The minimum allowable offset to the rake is 18” (457
mm). Please refer to the local building and fire codes for additional setback and pathway requirements.

- **Mounting hardware...** The GAF Solar Energy System is intended to be mounted to a roof using only the hardware provided. Using other unapproved means is a violation of the UL listing and will impact the GAF warranty.

- **Design loading...** Refer to Table 6 (Page 57) for the allowed mechanical loading of the GAF Solar Module Assembly.

- **Fire classification...** The GAF Solar Energy System has been rated as Class A for resistance to external fire exposure per UL 2703 when used with the following underlayment:
  1. One ply of self-adhered StormGuard® Film-Surfaced Leak Barrier
  2. One ply of VersaShield® SOLO™ Fire-Resistant Slip Sheet, mechanically fastened with plastic cap nails or staples.

For roof mounting, the acceptability of the completed assembly, including the fire resistance of the underlying components of the roof, shall be evaluated per local fire codes.

- **Solar trackers...** The GAF Solar Energy System has not been evaluated for use on a solar tracker.

- **Nonstructural component...** These products have been evaluated for serving as a nonstructural component of a building only. They are not intended to serve as a primary component of the building’s exterior surface. The supporting structure (integrated racking) provided with these systems can only support the solar laminate.

- **PV laminate specific...** The GAF Solar Module Assembly may be used to ground and/or mount a PV laminate complying with UL 1703 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions. The Solaria PowerXT and the Silfab SLA-M laminates have been evaluated for use on the GAF PV Mounting System.

- **Wiring accessibility...** These products and associated wiring must not be accessible from the interior space of the building. NEC procedures for installation of wiring must be followed.

- **Roof obstructions...** Do not install any portion of the solar system over any roof obstructions, plumbing, or attic vents. Do not attempt to cut or modify the Solar Module Assembly to accommodate any roof projections. Roof obstructions must be removed or relocated to another area of the roof.

- **Attic ventilation...** If the GAF Solar Energy System covers a large area of the roof, proper attic ventilation and moisture control must be considered.

- **Ice dams...** Do not install the GAF Solar Energy System near areas of the roof that are prone to ice damming.

- **Shingle mismatch...** When installing a GAF Solar Array on an existing roof, all the shingles in the plane of the roof with the solar array must be removed and replaced with GAF Shingles. New shingles used in the plane of the installed solar array may not initially match existing shingles in
the other roof planes due to weathering and available colors for new shingles. However, color variation may diminish over time.

**Installation Requirements**

- **Safety first**... Follow all of the safety precautions outlined in Section 1.

- **Follow roofing best practices**... Follow all related GAF Shingle application instructions and industry best practices. Special attention is needed when stripping the shingles, installing underlayment, and flashing around the GAF Solar Energy System.

- **Installation direction**... Each row of Solar Module Assemblies is positioned from left to right and then attached to the deck from right to left. Rows are installed from bottom to top.

- **Obtain permits**... The installer must comply with local, regional, and national building codes (IBC, IFC, NEC, etc.) and obtain necessary permits and approvals from the local jurisdiction prior to installing the GAF Solar Energy System.

- **Contact local utility**... Contact your local power provider for grid connection requirements prior to the system design and installation.

- **Deck-height variations**... Repair roof if deck-height variation (either a peak or valley) is greater than 0.75 inches (19 mm) over a 4' (1,219 mm) span between trusses.

- **Water damage**... Replace water-damaged sheathing (if any).

- **Relocate obstructions**... Relocate rooftop obstructions that are directly under the planned solar array location.
Grounding

Figure 7 below summarizes the GAF Solar Energy System grounding requirements and components. Details of the assembly steps are covered in Section 4.

A continuous bare solid copper conductor is strung throughout the solar array connecting each MLPE bracket and provides the connection to the system’s main grounding point. (See Permit Design Drawings for details on this terminating connection.) Each GAF Solar Module Assembly is bonded to the solid copper ground wire through the MLPE bracket using a UL Listed WEEB® Grounding Lug and Washer (WEEB®-LUG-8.0) as shown in Figure 8 below.
The adjustable feet and MLPE bracket are bonded to the GAF frame with the provided hex grounding screw (10-32x3/8”, serrated washer, thread cutting type F) as shown in Figure 9 below.

The two parts of the Adjustable Foot Assembly are bonded together via the provided hardware as shown in Figure 10 below.

The Top Flashing and Top Corner Flashing are bonded together using UL-approved DynoRaxx® DynoBond™ Grounding Jumpers as shown in Figure 7 above. A single 38” DynoBond™ is used between two flashing pieces. The 76” DynoBond™ is used in one location to provide bonding between the flashing pieces and the bare copper system ground wire. Figure 11 below shows how the DynoBond® clip attaches to the flashing piece. Figure 12 shows the connection between the 76” DynoBond® jumper and bare copper wire at one of the MLPE WEEB® Ground Lugs.
Figure 11 DynoBond™ clip connection to flashing

Figure 12 Connection between DynoBond™ Jumper and copper ground wire
Alternatively, the system can be gounded using only DynoBond™ clips and omitting a traditional ground wire. For full instructions including how to use a DynoBond™ clip to ground the system, refer to the full Dynobond™ install manual (DynoRaxx document number 070919).

