

AERIAL SITE VIEW



JURISDICTION CODES AND STANDARDS

GOVERNING CODES
 1. ALL WORK SHALL COMPLY WITH:
 2020 NATIONAL ELECTRIC CODE (NEC)
 2015 INTERNATIONAL BUILDING CODE (IBC)
 2015 INTERNATIONAL RESIDENTIAL CODE (IRC)
 2015 INTERNATIONAL FIRE CODE (IFC)

2018 NORTH CAROLINA STATE CODES
 AND ALL STATE AND LOCAL BUILDING, ELECTRICAL, AND PLUMBING CODES.

SITE CLASSIFICATION NOTES, OSHA REGULATION
 OCCUPANCY CLASS: SFR
 CONSTRUCTION CLASS: V-B
 ZONING TYPE: RESIDENTIAL

1. A LADDER SHALL BE IN PLACE FOR INSPECTION IN COMPLIANCE WITH OSHA REGULATIONS.
2. THIS PROJECT HAS BEEN REVIEWED AND WILL NOT DIRECT CONCENTRATED SOLAR RADIATION OR GLARE ONTO NEARBY PROPERTIES OR ROADWAYS.

3. JUNCTION BOXES UNDER PV ARRAY SHALL BE INSTALLED TO BE CONSIDERED ACCESSIBLE BY NEC 690.34

ELECTRICAL CRITERIA, NOTES
 TEMPERATURE SOURCE: ASHRAE
 WEATHER STATION: POPE AFB
 EXTREME MIN. TEMPERATURE: -10
 ASHRAE 2% HIGH TEMP: 36

1. DRAWINGS HAVE BEEN DETAILED ACCORDING TO UL LISTING REQUIREMENTS.
2. TERMINALS AND LUGS WILL BE TIGHTENED TO MANUFACTURER TORQUE SPECIFICATIONS (WHEN PROVIDED) IN ACCORDANCE WITH NEC 110.14(D) ON ALL ELECTRICAL.
3. PV MODULE CERTIFICATIONS WILL INCLUDE UL1703, IEC61646, IEC61730.
4. CONDUIT AND WIRE SPECIFICATIONS ARE BASED ON MINIMUM CODE REQUIREMENTS AND ARE NOT MEANT TO LIMIT UP-SIZING AS REQUIRED BY FIELD CONDITIONS.
5. PROPER ACCESS AND WORKING CLEARANCE AROUND EXISTING AND PROPOSED ELECTRICAL EQUIPMENT WILL BE PROVIDED AS PER SECTION [NEC 110.26].
6. 1. FOR THE PROPOSED PV ELECTRICAL INSTALLATION, TYPE NM-CABLE SHALL ONLY BE USED WHEN RUNNING ELECTRICAL WIRING THROUGH THE ATTIC SPACE OR INTERIOR OF THE PERMITTED STRUCTURE. INSTALLATION OF TYPE NM-CABLE SHALL COMPLY WITH NEC 334.10 AND NEC 334.12.

STRUCTURAL CRITERIA, NOTES
 DESIGN LOAD STANDARD: ASCE 7-10
 WIND EXPOSURE CATEGORY: B
 WIND SPEED (3-SEC GUST): 117 MPH
 GROUND SNOW LOAD: 10 PSF
 DESIGN ROOF SNOW LOAD: 10 PSF
 SEISMIC DESIGN CATEGORY: C
 SEISMIC RISK FACTOR: II



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ION DEVELOPER, LLC
 4801 N UNIVERSITY AVE #900 PROVO, UT 84604
 888.781.7074

ANTHONY GIOVANNI RIVERA
 LIMITED CLASSIFICATION LICENSE
 L.29168

SITE INFORMATION:
 CATHERINE HORN
 34 MCINTOSH COURT
 FUQUAY-VARINA, NORTH CAROLINA 27546
 (10) SILFAB SOLAR SIL-400 HC+
 (10) ENPHASE IQ8PLUS-72-2-US
 4KW DC, 2.9KW STC-AC,
 3.568KW CEC-AC

SCOPE OF WORK

INSTALLATION OF UTILITY INTERACTIVE PHOTOVOLTAIC SOLAR SYSTEM
 4 kW DC & 2.9 kW AC PHOTOVOLTAIC SOLAR ARRAY
 PV MODULES: (10) SILFAB SOLAR SIL-400 HC+
 INVERTER(S): (10) ENPHASE IQ8PLUS-72-2-US
 ROOF TYPE: COMPOSITION SHINGLE - 1 LAYER(S)
 PV MOUNTING HARDWARE: ECOFASTEN CLICKFIT

SHEET LIST

G-1 COVER SHEET
 V-2 SITE PLAN (AD. LIB)
 S-3 ROOF PLAN
 S-4 STRUCTURAL DETAILS
 S-5 STRUCTURAL CALCULATIONS & NOTES
 E-6 ELECTRICAL DETAILS (LINE DIAGRAM)
 E-7 ELECTRICAL CALCULATIONS & NOTES
 E-8 ELECTRICAL LOAD CALCULATIONS (AD. LIB)
 E-9 ELECTRICAL LABELS & LOCATIONS
 E-10 ELECTRICAL DIRECTORY PLACARD (AD. LIB)



DRAWING BY		DRS	
DATE		17-MAY-2023	
PROJECT ID		009N41	
SHEET NAME		COVER SHEET	
SHEET NUMBER	REVISION	G-1	0

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DRAWING BY
DRS

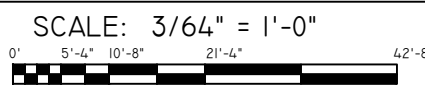
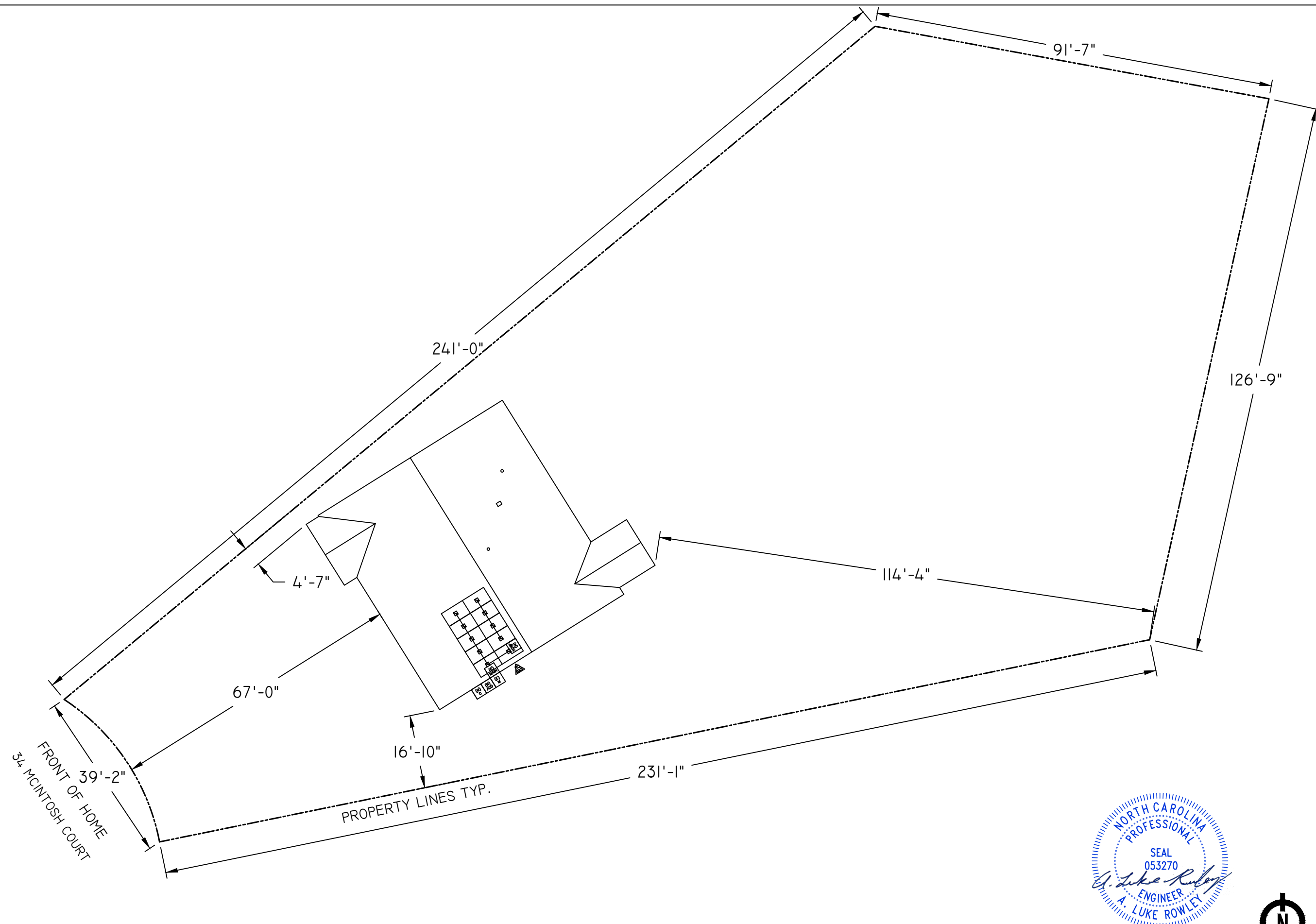
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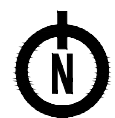
SHEET NAME
SITE PLAN

SHEET NUMBER
V-2

REVISION
0

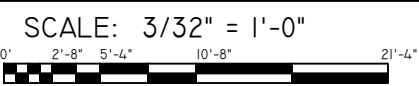
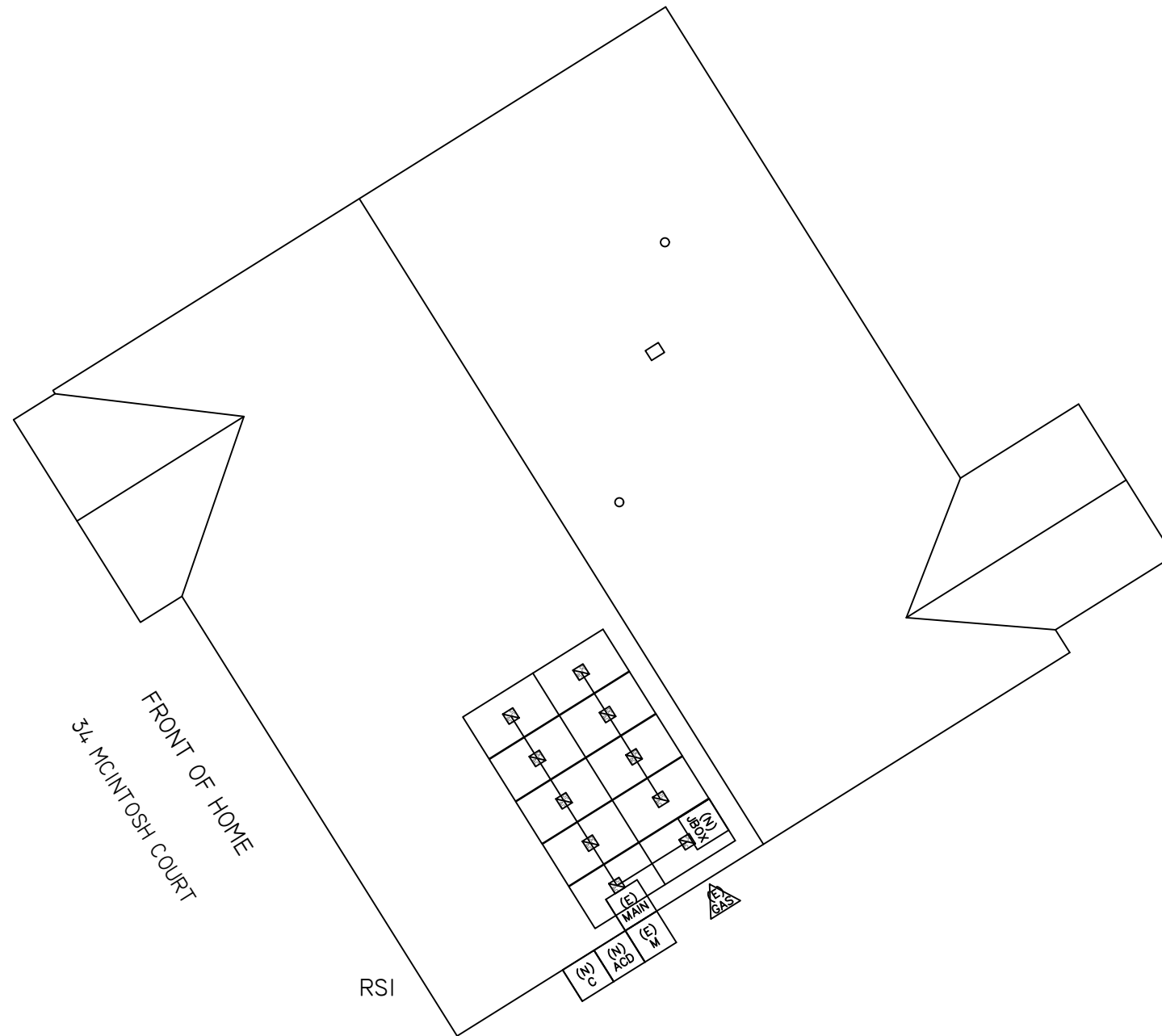


BUILDING LOCATION: 35.4699 -78.8285
LOT AREA (SQFT): 27007.2
BUILDING AREA (SQFT): 1890



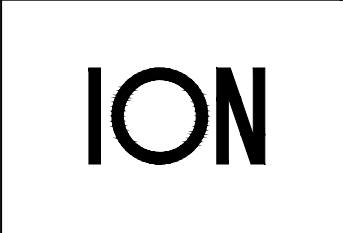
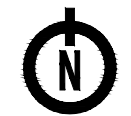
SITE NOTES:

JUNCTION BOXES UNDER PV ARRAY SHALL BE INSTALLED TO BE CONSIDERED ACCESSIBLE BY NEC 690.34



SYSTEM LEGEND			
	(E) UTILITY METER / MAIN SERVICE PANEL		(N) JUNCTION BOX
	(E) MAIN SERVICE PANEL		(N) AC DISCONNECT (VISIBLE-OPEN LOCKABLE LABELED DISCONNECT)
	(E) SUBPANEL		(N) MICROINVERTER
	(N) PV COMBINER PANEL		(N) DC DISCONNECT
	(N) PV LOAD CENTER		FIRE SETBACK
	(N) PV PRODUCTION METER		SUNEYE LOCATION
	(N) DC-DC / STRING INVERTER		(N) PV MODULE

ROOF SECTION CRITERIA AND SPECIFICATIONS				
ROOF SECTION	PV MODULE QTY	AZIMUTH	PITCH	TSRF
RSI	10	238	25	92%



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DRAWING BY
DRS

DATE
17-MAY-2023

PROJECT ID
009N41

SHEET NAME
ROOF PLAN

SHEET NUMBER S-3	REVISION 0
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RACKING INSTALLATION SCHEDULE AND STRUCTURAL CRITERIA

PV RACKING	
RACKING:	ECOFASTEN CLICKFIT
RACKING TYPE:	RAIL
STANDOFF:	CLICKFIT L-FOOT
STANDOFF TYPE:	L-FOOT & FLASHING
FASTENER:	5/16" X 3-1/2" ZINC PLATED STEEL LAG SCREW

SPAN AREA	TAG	SPAN
<i>RAIL - PORTRAIT - MODULE ORIENTATION</i>		
X- SPACING	P-X1	48 IN. O.C. MAX.
X-CANTILEVER	P-X2	16 IN. MAX.
Y- SPACING	P-Y1	41.3 IN. MIN. - 45.3 IN. MAX.
Y-CANTILEVER	P-Y2	15 IN. MIN. - 17 IN. MAX.

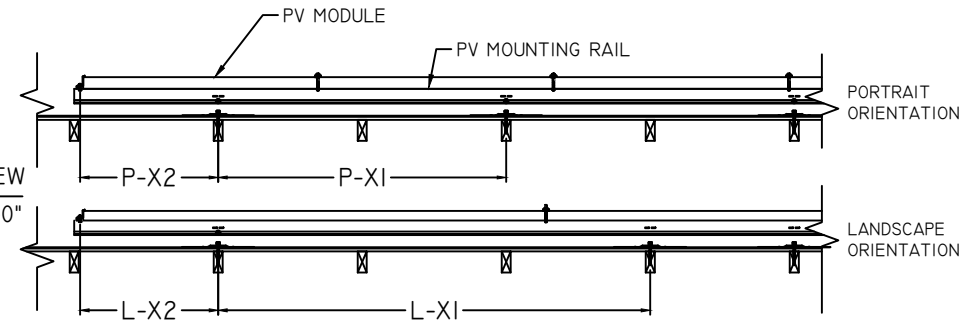
STRUCTURAL	
ROOF TYPE:	COMPOSITION SHINGLE
ROOF SHEATHING TYPE:	7/16" OSB
STRUCTURE TYPE:	MANUFACTURED WOOD TRUSS
RAFTER SIZE:	2x6
RAFTER SPACING:	24

<i>RAIL - LANDSCAPE - MODULE ORIENTATION</i>			
X- SPACING	L-X1	72 IN. O.C. MAX.	
X-CANTILEVER	L-X2	23 IN. MAX.	
Y- SPACING	L-Y1	21.1 IN. MIN. - 25.1 IN. MAX.	
Y-CANTILEVER	L-Y2	7.9 IN. MIN. - 9.8 IN. MAX.	

ARRAY PARAMETERS	
TOTAL ROOF AREA (SQ. FT.)	3086.3
TOTAL PV MODULE AREA (SQ. FT.)	213
% PV MODULE ROOF COVERAGE	7%

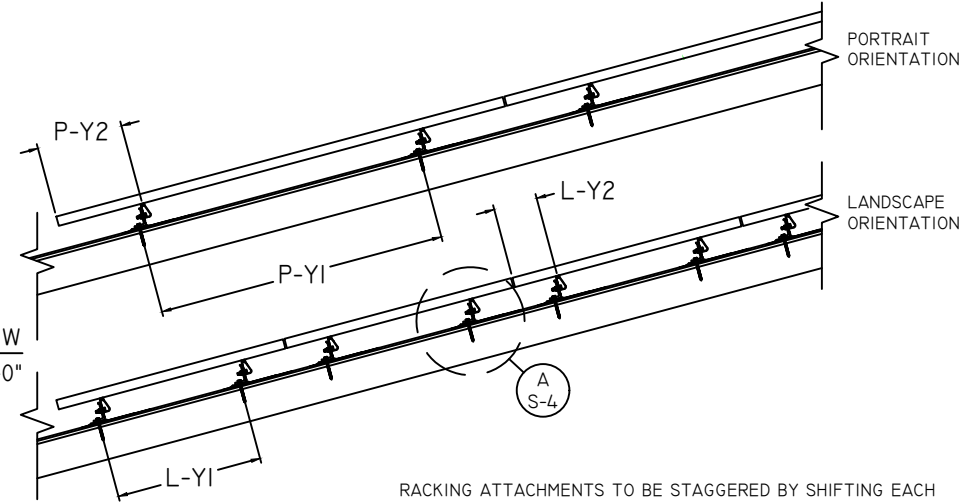
PV ARRAY DETAIL, FRONT VIEW

SCALE: 3/8" = 1'-0"

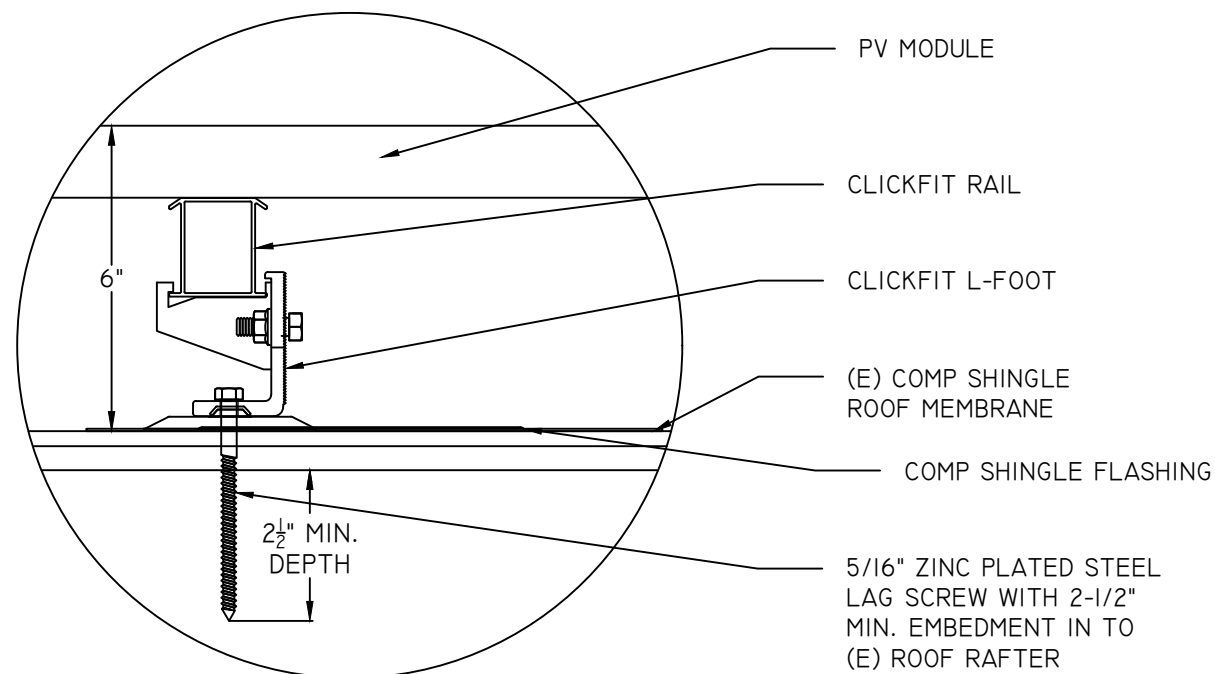


PV ARRAY DETAIL, SIDE VIEW

SCALE: 3/8" = 1'-0"



RACKING ATTACHMENTS TO BE STAGGERED BY SHIFTING EACH SUBSEQUENT ROW OF ATTACHMENTS ONE RAFTER OVER TO DISTRIBUTE LOAD ACROSS ALL FRAMING MEMBERS UNDER PV ARRAY.



