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## PG

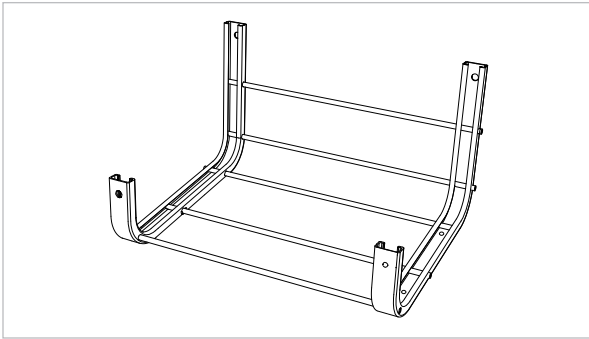
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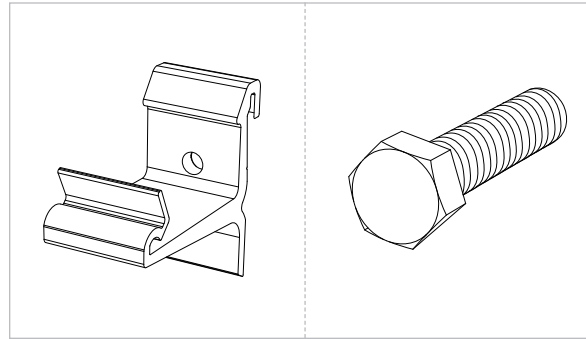
## PG

## GENERAL NOTES:

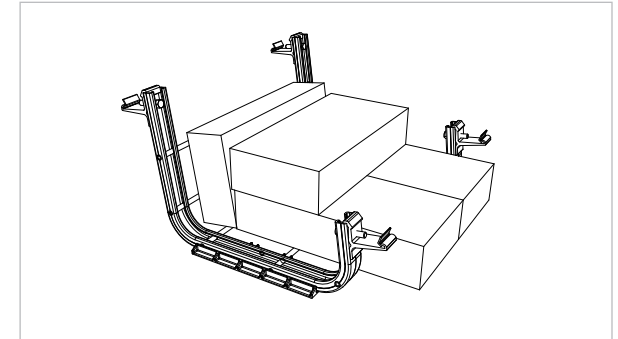
5	Refer to construction drawings for project specific details. Construction drawings have precedence over these installation guidelines.
6	
7	
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C	



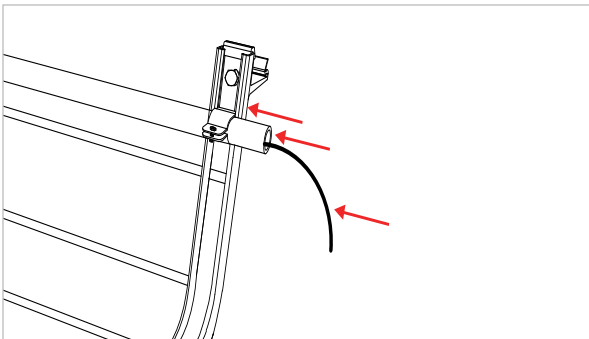
**BALLAST BAY:** The Ballast Bay frame is made of a mill finish Aluminum. This roof mount is a modular design that allows for easily getting around roof obstructions and accommodating roof undulations. The Ballast Bays are created such that they nest within each other to optimize shipping logistics.



**CLIP & BOLT:** The Module Clip is made of a mill finish Aluminum and engages the return flange underneath the panel to secure the module. This unique design takes advantage of the design of the module frame, attaching to the return flange of the frame creating a universal connection.

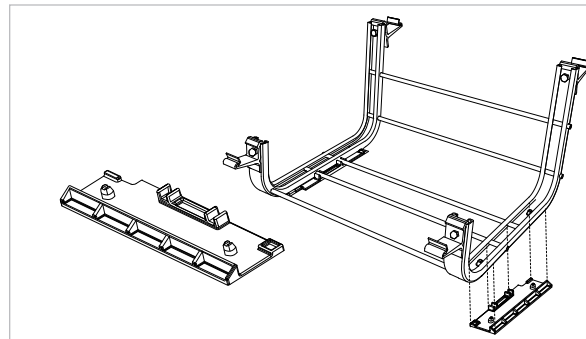


**BALLAST BLOCK:** The RM ballast bay can fit up to 4 standard 4"x8"x16" solid concrete cap blocks. Block weight can range from 26 – 38 lbs. The weight of the block will have a major impact on how many will be required for the project so be sure to verify your block weights before using the U-builder online tool.



**OPTIONAL WIRE MANAGEMENT:** Components by others.

**NOTE:** All conduit and wire ways should be grounded & bonded per the (NEC) National Electric Code.



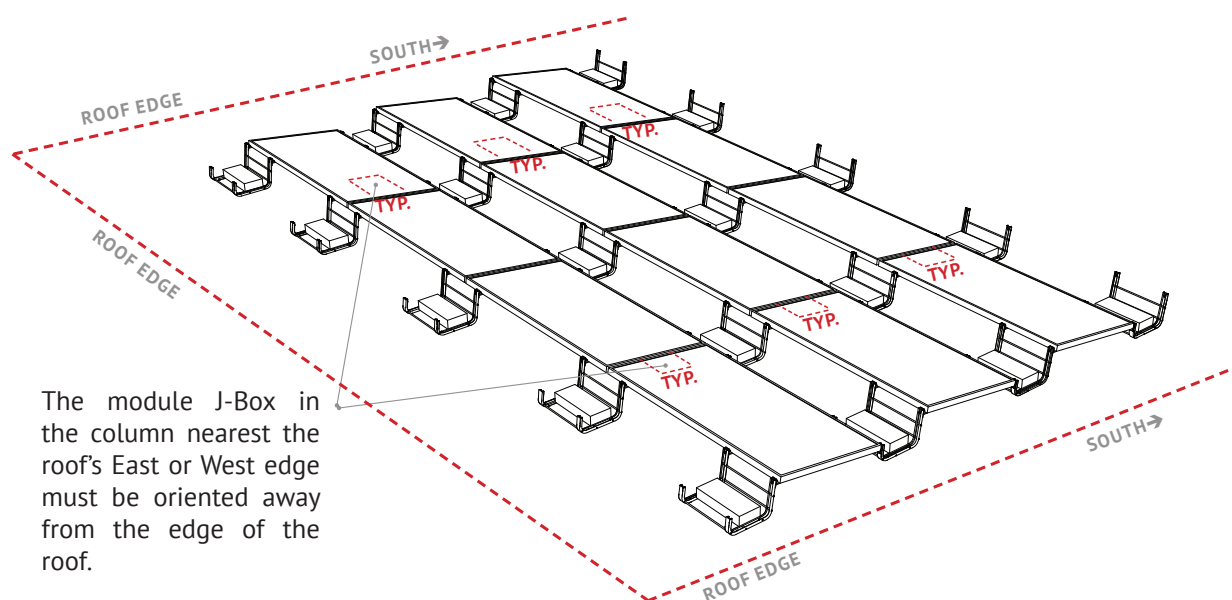
**OPTIONAL ROOF PAD:** The Roof Pad provide a protective interface between the Ballast Bay and roofing material to reduce any possible damage that could occur. The Roof Pad snaps into the holes on the bottom side of the Ballast Bay, two Roof Pads per bay. Please consult the roofing manufacturer to see whether it is required as well as to verify compatibility.

