HISTORIC DISTRICT COMMISSION
APPLICATION FOR WORK APPROVAL

City of Detroit - Planning & Development Department
2 Woodward Avenue, Suite 808
Detroit, Michigan 48226

APPLICATION ID
HDC2024-00007

PROPERTY INFORMATION

ADDRESS(ES): 2490 LONGFELLOW ST

HISTORIC DISTRICT: Boston-Edison

SCOPE OF WORK: **(Check ALL that apply)**

- ☐ Windows/ Doors
- ☐ Walls/ Siding
- ☐ Painting
- ☐ Roof/Gutters/ Chimney
- ☐ Porch/Deck/Balcony
- ☒ Other
- ☐ Demolition
- ☐ Signage
- ☐ New Building
- ☐ Addition
- ☐ Site Improvements (landscape, trees, fences, patios, etc.)

BRIEF PROJECT DESCRIPTION:
Roof Mounted Solar Installation with 7.90 KW System.

APPLICANT IDENTIFICATION

TYPE OF APPLICANT: Contractor

NAME: Joungho Choi	**COMPANY NAME:** Generation Solar		
ADDRESS: 1192 E Draper Pkwy, Suite 466	**CITY:** Draper	**STATE:** UT	**ZIP:** 84020
PHONE: +1 (888) 985-2859	**EMAIL:** mi.permitting@generationsolar.net		

I AGREE TO AND AFFIRM THE FOLLOWING:

☒ I understand that the failure to upload all required documentation may result in extended review times for my project and/or a denied application.

☒ I understand that the review of this application by the Historic District Commission does not waive my responsibility to comply with any other applicable ordinances including obtaining appropriate permits (building, sign, etc.) or other department approvals prior to beginning the work.

☒ I hereby certify that the information on this application is true and correct. I certify that the proposed work is authorized by the owner of record and I have been authorized to make this application as the property owner(s) authorized agent.

DocuSigned by:
Joungho Choi
DE61009522234AC...
SIGNATURE

01/10/2024
DATE

NOTE: Based on the scope of work, additional documentation may be required. See www/detroitmi.gov/hdc **for scope-specific requirements.**

PROJECT DETAILS – TELL US ABOUT YOUR PROJECT

Instructions: Add project details using the text box in each section. If your details exceed the space provided, attach the details via the attachment icon for that section.

ePLANS PERMIT NUMBER: (only applicable if you've already applied for permits through ePLANS)	N/A

GENERAL

1. DESCRIPTION OF EXISTING CONDITION

Please tell us about the current appearance and conditions of the areas you want to change. You may use a few sentences or attach a separate prepared document on the right. (For example, "existing roof on my garage is covered in gray asphalt shingles in poor condition.")

2. PHOTOGRAPHS

Help us understand your project. Please attach photographs of all areas where work is proposed.

3. DESCRIPTION OF PROJECT

In this box, tell us about what you want to do at the areas described above in box #1. (For example, Install new asphalt shingle roofing at garage.)

Roof Mounted Solar Project with 7.90 KW System.

4. DETAILED SCOPE OF WORK

In this box, please describe all steps necessary to complete the work described in box #3. (For example, "remove existing shingles, replace wood deck as necessary, replace wood eaves, install roof vents, replace rotted fascia boards, paint, clean worksite.")

SYSTEM SIZE: 7.90 kW-DC | 5.80 kW-AC

MODULE: (20) CS3U- 395W

INVERTER: (20) ENPHASE IQ8+-72-2-US

5. BROCHURES/CUT SHEETS

Please provide information on the products or materials you are proposing to install. For example, a brochure on the brand and color of the shingles proposed.

ADDITIONAL DETAILS

9. OTHER *Please provide any additional details. HDC Staff may ask you to submit additional information at a later time depending on your project.*	

WYSSLING CONSULTING
CORPORATE EXPERIENCE WITH SMALL BUSINESS VALUE

Scott E. Wyssling, PE
Coleman D. Larsen, SE, PE
Gregory T. Elvestad, PE

76 North Meadowbrook Drive
Alpine, UT 84004
office (201) 874-3483
swyssling@wysslingconsulting.com

November 22, 2023

Generation Solar
1192 East Draper Parkway, Ste. 466
Draper, UT 84020

Re: Engineering Services
Smith Residence
2490 Longfellow Street, Detroit, MI
7.900 kW System

To Whom It May Concern:

We have received information regarding solar panel installation on the roof of the above referenced structure. Our evaluation of the structure is to verify the existing capacity of the roof system and its ability to support the additional loads imposed by the proposed solar system.

A. Site Assessment Information

1. Site visit documentation identifying attic information including size and spacing of framing for the existing roof structure.
2. Design drawings of the proposed system including a site plan, roof plan and connection details for the solar panels. This information will be utilized for approval and construction of the proposed system.

B. Description of Structure:

Roof Framing: 2 x 6 dimensional lumber at 16” on center.
Roof Material: Composite Asphalt Shingles
Roof Slope: 27 degrees
Attic Access: Accessible
Foundation: Permanent

C. Loading Criteria Used

- **Dead Load**
  - Existing Roofing and framing = 7 psf
  - New Solar Panels and Racking = 3 psf
  - TOTAL = 10 PSF
- **Live Load** = 20 psf (reducible) – 0 psf at locations of solar panels
- **Ground Snow Load** = 25 psf
- **Wind Load** based on ASCE 7-10
  - Ultimate Wind Speed = 115 mph (based on Risk Category II)
  - Exposure Category C

Analysis performed of the existing roof structure utilizing the above loading criteria is in accordance with the 2015 International Residential Code, including provisions allowing existing structures to not require strengthening if the new loads do not exceed existing design loads by 105% for gravity elements and 110% for seismic elements. This analysis indicates that the existing framing will support the additional panel loading without damage, if installed correctly.

D. Solar Panel Anchorage

1. The solar panels shall be mounted in accordance with the most recent Unirac installation manual. If during solar panel installation, the roof framing members appear unstable or deflect non-uniformly, our office should be notified before proceeding with the installation.
2. The maximum allowable withdrawal force for a $^{5}/_{16}$" lag screw is 235 lbs per inch of penetration as identified in the National Design Standards (NDS) of timber construction specifications. Based on a minimum penetration depth of 2½", the allowable capacity per connection is greater than the design withdrawal force (demand). Considering the variable factors for the existing roof framing and installation tolerances, the connection using one $^{5}/_{16}$" diameter lag screw with a minimum of 2½" embedment will be adequate and will include a sufficient factor of safety.
3. Considering the wind speed, roof slopes, size and spacing of framing members, and condition of the roof, the panel supports shall be placed no greater than 48" on center.

Based on the above evaluation, this office certifies that with the racking and mounting specified, the existing roof system will adequately support the additional loading imposed by the solar system. This evaluation is in conformance with the 2015 IRC, current industry standards, and is based on information supplied to us at the time of this report.

Should you have any questions regarding the above or if you require further information do not hesitate to contact me.

Very truly yours,

Scott E. Wyssling, PE
Michigan License No. 6201068147

Signed 11/22/2023

SMITH RESIDENCE

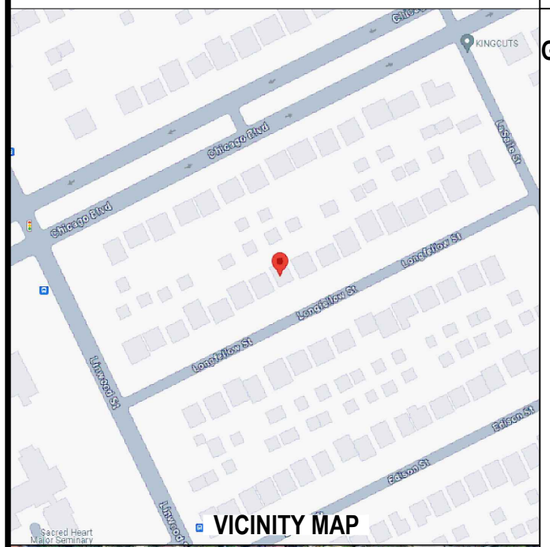
PHOTOVOLTAIC SYSTEM
2490 LONGFELLOW STREET
DETROIT, MI 48206

SYSTEM SIZE: 7.90 kW-DC | 5.80 kW-AC
MODULE: (20) CS3U- 395W
INVERTER: (20) ENPHASE IQ8+-72-2-US

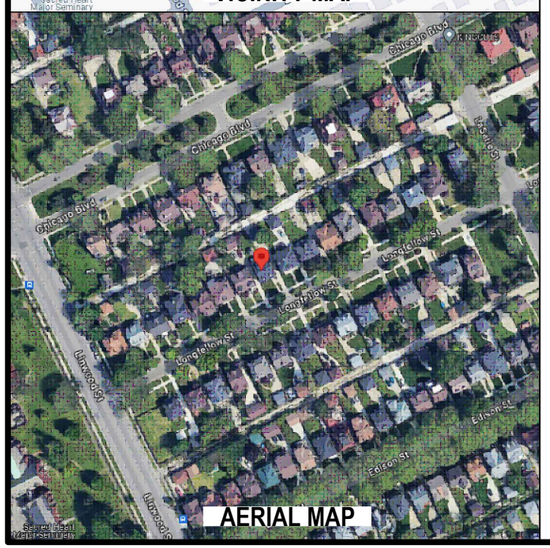
GOVERNING CODES:

ALL MATERIALS, EQUIPMENT, INSTALLATION AND WORK SHALL COMPLY WITH THE FOLLOWING APPLICABLE CODES:

- 2014 NATIONAL ELECTRIC CODE (NEC)
- 2015 MICHIGAN BUILDING CODE
- 2015 MICHIGAN PUMBING CODE
- 2015 INTERNATIONAL FUEL GAS CODE
- 2015 INTERNATIONAL MECHANICAL CODE
- 2015 MICHIGAN REHABILITATION CODE
- 2015 INTERNATIONAL FIRE CODE (IFC)
- 2015 INTERNATIONAL ENERGY CONSERV. CODE
- ICC/ANSI A117.1 - 2009



VICINITY MAP



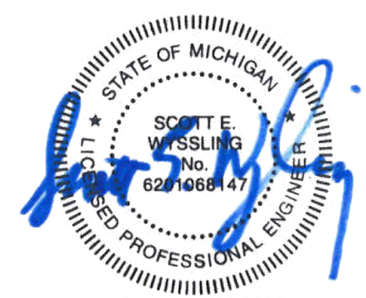
AERIAL MAP

GENERAL

1. UTILITY SHALL BE NOTIFIED BEFORE ACTIVATION OF PHOTOVOLTAIC SYSTEM.
2. 110.2 APPROVAL: ALL ELECTRICAL EQUIPMENT SHALL BE LABELED, LISTED, OR CERTIFIED BY A NATIONALLY RECOGNIZED TESTING LABORATORY ACCREDITED BY THE UNITED STATES OCCUPATIONAL SAFETY HEALTH ADMINISTRATION
3. CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS PRIOR TO INITIATING CONSTRUCTION.
4. CONTRACTOR SHALL REVIEW ALL MANUFACTURER INSTALLATION DOCUMENTS PRIOR TO INITIATING CONSTRUCTION.
5. ALL EQUIPMENT AND ASSOCIATED CONNECTIONS, ETC, AND ALL ASSOCIATED WIRING AND INTERCONNECTIONS SHALL BE INSTALLED ONLY BY QUALIFIED PERSONNEL.
6. THE CONTRACTOR OR OWNER MUST PROVIDE ROOF ACCESS (LADDER TO ROOF) FOR ALL THE REQUIRED INSPECTIONS. LADDERS MUST BE OSHA APPROVED, MINIMUM TYPE I WITH A 250LB. RATING, IN GOOD CONDITION AND DESIGNED FOR ITS INTENDED USE.
7. CONTRACTOR SHALL VERIFY THAT THE ROOF STRUCTURE WILL WITHSTAND THE ADDITIONAL LOADS.
8. LAG SCREWS SHALL PENETRATE A MINIMUM 2" INTO SOLID SAWN STRUCTURAL MEMBERS AND SHALL NOT EXCEED MANUFACTURER RECOMMENDATIONS FOR FASTENERS INTO ENGINEERED STRUCTURAL MEMBERS.
9. AN ACCESS POINT SHALL BE PROVIDED THAT DOES NOT PLACE THE GROUND LADDER OVER OPENINGS SUCH AS WINDOWS OR DOORS ARE LOCATED AT STRONG POINTS OF BUILDING CONSTRUCTION AND IN LOCATIONS WHERE THE ACCESS POINT DOES NOT CONFLICT WITH OVERHEAD OBSTRUCTIONS SUCH AS TREE LIMBS, WIRES, OR SIGNS.
10. WHERE DC CONDUCTORS ARE RUN INSIDE BUILDING, THEY SHALL BE CONTAINED IN A METAL RACEWAY; THEY SHALL NOT BE INSTALLED WITHIN 10" OF THE ROOF DECKING OR SHEATHING EXCEPT WHERE COVERED BY THE PV MODULES AND EQUIPMENT.
11. PLUMBING AND MECHANICAL VENTS THROUGH THE ROOF SHALL NOT BE COVERED BY SOLAR MODULES- - NO BUILDING, PLUMBING OR MECHANICAL VENTS TO BE COVERED, CONSTRUCTED OR ROUTED AROUND SOLAR MODULES.
12. ALL FIELD -INSTALLED JUNCTION, PULL AND OUTLET BOXES LOCATED BEHIND MODULES SHALL BE ACCESSIBLE DIRECTLY OR BY DISPLACEMENT OF A MODULE SECURED BY REMOVABLE FASTENERS.

ELECTRICAL

1. WIRING MATERIALS SHALL COMPLY WITH MAXIMUM CONTINUOUS CURRENT OUTPUT AT 25°C AND MAXIMUM VOLTAGE AT 600V; WIRE SHALL BE WET RATED AT 90°C.
2. EXPOSED PHOTOVOLTAIC SYSTEM CONDUCTORS ON THE ROOF WILL BE USE 2 OR PV-TYPE WIRE.
3. PHOTOVOLTAIC SYSTEM CONDUCTORS SHALL BE IDENTIFIED AND GROUPED. THE MEANS OF IDENTIFICATION SHALL BE PERMITTED BY SEPARATE COLOR-CODING, MARKING TAPE, TAGGING OR OTHER APPROVED MEANS.
4. ALL EXTERIOR CONDUIT, FITTINGS, AND BOXES SHALL BE RAIN-TIGHT AND APPROVED FOR USE IN WET LOCATIONS.
5. ALL METALLIC RACEWAYS AND EQUIPMENT SHALL BE BONDED AND ELECTRICALLY CONTINUOUS.
6. WHERE SIZES OF JUNCTION BOXES, RACEWAYS, AND CONDUITS ARE NOT SPECIFIED, CONTRACTOR SHALL SIZE THEM ACCORDING TO APPLICABLE CODES.
7. REMOVAL OF A UTILITY-INTERACTIVE INVERTER OR OTHER EQUIPMENT SHALL NOT DISCONNECT THE BUILDING CONNECTION BETWEEN THE GROUNDING ELECTRODE CONDUCTOR AND THE PV SOURCE AND/OR OUTPUT CIRCUIT GROUNDED CONDUCTOR.
8. FOR GROUNDED SYSTEMS, THE PHOTOVOLTAIC SOURCE AND OUTPUT CIRCUITS SHALL BE PROVIDED WITH A GROUND-FAULT PROTECTION DEVICE OR SYSTEM THAT DETECTS A GROUND FAULT, INDICATES THAT FAULT HAS OCCURED AND AUTOMATICALLY DISCONNECTS ALL CONDUCTORS OR CAUSES THE INVERTER TO AUTOMATICALLY CEASE SUPPLYING POWER TO OUTPUT CIRCUITS.
9. FOR UNGROUNDED SYSTEMS, THE INVERTER IS EQUIPPED WITH GROUND FAULT PROTECTION AND A GFI FUSE PORT FOR GROUND FAULT INDICATION.
10. PV MODULE FRAMES SHALL BE BONDED TO RACKING RAIL OR BARE COPPER GEC/GEC PER THE MODULE MANUFACTURER'S LISTED INSTRUCTION SHEET.
11. PV MODULE RACKING RAIL SHALL BE BONDED TO BARE COPPER GEC VIA WEEB LUG, ILSCO GBL-4DBT LAY-IN LUG, OR EQUIVALENT LISTED LUG.
12. THE PHOTOVOLTAIC INVERTER WILL BE LISTED AS UL 1741 COMPLIANT.
13. RACKING AND BONDING SYSTEM TO BE UL2703 RATED.
14. ANY REQUIRED GROUNDING ELECTRODE CONDUCTOR WILL BE CONTINUOUS, EXCEPT FOR SPLICES OR JOINTS AS BUS BARS WITHIN LISTED EQUIPMENT.
15. WHEN BACKFED BREAKER IS THE METHOD OF UTILITY INTERCONNECTION, THE BREAKERS SHALL NOT READ "LINE AND LOAD".
16. WHEN APPLYING THE 120% RULE, THE SOLAR BREAKER TO BE POSITIONED AT THE OPPOSITE END OF THE BUS BAR FROM THE MAIN BREAKER.
17. THE WORKING CLEARANCE AROUND THE EXISTING ELECTRICAL EQUIPMENT AS WELL AS THE NEW ELECTRICAL EQUIPMENT WILL BE MAINTAINED.



Signed 11/22/2023

SHEET INDEX:

LICENSE NUMBER: 6218537

SMITH, MIRANDA
2490 LONGFELLOW STREET
DETROIT, MI 48206
7348589871

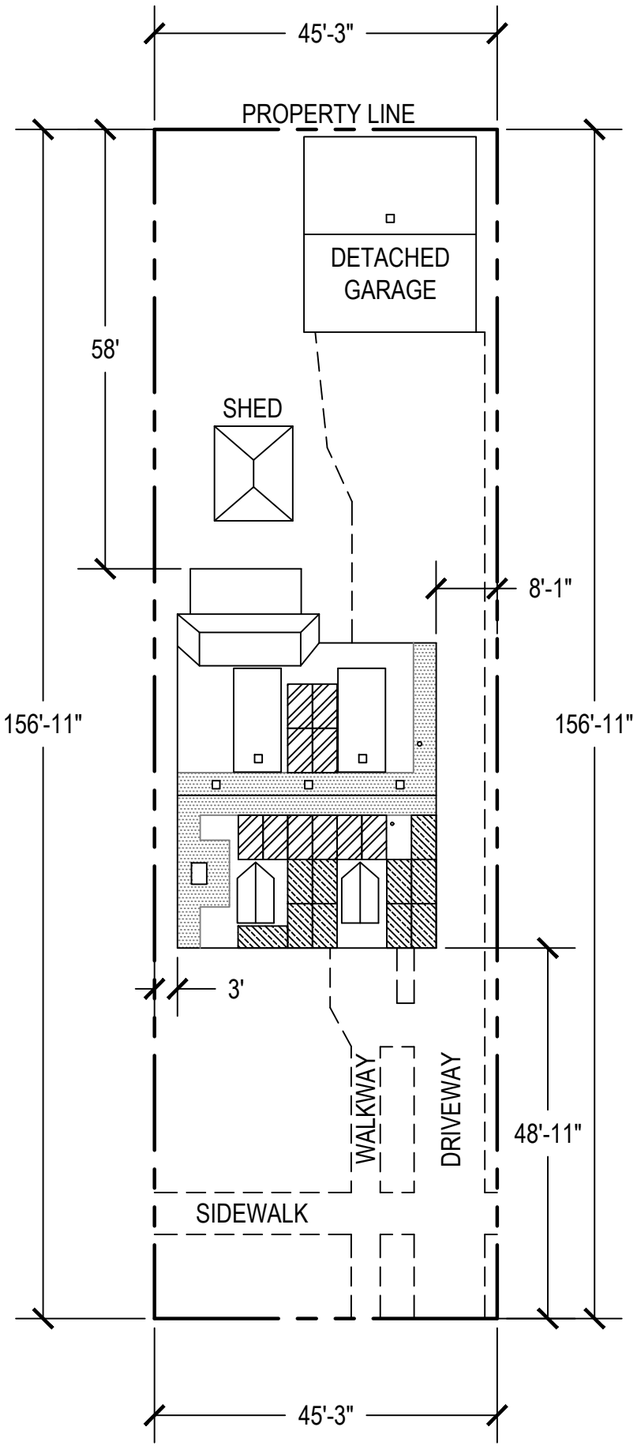
GENERATION SOLAR
1192 E. DRAPER PARKWAY STE 466
DRAPER, UT 84020
(888) 985-2859

COVER PAGE

JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN

REV #1:
REV #2:
REV #3:

PV-1



LONGFELLOW STREET

LEGEND:

PROPERTY LINE: ——— – – ———

DRIVEWAY: – — – — – — – — – —

FENCE: —○———○———○———

SCALE: 1" = 20'

LICENSE NUMBER: 6218537

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(888) 985-2859

STATE OF MICHIGAN
SCOTT E. WYSSLING
No. 6201068147
LICENSED PROFESSIONAL ENGINEER

Signed 11/22/2023

PROPERTY PLAN

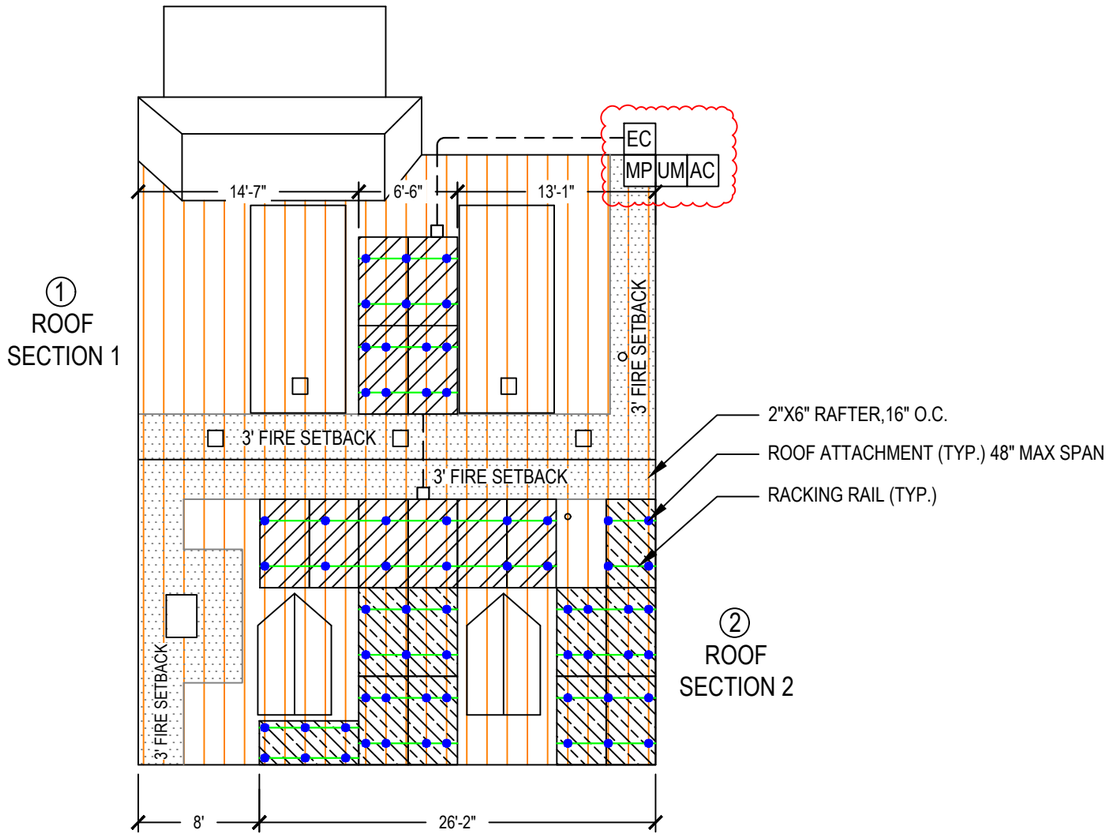
JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN

REV #1:
REV #2:
REV #3:

PV-2

ROOF DETAIL	CIRCUIT DETAIL
ROOF TYPE: ASPHALT SHINGLE	**ENPHASE CIRCUITS**
ROOF SECTION 1: 4 MODULES AZIMUTH: 334° PITCH: 27° ①	CIRCUIT # 1: 10 MODULES
ROOF SECTION 2: 16 MODULES AZIMUTH: 154° PITCH: 27° ②	CIRCUIT # 2: 10 MODULES

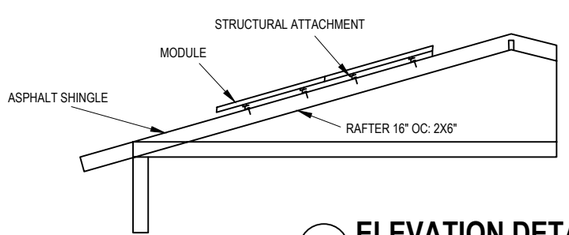
MODULE INFORMATION	
MODULE TYPE	CS3U-395W
MAX DESIGN LOAD (WIND & SNOW)	5400 PA UPWARD / 3600 PA DOWNWARD
MODULE WEIGHT	22.5 KG (49.6 LBS)
MODULE DIMENSIONS (H X L X D)	2000 × 992 × 35 MM (78.7 × 39.1 × 1.38 INCHES)
MODULE AREA	21.3692 FT^2
MODULE MECHANICAL SPECIFICATIONS	
DESIGN WIND SPEED	115 MPH
DESIGN SNOW LOAD	35 PSF
ROOF PITCH	27°
TOTAL ARRAY AREA (SQ. FT)	427.38
TOTAL ROOF AREA (SQ. FT)	1533.4002
ARRAY SQ. FT / TOTAL ROOF SQ. FT	27.87%



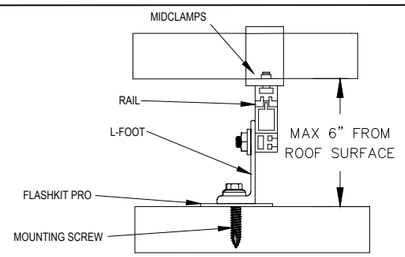
① ROOF SECTION 1

② ROOF SECTION 2

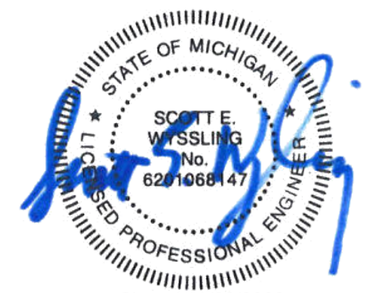
WIND UPLIFT AT ATTACHMENT POINTS IS PROVIDED WITH THE ENGINEERING LETTER.
SUPPORT LOCATIONS HAVE BEEN OPTIMIZED TO WITHSTAND UPLIFT



A **ELEVATION DETAIL**
SCALE: NTS



B **ATTACHMENT DETAIL**
SCALE: NTS



Signed 11/22/2023

SYSTEM LEGEND

PHOTOVOLTAIC SYSTEM:
DC SYSTEM SIZE: 7.90 kW
AC SYSTEM SIZE: 5.80 kW

- UM — MAIN SERVICE METER AND SERVICE POINT
- MP — MAIN SERVICE PANEL
- AC — UTILITY AC DISCONNECT
- EC — ENPHASE AC COMBINER PANEL
- (20) CS3U- 395W WITH ENPHASE IQ8+-72-2-US MICROINVERTERS MOUNTED UNDER EACH MODULE
- JUNCTION BOX AND CONDUIT
- CONDUIT RUN

CONDUIT TO BE RUN IN ATTIC IF POSSIBLE, OTHERWISE CONDUIT BLOCKS MIN. 1"/MAX 6" ABOVE ROOF SURFACE, CLOSE TO RIDGE LINES, AND UNDER EAVES; TO BE PAINTED TO MATCH EXTERIOR/EXISTING BACKGROUND COLOR OF ITS LOCATION; TO BE LABELED AT MAX 10' INTERVALS. CONDUIT RUNS ARE APPROXIMATE AND ARE TO BE DETERMINED IN THE BY THE INSTALLERS

- FIRE CODE SETBACK (18" MIN / 36" MAX)
- ROOF ATTACHMENT POINT
- RAIL
- RAFTER

SCALE: 1" = 10'

LICENSE NUMBER: 6218537

SMITH, MIRANDA
2490 LONGFELLOW STREET
DETROIT, MI 48206
7348589871

GENERATION SOLAR
1192 E. DRAPER PARKWAY STE 466
DRAPER, UT 84020
(888) 985-2859

SITE PLAN

JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN

REV #1:
REV #2:
REV #3:

PV-3

Ampacity Calculation:

Wiring Location: **OPTIMIZED Array to Inverter (Direct Current)**

All calculations show minimum sizing for ampacity
Actual wire sizing may be larger for voltage drop or other factors
All calculations are according the the 2020 National Electric Code

Initial Input Values

		Amps				Amps
Isc (Short Circuit Current)		10.25				
Number of circuits		10.25	X	1	=	10.25
Maximum Circuit Current (NEC 690.8 (A)(1+2)		10.25	X	125%	=	12.81
Overcurrent device rating (NEC 690.8 (B)(1)		12.81	X	125%	=	16.02
Minimum overcurrent device		20.00				OK
	SIZE AWG #					
Chosen Conductor Type THHN, RHW-2 or USE-2	10					
Conductor Derating						
NEC 690.31 (C) ref (NEC 310.16)						
Conductor 90°C Ampacity		30				
Conduit Fill Derating	3	30.00	X	1.00	=	30.00
Temperature Derating °F	105-113	30.00	X	.87	=	26.10
Ampacity vs. Overcurrent Device						
Conductor Ampacity Check		26.10	≥	12.81		OK
Conductor to Overcurrent Check		26.10	≥	20.00		OK

Ampacity Calculation:

Wiring Location: **INVERTER to Main Service (Alternating Current)**

All calculations show minimum sizing for ampacity
Actual wire sizing may be larger for voltage drop or other factors
All calculations are according the the 2020 National Electric Code

Initial Input Values

Inverter Continous AC ouput (Watts)	290					
Minimum Operating Voltage	240	**Watts**		**Volts**		**Amps**
		290	/	240	=	1.21
Inverter Continious AC Amps		1.21				
Number of circuits		1.21	X	20	=	24.17
Overcurrent device rating NEC 690.8 (B)(3)		24.17	X	125%	=	30.21
Minimum overcurrent device		40.00				OK
	SIZE AWG #					
Chosen Conductor Type THHN, RHW-2 or USE-2	6					
Conductor Derating						
NEC 690.31 (C) ref (NEC 310.16)						
Conductor 90°C Ampacity		75				
Conduit Fill Derating	3	75.00	X	1.00	=	75.00
Temperature Derating °F	105-113	75.00	X	.87	=	65.25
Ampacity vs. Overcurrent Device						
Conductor Ampacity Check		65.25	≥	30.21		OK
Conductor Overcurrent Check		65.25	≥	40.00		OK

PHOTOVOLTAIC SYSTEM:
DC SYSTEM SIZE: 7.900 kW
AC SYSTEM SIZE: 5.80 kW
INVERTER: (20) ENPHASE IQ8+-72-2-US
MODULE: (20) CS3U- 395W

NOTES:
1. ALL GROUNDING CONDUCTORS SHALL BE GREEN IN COLOR OR BARE, ATTACHED TO ALL METAL PARTS AND REFERENCED TO MAIN SERVICE PANEL GROUND.
2. ALL STATED CONDUIT SIZES SATISFY REQUIREMENTS PER CHAPTER 9, TABLE 1.0, ANNEX C (TABLE C.1), OF THE 2014 NEC. LARGER DIAMETER CONDUIT MAY BE USED TO FACILITATE EASE OF INSTALLATION.

INSTALLER NOTES:
0

STATE OF MICHIGAN
JOUNGHO CHOI
License No. 6201069813
LICENSED PROFESSIONAL ENGINEER

Signed 11/24/2023

LICENSE NUMBER: 6218537

SMITH, MIRANDA
2490 LONGFELLOW STREET
DETROIT, MI 48206
7348589871

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DRAPER, UT 84020
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ELECTRICAL CALCULATIONS

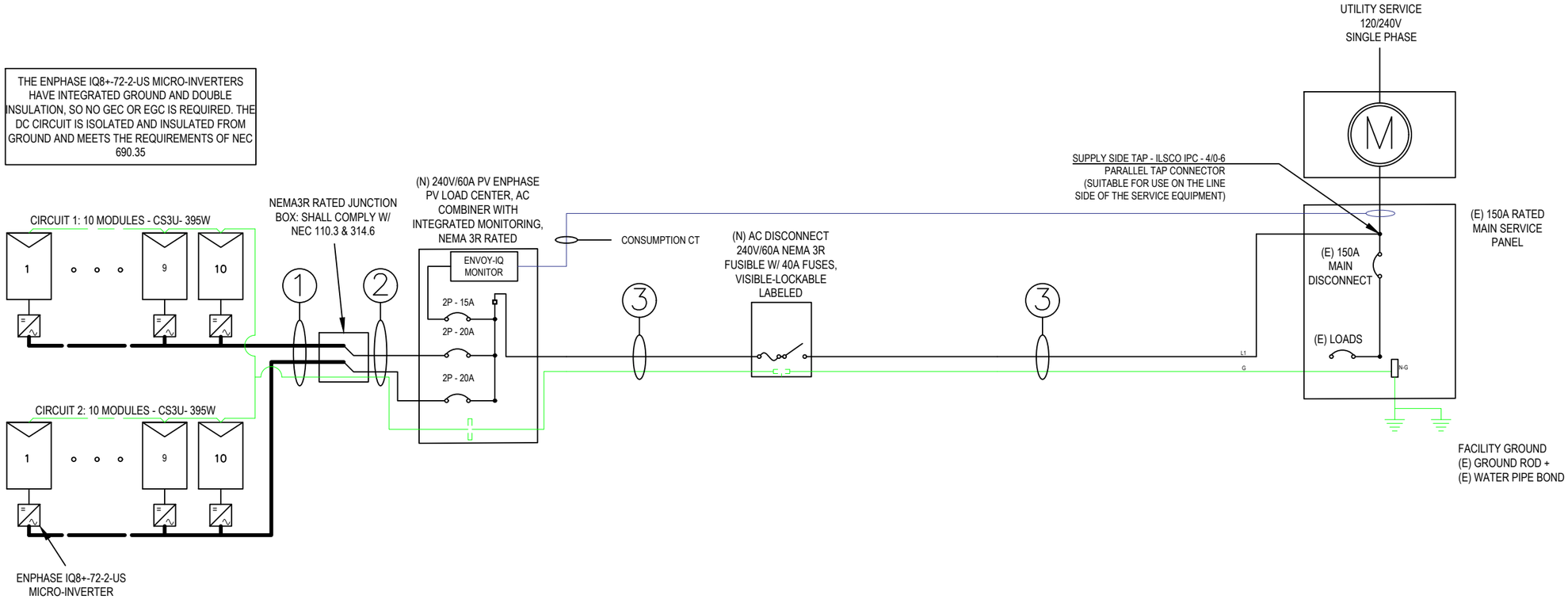
JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN

REV #1:
REV #2:
REV #3:

PV-4

UTILITY AC DISCONNECT MUST BE ACCESSIBLE, LOCKABLE, LABELED, BLADE-STYLE SWITCH, AND LOCATED WITHIN 5' FROM THE UTILITY METER

THE ENPHASE IQ8+-72-2-US MICRO-INVERTERS HAVE INTEGRATED GROUND AND DOUBLE INSULATION, SO NO GEC OR EGC IS REQUIRED. THE DC CIRCUIT IS ISOLATED AND INSULATED FROM GROUND AND MEETS THE REQUIREMENTS OF NEC 690.35



CONDUCTOR AND CONDUIT SCHEDULE					
TAG	WIRE TYPE	WIRE SIZE	# OF CONDUCTORS	CONDUIT TYPE	MIN. CONDUIT SIZE
1	PV WIRE	#10	2 - L1 L2	FREE AIR	N/A
1	BARE COPPER	#6	1 - BARE	FREE AIR	N/A
2	THWN-2	#10	2 - L1 L2	EMT	3/4"
2	THWN-2 EGC	#10	1 - GND	EMT	3/4"
3	THWN-2	#6	3 - L1 L2 N	EMT	3/4"
3	THWN-2 EGC	#8	1 - GND	EMT	3/4"

PV MODULE ELECTRICAL SPECIFICATIONS	
MODULE TYPE	CS3U- 395W
POWER MAX (P_{MAX})	395W
OPEN CIRCUIT VOLTAGE (V_{OC})	48.4V
SHORT CIRCUIT CURRENT (I_{SC})	10.25A
MAX POWER-POINT VOLTAGE (V_{MP})	40.6V
MAX POWER-POINT CURRENT (I_{MP})	9.73A
SERIES FUSE RATING	19.9A

INVERTER ELECTRICAL SPECIFICATIONS	
INVERTER TYPE	ENPHASE IQ8+-72-2-US
MAX INPUT DC VOLTAGE	60V
MAX DC SHORT CIRCUIT CURRENT	15A
MAXIMUM OUTPUT POWER	290W
MAXIMUM CONT. OUTPUT CURRENT	1.21A
CEC EFFICIENCY	97%
MAX UNITS PER 20A CIRCUIT	13

SYSTEM OVER-CURRENT PROTECTION DEVICE (OCPD) CALCULATIONS	
INVERTER TYPE	ENPHASE IQ8+-72-2-US
# OF INVERTERS	20
MAX CONTINUOUS OUTPUT CURRENT	1.21
(# OF INVERTERS) X (MAX CONT. OUTPUT CURRENT) X 125% <= OCPD RATING	
(20 x 1.21A x 1.25)= 30.25A <= 40A, OK	

PHOTOVOLTAIC SYSTEM:
DC SYSTEM SIZE: 7.900 kW
AC SYSTEM SIZE: 5.80 kW
INVERTER: (20) ENPHASE IQ8+-72-2-US
MODULE: (20) CS3U- 395W

NOTES:
1. MODULES ARE BONDED TO RAIL USING UL 2703 RATED BONDING SYSTEM - INTEGRATED BONDING MID-CLAMPS + DIRECT-BURIAL LAY-IN-LUGS; SEE ATTACHED FOR SPECIFICATIONS IF APPLICABLE
2. PV DC SYSTEM IS UNGROUNDED
3. PV ARRAY WILL HAVE A GROUNDING ELECTRODE SYSTEM IN COMPLIANCE WITH NEC 250.58 AND 690.47(A)
4. PV SOURCE, OUTPUT, AND INVERTER INPUT CIRCUIT WIRING METHODS SHALL COMPLY WITH NEC 690.1(G)
5. BACKFED PV BREAKER WILL BE INSTALLED AT OPPOSITE END OF THE BUS BAR FROM THE MAIN BREAKER. A PERMANENT WARNING LABEL TO BE INSTALLED PER SYSTEM SIGNAGE, PAGE
6. BARE COPPER IS TRANSITIONED TO THWN-2 VIA IRREVERSIBLE CRIMP; WHEN PRESENT, THE GEC TO BE CONTINUOUS
7. INVERTER(S) TO BE COMPLIANT WITH UL 1741 SUPPLEMENT A
8. CONDUIT AND CONDUCTOR SPECIFICATIONS ARE BASED ON MINIMUM CODE REQUIREMENTS AND ARE NOT MEANT TO LIMIT UP-SIZING AS REQUIRED BY FIELD CONDITIONS
9. CONDUIT AND CONDUCTOR SPECIFICATIONS ARE BASED ON MINIMUM CODE REQUIREMENTS AND ARE NOT MEANT TO LIMIT UPSIZING AS REQUIRED BY FIELD CONDITIONS.

INSTALLER NOTES:
0

STATE OF MICHIGAN
JOUNGHO CHOI
License No. 6201069813
LICENSED PROFESSIONAL ENGINEER

Signed 11/24/2023

LICENSE NUMBER: 6218537

SMITH, MIRANDA
2490 LONGFELLOW STREET
DETROIT, MI 48206
7348589871

GENERATION SOLAR
1192 E. DRAPER PARKWAY STE 466
DRAPER, UT 84020
(888) 985-2859

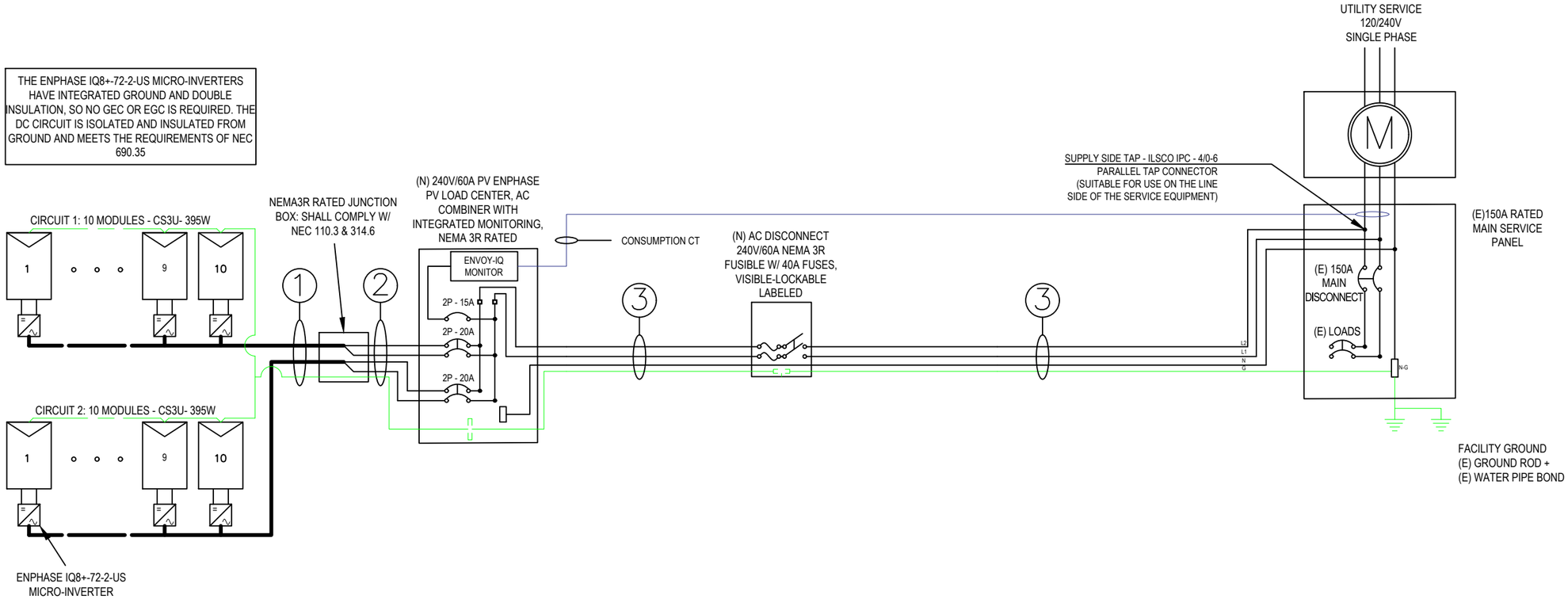
1-LINE DIAGRAM & CALCULATIONS

JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN
REV #1:
REV #2:
REV #3:

PV-5

UTILITY AC DISCONNECT MUST BE ACCESSIBLE, LOCKABLE, LABELED, BLADE-STYLE SWITCH, AND LOCATED WITHIN 5' FROM THE UTILITY METER

THE ENPHASE IQ8+-72-2-US MICRO-INVERTERS HAVE INTEGRATED GROUND AND DOUBLE INSULATION, SO NO GEC OR EGC IS REQUIRED. THE DC CIRCUIT IS ISOLATED AND INSULATED FROM GROUND AND MEETS THE REQUIREMENTS OF NEC 690.35



CONDUCTOR AND CONDUIT SCHEDULE					
TAG	WIRE TYPE	WIRE SIZE	# OF CONDUCTORS	CONDUIT TYPE	MIN. CONDUIT SIZE
1	PV WIRE	#10	2 - L1 L2	FREE AIR	N/A
1	BARE COPPER	#6	1 - BARE	FREE AIR	N/A
2	THWN-2	#10	2 - L1 L2	EMT	3/4"
2	THWN-2 EGC	#10	1 - GND	EMT	3/4"
3	THWN-2	#6	3 - L1 L2 N	EMT	3/4"
3	THWN-2 EGC	#8	1 - GND	EMT	3/4"

PV MODULE ELECTRICAL SPECIFICATIONS	
MODULE TYPE	CS3U- 395W
POWER MAX (P_{MAX})	395W
OPEN CIRCUIT VOLTAGE (V_{OC})	48.4V
SHORT CIRCUIT CURRENT (I_{SC})	10.25A
MAX POWER-POINT VOLTAGE (V_{MP})	40.6V
MAX POWER-POINT CURRENT (I_{MP})	9.73A
SERIES FUSE RATING	19.9A

INVERTER ELECTRICAL SPECIFICATIONS	
INVERTER TYPE	ENPHASE IQ8+-72-2-US
MAX INPUT DC VOLTAGE	60V
MAX DC SHORT CIRCUIT CURRENT	15A
MAXIMUM OUTPUT POWER	290W
MAXIMUM CONT. OUTPUT CURRENT	1.21A
CEC EFFICIENCY	97%
MAX UNITS PER 20A CIRCUIT	13

SYSTEM OVER-CURRENT PROTECTION DEVICE (OCPD) CALCULATIONS	
INVERTER TYPE	ENPHASE IQ8+-72-2-US
# OF INVERTERS	20
MAX CONTINUOUS OUTPUT CURRENT	1.21
(# OF INVERTERS) X (MAX CONT. OUTPUT CURRENT) X 125% <= OCPD RATING	
(20 x 1.21A x 1.25)= 30.25A <= 40A, OK	

PHOTOVOLTAIC SYSTEM:
DC SYSTEM SIZE: 7.900 kW
AC SYSTEM SIZE: 5.80 kW
INVERTER: (20) ENPHASE IQ8+-72-2-US
MODULE: (20) CS3U- 395W

NOTES:
1. MODULES ARE BONDED TO RAIL USING UL 2703 RATED BONDING SYSTEM - INTEGRATED BONDING MID-CLAMPS + DIRECT-BURIAL LAY-IN-LUGS; SEE ATTACHED FOR SPECIFICATIONS IF APPLICABLE
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INSTALLER NOTES:
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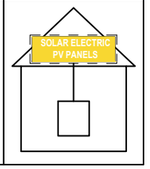
3-LINE DIAGRAM & CALCULATIONS

JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN
REV #1:
REV #2:
REV #3:

PV-5.1

SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWICH TO THE "OFF" POSITION TO SHUTDOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN ARRAY



LABEL 1
AT RAPID SHUTDOWN SYSTEM
[NEC 690.56(C)(1)(A)].

! WARNING !
ELECTRIC SHOCK HAZARD
TERMINALS ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION.
DC VOLTAGE IS ALWAYS PRESENT WHEN SOLAR MODULES ARE EXPLOSED TO SUNLIGHT

LABEL 2
AT EACH DISCONNECTING MEANS FOR PHOTOVOLTAIC EQUIPMENT
[NEC 690.15]

! WARNING !
ELECTRIC SHOCK HAZARD
TERMINALS ON BOTH LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION.

LABEL 3
AT EACH DISCONNECTING MEANS FOR PHOTOVOLTAIC EQUIPMENT
[NEC 690.13 AND 690.15]

MAXIMUM VOLTAGE: 60 V DC
MAXIMUM CIRCUIT CURRENT: 15 A DC
MAX RATED OUTPUT CURRENT OF THE CHARGE CONTROLLER OR DC-TO-DC CONVERTER (IF INSTALLED): 15 A DC

LABEL 4
AT EACH DC DISCONNECTING MEANS
[NEC 690.53]

PHOTOVOLTAIC AC DISCONNECT
OPERATING CURRENT: 30.25 A AC
OPERATING VOLTAGE: 240 V AC

LABEL 5
AT POINT OF INTERCONNECTION, MARKED AT DISCONNECTING MEANS
[NEC 690.54]

RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

LABEL 6
AT RAPID SHUTDOWN DISCONNECT SWITCH
[NEC 690.56(C)(3)].

! WARNING !
DUAL POWER SOURCES.
SECOND SOURCE IS PV SYSTEM

LABEL 7

! CAUTION !
PHOTOVOLTAIC SYSTEM CIRCUIT IS BACKFED

LABEL 8

AT POINT OF INTERCONNECTION; LABEL, SUCH AS LABEL 7 OR LABEL 8 MUST IDENTIFY PHOTOVOLTAIC SYSTEM
[NEC 705.12(B)(4)]

BI-DIRECTIONAL METER

LABEL 9
AT UTILITY METER
[NEC 690.56(B)]

PHOTOVOLTAIC DC DISCONNECT

LABEL 10
AT EACH DC DISCONNECTING MEANS
[NEC 690.13(B)]

PHOTOVOLTAIC SYSTEM EQUIPPED WITH RAPID SHUTDOWN

LABEL 11
AT RAPID SHUTDOWN SWITCH
[NEC 690.56(C)].
LETTERS AT LEAST 3/8 INCH; WHITE ON RED BACKGROUND; REFLECTIVE
[IFC 605.11.1.1]

WARNING: PHOTOVOLTAIC POWER SOURCE

LABEL 12
AT EXPOSED RACEWAYS, CABLE TRAYS, AND OTHER WIRING METHODS; SPACED AT MAXIMUM 10 FT SECTION OR WHERE SEPARATED BY ENCLOSURES, WALLS, PARTITIONS, CEILINGS, OR FLOORS.
[NEC 690.31(G)]
LETTERS AT LEAST 3/8 INCH; WHITE ON RED BACKGROUND; REFLECTIVE
[IFC 605.11.1.1]

UTILITY AC DISCONNECT

LABEL 13
AT EACH AC DISCONNECTING MEANS
[NEC 690.13(B)]

! WARNING !
POWER SOURCE OUTPUT CONNECTION - DO NOT RELOCATE THIS OVERCURRENT DEVISE

LABEL 14
AT POINT OF INTERCONNECTION OVERCURRENT DEVICE
[NEC 705.12(B)(2)(3)(B)]

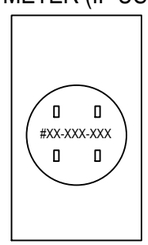
! CAUTION !
MULTIPLE SOURCES OF POWER

LABEL 15
AT POINT OF INTERCONNECTION
[NEC 705.10]

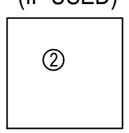
#03-359 LOCAL CODES

WARNING
THIS SERVICE METER IS ALSO SERVED BY A PHOTOVOLTAIC SYSTEM

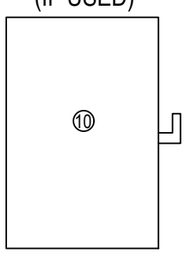
PRODUCTION METER (IF USED)



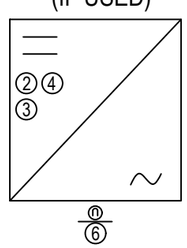
JUNCTION BOX (IF USED)



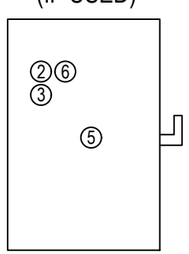
DC DISCONNECT (IF USED)



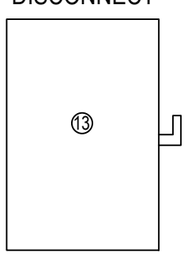
STRING INVERTER (IF USED)



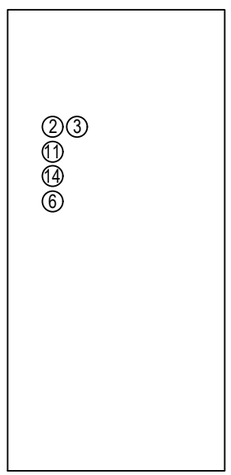
UTILITY AC DISCONNECT (IF USED)



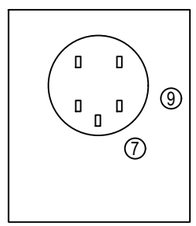
AC DISCONNECT



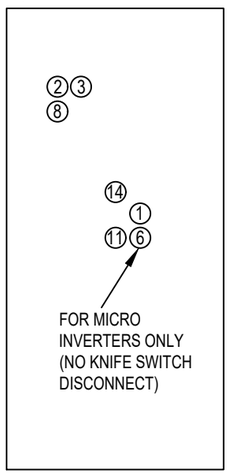
PV SUB PANEL (IF USED)



MAIN SERVICE METER



MAIN SERVICE PANEL FOR ILLUSTRATION ONLY (NOT ACTUAL MSP)



ALL SIGNAGE MUST BE PERMANENTLY ATTACHED AND BE WEATHER RESISTANT/SUNLIGHT RESISTANT AND CANNOT BE HAND-WRITTEN PER NEC 110.21(B)

PERMANENT PLAQUE OR DIRECTORY PROVIDING THE LOCATION OF THE SERVICE DISCONNECTING MEANS AND THE PHOTOVOLTAIC SYSTEM DISCONNECTING MEANS IF NOT IN THE SAME LOCATION
[NEC 690.56(B)]

WHERE THE PV SYSTEMS ARE REMOTELY LOCATED FROM EACH OTHER, A DIRECTORY IN ACCORDANCE WITH 705.10 SHALL BE PROVIDED AT EACH PV SYSTEM DISCONNECTING MEANS.
PV SYSTEM EQUIPMENT AND DISCONNECTING MEANS SHALL NOT BE INSTALLED IN BATHROOMS
[NEC 690.4(D),(E)]

LABELING NOTES
1.1 LABELING REQUIREMENTS BASED ON THE 2014 NATIONAL ELECTRICAL CODE, INTERNATIONAL FIRE CODE 605.11, OSHA STANDARD 1910.145, ANSI Z535
1.2 MATERIAL BASED ON THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION.
1.3 LABELS TO BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED.
1.4 LABELS TO BE A MINIMUM LETTER HEIGHT OF 3/8" AND PERMANENTLY AFFIXED.
1.5 ALERTING WORDS TO BE COLOR CODED. "DANGER" WILL HAVE RED BACKGROUND; "WARNING" WILL HAVE ORANGE BACKGROUND; "CAUTION" WILL HAVE YELLOW BACKGROUND. [ANSI Z535]

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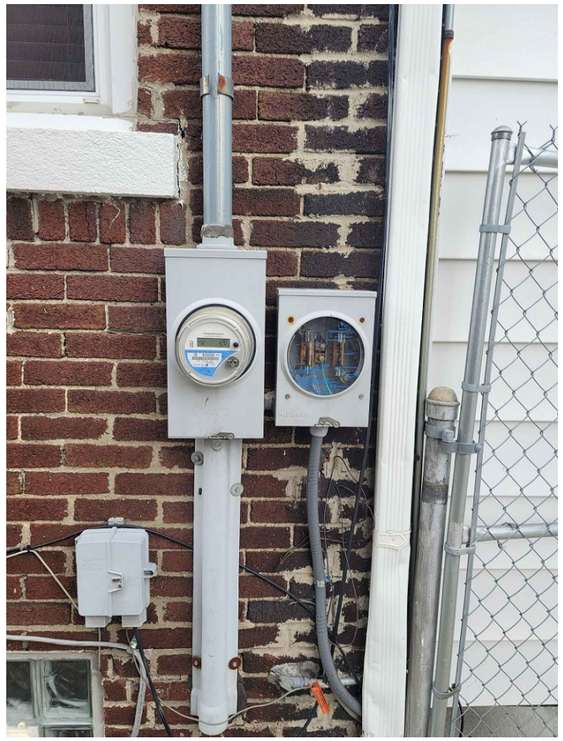
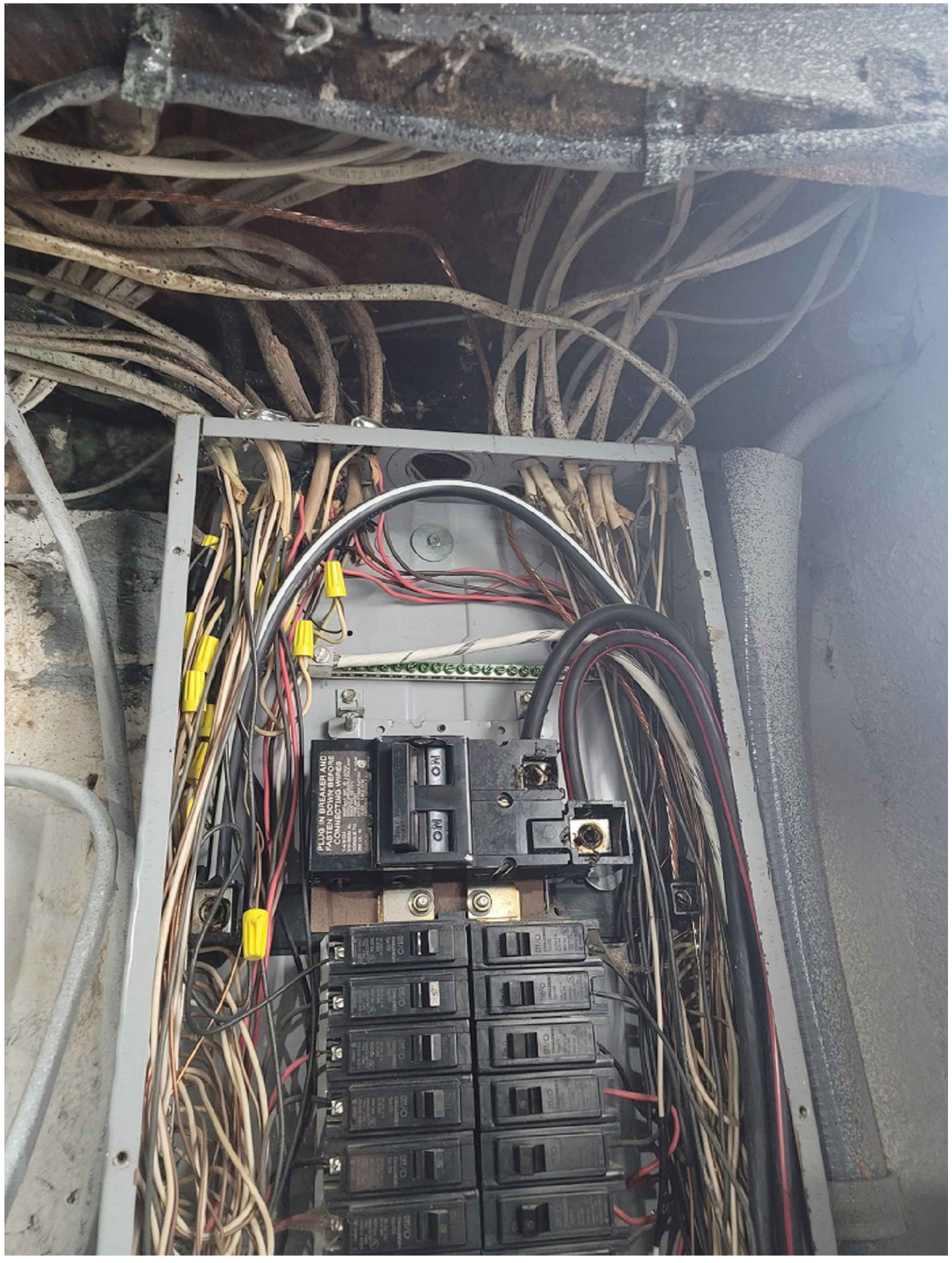
ELECTRICAL LABELS

PV-6





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ELECTRICAL PHOTOS

JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN

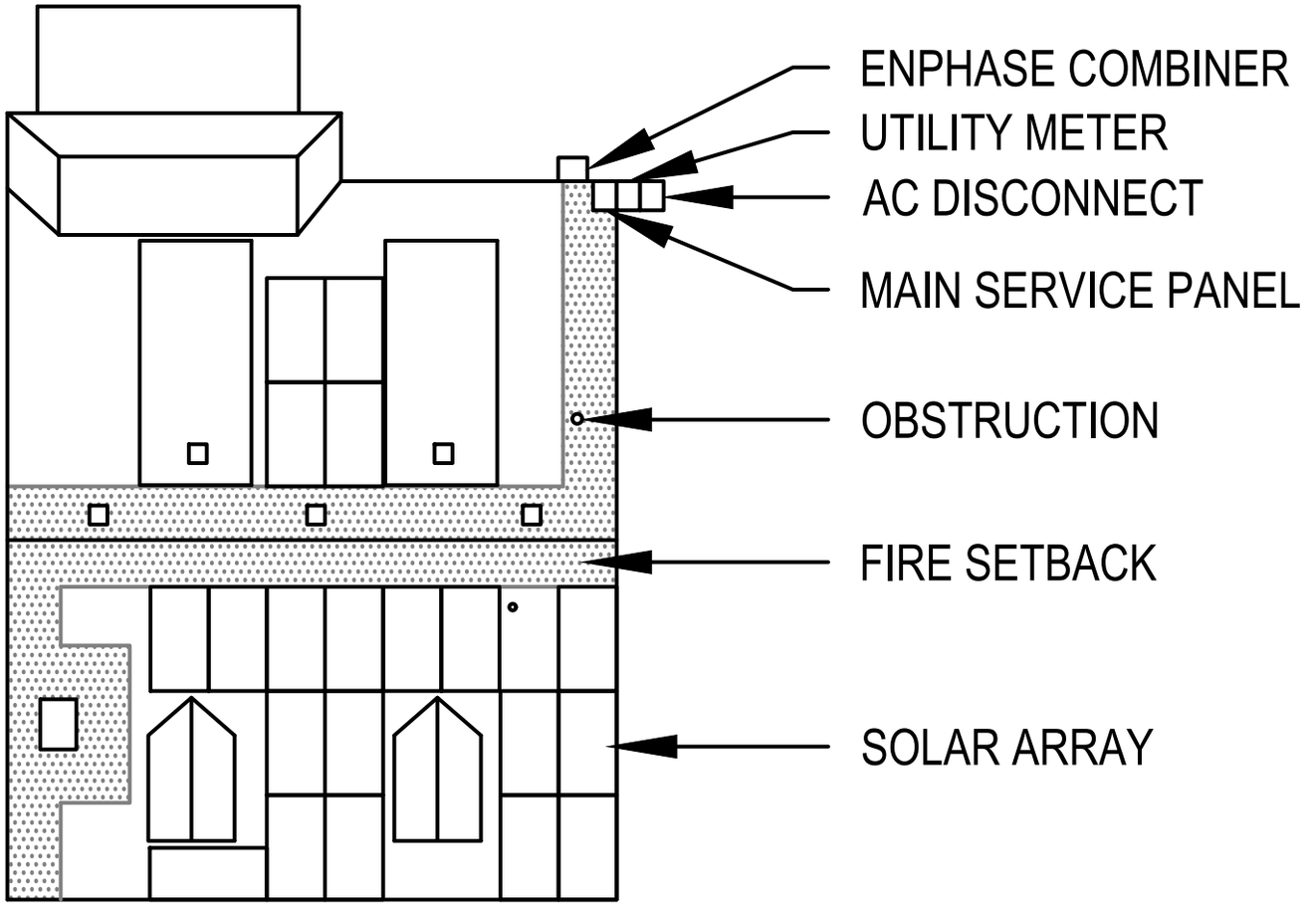
REV #1:
REV #2:
REV #3:

PV-7

⚠ CAUTION ⚠

POWER TO THIS BUILDING IS SUPPLIED FROM THE FOLLOWING SOURCES WITH DISCONNECTS LOCATED AS SHOWN

SERVICE 1 OF 1



2490 LONGFELLOW STREET, DETROIT, MI 48206

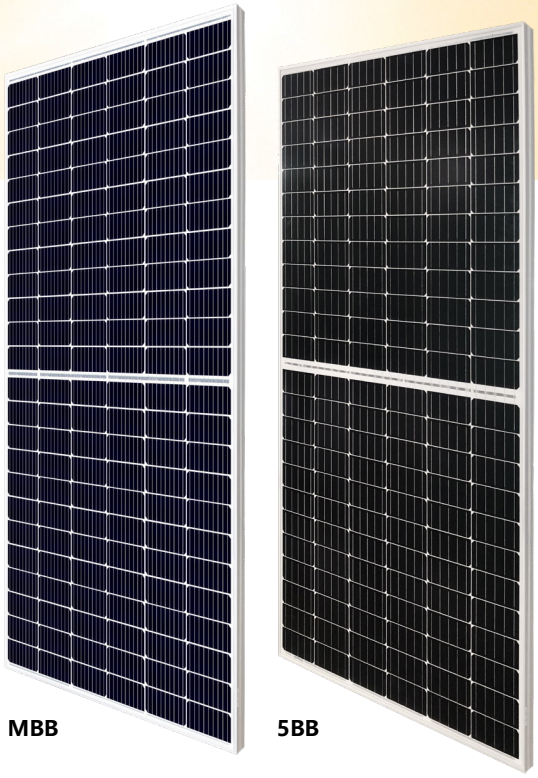
CanadianSolar

KuMax

HIGH EFFICIENCY MONO PERC MODULE

CS3U-380|385|390|395|400MS

(1000 V / 1500 V)



MBB 5BB

MORE POWER

- Low power loss in cell connection
- Low NMOT: 42 ± 3 °C
  Low temperature coefficient (Pmax): -0.36 % / °C
- Better shading tolerance
- High PTC rating of up to: 93.24 %

MORE RELIABLE

- Lower hot spot temperature
- Minimizes micro-crack impacts
- Heavy snow load up to 5400 Pa,
  wind load up to 3600 Pa*

25 years linear power output warranty*

12 years enhanced product warranty on materials and workmanship*

*According to the applicable Canadian Solar Limited Warranty Statement.

