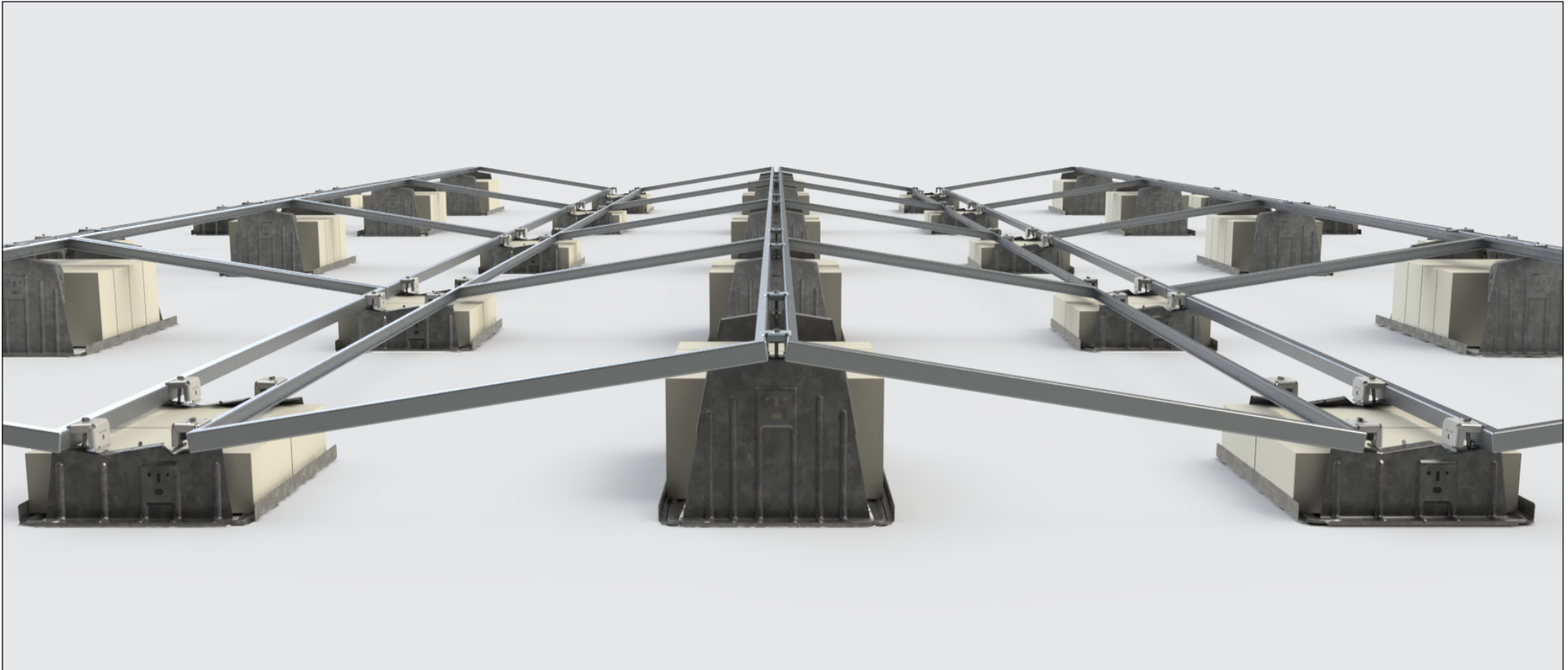




RMDT

INSTALLATION GUIDE



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

Publication Date	Notes / Changes
2016JUN08	INITIAL RELEASE
2017MAR10	LA COUNTY COMMENTS, ADDED REFERENCES FOR BALLAST BAYS - PVC ROOFS, UPDATED APPROVED MODULE LIST, UPDATED FIRE CERTIFICATION SLOPE
2017OCT03	UPDATE MODULE LIST AND ADD A NEW PAGE FOR OVERFLOW (11 & 12), REVISED REMAINING PAGE NUMBERS TO FLOW

PUB2017OCT03

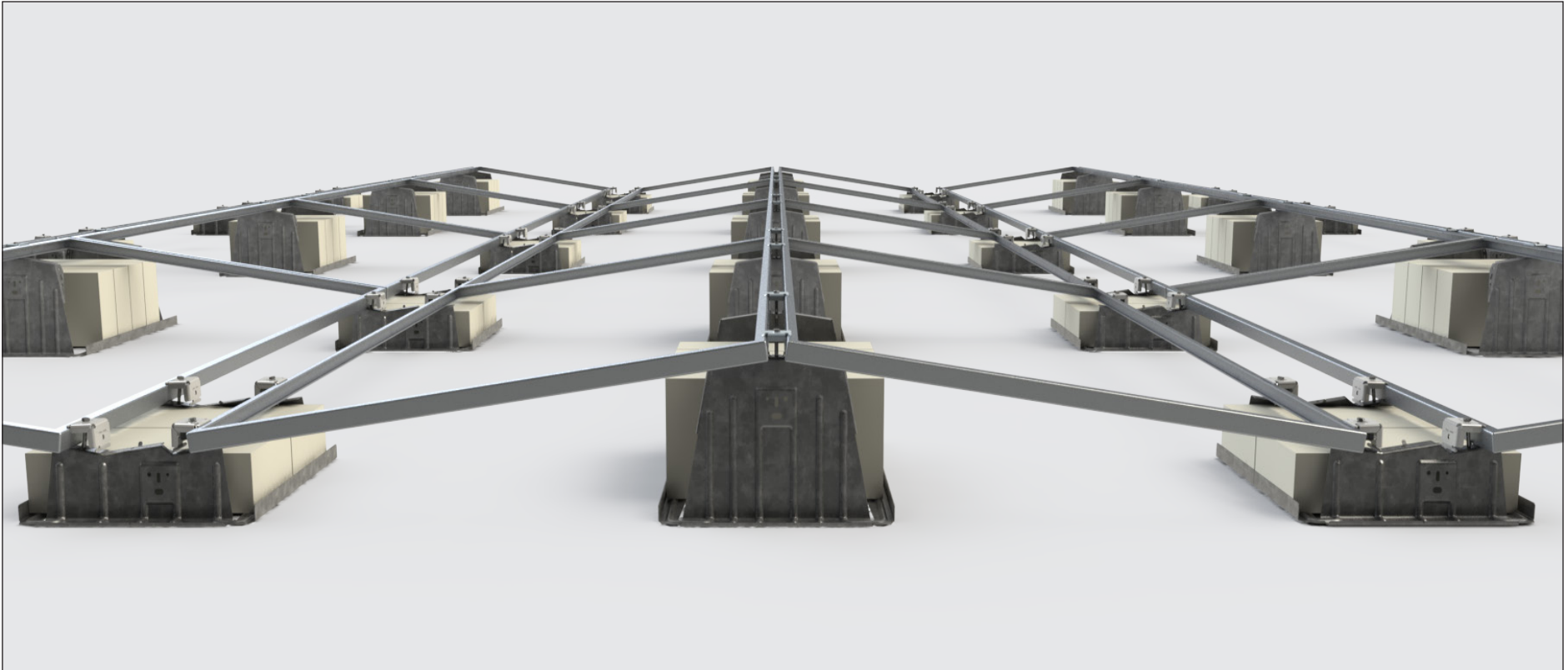


TABLE OF CONTENTS:

Tools & Specifications
 System Components
 System Level Fire Code Compliance
 Locate Array & Place Bays
 Place Ballast
 Place Modules & Attach Clamps
 Attach Clamps
 Module Installation & Wire Management
 Connect Grounding Lug

PG

1
2
3
4
5
6
7
8
9

TABLE OF CONTENTS (CONT):

Mechanical Loading Compliance
 Bonding & Grounding System Certification
 Bonding & Grounding System Certification
 Bonding & Grounding Electrical Diagram
 Temporary Bonding Procedures
Installation Supplement
 Ballast Bay(s) Roof Attachment
 Microinverter Install & Wire Mgmt.

PG

10
11
12
14

A
B

GENERAL NOTES:

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

TECHNICAL SPECIFICATIONS:

Material Types: 16G ASTM A653 GR50 Steel
G235 Galvanization

Hardware: Stainless Steel

Bonding and Grounding: UL2703 Listed Continuous Bonding Path.