A STANDOFF DETAIL
SCALE: 3" = 1'-0"

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3.568KW CEC-AC

DRAWING BY
DRS

DATE
17-MAY-2023

PROJECT ID
009N41

SHEET NAME
STRUCTURAL DETAILS

SHEET NUMBER REVISION
S-4 0



PV SYSTEM STRUCTURAL SPECIFICATIONS AND CALCULATIONS

PV SYSTEM EQUIPMENT SPECIFICATIONS

MODULE MANUFACTURER / TYPE	SILFAB SOLAR SIL-400 HC+
SOLAR MODULE WEIGHT (LBS)	47
SOLAR MODULE LENGTH (IN.)	75.3
SOLAR MODULE WIDTH (IN.)	40.8
SOLAR MODULE AREA (SQ. FT)	21.3
PV RACKING	ECOFASTEN CLICKFIT
PV RACKING TYPE	RAIL
PV ROOF ATTACHMENT	CLICKFIT L-FOOT
PV ROOF ATTACHMENT FASTENER	5/16" X 3-1/2" ZINC PLATED STEEL LAG SCREW
RACKING DEAD LOAD (PSF)	0.8
SOLAR MODULE DEAD LOAD (PSF)	2.21
TOTAL PV ARRAY DEAD LOAD (PSF)	3.01

PV SYSTEM STRUCTURAL SPECIFICATIONS

STRUCTURE TYPE - ROOF SHAPE	INHABITED - GABLE / FLAT ROOF
MIN. ROOF SLOPE (DEG.)	25
MEAN ROOF HEIGHT (FT.)	11
PORTRAIT ATT. SPACING (IN. O.C.)	48
LANDSCAPE ATT. SPACING (IN. O.C.)	72
# OF ATTACHMENT POINTS	22
MAX. POINT LOAD (LBS / ATT.)	37.7
MAX. TOTAL PV DEAD LOAD TO RAFTER (LBS)	75.5

DESIGN WIND PRESSURE AND CONNECTION UPLIFT CALCULATIONS

DESIGN WIND PRESSURE (PSF) = $P = q_h[(GCP)-(GCPI)]$	ASCE 7-10 (C&C)	EQN. 30.4-1
VELOCITY PRESSURE (PSF) = $q_h = 0.00256(KH)(Kzt)(Kd)(V^2)$		EQN. 30.3-1
TERRAIN EXPO. CONSTANT (A) = 7	TABLE 26.9-1	INTERNAL PRESSURE COEFF. (GCPI) = 0
TERRAIN EXPO. CONSTANT (Zg)(FT) = 1200	TABLE 26.9-1	
VP EXPOSURE COEFF. (KH) = 0.70	EQN. 30.3-1	
TOPOGRAPHIC FACTOR (Kzt) = 1.0	EQN. 26.8-1	QH (PSF) = 20.85
WIND DIRECTIONALITY FACTOR (Kd) = 0.85	TABLE 26.6-1	ASCE 7-10 VP (PSF) (0.6) X QH = 12.51

	UPLIFT				FIGURE 30.4-2B
	ZONE 1	ZONE 2	ZONE 3	ALL ZONES	
GABLE / HIP ROOF $7^\circ < \theta \leq 27^\circ$					
RAIL - PORTRAIT MODULE ORIENTATION	48 IN. O.C.	48 IN. O.C.	48 IN. O.C.	48 IN. O.C.	
EXTERNAL PRESSURE COEFF. (GCP) =	-0.9	-1.7	-2.6	0.5	
ASD PRESSURE (0.6P)(PSF) =	-11.26	-21.27	-32.53	17.38	
TRIBUTARY AREA (SQ. FT) =	12.6	12.6	9.4		
MAX. UPLIFT (0.6D+0.6P) (LBS) =	-118.7	-244.3	-289.2		
RAIL - LANDSCAPE MODULE ORIENTATION	72 IN. O.C.	72 IN. O.C.	72 IN. O.C.	72 IN. O.C.	
EXTERNAL PRESSURE COEFF. (GCP) =	-0.9	-1.7	-2.6	0.5	
ASD PRESSURE (0.6P)(PSF) =	-11.26	-21.27	-32.53	17.38	
TRIBUTARY AREA (SQ. FT) =	10.20	10.20	5.10		
MAX. UPLIFT (0.6D+0.6P) (LBS) =	-96.4	-132.4	-156.7		

ROOF ATTACHMENT FASTENER CHECK

CLICKFIT L-FOOT - 5/16" X 3-1/2" ZINC PLATED STEEL LAG SCREW		MANUFACTURER MAX. UPLIFT CAPACITY = 359.6 LBS
LAG SCREW WITHDRAWAL DESIGN VALUE (LBS) = $W = 1800(G^{3/2})(D^{3/4})$		12.2.1
ROOF ATTACHMENT FASTENER (D) = 5/16 IN. LAG SCREW	LUMBER SPECIFIC GRAVITY (G)= 0.42	TABLE 2.3.2
FASTENER QTY PER ATTACHMENT = 1	LOAD DURATION FACTOR (Cd) = 1.6	TABLE 12.3.3A
FASTENER EMBEDMENT DEPTH (IN.) = 2.5	PRYING COEFFICIENT = 1.4	
WITHDRAWAL DESIGN VALUE(W)(LBS / IN.) = 204.8		
LAG SCREW WITHDRAWAL CAPACITY (LBS) = 585.1		
MAX. ATT. WITHDRAWAL CAPACITY (LBS) = 359.6 > 289.2	MAX UPLIFT DEMAND (LBS) OK	

DESIGN LOCATION AND SITE SPECIFICATIONS

JURISDICTION	HARNETT COUNTY
STATE	NORTH CAROLINA
ADOPTED LOAD STANDARD	ASCE 7-10
OCCUPANCY / RISK CATEGORY	II
BASIC WIND SPEED (MPH (3-SEC GUST))	117
WIND EXPOSURE CATEGORY	B
GROUND SNOW LOAD (PSF) (Pg)	10
BASE ELEVATION (FT)	188

DESIGNED ROOF SNOW LOAD CALCULATIONS

ASCE 7-10 (C&C)	
SLOPED ROOF SNOW LOAD (PSF)	EQN. 7.4-1
$= Ps = (Cs)(0.7)(Ce)(Ct)(Is)(Pg)$	
EXPOSURE FACTOR (Ce) = 1.0	TABLE 7.3-1
THERMAL FACTOR (Ct) = 1.0	TABLE 7.3-2
IMPORTANCE FACTOR (Is) = 1.0	TABLE 1.5-2
SLOPE FACTOR (Cs) = 1.0	FIG. 7.4-1
Ps (PSF) = 10	OK

GRAVITY LOAD / FRAMING CALCULATIONS

DEAD LOAD (PSF)	RSI
ROOF MEMBRANE	COMPOSITION SHINGLE 4.0
SHEATHING	7/16" OSB 1.7
PITCH (DEG)	25
FRAMING	MANUFACTURED WOOD TRUSS - TOP CHORD 2X6 @ 24 IN. O.C. - SPF #2 @6 FT. MAX SPAN 1.4
TOTAL ROOF DEAD LOAD (PSF)	7.1
ADJUSTED TO SLOPED ROOF (PSF)	7.9
PV ARRAY ADJ. TO ROOF SLOPE (PSF)	3.3
ROOF LIVE LOAD > ROOF SNOW LOAD (PSF)	20.0
TOTAL LOAD (PSF)	31.3
RAFTER / TOP CHORD MEMBER PROPERTIES	SPF #2 - 2x6
SECTION MODULUS (S)(IN^3)	7.56
MOMENT OF INERTIA (I)(IN^4)	20.80
TOTAL LOAD ON MEMBER (W) (PLF)	62.5
MAX. MEMBER SPAN (L) (FT)	6
MODULUS OF ELASTICITY (E) (PSI)	1400000
SHEAR (Fv) (PSI)	135
AREA (A) (IN^2)	8.25
MAX BENDING STRESS CHECK	(Fb)(Cd)(Cf)(Cr)
BENDING (Fb) (PSI)	875
LOAD DURATION FACTOR (Cd)	1.25
SIZE FACTOR (Cf)	1.30
REPETITIVE MEMBER FACTOR (Cr)	1.15
ALLOWABLE BENDING STRESS (PSI)	1635.2
ACTUAL BENDING STRESS (PSI) = (wL^2)/(8(S))	446.5
	27% OK
MAX DEFLECTION CHECK - TOTAL LOAD	UNIFORM DISTRIBUTED
ALLOWABLE DEFLECTION	L / 180
ACTUAL MAX DEFLECTION	0.400 IN.
	(W)(L)^4 / 185(E)(I)
	0.026 IN.
	6% OK
MAX DEFLECTION CHECK - LIVE LOAD	L / 240
ALLOWABLE DEFLECTION	0.3 IN.
ACTUAL MAX DEFLECTION	0.026 IN.
	(W)(L)^4 / 185(E)(I)
	9% OK
MAX SHEAR CHECK	Fv (A)
ALLOWABLE SHEAR	1113.8 LBS.
	(w)(L)/2
	188 LBS.
ACTUAL MAX SHEAR	17% OK



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DATE
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SHEET NAME
STRUCTURAL CALCS

SHEET NUMBER
S-5

REVISION
0

PV SYSTEM ELECTRICAL SPECIFICATIONS AND CALCULATIONS

DESIGN LOCATION AND TEMPERATURES

TEMPERATURE DATA SOURCE	ASHRAE
STATE	NORTH CAROLINA
JURISDICTION	HARNETT COUNTY
WEATHER STATION	POPE AFB
ASHRAE EXTREME LOW TEMP (°C)	-10
ASHRAE 2% HIGH TEMP (°C)	36
DESIGNED MAX. SYSTEM VDROPP / VRISE	4.00%

PV MODULE SPECIFICATIONS

SILFAB SOLAR SIL-400 HC+	
RATED POWER (P _{MAX}) (W)	400
MAXIMUM POWER VOLTAGE (V _{MP})	36.05
MAXIMUM POWER CURRENT (I _{MP})	11.1
OPEN CIRCUIT VOLTAGE (V _{OC})	43.02
SHORT CIRCUIT CURRENT (I _{SC})	11.58
PMP/VMP TEMP. COEFFICIENT	-0.36
VOC TEMP. COEFFICIENT	-0.28
SERIES FUSE RATING	20
ADJ. MODULE VOC @ ASHRAE LOW TEMP	47.2
ADJ. MODULE VMP @ ASHRAE 2% AVG. HIGH TEMP	30.5

INVERTER SPECIFICATIONS

ENPHASE IQ8PLUS-72-2-US	
TYPE	MICROINVERTER
MAX. OR RECOMMENDED MODULE POWER (W)	440
MAXIMUM INPUT DC OPEN-CIRCUIT VOLTAGE (V _{OC})	60
MINIMUM START VOLTAGE (V)	30
MAXIMUM START VOLTAGE(V)	58
MAXIMUM INPUT CURRENT (I _{SC}) (A)	15
MAX CONTINUOUS OUTPUT POWER (VA)	290
MAX. CONTINUOUS OUTPUT CURRENT (A)	1.21
NOMINAL (L-L) OUTPUT VOLTAGE	240
CEC WEIGHTED EFFICIENCY (%)	97.0%

SYSTEM ELECTRICAL SPECIFICATIONS

CIR I	
NUMBER OF MODULES PER CIRCUIT	10
DC POWER RATING PER CIRCUIT (STC)(W DC)	4000
TOTAL MODULE QUANTITY	10 PV MODULES
STC DC POWER RATING OF ARRAY	4000W DC
INVERTER OUTPUT CIRCUIT CURRENT(A AC)	12.1
125% INVERTER OUTPUT CIRCUIT CURRENT(A AC)	15.13
CIRCUIT OCPD RATING (A)	20
COMBINED INVERTER CONTINUOUS OUTPUT CURRENT 12.1A AC	
PV POWER PRODUCTION SYSTEM OCPD RATING (X125%)	20A
MAX. ARRAY STC-AC POWER (W)	2900W AC (STC)
MAX. ARRAY CEC-AC POWER (W)	3568W AC (CEC)

AC VOLTAGE RISE CALCULATIONS

	DIST (FT)	COND.	VRISE(V)	VEND(V)	%VRISE
VRISE SEC. 1 (MICRO TO JBOX) *	28.8	12 Cu.	1.4	241.4	0.58%
VRISE SEC. 2 (JBOX TO COMBINER BOX)	18	10 Cu.	0.5	240.5	0.22%
VRISE SEC. 3 (COMBINER BOX TO POI)	10	10 Cu.	0.3	240.3	0.12%
TOTAL VRISE			2.2	242.2	0.92% OK

* 8 MICROINVERTER MAX SUB-BRANCH CIRCUIT SIZE TO COMPLY WITH VRISE CALCULATIONS.

RACEWAY / CONDUCTOR CALCULATIONS

MICROINV. TO JUNCTION BOX (1)

MAX INVERTER OUTPUT CIRCUIT CURRENT = 12.1 A AC
 CONDUCTOR SIZE / INSULATION / TYPE = 12 AWG 2C, TC-ER, CU.
 CONDUCTOR AMP. RATING @ 90°C = 30 A

PER NEC 690.8(B)(1)(W/OUT CORRECTION FACTORS)
 MAX INVERTER OUTPUT CURRENT X125%=15.0 A AC

PER NEC 690.8(B)(2)(WITH CORRECTION FACTORS)
 AMB. TEMP. AMP. CORRECTION = 0.91
 # OF CONDUCTORS IN RACEWAY CORRECTION = 1.0
 ADJUSTED CONDUCTOR AMPACITY (A) = 27.3 A AC

LARGER AMPACITY OF 690.8(B)(1) OR (B)(2) = 15.0 < 27.3
 (B)(1) - W/OUT CORRECTION FACTORS
 LARGER AMPACITY COMPLIANCE = 30.0 > 15.0 **OK**

RACEWAY SIZE / TYPE = 3/4 IN. EMT OR FREE AIR
 CONDUCTOR(S) / CABLE(S) CROSS-SECTION AREA (IN.^2) = 0.142 IN.^2
 CROSS-SECTIONAL AREA OF RACEWAY(IN.^2) = 0.533 IN.^2
 % ALLOWABLE RACEWAY FILL (NEC CH. 9, TBL I) = 53% > 27% **OK**

JUNCTION BOX TO JUNCTION BOX (2)

MAX INVERTER OUTPUT CIRCUIT CURRENT = 12.1 A AC
 CONDUCTOR SIZE / INSULATION / TYPE = 10 AWG 2C, NM-B W/G, CU.
 CONDUCTOR AMP. RATING @60°C = 30 A

PER NEC 690.8(B)(1)(W/OUT CORRECTION FACTORS)
 MAX INVERTER OUTPUT CURRENT X125%=15.0 A AC

PER NEC 690.8(B)(2)(WITH CORRECTION FACTORS)
 AMB. TEMP. AMP. CORRECTION = 0.82
 # OF CONDUCTORS IN RACEWAY CORRECTION = 1.0
 ADJUSTED CONDUCTOR AMPACITY (A) = 24.6 A AC

LARGER AMPACITY OF 690.8(B)(1) OR (B)(2) = 15.0 < 24.6
 (B)(1) - W/OUT CORRECTION FACTORS
 LARGER AMPACITY COMPLIANCE = 30.0 > 15.0 **OK**

RACEWAY SIZE / TYPE = FREE AIR

JUNCTION BOX TO COMBINER BOX (3)

MAX INVERTER OUTPUT CIRCUIT CURRENT = 12.1 A AC
 CONDUCTOR SIZE / INSULATION / TYPE = 10 AWG THHN / THWN-2, CU.
 CONDUCTOR AMP. RATING @75°C = 30 A

PER NEC 690.8(B)(1)(W/OUT CORRECTION FACTORS)
 MAX INVERTER OUTPUT CURRENT X125%=15.0 A AC

PER NEC 690.8(B)(2)(WITH CORRECTION FACTORS)
 AMB. TEMP. AMP. CORRECTION = 0.88
 # OF CONDUCTORS IN RACEWAY CORRECTION = 1.0
 ADJUSTED CONDUCTOR AMPACITY (A) = 26.4 A AC

LARGER AMPACITY OF 690.8(B)(1) OR (B)(2) = 15.0 < 26.4
 (B)(1) - W/OUT CORRECTION FACTORS
 LARGER AMPACITY COMPLIANCE = 30.0 > 15.0 **OK**

RACEWAY SIZE / TYPE = 3/4 IN. EMT
 CONDUCTOR(S) / CABLE(S) CROSS-SECTION AREA (IN.^2) = 0.063 IN.^2
 CROSS-SECTIONAL AREA OF RACEWAY(IN.^2) = 0.533 IN.^2
 % ALLOWABLE RACEWAY FILL (NEC CH. 9, TBL I) = 40% > 12% **OK**

COMBINER BOX TO MAIN PV OCPD (10)

COMBINED INVERTER CONTINUOUS OUTPUT CURRENT = 12.1 A AC
 CONDUCTOR SIZE / INSULATION / TYPE = 10 AWG THHN / THWN-2, CU.
 CONDUCTOR AMP. RATING @75°C = 35 A

PER NEC 690.8(B)(1)(W/OUT CORRECTION FACTORS)
 MAX COMBINED INVERTER CONTINUOUS OUTPUT CURRENT X125% =15.0 A AC

PER NEC 690.8(B)(2)(WITH CORRECTION FACTORS)
 AMB. TEMP. AMP. CORRECTION = 0.88
 # OF CONDUCTORS IN RACEWAY CORRECTION = 1.0
 ADJUSTED CONDUCTOR AMPACITY (A) = 30.8 A AC

LARGER AMPACITY OF 690.8(B)(1) OR (B)(2) = 15.0 < 30.8
 (B)(1) - W/OUT CORRECTION FACTORS
 LARGER AMPACITY COMPLIANCE = 35.0 > 15.0 **OK**

RACEWAY SIZE / TYPE = 3/4 IN. EMT
 CONDUCTOR(S) / CABLE(S) CROSS-SECTION AREA (IN.^2) = 0.084 IN.^2
 CROSS-SECTIONAL AREA OF RACEWAY(IN.^2) = 0.533 IN.^2
 % ALLOWABLE RACEWAY FILL (NEC CH. 9, TBL I) = 40% > 16% **OK**



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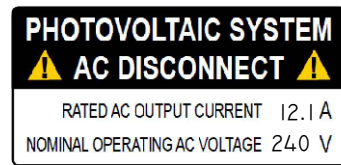


ION DEVELOPER, LLC
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 888.781.7074
 ANTHONY GIOVANNI RIVERA
 LIMITED CLASSIFICATION LICENSE L.29168

SITE INFORMATION:
 CATHERINE HORN
 34 MCINTOSH COURT
 FUQUAY-VARINA, NORTH CAROLINA 27546
 (10) SILFAB SOLAR SIL-400 HC+
 (10) ENPHASE IQ8PLUS-72-2-US
 4KW DC, 2.9KW STC-AC,
 3.568KW CEC-AC

DRAWING BY	DRS
DATE	17-MAY-2023
PROJECT ID	009N41
SHEET NAME	ELECTRICAL CALCS.
SHEET NUMBER	E-7
REVISION	0

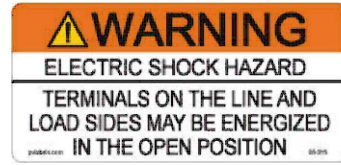
ELECTRICAL FIELD-APPLIED HAZARD MARKINGS



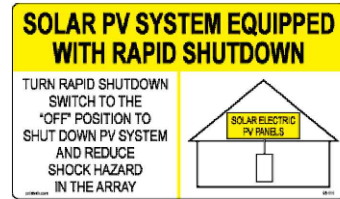
A AT EACH PV SYSTEM DISCONNECTING MEANS. [NEC 690.54, NEC 690.13(B)]



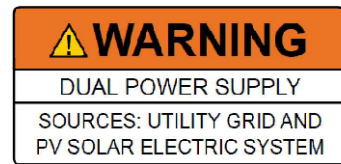
F SIGN LOCATED ON OR NO MORE THAN 3 FT FROM THE RAPID SHUT DOWN DISCONNECT SWITCH(S). IF MORE THAN ONE PV RSD IS IN AN ENCLOSURE, EACH SHALL BE LABELED. [NEC 690.56(C), NEC 690.12(C)]



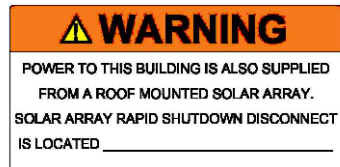
B FOR PV DISCONNECTING MEANS WHERE ALL TERMINALS OF THE DISCONNECTING MEANS MAY BE ENERGIZED IN THE OPEN POSITION. [NEC 690.13(B), NEC 705.22]



G FOR BUILDINGS WITH PV SYSTEMS. TO BE LOCATED AT EACH SERVICE EQUIPMENT LOCATION TO WHICH THE PV SYSTEM IS CONNECTED. [NEC 690.56(C)]



C AT EQUIPMENT CONTAINING OVERCURRENT DEVICES IN CIRCUITS SUPPLYING POWER TO A BUSBAR OR CONDUCTOR SUPPLIED FROM MULTIPLE SOURCES. [NEC 705.12(C)]



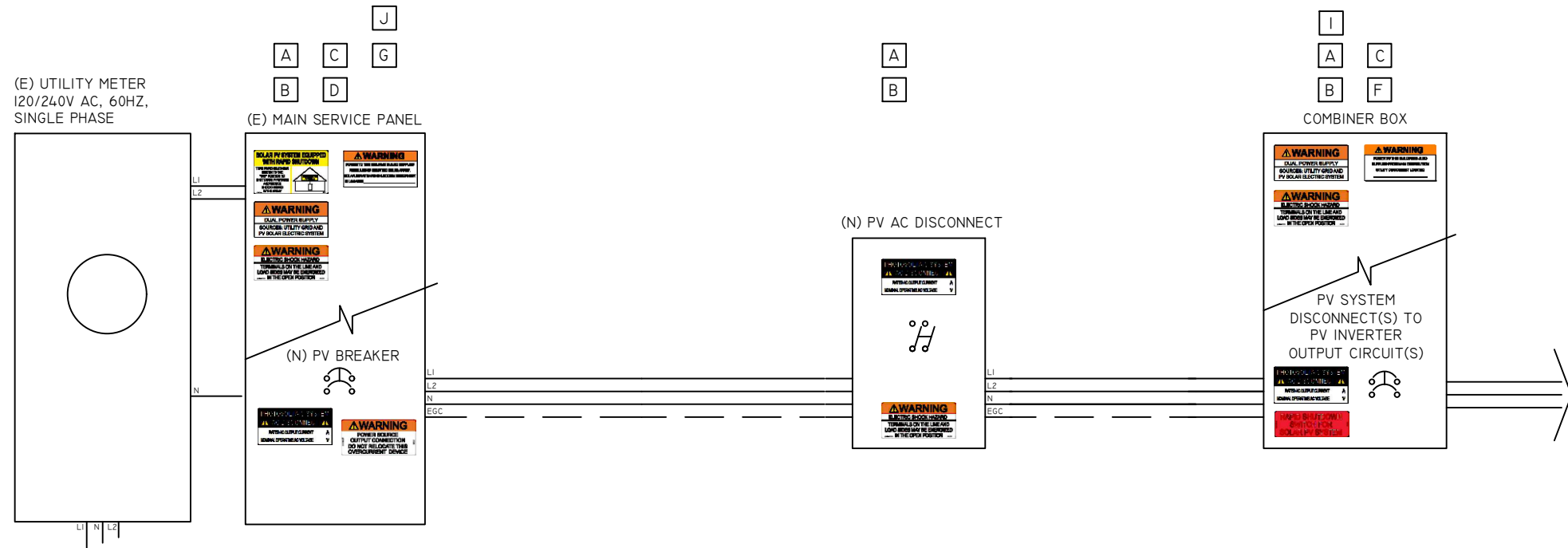
J PERMANENT DIRECTORY TO BE LOCATED AT MAIN SERVICE EQUIPMENT DENOTING THE LOCATION OF THE PV RAPID SHUTDOWN SYSTEM DISCONNECTING MEANS IF SOLAR ARRAY RAPID SHUT DOWN DISCONNECT SWITCH IS NOT GROUPED AND WITHIN LINE OF SITE OF MAIN SERVICE DISCONNECTING MEANS. [NEC 705.10, NEC 690.56(C)(1)]



D PLACED ADJACENT TO PV SYSTEM PLUG-IN TYPE BREAKER TO A BUSBAR FOR A LOAD SIDE CONNECTION. [NEC 705.12(B)(3)(2)]



I PERMANENT DIRECTORY TO BE LOCATED AT SOLAR ARRAY RAPID SHUTDOWN SWITCH DENOTING THE LOCATION OF THE SERVICE EQUIPMENT LOCATION IF SOLAR ARRAY RAPID SHUT DOWN DISCONNECT SWITCH IS NOT GROUPED AND WITHIN LINE OF SITE OF MAIN SERVICE DISCONNECTING MEANS. [NEC 705.10]



- ALL CAUTION, WARNING, OR DANGER SIGNS OR LABELS SHALL:
1. COMPLY WITH ANSI Z535.4-2011 STANDARDS.
 2. BE PERMANENTLY AFFIXED TO THE EQUIPMENT OR WIRING METHOD AND SHALL NOT BE HANDWRITTEN.
 3. SHALL BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED.
 4. UNLESS OTHERS SPECIFIED MINIMUM TEXT HEIGHT TO BE 1/8" (3MM).

