



TSB03-01

TECHNICAL BULLETIN

TO: BP Solar Distributors, Dealers and Installers
FROM: Bill Poulin, Product Line Manager
SUBJECT: Grounding Methods for BP Solar Universal Framed Modules
DATE: September 28, 2006
START: Effective Immediately

This technical bulletin details the acceptable methods that may be used to ground a BP Solar module in compliance with the National Electric Code (NEC) in the United States and that comply with the UL listing of the module. These methods apply to any module with a BP Solar Universal Frame.

When installing BP Solar photovoltaic modules, be sure to read and follow the installation instructions found in "Instruction Sheet - Crystalline Silicon Photovoltaic Modules," which is packaged with each module.

Warranty Information

Caution: Grounding of BP Solar photovoltaic modules **MUST** be performed in accordance with one of the procedures described in this document. However, any related damage, power loss or corrosion caused by errors or by failing to follow procedures that results in reduced performance or failure of the module is **not** covered by the Limited Warranty. Use of any grounding techniques not identified in this document will automatically invalidate the Limited Warranty.

Bonding Connection

A good connection between the grounding hardware and the module frame is essential for an effective ground. The anodization on a module frame provides a coating to minimize the corrosion due to weather. However, it also presents a barrier that reduces the effectiveness of the grounding connection. For an adequate ground, the grounding hardware must pierce the anodization layer. The two basic approaches are:

- Install a self-tapping or self-drilling fastener through the frame. This requires a minimum number of threads-per-inch to achieve an adequate electrical connection. This is discussed in further detail below.
- Use a stainless steel star (toothed) washer held against the frame by a bolt or nut.

Grounding to the Support Structure

Modules may be attached directly to an equipment grounding conductor, which is then connected to the appropriate grounding point. This is the most direct method to ground an array. Alternatively, Sections 690.45 and 250.136 of the 2005 NEC also permit modules to be bonded to a support structure **as long as** the support structure is then grounded appropriately. Either approach is acceptable provided that all requirements of the NEC and local codes are met.

Corrosion and Galvanic Action

Corrosion can increase the resistance of the grounding connection on the module, or can even cause the grounding connection to fail entirely. Corrosion can be caused by the effects of weather, humidity, dirt and so on. It can also be caused when two dissimilar metals are in contact (galvanic action). For typical applications, the following guidelines apply:

- Aluminum and copper should **not** be placed in direct contact with each other
- Stainless steel (SS) may be used between aluminum and copper as described below
- All fasteners (nuts, bolts, washers, etc.) should be stainless steel
- All other grounding hardware should be UL listed for direct burial (many grounding connectors are listed for indoor use only – these are **not** acceptable)
- Severe environments (coastal locations, presence of aggressive chemicals, heavy amounts of wind-blown alkaline soils, etc.) may require other steps. These should be evaluated separately by a qualified individual experienced in corrosion protection.

Acceptable Grounding Methods

Various methods of module frame grounding are presented below. These methods have been reviewed by UL. Be sure to check with your local electrical inspector **before** the start of a PV installation to determine which grounding methods are acceptable under local codes.

Method 1 – Use Supplied Hardware and Attachment Point

You may use the supplied #10-24 self-tapping screw, stainless steel cup washer and the pre-drilled grounding hole on the back of the frame. Make sure that the cup washer is placed between the wire and the module frame. The ground wire should be #14 AWG or larger. See Figure 1.

