Sample Product Label
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INTRODUCTION

Intended Users of This Manual:
This manual is intended as a guideline to assist a qualified solar systems integrator in the design and installation of a solar energy system using Global Solar PowerFLEX™ modules. It is for installation purposes only.

The electrical and mechanical design of a system using Global Solar PowerFLEX™ modules must be completed, and the installation must be approved, by a qualified solar systems integrator. The system integrator and installer are responsible to complete installation in accordance with the industry’s “Best Practices” methods and all applicable building, electrical, fire and other codes and regulations (the “Codes”) in addition to the specific recommendations stated in this manual. The Global Solar PowerFLEX™ modules are not intended for self-installation by end users.

This manual contains information for the installation of the following UL Listed and IEC Certified modules:
- FG-1BTM 6m module w/ mastic adhesive
- FG-1BTN 6m module w/o mastic adhesive
- FG-4BTM 4m module w/ mastic adhesive
- FG-4BTN 4m module w/o mastic adhesive
- FG-2BTM 2m module w/ mastic adhesive
- FG-2BTN 2m module w/o mastic adhesive
- FG-1BFM 6m module w/ mastic adhesive
- FG-1BFN 6m module w/o mastic adhesive
- FG-4BFM 4m module w/ mastic adhesive
- FG-4BFN 4m module w/o mastic adhesive
- FG-2BFM 2m module w/ mastic adhesive
- FG-2BFN 2m module w/o mastic adhesive
- FG-1BBM 6m module w/ mastic adhesive
- FG-1BBN 6m module w/o mastic adhesive
- FG-4BBM 4m module w/ mastic adhesive
- FG-4BBN 4m module w/o mastic adhesive
- FG-2BBM 2m module w/ mastic adhesive
- FG-2BBN 2m module w/o mastic adhesive
Part Number:

FG-1(Color)(Junction Box)(Adhesive)-(Power Bin ID)-(Certification)

Example:
- Part Number **FG-1BMT-275-E** is a module with a $P_{\text{max}}$ of 275 W, a black background color, top mounted junction box with mastic adhesive on the bottom of the module, and is only IEC certified.

Color
- **B** – Black back-sheet behind cells

Junction Box
- **T** – Top mounted, TE Connectivity SOLARLOK™ Micro Junction Box
- **F** – Top mounted, Multi-Contact JM/FM Photovoltaic Junction Box
- **B** – Bottom mounted, Multi-Contact JM/FM Photovoltaic Junction Box

Adhesive
- **M** – Butyl mastic adhesive on bottom of module
- **N** – No adhesive on the bottom of the module

Certification Compliance
- **Blank** – EN 61646, EN 61730, and UL 1703 listed
- **E** – EN 61646 and EN 61730

The module serial number directly indicates the manufacturing location of the module:
- **1XXXXXX** – GSET, Tucson, Arizona, USA
GENERAL INFORMATION

Global Solar Energy is the solar industry leader in the manufacture of highly efficient thin-film solar cells for glass module or flexible material uses. Global Solar Energy has provided CIGS (Copper Indium Gallium diSelenide) strings to its customers for over a decade and is on the forefront of CIGS technological improvements. With the PowerFLEX™ module, Global Solar Energy now supplies the BIPV (Building Integrated Photovoltaic) market with one of the most efficient, lightweight, flexible thin-film PV (photovoltaic) products available.

The PowerFLEX™ module is an attractive and durable PV module designed to withstand the harshest climates for years and to provide a reliable solar energy supply. The PowerFLEX™ module uses engineered thermoplastic encapsulants and adhesives intended to address many of the issues that have plagued other BIPV products. PowerFLEX™ modules are designed to be bonded to new roofs. They are available as a bare module or with factory applied butyl mastic adhesive, reducing installation time to a minimum.

As per local, state, and national electrical codes, only qualified and licensed electricians should complete the final wiring of the PowerFLEX™ PV array to the building electrical system. The other BOS (Balance of System) components in the system must also meet UL and/or IEC specifications for their use and must meet all applicable Code requirements. Code requirements include, in the United States, NEC (National Electric Code) codes for system integration and, in Canada, CSA C22.1; Safety Standard for Electrical Installations, Canadian Electrical Code, Part I.
DISCLAIMER OF WARRANTIES AND LIABILITY

The information contained in this manual is subject to change without prior notice. Global Solar Energy makes no warranty, either expressed or implied, with respect to the information contained in this manual. Global Solar Energy expressly warns to any user of this manual that it does not contain all the information necessary to design or install a system using the PowerFLEX™ modules and directs attention to applicable Codes and to industry best practices for design, installation, and connection of photovoltaic systems.