**SYSTEM LEVEL FIRE CLASSIFICATION:** The system fire class rating is only valid when the installation is conducted in accordance with the assembly instructions contained in this manual. RM Roof Mount has been classified to the system level fire portion of UL1703. It has achieved Class A performance for low sloped roofs when used in conjunction with type 1, type 2 and type 3 module constructions. System fire class rating requires a prescriptive method of mounting the module. Please see the specific conditions below for mounting details required to maintain the Class A fire rating. Minimum and maximum roof slopes are restricted through the system design and layout rules. The fire classification rating is only valid on roof pitches less than 2:12 (slopes  $\leq$  2 inches per foot, or 9.5 degrees).

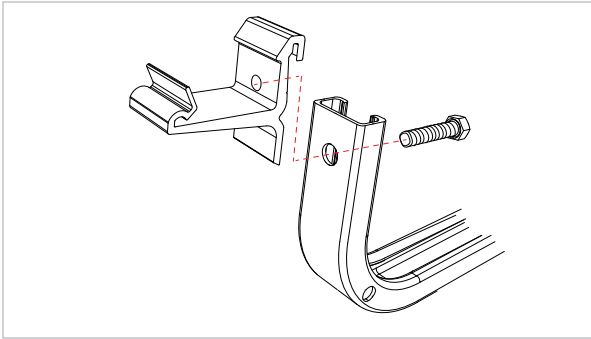
Module Type	System level Fire Rating	Mitigation
Type 1	Class A	Prescriptive. See notes & Illustration Below
Type 2	Class A	Prescriptive. See notes & Illustration Below
Type 3	Class A	None Required / No Limitations

### TYPE 1 / TYPE 2 CLASS A FIRE RATING MOUNTING ORIENTATION

Unirac RM has achieved Class A system level fire performance for type 1, type 2 and type 3 module constructions. In order to maintain the fire rating for type 1 and type 2 modules, the J-Box must be oriented away from the roof edge as in the illustration below. Type 3 module constructions do not require specific mounting orientations in order to meet Class A requirements.



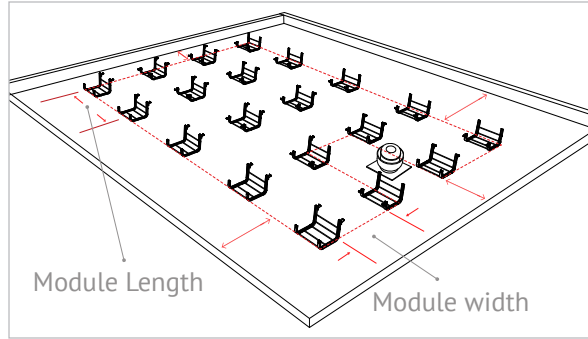
The module J-Box in the column nearest the roof's East or West edge must be oriented away from the edge of the roof.



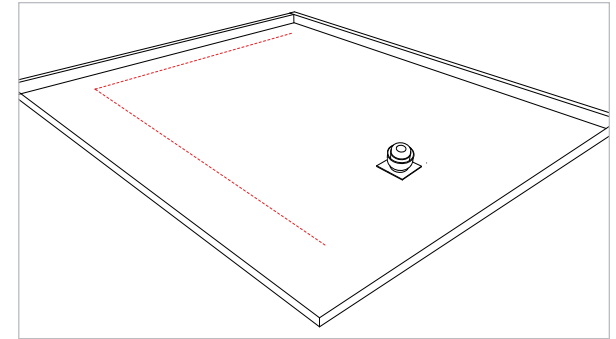
**ATTACH CLIPS LOOSELY TO BAY POSTS INTENDED TO HOLD MODULES.** All bolts and clips are single use only.

**NOTE: BOLT - Single Use Only - Do not re-torque once fully seated.**

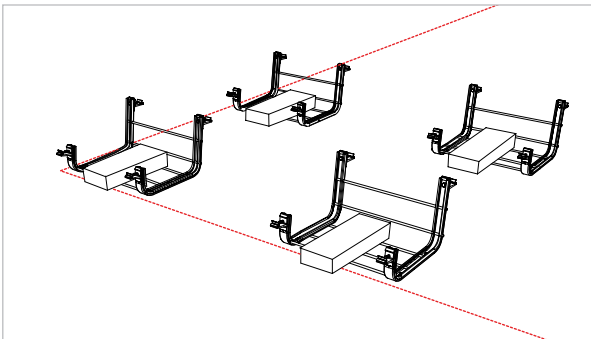
**NOTE: CLIP - Single Use Only - For complete electrical bonding path, clips must be tapped in place with hammer.**



