



INSTALLATION GUIDE



UNIRAC Code-Compliant Installation Manual

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INSTALLATION GUIDE

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GENERAL NOTES:

If provided 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

Coating(s): G235 Galvanization, G180 Galvanization, G40 Galvanization + InterCoat® ChemGuard, G60 Galvanization + InterCoat® ChemGuard or G80 Galvanization + InterCoat® ChemGuard

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:

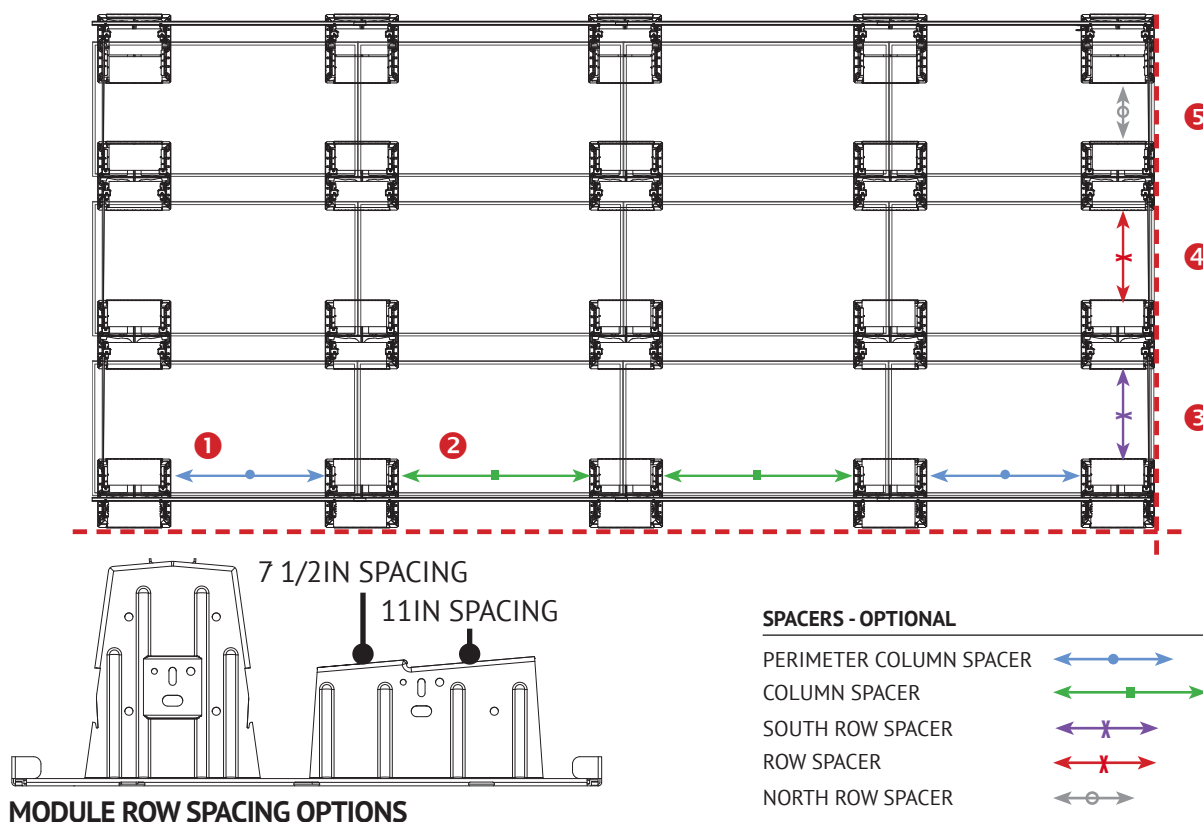
- 1/4-20 X 2 1/2" Hex Head Bolt - Module Clamps
- 1/4-20 X 1" Hex Head Bolt - Wind Deflectors
- 1/4-20 Stainless Steel U-Nuts
- 1/4" Flat Washer 1 1/2" O.D.

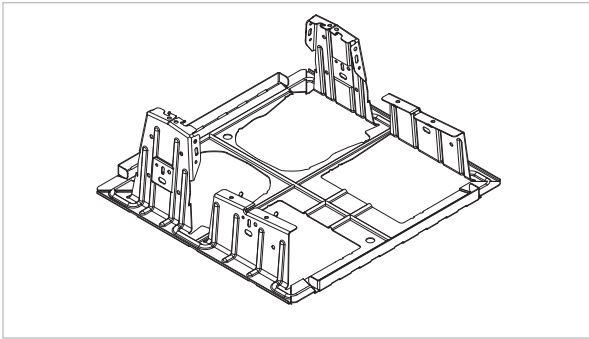
SAFETY:

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.

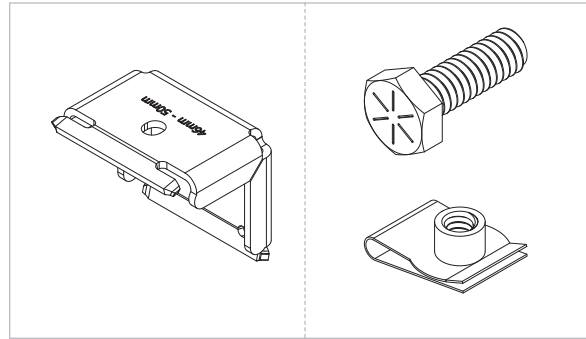
LAYOUT ASSISTANCE TOOL:

Module Dimensions:	RM5	Module location:	Spacing Equations (in Inches):	
			For 7.5" inter-row option:	For 11" inter-row option:
Module Length (ML) =	1	Perimeter Column Spacing =	$ML + (G/2) - 32.04"$	
Module Width (MW) =	2	Interior Column Spacing =	$ML + G - 21.36"$	
Preferred module gap? (1/4" - 1" is permissible)	3	South Row Spacing =	$(MW \times 0.996) - 12.79"$	$(MW \times 0.996) - 12.79"$
	4	Row Spacing =	$(MW \times 0.996) - 12.79"$	$(MW \times 0.996) - 9.25"$
East/West Module Gap (G) =	5	North Row Spacing =	$(MW \times 0.996) - 21.97"$	$(MW \times 0.996) - 18.46"$

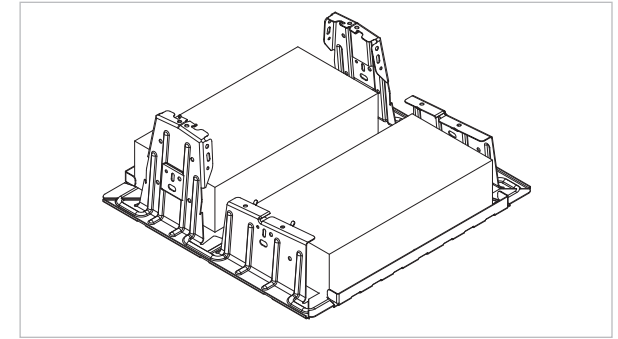




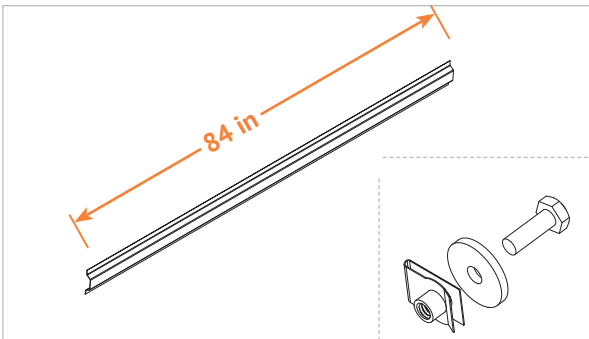
BALLAST BAY: The Ballast Bay is constructed of a high strength low alloy steel with a coating to protect against corrosion. This system has a modular design that allows for easy installation around roof obstructions and accommodates roof undulations. The Ballast Bays are designed to nest within each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



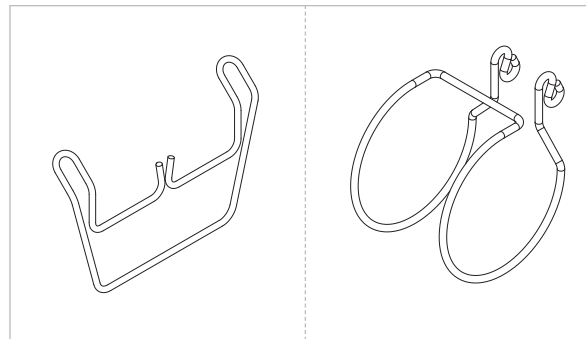
CLAMP & HARDWARE: The Module Clamp is made of Stainless Steel and can be used with module frame heights indicated on the clamp. The clamps are a portion of the UL2703 Listed system when installed according to this installation guide. A 1/4-20 stainless steel bolt and u-nut are the associated hardware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



BALLAST BLOCK: The RM 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.

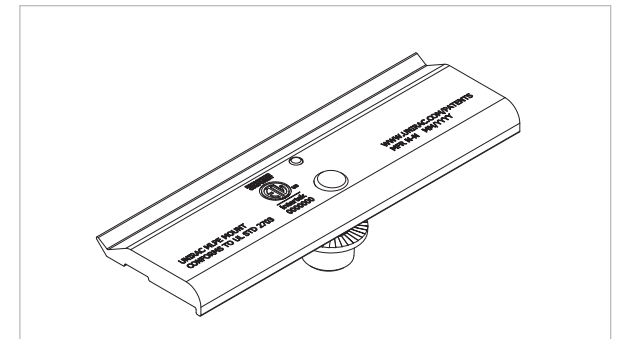


WIND DEFLECTOR: 18G G180 steel wind deflector aids in ballast reduction and provides fire mitigation. A 1/4" - 20 stainless steel bolt and fender washer (1.5" O.D) are associated hardware for wind deflectors. **NOTE: U-Nuts come in packages separate from deflector hardware.**



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.

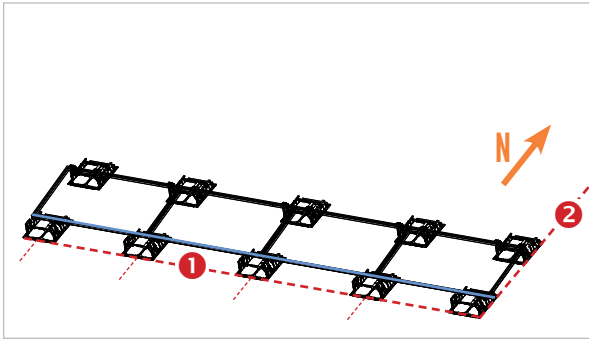


OPTIONAL MICROINVERTER MOUNTING: Microinverter / Power optimizer bracket, see page 9 for additional instructions.

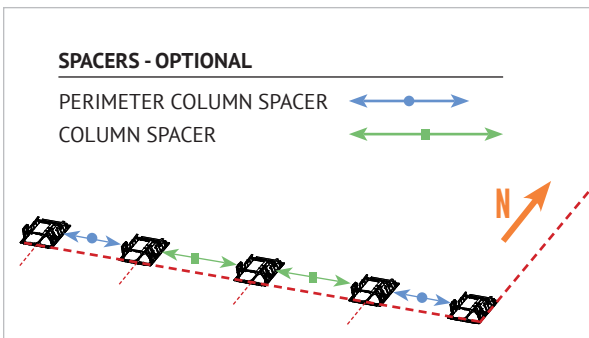


PART NUMBER DATA

S.No.	Part Number	Part Description
1	310800	RM5 BAY
2	310803	RM5 BAY, PVC
3	310810	RM5 WIND DEFLECTOR, 84"
4	310811	RM5 WIND DEFLECTOR, 98"
5	310820	RM5/DT ENDCLAMP 30-40MM
6	310821	RM5/DT ENDCLAMP 41-45MM
7	310822	RM5/DT ENDCLAMP 46-50MM
8	310830	RM5/DT PVC ROOF FRICTION PATCH
9	310850	RM5/DT WIRE MGMT CLIP
10	310851	RM5 WD WIRE MGMT CLIP
11	310860	RM5/DT 1/4-20 CLIP U-NUT SS18-8
12	310861	RM5, WIND DEFLECTOR HDW KIT
13	008114M	MLPE MOUNT ASSY
14	205000S	ENPHASE ENGAGE CABLE CLIP
15	008002S	GROUND WEEBLUG #1
16	008009P	ILSCO LAY IN LUG (GBL4DBT)
17	310999	FLASHLOC RM KIT