**Notes**

- The grounding hardware for the Adjustable Foot Assembly (Figure 10) can be reused up to 3 times.
- The grounding screws for the Adjustable Feet and MLPE bracket (Figure 9) are single-time use only.
- The DynoBond™ clips (Figure 11) are single-time use only.
- No more than two 10-14 AWG wires can be used in the Weeb® Grounding Lug (Figure 12). See manufacturer’s instructions.
- Systems that do not use an MLPE (i.e. use a string inverter instead) must still install the MLPE bracket and WEEB® Grounding Lug for proper system grounding.
- Use only UL-approved methods for splicing the solid copper ground wire.
Recommended Tools

The following tools (Figure 14) are recommended to properly install a GAF Solar Energy System (this list is representative only; additional tools may be required depending on the installation):

- Cordless drill
- 5/16" (8 mm) Hex driver bit (for the deck screws, solar foot and GND screw)
- #2 Phillips driver bit (for TE grounding clip and starter bar cover)
- 1/2" (13 mm) socket (for MLPE screw and S-8 split-bolt)
- 7/16" (11 mm) wrench
- Chalk line
- Torque wrench

Figure 14 Typical Tools Required
Prior to Installation

The following should be completed prior to the installation of the GAF Solar Energy System:

- **Review documentation...** Review the installation instructions and Permit Design Drawings thoroughly.

- **Ensure materials are onsite...** Ensure that all the correct materials in the appropriate quantities are present onsite.

- **Display permits...** Ensure all building/electrical permits are posted in a visible location onsite.

- **Discuss with the building owner...** Confirm access roads, material staging area, and ladder access area (as shown in the Permit Design Drawings). Also discuss work hours, installation noise, and electrical panel shutdown timing with the building owner.

- **Review site...** Review pre-existing site conditions prior to installation. If the installer notices any abnormalities in pre-existing site conditions, do **NOT** proceed with the installation until the matter is resolved with the building owner and with GAF. Typical abnormalities include:
  - Situations where site conditions do not match planned design
  - Roof obstructions
  - Excessive deck-height variations
## SECTION 4 — GAF SOLAR ENERGY SYSTEM INSTALLATION

The following steps outline the procedure to install the GAF Solar Energy System and are described in this Section:

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Prep the Roof</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2</td>
<td>Build the Starter Bar and the Solar Module Assembly</td>
</tr>
<tr>
<td>Step 3</td>
<td>Install the Starter Bar</td>
</tr>
<tr>
<td>Step 4</td>
<td>Install the First Row of Solar Module Assemblies</td>
</tr>
<tr>
<td>Step 5</td>
<td>Install the Remaining Rows of Solar Module Assemblies</td>
</tr>
<tr>
<td>Step 6</td>
<td>Install Side Flashing</td>
</tr>
<tr>
<td>Step 7</td>
<td>Install Top Flashing</td>
</tr>
<tr>
<td>Step 8</td>
<td>Install Top Flashing Underlayment and Shingles</td>
</tr>
</tbody>
</table>
Step 1: Prep the Roof

Follow the sequence below to complete this step.

**Step 1a: Prep and Clean the Deck**... For new roofs, start with a clean plywood/OSB deck. For existing roofs, proceed with a roof tear-off and clear the existing deck of all shingles and underlayment in the plane of the planned solar array. Remove or hammer in all protruding nails on the deck and prepare a **smooth and level deck surface**. Sweep away dirt and debris from the roof deck (Figure 15).

![Figure 15 Prep and clean the deck](image)

**Step 1b: Install Roofing Components on Eaves and Rakes**... Install a drip edge, leak barrier, and starter roll along the eaves and rakes using industry best practices. Refer to the latest version of the GAF Steep Slope PRO Field Guide for guidance.

**Step 1c: Install Initial Rows of Shingles up to Planned Location of the Starter Bars**... Using the Permit Design Drawings, determine the number of rows of shingles required between the eave and the Starter Bars. Locate and mark the lower-left corner of the solar array. The starting point must always land within the shingle headlap area. For example, in Figure 16 below, four rows of shingles are required to reach the starting point.
Step 1d: Install the Leak Barrier Underlayment in the Field of the Solar Array... Begin by snapping the following chalk lines on the deck:

- Snap a line 1.5" (38 mm) up from the top of the exposure of the last row of shingles installed (Figure 17).
- Snap a line marking the left, right, and top edge of the solar array.

Roll out the StormGuard® Leak Barrier, aligning its edge with the chalk line over the shingle headlap. Extend the leak barrier 3 feet (914 mm) beyond the left and right sides of the solar array (Figure 18).

