



Polar Bear[®] III HD 10 Degree Installation Manual

Document Number 9910035 Rev D

Nov 2016



System Fire Class Rating: Class A for low slope roofs with Type I & Type II Modules

Mechanical Load Rating: See [Appendix B: UL 2703 Grounding](#)

Revision History

Rev	ECO #	Date	Description of Changes	Approved By
A	C00430	16-FEB-16	INITIAL RELEASE	CN
B	C00457	12-SEP-16	Add Short Ballast Tray Installation, changed bonding/grounding wire size to #12 or #10 AWG Cu, Add Appendix F	CN
C	C00471	05-DEC-16	Added ground lug picture and torque requirements. Clarification of UL section. Added system label location information	CN
D	C00480	03-FEB-17	HD claw stamped hole identifiers have changed from "1" and "2" to "5D" and "10D" respectively	CN

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Introduction

Polar Bear® III HD 10 Degree flat roof system comprises of three major components that intuitively assemble into a flat roof PV mounting system array. The following features improve construction performance, optimize maintenance and increase power density:

- Just three major components (Support, Ballast Tray and Claw), light-weight and easy to move
- Tight-row spacing for increased power density
- Compatible accessories to simplify wire management and microinverter attachment
- Built-in rubber roof pads to help prevent roof top damage

Document Objective

This installation manual has been put together to assist in the proper steps required to build a photovoltaic array using Polar Bear III HD 10 Degree.

“THIS INSTALLATION MANUAL DOES NOT COVER SELECTION OF OR INSTALLATION OF ANY MATERIALS USED TO SEAL A MECHANICAL ATTACHMENT TO THE ROOF. FOR THESE INSTRUCTIONS PLEASE SEE OEM PROVIDER INSTALLATION MANUALS AND RELATED LITERATURE. A LIST OF OEM PROVIDERS IS SHOWN BELOW.

THIS INSTALLATION MANUAL DOES NOT COVER SELECTION OF OR INSTALLATION OF FASTENERS REQUIRED TO FASTEN A MECHANICAL ATTACHMENT TO THE ROOF STRUCTURE ITSELF. FOR THESE INSTRUCTIONS, PLEASE SEE OEM PROVIDERS INSTALLATION MANUALS AND RELATED LITERATURE. A LIST OF OEM PROVIDERS IS SHOWN BELOW”

OEM MECHANICAL ATTACHMENT PROVIDERS:

- Anchor Products: www.anchorp.com
- OMG Roofing Products: www.omgroofing.com
- ECOFasten Solar: www.ecofastensolar.com

Safety Overview

Safety is an essential part of every photovoltaic (PV) installation and every construction site. It is imperative to plan ahead for any safety concerns and hazards to promote safe work practices during installation. This section does not claim to address or support all safety concerns that may arise during the installation of PanelClaw mounting systems or any other aspect of the work being performed. Before beginning work, installers should refer to all local and federal safety, health, and regulatory requirements to assure compliance. Refer to OSHA Part 1926 and its related Subparts for federal construction related regulations and standards.

The section in [Appendix A: Safety](#) outlines some of the obvious / major hazards that could exist during the installation of PanelClaw products, and are divided to bring a level of clarity to such hazards. Some sections do not apply to all PanelClaw product lines and such exclusions are noted within each section.



PRIOR TO INSTALLATION, READ THE SAFETY PROVISIONS ATTACHED IN [APPENDIX A: SAFETY](#) AND REVIEW THE INSTALLATION MANUAL IN ITS ENTIRETY.

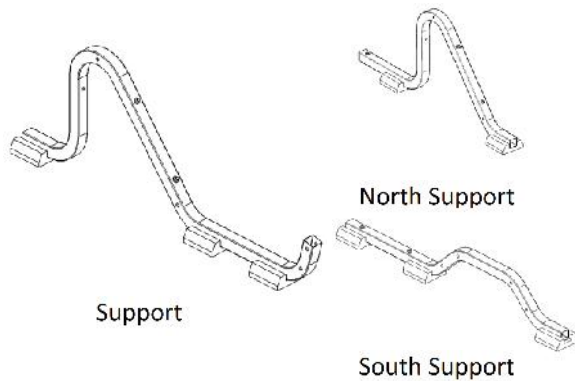


An annual corrosion inspection and potential corrective actions are required to maintain product warranty. Visible surface red rust on galvanized steel components must be locally coated with a commercially available galvanized paint or coating to maintain product warranty.

Parts and Hardware

Major Components

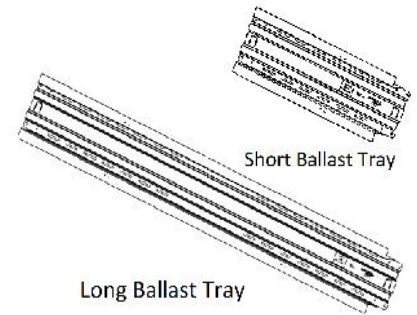
1 Supports



2 Claw

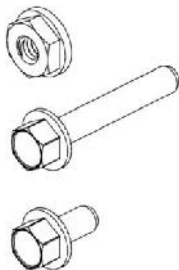


3 Ballast Trays



Hardware Kits

4 Claw Fastener Kit



5 Ballast Tray Nut Kit



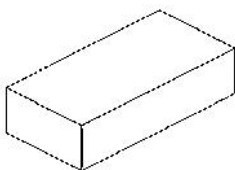
6 Ballast Tray Bolt Kit



Ballast

7 Ballast Block

(Customer supplied,
See [Appendix F: Ballast Blocks](#))



Mechanical Attachments

8 OMG Roofing Products

PowerGrip
PowerGrip Plus

EcoFasten® Solar

Anchor Products

U-Anchor 2000
U-Anchor 2400
U-Anchor 2600

System Accessories

9

Shim Pad
Microinverter Attachment Kit
Optimizer Attachment Kit

Ground Lug



Parts and Hardware

1	Support	Support unit with pre-installed integrated recycled rubber pads
2	Claw	Module clamp with integrated bonding. Used to attach modules to Supports
3	Ballast Tray	Connects Supports and captures 4" x 8" x 16" or 2" x 8" x 16" ballast.
4	Claw Fastener Kit	Serrated flange nuts Stainless Steel 18-8 Hex head cap screw Stainless Steel 18-8
5	Ballast Tray Nut Kit	Serrated flange nuts 1/4-20 Stainless Steel 18-8
6	Ballast Tray Bolt Kit	Hex head cap screw 1/4-20 x 0.5" Stainless Steel 18-8
7	Ballast Block	Solid cap concrete roof paver, conforms to ASTM C 1491-03 standard and manufactured for freeze-thaw resistance where applicable. Block must be specified so that it maintains its weight over the life of the system.
8	Mechanical Attachment (design dependent)	Designed with OMG Roofing Products (PowerGrip and PowerGrip Plus), EcoFasten® Solar, and Anchor Products (U-Anchor family) attachment systems as needed.

Required Tools

- 3/8" drive torque wrench (settings available up to 10 ft-lbs)
- 3/8" deep socket (bolts)
- 7/16" deep socket (nuts)
- 1/2" deep socket (5/16" bolts/nuts)
- Spacer Stick (supplied) [Figure 2](#) on page 8.
- Battery powered tools may be used as long as they do not exceed torque requirements

Torque Settings

Torque Setting	Fastening Operation
4-6 ft-lb (48-72 in-lb)	Attaching Ballast Tray to Support
8-10 ft-lb (96-120 in-lb)	Attaching Claw to Module Attaching Claw to Support
2 ft-lb (25 in-lb)	Attaching ground lug to Ballast Tray
3.75 ft-lb (45 in-lb)	Attaching bonding jumper to ground lug

Installation

Step 1: Attach Claws to Modules (Prep)

1. Lay module, glass side down, on work surface.
2. Place Claw over appropriate mounting hole while resting Claw flange against outside edge of module (reference the “ARRAY DIMENSIONS” table in the project drawings if the module has more than four mounting holes).
3. Insert bolt through Claw and module holes.
Note: Shift the Claw towards the module junction box such that it “bottoms out” against the bolt. This will ensure that the Claws on the module are always consistently spaced.
4. Reach under the module frame flange and thread nut onto bolt until snug.
5. Press Claw tab against module frame and tighten bolt to 8-10 ft-lb (96-120 in-lb) of torque (Figure 1).
6. Repeat Steps 2 through 5 for the other Claw.

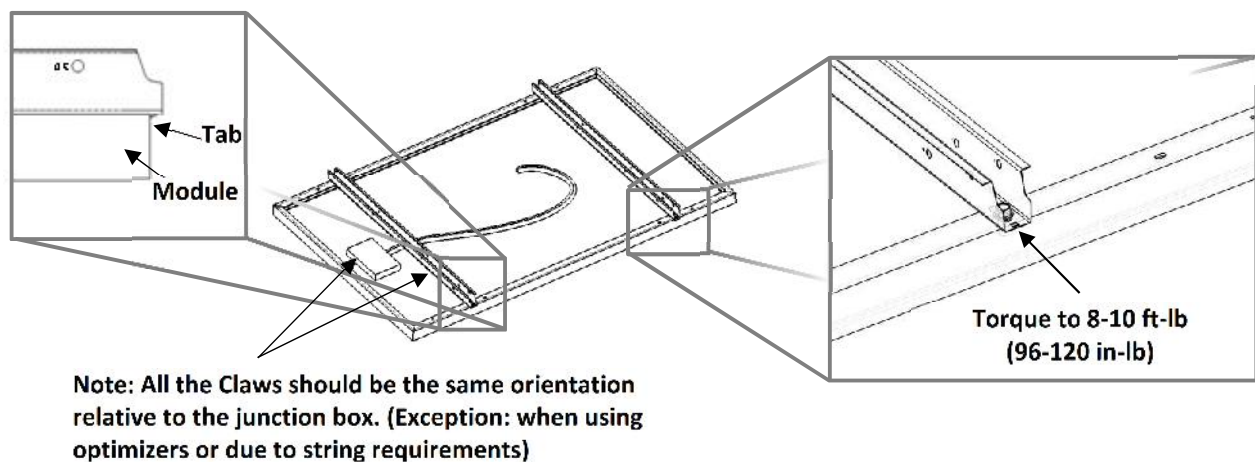


Figure 1 Claw Placement on Module

Step 2: Set up Spacer Stick

1. Consult the provided Racking Construction Set drawing for the Support spacing between modules (Spacing L) and Support spacing under modules (Spacing Q) (Figure 2). Dimensions L and Q are module dependent and vary for each manufacturer.
2. Reference the Q and L dimensions on the Racking Construction Set drawing. Set two spacer stick brackets to the Q dimension and 2 spacer stick bracket to the L dimension.