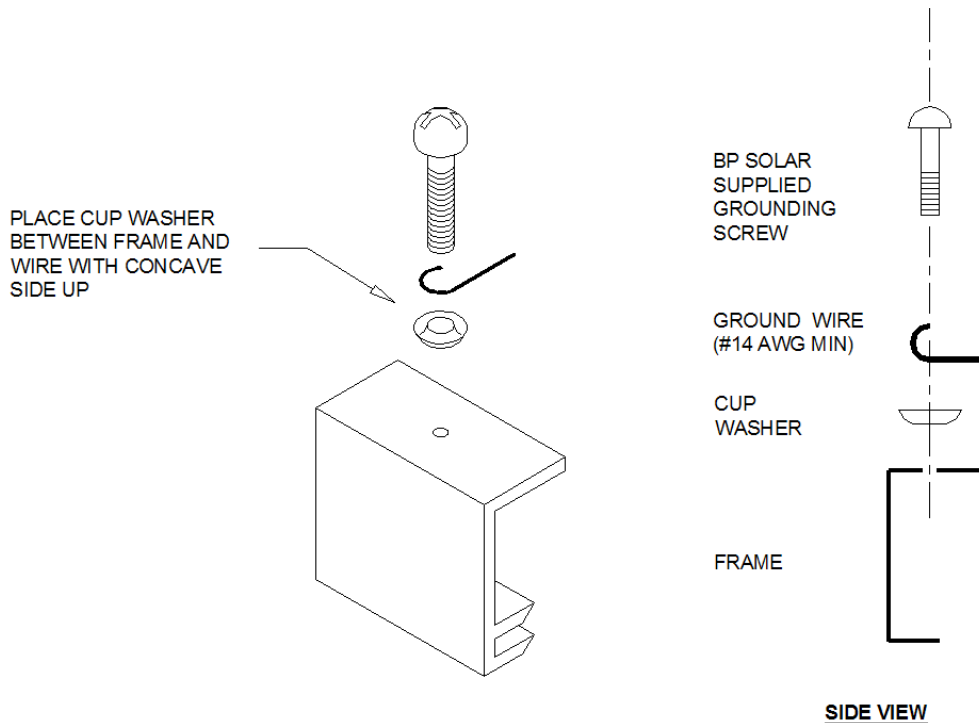


Figure 1 – Grounding with Supplied Hardware

Method 2 – Make a Hole for a Bolt or Threaded Connector

You may drill a hole in the side frame of the module. See Figure 2 for an illustration of the location of the side frame. To maintain the structural integrity of the module frame, any holes drilled are restricted to the specific areas shown in Figure 3 and Figure 4.

You may also use a portable metal punch tool to punch a hole in the bottom flange of the module. Only use a tool that is specifically designed for use on the appropriate thickness and type of material. The hole must be located in the specific area shown in Figure 5. Due to the risk of damaging the module, do not drill a hole in the bottom flange.

Caution: You must take appropriate steps to protect the module when drilling or punching the frame. Be particularly careful to prevent any damage to the backsheet lamination and cells. Any damage to the backsheet lamination or cells can create a shock and/or fire hazard. A damaged module is unfit for service and should not be installed. Any damage will void the module's warranty.