TOOLS REQUIRED OR RECOMMENDED FOR LAYOUT, ATTACHMENTS & INSTALLATION:

- Drill (**Do Not Use An Impact Driver**)
- 7/16" Socket
- Torque Wrench
- Tape Measure
- Chalk Reel
- Optional Spacers (See Diagram - Page Right)

GENERAL HARDWARE:

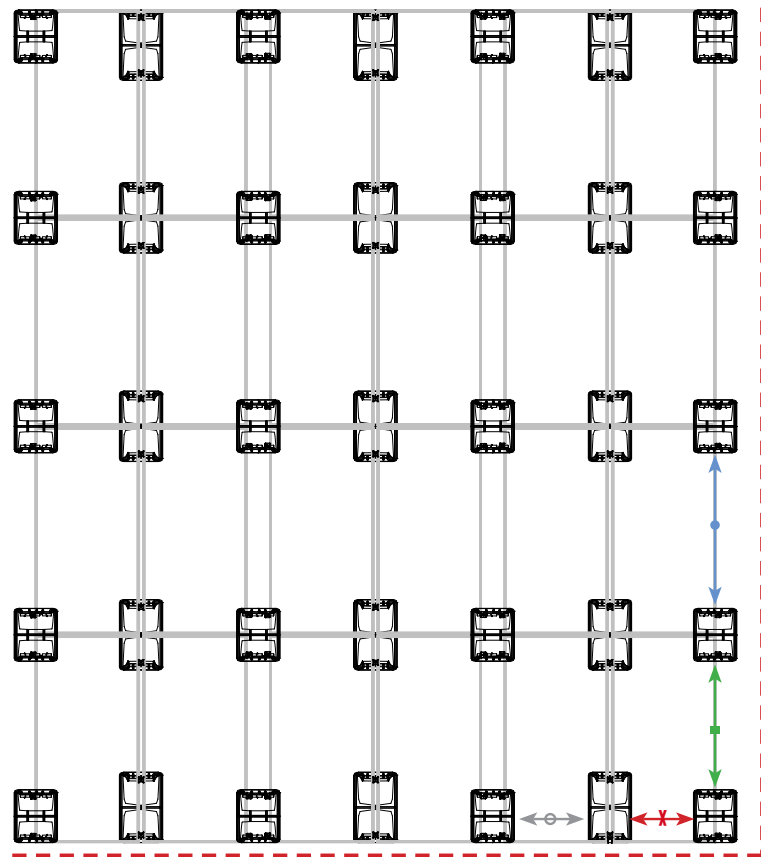
- 1/4-20 X 2 1/2" Hex Head Bolt - Module Clamps
- 1/4-20 Stainless Steel U-Nuts

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.

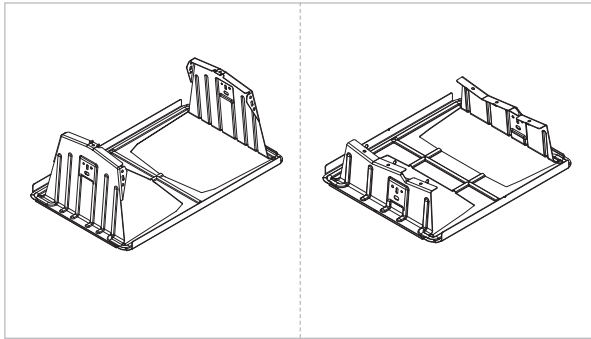
LAYOUT ASSISTANCE TOOL:

RM DT		Equations (Inches)	Project Specs (Spacing Inches)	
			Module Length (IN)	Module Width (IN)
1	Perimeter Column Spacing	$(\text{Module Length})+(\text{Gap Spacing})-19.7$		
2	Column Spacing	$(\text{Module Length})+(\text{Gap Spacing}/2)-29.55$		
3	E/W Edge Row Spacing	$0.996*(\text{Module Width})-15.74$		
4	Row Spacing	$0.996*(\text{Module Width})-11.25$		

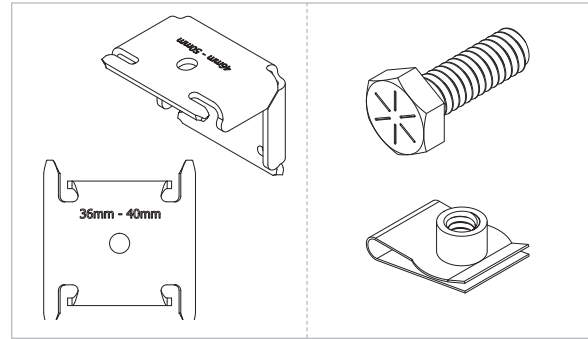


SPACERS - OPTIONAL

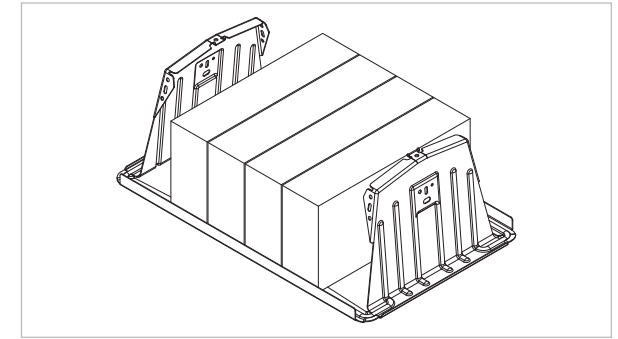
- PERIMETER COLUMN SPACER 
- COLUMN SPACER 
- E/W EDGE ROW SPACER 
- ROW SPACER 



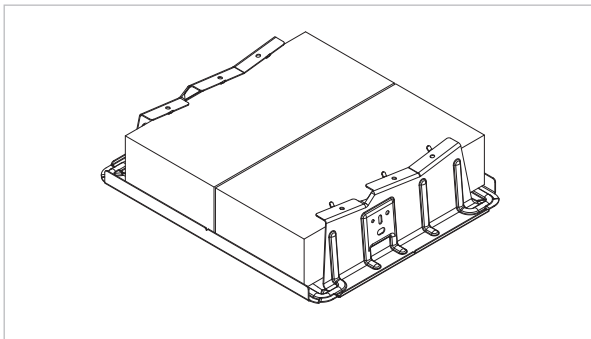
BALLAST BAY: The Ballast Bay is constructed of a high strength low alloy G235 Galvanized Steel. This system has a modular design that allows for easy installation around roof obstructions and accommodates roof undulations. The Ballast Bays are designed to nest within each other to optimize shipping logistics.
NOTE: Systems installed on PVC roofs require ballast bays with pre-installed Santoprene pads.



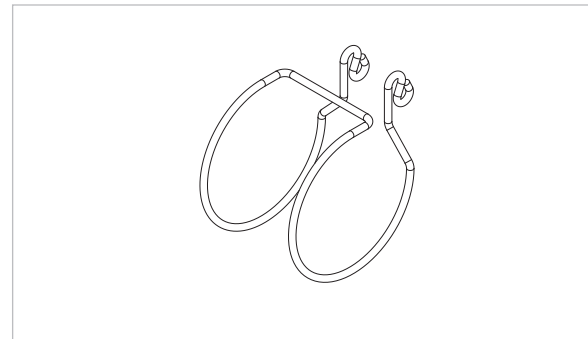
CLAMP & HARDWARE: The Module Clamp is made of Stainless Steel and can be used with module frame heights indicated on the clamp. The clamps are a portion of the UL2703 Listed system when installed according to this installation guide. A 1/4-20 stainless steel bolt and u-nut are the associated hardware for installing clamps.



RIDGE BALLAST BLOCK: The Ridge ballast bay can fit up to 5 standard 4"x8"x16" solid concrete cap blocks. Block weight can range from 26 – 38 lbs and shall meet ASTM C1491 requirements for freeze thaw durability. Verify your block weights before using the Unirac U-builder online design tool

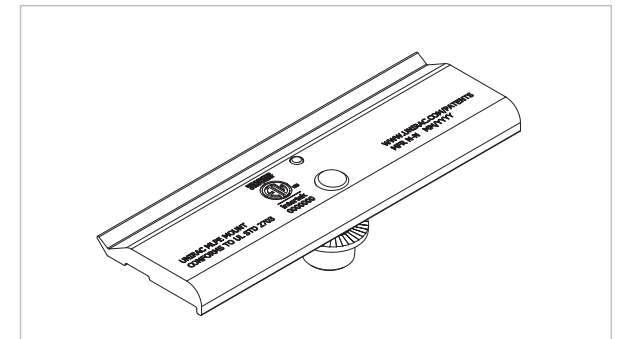


VALLEY BALLAST BLOCK: The Valley ballast bay can fit up to 2 standard 4"x8"x16" solid concrete cap blocks. Block weight can range from 26 – 38 lbs and shall meet ASTM C1491 requirements for freeze thaw durability. Verify your block weights before using the Unirac U-builder online design tool.



OPTIONAL WIRE MANAGEMENT: Custom Unirac wire clip along with mounting options for various off the shelf wire management clips.

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



OPTIONAL MICROINVERTER MOUNTING: Microinverter / Power optimizer bracket, see page B for additional instructions.