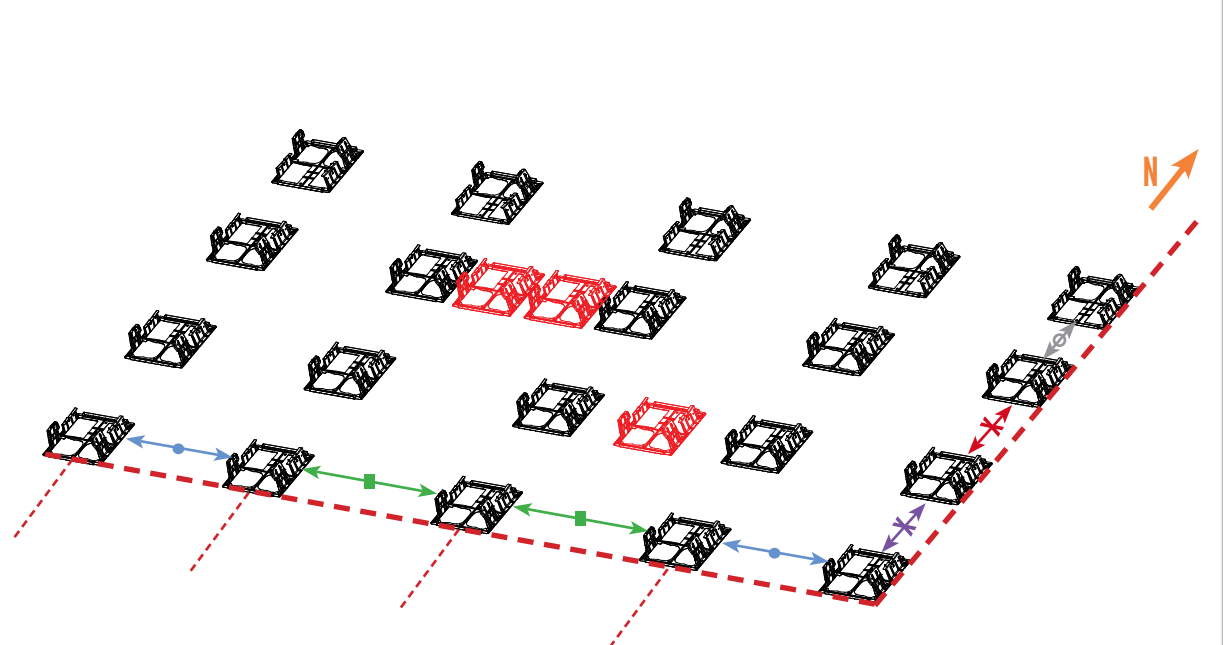


SNAP SOUTH PERIMETER CHALK LINE, THEN EAST OR WEST PERIMETER CHALK LINE. As best practice, on south edge of array mark lines to locate the center of each bay.



PLACE SOUTH PERIMETER BAYS FIRST. If slip sheets are required, place per manufacturers recommendations.

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



SPACERS - OPTIONAL

PERIMETER COLUMN SPACER	
COLUMN SPACER	
ROW SPACER	
NORTH ROW SPACER	
SOUTH ROW SPACER	

SUPPLEMENTAL BAYS - OPTIONAL

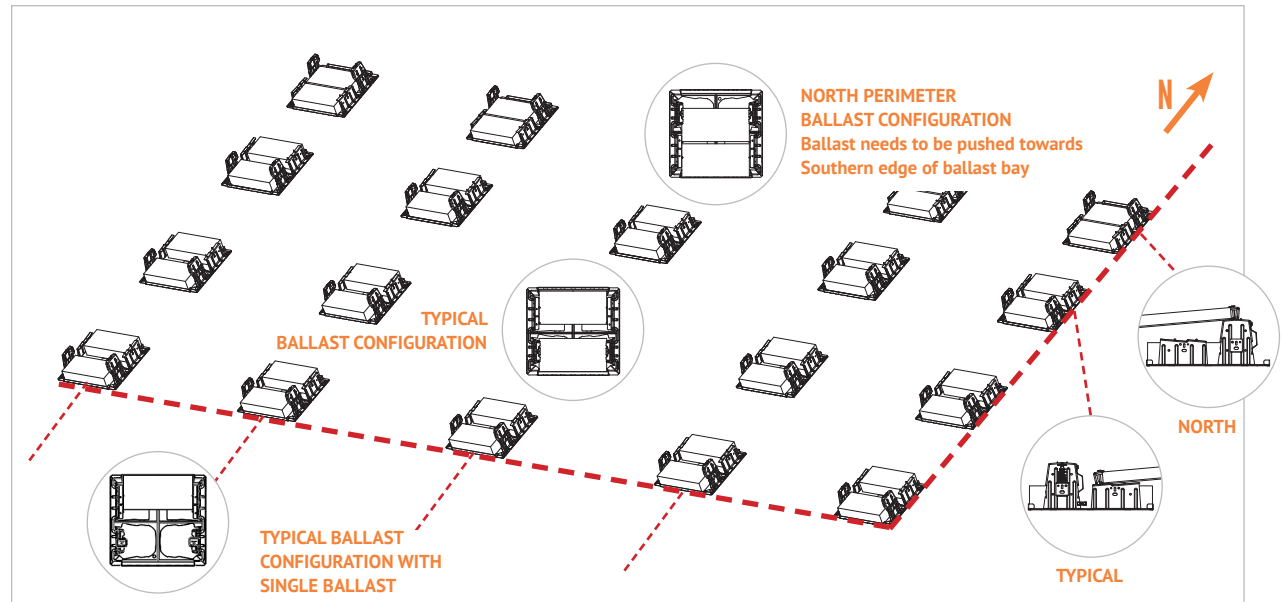
DUAL SUPPLEMENTAL BAYS	
SINGLE SUPPLEMENTAL BAY	

PLACE ALL BAYS.

NOTE: If mechanical attachment is required, place prior to installation of modules.

NOTE: If supplemental bay is required, install after the primary bays are installed. Supplemental bay needs to be centered in between primary bays.

PLACE ALL BALLAST: A maximum of two (2) ballast blocks can be placed in each ballast bay, typically pushed into the retention feature on the north or south edge. The North perimeter requires ballast blocks to be pushed towards the southern edge of the ballast bay to accommodate wind deflectors. 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.



SOUTHERN EDGE MODULE PLACEMENT: Each bay has two spacing options, select the appropriate tab according to layout requirements.

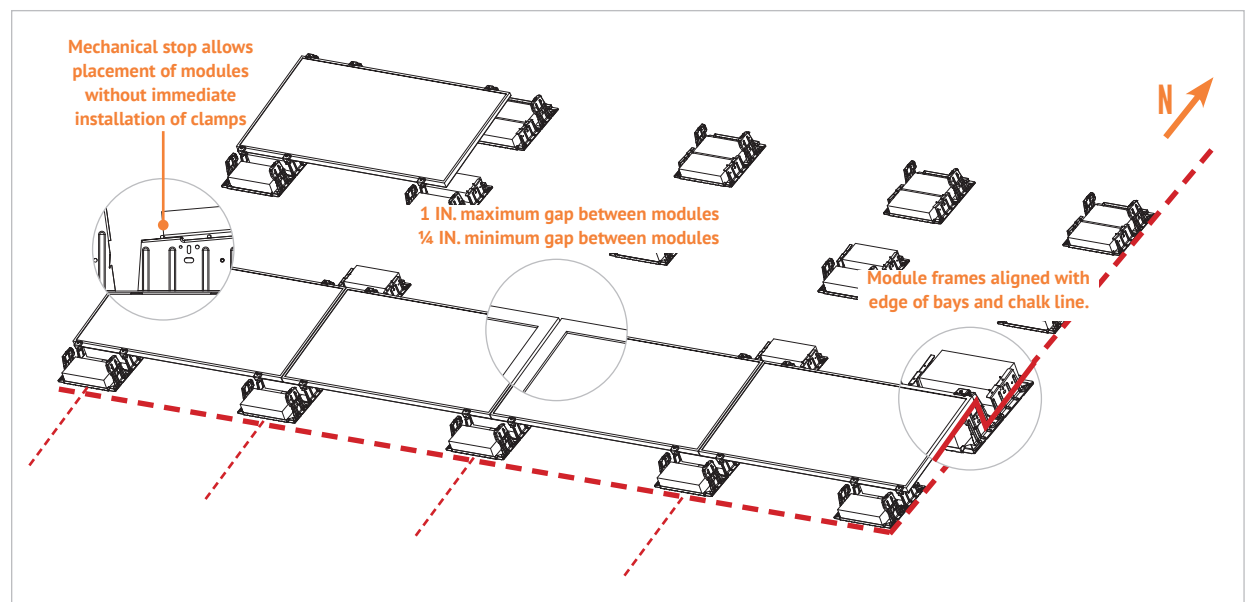
Place southern row of modules on bays. You may adjust second row of bays. Do not adjust southern most row of bays

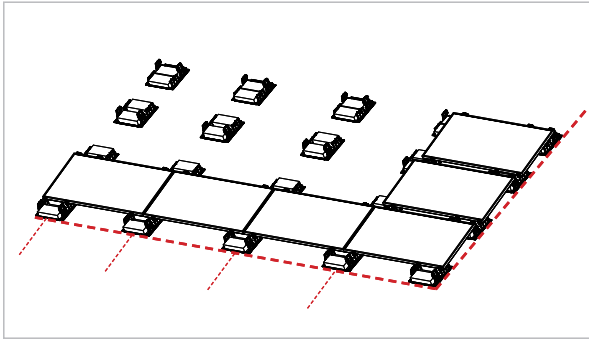
1 IN. Maximum gap between modules

¼ IN. Minimum gap between modules

NOTE: Modules may be placed on bays without immediate installation of clamps.

NOTE: Modules shall be mounted in landscape orientation only.



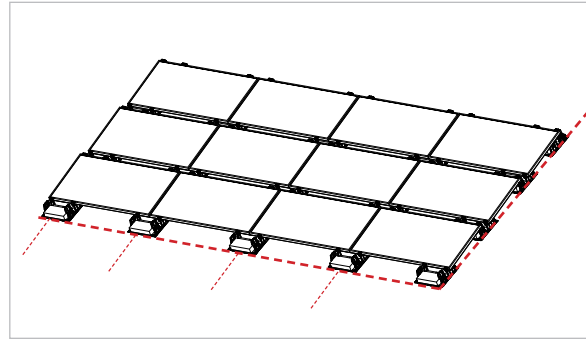


EAST OR WEST EDGE MODULE PLACEMENT

NOTE: Modules may be placed on bays without immediate installation of clamps.

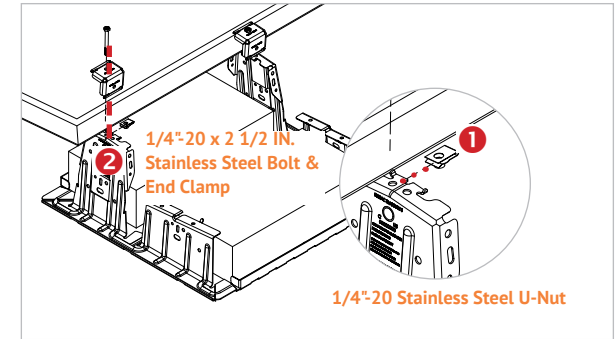
NOTE: Modules shall be mounted in landscape orientation only.

NOTE: Install wind deflector at the time of module installation. See page 7 for installation guide.



COMPLETE MODULE PLACEMENT

NOTE: Wiring, wire management, and electrical QC should be done as each row is built, especially in case of 7.5" row spacing to ensure adequate room for installation.