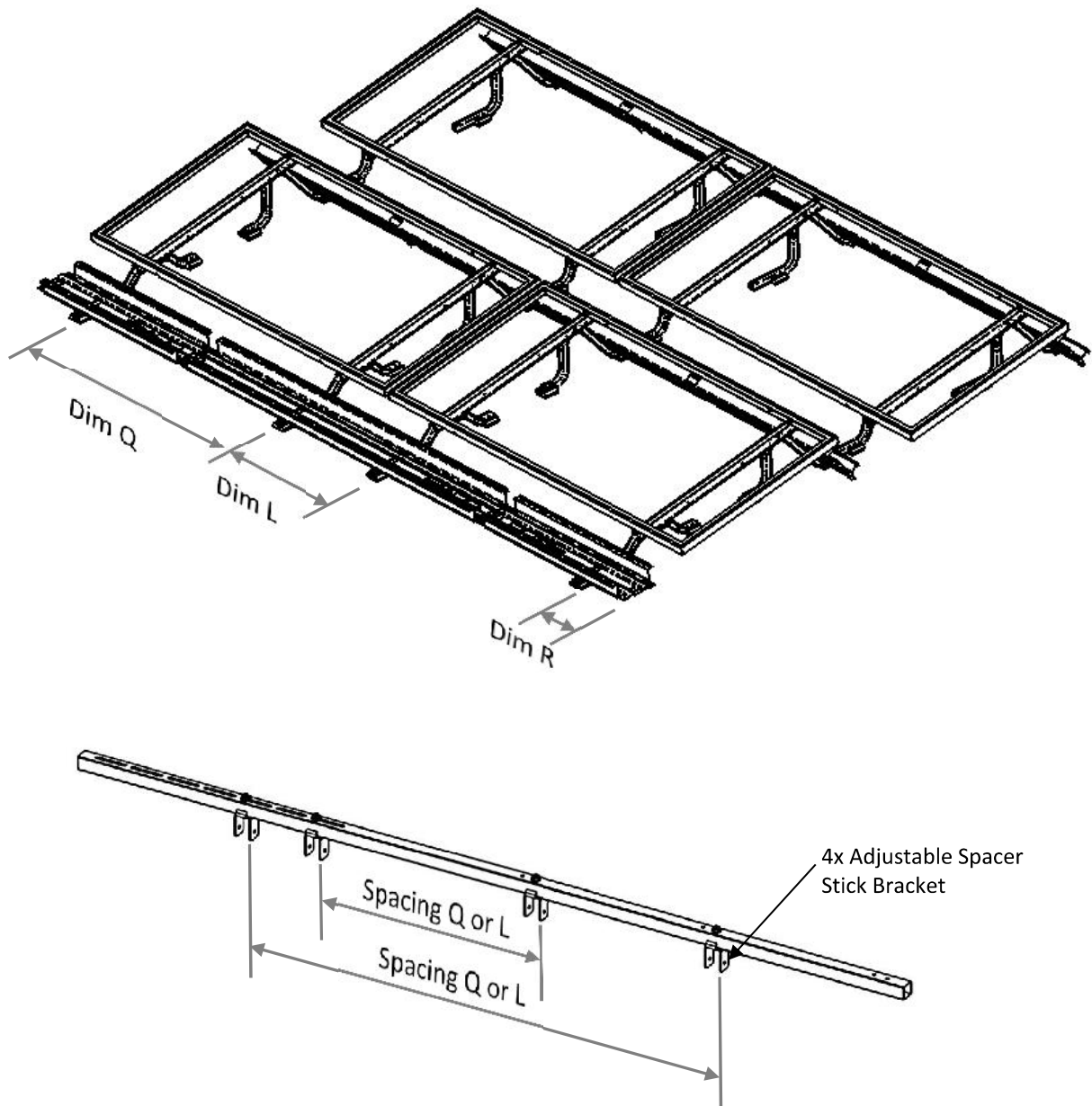


Figure 2 Spacer Stick

Step 3: Build Southern Row of Modules

1. Snap north-south and east-west layout lines (chalk or dry line recommended) for the edge of the array. Consult the Racking Construction Set drawing for the Support spacing from array edge (Spacing R).
2. Begin the array at the southeast or southwest corner.
3. Place the three South Supports in approximate locations east-west and use the Spacer Stick provided to set the Supports in the correct locations. Eastern Support roof pads must be lined

up with north-south snap line. Southern Support roof pads must align with the east-west snap line. (Figure 3).

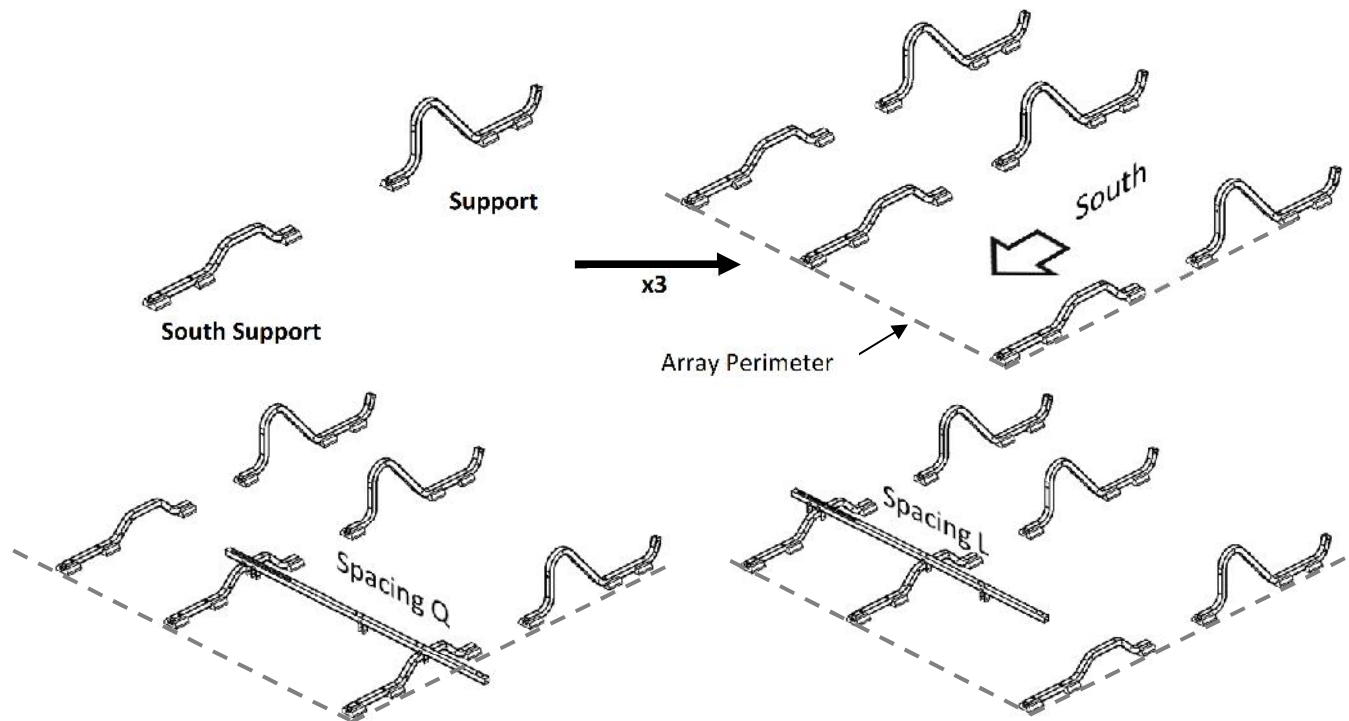


Figure 3 Starting the Array

4. Carry module (with Claws attached) to south-east (or west) corner.
5. Follow Figure 4 to align Claws over the South Support mounting holes. Insert bolts through Claw and Support mounting hole. Finger-tighten nuts onto bolts.
6. Lower module onto upper mounting hole of the Support. Move the Support in or out to align the holes. Insert bolts through the hole labeled “10D” on the Claw and upper mounting hole of the Support.

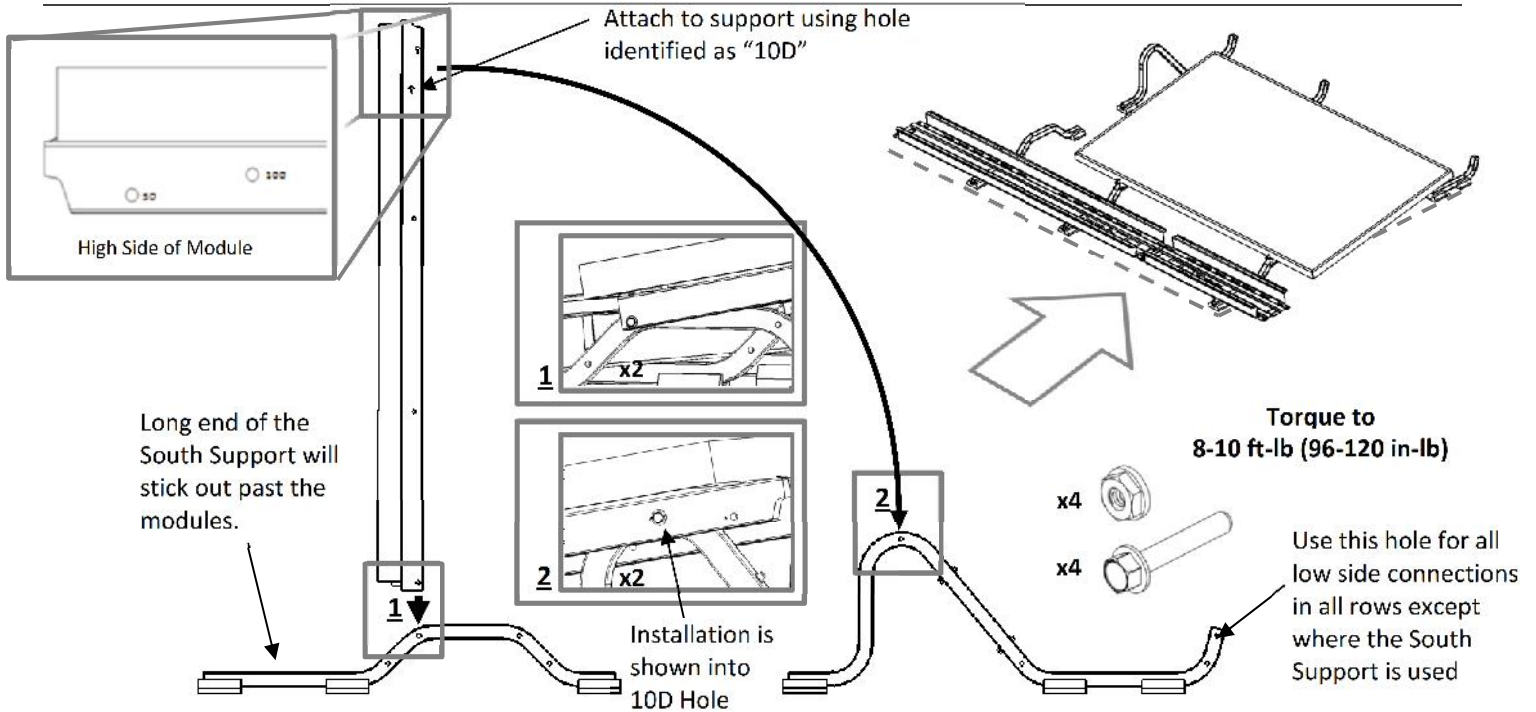


Figure 4 Attach Module to Supports

7. Tighten all four mounting bolts to 8-10 ft-lb (96-120 in-lb) of torque.
8. Repeat Steps 6 through 9 for southern row. Be sure to use inter-column spacer to ensure that a 1" spacing is maintained.
9. Follow [Figure 5](#). Place both Short and Long Ballast Trays on the South Supports. Center Long Ballast Tray between two modules and visually align the Short Ballast Tray with the edge of module. Shift Short Ballast Tray and find the appropriate Ballast Tray slots to connect two trays. Either slots or through holes at the end of the Long Ballast Tray may be used.