ION

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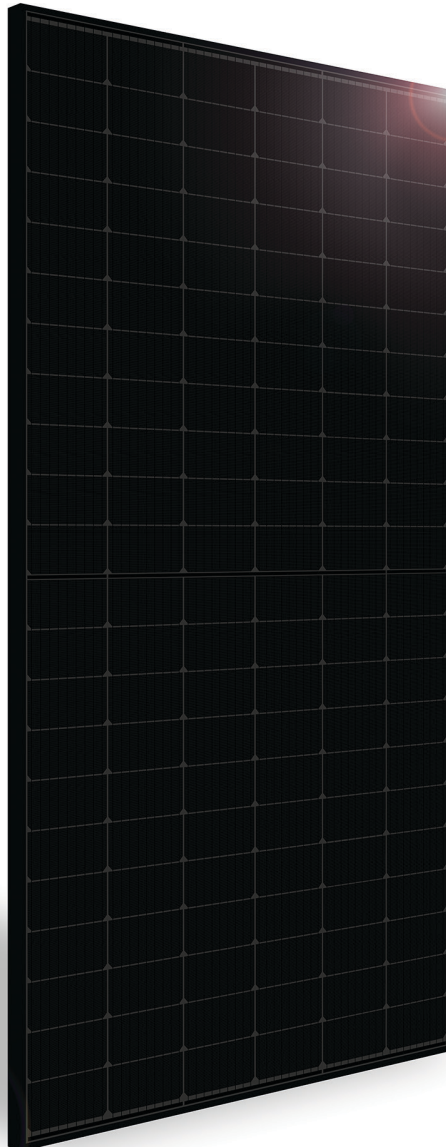
SHEET NAME
ELECTRICAL LABELS

SHEET NUMBER
E-9

REVISION
0

SILFAB PRIME

SIL-400 HC+



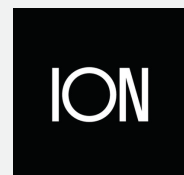
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* Chubb provides error and omission insurance to Silfab Solar Inc.

ELECTRICAL SPECIFICATIONS		400	
Test Conditions		STC	NOCT
Module Power (Pmax)	Wp	400	298
Maximum power voltage (Vpmax)	V	36.05	33.50
Maximum power current (Ipmax)	A	11.10	8.90
Open circuit voltage (Voc)	V	43.02	40.35
Short circuit current (Isc)	A	11.58	9.34
Module efficiency	%	20.2%	18.8%
Maximum system voltage (VDC)	V		1000
Series fuse rating	A		20
Power Tolerance	Wp		0 to +10

Measurement conditions: STC 1000 W/m² • AM 1.5 • Temperature 25 °C • NOCT 800 W/m² • AM 1.5 • Measurement uncertainty ≤ 3%
Sun simulator calibration reference modules from Fraunhofer Institute. Electrical characteristics may vary by ±5% and power by 0 to +10W.

MECHANICAL PROPERTIES / COMPONENTS	METRIC	IMPERIAL
Module weight	21.3kg ±0.2kg	47lbs ±0.4lbs
Dimensions (H x L x D)	1914 mm x 1036 mm x 35 mm	75.3 in x 40.8 in x 1.37 in
Maximum surface load (wind/snow)*	5400 Pa rear load / 5400 Pa front load	112.8 lb/ft ² rear load / 112.8 lb/ft ² front load
Hail impact resistance	ø 25 mm at 83 km/h	ø 1 in at 51.6 mph
Cells	132 Half cells - Si mono PERC 9 busbar - 83 x 166 mm	132 Half cells- Si mono PERC 9 busbar - 3.26 x 6.53 in
Glass	3.2 mm high transmittance, tempered, DSM antireflective coating	0.126 in high transmittance, tempered, DSM antireflective coating
Cables and connectors (refer to installation manual)	1350 mm, ø 5.7 mm, MC4 from Staubli	53 in, ø 0.22 in (12AWG), MC4 from Staubli
Backsheet	High durability, superior hydrolysis and UV resistance, multi-layer dielectric film, fluorine-free PV backsheet	
Frame	Anodized Aluminum (Black)	
Bypass diodes	3 diodes-30SQ045T (45V max DC blocking voltage, 30A max forward rectified current)	
Junction Box	UL 3730 Certified, IEC 62790 Certified, IP68 rated	

TEMPERATURE RATINGS		WARRANTIES	
Temperature Coefficient Isc	+0.064 %/°C	Module product workmanship warranty	25 years**
Temperature Coefficient Voc	-0.28 %/°C	Linear power performance guarantee	30 years
Temperature Coefficient Pmax	-0.36 %/°C		≥ 97.1% end 1st yr ≥ 91.6% end 12th yr ≥ 85.1% end 25th yr ≥ 82.6% end 30th yr
NOCT (± 2°C)	45 °C		
Operating temperature	-40/+85 °C		

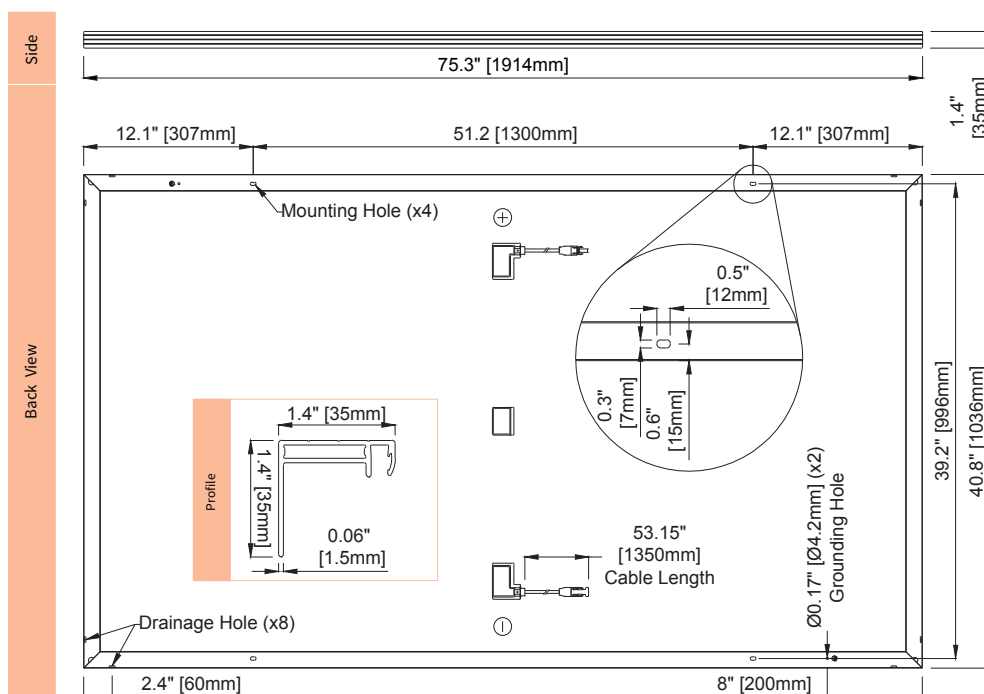
CERTIFICATIONS		SHIPPING SPECS	
Product	UL 61215-1:2017 Ed.1***, UL 61215-2:2017 Ed.1***, UL 61730-1:2017 Ed.1***, UL 61730-2:2017 Ed.1***, CSA C22.2#61730-1:2019 Ed.2***, CSA C22.2#61730-2:2019 Ed.2***, IEC 61215-1:2016 Ed.1***, IEC 61215-2:2016 Ed.1***, IEC 61730-1:2016 Ed.2***, IEC 61730-2:2016 Ed.2***, IEC 61701:2020 (Salt Mist Corrosion), IEC 62716:2013 (Ammonia Corrosion), UL Fire Rating: Type 2, CEC Listing***	Modules Per Pallet:	26 or 26 (California)
Factory	ISO9001:2015	Pallets Per Truck	32 or 31 (California)
		Modules Per Truck	832 or 806 (California)

* ⚠ Warning. Read the Safety and Installation Manual for mounting specifications and before handling, installing and operating modules.

** 12 year extendable to 25 years subject to registration and conditions outlined under "Warranty" at silfabsolar.com.

PAN files generated from 3rd party performance data are available for download at: silfabsolar.com/downloads.

*** Certification and CEC listing in progress. December 2022, expected completion.



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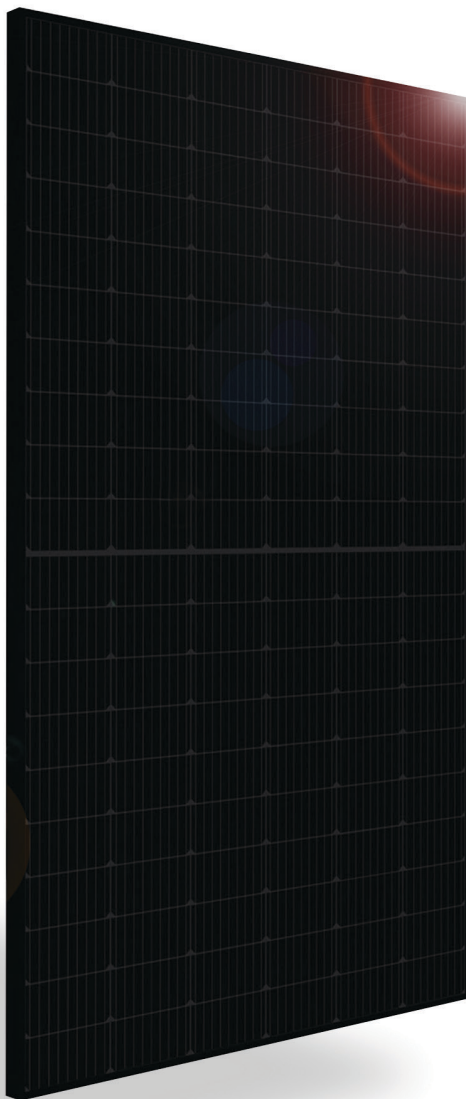
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SIL-380 HC



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ELECTRICAL SPECIFICATIONS		380	
Test Conditions		STC	NOCT
Module Power (Pmax)	Wp	380	284
Maximum power voltage (Vpmax)	V	35.32	32.83
Maximum power current (Ipmax)	A	10.77	8.64
Open circuit voltage (Voc)	V	42.17	39.55
Short circuit current (Isc)	A	11.36	9.16
Module efficiency	%	20.8%	19.4%
Maximum system voltage (VDC)	V		1000
Series fuse rating	A		20
Power Tolerance	Wp		±3%

Measurement conditions: STC 1000 W/m² • AM 1.5 • Temperature 25 °C • NOCT 800 W/m² • AM 1.5 • Measurement uncertainty ≤ 3%
Sun simulator calibration reference modules from Fraunhofer Institute. Electrical characteristics may vary by ±5% and power by ±3%.

MECHANICAL PROPERTIES / COMPONENTS	METRIC	IMPERIAL
Module weight	19.5kg ±0.2kg	43lbs ±0.4lbs
Dimensions (H x L x D)	1762 mm x 1037 mm x 35 mm	69.4 in x 40.8 in x 1.37 in
Maximum surface load (wind/snow)*	5400 Pa rear load / 5400 Pa front load	112.8 lb/ft ² rear load / 112.8 lb/ft ² front load
Hail impact resistance	ø 25 mm at 83 km/h	ø 1 in at 51.6 mph
Cells	120 Half cells - Si mono PERC 9 busbar - 83 x 166 mm	120 Half cells- Si mono PERC 9 busbar - 3.26 x 6.53 in
Glass	3.2 mm high transmittance, tempered, DSM antireflective coating	0.126 in high transmittance, tempered, DSM antireflective coating
Cables and connectors (refer to installation manual)	1350 mm, ø 5.7 mm, MC4 from Staubli	53.15 in, ø 0.22 in (12AWG), MC4 from Staubli
Backsheet	High durability, superior hydrolysis and UV resistance, multi-layer dielectric film, fluorine-free PV backsheet	
Frame	Anodized Aluminum (Black)	
Bypass diodes	3 diodes-30SQ045T (45V max DC blocking voltage, 30A max forward rectified current)	
Junction Box	UL 3730 Certified, IEC 62790 Certified, IP68 rated	

TEMPERATURE RATINGS		WARRANTIES	
Temperature Coefficient Isc	+0.064 %/°C	Module product workmanship warranty	25 years**
Temperature Coefficient Voc	-0.28 %/°C	Linear power performance guarantee	30 years
Temperature Coefficient Pmax	-0.36 %/°C		≥ 97.1% end 1st yr ≥ 91.6% end 12th yr ≥ 85.1% end 25th yr ≥ 82.6% end 30th yr
NOCT (± 2°C)	45 °C		
Operating temperature	-40/+85 °C		

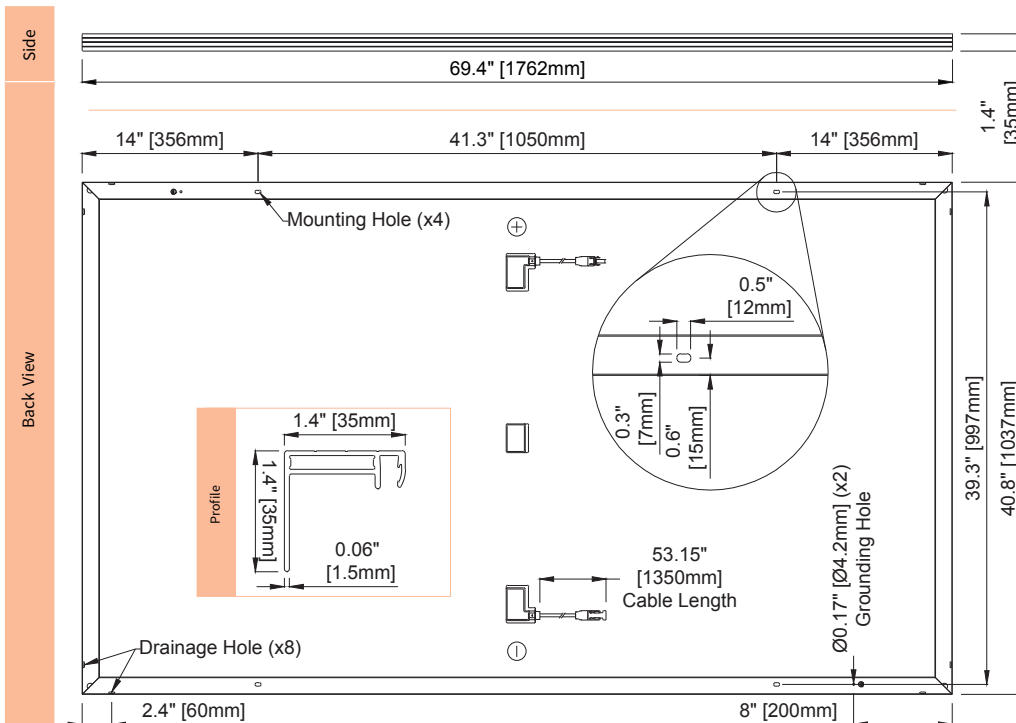
CERTIFICATIONS		SHIPPING SPECS	
Product	ULC ORD C1703, UL1703, CEC listed, UL 61215-1/-1-1/-2, UL 61730-1/-2, IEC 61215-1/-1-1/-2***, IEC 61730-1/-2***, CSA C22.2#61730-1/-2, IEC 62716 Ammonia Corrosion; IEC61701:2011 Salt Mist Corrosion Certified, UL Fire Rating: Type 2	Modules Per Pallet:	26 or 26 (California)
Factory	ISO9001:2015	Pallets Per Truck	34 or 32 (California)
		Modules Per Truck	884 or 832 (California)

* ⚠ Warning. Read the Safety and Installation Manual for mounting specifications and before handling, installing and operating modules.

** 12 year extendable to 25 years subject to registration and conditions outlined under "Warranty" at silfabsolar.com

*** Certification in progress.

PAN files generated from 3rd party performance data are available for download at: silfabsolar.com/downloads



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F +1 905.696.0267

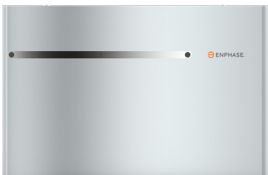
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IQ8 and IQ8+ Microinverters

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.



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.



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

* 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.

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



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COMPLETE RAIL-BASED RACKING SYSTEM

INSTALLATION GUIDE

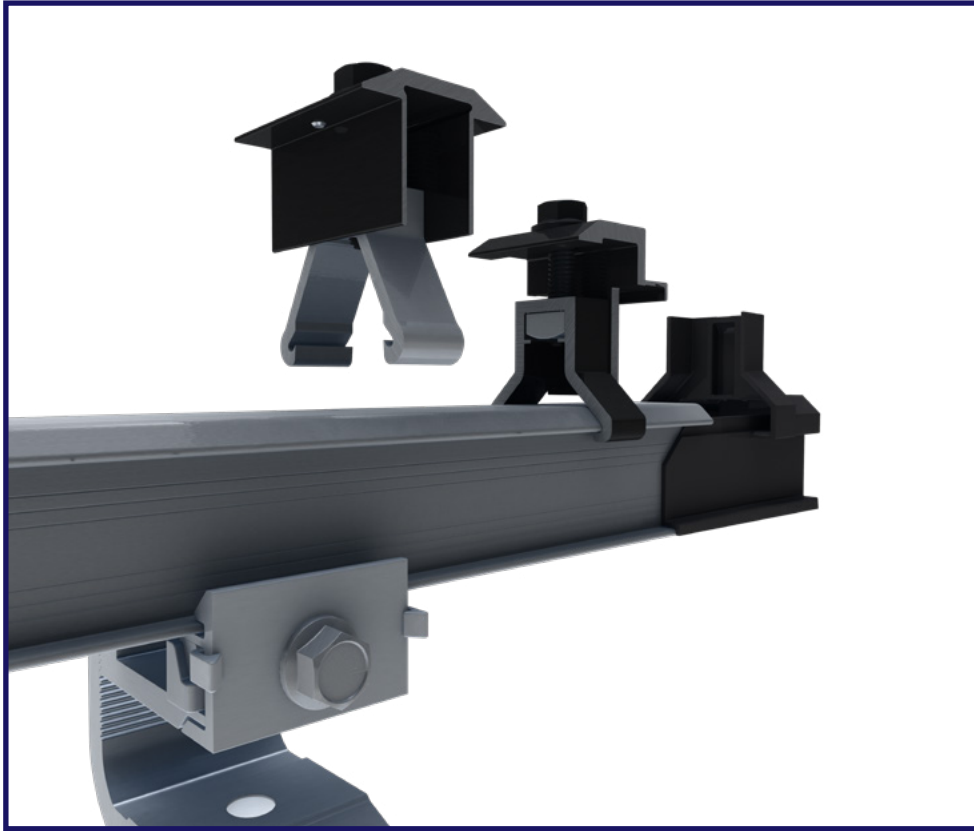
REVISION DATE: 03/03/22

VERSION: v2.7



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CLICKFIT

ClickFit conforms to UL 2703 and is one of the fastest installing rail-based systems in the industry. Thanks to its Click-In Rail assembly, the rails can be connected to any of EcoFasten's composition shingle, tile, and metal roof mounts in seconds without the need for fasteners or tools. The ClickFit system is made of robust materials, such as aluminum and coated steel, to ensure corrosion resistance and longevity. ClickFit has been tested in extreme weather conditions including wind, fire, and snow.

FEATURES

- Tool and fastener free rail attachment
- Fully integrated bonding
- Click-on Mid & End Clamps
- Compatible with a variety of EcoFasten roof attachments

INTRODUCTION

This manual describes the installation of the ClickFit mounting system for photovoltaic modules on steep-slope roofs. Described within are details for composition shingle and tile, attachments for ClickFit System. Other roof types as well as all other installation manuals can be found for download at www.EcoFastenSolar.com.

GENERAL INSTALLATION CONDITIONS

Failure to observe the requirements in this document can lead to the exclusion of all guarantees and product liability. EcoFasten Solar reserves the right to amend this document without prior notice.

STABILITY AND CONDITION OF THE ROOF

The roof must be in good condition and strong enough to support the weight of the modules, including the additional equipment, wind and snow loads. When in doubt, consult with the engineer of record, and/or the local building inspector.

APPLICATION RANGE OF CLICKFIT

Refer to Compatibility module list at the end of this document. Please refer to the Ecofasten ClickFit span tables for system structural certification and allowable spans.

WARRANTY

Guarantee according to the warranty conditions and general terms and conditions of EcoFasten Solar. These conditions can be found on the website at www.EcoFastenSolar.com.

LIABILITY

EcoFasten Solar cannot accept any liability whatsoever for damage or injury caused by not taking adequate safety precautions or (accurately) following the instructions given, or resulting from negligence during the installation of the product and any corresponding accessories specified in this document.

OVERVIEW

The ClickFit mounting system consists of patented adjustable tile hooks and L feet, rails, and the installation materials required for the mounting of photovoltaic modules on composition shingle or tile roofs. For simplicity, tile hooks and L feet will be referred to as “attachments”.

ATTACHING TO THE ROOF

The attachments are fastened to the rafters. Attachments are height-adjustable to level the system on uneven roof surfaces.

ATTACHING THE RAIL

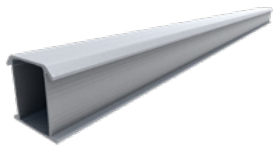
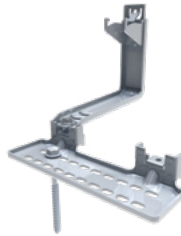
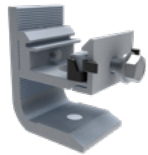
The rail assembles to the attachments with a click-connector, or Clicker. The rail simply clicks into place without the use of any tools.

ATTACHING THE MODULES

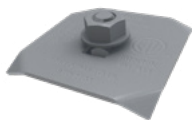
The modules are attached to the rails by means of mid clamps and end clamps.

Installer must review module and any 3rd party manufacturer’s documentation for compatibility and compliance with warranty terms and conditions.

