



TABLE OF CONTENTS:

Tools & Specifications	
System Components	
System Level Fire Code Compliance	
Attach Module Clips	
Locate Array / Set-Up On Roof	
Module to RM Bay Instructions	
Module to RM Bay instructions - Cont.	
Module Clip Torque Instructions	
Ballast Block Placement Diagrams	

PG

1	Ground Lug Connection Information
2	Bonding & Grounding System Certification
3	Grounding & Bonding Procedures
4	Ballast Bay Roof Attachment
4	Adding Bays - Adjustment Guide
4	Module Clip Bolt Cross Thread Information
5	Grounding Path Electrical Diagram
5	Supporting Information
6	

TABLE OF CONTENTS (CONT):

PG

7	Refer to construction drawings for project specific details. Construction drawings have precedence over these installation guidelines.
8	
9	
10	
A	
B	
C	
D	

GENERAL NOTES:

TECHNICAL SPECIFICATIONS:

Material Types: Mill finish aluminum for clamps and ballast bays (6063-T5, 6105-T52, 6063-T5, 6105-T5 or 6005A-T61)

Hardware: Stainless Steel with Threadlock compound

Bonding and Grounding: UL2703 Listed Continuous Bonding Path.

TOOLS REQUIRED OR RECOMMENDED FOR LAYOUT, ATTACHMENTS & INSTALLATION:

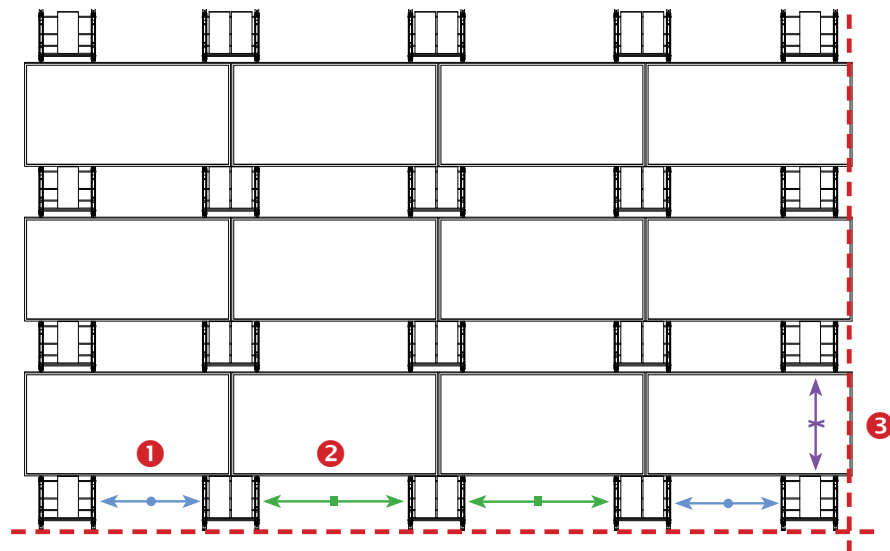
- Drill (**Do Not Use An Impact Driver**)
- 9/16" Socket
- Torque Wrench
- Optional torque limiter (8FT-LBS)
- Tape Measure
- Chalk Reel
- Optional Spacers (See Diagram - Page Right)

SAFETY:




All applicable OSHA safety guidelines should be observed when working on a PV installation job site. The installation and handling of PV solar modules, electrical installation and PV racking systems involves handling components with potentially sharp metal edges. Rules regarding the use of gloves and other personal protective equipment should be observed.

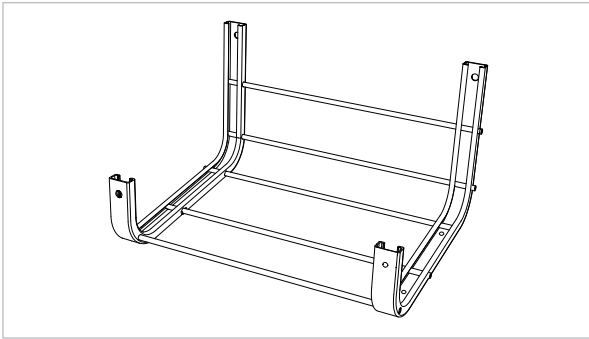
LAYOUT ASSISTANCE TOOL:

Module Dimensions:	RM10	Module location:	Spacing Equations (in Inches):
Module Length (ML) =	1	Perimeter Column Spacing =	$ML+(G/2)-33.25"$
Module Width (MW) =	2	Interior Column Spacing =	$ML+G-21.17"$
Preferred module gap? (1/4" - 1" is permissible)	3	Row Spacing =	Fully install one panel, cut spacer to N/S distance
East/West Module Gap (G) =			

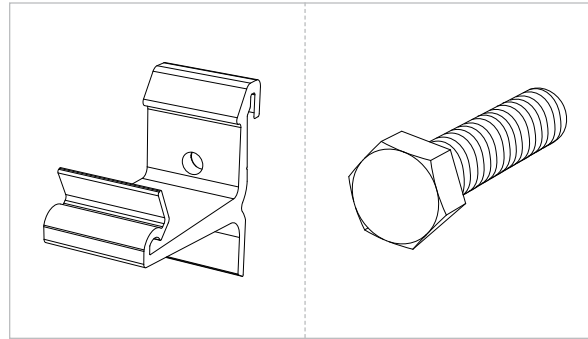


SPACERS - OPTIONAL

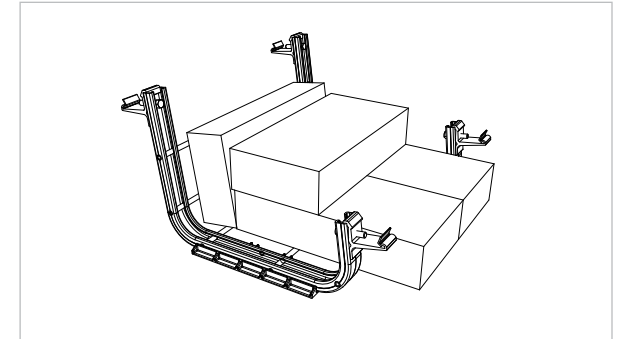
- PERIMETER COLUMN SPACER 
- COLUMN SPACER 
- SOUTH ROW SPACER 



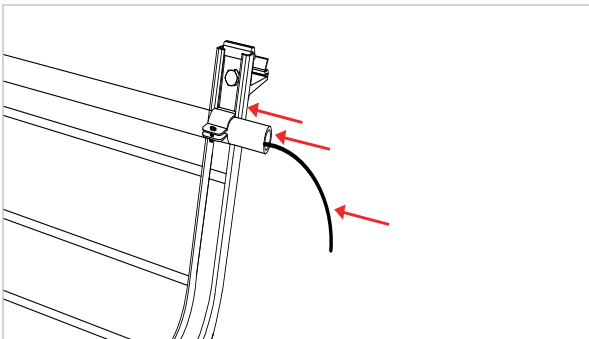
BALLAST BAY: The Ballast Bay frame is made of a mill finish Aluminum. This roof mount is a modular design that allows for easily getting around roof obstructions and accommodating roof undulations. The Ballast Bays are created such that they nest within each other to optimize shipping logistics.



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.