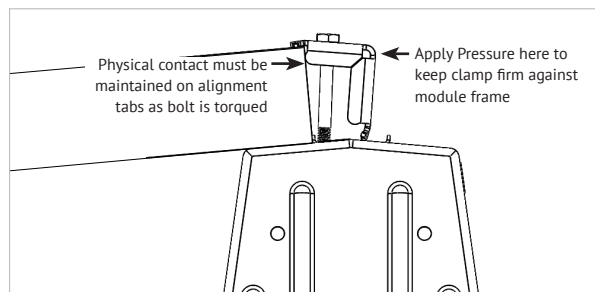


INSTALL U-NUT & INSTALL CLAMPS

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

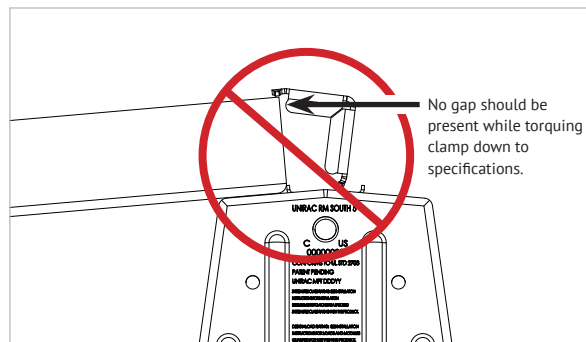
NOTE: CLAMP AND BOLT - Single Use Only - Do not re-torque once fully seated

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



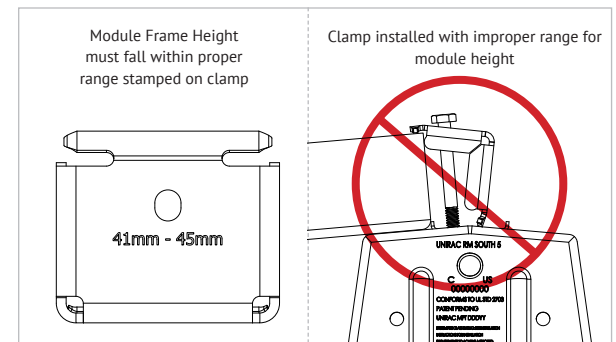
PROPER CLAMP INSTALLATION:

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



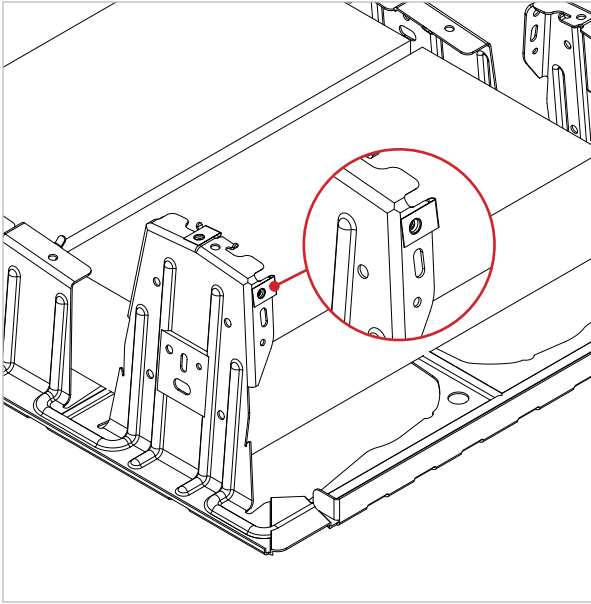
PROBLEM – CLAMP NOT SEATED AGAINST MODULE DURING TORQUING

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



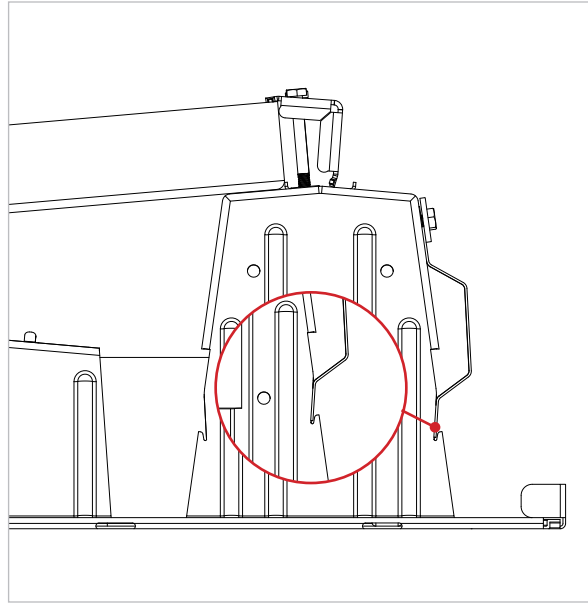
PROBLEM – NOT USING PROPER SIZE OF CLAMP FOR MODULE FRAME HEIGHT

- 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



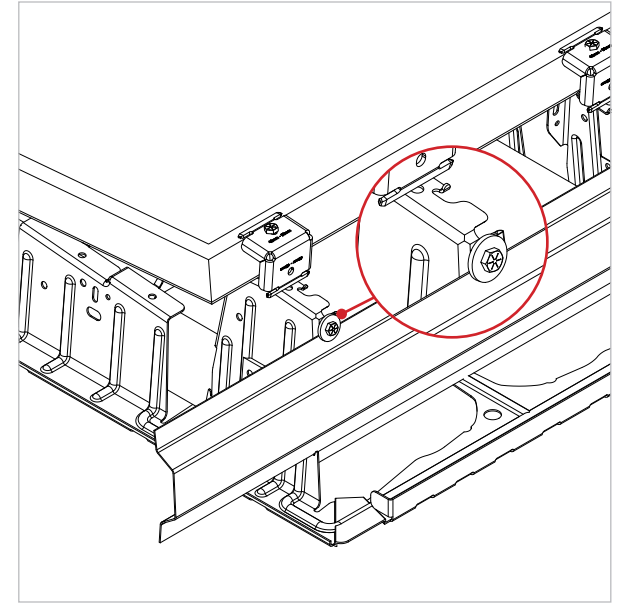
STEP 1 - U-NUTS:

Install u-nuts on side flange



STEP - 2 WIND DEFLECTOR:

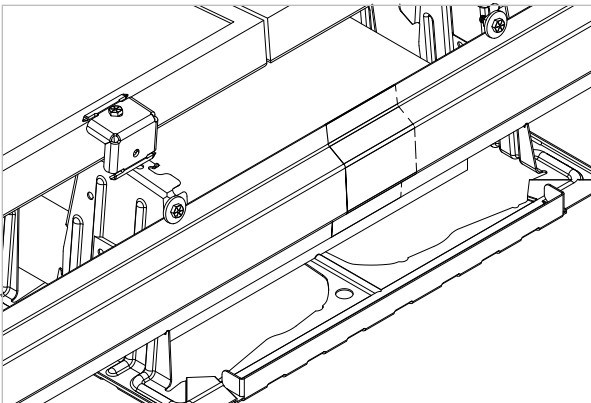
Position wind deflector in the slots provided in the bay



STEP 3 - HARDWARE: Secure wind deflector with 1 ½" O.D. flat washer and ¼-20 x 1" Bolt, as shown above

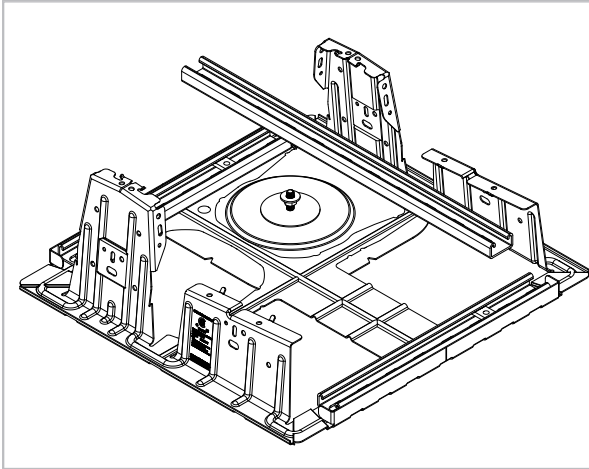
TORQUE VALUE: 10FT-LBS

NOTE: If the system requires wind deflectors do not leave arrays without installing wind deflectors. Wind deflectors are critical aerodynamics components in the case of any wind event.



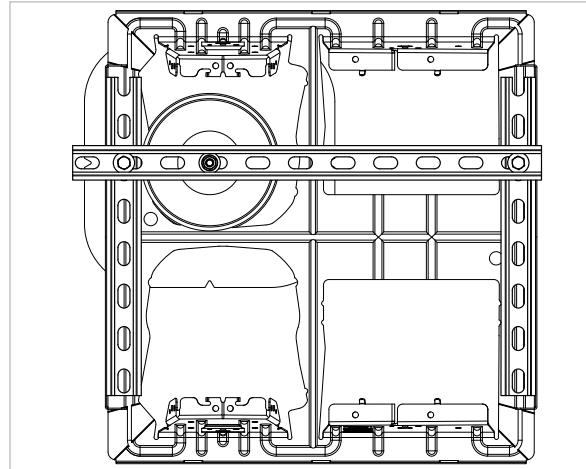
INSTALL BALLAST BAY WIND DEFLECTORS

NOTE: Wind deflectors overlap at splice



STEP 1 - PLACE NUT AND WASHER:

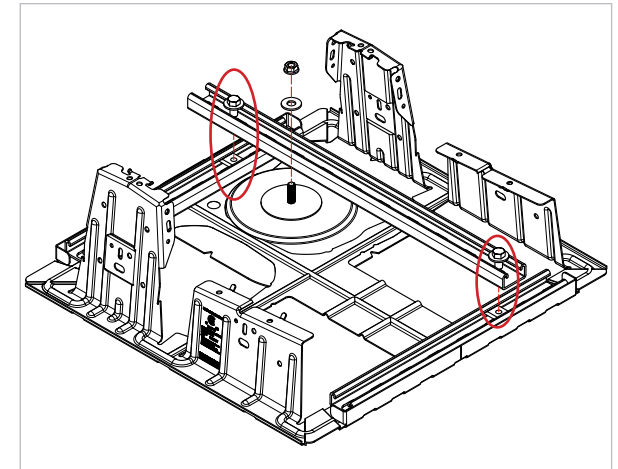
Include the nut and washer on the anchor stud prior to placing the stud through the strut.



STEP 2 - POSITION ROOF ATTACHMENT:

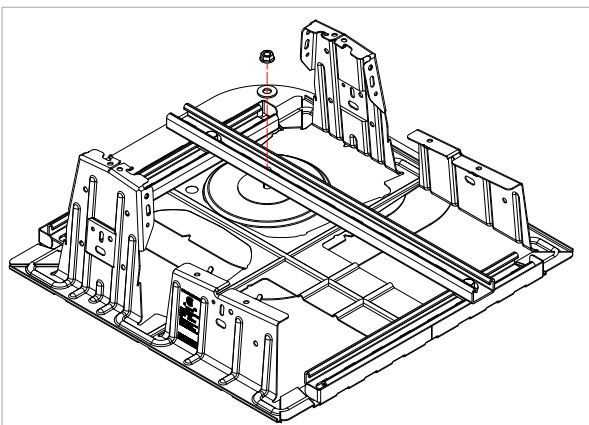
Position Roof Attachment under bay requiring attachment and install according to manufacturer installation instructions.

NOTE: Position attachment so that it is close to center of the bay as possible.



STEP 3 - PLACE UNISTRUT: Position strut sections on bay as pictured above. Align the cross-strut with the anchor's stud. Connect side strut sections to cross strut using a strutnut, bolt, and washer as pictured.

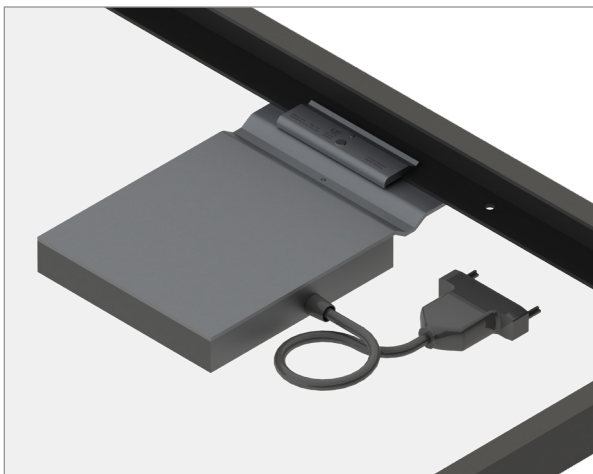
NOTE: Metal base of attachment where stud is located cannot exceed a height of 1/4".



STEP 4 - SECURE UNISTRUT TO ROOF

ATTACHMENT: 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



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



GROUNDING LUG MOUNTING DETAILS AS REQUIRED BY CODE & ENGINEER OF RECORD: 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.