SYSTEM COMPONENTS REQUIRED

**CLICKFIT RAIL****RAIL SPLICE****TILE HOOK****L-FOOT****END CAP****MID CLAMP****END CLAMP**

SYSTEM COMPONENTS ACCESSORIES

**FRAME MLPE MOUNT****MODULE JUMPER****MLPE MOUNT**

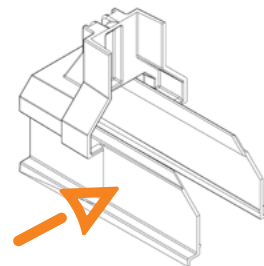
Refer to ClickFit Alternate Component Addendum for components not shown

RATINGS

Fire Rating*	Class A System Fire Rating
Max System Voltage	1500 VDC
Max Fuse Rating	40A
Certification	Conforms to UL STD 2703
Warranty	25 Year Material and Workmanship
UL 2703 Markings	Product listing label is located on the rail end-caps
Roof Pitch	2:12 – 12:12
UL 2703 Allowable Design Load Rating	10 psf downward, 5 psf upward, and 5 psf lateral
Max Module Size	25.6 sqft
Module Orientation	Portrait or Landscape
Multiple use Rated Components (Position Independent)	Mid Clamp, Frame MLPE Mount and MLPE Mount

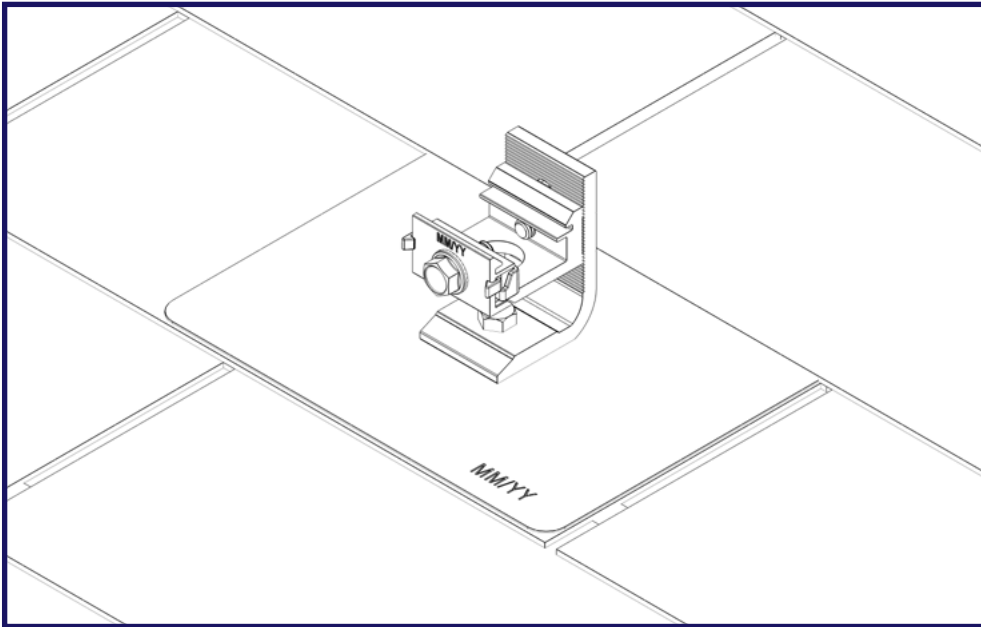
*Class A System fire rating with Type 1 & 2 PV modules. Any module-to-roof gap is permitted, with no skirt required. This rating is applicable with any roof attachment.

UL 2703 MARKING EXAMPLE:

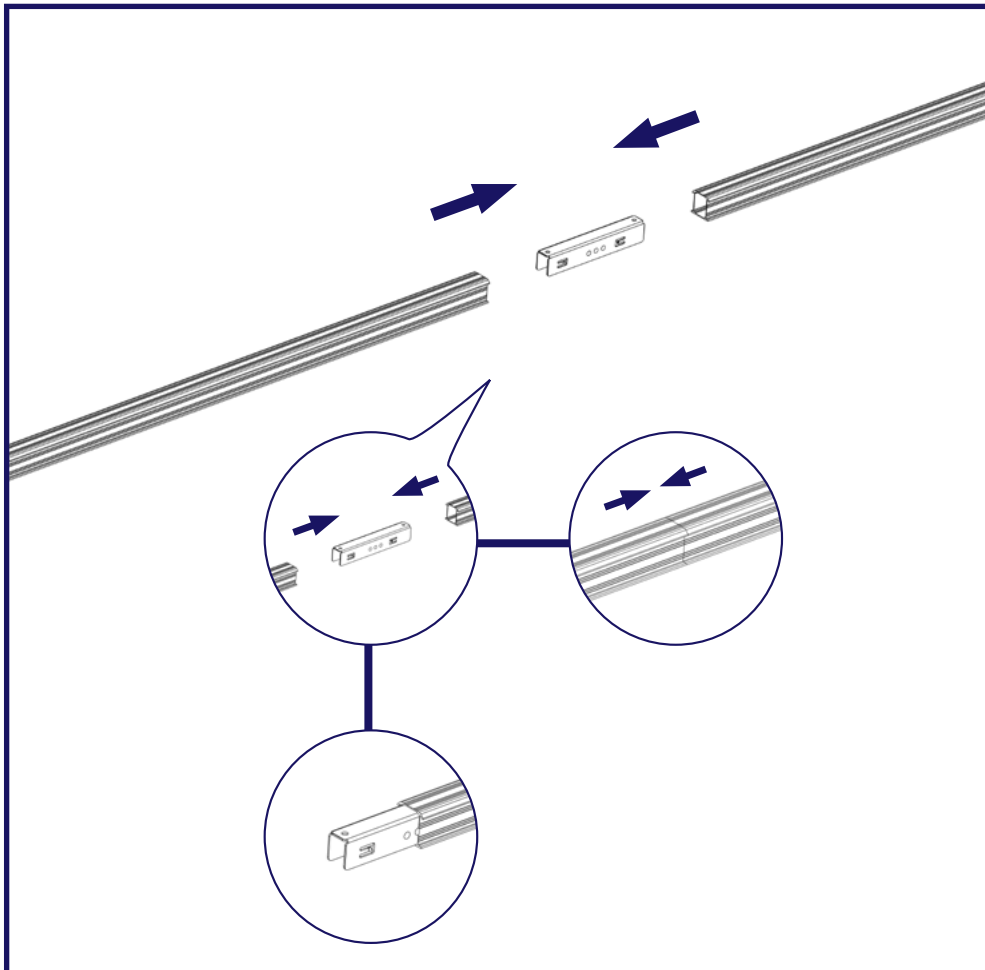


TORQUE SPECIFICATIONS

Component	Torque (in-lb)	Notes
Lag Screw	N/A	Fully Seat. Use visual indicator of the black EPDM ring around the bonded washer for torquing.
Mid-Clamp	144	
End-Clamp	96	
Rail Clicker Leveling Bolt	142	Pre-torqued upon delivery. Applies to Tile Hook and L-Foot/Clicker
Hook Height Bolt	N/A	Lightly clamp hook to flush with top of next tile row
Ground Lug	N/A	Refer to specific ground lug manufacturer's installation manual
MLPE Clip	144	
MLPE Mount	144	



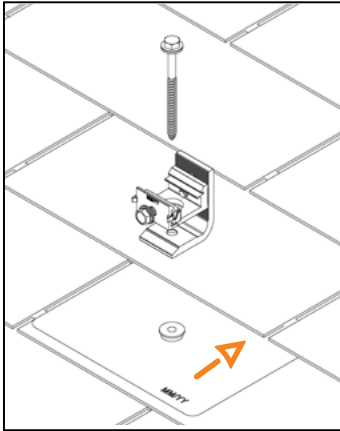
- Refer to span tables, local jurisdiction, or engineer of record specifications when determining setbacks from roof edges, attachment spans, etc.
- Mark the perimeter and corners of the array on the roof surface.
Add 3/4" to account for the gap between modules in each direction
- Draw or snap chalk lines where the rails will be installed,(refer to module manufacturer specs to determine allowable mounting locations).
- Locate rafters within the area of the array. It may be necessary to shift the array East or West on the roof in order to fall within the rail cantilever specs (1/ 3 of span).
- Stagger rafters every row if required by the local jurisdiction, engineer of record, or company policy.



PRE-INSTALLING RAIL SPLICES

1. Determine the number of rails required per row of modules.
2. Insert a rail splice into one rail. **Do not push it past the center bump.**
3. Slide the next rail onto the rail splice until the two rail ends meet.
4. Repeat steps 2 and 3 until the desired length is achieved. **This is usually easiest to do from the ground.**

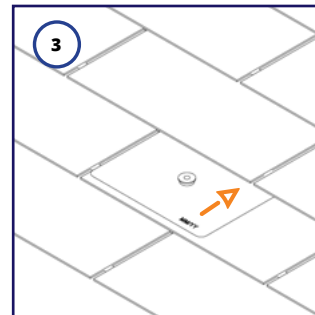
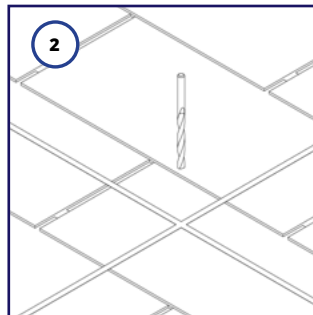
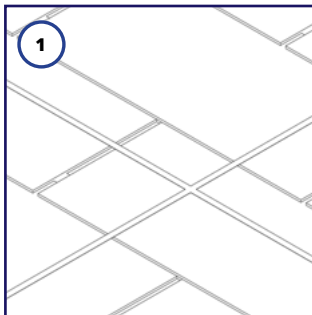
INSTALLATION OF FLASHING & L-FOOT



- ClickFit for comp shingle roofs uses EcoFasten GF-1 watertight flashing system.
- Other roof types may use different EcoFasten Solar attachments, visit ecofastensolar.com to learn about other applications.

Note the orientation of the L foot and Clicker. The two Clicker "arms" should be facing downslope

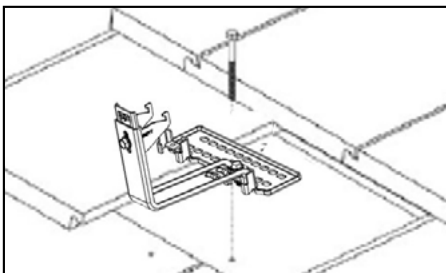
INSTALLATION STEPS:



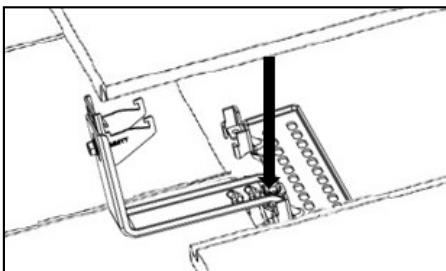
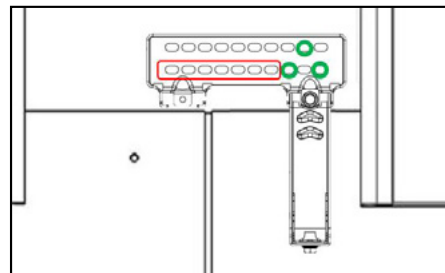
1. Locate rafter lines.
2. Drill 1/4" pilot holes at all attachment points and back fill using roof-compatible sealant.
3. Separate shingles where flashing is to be installed. Insert the flashing so the top portion is under the next row of shingles North. Ensure the flashing is pushed to the third-course of shingle to prevent water infiltration through the vertical joints between shingles.
4. Align GF-1 flashing hole with pilot hole. Insert the lag bolt with pre-installed bonded washer through the L foot and EPDM grommet. Tighten the lag bolt until fully seated. The EPDM Ring visual indicator is the most effective way to ensure a watertight seal.

INSTALLING TILE HOOKS

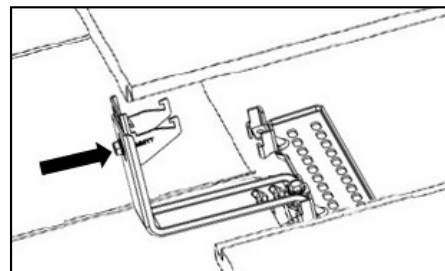
1. Locate rafters on the roof, mark the tiles to be removed. Hint: In some cases rafter tails are visible at the eaves of the roof, making it easy to find the rough location of the rafters. In other cases, the fascia board may have nail heads visible where it was attached to the rafters. In the worst-case a row of tiles may need to be moved to determine the rafter locations.
2. Slide the tile at the desired location upward to expose the roof sub surface. If the tile is to be notched, or if using a replacement flashing, remove it entirely. Clean the sub surface with a brush to remove any debris that could affect the sealing.
3. Locate the rafter center and mark it.
4. Place the tile hook with the hook itself in the valley of the next tile below. Drill one 1/4" pilot hole in the rafter center, taking care to keep the hook in the valley of the tile below. Backfill this hole with a roof-compatible sealant. For flat tiles, try to avoid having the hook land directly under a joint between tiles, this will create a larger gap or more notching than necessary.
5. Install one 5/16" x 4" lag screw on the row of holes closest to the tile hook arm. If possible, install the screw in one of the three holes directly next to the arm. If the lag screw must be installed in one of the seven holes furthest from the arm (denoted by the red rectangle below), install three deck screws in the pattern shown by the green circles below.
6. Adjust the height of the tile hook as necessary using the bolt shown in the fourth image.
7. Flash the surrounding area and lag screw head with roof-compatible sealant as necessary. Refer to Tile Hook Subflashing Installation guide on the next page.
8. Replace the tile that was moved and/or removed, or install the tile replacement flashing. If it is to be notched, mark the tile for notching. Notching can be done with a grinding wheel or by using a chisel.



5.



6.





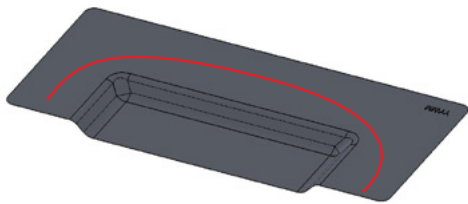
TILE HOOK SUB-FLASHING INSTALLATION

TOOLS REQUIRED:

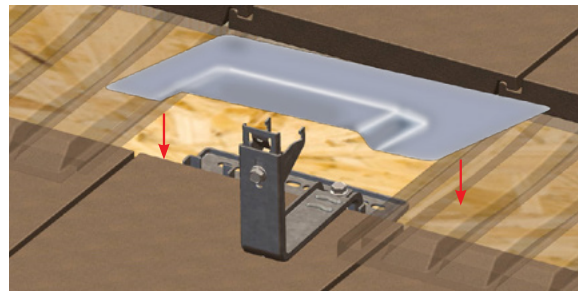
Caulking gun, roofing mastic applicator

MATERIALS REQUIRED:

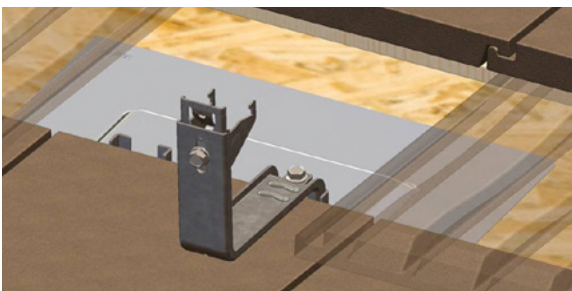
Roofing mastic, reinforcing fabric, roof sealant



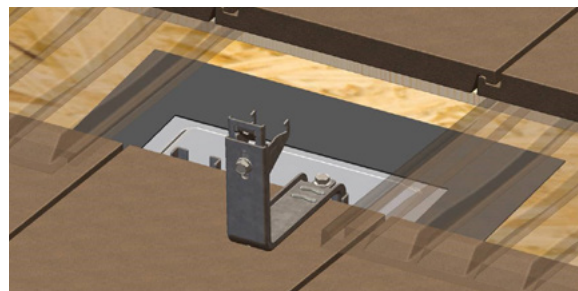
Apply a continuous line of the roofing manufacturer's approved sealant on the underside of the ClickFit tile hook sub-flashing to form a U-shape around the raised edges.



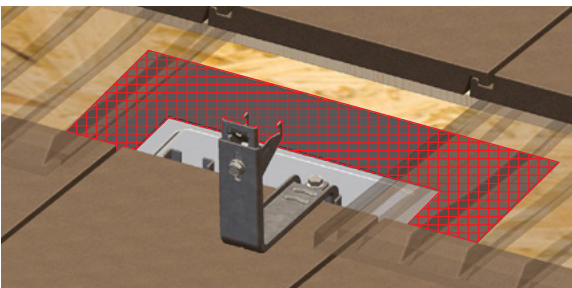
Lower the sub-flashing over the tile hook base. It may be necessary to move adjacent tiles to easily lower the sub-flashing onto the roof deck.



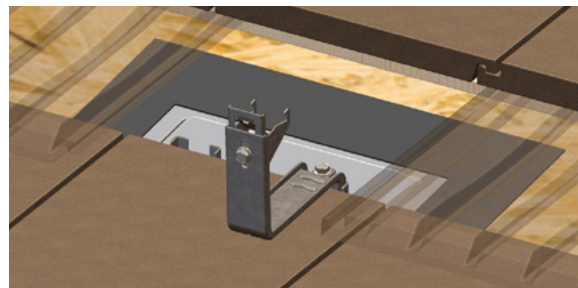
Place the sub-flashing over the base of the tile hook so the flashing covers the entire base.



EcoFasten recommends following the TRI guidelines three-course sealing method. Start the three-course sealing method by applying a layer of roofing mastic over the edges of the tile hook sub-flashing.



Place strips of reinforcing fabric over mastic to cover approximately 2" from the edge of the sub-flashing in both directions. Place strips on the side first, then the top edge.



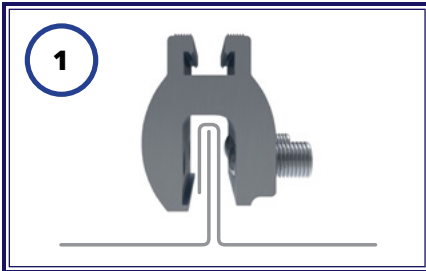
Apply a final layer of mastic to completely cover the reinforcing fabric. The flashing is now installed and sealed.

CLICKFIT INSTALLATION USING SIMPLEBLOCK-U®

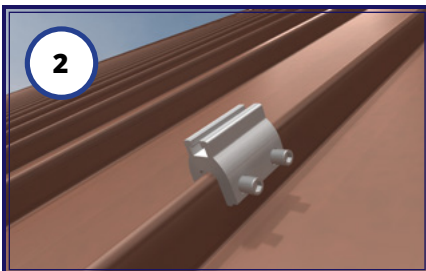
PRE-INSTALLATION:

The SimpleBlock-U can be installed on many different standing seam profiles. See SimpleBlock-U Installation Manual for compatible and non-compatible standing seam profiles. Be sure that each standing seam is no thicker than 1/2" in width.

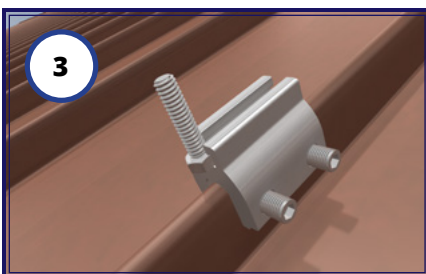
INSTALLATION:



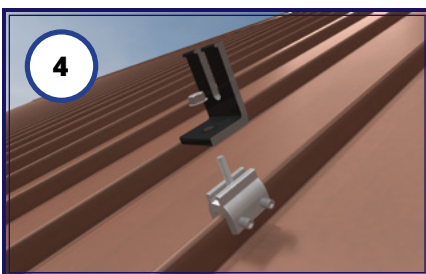
- 1 Position the SimpleBlock assembly on the panel seam. Make sure the block is fully seated on the metal seam.



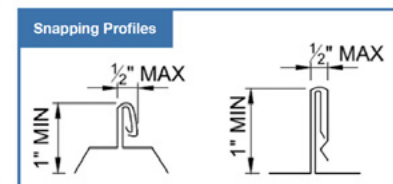
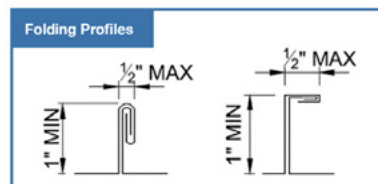
- 2 Torque the 2 preinstalled oval point set screws to 150in-lbs using the included 3/16" hex drive.



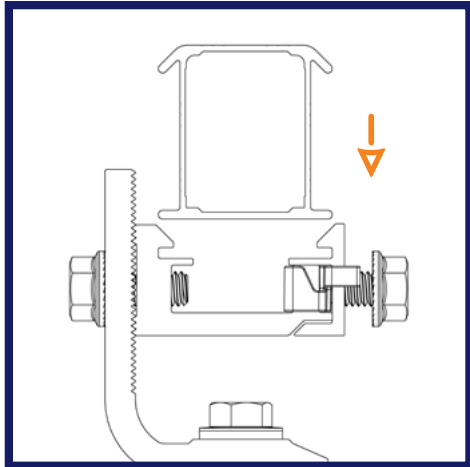
- 3 Included with the block, slide the hex bolt into the channel on top of the SimpleBlock-U assembly.



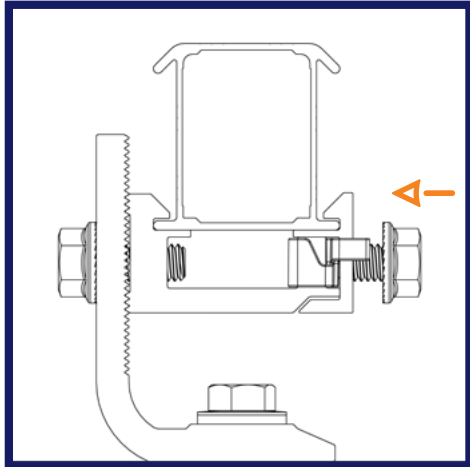
- 4 Place the ClickFit Universal L-Foot over the hex bolt followed by the serrated flange nut and torque to 150in-lbs.



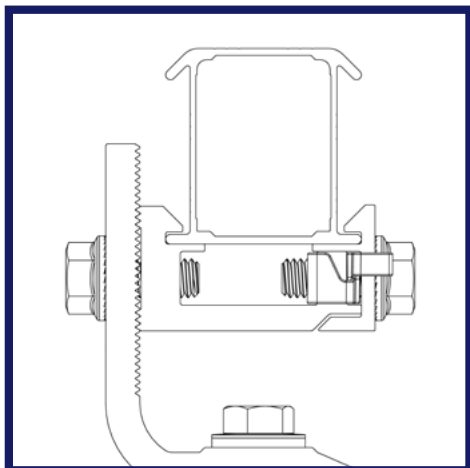
INSTALLING THE RAIL



1. Place the rail in the Clickers.
2. Ensure the rails extend a minimum of 2" past the last attachments in each row.



3. Push the rail into each L-foot; an audible click should be heard when the rail is fully seated. Verify the rail is sitting flush with both ledges. If attachments are extremely misaligned it may be necessary to loosen the leveling bolt and adjust the height of the L-foot. Tighten the clamping bolt to 144 in-lbs.