Global Solar Energy is not liable for damages of any kind, as a result of the use of the information contained in this manual. If any representations and warranties are made by Global Solar Energy regarding the PowerFLEX™ modules, such representations and warranties are not made in this manual but are included in a separate, written purchase agreement or warranty for the products. Global Solar expressly disclaims any warranty arising under this manual and any unwritten or implied warranty.

PURPOSE OF THIS MANUAL

This installation manual is to serve as a guide for use by an experienced photovoltaic system designer and/or installer. This manual is to be used only in coordination with all building, electrical, fire and other codes or regulations applicable at the site where a system using PowerFLEX™ modules is to be installed. Applicable local, state, and national codes take precedence if there is any discrepancy between this manual and all applicable local, state, and national codes.
SAFETY PRECAUTIONS

- The PowerFLEX™ module produces DC electricity when exposed to any light source. **Thus, the potential for an electrical shock is present whenever the module is exposed to light.** Caution must be used when working with or around the module.

- Do not connect or disconnect modules when current from the modules or an external source is present. PowerFLEX™ modules should therefore be covered to block light during interconnection and wiring. This is to reduce the risk of arcing, electric shock, and fire.

- Abide by all applicable local, state, and national Codes at all times during the installation of the PowerFLEX™ modules.

- Installation of the PowerFLEX™ modules must be conducted or overseen by a qualified and licensed roofing, electrical, or solar contractor. Modules are not designed for self-installation by an end-user.

- No objects or equipment should be placed or dropped on a PowerFLEX™ module. Stepping or walking on the module(s) is not recommended. Doing so creates risk of damage to the module and of arcing, electrical shock and fire. Damage caused to the module in this manner will void the product warranty.

- The PowerFLEX™ modules are not designed for concentrated sunlight, which may damage the modules. Under no circumstances should any kind of lens or other artificial method be used to direct concentrated sunlight onto the PowerFLEX™ module.

- There are no user serviceable parts within the PowerFLEX™ modules. Do not attempt to repair any part of a module.
• Do not disassemble the PowerFLEX™ modules or remove any part installed by the manufacturer.

CAUTION

Under no circumstances should the module be cut, penetrated, creased, bent or rolled with a diameter smaller than 20 inches (50cm). Any such action may cause a physical alteration to the module. Doing so may disable the module or may cause arcing, electric shock, or fire. Doing so will void the Limited Warranty.

The module should only be rolled sunny (PV cell) side in with the bottom of the module facing out.

The electrical leads must never be used to hold or move the module.

UNPACKING, HANDLING, AND STORING THE MODULES

Unpacking and Handling:

• FG-1 modules are shipped rolled on a core
• FG-2 modules are shipped flat in a box
• FG-4 modules are shipped rolled on a core

Rolled On Core -

Careful handling is required when unpacking, moving, and installing the PowerFLEX™ modules. While the PowerFLEX™ product is flexible, the module should not be bent or rolled into a diameter of less than 20 inches (50cm). Exceeding this limit may damage the module and void the warranty. The module should only be rolled sunny side in with the bottom of the module facing out.

Specific handling instructions include:

• Do not open the box with a knife or box cutter having a blade longer than 1 inch (25mm)
Carefully cut the packaging tape and unroll the modules on a dry, even surface free of any debris.

Image 1-2: Un-packing the PowerFLEX™ Module

Image 3-4: Packaging separation and module lead removal

- Separate all pieces of the packaging and un-thread the module leads
- Do not drop or place ANY objects on the modules including tools, equipment, or other system components
- Do not carry a module by its wires or junction box
- Do not stand on or scratch the modules
- Do not mark the modules using sharp implements
- Never leave a module unsupported or unsecured
• Keep all electrical contacts clean and dry during the installation of the modules