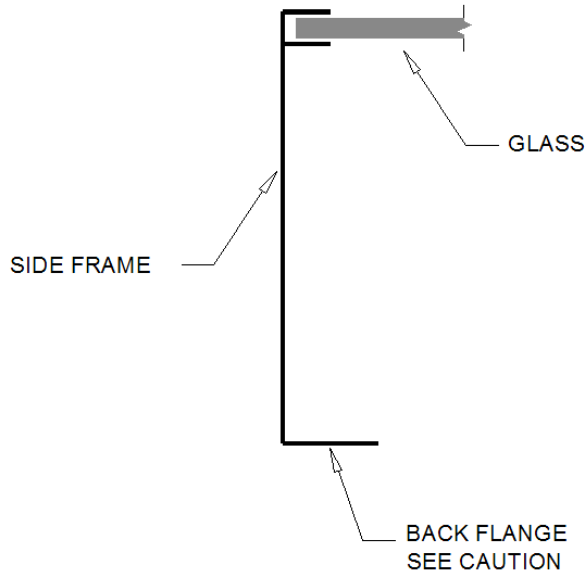


Figure 2 – Cross-section of module frame

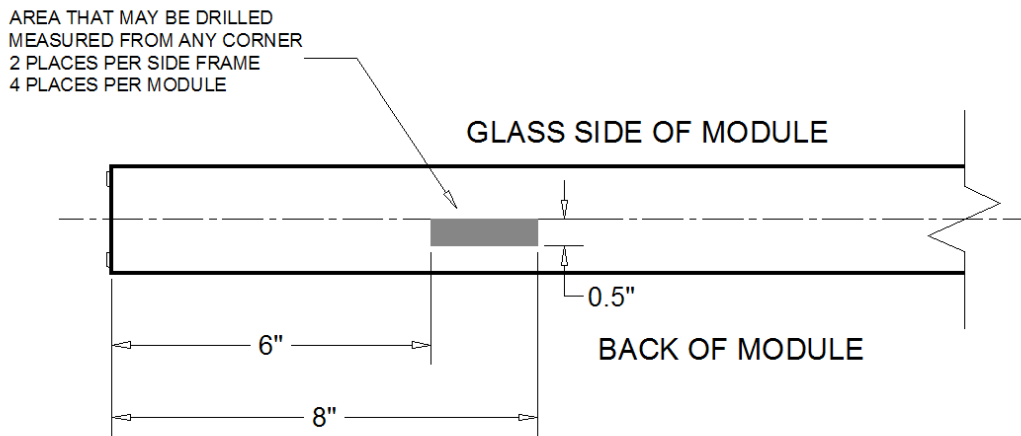


Figure 3 – Acceptable Locations for Drilling the Side (Long) Frame

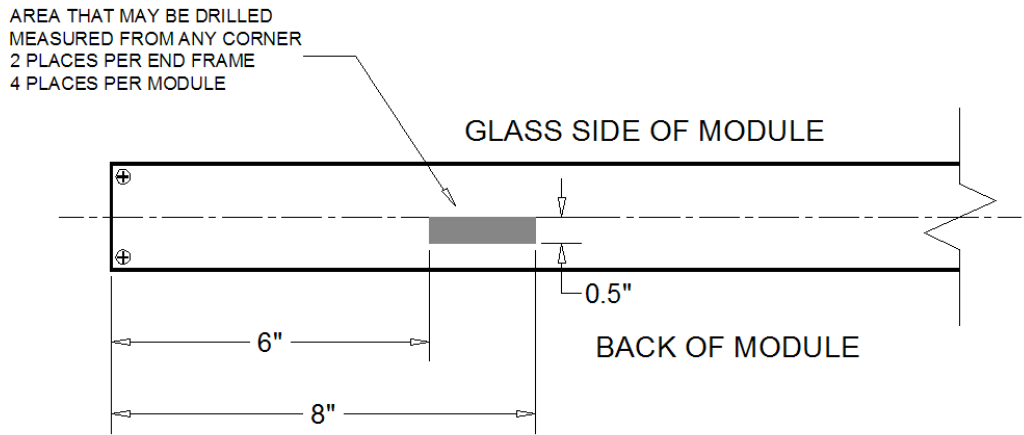


Figure 4 – Acceptable Locations for Drilling the End (Short) Frame

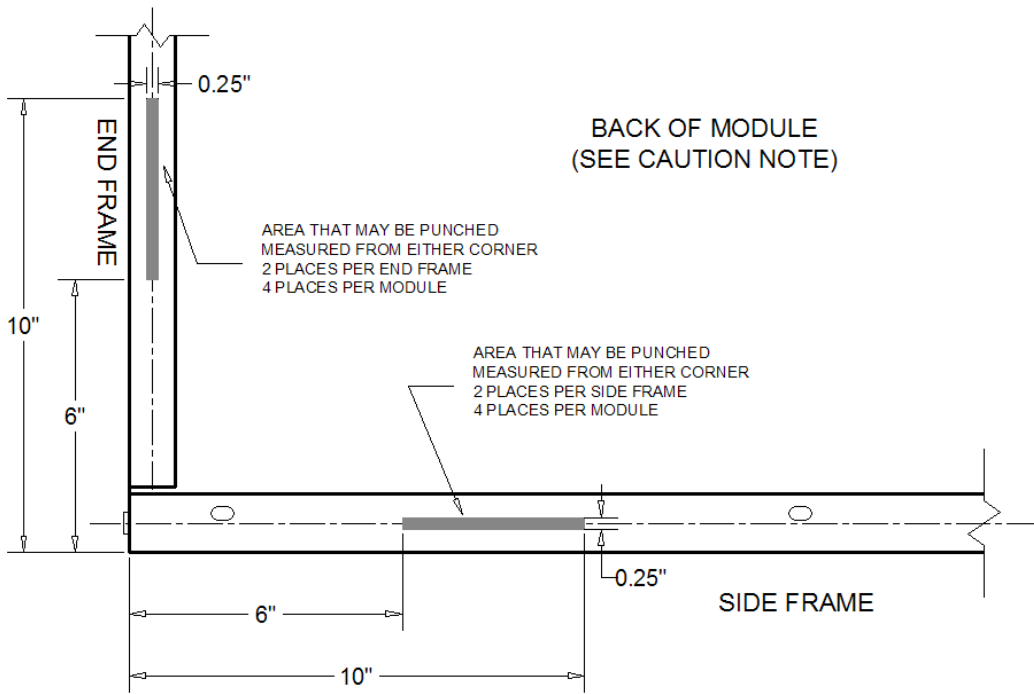


Figure 5 – Acceptable Locations for Punching the Bottom (Back) Flange

The hole can then be used for a bolt or threaded connector. The bolt or connector should be no larger than 1/4" dia. and no smaller than #10. Any bolt through the bottom flange should be no longer than 1" and must not contact the backsheet.



Service Post Connector

Three approaches are described below.

1. You may mount a service post connector such as the one shown in the illustration. Be sure to use a service post connector that is UL listed for direct burial. You will also need SS hardware – a flat washer, a star washer and nut – to complete this assembly. See Figure 6 for an illustration of this assembly.

2. You may mount a lay-in lug such as the one shown in the illustration. Be sure to use a lay-in lug that is UL listed for direct burial. You will need SS hardware – a bolt, flat washer, star washer and nut – to complete the assembly. See Figure 7 for an illustration of this assembly.



Lay-In Lug

3. You may use a SS bolt, flat washer, star washer and nut to bond the module to the mounting structure, which must in turn be grounded. This method is acceptable under Section 250.136(A) of the National Electrical Code.