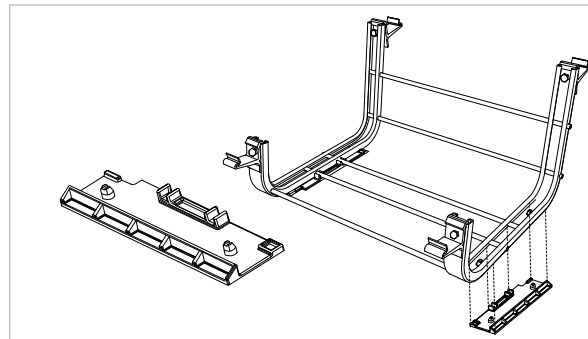


BALLAST BLOCK: The RM ballast bay can fit up to 4 standard 4"x8"x16" solid concrete cap blocks (6 blocks on north row modules). See "Complete Ballast Placement" page of this document for more information. Block weight can range from 26 – 38 lbs. The weight of the block will have a major impact on how 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: The Ballast Bay frame runners will accept standard strut-strap wire management solutions, or standard strut nuts, available for purchase through your local electrical supply store.

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



OPTIONAL ROOF PAD: The Roof Pad provides a protective interface between the Ballast Bay and roofing material to protect the roof membrane. 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 and to verify compatibility.

CAUTION: System labels for RM10 and RM10 Evo are identical. Visually inspect the system components to distinguish between RM10 and RM10 Evo.

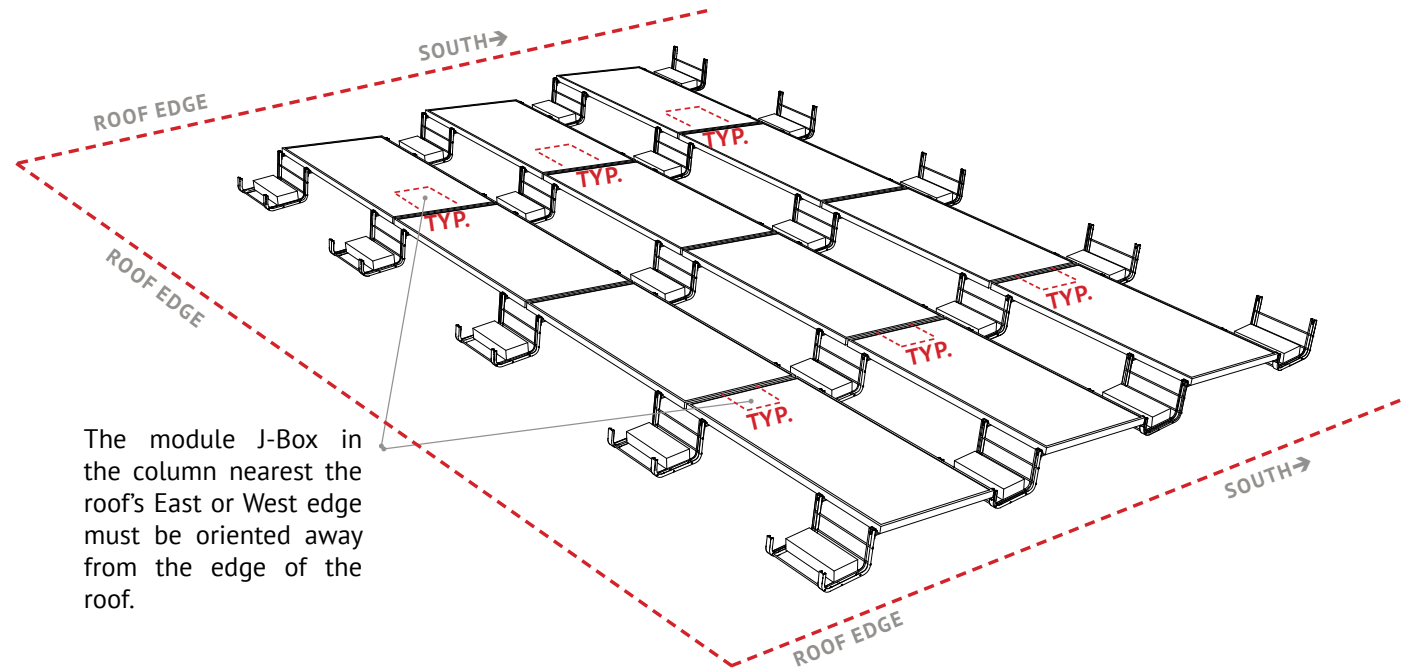
ROOF PAD NOTE:

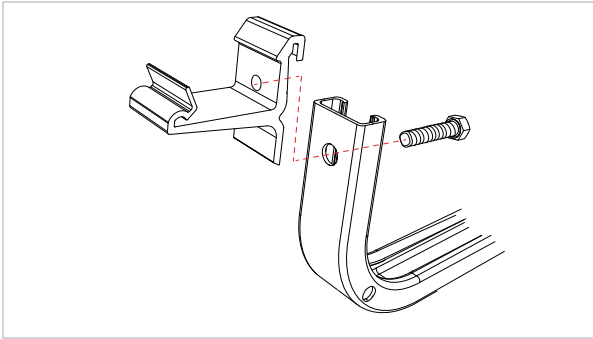
Roof pads are required for unattached system installation in certain seismic areas, or are included upon request. For more information about roof pad application, contact us at info@unirac.com or call 505.242.6411

*See page D for application guidance.

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 UL2703. It has achieved Class A performance for low sloped roofs when used in conjunction with the modules types listed below. System fire class ratings require that the J-Box be oriented away from the roof edge as in the illustration below. 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 < 2 inches per foot, or 9.5 degrees. Rack mounting system is to be installed over a fire resistant roof covering rated for the application.

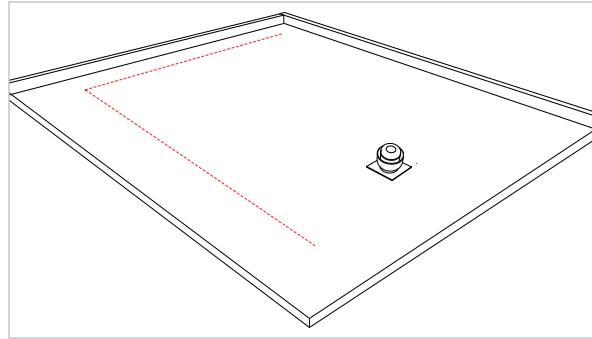
Module Type
Type 1
Type 2
Type 3 with aluminum frame
Type 19
Type 22
Type 25
Type 29
Type 30



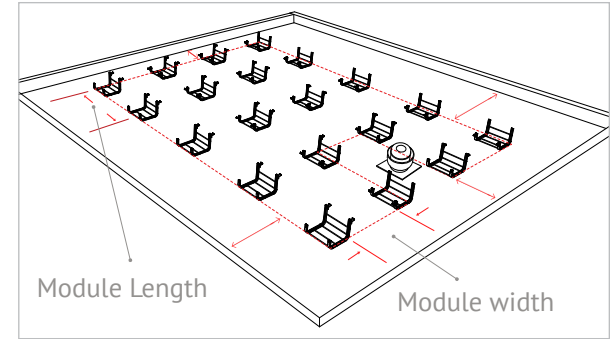


ATTACH CLIPS LOOSELY TO BAY POSTS INTENDED TO HOLD MODULES. For this initial setup, bolts should only be hand threaded a few turns.

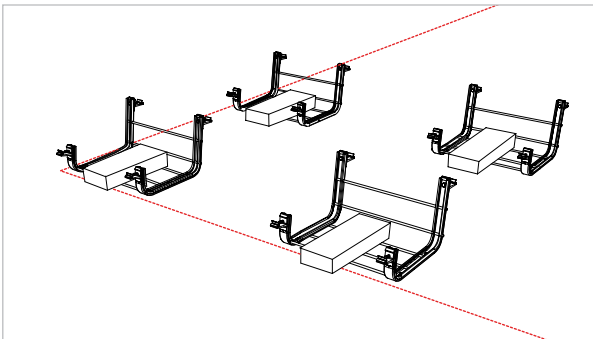
NOTE: CLIP - Single Use Only - For complete electrical bonding path, clips must be tapped in place with hammer.