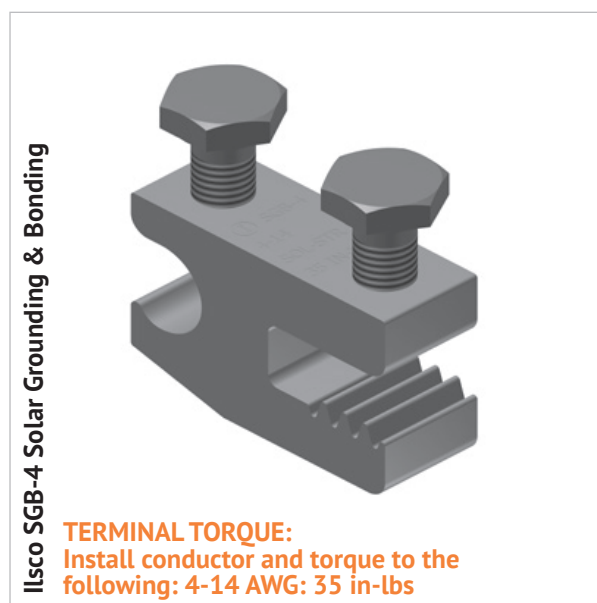
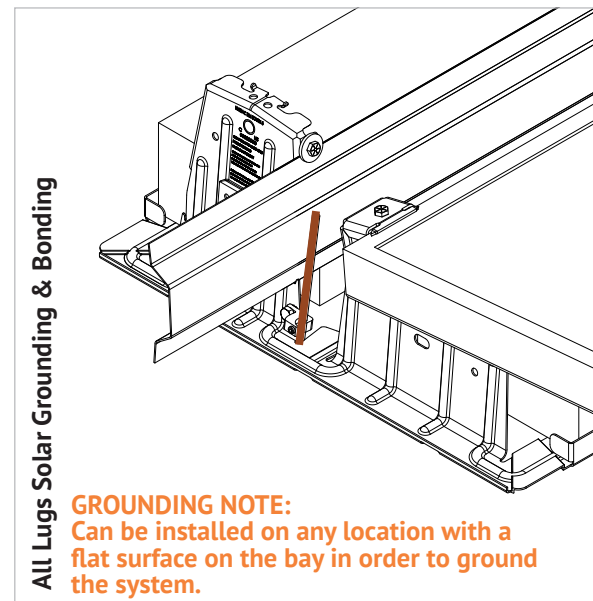
Unirac ROOFMOUNT is intended to be used with PV modules that have a system voltage less than or equal to that allowable by the National Electric Code (NEC). It is the installer's responsibility to check adherence to local codes.

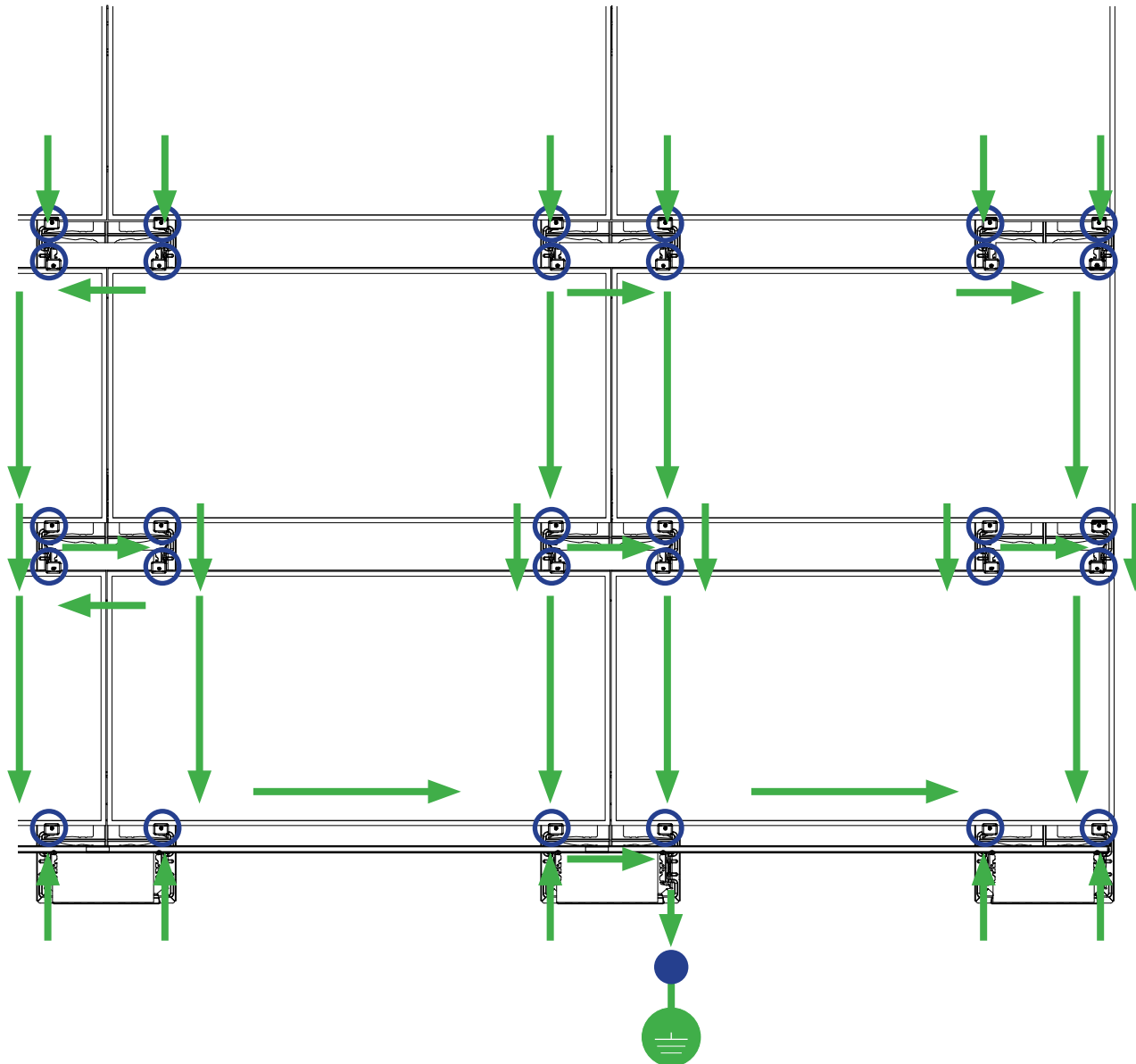
NOTE: The installation must be conducted in accordance with the National Electric Code ANSI / NFPA 70.

Ground Lug	Bolt Size	Torque Value
IlSCO Lug SGB-4	1/4"-20	6.5 ft-lbs (75 in-lbs)
IlSCO Lug GBL-4	#10-32	2.9 ft-lbs (35 in-lbs)
Wiley 6.7	1/4"-20	10 ft-lbs (120 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.

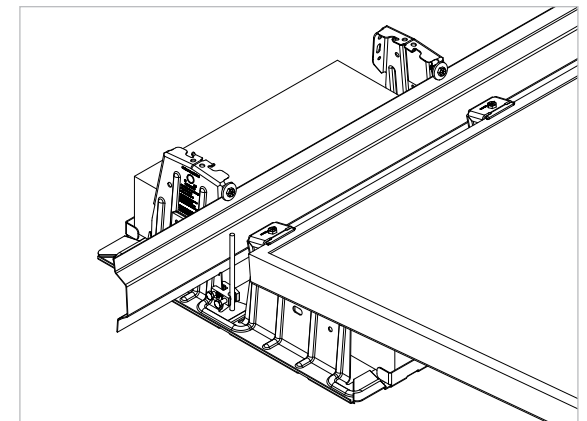
Although conformance with UL2703 was demonstrated without the use of oxide inhibitor material, it is recommended by IlSCO to provide an optimized bonding solution for their lay-in lug.





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

Module Frame
Module Bay w/ Grounding Clips

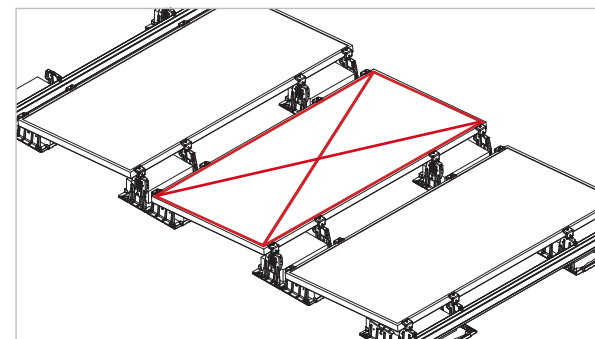


TEMPORARY GROUNDING & BONDING PROCEDURE: Periodic inspections should be conducted on the PV array to ensure there are not loose components, loose fasteners or corrosion. If any of the above items are found, the affected components are to be immediately replaced.

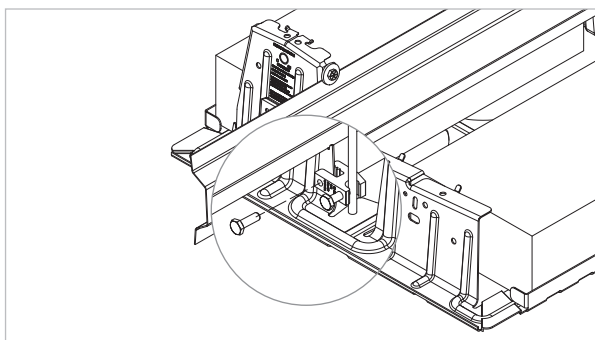
Note

- If a module must be removed or replaced, a temporary bonding jumper must be used to ensure safety of the personnel and PV system.
- 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.
- 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.

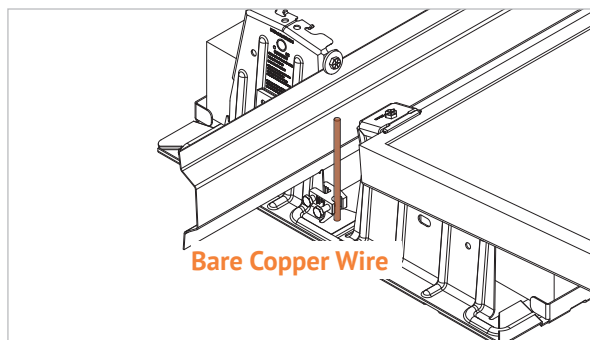
APPROVED LUGS and Terminal Torque see page 10



BONDING JUMPER REQUIRED: One example of a module removal that will require the use of a bonding jumper

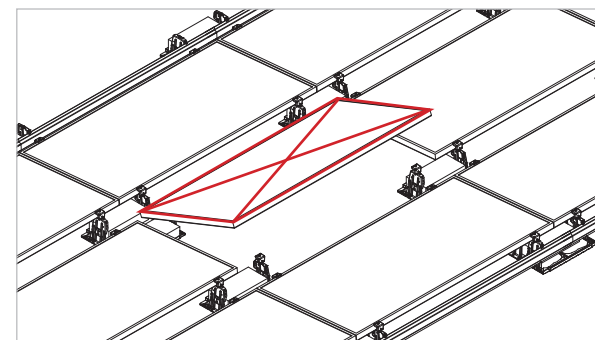


ATTACH LUGS: Use approved lug(s) to install on adjacent bays where the module is being removed.



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



BONDING JUMPER NOT REQUIRED, due to integrated bonding/grounding path throughout module frames/bays around this location.

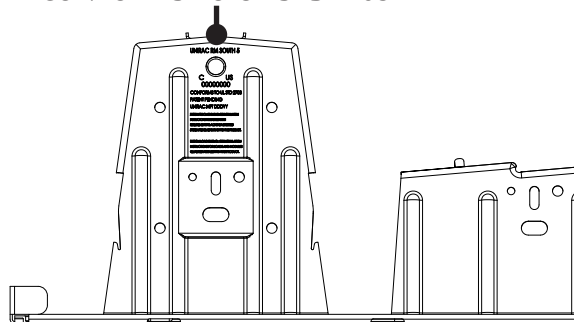
NOTE: CLAMP AND BOLT - Single Use Only - Use new clamps after any module replacements or system maintenance.

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 over a fire resistant roof covering rated for the application. RM ROOFMOUNT 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 type 1, 2, 29, and 30 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).

Refer to page right for proper installation of wind deflectors for required fire mitigation.

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

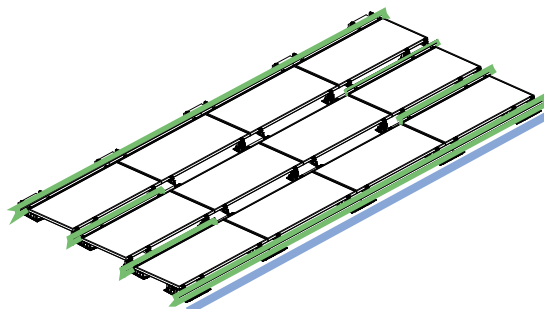
Unirac RM
CONFORMS TO UL STD2703



Module Type	System level Fire Rating	Mitigation
Type 1, 29, & 30	Class A	Prescriptive. See notes & Illustration Below
Type 2	Class A	Prescriptive. See notes & Illustration Below

TYPE 1 / TYPE 2 CLASS A FIRE RATING MOUNTING ORIENTATION

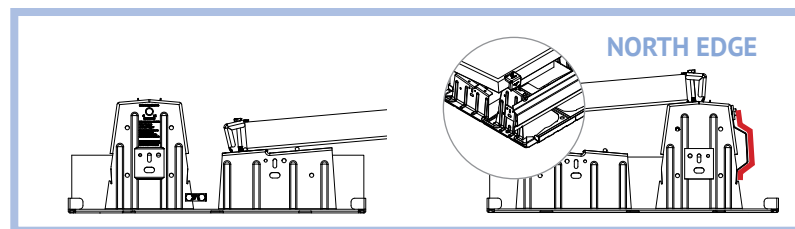
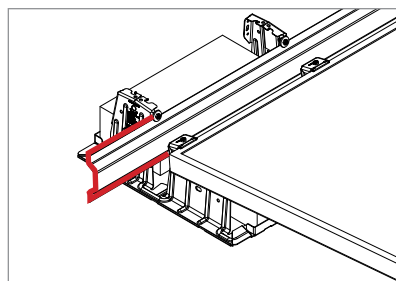
Unirac RM has achieved Class A system level fire performance for type 1, 2, 29, and 30 module constructions. In order to maintain the fire rating for type 1, 29, & 30 modules wind deflectors must be installed on the north edge of the array. Type 2 modules require wind deflectors to be installed on the north and south edges of the array and at all perimeter modules. **NOTE: See page 7 for installation of wind deflectors.**



Please use the U-builder tool to optimize the usage of wind deflectors for fire mitigation.