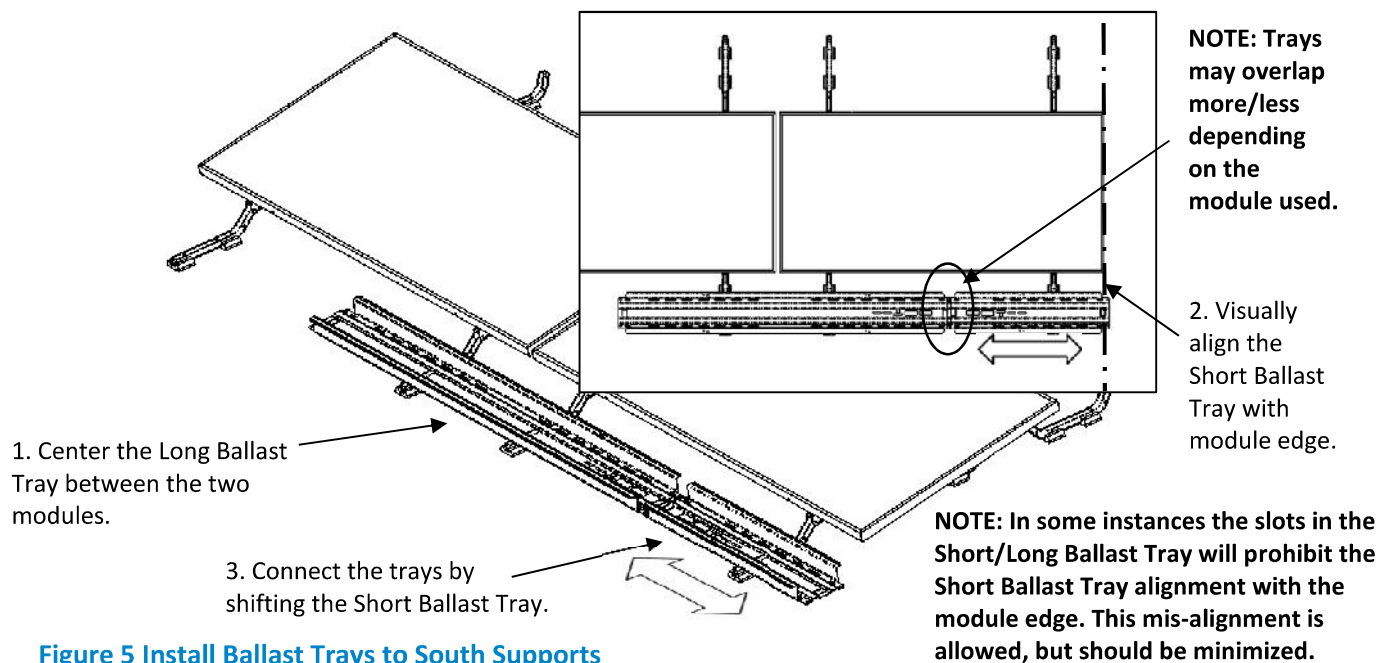


Figure 5 Install Ballast Trays to South Supports

10. Bolt Ballast Trays to the South Supports using two ¼-20 x 0.5" serrated flange bolts to the pre-installed rivet nuts. Bolt the Short Ballast Tray to the Long Ballast Tray using two ¼-20 x 0.5" serrated flange bolts and the pre-installed rivet nuts on the Short Ballast Tray. Torque all ¼-20 x 0.5" serrated flange bolts to 4-6 ft-lb (48-72 in-lb). Use the Spacer Stick to keep the Ballast Tray perpendicular to the Supports while maintaining the spacing between Supports.
11. Repeat Steps 3 through 12 but do not use another Short Ballast Tray until you reach the last module in the row. Consult Racking Construction Set drawing for proper long and short Ballast Tray placement.
12. Install required ballast into southern Ballast Trays and bend up the tabs at the ends of the row.
13. Move to the north side of the module and install Ballast Trays on the Supports. Center the Long Ballast Trays between two modules and hang them on the pre-installed bolts. Use the Spacer Stick to ensure the low sides of the Supports are properly spaced. Thread a serrated-flange nut onto each of the pre-installed support bolts and torque to 4-6 ft-lb (48-72 in-lb) (Figure 6).
NOTE: Do not fasten Long Ballast Trays to each other where they overlap.

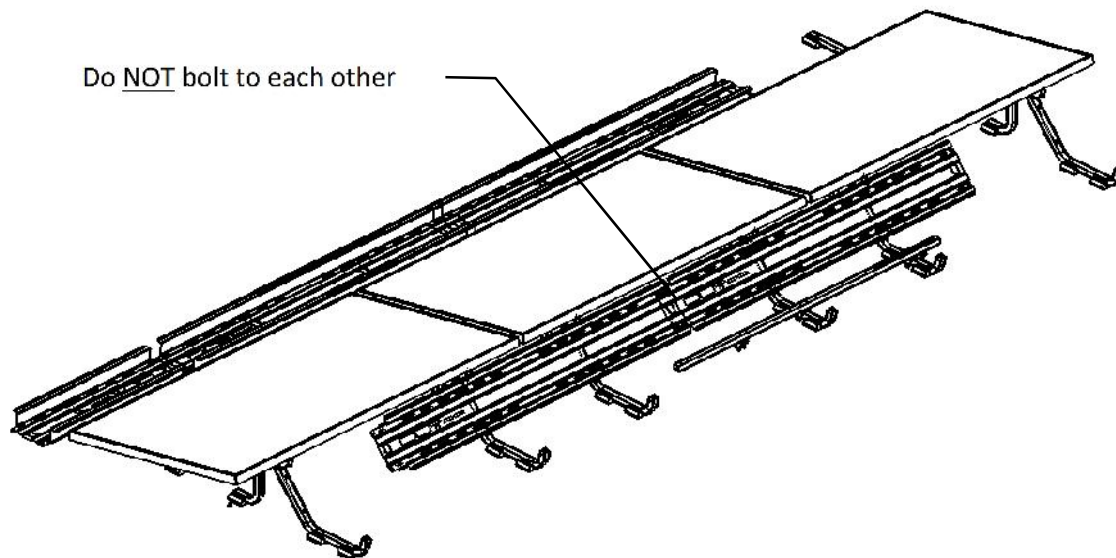


Figure 6 Attach Long Ballast Trays to Supports

14. Place Short Ballast Tray at either ends of the row and visually align the Short Ballast Tray with the edge of the module. Shift the Short Ballast Trays to find the appropriate slots. Either the slots or through holes of the Long Ballast Tray may be used to connect the Short and Long Ballast trays. Install the Short Ballast Trays using two ¼-20 x 0.5" serrated flange bolts and the pre-installed rivet nuts to attach the Long and Short Ballast Trays together. Install a serrated flange nut onto each support bolt (Figure 7). Nuts and bolts must be torqued to 4-6 ft-lb (48-72 in-lb).
15. Install required ballast into the ballast trays and bend up the tabs at the ends of the row.

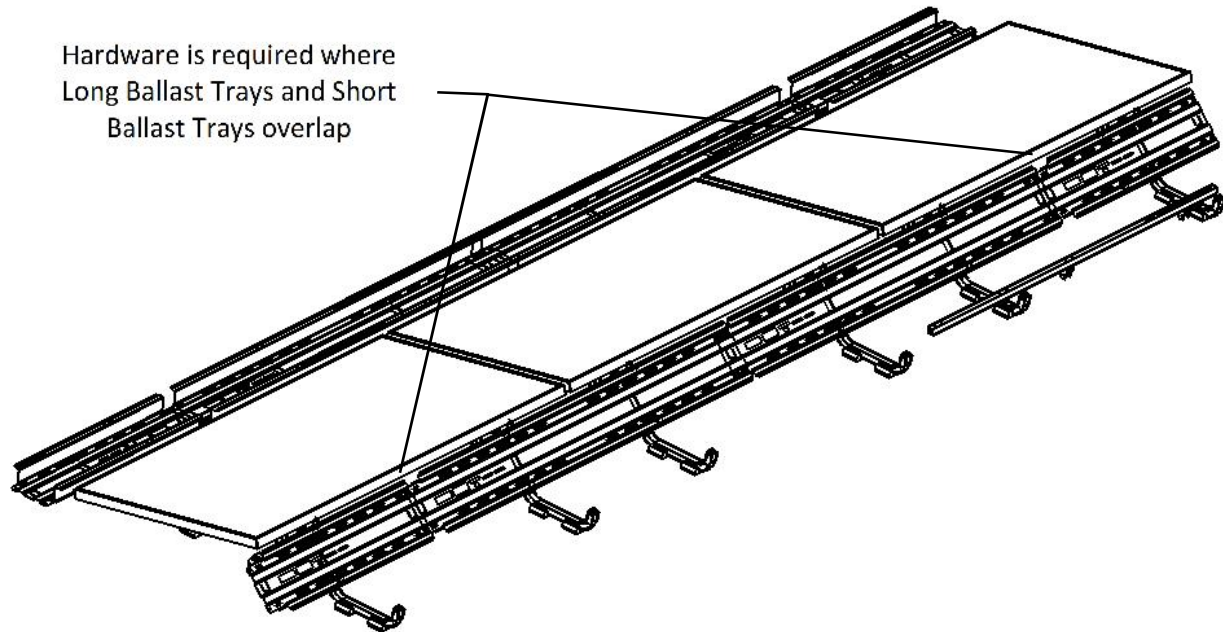


Figure 7 Attach Short Ballast Trays

Step 4: Install Array Row-By-Row

1. Place two Supports for each module at their approximate final resting location. If the row being built is the last row in the array, use North Supports.
2. Connect module Claws to lower mounting holes on the Support of the previous row. Finger-tighten bolts.
3. Tilt module down and adjust the placement of the previously spaced Supports to connect module Claw to the high side of the Support. Finger-tighten nuts and bolts. Be sure to align the outer support pads with north-south snap line.
4. Tighten all four mounting hardware to 8-10 ft-lb (96-120 in-lb) of torque.
5. Repeat Steps 1 through 4 for remainder of the row.
6. Install Long Ballast Trays, Short Ballast Trays and ballast blocks as done in the previous row.
7. Complete the array by constructing row-by-row until the north array edge. The north row in the array utilizes North Supports to secure the high side of the module. If the project requires north double capacity ballast, Ballast Trays are installed in both the inclined position and flat position of the North Supports in a similar fashion to the south array construction. See [Figure 8](#).