Note
- The GAF Solar Energy System requires a minimum two rows of shingles to be installed at the eave.
- Confirm that all measurements and setbacks comply with the Permit Design Drawings.
Figure 18 Install the leak barrier underlayment

Step 1e: Install QuickStart® Peel and Stick Starter Roll... Install the QuickStart® Peel and Stick Starter Roll over the shingle headlap, covering the 1.5 inch (38 mm) gap between the leak barrier and the top of the shingle exposure (Figure 19). The QuickStart® Peel and Stick Starter Roll should be the same width as the solar array.

Figure 19 Install QuickStart® Peel & Stick Starter Roll

Step 1f: Install the VersaShield® SOLO™ Fire-Resistant Slip Sheet in the Field of the Solar Array... The VersaShield® SOLO™ Fire-Resistant Slip Sheet should be installed over the StormGuard® Leak Barrier and the QuickStart® Peel and Stick Starter Roll, leaving the same 1.5 inch (38 mm) gap between the shingle headlap and the edge of the slip sheet (Figure 20). To fasten, use corrosion-resistant plastic cap nails or staples with plastic caps. The Slip Sheet should be the same width as the solar array.
For slopes between 4:12 and 6:12, side and end laps should be fastened 12 inches (305 mm) on center (o.c.) and 24 inches (610 mm) o.c. elsewhere. Stagger each row of 12 inches spaced fasteners. The side lap should be overlapped 3 inches (76 mm) and end lap 6 inches (152 mm).

For slopes greater than 6:12, side and end laps should be fastened 9 inches (228 mm) o.c. and 18 inches (457 mm) o.c. elsewhere. Stagger each row of 9 inches spaced fasteners.

**Note**

- To avoid interference with the Starter Bar, do not install the first row of cap nails along the lower edge of the VersaShield® SOLO™ Fire-Resistant Slip Sheet.
Step 2: Build the Starter Bars and the Solar Module Assemblies

Follow the sequence below to complete this step.

Step 2a: Assemble the Starter Bars
Step 2b: Install the Adjustable Feet
Step 2c: Install the MLPE Brackets
Step 2d: Install the WEEB® Lug and MLPE
Step 2e: Connect the PV Wires
Step 2f: Ensure Proper Wire Management

Step 2a: Assemble the Starter Bars... Each Starter Bar receives 3-5 Adjustable Feet Bases (check the approved system drawings for your installation) which are attached using the provided carriage bolts (5/16"-18 x 1" Steel, Zinc Plated) and nuts (Flanged, 0.313\(^\text{\prime\prime}\)-18, Steel, Zinc Plated). The tooth grooves of the Adjustable Foot Base should align with the tooth grooves of the Starter Bar. Use the factory-assembled position of the Adjustable Foot (above the second tooth) by default. Torque the nut to 75 inch-pounds (8.5 Nm) See Figure 21 below. Note that adjacent Starter Bars share a common foot as shown in Figure 22 below. Please refer to the Permit Design Drawings for the Starter Bar arrangement.

Figure 21 Assembling the Starter Bar
The GAF Solar Module Assembly is composed of the parts shown in Figure 23 below. Steps 2b-2f describe the steps necessary to complete this assembly. The completed assembly is shown in Figure 31 on Page 33.

**Step 2b:** **Install the Adjustable Feet...** Each solar module receives 3-5 Adjustable Feet, depending on local regulations and environmental conditions. Check the approved system drawings for your installation to determine the proper number. After hooking the Foot onto the channel along the solar module frame, rotate it into position and align the pre-drilled hole. Attach the Foot using the hex grounding screw into the pre-drilled hole (Figure 24, next page). Torque the screw to 40 inch-pounds (4.5 Nm). Repeat this step until all the Adjustable Feet are installed as shown in Figure 25.
Figure 24 Mounting the Adjustable Foot

1. Channel
2. Pre-drilled Holes
3. Hook onto the Channel and Rotate
4. Align the Pre-drilled Holes

Figure 25 Completed GAF Solar Module Assembly

- Adjustable Feet
- MLPE bracket location
- Module Junction Box
**Step 2c:** Install the MLPE Bracket. Position the MLPE Bracket in between the Adjustable Feet on the junction box end of the module as shown in Figure 25. The MLPE bracket is installed in the same manner as the adjustable feet. Align the predrilled holes and attach the Bracket onto the frame using the grounding screw. (Figure 26 below).

**Step 2d:** Install the WEEB® Lug and Power Electronics. Follow these steps to mount the WEEB® Grounding Lug and the MLPE onto the MLPE bracket.