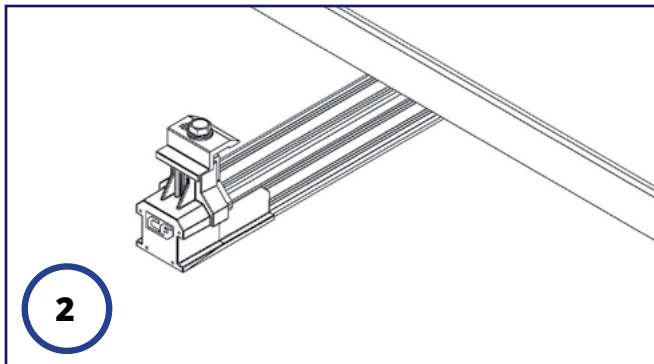
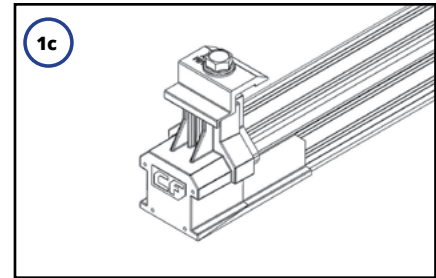
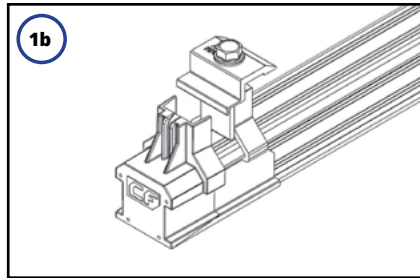
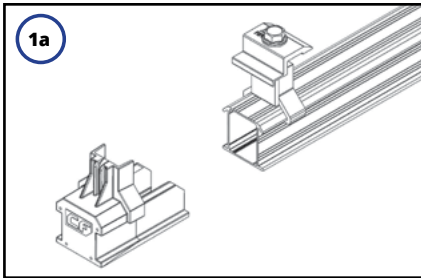


4. Level the rail if necessary by loosening the bolt attaching the Clicker to the L-foot or tile hook.

MODULE INSTALLATION

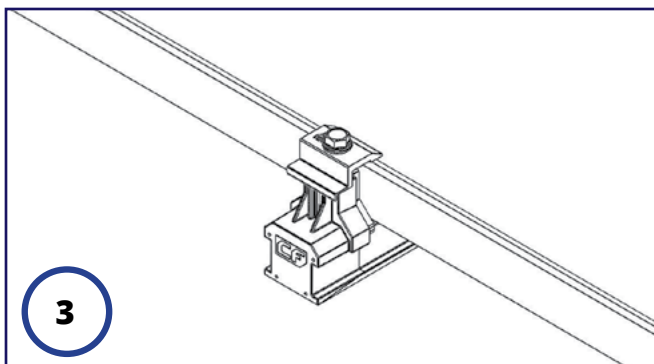
1 INSTALL THE END CLAMPS ON EACH RAIL ON WHATEVER END YOU ARE STARTING WITH

- 1a Snap the end clamp onto the rail.
- 1b Slide the end cap onto the rail.
- 1c Turn the leg of the end clamp around the cap.



2 PLACE MODULE

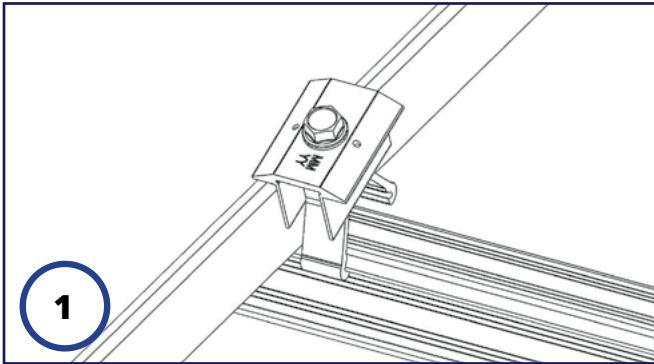
Place the module on the rail, ensuring the module junction box is up-slope.*



3 ALIGN AND TIGHTEN

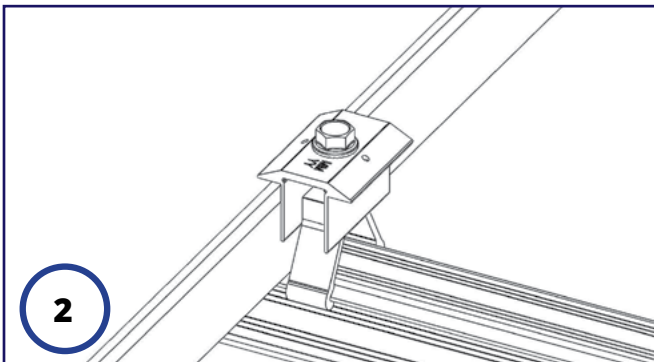
Slide the module to the end clamp and align it with the array corners. Tighten the end clamp to 96 in-lb

INSTALLING ADDITIONAL MODULES



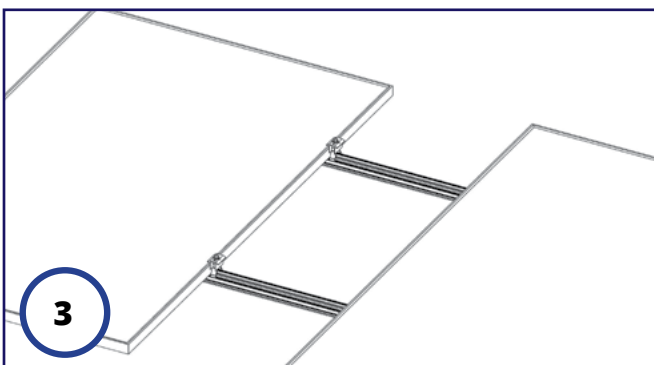
1 **CLICK IT ON**

Click a mid clamp onto each rail.



2 **SLIDE IT UP**

Slide the mid clamps until they are flush with the side of the existing module.



3 **PLACE AND TIGHTEN**

Place and slide the next module firmly against the mid clamps. Align the bottom edges of the modules. Tighten mid clamps to 144 in-lb.



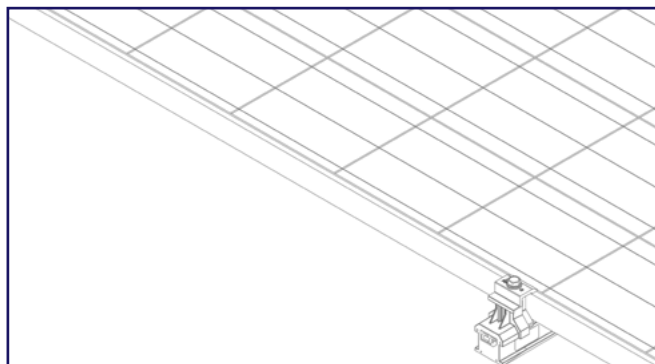
INSTALLING END CLAMPS AT THE END OF A ROW

1. Install the last mid clamps in the row.
2. Measure the rails from the last mid clamp to the module width plus 1".
3. Cut the rails at this mark. There is some adjustment in the end cap/clamp so it does not need to be a perfect cut.
4. Install end clamps and end caps, tighten to 96 in-lb

ALTERNATIVE METHOD:

1. Install the last module in the row, tighten the mid clamps.
2. Using a circular saw with a metal blade, or carefully with a reciprocating saw, cut the rail approximately 1" past the edge of the last module.
3. Install end clamps and end caps, tighten to 96 in-lb

Replace the tile that was moved and/or removed, or install the tile replacement flashing. If it is to be notched, mark the tile for notching. Notching can be done with a grinding wheel or by using a chisel.



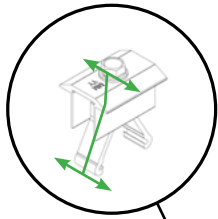
BONDING AND GROUNDING

BONDING PATHS

Bonding paths are carried throughout the array in a variety of ways. They are carried module-to-module and module-to-rail through mid clamps, carried at rail-to-rail connections through the bonding jumpers, and carried row-to-row using bonding jumpers either module-to-module on the module frame or rail-to-rail on the ends of the rails.

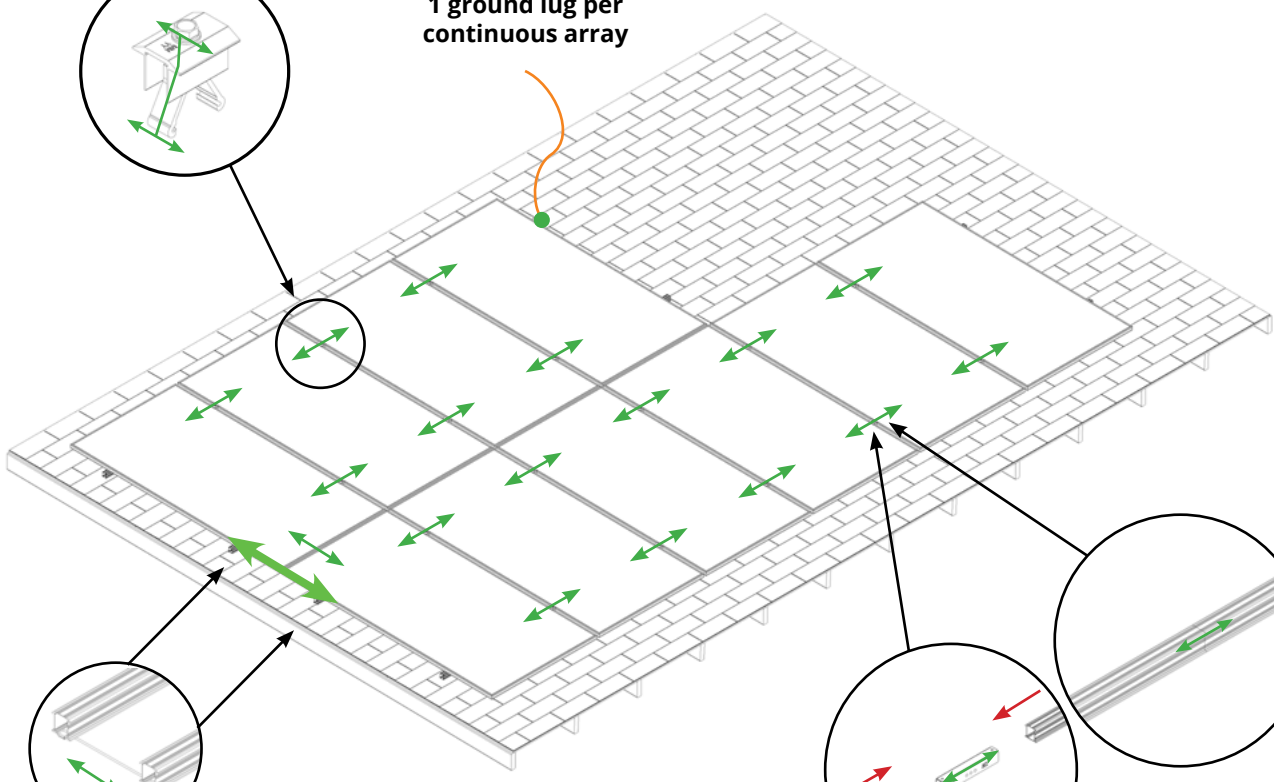
MID CLAMP

2 mid clamps bonding pairs of modules



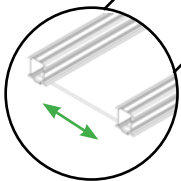
GROUNDING LUG

1 ground lug per continuous array



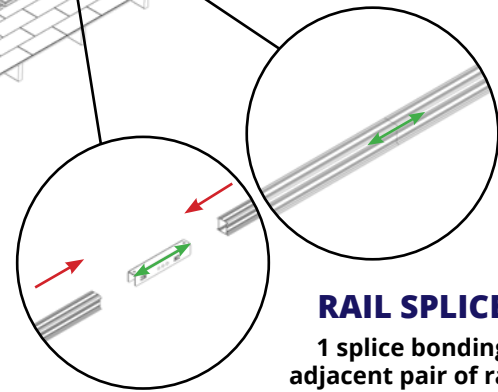
MODULE JUMPER

1 module jumper bonding module to module and row to row



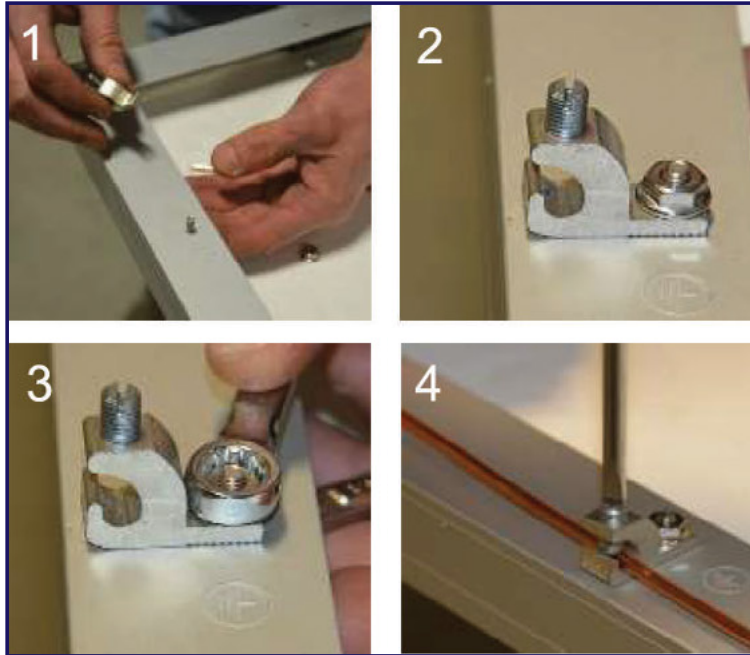
RAIL SPLICE

1 splice bonding adjacent pair of rails



GROUNDING

GROUNDING



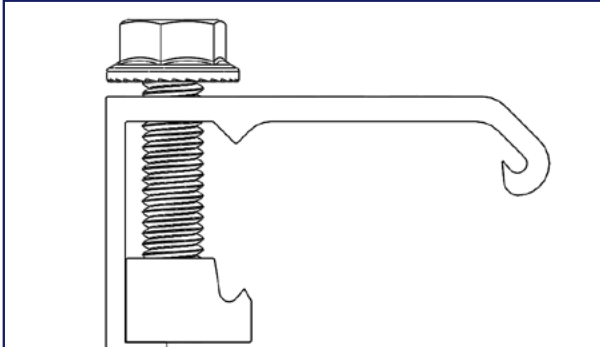
NECESSARY COMPONENTS

One of the following grounding lugs (or any UL 2703 Compliant ground Lug):

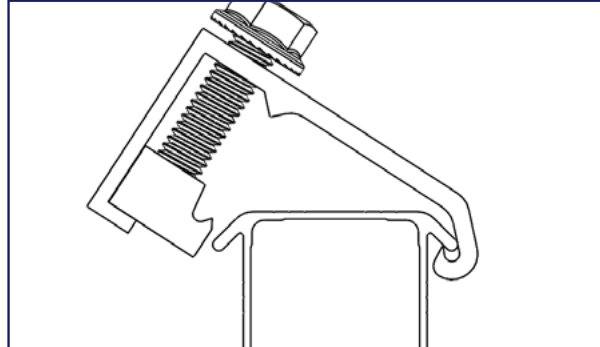
- BurndyCL50-1TN Ground Lug (UL 2703 - E3514343 / UL 467-E9999)
- ILSCO SGB-4 Ground Lug (UL 2703 - E354420 / UL 467 - E34440)
- ILSCO GBL-4DBT (UL 2703 - E354420 / UL467 - E34440)
- ILSCO GBL-4DBTH (UL 2703 - E354420 / UL 467 - E34440)
- ILSCO GBL-4SS (UL 2703 - E354420 / UL 467 - E34440)

*Equipment grounding wire should be sized in accordance with the National Electrical Code, NFPA70 and a minimum of 1/4" clearance is required between bare copper wires and aluminum components.

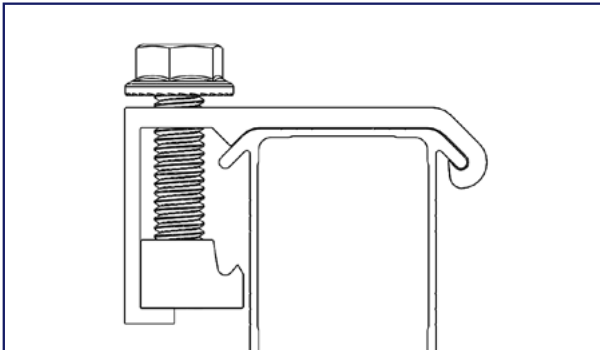
MLPE MOUNT INTALLATION



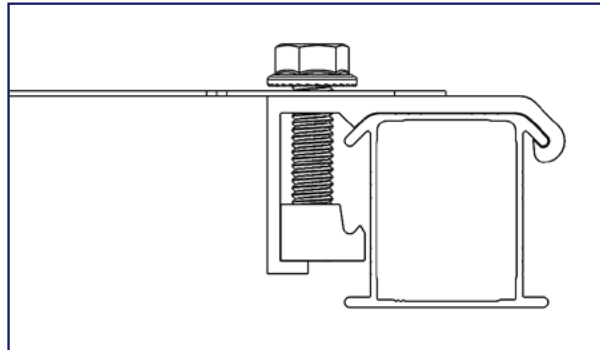
Lower the MLPE Mount to the rail



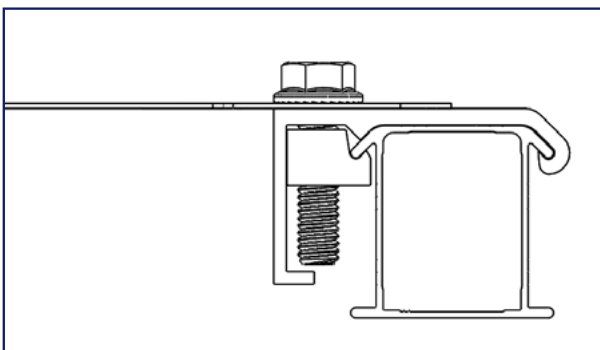
Tilt and hook the mount around the top "dog ear" of the rail



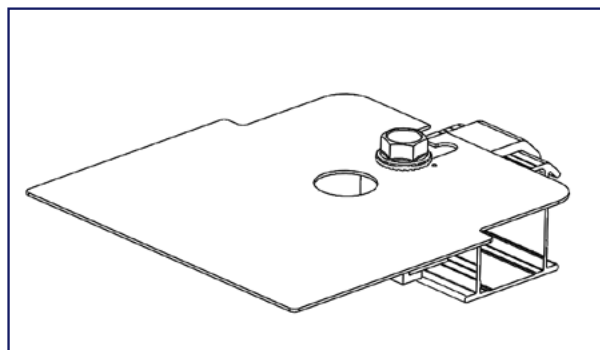
Set the MLPE Mount flush with the top of the rail



Slide the microinverter flange between the MLPE Mount and the serrated bolt flange

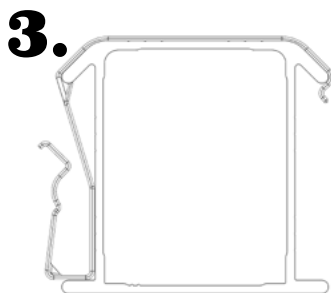
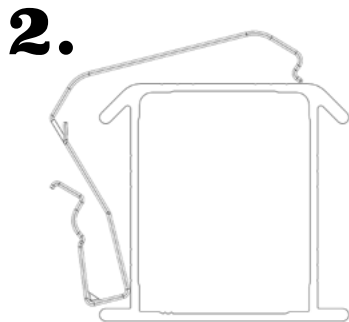
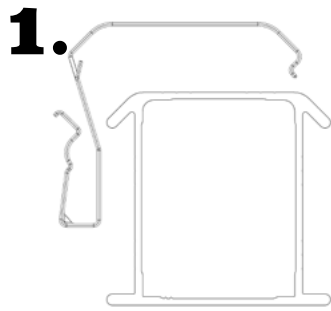


Tighten the bolt to 144 in-lbs



Repeat this process for all other microinverter and/or optimizer installations

WIRE CLIP INSTALLATION



With the ClickFit Rail in place and the Wire Clip in hand, place the wire end on either side of the rail. With the wire end touching the bottom lip of the rail, roll and click-in the Wire Clip to the opposite end of the rail. You will hear an audible click when the Wire Clip is set in place.

FRAME MLPE MOUNT



INSTALLING THE FRAME MLPE MOUNT ACCESSORY:

- Install the Frame MLPE Mount
- Slide the Frame MLPE Mount onto the lip of the micro-inverter/power optimizer.
- Slide the micro-inverter/power optimizer into the opposite lip of the module frame.
- Tighten the bolt to 144 in-lb to clamp the Frame MLPE Mount to the module frame and the micro-inverter/power optimizer to the Frame MLPE Mount.
- Ensure that the lip on the clip is tight against the frame and that the micro-inverter/power optimizer flange is tight against the clip flange to avoid rotation during tightening.

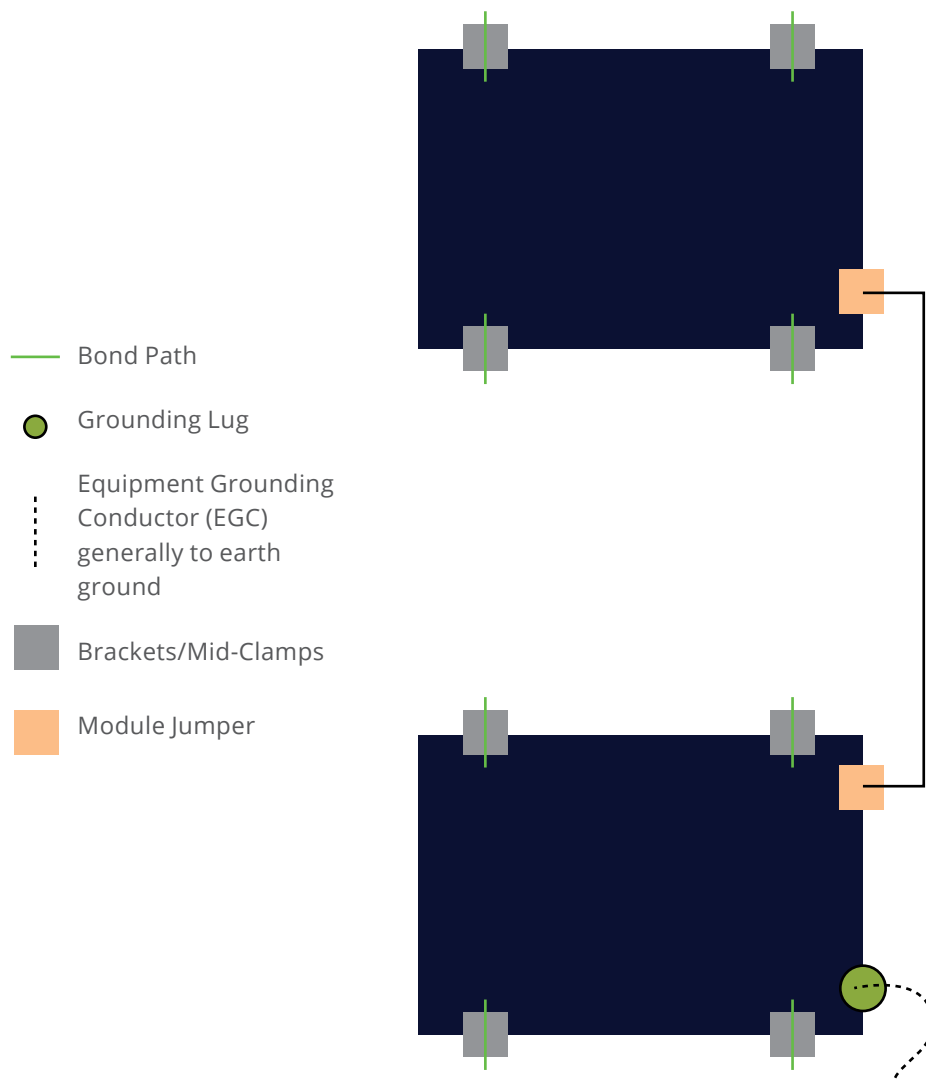
FRAME MLPE MOUNT AND MLPE MOUNT ARE COMPATIBLE WITH:

- **ENPHASE:** M250-72, 250-60, M215-60, C250-72, S230, S280, IQ 6, IQ 6+, IQ7, IQ 7A, IQ 7+, IQ7 PD, IQ 7X, Q Aggregator; IQ8-60, IQ8PLUS-72, IQ8A-72, IQ8H-208-72, IQ8H-240-72, IQ8M-72, may be followed by -2-US
- **SOLAREEDGE:** M1600, P300, P320, P340, P370, P400, P401, P405, P485, P505, P600, P700, P730, P800p, P800s, P801, P850, P860, P950, P960, P1100, P1101, S440, S500
- **SEE PAGE 26 FOR COMPATIBLE MODULE LIST**



MODULE MAINTENANCE AND SERVICING

During servicing or maintenance, module removal may disrupt the bonding path and could introduce the risk of electric shock. If module removal is required for servicing, then a Module Jumper shall be installed to the adjacent modules to maintain the bond path. Modules should only be removed by qualified persons in compliance with the instructions in this manual.