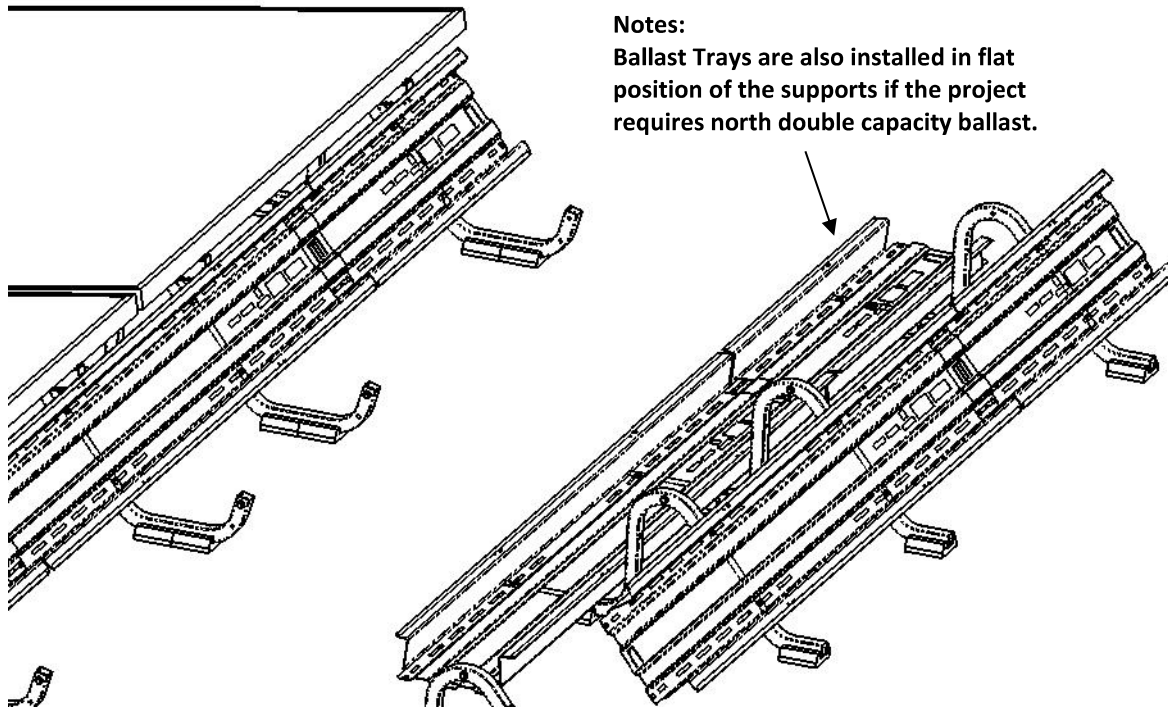


Figure 8 North Double Capacity Ballast Tray Installation

Step 5: Electrical Grounding

Please consult with national and local building code(s) for complete grounding requirements for your installation. The Polar Bear grounding method conforms to UL 2703 and is certified by UL for use with approved photovoltaic modules listed under UL 1703. Installers can quickly and easily establish UL-certified electric bonds between all connected array components, including modules and mounting system components, without the use of additional grounding devices, e.g. ground lugs and copper wire. At least one ground lug must be used to ground all strings within a physical sub-array provided the fuse rating for each string does not exceed 30 amps. Installers may opt to use multiple lugs per sub-array for redundancy. When grounding devices are installed according with the approved methodology and capacity below, the connections described above meet all the requirements outlined in NEC 690.43.

Grounding Instructions

For modules that have been evaluated for use with Polar Bear III HD 10 Degree, please follow the instructions below in [Appendix B: UL 2703 Grounding](#). Additional information regarding UL 2703 and the specific list of evaluated modules included in PanelClaw’s UL listing can be found in the “PB3 HD UL Overview and Module Listing” document (available at www.panelclaw.com).

For modules that have not been evaluated for use with Polar Bear III HD 10 Degree, please follow the instructions below in [Appendix C: Electrical Grounding \(UL 2703 not applicable\)](#).

Note: During grounding and bonding ensure that there is separation between bare copper and aluminum or galvanized steel components.

Appendix A: Safety

The subsections below outline some of the obvious / major hazards that could exist during the installation of PanelClaw products, and are divided to bring a level of clarity to such hazards. Some sections do not apply to all PanelClaw product lines and such exclusions are noted within each section.

Electrical Hazards: PanelClaw products are purely mechanical and do not contain any electrically live parts. When a photovoltaic module is exposed to sunlight it is electrically live and cannot be turned off. As soon as modules are installed using a PanelClaw system, an electrical shock hazard is present. All personnel on site should coordinate to ensure that such electrical hazards are clearly communicated. It is advised, at a minimum, that all personnel utilize caution and proper Personal Protective Equipment as outlined in that section. Only electrically qualified personnel should perform PV module installation. Refer to OSHA Part 1926 Subpart K – Electrical and NFPA 70E for additional information.

Fall Hazards: This section only applies to Polar Bear® products installed on locations six feet or higher above grade. Proper fall protection should be in place at all work sites. There are many fall protection solutions readily available to help reduce exposure to fall hazards. These may include personal fall arrest systems, safety nets, guardrails, and flagged setbacks from all roof edges as outlined in OSHA Part 1926 Subpart M – Fall Protection.

Trip Hazards: All PanelClaw arrays have elevated components that are installed above grade or above a roof surface. Such hazards should be identified and caution should be taken to avoid tripping over such components. Refer to the Fall Hazards section specifically if working with the Polar Bear product line. Make sure to pick up and not drag your feet when working on site, and always pay attention to your path of movement to note any obstructions that could create a trip hazard.

Lifting Hazards: The PanelClaw installation process involves lifting of heavy items that could lead to personal injury and damage to property. All personnel should be trained in the proper procedures for manually lifting. Evaluate an object’s size and weight prior to lifting, and follow these general guidelines for lifting:

1. Assess the lift and know the object weight.
2. Bend at the knees and get a good grip.
3. Keep back straight and lift straight up with legs without twisting. It is important to lift with the legs and not the back.
4. If an object is too large or heavy, ask for help and do not attempt to lift by yourself. In the case that mechanical assistance (e.g. crane, forklift, etc.) is required to complete the lifting operations, all machine operators of such devices should be licensed and trained.

Material Handling: All PanelClaw parts and components are made of aluminum and steel alloys and utilize stainless steel assembly hardware. These materials are considered non-toxic and require no special handling procedures. Metal components may have sharp edges, so be sure to handle with care and utilize proper personal protection equipment, especially gloves, during handling. Refer to OSHA Part 1926 Subpart H – Materials Handling, Storage, Use, and Disposal for additional information.

Personal Protective Equipment (PPE): All personnel should utilize and implement proper PPE per OSHA requirements. Refer to OSHA requirements for proper use and implementation of PPE. The following

items are suggested as a minimum to avoid injury based on the installation procedure outlined in this manual:

1. Appropriate work clothing
2. Electrically insulated hard hat
3. Protective eyewear
4. EH rated safety boots
5. Gloves
6. High-visibility safety vest
7. Hearing protection

If any PPE appears to be defective, stop the use of such equipment immediately, and ensure it is replaced before work continues. Refer to OSHA Part 1926 Subpart E – Personal Protective and Life Saving Equipment for additional information.

Hand and Power Tools: Access to all hand and power tools should be regulated and controlled at all times on site to prevent improper use and related injuries. When not in use, all equipment should be stored in a secured location. Only personnel who have been properly trained in the safe operation of any potentially dangerous tool should be allowed access. All required tools to perform the installation of PanelClaw racking are outlined in the installation procedure. All tools should be inspected daily and before use by the operator. If any tool appears to be defective, stop the use of such equipment immediately, and ensure it is replaced before work continues. Electrical power tools should follow proper lock-out tag-out procedures per OSHA requirements. Refer to OSHA Part 1926 Subpart I – Tools – Hand and Power for additional information.

Appendix B: UL 2703 Grounding

The Polar Bear III HD 10 Degree flat roof system may be used to ground and/or mount a PV module complying with UL1703 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions. For a list of modules which have been evaluated see PanelClaw’s “PB3 HD UL Overview and Module Listing” (available at www.panelclaw.com).

A periodic re-inspection of the system shall be performed for loose components, loose fasteners, and any corrosion. If found, they should be immediately replaced or remedied in accordance with the system installation instructions.

System Ground Path

The system ground path follows through the Tyco Lug, Ballast Tray, Support, Claw and into the module frame (Figure 9). The module frame’s anodization is broken via the through-bolt connection at the module mounting holes, which is secured with a serrated flange nut. The bonding continues through the module frame to the adjacent Claws as shown below.