MANAGEMENT SYSTEM CERTIFICATES

ISO 9001:2015 / Quality management system
ISO 14001:2015 / Standards for environmental management system
OHSAS 18001:2007 / International standards for occupational health & safety

PRODUCT CERTIFICATES*

IEC 61215 / IEC 61730: VDE / CE / CQC / MCS / KS / INMETRO
UL 1703 / IEC 61215 performance: CEC listed (US) / FSEC (US Florida)
UL 1703: CSA / IEC 61701 ED2: VDE / IEC 62716: VDE / IEC 60068-2-68: SGS
Take-e-way

* As there are different certification requirements in different markets, please contact your local Canadian Solar sales representative for the specific certificates applicable to the products in the region in which the products are to be used.

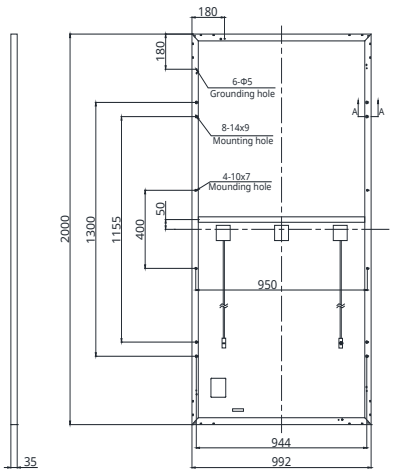
CANADIAN SOLAR INC. is committed to providing high quality solar products, solar system solutions and services to customers around the world. No. 1 module supplier for quality and performance / price ratio in IHS Module Customer Insight Survey. As a leading PV project developer and manufacturer of solar modules with over 40 GW deployed around the world since 2001.

* For detailed information, please refer to the Installation Manual.

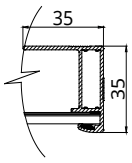
CANADIAN SOLAR INC.
545 Speedvale Avenue West, Guelph, Ontario N1K 1E6, Canada, www.canadiansolar.com, support@canadiansolar.com

ENGINEERING DRAWING (mm)

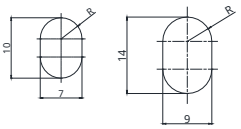
Rear View



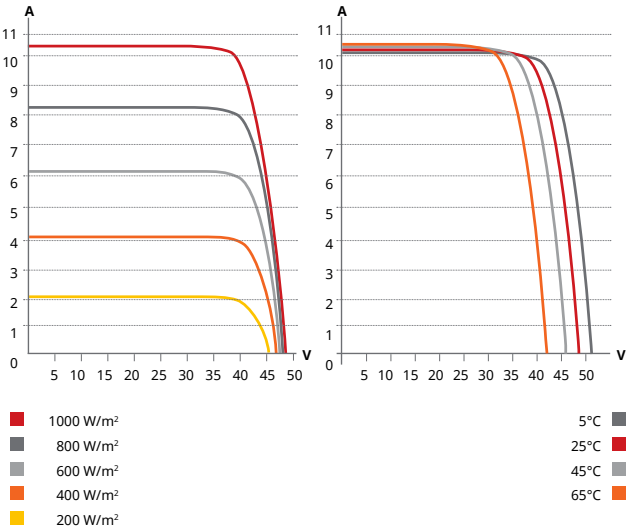
Frame Cross Section A-A



Mounting Hole



CS3U-400MS / I-V CURVES



ELECTRICAL DATA | STC*

CS3U	380MS	385MS	390MS	395MS	400MS
Nominal Max. Power (Pmax)	380 W	385 W	390 W	395 W	400 W
Opt. Operating Voltage (Vmp)	40.0 V	40.2 V	40.4 V	40.6 V	40.8 V
Opt. Operating Current (Imp)	9.50 A	9.58 V	9.66 A	9.73 A	9.81 A
Open Circuit Voltage (Voc)	47.8 V	48.0 V	48.2 V	48.4 V	48.6 V
Short Circuit Current (Isc)	10.01 A	10.09 A	10.17 A	10.25 A	10.33 A
Module Efficiency	19.2%	19.4%	19.7%	19.9%	20.2%
Operating Temperature	-40°C ~ +85°C				
Max. System Voltage	1500V (IEC/UL) or 1000V (IEC/UL)				
Module Fire Performance	TYPE 1 (UL 1703) or Class C (IEC 61730)				
Max. Series Fuse Rating	30 A				
Application Classification	Class A				
Power Tolerance	0 ~ + 10 W				

* Under Standard Test Conditions (STC) of irradiance of 1000 W/m², spectrum AM 1.5 and cell temperature of 25°C.

ELECTRICAL DATA | NMOT*

CS3U	380MS	385MS	390MS	395MS	400MS
Nominal Max. Power (Pmax)	283 W	287 W	290 W	294 W	298 W
Opt. Operating Voltage (Vmp)	37.2 V	37.4 V	37.6 V	37.8 V	38.0 V
Opt. Operating Current (Imp)	7.60 A	7.66 A	7.72 A	7.78 A	7.84 A
Open Circuit Voltage (Voc)	44.8 V	45.0 V	45.2 V	45.4 V	45.6 V
Short Circuit Current (Isc)	8.08 A	8.14 A	8.20 A	8.27 A	8.33 A

* Under Nominal Module Operating Temperature (NMOT), irradiance of 800 W/m², spectrum AM 1.5, ambient temperature 20°C, wind speed 1 m/s.

MECHANICAL DATA

Specification	Data
Cell Type	Mono-crystalline
Cell Arrangement	144 [2 X (12 X 6)]
Dimensions	2000 X 992 X 35 mm (78.7 X 39.1 X 1.38 in)
Weight	22.5 kg (49.6 lbs)
Front Cover	3.2 mm tempered glass
Frame	Anodized aluminium alloy, crossbar enhanced
J-Box	IP68, 3 bypass diodes
Cable	4 mm² (IEC), 12 AWG (UL)
Cable Length (Including Connector)	Portrait: 400 mm (15.7 in) (+) / 280 mm (11.0 in) (-); landscape: 1250 mm (49.2 in); leap-frog connection: 1670 mm (65.7 in)*
Connector	T4 series or H4 UTX or MC4-EVO2
Per Pallet	30 pieces
Per Container (40' HQ)	660 pieces

* For detailed information, please contact your local Canadian Solar sales and technical representatives.

TEMPERATURE CHARACTERISTICS

Specification	Data
Temperature Coefficient (Pmax)	-0.36 % / °C
Temperature Coefficient (Voc)	-0.29 % / °C
Temperature Coefficient (Isc)	0.05 % / °C
Nominal Module Operating Temperature	42 ± 3°C

PARTNER SECTION

* The specifications and key features contained in this datasheet may deviate slightly from our actual products due to the on-going innovation and product enhancement. Canadian Solar Inc. reserves the right to make necessary adjustments to the information described herein at any time without further notice. Please be kindly advised that PV modules should be handled and installed by qualified people who have professional skills and please carefully read the safety and installation instructions before using our PV modules.

CANADIAN SOLAR INC.
545 Speedvale Avenue West, Guelph, Ontario N1K 1E6, Canada, www.canadiansolar.com, support@canadiansolar.com

Enphase IQ Combiner 4/4C

X-IQ-AM1-240-4
X-IQ-AM1-240-4C

X-IQ-AM1-240-4C

X-IQ-AM1-240-4

The **Enphase IQ Combiner 4/4C** with Enphase IQ Gateway and integrated LTE-M1 cell modem (included only with IQ Combiner 4C) consolidates interconnection equipment into a single enclosure and streamlines IQ microinverters and storage installations by providing a consistent, pre-wired solution for residential applications. It offers up to four 2-pole input circuits and Eaton BR series busbar assembly.

Smart

- Includes IQ Gateway for communication and control
- Includes Enphase Mobile Connect cellular modem (CELLMODEM-M1-06-SP-05), included only with IQ Combiner 4C
- Includes solar shield to match Enphase IQ Battery aesthetics and deflect heat
- Flexible networking supports Wi-Fi, Ethernet, or cellular
- Optional AC receptacle available for PLC bridge
- Provides production metering and consumption monitoring

Simple

- Centered mounting brackets support single stud mounting
- Supports bottom, back and side conduit entry
- Up to four 2-pole branch circuits for 240 VAC plug-in breakers (not included)
- 80A total PV or storage branch circuits

Reliable

- Durable NRTL-certified NEMA type 3R enclosure
- Five-year limited warranty
- Two years labor reimbursement program coverage included for both the IQ Combiner SKU's
- UL listed

UL LISTED

To learn more about Enphase offerings, visit **enphase.com**

ENPHASE

Enphase IQ Combiner 4/4C

MODEL NUMBER	
IQ Combiner 4 (X-IQ-AM1-240-4)	IQ Combiner 4 with Enphase IQ Gateway printed circuit board for integrated revenue grade PV production metering (ANSI C12.20 +/- 0.5%) and consumption monitoring (+/- 2.5%). Includes a silver solar shield to match the IQ Battery system and IQ System Controller 2 and to deflect heat.
IQ Combiner 4C (X-IQ-AM1-240-4C)	IQ Combiner 4C with Enphase IQ Gateway printed circuit board for integrated revenue grade PV production metering (ANSI C12.20 +/- 0.5%) and consumption monitoring (+/- 2.5%). Includes Enphase Mobile Connect cellular modem (CELLMODEM-M1-06-SP-05), a plug-and-play industrial-grade cell modem for systems up to 60 microinverters. (Available in the US, Canada, Mexico, Puerto Rico, and the US Virgin Islands, where there is adequate cellular service in the installation area.) Includes a silver solar shield to match the IQ Battery and IQ System Controller and to deflect heat.
ACCESSORIES AND REPLACEMENT PARTS	(not included, order separately)
Ensemble Communications Kit COMMS-CELLMODEM-M1-06 CELLMODEM-M1-06-SP-05 CELLMODEM-M1-06-AT-05	- Includes COMMS-KIT-01 and CELLMODEM-M1-06-SP-05 with 5-year Sprint data plan for Ensemble sites - 4G based LTE-M1 cellular modem with 5-year Sprint data plan - 4G based LTE-M1 cellular modem with 5-year AT&T data plan
Circuit Breakers BRK-10A-2-240V BRK-15A-2-240V BRK-20A-2P-240V BRK-15A-2P-240V-B BRK-20A-2P-240V-B	Supports Eaton BR210, BR215, BR220, BR230, BR240, BR250, and BR260 circuit breakers. Circuit breaker, 2 pole, 10A, Eaton BR210 Circuit breaker, 2 pole, 15A, Eaton BR215 Circuit breaker, 2 pole, 20A, Eaton BR220 Circuit breaker, 2 pole, 15A, Eaton BR215B with hold down kit support Circuit breaker, 2 pole, 20A, Eaton BR220B with hold down kit support
EPLC-01	Power line carrier (communication bridge pair), quantity - one pair
XA-SOLARSHIELD-ES	Replacement solar shield for IQ Combiner 4/4C
XA-PLUG-120-3	Accessory receptacle for Power Line Carrier in IQ Combiner 4/4C (required for EPLC-01)
XA-ENV-PCBA-3	Replacement IQ Gateway printed circuit board (PCB) for Combiner 4/4C
X-IQ-NA-HD-125A	Hold down kit for Eaton circuit breaker with screws.
ELECTRICAL SPECIFICATIONS	
Rating	Continuous duty
System voltage	120/240 VAC, 60 Hz
Eaton BR series busbar rating	125 A
Max. continuous current rating	65 A
Max. continuous current rating (input from PV/storage)	64 A
Max. fuse/circuit rating (output)	90 A
Branch circuits (solar and/or storage)	Up to four 2-pole Eaton BR series Distributed Generation (DG) breakers only (not included)
Max. total branch circuit breaker rating (input)	80A of distributed generation / 95A with IQ Gateway breaker included
Envoy breaker	10A or 15A rating GE/Siemens/Eaton included
Production metering CT	200 A solid core pre-installed and wired to IQ Gateway
Consumption monitoring CT (CT-200-SPLIT)	A pair of 200 A split core current transformers
MECHANICAL DATA	
Dimensions (WxHxD)	37.5 x 49.5 x 16.8 cm (14.75" x 19.5" x 6.63"). Height is 21.06" (53.5 cm) with mounting brackets.
Weight	7.5 kg (16.5 lbs)
Ambient temperature range	-40° C to +46° C (-40° to 115° F)
Cooling	Natural convection, plus heat shield
Enclosure environmental rating	Outdoor, NRTL-certified, NEMA type 3R, polycarbonate construction
Wire sizes	• 20 A to 50 A breaker inputs: 14 to 4 AWG copper conductors • 60 A breaker branch input: 4 to 1/0 AWG copper conductors • Main lug combined output: 10 to 2/0 AWG copper conductors • Neutral and ground: 14 to 1/0 copper conductors Always follow local code requirements for conductor sizing.
Altitude	To 2000 meters (6,560 feet)
INTERNET CONNECTION OPTIONS	
Integrated Wi-Fi	802.11b/g/n
Cellular	CELLMODEM-M1-06-SP-05, CELLMODEM-M1-06-AT-05 (4G based LTE-M1 cellular modem). Note that an Enphase Mobile Connect cellular modem is required for all Ensemble installations.
Ethernet	Optional, 802.3, Cat5E (or Cat 6) UTP Ethernet cable (not included)
COMPLIANCE	
Compliance, IQ Combiner	UL 1741, CAN/CSA C22.2 No. 107.1, 47 CFR, Part 15, Class B, ICES 003 Production metering: ANSI C12.20 accuracy class 0.5 (PV production) Consumption metering: accuracy class 2.5
Compliance, IQ Gateway	UL 60601-1/CANCSA 22.2 No. 61010-1

To learn more about Enphase offerings, visit **enphase.com**

ENPHASE

DATA SHEET

IQ8 and IQ8+ Microinverters

Our newest IQ8 Microinverters are the industry's first microgrid-forming, software-defined microinverters with split-phase power conversion capability to convert DC power to AC power efficiently. The brain of the semiconductor-based microinverter is our proprietary application-specific integrated circuit (ASIC) which enables the microinverter to operate in grid-tied or off-grid modes. This chip is built in advanced 55nm technology with high speed digital logic and has super-fast response times to changing loads and grid events, alleviating constraints on battery sizing for home energy systems.

Part of the Enphase Energy System, IQ8 Series Microinverters integrate with the Enphase IQ Battery, Enphase IQ Gateway, and the Enphase App monitoring and analysis software.

Enphase 25 year limited warranty

IQ8 Series Microinverters redefine reliability standards with more than one million cumulative hours of power-on testing, enabling an industry-leading limited warranty of up to 25 years.

Connect PV modules quickly and easily to IQ8 Series Microinverters using the included Q-DCC-2 adapter cable with plug-n-play MC4 connectors.

UL CERTIFIED SAFETY

IQ8 Series Microinverters are UL Listed as PV Rapid Shut Down Equipment and conform with various regulations, when installed according to manufacturer's instructions.

Easy to install

- Lightweight and compact with plug-n-play connectors
- Power Line Communication (PLC) between components
- Faster installation with simple two-wire cabling

High productivity and reliability

- Produce power even when the grid is down*
- More than one million cumulative hours of testing
- Class II double-insulated enclosure
- Optimized for the latest high-powered PV modules

Microgrid-forming

- Complies with the latest advanced grid support**
- Remote automatic updates for the latest grid requirements
- Configurable to support a wide range of grid profiles
- Meets CA Rule 21 (UL 1741-SA) requirements

IQ8SP-DS-0002-01-EN-US-2022-03-17

* Only when installed with IQ System Controller 2, meets UL 1741.

** IQ8 and IQ8Plus supports split phase, 240V installations only.

IQ8 and IQ8+ Microinverters

INPUT DATA (DC)		IQ8-60-2-US	IQ8PLUS-72-2-US
Commonly used module pairings[1]	W	235 – 350	235 – 440
Module compatibility		60-cell/120 half-cell	60-cell/120 half-cell, 66-cell/132 half-cell and 72-cell/144 half-cell
MPPT voltage range	V	27 – 37	29 – 45
Operating range	V	25 – 48	25 – 58
Min/max start voltage	V	30 / 48	30 / 58
Max input DC voltage	V	50	60
Max DC current[2] [module Isc]	A	15	
Overvoltage class DC port		II	
DC port backfeed current	mA	0	
PV array configuration		1x1 Ungrounded array; No additional DC side protection required; AC side protection requires max 20A per branch circuit	
OUTPUT DATA (AC)		**IQ8-60-2-US**	**IQ8PLUS-72-2-US**
Peak output power	VA	245	300
Max continuous output power	VA	240	290
Nominal (L-L) voltage/range[3]	V	240 / 211 – 264	
Max continuous output current	A	1.0	1.21
Nominal frequency	Hz	60	
Extended frequency range	Hz	50 – 68	
AC short circuit fault current over 3 cycles	Arms	2	
Max units per 20 A (L-L) branch circuit[4]		16	13
Total harmonic distortion		<5%	
Overvoltage class AC port		III	
AC port backfeed current	mA	30	
Power factor setting		1.0	
Grid-tied power factor (adjustable)		0.85 leading – 0.85 lagging	
Peak efficiency	%	97.5	97.6
CEC weighted efficiency	%	97	97
Night-time power consumption	mW	60	
MECHANICAL DATA			
Ambient temperature range		-40°C to +60°C (-40°F to +140°F)	
Relative humidity range		4% to 100% (condensing)	
DC Connector type		MC4	
Dimensions (HxWxD)		212 mm (8.3”) x 175 mm (6.9”) x 30.2 mm (1.2”)	
Weight		1.08 kg (2.38 lbs)	
Cooling		Natural convection – no fans	
Approved for wet locations		Yes	
Pollution degree		PD3	
Enclosure		Class II double-insulated, corrosion resistant polymeric enclosure	
Environ. category / UV exposure rating		NEMA Type 6 / outdoor	
COMPLIANCE			
Certifications		CA Rule 21 (UL 1741-SA), UL 62109-1, UL1741/IEEE1547, FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 107.1-01 This product is UL Listed as PV Rapid Shut Down Equipment and conforms with NEC 2014, NEC 2017, and NEC 2020 section 690.12 and C22.1-2018 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according to manufacturer’s instructions.	

(1) No enforced DC/AC ratio. See the compatibility calculator at https://link.enphase.com/module-compatibility
(2) Maximum continuous input DC current is 10.6A (3) Nominal voltage range can be extended beyond nominal if required by the utility. (4) Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

ROP-E-Tap

ILSCO

Insulation Piercing Connectors
Dual Rated

RoHS Compliant

UL LISTED 453G

SA LR-29601

TYPE
IPC

Insul-Eater

Features
- Body is molded from tough, resilient glass-filled nylon
- Compact design
- Tin plated copper contact teeth
- Insulation piercing
- Perforated end tabs
- Pre-filled with silicone lubricant
- Versatile
- Increased safety
- Horizontal line grid
- Temperature rating 90˚ C

Benefits
- Provides high degree of breakage resistance and long dependable use
- Saves space
- Easily penetrates most types of insulation
- No need to strip the conductor which saves installation time
- Break out easily by hand
- Prevents oxidation and moisture from entering the contact area
- Can be used as a splice or tap connector
- Contains no external energized parts. Can be installed "hot" on energized conductors providing tap conductor is not under load.
- Provides a visual guide for proper installation of conductors

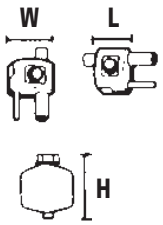



Fig. 1


Fig. 2


Fig. 3


Fig. 4

Catalog Number	Figure Number	Wire Range		Volts	Current Rating		Dimensions			Torque	Bolt Head
		Main	Tap		CU	AL	L	W	H	Ft. Lbs.	Size
IPC-1/0-2	3	1/0-8	2-8	300 (480 Grounded Y System)	130	100	1-7/32	1-15/32	2-5/16	16	1/2
IPC-4/0-6	2	4/0-4	6-14	600	75	60	1-27/64	1	1-7/8	13	1/2
IPC-4/0-2/0	3	4/0-2	2/0-6	600	195	150	1-21/32	1-7/8	2-7/8	25	1/2
IPC-250-4/0	2	250kcmil-1	4/0-6	600	260	205	1-7/8	2-11/32	3-11/32	30	5/8
IPC-350-4/0	3	350kcmil-4/0	4/0-10	300 (480 Grounded Y System)	260	205	1-43/64	2-7/16	3-1/8	25	5/8
IPC-350-350	4	350kcmil-4/0	350kcmil-4/0	300 (480 Grounded Y System)	350	280	2-43/64	2-23/32	3-1/4	25	5/8
IPC-500-12	1	500kcmil-250kcmil	10-12	300 (480 Grounded Y System)	40	35	1-43/64	2-7/16	3-1/4	25	5/8
IPC-500-250	1	500kcmil-250kcmil	250kcmil-4	600	290	230	2-27/64	2-29/32	3-3/4	55	5/8-11/16
IPC-500-500	1	500kcmil-300kcmil	500kcmil-250kcmil	600	430	350	3-3/16	3-5/8	5	75	7/8-7/8
IPC-750-500	1	750kcmil-500kcmil	500kcmil-350kcmil	600	430	350	3-3/16	3-5/8	5	75	7/8-7/8

All wire sizes, unless noted otherwise, are American Wire Gauge (AWG)
Tested to UL 486A/B, UL File E6207

ILSCO 4730 Madison Road, Cincinnati, Ohio 45227-1426 Phone 513 533-6200 Fax 513 871-4084 Web site www.ilsco.com
Canada 1050 Lakeshore Road East, Mississauga, Ontario, Canada L5E1E4 Phone 905 274-2341 Fax 905 274-8763

SM SOLAR MOUNT

INSTALLATION GUIDE

UNIRAC®

BETTER SOLAR STARTS HERE

UNIRAC Code-Compliant Installation Manual

UNIRAC welcomes input concerning the accuracy and user-friendliness of this publication. Please write to publications@unirac.com.

PUB2023FEB10

SM SOLAR MOUNT

INSTALLATION GUIDE

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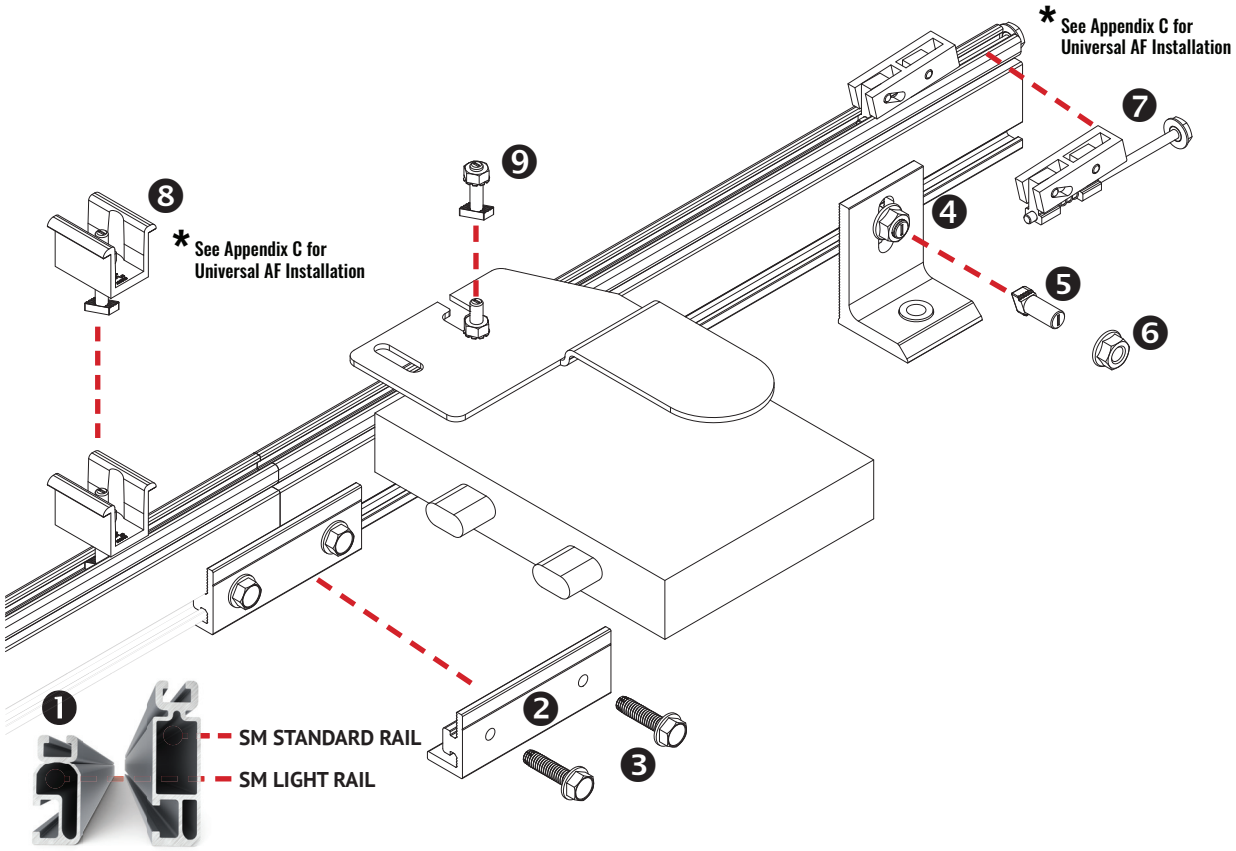
PRO SERIES SYSTEM

STANDARD SERIES SYSTEM

SM SOLAR MOUNT

PRO SERIES SYSTEM COMPONENTS

INSTALLATION GUIDE



❶**RAIL**: Supports PV modules. Use at least two per row of modules. Aluminum extrusion, available in mill, clear anodized, or dark anodized.

❷❸**RAIL SPLICE**: Non structural splice joins, aligns, and electrically bonds rail sections into single length of rail. Forms a rigid splice joint, 4 inches long, preassembled with bonding hardware. Available in dark anodized or mill finish.

❹**L-FOOT**: Use to secure rails through roofing material to building structure. Refer to loading tables or U-Builder for spacing.

❺ **L-FOOT T- BOLT**: (3/8" x ¾" or 1") – Use one per L-foot to secure rail to L-foot. Stainless steel. Supplied with L-foot in combination with flange nut, provides electrical bond between L-foot and rail.

❻**SERRATED FLANGE NUT** : Use one per L-foot to secure and bond rail to L-foot. Stainless steel. Supplied with L-foot.

❼**MODULE ENDCLAMP**: Pre-assembled universal clamp that secures module to rail at module flange by tightening 1/2" hex head bolt.

❽**MODULE MIDCLAMP**: Pre-assembled clamp provides module to module and module to rail bond. Aluminum clamp with stainless steel bonding pins and T-bolt. Available in clear or dark finish.

❾**MICROINVERTER MOUNTING BOLT**: Preassembled bolt, nut, and captive star washer attaches and bonds microinverter to rail.

NOTE - POSITION INDICATOR: T-bolts have a slot in the hardware end corresponding to the direction of the T-Head.

NOTE - Pro Series Mid and End Clamps are single use only

Wrenches and Torque

	Wrench or Socket Size	Recommended Torque (ft-lbs)
Mid Clamp ❽	1/2"	11
MLPE Mount ❾	1/2"	10
End Clamp ❼	1/2"	5
L-Foot to Rail ❻	1/2"	30
Rail Splice ❸	1/2"	10

Anti-Seize ❻❾

Stainless steel hardware can seize up, a process called galling. To significantly reduce its likelihood:
1. Apply minimal lubricant to bolts only where indicated in installation process, preferably Anti-Seize commonly found at auto parts stores (Anti-seize has been factory applied to mid clamp bolts)
2. Shade hardware prior to installation, and
3. Avoid spinning stainless nuts onto bolts at high speed.

RAILS

TYPE	PART NUMBER	DESCRIPTION
LIGHT RAIL	315168M	SM LIGHT RAIL 168" MILL
	315168D	SM LIGHT RAIL 168" DRK
	315208M	SM LIGHT RAIL 208" MILL
	315208D	SM LIGHT RAIL 208" DRK
	315246M	SM LIGHT RAIL 246" MILL
	315246D	SM LIGHT RAIL 246" DRK
STANDARD RAIL	320132M	SM RAIL 132" MILL
	310132C	SM RAIL 132" CLR
	320168M	SM RAIL 168" MILL
	310168C	SM RAIL 168" CLR
	310168D	SM RAIL 168" DRK
	320208M	SM RAIL 208" MILL
	310208C	SM RAIL 208" CLR
	320246M	SM RAIL 246" MILL
	310246C	SM RAIL 246" CLR
	310246D	SM RAIL 246" DRK
HEAVY DUTY RAIL	410144M	SMHD, RAIL 144" MILL
	410168M	SMHD, RAIL 168" MILL
	410204M	SMHD RAIL 204" MILL
	410246M	SMHD, RAIL 246" MILL

SYMBOL	DESCRIPTION
AL	ALUMINUM
CLR	CLEAR ANODIZED
DRK	DARK BRONZE ANODIZED
SS	STAINLESS STEEL
DRK SS	BLACK OXIDE COATED STAINLESS STEEL

LETTER	SUPPORTED MODULE THICKNESS
B	30MM -32MM
C	33MM -36MM
D	38MM -40MM
K	39MM -41MM
F	45MM -47MM
E	50MM -51MM

MID CLAMPS AND END CLAMPS

S.NO.	PART NUMBER	DESCRIPTION
1	302021C	SM ENDCLAMP B CLR AL
2	302021D	SM ENDCLAMP B DRK AL
3	302022C	SM ENDCLAMP C CLR AL
4	302022D	SM ENDCLAMP C DRK AL
5	302023C	SM ENDCLAMP D CLR AL
6	302023D	SM ENDCLAMP D DRK AL
7	302024C	SM ENDCLAMP E CLR AL
8	302024D	SM ENDCLAMP E DRK AL
9	302025C	SM ENDCLAMP F CLR AL
10	302025D	SM ENDCLAMP F DRK AL
11	302026C	SM ENDCLAMP K CLR AL
12	302026D	SM ENDCLAMP K DRK AL
13	302027C	SM BND MIDCLAMP BC SS
14	302027D	SM BND MIDCLAMP BC DRK SS
15	302028C	SM BND MIDCLAMP EF SS
16	302028D	SM BND MIDCLAMP EF DRK SS
17	302029C	SM BND MIDCLAMP DK SS
18	302029D	SM BND MIDCLAMP DK DRK SS
19	302030D	SM MIDCLAMP PRO DRK
20	302030M	SM MIDCLAMP PRO MILL
21	302035M	SM ENDCLAMP PRO W/CAP
22	302045D	UNIVERSAL AF MID CLAMP DRK
23	302045M	UNIVERSAL AF MID CLAMP MILL
24	302050D	UNIVERSAL AF END CLAMP DRK
25	302050M	UNIVERSAL AF END CLAMP MILL

COMPONENTS

S.NO.	PART NUMBER	DESCRIPTION
1	303019M	BND SPLICE BAR PRO SERIES MILL
2	303019D	BND SPLICE BAR PRO SERIES DRK
3	304001C	L-FOOT SERR W/ T-BOLT, CLR
4	304001D	L-FOOT SERR W/ T-BOLT, DRK
5	009010S	SPLICE TEK SCRW #12-14X3/4" SS
6	009020S	BND T-BOLT&NUT 3/8" X 3/4" SS
7	009021S	BND T-BOLT&NUT 3/8" X 1" SS
8	004055M	FLASHKIT PRO, MILL 10 PK
9	004055D	FLASHKIT PRO, DRK 10 PK
10	004015D	SOLARMOUNT FLASHKIT PRO SB, DARK
11	004015M	SOLARMOUNT FLASHKIT PRO SB, MILL
12	004085M	FLASHLOC COMP KIT MILL
13	004085D	FLASHLOC COMP KIT DRK
14	004275M	FLASHLOC DUO MILL
15	004275D	FLASHLOC DUO DARK
16	003250W	#12-14 X 2.50 SCREW HDW SS SD
17	004CT5H	SOLARHOOK UNIV SIDE MT CT5
18	004CT1H	SOLARHOOK SPANISH 7" BASE
19	004CT2H	SOLARHOOK SPANISH 9" BASE
20	004FLAT	SOLARHOOK FLASHING FLAT
21	004FLCT	SOLARHOOK FLASHING SPANISH FLCT
22	004AT1H	SOLARHOOK FLAT TILE
23	004ST1S	SOLARHOOK STONE COATED MT ST1
24	004AST1	SOLARHOOK ADJ STONE COATED ST1
25	004300M	STANDOFF 3" 2 PIECE AL, MILL
26	004300D	STANDOFF 3" 2 PIECE AL, DRK
27	004400M	STANDOFF 4" 2 PIECE AL, MILL

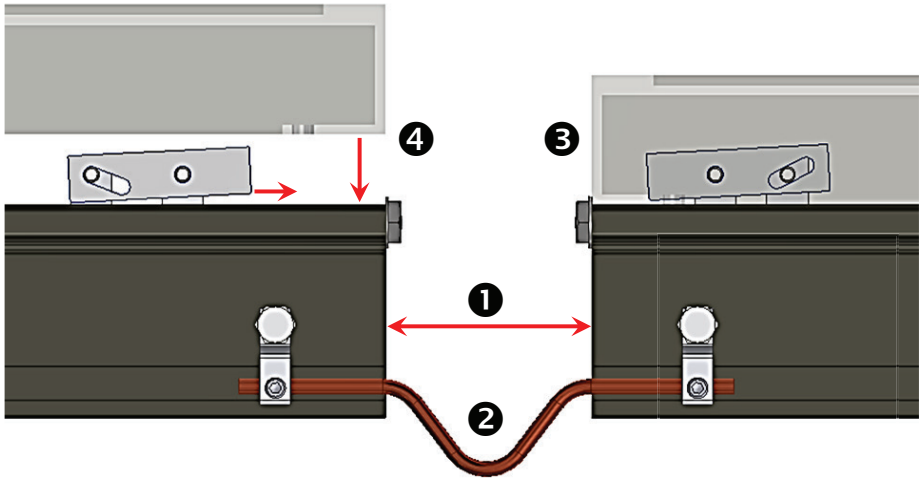
S.NO.	PART NUMBER	DESCRIPTION
28	004400D	STANDOFF 4" 2 PIECE AL, DRK
29	004600M	STANDOFF 6" 2 PIECE AL, MILL
30	004600D	STANDOFF 6" 2 PIECE AL, DRK
31	004700M	STANDOFF 7" 2 PIECE AL, MILL
32	004700D	STANDOFF 7" 2 PIECE AL, DRK
33	330007M	AL STNDOFF 3/8" BOLT&EPDMWSHR
34	004013C	FLASH SOFT AL 18X18 OATEY 12836

EXPANSION JOINT USED AS THERMAL BREAK

Expansion joints prevent buckling of rails or system failure due to thermal expansion. Determine location of expansion joints prior to installation of L-feet and rails. To create a thermal expansion joint, set gap between rails that is sufficient for proper installation of end clamps and tooling to achieve required torque. A thermal break is required when a continuous length of spliced rails exceeds the length, in feet, shown in the table to the right. For additional concerns on thermal breaks in your specific project, please consult a licensed structural engineer.

Rails in expansion joint configurations are considered cantilevered and must follow the cantilever rule, on both sides of the expansion joint, which states that the maximum amount of rail that can be cantilevered is 1/3 the respective adjacent span. An expansion joint must not be spanned by a PV module. Installing a module over an expansion joint would defeat the goal of a thermal break and could result in damage to the array.

Bonding connection for splice used as a thermal break. Option shown uses two Ilsco lugs (Model No. GBL-4DBT P/N GBL-4DBT - see product data sheet for more details) and solid copper wire. Optional grounding may be achieved through Enphase microinverter. See page 11.



	Maximum Continuous Length (ft.) of Spliced Rails			
	Solarmount Standard		Solarmount Light	
	Attachment Span		Attachment Span	
ΔT (°F)	48"	72"	48"	72"
0-40	86	105	70	81
40-50	70	93	62	81
50-60	70	81	54	69
60-70	62	69	54	69
70-80	54	69	46	57
80-90	54	69	46	57
90-100	54	57	46	57
100-120	46	57	38	45
120-140	38	45	38	45

The values displayed are the maximum allowed rail length, in feet, without a thermal break.
These values apply only to the Flashkit Pro L-foot. For Flashloc Comp Mount, or if your span is less than 48", refer to the Solarmount Design & Engineering Guide for max lengths of continuous rail before a thermal break is required.
The installer is responsible for determining the maximum temperature difference (ΔT) used to establish the maximum rail length, without expansion joint, at the install location.
As spans increase, so does the maximum reaction force that the rail exerts on the L-foot. It is the responsibility of the installer to ensure that Maximum Reaction Force does not exceed the shear capacity of the roof connection. See SM Design and Engineering Guide for corresponding reaction forces.
ΔT refers to the maximum difference in the temperature of the rail between installation and the extreme high or low temperature. The Extreme Annual Design Conditions table at the following url can be used as a reference when determining ΔT.

http://ashrae-meteo.info/

PLANNING YOUR SOLARMOUNT INSTALLATIONS

The installation can be laid out with rails parallel to the rafters or perpendicular to the rafters. Note that SOLARMOUNT rails make excellent straight edges for doing layouts.

Center the installation area over the structural members as much as possible.

Leave enough room to safely move around the array during installation. Some building codes and fire codes require minimum clearances around such installations, and the installer should check local building code requirements for compliance.

The length of the installation area is equal to:

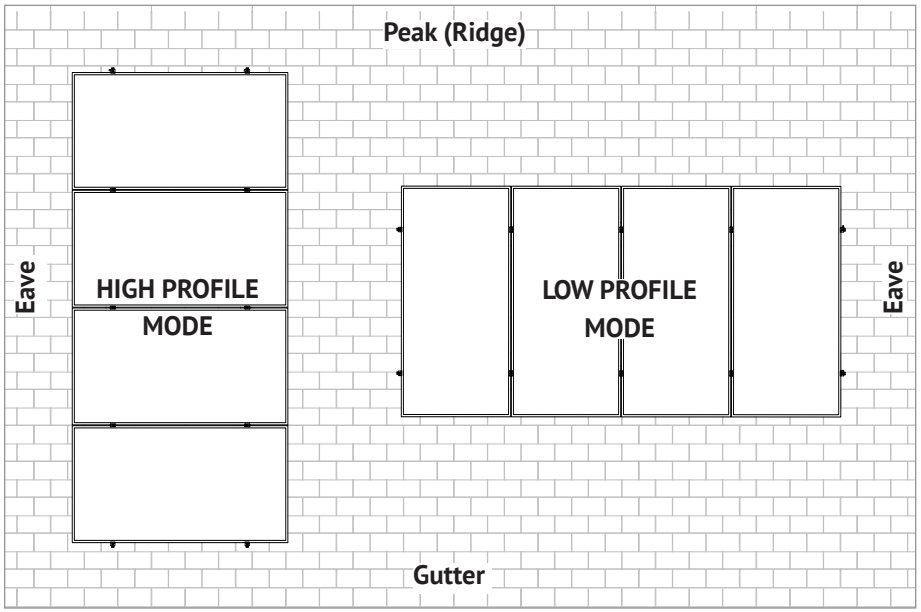
Standard Series:

- the total width of the modules,
- plus 1/4" inch for each space between modules (for mid- clamp),
- plus approximately 3" (1½ inches for each Endclamp)

Pro Series:

- the total width of the modules,
- plus 1" inch for each space between modules (for mid- clamp),
- plus 0 to 1" (0 to ½ inches for each Endclamp)

RAILS MAY BE PLACED PARALLEL OR PERPENDICULAR TO RAFTERS



LAYING OUT L-FEET FOR TOP CLAMPS

L-feet, in conjunction with proper flashing equipment and techniques, can be used for attachment through existing roofing material, such as asphalt shingles, sheathing or sheet metal to the building structure.

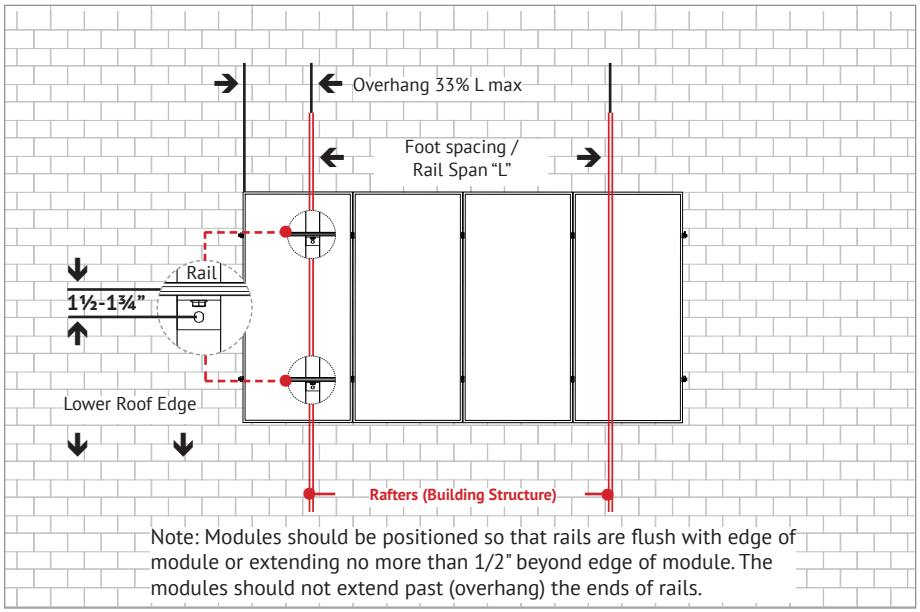
Locate and mark the position of the L-feet lag screw holes within the installation area as shown below. Follow manufacturer module installation guide for rail spacing based on appropriate mounting locations

NOTE: For expansion joint requirements, refer to page 4. Rail Lengths and locations of l-feet for expansion joints will need to be determined at this stage in planning system layout.

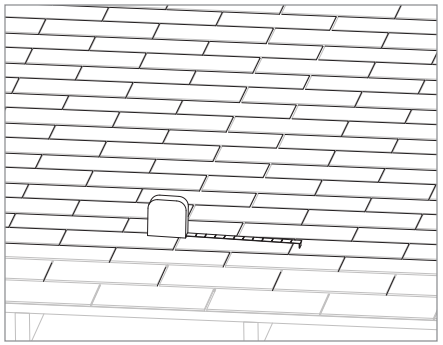
If multiple rows are to be installed adjacent to one another, it is not likely that each row will be centered above the rafters. Adjust as needed, following the guidelines below as closely as possible.

Refer to Unirac Solarmount D&E Guide & U-Builder for allowable spans and cantilevers.

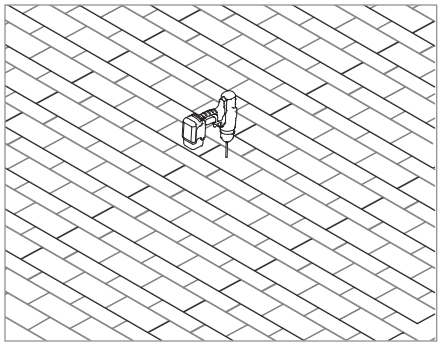
LAYOUT WITH RAILS PERPENDICULAR TO RAFTERS (RECOMMENDED)



Note: Modules should be positioned so that rails are flush with edge of module or extending no more than 1/2" beyond edge of module. The modules should not extend past (overhang) the ends of rails.



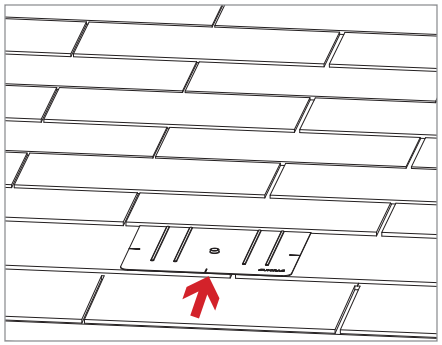
ROOF PREPARATION: Layout and install flashing at rafter locations determined per Design and Engineering Guide.



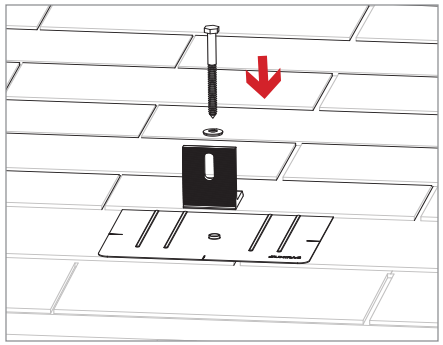
DRILL PILOT HOLES: Center the roof attachment over the rafter and drill a pilot hole(s) for the lag bolt(s).

NOTE: Determine lag bolt size and embedment depth.

Quick Tip: Pre-drill the pilot hole through the flat flashing lag bolt location for easier installation.

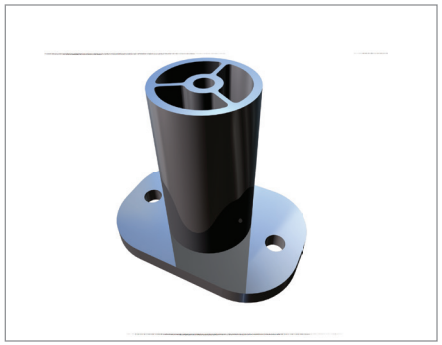


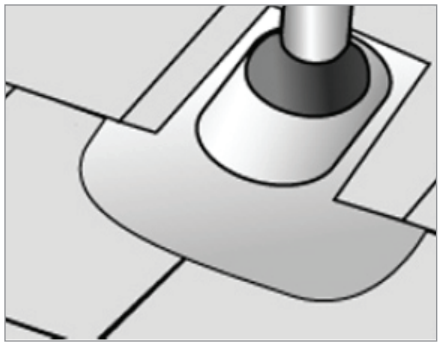
FLASHING INSTALLATION: Insert the flashing so the top part is under the next row of shingles and the hole lines up with the pilot hole.



INSTALL LAG BOLTS & L-FOOT: Insert the lag bolt through the L-Foot in the order shown in the illustration. Verify proper orientation before tightening lag bolts.

For high snow load conditions, install the L-foot as shown above, and install the rail on the downslope face of the L-Foot

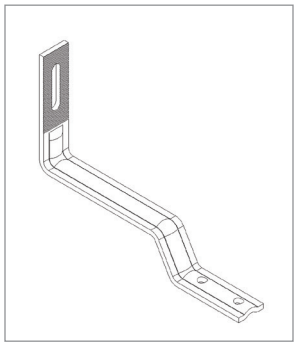


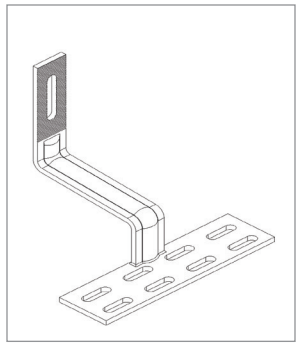


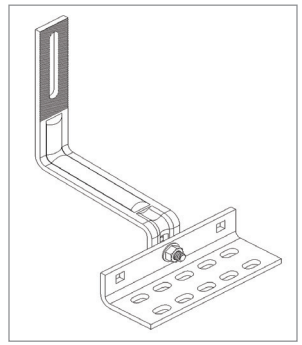
2 PIECE ALUMINUM STANDOFF WITH FLASHING & L-FOOT:

- If necessary cut an opening in the roofing material over a rafter to accommodate the flashing riser.
- Install the standoff, ensuring that both lag bolts are screwed into the rafter.
- Insert the flashing under the shingle above and over the shaft of the standoff. (No-Calk™ collar does not require sealing of the flashing and standoff shaft)
- Add L-Foot to top with bolt that secures the EPDM washer to the top of the standoff.

See Standoffs Installation Manual for Additional Details.





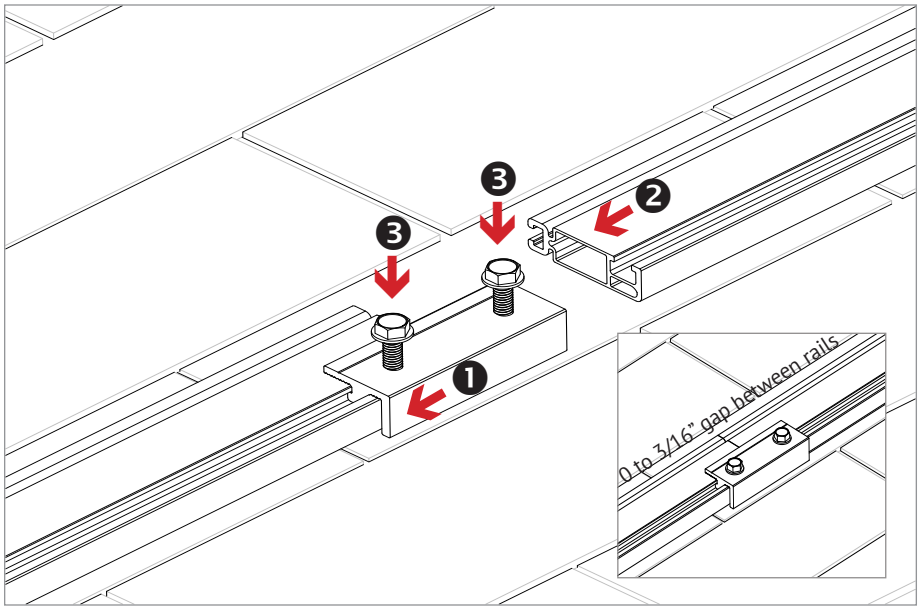


Side MOUNT SOLARHOOK:

- Remove or slide up the roof tile, position the roof hook above the roof rafter
- Place SolarHook in the middle of the underlying interlocking tile's valley. Drill 3/16 inch pilot holes through the underlayment into the center of the rafters. Securely fasten each tile hook to the rafters using included lag screws.
- Slide down or re-insert the tile.

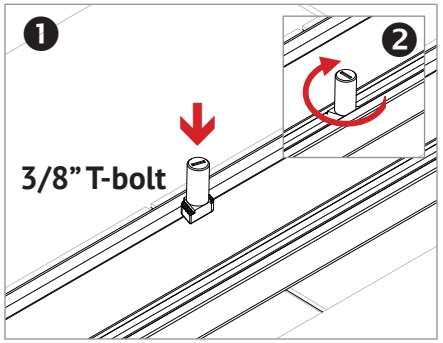
See Unirac Solarhook Installation Manual for Additional Information.

SPLICE INSTALLATION (IF REQUIRED PER SYSTEM DESIGN)
If your installation uses SOLARMOUNT splice bars, attach the rails together before mounting to the L-feet/footings. Use splice bars only with flush installation and those that use low-profile tilt legs. A rail must be supported by more than one footing on both sides of the splice. There can be a gap between rails, up to 3/16" at the splice connections. To install, slide T-feature on splice into the T-slot on each rail, centering the splice between the two rails. Tighten each bolt until the bolt-head is flush against the splice and torqued to 10 ft-lbs. Installation is complete when the bonding hardware penetrates the opposite side of the rail and the assembly torque is achieved. T-bolts should not be placed less than a distance of 1" from the end of the rail regardless of a splice.

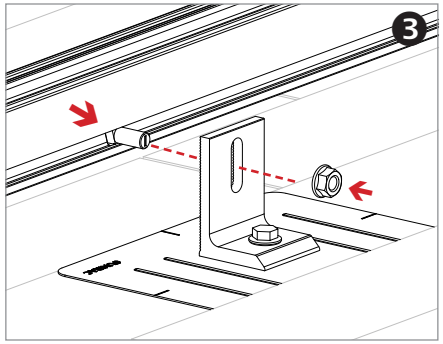


TORQUE VALUE
Hex head socket size ½" – Do not exceed 10 ft-lbs. Do not use Anti-Seize. See table on page 4 for max length of spliced rails. An expansion joint is required above the lengths published in the table.

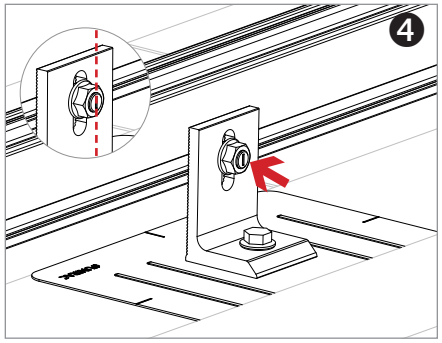
Rails in splice joint configurations are considered cantilevered and must follow the cantilever rule, on both sides of the splice, which states that the maximum amount of rail that can be cantilevered is 1/3 the respective adjacent span. See table on page 4.



PLACE T-BOLT INTO RAIL & SECURE BOLT: Insert 3/8" T-bolt into rail at L-foot locations. Apply Anti-Seize to bolt. Rotate T-bolt into position.



SECURE T-BOLT: Apply Anti-Seize to bolt. Rotate T-bolt into position.



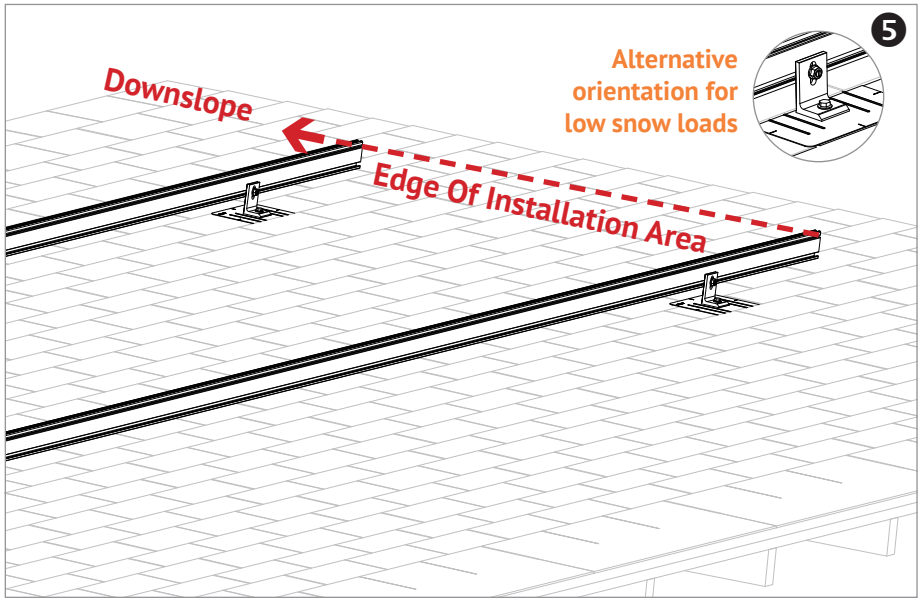
ALIGN POSITION INDICATOR: Hand tighten nut until rail alignment is complete. Verify that position indicator on bolt is vertical (perpendicular to rail)

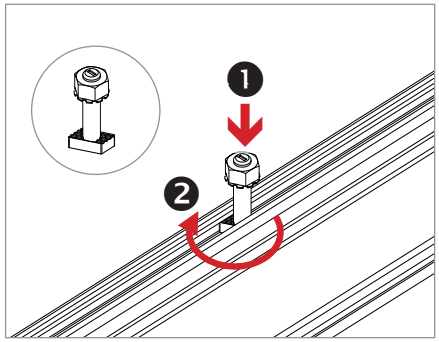
TORQUE VALUE: 3/8" nut to 30 ft-lbs

ALIGN RAILS: Align one pair of rail ends to the edge of the installation area. The opposite pair of rail ends will overhang installation area. Do not Trim them off until the installation is complete. If the rails are perpendicular to the rafters, either end of the rails can be aligned, but the first module must be installed at the aligned end.

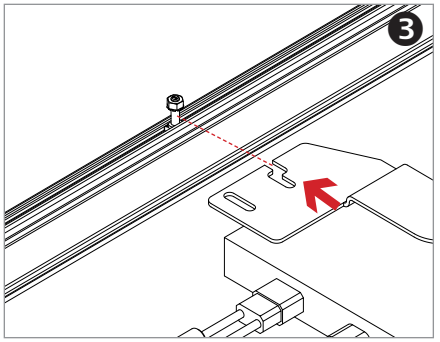
If the rails are parallel to the rafters, the aligned end of the rails must face the lower edge of the roof. Securely tighten all hardware after alignment is complete.