— Type 1, 29, & 30 Requires fire mitigation on North Edge when there are no additional wind deflectors throughout the array

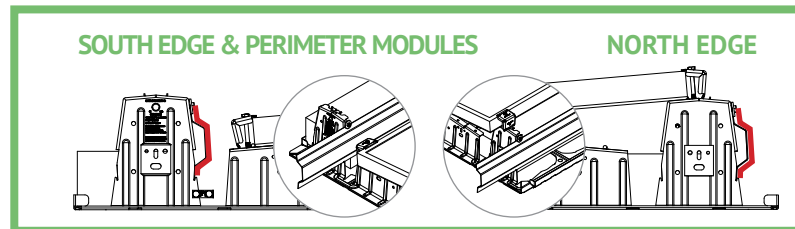
— Type 2 Requires fire mitigation on all perimeter modules within array.



TYPE 1, 29, & 30: Install wind deflectors on North edge of array.

TYPE 2 EAST/WEST EDGES ONLY: Install wind deflectors in each row with 6" overhang on east and west edges. This applies for any deflector installed on east and west edges throughout the array.

TORQUE VALUE: 10FT-LBS
All Wind Deflector Hardware
(1/4-20 x 1inch bolt, 1/4-20 u-nut & 1/4inch flat washer 1 1/2in O.D.)



TYPE 2: Install wind deflectors on all perimeter modules within array
NOTE: Wind deflector should be secured to supplemental bay by two hardware kits.



MECHANICAL LOAD TEST

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

- Test Loads = 1.5 x Design Loads
- PV modules may have a reduced load rating, independent of the RM5 load rating. Please consult the PV module manufacturer's installation guide for more information.

TESTED MODULES

Module Manufacturer	Model / Series	Area (sq ft)	Standard Installation Configuration - No Mid Bay		Installed with Additional Bay at Modules East/West Center	
			Up Design Load (psf)	Down Design Load (psf)	Up Design Load (psf)	Down Design Load (psf)
Jinko	JKMxxxM-72HL4-V	27.8	17.24	36.20	Not Tested	Not Tested
Canadian Solar	CS7N-xxxMB-AG	33.4	15.67	14.85	23.52	33.33

NOTE:

All installation configurations have achieved a minimum of 5psf design load in the downslope direction.

ELECTRICAL BONDING & GROUNDING TEST MODULES: This racking system may be used to ground and/or mount a PV module complying with UL1703 or UL61730 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions.

Manufacture	Module Model / Series	Manufacture	Module Model / Series	Manufacture	Module Model / Series
Aionrise	AION60G1, AION72G1	Canadian Solar	CS3Y-MB-AG, CS5A-M CS6K-(M/MS/P), CS6P-(M/P) CS6R-MS, CS6U-(M/P) CS6.1-54TM-H, CS6.1-60TM-H CS6.1-72TB-H, CS7N-xxxTB-AG CS7L-MB-AG, CS7L-TB-AG CS6V-M, CS6W-(MB-AG/MS) CS6X-P, CS7L-MB-AG, ELPS CS6(P/A)-MM CS6R-xxxMS-HL, CS7N-xxxMB-AG CS7L-xxxMB-AG	HT-SAAE	HT72-156(M/P), HT72-156P-C, HT72-156P(V)-C HT60-156M-C, HT60-156M(V)-C, HT72-166M HT72-18X
Aleo	P18 & P19 S18, S19, S59, & S79			Hyperion Solar	HY-DH108P8(B), HY-DH108N8B HY-DH144P8 HY-DH156N8 HY-DH156P8
Aptos Solar	DNA-120-MF10 DNA-120-(MF/BF)26 DNA-144-(MF/BF)26 DNA-108-(MF/BF)10-xxxW DNA-120-(MF/BF)10-xxxW			Hyundai	HiS-SxxxYH(BK) HiS-SxxxXG(BK) HiN-SxxxXG(BK)
Astronergy	CHSM6610(P/M)/HV CHSM6612(P/M)/HV CHSM72(P/M)-HC CHSM72M(DG)/F-BH	Centrosolar America	C-Series & E-Series	Hyundai Heavy Industries	MG, TG, RG, KG, MI, RI, KI, HI & TI Series HiA-SxxxHG, HiD-SxxxRG(BK), HiS-S400PI
AU Optronics	PM Series	CertainTeed	CTxxxMxx-(01/02/03/04) CTxxxPxx-01 CTM10400HC11-08, CTM10400HC11-09	Imperial Star	ISM7-SHDD108-400/M
Auxin	AXN6M610T, AXN6P610T AXN6M612T, AXN6P612T	Eco Solargy	Orion 1000 & Apollo 1000	Inxeption	mSolar 108BB HC Series (TXI10-xxx108BB) mSolar 144BB HC Series (TXS6-xxx144BB)
Axitec	AC-xxx(M/P)/(60/72)(S/V) AC-xxxP/156-60S AXIpremium X HC: AC-xxxMH/(120/144)(S/V) AXIblackpremium X HC: AC-xxxMH/(120/144)(SB/VB) AXIpremium XL HC: AC-xxxMH/120(S/V) AXIblackpremium XL HC: AC-xxxMH/120(SB/VB)	ET Solar	ETAC & ET Modules ET-M672BHxxxTW, ET-M772BH520-550WW/WB	ITEK	iT, iT-HE & iT-SE Series
		Flextronics	FXS	Japan Solar	JPS-60 & JPS-72 Series
		Freedom Forever	FF-MP-BBB-xxx, FF-MP1-BBB-xxx	JA Solar	JAM54S30 xxx/MR JAM54S31 xxx/MR JAP6-60, JAM6-60 JAP6-72, JAM6-72 JAM72D30MB, JAM78D10MB, JAM72S30 /MR JAP6(k)-60-xxx/4BB, JAP60S##-xxx/** JAM6(k)-60-xxx/**, JAM60S##-xxx/** JAP6(k)-72-xxx/4BB, JAP72S##-xxx/** JAM6(k)-72-xxx/**, JAM72S##-xxx/** i. #: 01, 02, 03, 09, 10 ii. **: SC, PR, BP, HiT, IB, MW, MR ** = Backsheet, ## Cell technology
Bluesun Solar	BSMxxxM10-72HBD	FreeVolt	PVGraf		
Boviet Solar	BVM6610 & BVM6612 BVM6612M-XXXS-H-HC-BF-DG BVM7612M-H-HC-BF-DG	GCL	GCL-P6 & GCL-M6 Series		
BYD	P6K Series, MHK	Hansol	TD-AN3, TD-AN4, UD-AN1 & UB-AN1		
Canadian Solar	CS1(K/H/U/Y)-MS, CS3(U/K)-MB-AG CS3K-(MB/MS/P/PB), CS3L-(P/MS) CS3N-MS, CS3U-(MB/MS/P/PB/PB-AG) CS3W-(MB-AG/MS/P/P-PB-AG)	Hanwha SolarOne	HSL 60 & HSL 72		
		Heliene	36M, 60M, 60P, 72M & 72P Series 144HC M6 144HC M10 SL Bifacial		

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Manufacture	Module Model / Series
Jinko	JKMxxx(P/PP)-60, JKMxxxPP-60(Plus)
	JKMxxxPP-60B, JKMxxxM-60
	JKMxxxM-60(B/L/HL/BL/LV)
	JKMxxxM-60-V, JKMxxxPP-60B-J4
	JKMSxxxM-60
	JK07(A/B)
	JKMSxxx(P/PP)-60, JKMSxxxPP-60B-J4
	JKMxxx(M/P/PP)-72, JKMxxx-72L-V
	JKMxxxM-72L-V, JKMxxxM-72HL(4)-V
	JKMxxxM-72HLM-TV
	JKMxxx(M/PP)-72, JKMxxxPP-72(Plus)
	JKMxxx(P/PP)-72B
	JKMSxxx-72, JKMSxxx(P/PP)-72
	JKMxxxM-7RL3-V, JKMxxxM-72HBL-V
	JKMxxxM-72HL4-TV
	JKMxxxM-6RL3-B
	JKMxxxN-72HL4-BDV
Kyocera	KD-F Series
	LA Solar
LA Solar	LSxxxHC, LSxxxBL
	LSxxxBF, BLA Model
	LGxxx(E1C/E1K/N1C/N1K/N2T/N2W/S1C/S2W/Q1C/Q1K)-A5
	LGxxx(A1C/M1C/M1K/N1C/N1K/Q1C/Q1K/QAC/QAK)-A6
	LGxxxN2T-B5
	LGxxxN1K-B6
	LGxxx(N1C/N1K/N2T/N2W)-E6
	LGxxxN2T-J5
	LGxxx(N1K/N1W/N2T/N2W)-L5
	LGxxx(M1C/N1C/Q1C/Q1K)-N5
	LGxxx(N1C/N1K/N2W/Q1C/Q1K)-V5
	LGxxxN3K-V6

Manufacture	Module Model / Series
LONGi	LR6-60, LR6-60(BK/PE/PB/PH/HPB/HIB/HPH/HHI)
	LR6-72, LR6-72(BK/HV/PE/PB/PH/HPH/HHI)
	LR4-60(HPB/HIB/HPH/HHI)
Maxeon	LR4-72(HPH/HHI)
	LR5-54-HPB-xxxM
	LR5-72HBD xxxM
Meyer Burger	SPR-MAX3-xxx-COM
	SPR-MAX3-XXX-R
	SPR-MAX3-XXX-BLK-R
Mission Solar Energy	MSExxxSX9R
	MSE MONO & MSE PERC
	MSExxx(SR8T/SR8K/SR9S/SX5T/SX5K/SX6W)
Mitrex	MSExxxHT0B
	Mxxx-L3H, Mxxx-I3H
Mitsubishi	MJE & MLE Series
	mSolar
	TXI10-xxx108BB
Neo Solar Power Co.	D6M Series
	NESE xxx-72MHB-M10
	NESE xxx-60MH-M6
NE Solar	NESE XXX 72MHT-M10
	NESE XXX 72THB-M10
	NESE XXX 72MHB-M10
Panasonic	VBHNxxxSA(15/16)
	VBHNxxxKA(01/02)
	VBHNxxxSA17(G/E) & SA18(E)
Peimar	VBHNxxxKA(03/04)
	EVVPVxxx
	EVVPVxxx(H/K/PK/HK/HK2)
Peimar	SGxxxM (FB/BF), SMxxxM

Manufacture	Module Model / Series
Philadelphia Solar	PS-M108(HCBF)-400W (30 & 35mm frames)
Phono Solar	PSxxxM4(H)-24/TH
Phono Solar Tech.	Standard Modules
Prism Solar	P72 Series P72X-xxx
Q Cells	Q.PRO L-G2, Q.PEAK (BLK) (G3/G3.1)
	Q.PLUS/PRO G3, Q.PLUS BFR G3.1, Q.PRO/PLUS G4
	Q.PLUS/PEAK/PRO - L G4.x
	B.LINE PLUS/PRO - L G4.x
	Q.PRO BFR G4x, Q.PEAK (BLK) G4.1 (TAA/MAX)
	Q.PLUS BFR G4.1(TAA/MAX)
	B.LINE (PLUS/PRO) BFR G4.1
	Q.PLUS L-G4.2/TAA
	Q.PRO EC-G4.4
	Q.PEAK DUO (BLK) G5
	Q.PEAK DUO L-(G5/G5.1/G5.2/G5.3)
	B.LINE PEAK DUO L-(G5/G5.1/G5.2/G5.3)
	Q.PEAK DUO (BLK)-G6+
	Q.PEAK DUO BLK-G6+/TS
	Q.PEAK DUO L-(G6/6.2/6.3)
	Q.PEAK DUO (G7/G7.2)
	Q.PEAK DUO (BLK)-G7
	Q.PEAK DUO L-(G7/G7.1/G7.2/G7.3/G7.7)
	B.LINE PEAK DUO (G7/G7.2)
	B.LINE PEAK DUO L-(G7/G7.1/G7.2/G7.3)
	Q.PEAK DUO (BLK) G8(+)
	Q.PEAK DUO L-(G8/G8.1/G8.2/G8.3/G8.3 BFG)
	Q.TRON M-G2+ SERIES
	Q.TRON BLK M-G2+ SERIES
	Q.PEAK DUO XL-G11S.3 / BFG
	Q.PEAK DUO (BLK) ML G9(+)
	Q.PEAK DUO XL (G9/G9.2/G9.3)
	Q.PEAK DUO XL-G9.3/BFG
	Q.PEAK DUO BLK-G10(+)