**Flat in Box -**

*Image-5: Un-packaging the PowerFLEX™ Module*

*Image-6: Un-packaging the PowerFLEX™ Module*

*Image 7-8: Packaging removal and module separation*
• Modules are packaged in groups of 2 that are alternated to maximize module protection and shipping space
• Each J-Box is further covered with a cardboard or foam covering to protect it from any potential shipping damage
• It is possible to separate each module and remove the module packaging without a knife or box cutter
  o If a knife or box cutter is used, great care must be taken to prevent the module from being damaged
• Do not drop or place ANY objects on the modules including tools, equipment, or other system components
• Do not carry a module by its wires or junction box
• Do not stand on or scratch the modules
• Do not mark the modules using sharp implements
• Never leave a module unsupported or unsecured
• Keep all electrical contacts clean and dry during the installation of the modules

Storage:
• The PowerFLEX™ modules may be stored up to 6 months at ambient temperatures between 40°F & 75°F (4.4°C & 25°C) and less than 85% relative humidity, non-condensing.
• While in storage, the PowerFLEX™ modules should remain in their original packaging and should not be stacked more than 3 high for coiled modules and 4 high for modules shipped flat.
• Packaged modules are not designed to be exposed to direct sunlight, rain, or outdoor weather exposure. Doing so may damage the modules.

INSTALLING PowerFLEX™ modules
Before installing modules, contact the appropriate authorities and obtain any required building permits and to determine installation and inspection requirements that apply to the installation site.
Verify that the Solar System design has been approved by appropriate authorities relative to applicable Codes and that the construction or structure (roof, facade, support, etc.) where the modules are being installed is properly rated for the additional load.

When installing the modules, make sure the assembly is mounted over a fire resistant roof covering rated for the application and at a slope consistent with the desired fire rating (See Fire Rating Section).

**DESIGN CONSIDERATIONS:**

**The following guidelines should be evaluated and considered by the PV system designer and are provided here for reference only.**

**Environmental conditions:**

- The PowerFLEX™ modules are intended for use in general open climates, as defined in IEC 60721-2-1: Classification of environmental conditions Part 2-1: Environmental conditions appearing in nature - temperature and humidity.
- The PowerFLEX™ modules must not be installed in the proximity of highly flammable gases and vapors (e.g., filling stations, gas containers, paint equipment).
- The PowerFLEX™ modules must not be installed near open flames or flammable materials.
- Do not expose the PowerFLEX™ modules to artificially concentrated light sources.
- To ensure proper adhesion, follow the roofing material and adhesive manufacturer’s recommendations for best practices. In addition, the new roofing system must be completely dry before PowerFLEX™ modules are installed. Any moisture on the roof will prevent the module from fully bonding to the roofing substrate.
- Furthermore, do not install PowerFLEX™ modules if there is a chance of rain or any other type of precipitation on the day of installation or if outside the specified temperature range.
System and Site Considerations:

- The PowerFLEX™ modules are intended for use only in applications where they do not serve as part of a building primary structural frame.
- Do not install the PowerFLEX™ modules so that the building or other structure, or other systems or components, exert damaging mechanical or electrical influences on the modules.
- The system designer should consider module and array mismatch effects to maximize array performance.
- To minimize risk of damage in the event of an indirect lightning strike or external electrical malfunction, avoid forming loops in electrical leads and wiring when designing the system.
- The PowerFLEX™ modules should be installed with the long axis of the module parallel to the roof slope and with the junction box at the high point. If an installation with the long edge horizontal to the roof slope is necessary, care must be taken to ensure that the module edges are suitably protected from the direct flow of shedding water. This may be accomplished with the proper application of roof sealing tape along module edges.
- PowerFLEX™ modules should be firmly fixed in place in a manner suitable to withstand all expected loads, including wind and snow loads.
- The roofing surface must be flat enough to allow full contact between the module adhesive and the exposed roofing material in every instance. Installing any module not in full contact with the roofing material will void the module warranty.
- The PowerFLEX™ module assembly has a UL Fire rating of Class C:
  - UL790 When applied to non-combustible deck materials
  - UL1703 When applied to metal sheet with a thickness of 0.5mm or greater
  - The minimum allowed roof pitch is ½:12 (3°) with positive drainage.
  - The maximum allowed roof pitch is 10:12 (40°) unless securely fastened to avoid creep.
• Although designed to be shade tolerant, best performance will occur when shading is avoided. Partial shading (e.g., from foliage or even from dirt deposits) will cause a reduction in power production. A module is considered "shade-free" if the sun is unobstructed across the module’s entire surface during daylight hours for the entire year.

• Avoid ponding water. At a minimum PowerFLEX™ modules must be installed over a roof that has verifiable positive drainage per NRCA’s (National Roofing Contractors Association) guidelines. Refer to the roofing material manufacturer for any additional requirements. Modules installed where ponding water occurs will not be covered by the product warranty.