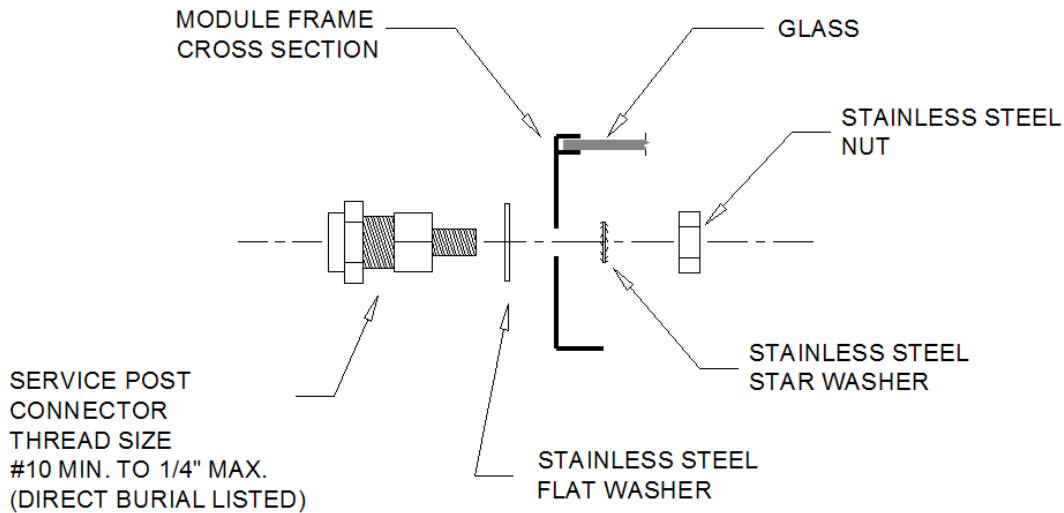


Figure 6 – Mounting a Service Post Connector

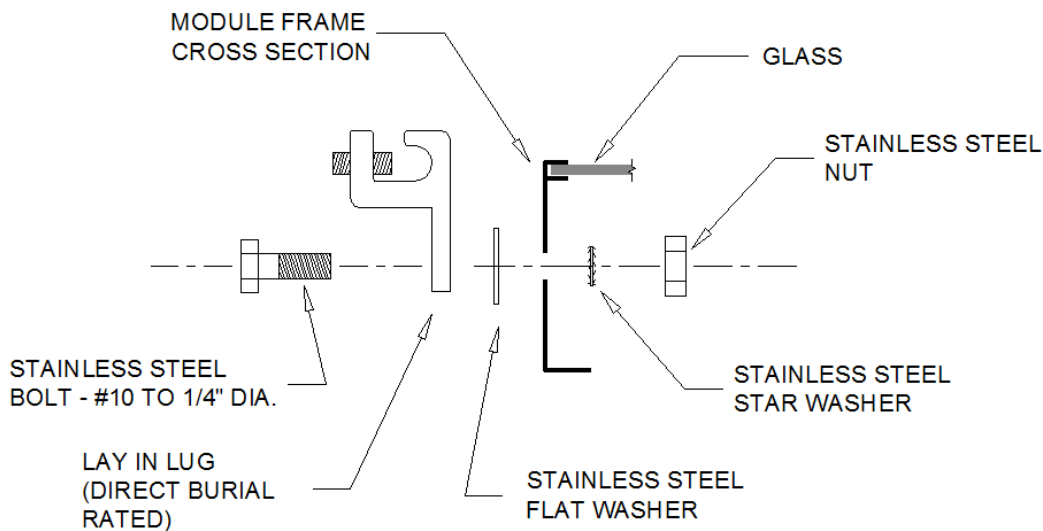


Figure 7 – Mounting a Lay-in Lug

Method 3 – Install a Self Tapping / Self Drilling Screw

You may drill a hole for a stainless steel self-tapping screw or drill a stainless steel self-drilling screw into the frame. [Note: Self-tapping screws are also called thread-cutting or thread-forming screws. A regular sheet metal screw is **not** the same as a self-tapping screw.]

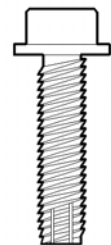
The screws should be no larger than 1/4" dia. and no smaller than #10. Refer to Figure 3 and Figure 4 for the acceptable locations for these screws.

To achieve adequate thread contact with the frame, you must follow the following requirements

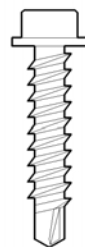
- For a single screw, the thread pitch must be at least 32 threads-per-inch (TPI). A single screw less than 32 TPI does not provide sufficient thread contact.
- For two screws, the thread pitch must be at least 16 TPI.
- Note that the 10-24 screw supplied with the module is intended only for use on the bottom flange, and will not provide adequate thread contact with the side of the frame, which is thinner.

The screw(s) can then be used as described below.

1. Place one stainless steel washer over the screw hole, and then drive the self-tapping screw into the hole. A copper wire can be wrapped around the screw and compressed against the washer (not the module frame) using a second stainless steel washer.



Thread Cutting screw



Self-drilling screw

2. Place one stainless steel washer over the screw hole, then secure a ring terminal or spade terminal against the washer with the screw head. The ring or spade terminal is then attached to the equipment grounding conductor.
3. Alternatively, a single screw may be used to secure a lay-in lug as described in Method 2. You must use a stainless steel washer and star washer as described in for that method. In this case, the screw threads are not providing the electrical ground contact. However, the screw needs to provide sufficient torque to ensure that the lug is mechanically secure.