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Manufacture	Module Model / Series	Manufacture	Module Model / Series	Manufacture	Module Model / Series	
Q Cells (cont.)	Q.PEAK DUO G10+	S-Energy	SN72, SN60 Series	Suniva	Optimus Series, MV Series	
	Q.PEAK DUO (BLK) ML-G10.(a)(+)		SL45-60BG1/BHI	Sunmac Solar	M754SH-BB Series	
	Q.PEAK DUO BLK G10+ /AC	Seraphim	SL45-60MBI-xxxZ	SunPower	X-Series 72 & E-Series 72	
	Q.PEAK DUO BLK ML-G10+ / TS		SEG-(6PA/6PB/6MA/6MA-HV/6MB/E01/E11)		X-Series 96 & E-Series 96	
	Q.PEAK DUO BLK ML-G10+ / t		SRP-(6QA/6QB)		P-Series, Sig Black	
	Q.PEAK DUO XL-(G10/G10.2/G10.3/G10.c/G10.d)		SRP-xxx-6MB-HV, SRP-320-375-BMB-HV, SRP-xxx-BMC-HV, SRP-390-415-BMA-HV, SRP-390-405-BMD-HV		SPR E20 435 COM (G4 Frame)	
	Q.PEAK DUO XL-G10.3/BFG	Sharp	ND-24CQCJ, ND-25CQCS	SunTech	Axxx-BLK-G-AC, SPR-Mxxx-H-AC	
	Q.PEAK DUO XL-G10.d/BFG		ND-Q235F4, ND-F4Q300		SPR-Mxxx-BLK-H-AC	
Q.PEAK DUO XL-G11.3)		NU-SA, NU-SC				
REC	Q.PEAK DUO XL-G11.3/BFG	Silfab	SLA-M/P, SLG-M/P	Talesun	TP572, TP596, TP654, TP660	
	Q.TRON XL-G2.3/BFG		SILxxx(BG/BK/BL/HC/HC+/HL/HM/HN/ML/NL/NT/NX/NU/QD/QM)		TP672, Hipor M, Smart	
	PEAK & ECO	Solar4America	S4Axxx-108MH10BB, S4Axxx-72MH5BB	Tesla	TD6172M, TP7G54M(H),	
			S4Axxx-144MH10xxx, S4Axxx-144TH10xxx		TD7G72M	
			S4Axxx-144TH16xxx, S4Axxx-108MH10xxx			
			S4Axxx-108TH10xxx			
		SolarEver USA	SE-166*83-xxxM-120N	Thornova	TS-BG54	
			SE-182*91-xxxM-108N			
Solaria			PowerXTxxxR-PD/BD/AC		Trina Solar	PA05, PD05, DD05, DD06
			PowerXTxxxC			DE06, DE09.05, DE09C.07
SolarTech	PowerXT-xxxR-PM (AC)	Universal Solar	PD14, PE14, DD14, DE14, DE15, DE15V(II)			
	PowerX-400R		DEG15HC.20(II), DEG15MC.20(II), DEG15VC.20(II)			
SolarWorld	STU HJT & STU PERC	URE	DE18M(II), DEG18MC.20(II)			
	Sunmodule Protect/Plus		DE19, DEG19C.20, TSM-NE09RC.05			
Sonali	SS-M-360 to 390 Series	Sun Edison/Flex-tronics	TSM-NEG19RC.20, TSM-DEG21C.20			
	SS-M-390 to 400 Series		UNI4xx-144BMH-DG			
	SS-M-440 to 460 Series		UNI5xx-144BMH-DG			
	SS-M-430 to 460 BiFacial Series		UNIxxx-108M-BB			
			UNIxxx-120M-BB			
			UNIxxx-120MH			
			UP-Mxxx			
			D7K_H8A, D7M_(H7A/H8A)			
			FAKxxx(C8G/E8G), FAMxxxE7G-BB			
			FAMxxxE8G(-BB), FBKxxxM8G			

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Manufacture	Module Model / Series
URECO	F6MxxxE7G-BB FBMxxxMFG-BB
Vikram Solar	Eldorado, Solivo & Somera PREXOS VSMDHT.60.AAA.05 PREXOS VSMDHT.72.AAA.05 Paradea VSMDH.72.AAA.05 Paradea VSMDH.66.AAA.05
VSUN	VSUNxxx-60M-BB, VSUNxxx-72MH VSUN400-415-144BMH VSUN4xx-144BMH-DG VSUN5xx-144BMH-DG VSUNxxx-108M-BB VSUNxxx-120M-BB VSUNxxx-120BMH VSUNxxx-132BMH VSUNxxx-108BMH VSUNxxxN-144BMH VSUNxxxN-144MH VSUNxxx-144BMH VSUNxxx-144MH VSUNxxx-144M-BW VSUNxxx-144M-BB
Waaree	Arka Series WSMDi
Winaico	WST & WSP Series
Yingli	YGE 60 Cell YGE 60 Cell Series 2 YLM 60 YLM 72 YLM-VG
Yotta Energy	YSM-B450-1

Manufacture	Module Model / Series
ZNShine Solar	ZXM7-SHLDD144 ZXM7-SHDB144 ZXM6-72 Series, ZXM6-NH144 ZXM6-NHLDD144-XXX/M ZXM7-SH108 Series ZXM7-UHLDD144

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INSTALLATION GUIDE



UL 3741 PV Hazard Control Installation Addendum

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INSTALLATION GUIDE

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INTRODUCTION

This manual describes the proper procedure to install the RM5 product to meet the requirements of the UL3741 PV Hazard Control Standard. This manual also applies to RM5 systems that include supplementary bays. All installers must thoroughly read this manual and have a clear understanding of the installation procedures prior to installation. Failure to follow the methods and procedures outlined in this guide may result in injury and/or damage to property.



**IDENTIFIES CONDITIONS OR PROCEDURES,
WHICH IF NOT FOLLOWED, COULD RESULT IN
SERIOUS INJURY, DEATH OR PROPERTY DAMAGE.**



**IDENTIFIES CONDITIONS OR PROCEDURES,
WHICH IF NOT FOLLOWED, COULD RESULT IN
SERIOUS DAMAGE OR FAILURE OF EQUIPMENT.**

IT IS THE INSTALLER'S RESPONSIBILITY TO:

- Ensure safe installation of all electrical aspects of the array. All electrical installation and procedures should be conducted by a licensed and bonded electrician or solar contractor. Routine maintenance of a module or panel shall not involve breaking or disturbing the bonding path of the system. All work must comply with national, state and local installation procedures, product, and safety standards.
- Comply with all applicable local or national building and fire codes, including any that may supersede this manual.
- Ensure that RM5 and other products are appropriate for the specific installation and are designed for the installation environment.
- PV system must be installed on a non conductive roof.
- Use only Unirac parts or parts recommended by Unirac; substituting parts may void any applicable warranty.
- Ensure provided information is accurate. Issues resulting from inaccurate information are the installer's responsibility.
- Ensure bare copper grounding wire does not contact aluminum and zinc-plated steel components, to prevent risk of galvanic corrosion.
- If loose components or loose fasteners are found during periodic inspection, re-tighten immediately. Any components showing signs of corrosion or damage that compromise safety shall be replaced immediately.
- Ensure the system is grounded and bonded to meet the requirements of the National Electric Code.
- Disconnect AC power before servicing or removing modules, AC modules, microinverters and power optimizers.
- Review module manufacturer's documentation for compatibility and compliance with warranty terms and conditions.
- Installers shall refer to the RM5 installation manual for complete installation instructions



To reduce the risk of injury, read all instructions.



RATINGS

UL3741 LISTED



CONFORMS TO STD ANSI/UL 3741

- Max PVHCS System Voltage: 1000V

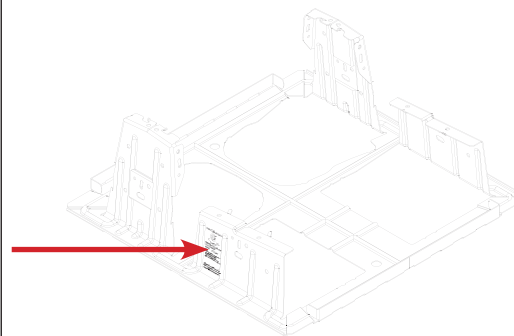
RM5 List of approved PV Hazard Control Equipment or Components evaluated at 1000V Max System Voltage:

(Not all listed items must be implemented in a single system to achieve compliance to UL3741. Rather these are the items approved for use to meet the criteria outlined in this manual)

- All Modules listed in RM5 Installation Guide with max module area of 33.44 ft²
- RM5 Components
 - RM5 Bay (PN: 310800, 310803 (PVC))
 - Wind Deflector, (PN: 310810 (84"), 310811 (98"))
 - Endclamp (PN: 310820 (30-40mm), 310821 (41-45mm), 310822 (46-50mm))
 - 1/4-20 Clip U-Nut (PN: 310860)
 - Wind Deflector Hardware (PN: 310861)
- Wire Clips
 - Hellermann Tyton Cable Ties & Edge Clips (Mnfr PNs CTT60R0HSC2, 156-02224 & 156-02226)
- PV Connectors (UL 6703 Listed) shall be compatible and approved for the application.
- PV Wire (UL 4703 Listed)
- RayTray v2 Solar Wire Management System (UL 870 Listed)
- Listed Conduit (all sizes apply)
 - Electrical Metallic Tubing (EMT) (Sizes 3/4" and greater) (UL 797 Listed)
 - Rigid Metal Conduit (RMC) (Sizes 3/4" and greater) (UL 6 Listed)
 - Intermediate Metal Conduit (IMC) (Sizes 3/4" and greater) (UL 1242 listed)
 - Flexible Nonmetallic Conduit (Sizes 3/4" and greater) (UL1660 Listed)
 - PVC - Schedule 40 or 80 (Sizes 3/4" and greater) (UL 651)
 - Aluminum Channel Strut (P1000T or P1000HS EA) (UL 5B Listed)
 - Listed Tubing, Fittings and Grounding Components

MARKINGS

Product marking are located on the Ballast Bay as shown



APPROVED ELECTRICAL EQUIPMENT (UL 1741 LISTED)

Canadian Solar Inverters

- CSI-25K-T480GL01-UB
- CSI-30K-T480GL01-UB
- CSI-36K-T480GL01-UB
- CSI-40K-T480GL01-UB
- CSI-50K-T480GL01-UB
- CSI-60K-T480GL01-UB
- CSI-66K-T480GL01-UB
- CSI-30KTL-GS-FLB
- CSI-40KTL-GS-FLB
- CSI-60KTL-GS-B
- CSI-75K-T480GL03-U
- CSI-80K-T480GL03-U
- CSI-90K-T480GL03-U
- CSI-100K-T480GL03-U

Chint Inverters

- CPS SCA25KTL-DO/US-208
- CPS SCA25KTL-DO-R/US-480
- CPS SCA36KTL-DO/US-480
- CPS SCA50KTL-DO/US-480
- CPS SCA60KTL-DO/US-480

Fronius Inverters

- Fronius Symo Advanced 10.0-3 208-240 (may be followed by Lite)
- Fronius Symo Advanced 12.0-3 208-240 (may be followed by Lite)
- Fronius Symo Advanced 15.0-3 480 (may be followed by Lite)
- Fronius Symo Advanced 20.0-3 480 (may be followed by Lite)
- Fronius Symo Advanced 22.7-3 480 (may be followed by Lite)
- Fronius Symo Advanced 24.0-3 480 (may be followed by Lite)

SMA Inverters

- STP 33-US-41
- STP 50-US-41
- STP 62-US-41
- STP 20-US-50
- STP 25-US-50
- STP 30-US-50

Solectria Inverters

- SolectriaRenewablesPVI25TL-208
- SolectriaRenewablesPVI25TL-480-R
- SolectriaRenewablesPVI50TL-480
- SolectriaRenewablesPVI60TL-480

Sungrow Inverters

- SG36CX-US
- SG60CX-US

Solis Inverters

- Solis-25K-US (followed by -US-SW, -US-F-SW or -US-LSW)
- Solis-30K-US (followed by -US-SW, -US-F-SW or -US-LSW)
- Solis-36K-US (followed by -US-SW, -US-F-SW or -US-LSW)
- Solis-40K-US (followed by -US-SW, -US-F-SW or -US-LSW)
- Solis-50K-US (followed by -US-SW, -US-F-SW, -US-F-LSW or -US-LSW)
- Solis-60K-US (followed by -US-F-SW, or -US-F-LSW)
- Solis-66K-US (followed by -US-F-SW, or -US-F-LSW)

GoodWe Inverters

- GW50K-SMT-US
- GW60K-SMT-US
- GW6000A-MS
- GW7600A-MS
- GW8600A-MS
- GW9600A-MS



INTRODUCTION: UNDERSTANDING UL 3741 AND NEC 690.12

2020 NEC 690.12(B)(2) Controlling Conductors within the array boundary

The RM5 Photovoltaic Hazard Control System (PVHCS) is a UL 3741 Listed system that complies with NEC 690.12(B)(2)(1), when installed by qualified persons per the installation procedures outlined in the RM5 System Installation Manual and this Addendum. Ensure that all PVRSE, including inverters, are contained within the array boundary per NEC 690.12. Please refer to the following pages of this addendum for various example cases of system designs that comply with 690.12(B)(2).