• In order to eliminate the possibility of ponding water on the module, do not install PowerFLEX™ modules near roofing drains, in crickets, or on other low areas of the roof.

• In addition to a WMS (Wire Management System), it is also beneficial to cover the junction box of the PowerFLEX™ module to protect the Junction Box and wires from UV irradiation and possible snow and ice forces.

• Array layout, design and wire management systems should not affect slope-to-drain of the roofing system.

• PowerFLEX™ modules are designed for use in series strings. The maximum series connections are dependent on the absolute lowest recorded temperature, system specifications, and local, state, and national electrical codes.

Inverter Selection

• Transformerless Inverters can be used with GSE PowerFLEX™ modules in all appropriate array and string sizes on non-metallic roofing substrates. This can include all roof structures that do not contain continuous metal surfaces within a 2” separation plane below the modules. This also does not to pertain to any metallic hardware or piping penetrations.
The use of Transformerless Inverters with GSE PowerFLEX™ modules on metallic roofing surfaces is not recommended. Transformerless (non galvanic isolation) inverters produce some AC ripple current that will oscillate through the array and induce unsafe capacitive discharge currents.

The use of SMA Transformerless Inverters with GSE PowerFLEX™ modules on metallic roofing surfaces is strictly limited to the Tripower inverters (from 12-60KW) that all include “Quiet-Rail” technology. Without the “Quiet-Rail” topology, some AC ripple current will oscillate through the array and induce capacitive discharge currents. To elevate any potential safety concerns for equipment and personnel, the inverters residual current monitoring will ultimately separate the array from the grid.

**PowerFLEX™ ROOFING INSTALLATION GUIDANCE**

The following guidelines are provided for the installation of the PowerFLEX™ module with Butyl Mastic adhesive attached to a 20 inch or wider roofing surface (21 inch or wider SSR pans are recommended to minimize potential shading). Installation requires at least two qualified installers in order to properly handle the modules.

The PowerFLEX™ modules are designed to be adhered to a metal Kynar coated Galvalume™ or Zincalume™ pan or other approved roofing surfaces using the butyl mastic adhesive. Refer to the section “Installation of Mastic onto Modules without Mastic” if the modules did not come with attached mastic.

GSE only recommends new, fully-adhered membrane (100% adhesive coverage between the membrane and roof decking) roofing construction. Roofing membranes that are older or not fully adhered are not recommended. Installation on existing or non-approved roofing surfaces may void the module warranty unless the system integrator secures confirmation in writing from Global Solar Energy that the other roofing surface is suitable for use with the modules.
Primer is required for an optimal bond to EPDM and TPO roofing membranes. Material selection and application must be done per roofing membrane manufacturer’s recommendations for peel and stick product applications.

If there is any doubt about adhesion to the roofing surface; adhesion testing of a small area must be conducted before the array is installed to minimize risk of future delamination.

A. ADCO HelioBond® PVA 600BT has been qualified for adhesion to the back-sheet of the PowerFLEX™ module.

B. PowerFLEX™ modules should only be bonded to roofing surfaces that are at least 20” (51cm) wide (21” (53cm) recommended) and 2 inches (5cm) longer than the overall PowerFLEX™ module length with a flat profile. The module must not be bonded to uneven roofing surfaces with decorative stippling, pencil beads, stiffening ribs, or over-lapping roof seams.

**Fig-1: Minimum Roofing Sizes**
C. The ambient temperature at the time of installation should be between 40°F - 95°F (4.4°C - 35°C). If the temperature is higher than 95°F (35°C) the release liner may be difficult to remove from the butyl mastic. If the temperature is lower than 40°F (4.4°C), the butyl mastic may not adhere properly to the roofing surface. The minimum recommended installation temperature is 40°F (4.4°C) and rising. In hotter climates, the modules should be stored in a shaded area prior to installation to prevent excessive heating of the adhesive.

D. The roofing surface must be cleaned, dry and free of all debris; talc, dust, dirt, oil, ice, snow or moisture will inhibit good adhesion and limit the installation lifetime. In order to achieve the required adhesion, the roofing surface must be cleaned with a roofing manufacturer recommended cleaning solution or alternatively, washed with a mild soap and water solution and then wiped down with a solution of at least 70% isopropyl alcohol and 30% water.