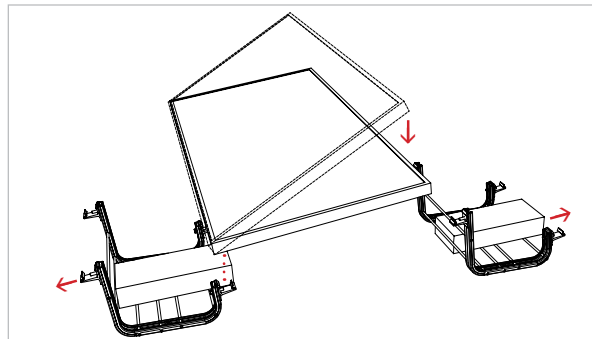
MARK ROOF WHERE ARRAY WILL START: Use chalk line to mark distances from roof edge as called out in construction documents.



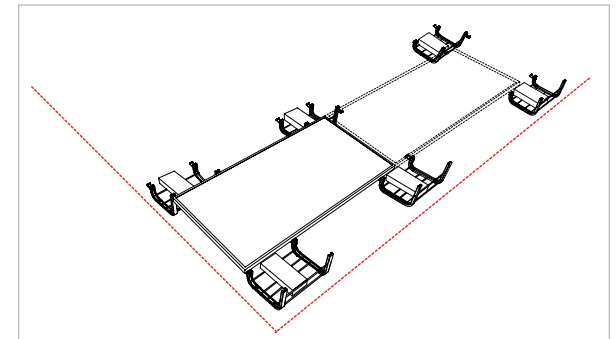
LOCATE ARRAY ON ROOF: Align Ballast Bays with previous chalk lines, using bay spacers as shown on Page 1 if desired.



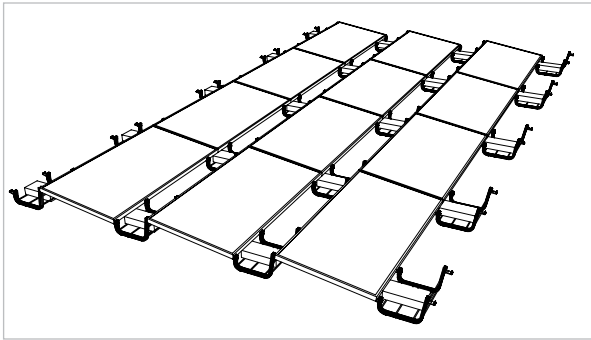
PLACE SOME BALLAST IN 1ST FOUR BAYS FOR FIRST MODULE



PLACE MODULE IN CLIPS

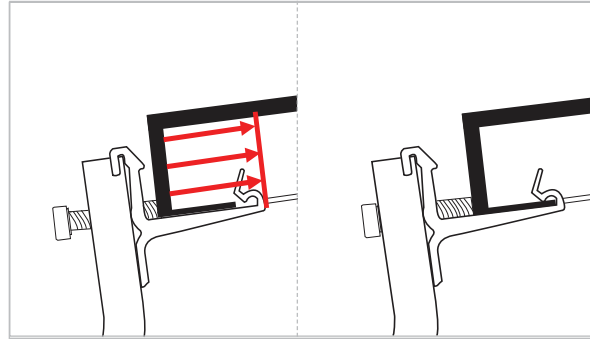


PLACE ANOTHER MODULE IN NEXT BAY CLIP

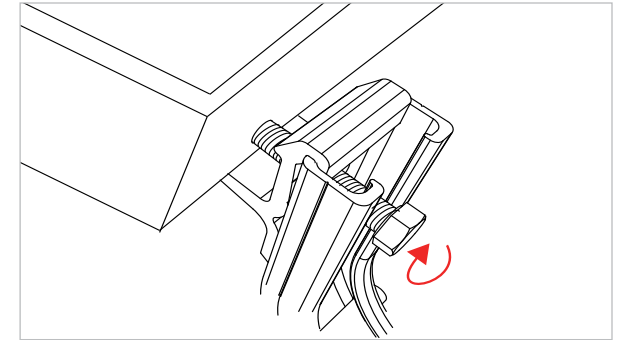


SEAT REMAINING MODULES IN CLAMPS: It is recommended to finish one row before beginning the next.

NOTE: 1/4" - 1" gap is required between modules for thermal expansion.



FULLY SEAT MODULE IN CLIPS AND TIGHTEN BOLTS: A gentle tug on the bays will seat the module into the module clip. It is NOT recommended to use the bolt to seat the module. Tighten bolts to **7-9FT-LBS**. It is recommended to tighten bolts one row at a time, working outward from the north or south edge of the array.



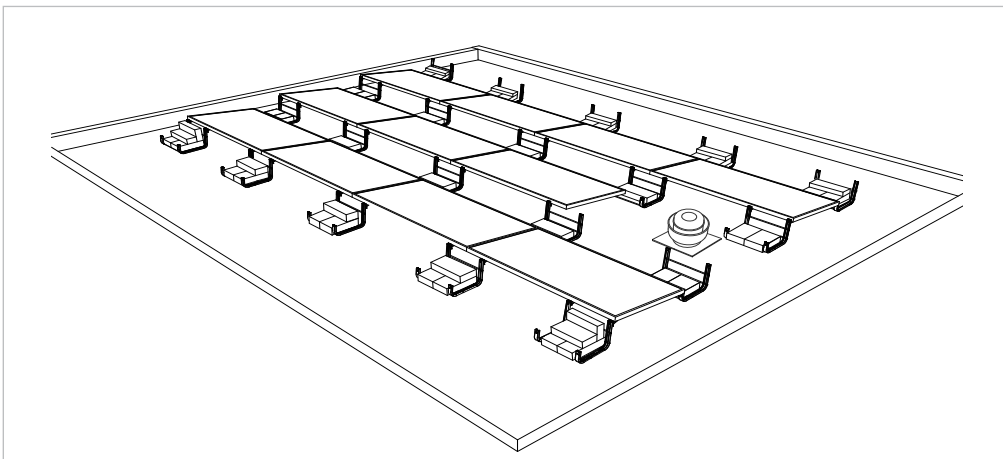
CHECK CLIP BOLT TORQUE IN SEQUENCE:

NOTE: Due to the thread-lock applied to the bolts, torque must be checked within 4 hours of initial tightening. Thread-lock will be fully cured after 72 hours.