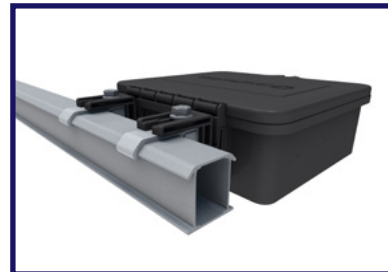


JUNCTION BOX INSTALLATION



JUNCTION BOX PREP

Prior to installation, use step drill bit to place pass through holes for conduits or water-tight connectors. Drill bit starter locations are provided on the sides and front of enclosure. Do not install conduit facing up roof.

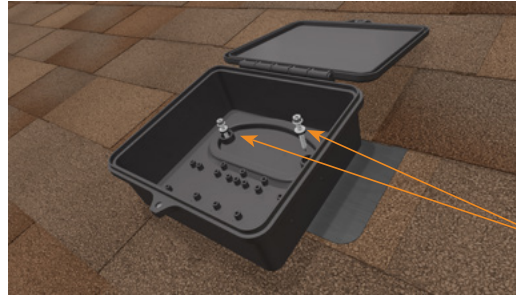
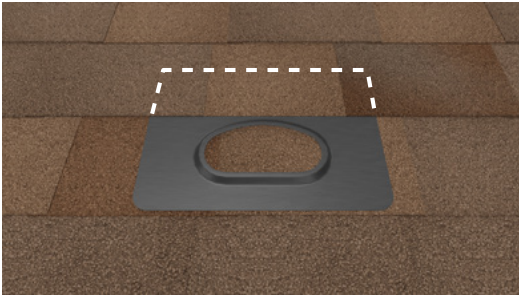


RAIL INSTALLATION

Use rail-specific MLPE mounting hardware to attach Rail Hangers to rail. Ensure junction box is pushed as close to the rail as possible. Torque to 80-in lbs(1/2" or 7/16" socket), do not overtighten.

**If installing in areas with ground snow loads greater than 40 psf, install Junction Box under module directly next to module frame edge.*

JUNCTION BOX INSTALLATION



DECK SCREWS WITH SEALING WASHERS (2X)

DECK MOUNTED INSTALLATION

Align sealing oval of box to align with mating feature on flashing. An EPDM foam gasket is pre-installed to the underside of the junction box to seal the flashing to the box without the need for additional sealant. Secure with supplied #12 x 1- " deck screws (2x) until the junction box is pulled tight to the flashing. Do not over-tighten screws to avoid stripping screws in OSB.

**If installing pass through fittings, ensure that the Junction Box and roof deck are both properly prepared. Complete installation process before attaching the Junction box to the deck.*



FINALIZING INSTALLATION

Install wiring, conduit and fittings per NEC requirements and following local AHJ guidance. Using Philips Head Driver tighten the bolt.

For additional details refer to the full Junction Box Installation Manual.



SKIRT INSTALLATION (OPTIONAL)

The skirt is designed to give the rows of the array facing the eave of the roof a uniform appearance. The installation consists of three basic components listed below.

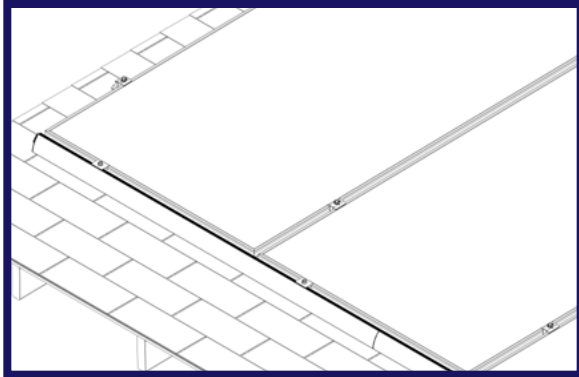


SKIRT & END CAP

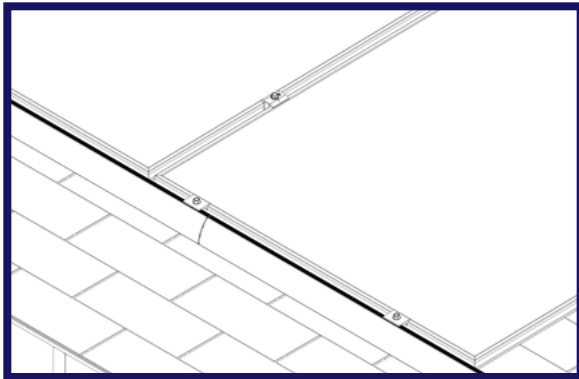


SKIRT CLAMP

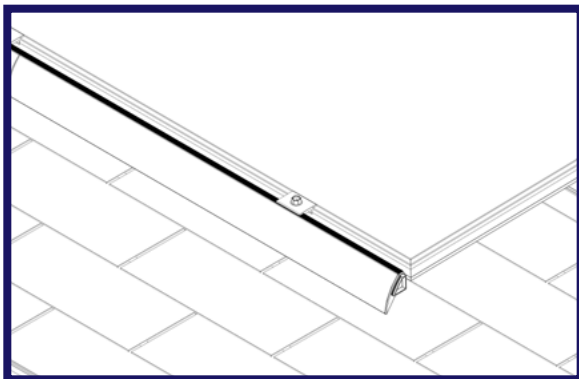
1. Once the first row of modules is installed (or after the array is complete), locate the correct length and number of skirts for the array.
2. Locate the correct amount of skirt clamps for the array. 80" skirts are preferred when applicable. The general rule when using 80" skirts is the number of modules plus one for the end of the array. When using 65" skirts, the rule changes to 2 skirt clamps per module. The general rule is number of modules plus one for the end of the array. If you have ten modules you will need eleven skirt clamps. In the case of heavy snow loads or other circumstances call EcoFasten Solar for additional instructions.
3. Working with a helper, align the end of the skirt with one edge of the array, drop the first skirt clamp onto the module and skirt, ensure all flat faces are parallel and fully engaged with each other. Skirt clamps must be installed within 10 inches from the end of the Skirt. Ensure the clamp is engaging either the top of the skirt or the step depending on the module size. Tighten bolt to 12 ft-lb.
4. There should be enough play in the assembly to drop the next skirt clamp onto the next module at roughly the same location relative to the clamp on the last module. Ensure all faces are parallel and fully engaged with each other. Slide next skirt over the skirt end cap or coupling of the first skirt. Tighten bolt to 12 ft-lb.
5. Repeat steps 3 and 4 until the end of the array is reached. Install a skirt clamp within 10 inches from the end of the array. Cut the skirt flush with the end of the array as necessary. An additional skirt clamp may be necessary to hold a short piece of skirt at the end of the array.
6. Once the last skirt is cut and clamped in place, install an end cap in the end of the last skirt. To ensure the end cap stays in place through various weather conditions, it is acceptable to install a small amount of roof sealant onto the edge of the end cap that will contact the inside face of the skirt. Replace the tile that was moved and/or removed, or install the tile replacement flashing. If it is to be notched, mark the tile for notching. Notching can be done with a grinding wheel or by using a chisel.



Install first skirt clamp within 10 inches from the end of the array with 80" skirts, the second clamp location will be similar to the first clamp but installed on the second module. Continue to the end of the array.



Install last skirt clamp within 10 inches from the end of the array prior to cutting.



Install end cap on the last module. Adding a small amount of sealant is optional.

THINGS TO CONSIDER PRIOR TO INSTALLING THE SKIRT ARE:

- Potential snow drifting in the area the skirt is to be installed. If the snow load is greater than 20psf in your region two skirt clamps are required per module and skirt coupler must be used. Contact EcoFasten for information on the skirt coupler.
- There are three options for skirts: A, B and C. The A & B skirts can be identified by looking at the inner channel, if it's ribbed then it is a B skirt and will use 32mm (inner channel) and 38mm utilizing the top of the skirt. A skirts will have a smooth inner channel and use 35mm (inner channel) and 40mm utilizing the top of the skirt. C skirts will only use 30mm skirts and do NOT have an inner channel.

UL 2703 CERTIFIED MODULES

This racking system may be used to ground and/or mount a PV module complying with UL 1703 or UL 61730 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions.

Unless otherwise noted, "xxx" refers to the module power rating and both black and silver frames are included in the certification. " "

MANUFACTURER	LIST OF UL 2703 APPROVED MODULES
Adani	Adani modules with 35 and 40mm frames ASX-Y-ZZ-xxx Where "X" can be B, M or P, "Y" can be 6 or 7, and "ZZ" can be blank, PERC, B-PERC, or AB-PERC
Aionrise	Aionrise modules with 35 and 40mm frames AIONyyG1-xxx Where "yy" can be 60 or 72
Amerisolar	Amerisolar modules with 35, 40 and 50 mm frames AS-bYxxxZ Where "b" can be 5 or 6; "Y" can be M, P, M27, P27, M30, or P30; and "Z" can be blank, W or WB
Aptos Solar	Aptos modules with 35 and 40 mm frames DNA-yy-zzaa-xxx Where "yy" can be 120 or 144; "zz" can be MF or BF; and "aa" can be 23 or 26
Astronergy Solar	Astronergy modules with 30, 35, 40, and 45 mm frames aaSMbbyC/zz-xxx Where "aa" can be CH or A; "bb" can be 60, 66, or 72; "yy" can be blank, 10 or 12; "C" can M, P, M(BL), M-HC, M(BL)-HC, P-HC, M(DG), or M(DGT); and "zz" can be blank, HV, F-B, or F-BH
ASUN	ASUN modules with 35 and 40 mm frames ASUN-xxx-YYZZ-aa Where "YY" can be 60 or 72; "ZZ" can be M, or MH5; and "aa" can be blank or BB
Auxin	Auxin modules with 40 mm frames AXN6y6zAxxxB Where "y" can be M or P; "z" can be 08, 09, 10, 11, or 12; and "A" can be F, M or T; and "B" can be blank, A, B or C

MANUFACTURER	LIST OF UL 2703 APPROVED MODULES
Axitec	Axitec Modules with 30, 35 and 40 mm frames AC-xxxY/aaZZb Where "Y" can be M, P or MH; "aa" can be blank, 125- or 156-; "ZZ" can be 54, 60, 72, 108, 120, or 144; "b" can be S, X, V, VB, XV, or MX
Boviet	Boviet modules with 35 and 40mm frames BVM66aaYY-xxxBcc Where "aa" can be 9, 10 or 12; "YY" is M, or P; and "B" can be blank, L or S; and "cc" can be blank, H, H-BF, H-HC, HC-BF or H-HC-BF
BYD	BYD modules with 35 mm frames BYDxxxAY-ZZ Where "A" can be M6, P6, MH or PH; "Y" can be C or K; and "ZZ" can be 30 or 36
Canadian Solar	Canadian Solar modules with 30, 35 and 40 mm frames CSbY-xxxZ Where "b" can be 1, 3 or 6; "Y" can be H, K, L, N, P, U, V, W, X or Y; and "Z" can be M, P, MS, PX, M-SD, P-AG, P-SD, MB-AG, PB-AG, MS-AG, or MS-SD
CertainTeed	CertainTeed modules with 35 and 40mm frames CTxxxYZZ-AA Where "Y" can be M, P, or HC; "ZZ" can be 00, 01, 10, or 11; and "AA" can be 01, 02, 03, 04 or 06
CSUN	Csun modules with 35 and 40 mm frames YYxxx-zzAbb Where "YY" is CSUN or SST; "zz" is blank, 60, or 72; and "A" is blank, P or M or MM; "bb" is blank, BB, 5BB, BW, or ROOF
Dehui	Dehui modules with 35 and 40mm frames DH-MYYYY-xxx Where "YYYY" can be 760, 772, 860, 872; and "Z" can be B or W
Ecosolargy	Ecosolargy modules with 35, 40, and 50 mm frames ECOxxxYzzA-bbD Where "Y" can be A, H, S, or T; "zz" can be 125 or 156; "A" can be M or P; "bb" can be 60 or 72; and "D" can be blank or B
ET Solar	ET Solar modules with 35, 40, and 50 mm frames ET-YZZZxxxAA Where "Y" can be P, L, or M; "ZZZ" can be 660, 660BH, 672, 672BH, 754BH or 766BH; and "AA" can be TB, TW, WB, WW, BB, WBG, WWG, WBAC, WBCO, WWCO, WWBCO or BBAC



MANUFACTURER	LIST OF UL 2703 APPROVED MODULES
Flex	Flex modules with 35, 40, and 50 mm frames FXS-xxxYY-ZZ; Where "YY" can be BB or BC; and "ZZ" can be MAA1B, MAA1W, MAB1W, SAA1B, SAA1W, SAC1B, SAC1W, SAD1W, SBA1B, SBA1W, SBC1B, or SBC1W
GCL	GCL modules with 35 mm and 40 mm frames GCL-ab/YY xxx Where "a" can be M or P; "b" can be 3 or 6; and "YY" can be 60, 72, 72H, or 72DH
GigaWatt Solar	Gigawatt modules with 40 mm frames GWxxxYY Where "YY" can be either PB or MB
Hansol	Hansol modules with 35 and 40 frames HSxxxYY-zz Where "YY" can be PB, PD, PE, TB, TD, UB, UD, or UE; and "zz" can be AH2, AN1, AN3, AN4, HH2, HV1, or JH2
Hanwha Solar	Hanwha Solar modules with 40, 45, and 50 mm frames HSLaaP6-YY-1-xxxZ Where "aa" can be either 60 or 72; "YY" can be PA or PB; and "Z" can be blank or B
Hanwha Q CELLS	Hanwha Q CELLS Modules with 32, 35, 40, and 42mm frames aaYY-ZZ-xxx where "aa" can be Q. or B.; "YY" can be PLUS, PRO, PEAK, LINE PRO, LINE PLUS, PLUS DUO or PEAK DUO; and "ZZ" can be G3, G3.1, G4, G4.1, L-G2, L-G2.3, L-G3, L-G3.1, L-G3y, L-G4, L-G4.2, L-G4y, LG4.2/TAA, BFR-G3, BLK-G3, BFR-G3.1, BLK-G3.1, BFR-G4, BFR-G4.1, BFR G4.3, BLK-G4.1, G4/SC, G4.1/SC, G4.1/TAA, G4.1/MAX, BFR G4.1/TAA, BFR G4.1/MAX, BLK G4.1/TAA, BLK G4.1/SC, EC-G4.4, G5, G5/SC, G5/TS, BLK-G5, BLK-G5/SC, BLK-G5/TS, L-G5, L-G5.1, L-G5.2, L-G5.2/H, L-G5.3, G6, G6/SC, G6/TS, G6+, BLK-G6, L-G6, L-G6.1, L-G6.2, L-G6.3, G7, BLK-G6+, BLK-G6+/AC, BLK-G6+/HL, BLK-G6+/SC, BLK-G6/TS, G6+/TS, BLK-G6+/TS, BLK-G7, G7.2, G8, BLK-G8, G8+, BLK-G8+ L-G7, L-G7.1, L-G7.2, L-G7.3, L-G8, L-G8.1, L-G8.2, L-G8.3, L-G8.3/BFF, ML-G9, BLK ML-G9, ML-G9+, BLK ML-G9+, BLK-G10+, BLK-G10+/AC, ML-G10, BLK ML-G10, ML-G10+, BLK ML-G10+, ML-G10.a, BLK ML-G10.a, ML-G10.a+, BLK ML-G10.a+, XL-G9, XL-G9.2, XL-G9.3, XL-G10.2, XL-G10.3, XL-G10.c or XL-G10.d



MANUFACTURER	LIST OF UL 2703 APPROVED MODULES
Heliene	Heliene modules with 40 mm frames YYZZxxxA Where "YY" can be 36, 60, 72, 96, 120 or 144; "ZZ" can be HC, M, P, or MBLK; and "A" can be blank, HomePV, or Bifacial
HT-SAAE	HT-SAAE modules with 35 and 40 mm frames HTyy-aaaZ-xxx Where "yy" can be 60, 66 or 72; "aaa" can be 18, 156 or 166; "Z" can be M, P, M-C, P-C, M(S), M(VS), M(V), P(V), M(V)-C, P(V)-C, or X
Hyundai	Hyundai modules with 33, 35, 40 and 50 mm frames HiY-SxxxZZ Where "Y" can be A, D or S; "S" can be M or S; and "ZZ" can be HG, HI, KI, MI, MF, MG, PI, RI, RG, RG(BF), RG(BK), SG, TI or TG
Itek	Itek Modules with 40 and 50 mm frames IT-xxx-YY Where "YY" can be blank, HE, or SE, or SE72
JA Solar	JA Solar modules with 30, 35, 40 and 45 mm frames JAyyzz-bbww-xxx/aa Where "yy" can be M, P, M6 or P6; "zz" can be blank, (K), (L), (R), (V), (BK), (FA), (TG), (FA)(R), (L)(BK), (L)(TG), (R)(BK), (R)(TG), (V)(BK), (BK)(TG), or (L)(BK)(TG); "bb" can be 48, 54, 60, 66, 72 or 78; "ww" can be D09, S01, S02, S03, S06, S09, S10, S12, S17, S20, S30 or S31; and "aa" can be BP, MR, SI, SC, PR, 3BB, 4BB, 4BB/RE, 5BB
Jinko	Jinko modules with 35 and 40 mm frames JKMYxxxZZ-aa Where "Y" can either be blank or S; "ZZ" can be M, P, or PP; and "aa" can be blank, 60, 60B, 60H, 60L, 60BL, 60HL, 60HB, 60HBL, 6HBL-EP, 60-J4, 60B-J4, 60B-EP, 60(Plus), 60-V, 60-MX, 6RL3, 6RL3-B, 6TL3-B, 7RL3-V, 7RL3-TV, 72, 72B, 72-J4, 72B-J4, 72(Plus), 72-V, 72H-V, 72L-V, 72HL-V, 72-MX, 72H-BDVP, 72HL-TV, or 72HL-V-MX3
Kyocera	Kyocera Modules with 46mm frames KYxxxZZ-AA Where "Y" can be D or U; "ZZ" can be blank, GX, or SX; and "AA" can be LPU, LFU, UPU, LPS, LPB, LFB, LFBS, LFB2, LPB2, 3AC, 3BC, 3FC, 4AC, 4BC, 4FC, 4UC, 5AC, 5BC, 5FC, 5UC, 6BC, 6FC, 8BC, 6MCA, or 6MPA
LG	LG modules with 35, 40, and 46 mm frames LGxxxYaZ-bb Where "Y" can be A, E, M, N, Q, S; "a" can be A, 1, 2 or 3; "Z" can be C, K, T, or W; and "bb" can be A3, A5, A6, B3, B6, E6, E6.AW5, G3, G4, J5, K4, L5, N5, V5, V6

MANUFACTURER	LIST OF UL 2703 APPROVED MODULES
Longi	Longi modules with 30, 35 and 40 mm frames LRa-YYZZ-xxxM Where "a" can be 4 or 6; "YY" can be blank, 60, 66 or 72; and "ZZ" can be blank, BK, BP, HV, PB, PE, PH, HBD, HIB, HIH, HPB, HPH, or HIBD
Mission Solar	Mission Solar modules with 33, 35 and 40 mm frames YYYbb-xxxZZaa Where "YYY" can be MSE or TXS; "bb" can be blank, 6 or 60A; "ZZ" can be blank, MM, SE, SO, SQ, SR, SX, TS, 120 or 144; and "aa" can be blank, BB, BW, 1J, 4J, 4S, 5K, 5R, 5T, 60, 6J, 6S, 6W, 6Z, 8K, 8T, or 9S
Mitsubishi	Mitsubishi modules with 46 mm frames PV-MYYxxxZZ Where "YY" can be LE or JE; and "ZZ" can be either HD, HD2, or FB
Motech	IM and XS series modules with 40, 45, and 50 mm frames
Next Energy Alliance	Next Energy Alliance modules with 35 and 40mm frames yyNEA-xxxZZ where "yy" can be blank or US; "ZZ" can be M, MB or M-60
Neo Solar Power	Neo Solar Power modules with 35 mm frames D6YxxxZZaa Where "Y" can be M or P; "ZZ" can be B3A, B4A, E3A, E4A, H3A, H4A; and "aa" can be blank, (TF), ME or ME (TF)
Panasonic (HIT)	Panasonic modules with 35 and 40 mm frames VBHNxxxYYzza Where "YY" can be either KA, RA, SA or ZA; "zz" can be either 01, 02, 03, 04, 06, 06B, 11, 11B, 15, 15B, 16, 16B, 17, or 18; and "A" can be blank E, G or N
Panasonic (EverVolt)	Panasonic modules with 30 mm frames EVPVxxxA Where "A" can be blank or H, K or PK
Peimar	Peimar modules with 40 mm frames SbxxxYzz Where "b" can be G, M or P; "Y" can be M or P; and "zz" can be blank, (BF), or (FB)
Philadelphia Solar	Philadelphia modules with 35 and 40 mm frames PS-YzzAA-xxx Where "Y" can be M or P; "zz" can be 60, 72 or 144; and "AA" can be blank, (BF), (HC) or (HCBF)

MANUFACTURER	LIST OF UL 2703 APPROVED MODULES
Phono Solar	Phono Solar modules with 35, 40, and 45 mm frames PSxxxY-ZZ/A Where "Y" can be M, M1, MH, M1H, M4, M4H, or P; "ZZ" can be 20 or 24; and "A" can be F, T, U, UH, or TH
Recom	Recom modules with 35 and 40 mm frames RCM-xxx-6yy Where "yy" can be MA, MB, ME or MF
REC Solar	REC modules with 30, 38 and 45 mm frames RECxxxYYZZ Where "YY" can be AA, M, NP, NP2, PE, PE72, TP, TP2, TP2M, TP2SM, TP2S, TP3M or TP4; and "ZZ" can be blank, Black, BLK, BLK2, SLV, 72 or Pure
Renesola	ReneSola modules with 35, 40 and 50 mm frames AAxxxY-ZZ Where "AA" can be SPM(SLP) or JC; "Y" can be blank, F, M or S; and "ZZ" can be blank, Ab, Ab-b, Abh, Abh-b, Abv, Abv-b, Bb, Bb-b, Bbh, Bbh-b, Bbv, Bbv-b, Db, Db-b, or 24/Bb
Renogy	Renogy Modules with 40 and 50 mm frames RNG-xxxY Where "xxx" is the module power rating; and "Y" can be D or P
Risen	Risen Modules with 35 and 40 mm frames RSMyy-6-xxxZZ Where "yy" can be 60, 72, 120, 132 or 144; and "ZZ" can be M or P
S-Energy	S-Energy modules with 35 and 40mm frames SABB-CCYYY-xxxZ Where "A" can be C, L or N; "BB" can be blank, 20, 40 or 45; "CC" can be blank, 60 or 72; "YYY" can be blank, MAE, MAI, MBE, MBI, MCE or MCI; and "Z" can be V, M-10, P-10 or P-15
SEG Solar	SEG Solar modules with 35 and 40 mm frames SEG-aYY-xxx-ZZ Where "a" can be blank, 6 or B; "YY" can be blank, MA, MB, PA, or PB; and "ZZ" can be blank, BB, BG, BW, HV, WB, WW, BMB, BMA-HV, BMA-TB, BMB- HV, BMB-TB, BMD-HV
Seraphim USA	Seraphim modules with 35, 40 and 50 mm frames SRP-xxx-YYY-ZZ Where "xxx" is the module power rating; and "YYY" can be 6MA, 6MB, 6PA, 6PB, BMD, 6QA-XX-XX, and 6QB-XX-XX; ZZ is blank, BB or HV