- Build the WEEB® grounding assembly as shown in Figure 27. Leave the flange nut loose for now. The WEEB® assembly consists of the following:
  - 5/16”-18 x 3/4” Hex Cap Screw, zinc
  - 5/16” External Tooth Washer
  - WEEB® Washer
  - WEEB® Grounding Lug
  - WEEB® 1/4”-20 Hex Cap Screw, SS (WEEB® Terminal Screw)
  - 5/16”-18 Flange Nut, Zinc.
- Slide the WEEB® assembly into the slot of the MLPE foot and center it (Figure 28).
- Slide the MLPE under the WEEB® Washer and tighten the flange nut to 120 inch-pounds (13.5 Nm) (Figure 28).
Step 2e:  **Connect the PV Wires...** Connect the module cables to the mating connectors on the MLPE.

Step 2f:  **Ensure Proper Wire Management...** It is critical to ensure that no wires come in contact with any of the Side Flashing of the array. Secure the wires to the MLPE bracket and module frame as needed. See Figure 30.

**Note**
- Do not exceed the cables’ minimum bend radius. See NEC for details.
Figure 30 Proper wire management.

Figure 31 shows the front and back of the completed GAF Solar Module Assembly.

Figure 31 Completed Module Assembly
Step 3: Install the Starter Bar

Follow the sequence below to complete this step.

**Step 3a: Snap Chalk Line**
Snap a chalk line 5.25 inches (133 mm) from the edge of the shingle exposure line (Figure 32).

**Step 3b: Position and Attach the Starter Bars to the Deck**
Align the top edge of the feet of the Starter Bars with the chalk line as shown in Figure 32. Each Foot has two rows of three pre-drilled screw holes. Use either row of screw holes to avoid seams and knots in the roof deck. Fasten the starter bar to the deck using #14 – 1-1/2” (37.5 mm) Panel-Tite™ Roofing Fasteners (Figure 33). Do not overtighten the roofing fasteners.

---

**Figure 32 Position the first Starter Bar**

**Figure 33 Attach the Starter Bar to the deck**
Note

- Because adjacent Starter Bars are spliced together using a common Foot Base, it is typically easier to assemble all of the Starter Bars together before attaching them to the deck. This allows the entire row to be aligned at once (Figure 34).

Stretch a mason line along the top edge of the Start Bars to verify that everything is at the same height (Figure 37). Adjust the feet as necessary (Figure 38).
Step 4: Install the First Row of Solar Module Assemblies

Follow the sequence below to complete this step.

**Step 4a: Mount the Solar Module Assemblies onto the Starter Bar...** Place the Solar Module Assemblies into the Starter Bars from left to right. Holding the Solar Module Assembly at ~15° angle, slide it downward until it hooks into the starter bar (Figure 35).

Align the first Solar Module Assembly with left edge of the Starter bar. Place the next Solar Module Assembly into the Starter Bar a few inches to the right of the first Solar Module Assembly. Slide it to the left until it interlocks with the first Solar Module Assembly (Figure 36). Repeat these steps from left to right until the row is complete.

Figure 35 Mount Solar Module Assembly onto the Starter Bar

Figure 36 Placing and Aligning Solar Module Assemblies
Stretch a mason line along the top edge of the row of Solar Module Assemblies to verify that all of the Assemblies are at the same height (Figure 37). Adjust the feet as necessary.

![Mason Line along the Top Edge of Solar Module Assemblies](image)

Figure 37 Checking Height of Solar Module Assemblies

The height of the foot can be adjusted from a minimum 1.72 inches to a maximum 3.15 inches. (Figure 38). If height adjustments are needed:
1. Loosen the carriage bolt and nut.
2. Align the interface to the correct tooth groove height
3. Retighten the carriage bolt and nut to 125 inch-pounds (14.12 Nm). The nut may be re-torqued up to 3 times when adjusting the height.

![Figure 38 Foot Adjustment Range](image)

Step 4b: Make Electrical Connections between MLPEs... Complete the wiring according to the Permit Design Drawings. Typical connections are shown in Figure 39. Follow proper wire management techniques to secure the wires.
Note
- Refer to the MLPE manufacturer’s installation instructions for any electrical testing and verification steps that may be required before proceeding.

Step 4c: **Align and Attach the Solar Module Assemblies to the Deck...** Starting from the rightmost Solar Module Assembly in the row, align the inner edge of the module with the outer edge of the Starter Bar, per Figure 40. This step is critical to ensure proper flashing installation.

Note
- Ensure that the right edge of the array is properly aligned.

**WARNING:** Before attaching the Adjustable Feet to the deck, ensure that no electrical cables are stuck underneath the mounting feet.
The number of #14 – 1-1/2” (37.5mm) Panel-Tite Roofing Fasteners required per foot depends on the number of feet and mounting surface. Follow the table below:

<table>
<thead>
<tr>
<th>Decking Type</th>
<th>Screws per Mounting Foot</th>
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</thead>
<tbody>
<tr>
<td>Plywood</td>
<td>3</td>
</tr>
<tr>
<td>OSB</td>
<td>6</td>
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</table>

Do not overtighten the roofing fasteners.