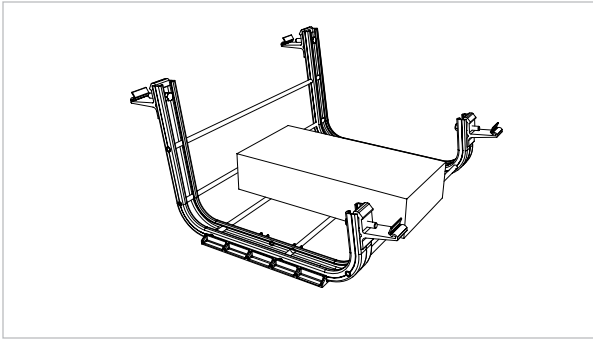
TORQUE VALUE:

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

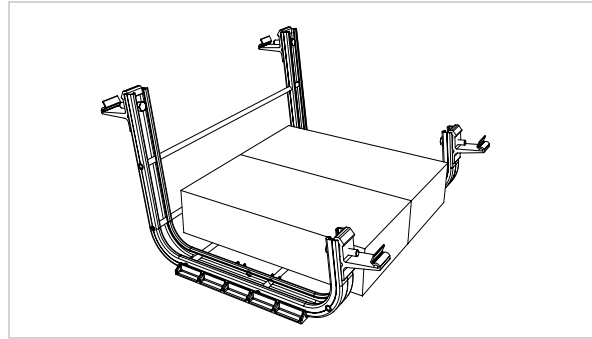
NOTE: BOLT - Single Use Only



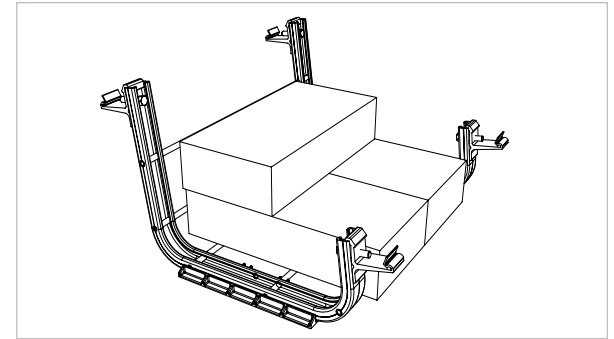
COMPLETE BALLASTED PLACEMENT: Place ballast as required. Deviations from block arrangements shown in this guide may cause shading. Site specific module loading and ballast calculations should be determined for each individual project in accordance with the U-Builder software and the Unirac Design and 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 SEAOC PV1, PV2 and ASCE 7.



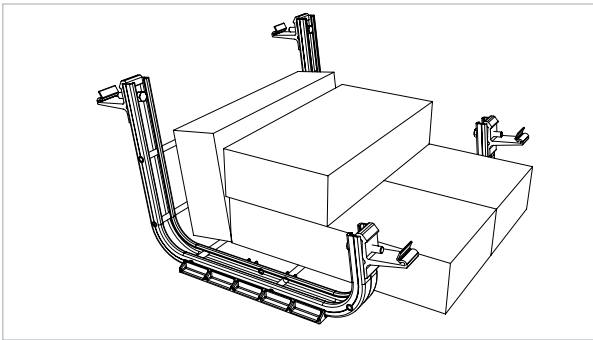
1-Block Configuration



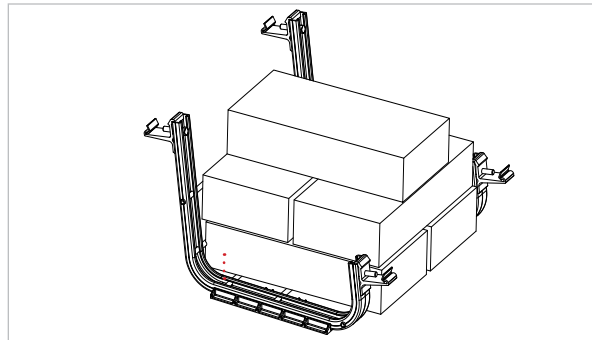
2-Block Configuration



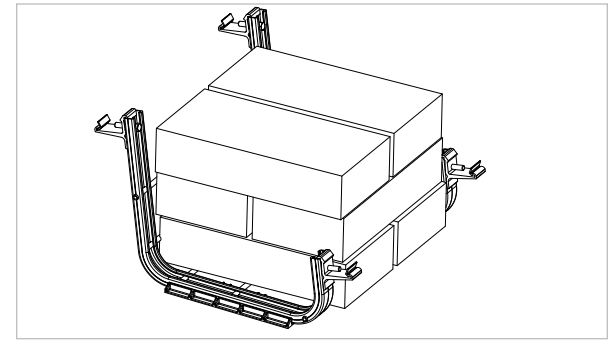
3-Block Configuration



4-Block Configuration

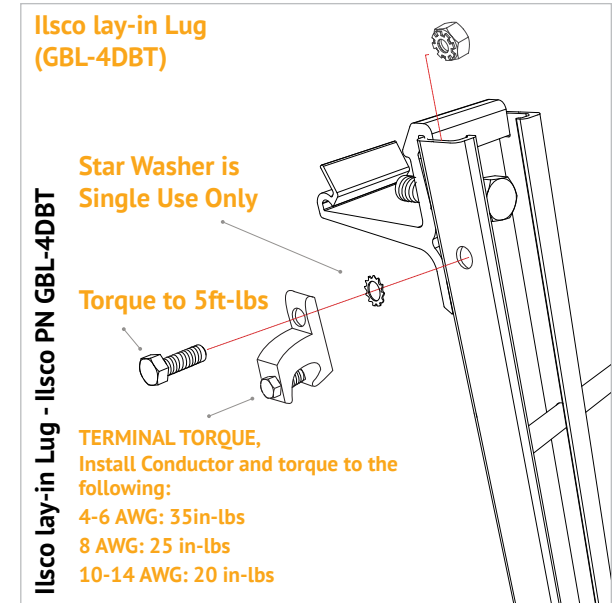
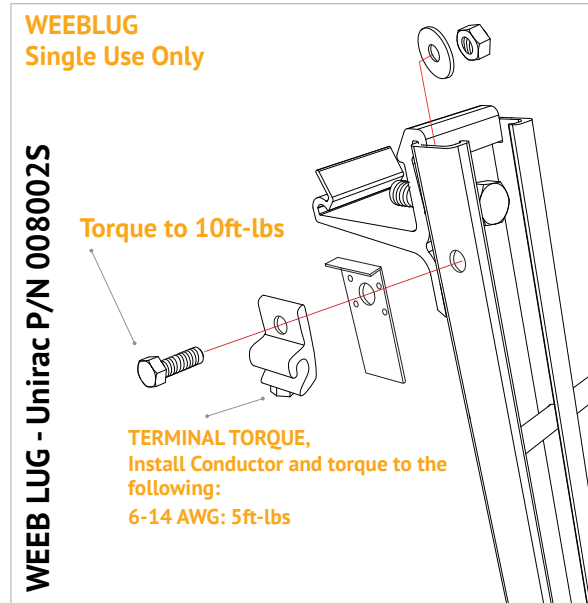
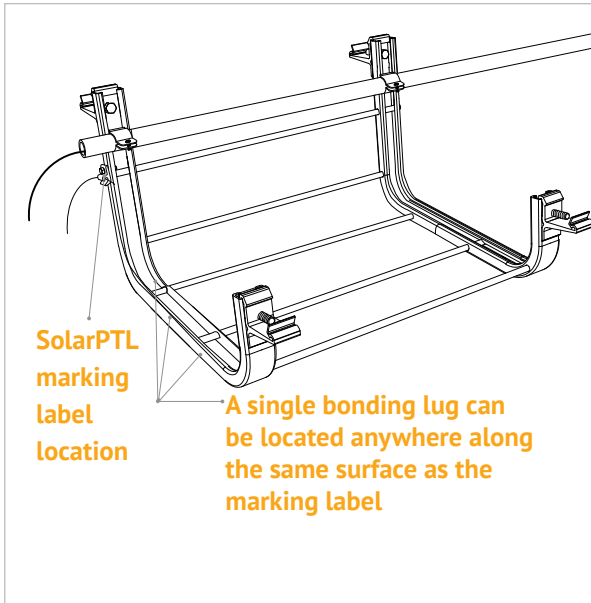