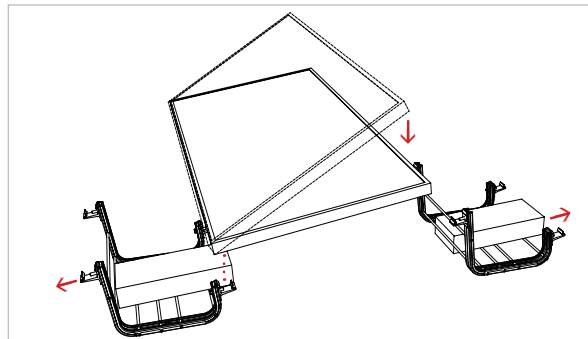
**LOCATE ARRAY ON ROOF**



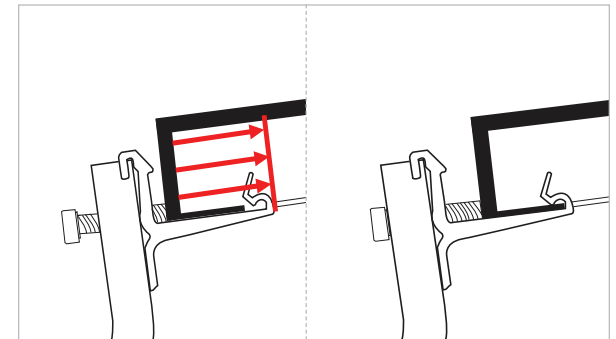
**MARK ROOF WHERE ARRAY WILL START**



**PLACE SOME BALLAST IN 1ST FOUR BAYS FOR FIRST MODULE**

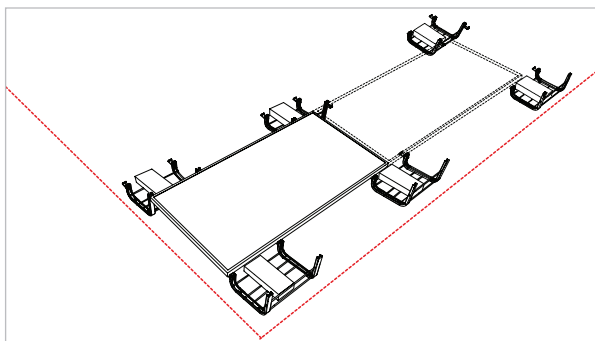


**PLACE MODULE IN CLIPS**

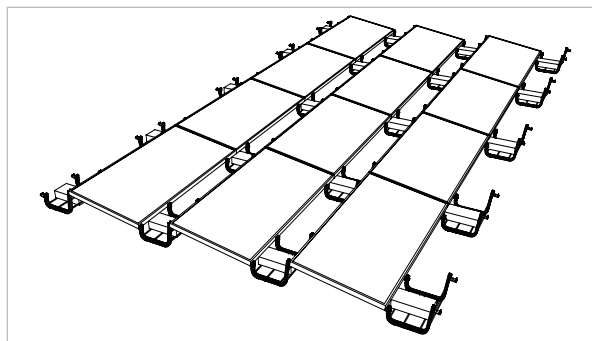


**FULLY SEAT MODULE IN CLIPS AND TIGHTEN BOLTS**

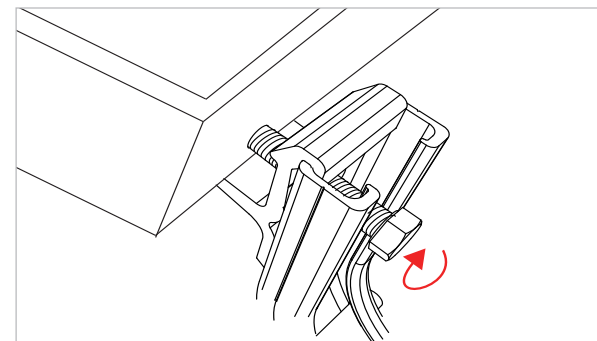
If module frame is not fully seated, then tightening the bolt is actually dragging ballast bays, and could result in frame damage including deformation or puncture. A gentle tug apart of the bays will seat the module into the module clip. It is NOT recommended to use the bolt to seat the module.



PLACE ANOTHER MODULE IN NEXT BAY CLIPS



REPEAT INTERCONNECTING ADJACENTLY

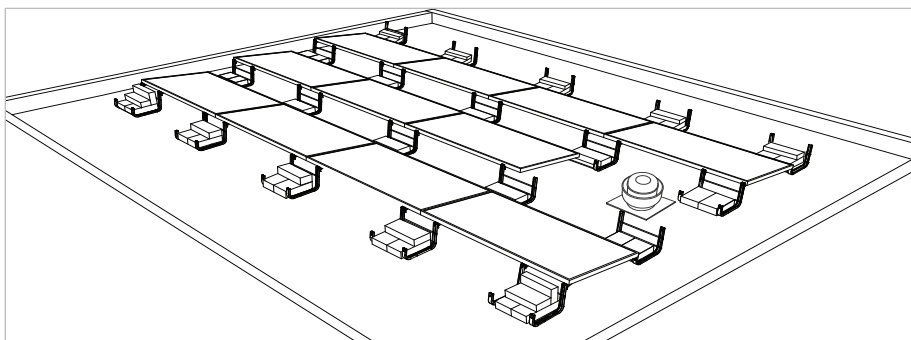


TORQUE CLIP BOLTS IN SEQUENCE

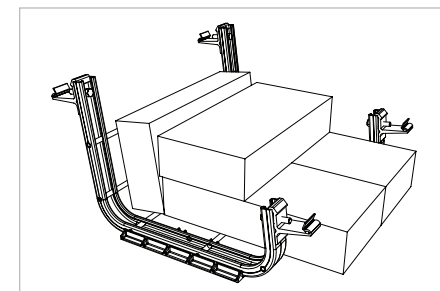
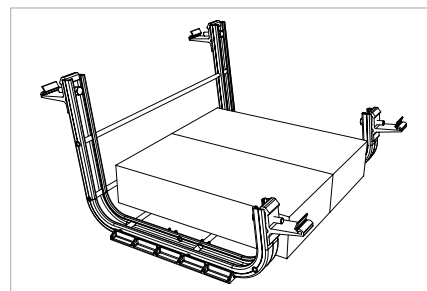
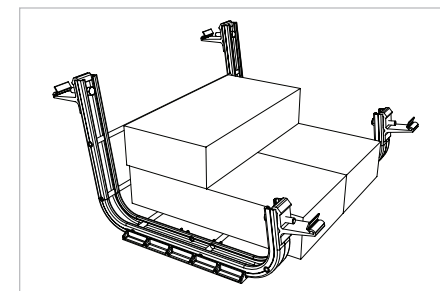
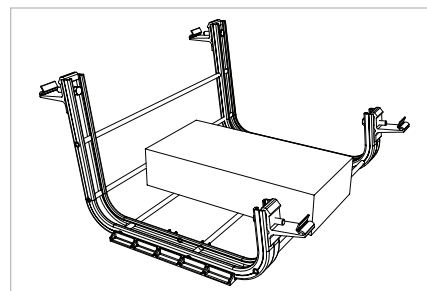
**TORQUE VALUE:**