Figure 41 Attach the Solar Module Assembly to the Deck

**Step 4d:** Install Grounding... Attach the continuous bare copper ground wire to each WEEB® Grounding Lug. Include the DynoBond® Ground Jumper where applicable (Figure 42). Tighten the WEEB® Terminal Screw to 84 inch-pounds (9.5 Nm). Leave some slack in the copper wire between Solar Module Assemblies for wire management.

**Step 4e:** Create the MLPE Map... Create the MLPE map per manufacturer’s instructions (Figure 43). This map is required for system monitoring and maintenance.
Peel the MLPE Bar Code

Affix the Bar Code to the MLPE Map

Figure 43 Create MLPE Map
Step 5: Install the Remaining Rows of Solar Module Assemblies

Follow the sequence below to complete this step.

Step 5a: **Install Row of Solar Module Assemblies**

Repeat the sequence in Step 4 to build each row from left to right and from bottom to top. Each Solar Module Assembly must align with the one below it. Align the Solar Module Assemblies from right to left.

![Figure 44 Align Solar Module Assemblies](image)

Step 5b: **Electrically Connect Row-to-Row**

Make the necessary electrical connections from row-to-row (Figure 45) following the Permit Design Drawings. Ensure proper wire management including the home run and the ground wire. Ensure that the wires will not come in contact with the side flashing. Route the home run wire in the spacing between the mounting feet. The existing cables are long enough to extend from one row to the other.

![Figure 45 Complete Row-To-Row Wiring](image)
Step 6: Install Side Flashing

Follow the sequence below to complete this step.

Step 6a: Install Starter Bar Covers
Attach the Left and Right Starter Bar Covers using the provided screws with a #2 Phillips bit (Figure 46).

Step 6b: Install Step Flashing
The Step Flashing installs as you would with a typical skylight. Slip the first Step Flashing behind the Starter Bar Cover. Continue installing the Step Flashing and shingles up to the top of the array. Repeat for each side. See the GAF Steep Slope PRO Field Guide for installation assistance.

Step 6c: Install Counterflashing

The final Step Flashing should extend past the top of the array. In addition, make sure the shingle exposure will extend underneath the Top Corner Flashing (installed in next step). See Figure 48.
Step 6c: **Install Counterflashing...** The Counterflashing is installed from the bottom to the top. The Counterflashing is first mounted on a channel within the module frame and then pressed until a snap fit is created. Install the Left and Right Counterflashing as shown in Figure 49.

- Remove the plastic film covering from the flashing before installation. Leaving the flashing exposed to high outdoor temperatures for prolonged periods may make it difficult to remove.
- The Left and Right Counterflashing are tapered from bottom (wide) to top (narrow).
Step 7: Install Top Flashing

Follow the sequence below to complete this step.

---

**Step 7a: Install the Top Flashing Frame Insert**

*The Top Flashing Frame Insert snaps onto the top edge of the Solar Module Assembly as shown in Figure 50. Verify that every tab is engaged by pulling back on the Frame Insert. Install one Frame Insert for each Solar Module Assembly along the top row.*

**Step 7b: Install the Top Flashing Supports and DynoBond™ Jumpers**

*Place Top Flashing Supports at the corners of the array and at every module-to-module joint. It is important to place the corner Top Flashing Supports 1/4"-1/2" (6-12 mm) from the edge of the Counterflashing as shown in Figure 51. The remaining Top Flashing Supports must be centered on the joint between the Solar Module Assemblies. Each support should be fastened to the deck with two standard roofing nails within 1 inch (25 mm) of the edge. See Figure 51.*

---

**Figure 50 Install Top Flashing Frame Insert**

---

**Step 7c: Position the Top Flashing**

**Step 7d: Install the Grounding Clips on the Top Flashing**

**Step 7e: Nail the Top Flashing in Place**

**Step 7f: Install the Top Corner Flashing**

---

**Step 7c: Position the Top Flashing**

**Step 7d: Install the Grounding Clips on the Top Flashing**

**Step 7e: Nail the Top Flashing in Place**

**Step 7f: Install the Top Corner Flashing**
In high snow load areas, additional Top Flashing Supports may be required.

Bend each 38” DynoBond™ Jumper into a U-shape and pass it through the slot in one of the Top Flashing Supports. The 76” DynoBond™ Jumper is further routed through one of the MLPE Weeb® Grounding Lugs. See Figure 52. Further details on the system grounding can be found in the grounding Section on Page 17.

Attach the 76” DynoBond™ Jumper to the copper grounding wire at a WEEB™ Grounding Lug (Figure 53). Torque the terminal screw to 85 inch-pounds (9.6 Nm).
Step 7c: **Position the Top Flashing...** Position the Top Flashing so that it is aligned with the Solar Module Assembly. The Top Flashing hooks into the Top Flashing Frame Insert (Figure 54).

![Figure 54 Positioning the Top Flashing](image)

Step 7d: **Install the Grounding Clips on the Top Flashing...** The DynoBond™ Jumper clips are designed to penetrate the finishing coat on the edge of the Top Flashing. Use a hammer to lightly tap the clip into place (Figure 55).