5-Block Configuration



6-Block Configuration

NOTE: Use 5 and 6 block configurations only in unobstructed North Bays



Although conformance with UL2703 was demonstrated without the use of oxide inhibitor material, it is recommended by IIsco 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 IIsco products. The WEEBLug has a grounding symbol located on the lug assembly. The IIsco 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 1500VDC. A min. 10 AWG, 105 degrees Celsius copper grounding conductor should be used to ground a 1500 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
IIsco 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:

- 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
Astronergy / Chint	CHSM6610M (BF)+HV , AstroSemi CHSM72M-HC
AU Optronics (BenQ Solar)	PM Series
Auxin	AXN6M610T, AXN6P610T, AXN-6M612T & AXN6P612T
Axitec	AC-XXXX/156-60, AC-XXXX/72S, AC-XXXXM/72S
Boviet	(40mm) BVM6610(P/M) & BVM6612(P/M) (35mm x 35mm) torque to 5ft-lbs BVM6610(P/M) & BVM6612(P/M)
Canadian Solar	CS5A-M, CS6P-M, CS6P-P, CS6X-P CS3W-P, CS3U-P (HE), CS3U-MS, CS3K-P (HE), CS3K-MS (Black), CS6K-MS (AllBlack) , CS6K-M, CS6K-P (HE), CS6K, CS3U-PB-AG, CS3U-MB-AG, CS3K-PB-AG, CS3K-MB-AG, CS3W-PB-AG, CS3W-MB-AG CS6U-M, CS6U-P (HE), CS1K-MS, CS1H-MS, CS1U-MS, CS3W-P-PB-AG, CS3L-P ELPS CS6P-MM, ELPS CS6A-MM

Manufacturer	Module Model / Series
Centrosolar America	C-Series & E-Series
CertainTeed	CT M/P-01, CT M-02 & CT M-03
CSUN	CSUN-72M, CSUN-72P
ET Solar	ET Module (40mm framed) ET AC Module (40mm framed)
Flex	FXS 60
GCL	GCL-P6 & GCL-M6
Hansol	UB-AN1, UD-AN1, TD-AN4, TD-AN3
Hanwha SolarOne	SolarOne HSL 60 SolarOne HSL 72
Heliene	72M, 72P, 60M & 60P
HT-SAAE	HT72-156M-C, HT72-156M(V)-C, HT72-156M, HT72-156M(V), HT72-156P-C, HT72-156P(V)-C
Hyundai Heavy Industries	TI, RI, KI, HI, MI & MG Series
JA Solar	JAP6 60, JAM6-60 /SI, JAM6(K)-60, JAP6(k)-72 /4BB, JAP72SYY /ZZ, JAP6(k)-60 /4BB, JAP60SYY /ZZ, JAM6(k)-72 /ZZ, JAM72SYY /ZZ, Note: YY: 01, 02, 03, 09, 10 ZZ: SC, PR, BP, HIT, IB, MW

Manufacturer	Module Model / Series
Jinko Solar	Standard, JKM P-60B JKM M-60(B/BL/V/HB/H/L/HL) JKM PP-72(Plus) JKM M-72(V/Plus) JKM M-72HL4-(V/TV) JKM PP-72-(L-V/V/HL-V)
Kyocera	KD-F Series
LG Electronics	LGxxx(E1C/E1K/N1C/N1K/N2T/N2W/Q1C/Q1K/S1C/S2W)-A5, LGxxx(N1C/N1K/N2W/Q1C/Q1K)-V5, LGxxxN2T-J5, LGxxx(N1K/N2T/N2W)-E6, LGxxx(A1C/M1C/M1K/N1C/N1K/Q1C/Q1K/QAC/QAK)-A6 LGxxxN1K-B6 LGxxxN3K-V6
LONGi	(40mm) LR6-60 & LR6-72 Series (35mm) LR4-72HPH, LR4-72HIH, LR6-72, LR6-72BK, LR6-72HV, LR6-72PE, LR6-72PB, LR6-72PH, LR6-72HPH, LR6-72HIH
Mission Solar	MSE Series
Panasonic	VBHN SA15/16/17(G/E)/18(E) VBHN KA01/03/04

Manufacturer	Module Model / Series
Phono Solar Technology	Standard Modules
Q-Cells	Q.PEAK DUO L-G4.2/L-G5/L-G5.1/L-G5.2/L-G5.3, Q.PEAK DUO L-G6/L-G6.2/L-G6.3 Q.PLUS L-G4.2/TAA B.LINE PRO L-G4.1 Q.PLUS/PEAK/PRO L-G4.2 Q.PLUS/PEAK/PRO L-G4/L-G4.1 B.LINE PLUS/PRO L-G4.2 Q.PEAK DUO G5/G6/G7.x/G8 B.LINE PEAK DUO G7/G7.2/L-G7/L-G7.1/L-G7.2/L-G7.3 Q.PEAK DUO XL-G10.3/BFG Q.PEAK DUO XL-(G10.2/G10.3/G10.c/G10.d) Q.PEAK DUO (BLK) ML-G10(+)
Renesola	All 60-cell modules

- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
- Items in parenthesis are those that may or may not be present in a compatible module's model ID
- Slashes "/" between one or more items indicates that either of those items may be the one that is present in a module's model ID
- Please see the RM5 UL2703 Test Report at Unirac.com to ensure the exact solar module selected is approved for use with RM10

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:

- 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
REC	Peak & Eco RECxxxAA (72/BLK/Pure) RECxxxNP (N-PEAK) (BLK) RECxxxNP2 (Black) RECxxxPE (BLK), TP2M RECxxxTP2(BLK2) TP2SM72, TP2S72, TP2S72 XV RECxxxTP3M (Black) RECxxxTP4 (Black)
Risen	RSM72-6 (P/M), RSM144-6
S-Energy	SN P-10, M-10 & SN P-15
Seraphime	SEG-6, SEG-E & SRP-6 Series
Sharp	ND-24CQC, ND-25CQCS, ND-Q235F4, ND-F4Q300
Silfab	SLA & SLG Series, SLA-X SIL-XXX-ML/NL/BL/HL/NT/HC
SolarWorld	Sunmodule Protect Sunmodule Plus

Manufacturer	Module Model / Series
Suniva	OPTIMUS & MV Series
Suntech	STP Series
Sun Edison	F-Series & R-Series
SolarWorld	SunModule Plus & Protect
SunPower	A-Series, X-Series, E-Series, AC & Sig Black
Talesun Solar	TP572, TP596, TP654, TP660, TP672, HIPRO TP660, SMART TP660P
Trina	PA05, PD05, DD05, DE06, DD06 PD14, DD14A(II), DE14A(II), PE14, PD14, DE15
URE	D7 (M/K) H7A, D7 (M/K) H8A
Vikram	Eldora, Solivo, Somera
Yingli	YGE60/72, YLM60/72, YLM-VG

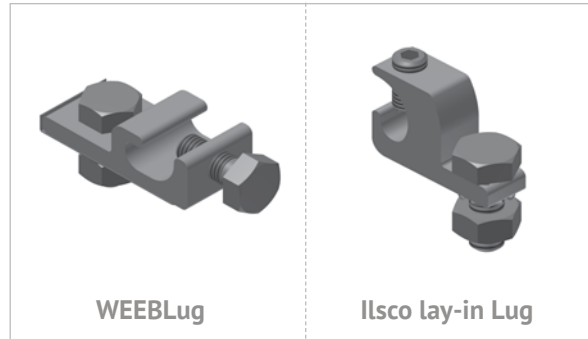
- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
- Items in parenthesis are those that may or may not be present in a compatible module's model ID
- Slashes "/" between one or more items indicates that either of those items may be the one that is present in a module's model ID
- Please see the RM5 UL2703 Test Report at Unirac.com to ensure the exact solar module selected is approved for use with RM10

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.