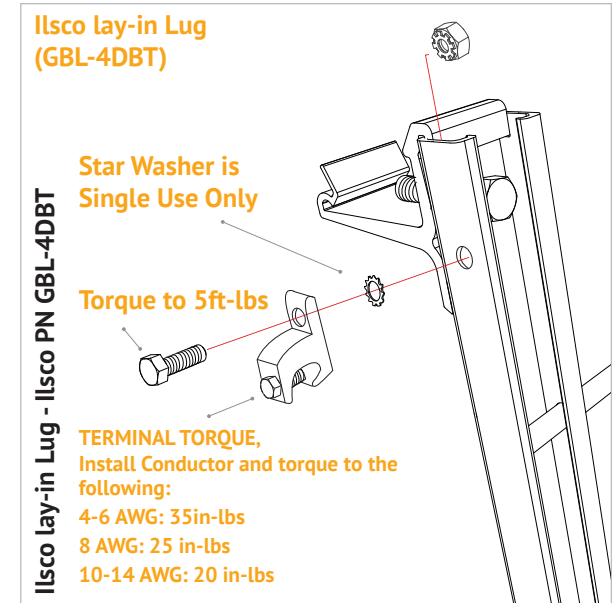
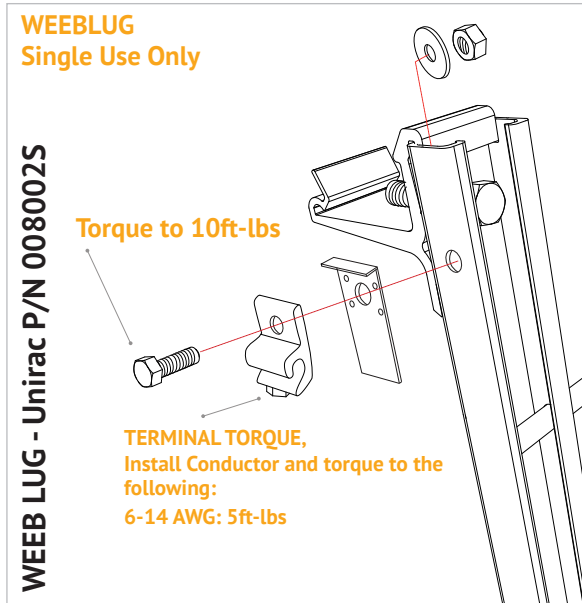
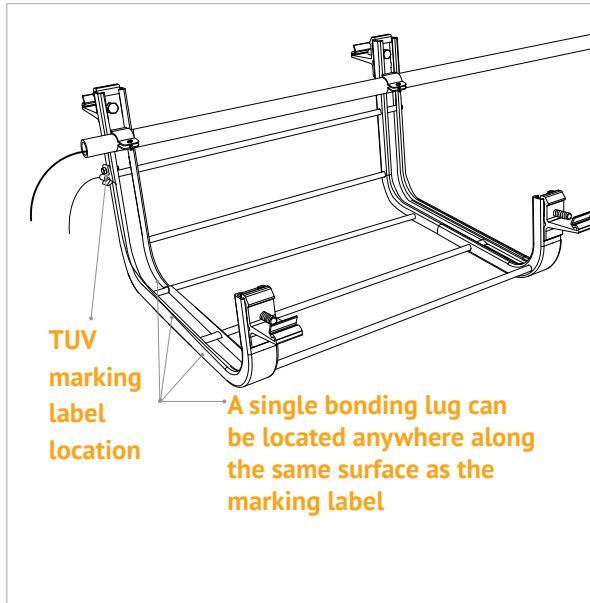
7FT-LBS - Minimum - 9FT-LBS - Maximum

**NOTE: BOLT - Single Use Only - Do not re-torque once fully seated.**



**COMPLETE BALLASTED PLACEMENT:** Place ballast as required. Deviations from block arrangements shown in this guide may cause shading. Site specific module loading and ballast calculations should be determined for each individual project in accordance with the U-Builder software and the Unirac Design and Engineering guide for ROOFMOUNT. This system has been rated for the mechanical load provisions of UL2703. In addition, it has been designed and tested to comply with the more rigorous requirements of SEAO PV1, PV2 and ASCE 7.





Although conformance with UL2703 was demonstrated without the use of oxide inhibitor material, it is recommended by IlSCO to provide an optimized bonding solution for their lay-in lug.

**GROUNDING LUG MOUNTING DETAILS AS REQUIRED BY CODE & ENGINEER OF RECORD:** Details are provided for both the WEEB and IlSCO products. The WEEBLug has a grounding symbol located on the lug assembly. The IlSCO lug has a green colored set screw for grounding indication purposes. One lug is recommended per continuous array, not to exceed 150ft X 150ft.

Unirac Roof Mount is intended to be used with PV arrays that have a system voltage less than or equal to 1000VDC. A min. 10 AWG, 105 degrees Celsius copper grounding conductor should be used to ground a 1000 VDC system, according to the (NEC) National Electric Code and the authority having jurisdiction. It is the installers responsibility to check codes, which may vary.

**NOTE:** The installation must be conducted in accordance with the National Electric Code ANSI / NFPA 70.

Ground Lug	Bolt Size	Drill Size	Torque Value
WEEB Lug	1/4"-20	17/64"	10 ft-lbs
IlSCO Lug	#10-32	7/32"	5 ft-lbs

**ELECTRICAL BONDING & GROUNDING TEST MODULES:** This racking system may be used to ground and/or mount a PV module complying with UL 1703 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions. The modules selected for UL 2703 bonding & grounding testing were selected to represent the broadest range possible of modules on the market. The tests performed cover the following basic module parameters:

- 60, 72 & 96 cell modules
- Frame thickness greater than or equal to 1.0mm
- Basic single and double wall frame profile (some complex frame profiles could require further analysis to determine applicability)
- Clear and dark anodized aluminum frames
- The frame profile must not have any feature that might interfere with bonding devices that are integrated into the racking system

#### VERIFIED COMPATIBLE MODULES:

Manufacturer	Module Model / Series
AU Optronics (BenQ Solar)	PM Series
Canadian Solar	CS5A-M
Canadian Solar	CS6P-M
Canadian Solar	CS6P-P
Canadian Solar	CS6X-P
Canadian Solar	CS6K-MS
Canadian Solar	CS6K-M
Canadian Solar	CS6K-P
Canadian Solar	CS6U-M
Canadian Solar	CS6U-P
Centrosolar America	C-Series
Centrosolar America	E-Series
ET Solar	ET AC Module
ET Solar	ET Module
Flex	FXS 60
Hanwha SolarOne	SolarOneHSL 60
Hanwha SolarOne	SolarOneHSL 72
Hyundai Heavy Industries	Heavy IndustriesMISeries
Hyundai Heavy Industries	Heavy IndustriesMG Series
JA Solar	JAP6-60
JA Solar	JAP6-72