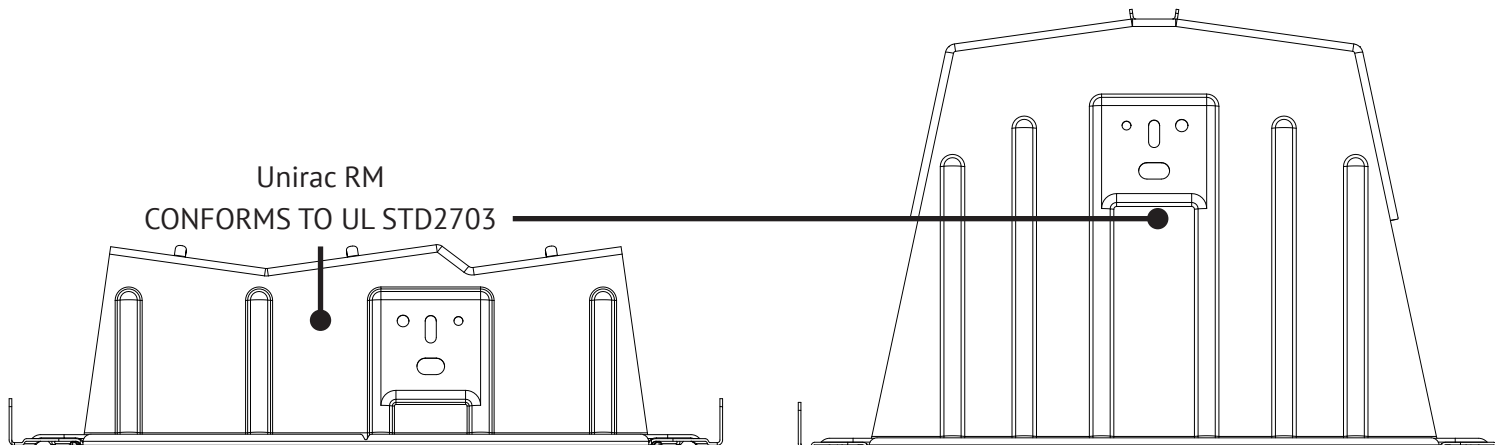
SYSTEM LEVEL FIRE CLASSIFICATION: The system fire class rating is only valid when the installation is conducted in accordance with the assembly instructions contained in this manual. RM ROOFMOUNT has been classified to the system level fire portion of UL1703. It has achieved Class A performance for low sloped roofs when used in conjunction with type 1 and type 2 module constructions. 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 < 2 inches per foot, or 9.5 degrees).

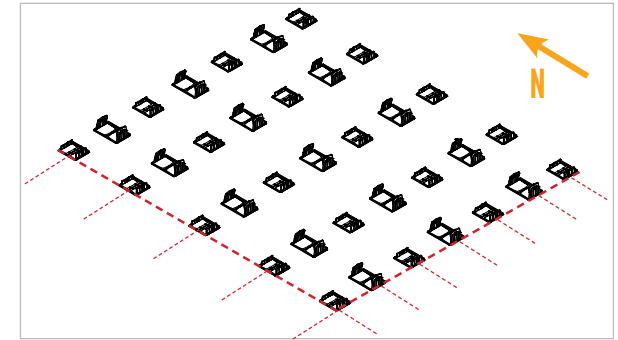
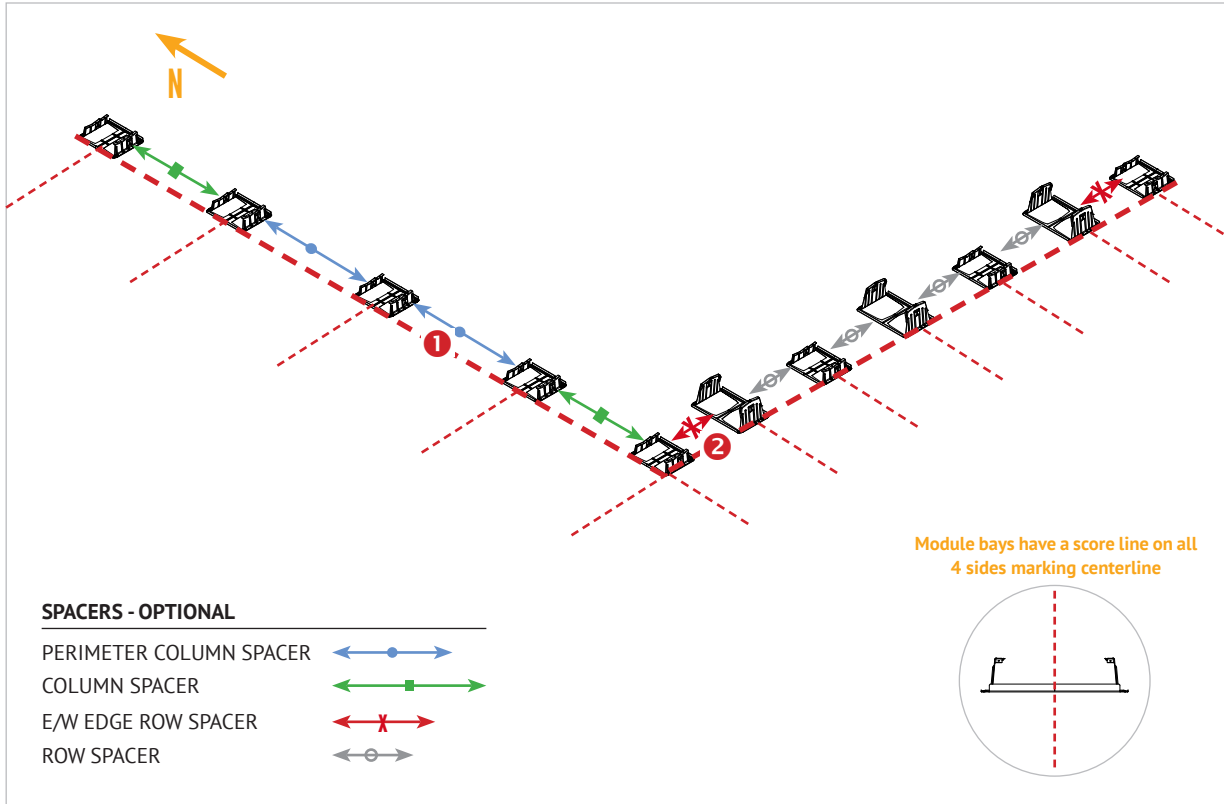
NOTE: Type I or Type II information is generally located on back of modules or through manufacturers documentation. Some building codes and fire codes require minimum clearances around such installations, and the installer should check local building code requirements for compliance.

Module Type	System level Fire Rating	Mitigation
Type 1	Class A	None Required / No Limitations
Type 2	Class A	None Required / No Limitations

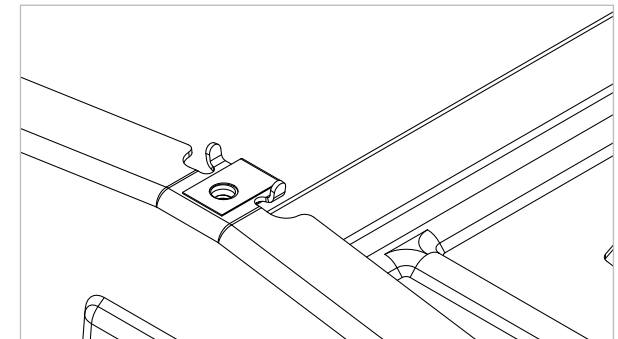
TYPE 1 / TYPE 2 CLASS A FIRE RATING MOUNTING ORIENTATION

Unirac RM Dual tilt has achieved Class A system level fire performance for type 1 and type 2 module constructions. There are no provisions necessary in order to meet Class A requirements for this product.





FILL IN BAYS



INSTALL U-NUT It is recommended to install u-nuts prior to placing ballast blocks & modules on the bays.

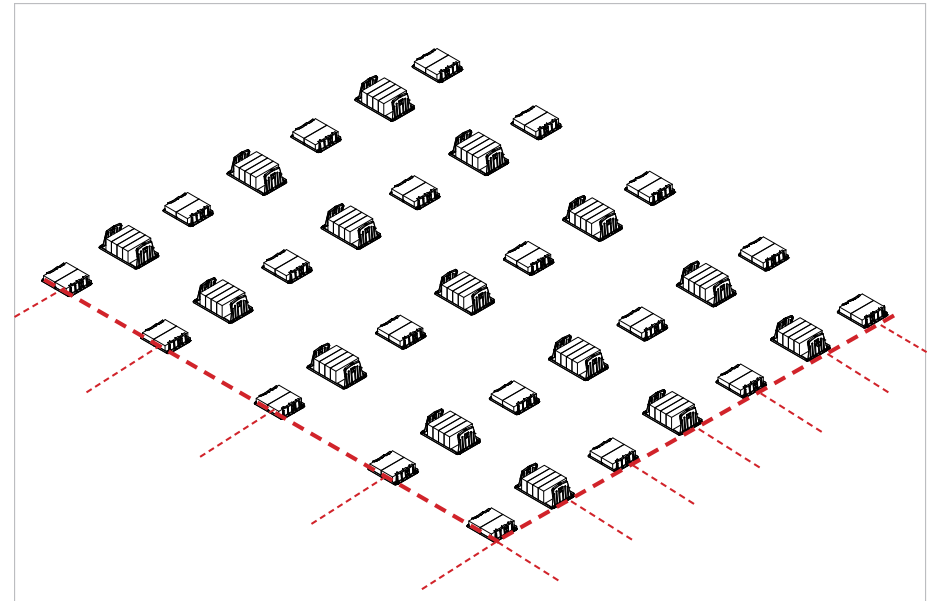
NOTE: U-NUT - Single Use Only - Do not re-torque once fully seated

1 2 SNAP WEST PERIMETER CHALK LINE, THEN NORTH OR SOUTH PERIMETER CHALK LINE. As best practice, mark lines on perimeter chalk lines to locate center of bays

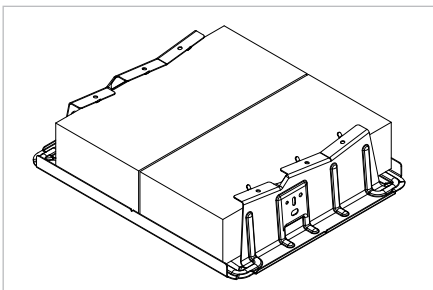
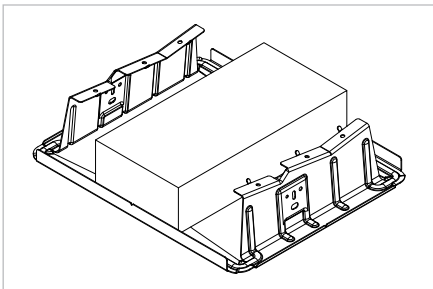
PLACE WEST PERIMETER BAYS FIRST, THEN NORTH OR SOUTH PERIMETER BAYS. If slip sheets are required, place per manufacturer recommendations.