CAUTION: Module removal may disrupt the bonding path and could introduce the risk of electric shock. Additional steps may be required to maintain the bonding path. Modules should only be removed by qualified persons in compliance with the instructions in this manual.



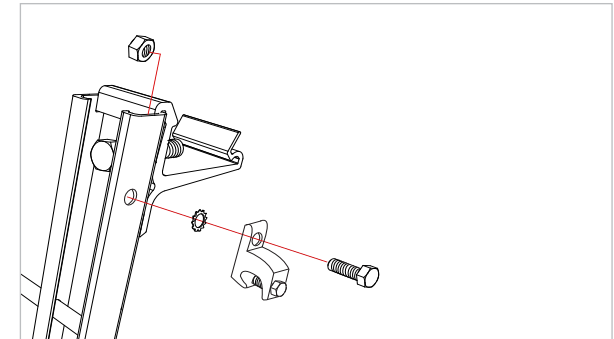
APPROVED LUGS

WEEBLug UNIRAC PN 008002S

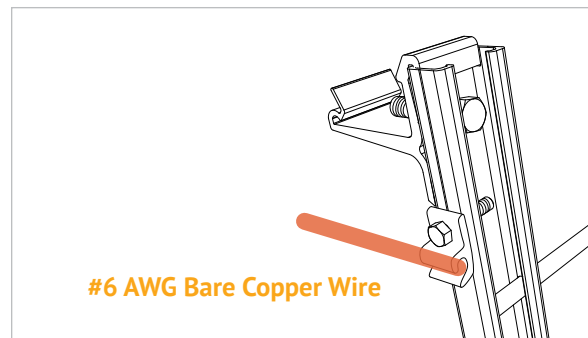
See product data sheet

IlSCO lay-in Lug IlSCO PN GBL-4DBT

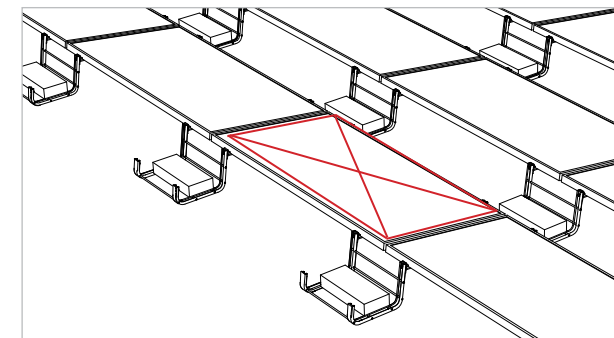
See product data sheet



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

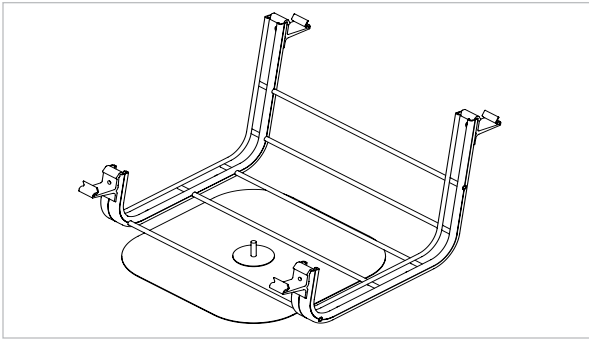


INSERT COPPER WIRE: Insert bare copper (#6 AWG) wire into each lug, providing a bonding jumper across the missing module location.



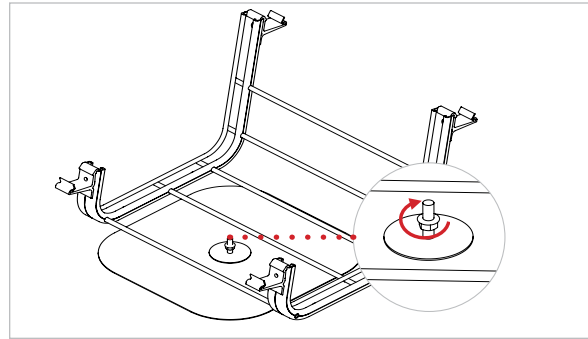
REMOVE MODULE & REVERSE THE OPERATION AFTER MAINTENANCE IS COMPLETE

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.

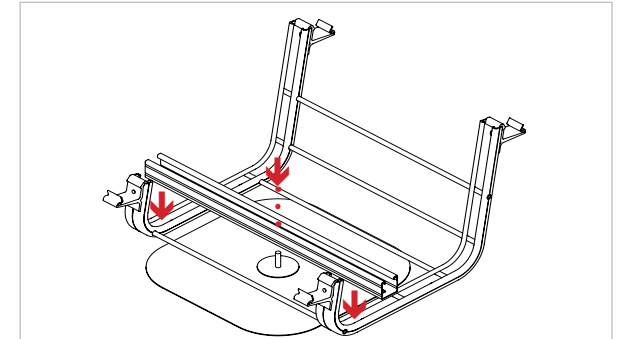


STEP 1 - POSITION U-ANCHOR: Position Roof attachment under bay requiring attachment and install according to manufacturer installation instructions.

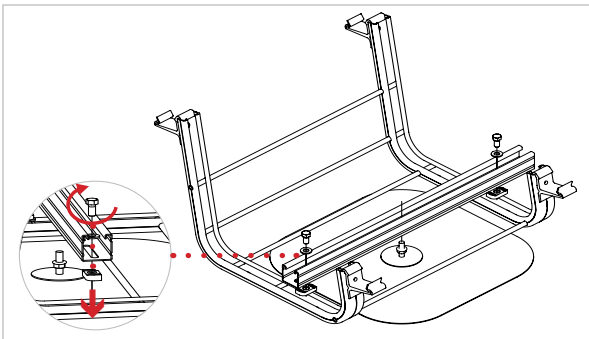
NOTE: Center roof attachment under ballast bay as close as possible.



STEP 2 - ENGAGE FLANGE NUT: Place 3/8-16 serrated flange nut and 1" OD washer on the anchor stud approximately halfway down, nut serrations facing up.

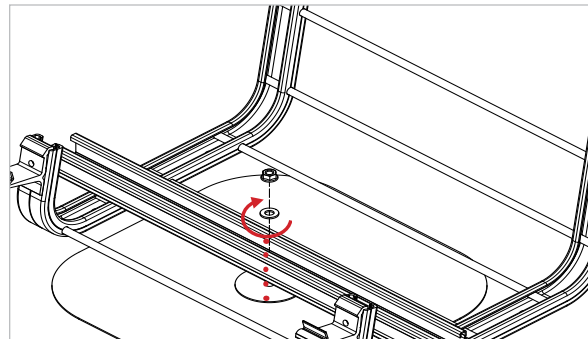


STEP - 3 PLACE UNISTRUT: Place 24" Unistrut across RM bay with the anchor stud though a slot.