E. The area designated for the installation of the PV array must be allowed to dry completely after cleaning so as not to trap any moisture between the roofing surface and the butyl mastic.

F. To ensure proper adhesion, follow the roofing material and adhesive manufacturer’s recommendations for best practices. In addition, the new roofing system must be completely dry before PowerFLEX™ modules are installed. Any moisture on the roof will prevent the module from fully bonding to the roofing substrate.

G. After the area is dry, align the PV array over the area of intended installation and verify that the layout sizing is correct. Maintain a minimum separation of at least ½” (1.3cm) when bonding in a factory and at least ¾” (2cm) when bonding at site to allow for variations in positioning the PowerFLEX™ modules and to assist in water drainage.

H. It is recommended that each module be visually inspected for damage just prior to bonding. If practical, an electrical test may also be performed. Attempting to remove a bonded module will result in damage to the module and may result in damage to the roofing surface. Such damages are not covered by the product warranty.

I. Starting from the connector end of the PowerFLEX™ module, peel approximately 12 inches (30cm) of the plastic liner off of the module exposing the butyl mastic. Fold the plastic liner under the module.
**CAUTION:** The PowerFLEX™ module must be properly aligned on the roofing surface, and will not move on the roofing surface after this process. Press the module end with exposed butyl mastic to the roof surface. **The module must not be rolled to less than 20 inches (50cm) diameter.**
J. From the non-connector end of the PowerFLEX™ module and with the backing still attached to the non-connector end, roll the module onto itself until you reach the connector end of the module. Once the folded backing is exposed one person should peel the exposed backing from the module as another person unrolls the PowerFLEX™ module onto the roofing surface making sure the module is aligned and no air bubbles are trapped under the module. Take care to not rip apart the release liner while pulling it off the backside of the laminate. This may form areas where the adhesive cannot stick to the substrate and could lead to de-bonding over time.

![Image-11: Application of Module Maintaining Inner Diameter](image1)

Image-11: Application of Module Maintaining Inner Diameter

![Diagram](fig4)

Fig-4: Application of Module Maintaining Inner Diameter (with Top J-Box)
Starting in the middle of the PowerFLEX™ module and then progressing to the edges; use a roller (no heavier than 80 lbs or 36 kgs) to ensure adherence of the module to the roofing surface. The application force should be no greater than 2,016lb/ft² (9,843 kg/m²) to prevent damage to the bypass diodes but sufficient to ensure good adhesion. Use a narrow, rounded edge detail roller along the perimeter of the module to ensure proper edge adhesion. Recommended rolling tools may be found in the Appendix of this document. **The edge roller should be used as in Image-13 until the edge is uniformly black in color.**
Image-13: Use of edge-roller for proper adhesion
### Physical Specifications:

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Adhesive</th>
<th>Part No.</th>
<th>Length (m)</th>
<th>Width (m)</th>
<th>Thickness (mm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Mastic</td>
<td>FG-1BXN-XXX</td>
<td>5.75</td>
<td>0.49</td>
<td>2.6</td>
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<td>in wattages of 300, 275</td>
<td>w/o Mastic</td>
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<td>0.49</td>
<td>2.6</td>
<td>7.2</td>
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<td>Mastic</td>
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<td>w/o Mastic</td>
<td>FG-4BXN-XXX</td>
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<td>0.49</td>
<td>2.6</td>
<td>4.9</td>
</tr>
<tr>
<td>PowerFLEX™ 2</td>
<td>Mastic</td>
<td>FG-2BXN-XXX</td>
<td>2.02</td>
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<td>3.0</td>
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<tr>
<td>in wattages of 100, 90</td>
<td>w/o Mastic</td>
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<td>2.02</td>
<td>0.49</td>
<td>2.6</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Note 1: For Field connections, use #12AWG or larger aluminum or copper wires insulated for a minimum of 194°F (90°C).

Note 2: Modules with the “-E” suffix are not UL Listed and only IEC Certified.

Note 3: The “X” in the Part Number may represent “T” for a top mounted TE Connectivity j-box, “F” for a top mounted Multi-Contact j-box, or a “B” for a bottom mounted Multi-Contact j-box.