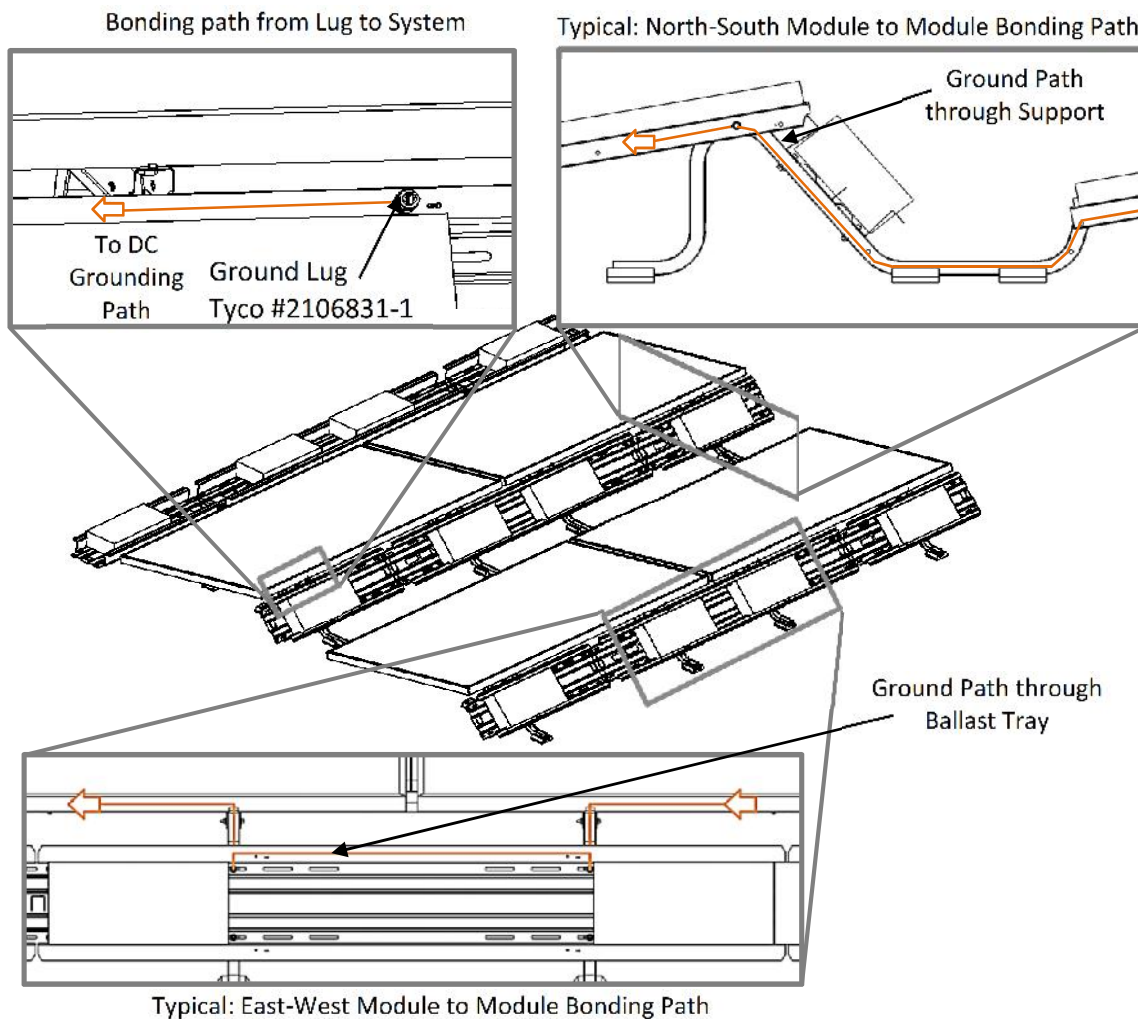


Figure 9 System Ground Path with UL2703 Listed Module

Grounding Instructions:

PanelClaw components within the array are required to be electrically bonded to other DC grounding paths via the use of either a #12 or #10 AWG Cu bonding jumpers and a UL 467 listed Tyco solid wire grounding assembly, part number 2106831-1, manufactured by Tyco Electronics Corporation. The conductor size should be selected in accordance with NEC 690.45 and NEC 250.122.

To ground the array, first determine the groupings of strings whose power output wiring is grounded together at an equipotential grounding conductor location. This could be all the strings within a physical sub-array, or all the strings grouped by a single combiner box. Once the groupings of strings at equipotential have been determined, a Tyco solid wire grounding assembly must be attached to one Ballast Tray within each group of strings. PanelClaw’s Polar Bear Ballast Trays have a hole to which this grounding device/lug can be attached (see [Figure 10](#)). In an array that requires multiple bonding jumpers to satisfy the equipotential requirements, each bonding jumper should be located and installed on a Support within the group of strings which will be grounded by that jumper.

Note: Every independent array section must include at least one grounding device/lug.

To attach the Tyco grounding device/lug to the Ballast Tray, the mounting hex washer and threaded post end should be installed to the specified hole in the Ballast Tray and torqued to 25 in-lb. Once the grounding device/lug has been attached to the Ballast Tray, a copper bonding jumper from an acceptable DC grounded location outside of the array must be installed to the wire slot end and torqued to 45 in-lb. For additional instruction regarding the installation of the Tyco solid wire grounding assembly, please refer to the Tyco Electronics instructions sheet (document number 408-10262) via their website www.te.com.

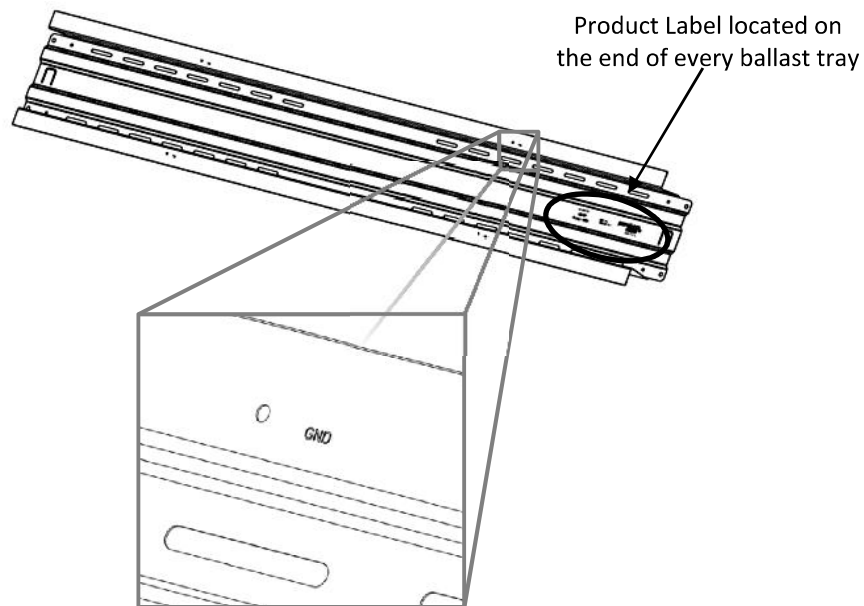


Figure 10 Ground Lug Attachment Location

Appendix C: Electrical Grounding (UL 2703 not applicable)

The Polar Bear III HD 10 Degree flat roof system must be electrically bonded to the other DC grounding paths.

System Ground Path

The system ground path follows through the module to the Tyco Lug into the Ballast Tray via a solid #12 or #10 AWG Cu bonding jumper. The conductor size should be selected in accordance with NEC 690.45 and NEC 250.122. The Ballast Tray is bonded to the Support, and Claw. (See [Figure 11](#)).

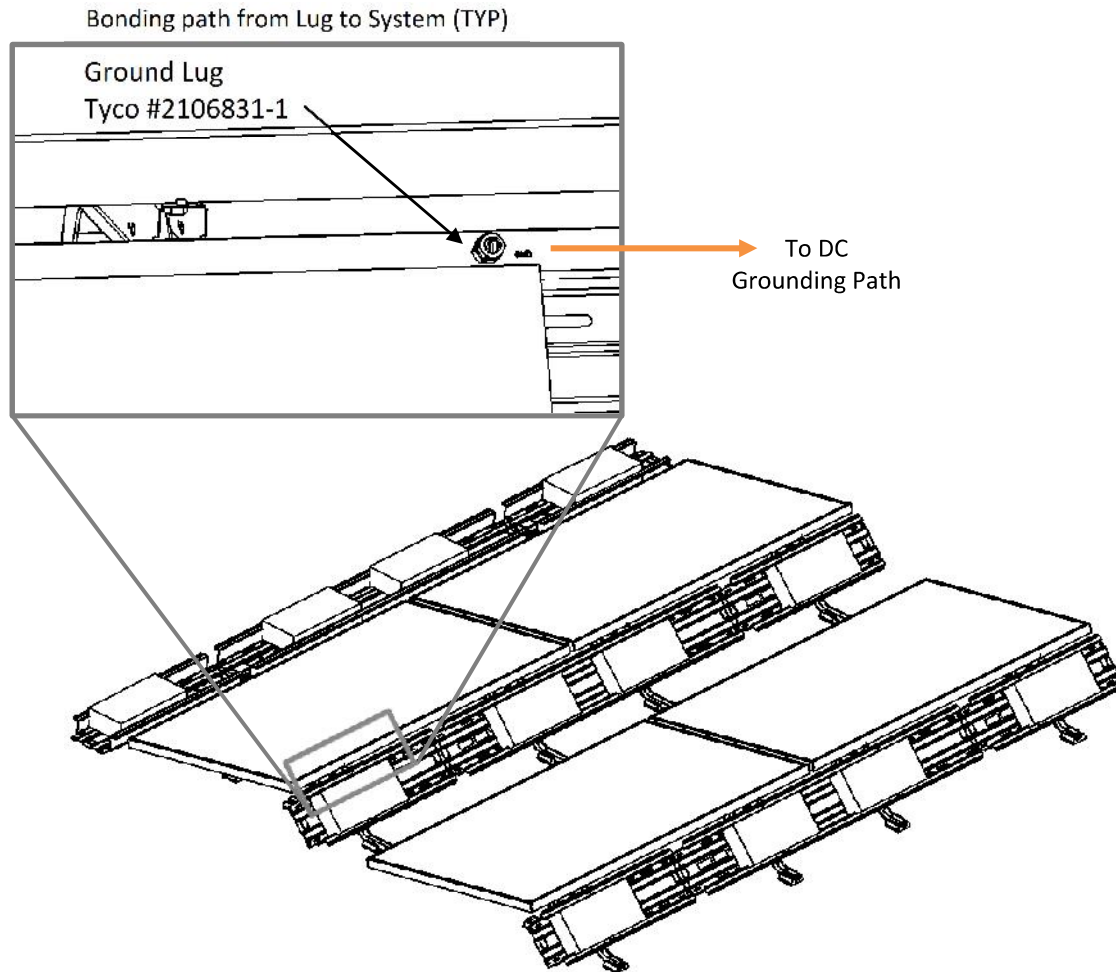


Figure 11 System Ground Path

Grounding Instructions:

PanelClaw components within the array are required to be electrically bonded to other DC grounding paths via the use of either a #12 or #10 AWG Cu bonding jumpers and a UL 467 listed Tyco solid wire grounding assembly, part number 2106831-1, manufactured by Tyco Electronics Corporation. The conductor size should be selected in accordance with NEC 690.45 and NEC 250.122.

To ground the array, a Tyco solid wire grounding assembly, part number 2106831-1, manufactured by Tyco Electronics Corporation, must be installed on each Ballast Tray. As you run the copper wire necessary to ground each module (not provided), ensure the same copper wire is run through every Tyco solid wire grounding assembly and secured per Tyco Electronics Corporation, LLC specifications (www.te.com). See [Figure 13](#).

To attach the Tyco grounding device/lug to the Ballast Tray, the mounting hex washer and threaded post end should be installed to the specified hole in the Ballast Tray and torqued to 2.08 ft-lb (25in-lb) (see [Figure 12](#)). Once the grounding device/lug has been attached to the Ballast Tray, a copper bonding jumper from an acceptable DC grounded location outside of the array must be installed to the wire slot end and torqued to 3.75ft-lb (45in-lb). For additional instruction regarding the installation of the Tyco solid wire grounding assembly, please refer to the Tyco Electronics instructions sheet (document number 408-10262) via their website www.te.com.