2020 NEC 690.12 Background

2020 NEC 690.12 Rapid Shutdown of PV Systems on Buildings requires that all PV arrays installed on or in buildings shall include rapid shutdown functions to reduce shock hazard for Fire Fighters (FF) in accordance with 690.12(A) through (D):

A. Controlled Conductors

- (1) PV system DC circuits
- (2) Inverter output circuits originating from inverters located within array boundary

B. Controlled Limits

- (1) Outside Array Boundary: $\leq 30V$ within 30 seconds
- (2) Inside Array Boundary:
 - (1) Listed PV Hazard Control System (UL 3741)
 - (2) $\leq 80V$ within 30 seconds after rapid shutdown initiation
 - (3) PV array without exposed wiring methods or conductive parts

C. Initiation devices

- Initiation device(s) shall initiate the rapid shutdown function of the PV system

D. Equipment

- Equipment that performs rapid shutdown functions other than initiation devices, such as listed disconnect switches, circuit breakers, or control switches.

E. NEC defines the array as a mechanically and electrically integrated grouping of modules with support structure, including any attached system components such as inverter(s) or dc-to-dc converter(s) and attached associated wiring. This indicates the RM5 Racking and collocated inverters are part of the array.

F. NEC 690.12(B) defines the array boundary as 1ft from array in all directions. This indicates that the array boundary can extend 1ft from the edge of the RM5 racking, inverter or module.



INSTALLATION METHODS PER UL 3741 AND NEC 690.12

The following case studies are provided and recommended by Unirac to show examples of installation configurations that comply with NEC 690.12(B). Compliance is not limited to these examples.

Case 1: UL 3741 Listed System – **See page 6**

Case 2: UL 3741 Listed System with Contiguous Sub-Array – **See page 7**

Case 3: UL 3741 Listed System with Non-Contiguous Sub-Array – **See page 8**

Case 4: UL 3741 Listed System with MLPE Sub-Array – **See page 9**

The simplest installation method to comply with NEC690.12(B) is to utilize the RM5 UL 3741 system with a contiguous array with one or more collocated inverters, as all inverter DC input circuits are within the 1ft array boundary (Case 1). Installations where sub-arrays are required and cannot be included within the 1ft array boundary can comply by using a single or combining one or more of the three options below (Cases 2-4).

UL 3741 LISTED SYSTEM, CASE 1

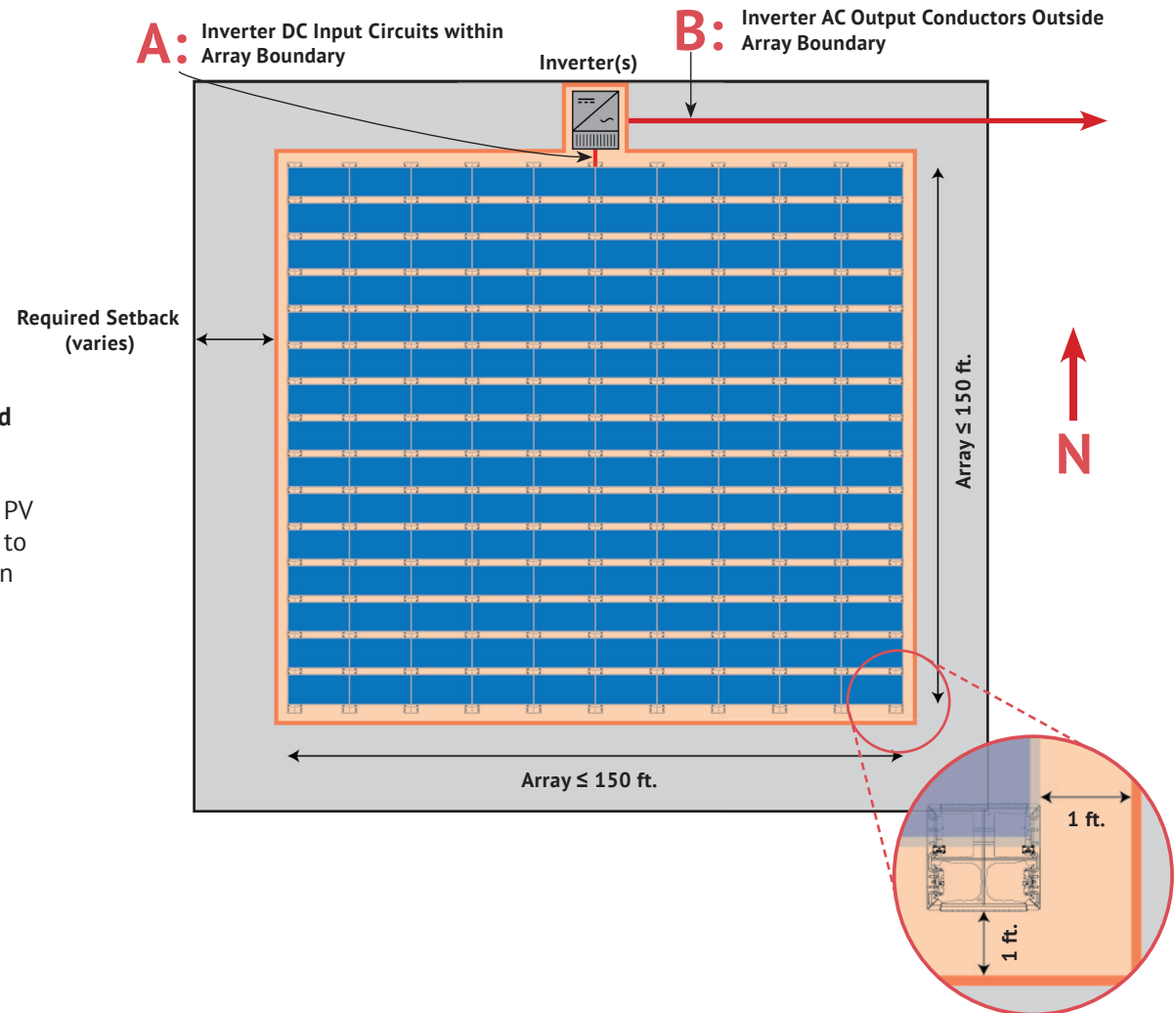
Array(s) comply with NEC 690.12(B)(2)(1)

PV Circuit Voltages

- **Outside Array Boundary:** $\leq 30V$ within 30 seconds
- **Inside Array Boundary:** $\leq 1000V$

Case 1: Array(s) complies with 690.12(B) by utilizing a listed UL 3741 PV Hazard Control System

- All inverter input circuits (DC) are contained within the PV array boundary and do not require additional measures to reduce string voltages per 690.12(B)(2)(1) after initiation (Inverter DC disconnect, AC breaker or AC disconnect).
- Inverter output circuits (AC) are outside of the array boundary and meet the 690.12(B)(1) requirement after initiation (AC breaker or AC disconnect).



UL 3741 LISTED SYSTEM, CASE 2

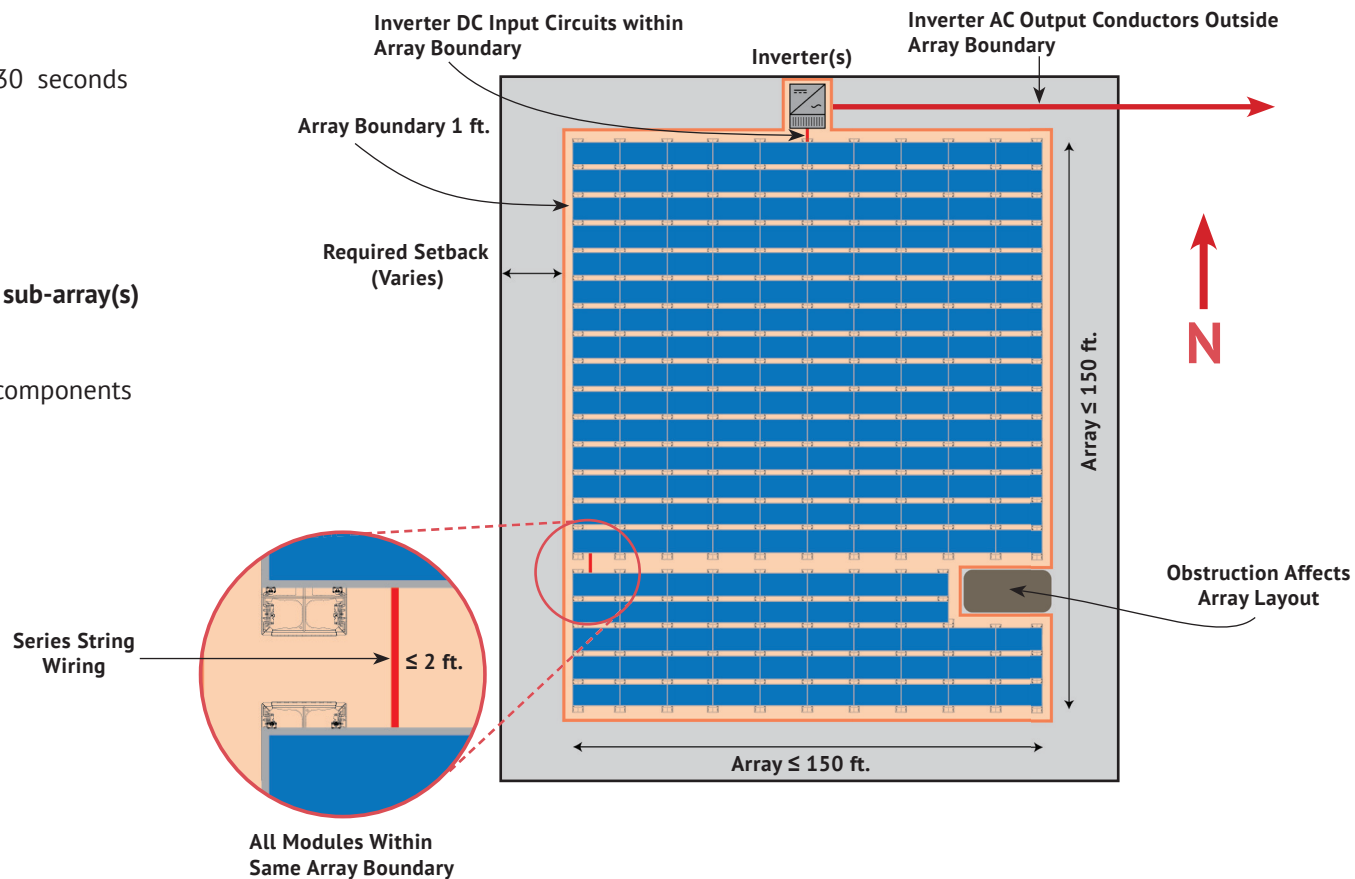
Sub-Array(s) are within the same Array Boundary and Array(s) comply with NEC 690.12(B)(2)(1)

PV Circuit Voltages

- Outside Array Boundary: $\leq 30V$ within 30 seconds
- Inside Array Boundary: $\leq 1000V$

Case 2: Maintaining NEC Compliance with sub-array(s) within array boundary

Maximum 2 ft. spacing between all array components resulting in a single array boundary.