Mount modules to the rails as soon as possible. Large temperature changes may bow the rails within a few hours if module placement is delayed.

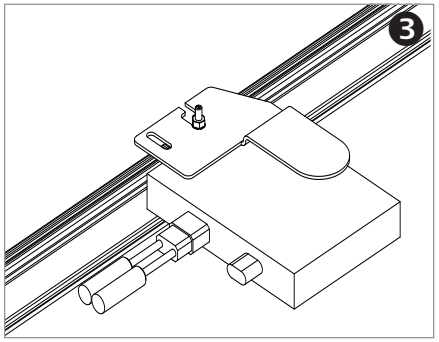




INSTALL MICROINVERTER MOUNT T-BOLT: Apply Anti-Seize and install pre-assembled ¼" dia. bonding T-bolts into top ¼" rail slot at microinverter locations. Rotate bolts into position.

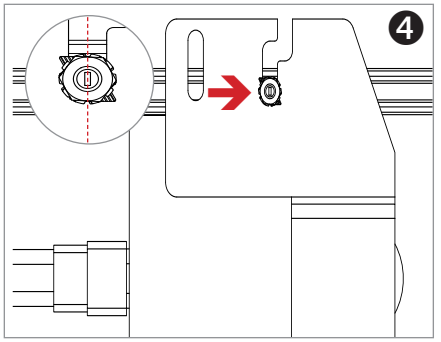


INSTALL MICROINVERTER: Install microinverter on to rail. Engage with bolt.

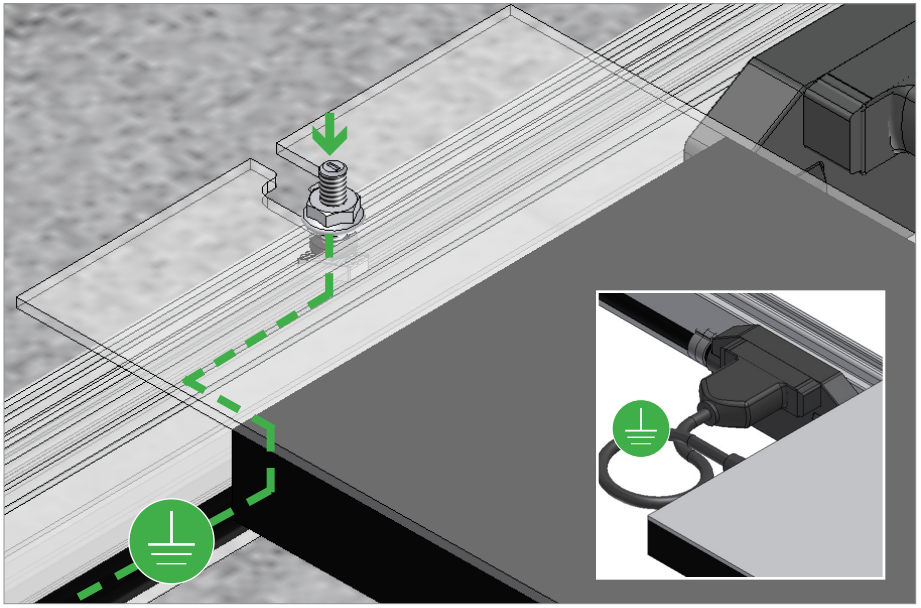


INSTALL MICROINVERTER:

TORQUE VALUE
1/4" nut to 10 ft-lbs with Anti-Seize.



ALIGN POSITION INDICATOR: Verify that position indicator on bolt is perpendicular to rail.



SM EQUIPMENT GROUNDING THROUGH ENPHASE MICROINVERTERS

The Enphase M215 and M250 microinverters have integrated grounding capabilities built in. In this case, the DC circuit is isolated from the AC circuit, and the AC equipment grounding conductor (EGC) is built into the Enphase Engage integrated grounding (IG) cabling.

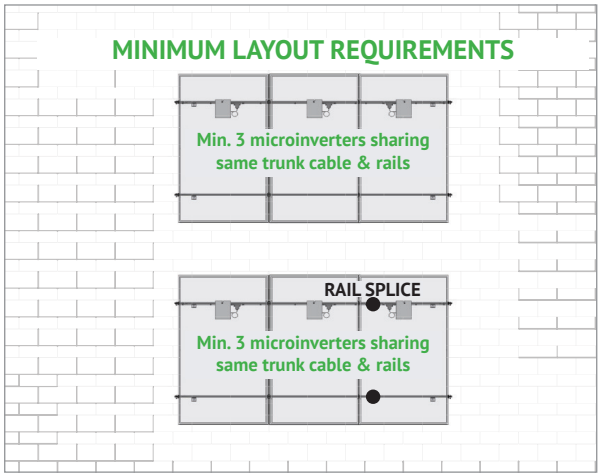
In order to ground the SOLARMOUNT racking system through the Enphase microinverter and Engage cable assembly, there must be a minimum of three PV modules connected to the same trunk cable within a continuous row. Continuous row is defined as a grouping of modules installed and bonded per the requirements of this installation guide sharing the same two rails. The microinverters are bonded to the SOLARMOUNT rail via the mounting hardware. Complete equipment grounding is achieved through the Enphase Engage cabling with integrated grounding (IG). No additional EGC grounding cables are required, as all fault current is carried to ground through the Engage cable.

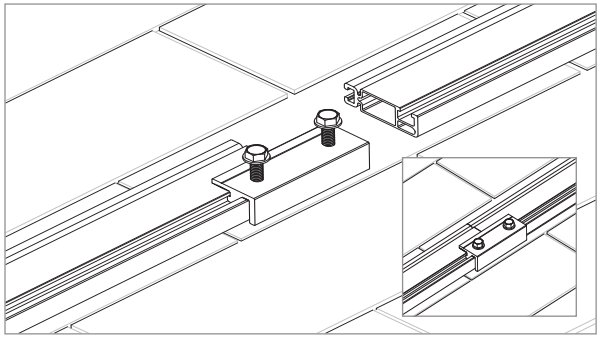
SOLARMOUNT INTEGRATED BONDING ADVANTAGE

WITH SYSTEM GROUNDING THROUGH ENPHASE MICROINVERTERS AND TRUNK CABLES

LOSE ALL THE COPPER & LUGS

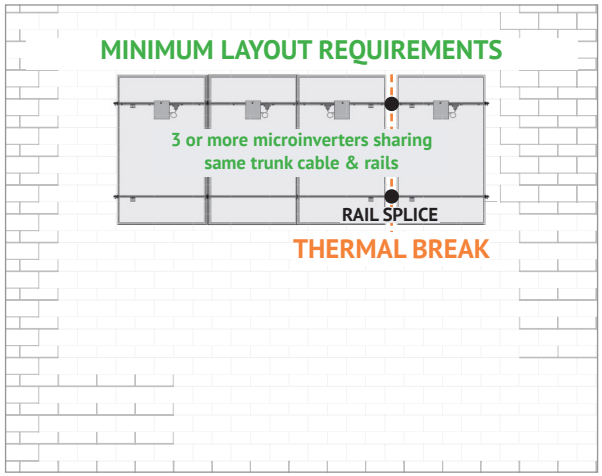
CONTINUOUS RAIL & ELECTRICAL BONDING SPLICE
Enphase Microinverter (MI) Requirements (Model No. M215 & M250)
3 Microinverters sharing same trunk cable & rails

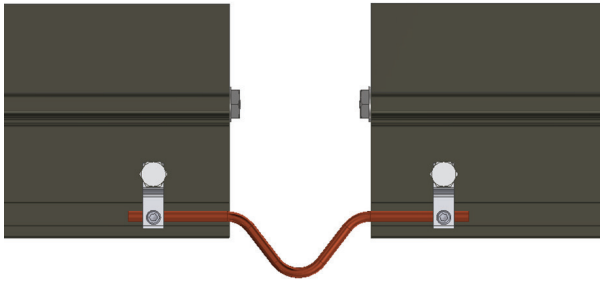




ELECTRICAL BONDING SPLICE

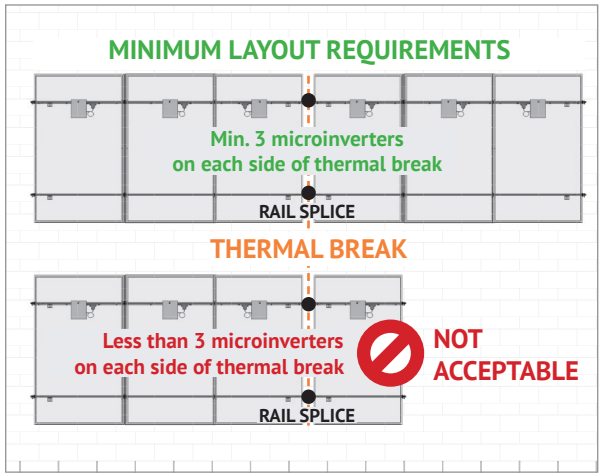
EXPANSION JOINT W/GROUNDING LUGS & COPPER JUMPER
Enphase Microinverter (MI) Requirements (Model No. M215 & M250)
3 or more Microinverters sharing same trunk cable & rails

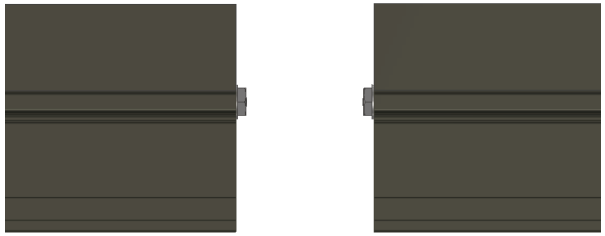




EXPANSION JOINT USED AS THERMAL BREAK W/ GROUNDING LUGS & COPPER JUMPER

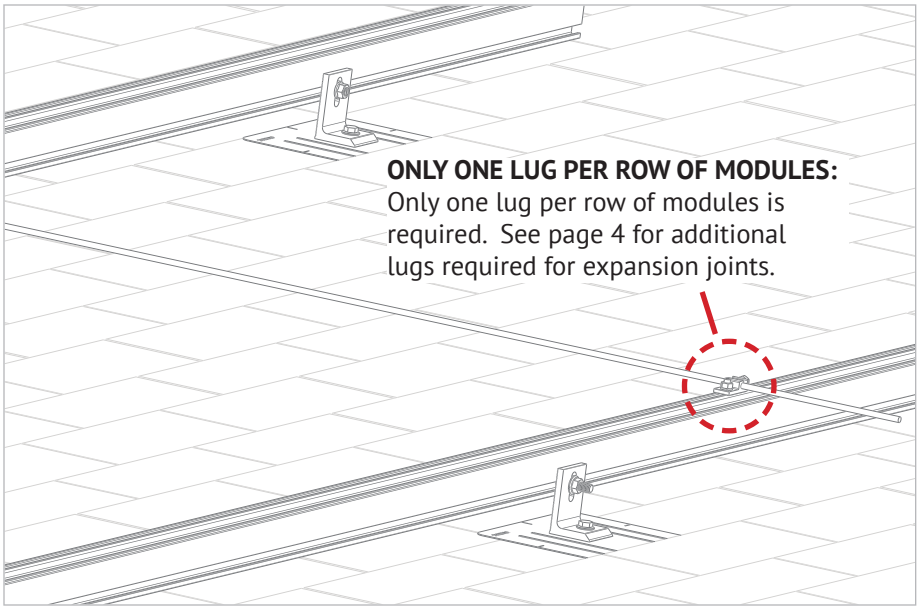
EXPANSION JOINT W/O ELECTRICAL BONDING CONNECTION
Enphase Microinverter (MI) Requirements (Model No. M215 & M250)
MIn. 3 Microinverters on each side of thermal break





EXPANSION JOINT USED AS THERMAL BREAK W/O ELECTRICAL BONDING CONNECTION

NOTE:
THE ABOVE IMAGES ARE SAMPLE CONFIGURATIONS TO ILLUSTRATE THE REQUIREMENTS FOR SM SYSTEM GROUNDING THROUGH ENPHASE MICROINVERTERS DESCRIBED ON page 10.



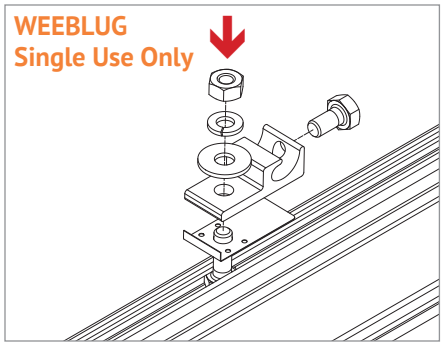
ONLY ONE LUG PER ROW OF MODULES:
Only one lug per row of modules is required. See page 4 for additional lugs required for expansion joints.

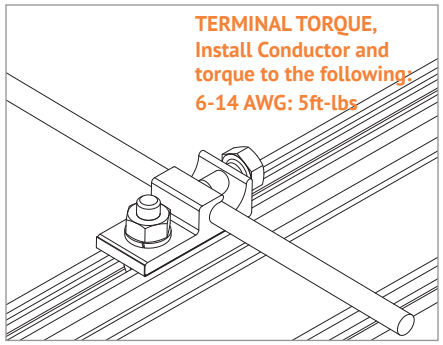
GROUNDING LUG MOUNTING DETAILS:
Details are provided for both the WEEB and Ilsco products. The WEEBLug has a grounding symbol located on the lug assembly. The Ilsco lug has a green colored set screw for grounding indication purposes. Installation must be in accordance with NFPA NEC 70, however the electrical designer of record should refer to the latest revision of NEC for actual grounding conductor cable size.

Required if not using approved integrated grounding microinveters

GROUNDING LUG - BOLT SIZE & DRILL SIZE		
GROUND LUG	**BOLT SIZE**	**DRILL SIZE**
WEEBLug	1/4"	N/A - Place in Top SM Rail Slot
ILSCO Lug	#10-32	7/32"

- Torque value depends on conductor size.
- See product data sheet for torque value.

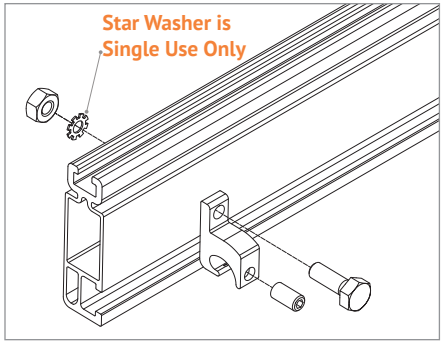


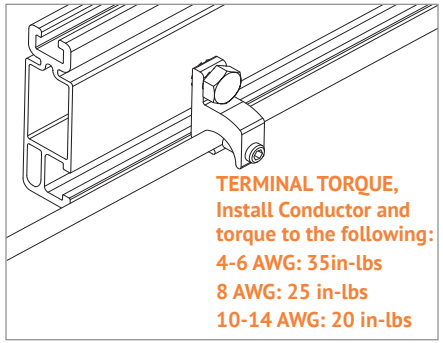


WEEBLUG CONDUCTOR - UNIRAC P/N 008002S:
Apply Anti Seize and insert a bolt in the aluminum rail and through the clearance hole in the stainless steel flat washer. Place the stainless steel flat washer on the bolt, oriented so the dimples will contact the aluminum rail. Place the lug portion on the bolt and stainless steel flat washer. Install stainless steel flat washer, lock washer and nut. Tighten the nut until the dimples are completely embedded into the rail and lug.

TORQUE VALUE 10 ft lbs.

See product data sheet for more details, Model No. WEEB-LUG-6.7



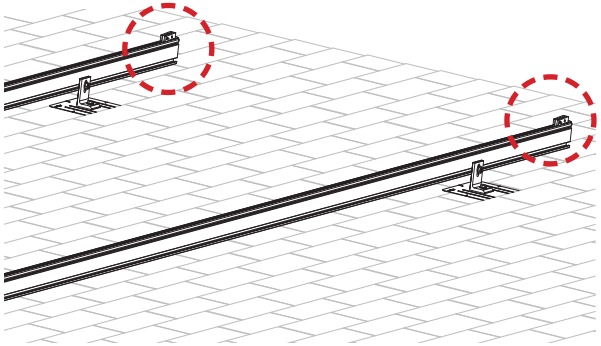


ILSCO LAY-IN LUG CONDUCTOR - UNIRAC P/N 008009P: Alternate Grounding Lug - Drill, deburr hole and bolt thru both rail walls per table.

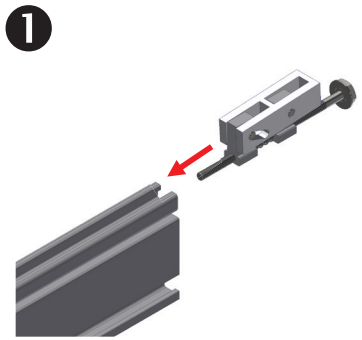
TORQUE VALUE 5 ft lbs.

See ILSCO product data sheet for more details, Model No. GBL-4DBT.

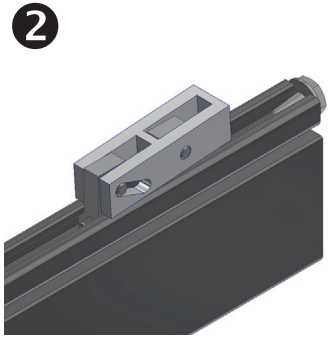
NOTE: ISOLATE COPPER FROM ALUMINUM CONTACT TO PREVENT CORROSION



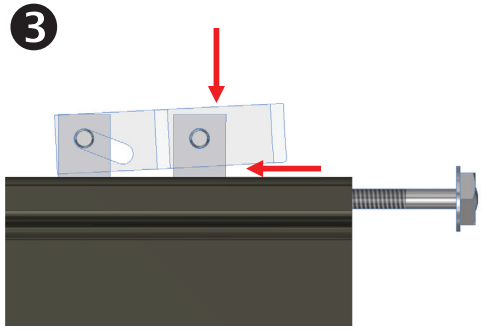
INSTALL MODULE END CLAMPS: The End clamp is supplied as an assembly with a 1/2" hex head bolt that is accessible at the ends of rails. The clamp should be installed on the rails prior to installing end modules.



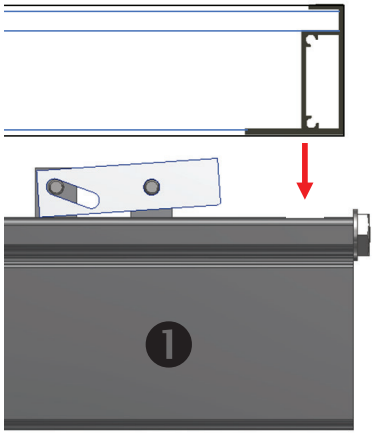
INSTALL END CLAMPS ON RAIL: Slide end clamp on to rail by engaging the two t-guide brackets with the top slot of the rails. **Ensure bolt is extended as far as possible so that clamp is positioned at max. distance from end of rail.**

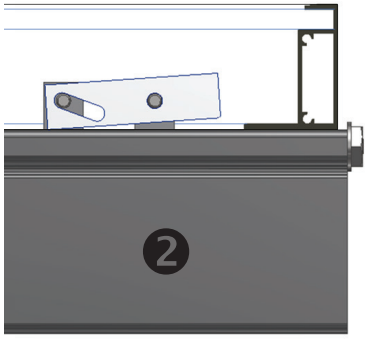


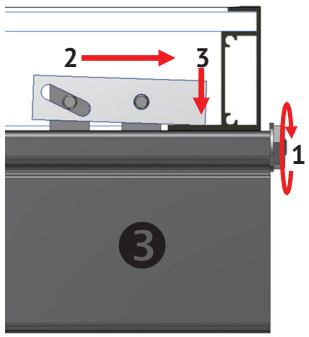
POSITION END CLAMPS: Slide end clamp assembly on to rail until bolt head engages with end of rail **End clamps are positioned on rails prior to the first end module and prior to the last end module.**



NOTE: To assist insertion of clamp into rail slot, Pressure may be applied to top or side of bracket as shown. Do not force clamp into rail by pushing on bolt with excessive force.

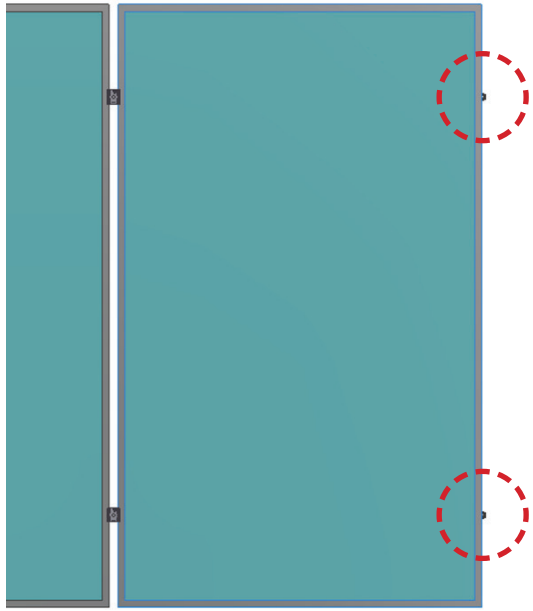


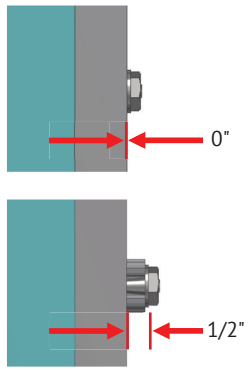




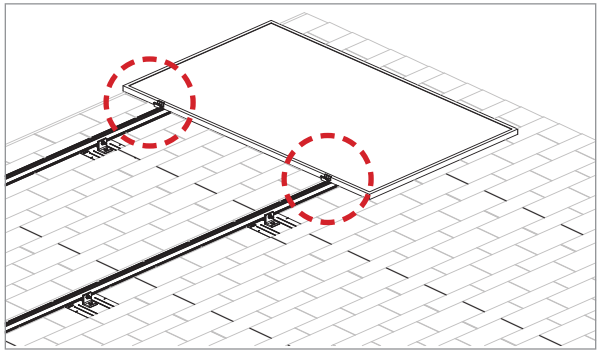
INSTALL FIRST MODULE: Install the first end module onto rails with the flange of the module frame positioned between end clamps an ends of rails.

ENGAGE CLAMP: While holding module in position and with flange in full contact with rail, rotate end clamp bolt until clamp engages with flange to provide clamp force.
To ensure bolt is not over-torqued, use low torque setting on drill or If using an impact driver, stop rotation as soon as impact action of driver begins.
TORQUE VALUE
End clamp bolt to 5 ft-lbs, No anti-seize

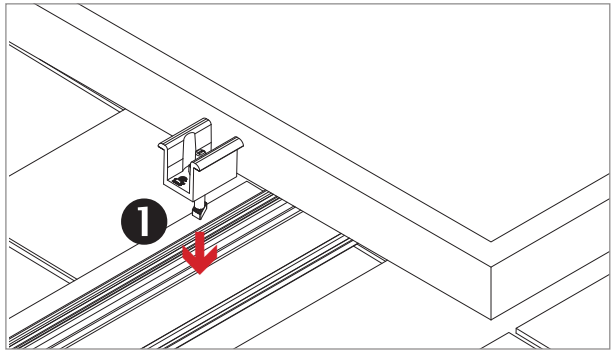




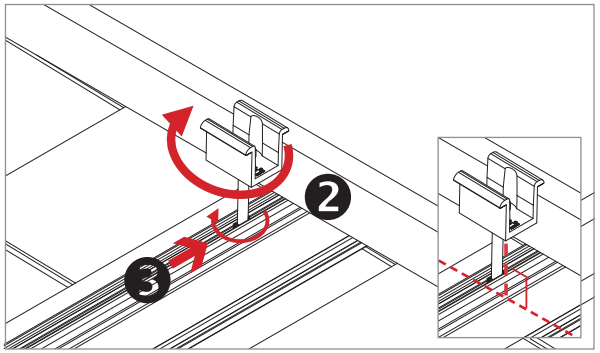
For best appearance, position module flush with ends of rails. Rails should not extend more than 1/2" beyond module. Module must be fully supported by rails and cannot overhang ends of rails.



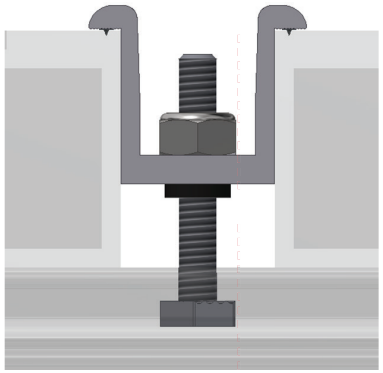
INSTALL MIDCLAMPS: Midclamp is supplied as an assembly with a T-bolt for module installation. Clamp assemblies may be positioned in rail near point of use prior to module placement.



INSERT MIDCLAMP ASSEMBLY: Insert 1/4" T-Bolt into top slot of rail

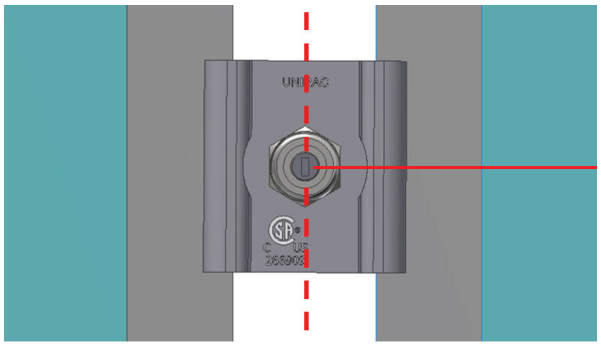


MIDCLAMP: Rotate midclamp assembly and slide until clamp is against module frame. Do not tighten nut until next module is in position. Ensure bolt is perpendicular to rail.

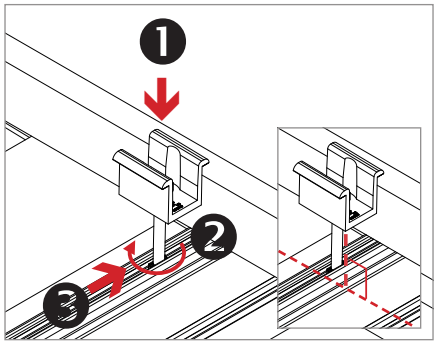


PLACE ADJACENT MODULE AGAINST CLAMPS:
Modules must be tight against clamps with no gaps. Tighten nut to required torque.

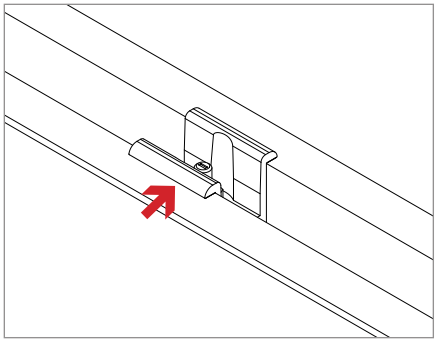
TORQUE VALUE: 11 ft-lbs. No anti-seize.



POSITION INDICATOR - SERRATED T-BOLT:
Verify the T-bolt position indicator is perpendicular to the rail.

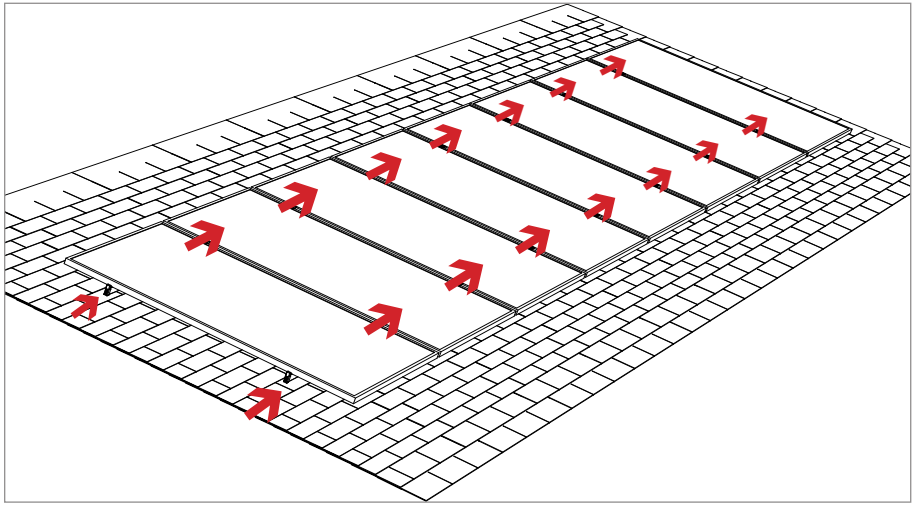


INSTALL REMAINING MID-CLAMPS: Proceed with module installation. Engage each module with previously positioned Midclamp assemblies.

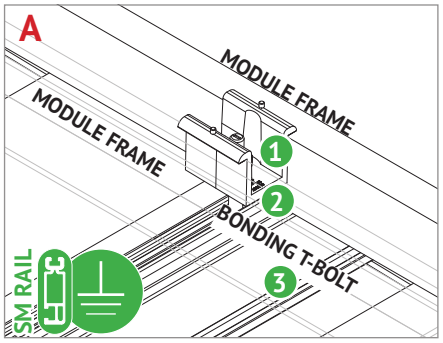


POSITION T-BOLT ALIGNMENT MARKS: Verify that the position indicator(s) & T-bolt shaft(s) are angled in the correct position. Tighten to final torque.

TORQUE VALUE: 11 ft-lbs. No anti-seize.

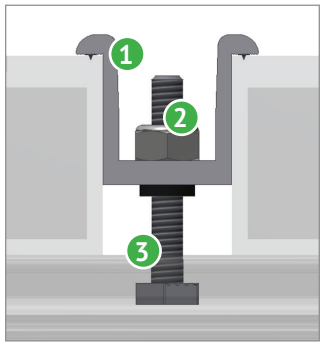


FINISH MODULE INSTALLATION: Proceed with module installation. Engage each module with the previously positioned clamp assembly:

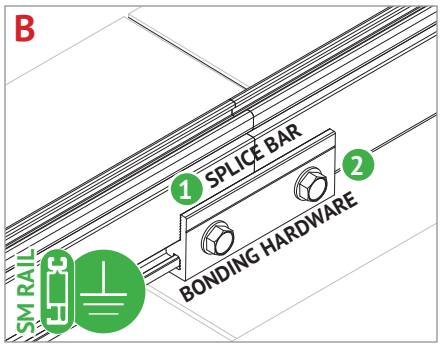


BONDING MIDCLAMP ASSEMBLY

1. Aluminum mid clamp with stainless steel bonding pins that pierce module frame anodization to bond module to module through clamp
2. Stainless steel nut bonds aluminum clamp to stainless steel T-bolt
3. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, clamp, and modules to SM rail



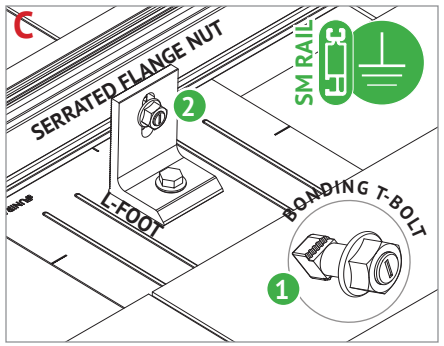
BONDING MIDCLAMP ASSEMBLY



BONDING RAIL SPLICE BAR

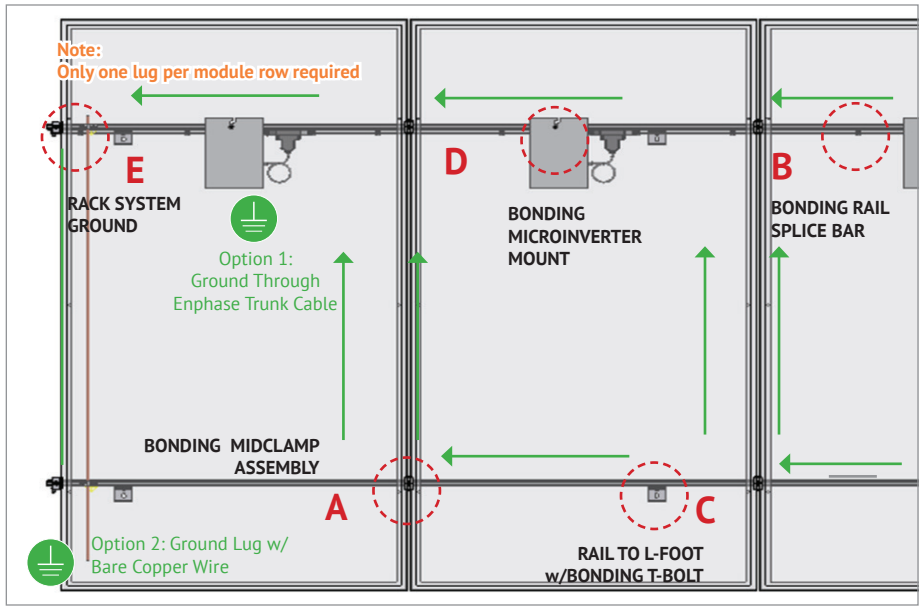
1. Bonding Hardware creates bond between splice bar and each rail section
2. Aluminum splice bar spans across rail gap to create rail to rail bond. Rail on at least one side of splice will be grounded.

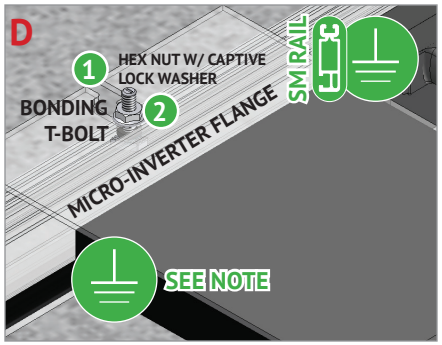
Note: Splice bar and bolted connection are non-structural. The splice bar function is rail alignment and bonding.



RAIL TO L-FOOT w/BONDING T-BOLT

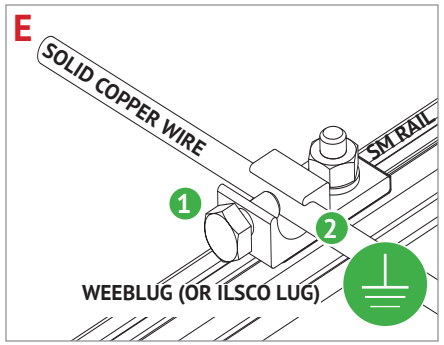
1. Serrated flange nut removes L-foot anodization to bond L-Foot to stainless steel T-bolt
2. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, and L-foot to grounded SM rail





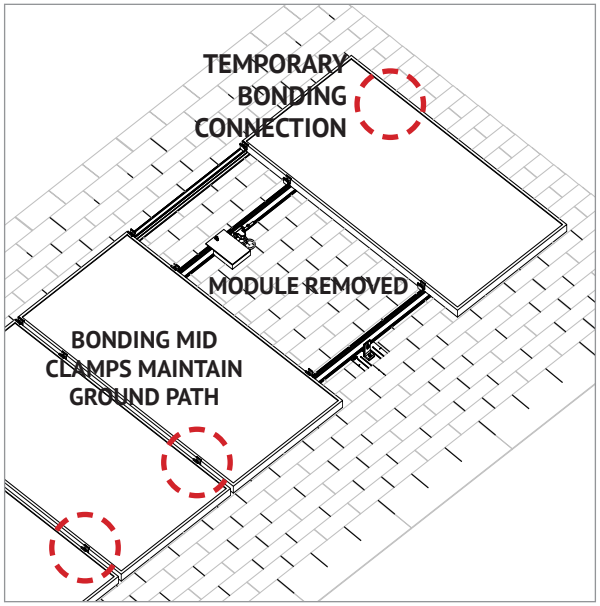
BONDING MICROINVERTER MOUNT

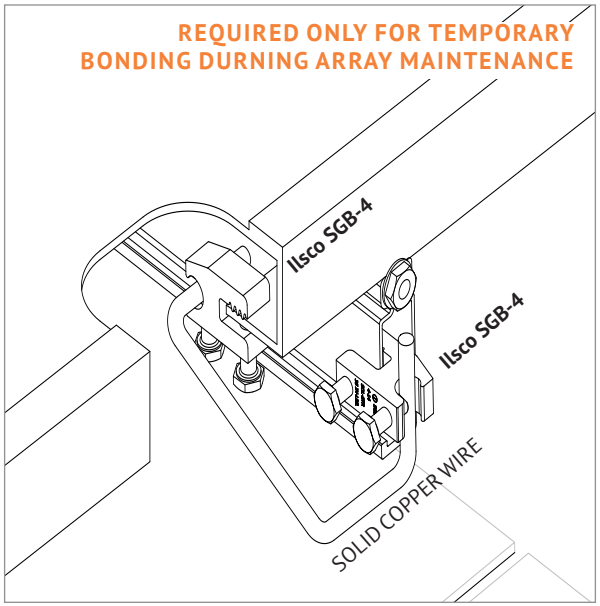
1. Hex nut with captive lock washer bonds metal microinverter flange to stainless steel T-bolt
2. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, and L-foot to grounded SM rail **System ground including racking and modules may be achieved through the trunk cable of approved microinverter systems. See page 11 for details**



RACK SYSTEM GROUND

1. WEEB washer dimples pierce anodized rail to create bond between rail and lug
2. Solid copper wire connected to lug is routed to provide final system ground connection.
   NOTE: Ilsco lug can also be used when secured to the side of the rail. See page 12 for details





TEMPORARY BONDING CONNECTION DURING ARRAY MAINTENANCE
When removing modules for replacement or system maintenance, any module left in place that is secured with a bonding Midclamp will be properly grounded. If a module adjacent to the end module of a row is removed or if any other maintenance condition leaves a module without a bonding mid clamp, a temporary bonding connection must be installed as shown

- Attach Ilsco SGB4 to wall of rail
- Attach Ilsco SGB4 to module frame
- Install solid copper wire jumper to Ilsco lugs

ELECTRICAL CONSIDERATIONS
SOLARMOUNT is intended to be used with PV modules that have a system voltage less than or equal to that allowable by NEC. For standard system grounding a minimum 10AWG, 105°C copper grounding conductor should be used to ground a system, according to the National Electric Code (NEC). It is the installer's responsibility to check local codes, which may vary. See below for interconnection information.

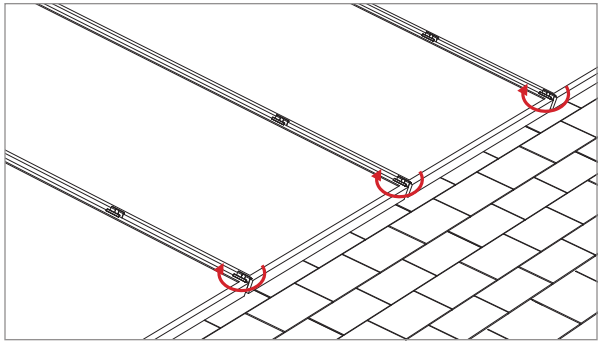
INTERCONNECTION INFORMATION
There is no size limit on how many SOLARMOUNT & PV modules can be mechanically interconnected for any given configuration, provided that the installation meets the requirements of applicable building and fire codes.

GROUNDING NOTES
The installation must be conducted in accordance with the National Electric Code (NEC) and the authority having jurisdiction. Please refer to these resources in your location for required grounding lug quantities specific to your project.

The grounding / bonding components may overhang parts of the array so care must be made when walking around the array to avoid damage.

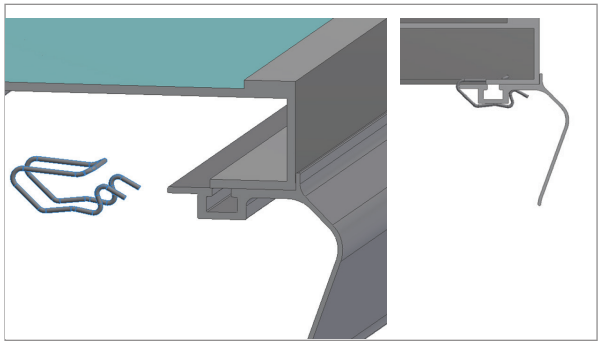
Conductor fastener torque values depend on conductor size. See product data sheets for correct torque values.

PERIODIC INSPECTION: Conduct periodic inspections for loose components, loose fasteners or any corrosion, immediately replace any affected components.

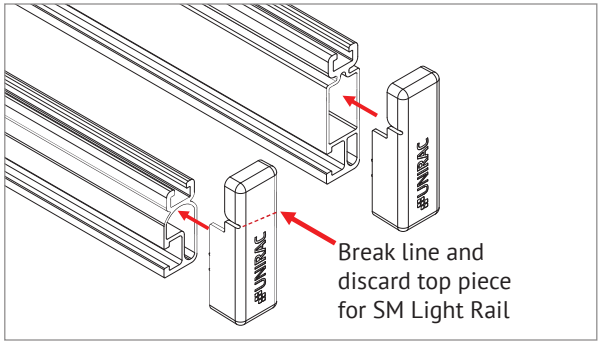


TRIM MIDCLAMPS: Ensure Trim lip is in contact with module face and verify alignment marks on T-bolts are in proper position, tighten midclamp on Trim, repeat at each gap between modules.

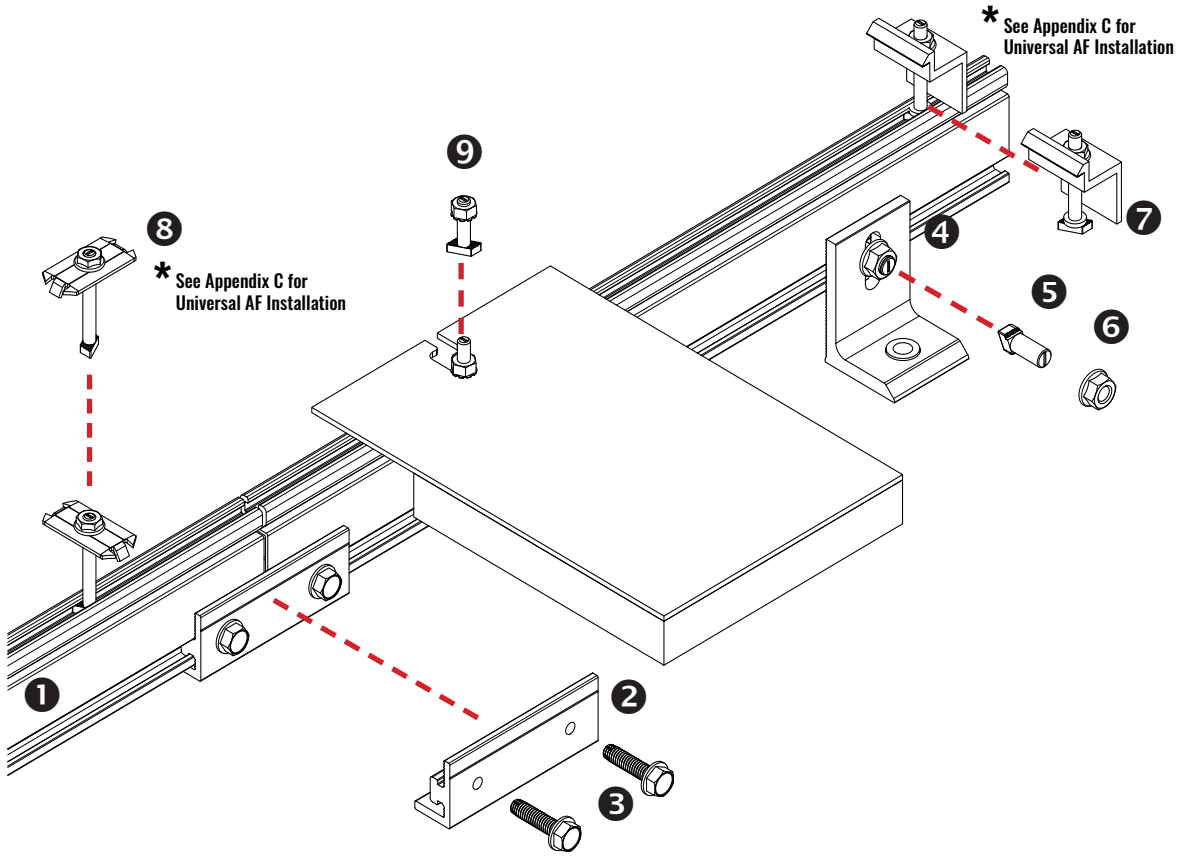
TORQUE VALUE: 11 ft-lbs. No anti-seize.



FINISH TRIM INSTALLATION. CUT EXCESS TRIM AND INSTALL TRIM CLIPS:
Attach trim to modules with at least one trim clip at each end of array and at locations where additional support is needed. Each section of trim must be attached to modules with at least one mid clamp.



INSTALL END CAPS: End caps install as supplied on SM standard rail and SM light rail. If desired for SM light rail, the end cap may be modified as shown by hand, or by using a cutting tool.



❶**RAIL**: Supports PV modules. Use at least two per row of modules. Aluminum extrusion, available in mill, clear anodized, or dark anodized.

❷❸**RAIL SPLICE**: Non structural splice joins, aligns, and electrically bonds rail sections into single length of rail. Forms a rigid splice joint, 4 inches long, preassembled with bonding hardware. Available in dark anodized or mill finish.

❹**L-FOOT**: Use to secure rails through roofing material to building structure. Refer to loading tables or U-Builder for spacing.

❺ **L-FOOT T- BOLT**: (3/8" x ¾" or 1") – Use one per L-foot to secure rail to L-foot. Stainless steel. Supplied with L-foot in combination with flange nut, provides electrical bond between L-foot and rail.

❻**SERRATED FLANGE NUT** : Use one per L-foot to secure and bond rail to Lfoot. Stainless steel. Supplied with L-foot.

❼**MODULE ENDCLAMP**: Provides bond from rail to endclamp. Pre-assembled aluminum clamp available in clear or dark finish. Supplied washer keeps clamp and bolt upright for ease of assembly.

❽**MODULE MIDCLAMP**: Pre-assembled clamp provides module to module and module to rail bond. Stainless steel clamp and T-bolt. Available in clear or dark finish.

❾**MICROINVERTER MOUNTING BOLT**: Pre-assembled bolt and nut attaches and bonds microinverter to rail. Washer at base keeps bolt upright for ease of assembly.

NOTE - POSITION INDICATOR: T-bolts have a slot in the hardware end corresponding to the direction of the T-Head.

NOTE - Standard Series Mid and End Clamps are single use.

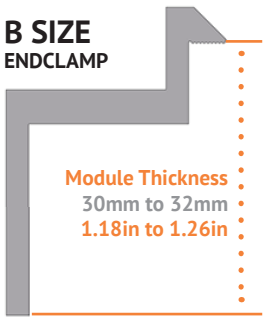
Wrenches and Torque

	Wrench Size	Recommended Torque (ft-lbs)
1/4" Hardware ❼❽❾	7/16"	*10
3/8" Hardware ❺	9/16"	*30
#12 Hardware ❸	5/16"	10

Torques are not designed for use with wood connectors *w/Anti-Seize.

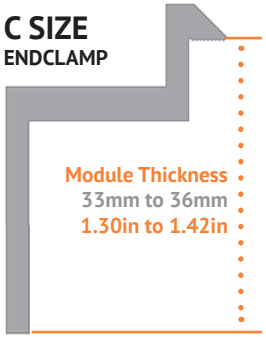
Anti-Seize*

Stainless steel hardware can seize up, a process called galling. To significantly reduce its likelihood:
1. Apply minimal lubricant to bolts, preferably Anti-Seize commonly found at auto parts stores
2. Shade hardware prior to installation, and
3. Avoid spinning stainless nuts onto bolts at high speed.



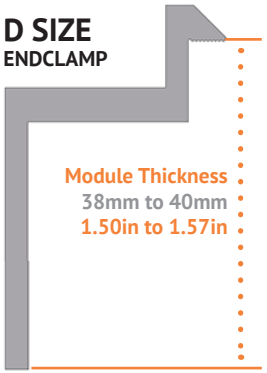
B SIZE
ENDCLAMP

Module Thickness
30mm to 32mm
1.18in to 1.26in



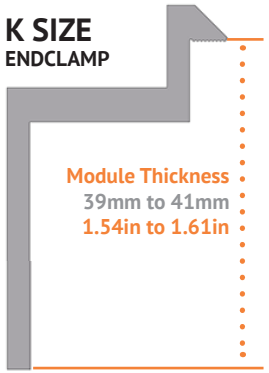
C SIZE
ENDCLAMP

Module Thickness
33mm to 36mm
1.30in to 1.42in



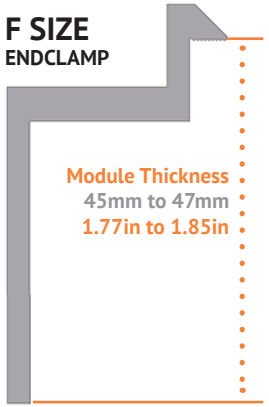
D SIZE
ENDCLAMP

Module Thickness
38mm to 40mm
1.50in to 1.57in



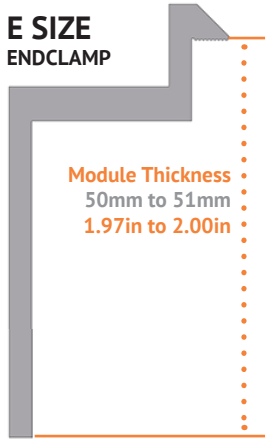
K SIZE
ENDCLAMP

Module Thickness
39mm to 41mm
1.54in to 1.61in



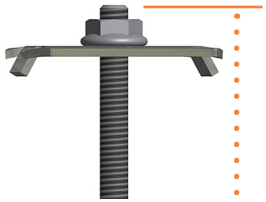
F SIZE
ENDCLAMP

Module Thickness
45mm to 47mm
1.77in to 1.85in



E SIZE
ENDCLAMP

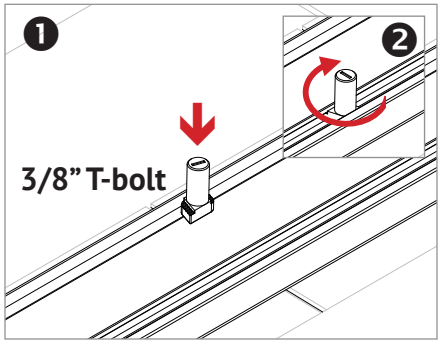
Module Thickness
50mm to 51mm
1.97in to 2.00in



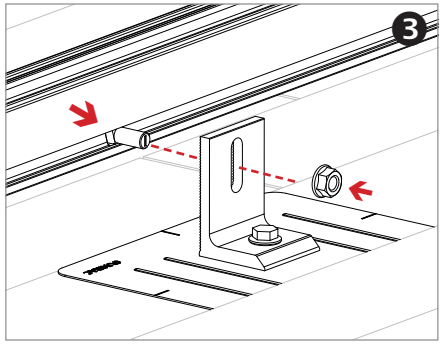
BC SIZE
MIDCLAMP
2in Long T-bolt

DK SIZE
MIDCLAMP
2.25in Long T-bolt

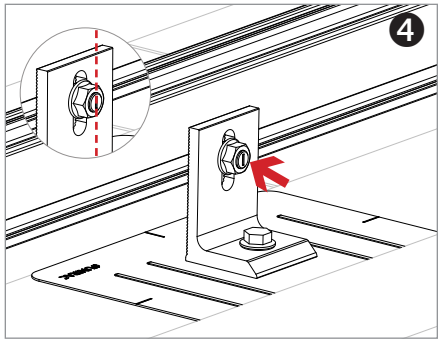
EF SIZE
MIDCLAMP
2.5in Long T-bolt



PLACE T-BOLT INTO RAIL & SECURE BOLT: Insert 3/8" T-bolt into rail at L-foot locations. Apply Anti-Seize to bolt. Rotate T-bolt into position.



SECURE T-BOLT: Apply Anti-Seize to bolt. Rotate T-bolt into position.



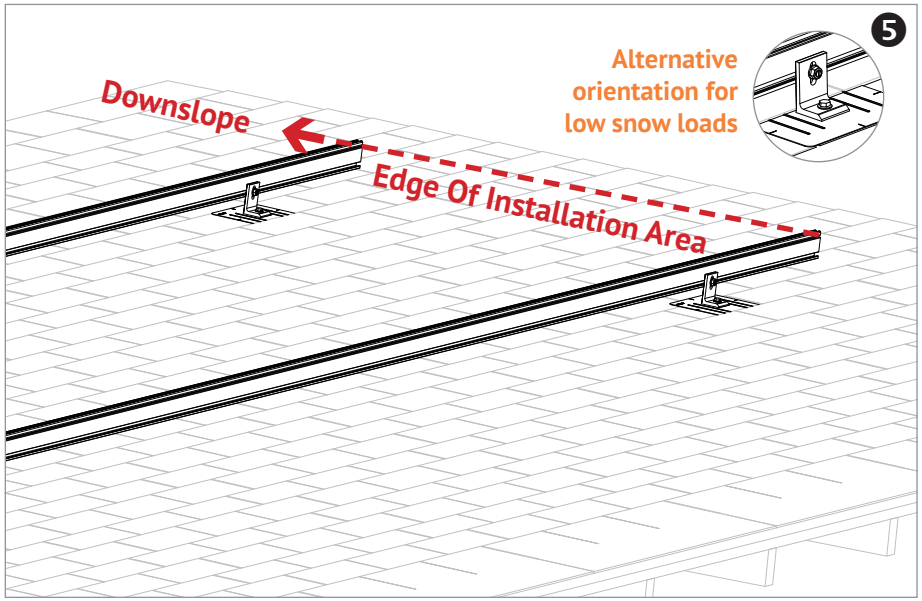
ALIGN POSITION INDICATOR: Hand tighten nut until rail alignment is complete. Verify that position indicator on bolt is vertical (perpendicular to rail)

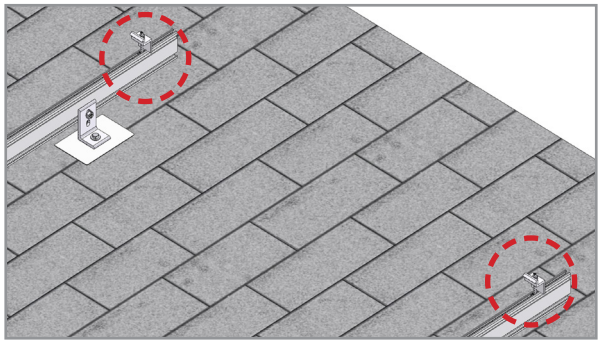
TORQUE VALUE: 3/8" nut to 30 ft-lbs

ALIGN RAILS: Align one pair of rail ends to the edge of the installation area. The opposite pair of rail ends will overhang installation area. Do not Trim them off until the installation is complete. If the rails are perpendicular to the rafters, either end of the rails can be aligned, but the first module must be installed at the aligned end.

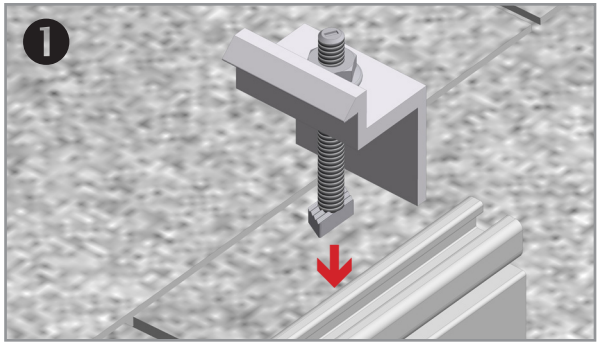
If the rails are parallel to the rafters, the aligned end of the rails must face the lower edge of the roof. Securely tighten all hardware after alignment is complete.

Mount modules to the rails as soon as possible. Large temperature changes may bow the rails within a few hours if module placement is delayed.

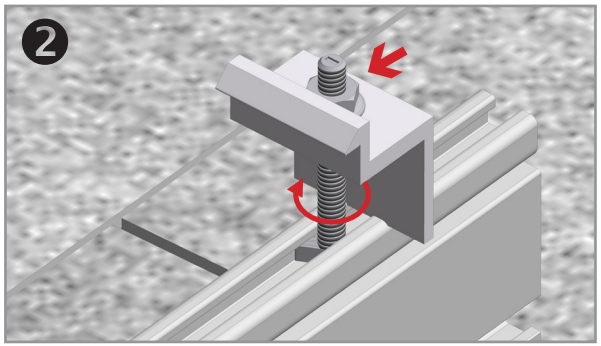




INSTALL MODULE ENDCLAMPS: The Endclamp is supplied as an assembly with a T-bolt, serrated flange nut, and washer. The washer retains the clamp at the top of the assembly. This will enable the clamp to remain upright for module installation.

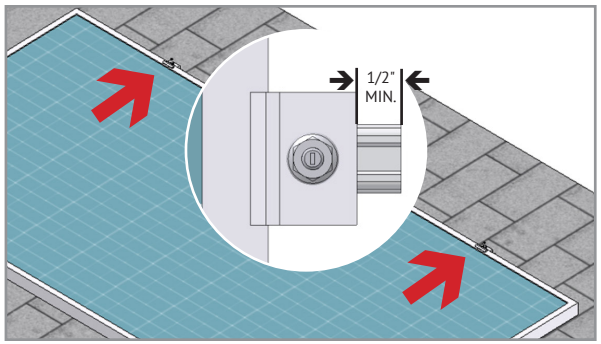


INSERT ENDCLAMP T-BOLT: Insert 1/4" T-bolt into rail.



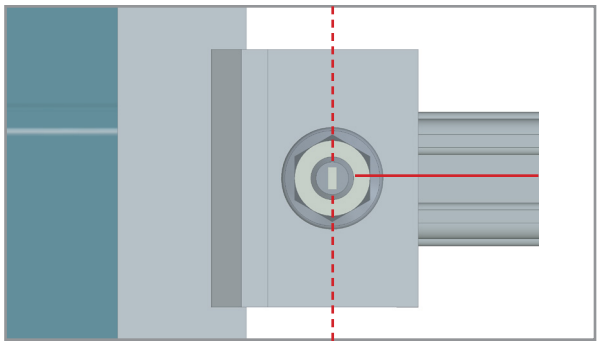
ROTATE ENDCLAMP T-BOLT: Rotate T-bolt into position. Verify that the position indicator & T-bolt shaft are angled in the correct position.

End clamps are positioned on rails prior to the first end module and installed after the last end module.

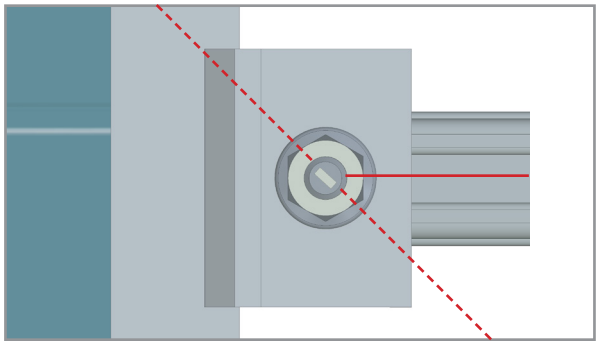


INSTALL FIRST MODULE: Install the first end module onto rails. Engage module frame with Endclamps. Verify that the position indicator & T-bolt shaft are angled in the correct position.

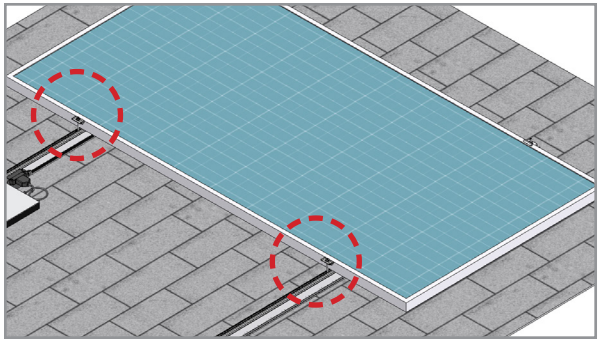
TORQUE VALUE: 1/4" nuts to 10 ft-lbs. with Anti Seize



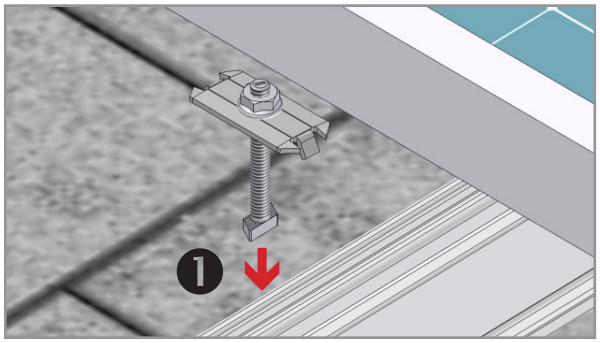
POSITION INDICATOR - SERRATED T-BOLT: Verify the T-bolt position indicator is perpendicular to the rail.