MANUFACTURER	LIST OF UL 2703 APPROVED MODULES
Sharp	Sharp modules with 35 and 40 mm frames NUYYxxx Where "YY" can be SA or SC
Silfab	Silfab Modules with 35 and 38 mm frames SYY-Z-xxxAb Where "YY" can be IL, SA, LA, SG or LG; "Z" can be blank, M, P, or X; "A" can be blank, B, H, M, N; and "b" can be A, C, G, K, L, N, T, U or X
Solaria	Solaria modules with 35 and 40 mm frames PowerXT-xxxY-ZZ Where "Y" can be R or C; and "ZZ" can be AC, BD, BX, BY, PD, PL, PM, PM-AC, PX, PZ, WX or WZ
Solarcity (Tesla)	Solarcity modules with 40 mm frames SCxxxYY Where "YY" can be blank, B1 or B2
SolarTech	SolarTech modules with 40 and 42 mm frames AAA-xxxYY Where "AAA" can be PERCB-B, PERCB-W, HJT B-B, HJT B-W or STU; "YY" can be blank, PERC or HJT
SolarWorld AG	SolarWorld Sunmodule Plus, Protect, Bisun, XL, Bisun XL, may be followed by mono, poly, duo, black, bk, or clear; modules with 31, 33 or 46 mm frames SW-xxx
SolarWorld Americas	SolarWorld Sunmodule Plus, Protect, Bisun, XL, Bisun XL, may be followed by mono, poly, duo, black, bk, or clear; modules with 33 mm frames SWA-xxx
Sonali	Sonali Modules with 40 mm frames SSxxx
Stion	Stion Thin film modules with 35 mm frames STO-xxx or STO-xxxA
SunEdison	SunEdison Modules with 35, 40 & 50 mm frames SE-YxxxZABCDE Where "Y" can be B, F, H, P, R, or Z; "Z" can be 0 or 4; "A" can be B, C, D, E, H, I, J, K, L, M, or N; "B" can be B or W; "C" can be A or C; "D" can be 3, 7, 8, or 9; and "E" can be 0, 1 or 2
Suniva	Suniva modules with 35, 38, 40, 46, and 50 mm frames OPTxxx-AA-B-YYY-Z MVXxxx-AA-B-YYY-Z Where "AA" is either 60 or 72; "B" is either 4 or 5; "YYY" is either 100,101,700,1B0, or 1B1; and "Z" is blank or B



MANUFACTURER	LIST OF UL 2703 APPROVED MODULES
Sunpower	Sunpower standard (G3 or G4) or InvisiMount (G5) 35, 40 and 46 mm frames SPR-Zb-xxx-YY Where "Z" is either A, E, P, M or X; "b" can be blank, 17, 18, 19, 20, 21, or 22; and "YY" can be blank, BLK, COM, C-AC, D-AC, E-AC, BLK-E-AC, G-AC, BLK-C-AC, or BLK-D-AC
Sunspark	Sunspark modules with 40 mm frames SYY-xxxZ-A Where "YY" can be MX or ST; and "Z" can be M, MB, M3, M3B, P or W; and "A" can be 60 or 72
Suntech	Suntech Modules with 35, 40 and 50mm frames STPxxxxy-zz/aa Where "y" is blank or S; and "z" can be 20, 24, A60 or A72U; and "aa" can be Vd, Vem, Vfw, Vfh, Wdb, Wde, Wd, or Wfhb
Talesun	Talesun modules with 35 and 40mm frames TP6yZZaaxxx-b Where "y" can be blank, F, H, or L; "ZZ" can be 60 or 72; "aa" can be M, M(H), or P; and "b" can be blank, B, T, or (H)
Tesla	Tesla modules with 40 mm frames TxxxY Where "Y" can be H or S
Trina	Trina Modules with 30, 35, 40 and 46mm frames TSM-xxxYYZZ Where "YY" can be DD05, DD06, DD14, DE09, DE14, DE06X, DE15, DE15V, DEG15, PA05, PC05, PD05, PD06, PA14, PC14, PD14, PE14, or PE15 ; and "ZZ" can be blank, (II), .05, .05(II), .08, .10, .18, .08D, .18D, 0.82, .002, .00S, 05S, 08S, A, A.05, A.08, A.10, A.18, A(II), A.05(II), A.08(II), A.082(II), A.10(II), A.18(II), H, H(II), H.05(II), H.08(II), HC.20(II), HC.20(II), M, M(II), M.05(II), MC.20(II)
URE	URE modules with 35 mm frames DyZxxxxaa Where "D" can be D or F, "y" can be A, 6 or 7; "Z" can be K or M; and "aa" can be H3A, H4A, H8A, E7G-BB, E8G or E8G-BB
Vikram	Vikram solar modules with 40 mm frames VSyy.ZZ.AAA.bb Where "yy" can be M, P, MBB, MH, MS, MHBB, or PBB; "ZZ" can be 60 or 72; "AAA" is the module power rating; and "bb" can be 03, 04 or 05



MANUFACTURER	LIST OF UL 2703 APPROVED MODULES
VSUN	VSUN modules with 30, 35 and 40 mm frames VSUNxxx-YYz-aa Where "YY" can be 60, 72, 108, 120, or 144; "z" can be M, P, MH, PH, or BMH; and "aa" can be blank, BB or BW
Waaree	Waaree modules with 40mm frames WSyy-xxx where "yy" can be blank or M
Winaico	Winaico modules with 35 and 40 mm frames Wsy-xxxZa Where "y" can be either P or T; "Z" can be either M, P, or MX; and "a" can be blank or 6
Yingli	Yingli modules with 35 and 40 mm frames YLxxxZ-yy Where "Z" can be D or P; "yy" can be 29b, 30b, 34d, 35b, 36b or 40d
ZN Shine	ZN Shine modules with 35mm frames ZXMY-AAA-xxx/M Where "Y" can be 6 or 7, "AAA" can be 72, NH120, NH144 or NHDB144

CLAMP PART NUMBERS

END CLAMPS

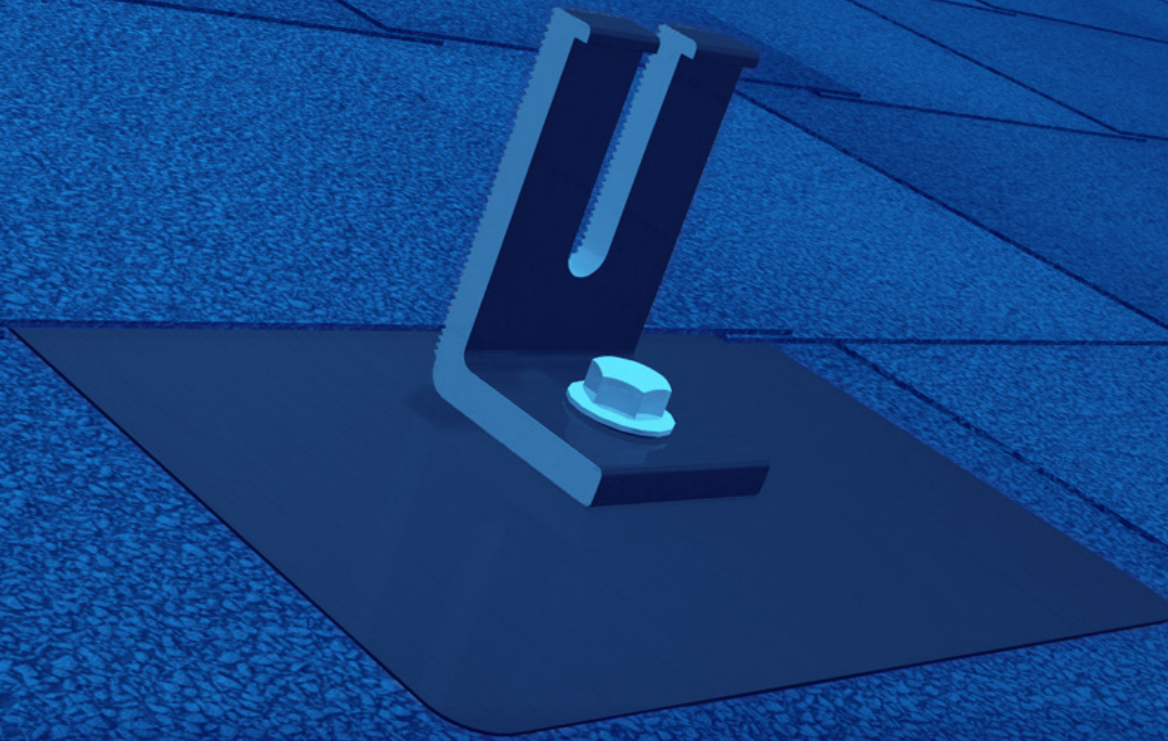
Frame Thickness	Article Number
30 mm	2099016
32 mm	2099017
35 mm	2099018
38 mm	2099019
40 mm	2099020
45 mm	2099021

MID CLAMPS

Frame Thickness	Article Number
30-40 mm	2099022
40-50 mm	2099023

INSTALLER RESPONSIBILITIES

Periodic re-inspection of components shall be performed to verify that there is no corrosion detrimental to system strength and electrical conductivity, no loose bolts, and/or other variables that could compromise array safety. Any corroded or damaged components shall be immediately replaced.



GF-1[®]

COMPLETE MOUNT & FLASHING ASSEMBLY

INSTALLATION GUIDE

REVISION: 04/05/22

VERSION: V2.4

GF-1

INSTALLATION GUIDE



EcoFasten[®]
For Installers. By Installers.

CLICKING THE PAGE NAME WILL TAKE YOU TO THAT PAGE

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[COMPONENTS](#) [PAGE 03](#)

[INSTALLATION](#) [PAGE 04](#)

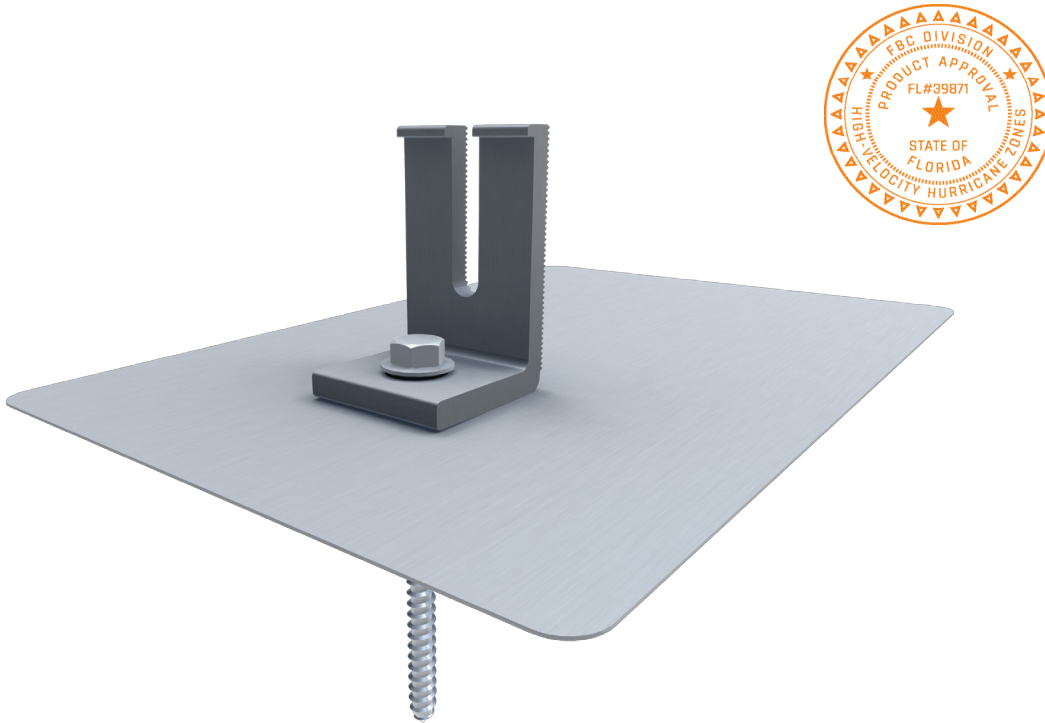
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[SPECIFICATIONS](#) [PAGE 12](#)

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GF-1

INSTALLATION GUIDE



GF-1

GF-1 is our most versatile solution for composition shingle roofs. Install the flashing using a single fastener for a quick & easy installation. When using the GF-1 flashing grommet and an EcoFasten compression bracket, a watertight seal is created, maintaining the integrity of the roof.

FEATURES

- Mill or black finish
- Patented Watertight Technology
- Installs without removing shingles
- Single lag bolt attachment
- Compatible with a variety of compression brackets
- Florida Product Approved for any combination of 8"x12" GF-1 flashing with the ClickFit L-foot & Lag Screw

FEATURES + BENEFITS

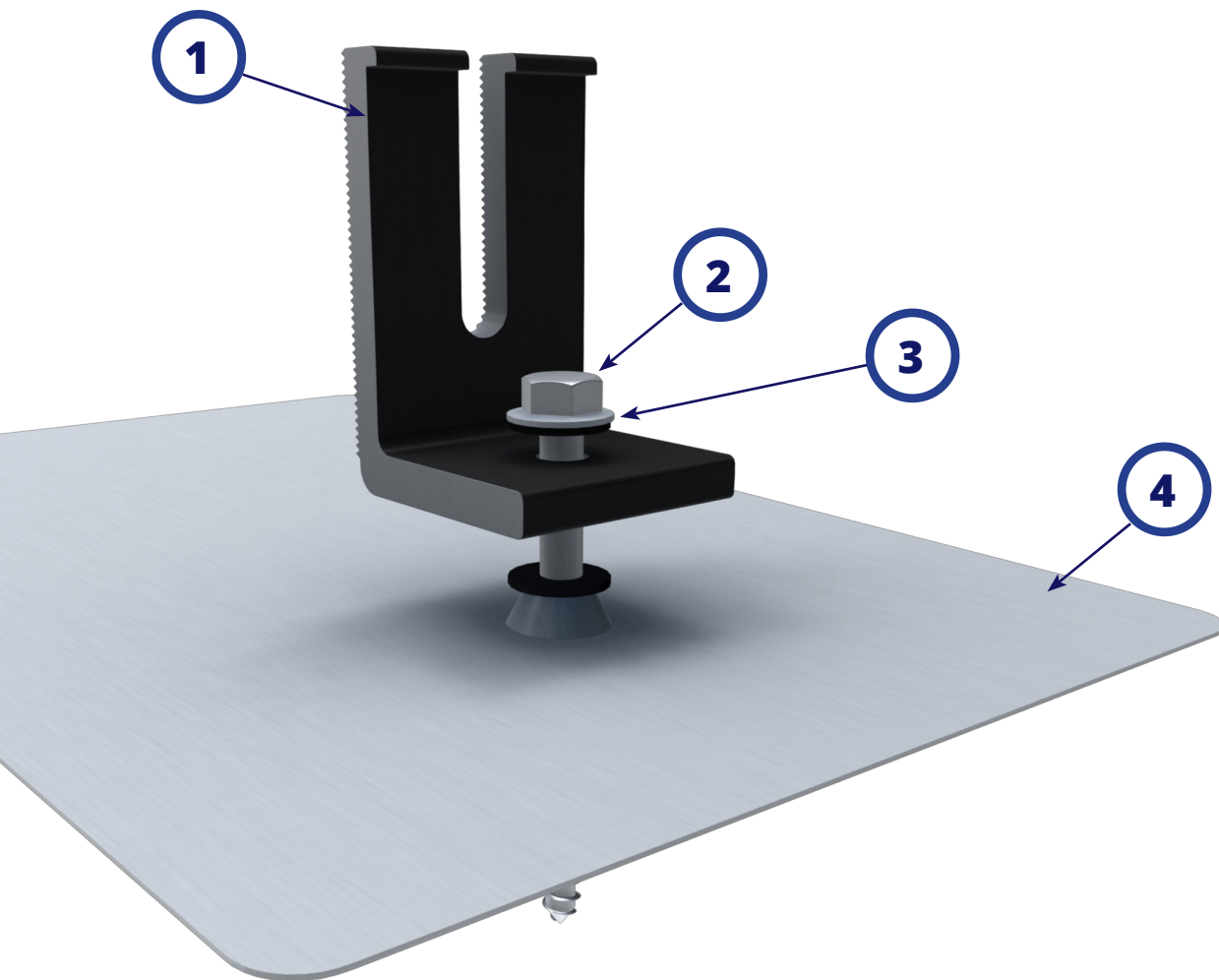
GF-1

INSTALLATION GUIDE



EcoFasten[®]
For Installers. By Installers.

SYSTEM COMPONENTS



1. L-FOOT SCL-101 BLK 3"
(OTHER OPTIONS AVAILABLE)

2. 5/16" LAG BOLT
(AVAILABLE IN 3" AND 4")

3. 5/16" EPDM BONDED WASHER

4. GF-1 FLASHING GLV MLL 8X12" -
GALVALUME FLASHING WITH PRE-
INSTALLED EPDM RUBBER GASKET

(AVAILABLE IN 8X10 & 8X12, WITH MILL & BLACK
FINISH OPTIONS)

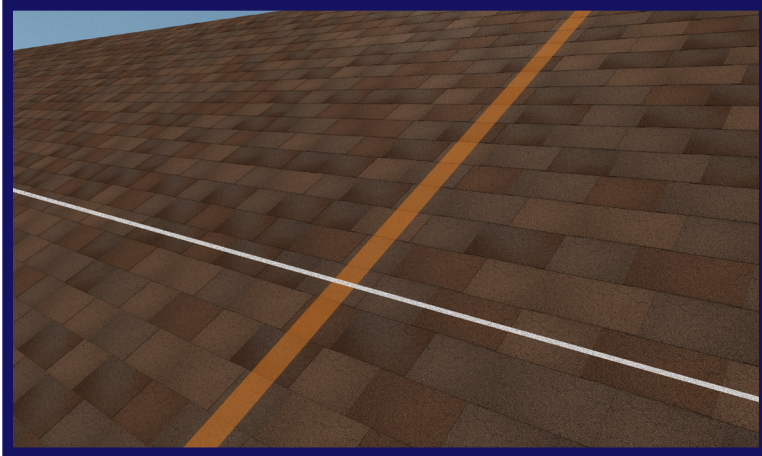
COMPONENTS

GF-1

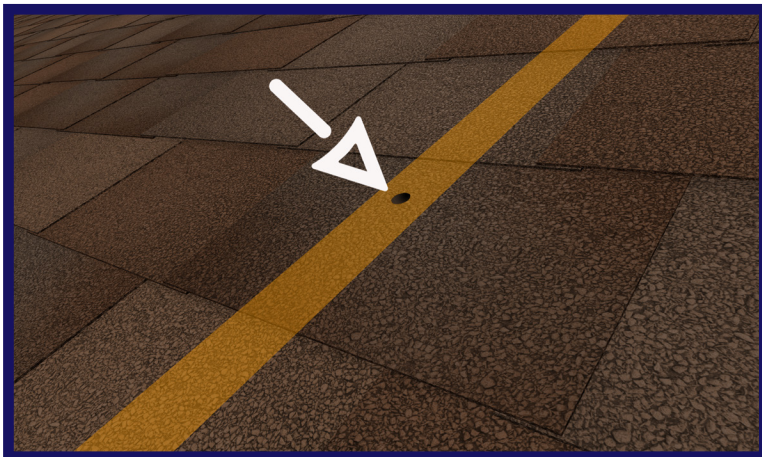
INSTALLATION GUIDE



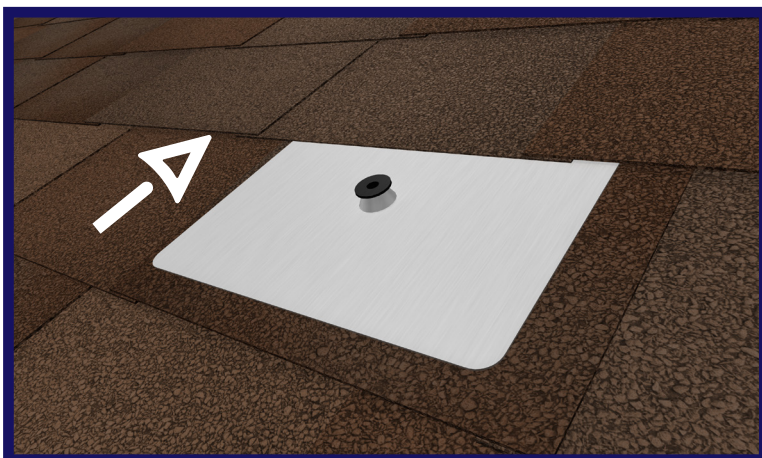
INSTALLING GF-1



Snap horizontal lines across the roof to mark the mount rows, then locate the rafter and mark the installation position of each GF-1 flashing.



Drill a 7/32" pilot hole into the rafter or structural member for the lag screw. Backfill with sealant compatible with the roof type.



Slide flashing up under the next row of shingles directly above the pilot hole, taking care to align the hole in the flashing with the pilot hole.

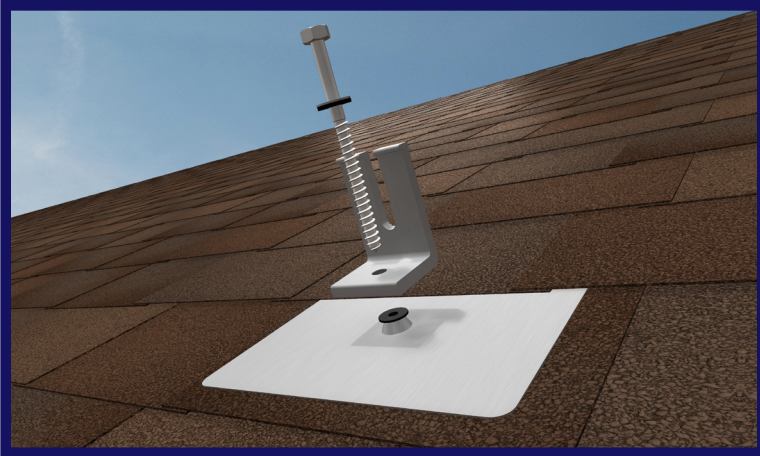
GF-1

INSTALLATION GUIDE

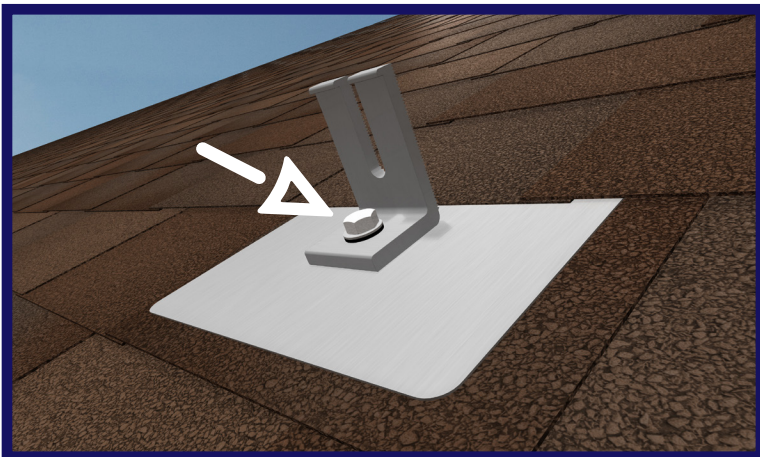


EcoFasten[®]
For Installers. By Installers.