Manufacturer	Module Model / Series
Jinko Solar	Standard
Kyocera	KD-F Series
LG Electronics	MONO X
LG Electronics	MONO NEON
Phono Solar Technology	Standard Modules
REC	Peak
REC	Eco
Renesola	All 60-cell modules
Sharp	ND-24CQCI
Sharp	ND-25CQCS
Sharp	ND-Q235F4
Sharp	ND-F4Q300
SolarWorld	Sunmodule Protect
SolarWorld	Sunmodule Plus
Suniva	OPTIMUS Series
Suniva	MV Series
Suntech	STP XXX
Sun Edison	F-Series
Sun Edison	R-Series
SolarWorld	SunModule Protect
SolarWorld	SunModule Plus

Manufacturer	Module Model / Series
SunPower	X-Series
SunPower	E-Series
SunPower	Sig Black
SunPower	AC
Trina	PA05
Trina	PD05
Trina	PD14
Yingli	YGE-U 72
Yingli	YGE-60
Yingli	YGE-Z 60
Yingli	Panda 60

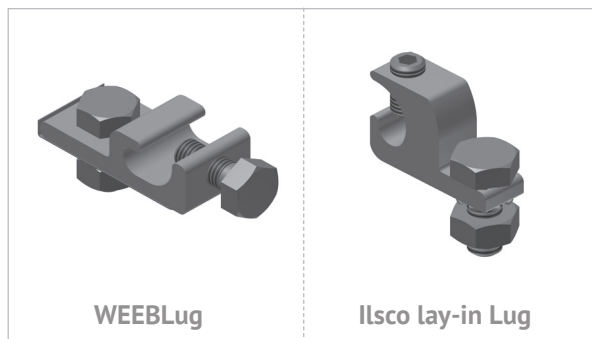


## TEMPORARY GROUNDING & BONDING PROCEDURE:

Periodic inspections should be conducted on the PV array to ensure there are not loose components, loose fasteners or corrosion. If any of the above items are found, the affected components are to be immediately replaced. **If a module must be removed or replaced, a temporary bonding jumper must be used to ensure safety of the personnel and PV system.**

**NOTE:** Removing a PV module from a system is not considered to be routine maintenance. This type of activity should only be performed by trained and qualified installers.

**NOTE:** In order to prevent corrosion induced by dissimilar metals, it is important to verify that the bare copper wire does not come into contact with aluminum. These materials must be kept separate.



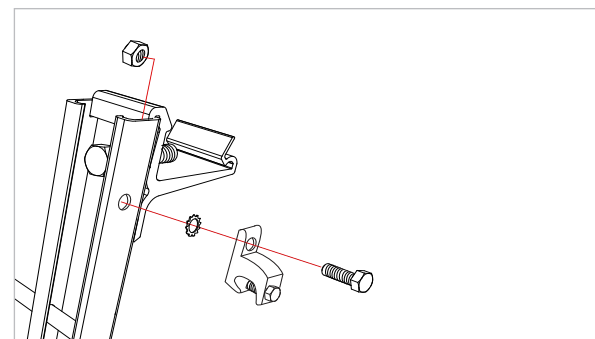
### APPROVED LUGS

WEEBLug UNIRAC PN 0080025

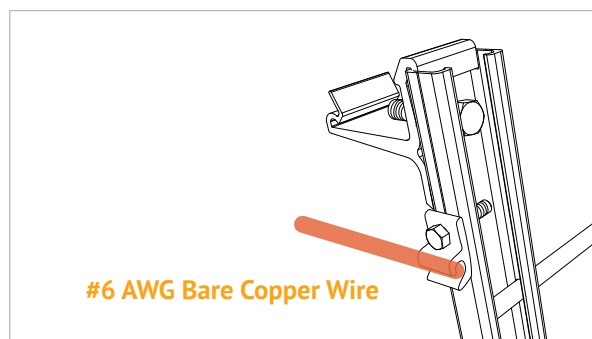
**See product data sheet**

IlSCO lay-in Lug IlSCO PN GBL-4DBT

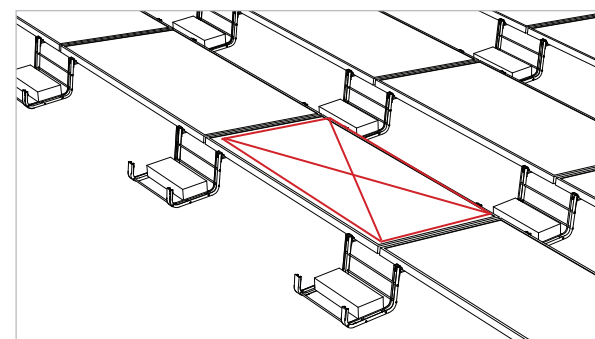
**See product data sheet**



**ATTACH LUGS:** Use approved lug(s) to install on adjacent bays where the module is being removed.



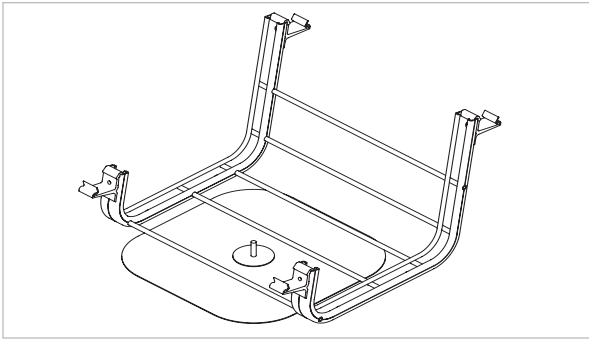
**INSERT COPPER WIRE:** Insert bare copper (#6 AWG) wire into each lug, providing a bonding jumper across the missing module location.



**REMOVE MODULE & REVERSE THE OPERATION AFTER MAINTENANCE IS COMPLETE**

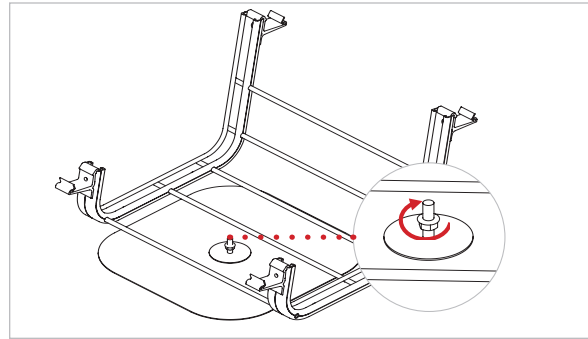
**NOTE:** Removing a PV module from a system is not considered to be routine maintenance. This type of activity should only be performed by trained and qualified installers.