NOTE: Custom spacers can be made to aid in the placement of bays on the roof. See page 1.

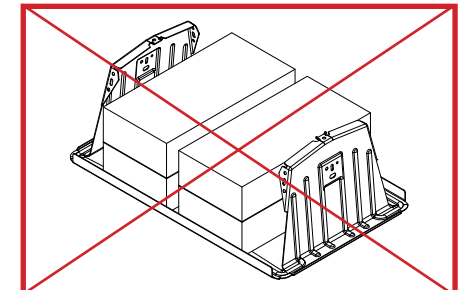
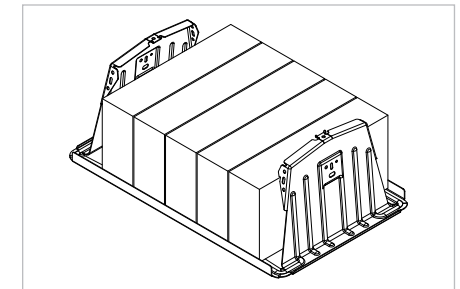
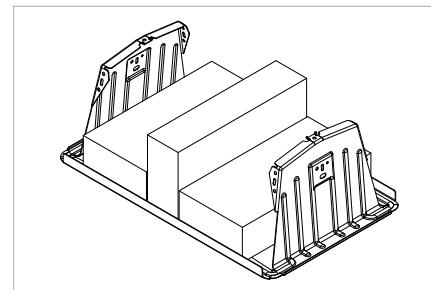
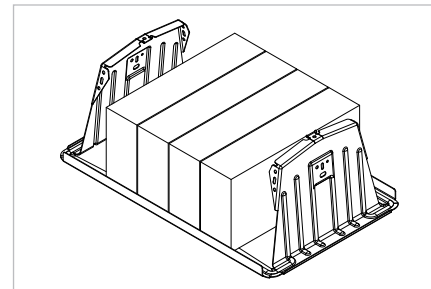
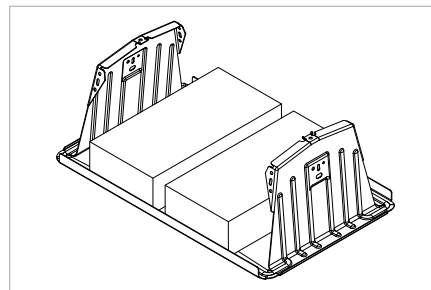
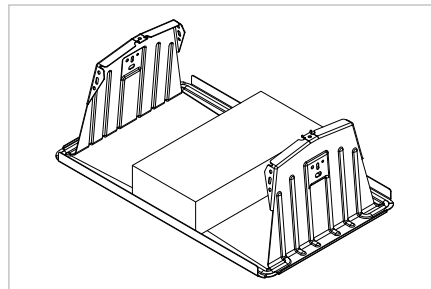
PLACE ALL BALLAST: A maximum of 2 ballasts can be placed in valley bay, and up to 5 ballasts can be placed in the ridge. Site specific ballast calculations should be created for each individual project in accordance with the U-Builder design software. This system has been rated for the mechanical load 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.



VALLEY BALLAST BLOCK OPTIONS:

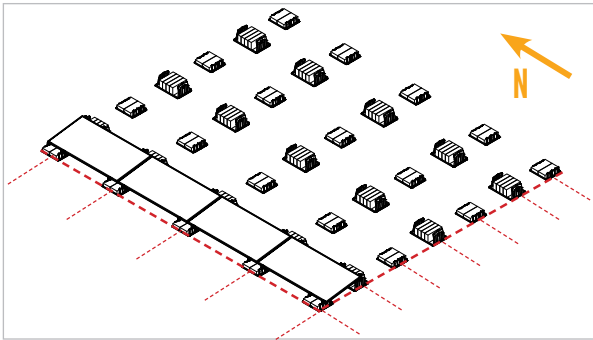


RIDGE BALLAST BLOCK OPTIONS:



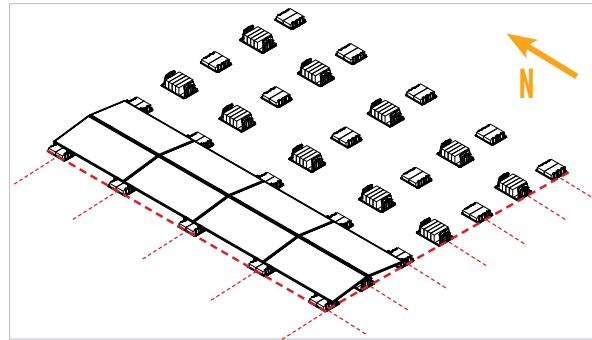


RMDT MODULE PLACEMENT & ATTACH CLAMPS



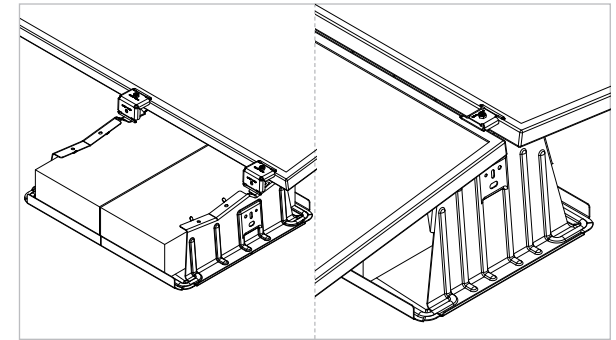
WESTERN EDGE MODULE PLACEMENT. Tabs on valley and ridge bay provide mechanical stop and aid in proper spacing at ridge. Rows of modules must be wired together at this time. See page 8 for wire management options.

NOTE: Modules may be placed on bays without immediate installation of clamps. Column Spacing: 1 inch maximum gap between modules / ¼ inch minimum gap between modules.



EAST OR WEST EDGE MODULE PLACEMENT. Rows of modules must be wired together at this time. See page 8 for wire management options.

NOTE: Clamps should be installed for each East/West pair of rows after wiring has been completed.

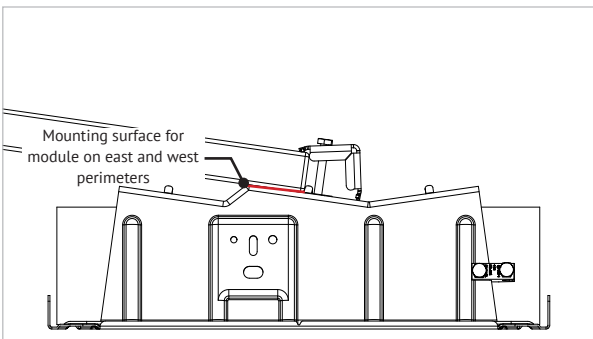


INSTALL CLAMPS

NOTE: U-NUT - Single Use Only - Do not re-torque once fully seated

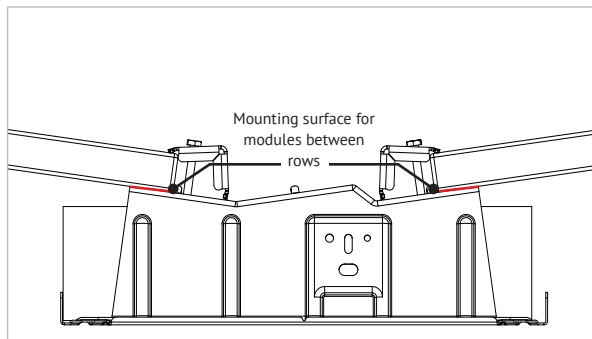
NOTE: CLAMP AND BOLT - Single Use Only - Do not re-torque once fully seated

TORQUE VALUE: 7FT-LBS MINIMUM to achieve UL2703 required clamp load



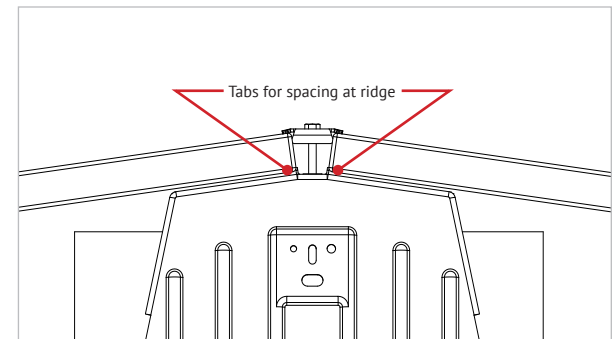
PROPER VALLEY BAY ORIENTATION AT EAST AND WEST PERIMETERS:

- Valley bays are designed to tuck up underneath the modules for east and west perimeters
- Bent tabs on all mounting surfaces act as a mechanical stop for the modules



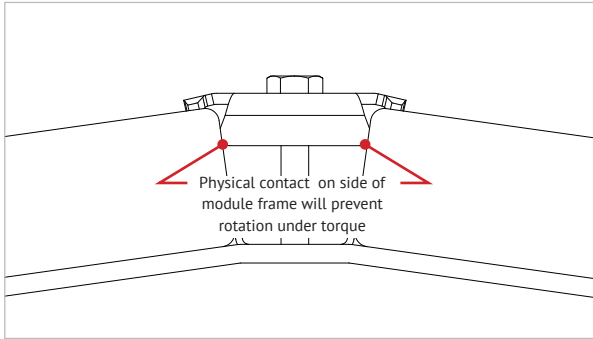
PROPER INTER-ROW SPACING:

- Inter row spacing at the valley is designed to provide an 8" space for walkways
- Bent tabs on all mounting surfaces act as a mechanical stop for the modules



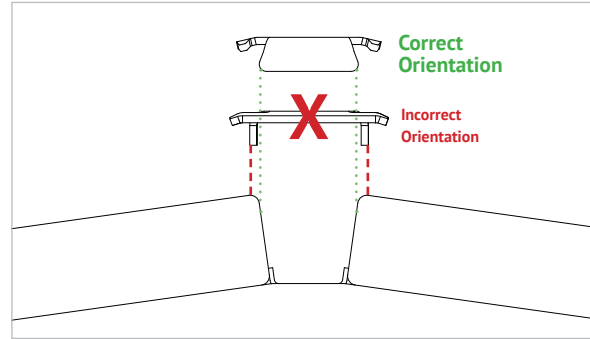
CLOSE UP MOUNTING AT RIDGE:

- Bent tabs on the mounting surfaces aid in setting the correct gap between modules at the ridge

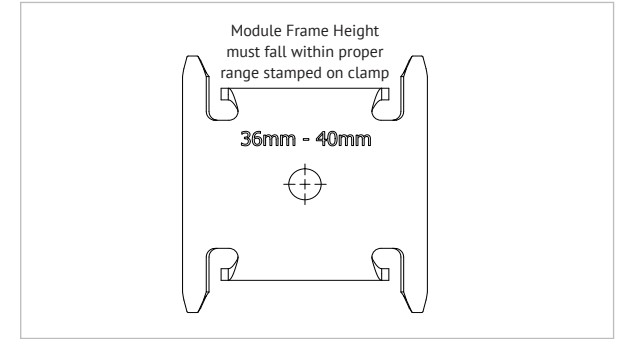


PROPER MID CLAMP INSTALLATION

- The top of the clamp is stamped for module frame height.
- Clamp should be firmly held against module frame while being torqued

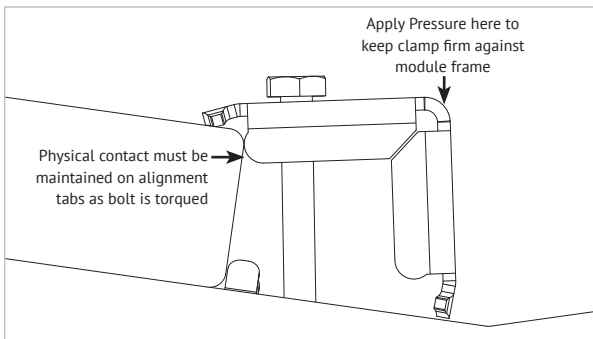


PROBLEM – CLAMP NOT ORIENTED CORRECTLY



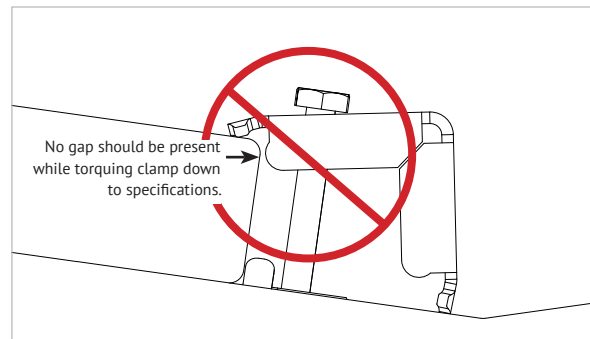
PROBLEM – NOT USING PROPER SIZE OF CLAMP FOR MODULE FRAME HEIGHT

- Double check the stamping on clamp to use the correct leg of clamp for module frame height
- The module height shall fall within the range shown on the top of the clamp



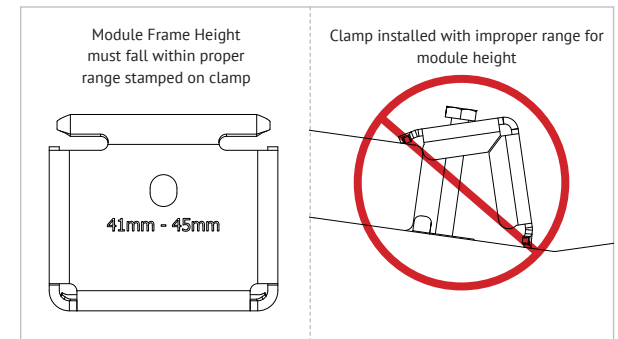
PROPER CLAMP INSTALLATION:

- Clamp is stamped for module frame height on each leg
- Clamp should be firmly held against module frame while being torqued



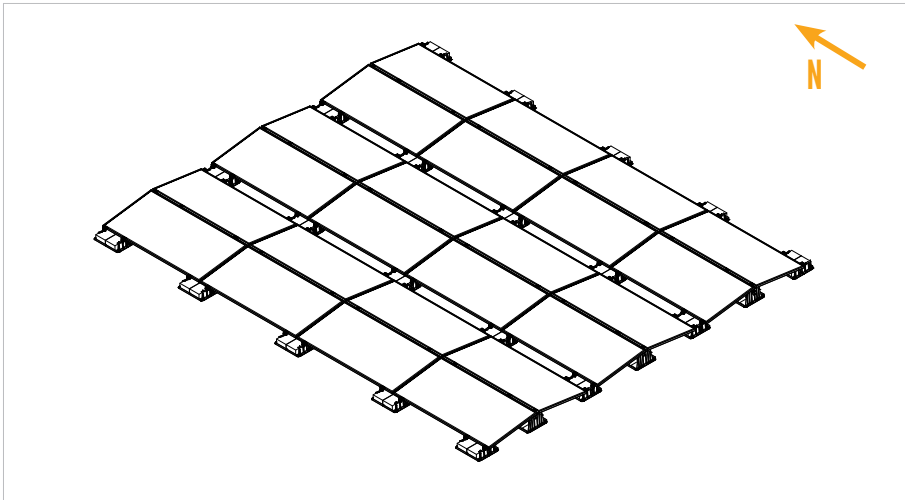
PROBLEM – CLAMP NOT SEATED AGAINST MODULE DURING TORQUING

- Clamp needs to be held securely against the module frame during torquing for proper installation