### Rated / CEC Electrical Specifications at STC:

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<tr>
<th>Type</th>
<th>Part No.</th>
<th>Pmax (W)</th>
<th>Vmax (V)</th>
<th>Imax (A)</th>
<th>Voc (V)</th>
<th>Isc (A)</th>
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</thead>
<tbody>
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<td>PowerFLEX™ 4</td>
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</tbody>
</table>

Note 1: Standard Test Conditions (STC): Cell Temperature at 25°C; Solar irradiance intensity of 1000 W/m²; AM 1.5 solar reference spectrum (ASTM E892).

Note 2: The electrical characteristics of Pmax are within +10 / -7 percent of the indicated value.

Note 3: Other electrical characteristics are within ±10 percent of the indicated values.

Note 4: Modules with the “-E” suffix are not UL Listed and only IEC Certified.

Note 5: The “X” in the Part Number may represent “T” for a top mounted TE Connectivity j-box, “F” for a top mounted Multi-Contact j-box, or a “B” for a bottom mounted Multi-Contact j-box.
Temperature Coefficients:

<table>
<thead>
<tr>
<th></th>
<th>Pmax (W)</th>
<th>Vmax (V)</th>
<th>Isc (A)</th>
<th>Voc (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerFLEX™ PV Module</td>
<td>-0.43 %/°C</td>
<td>-0.38 %/°C</td>
<td>-0.03 %/°C</td>
<td>-0.33 %/°C</td>
</tr>
</tbody>
</table>

Bypass Diode Specifications:

<table>
<thead>
<tr>
<th>Type</th>
<th>Configuration</th>
<th>V_f</th>
<th>A_f(AV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vishay MBR20H150CT</td>
<td>Bypass</td>
<td>0.75</td>
<td>20</td>
</tr>
<tr>
<td>(TE Connectivity J-Boxes)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vishay SPK15200</td>
<td>Bypass</td>
<td>0.60</td>
<td>15</td>
</tr>
<tr>
<td>(Multi-Contact J-Boxes)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note 1: The maximum series fuse rating: 10.0 A E.g. KLK D 10.

Fire Rating:

The module assembly is to be mounted over a non-combustible roof covering rated for the application. UL Fire rating of Class C applies when the module is mounted on a steel sheet of 26 gauge (0.5mm) or greater in thickness.

The PowerFLEX™ module assembly has a UL Fire rating of Class C:
- UL790
  - When applied to non-combustible deck materials
- UL1703
  - When applied to metal sheet with a thickness of 0.5mm or greater
- The maximum allowed roof pitch is 10:12 (40°) unless securely fastened to avoid creep.

Other Specifications:

- Under real world conditions, a photovoltaic module is likely to experience conditions that produce more current or voltage than reported at standard test conditions. Accordingly, the values of Isc should be multiplied by a factor of 1.23 and Voc should be multiplied by a factor of 1.12 when determining component voltage ratings, conductor ampacities, fuse sizes, and size controls connected to the PV output.
• Refer to Section 690-8 of the National Electrical Code for an additional multiplying factor of 125 percent (80 percent de-rating) which may be applicable.

• The PowerFLEX™ module is lead free and is presently exempt from RoHS requirements.

• For field connections, use #12AWG (4mm²) or larger aluminum or copper wires insulated for a minimum of 194°F (90°C).

• The maximum system voltage: UL 600V / IEC 1000V

• A series fuse rating of 10A or lower is required.

• PowerFLEX™ modules conform to IEC 61730, Application Class A and Safety Class II requirements.

**MODULE WIRING**

Make sure that the connection is safe and tight. The locking connector should be secured enough to avoid mechanical stress or damage. **The connector should only be used to connect the circuit. It should never be used as a DC disconnect.**

![Tyco Module Wiring Diagram]

Fig-7: Tyco Module Wiring
Use of suitable materials:

Tyco SOLARLOK (TE Connectivity) Connectors and Multi-Contact MC4 / MC4+ of #12 AWG (4mm²) or larger are recommended:

- TE Connectivity SOLARLOK Male (positive) – Part Number: 6-1394461-2
- TE Connectivity SOLARLOK Female (negative) – Part Number: 1394462-4
- Multi-Contact Male (positive) – Part Number: PV-KST4
- Multi-Contact Female (negative) – Part Number: PV-KBT4

- For series connections, the positive labeled male connector on the junction box of a module should be connected to the negative (blue rubber ring) female connector of an adjacent module’s junction box.

- Adaptors to convert the Tyco SOLARLOK connectors to other types are commercially available. Removing the supplied connectors or cutting the module leads will void the product warranty as well as the UL/IEC certification.