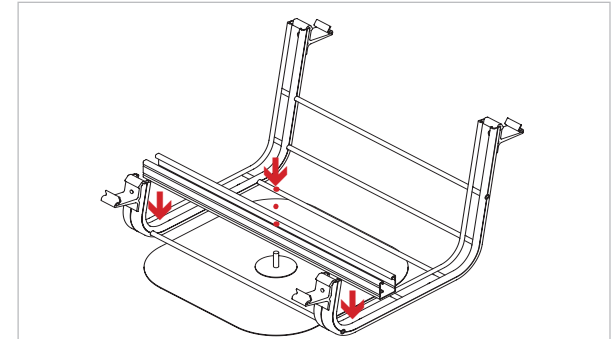


**STEP 1 - POSITION U-ANCHOR:** Position U-Anchor under bay requiring attachment and install according to manufacturer installation instructions.

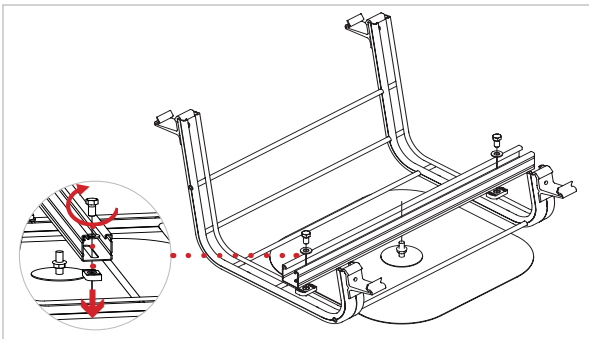
**NOTE:** Center U-Anchor under ballast bay as close as possible.



**STEP 2 - ENGAGE FLANGE NUT:** Place 3/8-16 serrated flange nut on the anchor stud approximately halfway down, serrations facing up.

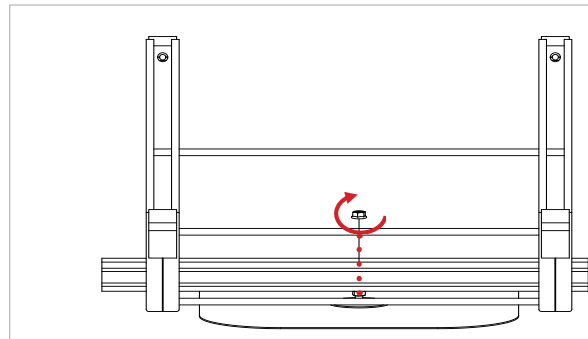


**STEP - 3 PLACE UNISTRUT:** Place 24" Unistrut across RM bay with the anchor stud through a slot.



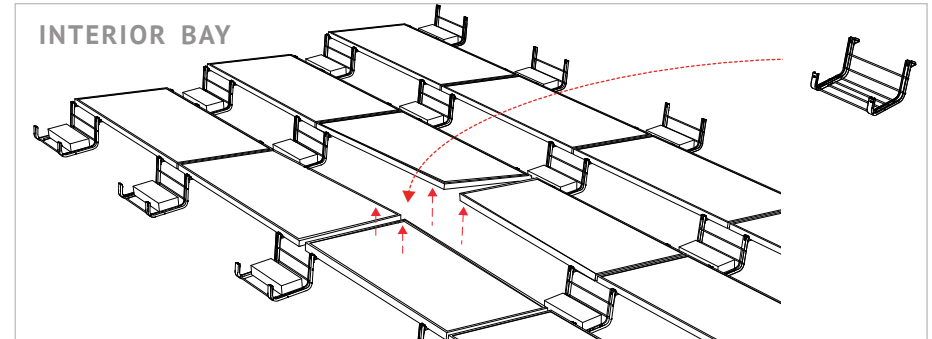
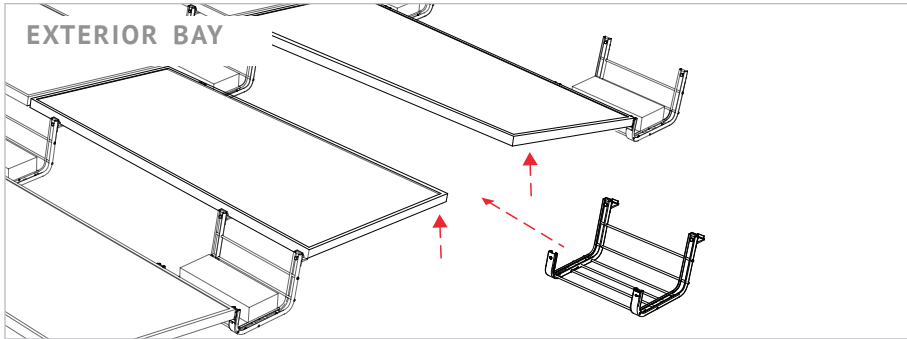
**STEP 6 - SECURE UNISTRUT TO BAY:** Place strut nuts inside RM channels under Unistrut, and tighten with 3/8-16 x 3/4" bolt to 30 ft-lb.