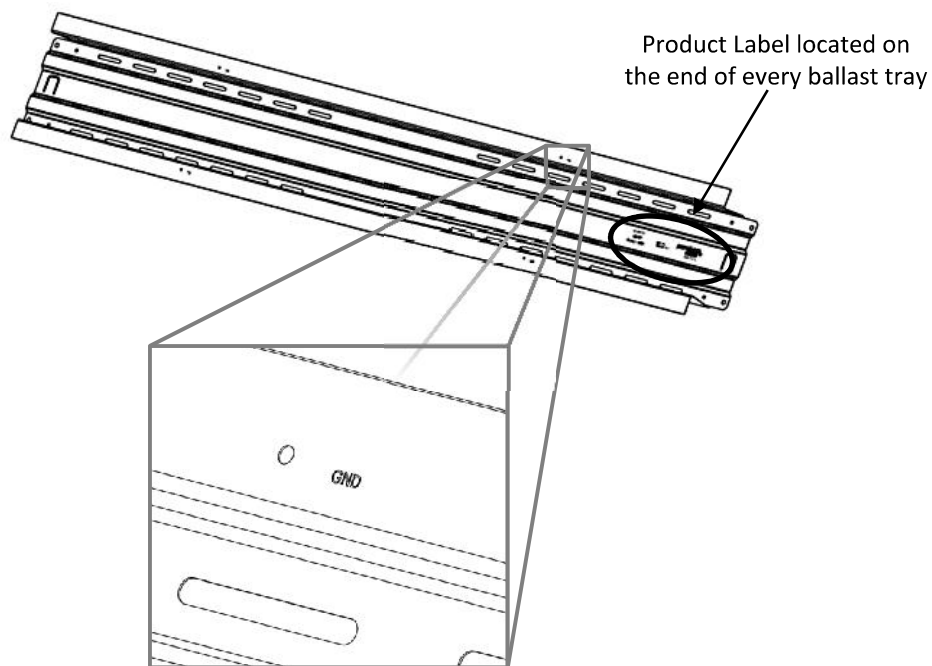


Figure 12 Ground Lug Attachment Location

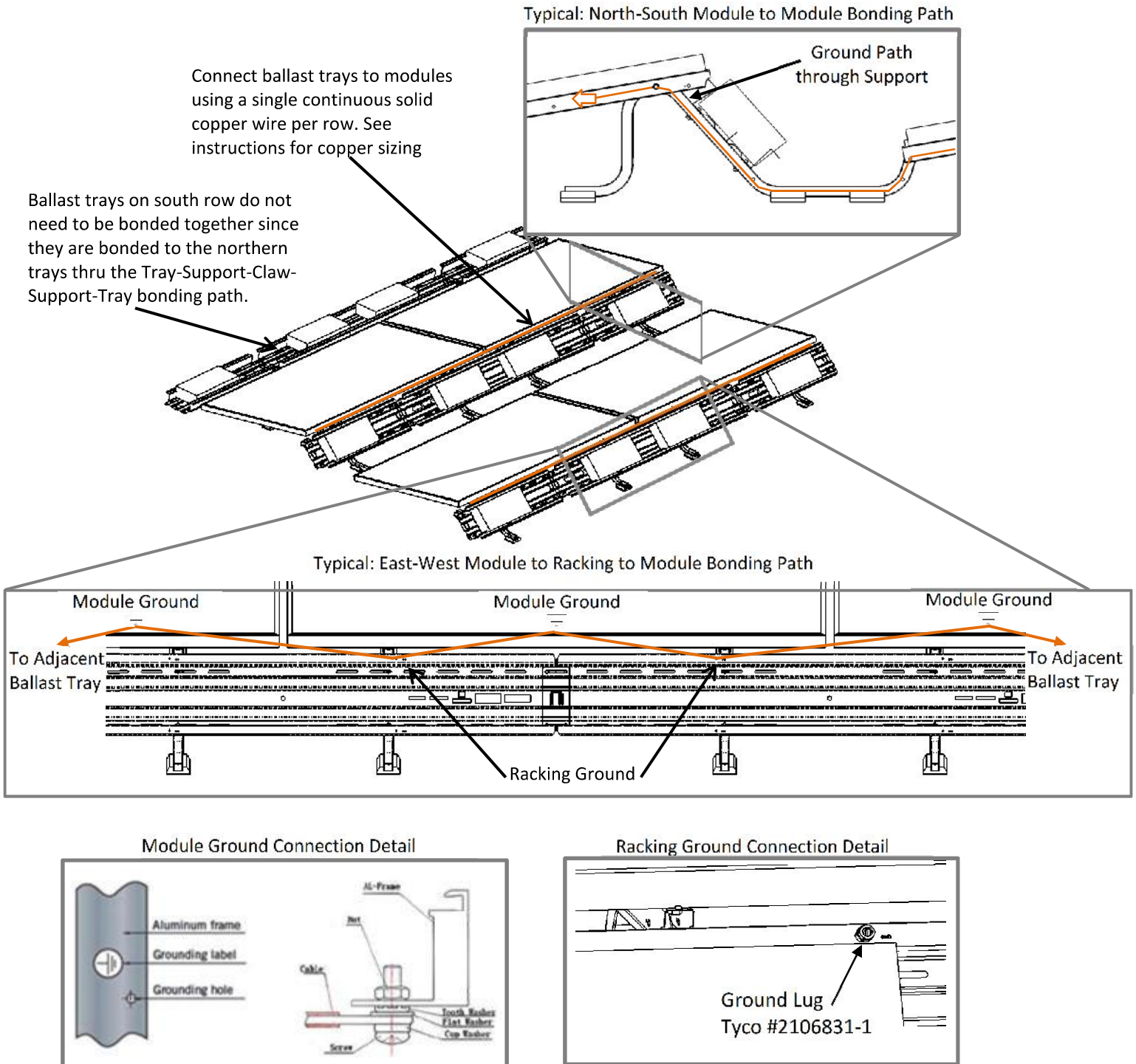


Figure 13 Bonding and Grounding Instructions

Appendix D: UL 2703 Fire Classification

The system has a Fire Class A rating for low slope roofs with Type I and Type II modules when the following requirements are met:

- System is installed over a fire resistant roof covering rated for the application (UL2703, 26.3B)
- Roof slope is less than 2"/ft

Appendix E: Shim Pad Installation

Installation

Follow [Figure 14](#), place the Shim Pads underneath the support pads and compress firmly. Stack the Shim Pads as needed to get the suitable height, a maximum of 2 Shim Pads can be stacked. **Notes: Shim Pads installation is not required on all three pads, select the appropriate locations and stack suitable numbers of Shim Pads.**

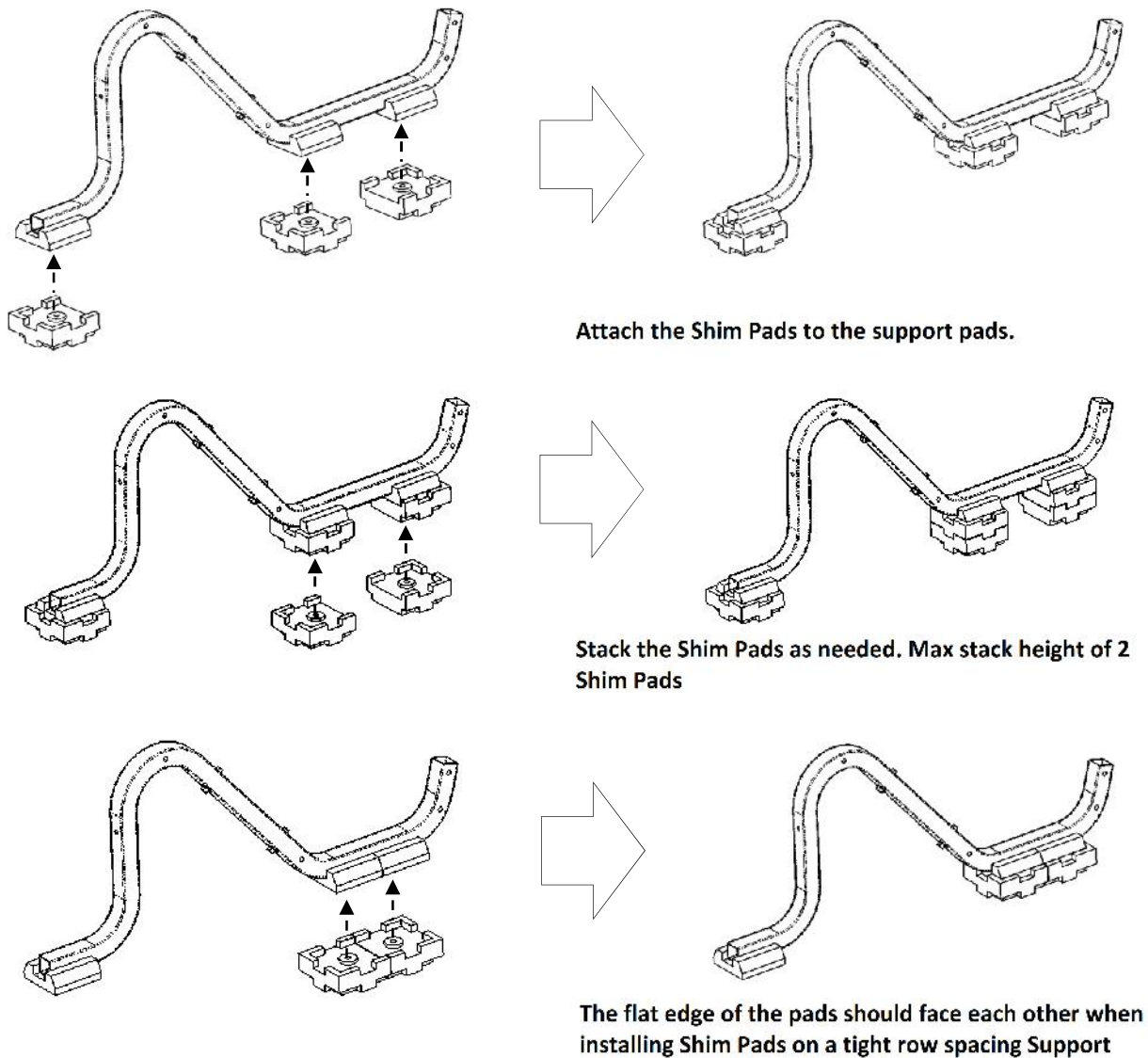


Figure 14 Shim Pads Installation

Appendix F: Ballast Blocks

PanelClaw does not provide the ballast blocks required to construct the system in accordance with PanelClaw’s Racking Construction Set drawings. However, PanelClaw maintains a list of potential block suppliers across the country and this list is available upon request.