![Figure 55 Attaching the DynoBond™ Grounding Jumper Clip](image)

**Note**
- The DynoBond™ Grounding Jumper Clips are designed for 1-time use only.
Step 7e: **Nail the Top Flashing in Place**... Attach the Top Flashing to the deck using a minimum of four evenly spaced standard roofing nails. Trim excess VersaShield® SOLO™ within ~1 inch of the Top Flashing. (Figure 56)

**WARNING:** Before fastening the Top Flashing to the deck, make sure that no electrical cables are trapped underneath the flat portion.

![Top Flashing Installation](image)

*Figure 56 Installing the Top Flashing*

Step 7f: **Install the Top Corner Flashing**... See the Permit Design Drawings to identify the Top Corner Flashing (Left or Right) that contains the wire conduit. Attach the prescribed conduit to the Top Corner Flashing before proceeding. See Figure 58 for a typical example. Install the Top Corner Flashing over the Top Flashing (Figure 57). Remember to attach the previously installed DynoBond™ Jumper Clip to each flashing. The Top Corner Flashing should be fastened with standard roofing nails along the top edge.

**NOTE**
- The nails should be covered by the leak barrier that will be installed in Step 8c.
Figure 57 Install Top Corner Flashing

Figure 58 Top Corner Flashing with Conduit
Step 8: Install Top Flashing Underlayment and Complete Shingles

Follow the sequence below to complete this step.

**Step 8a:** Install the QuickStart® Starter Roll over the Top Corner Flashing... Install a strip of QuickStart® Peel and Stick Starter Roll over each the Top Corner Flashing as shown in Figure 59. Notch as needed.

![Figure 59 Apply QuickStart® Peel and Stick Over the Top Corner Flashing](image)

**Step 8b:** Install Shingles over the Top Corner Flashing... Install the shingles over the Top Corner Flashing. Notch as needed as shown in Figure 60.

![Figure 60 Install Shingles over Top Corner Flashing](image)

**NOTE**
- Protect the wires from abrasion on the shingles and other physical damage until the installation is complete.

**Step 8c:** Install the Leak Barrier over the Top Flashing... Install StormGuard® Leak Barrier over the nailing area of the Top Flashing. The Leak Barrier should cover the headlap of the adjacent row of shingles and extend past the array approximately 3 feet (914 mm) (Figure 61).
Step 8d: Install QuickStart® Peel and Stick Starter Roll over the Leak Barrier... The QuickStart® Peel and Stick Starter Roll is the starter course for the row of shingles that will be installed above the array. The QuickStart® Peel and Stick Starter Roll is should extend to the edges of the Leak Barrier (Figure 62).
Step 8e: Install Remaining Rows of Shingles... Continue installing shingles up to the roof peak following roofing best practices (Figure 63).

Completed GAF Solar Energy System

The following figure shows the completed GAF Solar Energy System.
SECTION 5 — WIRE MANAGEMENT

An MLPE (AC Microinverter or DC Power Optimizer) is integrated into the GAF Module Assembly. Following are typical examples of how the MLPES are wired in the field. Refer to the Permit Design Drawings for exact details for your installation.

**DC Optimizer**

The typical schematic with a DC optimizer is shown below:

![Figure 65 Typical DC Optimizer Wiring](image)

**AC Microinverter**

The typical schematic with an AC Microinverter is shown below:

![Figure 66 Typical AC Microinverter Wiring](image)
The installing contractor must ensure that none of the wiring comes in contact with any of the Side Flashing. Use wire ties wherever necessary and route the wires through the gaps between the Adjustable Feet for proper wire management (Figure 67). The minimum clearance between the wires and Side Flashing is 2 inches (51 mm). Always obey the cables’ minimum bend radius.

Figure 67 Typical Wire Management
SECTION 6 — GAF SOLAR ENERGY SYSTEM MAINTENANCE

- The GAF Solar Energy System has no user-serviceable parts and requires no routine maintenance. However, periodic re-inspection of the PV installation for loose components, loose fasteners, and any corrosion of components is required. If any issues are found, the affected components must be immediately replaced by the installer.

- Do NOT attempt to dismantle the equipment or make any internal repairs. Any attempt to open the equipment could compromise the integrity of the system and void the warranty on the system.

- Do NOT attempt to clean soiled solar module assemblies. GAF Solar Module Assemblies are naturally cleaned by seasonal rains. In the unlikely event that cleaning is required, contact your installer.

- Direct all inquiries to GAF Solar Technical Support at 1-800-ROOF-411.