**TORQUE VALUE: 30FT-LBS**

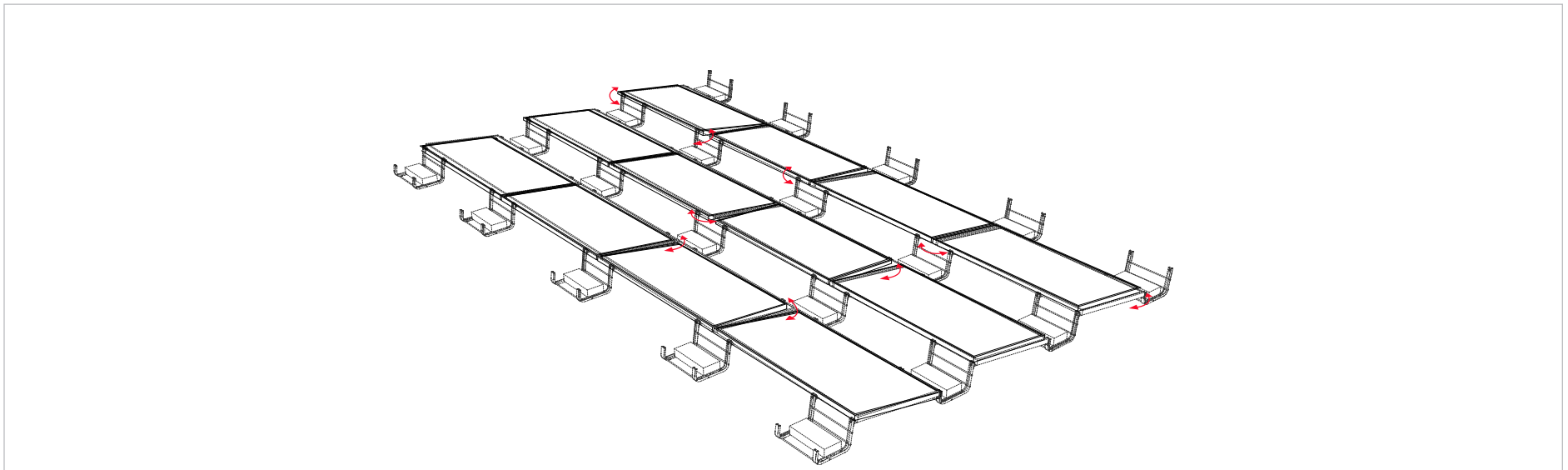


**STEP 5 - SECURE UNISTRUT TO U-ANCHOR:** Tighten nut that was placed on U-Anchor stud in step 2 until making contact with the underside of the Unistrut. Then place another 3/8-16 serrated flange nut on the stud, serrations facing down and tighten to 30 ft-lb.

**TORQUE VALUE: 30FT-LBS**

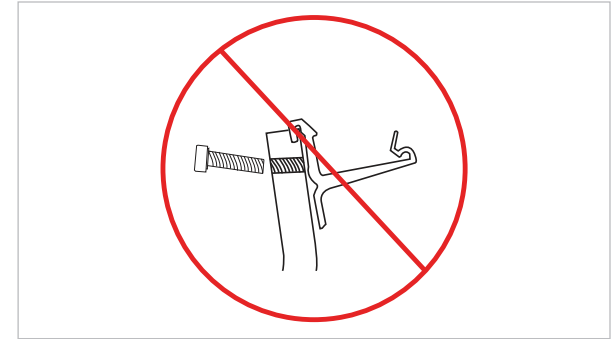
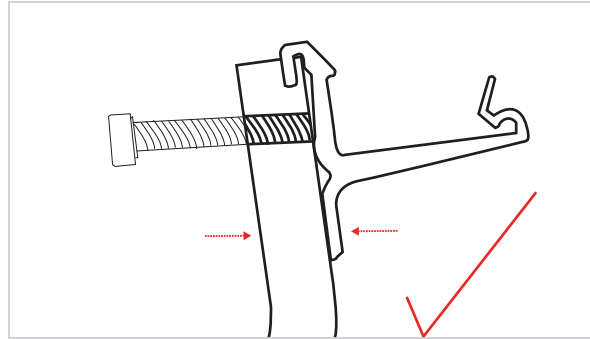
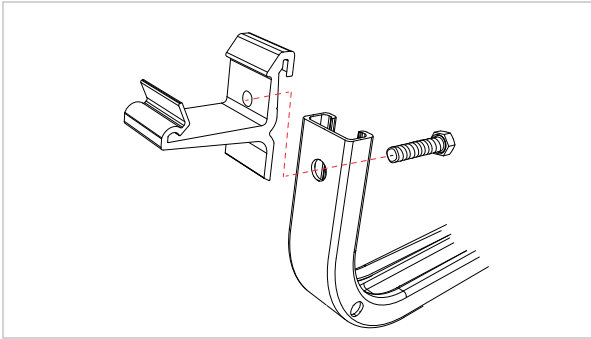


**PROBLEM - ADDING BAYS AFTER INSTALLATION COMPLETED:** Apply gentle, even uplift on the adjoining module frames, and maneuver bay into place



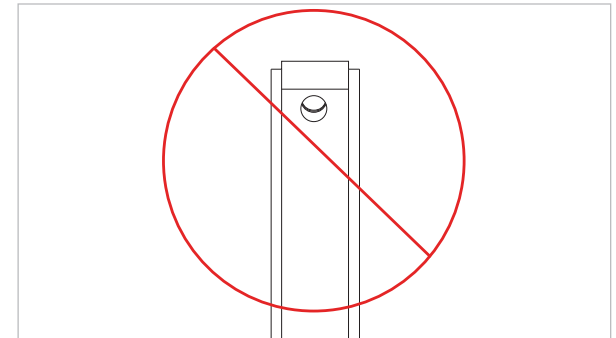
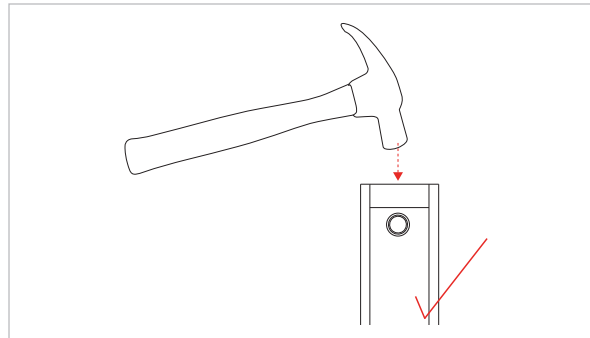
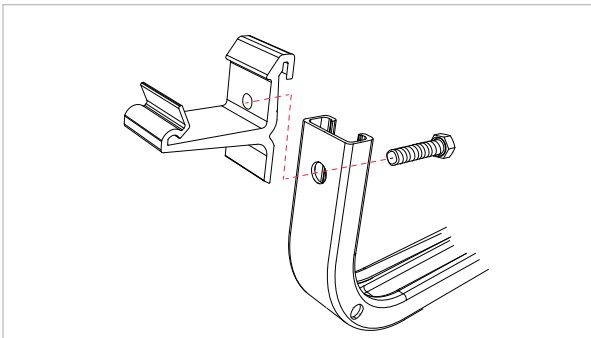
**PROBLEM - ARRAY BUCKLES, OR HAS INCONSISTENT OR UN-PARALLEL GAPS BETWEEN MODULES:** Loosen neighboring clips and re-adjust

- Sequentially tightening from installation outset can prevent this.