BALLAST BLOCKS FOR **ANY** BALLASTED ROOFTOP SYSTEM MUST BE MANUFACTURED TO RESIST FREEZE-THAW AS REQUIRED BY LOCAL CONDITIONS **AND** TO MAINTAIN THEIR WEIGHT OVER THE LIFE OF THE SYSTEM. IT IS STRONGLY RECOMMENDED THAT INSTALLERS WEIGH SEVERAL BLOCKS ON-SITE TO ENSURE BLOCK WEIGHTS MATCH THE WEIGHT OF THE BLOCKS SPECIFIED IN PANELCLAW’S RACKING CONSTRUCTION SET DRAWINGS. BLOCK WEIGHT VARIANCES LISTED IN THE CHART BELOW ARE ACCEPTABLE.

Ballast Block Description	Nominal Weight kg [lb]	Allowable Weight Variance (+ or -) Kg [lb]
BLOCK, CONCRETE, 2"X 8"X 16"	6.6 [14.6]	0.45 [1.00]
BLOCK, CONCRETE, 3"X 8"X 16"	10.7 [23.6]	0.57 [1.25]
BLOCK, CONCRETE, 4"X 8"X 16"	14.8 [32.6]	0.68 [1.50]

BLOCKS WITH A WEIGHT VARIANCE GREATER THAN WHAT IS SHOWN IN THE CHART ABOVE MUST NOT BE USED.

FAILURE TO FOLLOW THESE PRACTICES MAY RESULT IN SYSTEM PERFORMANCE BELOW DESIGN CRITERIA AND/OR MAY CAUSE STRUCTURAL DAMAGE TO THE BUILDING AND/OR ARRAY.

Polar Bear[®] III HD and Polar Bear III First Solar[®]

PanelClaw[®]'s Polar Bear III and Polar Bear III HD products have been tested in accordance with the *ANSI/UL 2703-2015 Standard for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels*. The test program includes temperature and humidity cycling; electrical resistance and conductance testing; fire performance; manufacturing and operational quality reviews; and module-specific mechanical load testing and review. The UL 2703 mechanical strength, electric bonding and grounding, and fire performance requirements closely mirror UL 1703, the standard for flat-plate PV modules.

Additionally, Polar Bear III HD and Polar Bear III First Solar mounting systems have achieved a Class A System Fire Rating with Type 1 and Type 2 modules and with First Solar modules.

PanelClaw's Polar Bear systems are listed for their mechanical strength, ability to electrically bond and ground modules, and fire performance. Each PanelClaw product installation manual contains instructions for both bonding and grounding listed modules, and fire performance. These instructions must be followed to maintain compliance with the listing.

PV system installers using PanelClaw racking products can quickly and easily establish UL-certified electric bonds between all connected array components, including modules and mounting system components, *without* the use of dedicated grounding devices, e.g. ground lugs and copper wire. Multiple strings within an array having a fuse rating of up to 30 amps can be grounded via a single properly sized ground lug acting as a Grounding Electrode Conductor (GEC).

All PanelClaw module mounting attachments ("Claws") for all PanelClaw products are certified as recognized components under UL 2703 for module-to-module and module-to-mounting system electric bonding. For projects using modules not currently included in PanelClaw's UL Listing, additional approvals from the module manufacturer and the relevant permitting authority may be necessary to utilize the UL 2703 electric bonding and grounding method described in the PanelClaw product installation manual.

PanelClaw's UL Test Program

In 2012, PanelClaw opened the mounting system industry's first Intertek[®] Satellite Test Laboratory in order to accelerate the company's product innovation cycle and develop close partnerships with Nationally Recognized Test Laboratories (NRTL's) in the United State. In 2015, PanelClaw transitioned to UL under its *UL Client Test Data Program (CTDP)*. The company's commitment to the development of codes and standards for mounting systems; product testing; and certification is unwavering.



Helpful Links

UL provides a summary of requirements for the UL2703 specification. This summary can be found by visiting the UL 2703 Guide Information web page. An excerpt can be found in [Appendix A: UL 2703](#) of this document.

The UL Online Certifications Directory contains the most up-to-date, complete listing of modules which are listed for use with PanelClaw mounting systems. See [Appendix B: Module List](#) of this document for a list of listed photovoltaic modules which have been assessed, as of the release of this document, for use with the Polar Bear III HD 10°, Polar Bear III HD 5°, and Polar Bear III 3° First Solar mounting systems.

Helpful Phone Numbers

For additional information regarding PanelClaw's UL 2703 listings, please contact Applications Engineering at +1 (978) 688-4900.

For additional information regarding UL 2703, please contact UL Regulatory Services at +1 (847) 664-2554.

Adding Modules to PanelClaw Product Listings

PanelClaw regularly adds new modules to our product listings. If you are working with or plan to work with a module not listed on this document or under PanelClaw's listing on UL's online certification directory, please contact your PanelClaw sales representative. We work closely with all module manufacturers in the industry and have developed a standard process for evaluating and adding new modules with our mounting systems.

Appendix A: UL 2703

UL 2703 Guide Information – QIMS Guide Information: The data below is taken from UL’s website and represents the most current information as of January 20, 2017.



ONLINE CERTIFICATIONS DIRECTORY

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QIMS.GuideInfo

Mounting Systems, Mounting Devices, Clamping Devices and Ground Lugs for Use with Photovoltaic Modules and Panels

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[Distributed Generation Power Systems Equipment] Mounting Systems, Mounting Devices, Clamping Devices and Ground Lugs for Use with Photovoltaic Modules and Panels

[See General Information for Distributed Generation Power Systems Equipment](#)

USE AND INSTALLATION

This category covers photovoltaic (PV) mounting systems, mounting devices, clamping devices (which may be for bonding and/or mechanical loading) and ground lugs tested in combination with specific PV modules and panels and specified module frames and mounting structures as identified in the individual certifications. These systems and devices are investigated for one of two installation types: (1) ground mounted, or (2) intended to serve as part of a nonstructural component of a building, such as a stand-alone system on a building, curtain wall, facade, atrium, skylight, etc., which is applied extant to the primary building structure. Both mounting systems and clamping devices may be investigated for mechanical mounting alone, or mechanical mounting and ground bonding as identified in the individual certifications. Ground lugs may be tested in combination with specific PV modules, specific PV module frames, or specific mounting-system rails as identified in the individual certifications.

Only those features noted in the individual certifications and/or the Reports for specific products have been investigated by UL.

The installation of these mounting systems, clamping devices or bonding devices is intended to be in accordance with ANSI/NFPA 70, "National Electrical Code," in addition to any applicable building codes.

Authorities Having Jurisdiction should be consulted as to conformance with applicable building codes, including the class of roof covering, and any additional safety investigations that may be required.

FLAME CLASSES

When applicable, PV mounting systems are marked "Class A," "Class B" or "Class C" to denote their resistance to external fire exposure when installed in combination with specific PV modules and according to the PV mounting system installation instructions.

PRODUCT IDENTITY

One of the following product identities appears on the product:

Photovoltaic Bonding Device

Photovoltaic Ground Lug

Photovoltaic Module Clamping Device

Photovoltaic Mounting and Bonding Device

Photovoltaic Mounting Device

Photovoltaic Mounting System

The word "Photovoltaic" may be abbreviated "PV."

RELATED PRODUCTS

PV modules and panels are covered under Photovoltaic Modules and Panels ([QIGU](#)).

Low-concentration flat-plate modules are covered under Flat-plate, Low-concentration Photovoltaic Modules and Panels ([QHZU](#)).

PV concentrators are covered under Concentrator Photovoltaic Modules and Assemblies ([QICP](#)).

AC modules are covered under AC Modules and Photovoltaic Modules with Integrated Electronics ([QHYZ](#)).

ADDITIONAL INFORMATION

For additional information, see Electrical Equipment for Use in Ordinary Locations ([AALZ](#)).

REQUIREMENTS

The basic requirements used to investigate products in this category are contained in [UL 2703](#), "Outline of Investigation for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels."

The System Fire Test Requirement from [ANSI/UL 1703](#), "Flat-Plate Photovoltaic Modules and Panels," may be utilized in lieu of the [UL 2703](#) Fire Test.

Ground lugs are additionally investigated to [ANSI/UL 467](#), "Grounding and Bonding Equipment."

Constructions that penetrate roofing may be investigated utilizing the Wind-Driven Rain Test from [UL 2582](#), "Outline of Investigation for Hip and Ridge Vents."

UL MARK

The Certification Mark of UL on the product or on the smallest unit container in which the product is packaged is the only method provided by UL to identify products manufactured under its Certification and Follow-Up Service. The [Certification Mark](#) for these products includes the UL symbol, the words "CERTIFIED" and "SAFETY," the geographic identifier(s), and a file number.

Alternate UL Mark

The Listing Mark of UL on the product or on the smallest unit container in which the product is packaged is the only method provided by UL to identify products manufactured under its Listing and Follow-Up Service. The Listing Mark for these products includes the UL symbol (as illustrated in the Introduction of this Directory) together with the word "LISTED," a control number, and one of the following product names: "Photovoltaic Mounting System," "Photovoltaic Module Clamping Device," "Photovoltaic Mounting Device," "Photovoltaic Bonding Device," "Photovoltaic Mounting and Bonding Device" or "Photovoltaic Ground Lug." The word "Photovoltaic" may be abbreviated "PV."

For PV mounting systems additionally investigated for resistance to external fire exposure, the Listing Mark includes the words **CLASS A**, **CLASS B** or **CLASS C**, as appropriate.

UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. UL shall not incur any obligation or liability for any loss, expense or damages, including incidental or consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Guide Information.