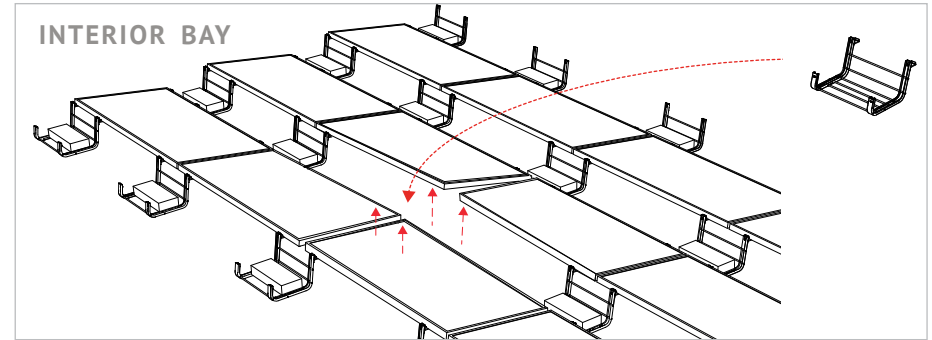
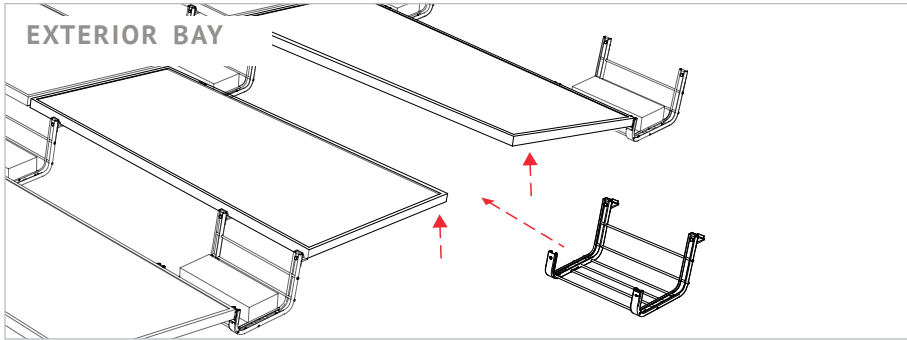
STEP 4 - SECURE UNISTRUT TO BAY: Place strut nuts inside RM channels under Unistrut, and secure Unistrut with 3/8-16 x 3/4" bolt and 1" OD washer to 30 ft-lb.

TORQUE VALUE: 30FT-LBS

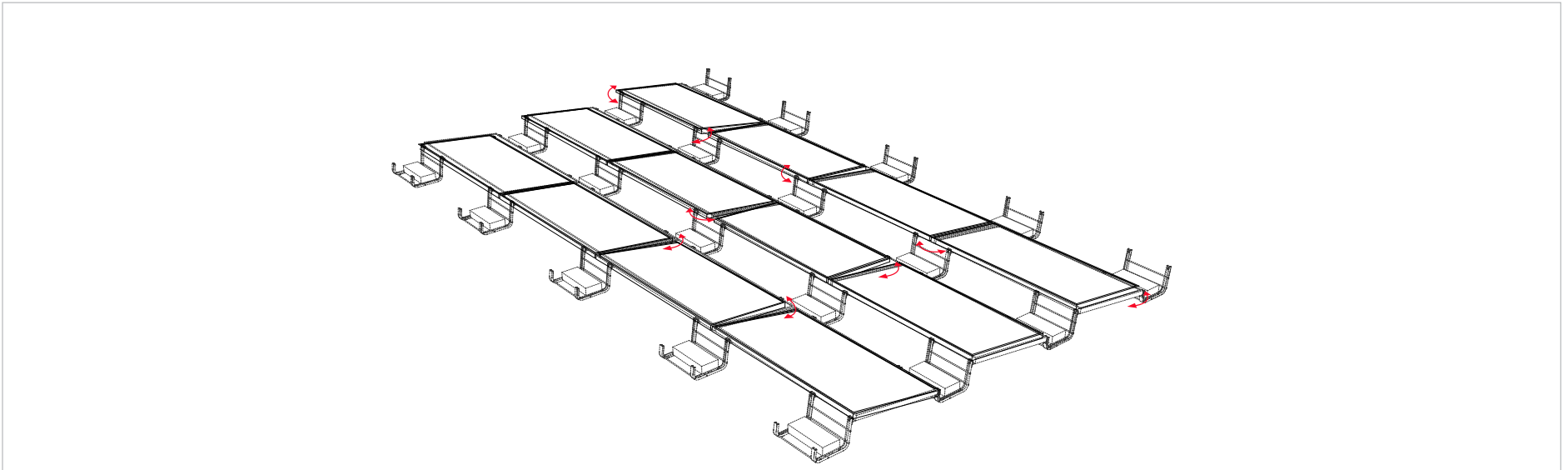


STEP 5 - SECURE UNISTRUT TO U-ANCHOR: Tighten nut that was placed on roof attachment stud in step 2 until making contact with the underside of the Unistrut. Then place another 3/8-16 serrated flange nut and 1" OD washer on the stud, serrations facing down and tighten to 30 ft-lb.

TORQUE VALUE: 30FT-LBS

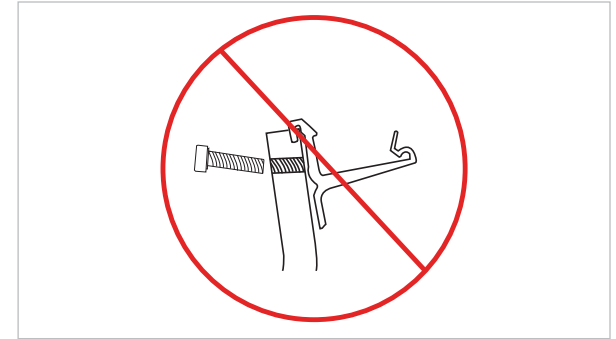
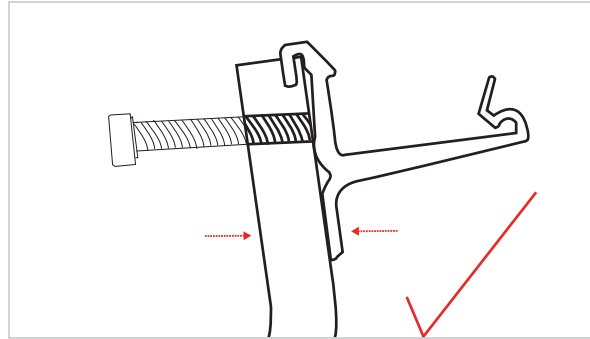
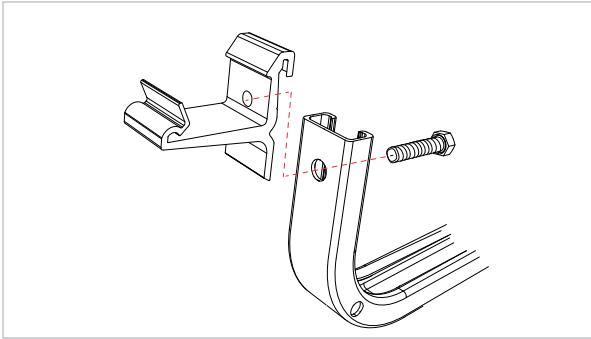


PROBLEM - ADDING BAYS AFTER INSTALLATION COMPLETED: Apply gentle, even uplift on the adjoining module frames, and maneuver bay into place