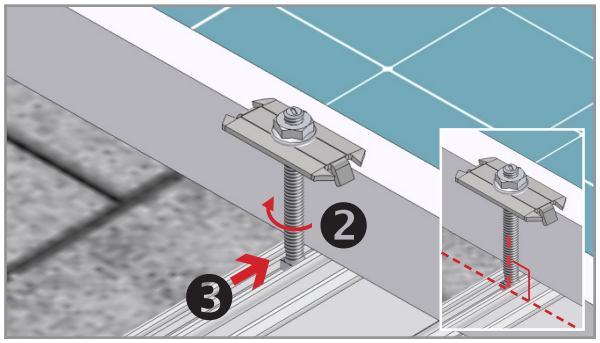
POSITION INDICATOR - NON-SERRATED T-BOLT: Verify the T-bolt position indicator is angled as shown. **FOR USE WITH MILL FINISH RAIL ONLY.**



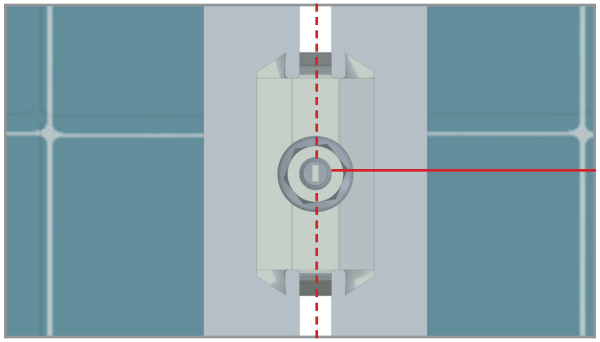
INSTALL MIDCLAMPS: Midclamp is supplied as an assembly with a T-bolt for module installation. Clamp assemblies may be positioned in rail near point of use prior to module placement.



INSERT MIDCLAMP T-BOLT: Apply Anti-Seize and insert 1/4" T-bolt into rail.

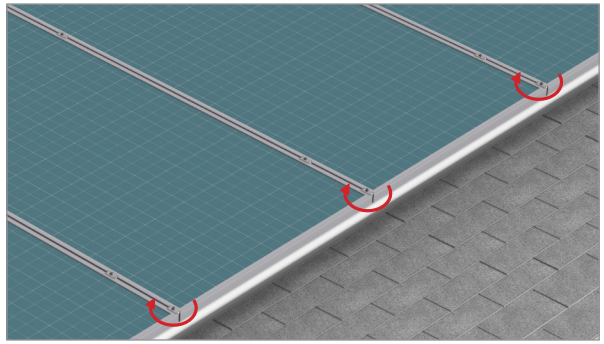


ROTATE MIDCLAMP T-BOLT: Rotate bolt into position and slide until bolt and clamp are against module frame. Do not tighten nut until next module is in position. Verify that the position indicator & T-bolt shaft are angled in the correct position.



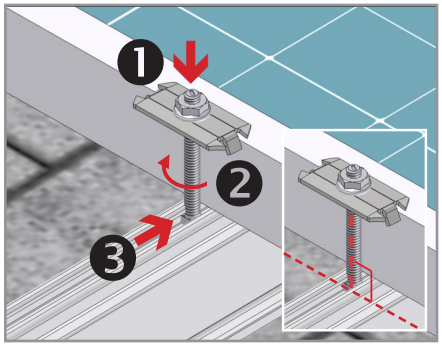
POSITION INDICATOR - SERRATED T-BOLT: Verify the T-bolt position indicator is perpendicular to the rail.

TRIM INSTALLATION INSTRUCTIONS



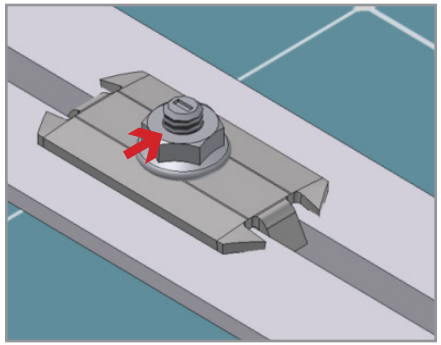
TRIM MIDCLAMPS: Ensure Trim lip is in contact with module face and verify alignment marks on T-bolts are in proper position, tighten midclamp on Trim, repeat at each gap between modules.

TORQUE VALUE: 1/4" nuts to 10 ft-lbs with Anti Seize



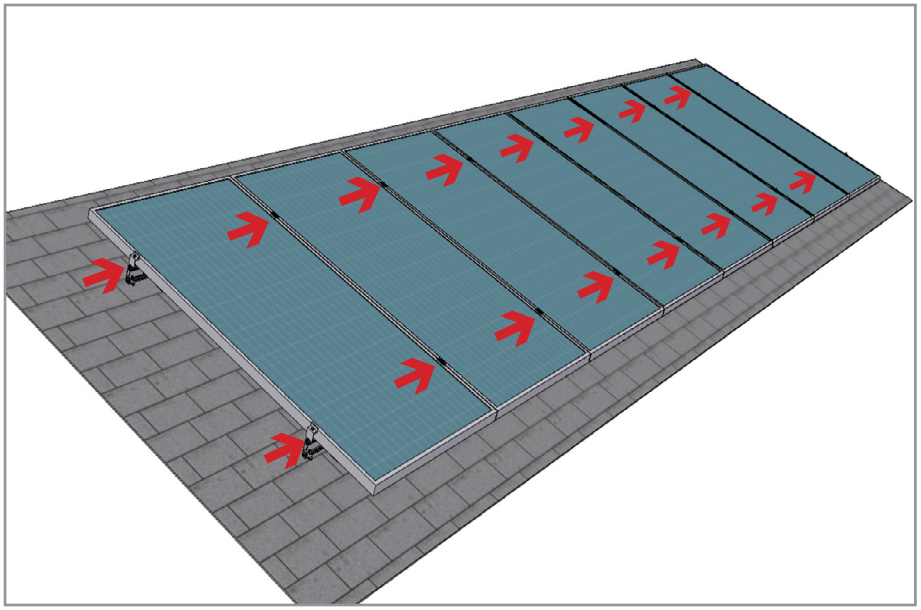
INSTALL REMAINING MID-CLAMPS: Proceed with module installation. Engage each module with previously positioned Midclamp assemblies.

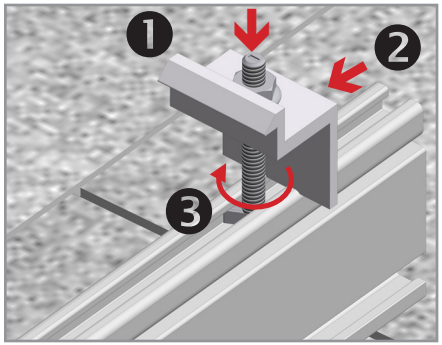
NOTE: Apply Anti-Seize to each Mid Clamp prior to installation.



POSITION T-BOLT ALIGNMENT MARKS:
Verify that the position indicator(s) & T-bolt shaft(s) are angled in the correct position.

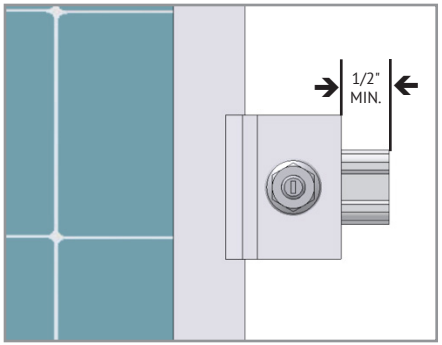
TORQUE VALUE: 1/4" nuts to 10 ft-lbs. with Anti Seize





INSTALL ENDCLAMPS: Apply Anti-Seize and install final Endclamps in same manner as first Endclamps. Slide clamps against module.

TORQUE VALUE: 1/4" nuts to 10 ft-lbs. with Anti Seize.

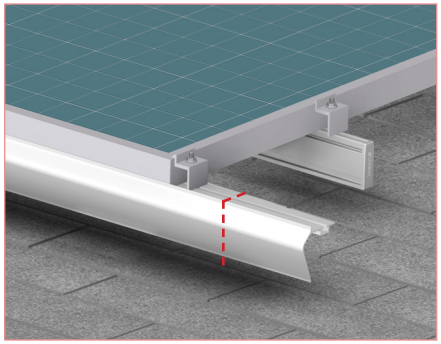


POSITION T-BOLT ALIGNMENT MARKS & CUT RAIL: Verify that the position indicator(s) & T-bolt shaft(s) are angled in the correct position. Trim off any excess rail, being careful not to cut into the roof. Allow ½" between the Endclamp and the end of the rail.

FINISH MODULE INSTALLATION: Proceed with module installation. Engage each module with the previously positioned clamp assembly:

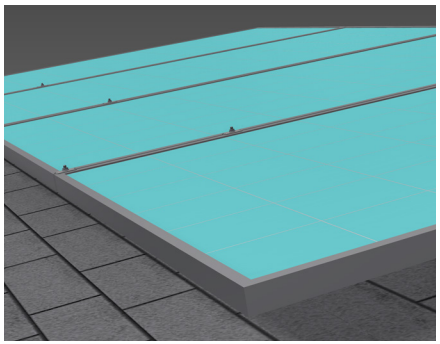
- Install second module
- Install remaining Midclamps & modules & position alignment marks
- Install Endclamps & position alignment marks
- Cut rail to desired length

TRIM INSTALLATION INSTRUCTIONS

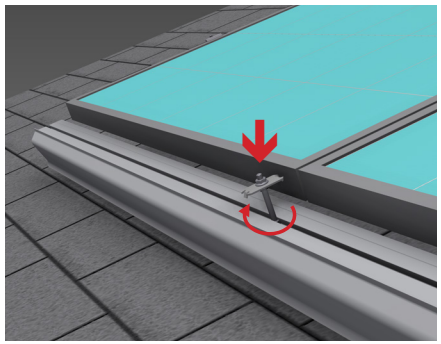


FINISH TRIM INSTALLATION, INSTALL ENDCLAMP & CUT EXCESS RAIL: Install final endclamp & Cut away excess Trim at end of array or where required for proper cantilevers. **See D&E Guide or U-Builder for allowable cantilevers.**

TORQUE VALUE
1/4" nuts to 10 ft-lbs with Anti Seize

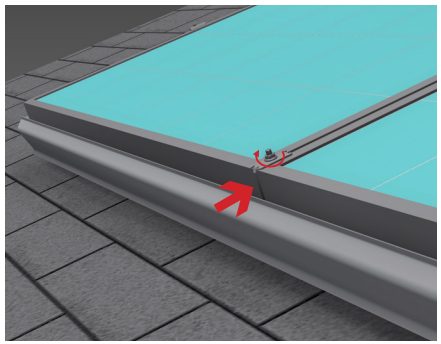


PREPARATION: At front edge of array, ensure at least 3.25 inches of space between modules and roof surface and that modules are aligned to within 3/8". Plan for Trim length so that Endclamps can be properly installed.



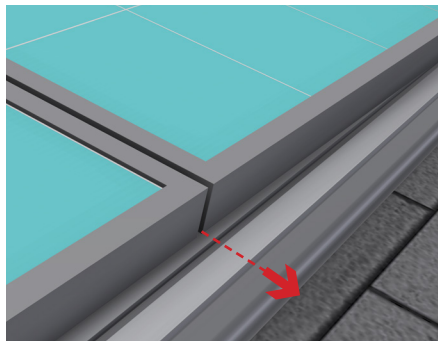
1ST MIDCLAMP: Position Trim in front of array. Insert Midclamp into the Trim slot, aligned with the gap between the 1st two modules at either end of array.

NOTE: Apply Anti-Seize to Each Mid-Clamp prior to installation

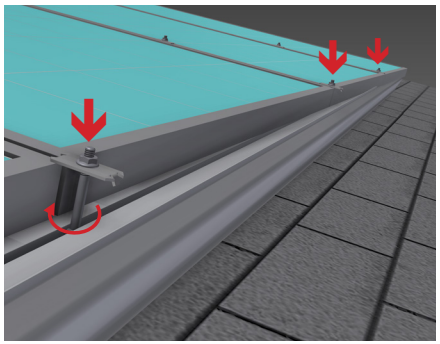


MOUNT TRIM: Position Trim beneath modules by sliding T-bolt into gap between modules and tighten. Midclamp should stay in position and support Trim. Tighten snugly enough so that Trim is held firmly in place.

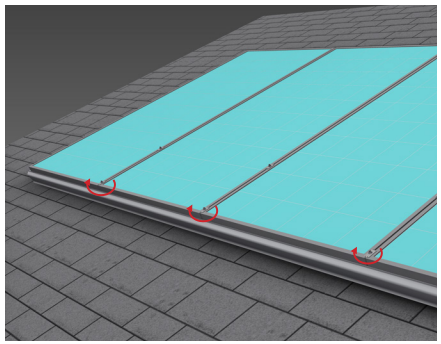
TORQUE VALUE: Do not exceed specified torque value (10 ft-lbs)



CLEAR T-BOLT SLOT: Rotate unattached end of Trim out and away from array so T-bolt slot (at next T-bolt insertion point) is clear of modules. This may require force to deflect the Trim slightly. Deflect only enough to insert T-bolt.

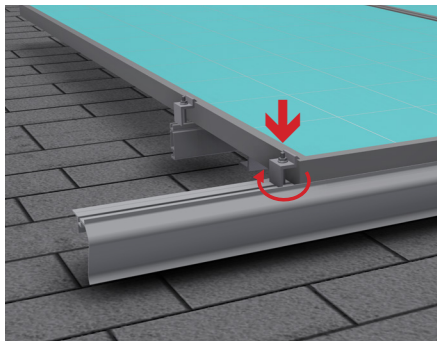


INSERT MIDCLAMPS: Insert T-bolt into slot and slide clamp (rotating Trim) into position between modules and leave loose. Continue to work down array, inserting Midclamps and positioning in gaps between modules.



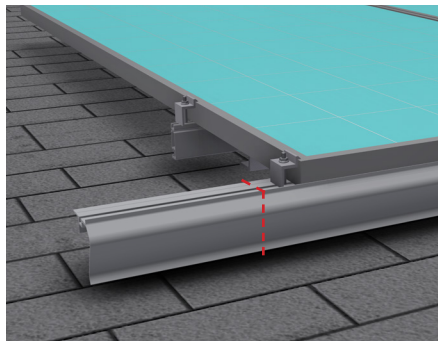
FASTEN MIDCLAMPS: Return to each inserted Midclamp. Ensuring Trim lip is in contact with module face and verifying alignment marks on T-bolts are in proper position, tighten clamp.

TORQUE VALUE
1/4" nuts to 10 ft-lbs w/ Anti Seize

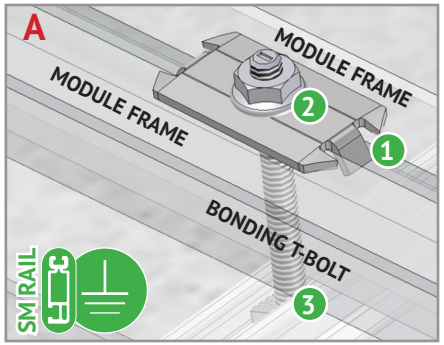


ENDCLAMPS: Install Endclamps per previous Endclamp install instructions

TORQUE VALUE
1/4" nuts to 10 ft-lbs w/ Anti Seize

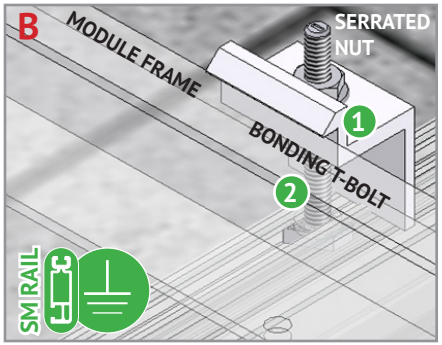


CUT EXCESS TRIM: Mark excess Trim and cut at end of array or where required for proper cantilevers.



BONDING MIDCLAMP ASSEMBLY

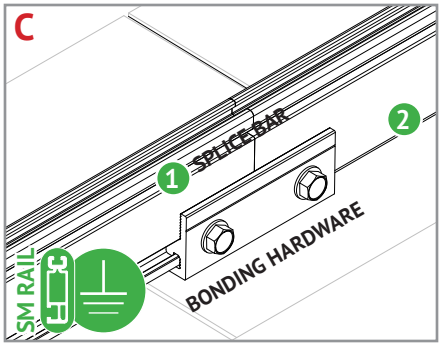
1. Stainless steel Midclamp points, 2 per module, pierce module frame anodization to bond module to module through clamp.
2. Serrated flange nut bonds stainless steel clamp to stainless steel T-bolt
3. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, clamp, and modules to grounded SM rail.



ENDCLAMP ASSEMBLY

1. Serrated flange nut bonds aluminum Endclamp to stainless steel T-bolt
2. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, and Endclamp to grounded SM rail

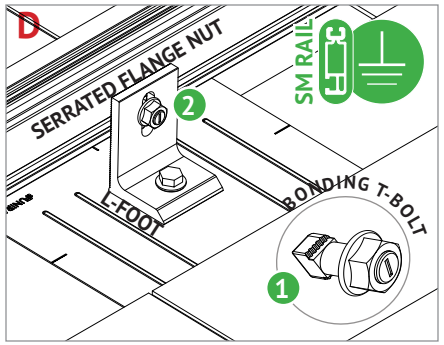
Note: End clamp does not bond to module frame.



BONDING RAIL SPLICE BAR

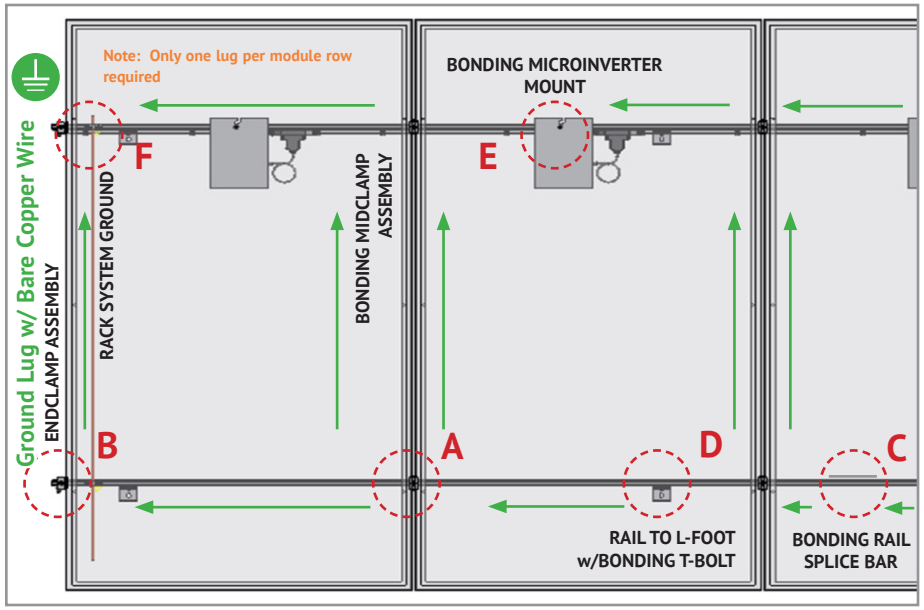
1. Bonding Hardware creates bond between splice bar and each rail section
2. Aluminum splice bar spans across rail gap to create rail to rail bond. Rail on at least one side of splice will be grounded.

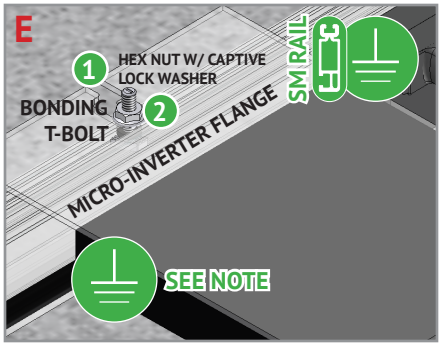
Note: Splice bar and bolted connection are non-structural. The splice bar function is rail alignment and bonding.



RAIL TO L-FOOT w/BONDING T-BOLT

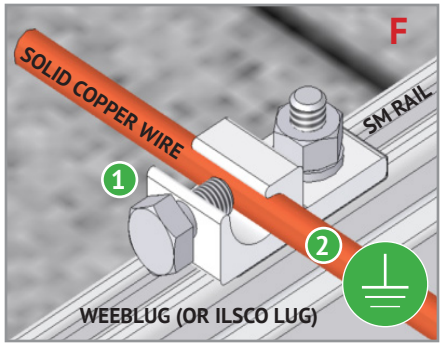
1. Serrated flange nut removes L-foot anodization to bond L-Foot to stainless steel T-bolt
2. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, and L-foot to grounded SM rail





BONDING MICROINVERTER MOUNT

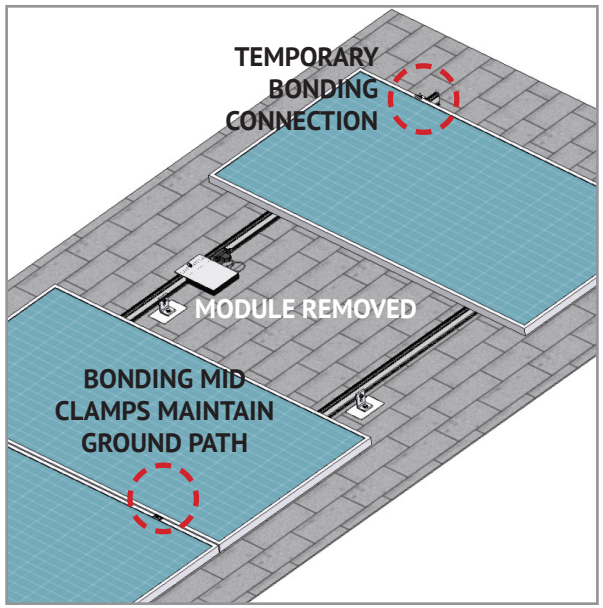
1. Hex nut with captive lock washer bonds metal microinverter flange to stainless steel T-bolt
2. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, and L-foot to grounded SM rail System ground including racking and modules may be achieved through the trunk cable of approved microinverter systems. See page 11 for details

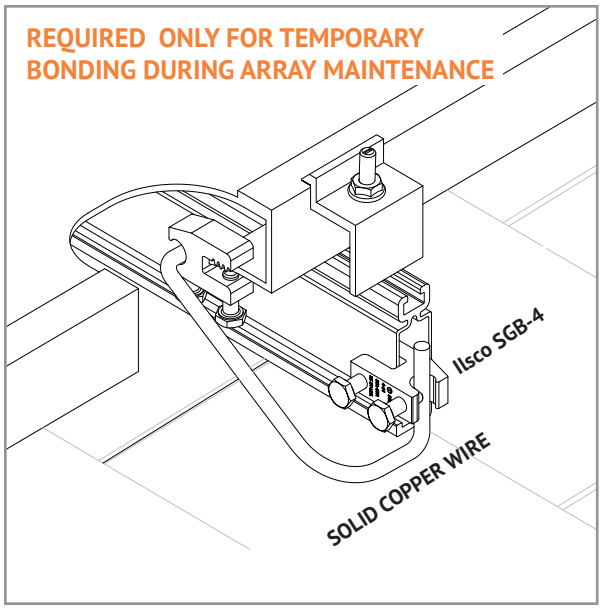


RACK SYSTEM GROUND

1. WEEB washer dimples pierce anodized rail to create bond between rail and lug
2. Solid copper wire connected to lug is routed to provide final system ground connection.

NOTE: Ilsco lug can also be used when secured to the side of the rail. **See page 11 for details**





TEMPORARY BONDING CONNECTION DURING ARRAY MAINTENANCE

When removing modules for replacement or system maintenance, any module left in place that is secured with a bonding Midclamp will be properly grounded. If a module adjacent to the end module of a row is removed or if any other maintenance condition leaves a module without a bonding mid clamp, a temporary bonding connection must be installed as shown

- Attach Ilsco SGB4 to wall of rail
- Attach Ilsco SGB4 to module frame
- Install solid copper wire jumper to Ilsco lugs

ELECTRICAL CONSIDERATIONS

SOLARMOUNT is intended to be used with PV modules that have a system voltage less than or equal to that allowable by the NEC. For standard system grounding a minimum 10AWG, 105°C copper grounding conductor should be used to ground a 1000 VDC system, according to the National Electric Code (NEC). It is the installer's responsibility to check local codes, which may vary. See below for interconnection information.

INTERCONNECTION INFORMATION

There is no size limit on how many SOLARMOUNT & PV modules can be mechanically interconnected for any given configuration, provided that the installation meets the requirements of applicable building and fire codes.

GROUNDING NOTES

The installation must be conducted in accordance with the National Electric Code (NEC) and the authority having jurisdiction. Please refer to these resources in your location for required grounding lug quantities specific to your project.

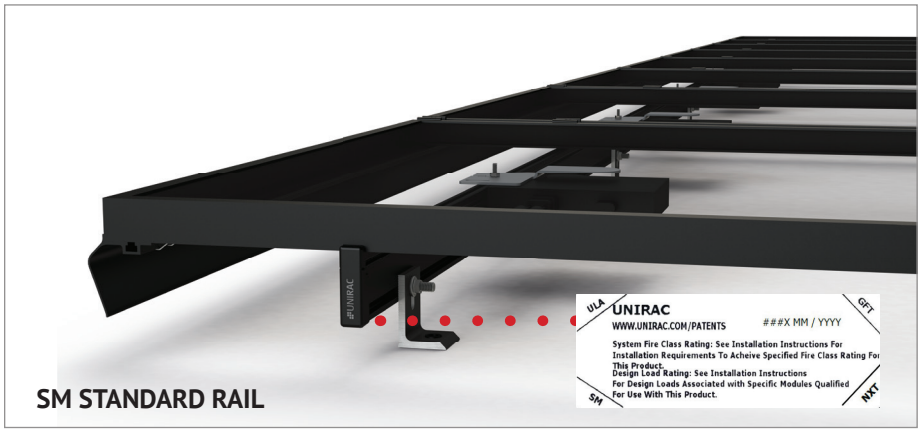
The grounding / bonding components may overhang parts of the array so care must be made when walking around the array to avoid damage.

Conductor fastener torque values depend on conductor size. See product data sheets for correct torque values.

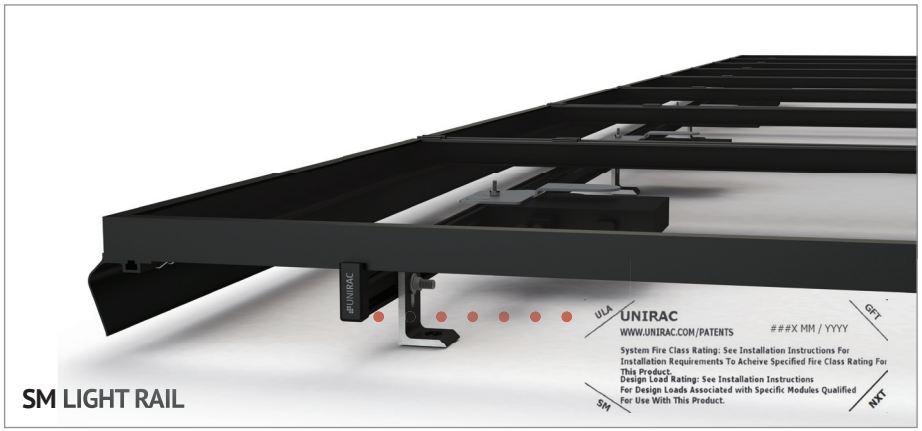
UL2703 CERTIFICATION MARKING LABEL

Unirac SOLARMOUNT is listed to UL 2703. Certification marking is embossed on all mid clamps as shown. Labels with additional information will be provided . After the racking system is fully assembled, a single label should be applied to the SOLARMOUNT rail at the edge of the array. Before applying the label, the corners of the label that do not pertain to the system being installed must be removed so that only the installed system type is showing.

Note: The sticker label should be placed such that it is visible, but not outward facing.



SM STANDARD RAIL



SM LIGHT RAIL

The SOLARMOUNT system has been certified and listed to the UL 2703 standard (Rack Mounting Systems and Clamping Devices for Flat-Plate Photovoltaic Modules and Panels). This standard included electrical grounding, electrical bonding, mechanical load and fire resistance testing.

In conducting these tests, specific modules are selected for their physical properties so that the certifications can be broadly applied. The following lists the specific modules that were tested and the applicability of those certifications to other modules that might come onto the market. PV modules may have a reduced mechanical load rating, independent of the SM load rating. Please consult the PV module manufacturer's installation guide for more information.

In addition to UL 2703 certification, Unirac performs internal testing beyond the requirements of certification tests in order to establish system functional limits, allowable loads, and factors of safety. These tests include functional system tests, and destructive load testing.

MECHANICAL LOAD TEST MODULES

The modules selected for UL 2703 mechanical load testing were selected to represent the broadest range possible for modules on the market. The tests performed cover the following basic module parameters:
Frame thicknesses greater than or equal to 1.0 mm
Basic single and double wall frame profiles (some complex frame profiles could require further analysis to determine applicability)
Clear and dark anodized aluminum frames`

Tested Modules			
Module Manufacturer	Model/Series	Area [sqft]	UL2703 Certification Load Ratings
Hyundai	HiS-S325TI	21.06	Down– 113 PSF, Up – 50 PSF Down-Slope – 15 PSF
SunPower	SPR-P19-395-COM	22.20	Down– 113 PSF, Up – 50 PSF Down-Slope – 15 PSF
First Solar	FS-6xxx-P	27.12	Down– 33.9 PSF, Up – 33.9 PSF Down-Slope – 16.5 PSF

SYSTEM LEVEL FIRE CLASSIFICATION

The system fire class rating requires installation in the manner specified in the SOLARMOUNT Installation Guide. SOLARMOUNT has been classified to the system level fire portion of UL2703. SOLARMOUNT has achieved system level performance for steep sloped roofs and low sloped roofs. See table below for definition of steep sloped and low sloped roofs. The system is to be mounted over fire resistant roof covering rated for the application. There is no required minimum or maximum height limitation above the roof deck to maintain the system fire rating for SOLARMOUNT. Module Types, System Level Fire Ratings, & Mitigation Requirements are listed below:

ROOF TYPE	Rail Type	Module Fire Type	System Level Fire Rating	Rail Direction	Module Orientation	Mitigation Required
Steep Slope - roof pitches ≥ 2 in/ft	Standard & HD Rail	1, 2, 3 with metal frame, 10 with metal frame, 19, 22, 25, 29, & 30	Class A	Parallel OR Perpendicular to Ridge	Landscape OR Portrait	None Required
	Light Rail	1 & 2				None Required
	Standard, Light, & HD Rail	4 & 5				Trim installation per Solar Mount Installation Guide
Low Slope - roof pitches < 2in/ft	Standard & HD Rail	Type 1, 2, 29, & 30	Class A	Parallel OR Perpendicular to Ridge	Landscape OR Portrait	None Required
	Light Rail					
	Standard, Light, & HD Rail					

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.

Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the SOLARMOUNT system.

Manufacture	Module Model / Series
Aionrise	AION60G1, AION72G1
Aleo	P-Series & S-Series
Aptos Solar	DNA-120-(MF/BF)10-xxxW DNA-120-MF10 DNA-120-(MF/BF)23 DNA-144-(MF/BF)23 DNA-120-(MF/BF)26 DNA-144-(MF/BF)26 DNA-108-(MF/BF)10-xxxW
Astronergy	CHSM6612 M, M/HV CHSM6612P Series CHSM6612P/HV Series CHSM72M-HC CHSM72M(DG)/F-BH
Auxin	AXN6M610T AXN6P610T AXN6M612T AXN6P612T
Axitec	AC-xxx(M/P)/60S, AC-xxx(M/P)/72S AC-xxxP/156-60S AC-xxxMH/120(S/V/SB/VB) AC-xxxMH/144(S/V/SB/VB)
Boviet	BVM6610, BVM6612
BYD	P6K & MHK-36 Series
Canadian Solar	CS1(H/K/U/Y)-MS CS3K-(MB/MB-AG/MS/P/P HE/PB-AG) CS3L-(MS/P) CS3N-MS CS3U-(MB/MB-AG/MS/P/P HE/PB/PB-AG) CS3W-(MS/MB-AG/P/P-PB-AG) CS3Y-MB-AG

Manufacture	Module Model / Series
Canadian Solar (cont.)	CS5A-M CS6K-(M/MS/MS AllBlack/P/P HE) CS6P-(M/P) CS6R-MS CS6U-(M/P/P HE) CS6W-(MS/MB-AG) CS6X-P, CSX-P ELPS CS6(A/P)-MM
Centrosolar America	C-Series & E-Series
CertainTeed	CT2xxMxx-01, CT2xxPxx-01, CTxxxMxx-01 CTxxxPxx-01, CTxxxMxx-02, CTxxxMxx-03 CTxxxMxx-04, CTxxxHC11-04
Eco Solargy	Orion 1000 & Apollo 1000
EMMVEE	ExxxP72-B ExxxM72-B ExxxH CM120-B
ET Solar	ET AC Module, ET Module ET-M772BH520-550WW/WB
First Solar	FS-6XXX(A) FS-6XXX(A)-P, FS-6XXX(A)-P-I
Flextronics	FXS-xxxBB
Freedom Forever	FF-MP-BBB-xxx, FF-MP1-BBB-xxx
FreeVolt	PVGraf
GCL	GCL-P6 & GCL-M6 Series
Hansol	TD-AN3, TD-AN4 UB-AN1, UD-AN1
Hanwha SolarOne	HSL 60
Heliene	36M, 36P 60M, 60P, 72M & 72P Series 144HC M6 144HC M10 SL Bifacial

Manufacture	Module Model / Series
HT-SAAE	HT60-156M-C HT60-156M(V)-C HT72-156(M/P) HT72-156P-C, HT72-156P(V)-C HT72-156M(PDV)-BF, HT72-156M(PD)-BF HT72-166M, HT72-18X
Hyperion Solar	HY-DH108P8
Hyundai	KG, MG, RW, TG, RI, RG, TI, KI, HI Series HiA-SxxxHG, HiD-SxxxRG(BK), HiS-S400PI HiS-SxxxYH(BK) HiS-SxxxXG(BK) HiN-SxxxXG(BK)
ITEK	iT-SE Series
Japan Solar	JPS-60 & JPS-72 Series
JA Solar	JAM72D30MB, JAM78D10MB JAM72S30 /MR JAP6 60-xxx JAM6(K)-60/xxx, JAP6(k)-72-xxx/4BB JAP72S##-xxx/** JAP6(k)-60-xxx/4BB, JAP60S##-xxx/** JAM6(k)-72-xxx/**, JAM72S##-xxx/** JAM6(k)-60-xxx/**, JAM60S##-xxx/** i. ##: 01, 02, 03, 09, 10 ii. **: SC, PR, BP, HiT, IB, MW, MR ** = Backsheet, ## Cell technology

- 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
- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- **Listed models can be used to achieve a Class A fire system rating for steep slope applications. See page 30**

Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the SOLARMOUNT system.

Manufacture	Module Model / Series
Jinko	JKM & JKMS Series JKMxxxM-72HL-V JKMxxxM-72HL4-(T)V JKMxxxM-72HLM-TV JKMxxxM-7RL3-V JKMxxxM-72HL4-TV
Kyocera	KD-F & KU Series
LA Solar	LSxxxHC(166) LSxxxBL LSxxxHC
LG Electronics	LGxxx(E1C/E1K/N1C/N1K/N2T/N2W/S1C/S2W/Q1C/Q1K)-A5 LGxxx(A1C/M1C/M1K/N1C/N1K/Q1C/Q1K/QAC/QAK)-A6 LGxxxN2W-B3 LGxxxN2T-B5 LGxxxN1K-B6 LGxxx(N1C/N1K/N2T/N2W)-E6 LGxxx(N1C/N1K/N2W/S1C/S2W)-G4 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	LR4-60(HPB/HPH) LR4-72(HPH) LR6-60 LR6-60(BK/HPB/HPH/HV/PB/PE/PH) LR6-72 LR6-72(BK/HV/PB/PE/PH) RealBlack LR4-60HPB RealBlack LR6-60HPB
Maxeon	SPR-MAX3-xxx-COM
Meyer Burger	Meyer Burger Black, Meyer Burger White Meyer Burger Glass
Mission Solar Energy	MSE Mono, MSE Perc MSExxx(SR8T/SR8K/SR9S/SX5T) MSExxx(SX5K/SX6W)
Mitrex	Mxxx-L3H, Mxxx-I3H
Mitsubishi	MJE & MLE Series
Neo Solar Power Co.	D6M Series
NE Solar	NESE xxx-72MHB-M10 NESE xxx-60MH-M6
Panasonic	VBHNxxxSA06/SA06B/SA11/SA11B VBHNxxxSA15/SA15B/SA16/SA16B, VBHNxxxKA, VBHNxxxKA03/04, VBHNxxxSA17/SA17G/SA17E/SA18/SA18E, VBHNxxxZA01/ZA02/ZA03/VBHNxxxZA04 EVPVxxx EVPVxxx(H/K/PK/HK)

Manufacture	Module Model / Series
Peimar	SGxxxM (FB/BF) SMxxxM
Phono Solar	PSxxxM1-20/U PSxxxM1H-20/U PSxxxM1-20UH PSxxxM1H-20UH PSxxxM4(H)-24/TH PSxxxM1-20/UH PSxxxM1H-20/UH PSxxxM-24/T PSxxxMH-24/T PSxxxM-24/TH PSxxxMH-24/TH
Prism Solar	P72 Series, P72X-xxx
Q.Cells	Plus, Pro, Peak, G3, G4, Peak G5(SC) , G6(+)(SC)(AC), G7, G8(+), Plus, Pro, Peak L-G2, L-G4, L-G5 Peak L-G5, L-G6, L-G7, L-G8(BFF) Q.PEAK DUO(BLK)-G6+ Q.PEAK DUO BLK-G6+/TS Q.PEAK DUO (BLK)-G7

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- Use with a maximum over current protection device OCPD of 30A
- **Listed models can be used to achieve a Class A fire system rating for steep slope applications. See page 30**

Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the SOLARMOUNT system.

Manufacture	Module Model / Series
Q.Cells (cont.)	Q.PEAK DUO L-(G7/G7.1/G7.2/G7.3/G7.7) Q.PEAK DUO (BLK) G8(+) Q.PEAK DUO L-(G8/G8.1/G8.2/G8.3) Q.PEAK DUO L-G8.3 (BFF/BFG/BGT) 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-G10+ Q.PEAK DUO BLK G10(+) Q.PEAK DUO BLK G10+ /AC Q.PEAK DUO (BLK) ML-G10(a)(+) Q.PEAK DUO XL-(G10/G10.2/G10.3/G10.c/G10.d) Q.PEAK DUO XL-G10.3/BFG Q.PEAK DUO XL-G10.d/BFG Q.PEAK DUO XL-(G11.2/G11.3) Q.PEAK DUO XL-G11.3/BFG
REC	RECxxxAA (BLK/Pure) RECxxxNP (N-PEAK) RECxxxNP2 (Black) RECxxxPE, RECxxxPE72 RECxxxTP, RECxxxTP72 RECxxxTP2(M/BLK2) RECxxxTP2S(M)72 RECxxxTP3M (Black) RECxxxTP4 (Black)
Renesola	All 60-cell modules
Risen	RSM Series, RSM110-8-xxxBMDG
SEG Solar	SEG-xxx-BMD-HV/TB

Manufacture	Module Model / Series
S-Energy	SN72 & SN60 Series
Seraphim	SEG-(6PA/6PB/6MA/6MA-HV/6MB/E01/E11) SRP-(6QA/6QB) SRP-xxx-6MB-HV, SRP-320-375-BMB-HV, SRP-xxx-BMC-HV, SRP-390-450-BMA-HV, SRP-xxx-BMZ-HV, SRP-390-405-BMD-HV
Sharp	NU-SA & NU-SC Series
Silfab	SLA-M, SLA-P, SLG-M, SLG-P & BC Series SIL-xxx(BK/BL/HC/HC+/HL/HM/HN/ML/NL/NT/NX/NU)
Solar4America	S4Axxx-108MH10BB, S4Axxx-72MH5BB
SolarEver USA	SE-166*83-xxxM-120N SE-182*91-xxxM-108N
Solaria	PowerXT-xxxR-(AC/PD/BD) PowerXT-xxxC-PD PowerXT-xxxR-PM (AC) PowerX-400R
Solartech	STU HJT, STU PERC & Quantum PERC
SolarWorld	Sunmodule Protect, Sunmodule Plus/Pro
Sonali	SS-M-360 to 390 Series SS-M-390 to 400 Series SS-M-440 to 460 Series SS-M-430 to 460 BiFacial Series
Sun Edison	F-Series, R-Series
Suniva	MV Series & Optimus Series (35mm)

Manufacture	Module Model / Series
Sunmac Solar	M754SH-BB Series
SunPower	AC, X-Series, E-Series & P-Series SPR E20 435 COM (G4 Frame) Axxx-BLK-G-AC, SPR-Mxxx-H-AC SPR-Mxxx-H-AC
SunTech	STP, STPXXXS - B60/Wnhb
Talesun	TP572, TP596, TP654, TP660 TP672, Hipor M, Smart, TD6I72M
Tesla	SC, SC B, SC B1, SC B2, TxxxS, TxxxH
Trina	PA05, PD05, DD05, DD06, DE06, DE09.05 PD14, PE14, DD14, DE14, DE15, DE15V(II) DEG15HC.20(II), DEG15MC.20(II) DEG15VC.20(II), DE18M(II), DEG18MC.20(II) DE19, DEG19C.20
TSMC	TS-150C2 CIGSw
Universal Solar	UNI4xx-144BMH-DG UNI5xx-144BMH-DG UNIxxx-108M-BB UNIxxx-120M-BB UNIxxx-120MH
Upsolar	UP-MxxxP, UP-MxxxM(-B)
URECO	D7Kxxx(H7A/H8A), D7Mxxx(H7A/H8A) FAKxxx(C8G/E8G), FAMxxxE7G-BB FAMxxxE8G(-BB), FBKxxxM8G F6MxxxE7G-BB FBMxxxMFG-BB
Vikram	Eldora, Somera, Ultima PREXOS VSMDHT.60.AAA.05 PREXOS VSMDHT.72.AAA.05

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- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- **Listed models can be used to achieve a Class A fire system rating for steep slope applications. See page 30**

Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the SOLARMOUNT system.

Manufacture	Module Model / Series
Vina	VNS-72M1-5-xxxW-1.5, VNS-72M3-5-xxxW-1.5, VNS-144M1-5-xxxW-1.5, VNS-144M3-5-xxxW-1.5, VNS-120M3-5-xxxW-1.0
VSUN	VSUNxxx-60M-BB, VSUNxxx-72MH VSUN4xx-144BMH VSUN4xx-144BMH-DG VSUN5xx-144BMH-DG VSUNxxx-108M-BB VSUNxxx-120M-BB VSUNxxx-120BMH VSUNxxx-132BMH VSUNxxx-108BMH
Waaree	Ahnay Series Bi-33
Winaico	WST & WSP Series
Yingli	YGE & YLM Series
Yotta Energy	YSM-B450-1
ZNShine	ZXM6-72 Series, ZXM6-NH144 ZXM6-NHLDD144 ZXM7-SH108 Series

- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
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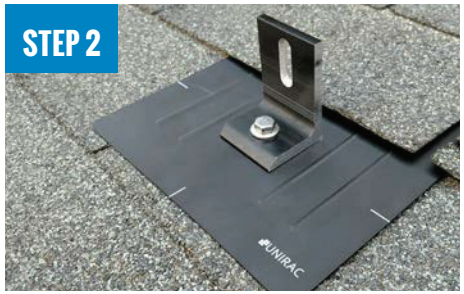
- Slashes "/" between one or more items indicates that either of those items may be the one that is present in a module's model ID
- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- **Listed models can be used to achieve a Class A fire system rating for steep slope applications. See page 30**

INSTALL **FLASH**KIT PRO FLASHING



INSTALL L-FOOT

ATTACH L-FOOT TO RAIL

PRE-INSTALL

- Locate roof rafters and snap chalk lines to mark the installation point for each roof attachment.
- Drill a 7/32" pilot hole at each roof attachment. Fill each pilot hole with sealant.

STEP 1 INSTALL **FLASH**KIT PRO FLASHING

- Add a U-shaped bead of roof sealant to the underside of the flashing with the open side of the U pointing down the roof slope. Slide the aluminum flashing underneath the row of shingles directly up slope from the pilot hole as shown. Align the indicator marks on the lower end of the flashing with the chalk lines on the roof to center the raised hole in the flashing over the pilot hole in the roof. When installed correctly, the flashing will extend under the two courses of shingles above the pilot hole.

STEP 2 INSTALL L-FOOT

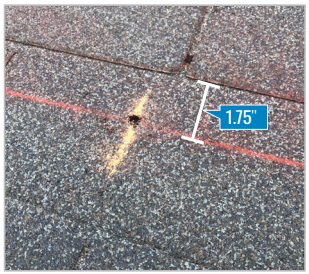
- Fasten L-foot and Flashing into place by passing the included lag bolt and pre-installed stainless steel-backed EPDM washer through the L-foot EPDM grommet, and the raised hole in the flashing, into the pilot hole in the roof rafter.
- Drive the lag bolt down until the L-foot is held firmly in place. It is normal for the EPDM on the underside of the stainless steel backed EPDM washer to compress and expand beyond the outside edge of the steel washer when the proper torque is applied.

TIP:

- Use caution to avoid over-torqueing the lag bolt if using an impact driver.
- Repeat Steps 1 and 2 at each roof attachment point.

STEP 3 ATTACH L-FOOT TO RAIL

- Insert the included 3/8"-16 T-bolts into the lower slot on the Rail (sold separately), spacing the bolts to match the spacing between the roof attachments.
- Position the Rail against the L-Foot and insert the threaded end of the T-Bolt through the continuous slot in the L-Foot. Apply anti-seize to bolt threads to prevent galling of the T-bolt and included 3/8" serrated flange nut. Place the 3/8" flange nut on the T-bolt and finger tighten. Repeat STEP 3 until all L-Feet are secured to the Rail with a T-bolt. Adjust the level and height of the Rail and torque each bolt to 30ft-lbs.



PRE-INSTALL

Snap chalk lines for attachment rows. On shingle roofs, snap lines 1-3/4" below upslope edge of shingle course. Locate rafters and mark attachment locations.

At each location, drill a 7/32" pilot hole. Clean roof surface of dirt, debris, snow, and ice. Next, BACKFILL ALL PILOT HOLES WITH SEALANT.

NOTE: Space mounts per racking system install specifications.

STEP 1: SECURE

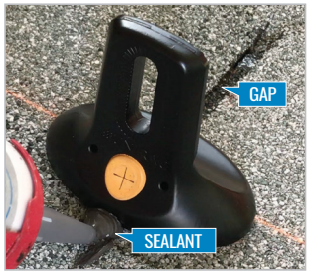
Place **FLASH**LOC over pilot hole with lag on down-slope side. Align indicator marks on sides of mount with chalk line. Pass included lag bolt and sealing washer through **FLASH**LOC into pilot hole. Drive lag bolt until mount is held firmly in place.

NOTE: The EPDM in the sealing washer will expand beyond the edge of the metal washer when proper torque is applied.

STEP 2: SEAL

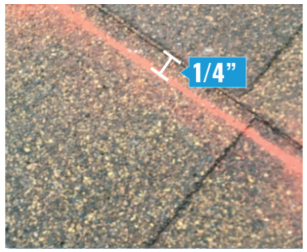
Insert tip of UNIRAC provided sealant into port. Inject until sealant exits both vents. Follow sealant manufacturer's instructions. Follow sealant manufacturer's cold weather application guidelines, if applicable.

Continue array installation, attaching rails to mounts with provided T-bolts.



NOTE: When **FLASH**LOC is installed over gap between shingle tabs or vertical joints, fill gap/joint with sealant between mount and upslope edge of shingle course.

USE ONLY UNIRAC APPROVED SEALANTS: Chemlink Duralink 50, Chemlink M-1, Geocel 4500, or Geocel S-4

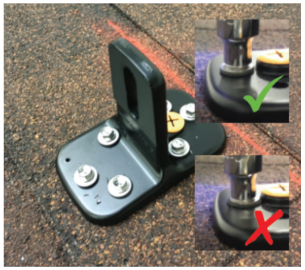


PRE-INSTALL CLEAN SURFACE AND MARK LOCATION

Ensure existing roof structure is capable of supporting loads prescribed in Flashloc Duo D&E Guide. Clean roof surface of dirt, debris, snow and ice.

Snap chalk lines for attachment rows. On shingle roofs, snap lines 1/4” below upslope edge of shingle coarse. This line will be used to align the upper edge of the mount.

NOTE: Space mounts per span charts found in Flashloc Duo D&E Guide.



STEP ONE: SECURE

ATTACHING TO A RAFTER: Place FLASHLOC DUO over rafter location and align upper edge of mount with horizontal chalk line. Secure mount with the two (2) provided rafter screws. BACKFILL ALL PILOT HOLES WITH SEALANT.

ATTACHING TO SHEATHING: Place FLASHLOC DUO over desired location and align upper edge of mount with horizontal chalk line. Secure mount with the two (2) provided rafter screws. Next, secure mount with four (4) deck screws by drilling through the FLASHLOC DUO deck mount hole locations. Unirac recommends using a drill as opposed to an impact gun to prevent over-tightening or stripping roof sheathing.

IMPORTANT: SECURELY ATTACH MOUNT BUT DO NOT OVERTIGHTEN SCREWS.

STEP TWO: SEAL

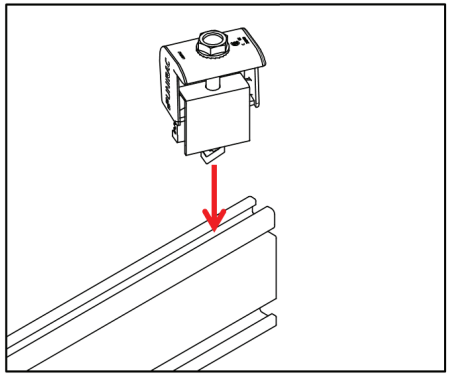
Insert tip of UNIRAC approved sealant into port and inject until sealant exits vent.
Continue array installation, attaching rails to mounts with provided T-bolts. Follow sealant manufacturer's instructions. Follow sealant manufacturer's cold weather application guidelines, if applicable.

NOTE: When FLASHLOC DUO is installed over gap between shingle tabs or vertical joints, fill gap/joint with sealant between mount and upslope edge of shingle course.

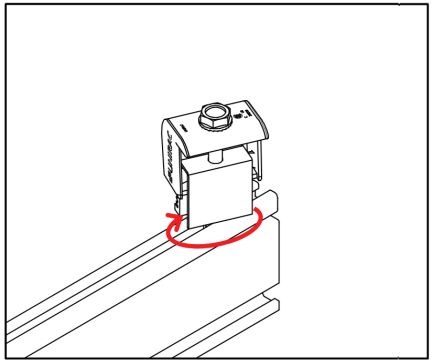
CUT SHINGLES AS REQUIRED: DO NOT INSTALL THE FLASHLOC SLIDER ACCROSS THICKNESS VARIATIONS GREATER THAN 1/8" SUCH AS THOSE FOUND IN HIGH DEFINITION SHINGLES.

NOTE: When installing included rail attachment hardware, torque T-bolt nut to 30 ft-lbs.
NOTE: If an exploratory hole falls outside of the area covered by the sealant, flash hole accordingly.

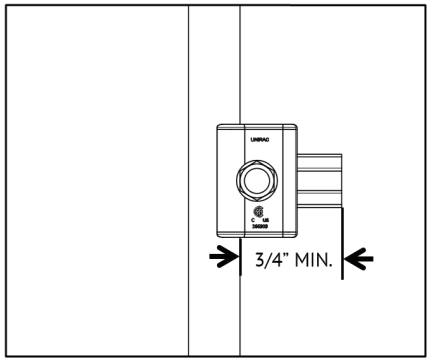
USE ONLY UNIRAC APPROVED SEALANTS. PLEASE CONTACT UNIRAC FOR FULL LIST OF COMPATIBLE SEALANTS.



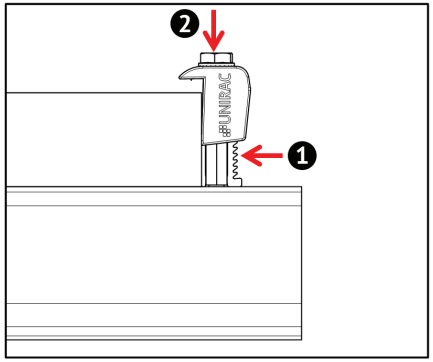
STEP 1: Position clamp to align T-bolt with rail slot. Lower clamp and Insert T-bolt into rail slot.



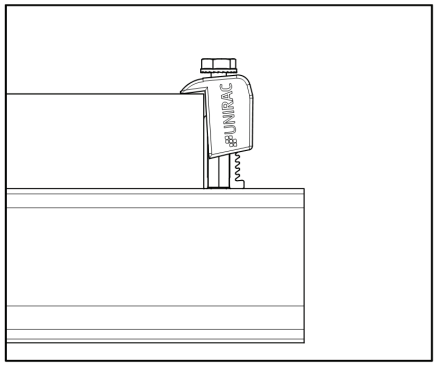
STEP 2: Rotate clamp clockwise 2/3 of a turn to engage T-bolt inside rail slot.



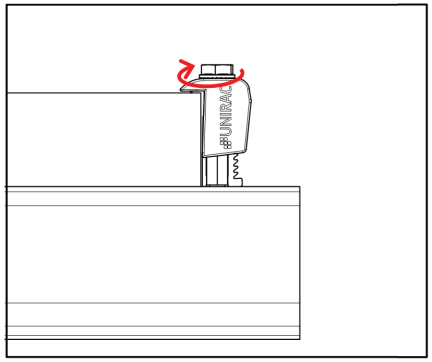
STEP 3: Place module at least 3/4" from end of rail and position clamp against module frame.



STEP 4: While applying pressure to hold the clamp against the module, push down on the module side of the clamp cap.

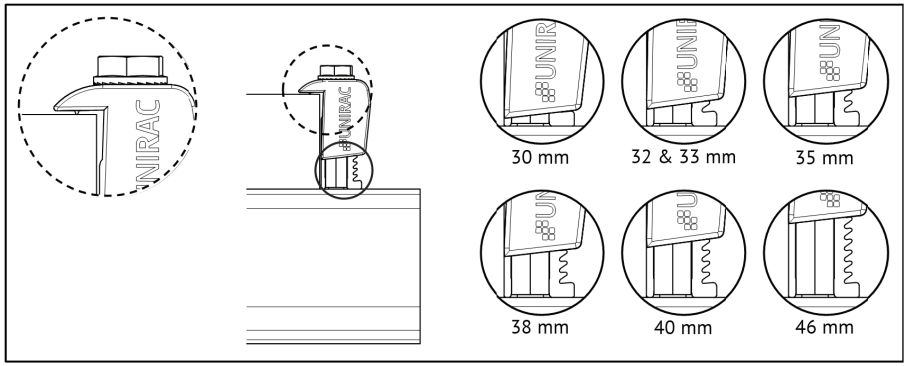


STEP 5: When the cap contacts the module frame, release and it will re-engage to the clamp base.



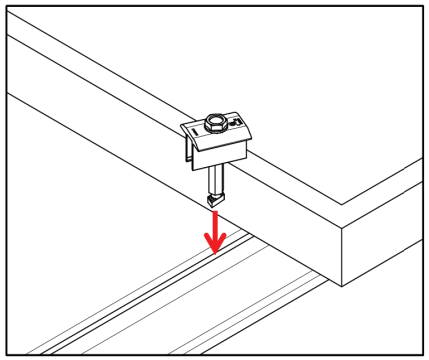
STEP 6: Tighten bolt and torque to 15 ft-lbs.

NOTE - Universal AF End Clamps are single use.

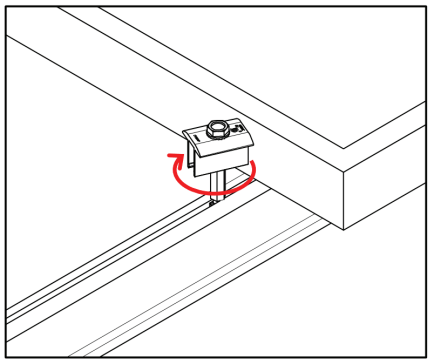


STEP 7: Confirm clamp is engaged in correct module height position and that the top of the cap is sitting level with the module frame.

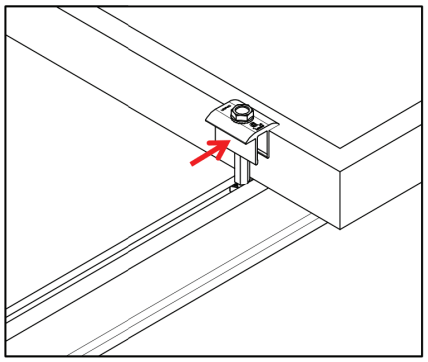
NOTE: When installing 46mm modules, loosen bolt by 1 turn before positioning clamp against module frame. Do not force clamp onto module frame as this may damage the bonding pin.



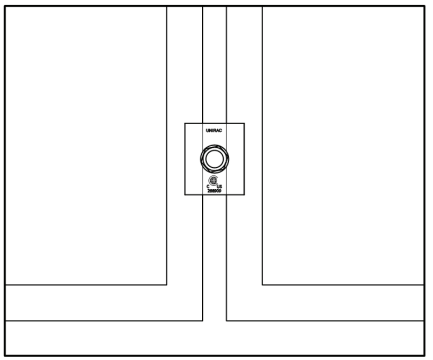
STEP 1: Position clamp to align T-bolt with rail slot. Lower clamp and insert T-bolt into rail slot



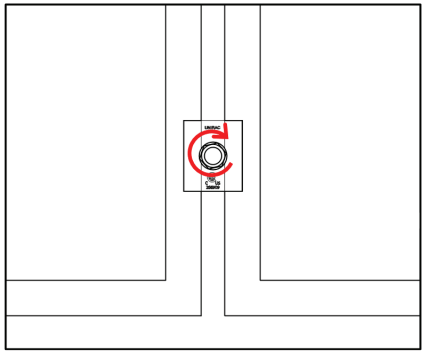
STEP 2: Rotate clamp clockwise 2/3 of a turn to engage T-bolt inside rail slot.



STEP3: Slide clamp into position against module.

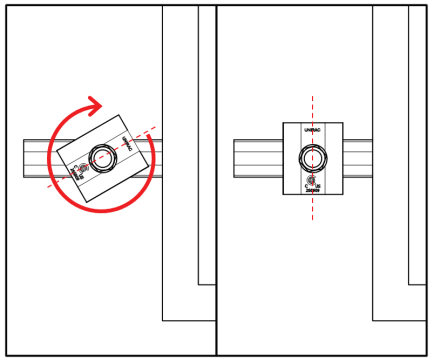


STEP 4: Place second module.