Extension Cabling:

- AWG (mm²) of extension cables should be at least as large as the
- 12 AWG 4 (mm²) of the module junction box cables and sized for the minimum wire losses.
• The positive labeled male connector on the junction box should be connected with a negative (blue rubber ring) female connector of an extension cable.
• The negative (blue rubber ring) female connector on the junction box should be connected with a positive male connector of an extension cable.

**Cable Protection:**

• Secure the cables using UV-resistant cable ties to prevent exposed cables from becoming a trip-hazard, to protect against damage to the system or adjacent structures, and to protect against shading of the modules.
• In addition to a WMS (Wire Management System), it is also recommended to cover the junction box of the PowerFLEX™ module to protect the Junction Box and wires from UV irradiation and possible snow and ice forces.

**Grounding:**

**ATTENTION:**
For proper wiring and grounding please follow best practices and codes for your country:
• NEC 690.5—United States
• DIN VDE – Germany
• CSA – Canada
• IEC 60364 – Many European Countries
• BS 7671 – Great Britain

• NEC 690.5 requires that all PV systems be provided with dc ground-fault protection meeting the requirements of 690.5(A) through (C).
• When PowerFLEX™ modules are adhered to a metal pan or surface the metal should be grounded using grounding clamps i.e. GBL-1/0.
• Metal parts (pans, conduit, etc.) that are in contact with the PowerFLEX™ modules may be grounded by using grounding clamps or bonding methods described in the KDER and NEC.
• Equipment grounding conductors for PV source and PV output circuits shall be sized in accordance with 690.45 (A) or (B).
• Refer to the NEC (National Electric Code) for information pertaining to appropriate methods of wiring associated with a PV system.

THIRD PARTY SUPPLIER CONTACT INFORMATION

Butyl Mastic and Primers:
Adco Products Inc.
HelioBond® PVA 600BT
Millennium Single Ply Primer
Millennium 240 Primer (low VOC)
Technical Information:
www.adcocorp.com

Electrical Interconnect:
TE Connectivity (Tyco Electronics)
solarlok
Technical Information:
www.te.com

Coupler Information:
For FG-XBT models use TE SOLARLOK Connectors for 12 AWG or greater:
  • Male (positive) – Part Number: 6-1394461-2
  • Female (negative) – Part Number: 1394462-4
www.te.com/catalog

For FG-XBF and FG-XBB models use Multi-Contact MC4 / MC4+
  Connectors for 12 AWG or greater:
  • Multi-Contact Male (positive) – Part Number: PV-KST4
  • Multi-Contact Female (negative) – Part Number: PV-KBT4
www.multi-contact.com

Cable Information:
Tyco Model 1986166-2
Product Type Features:
  • Product Type = Cable
  • Cable Type = RHH, RHW-2, XHHW, PV Wire and USE-2 Rated, UL 854 Approved
  • Color = Black
  • Wire Size (mm² [AWG]) = 4² [12]
www.te.com/catalog

Maintenance:
See “PowerFLEX™ Module Maintenance Guide” Doc. 1000395
# INSTALLATION CHECKLIST

Note: Global Solar may use these check lists to validate any warranty claims.

## Pre-Installation Check List

<table>
<thead>
<tr>
<th>#</th>
<th>QUESTION</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Is the roof design a fully adhered roof? (\text{(Mechanically attached membrane roofs are not acceptable.)})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Does the installation avoid areas of that have visible evidence of ponding water?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Is there adequate drainage in and around the area designated for the PV array?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Is the slope of the area designated for the PV array a minimum of 3°?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Has the area designated for the PV array been cleaned per the roofing manufacturer’s specifications and compatible with the butyl mastic per the butyl mastic supplier recommendations?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Is the area designated for the PV array free of dirt and debris?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Does the area designated for the PV array have an ambient temperature between 40°F - 95°F (4.4°C - 35°C) during times the installation will take place?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Does the proposed system satisfy all applicable electrical and building codes?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Post-Installation Check List