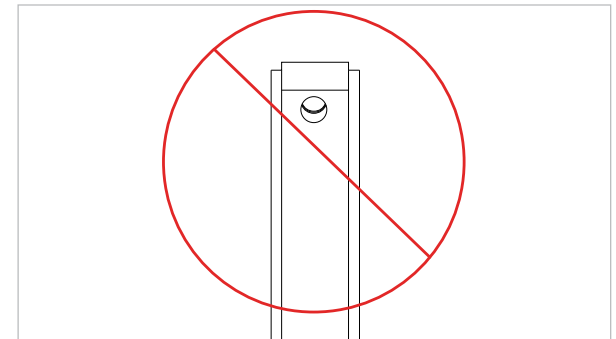
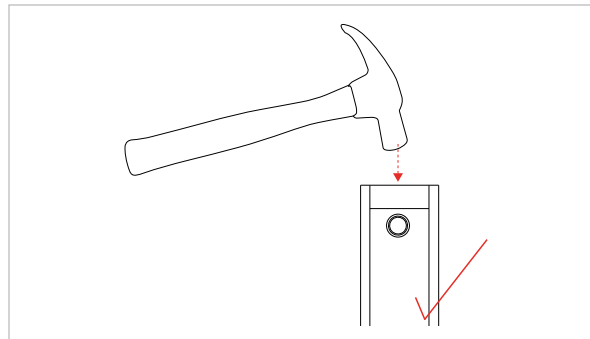
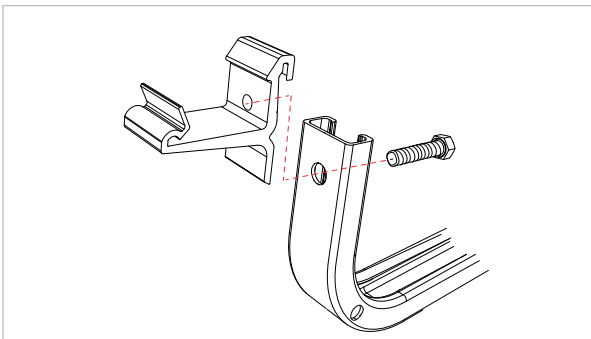
PROBLEM - ARRAY BUCKLES, OR HAS INCONSISTENT OR UN-PARALLEL GAPS BETWEEN MODULES: Loosen neighboring clips and re-adjust

- Sequentially tightening from installation outset can prevent this.



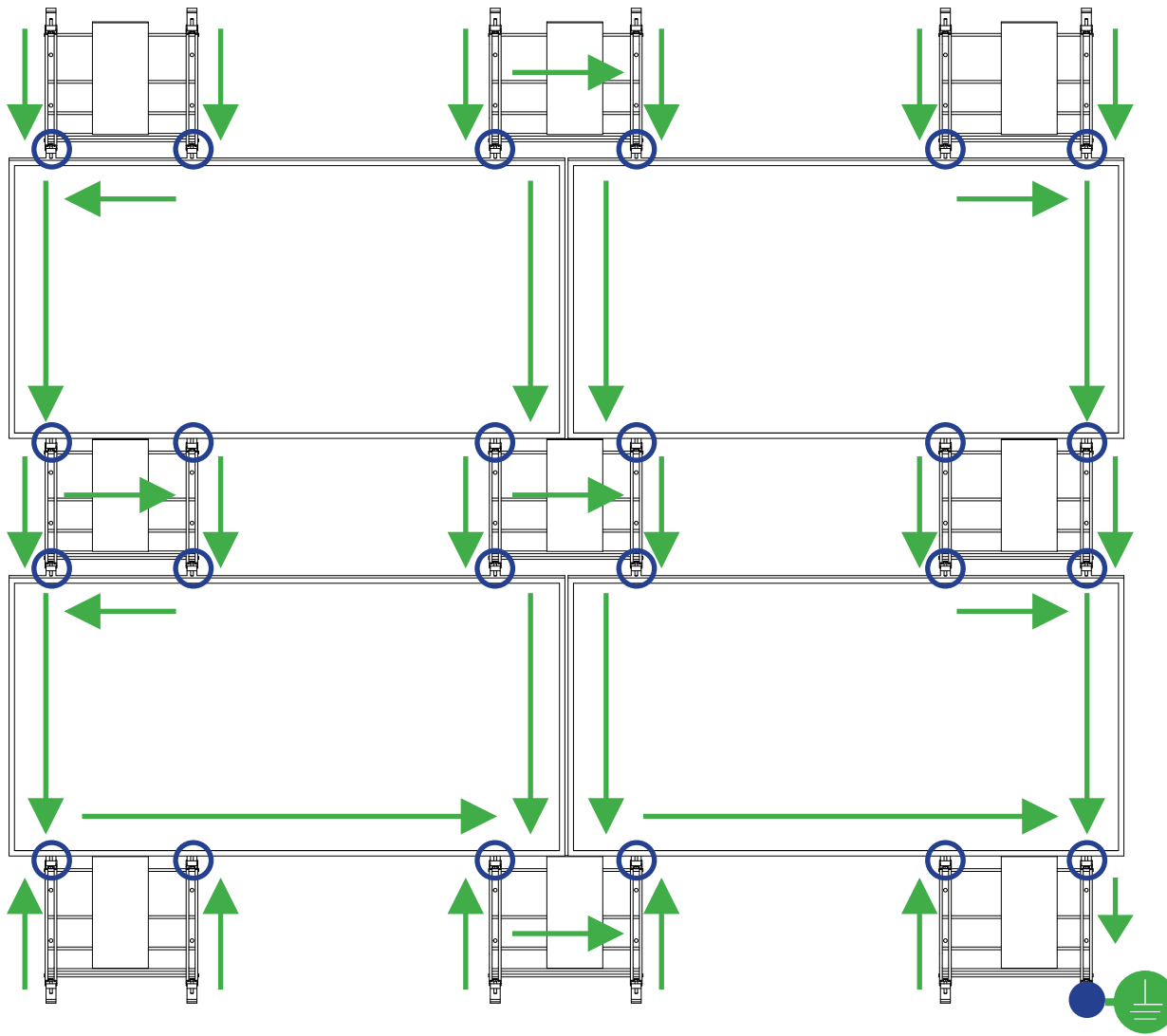
PROBLEM - CLIP BOLT CROSS-THREADS: Back bolt out and replace clip, or use thread cleaning too.

- 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

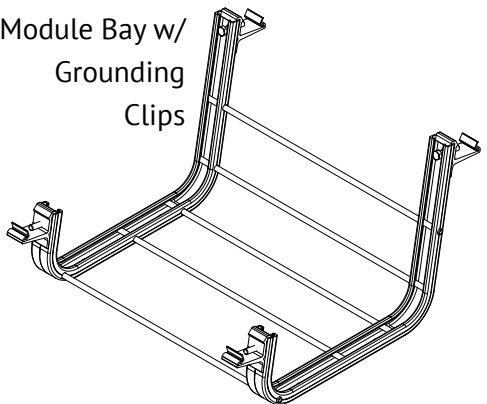
 Ground Lug

 Grounding Clip & Bolt

 Min. 10 AWG Cooper Wire

 Module Frame

Module Bay w/
Grounding
Clips



ROOF PAD GUIDANCE

- Roof pads are always applied 2 per bay (one on each ski to avoid unbalancing the chassis).
- When installing minimum roof pads for friction (at a 1:4 ratio), apply 2 roof pads to every 4th bay.
 - Alternatively, install 2 roof pads to every other bay in a row of bays, then skip a row, and do it again.
 - Skip any bays that have mechanical roof attachments (i.e. Flashloc RM, Anchor or OMG Products).

EPDM	1:1	Pads on each bay
TPO	1:4	Pads on 1 of every 4 bays
PVC	1:4	Pads on 1 of every 4 bays
Mineral Cap	N/A	No pads required

MECHANICAL LOAD TEST QUALIFICATION

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

- Frame thickness greater than or equal to 1.0mm
- Basic single and double wall frame profiles

Module Manufacturer	Model / Series	Area [sqft]	Design Load [PSF]
SunPower	SPR-E20-327 / E-Series	17.54	15 up / 50 down
Canadian Solar	CS3W-PB-AG	24.05	17 up / 20 down
Jinko Solar	JKM M-72HL4-V	27.76	13.3 up / 30 down