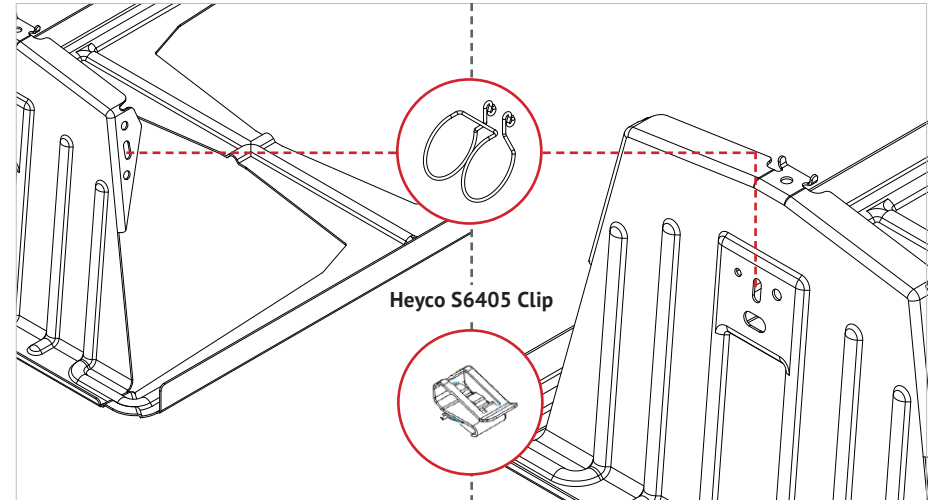


PROBLEM – NOT USING PROPER SIZE OF CLAMP FOR MODULE FRAME HEIGHT

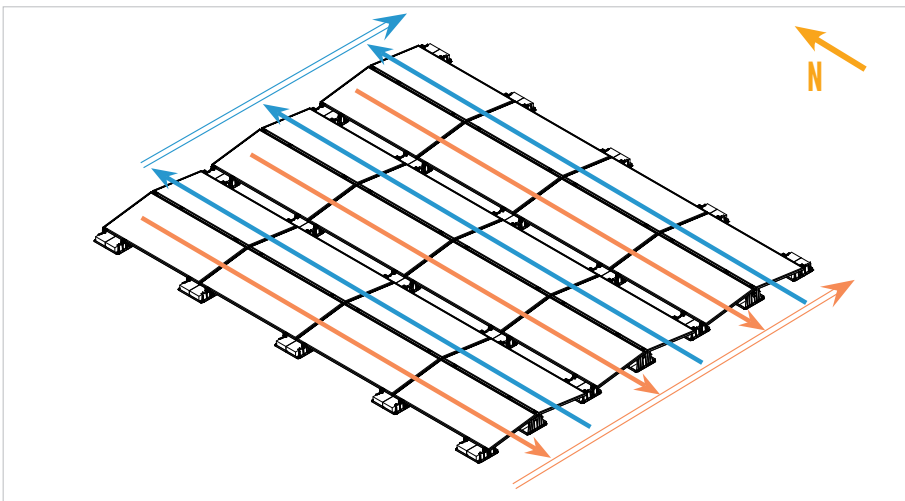
- Double check the stamping on clamp to use the correct leg of clamp for module frame height
- The module height shall fall within the range shown on the top of the clamp
- Excessive angle on clamp will inhibit required clamp load on module



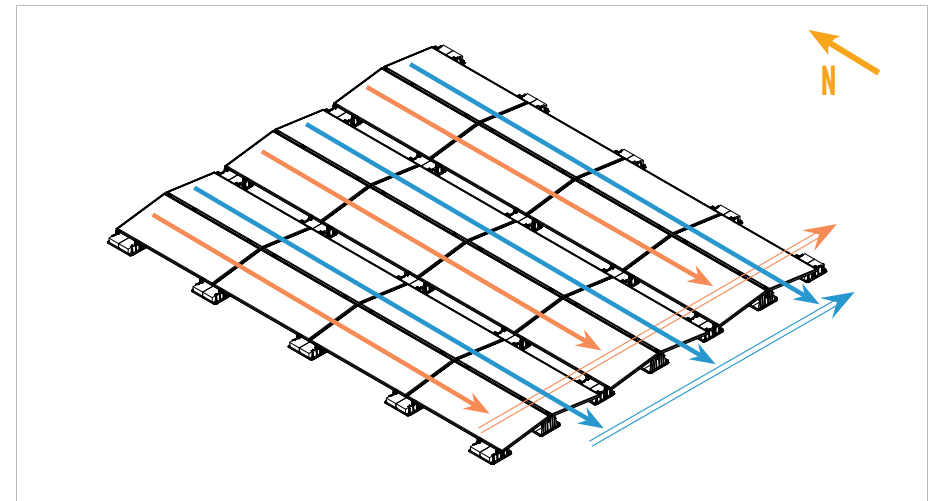
FILL IN ALL MODULES. Wire each row as modules are installed, and secure the modules in place after each east/west row pair is complete.



WIRE MANAGEMENT: Unirac provides a custom clip for wire management. Additional holes are included in the bay to accommodate other off the shelf wire management clips.

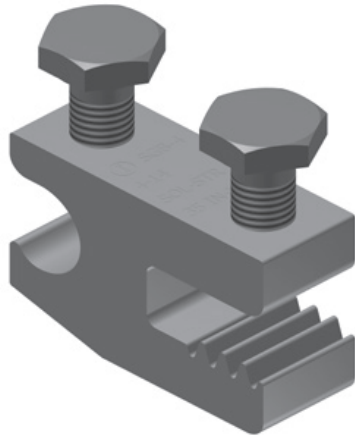


WIRE MANAGEMENT OPTION 1: Wire and bundle all east facing modules, run east facing bundle down north perimeter (or south perimeter) and vice versa for all west facing modules



WIRE MANAGEMENT OPTION 2: Wire and bundle all east facing modules, wire and bundle all west facing modules. Run bundles along north or south perimeter

Ilsc SGB-4 Solar Grounding & Bonding



TERMINAL TORQUE:
Install Conductor and torque to the following: 4-14 AWG: 35 in-lbs

GROUNDING LUG MOUNTING DETAILS AS REQUIRED BY CODE & ENGINEER OF RECORD: The Ilsc 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 ROOFMOUNT is intended to be used with PV modules that have a system voltage less than or equal to that allowable by the National Electric Code (NEC). It is the installer's responsibility to check adherence to local codes.

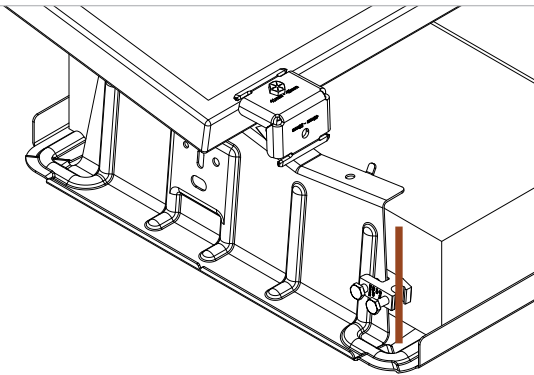
NOTE: The installation must be conducted in accordance with the National Electric Code ANSI / NFPA 70.

Ground Lug	Bolt Size	Torque Value
Ilsc Lug	1/4"-20	6.5 ft-lbs (75 in-lbs)

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 or galvanized steel. These materials must be kept separate.

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

Ilsc SGB-4 Solar Grounding & Bonding



GROUNDING NOTE:
Can be installed on any location with a flat surface on the bay in order to ground the system.

MECHANICAL LOAD TEST QUALIFICATION

The Unirac RM system has been tested to the mechanical load provisions of UL2703 and covers the following basic parameter(s):

- Tested loads: 25 psf up, 54 psf down
- Certification Loads: 16.7 psf up, 36 psf down, 5 psf down-slope

TESTED MODULE

Module Manufacturer	Model / Series
Hyundai	HIS-S325TI

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.

VERIFIED COMPATIBLE MODULES:

Manufacture	Module Model / Series	Cells	Frame Height (MM)
Aleo	P18 & P19	60	35
Aleo	S18, S19, S59, & S79	60	50
AU Optronics	PM Series	60	40
AU Optronics	PM Series	72	40
Auxin	AXN6M610Txxx	60	40
Auxin	AXN6P610Txxx	60	40
Auxin	AXN6M612Txxx	72	40
Auxin	AXN6P612Txxx	72	40
Canadian Solar	CS5A-M & CS6P-M	60	40
Canadian Solar	CS6X-P, CS6U-P, & CS6U-M	72	40
Canadian Solar	CS6K-MS & CS6K-M	60	40
Canadian Solar	CS6K-P & CS6P-P	60	40
Canadian Solar	CS3U-P & CS3U-MS	72	40
Canadian Solar	CS3K-P & CS3K-MS	60	40
Centrosolar America	C-Series & E-Series	60/72	40
CertainTeed	CT2xxMxx-01	60	35
CertainTeed	CT2xxPxx-01	60	35
CertainTeed	CTxxxMxx-01	72	40
CertainTeed	CTxxxPxx-01	72	40
CertainTeed	CTxxxMxx-02	60/72	40
ET Solar	ETAC & ET Modules	60/72	40
Eco Solargy	Orion 1000 ECOxxx156P	60	40
Hanwha SolarOne	HSL 60 & HSL 72	60/72	40
Heliene	36M Series	36	40
Heliene	60M Series	60	40
Heliene	72M Series	72	40
Hyundai Heavy Industries	MG, TG, RG, & KG Series	60	35
Hyundai Heavy Industries	TI & RI Series	72	50
Hyundai Heavy Industries	MI, RI, KI, & TI Series	72	40
JA Solar	JAP6 60 & JAM6 60	60	40
JA Solar	JAP6 72 & JAM6 72	72	45

Manufacture	Module Model / Series	Cells	Frame Height (MM)
Jinko	JKMxxxM & JKMsxxxP	60	40
Jinko	JKMxxxPP & JKMSxxxPP	60	40
Jinko	JKMxxxP	72	40
Jinko	JKMSxxxP	60	40
Kyocera	KD-F Series	60	46
LG Electronics	MONO X	60	35
LG Electronics	MONO X 2	60	40
LG Electronics	MONO X Plus	60/72	40
LG Electronics	NeON 2/2 Black	60	40
LG Electronics	NeON 2	72	40/46
LG Electronics	NeON R/R Black (Black Contact)	60	40
LG Electronics	NeON 2 Bifacial	72	40
LG Electronics	MONO X	72	46
LG Electronics	NeON 2 AC	60	40
Mission Solar Energy	MSE MONO & MSE PERC	60/72	40
Mitsubishi	MJE Series	60	46
Mitsubishi	MLE Series	120	46
Phono Solar Tech.	Standard Modules	60	40
Phono Solar Tech.	Standard Modules	72	45
Panasonic	VBHNxxxSA15	96	35
Panasonic	VBHNxxxSA16	96	35
Panasonic	VBHNxxxKA01	96	35
Panasonic	VBHNxxxKA02	96	35
Q.Cells	Q.PLUS/PEAK/PRO - L G4.x	72	35
Q.Cells	B.LINE PLUS/PRO - L G4.x	72	35
Q.Cells	Q.PLUS L-G4.2/TAA	72	35
Q.Cells	Q.PRO L-G2 xxx	72	40/42
Q.Cells	Q.PLUS BFR G4.1	60	32
Q.Cells	Q.PRO BFR G4x	60	32
Q.Cells	Q.PEAK-G4.1	60	32
Q.Cells	Q.PEAK-G4.1/MAX	60	32