- For more information on GAF solar products and services for solar applications, visit gaf.com/solar.
SECTION 7 — APPENDIX

GAF Solar Module Technical Data

Table 4 Solaria Laminate Specifications

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**Performance at NOCT (800W/m², 20°C Amb, Wind 1 m/s, AM 1.5)**

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**Temperature Characteristics**

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<td>Temp. Coeff. of Isc [% / °C]</td>
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**Design Parameters**

| Operating temperature [°C] | -40 to +85 |
| Max System Voltage [V] | 1000 |
| Max Fuse Rating [A] | 15 |
| Bypass Diodes [A] | 4 |

**IV Curves vs. Irradiance (350W Module)**

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**Mechanical Characteristics**

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<th>Cell Type</th>
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<tr>
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<td>AR Coated, Tempered / 3.2mm</td>
</tr>
<tr>
<td>Frame Type</td>
<td>Anodized Aluminum</td>
</tr>
<tr>
<td>Cable Type / Length</td>
<td>12 AWG PV Wire (UL) / 1000mm</td>
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<td>Connector Type</td>
<td>Amphenol H4 (MC4 compatible)</td>
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<td>Junction Box</td>
<td>IP67 / 4 diodes</td>
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<td>Front Load (UL 1703)</td>
<td>5400 Pa / 113 psf*</td>
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<tr>
<td>Rear Load (UL 1703)</td>
<td>2400 Pa / 50 psf*</td>
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*Refer to Solaria Installation Manual for details

**Certifications / Warranty**

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<td>Fire Type (UL 1703)</td>
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<tr>
<td>Power &amp; Product Warranty</td>
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* Warranty details at www.solaria.com
### Table 5 Silfab Laminate Specifications

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<th><strong>Electrical Specifications</strong></th>
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<td>Maximum power current (Ipmax)</td>
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<td>Power Tolerance</td>
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**Measurement conditions:** STC 1000 W/m² - AM 1.5G - Temperature 25 °C - NOCT 80 °C - AM 1.5G - Measurement uncertainty ± 3%

**Temperature Ranges**

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<td>Temperature Coefficient Pmax</td>
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<td>NOCT (± 2°C)</td>
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**Mechanical Properties and Components**

<table>
<thead>
<tr>
<th><strong>SILFAB SLA Monocrystalline</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hail impact resistance</td>
</tr>
<tr>
<td>Cells</td>
</tr>
<tr>
<td>Glass</td>
</tr>
<tr>
<td>Backsheet</td>
</tr>
<tr>
<td>Bypass diodes</td>
</tr>
<tr>
<td>Cables and connectors</td>
</tr>
</tbody>
</table>

#### Certifications

<table>
<thead>
<tr>
<th><strong>SILFAB SLA Monocrystalline</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
</tr>
<tr>
<td>Factory</td>
</tr>
<tr>
<td>ISO 9001:2008</td>
</tr>
</tbody>
</table>

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**Warning:** Read the installation and User Manual before handling, installing and operating modules.

Third-party generated pan files from PV Evolution Labs available for download at: www.silfab.ca/downloads

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### Table 6 Mechanical Properties of the GAF Solar Energy System

<table>
<thead>
<tr>
<th></th>
<th>With Solaria Laminates</th>
<th>With Silfab Laminates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (Framed Module + 5 Mounting Feet + MLPE Bracket)</td>
<td>55 lb. (53 kg)</td>
<td>51 lb. (23 kg)</td>
</tr>
<tr>
<td><strong>Width</strong></td>
<td>45.0 inches (1,143 mm)</td>
<td>40 inches (1,016 mm)</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>65.3 inches (1,659 mm)</td>
<td>66.5 inches (1,689 mm)</td>
</tr>
<tr>
<td><strong>Depth, Front</strong></td>
<td>1.67 inches (42 mm)</td>
<td></td>
</tr>
<tr>
<td><strong>Depth, Back</strong></td>
<td>Adjustable</td>
<td></td>
</tr>
<tr>
<td><strong>Frame</strong></td>
<td>Black anodized aluminum</td>
<td>Black powder-coated aluminum</td>
</tr>
<tr>
<td><strong>Mechanical Loading</strong></td>
<td>50 lb./ft² (244 kg/m²) positive design load</td>
<td>50 lb./ft² (244 kg/m²) positive design load</td>
</tr>
<tr>
<td></td>
<td>40 lb./ft² (195 kg/m²) negative design load</td>
<td>50 lb./ft² (244 kg/m²) negative design load</td>
</tr>
<tr>
<td><strong>Fire Rating</strong></td>
<td>Class A per UL 2703</td>
<td></td>
</tr>
</tbody>
</table>

To achieve a Class A fire rating, the solar array must be installed with one ply of StormGuard® Film-Surfaced Leak Barrier followed by one ply of VersaShield® SOLO™ Fire-Resistant Slip Sheet over minimum 15/32 inches (11.9 mm) thick plywood or 7/16 inches (11.1 mm) OSB roof deck. Please refer to Underwriters Laboratories Certifications Directory for actual assemblies.
GAF Solar Energy System Codes and Standards
The GAF Solar Energy System includes the GAF Solar Module Assembly, the underlayment system, and flashing components. Certifications are listed below.