Method 4 – Use an Existing Mounting Hole

You may use an existing mounting hole on the bottom flange. Three approaches are described below.

1. You may mount a Service Post Connector as described in Method 2.
2. You may mount a lay-in lug as described in Method 2. The bolt should be 5/16" diameter. See also Figure 8.

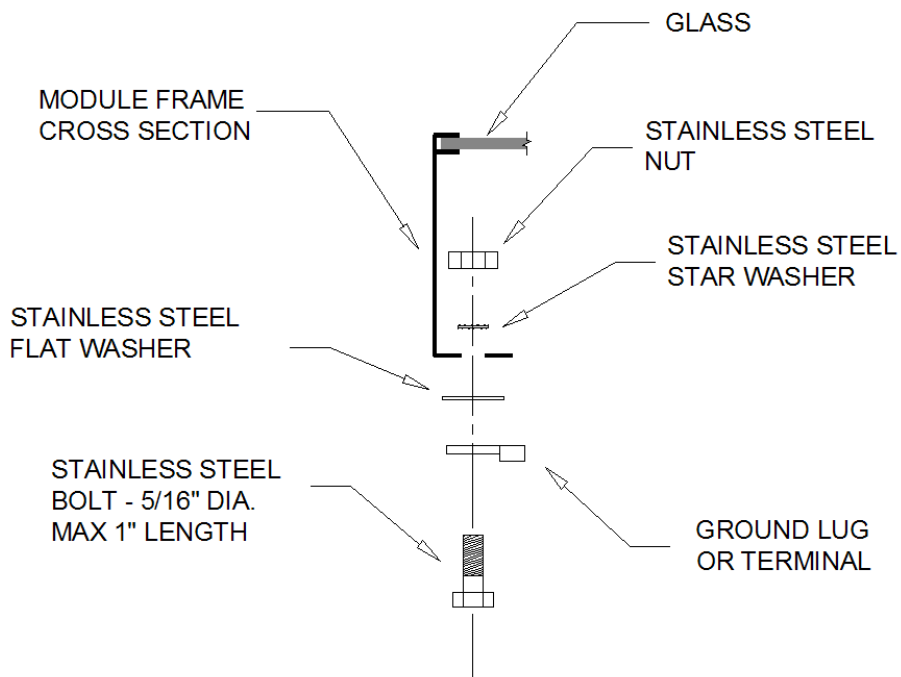


Figure 8 – Using a Mounting Hole with Ground Lug or Terminal

3. You may use a stainless steel bolt with star washers to bond the module to the support structure frame. The bolt should be 5/16" diameter. Star washers must be used to make contact through the anodization of the module. If the support frame is anodized, you must use a star washer to make contact as well. You must either put a star washer between the module and the support structure, or you must place a star washer under the bolt head and another under the nut. See also Figure 9 and Figure 10.