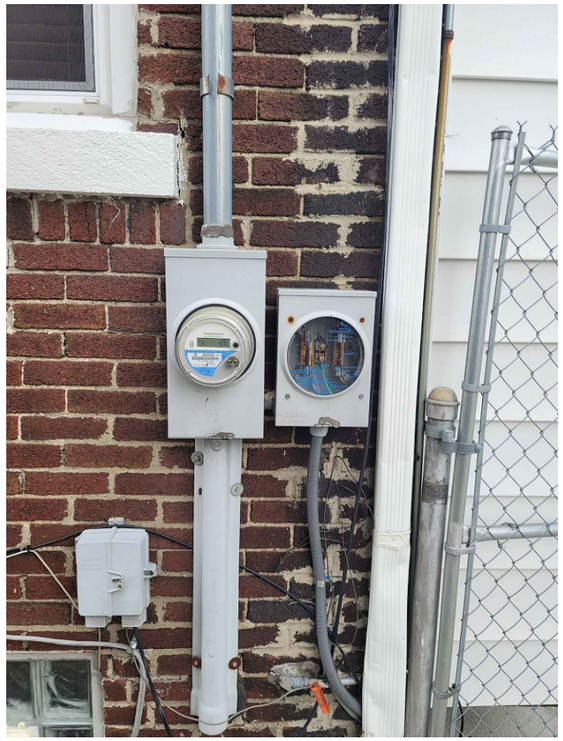


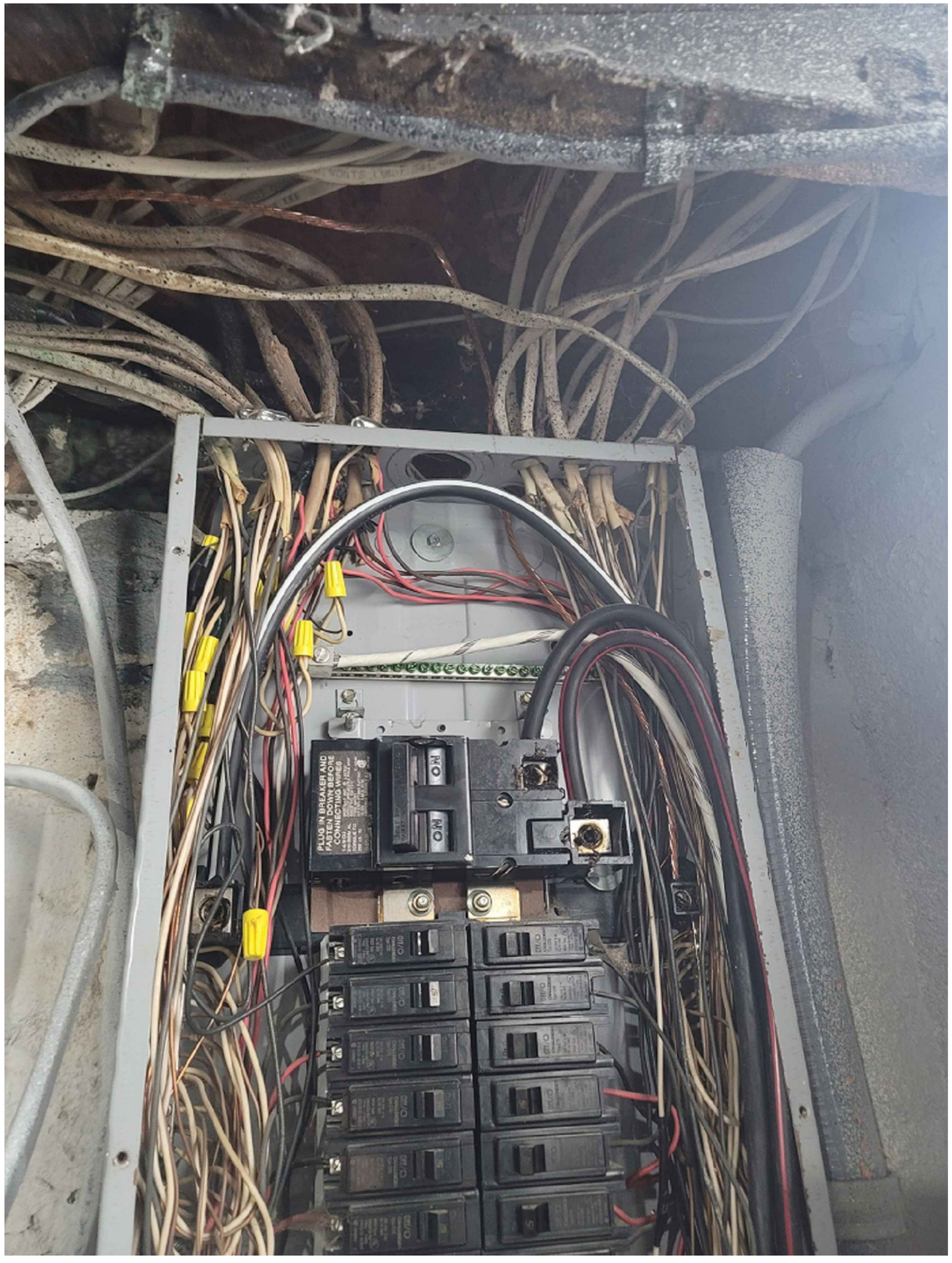
STEP 5: Tighten bolt and torque to 15 ft-lbs.

NOTE - Universal AF Mid Clamps are single use.



NOTE: If excessive force is applied in step 2, the cap may over-rotate causing it to be mis-aligned with the module frame. If this occurs, keep rotating the cap clockwise until it returns to the original position.





LICENSE NUMBER: 6218537

SMITH, MIRANDA
2490 LONGFELLOW STREET
DETROIT, MI 48206
7348589871

GENERATION SOLAR
1192 E. DRAPER PARKWAY STE 466
DRAPER, UT 84020
(888) 985-2859

ELECTRICAL PHOTOS

JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN

REV #1:
REV #2:
REV #3:

PV-7

WYSSLING CONSULTING
CORPORATE EXPERIENCE WITH SMALL BUSINESS VALUE

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November 22, 2023

Generation Solar
1192 East Draper Parkway, Ste. 466
Draper, UT 84020

Re: Engineering Services
Smith Residence
2490 Longfellow Street, Detroit, MI
7.900 kW System

To Whom It May Concern:

We have received information regarding solar panel installation on the roof of the above referenced structure. Our evaluation of the structure is to verify the existing capacity of the roof system and its ability to support the additional loads imposed by the proposed solar system.

A. Site Assessment Information

1. Site visit documentation identifying attic information including size and spacing of framing for the existing roof structure.
2. Design drawings of the proposed system including a site plan, roof plan and connection details for the solar panels. This information will be utilized for approval and construction of the proposed system.

B. Description of Structure:

Roof Framing: 2 x 6 dimensional lumber at 16” on center.
Roof Material: Composite Asphalt Shingles
Roof Slope: 27 degrees
Attic Access: Accessible
Foundation: Permanent

C. Loading Criteria Used

- **Dead Load**
  - Existing Roofing and framing = 7 psf
  - New Solar Panels and Racking = 3 psf
  - TOTAL = 10 PSF
- **Live Load** = 20 psf (reducible) – 0 psf at locations of solar panels
- **Ground Snow Load** = 25 psf
- **Wind Load** based on ASCE 7-10
  - Ultimate Wind Speed = 115 mph (based on Risk Category II)
  - Exposure Category C

Analysis performed of the existing roof structure utilizing the above loading criteria is in accordance with the 2015 International Residential Code, including provisions allowing existing structures to not require strengthening if the new loads do not exceed existing design loads by 105% for gravity elements and 110% for seismic elements. This analysis indicates that the existing framing will support the additional panel loading without damage, if installed correctly.

D. Solar Panel Anchorage

1. The solar panels shall be mounted in accordance with the most recent Unirac installation manual. If during solar panel installation, the roof framing members appear unstable or deflect non-uniformly, our office should be notified before proceeding with the installation.
2. The maximum allowable withdrawal force for a $^{5}/_{16}$" lag screw is 235 lbs per inch of penetration as identified in the National Design Standards (NDS) of timber construction specifications. Based on a minimum penetration depth of 2½", the allowable capacity per connection is greater than the design withdrawal force (demand). Considering the variable factors for the existing roof framing and installation tolerances, the connection using one $^{5}/_{16}$" diameter lag screw with a minimum of 2½" embedment will be adequate and will include a sufficient factor of safety.
3. Considering the wind speed, roof slopes, size and spacing of framing members, and condition of the roof, the panel supports shall be placed no greater than 48" on center.

Based on the above evaluation, this office certifies that with the racking and mounting specified, the existing roof system will adequately support the additional loading imposed by the solar system. This evaluation is in conformance with the 2015 IRC, current industry standards, and is based on information supplied to us at the time of this report.

Should you have any questions regarding the above or if you require further information do not hesitate to contact me.

Very truly yours,

Scott E. Wyssling, PE
Michigan License No. 6201068147

Signed 11/22/2023

SMITH RESIDENCE

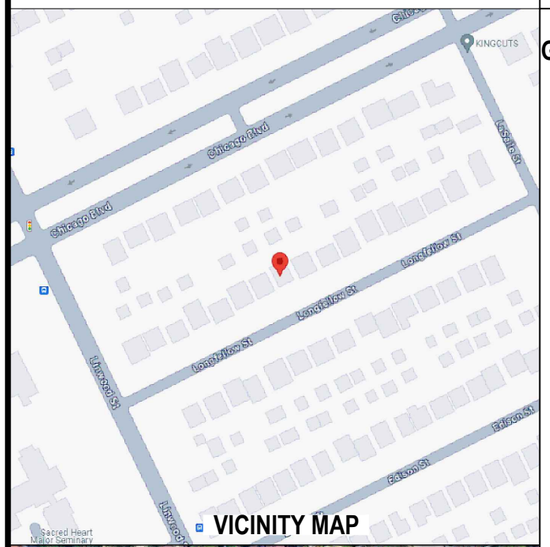
PHOTOVOLTAIC SYSTEM
2490 LONGFELLOW STREET
DETROIT, MI 48206

SYSTEM SIZE: 7.90 kW-DC | 5.80 kW-AC
MODULE: (20) CS3U- 395W
INVERTER: (20) ENPHASE IQ8+-72-2-US

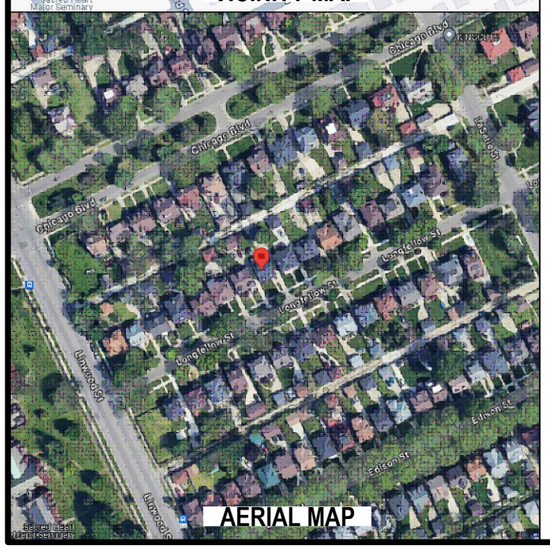
GOVERNING CODES:

ALL MATERIALS, EQUIPMENT, INSTALLATION AND WORK SHALL COMPLY WITH THE FOLLOWING APPLICABLE CODES:

- 2014 NATIONAL ELECTRIC CODE (NEC)
- 2015 MICHIGAN BUILDING CODE
- 2015 MICHIGAN PUMBING CODE
- 2015 INTERNATIONAL FUEL GAS CODE
- 2015 INTERNATIONAL MECHANICAL CODE
- 2015 MICHIGAN REHABILITATION CODE
- 2015 INTERNATIONAL FIRE CODE (IFC)
- 2015 INTERNATIONAL ENERGY CONSERV. CODE
- ICC/ANSI A117.1 - 2009



VICINITY MAP



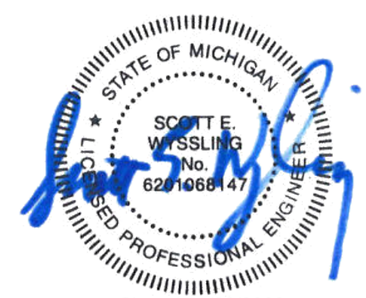
AERIAL MAP

GENERAL

1. UTILITY SHALL BE NOTIFIED BEFORE ACTIVATION OF PHOTOVOLTAIC SYSTEM.
2. 110.2 APPROVAL: ALL ELECTRICAL EQUIPMENT SHALL BE LABELED, LISTED, OR CERTIFIED BY A NATIONALLY RECOGNIZED TESTING LABORATORY ACCREDITED BY THE UNITED STATES OCCUPATIONAL SAFETY HEALTH ADMINISTRATION
3. CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS PRIOR TO INITIATING CONSTRUCTION.
4. CONTRACTOR SHALL REVIEW ALL MANUFACTURER INSTALLATION DOCUMENTS PRIOR TO INITIATING CONSTRUCTION.
5. ALL EQUIPMENT AND ASSOCIATED CONNECTIONS, ETC, AND ALL ASSOCIATED WIRING AND INTERCONNECTIONS SHALL BE INSTALLED ONLY BY QUALIFIED PERSONNEL.
6. THE CONTRACTOR OR OWNER MUST PROVIDE ROOF ACCESS (LADDER TO ROOF) FOR ALL THE REQUIRED INSPECTIONS. LADDERS MUST BE OSHA APPROVED, MINIMUM TYPE I WITH A 250LB. RATING, IN GOOD CONDITION AND DESIGNED FOR ITS INTENDED USE.
7. CONTRACTOR SHALL VERIFY THAT THE ROOF STRUCTURE WILL WITHSTAND THE ADDITIONAL LOADS.
8. LAG SCREWS SHALL PENETRATE A MINIMUM 2" INTO SOLID SAWN STRUCTURAL MEMBERS AND SHALL NOT EXCEED MANUFACTURER RECOMMENDATIONS FOR FASTENERS INTO ENGINEERED STRUCTURAL MEMBERS.
9. AN ACCESS POINT SHALL BE PROVIDED THAT DOES NOT PLACE THE GROUND LADDER OVER OPENINGS SUCH AS WINDOWS OR DOORS ARE LOCATED AT STRONG POINTS OF BUILDING CONSTRUCTION AND IN LOCATIONS WHERE THE ACCESS POINT DOES NOT CONFLICT WITH OVERHEAD OBSTRUCTIONS SUCH AS TREE LIMBS, WIRES, OR SIGNS.
10. WHERE DC CONDUCTORS ARE RUN INSIDE BUILDING, THEY SHALL BE CONTAINED IN A METAL RACEWAY; THEY SHALL NOT BE INSTALLED WITHIN 10" OF THE ROOF DECKING OR SHEATHING EXCEPT WHERE COVERED BY THE PV MODULES AND EQUIPMENT.
11. PLUMBING AND MECHANICAL VENTS THROUGH THE ROOF SHALL NOT BE COVERED BY SOLAR MODULES- - NO BUILDING, PLUMBING OR MECHANICAL VENTS TO BE COVERED, CONSTRUCTED OR ROUTED AROUND SOLAR MODULES.
12. ALL FIELD -INSTALLED JUNCTION, PULL AND OUTLET BOXES LOCATED BEHIND MODULES SHALL BE ACCESSIBLE DIRECTLY OR BY DISPLACEMENT OF A MODULE SECURED BY REMOVABLE FASTENERS.

ELECTRICAL

1. WIRING MATERIALS SHALL COMPLY WITH MAXIMUM CONTINUOUS CURRENT OUTPUT AT 25°C AND MAXIMUM VOLTAGE AT 600V; WIRE SHALL BE WET RATED AT 90°C.
2. EXPOSED PHOTOVOLTAIC SYSTEM CONDUCTORS ON THE ROOF WILL BE USE 2 OR PV-TYPE WIRE.
3. PHOTOVOLTAIC SYSTEM CONDUCTORS SHALL BE IDENTIFIED AND GROUPED. THE MEANS OF IDENTIFICATION SHALL BE PERMITTED BY SEPARATE COLOR-CODING, MARKING TAPE, TAGGING OR OTHER APPROVED MEANS.
4. ALL EXTERIOR CONDUIT, FITTINGS, AND BOXES SHALL BE RAIN-TIGHT AND APPROVED FOR USE IN WET LOCATIONS.
5. ALL METALLIC RACEWAYS AND EQUIPMENT SHALL BE BONDED AND ELECTRICALLY CONTINUOUS.
6. WHERE SIZES OF JUNCTION BOXES, RACEWAYS, AND CONDUITS ARE NOT SPECIFIED, CONTRACTOR SHALL SIZE THEM ACCORDING TO APPLICABLE CODES.
7. REMOVAL OF A UTILITY-INTERACTIVE INVERTER OR OTHER EQUIPMENT SHALL NOT DISCONNECT THE BUILDING CONNECTION BETWEEN THE GROUNDING ELECTRODE CONDUCTOR AND THE PV SOURCE AND/OR OUTPUT CIRCUIT GROUNDED CONDUCTOR.
8. FOR GROUNDED SYSTEMS, THE PHOTOVOLTAIC SOURCE AND OUTPUT CIRCUITS SHALL BE PROVIDED WITH A GROUND-FAULT PROTECTION DEVICE OR SYSTEM THAT DETECTS A GROUND FAULT, INDICATES THAT FAULT HAS OCCURED AND AUTOMATICALLY DISCONNECTS ALL CONDUCTORS OR CAUSES THE INVERTER TO AUTOMATICALLY CEASE SUPPLYING POWER TO OUTPUT CIRCUITS.
9. FOR UNGROUNDED SYSTEMS, THE INVERTER IS EQUIPPED WITH GROUND FAULT PROTECTION AND A GFI FUSE PORT FOR GROUND FAULT INDICATION.
10. PV MODULE FRAMES SHALL BE BONDED TO RACKING RAIL OR BARE COPPER GEC/GEC PER THE MODULE MANUFACTURER'S LISTED INSTRUCTION SHEET.
11. PV MODULE RACKING RAIL SHALL BE BONDED TO BARE COPPER GEC VIA WEEB LUG, ILSCO GBL-4DBT LAY-IN LUG, OR EQUIVALENT LISTED LUG.
12. THE PHOTOVOLTAIC INVERTER WILL BE LISTED AS UL 1741 COMPLIANT.
13. RACKING AND BONDING SYSTEM TO BE UL2703 RATED.
14. ANY REQUIRED GROUNDING ELECTRODE CONDUCTOR WILL BE CONTINUOUS, EXCEPT FOR SPLICES OR JOINTS AS BUS BARS WITHIN LISTED EQUIPMENT.
15. WHEN BACKFED BREAKER IS THE METHOD OF UTILITY INTERCONNECTION, THE BREAKERS SHALL NOT READ "LINE AND LOAD".
16. WHEN APPLYING THE 120% RULE, THE SOLAR BREAKER TO BE POSITIONED AT THE OPPOSITE END OF THE BUS BAR FROM THE MAIN BREAKER.
17. THE WORKING CLEARANCE AROUND THE EXISTING ELECTRICAL EQUIPMENT AS WELL AS THE NEW ELECTRICAL EQUIPMENT WILL BE MAINTAINED.



Signed 11/22/2023

SHEET INDEX:

LICENSE NUMBER: 6218537

SMITH, MIRANDA
2490 LONGFELLOW STREET
DETROIT, MI 48206
7348589871

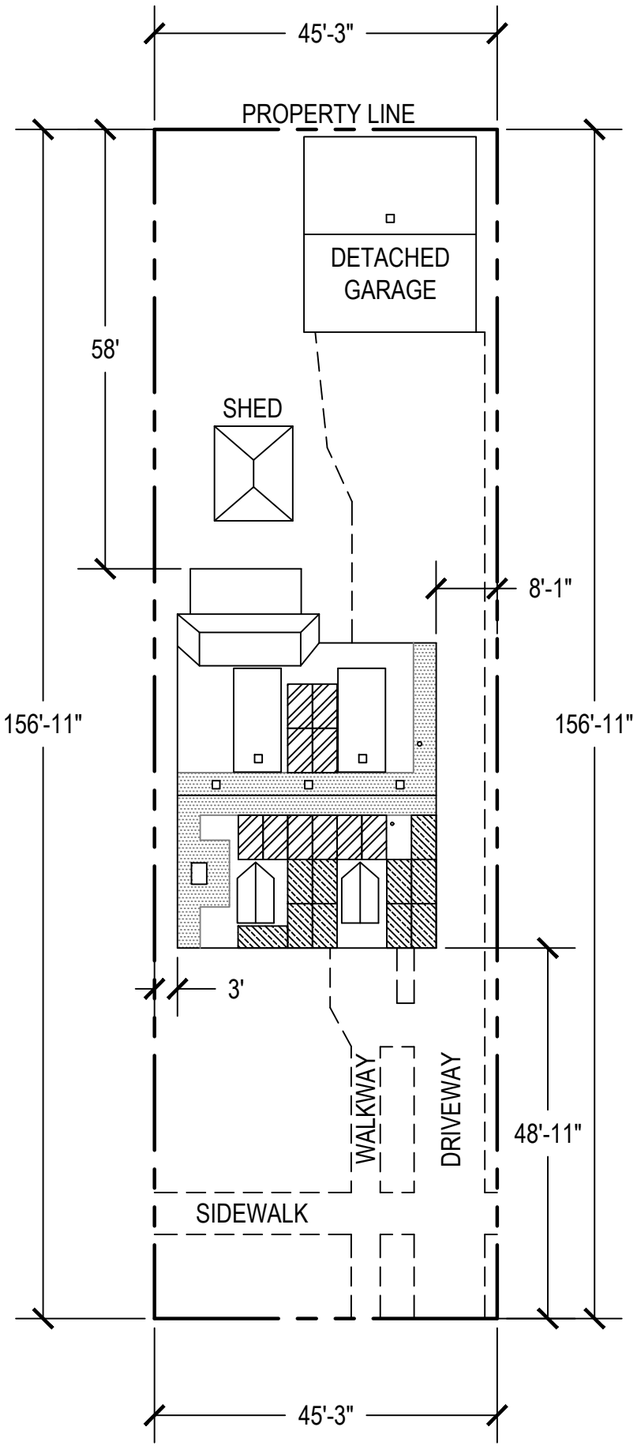
GENERATION SOLAR
1192 E. DRAPER PARKWAY STE 466
DRAPER, UT 84020
(888) 985-2859

COVER PAGE

JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN

REV #1:
REV #2:
REV #3:

PV-1



LONGFELLOW STREET

LEGEND:

PROPERTY LINE: ——— – – ———

DRIVEWAY: – — – — – — – — – —

FENCE: —○———○———○———

SCALE: 1" = 20'

LICENSE NUMBER: 6218537

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STATE OF MICHIGAN
SCOTT E. WYSSLING
No. 6201068147
LICENSED PROFESSIONAL ENGINEER

Signed 11/22/2023

PROPERTY PLAN

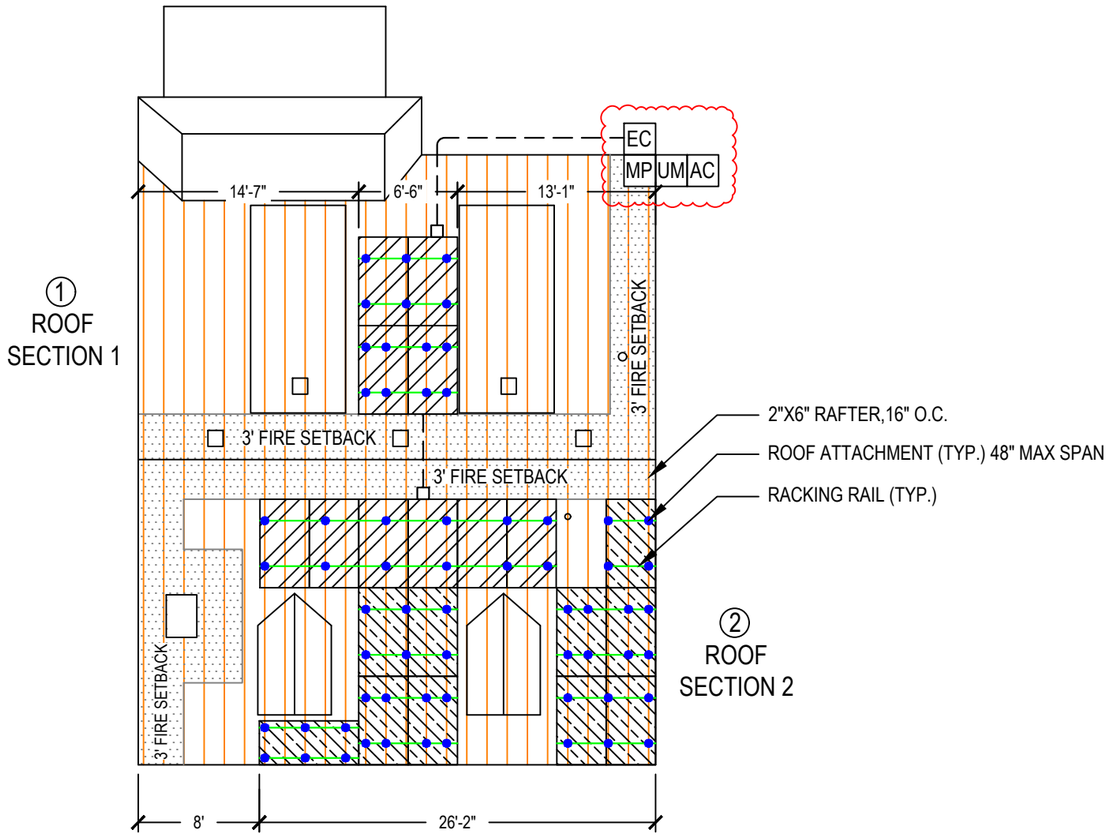
JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN

REV #1:
REV #2:
REV #3:

PV-2

ROOF DETAIL	CIRCUIT DETAIL
ROOF TYPE: ASPHALT SHINGLE	**ENPHASE CIRCUITS**
ROOF SECTION 1: 4 MODULES AZIMUTH: 334° PITCH: 27° ①	CIRCUIT # 1: 10 MODULES
ROOF SECTION 2: 16 MODULES AZIMUTH: 154° PITCH: 27° ②	CIRCUIT # 2: 10 MODULES

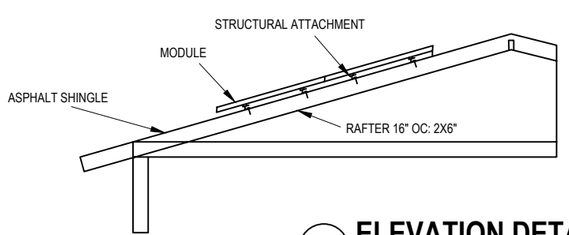
MODULE INFORMATION	
MODULE TYPE	CS3U-395W
MAX DESIGN LOAD (WIND & SNOW)	5400 PA UPWARD / 3600 PA DOWNWARD
MODULE WEIGHT	22.5 KG (49.6 LBS)
MODULE DIMENSIONS (H X L X D)	2000 × 992 × 35 MM (78.7 × 39.1 × 1.38 INCHES)
MODULE AREA	21.3692 FT^2
MODULE MECHANICAL SPECIFICATIONS	
DESIGN WIND SPEED	115 MPH
DESIGN SNOW LOAD	35 PSF
ROOF PITCH	27°
TOTAL ARRAY AREA (SQ. FT)	427.38
TOTAL ROOF AREA (SQ. FT)	1533.4002
ARRAY SQ. FT / TOTAL ROOF SQ. FT	27.87%



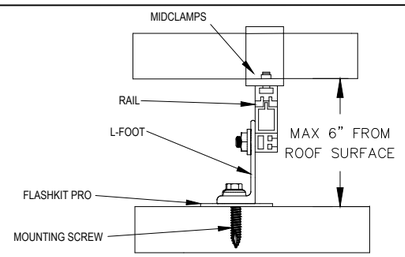
① ROOF SECTION 1

② ROOF SECTION 2

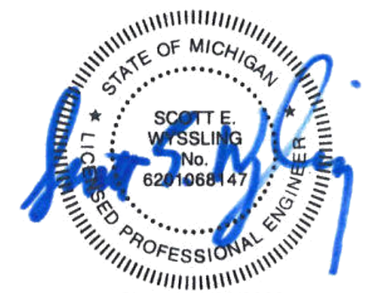
WIND UPLIFT AT ATTACHMENT POINTS IS PROVIDED WITH THE ENGINEERING LETTER.
SUPPORT LOCATIONS HAVE BEEN OPTIMIZED TO WITHSTAND UPLIFT



A **ELEVATION DETAIL**
SCALE: NTS



B **ATTACHMENT DETAIL**
SCALE: NTS



Signed 11/22/2023

SYSTEM LEGEND

PHOTOVOLTAIC SYSTEM:
DC SYSTEM SIZE: 7.90 kW
AC SYSTEM SIZE: 5.80 kW

- UM — MAIN SERVICE METER AND SERVICE POINT
- MP — MAIN SERVICE PANEL
- AC — UTILITY AC DISCONNECT
- EC — ENPHASE AC COMBINER PANEL
- (20) CS3U- 395W WITH ENPHASE IQ8+-72-2-US MICROINVERTERS MOUNTED UNDER EACH MODULE
- JUNCTION BOX AND CONDUIT
- CONDUIT RUN

CONDUIT TO BE RUN IN ATTIC IF POSSIBLE, OTHERWISE CONDUIT BLOCKS MIN. 1"/MAX 6" ABOVE ROOF SURFACE, CLOSE TO RIDGE LINES, AND UNDER EAVES; TO BE PAINTED TO MATCH EXTERIOR/EXISTING BACKGROUND COLOR OF ITS LOCATION; TO BE LABELED AT MAX 10' INTERVALS. CONDUIT RUNS ARE APPROXIMATE AND ARE TO BE DETERMINED IN THE BY THE INSTALLERS

- FIRE CODE SETBACK (18" MIN / 36" MAX)
- ROOF ATTACHMENT POINT
- RAIL
- RAFTER

SCALE: 1" = 10'

LICENSE NUMBER: 6218537

SMITH, MIRANDA
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7348589871

GENERATION SOLAR
1192 E. DRAPER PARKWAY STE 466
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(888) 985-2859

SITE PLAN

JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN

REV #1:
REV #2:
REV #3:

PV-3

Ampacity Calculation:

Wiring Location: **OPTIMIZED Array to Inverter (Direct Current)**

All calculations show minimum sizing for ampacity
Actual wire sizing may be larger for voltage drop or other factors
All calculations are according the the 2020 National Electric Code

Initial Input Values

		Amps				Amps
Isc (Short Circuit Current)		10.25				
Number of circuits		10.25	X	1	=	10.25
Maximum Circuit Current (NEC 690.8 (A)(1+2)		10.25	X	125%	=	12.81
Overcurrent device rating (NEC 690.8 (B)(1)		12.81	X	125%	=	16.02
Minimum overcurrent device		20.00				OK
	SIZE AWG #					
Chosen Conductor Type THHN, RHW-2 or USE-2	10					
Conductor Derating						
NEC 690.31 (C) ref (NEC 310.16)						
Conductor 90°C Ampacity		30				
Conduit Fill Derating	3	30.00	X	1.00	=	30.00
Temperature Derating °F	105-113	30.00	X	.87	=	26.10
Ampacity vs. Overcurrent Device						
Conductor Ampacity Check		26.10	≥	12.81		OK
Conductor to Overcurrent Check		26.10	≥	20.00		OK

Ampacity Calculation:

Wiring Location: **INVERTER to Main Service (Alternating Current)**

All calculations show minimum sizing for ampacity
Actual wire sizing may be larger for voltage drop or other factors
All calculations are according the the 2020 National Electric Code

Initial Input Values

Inverter Continous AC ouput (Watts)	290					
Minimum Operating Voltage	240	**Watts**		**Volts**		**Amps**
		290	/	240	=	1.21
Inverter Continious AC Amps		1.21				
Number of circuits		1.21	X	20	=	24.17
Overcurrent device rating NEC 690.8 (B)(3)		24.17	X	125%	=	30.21
Minimum overcurrent device		40.00				OK
	SIZE AWG #					
Chosen Conductor Type THHN, RHW-2 or USE-2	6					
Conductor Derating						
NEC 690.31 (C) ref (NEC 310.16)						
Conductor 90°C Ampacity		75				
Conduit Fill Derating	3	75.00	X	1.00	=	75.00
Temperature Derating °F	105-113	75.00	X	.87	=	65.25
Ampacity vs. Overcurrent Device						
Conductor Ampacity Check		65.25	≥	30.21		OK
Conductor Overcurrent Check		65.25	≥	40.00		OK

PHOTOVOLTAIC SYSTEM:
DC SYSTEM SIZE: 7.900 kW
AC SYSTEM SIZE: 5.80 kW
INVERTER: (20) ENPHASE IQ8+-72-2-US
MODULE: (20) CS3U- 395W

NOTES:
1. ALL GROUNDING CONDUCTORS SHALL BE GREEN IN COLOR OR BARE, ATTACHED TO ALL METAL PARTS AND REFERENCED TO MAIN SERVICE PANEL GROUND.
2. ALL STATED CONDUIT SIZES SATISFY REQUIREMENTS PER CHAPTER 9, TABLE 1.0, ANNEX C (TABLE C.1), OF THE 2014 NEC. LARGER DIAMETER CONDUIT MAY BE USED TO FACILITATE EASE OF INSTALLATION.

INSTALLER NOTES:
0

STATE OF MICHIGAN
JOUNGHO CHOI
License No. 6201069813
LICENSED PROFESSIONAL ENGINEER

Signed 11/24/2023

LICENSE NUMBER: 6218537

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ELECTRICAL CALCULATIONS

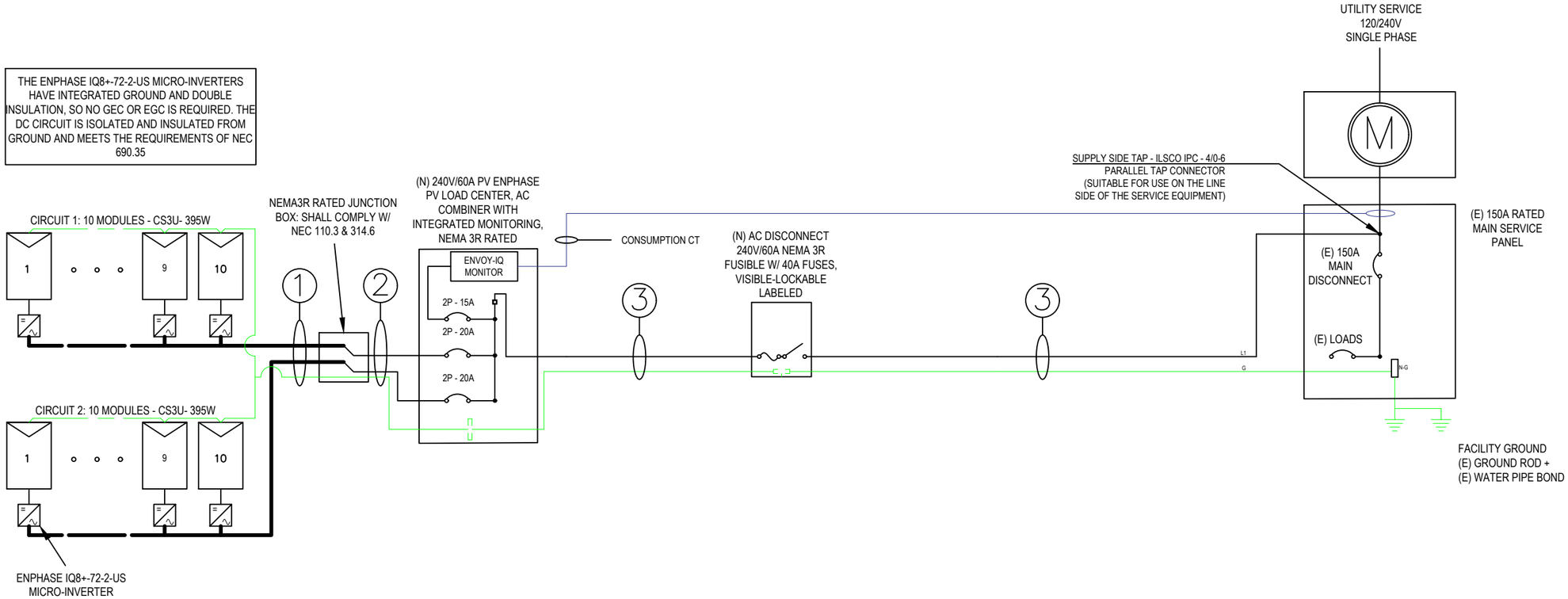
JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN

REV #1:
REV #2:
REV #3:

PV-4

UTILITY AC DISCONNECT MUST BE ACCESSIBLE, LOCKABLE, LABELED, BLADE-STYLE SWITCH, AND LOCATED WITHIN 5' FROM THE UTILITY METER

THE ENPHASE IQ8+-72-2-US MICRO-INVERTERS HAVE INTEGRATED GROUND AND DOUBLE INSULATION, SO NO GEC OR EGC IS REQUIRED. THE DC CIRCUIT IS ISOLATED AND INSULATED FROM GROUND AND MEETS THE REQUIREMENTS OF NEC 690.35



CONDUCTOR AND CONDUIT SCHEDULE					
TAG	WIRE TYPE	WIRE SIZE	# OF CONDUCTORS	CONDUIT TYPE	MIN. CONDUIT SIZE
1	PV WIRE	#10	2 - L1 L2	FREE AIR	N/A
1	BARE COPPER	#6	1 - BARE	FREE AIR	N/A
2	THWN-2	#10	2 - L1 L2	EMT	3/4"
2	THWN-2 EGC	#10	1 - GND	EMT	3/4"
3	THWN-2	#6	3 - L1 L2 N	EMT	3/4"
3	THWN-2 EGC	#8	1 - GND	EMT	3/4"

PV MODULE ELECTRICAL SPECIFICATIONS	
MODULE TYPE	CS3U- 395W
POWER MAX (P_{MAX})	395W
OPEN CIRCUIT VOLTAGE (V_{OC})	48.4V
SHORT CIRCUIT CURRENT (I_{SC})	10.25A
MAX POWER-POINT VOLTAGE (V_{MP})	40.6V
MAX POWER-POINT CURRENT (I_{MP})	9.73A
SERIES FUSE RATING	19.9A

INVERTER ELECTRICAL SPECIFICATIONS	
INVERTER TYPE	ENPHASE IQ8+-72-2-US
MAX INPUT DC VOLTAGE	60V
MAX DC SHORT CIRCUIT CURRENT	15A
MAXIMUM OUTPUT POWER	290W
MAXIMUM CONT. OUTPUT CURRENT	1.21A
CEC EFFICIENCY	97%
MAX UNITS PER 20A CIRCUIT	13

SYSTEM OVER-CURRENT PROTECTION DEVICE (OCPD) CALCULATIONS	
INVERTER TYPE	ENPHASE IQ8+-72-2-US
# OF INVERTERS	20
MAX CONTINUOUS OUTPUT CURRENT	1.21
(# OF INVERTERS) X (MAX CONT. OUTPUT CURRENT) X 125% <= OCPD RATING	
(20 x 1.21A x 1.25)= 30.25A <= 40A, OK	

PHOTOVOLTAIC SYSTEM:
DC SYSTEM SIZE: 7.900 kW
AC SYSTEM SIZE: 5.80 kW
INVERTER: (20) ENPHASE IQ8+-72-2-US
MODULE: (20) CS3U- 395W

NOTES:
1. MODULES ARE BONDED TO RAIL USING UL 2703 RATED BONDING SYSTEM - INTEGRATED BONDING MID-CLAMPS + DIRECT-BURIAL LAY-IN-LUGS; SEE ATTACHED FOR SPECIFICATIONS IF APPLICABLE
2. PV DC SYSTEM IS UNGROUNDED
3. PV ARRAY WILL HAVE A GROUNDING ELECTRODE SYSTEM IN COMPLIANCE WITH NEC 250.58 AND 690.47(A)
4. PV SOURCE, OUTPUT, AND INVERTER INPUT CIRCUIT WIRING METHODS SHALL COMPLY WITH NEC 690.1(G)
5. BACKFED PV BREAKER WILL BE INSTALLED AT OPPOSITE END OF THE BUS BAR FROM THE MAIN BREAKER. A PERMANENT WARNING LABEL TO BE INSTALLED PER SYSTEM SIGNAGE, PAGE
6. BARE COPPER IS TRANSITIONED TO THWN-2 VIA IRREVERSIBLE CRIMP; WHEN PRESENT, THE GEC TO BE CONTINUOUS
7. INVERTER(S) TO BE COMPLIANT WITH UL 1741 SUPPLEMENT A
8. CONDUIT AND CONDUCTOR SPECIFICATIONS ARE BASED ON MINIMUM CODE REQUIREMENTS AND ARE NOT MEANT TO LIMIT UP-SIZING AS REQUIRED BY FIELD CONDITIONS
9. CONDUIT AND CONDUCTOR SPECIFICATIONS ARE BASED ON MINIMUM CODE REQUIREMENTS AND ARE NOT MEANT TO LIMIT UPSIZING AS REQUIRED BY FIELD CONDITIONS.

INSTALLER NOTES:
0

STATE OF MICHIGAN
JOUNGHO CHOI
License No. 6201069813
LICENSED PROFESSIONAL ENGINEER

Signed 11/24/2023

LICENSE NUMBER: 6218537

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7348589871

GENERATION SOLAR
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(888) 985-2859

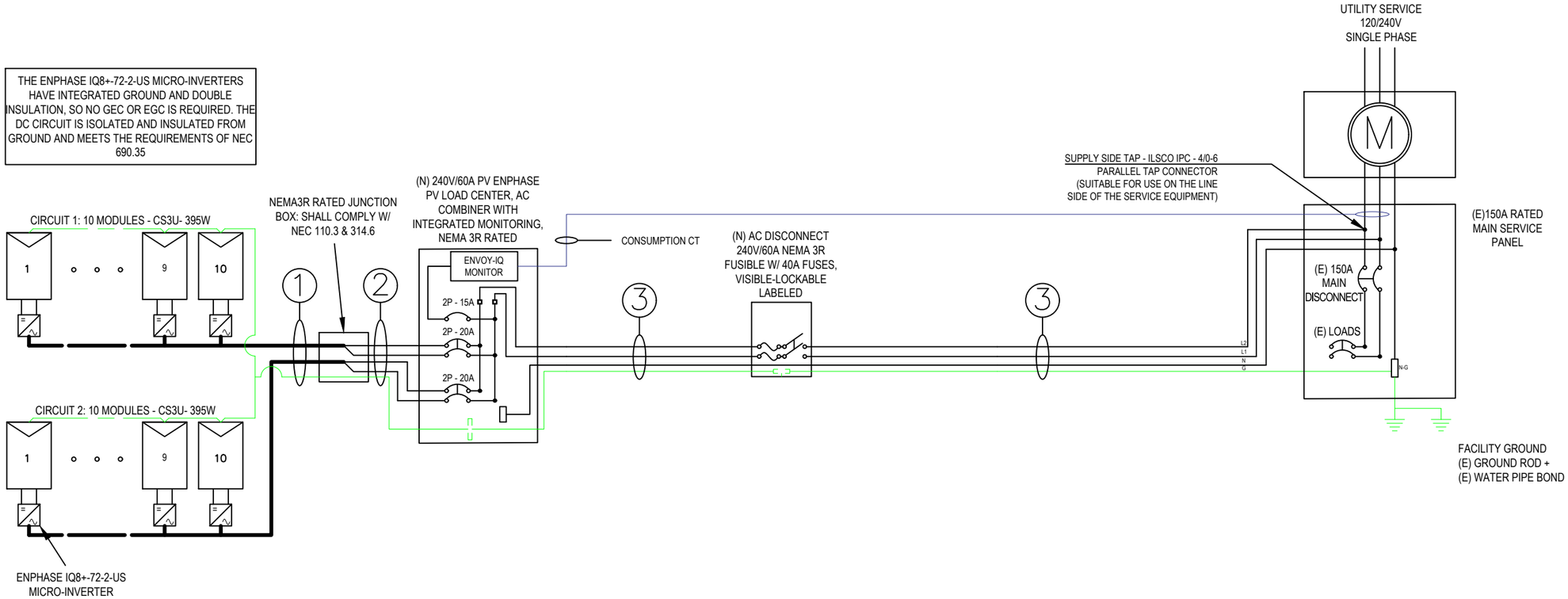
1-LINE DIAGRAM & CALCULATIONS

JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN
REV #1:
REV #2:
REV #3:

PV-5

UTILITY AC DISCONNECT MUST BE ACCESSIBLE, LOCKABLE, LABELED, BLADE-STYLE SWITCH, AND LOCATED WITHIN 5' FROM THE UTILITY METER

THE ENPHASE IQ8+-72-2-US MICRO-INVERTERS HAVE INTEGRATED GROUND AND DOUBLE INSULATION, SO NO GEC OR EGC IS REQUIRED. THE DC CIRCUIT IS ISOLATED AND INSULATED FROM GROUND AND MEETS THE REQUIREMENTS OF NEC 690.35



CONDUCTOR AND CONDUIT SCHEDULE					
TAG	WIRE TYPE	WIRE SIZE	# OF CONDUCTORS	CONDUIT TYPE	MIN. CONDUIT SIZE
1	PV WIRE	#10	2 - L1 L2	FREE AIR	N/A
1	BARE COPPER	#6	1 - BARE	FREE AIR	N/A
2	THWN-2	#10	2 - L1 L2	EMT	3/4"
2	THWN-2 EGC	#10	1 - GND	EMT	3/4"
3	THWN-2	#6	3 - L1 L2 N	EMT	3/4"
3	THWN-2 EGC	#8	1 - GND	EMT	3/4"

PV MODULE ELECTRICAL SPECIFICATIONS	
MODULE TYPE	CS3U- 395W
POWER MAX (P_{MAX})	395W
OPEN CIRCUIT VOLTAGE (V_{OC})	48.4V
SHORT CIRCUIT CURRENT (I_{SC})	10.25A
MAX POWER-POINT VOLTAGE (V_{MP})	40.6V
MAX POWER-POINT CURRENT (I_{MP})	9.73A
SERIES FUSE RATING	19.9A

INVERTER ELECTRICAL SPECIFICATIONS	
INVERTER TYPE	ENPHASE IQ8+-72-2-US
MAX INPUT DC VOLTAGE	60V
MAX DC SHORT CIRCUIT CURRENT	15A
MAXIMUM OUTPUT POWER	290W
MAXIMUM CONT. OUTPUT CURRENT	1.21A
CEC EFFICIENCY	97%
MAX UNITS PER 20A CIRCUIT	13

SYSTEM OVER-CURRENT PROTECTION DEVICE (OCPD) CALCULATIONS	
INVERTER TYPE	ENPHASE IQ8+-72-2-US
# OF INVERTERS	20
MAX CONTINUOUS OUTPUT CURRENT	1.21
(# OF INVERTERS) X (MAX CONT. OUTPUT CURRENT) X 125% <= OCPD RATING	
(20 x 1.21A x 1.25)= 30.25A <= 40A, OK	

PHOTOVOLTAIC SYSTEM:
DC SYSTEM SIZE: 7.900 kW
AC SYSTEM SIZE: 5.80 kW
INVERTER: (20) ENPHASE IQ8+-72-2-US
MODULE: (20) CS3U- 395W

NOTES:
1. MODULES ARE BONDED TO RAIL USING UL 2703 RATED BONDING SYSTEM - INTEGRATED BONDING MID-CLAMPS + DIRECT-BURIAL LAY-IN-LUGS; SEE ATTACHED FOR SPECIFICATIONS IF APPLICABLE
2. PV DC SYSTEM IS UNGROUNDED
3. PV ARRAY WILL HAVE A GROUNDING ELECTRODE SYSTEM IN COMPLIANCE WITH NEC 250.58 AND 690.47(A)
4. PV SOURCE, OUTPUT, AND INVERTER INPUT CIRCUIT WIRING METHODS SHALL COMPLY WITH NEC 690.1(G)
5. BACKFED PV BREAKER WILL BE INSTALLED AT OPPOSITE END OF THE BUS BAR FROM THE MAIN BREAKER. A PERMANENT WARNING LABEL TO BE INSTALLED PER SYSTEM SIGNAGE, PAGE
6. BARE COPPER IS TRANSITIONED TO THWN-2 VIA IRREVERSIBLE CRIMP; WHEN PRESENT, THE GEC TO BE CONTINUOUS
7. INVERTER(S) TO BE COMPLIANT WITH UL 1741 SUPPLEMENT A
8. CONDUIT AND CONDUCTOR SPECIFICATIONS ARE BASED ON MINIMUM CODE REQUIREMENTS AND ARE NOT MEANT TO LIMIT UP-SIZING AS REQUIRED BY FIELD CONDITIONS
9. CONDUIT AND CONDUCTOR SPECIFICATIONS ARE BASED ON MINIMUM CODE REQUIREMENTS AND ARE NOT MEANT TO LIMIT UPSIZING AS REQUIRED BY FIELD CONDITIONS.

INSTALLER NOTES:
0

STATE OF MICHIGAN
JOUNGHO CHOI
License No. 6201069813
LICENSED PROFESSIONAL ENGINEER

Signed 11/24/2023

LICENSE NUMBER: 6218537

SMITH, MIRANDA
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7348589871

GENERATION SOLAR
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DRAPER, UT 84020
(888) 985-2859

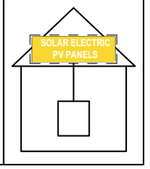
3-LINE DIAGRAM & CALCULATIONS

JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN
REV #1:
REV #2:
REV #3:

PV-5.1

SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWICH TO THE "OFF" POSITION TO SHUTDOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN ARRAY



LABEL 1
AT RAPID SHUTDOWN SYSTEM
[NEC 690.56(C)(1)(A)].

! WARNING !
ELECTRIC SHOCK HAZARD
TERMINALS ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION.
DC VOLTAGE IS ALWAYS PRESENT WHEN SOLAR MODULES ARE EXPLOSED TO SUNLIGHT

LABEL 2
AT EACH DISCONNECTING MEANS FOR PHOTOVOLTAIC EQUIPMENT
[NEC 690.15]

! WARNING !
ELECTRIC SHOCK HAZARD
TERMINALS ON BOTH LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION.

LABEL 3
AT EACH DISCONNECTING MEANS FOR PHOTOVOLTAIC EQUIPMENT
[NEC 690.13 AND 690.15]

MAXIMUM VOLTAGE: 60 V DC
MAXIMUM CIRCUIT CURRENT: 15 A DC
MAX RATED OUTPUT CURRENT OF THE CHARGE CONTROLLER OR DC-TO-DC CONVERTER (IF INSTALLED): 15 A DC

LABEL 4
AT EACH DC DISCONNECTING MEANS
[NEC 690.53]

PHOTOVOLTAIC AC DISCONNECT
OPERATING CURRENT: 30.25 A AC
OPERATING VOLTAGE: 240 V AC

LABEL 5
AT POINT OF INTERCONNECTION, MARKED AT DISCONNECTING MEANS
[NEC 690.54]

RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

LABEL 6
AT RAPID SHUTDOWN DISCONNECT SWITCH
[NEC 690.56(C)(3)].

! WARNING !
DUAL POWER SOURCES.
SECOND SOURCE IS PV SYSTEM

LABEL 7

! CAUTION !
PHOTOVOLTAIC SYSTEM CIRCUIT IS BACKFED

LABEL 8

AT POINT OF INTERCONNECTION; LABEL, SUCH AS LABEL 7 OR LABEL 8 MUST IDENTIFY PHOTOVOLTAIC SYSTEM
[NEC 705.12(B)(4)]

BI-DIRECTIONAL METER

LABEL 9
AT UTILITY METER
[NEC 690.56(B)]

PHOTOVOLTAIC DC DISCONNECT

LABEL 10
AT EACH DC DISCONNECTING MEANS
[NEC 690.13(B)]

PHOTOVOLTAIC SYSTEM EQUIPPED WITH RAPID SHUTDOWN

LABEL 11
AT RAPID SHUTDOWN SWITCH
[NEC 690.56(C)].
LETTERS AT LEAST 3/8 INCH; WHITE ON RED BACKGROUND; REFLECTIVE
[IFC 605.11.1.1]

WARNING: PHOTOVOLTAIC POWER SOURCE

LABEL 12
AT EXPOSED RACEWAYS, CABLE TRAYS, AND OTHER WIRING METHODS; SPACED AT MAXIMUM 10 FT SECTION OR WHERE SEPARATED BY ENCLOSURES, WALLS, PARTITIONS, CEILINGS, OR FLOORS.
[NEC 690.31(G)]
LETTERS AT LEAST 3/8 INCH; WHITE ON RED BACKGROUND; REFLECTIVE
[IFC 605.11.1.1]

UTILITY AC DISCONNECT

LABEL 13
AT EACH AC DISCONNECTING MEANS
[NEC 690.13(B)]

! WARNING !
POWER SOURCE OUTPUT CONNECTION - DO NOT RELOCATE THIS OVERCURRENT DEVISE

LABEL 14
AT POINT OF INTERCONNECTION OVERCURRENT DEVICE
[NEC 705.12(B)(2)(3)(B)]

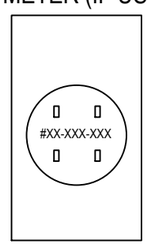
! CAUTION !
MULTIPLE SOURCES OF POWER

LABEL 15
AT POINT OF INTERCONNECTION
[NEC 705.10]

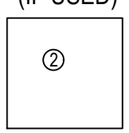
#03-359 LOCAL CODES

WARNING
THIS SERVICE METER IS ALSO SERVED BY A PHOTOVOLTAIC SYSTEM

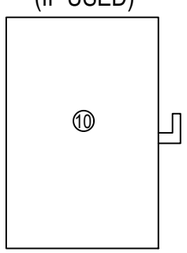
PRODUCTION METER (IF USED)



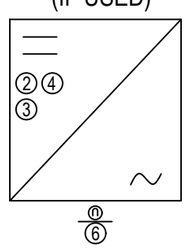
JUNCTION BOX (IF USED)



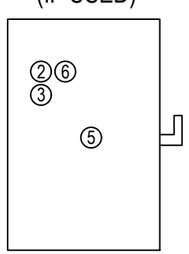
DC DISCONNECT (IF USED)



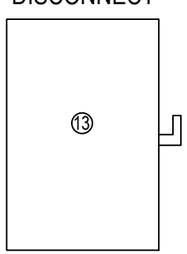
STRING INVERTER (IF USED)



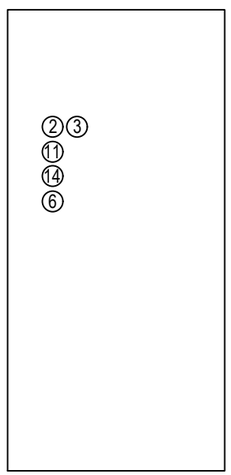
UTILITY AC DISCONNECT (IF USED)



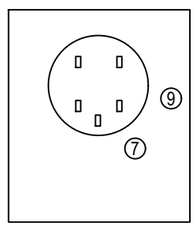
AC DISCONNECT



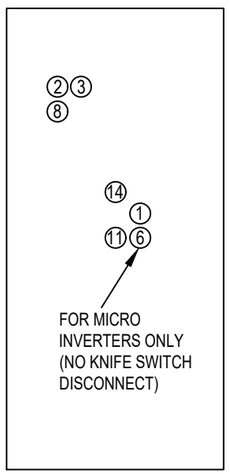
PV SUB PANEL (IF USED)



MAIN SERVICE METER



MAIN SERVICE PANEL FOR ILLUSTRATION ONLY (NOT ACTUAL MSP)



ALL SIGNAGE MUST BE PERMANENTLY ATTACHED AND BE WEATHER RESISTANT/SUNLIGHT RESISTANT AND CANNOT BE HAND-WRITTEN PER NEC 110.21(B)

PERMANENT PLAQUE OR DIRECTORY PROVIDING THE LOCATION OF THE SERVICE DISCONNECTING MEANS AND THE PHOTOVOLTAIC SYSTEM DISCONNECTING MEANS IF NOT IN THE SAME LOCATION
[NEC 690.56(B)]

WHERE THE PV SYSTEMS ARE REMOTELY LOCATED FROM EACH OTHER, A DIRECTORY IN ACCORDANCE WITH 705.10 SHALL BE PROVIDED AT EACH PV SYSTEM DISCONNECTING MEANS.
PV SYSTEM EQUIPMENT AND DISCONNECTING MEANS SHALL NOT BE INSTALLED IN BATHROOMS
[NEC 690.4(D),(E)]

LABELING NOTES
1.1 LABELING REQUIREMENTS BASED ON THE 2014 NATIONAL ELECTRICAL CODE, INTERNATIONAL FIRE CODE 605.11, OSHA STANDARD 1910.145, ANSI Z535
1.2 MATERIAL BASED ON THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION.
1.3 LABELS TO BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED.
1.4 LABELS TO BE A MINIMUM LETTER HEIGHT OF 3/8" AND PERMANENTLY AFFIXED.
1.5 ALERTING WORDS TO BE COLOR CODED. "DANGER" WILL HAVE RED BACKGROUND; "WARNING" WILL HAVE ORANGE BACKGROUND; "CAUTION" WILL HAVE YELLOW BACKGROUND. [ANSI Z535]

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Signed 11/24/2023

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1192 E. DRAPER PARKWAY STE 466
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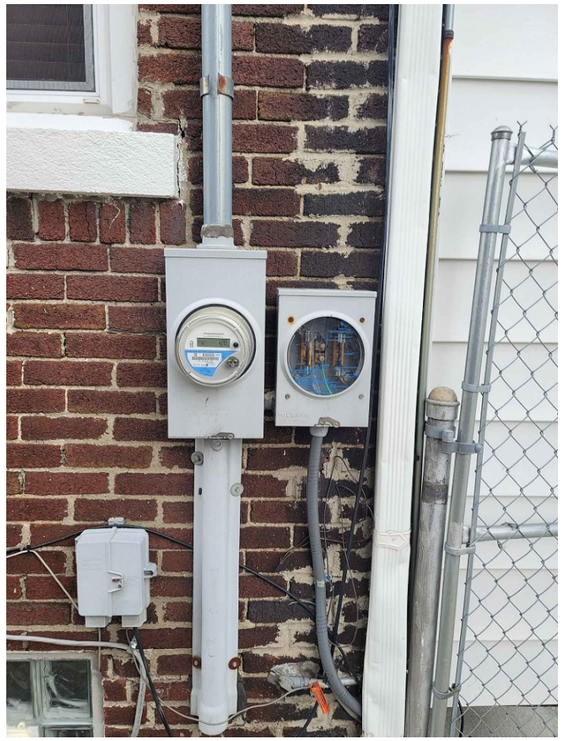
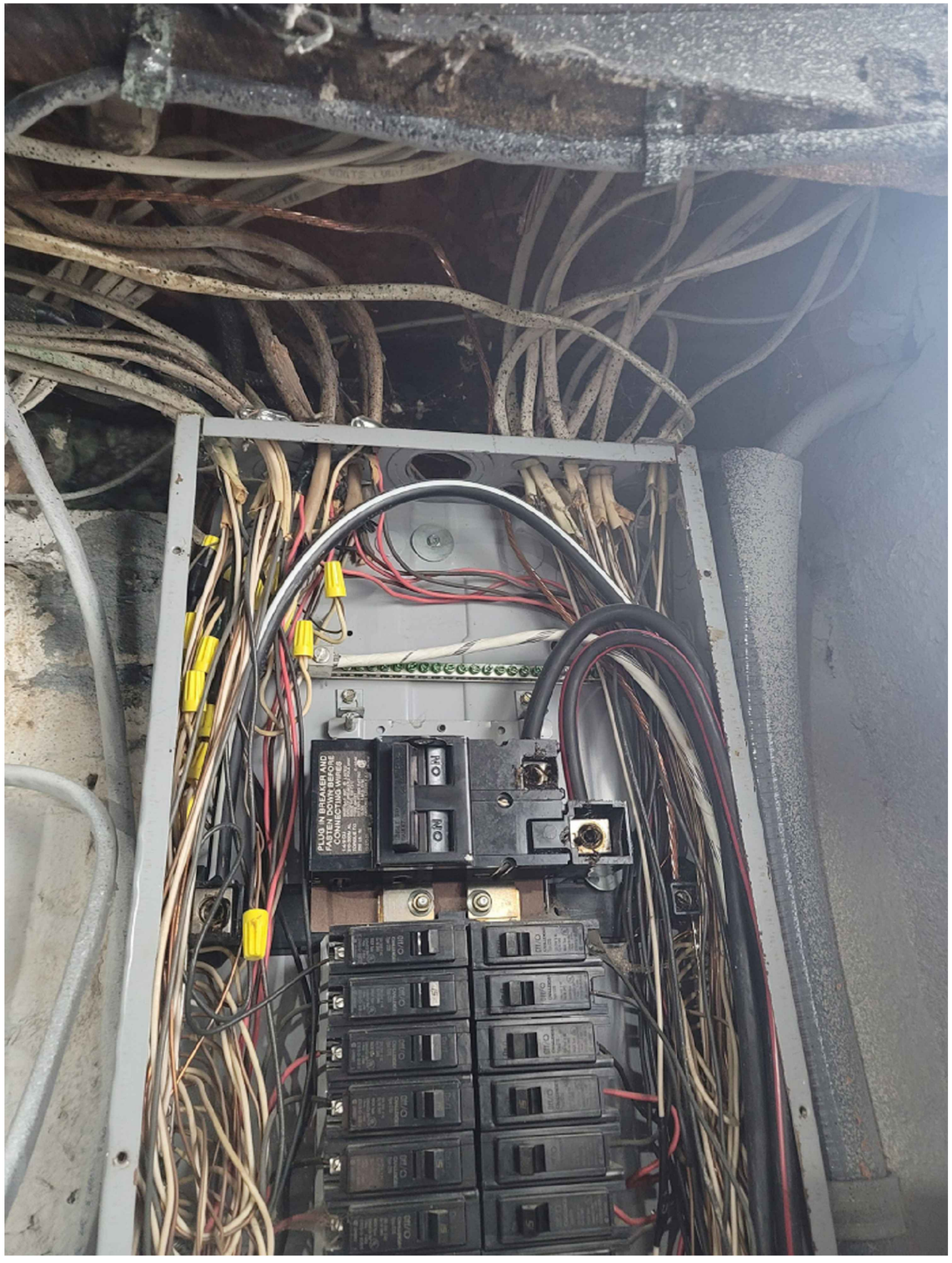
(888) 985-2859

ELECTRICAL LABELS

PV-6





LICENSE NUMBER: 6218537

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ELECTRICAL PHOTOS

JOB #: 4184
DATE: 11/21/2023
DRAWN BY: IAN

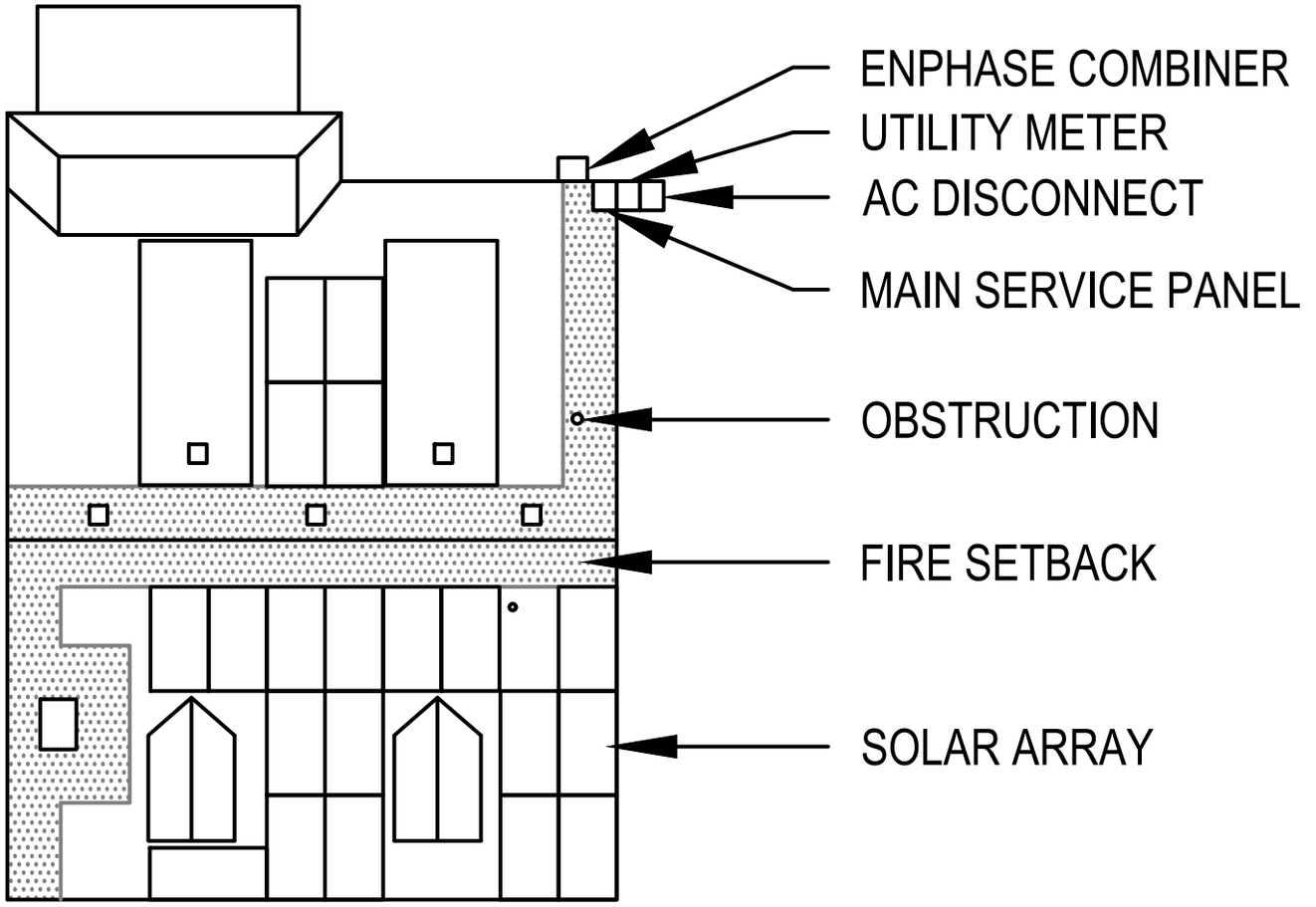
REV #1:
REV #2:
REV #3:

PV-7

⚠ CAUTION ⚠

POWER TO THIS BUILDING IS SUPPLIED FROM THE FOLLOWING SOURCES WITH DISCONNECTS LOCATED AS SHOWN

SERVICE 1 OF 1



2490 LONGFELLOW STREET, DETROIT, MI 48206

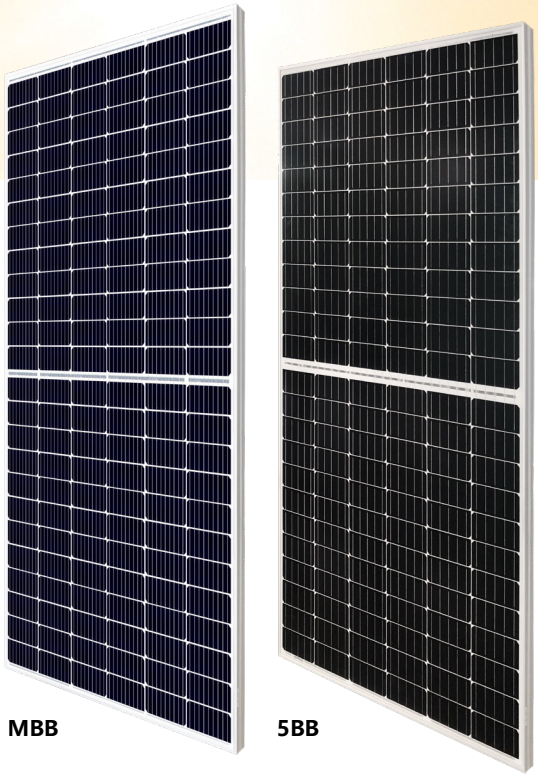
CanadianSolar

KuMax

HIGH EFFICIENCY MONO PERC MODULE

CS3U-380|385|390|395|400MS

(1000 V / 1500 V)



MBB 5BB

MORE POWER

- Low power loss in cell connection
- Low NMOT: 42 ± 3 °C
  Low temperature coefficient (Pmax): -0.36 % / °C
- Better shading tolerance
- High PTC rating of up to: 93.24 %

MORE RELIABLE

- Lower hot spot temperature
- Minimizes micro-crack impacts
- Heavy snow load up to 5400 Pa,
  wind load up to 3600 Pa*

25 years linear power output warranty*

12 years enhanced product warranty on materials and workmanship*

*According to the applicable Canadian Solar Limited Warranty Statement.