<table>
<thead>
<tr>
<th>#</th>
<th>QUESTION</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Was the roofing surface installed properly?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Were all modules damaged during installation replaced?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Were wires adequately secured to prevent shading and a potential trip</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>hazard?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Is the module spacing designed to minimize stress on the J-Box?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Did all of the PV modules adhere properly to the UL/GSE approved</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>roofing surface?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Was a roller employed to ensure adequate adhesion to the roofing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>surface? Was an edge roller used along the module edge?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Were the modules properly aligned on the roofing surface?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Have the module serial numbers been recorded and registered with</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Global Solar Energy?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Was the roofing surface cleaned with mild liquid cleaner and warm water?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Was the roofing surface wiped with Isopropyl Alcohol after cleaning</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>with mild liquid cleaner?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Was the roofing surface primed before the modules were adhered to the</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>roof?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#</td>
<td>QUESTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>-------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>What is the designed operating voltage of the array?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>What is the actual operating voltage of the array during a clear day around noon?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>What was the make and model of inverter installed at this site?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Was the PV system attached to a battery backup system?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>What types of batteries (if any) were installed at this site?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>What is the voltage and amp-hour capacity of the batteries?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX

ROLLER TOOL RECOMMENDATIONS:
The following roller tools are recommended to assure proper bonding of the module adhesive and roofing surface. Roller tools of similar dimension, weight, and design are acceptable.

- Primary roller:
  - Everhard “Heavy Membrane Roller”
  - 4-1/2” (114mm) diameter X 15” (381mm) wide with 40-1/2” (1.03m) handle
  - Approximately 80 Lbs (36 kg)

- Edge roller:
  - Everhard “Detail Roller”
  - 2” (50mm) diameter X 1/4 “ (6.4mm) with rounded edges
  - Less than 0.5 Lbs (0.2 kg)
REQUIRED MATERIALS:

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof Surface Cleaner</td>
<td>The roofing surface must be cleaned with a roofing manufacturer recommended cleaning solution or alternatively, washed with a mild soap and water solution.</td>
</tr>
<tr>
<td>Cleaning Brush</td>
<td>Scrub roofing surface during initial cleaning with warm soapy water</td>
</tr>
<tr>
<td>IPA (Isopropyl Alcohol)</td>
<td>Wipe the cleaned roofing surface once it's dry with a clean cloth and IPA to remove any remaining debris.</td>
</tr>
<tr>
<td>Primer</td>
<td>Prime the IPA wiped roofing surface per mfg's recommendations once it's dry to aid in adhesion.</td>
</tr>
</tbody>
</table>

PATENTS
5,441,897  5,356,839  6,310,281
6,372,538  7,194,197  7,760,992

Global Solar Energy Inc.
8500 South Rita Road
Tucson, AZ  85747  USA
www.globalsolar.com
Phone: +1 (520) 546-6313
Fax: +1 (520) 546-6318
info@globalsolar.com
APPLICATION OF MASTIC ONTO MODULES WITHOUT MASTIC

The following guidelines are for the application of qualified butyl mastic adhesive onto the PowerFLEX™ module (ADCO HelioBond® PVA 600BT butyl mastic).

Adhesive Properties:
Qualified butyl mastic adhesive:
Thicknes required: 30 mils (Approximately 0.8 mm)
Width: 19.64 inches (499 mm)

Adhesive Preparation:
Butyl mastic should be cut to the following dimensions:
- ¼ inches (6.35mm) longer than the module
- -0, +¼ inches (-0, +6.35mm) wider than the module

Module Preparation:
Wipe down the back of the module (roof side) with a damp (IPA 70%) lint-free towel and allow to air dry.

Adhesive Application:
Lay module face down (sunny side down) on a clean flat surface. Lay the butyl mastic, paper side down on top of the module. Align the butyl mastic so it overhangs the module on the long sides by at least 1.5mm and on the short side by 3mm. Without shifting the butyl mastic, peel twelve inches (30cm) of the paper liner off of the mastic and fold underneath. Taking care not to shift the mastic, lay the exposed mastic down onto the module. Roll the remainder of the butyl mastic up until the excess paper liner is visible. While one individual pulls the paper liner free, a second individual will un-roll the butyl mastic. Great care needs to be taken to prevent catching any air bubbles between the mastic and the module. Once the mastic has been laid on the module, use a soft rubber roller and apply gentle pressure to the mastic (plastic liner). Excess mastic may be trimmed flush with the edge of the module if desired.

When applying butyl mastic to an FG-XBBN (back-side J-Box) measure the header dimensions on the module and account for the above overlap of mastic. Beginning at the header of the mastic, cut out a hole where the J-Box will be coming through the mastic before applying the mastic. The dimensions of the hole in the mastic should be at least 45mm X 145mm. After you have successfully applied the header / J-Box portion of the mastic un-roll the remainder of the mastic and apply to the module as described above.