UL 3741 LISTED SYSTEM, CASE 3

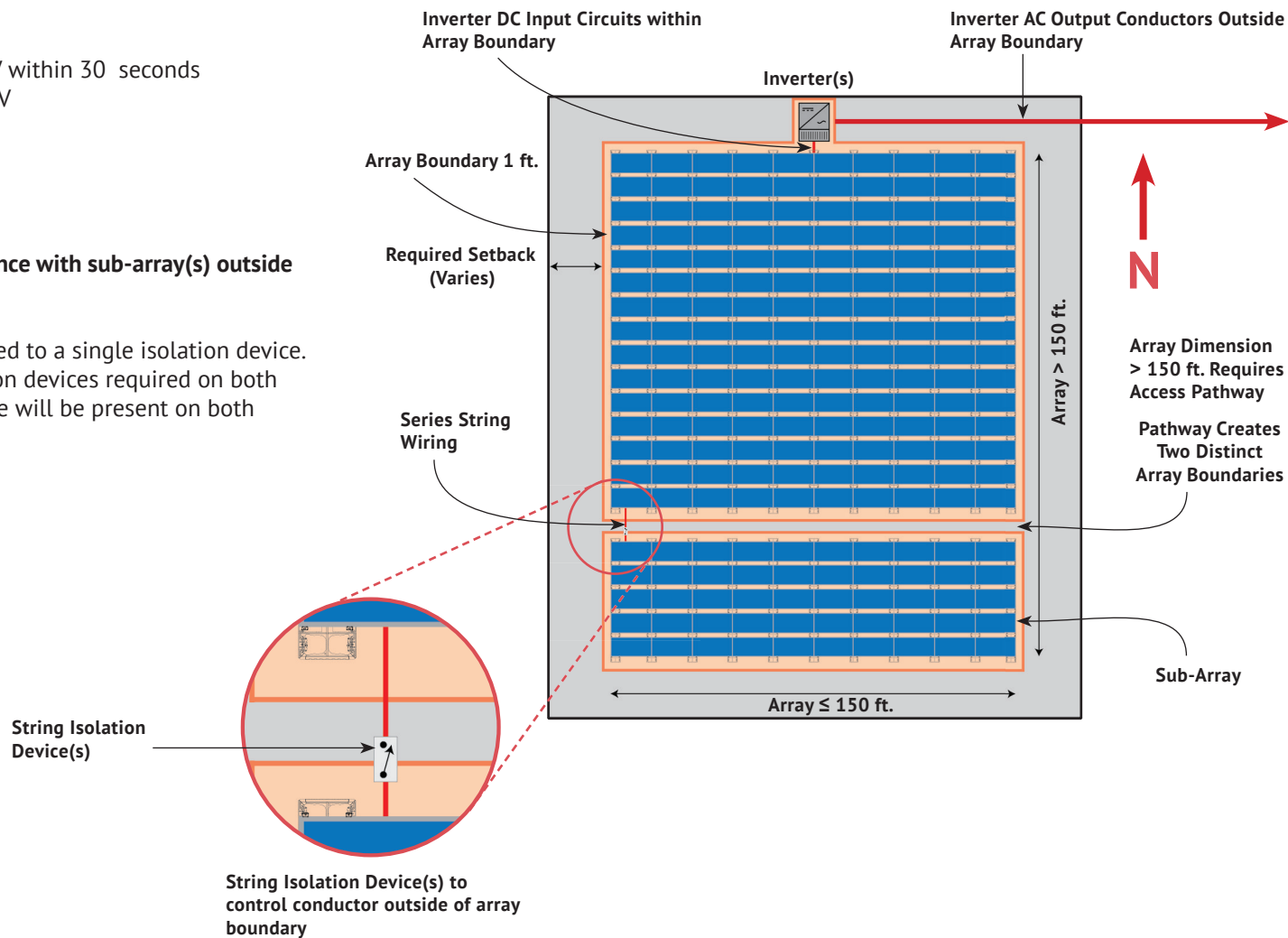
Multiple Sub-Arrays with conductors outside of Array Boundary are controlled via String Isolation Device(s)

PV Circuit Voltages

- Outside Array Boundary: $\leq 30V$ within 30 seconds
- Inside Array Boundary: $\leq 1000V$

Case 3: Maintaining NEC Compliance with sub-array(s) outside of array boundary

Complete string must be connected to a single isolation device. If used for a partial string, isolation devices required on both sides of the pathway since voltage will be present on both sides.



UL 3741 LISTED SYSTEM, CASE 4

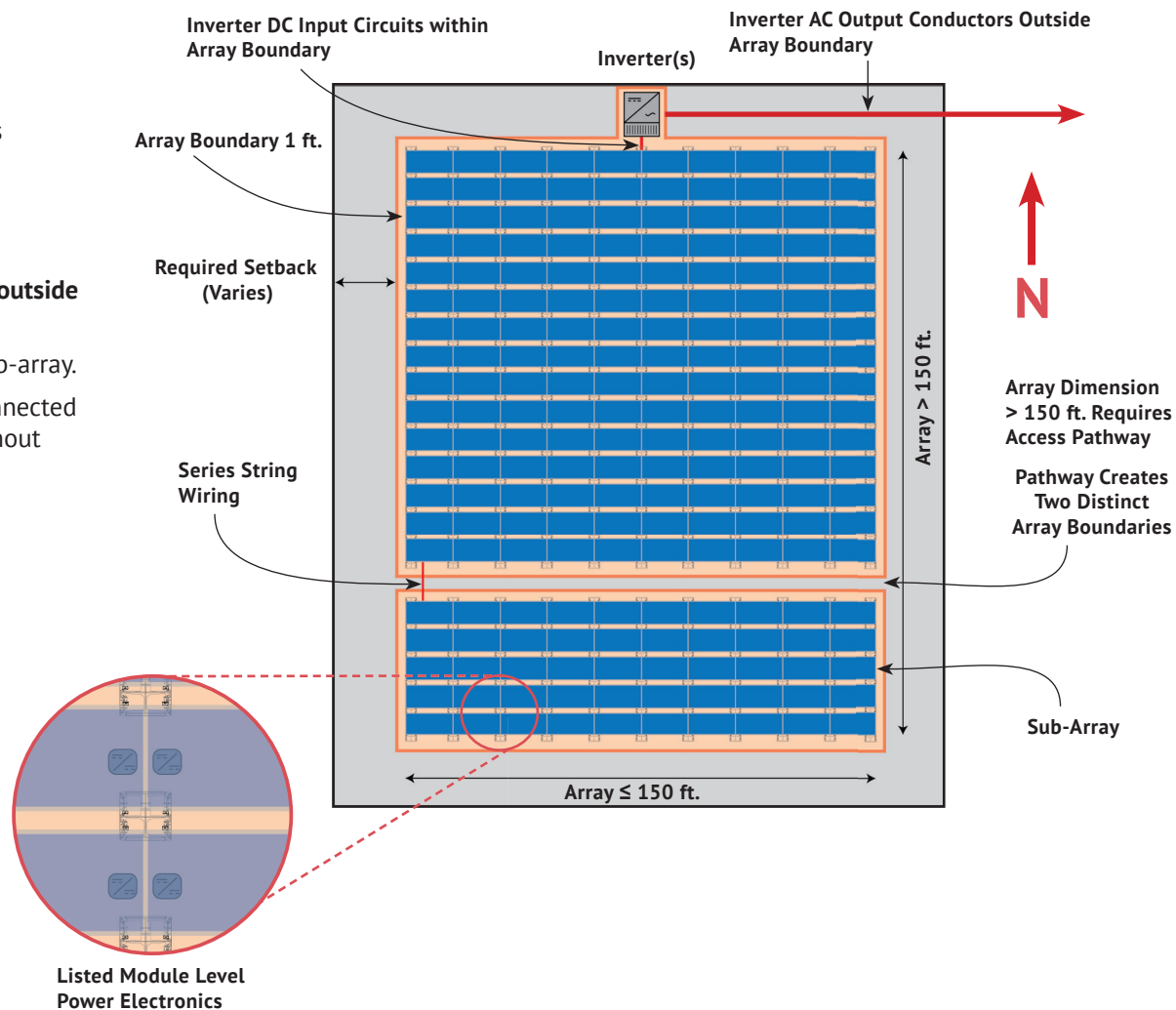
Sub-array(s) using MLPEs to control circuits for 690.12(B)(1) and (B)(2) compliance

PV Circuit Voltages

- Outside Array Boundary: $\leq 30V$ within 30 seconds
- Inside Array Boundary: $\leq 1000V$
- Sub Array Boundary: $\leq 80V$ inside within 30 Seconds

Case 4: Maintaining NEC Compliance with sub-array(s) outside of array boundary

- Utilize Module-Level Power Electronics on lower sub-array.
- All modules on the same inverter input must be connected to an MLPE. Upper array utilizes UL3741 listing without MLPEs for compliance.



NOTE:
When using MLPE devices, review installation instructions for both the MLPE device and Inverter to verify that both devices comply with UL1741 Rapid Shutdown requirements.

UL 3741 WIRE MANAGEMENT GUIDELINES

The RM5 wire management components noted in the list of approved PVHCS equipment on page 2 were evaluated and approved for providing wire protection against potential FF interactions. To achieve wire protection as required per UL 3741, all wires shall be routed such that they are not exposed to potential FF interactions. It is achieved using:

WIRE CLIPS

- Route wires under modules using approved wire clips. *See figures 1&2.*
- Do not allow wires to sag between clips.
- Do not overtighten or pinch wires.
- Utilize wire clips to prevent contact between the wire and the metallic components of the module and racking system.

RACEWAYS

- Protect wires in exposed areas such as inner row spaces and pathways by utilizing the listed raceways on page 2 (RayTray, conduit, etc.). *See figures 3&4.*
- Ensure that PV wire is not exposed to sharp edges when entering or exiting listed raceways.



Figure : 1

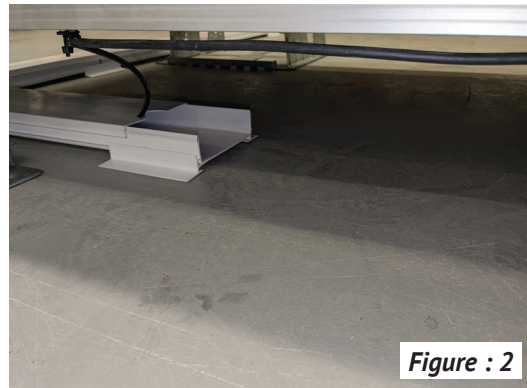


Figure : 2

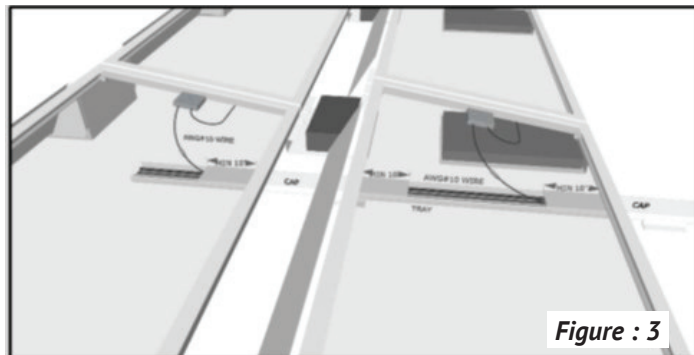


Figure : 3

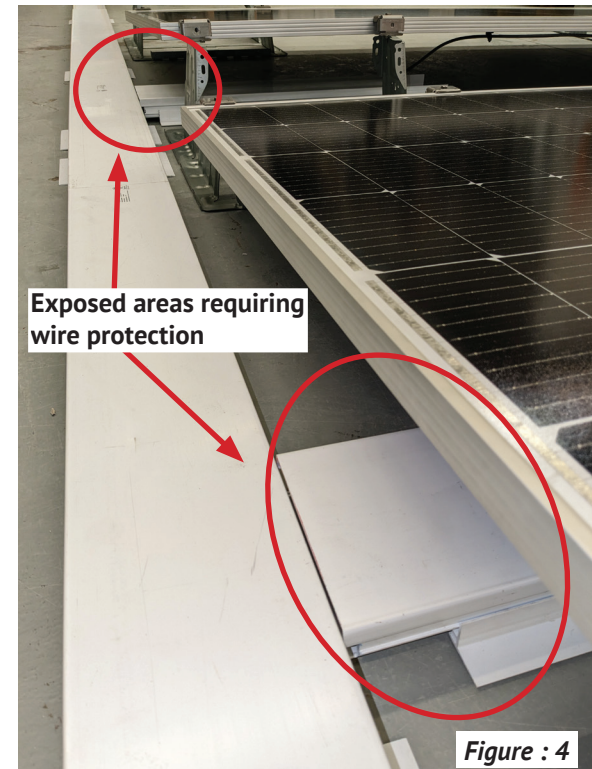


Figure : 4