MANAGEMENT SYSTEM CERTIFICATES

ISO 9001:2015 / Quality management system
ISO 14001:2015 / Standards for environmental management system
OHSAS 18001:2007 / International standards for occupational health & safety

PRODUCT CERTIFICATES*

IEC 61215 / IEC 61730: VDE / CE / CQC / MCS / KS / INMETRO
UL 1703 / IEC 61215 performance: CEC listed (US) / FSEC (US Florida)
UL 1703: CSA / IEC 61701 ED2: VDE / IEC 62716: VDE / IEC 60068-2-68: SGS
Take-e-way

* As there are different certification requirements in different markets, please contact your local Canadian Solar sales representative for the specific certificates applicable to the products in the region in which the products are to be used.

CANADIAN SOLAR INC. is committed to providing high quality solar products, solar system solutions and services to customers around the world. No. 1 module supplier for quality and performance / price ratio in IHS Module Customer Insight Survey. As a leading PV project developer and manufacturer of solar modules with over 40 GW deployed around the world since 2001.

* For detailed information, please refer to the Installation Manual.

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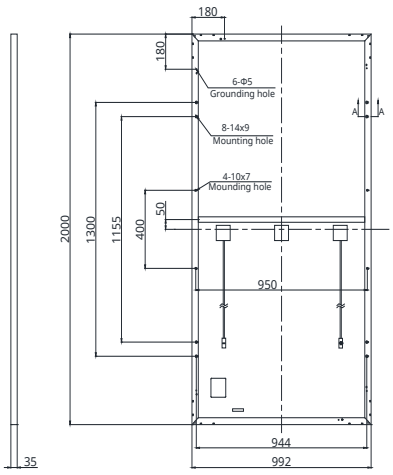
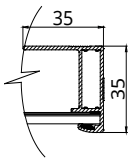
545 Speedvale Avenue West, Guelph, Ontario N1K 1E6, Canada, www.canadiansolar.com, support@canadiansolar.com

ENGINEERING DRAWING (mm)

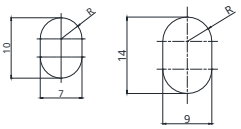
Rear View



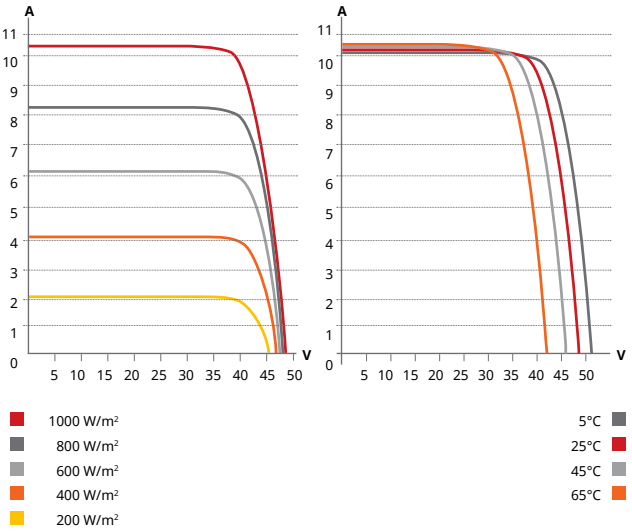
Frame Cross Section A-A



Mounting Hole



CS3U-400MS / I-V CURVES



ELECTRICAL DATA | STC*

CS3U	380MS	385MS	390MS	395MS	400MS
Nominal Max. Power (Pmax)	380 W	385 W	390 W	395 W	400 W
Opt. Operating Voltage (Vmp)	40.0 V	40.2 V	40.4 V	40.6 V	40.8 V
Opt. Operating Current (Imp)	9.50 A	9.58 V	9.66 A	9.73 A	9.81 A
Open Circuit Voltage (Voc)	47.8 V	48.0 V	48.2 V	48.4 V	48.6 V
Short Circuit Current (Isc)	10.01 A	10.09 A	10.17 A	10.25 A	10.33 A
Module Efficiency	19.2%	19.4%	19.7%	19.9%	20.2%
Operating Temperature	-40°C ~ +85°C				
Max. System Voltage	1500V (IEC/UL) or 1000V (IEC/UL)				
Module Fire Performance	TYPE 1 (UL 1703) or Class C (IEC 61730)				
Max. Series Fuse Rating	30 A				
Application Classification	Class A				
Power Tolerance	0 ~ + 10 W				

* Under Standard Test Conditions (STC) of irradiance of 1000 W/m², spectrum AM 1.5 and cell temperature of 25°C.

ELECTRICAL DATA | NMOT*

CS3U	380MS	385MS	390MS	395MS	400MS
Nominal Max. Power (Pmax)	283 W	287 W	290 W	294 W	298 W
Opt. Operating Voltage (Vmp)	37.2 V	37.4 V	37.6 V	37.8 V	38.0 V
Opt. Operating Current (Imp)	7.60 A	7.66 A	7.72 A	7.78 A	7.84 A
Open Circuit Voltage (Voc)	44.8 V	45.0 V	45.2 V	45.4 V	45.6 V
Short Circuit Current (Isc)	8.08 A	8.14 A	8.20 A	8.27 A	8.33 A

* Under Nominal Module Operating Temperature (NMOT), irradiance of 800 W/m², spectrum AM 1.5, ambient temperature 20°C, wind speed 1 m/s.

MECHANICAL DATA

Specification	Data
Cell Type	Mono-crystalline
Cell Arrangement	144 [2 X (12 X 6)]
Dimensions	2000 X 992 X 35 mm (78.7 X 39.1 X 1.38 in)
Weight	22.5 kg (49.6 lbs)
Front Cover	3.2 mm tempered glass
Frame	Anodized aluminium alloy, crossbar enhanced
J-Box	IP68, 3 bypass diodes
Cable	4 mm² (IEC), 12 AWG (UL)
Cable Length (Including Connector)	Portrait: 400 mm (15.7 in) (+) / 280 mm (11.0 in) (-); landscape: 1250 mm (49.2 in); leap-frog connection: 1670 mm (65.7 in)*
Connector	T4 series or H4 UTX or MC4-EVO2
Per Pallet	30 pieces
Per Container (40' HQ)	660 pieces

* For detailed information, please contact your local Canadian Solar sales and technical representatives.

TEMPERATURE CHARACTERISTICS

Specification	Data
Temperature Coefficient (Pmax)	-0.36 % / °C
Temperature Coefficient (Voc)	-0.29 % / °C
Temperature Coefficient (Isc)	0.05 % / °C
Nominal Module Operating Temperature	42 ± 3°C

PARTNER SECTION

* The specifications and key features contained in this datasheet may deviate slightly from our actual products due to the on-going innovation and product enhancement. Canadian Solar Inc. reserves the right to make necessary adjustments to the information described herein at any time without further notice. Please be kindly advised that PV modules should be handled and installed by qualified people who have professional skills and please carefully read the safety and installation instructions before using our PV modules.

CANADIAN SOLAR INC.
545 Speedvale Avenue West, Guelph, Ontario N1K 1E6, Canada, www.canadiansolar.com, support@canadiansolar.com

Enphase IQ Combiner 4/4C

X-IQ-AM1-240-4
X-IQ-AM1-240-4C

X-IQ-AM1-240-4C

X-IQ-AM1-240-4

The **Enphase IQ Combiner 4/4C** with Enphase IQ Gateway and integrated LTE-M1 cell modem (included only with IQ Combiner 4C) consolidates interconnection equipment into a single enclosure and streamlines IQ microinverters and storage installations by providing a consistent, pre-wired solution for residential applications. It offers up to four 2-pole input circuits and Eaton BR series busbar assembly.

Smart

- Includes IQ Gateway for communication and control
- Includes Enphase Mobile Connect cellular modem (CELLMODEM-M1-06-SP-05), included only with IQ Combiner 4C
- Includes solar shield to match Enphase IQ Battery aesthetics and deflect heat
- Flexible networking supports Wi-Fi, Ethernet, or cellular
- Optional AC receptacle available for PLC bridge
- Provides production metering and consumption monitoring

Simple

- Centered mounting brackets support single stud mounting
- Supports bottom, back and side conduit entry
- Up to four 2-pole branch circuits for 240 VAC plug-in breakers (not included)
- 80A total PV or storage branch circuits

Reliable

- Durable NRTL-certified NEMA type 3R enclosure
- Five-year limited warranty
- Two years labor reimbursement program coverage included for both the IQ Combiner SKU's
- UL listed

UL LISTED

To learn more about Enphase offerings, visit **enphase.com**

ENPHASE

Enphase IQ Combiner 4/4C

MODEL NUMBER	
IQ Combiner 4 (X-IQ-AM1-240-4)	IQ Combiner 4 with Enphase IQ Gateway printed circuit board for integrated revenue grade PV production metering (ANSI C12.20 +/- 0.5%) and consumption monitoring (+/- 2.5%). Includes a silver solar shield to match the IQ Battery system and IQ System Controller 2 and to deflect heat.
IQ Combiner 4C (X-IQ-AM1-240-4C)	IQ Combiner 4C with Enphase IQ Gateway printed circuit board for integrated revenue grade PV production metering (ANSI C12.20 +/- 0.5%) and consumption monitoring (+/- 2.5%). Includes Enphase Mobile Connect cellular modem (CELLMODEM-M1-06-SP-05), a plug-and-play industrial-grade cell modem for systems up to 60 microinverters. (Available in the US, Canada, Mexico, Puerto Rico, and the US Virgin Islands, where there is adequate cellular service in the installation area.) Includes a silver solar shield to match the IQ Battery and IQ System Controller and to deflect heat.
ACCESSORIES AND REPLACEMENT PARTS	(not included, order separately)
Ensemble Communications Kit COMMS-CELLMODEM-M1-06 CELLMODEM-M1-06-SP-05 CELLMODEM-M1-06-AT-05	- Includes COMMS-KIT-01 and CELLMODEM-M1-06-SP-05 with 5-year Sprint data plan for Ensemble sites - 4G based LTE-M1 cellular modem with 5-year Sprint data plan - 4G based LTE-M1 cellular modem with 5-year AT&T data plan
Circuit Breakers BRK-10A-2-240V BRK-15A-2-240V BRK-20A-2P-240V BRK-15A-2P-240V-B BRK-20A-2P-240V-B	Supports Eaton BR210, BR215, BR220, BR230, BR240, BR250, and BR260 circuit breakers. Circuit breaker, 2 pole, 10A, Eaton BR210 Circuit breaker, 2 pole, 15A, Eaton BR215 Circuit breaker, 2 pole, 20A, Eaton BR220 Circuit breaker, 2 pole, 15A, Eaton BR215B with hold down kit support Circuit breaker, 2 pole, 20A, Eaton BR220B with hold down kit support
EPLC-01	Power line carrier (communication bridge pair), quantity - one pair
XA-SOLARSHIELD-ES	Replacement solar shield for IQ Combiner 4/4C
XA-PLUG-120-3	Accessory receptacle for Power Line Carrier in IQ Combiner 4/4C (required for EPLC-01)
XA-ENV-PCBA-3	Replacement IQ Gateway printed circuit board (PCB) for Combiner 4/4C
X-IQ-NA-HD-125A	Hold down kit for Eaton circuit breaker with screws.
ELECTRICAL SPECIFICATIONS	
Rating	Continuous duty
System voltage	120/240 VAC, 60 Hz
Eaton BR series busbar rating	125 A
Max. continuous current rating	65 A
Max. continuous current rating (input from PV/storage)	64 A
Max. fuse/circuit rating (output)	90 A
Branch circuits (solar and/or storage)	Up to four 2-pole Eaton BR series Distributed Generation (DG) breakers only (not included)
Max. total branch circuit breaker rating (input)	80A of distributed generation / 95A with IQ Gateway breaker included
Envoy breaker	10A or 15A rating GE/Siemens/Eaton included
Production metering CT	200 A solid core pre-installed and wired to IQ Gateway
Consumption monitoring CT (CT-200-SPLIT)	A pair of 200 A split core current transformers
MECHANICAL DATA	
Dimensions (WxHxD)	37.5 x 49.5 x 16.8 cm (14.75" x 19.5" x 6.63"). Height is 21.06" (53.5 cm) with mounting brackets.
Weight	7.5 kg (16.5 lbs)
Ambient temperature range	-40° C to +46° C (-40° to 115° F)
Cooling	Natural convection, plus heat shield
Enclosure environmental rating	Outdoor, NRTL-certified, NEMA type 3R, polycarbonate construction
Wire sizes	• 20 A to 50 A breaker inputs: 14 to 4 AWG copper conductors • 60 A breaker branch input: 4 to 1/0 AWG copper conductors • Main lug combined output: 10 to 2/0 AWG copper conductors • Neutral and ground: 14 to 1/0 copper conductors Always follow local code requirements for conductor sizing.
Altitude	To 2000 meters (6,560 feet)
INTERNET CONNECTION OPTIONS	
Integrated Wi-Fi	802.11b/g/n
Cellular	CELLMODEM-M1-06-SP-05, CELLMODEM-M1-06-AT-05 (4G based LTE-M1 cellular modem). Note that an Enphase Mobile Connect cellular modem is required for all Ensemble installations.
Ethernet	Optional, 802.3, Cat5E (or Cat 6) UTP Ethernet cable (not included)
COMPLIANCE	
Compliance, IQ Combiner	UL 1741, CAN/CSA C22.2 No. 107.1, 47 CFR, Part 15, Class B, ICES 003 Production metering: ANSI C12.20 accuracy class 0.5 (PV production) Consumption metering: accuracy class 2.5
Compliance, IQ Gateway	UL 60601-1/CANCSA 22.2 No. 61010-1

To learn more about Enphase offerings, visit **enphase.com**

ENPHASE

DATA SHEET

IQ8 and IQ8+ Microinverters

Our newest IQ8 Microinverters are the industry's first microgrid-forming, software-defined microinverters with split-phase power conversion capability to convert DC power to AC power efficiently. The brain of the semiconductor-based microinverter is our proprietary application-specific integrated circuit (ASIC) which enables the microinverter to operate in grid-tied or off-grid modes. This chip is built in advanced 55nm technology with high speed digital logic and has super-fast response times to changing loads and grid events, alleviating constraints on battery sizing for home energy systems.

Part of the Enphase Energy System, IQ8 Series Microinverters integrate with the Enphase IQ Battery, Enphase IQ Gateway, and the Enphase App monitoring and analysis software.

Enphase 25 year limited warranty

IQ8 Series Microinverters redefine reliability standards with more than one million cumulative hours of power-on testing, enabling an industry-leading limited warranty of up to 25 years.

Connect PV modules quickly and easily to IQ8 Series Microinverters using the included Q-DCC-2 adapter cable with plug-n-play MC4 connectors.

UL CERTIFIED SAFETY

IQ8 Series Microinverters are UL Listed as PV Rapid Shut Down Equipment and conform with various regulations, when installed according to manufacturer's instructions.

Easy to install

- Lightweight and compact with plug-n-play connectors
- Power Line Communication (PLC) between components
- Faster installation with simple two-wire cabling

High productivity and reliability

- Produce power even when the grid is down*
- More than one million cumulative hours of testing
- Class II double-insulated enclosure
- Optimized for the latest high-powered PV modules

Microgrid-forming

- Complies with the latest advanced grid support**
- Remote automatic updates for the latest grid requirements
- Configurable to support a wide range of grid profiles
- Meets CA Rule 21 (UL 1741-SA) requirements

IQ8SP-DS-0002-01-EN-US-2022-03-17

* Only when installed with IQ System Controller 2, meets UL 1741.

** IQ8 and IQ8Plus supports split phase, 240V installations only.

IQ8 and IQ8+ Microinverters

INPUT DATA (DC)		IQ8-60-2-US	IQ8PLUS-72-2-US
Commonly used module pairings[1]	W	235 – 350	235 – 440
Module compatibility		60-cell/120 half-cell	60-cell/120 half-cell, 66-cell/132 half-cell and 72-cell/144 half-cell
MPPT voltage range	V	27 – 37	29 – 45
Operating range	V	25 – 48	25 – 58
Min/max start voltage	V	30 / 48	30 / 58
Max input DC voltage	V	50	60
Max DC current[2] [module Isc]	A	15	
Overvoltage class DC port		II	
DC port backfeed current	mA	0	
PV array configuration		1x1 Ungrounded array; No additional DC side protection required; AC side protection requires max 20A per branch circuit	
OUTPUT DATA (AC)		**IQ8-60-2-US**	**IQ8PLUS-72-2-US**
Peak output power	VA	245	300
Max continuous output power	VA	240	290
Nominal (L-L) voltage/range[3]	V	240 / 211 – 264	
Max continuous output current	A	1.0	1.21
Nominal frequency	Hz	60	
Extended frequency range	Hz	50 – 68	
AC short circuit fault current over 3 cycles	Arms	2	
Max units per 20 A (L-L) branch circuit[4]		16	13
Total harmonic distortion		<5%	
Overvoltage class AC port		III	
AC port backfeed current	mA	30	
Power factor setting		1.0	
Grid-tied power factor (adjustable)		0.85 leading – 0.85 lagging	
Peak efficiency	%	97.5	97.6
CEC weighted efficiency	%	97	97
Night-time power consumption	mW	60	
MECHANICAL DATA			
Ambient temperature range		-40°C to +60°C (-40°F to +140°F)	
Relative humidity range		4% to 100% (condensing)	
DC Connector type		MC4	
Dimensions (HxWxD)		212 mm (8.3”) x 175 mm (6.9”) x 30.2 mm (1.2”)	
Weight		1.08 kg (2.38 lbs)	
Cooling		Natural convection – no fans	
Approved for wet locations		Yes	
Pollution degree		PD3	
Enclosure		Class II double-insulated, corrosion resistant polymeric enclosure	
Environ. category / UV exposure rating		NEMA Type 6 / outdoor	
COMPLIANCE			
Certifications		CA Rule 21 (UL 1741-SA), UL 62109-1, UL1741/IEEE1547, FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 107.1-01 This product is UL Listed as PV Rapid Shut Down Equipment and conforms with NEC 2014, NEC 2017, and NEC 2020 section 690.12 and C22.1-2018 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according to manufacturer’s instructions.	

(1) No enforced DC/AC ratio. See the compatibility calculator at https://link.enphase.com/module-compatibility
(2) Maximum continuous input DC current is 10.6A (3) Nominal voltage range can be extended beyond nominal if required by the utility. (4) Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

ROP-E-Tap

ILSCO

Insulation Piercing Connectors
Dual Rated

RoHS Compliant

UL LISTED 453G

SA LR-29601

TYPE
IPC

Insul-Eater

Features
- Body is molded from tough, resilient glass-filled nylon
- Compact design
- Tin plated copper contact teeth
- Insulation piercing
- Perforated end tabs
- Pre-filled with silicone lubricant
- Versatile
- Increased safety
- Horizontal line grid
- Temperature rating 90˚ C

Benefits
- Provides high degree of breakage resistance and long dependable use
- Saves space
- Easily penetrates most types of insulation
- No need to strip the conductor which saves installation time
- Break out easily by hand
- Prevents oxidation and moisture from entering the contact area
- Can be used as a splice or tap connector
- Contains no external energized parts. Can be installed "hot" on energized conductors providing tap conductor is not under load.
- Provides a visual guide for proper installation of conductors

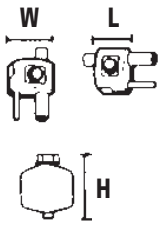



Fig. 1


Fig. 2


Fig. 3


Fig. 4

Catalog Number	Figure Number	Wire Range		Volts	Current Rating		Dimensions			Torque	Bolt Head
		Main	Tap		CU	AL	L	W	H	Ft. Lbs.	Size
IPC-1/0-2	3	1/0-8	2-8	300 (480 Grounded Y System)	130	100	1-7/32	1-15/32	2-5/16	16	1/2
IPC-4/0-6	2	4/0-4	6-14	600	75	60	1-27/64	1	1-7/8	13	1/2
IPC-4/0-2/0	3	4/0-2	2/0-6	600	195	150	1-21/32	1-7/8	2-7/8	25	1/2
IPC-250-4/0	2	250kcmil-1	4/0-6	600	260	205	1-7/8	2-11/32	3-11/32	30	5/8
IPC-350-4/0	3	350kcmil-4/0	4/0-10	300 (480 Grounded Y System)	260	205	1-43/64	2-7/16	3-1/8	25	5/8
IPC-350-350	4	350kcmil-4/0	350kcmil-4/0	300 (480 Grounded Y System)	350	280	2-43/64	2-23/32	3-1/4	25	5/8
IPC-500-12	1	500kcmil-250kcmil	10-12	300 (480 Grounded Y System)	40	35	1-43/64	2-7/16	3-1/4	25	5/8
IPC-500-250	1	500kcmil-250kcmil	250kcmil-4	600	290	230	2-27/64	2-29/32	3-3/4	55	5/8-11/16
IPC-500-500	1	500kcmil-300kcmil	500kcmil-250kcmil	600	430	350	3-3/16	3-5/8	5	75	7/8-7/8
IPC-750-500	1	750kcmil-500kcmil	500kcmil-350kcmil	600	430	350	3-3/16	3-5/8	5	75	7/8-7/8

All wire sizes, unless noted otherwise, are American Wire Gauge (AWG)
Tested to UL 486A/B, UL File E6207

ILSCO 4730 Madison Road, Cincinnati, Ohio 45227-1426 Phone 513 533-6200 Fax 513 871-4084 Web site www.ilsco.com
Canada 1050 Lakeshore Road East, Mississauga, Ontario, Canada L5E1E4 Phone 905 274-2341 Fax 905 274-8763

SM SOLAR MOUNT

INSTALLATION GUIDE

UNIRAC®

BETTER SOLAR STARTS HERE

UNIRAC Code-Compliant Installation Manual

UNIRAC welcomes input concerning the accuracy and user-friendliness of this publication. Please write to publications@unirac.com.

PUB2023FEB10

SM SOLAR MOUNT

INSTALLATION GUIDE

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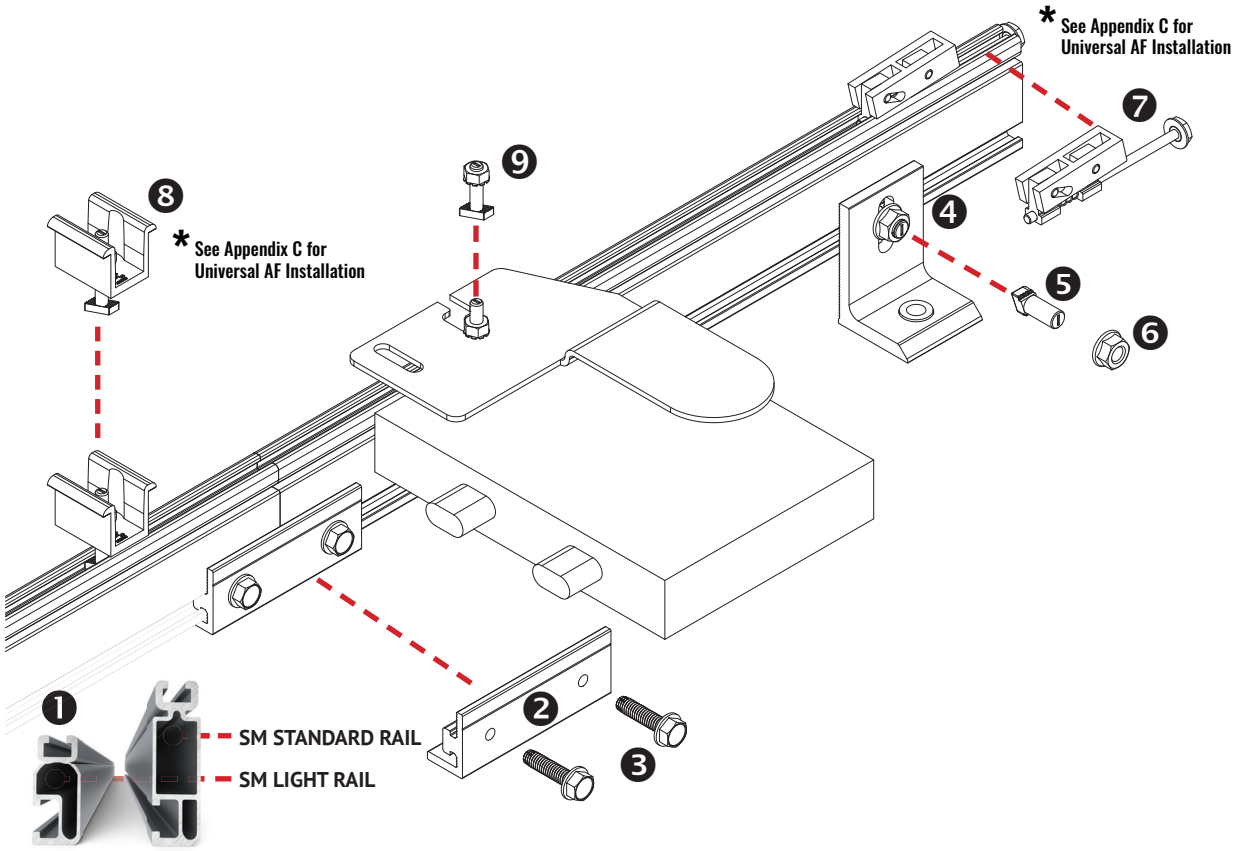
PRO SERIES SYSTEM

STANDARD SERIES SYSTEM

SM SOLAR MOUNT

PRO SERIES SYSTEM COMPONENTS

INSTALLATION GUIDE



❶**RAIL**: Supports PV modules. Use at least two per row of modules. Aluminum extrusion, available in mill, clear anodized, or dark anodized.

❷❸**RAIL SPLICE**: Non structural splice joins, aligns, and electrically bonds rail sections into single length of rail. Forms a rigid splice joint, 4 inches long, preassembled with bonding hardware. Available in dark anodized or mill finish.

❹**L-FOOT**: Use to secure rails through roofing material to building structure. Refer to loading tables or U-Builder for spacing.

❺ **L-FOOT T- BOLT**: (3/8" x ¾" or 1") – Use one per L-foot to secure rail to L-foot. Stainless steel. Supplied with L-foot in combination with flange nut, provides electrical bond between L-foot and rail.

❻**SERRATED FLANGE NUT** : Use one per L-foot to secure and bond rail to L-foot. Stainless steel. Supplied with L-foot.

❼**MODULE ENDCLAMP**: Pre-assembled universal clamp that secures module to rail at module flange by tightening 1/2" hex head bolt.

❽**MODULE MIDCLAMP**: Pre-assembled clamp provides module to module and module to rail bond. Aluminum clamp with stainless steel bonding pins and T-bolt. Available in clear or dark finish.

❾**MICROINVERTER MOUNTING BOLT**: Preassembled bolt, nut, and captive star washer attaches and bonds microinverter to rail.

NOTE - POSITION INDICATOR: T-bolts have a slot in the hardware end corresponding to the direction of the T-Head.

NOTE - Pro Series Mid and End Clamps are single use only

Wrenches and Torque

	Wrench or Socket Size	Recommended Torque (ft-lbs)
Mid Clamp ❽	1/2"	11
MLPE Mount ❾	1/2"	10
End Clamp ❼	1/2"	5
L-Foot to Rail ❻	1/2"	30
Rail Splice ❸	1/2"	10

Anti-Seize ❻❾

Stainless steel hardware can seize up, a process called galling. To significantly reduce its likelihood:
1. Apply minimal lubricant to bolts only where indicated in installation process, preferably Anti-Seize commonly found at auto parts stores (Anti-seize has been factory applied to mid clamp bolts)
2. Shade hardware prior to installation, and
3. Avoid spinning stainless nuts onto bolts at high speed.

RAILS

TYPE	PART NUMBER	DESCRIPTION
LIGHT RAIL	315168M	SM LIGHT RAIL 168" MILL
	315168D	SM LIGHT RAIL 168" DRK
	315208M	SM LIGHT RAIL 208" MILL
	315208D	SM LIGHT RAIL 208" DRK
	315246M	SM LIGHT RAIL 246" MILL
	315246D	SM LIGHT RAIL 246" DRK
STANDARD RAIL	320132M	SM RAIL 132" MILL
	310132C	SM RAIL 132" CLR
	320168M	SM RAIL 168" MILL
	310168C	SM RAIL 168" CLR
	310168D	SM RAIL 168" DRK
	320208M	SM RAIL 208" MILL
	310208C	SM RAIL 208" CLR
	320246M	SM RAIL 246" MILL
	310246C	SM RAIL 246" CLR
	310246D	SM RAIL 246" DRK
HEAVY DUTY RAIL	410144M	SMHD, RAIL 144" MILL
	410168M	SMHD, RAIL 168" MILL
	410204M	SMHD RAIL 204" MILL
	410246M	SMHD, RAIL 246" MILL

SYMBOL	DESCRIPTION
AL	ALUMINUM
CLR	CLEAR ANODIZED
DRK	DARK BRONZE ANODIZED
SS	STAINLESS STEEL
DRK SS	BLACK OXIDE COATED STAINLESS STEEL

LETTER	SUPPORTED MODULE THICKNESS
B	30MM -32MM
C	33MM -36MM
D	38MM -40MM
K	39MM -41MM
F	45MM -47MM
E	50MM -51MM

MID CLAMPS AND END CLAMPS

S.NO.	PART NUMBER	DESCRIPTION
1	302021C	SM ENDCLAMP B CLR AL
2	302021D	SM ENDCLAMP B DRK AL
3	302022C	SM ENDCLAMP C CLR AL
4	302022D	SM ENDCLAMP C DRK AL
5	302023C	SM ENDCLAMP D CLR AL
6	302023D	SM ENDCLAMP D DRK AL
7	302024C	SM ENDCLAMP E CLR AL
8	302024D	SM ENDCLAMP E DRK AL
9	302025C	SM ENDCLAMP F CLR AL
10	302025D	SM ENDCLAMP F DRK AL
11	302026C	SM ENDCLAMP K CLR AL
12	302026D	SM ENDCLAMP K DRK AL
13	302027C	SM BND MIDCLAMP BC SS
14	302027D	SM BND MIDCLAMP BC DRK SS
15	302028C	SM BND MIDCLAMP EF SS
16	302028D	SM BND MIDCLAMP EF DRK SS
17	302029C	SM BND MIDCLAMP DK SS
18	302029D	SM BND MIDCLAMP DK DRK SS
19	302030D	SM MIDCLAMP PRO DRK
20	302030M	SM MIDCLAMP PRO MILL
21	302035M	SM ENDCLAMP PRO W/CAP
22	302045D	UNIVERSAL AF MID CLAMP DRK
23	302045M	UNIVERSAL AF MID CLAMP MILL
24	302050D	UNIVERSAL AF END CLAMP DRK
25	302050M	UNIVERSAL AF END CLAMP MILL

COMPONENTS

S.NO.	PART NUMBER	DESCRIPTION
1	303019M	BND SPLICE BAR PRO SERIES MILL
2	303019D	BND SPLICE BAR PRO SERIES DRK
3	304001C	L-FOOT SERR W/ T-BOLT, CLR
4	304001D	L-FOOT SERR W/ T-BOLT, DRK
5	009010S	SPLICE TEK SCRW #12-14X3/4" SS
6	009020S	BND T-BOLT&NUT 3/8" X 3/4" SS
7	009021S	BND T-BOLT&NUT 3/8" X 1" SS
8	004055M	FLASHKIT PRO, MILL 10 PK
9	004055D	FLASHKIT PRO, DRK 10 PK
10	004015D	SOLARMOUNT FLASHKIT PRO SB, DARK
11	004015M	SOLARMOUNT FLASHKIT PRO SB, MILL
12	004085M	FLASHLOC COMP KIT MILL
13	004085D	FLASHLOC COMP KIT DRK
14	004275M	FLASHLOC DUO MILL
15	004275D	FLASHLOC DUO DARK
16	003250W	#12-14 X 2.50 SCREW HDW SS SD
17	004CT5H	SOLARHOOK UNIV SIDE MT CT5
18	004CT1H	SOLARHOOK SPANISH 7" BASE
19	004CT2H	SOLARHOOK SPANISH 9" BASE
20	004FLAT	SOLARHOOK FLASHING FLAT
21	004FLCT	SOLARHOOK FLASHING SPANISH FLCT
22	004AT1H	SOLARHOOK FLAT TILE
23	004ST1S	SOLARHOOK STONE COATED MT ST1
24	004AST1	SOLARHOOK ADJ STONE COATED ST1
25	004300M	STANDOFF 3" 2 PIECE AL, MILL
26	004300D	STANDOFF 3" 2 PIECE AL, DRK
27	004400M	STANDOFF 4" 2 PIECE AL, MILL

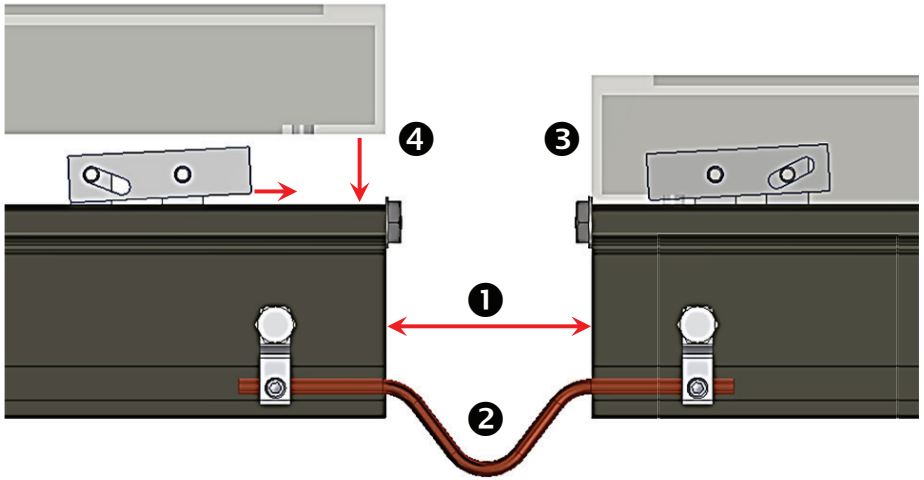
S.NO.	PART NUMBER	DESCRIPTION
28	004400D	STANDOFF 4" 2 PIECE AL, DRK
29	004600M	STANDOFF 6" 2 PIECE AL, MILL
30	004600D	STANDOFF 6" 2 PIECE AL, DRK
31	004700M	STANDOFF 7" 2 PIECE AL, MILL
32	004700D	STANDOFF 7" 2 PIECE AL, DRK
33	330007M	AL STNDOFF 3/8" BOLT&EPDMWSHR
34	004013C	FLASH SOFT AL 18X18 OATEY 12836

EXPANSION JOINT USED AS THERMAL BREAK

Expansion joints prevent buckling of rails or system failure due to thermal expansion. Determine location of expansion joints prior to installation of L-feet and rails. To create a thermal expansion joint, set gap between rails that is sufficient for proper installation of end clamps and tooling to achieve required torque. A thermal break is required when a continuous length of spliced rails exceeds the length, in feet, shown in the table to the right. For additional concerns on thermal breaks in your specific project, please consult a licensed structural engineer.

Rails in expansion joint configurations are considered cantilevered and must follow the cantilever rule, on both sides of the expansion joint, which states that the maximum amount of rail that can be cantilevered is 1/3 the respective adjacent span. An expansion joint must not be spanned by a PV module. Installing a module over an expansion joint would defeat the goal of a thermal break and could result in damage to the array.

Bonding connection for splice used as a thermal break. Option shown uses two Ilsco lugs (Model No. GBL-4DBT P/N GBL-4DBT - see product data sheet for more details) and solid copper wire. Optional grounding may be achieved through Enphase microinverter. See page 11.



	Maximum Continuous Length (ft.) of Spliced Rails			
	Solarmount Standard		Solarmount Light	
	Attachment Span		Attachment Span	
ΔT (°F)	48"	72"	48"	72"
0-40	86	105	70	81
40-50	70	93	62	81
50-60	70	81	54	69
60-70	62	69	54	69
70-80	54	69	46	57
80-90	54	69	46	57
90-100	54	57	46	57
100-120	46	57	38	45
120-140	38	45	38	45

The values displayed are the maximum allowed rail length, in feet, without a thermal break.
These values apply only to the Flashkit Pro L-foot. For Flashloc Comp Mount, or if your span is less than 48", refer to the Solarmount Design & Engineering Guide for max lengths of continuous rail before a thermal break is required.
The installer is responsible for determining the maximum temperature difference (ΔT) used to establish the maximum rail length, without expansion joint, at the install location.
As spans increase, so does the maximum reaction force that the rail exerts on the L-foot. It is the responsibility of the installer to ensure that Maximum Reaction Force does not exceed the shear capacity of the roof connection. See SM Design and Engineering Guide for corresponding reaction forces.
ΔT refers to the maximum difference in the temperature of the rail between installation and the extreme high or low temperature. The Extreme Annual Design Conditions table at the following url can be used as a reference when determining ΔT.

http://ashrae-meteo.info/

PLANNING YOUR SOLARMOUNT INSTALLATIONS

The installation can be laid out with rails parallel to the rafters or perpendicular to the rafters. Note that SOLARMOUNT rails make excellent straight edges for doing layouts.

Center the installation area over the structural members as much as possible.

Leave enough room to safely move around the array during installation. Some building codes and fire codes require minimum clearances around such installations, and the installer should check local building code requirements for compliance.

The length of the installation area is equal to:

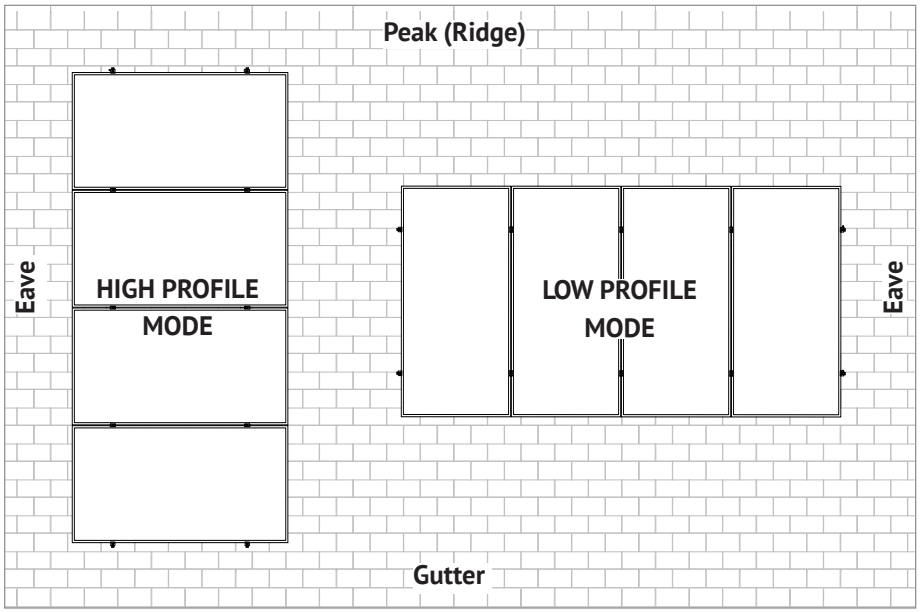
Standard Series:

- the total width of the modules,
- plus 1/4" inch for each space between modules (for mid- clamp),
- plus approximately 3" (1½ inches for each Endclamp)

Pro Series:

- the total width of the modules,
- plus 1" inch for each space between modules (for mid- clamp),
- plus 0 to 1" (0 to ½ inches for each Endclamp)

RAILS MAY BE PLACED PARALLEL OR PERPENDICULAR TO RAFTERS



LAYING OUT L-FEET FOR TOP CLAMPS

L-feet, in conjunction with proper flashing equipment and techniques, can be used for attachment through existing roofing material, such as asphalt shingles, sheathing or sheet metal to the building structure.

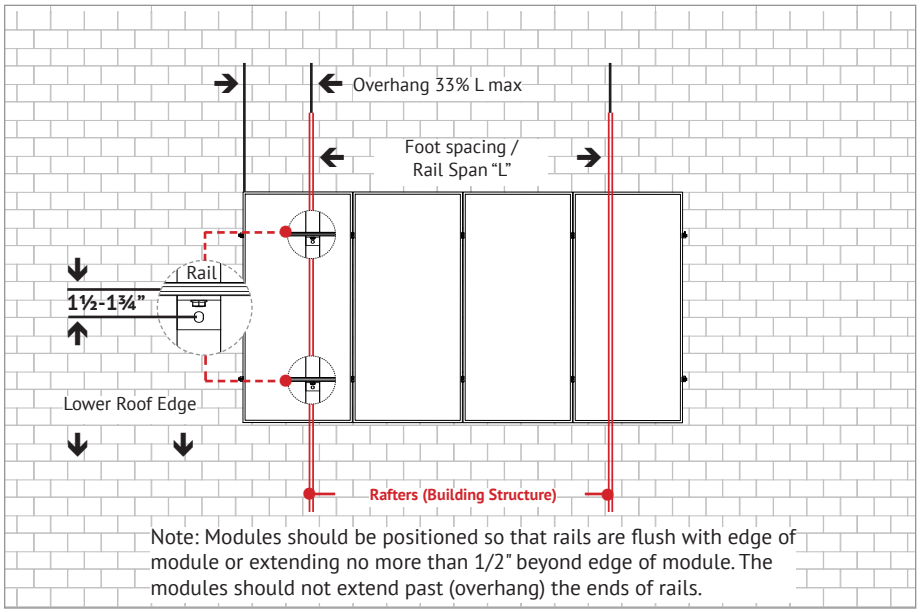
Locate and mark the position of the L-feet lag screw holes within the installation area as shown below. Follow manufacturer module installation guide for rail spacing based on appropriate mounting locations

NOTE: For expansion joint requirements, refer to page 4. Rail Lengths and locations of l-feet for expansion joints will need to be determined at this stage in planning system layout.

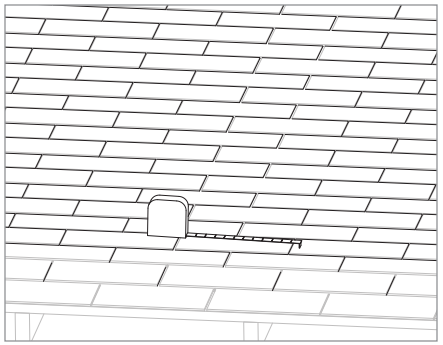
If multiple rows are to be installed adjacent to one another, it is not likely that each row will be centered above the rafters. Adjust as needed, following the guidelines below as closely as possible.

Refer to Unirac Solarmount D&E Guide & U-Builder for allowable spans and cantilevers.

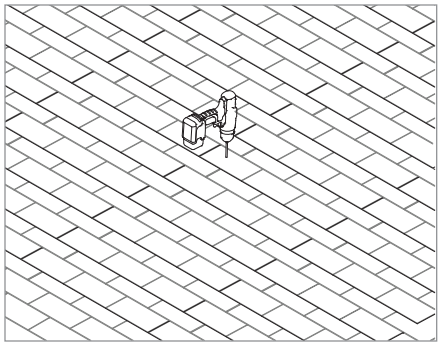
LAYOUT WITH RAILS PERPENDICULAR TO RAFTERS (RECOMMENDED)



Note: Modules should be positioned so that rails are flush with edge of module or extending no more than 1/2" beyond edge of module. The modules should not extend past (overhang) the ends of rails.



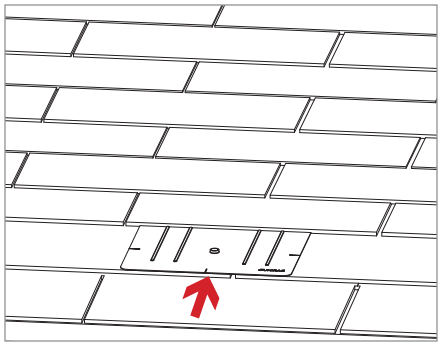
ROOF PREPARATION: Layout and install flashing at rafter locations determined per Design and Engineering Guide.



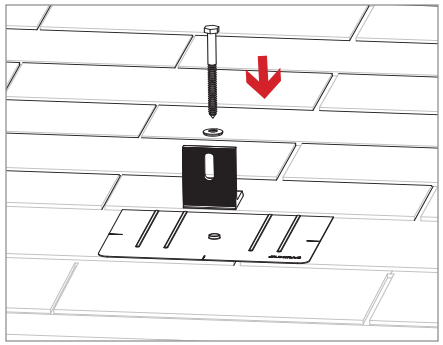
DRILL PILOT HOLES: Center the roof attachment over the rafter and drill a pilot hole(s) for the lag bolt(s).

NOTE: Determine lag bolt size and embedment depth.

Quick Tip: Pre-drill the pilot hole through the flat flashing lag bolt location for easier installation.

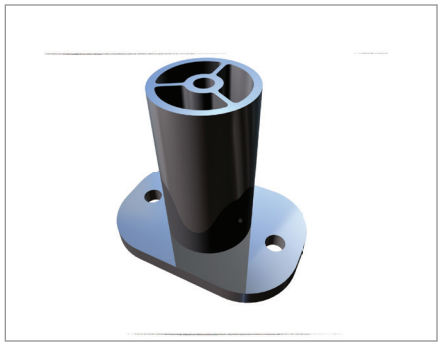


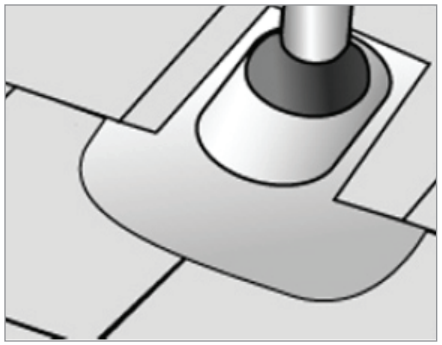
FLASHING INSTALLATION: Insert the flashing so the top part is under the next row of shingles and the hole lines up with the pilot hole.



INSTALL LAG BOLTS & L-FOOT: Insert the lag bolt through the L-Foot in the order shown in the illustration. Verify proper orientation before tightening lag bolts.

For high snow load conditions, install the L-foot as shown above, and install the rail on the downslope face of the L-Foot

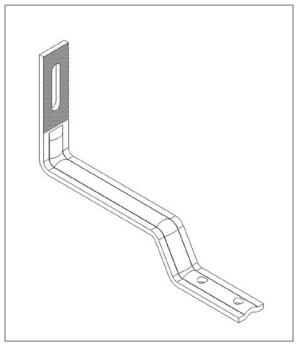


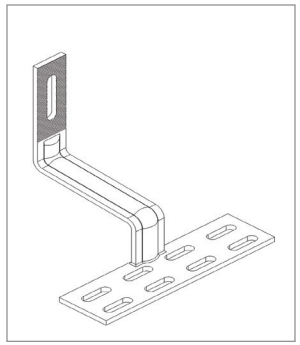


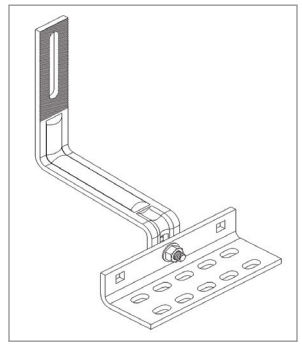
2 PIECE ALUMINUM STANDOFF WITH FLASHING & L-FOOT:

- If necessary cut an opening in the roofing material over a rafter to accommodate the flashing riser.
- Install the standoff, ensuring that both lag bolts are screwed into the rafter.
- Insert the flashing under the shingle above and over the shaft of the standoff. (No-Calk™ collar does not require sealing of the flashing and standoff shaft)
- Add L-Foot to top with bolt that secures the EPDM washer to the top of the standoff.

See Standoffs Installation Manual for Additional Details.





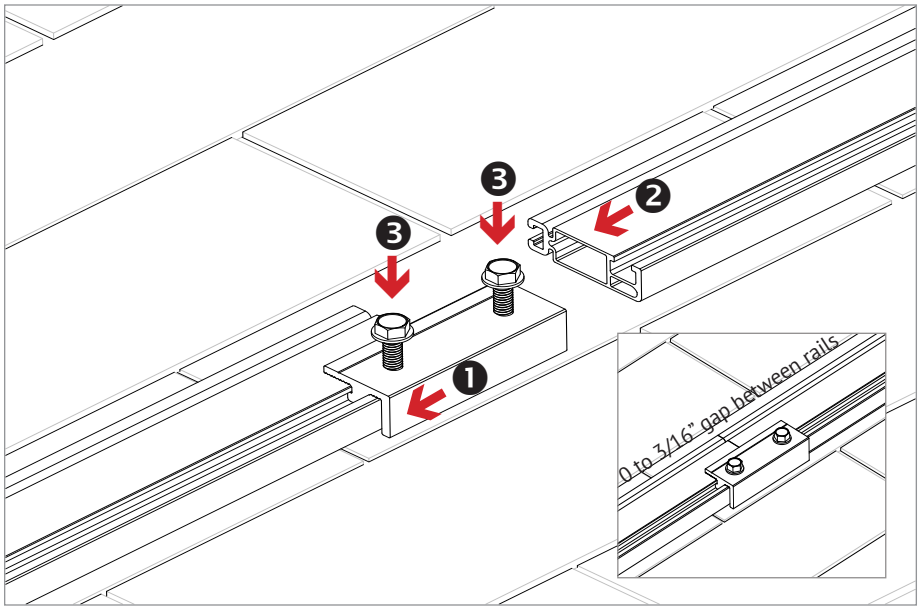


Side MOUNT SOLARHOOK:

- Remove or slide up the roof tile, position the roof hook above the roof rafter
- Place SolarHook in the middle of the underlying interlocking tile's valley. Drill 3/16 inch pilot holes through the underlayment into the center of the rafters. Securely fasten each tile hook to the rafters using included lag screws.
- Slide down or re-insert the tile.

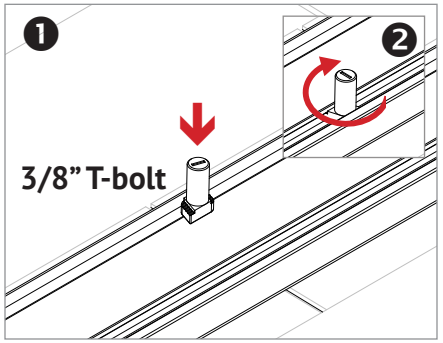
See Unirac Solarhook Installation Manual for Additional Information.

SPLICE INSTALLATION (IF REQUIRED PER SYSTEM DESIGN)
If your installation uses SOLARMOUNT splice bars, attach the rails together before mounting to the L-feet/footings. Use splice bars only with flush installation and those that use low-profile tilt legs. A rail must be supported by more than one footing on both sides of the splice. There can be a gap between rails, up to 3/16" at the splice connections. To install, slide T-feature on splice into the T-slot on each rail, centering the splice between the two rails. Tighten each bolt until the bolt-head is flush against the splice and torqued to 10 ft-lbs. Installation is complete when the bonding hardware penetrates the opposite side of the rail and the assembly torque is achieved. T-bolts should not be placed less than a distance of 1" from the end of the rail regardless of a splice.

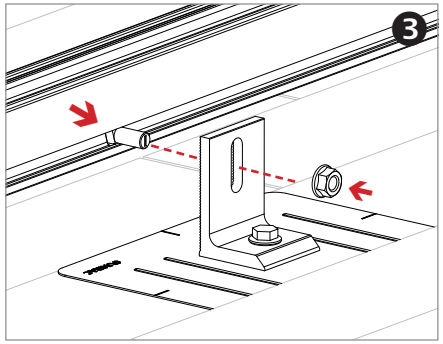


TORQUE VALUE
Hex head socket size ½" – Do not exceed 10 ft-lbs. Do not use Anti-Seize. See table on page 4 for max length of spliced rails. An expansion joint is required above the lengths published in the table.

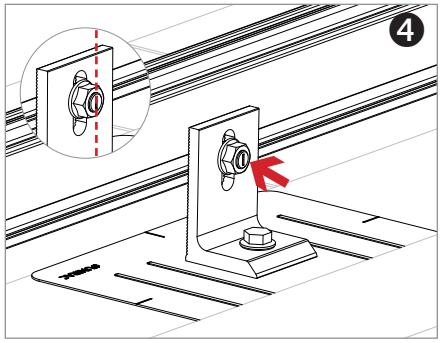
Rails in splice joint configurations are considered cantilevered and must follow the cantilever rule, on both sides of the splice, which states that the maximum amount of rail that can be cantilevered is 1/3 the respective adjacent span. See table on page 4.



PLACE T-BOLT INTO RAIL & SECURE BOLT: Insert 3/8" T-bolt into rail at L-foot locations. Apply Anti-Seize to bolt. Rotate T-bolt into position.



SECURE T-BOLT: Apply Anti-Seize to bolt. Rotate T-bolt into position.



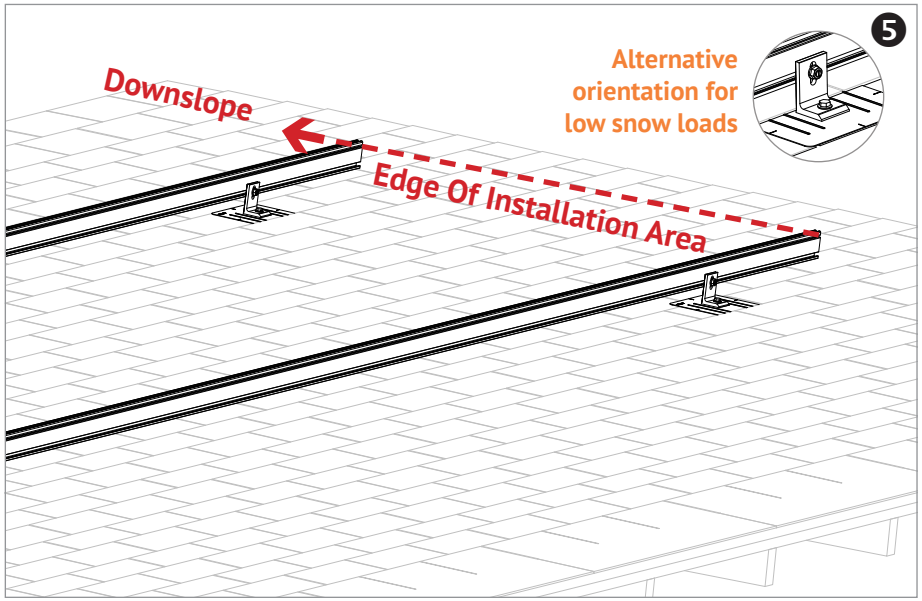
ALIGN POSITION INDICATOR: Hand tighten nut until rail alignment is complete. Verify that position indicator on bolt is vertical (perpendicular to rail)

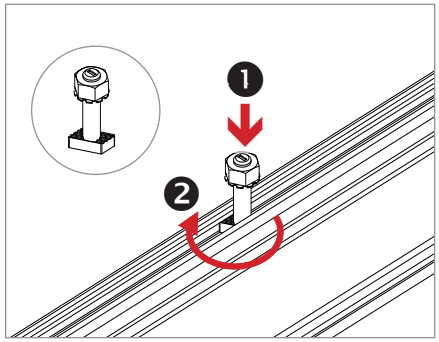
TORQUE VALUE: 3/8" nut to 30 ft-lbs

ALIGN RAILS: Align one pair of rail ends to the edge of the installation area. The opposite pair of rail ends will overhang installation area. Do not Trim them off until the installation is complete. If the rails are perpendicular to the rafters, either end of the rails can be aligned, but the first module must be installed at the aligned end.