INSTALLING GF-1



Thread the EPDM bonded washer onto the lag bolt followed by one of EcoFasten's compression brackets and then insert the lag bolt into the gasketed hole in the flashing.



Drive the lag bolt down into the rafter using an impact driver. Torque range is between 100-400 torque inch-pounds depending on the type of wood and time of year. The visual indicator for proper torque is when the EPDM on the underside of the bonded washer begins to push out the sides as the washer compresses. Do not over torque.

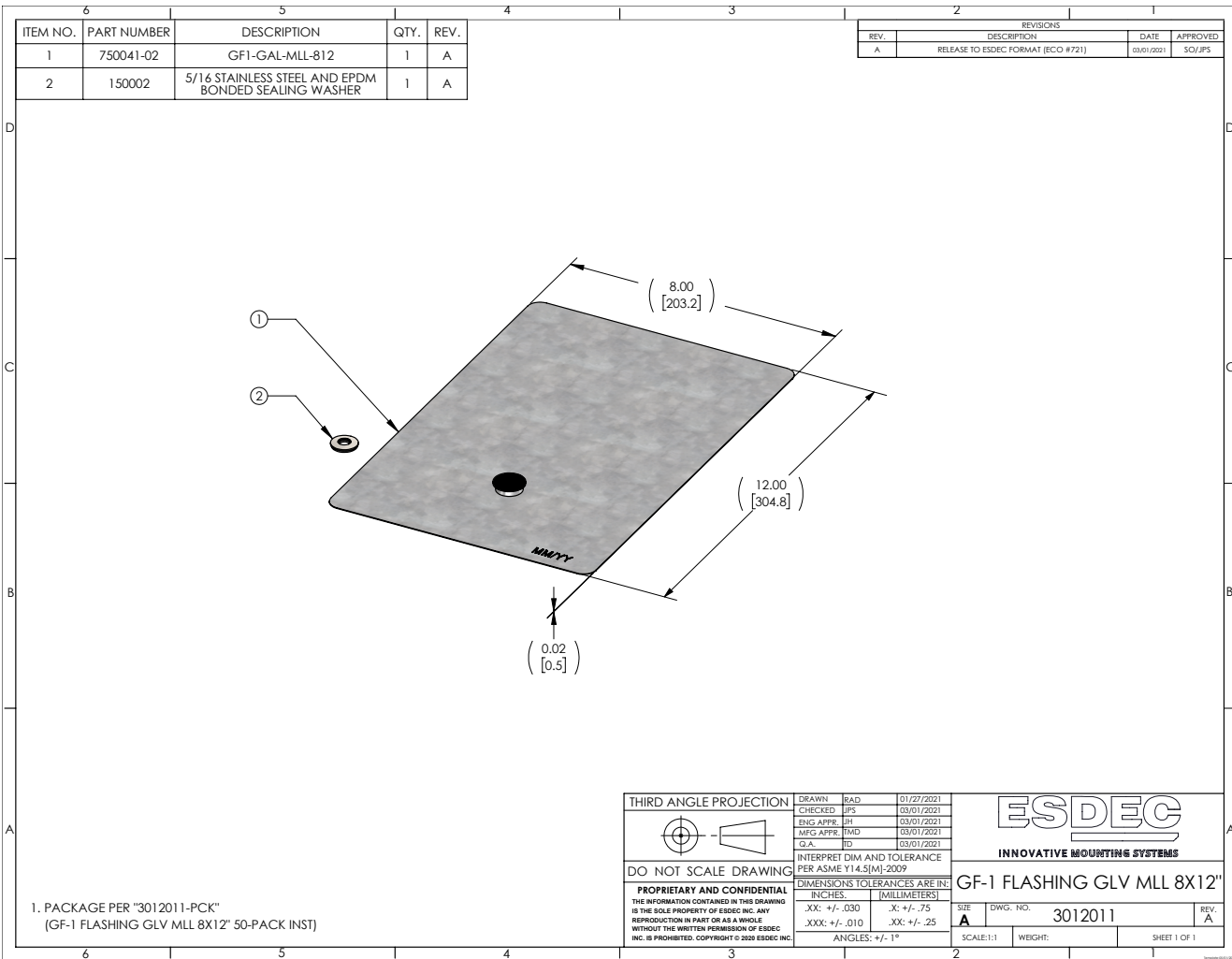
INSTALLATION

GF-1

INSTALLATION GUIDE



CUT SHEET: GF-1 FLASHING GLV MLL/BLK



LINE DRAWINGS

GF-1

INSTALLATION GUIDE



CUT SHEET: L-FOOT L-102 BLK 3"

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	REV.
1	450050-01	L-102-3 ANOD BLK	1	01
2	150009-08	SS HEX HD CAP SCREW, FULL THD, 3/8-16 UNC X 1.25 LONG	1	01
3	150011-03	SS SERRATED FLANGE LOCK NUT, 3/8-16	1	02

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	RELEASE TO ESDC FORMAT (ECO#723)	04/02/2021	RAD/JPS

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SCALE: 1:1	WEIGHT:		SHEET 1 OF 1																																

1. PACKAGE PER "3011015-PCK"
(L-FOOT L-102 BLK 3" 50-PACK INST)

LINE DRAWINGS

GF-1

INSTALLATION GUIDE



CUT SHEET: L-FOOT L-102 MLL 6"

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	REV.
1	450082-02	L-102-6	1	01
2	150009-08	SS HEX HD CAP SCREW, FULL THD, 3/8-16 UNC X 1.25 LONG	1	01
3	150011-03	SS SERRATED FLANGE LOCK NUT, 3/8-16	1	02

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	RELEASE TO ESDC FORMAT (ECO #722)	04/05/2021	RAD/JFS

<p>THIRD ANGLE PROJECTION</p>	<table border="1"> <tr><td>DRAWN</td><td>RAD</td><td>02/01/2021</td></tr> <tr><td>CHECKED</td><td>JFS</td><td>04/05/2021</td></tr> <tr><td>ENG APPR</td><td>JH</td><td>04/05/2021</td></tr> <tr><td>MFG APPR</td><td>TMD</td><td>04/05/2021</td></tr> <tr><td>Q.A.</td><td>TD</td><td>04/05/2021</td></tr> </table>	DRAWN	RAD	02/01/2021	CHECKED	JFS	04/05/2021	ENG APPR	JH	04/05/2021	MFG APPR	TMD	04/05/2021	Q.A.	TD	04/05/2021	<p>ESDEC INNOVATIVE MOUNTING SYSTEMS</p>
DRAWN	RAD	02/01/2021															
CHECKED	JFS	04/05/2021															
ENG APPR	JH	04/05/2021															
MFG APPR	TMD	04/05/2021															
Q.A.	TD	04/05/2021															
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.XXX: +.010	.XX: +.25																
SIZE	DWG. NO.	REV.															
A	3011016	A															

1. PACKAGE PER "3011016-PCK"
(L-FOOT L-102 MLL 6" 50-PACK INST)

LINE DRAWINGS

GF-1

INSTALLATION GUIDE



CUT SHEET: L-FOOT SCL-101 MLL/BLK 3"

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	REV.
1	450049-02	L FOOT W/ STANDARD DIMPLE AND OPEN SLOT, 3 IN TALL MLL	1	01
2	150009-08	SS HEX HD CAP SCREW, FULL THD, 3/8-16 UNC X 1.25 LONG	1	01
3	150011-03	SS SERRATED FLANGE LOCK NUT, 3/8-16	1	02

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	NEW RELEASE TO ESDC FORMAT (ECO #748)	04/05/2021	RAD/JPS

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CHECKED	JPS	04/05/2021																								
ENG APPR	JH	04/05/2021																								
MFG APPR	TMD	04/05/2021																								
G.A.	TD	04/05/2021																								
SIZE	DWG. NO.	REV.																								
A	3011017	A																								
SCALE: 1:1	WEIGHT:	SHEET 1 OF 1																								

1. PACKAGE PER "3011017-PCK"
(L-FOOT SCL-101 MLL 3" 50-PACK INST.)

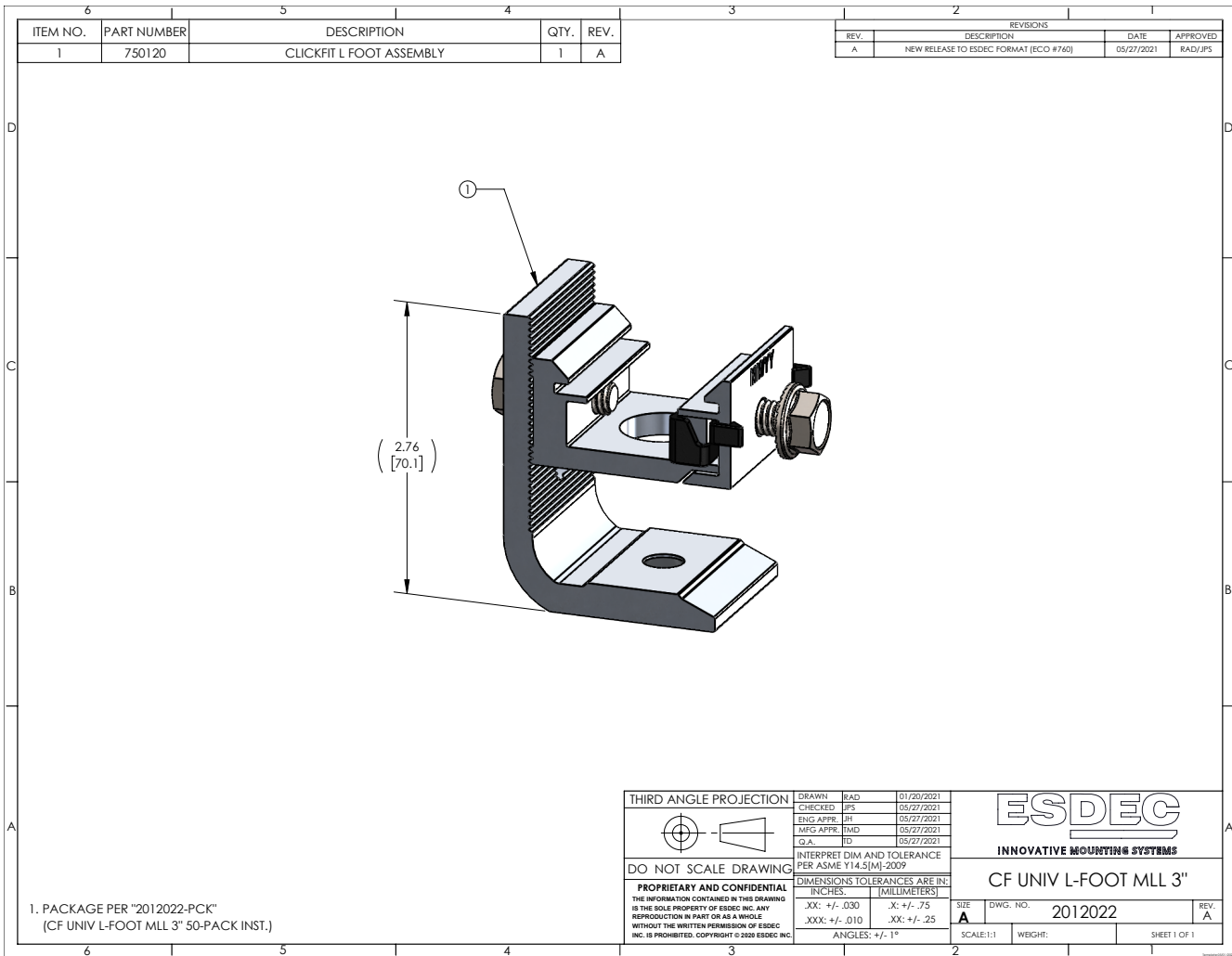
LINE DRAWINGS

GF-1

INSTALLATION GUIDE



CUT SHEET: CF UNIV L-FOOT MLL 3" - 2012022



LINE DRAWINGS

GF-1

INSTALLATION GUIDE



CUT SHEET: RI COMP SLIDE AL BLK - 2011013

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	REV.
1	450092-01	ROCKIT V3 SLIDE.COMP	1	01
2	53-100-010	LAG SCREW, 5/16-4", THREAD 3", EPDM BACKED WASHER	1	C

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	NEW RELEASE TO ESDEC FORMAT (ECO #733)	07/14/2021	RAD/JFS

THIRD ANGLE PROJECTION 	DRAWN: RAD 02/26/2021 CHECKED: JFS 04/13/2021 ENG APPR: JH 04/13/2021 MFG APPR: TD 04/13/2021 QA: RT 04/13/2021	<p>ESDEC INNOVATIVE MOUNTING SYSTEMS</p>
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DIMENSIONS TOLERANCES ARE IN: INCHES: .XX: +/- .030 .X: +/- .75 .XXX: +/- .010 .XX: +/- .25 ANGLES: +/- 1°		INTERPRET DIM AND TOLERANCE PER ASME Y14.5[M]-2009 DWG. NO. 2011013 SCALE: 2:3 WEIGHT: SHEET 1 OF 1

1. PACKAGE PER "2011013-PCK"
(RI COMP SLIDE AL BLK 50-PACK INST.)

LINE DRAWINGS

GF-1

INSTALLATION GUIDE



EcoFasten[®]
For Installers. By Installers.

SYSTEM COMPONENTS

1. **GF-1 Flashing:**

All flashing options come with a pre-installed integrated EPDM grommet and one bonded stainless steel EPDM washer. Flashing are available in three options:

1. 8 x 12" .032 gauge galvalume with mill or black (kynar painted) finish.
2. 8 x 10" .032 gauge galvalume with black (kynar painted) finish.
3. 8 x 12" .032 gauge aluminum with black (kynar painted) finish.

2. **Aluminum Compression Bracket:**

Compatible with a variety of EcoFasten compression brackets. EcoFasten compression brackets are made out 6000 series aluminum with options available for mill or black finishes depending on the bracket.

3. **Recommended Fasteners**

5/16"x4" lag bolts. 3" option also available.

4. **Recommended Sealant:**

If required by roof manufacturer, sealant shall be roof manufacturer approved.

DELIVERY / STORAGE / HANDLING

Inspect material upon delivery. Notify manufacturer within 24 hours of any missing or defective items. Keep material dry, covered and off the ground until installed.

GF-1

INSTALLATION GUIDE



EcoFasten[®]
For Installers. By Installers.

FLORIDA PRODUCT APPROVAL

Approved for any combination of 8"x12" GF-1 flashing with the ClickFit L-foot & Lag Screw.

PATENTS

Visit www.efpatents.com for patent information.

DESIGN REQUIREMENTS

1. Bracket spacing to be recommended by project engineer.
2. It is important to design new structures or assess existing structures to make sure they withstand retained loads.

EXAMINATION

1. Substrate: Inspect structure on which brackets are to be installed and verify that it will withstand any additional loading that may be incurred.
2. Notify General Contractor of any deficiencies before installing EcoFasten Solar brackets.
3. Verify that roofing material has been installed correctly prior to installing solar attachment bracket.

INSTALLATION

Comply with architectural drawings and project engineer's recommendation for location of system. Comply with Manufacturer's written installation instructions for installation and layout.

ESDEC, INC. TEST REPORT

SCOPE OF WORK

UL 441 TESTING ON ECOFASTEN'S GF1

REPORT NUMBER

104500499LAX-001

ISSUE DATE

09-DECEMBER-2020

PAGES

6

DOCUMENT CONTROL NUMBER

GFT-OP-10a (21-June-2019)

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SUMMARY REPORT

09-DECEMBER-2020

Intertek Report No.: 104500499LAX-001

Intertek Project No.: G104500499

Yann Schwarz
ESDEC, Inc.
28357 Industrial Blvd.
Hayward, CA 94545

Ph: 510 225-0973
Email: yann.schwarz@esdec.com

Subject: Project Summary of the Rain Testing per UL 441 on Ecofasten's GF1

Dear Mr. Yann Schwarz

Intertek was contracted by ESDEC, Inc. to perform testing in general accordance with UL 441 on Ecofasten's GF1 photovoltaic (PV) module attachment. Results obtained are tested values and were secured by using the designated test method(s). Testing was conducted at ESDEC's test facility at 28357 Industrial BLVD, Hayward, CA 94545.

This letter report represents the summary of our evaluation of the above referenced product(s).

UL 441, Safety for Gas Vents, Section 27: Rain Test

This letter report does not constitute certification of this product or any opinion or endorsement by this laboratory. If there are any questions regarding the results contained in this report, or any of the other services offered by Intertek, please do not hesitate to contact your dedicated Intertek Project Manager.

Completed by:	Deep Vora	Reviewed by:	Samantha Doshi
Title:	Project Engineer	Title:	Team Lead - Solar
Signature:		Signature	
Date	December 09, 2020	Date:	December 09, 2020

Please note: this Letter Report does not represent authorization for the use of any Intertek certification marks.

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SUMMARY REPORT

SECTION 1

MATERIAL SOURCE/INSTALLATION

The test specimen was provided by the client. The specimen was installed onto a Spruce-Pine-Fir wood deck. The test deck measured 3' wide by 3' high and was constructed of #2 Spruce Pine Fir nominal 2x4 lumber. One rafter was centered on deck for bolt attachment. The rafters were attached to the top and bottom plates with 3" long roofing screws. A sheet of nominal 15/32" thick plywood was secured to the studs with #8 x 1-5/8" roofing screws. The test deck was then covered with #30 felt paper and three-tab asphalt shingles.

Description/Installation (GF1 by Ecofasten): The test specimen was composed of an 8" x 12" x 0.03125" thick galvalume flashing and a 1-7/8" wide by 3" high extruded aluminum L-foot. The underside of the L-foot was secured with one 5/16"x 4" lag screw with a EPDM backed washer through the L-foot, flashing and into the center rafter of the test deck. The GF1 assembly was installed without sealant.

GF1 L-Foot Part numbers covered by this test report are as follows:

Part Number	Description
3011015 or L-102-3-ANOD BLK	L-FOOT L-102 BLK 3"
3011017 or SCL-101-3 ANOD BLK	L-FOOT SCL-1010 MLL 3"
3011018 or SCL-101-3	L-FOOT SCL-1010 BLK 3"

SECTION 3

LIST OF OFFICIAL OBSERVERS

NAME	COMPANY
Jae Hendrickson	ESDEC, Inc.

SECTION 4

TEST RESULTS

The temperature during testing was 18°C (64°F) and the humidity was 57%. The results are tabulated as follows:

Test Specimen #1 (GF1 by Ecofasten):

TITLE OF TEST	RESULTS	ALLOWED	NOTE
Water Penetration, Per UL 441 - One hour of water spray	Pass	No leakage	1, 2, 3

General Note: All testing was performed in accordance with the referenced standard(s).

Note 1: Tested at 2/12 pitch

Note 2: Test results are applicable for asphalt shingle roofs having a slope of 2:12 or greater

Note 3: No sealant was used in this test. Any Roofing manufacturer approved sealant is allowed

SUMMARY REPORT

SECTION 5
PHOTOGRAPHS



Photo No. 1

Unassembled Test Specimen (including 1 lag screw, 1 flashing, and 1 aluminium L-foot)



Photo No. 2

Test Specimen Under Test

SUMMARY REPORT



Photo No. 3
Test Specimen After Test

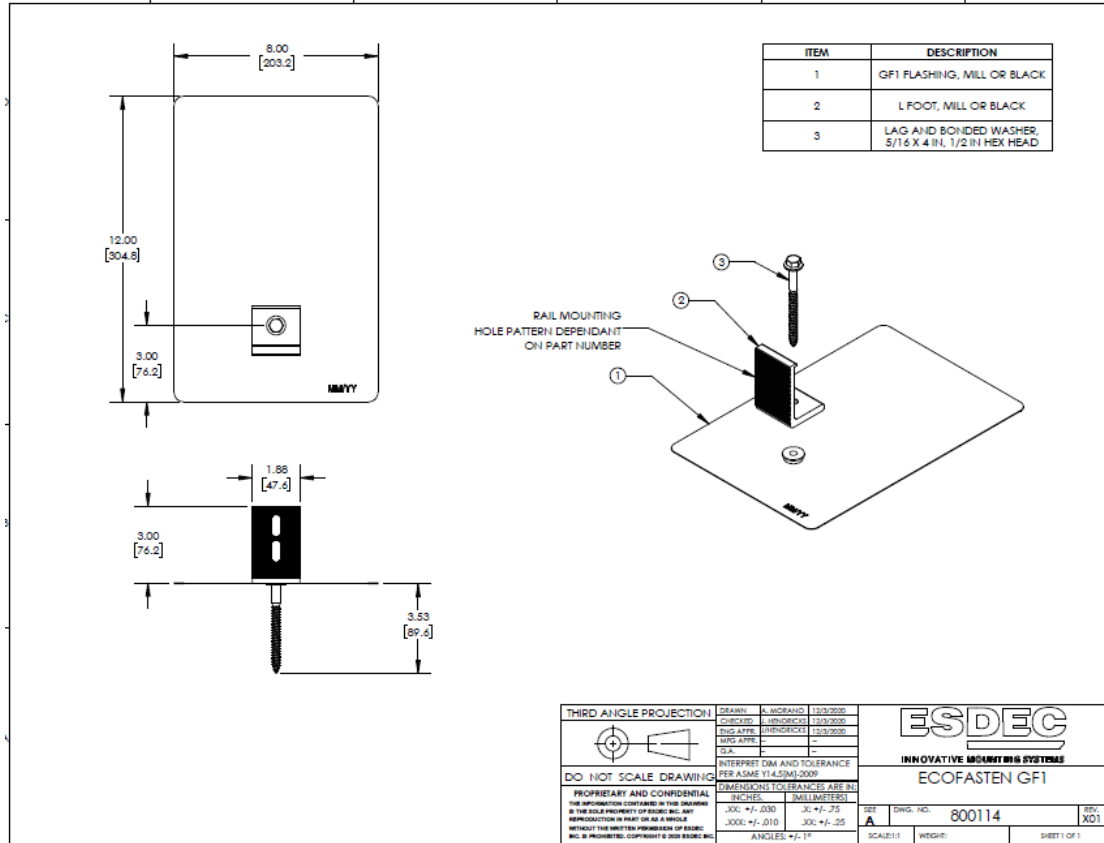


Photo No. 4
Underside of Test Desk After Test – no visible water penetration

SUMMARY REPORT

SECTION 6
DRAWINGS

The test specimen drawings have been reviewed by Intertek and are representative of the test specimen(s) reported herein. Any deviations are documented herein or on the drawings.



Drawing No. 1
Ecofasten's GF1