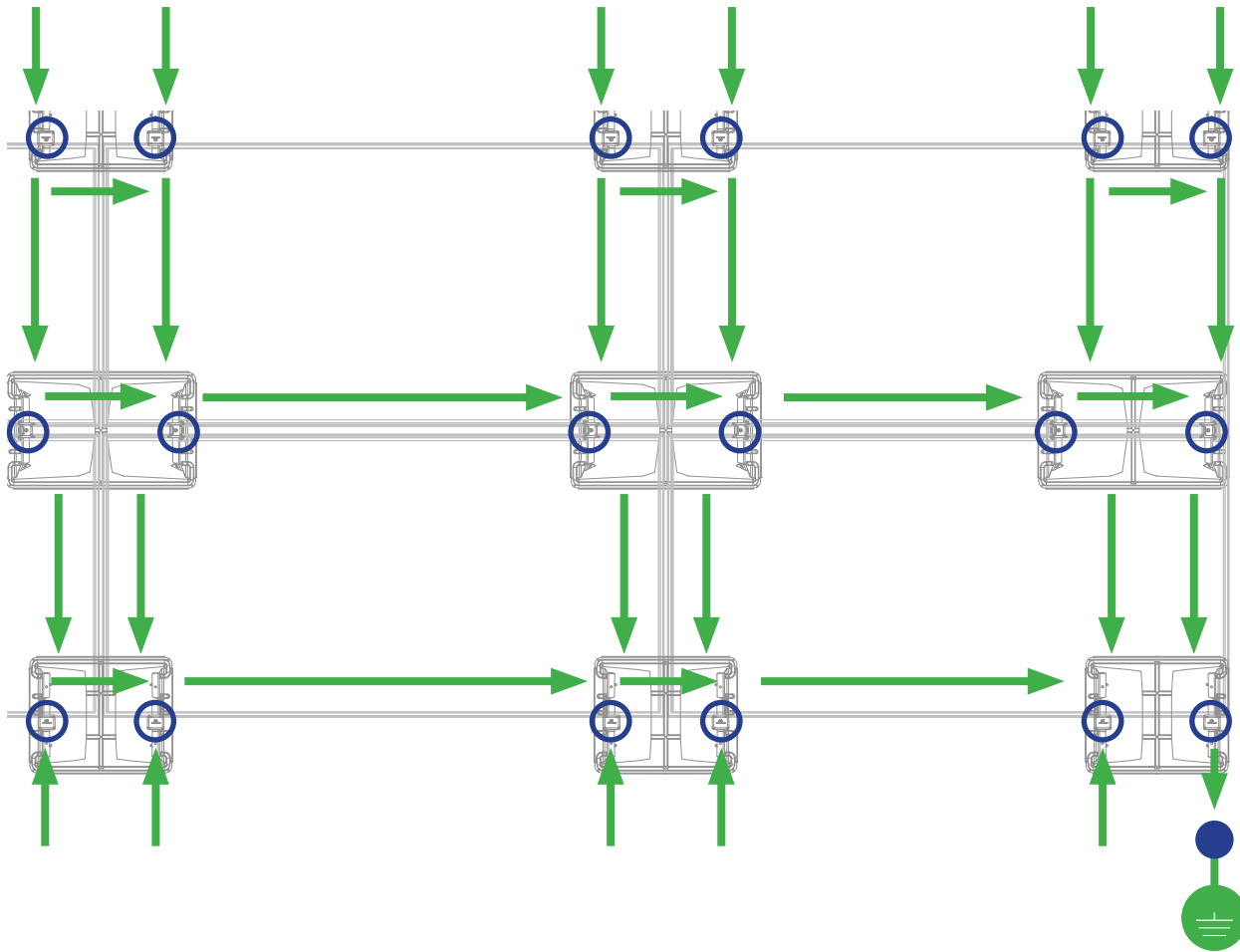
Manufacture	Module Model / Series	Cells	Frame Height (MM)
Q.Cells	Q.PEAK BLK G4.1	60	32
Q.Cells	Q.PRO/Q.PLUS G4	60	32
Q.Cells	Q.PEAK-G4.1/TAA	60	32
Q.Cells	Q.PEAK BLK G4.1/TAA	60	32
Q.Cells	Q.PLUS BFR G4.1/TAA	60	32
Q.Cells	Q.PLUS BFR G4.1/MAX	60	32
Q.Cells	B.LINE PLUS BFR G4.1	60	32
Q.Cells	B.LINE PRO BFR G4.1	60	32
Q.Cells	Q.PRO EC-G4.4	60	32
Q.Cells	Q.PEAK-G3 & G3.1	60	35
Q.Cells	Q.PEAK BLK G3 & G3.1	60	35
Q.Cells	Q.PLUS BFR G3.1	60	35
Q.Cells	Q.PLUS G3 & Q.PRO G3	60	35
REC	PEAK & ECO	60	38
REC	PE 72	72	45
Renesola	60 Cell Modules & Vitrus2	60/72	40
Sharp	ND-24CQJ & ND-25CQCS	60	46
Sharp	ND-Q235F4 & ND-F4Q300	60	46
Sharp	NU-SA	60	35
Sharp	NU-SC	72	40
Silfab	SLA-M/P	60	38
SolarWorld	Sunmodule Protect/Plus	60/72	33
Suniva	Optimus Series 60	60	35
Suniva	Optimus Series 72	72	38
Suniva	MV Series 60	60	40
Suniva	MV Series 72	72	46
Suntech	STP "XXX"	60	35
Suntech	STP "XXX"	72	40
Sun Edison/Flextronics	F-Series / FLEX FXS	60	35/50
Sun Edison/Flextronics	R-Series / FLEX FXS	72	35/50
SunPower	X-Series 72 & E-Series 72	72	46







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.

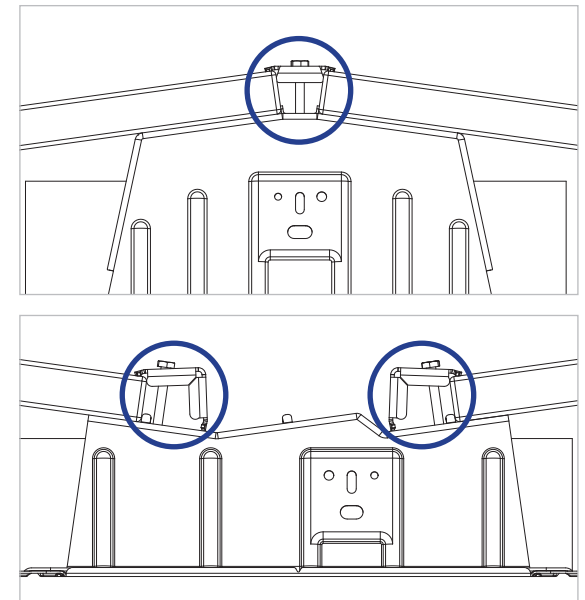
VERIFIED COMPATIBLE MODULES (CONTINUED):

Manufacture	Module Model / Series	Cells	Frame Height (MM)
SunPower	X-Series 96 & E-Series 96	96	46
SunPower	P-Series	498	46
SunPower	Sig Black 72	72	46
SunPower	Sig Black 96	96	46
SunPower	AC	60	46
Trina	PA05, PD05, & DD05	60	35
Trina	PD14, PE14, & DD14	72	40
Yingli	YGE-U72	72	40
Yingli	Panda 60	60	40
Yingli	DS YGE 60 Cell Series	60	40
Yingli	DS YGE 60 Cell Series 2	60	35



-  Fault Current Ground Path
-  Ground Lug
-  Grounding Clip & Bolt
-  Min. 10 AWG Copper Wire

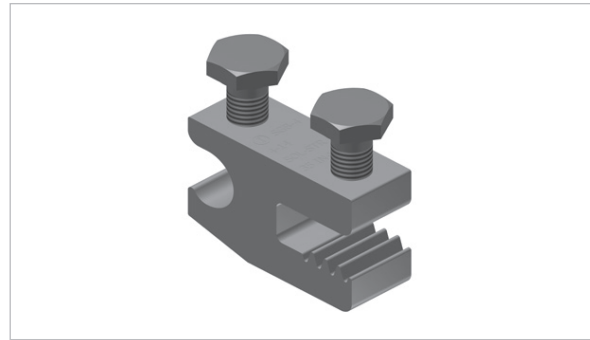
Module Frame
 Module Bay w/ Grounding Clips



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.**

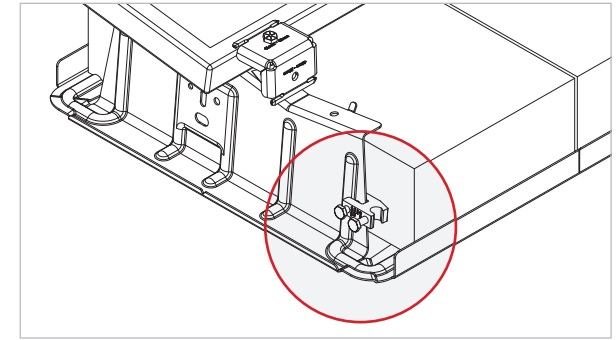
NOTE: Removing a PV module from a system is not considered to be routine maintenance. This type of activity should only be performed by trained and qualified installers.