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Appendix B: Module List

The following tables define the listed modules and their respective load ratings which can be used with the Polar Bear III HD system and Polar Bear III First Solar. All modules listed have been evaluated for mechanical loading and grounding and bonding. For the complete module listing for PanelClaw, go to: http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/showpage.html?name=QIMS.E339731&ccnshorttitle=Mounting+Syst+ems,+Mounting+Devices,+Clamping+Devices+and+Ground+Lugs+for+Use+with+Photovoltaic+Modules+and+Panels&objid=1081821053&cfgid=1073741824&version=versionless&parent_id=1081534547&sequence=1

Module Manufacturer: Boviet

Module Listed with: Intertek		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	Boviet	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	BVM6612P-XXX	33	33	20	33	33	20
	BVM6610P-XXX	33	33	20	33	33	20

Module Manufacturer: Canadian Solar

Module Listed with: CSA		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	CANADIAN	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	CS6U XXX M	61	47	20	61	47	20
	CS6U XXX P	61	47	20	61	47	20
	CS6X XXX P	62	48	20	62	48	20
	CS6K XXX M	72	50	20	72	50	20
	CS6K XXX P	72	50	20	72	50	20
	CS6K XXX MS	72	50	20	72	50	20
	CS6K XXX MS	72	50	20	72	50	20
	CS6K XXX M	72	50	20	72	50	20
	CS6P XXX P	73	50	20	73	50	20

Module Manufacturer: CSUN

Module Listed with: Intertek		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	China Sunergy	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	CSUN XXX - 72P	30	30	20	30	30	20
	CSUN XXX - 72M	30	30	20	30	30	20
	CSUN XXX - 60P - BW	30	30	20	30	30	20
	CSUN XXX - 60M - BW	30	30	20	30	30	20
	CSUN XXX - 60M - BB	30	30	20	30	30	20

Module Manufacturer: First Solar

Module Listed with: UL		Polar Bear III First Solar		
		System Ratings (PSF)		
Module Manufacturer Name	FIRST SOLAR	Positive	Negative	Down-Slope
Module Model Number or Series Number	FS 2 Series	30	20	6.5
	FS 3 Series	30	20	6.5
	FS 4 Series	30	20	6.5

Module Manufacturer: Hanwha

Module Listed with: CSA		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	HANWHA	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	Q.PLUS G4 XXX	71	55	20	71	55	20
	Q.PLUS BFR G4.1 XXX	71	55	20	71	55	20
	Q.PRO BFR G4 XXX	71	55	20	71	55	20
	Q.PRO BFR G4.1 XXX	71	55	20	71	55	20
	Q.PRO BFR G4.3 XXX	71	55	20	71	55	20
	B.LINE PLUS BFR G4.1 XXX	71	55	20	71	55	20
	B.LINE PRO BFR G4.1 XXX	71	55	20	71	55	20
	Q.PLUS L G4.1 XXX	59	33	20	59	33	20
	Q.PLUS L G4.2 XXX	59	33	20	59	33	20
	Q.PRO L G4 XXX	59	33	20	59	33	20
	Q.PRO L G4.1 XXX	59	33	20	59	33	20
	Q.PRO L G4.2 XXX	59	33	20	59	33	20
	B.LINE PLUS L G4.2 XXX	59	33	20	59	33	20
	B.LINE PRO L G4.1 XXX	59	33	20	59	33	20
	B.LINE PRO L G4.2 XXX	59	33	20	59	33	20
	Q.PLUS G4.1/SC XXX	50	50	20	50	50	20
	Q.PLUS G4.1/SC XXX	50	50	20	50	50	20
	Q.PRO G4/SC XXX	50	50	20	50	50	20

Module Manufacturer: Hyundai

Module Listed with: UL		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	HYUNDAI	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	HiS-M XXX RG (BK)	72	50	20	72	50	20
	HiS-S XXX RG (BK)	72	50	20	72	50	20
	HiS-S XXX RG	72	50	20	72	50	20
	HiS-S XXX RG	72	50	20	72	50	20
	HIS-M XXX RI	60	47	20	60	47	20
	HIS-S XXX RI	60	47	20	60	47	20
	HIS-M XXX TI	60	47	20	60	47	20
	HIS-S XXX TI	60	47	20	60	47	20
	HIS-M XXX KI	60	47	20	60	47	20
	HIS-S XXX KI	60	47	20	60	47	20

Module Manufacturer: JA Solar

Module Listed with: Shanghai ETL		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	JA SOLAR	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	JAM6(k)-60-XXX/4BB	50	50	20	50	50	20
	JAP6-60-XXX/4BB	50	50	20	50	50	20
	JAM6(k)-60-XXX/PR	50	50	20	50	50	20
	JAP6-60-XXX/4BB/RE	50	50	20	50	50	20
	JAM6(k)-72-XXX/4BB	50	47	20	50	47	20
	JAM6-72-XXX/4BB	50	47	20	50	47	20
	JAM6(k)-72-XXX/PR	50	47	20	50	47	20
	JAP6-72-XXX/4BB/RE	50	47	20	50	47	20

Module Manufacturer: Jinko Solar

Module Listed with: UL		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	JINKO SOLAR	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	JKMS XXX PP	72	33	20	72	33	20
	JKM XXX PP-V	72	33	20	72	33	20
	JKMS XXX PP	61	33	20	61	33	20
	JKM XXX PP-V	61	33	20	61	33	20

Module Manufacturer: Kyocera

Module Listed with: UL		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	Kyocera	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	KU-XXX-6MCA	30	30	20	30	30	20

Module Manufacturer: LG

Module Listed with: INTERTEK		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	LG	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	LG XXX S1C-G4	72	56	20	72	56	20
	LG XXX N1K-G4	72	56	20	72	56	20
	LG (XXX) N1C-G4	72	56	20	72	56	20
	LG XXX S2W-G4	60	47	20	60	47	20
	LG XXX N2W-B3	60	47	20	60	47	20
	LG XXX N2W-G4	60	47	20	60	47	20
	LG XXX N2W-A5	57	44	20	57	44	20
	LG XXX S2W-A5	57	44	20	57	44	20
	LG XXX N2T-A5	56	44	20	56	44	20
	LG XXX S1C-A5	69	54	20	69	54	20
	LG XXX N1C-A5	69	54	20	69	54	20
LG XXX N1K-A5	69	54	20	69	54	20	
LG XXX N1T-A5	67	52	20	67	52	20	

Module Manufacturer: Mission Solar

Module Listed with: RETC		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	Mission solar	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	MSE XXX SQ5T	30	30	20	30	30	20

Module Manufacturer: Mitsubishi Electric

Module Listed with: Intertek		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	Mitsubishi Electric	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	PV-MJE XXX FB	72	34	20	72	34	20
	PV-MLE XXX HD2	72	34	20	72	34	20

Module Manufacturer: NSP

Module Listed with: UL		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	NSP	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	D6M XXX E4AME	30	30	20	30	30	20

Module Manufacturer: Phono Solar

Module Listed with: INTERTEK		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	PHONO SOLAR	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	PS XXX P-20/U BB AC	73	57	20	73	57	20
	PS XXX M-20/U BB AC	73	57	20	73	57	20
	PS XXX P-20/UV	73	57	20	73	57	20
	PS XXX P-20/U	73	57	20	73	57	20
	PS XXX P-20/UK	73	57	20	73	57	20
	PS XXX P-24/T	61	47	20	61	47	20
	PS XXX P-24/TV	61	47	20	61	47	20
	PS XXX P-24/TK	61	47	20	61	47	20

Module Manufacturer: REC

Module Listed with: UL/VDE		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	REC Solar	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	REC XXX PE	72	56	20	72	56	20
	REC XXX TP	72	33	20	72	33	20
	REC XXX TP2	72	33	20	72	33	20
	REC XXX PE 72	57	44	20	57	44	20
	REC XXX TP 72	57	33	20	57	33	20

Module Manufacturer: ReneSola

Module Listed with: INTERTEK		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	ReneSola	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	JC XXX M-24/Bbs	50	50	20	50	50	20
	JC XXX M-24/Bbs	50	50	20	50	50	20
	JC XXX M-24/Bbs	50	47	20	50	47	20
	JC XXX M-24/Bbs	50	47	20	50	47	20

Module Manufacturer: S-Energy

Module Listed with: UL		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	S-Energy	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	SN XXX P-10-SN XXX P-10	30	30	20	30	30	20
	SN XXX P-10-SN XXX P-10	30	30	20	30	30	20
	SN XXX P-10-SN XXX P-10	30	30	20	30	30	20

Module Manufacturer: Sharp

Module Listed with: UL Suzhou(China)		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	Sharp	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	NU-SA XXX	30	30	20	30	30	20
	NU-SC XXX	30	30	20	30	30	20

Module Manufacturer: SolarWorld

Module Listed with: CSA		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	SOLARWORLD	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	SW XXX XL mono	59	46	20	59	46	20
	SW BS XXX XL duo	50	46	20	50	46	20
	SW XXX mono	71	55	20	71	55	20
	SW PT XXX mono	71	55	20	71	55	20
	SW BS XXX duo	71	55	20	71	55	20

Module Manufacturer: Suniva

Module Listed with: CSA		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	Suniva	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	OPT XXX-60-4-100	30	30	20	30	30	20
	OPT XXX-60-4-1B0	30	30	20	30	30	20
	ART XXX-60-4-800	30	30	20	30	30	20
	MXV XXX-60-5-800	30	30	20	30	30	20
	OPT XXX-72-4-100	30	30	20	30	30	20
	MXV XXX-72-5-800	30	30	20	30	30	20

Module Manufacturer: SunPower Corp.

Module Listed with: UL		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	SunPower Corp.	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	SPR-P17-XXX-COM	30	30	19	30	30	19

Module Manufacturer: Trina

Module Listed with: UL		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	Trina	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	TSM- XXX -PD05.08	30	30	20	30	30	20
	TSM- XXX -PD05.05	30	30	20	30	30	20
	TSM- XXX- DD05A(II)	30	30	20	30	30	20
	TSM- XXX -DD05A.08(II)	30	30	20	30	30	20
	TSM- XXX -DD05A.05(II)	30	30	20	30	30	20
	TSM- XXX -PD05.08D	30	30	20	30	30	20
	TSM- XXX -PD05.082	30	30	20	30	30	20
	TSM- XXX -DD05A.082(II)	30	30	20	30	30	20
	TSM- XXX- PD05.08S	30	30	20	30	30	20
	TSM- XXX-DD05A.08S(II)	30	30	20	30	30	20
	TSM- XXX- PD05.05S	30	30	20	30	30	20
	TSM- XXX-DD05A.05S(II)	30	30	20	30	30	20
	TSM- XXX- PD14	30	30	20	30	30	20
	TSM- XXX -PE14A	30	30	20	30	30	20
	TSM- XXX -PD14.002	30	30	20	30	30	20
	TSM- XXX - PD14.00S	30	30	20	30	30	20
	TSM- XXX -DD14A(II)	30	30	20	30	30	20
	TSM- XXX- DE14A(II)	30	30	20	30	30	20
	TSM- XXX-DD14A.002(II)	30	30	20	30	30	20
	TSM- XXX-DD14A.00S(II)	30	30	20	30	30	20
TSM- XXX- PD14.18/PD14.10	30	30	20	30	30	20	

Module Manufacturer: Yingli

Module Listed with: UL		PB3 HD 5D			PB3 HD 10D		
		System Ratings (PSF)			System Ratings (PSF)		
Module Manufacturer Name	YINGLI	Positive	Negative	Down-Slope	Positive	Negative	Down-Slope
Module Model Number or Series Number	YL XXX D-30b	30	30	20	30	30	20
	YL XXX P-29b	30	30	20	30	30	20
	YL XXX D-36b	30	30	20	30	30	20
	YL XXX P-35b	30	30	20	30	30	20

For the complete module listing for PanelClaw, go to: http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/showpage.html?name=QIMS.E339731&ccnshorttitle=Mounting+Systems,+Mounting+Devices,+Clamping+Devices+and+Ground+Lugs+for+Use+with+Photovoltaic+Modules+and+Panels&objid=1081821053&cfgid=1073741824&version=versionless&parent_id=1081534547&sequence=1