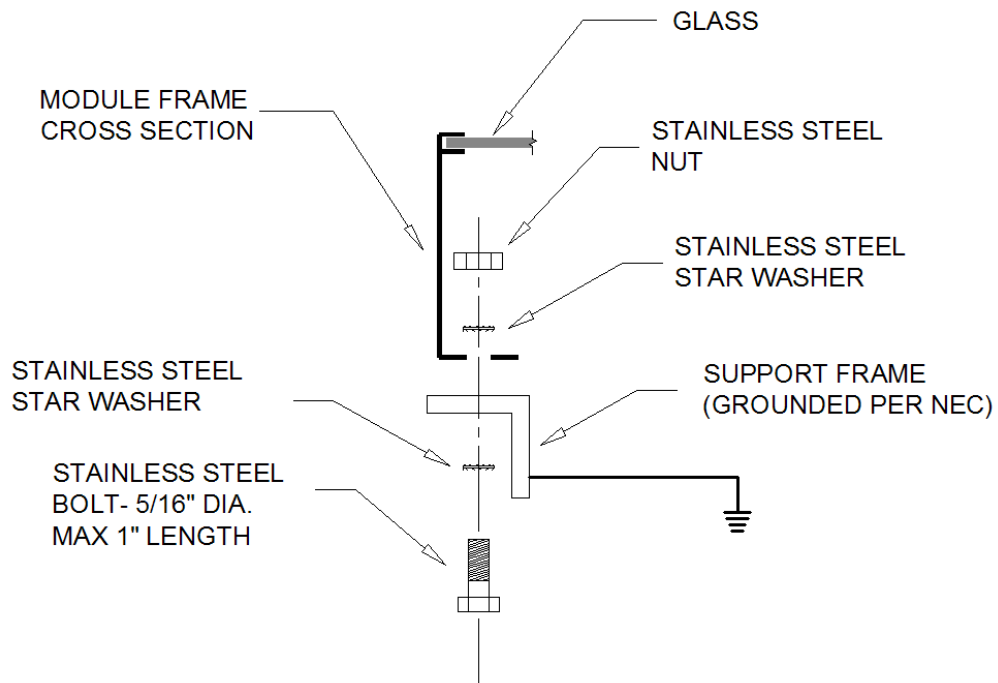


Figure 9 – Bonding the Module to Support Structure

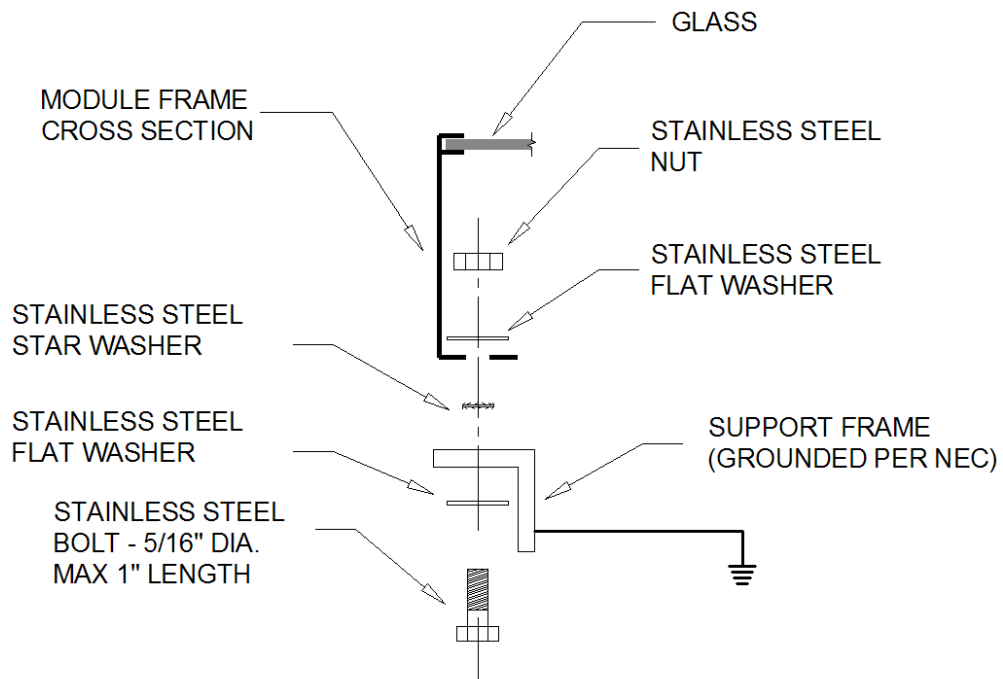


Figure 10 – Bonding the Module to Support Structure (Alternate Approach)

NOTES:

Screw thread pitch and fastener sizes are specified with English units in this technical bulletin; metric equivalent sizes may also be used.

BP Solar does not endorse the use of any specific manufacturer's hardware for any grounding method.