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 or galvanized steel. These materials must be kept separate.

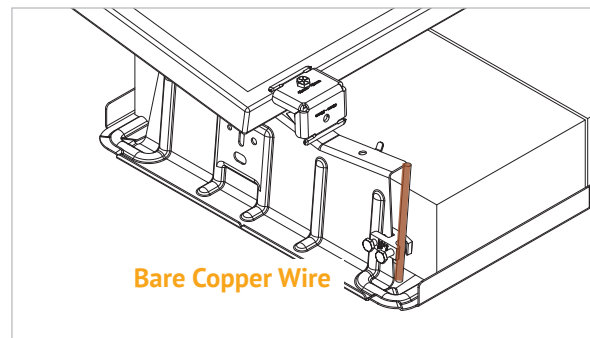


APPROVED LUGS:
IlSCO lay-in Lug IlSCO - SGB-4

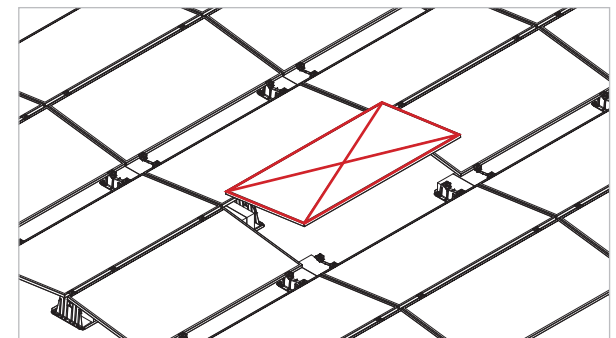
TERMINAL TORQUE: Install conductor and torque to the following: 4-14 AWG: 35in-lbs



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

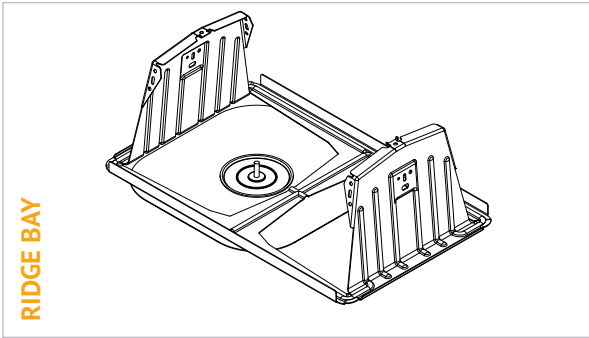


INSERT COPPER WIRE: Insert bare copper wire into each lug, providing a bonding jumper across the missing module location.



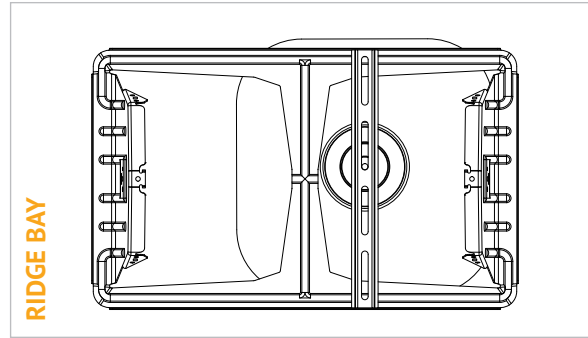
REMOVE MODULE & REVERSE THE OPERATION AFTER MAINTENANCE IS COMPLETE

NOTE: CLAMP AND BOLT - Single Use Only - Use new clamps after any module replacements or system maintenance.

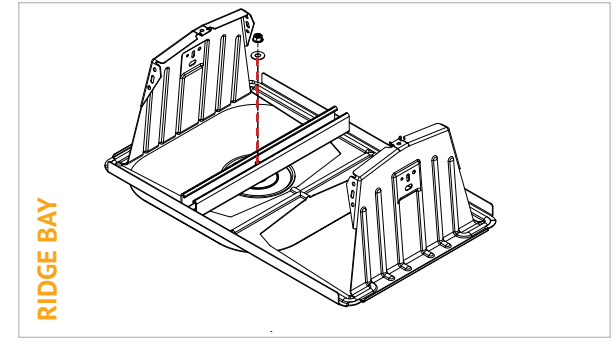


STEP 1 - POSITION U-ANCHOR: Position U-Anchor under bay requiring attachment and install according to manufacturer installation instructions.

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

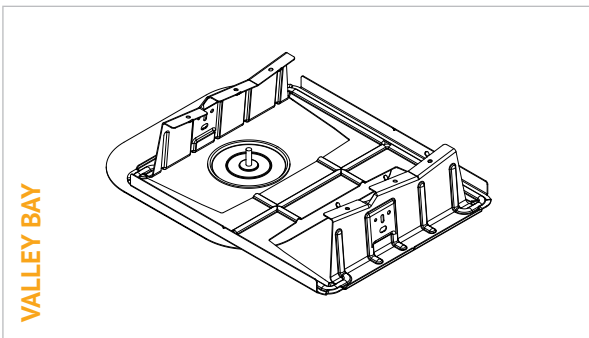


STEP - 2 PLACE UNISTRUT: Place Unistrut across bay with the anchor stud through a slot.



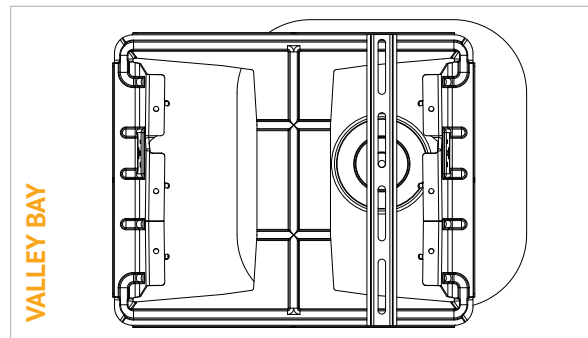
STEP 3 - SECURE UNISTRUT TO U-ANCHOR: Place 3/8" washer and 3/8-16 serrated flange nut on anchor stud, serrations facing down and tighten to 30 ft-lb.

TORQUE VALUE: 30FT-LBS

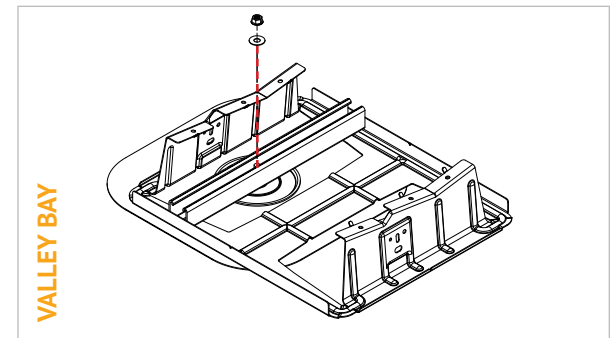


STEP 1 - POSITION U-ANCHOR: Position U-Anchor under bay requiring attachment and install according to manufacturer installation instructions.

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



STEP - 2 PLACE UNISTRUT: Place Unistrut across bay with the anchor stud through a slot.



STEP 3 - SECURE UNISTRUT TO U-ANCHOR: Place 3/8" washer and 3/8-16 serrated flange nut on anchor stud, serrations facing down and tighten to 30 ft-lb.

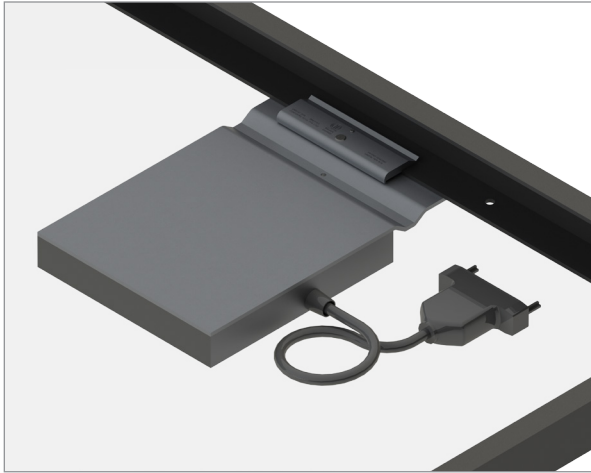
TORQUE VALUE: 30FT-LBS



RMDT MICROINVERTER INSTALL & WIRE MGMT. :

B

INSTALLATION GUIDE - SUPPLEMENT : PAGE



PRE-INSTALL MICROINVERTERS: Install MLPE in a location on the module that will not interfere with ballast bays or grounding lugs. To use trunk cable most efficiently, install MLPE components in the same locations on all modules in the same row.

TORQUE VALUE: 20FT-LBS