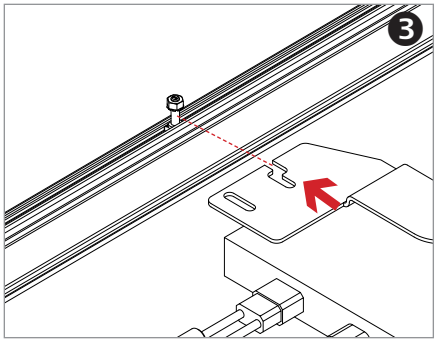
If the rails are parallel to the rafters, the aligned end of the rails must face the lower edge of the roof. Securely tighten all hardware after alignment is complete.

Mount modules to the rails as soon as possible. Large temperature changes may bow the rails within a few hours if module placement is delayed.

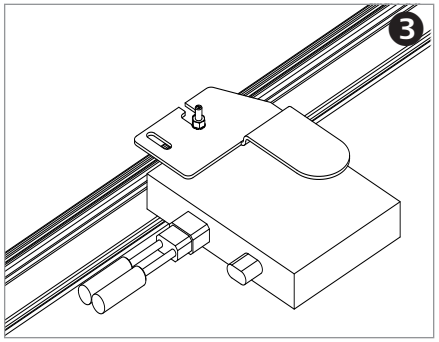




INSTALL MICROINVERTER MOUNT T-BOLT: Apply Anti-Seize and install pre-assembled ¼" dia. bonding T-bolts into top ¼" rail slot at microinverter locations. Rotate bolts into position.

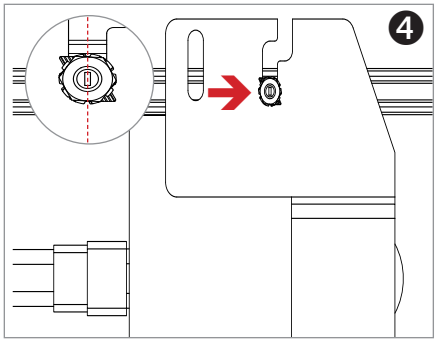


INSTALL MICROINVERTER: Install microinverter on to rail. Engage with bolt.

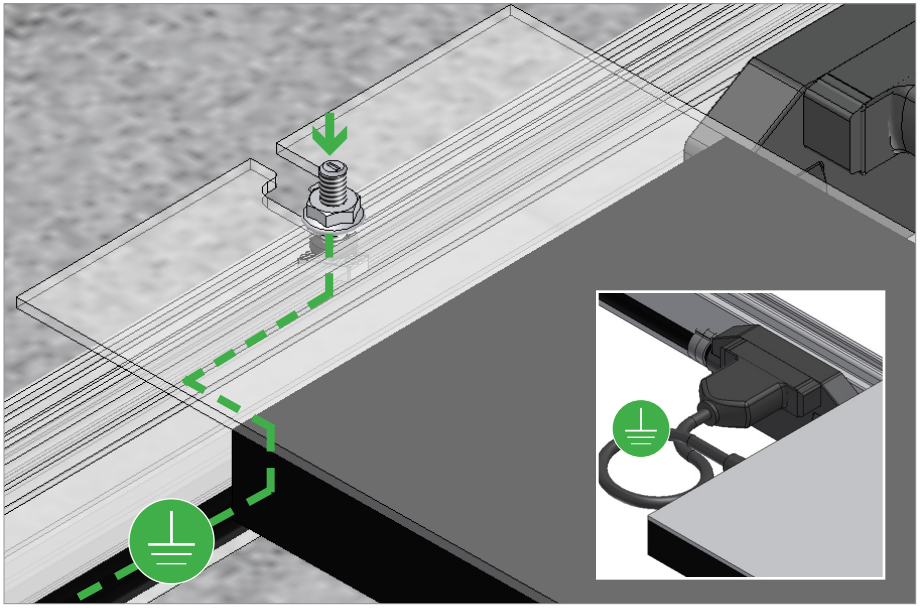


INSTALL MICROINVERTER:

TORQUE VALUE
1/4" nut to 10 ft-lbs with Anti-Seize.



ALIGN POSITION INDICATOR: Verify that position indicator on bolt is perpendicular to rail.



SM EQUIPMENT GROUNDING THROUGH ENPHASE MICROINVERTERS

The Enphase M215 and M250 microinverters have integrated grounding capabilities built in. In this case, the DC circuit is isolated from the AC circuit, and the AC equipment grounding conductor (EGC) is built into the Enphase Engage integrated grounding (IG) cabling.

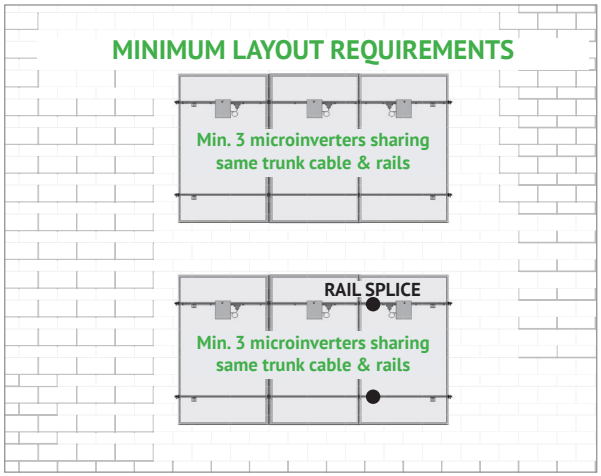
In order to ground the SOLARMOUNT racking system through the Enphase microinverter and Engage cable assembly, there must be a minimum of three PV modules connected to the same trunk cable within a continuous row. Continuous row is defined as a grouping of modules installed and bonded per the requirements of this installation guide sharing the same two rails. The microinverters are bonded to the SOLARMOUNT rail via the mounting hardware. Complete equipment grounding is achieved through the Enphase Engage cabling with integrated grounding (IG). No additional EGC grounding cables are required, as all fault current is carried to ground through the Engage cable.

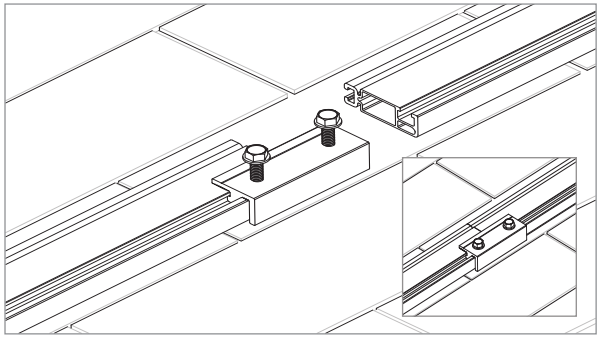
SOLARMOUNT INTEGRATED BONDING ADVANTAGE

WITH SYSTEM GROUNDING THROUGH ENPHASE MICROINVERTERS AND TRUNK CABLES

LOSE ALL THE COPPER & LUGS

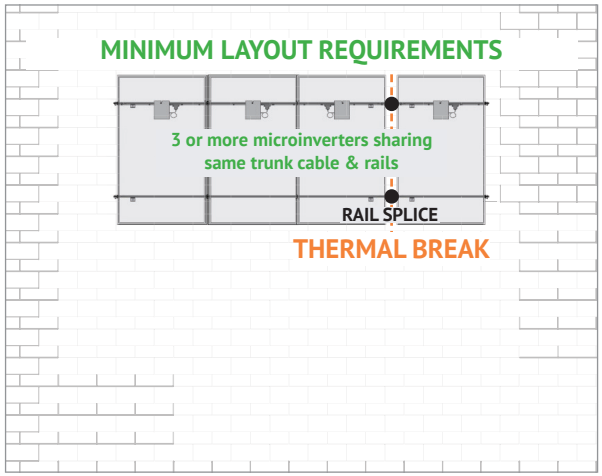
CONTINUOUS RAIL & ELECTRICAL BONDING SPLICE
Enphase Microinverter (MI) Requirements (Model No. M215 & M250)
3 Microinverters sharing same trunk cable & rails

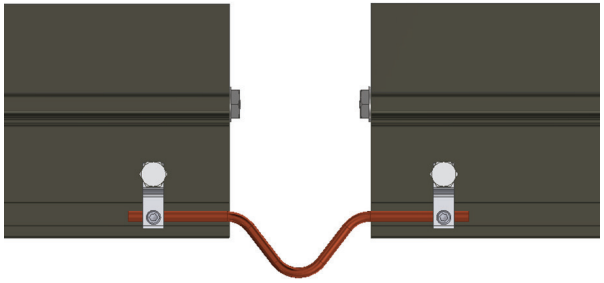




ELECTRICAL BONDING SPLICE

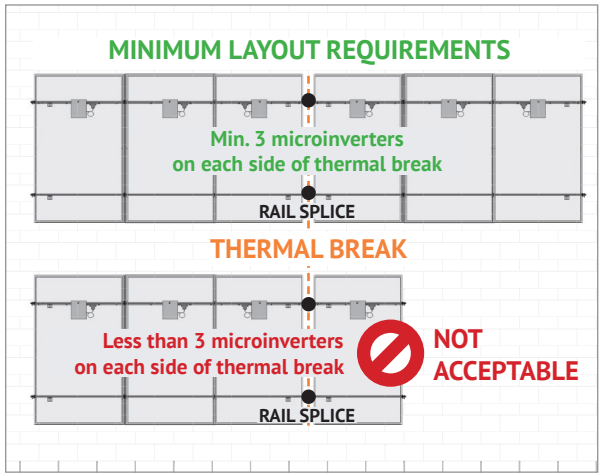
EXPANSION JOINT W/GROUNDING LUGS & COPPER JUMPER
Enphase Microinverter (MI) Requirements (Model No. M215 & M250)
3 or more Microinverters sharing same trunk cable & rails

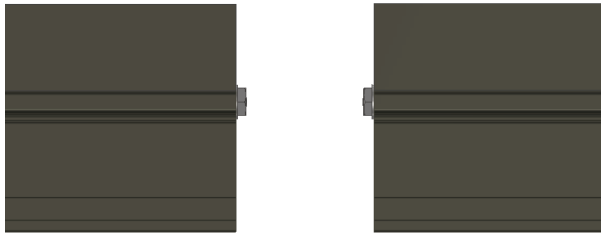




EXPANSION JOINT USED AS THERMAL BREAK W/ GROUNDING LUGS & COPPER JUMPER

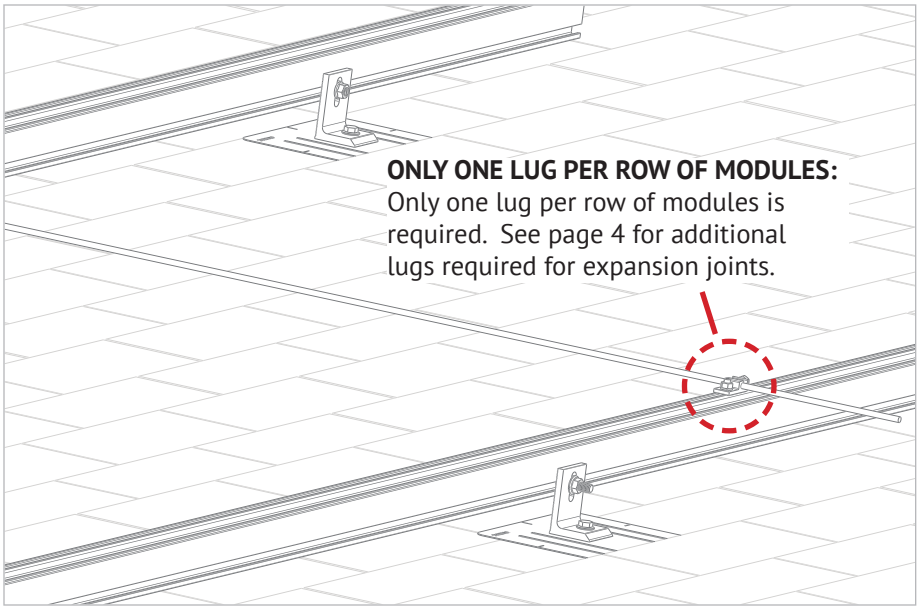
EXPANSION JOINT W/O ELECTRICAL BONDING CONNECTION
Enphase Microinverter (MI) Requirements (Model No. M215 & M250)
MIn. 3 Microinverters on each side of thermal break





EXPANSION JOINT USED AS THERMAL BREAK W/O ELECTRICAL BONDING CONNECTION

NOTE:
THE ABOVE IMAGES ARE SAMPLE CONFIGURATIONS TO ILLUSTRATE THE REQUIREMENTS FOR SM SYSTEM GROUNDING THROUGH ENPHASE MICROINVERTERS DESCRIBED ON page 10.



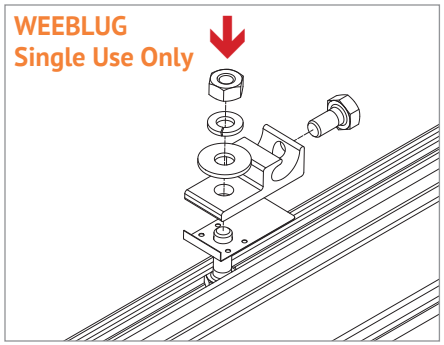
ONLY ONE LUG PER ROW OF MODULES:
Only one lug per row of modules is required. See page 4 for additional lugs required for expansion joints.

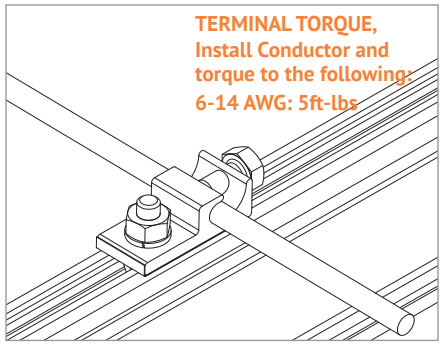
GROUNDING LUG MOUNTING DETAILS:
Details are provided for both the WEEB and Ilsco products. The WEEBLug has a grounding symbol located on the lug assembly. The Ilsco lug has a green colored set screw for grounding indication purposes. Installation must be in accordance with NFPA NEC 70, however the electrical designer of record should refer to the latest revision of NEC for actual grounding conductor cable size.

Required if not using approved integrated grounding microinveters

GROUNDING LUG - BOLT SIZE & DRILL SIZE		
GROUND LUG	**BOLT SIZE**	**DRILL SIZE**
WEEBLug	1/4"	N/A - Place in Top SM Rail Slot
ILSCO Lug	#10-32	7/32"

- Torque value depends on conductor size.
- See product data sheet for torque value.

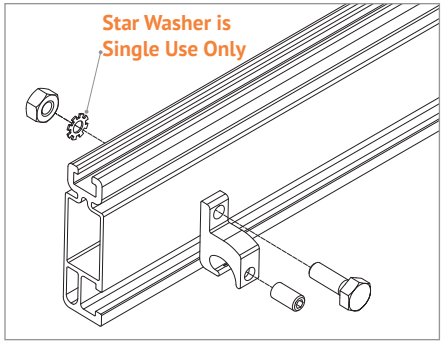


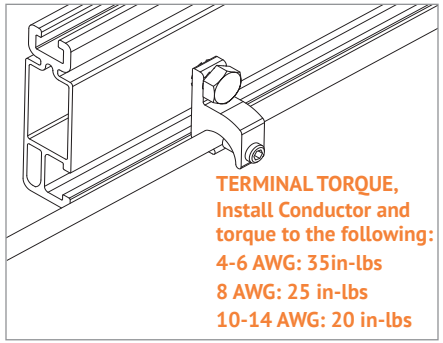


WEEBLUG CONDUCTOR - UNIRAC P/N 008002S:
Apply Anti Seize and insert a bolt in the aluminum rail and through the clearance hole in the stainless steel flat washer. Place the stainless steel flat washer on the bolt, oriented so the dimples will contact the aluminum rail. Place the lug portion on the bolt and stainless steel flat washer. Install stainless steel flat washer, lock washer and nut. Tighten the nut until the dimples are completely embedded into the rail and lug.

TORQUE VALUE 10 ft lbs.

See product data sheet for more details, Model No. WEEB-LUG-6.7



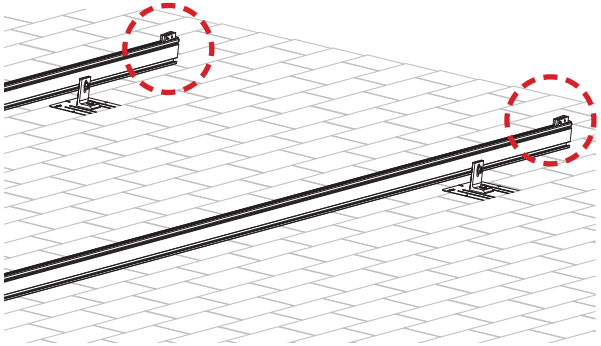


ILSCO LAY-IN LUG CONDUCTOR - UNIRAC P/N 008009P: Alternate Grounding Lug - Drill, deburr hole and bolt thru both rail walls per table.

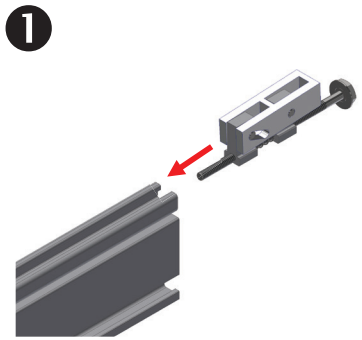
TORQUE VALUE 5 ft lbs.

See ILSCO product data sheet for more details, Model No. GBL-4DBT.

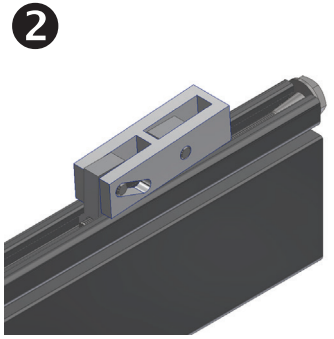
NOTE: ISOLATE COPPER FROM ALUMINUM CONTACT TO PREVENT CORROSION



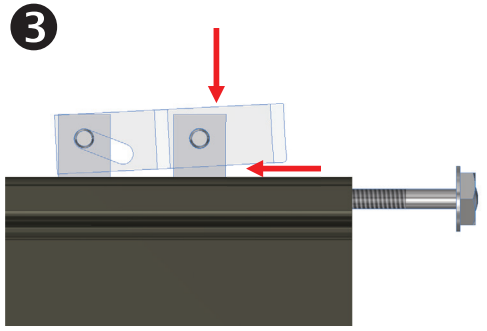
INSTALL MODULE END CLAMPS: The End clamp is supplied as an assembly with a 1/2" hex head bolt that is accessible at the ends of rails. The clamp should be installed on the rails prior to installing end modules.



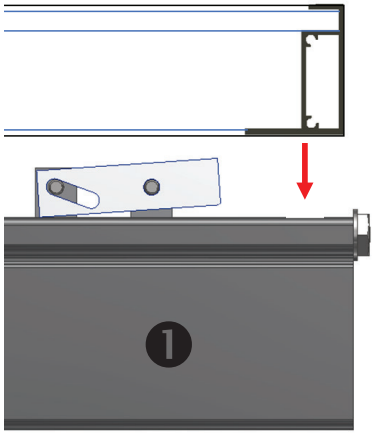
INSTALL END CLAMPS ON RAIL: Slide end clamp on to rail by engaging the two t-guide brackets with the top slot of the rails. **Ensure bolt is extended as far as possible so that clamp is positioned at max. distance from end of rail.**

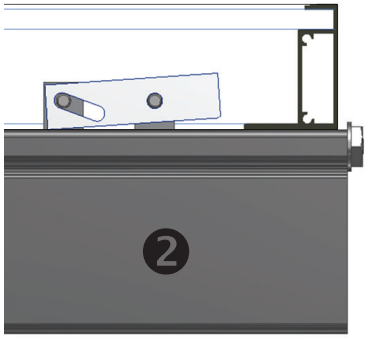


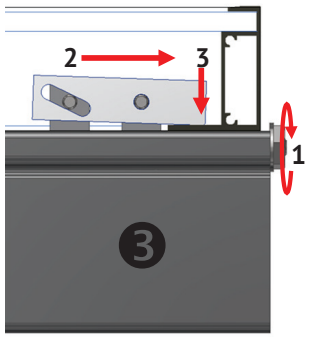
POSITION END CLAMPS: Slide end clamp assembly on to rail until bolt head engages with end of rail **End clamps are positioned on rails prior to the first end module and prior to the last end module.**



NOTE: To assist insertion of clamp into rail slot, Pressure may be applied to top or side of bracket as shown. Do not force clamp into rail by pushing on bolt with excessive force.

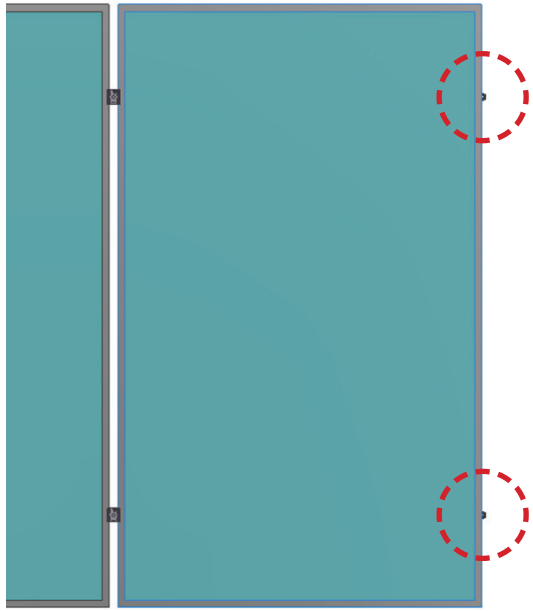


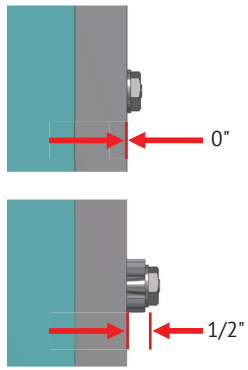




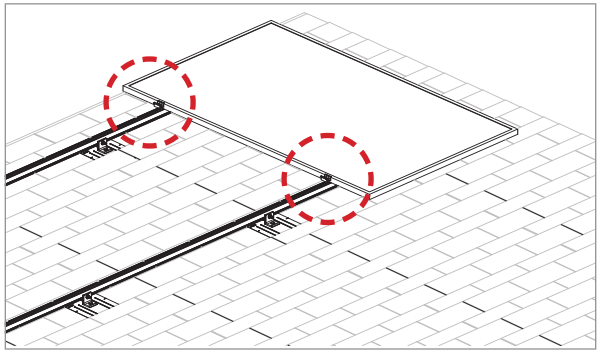
INSTALL FIRST MODULE: Install the first end module onto rails with the flange of the module frame positioned between end clamps an ends of rails.

ENGAGE CLAMP: While holding module in position and with flange in full contact with rail, rotate end clamp bolt until clamp engages with flange to provide clamp force.
To ensure bolt is not over-torqued, use low torque setting on drill or If using an impact driver, stop rotation as soon as impact action of driver begins.
TORQUE VALUE
End clamp bolt to 5 ft-lbs, No anti-seize

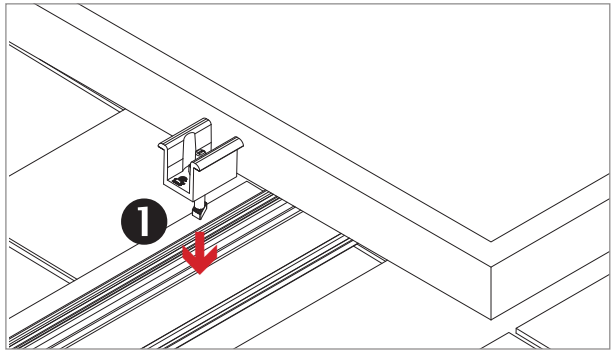




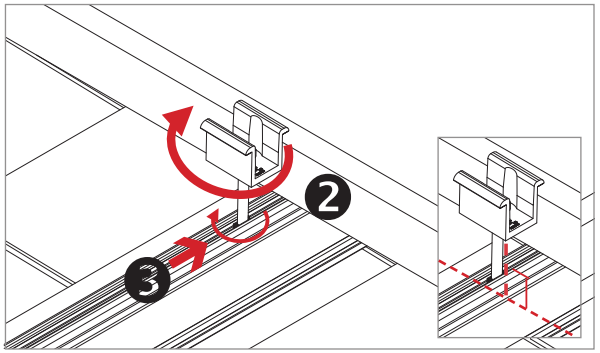
For best appearance, position module flush with ends of rails. Rails should not extend more than 1/2" beyond module. Module must be fully supported by rails and cannot overhang ends of rails.



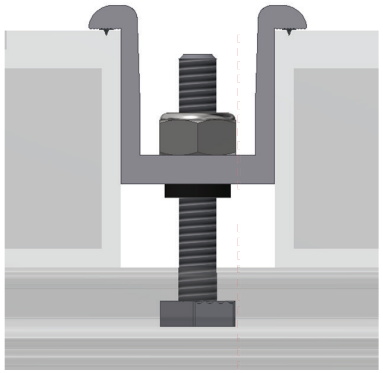
INSTALL MIDCLAMPS: Midclamp is supplied as an assembly with a T-bolt for module installation. Clamp assemblies may be positioned in rail near point of use prior to module placement.



INSERT MIDCLAMP ASSEMBLY: Insert 1/4" T-Bolt into top slot of rail

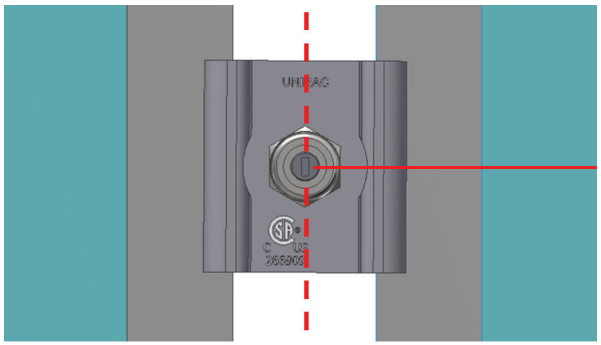


MIDCLAMP: Rotate midclamp assembly and slide until clamp is against module frame. Do not tighten nut until next module is in position. Ensure bolt is perpendicular to rail.

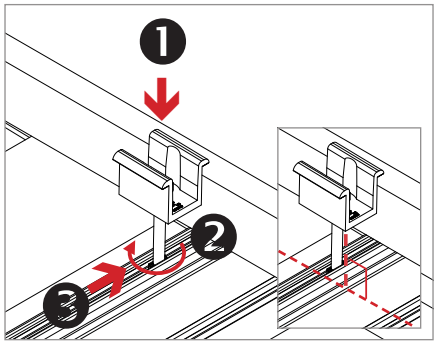


PLACE ADJACENT MODULE AGAINST CLAMPS:
Modules must be tight against clamps with no gaps. Tighten nut to required torque.

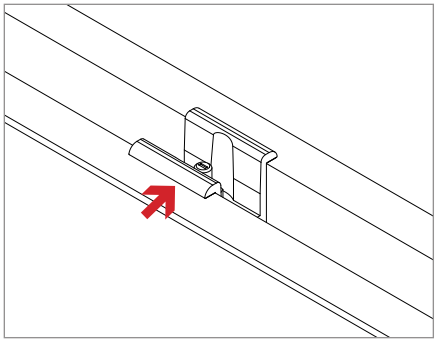
TORQUE VALUE: 11 ft-lbs. No anti-seize.



POSITION INDICATOR - SERRATED T-BOLT:
Verify the T-bolt position indicator is perpendicular to the rail.

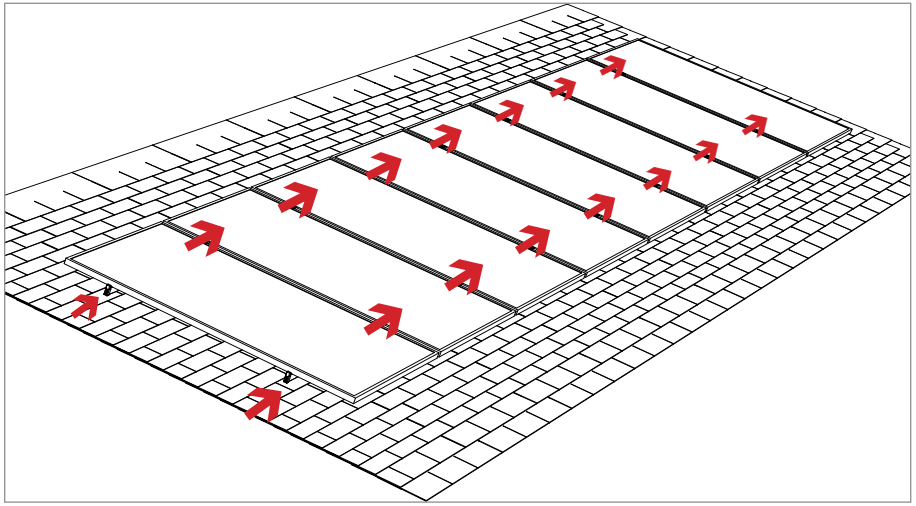


INSTALL REMAINING MID-CLAMPS: Proceed with module installation. Engage each module with previously positioned Midclamp assemblies.

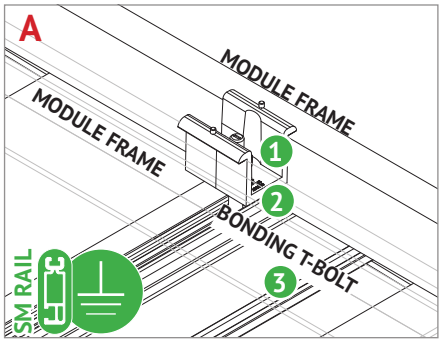


POSITION T-BOLT ALIGNMENT MARKS: Verify that the position indicator(s) & T-bolt shaft(s) are angled in the correct position. Tighten to final torque.

TORQUE VALUE: 11 ft-lbs. No anti-seize.

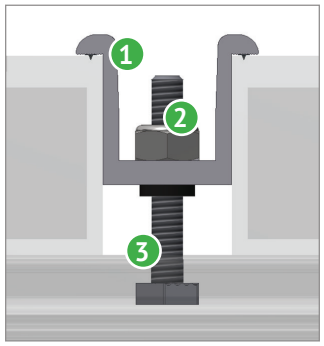


FINISH MODULE INSTALLATION: Proceed with module installation. Engage each module with the previously positioned clamp assembly:

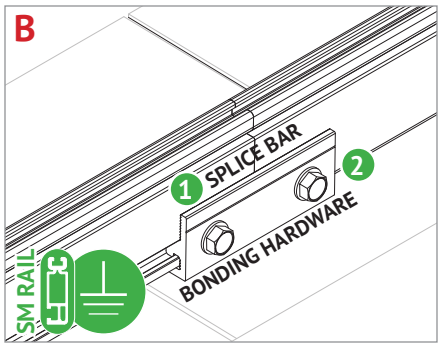


BONDING MIDCLAMP ASSEMBLY

1. Aluminum mid clamp with stainless steel bonding pins that pierce module frame anodization to bond module to module through clamp
2. Stainless steel nut bonds aluminum clamp to stainless steel T-bolt
3. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, clamp, and modules to SM rail



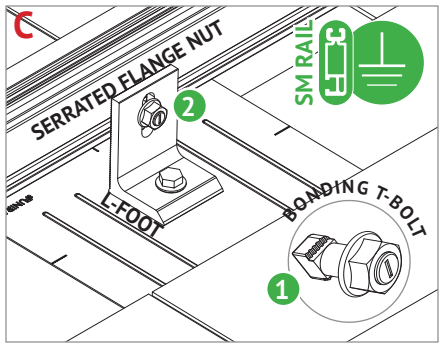
BONDING MIDCLAMP ASSEMBLY



BONDING RAIL SPLICE BAR

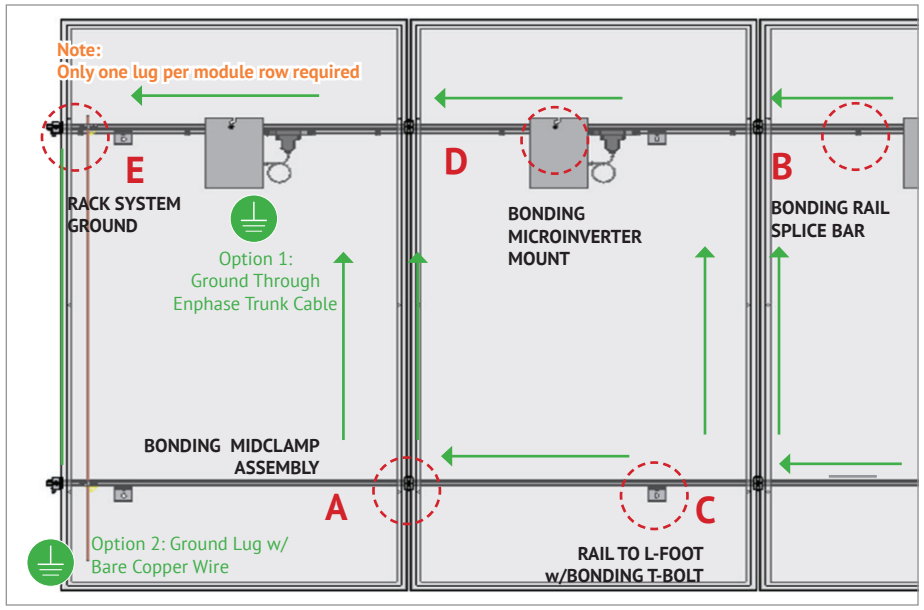
1. Bonding Hardware creates bond between splice bar and each rail section
2. Aluminum splice bar spans across rail gap to create rail to rail bond. Rail on at least one side of splice will be grounded.

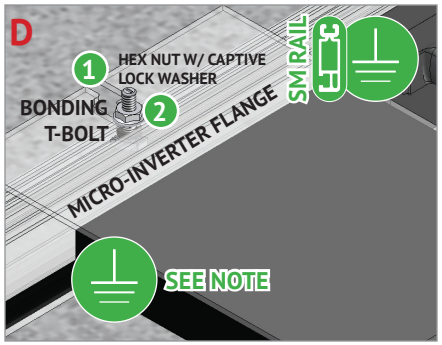
Note: Splice bar and bolted connection are non-structural. The splice bar function is rail alignment and bonding.



RAIL TO L-FOOT w/BONDING T-BOLT

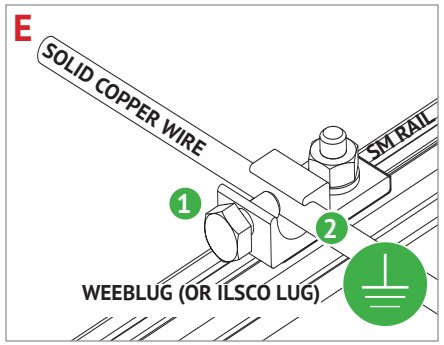
1. Serrated flange nut removes L-foot anodization to bond L-Foot to stainless steel T-bolt
2. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, and L-foot to grounded SM rail





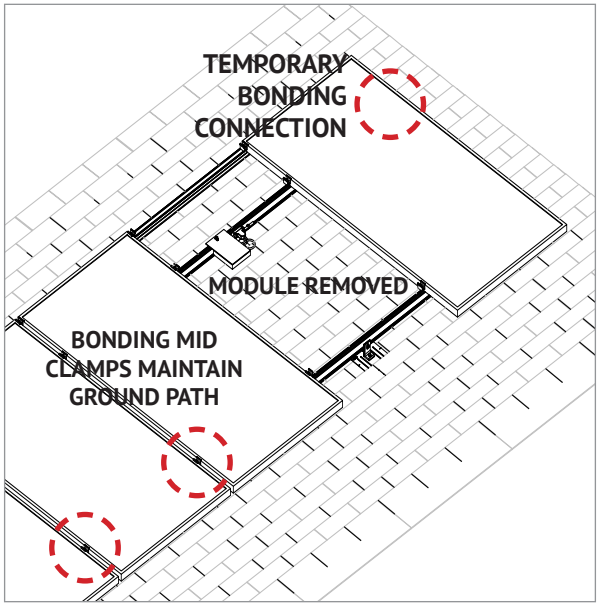
BONDING MICROINVERTER MOUNT

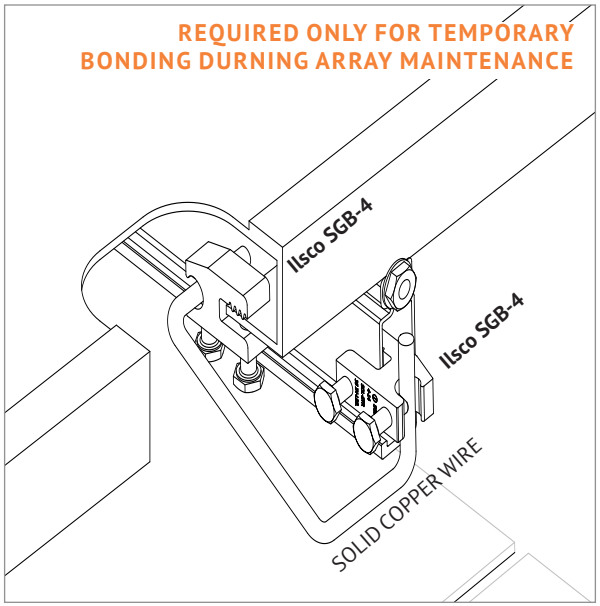
1. Hex nut with captive lock washer bonds metal microinverter flange to stainless steel T-bolt
2. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, and L-foot to grounded SM rail **System ground including racking and modules may be achieved through the trunk cable of approved microinverter systems. See page 11 for details**



RACK SYSTEM GROUND

1. WEEB washer dimples pierce anodized rail to create bond between rail and lug
2. Solid copper wire connected to lug is routed to provide final system ground connection.
   NOTE: Ilsco lug can also be used when secured to the side of the rail. See page 12 for details





TEMPORARY BONDING CONNECTION DURING ARRAY MAINTENANCE
When removing modules for replacement or system maintenance, any module left in place that is secured with a bonding Midclamp will be properly grounded. If a module adjacent to the end module of a row is removed or if any other maintenance condition leaves a module without a bonding mid clamp, a temporary bonding connection must be installed as shown

- Attach Ilsco SGB4 to wall of rail
- Attach Ilsco SGB4 to module frame
- Install solid copper wire jumper to Ilsco lugs

ELECTRICAL CONSIDERATIONS
SOLARMOUNT is intended to be used with PV modules that have a system voltage less than or equal to that allowable by NEC. For standard system grounding a minimum 10AWG, 105°C copper grounding conductor should be used to ground a system, according to the National Electric Code (NEC). It is the installer's responsibility to check local codes, which may vary. See below for interconnection information.

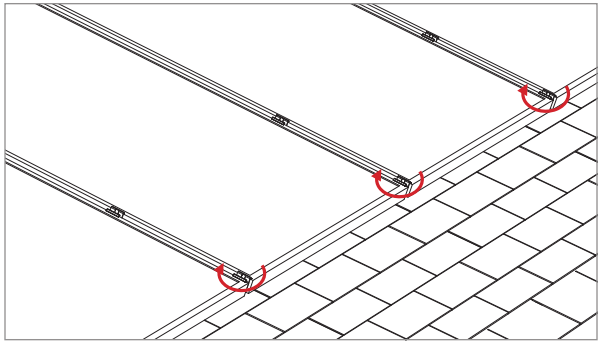
INTERCONNECTION INFORMATION
There is no size limit on how many SOLARMOUNT & PV modules can be mechanically interconnected for any given configuration, provided that the installation meets the requirements of applicable building and fire codes.

GROUNDING NOTES
The installation must be conducted in accordance with the National Electric Code (NEC) and the authority having jurisdiction. Please refer to these resources in your location for required grounding lug quantities specific to your project.

The grounding / bonding components may overhang parts of the array so care must be made when walking around the array to avoid damage.

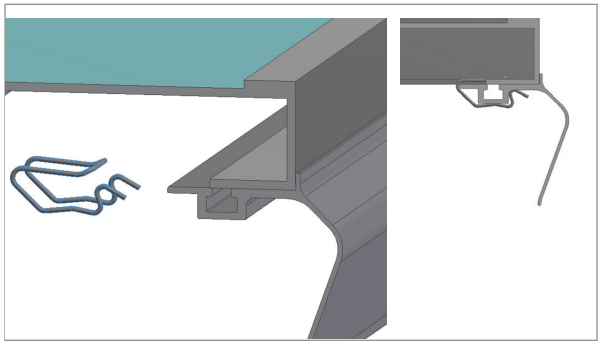
Conductor fastener torque values depend on conductor size. See product data sheets for correct torque values.

PERIODIC INSPECTION: Conduct periodic inspections for loose components, loose fasteners or any corrosion, immediately replace any affected components.

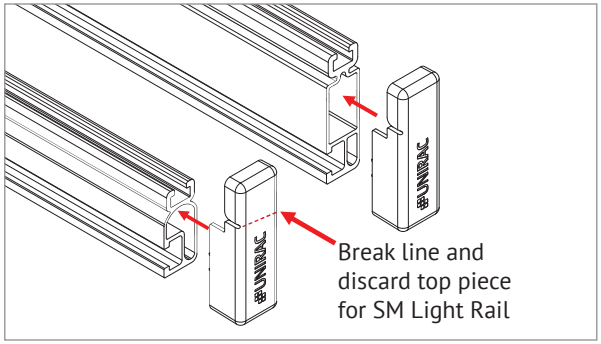


TRIM MIDCLAMPS: Ensure Trim lip is in contact with module face and verify alignment marks on T-bolts are in proper position, tighten midclamp on Trim, repeat at each gap between modules.

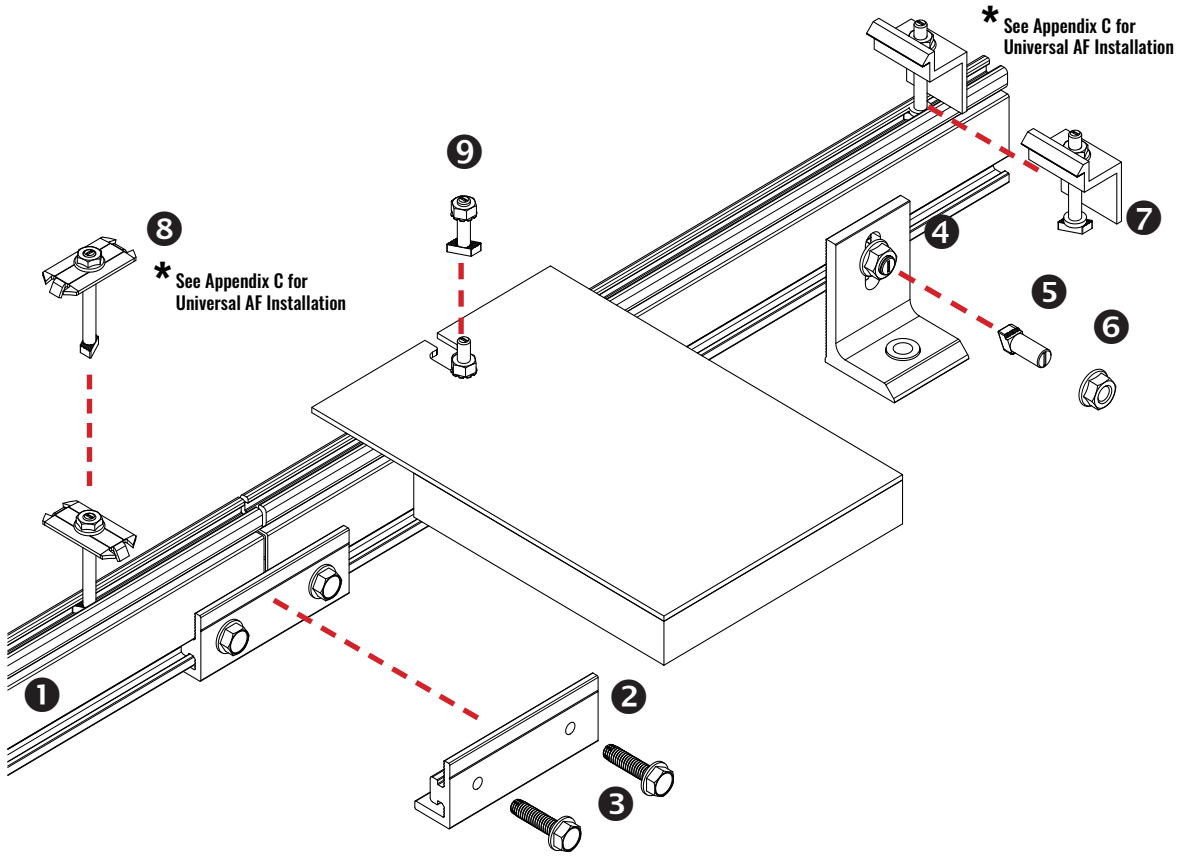
TORQUE VALUE: 11 ft-lbs. No anti-seize.



FINISH TRIM INSTALLATION. CUT EXCESS TRIM AND INSTALL TRIM CLIPS:
Attach trim to modules with at least one trim clip at each end of array and at locations where additional support is needed. Each section of trim must be attached to modules with at least one mid clamp.



INSTALL END CAPS: End caps install as supplied on SM standard rail and SM light rail. If desired for SM light rail, the end cap may be modified as shown by hand, or by using a cutting tool.



❶**RAIL**: Supports PV modules. Use at least two per row of modules. Aluminum extrusion, available in mill, clear anodized, or dark anodized.

❷❸**RAIL SPLICE**: Non structural splice joins, aligns, and electrically bonds rail sections into single length of rail. Forms a rigid splice joint, 4 inches long, preassembled with bonding hardware. Available in dark anodized or mill finish.

❹**L-FOOT**: Use to secure rails through roofing material to building structure. Refer to loading tables or U-Builder for spacing.

❺ **L-FOOT T- BOLT**: (3/8" x ¾" or 1") – Use one per L-foot to secure rail to L-foot. Stainless steel. Supplied with L-foot in combination with flange nut, provides electrical bond between L-foot and rail.

❻**SERRATED FLANGE NUT** : Use one per L-foot to secure and bond rail to Lfoot. Stainless steel. Supplied with L-foot.

❼**MODULE ENDCLAMP**: Provides bond from rail to endclamp. Pre-assembled aluminum clamp available in clear or dark finish. Supplied washer keeps clamp and bolt upright for ease of assembly.

❽**MODULE MIDCLAMP**: Pre-assembled clamp provides module to module and module to rail bond. Stainless steel clamp and T-bolt. Available in clear or dark finish.

❾**MICROINVERTER MOUNTING BOLT**: Pre-assembled bolt and nut attaches and bonds microinverter to rail. Washer at base keeps bolt upright for ease of assembly.

NOTE - POSITION INDICATOR: T-bolts have a slot in the hardware end corresponding to the direction of the T-Head.

NOTE - Standard Series Mid and End Clamps are single use.

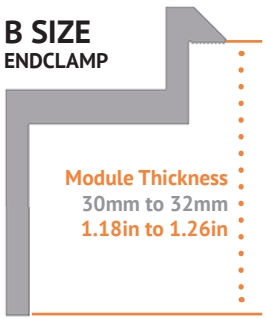
Wrenches and Torque

	Wrench Size	Recommended Torque (ft-lbs)
1/4" Hardware ❼❽❾	7/16"	*10
3/8" Hardware ❺	9/16"	*30
#12 Hardware ❸	5/16"	10

Torques are not designed for use with wood connectors *w/Anti-Seize.

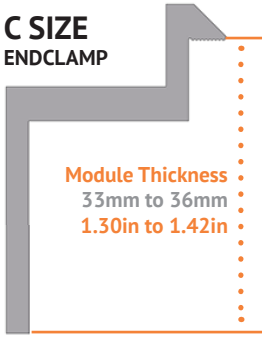
Anti-Seize*

Stainless steel hardware can seize up, a process called galling. To significantly reduce its likelihood:
1. Apply minimal lubricant to bolts, preferably Anti-Seize commonly found at auto parts stores
2. Shade hardware prior to installation, and
3. Avoid spinning stainless nuts onto bolts at high speed.



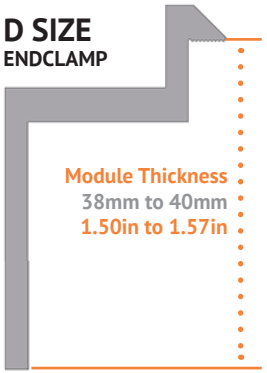
B SIZE
ENDCLAMP

Module Thickness
30mm to 32mm
1.18in to 1.26in



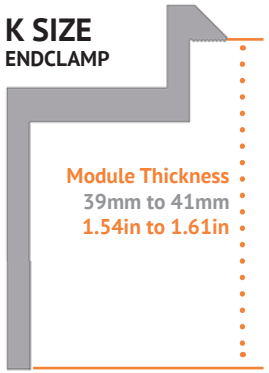
C SIZE
ENDCLAMP

Module Thickness
33mm to 36mm
1.30in to 1.42in



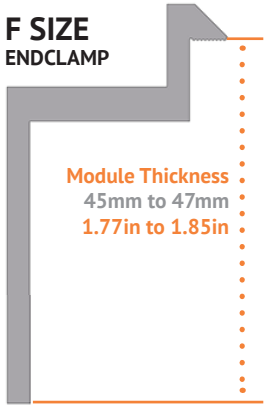
D SIZE
ENDCLAMP

Module Thickness
38mm to 40mm
1.50in to 1.57in



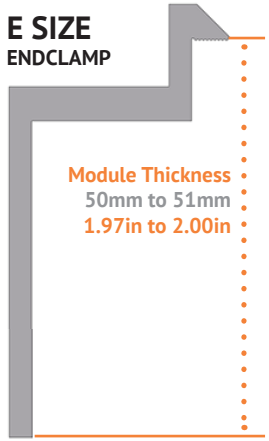
K SIZE
ENDCLAMP

Module Thickness
39mm to 41mm
1.54in to 1.61in



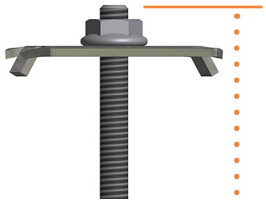
F SIZE
ENDCLAMP

Module Thickness
45mm to 47mm
1.77in to 1.85in



E SIZE
ENDCLAMP

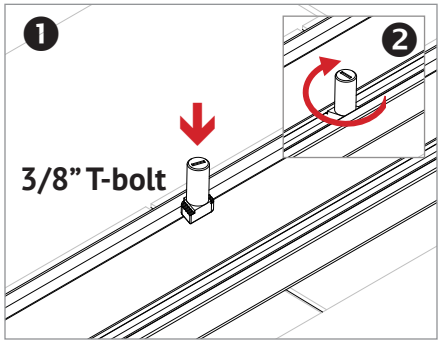
Module Thickness
50mm to 51mm
1.97in to 2.00in



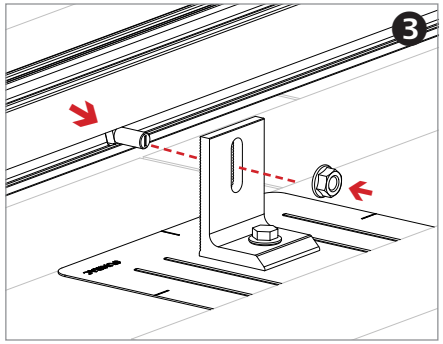
BC SIZE
MIDCLAMP
2in Long T-bolt

DK SIZE
MIDCLAMP
2.25in Long T-bolt

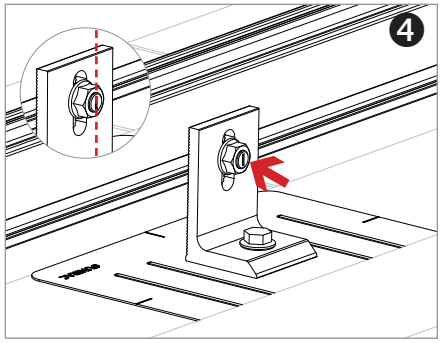
EF SIZE
MIDCLAMP
2.5in Long T-bolt



PLACE T-BOLT INTO RAIL & SECURE BOLT: Insert 3/8" T-bolt into rail at L-foot locations. Apply Anti-Seize to bolt. Rotate T-bolt into position.



SECURE T-BOLT: Apply Anti-Seize to bolt. Rotate T-bolt into position.



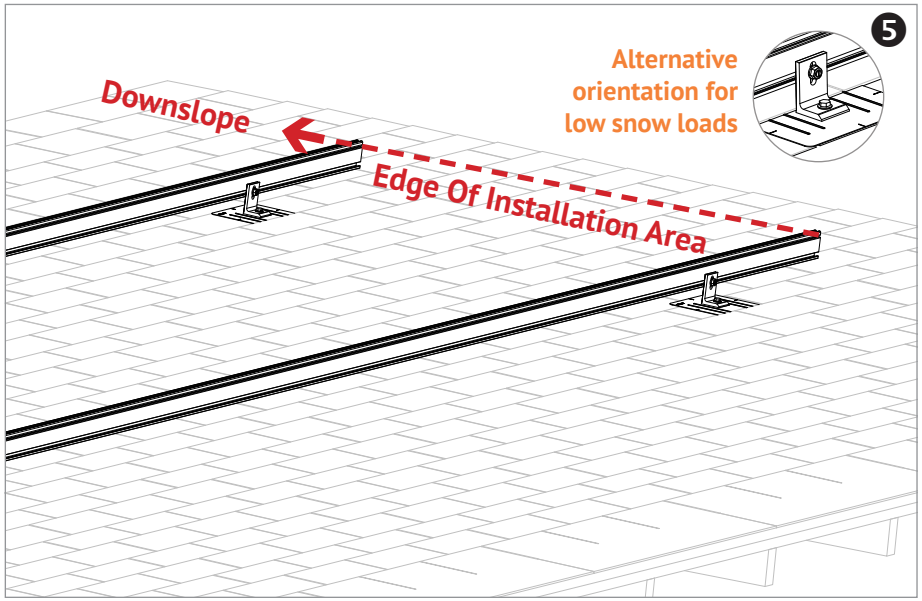
ALIGN POSITION INDICATOR: Hand tighten nut until rail alignment is complete. Verify that position indicator on bolt is vertical (perpendicular to rail)

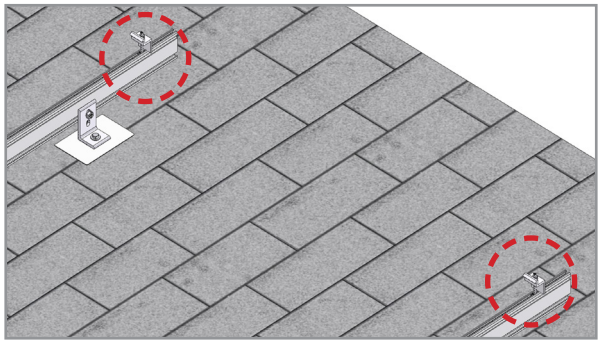
TORQUE VALUE: 3/8" nut to 30 ft-lbs

ALIGN RAILS: Align one pair of rail ends to the edge of the installation area. The opposite pair of rail ends will overhang installation area. Do not Trim them off until the installation is complete. If the rails are perpendicular to the rafters, either end of the rails can be aligned, but the first module must be installed at the aligned end.

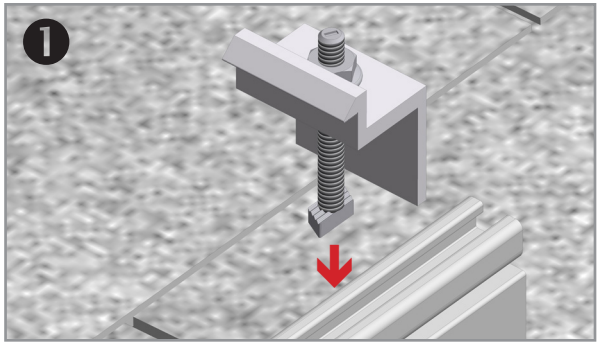
If the rails are parallel to the rafters, the aligned end of the rails must face the lower edge of the roof. Securely tighten all hardware after alignment is complete.

Mount modules to the rails as soon as possible. Large temperature changes may bow the rails within a few hours if module placement is delayed.

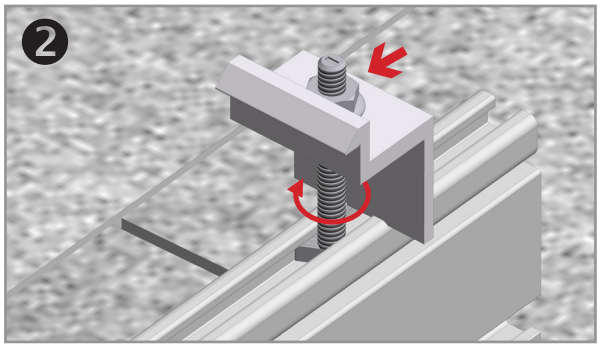




INSTALL MODULE ENDCLAMPS: The Endclamp is supplied as an assembly with a T-bolt, serrated flange nut, and washer. The washer retains the clamp at the top of the assembly. This will enable the clamp to remain upright for module installation.

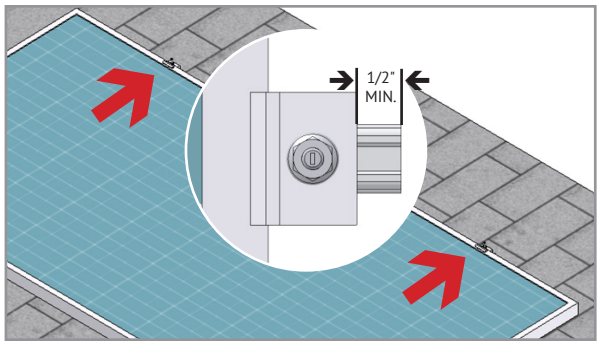


INSERT ENDCLAMP T-BOLT: Insert 1/4" T-bolt into rail.



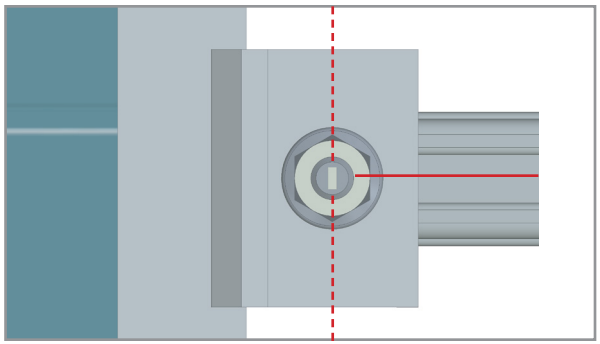
ROTATE ENDCLAMP T-BOLT: Rotate T-bolt into position. Verify that the position indicator & T-bolt shaft are angled in the correct position.

End clamps are positioned on rails prior to the first end module and installed after the last end module.

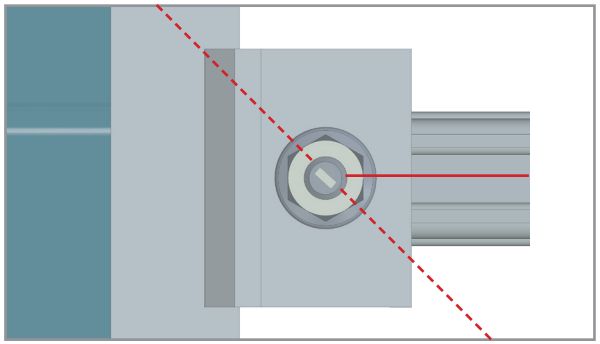


INSTALL FIRST MODULE: Install the first end module onto rails. Engage module frame with Endclamps. Verify that the position indicator & T-bolt shaft are angled in the correct position.