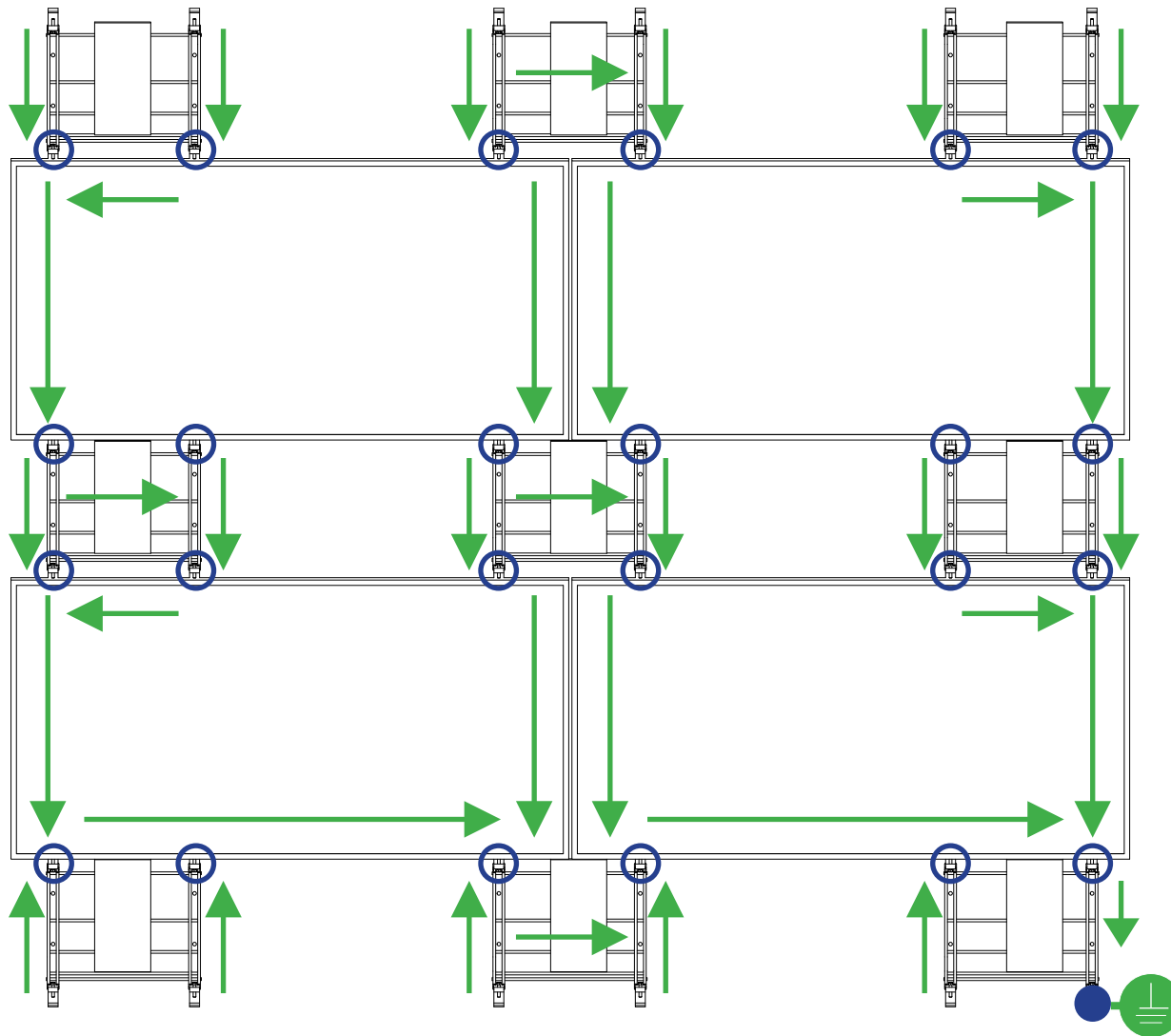
**PROBLEM - CLIP BOLT CROSS-THREADS:** Back bolt out and replace clip, or use thread cleaning too.

- Starting bolts with fingers instead of a power driver can minimize or eliminate cross-threading.
- When using power driver, hold it perpendicular to clip, and squeeze bottom of clip flat against bay post.



**PROBLEM - MODULE CLIP THREADED HOLE AND BAY POST HOLE NOT LINED UP:** Tight fit between these parts is critical for electrical bonding.

- Lining up holes may require assistance of a hammer or similar device.



→ Fault Current Ground Path

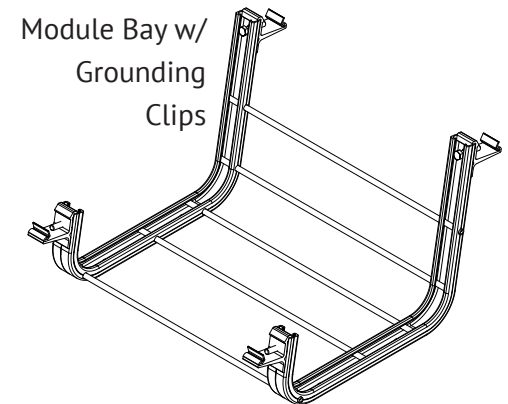
● Ground Lug

○ Grounding Clip & Bolt

⊕ Min. 10 AWG Cooper Wire



Module Frame



Module Bay w/  
Grounding  
Clips

### MECHANICAL LOAD TEST QUALIFICATION

The Unirac RM system has been tested to the mechanical load provisions of UL2703 and covers the following basic parameters:

- Up to 96 cell framed modules
- Frame thickness greater than or equal to 1.0mm
- Basic single and double wall frame profiles
- Certification loads : 15 psf up, 50 psf down

### TESTED MODULE

Module Manufacturer	Model / Series
SunPower	SPR-E20-327 / E-Series

### DOCUMENT REVISION HISTORY - INTERNAL USE ONLY - NOT FOR PUBLIC RELEASE

Publication Date	Notes / Changes
15FEB10	Temporary grounding & bonding procedure
	Re-inspection notes
	Ballast requirements
	Bonding path diagram
15APR10	Clip & bolt uses
	TUV MARK / LABEL
	ILSCO lug graphic
	Proper seating of module within clip
15APR30	Add mechanical load ratings per TUV request
15JUN15	New Manual Layout w/ Adjustments Guide Added
	Attachment Supplement - U-Anchor Added
15JUL09	Bonding & Grounding Notes - TUV Updates
2016AUG26	UL2703 Bonding Notes & Module Additions