PV Laminate (Frameless)
The PV laminates are certified to UL 1703.

GAF Solar Module Assembly and Flashing
- The GAF Solar Module Assembly and Flashing are certified to UL 2703.
- The certification includes the MLPE Mounting Bracket and Grounding Lug.

GAF Solar Array
The GAF Solar Array was tested to comply with the following roofing standards:
- UL 1897 – Uplift Tests for Roof-Covering Systems
- TAS 100 – Test Procedure for Wind and Wind-Driven Rain Resistance of Discontinuous Roof Systems

Fire Rating
The GAF Solar Module Assembly, in combination with the underlayment system, is classified as a Class A fire rated system per UL 2703.

Underlayment System
StormGuard® Film-Surfaced Leak Barrier is tested and certified to comply with the following standards:
- Used as Steep Roofing Underlayment for Ice Dam Protection
- ICC-ES Evaluation Report (ESR-1322)
- Miami-Dade County Product Control approved (18-0119.15)
- State of Florida approved (FL10626)
- UL Classified

VersaShield® SOLO™ Fire-Resistant Slip Sheet is tested and certified to comply with the following standards:
- UL Classified
- Miami-Dade County Product Control approved (16-1216.02)

QuickStart® Peel and Stick Starter Roll is tested and certified to comply with the following standards:
- Meets or exceeds the physical requirements of ASTM D1970
- State of Florida approved (FL10124)

Note
- Refer to UL Online Certification Directory for actual assemblies.
- Follow all instructions in this document to assure the system is installed as certified.
Alternate Solar System Configurations

The GAF Solar Array can be assembled in non-rectangular configurations. This section describes the unique steps required for these configurations.

Type B – Left Bottom Inside Corner OR Right Bottom Inside Corner Configuration
With this configuration, the Counterflashing must be field-modified to accommodate the adjoining Starter Bar. The other flashing components are used as is.

**Step 1:** Trim the Right Counterflashing as shown in Figure 69 or the Left Counterflashing as shown in Figure 70. The Right Counterflashing requires a compound cut while the Left Counterflashing requires a single straight cut.
Step 2: Install the shingles, underlayment, Starter Bar, Solar Module Assembly, Step Flashing, and the field-trimmed Counterflashing as shown in Figure 71.

Step 3: Snap a chalk line to align the Adjustable Feet to the adjacent Starter Bar as shown in Figure 72. Leave a small (approximately 1/8 inch) gap between the Inside Counterflashing and the Starter Bar. Attach the Starter Bar to the deck.

Step 4: Align and attach Solar Module Assemblies 2 and 3 as shown below. Complete the array following the standard installation procedures.
**Type C – Left Bottom inside Corner AND Right Bottom inside Corner Configuration**

With this configuration, the Left and Right Counterflashing as well as the Starter Bar must be field-modified to ensure a proper fit. The other flashing components remain the same.

**Step 1:**

Following the standard installation procedures, install the shingles up to the location of Starter Bars 1 and 2 as well as the adjacent underlayment. Locate and attach Starter Bar 1. Next, align and attach Starter Bar 2 using the appropriate spacing per the Permit Design Drawings.

**Note**
- Accurate placement of Starter Bar 2 is critical to the assembly of the rest of the array.

**Step 2:**

Attach the Solar Module Assemblies as shown in Figure 76. Continue to step flash and shingle along the sides of the Solar Module Assemblies. Trim the Right Counterflashing as shown in Figure 69. Attach the Right Counterflashing to Solar Module Assembly 1.
Step 3: Install the underlayment. Field modify Starter Bar 3 by removing 1 inch from both sides. Snap a chalk line to align and attach the shortened Starter Bar 3 as shown in Figure 77. Trim the Left Counterflashing as shown in Figure 70. Install the Left Counterflashing to Solar Module Assembly 2. Complete the array following the standard installation procedures.
### Version Control

<table>
<thead>
<tr>
<th>Version Number</th>
<th>Date</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0.0</td>
<td>5/2017</td>
<td>Added info on Alignment Pins, Version Control Table, Custom Step Flashing, and lab tested design load values.</td>
</tr>
<tr>
<td>1.0.1</td>
<td>7/2017</td>
<td>Added alternate array configurations and 2 wire WEEB lug.</td>
</tr>
<tr>
<td>1.1.0</td>
<td>11/2017</td>
<td>Added Silfab laminate, adjustable feet, updated SKU numbers and right counterflashing install, wire management techniques and grounding methods for the adjustable feet.</td>
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<tr>
<td>2.0</td>
<td>03/2018</td>
<td>Edited for clarity</td>
</tr>
<tr>
<td>3.0</td>
<td>04/2019</td>
<td>Updated product name, updated SKUs, added Solaria laminate, removed SolarWorld laminate</td>
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<tr>
<td>3.1</td>
<td>08/2019</td>
<td>Added three-feet mounting option, more Dynobond grounding options</td>
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Table 8: Version Control Table