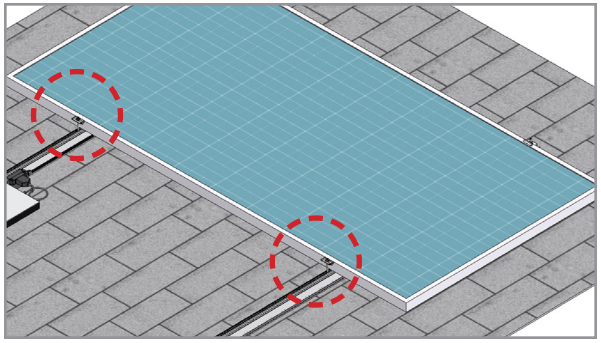
TORQUE VALUE: 1/4" nuts to 10 ft-lbs. with Anti Seize



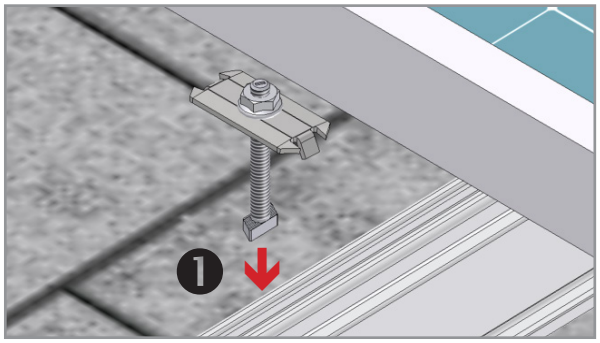
POSITION INDICATOR - SERRATED T-BOLT: Verify the T-bolt position indicator is perpendicular to the rail.



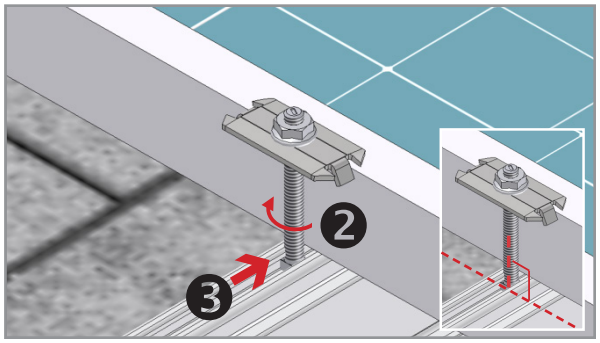
POSITION INDICATOR - NON-SERRATED T-BOLT: Verify the T-bolt position indicator is angled as shown. **FOR USE WITH MILL FINISH RAIL ONLY.**



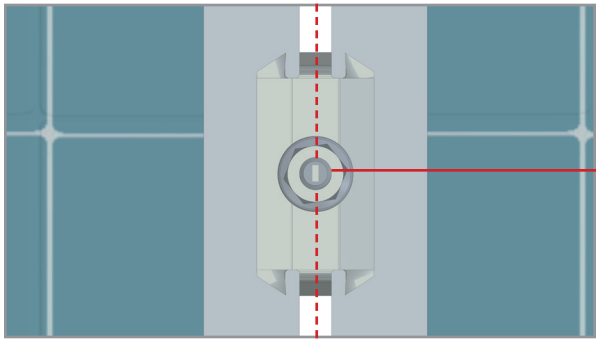
INSTALL MIDCLAMPS: Midclamp is supplied as an assembly with a T-bolt for module installation. Clamp assemblies may be positioned in rail near point of use prior to module placement.



INSERT MIDCLAMP T-BOLT: Apply Anti-Seize and insert 1/4" T-bolt into rail.

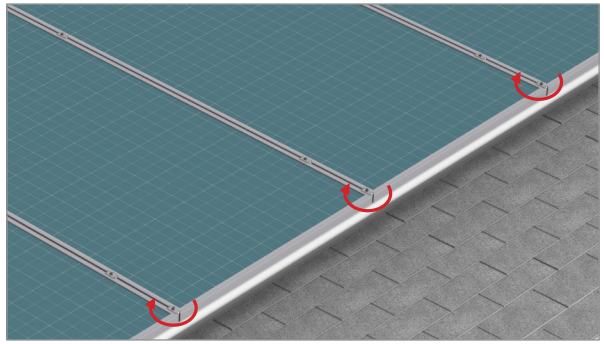


ROTATE MIDCLAMP T-BOLT: Rotate bolt into position and slide until bolt and clamp are against module frame. Do not tighten nut until next module is in position. Verify that the position indicator & T-bolt shaft are angled in the correct position.



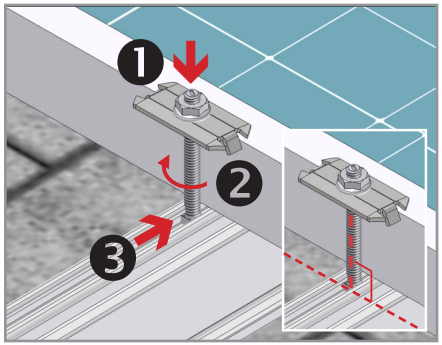
POSITION INDICATOR - SERRATED T-BOLT: Verify the T-bolt position indicator is perpendicular to the rail.

TRIM INSTALLATION INSTRUCTIONS



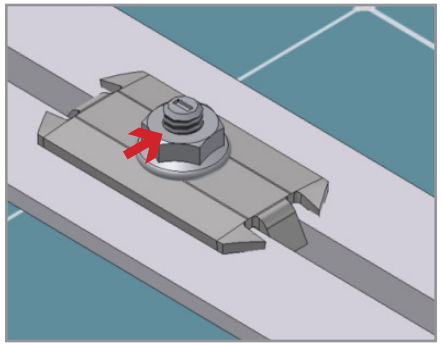
TRIM MIDCLAMPS: Ensure Trim lip is in contact with module face and verify alignment marks on T-bolts are in proper position, tighten midclamp on Trim, repeat at each gap between modules.

TORQUE VALUE: 1/4" nuts to 10 ft-lbs with Anti Seize



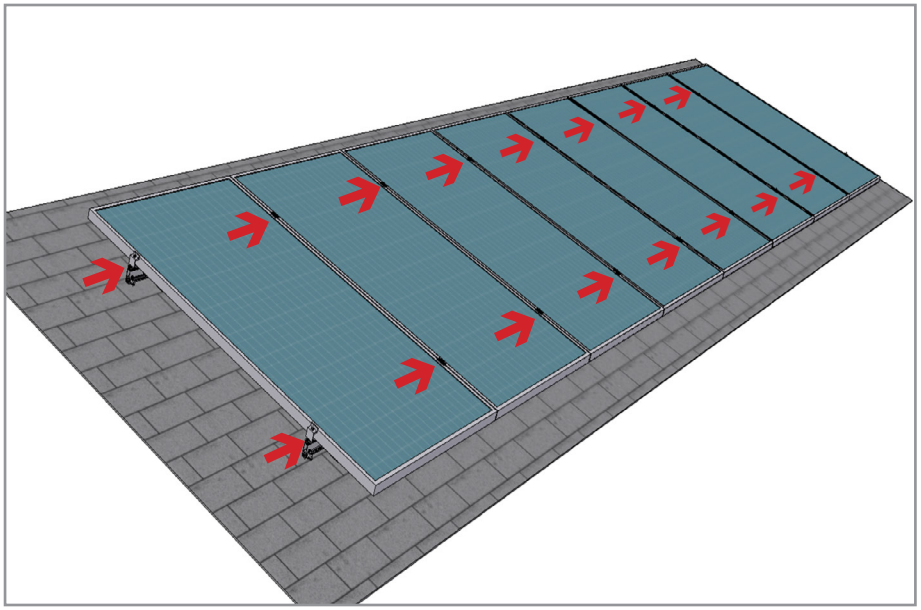
INSTALL REMAINING MID-CLAMPS: Proceed with module installation. Engage each module with previously positioned Midclamp assemblies.

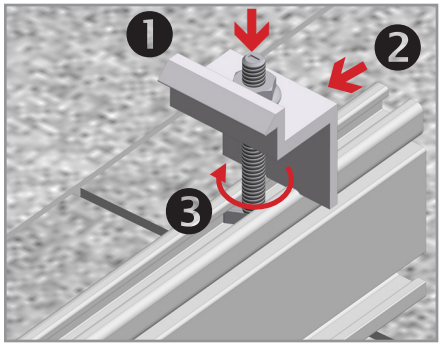
NOTE: Apply Anti-Seize to each Mid Clamp prior to installation.



POSITION T-BOLT ALIGNMENT MARKS:
Verify that the position indicator(s) & T-bolt shaft(s) are angled in the correct position.

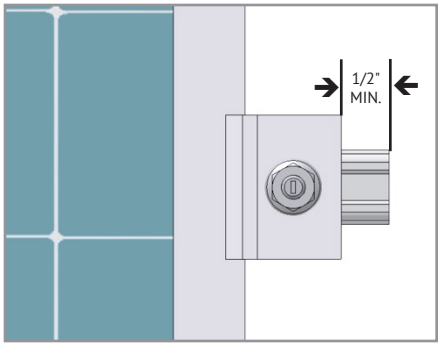
TORQUE VALUE: 1/4" nuts to 10 ft-lbs. with Anti Seize





INSTALL ENDCLAMPS: Apply Anti-Seize and install final Endclamps in same manner as first Endclamps. Slide clamps against module.

TORQUE VALUE: 1/4" nuts to 10 ft-lbs. with Anti Seize.

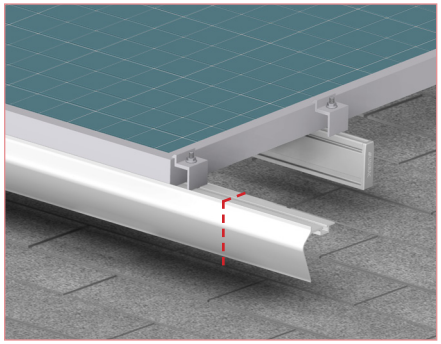


POSITION T-BOLT ALIGNMENT MARKS & CUT RAIL: Verify that the position indicator(s) & T-bolt shaft(s) are angled in the correct position. Trim off any excess rail, being careful not to cut into the roof. Allow ½" between the Endclamp and the end of the rail.

FINISH MODULE INSTALLATION: Proceed with module installation. Engage each module with the previously positioned clamp assembly:

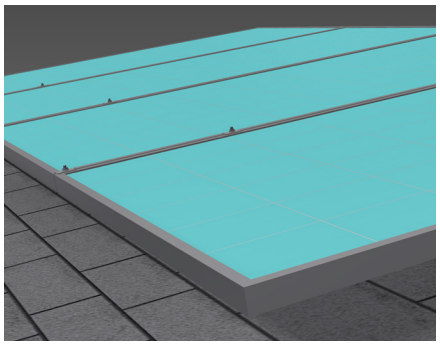
- Install second module
- Install remaining Midclamps & modules & position alignment marks
- Install Endclamps & position alignment marks
- Cut rail to desired length

TRIM INSTALLATION INSTRUCTIONS

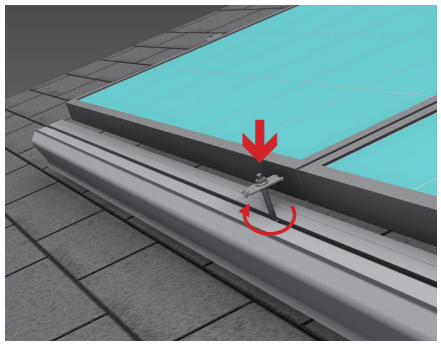


FINISH TRIM INSTALLATION, INSTALL ENDCLAMP & CUT EXCESS RAIL: Install final endclamp & Cut away excess Trim at end of array or where required for proper cantilevers. **See D&E Guide or U-Builder for allowable cantilevers.**

TORQUE VALUE
1/4" nuts to 10 ft-lbs with Anti Seize

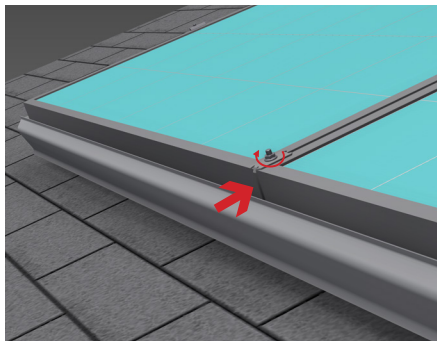


PREPARATION: At front edge of array, ensure at least 3.25 inches of space between modules and roof surface and that modules are aligned to within 3/8". Plan for Trim length so that Endclamps can be properly installed.



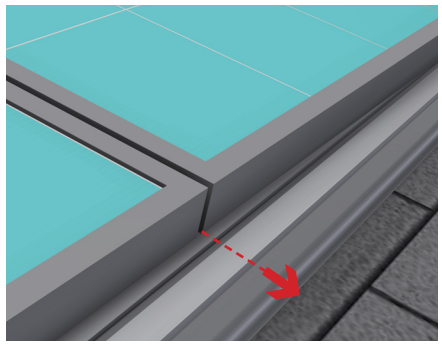
1ST MIDCLAMP: Position Trim in front of array. Insert Midclamp into the Trim slot, aligned with the gap between the 1st two modules at either end of array.

NOTE: Apply Anti-Seize to Each Mid-Clamp prior to installation

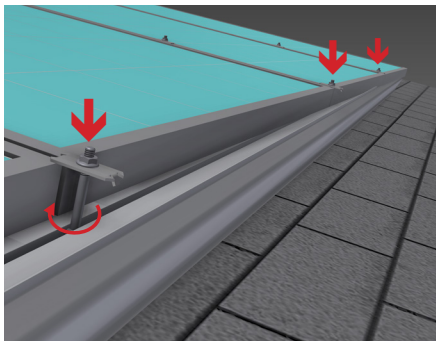


MOUNT TRIM: Position Trim beneath modules by sliding T-bolt into gap between modules and tighten. Midclamp should stay in position and support Trim. Tighten snugly enough so that Trim is held firmly in place.

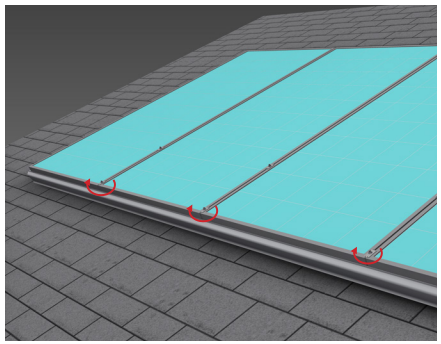
TORQUE VALUE: Do not exceed specified torque value (10 ft-lbs)



CLEAR T-BOLT SLOT: Rotate unattached end of Trim out and away from array so T-bolt slot (at next T-bolt insertion point) is clear of modules. This may require force to deflect the Trim slightly. Deflect only enough to insert T-bolt.

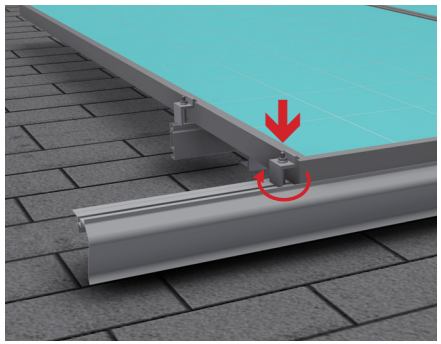


INSERT MIDCLAMPS: Insert T-bolt into slot and slide clamp (rotating Trim) into position between modules and leave loose. Continue to work down array, inserting Midclamps and positioning in gaps between modules.



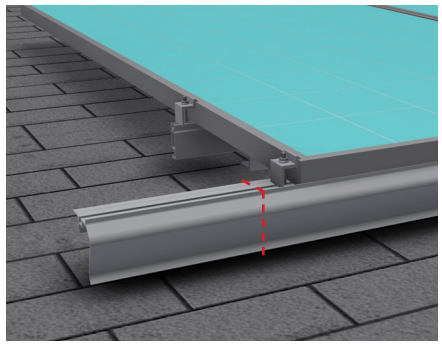
FASTEN MIDCLAMPS: Return to each inserted Midclamp. Ensuring Trim lip is in contact with module face and verifying alignment marks on T-bolts are in proper position, tighten clamp.

TORQUE VALUE
1/4" nuts to 10 ft-lbs w/ Anti Seize

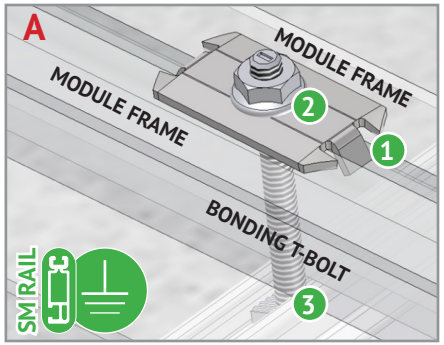


ENDCLAMPS: Install Endclamps per previous Endclamp install instructions

TORQUE VALUE
1/4" nuts to 10 ft-lbs w/ Anti Seize

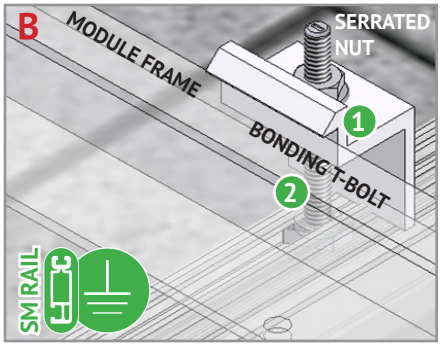


CUT EXCESS TRIM: Mark excess Trim and cut at end of array or where required for proper cantilevers.



BONDING MIDCLAMP ASSEMBLY

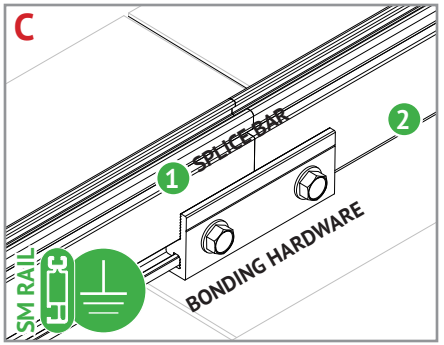
1. Stainless steel Midclamp points, 2 per module, pierce module frame anodization to bond module to module through clamp.
2. Serrated flange nut bonds stainless steel clamp to stainless steel T-bolt
3. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, clamp, and modules to grounded SM rail.



ENDCLAMP ASSEMBLY

1. Serrated flange nut bonds aluminum Endclamp to stainless steel T-bolt
2. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, and Endclamp to grounded SM rail

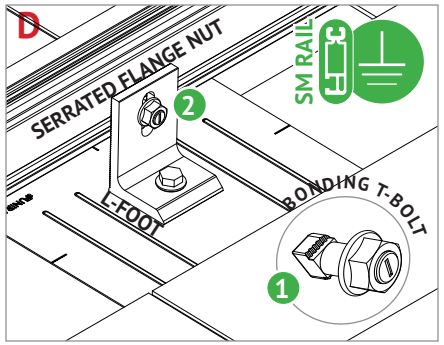
Note: End clamp does not bond to module frame.



BONDING RAIL SPLICE BAR

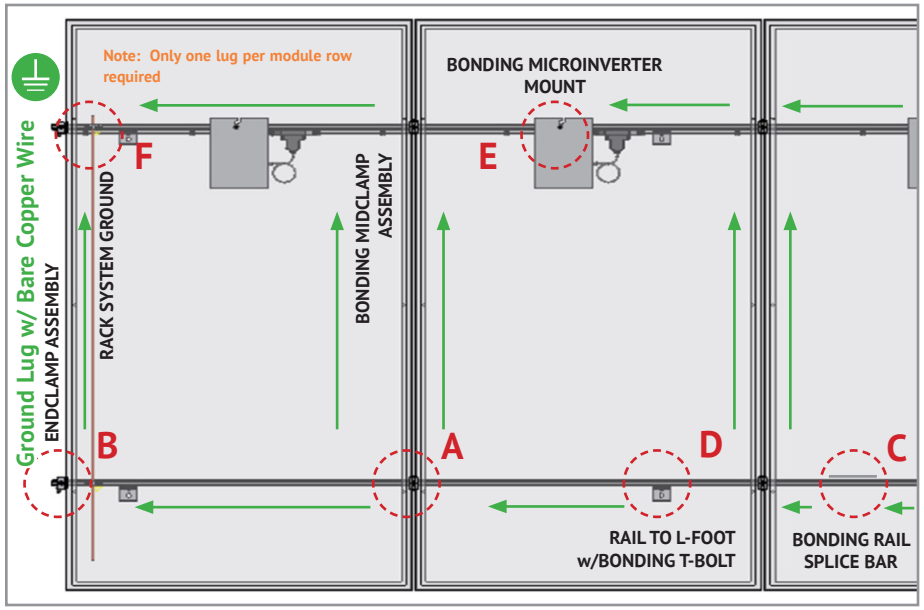
1. Bonding Hardware creates bond between splice bar and each rail section
2. Aluminum splice bar spans across rail gap to create rail to rail bond. Rail on at least one side of splice will be grounded.

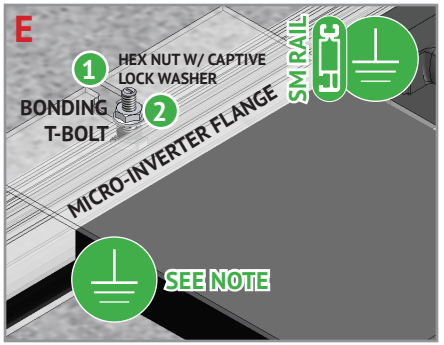
Note: Splice bar and bolted connection are non-structural. The splice bar function is rail alignment and bonding.



RAIL TO L-FOOT w/BONDING T-BOLT

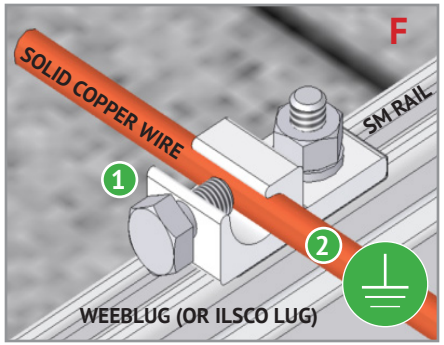
1. Serrated flange nut removes L-foot anodization to bond L-Foot to stainless steel T-bolt
2. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, and L-foot to grounded SM rail





BONDING MICROINVERTER MOUNT

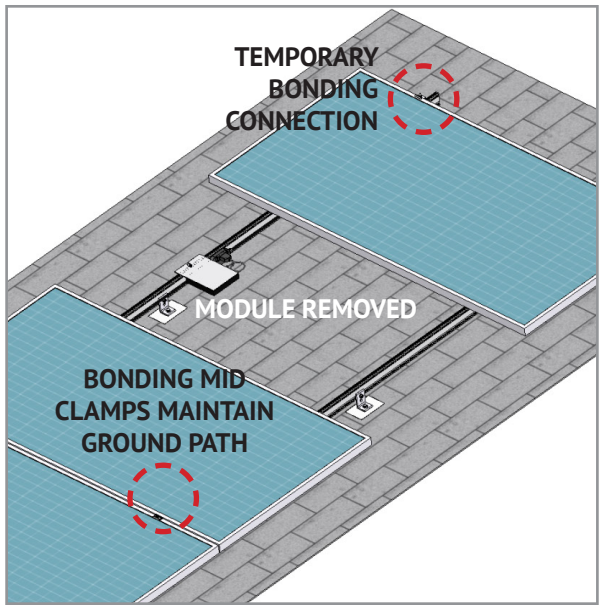
1. Hex nut with captive lock washer bonds metal microinverter flange to stainless steel T-bolt
2. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, and L-foot to grounded SM rail System ground including racking and modules may be achieved through the trunk cable of approved microinverter systems. See page 11 for details

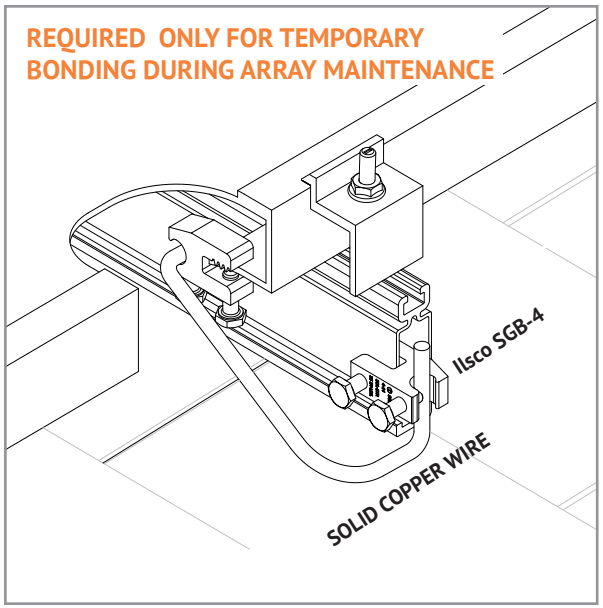


RACK SYSTEM GROUND

1. WEEB washer dimples pierce anodized rail to create bond between rail and lug
2. Solid copper wire connected to lug is routed to provide final system ground connection.

NOTE: Ilsco lug can also be used when secured to the side of the rail. **See page 11 for details**





TEMPORARY BONDING CONNECTION DURING ARRAY MAINTENANCE

When removing modules for replacement or system maintenance, any module left in place that is secured with a bonding Midclamp will be properly grounded. If a module adjacent to the end module of a row is removed or if any other maintenance condition leaves a module without a bonding mid clamp, a temporary bonding connection must be installed as shown

- Attach Ilsco SGB4 to wall of rail
- Attach Ilsco SGB4 to module frame
- Install solid copper wire jumper to Ilsco lugs

ELECTRICAL CONSIDERATIONS

SOLARMOUNT is intended to be used with PV modules that have a system voltage less than or equal to that allowable by the NEC. For standard system grounding a minimum 10AWG, 105°C copper grounding conductor should be used to ground a 1000 VDC system, according to the National Electric Code (NEC). It is the installer's responsibility to check local codes, which may vary. See below for interconnection information.

INTERCONNECTION INFORMATION

There is no size limit on how many SOLARMOUNT & PV modules can be mechanically interconnected for any given configuration, provided that the installation meets the requirements of applicable building and fire codes.

GROUNDING NOTES

The installation must be conducted in accordance with the National Electric Code (NEC) and the authority having jurisdiction. Please refer to these resources in your location for required grounding lug quantities specific to your project.

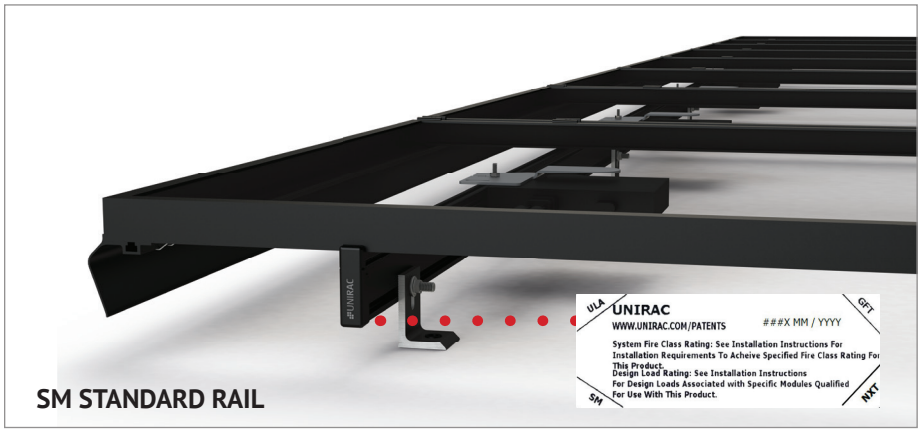
The grounding / bonding components may overhang parts of the array so care must be made when walking around the array to avoid damage.

Conductor fastener torque values depend on conductor size. See product data sheets for correct torque values.

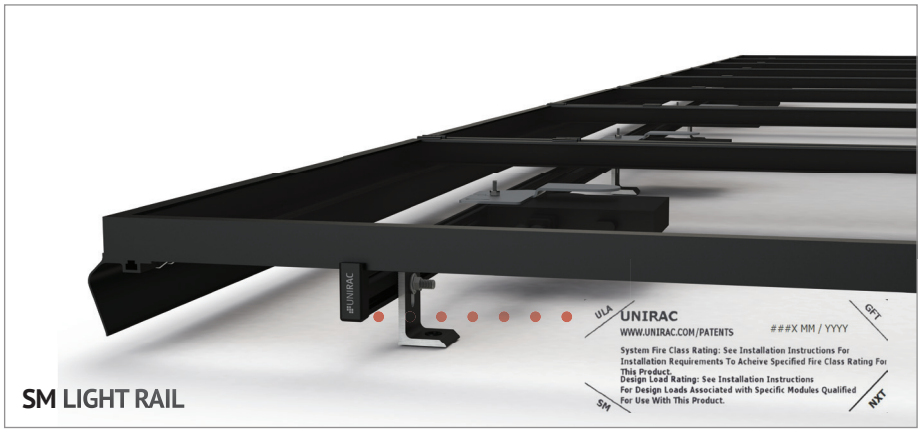
UL2703 CERTIFICATION MARKING LABEL

Unirac SOLARMOUNT is listed to UL 2703. Certification marking is embossed on all mid clamps as shown. Labels with additional information will be provided . After the racking system is fully assembled, a single label should be applied to the SOLARMOUNT rail at the edge of the array. Before applying the label, the corners of the label that do not pertain to the system being installed must be removed so that only the installed system type is showing.

Note: The sticker label should be placed such that it is visible, but not outward facing.



SM STANDARD RAIL



SM LIGHT RAIL

The SOLARMOUNT system has been certified and listed to the UL 2703 standard (Rack Mounting Systems and Clamping Devices for Flat-Plate Photovoltaic Modules and Panels). This standard included electrical grounding, electrical bonding, mechanical load and fire resistance testing.

In conducting these tests, specific modules are selected for their physical properties so that the certifications can be broadly applied. The following lists the specific modules that were tested and the applicability of those certifications to other modules that might come onto the market. PV modules may have a reduced mechanical load rating, independent of the SM load rating. Please consult the PV module manufacturer's installation guide for more information.

In addition to UL 2703 certification, Unirac performs internal testing beyond the requirements of certification tests in order to establish system functional limits, allowable loads, and factors of safety. These tests include functional system tests, and destructive load testing.

MECHANICAL LOAD TEST MODULES

The modules selected for UL 2703 mechanical load testing were selected to represent the broadest range possible for modules on the market. The tests performed cover the following basic module parameters:
Frame thicknesses greater than or equal to 1.0 mm
Basic single and double wall frame profiles (some complex frame profiles could require further analysis to determine applicability)
Clear and dark anodized aluminum frames`

Tested Modules			
Module Manufacturer	Model/Series	Area [sqft]	UL2703 Certification Load Ratings
Hyundai	HiS-S325TI	21.06	Down– 113 PSF, Up – 50 PSF Down-Slope – 15 PSF
SunPower	SPR-P19-395-COM	22.20	Down– 113 PSF, Up – 50 PSF Down-Slope – 15 PSF
First Solar	FS-6xxx-P	27.12	Down– 33.9 PSF, Up – 33.9 PSF Down-Slope – 16.5 PSF

SYSTEM LEVEL FIRE CLASSIFICATION

The system fire class rating requires installation in the manner specified in the SOLARMOUNT Installation Guide. SOLARMOUNT has been classified to the system level fire portion of UL2703. SOLARMOUNT has achieved system level performance for steep sloped roofs and low sloped roofs. See table below for definition of steep sloped and low sloped roofs. The system is to be mounted over fire resistant roof covering rated for the application. There is no required minimum or maximum height limitation above the roof deck to maintain the system fire rating for SOLARMOUNT. Module Types, System Level Fire Ratings, & Mitigation Requirements are listed below:

ROOF TYPE	Rail Type	Module Fire Type	System Level Fire Rating	Rail Direction	Module Orientation	Mitigation Required
Steep Slope - roof pitches ≥ 2 in/ft	Standard & HD Rail	1, 2, 3 with metal frame, 10 with metal frame, 19, 22, 25, 29, & 30	Class A	Parallel OR Perpendicular to Ridge	Landscape OR Portrait	None Required
	Light Rail	1 & 2				None Required
	Standard, Light, & HD Rail	4 & 5				Trim installation per Solar Mount Installation Guide
Low Slope - roof pitches < 2in/ft	Standard & HD Rail	Type 1, 2, 29, & 30	Class A	Parallel OR Perpendicular to Ridge	Landscape OR Portrait	None Required
	Light Rail					
	Standard, Light, & HD Rail					

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.

Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the SOLARMOUNT system.

Manufacture	Module Model / Series
Aionrise	AION60G1, AION72G1
Aleo	P-Series & S-Series
Aptos Solar	DNA-120-(MF/BF)10-xxxW DNA-120-MF10 DNA-120-(MF/BF)23 DNA-144-(MF/BF)23 DNA-120-(MF/BF)26 DNA-144-(MF/BF)26 DNA-108-(MF/BF)10-xxxW
Astronergy	CHSM6612 M, M/HV CHSM6612P Series CHSM6612P/HV Series CHSM72M-HC CHSM72M(DG)/F-BH
Auxin	AXN6M610T AXN6P610T AXN6M612T AXN6P612T
Axitec	AC-xxx(M/P)/60S, AC-xxx(M/P)/72S AC-xxxP/156-60S AC-xxxMH/120(S/V/SB/VB) AC-xxxMH/144(S/V/SB/VB)
Boviet	BVM6610, BVM6612
BYD	P6K & MHK-36 Series
Canadian Solar	CS1(H/K/U/Y)-MS CS3K-(MB/MB-AG/MS/P/P HE/PB-AG) CS3L-(MS/P) CS3N-MS CS3U-(MB/MB-AG/MS/P/P HE/PB/PB-AG) CS3W-(MS/MB-AG/P/P-PB-AG) CS3Y-MB-AG

Manufacture	Module Model / Series
Canadian Solar (cont.)	CS5A-M CS6K-(M/MS/MS AllBlack/P/P HE) CS6P-(M/P) CS6R-MS CS6U-(M/P/P HE) CS6W-(MS/MB-AG) CS6X-P, CSX-P ELPS CS6(A/P)-MM
Centrosolar America	C-Series & E-Series
CertainTeed	CT2xxMxx-01, CT2xxPxx-01, CTxxxMxx-01 CTxxxPxx-01, CTxxxMxx-02, CTxxxMxx-03 CTxxxMxx-04, CTxxxHC11-04
Eco Solargy	Orion 1000 & Apollo 1000
EMMVEE	ExxxP72-B ExxxM72-B ExxxH CM120-B
ET Solar	ET AC Module, ET Module ET-M772BH520-550WW/WB
First Solar	FS-6XXX(A) FS-6XXX(A)-P, FS-6XXX(A)-P-I
Flextronics	FXS-xxxBB
Freedom Forever	FF-MP-BBB-xxx, FF-MP1-BBB-xxx
FreeVolt	PVGraf
GCL	GCL-P6 & GCL-M6 Series
Hansol	TD-AN3, TD-AN4 UB-AN1, UD-AN1
Hanwha SolarOne	HSL 60
Heliene	36M, 36P 60M, 60P, 72M & 72P Series 144HC M6 144HC M10 SL Bifacial

Manufacture	Module Model / Series
HT-SAAE	HT60-156M-C HT60-156M(V)-C HT72-156(M/P) HT72-156P-C, HT72-156P(V)-C HT72-156M(PDV)-BF, HT72-156M(PD)-BF HT72-166M, HT72-18X
Hyperion Solar	HY-DH108P8
Hyundai	KG, MG, RW, TG, RI, RG, TI, KI, HI Series HiA-SxxxHG, HiD-SxxxRG(BK), HiS-S400PI HiS-SxxxYH(BK) HiS-SxxxXG(BK) HiN-SxxxXG(BK)
ITEK	iT-SE Series
Japan Solar	JPS-60 & JPS-72 Series
JA Solar	JAM72D30MB, JAM78D10MB JAM72S30 /MR JAP6 60-xxx JAM6(K)-60/xxx, JAP6(k)-72-xxx/4BB JAP72S##-xxx/** JAP6(k)-60-xxx/4BB, JAP60S##-xxx/** JAM6(k)-72-xxx/**, JAM72S##-xxx/** JAM6(k)-60-xxx/**, JAM60S##-xxx/** i. ##: 01, 02, 03, 09, 10 ii. **: SC, PR, BP, HiT, IB, MW, MR ** = Backsheet, ## Cell technology

- 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
- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- **Listed models can be used to achieve a Class A fire system rating for steep slope applications. See page 30**

Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the SOLARMOUNT system.

Manufacture	Module Model / Series
Jinko	JKM & JKMS Series JKMxxxM-72HL-V JKMxxxM-72HL4-(T)V JKMxxxM-72HLM-TV JKMxxxM-7RL3-V JKMxxxM-72HL4-TV
Kyocera	KD-F & KU Series
LA Solar	LSxxxHC(166) LSxxxBL LSxxxHC
LG Electronics	LGxxx(E1C/E1K/N1C/N1K/N2T/N2W/S1C/S2W/Q1C/Q1K)-A5 LGxxx(A1C/M1C/M1K/N1C/N1K/Q1C/Q1K/QAC/QAK)-A6 LGxxxN2W-B3 LGxxxN2T-B5 LGxxxN1K-B6 LGxxx(N1C/N1K/N2T/N2W)-E6 LGxxx(N1C/N1K/N2W/S1C/S2W)-G4 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	LR4-60(HPB/HPH) LR4-72(HPH) LR6-60 LR6-60(BK/HPB/HPH/HV/PB/PE/PH) LR6-72 LR6-72(BK/HV/PB/PE/PH) RealBlack LR4-60HPB RealBlack LR6-60HPB
Maxeon	SPR-MAX3-xxx-COM
Meyer Burger	Meyer Burger Black, Meyer Burger White Meyer Burger Glass
Mission Solar Energy	MSE Mono, MSE Perc MSExxx(SR8T/SR8K/SR9S/SX5T) MSExxx(SX5K/SX6W)
Mitrex	Mxxx-L3H, Mxxx-I3H
Mitsubishi	MJE & MLE Series
Neo Solar Power Co.	D6M Series
NE Solar	NESE xxx-72MHB-M10 NESE xxx-60MH-M6
Panasonic	VBHNxxxSA06/SA06B/SA11/SA11B VBHNxxxSA15/SA15B/SA16/SA16B, VBHNxxxKA, VBHNxxxKA03/04, VBHNxxxSA17/SA17G/SA17E/SA18/SA18E, VBHNxxxZA01/ZA02/ZA03/VBHNxxxZA04 EVPVxxx EVPVxxx(H/K/PK/HK)

Manufacture	Module Model / Series
Peimar	SGxxxM (FB/BF) SMxxxM
Phono Solar	PSxxxM1-20/U PSxxxM1H-20/U PSxxxM1-20UH PSxxxM1H-20UH PSxxxM4(H)-24/TH PSxxxM1-20/UH PSxxxM1H-20/UH PSxxxM-24/T PSxxxMH-24/T PSxxxM-24/TH PSxxxMH-24/TH
Prism Solar	P72 Series, P72X-xxx
Q.Cells	Plus, Pro, Peak, G3, G4, Peak G5(SC) , G6(+)(SC)(AC), G7, G8(+), Plus, Pro, Peak L-G2, L-G4, L-G5 Peak L-G5, L-G6, L-G7, L-G8(BFF) Q.PEAK DUO(BLK)-G6+ Q.PEAK DUO BLK-G6+/TS Q.PEAK DUO (BLK)-G7

- 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
- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- **Listed models can be used to achieve a Class A fire system rating for steep slope applications. See page 30**

Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the SOLARMOUNT system.

Manufacture	Module Model / Series
Q.Cells (cont.)	Q.PEAK DUO L-(G7/G7.1/G7.2/G7.3/G7.7) Q.PEAK DUO (BLK) G8(+) Q.PEAK DUO L-(G8/G8.1/G8.2/G8.3) Q.PEAK DUO L-G8.3 (BFF/BFG/BGT) 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-G10+ Q.PEAK DUO BLK G10(+) Q.PEAK DUO BLK G10+ /AC Q.PEAK DUO (BLK) ML-G10(a)(+) Q.PEAK DUO XL-(G10/G10.2/G10.3/G10.c/G10.d) Q.PEAK DUO XL-G10.3/BFG Q.PEAK DUO XL-G10.d/BFG Q.PEAK DUO XL-(G11.2/G11.3) Q.PEAK DUO XL-G11.3/BFG
REC	RECxxxAA (BLK/Pure) RECxxxNP (N-PEAK) RECxxxNP2 (Black) RECxxxPE, RECxxxPE72 RECxxxTP, RECxxxTP72 RECxxxTP2(M/BLK2) RECxxxTP2S(M)72 RECxxxTP3M (Black) RECxxxTP4 (Black)
Renesola	All 60-cell modules
Risen	RSM Series, RSM110-8-xxxBMDG
SEG Solar	SEG-xxx-BMD-HV/TB

Manufacture	Module Model / Series
S-Energy	SN72 & SN60 Series
Seraphim	SEG-(6PA/6PB/6MA/6MA-HV/6MB/E01/E11) SRP-(6QA/6QB) SRP-xxx-6MB-HV, SRP-320-375-BMB-HV, SRP-xxx-BMC-HV, SRP-390-450-BMA-HV, SRP-xxx-BMZ-HV, SRP-390-405-BMD-HV
Sharp	NU-SA & NU-SC Series
Silfab	SLA-M, SLA-P, SLG-M, SLG-P & BC Series SIL-xxx(BK/BL/HC/HC+/HL/HM/HN/ML/NL/NT/NX/NU)
Solar4America	S4Axxx-108MH10BB, S4Axxx-72MH5BB
SolarEver USA	SE-166*83-xxxM-120N SE-182*91-xxxM-108N
Solaria	PowerXT-xxxR-(AC/PD/BD) PowerXT-xxxC-PD PowerXT-xxxR-PM (AC) PowerX-400R
Solartech	STU HJT, STU PERC & Quantum PERC
SolarWorld	Sunmodule Protect, Sunmodule Plus/Pro
Sonali	SS-M-360 to 390 Series SS-M-390 to 400 Series SS-M-440 to 460 Series SS-M-430 to 460 BiFacial Series
Sun Edison	F-Series, R-Series
Suniva	MV Series & Optimus Series (35mm)

Manufacture	Module Model / Series
Sunmac Solar	M754SH-BB Series
SunPower	AC, X-Series, E-Series & P-Series SPR E20 435 COM (G4 Frame) Axxx-BLK-G-AC, SPR-Mxxx-H-AC SPR-Mxxx-H-AC
SunTech	STP, STPXXXS - B60/Wnhb
Talesun	TP572, TP596, TP654, TP660 TP672, Hipor M, Smart, TD6I72M
Tesla	SC, SC B, SC B1, SC B2, TxxxS, TxxxH
Trina	PA05, PD05, DD05, DD06, DE06, DE09.05 PD14, PE14, DD14, DE14, DE15, DE15V(II) DEG15HC.20(II), DEG15MC.20(II) DEG15VC.20(II), DE18M(II), DEG18MC.20(II) DE19, DEG19C.20
TSMC	TS-150C2 CIGSw
Universal Solar	UNI4xx-144BMH-DG UNI5xx-144BMH-DG UNIxxx-108M-BB UNIxxx-120M-BB UNIxxx-120MH
Upsolar	UP-MxxxP, UP-MxxxM(-B)
URECO	D7Kxxx(H7A/H8A), D7Mxxx(H7A/H8A) FAKxxx(C8G/E8G), FAMxxxE7G-BB FAMxxxE8G(-BB), FBKxxxM8G F6MxxxE7G-BB FBMxxxMFG-BB
Vikram	Eldora, Somera, Ultima PREXOS VSMDHT.60.AAA.05 PREXOS VSMDHT.72.AAA.05

- 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
- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- **Listed models can be used to achieve a Class A fire system rating for steep slope applications. See page 30**

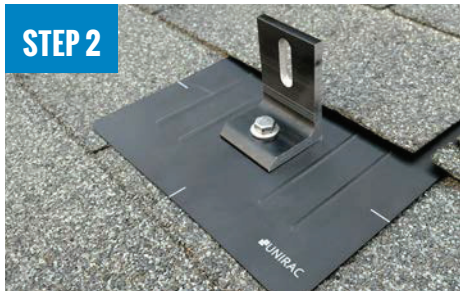
Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the SOLARMOUNT system.

Manufacture	Module Model / Series
Vina	VNS-72M1-5-xxxW-1.5, VNS-72M3-5-xxxW-1.5, VNS-144M1-5-xxxW-1.5, VNS-144M3-5-xxxW-1.5, VNS-120M3-5-xxxW-1.0
VSUN	VSUNxxx-60M-BB, VSUNxxx-72MH VSUN4xx-144BMH VSUN4xx-144BMH-DG VSUN5xx-144BMH-DG VSUNxxx-108M-BB VSUNxxx-120M-BB VSUNxxx-120BMH VSUNxxx-132BMH VSUNxxx-108BMH
Waaree	Ahnay Series Bi-33
Winaico	WST & WSP Series
Yingli	YGE & YLM Series
Yotta Energy	YSM-B450-1
ZNShine	ZXM6-72 Series, ZXM6-NH144 ZXM6-NHLDD144 ZXM7-SH108 Series

- 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
- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- **Listed models can be used to achieve a Class A fire system rating for steep slope applications. See page 30**

INSTALL **FLASH**KIT PRO FLASHING



INSTALL L-FOOT

ATTACH L-FOOT TO RAIL

PRE-INSTALL

- Locate roof rafters and snap chalk lines to mark the installation point for each roof attachment.
- Drill a 7/32" pilot hole at each roof attachment. Fill each pilot hole with sealant.

STEP 1 INSTALL **FLASH**KIT PRO FLASHING

- Add a U-shaped bead of roof sealant to the underside of the flashing with the open side of the U pointing down the roof slope. Slide the aluminum flashing underneath the row of shingles directly up slope from the pilot hole as shown. Align the indicator marks on the lower end of the flashing with the chalk lines on the roof to center the raised hole in the flashing over the pilot hole in the roof. When installed correctly, the flashing will extend under the two courses of shingles above the pilot hole.

STEP 2 INSTALL L-FOOT

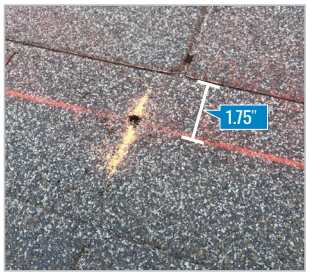
- Fasten L-foot and Flashing into place by passing the included lag bolt and pre-installed stainless steel-backed EPDM washer through the L-foot EPDM grommet, and the raised hole in the flashing, into the pilot hole in the roof rafter.
- Drive the lag bolt down until the L-foot is held firmly in place. It is normal for the EPDM on the underside of the stainless steel backed EPDM washer to compress and expand beyond the outside edge of the steel washer when the proper torque is applied.

TIP:

- Use caution to avoid over-torqueing the lag bolt if using an impact driver.
- Repeat Steps 1 and 2 at each roof attachment point.

STEP 3 ATTACH L-FOOT TO RAIL

- Insert the included 3/8"-16 T-bolts into the lower slot on the Rail (sold separately), spacing the bolts to match the spacing between the roof attachments.
- Position the Rail against the L-Foot and insert the threaded end of the T-Bolt through the continuous slot in the L-Foot. Apply anti-seize to bolt threads to prevent galling of the T-bolt and included 3/8" serrated flange nut. Place the 3/8" flange nut on the T-bolt and finger tighten. Repeat STEP 3 until all L-Feet are secured to the Rail with a T-bolt. Adjust the level and height of the Rail and torque each bolt to 30ft-lbs.



PRE-INSTALL

Snap chalk lines for attachment rows. On shingle roofs, snap lines 1-3/4" below upslope edge of shingle course. Locate rafters and mark attachment locations.

At each location, drill a 7/32" pilot hole. Clean roof surface of dirt, debris, snow, and ice. Next, BACKFILL ALL PILOT HOLES WITH SEALANT.

NOTE: Space mounts per racking system install specifications.

STEP 1: SECURE

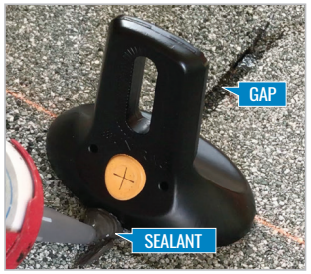
Place **FLASH**LOC over pilot hole with lag on down-slope side. Align indicator marks on sides of mount with chalk line. Pass included lag bolt and sealing washer through **FLASH**LOC into pilot hole. Drive lag bolt until mount is held firmly in place.

NOTE: The EPDM in the sealing washer will expand beyond the edge of the metal washer when proper torque is applied.

STEP 2: SEAL

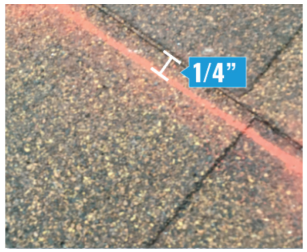
Insert tip of UNIRAC provided sealant into port. Inject until sealant exits both vents. Follow sealant manufacturer's instructions. Follow sealant manufacturer's cold weather application guidelines, if applicable.

Continue array installation, attaching rails to mounts with provided T-bolts.



NOTE: When **FLASH**LOC is installed over gap between shingle tabs or vertical joints, fill gap/joint with sealant between mount and upslope edge of shingle course.

USE ONLY UNIRAC APPROVED SEALANTS: Chemlink Duralink 50, Chemlink M-1, Geocel 4500, or Geocel S-4

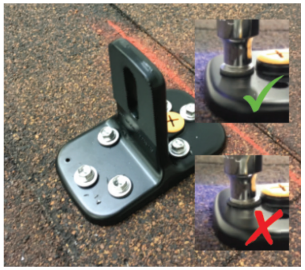


PRE-INSTALL CLEAN SURFACE AND MARK LOCATION

Ensure existing roof structure is capable of supporting loads prescribed in Flashloc Duo D&E Guide. Clean roof surface of dirt, debris, snow and ice.

Snap chalk lines for attachment rows. On shingle roofs, snap lines 1/4” below upslope edge of shingle coarse. This line will be used to align the upper edge of the mount.

NOTE: Space mounts per span charts found in Flashloc Duo D&E Guide.



STEP ONE: SECURE

ATTACHING TO A RAFTER: Place FLASHLOC DUO over rafter location and align upper edge of mount with horizontal chalk line. Secure mount with the two (2) provided rafter screws. BACKFILL ALL PILOT HOLES WITH SEALANT.

ATTACHING TO SHEATHING: Place FLASHLOC DUO over desired location and align upper edge of mount with horizontal chalk line. Secure mount with the two (2) provided rafter screws. Next, secure mount with four (4) deck screws by drilling through the FLASHLOC DUO deck mount hole locations. Unirac recommends using a drill as opposed to an impact gun to prevent over-tightening or stripping roof sheathing.

IMPORTANT: SECURELY ATTACH MOUNT BUT DO NOT OVERTIGHTEN SCREWS.

STEP TWO: SEAL

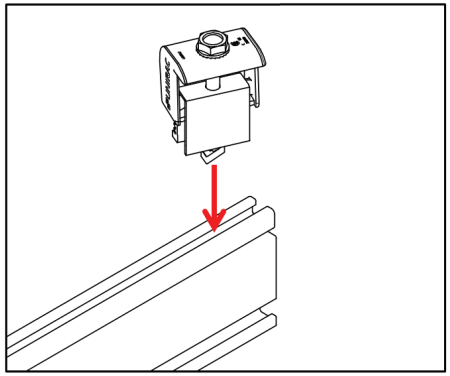
Insert tip of UNIRAC approved sealant into port and inject until sealant exits vent.
Continue array installation, attaching rails to mounts with provided T-bolts. Follow sealant manufacturer's instructions. Follow sealant manufacturer's cold weather application guidelines, if applicable.

NOTE: When FLASHLOC DUO is installed over gap between shingle tabs or vertical joints, fill gap/joint with sealant between mount and upslope edge of shingle course.

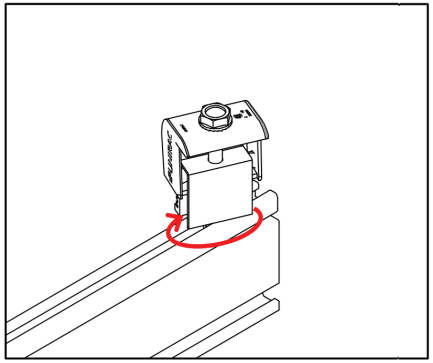
CUT SHINGLES AS REQUIRED: DO NOT INSTALL THE FLASHLOC SLIDER ACCROSS THICKNESS VARIATIONS GREATER THAN 1/8" SUCH AS THOSE FOUND IN HIGH DEFINITION SHINGLES.

NOTE: When installing included rail attachment hardware, torque T-bolt nut to 30 ft-lbs.
NOTE: If an exploratory hole falls outside of the area covered by the sealant, flash hole accordingly.

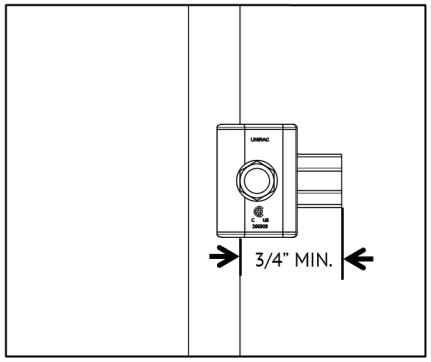
USE ONLY UNIRAC APPROVED SEALANTS. PLEASE CONTACT UNIRAC FOR FULL LIST OF COMPATIBLE SEALANTS.



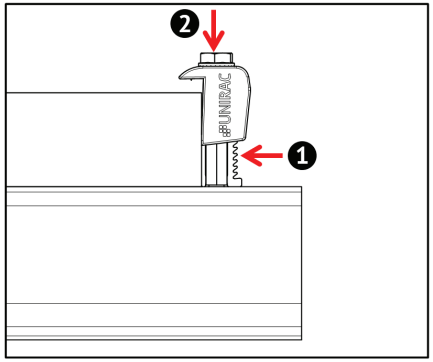
STEP 1: Position clamp to align T-bolt with rail slot. Lower clamp and Insert T-bolt into rail slot.



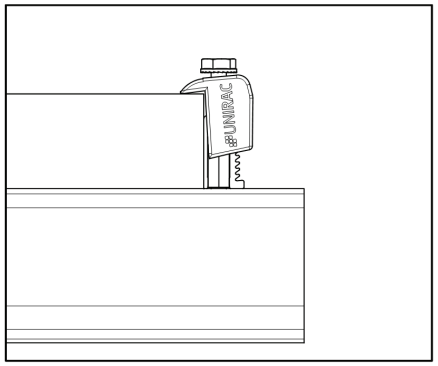
STEP 2: Rotate clamp clockwise 2/3 of a turn to engage T-bolt inside rail slot.



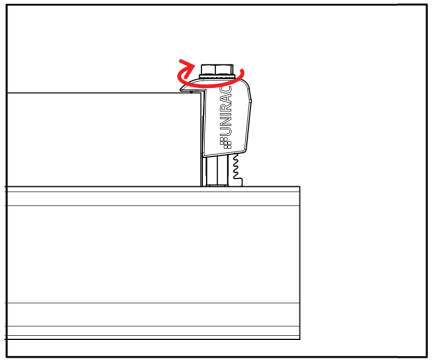
STEP 3: Place module at least 3/4" from end of rail and position clamp against module frame.



STEP 4: While applying pressure to hold the clamp against the module, push down on the module side of the clamp cap.

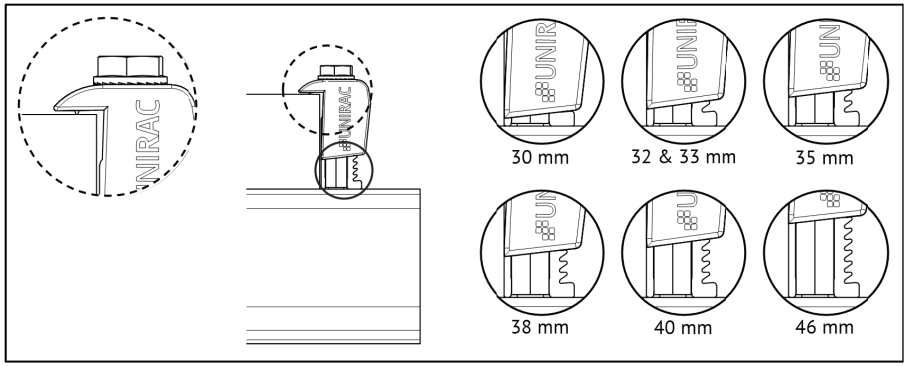


STEP 5: When the cap contacts the module frame, release and it will re-engage to the clamp base.



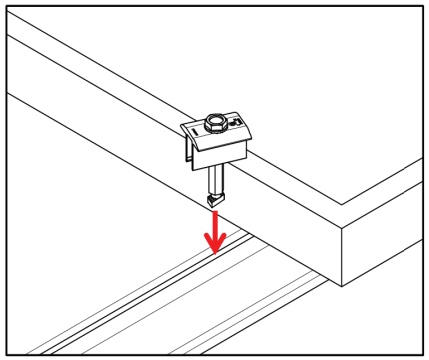
STEP 6: Tighten bolt and torque to 15 ft-lbs.

NOTE - Universal AF End Clamps are single use.

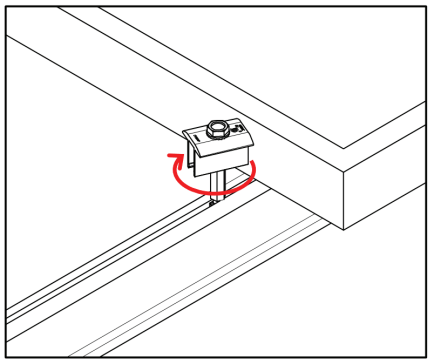


STEP 7: Confirm clamp is engaged in correct module height position and that the top of the cap is sitting level with the module frame.

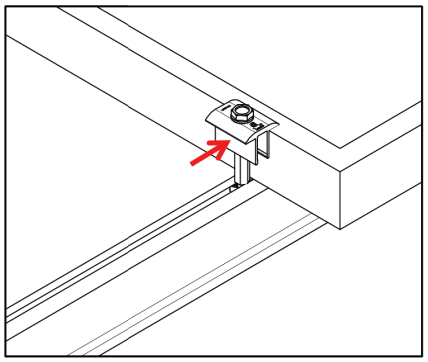
NOTE: When installing 46mm modules, loosen bolt by 1 turn before positioning clamp against module frame. Do not force clamp onto module frame as this may damage the bonding pin.



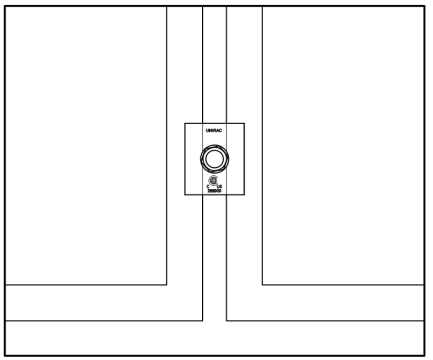
STEP 1: Position clamp to align T-bolt with rail slot. Lower clamp and insert T-bolt into rail slot



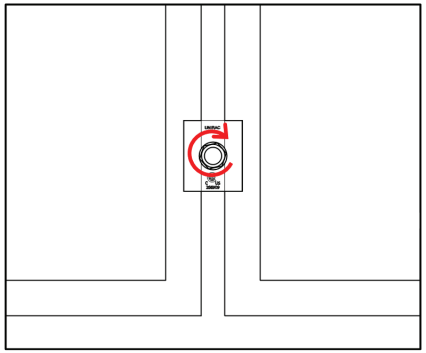
STEP 2: Rotate clamp clockwise 2/3 of a turn to engage T-bolt inside rail slot.



STEP3: Slide clamp into position against module.

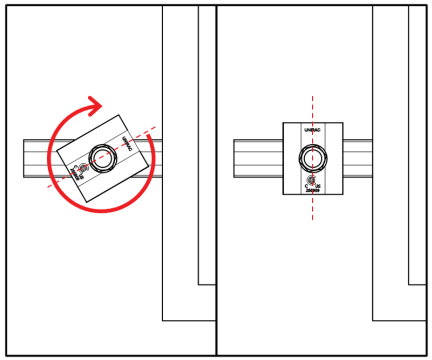


STEP 4: Place second module.



STEP 5: Tighten bolt and torque to 15 ft-lbs.

NOTE - Universal AF Mid Clamps are single use.



NOTE: If excessive force is applied in step 2, the cap may over-rotate causing it to be mis-aligned with the module frame. If this occurs, keep rotating the cap clockwise until it returns to the original position.