Historic Preservation Services
Community Development & Neighborhood Services
281 N. College Ave.
Fort Collins, CO 80524

970.224.6078
preservation@fcgov.com
fcgov.com/historicpreservation

REPORT OF ALTERATIONS TO DESIGNATED RESOURCE
Site Number/Address: 300 Peterson St.
Laurel School National Register Historic District
ISSUED: March 11, 2025

Kevin J. Cross
c/o Andrew Krueger, Sandbox Solar, LLC
112 Racquette Dr., Unit C
Fort Collins, CO 80524

Dear Kevin Cross:

This report is to inform you of the results of this office's review of proposed alterations to the Williamson/Spangler Residence at 300 Peterson St., pursuant to Fort Collins Municipal Code, Chapter 14, Article IV. A copy of this report may be forwarded to the Colorado Office of Archaeology and Historic Preservation as well.

The alterations reviewed include:

- Flush-mounted rooftop solar PV system
    - *Note:* Although this work generally meets adopted standards for historic preservation review of solar systems, the location of the AC disconnect and combiner equipment does not; if this equipment were relocated from the north elevation to the east elevation, this would meet the review standards. Although the north elevation is not the primary elevation of this historic home, it does face the street; moving this equipment to the east would entirely eliminate visual impact of the solar system from public rights of way. This alteration to this single-unit dwelling on the National Register of Historic Places is not required to comply with this guidance, but please consider the change.

Our staff review of the proposed work finds the alterations generally meet the SOI Standards for Rehabilitation, except as noted above, and the project appears to have minimal effects to the historic resource, meeting the requirements of Article IV cited above.

Notice of the approved application has been provided to building and zoning staff to facilitate the processing of any permits that are needed for the work.

Please note that work beyond that indicated in your permit application/correspondence requires additional approval.

If you have any questions regarding this report, or if I may be of any assistance, please do not hesitate to contact me. I can be reached at yjones@fcgov.com or at 970-224-6078.

Sincerely,
Yani Jones, Historic Preservation Planner

City of Fort Collins

BUILDING PERMIT APPLICATION:

Solar PV

All information on the application must be filled out (as applicable).

Scope of work *(check one)*

New system installation ☑ Alterations to an existing system ☐ (new equipment or expansion) Reinstallation of an existing system ☐ (same equipment and same location)

USE / TYPE OF BUILDING *(check the correct uses below):*

Residential ☑ Commercial ☐

Single family detached ☑ Duplex/Two-Family ☐ Single Family Attached (Townhome) ☐ Multi-Family (Apartment/Condo) ☐

Garage ☐ Bank ☐ Bar ☐ Church ☐ Hotel/Motel ☐ Medical Office ☐ Retail ☐ Other ☐: _____

JOB SITE ADDRESS: 300 Peterson St Fort Collins, CO 80524 **UNIT#:** _____

PROPERTY OWNER INFO: (All owner information is required – NOT optional)

Last Name Cross First Name Kevin Middle _____

Street Address 300 Peterson St City Fort Collins State CO Zip 80524

Phone # (970) 484-3141 Email jkevin87@comcast.net

CONTRACTOR INFO:

Company Name Sandbox Solar LLC

License Holder Name Ian Skor LIC # S-3665 CERT # 4119-S

CONSTRUCTON INFO *(check any that apply)*:

PV (photovoltaic) ☑ Thermal Hydronic System ☐ Battery Storage ☐

Mounting: Ground ☐ Roof ☑

UTILITES INFO:

Electric Service Upgrade? Yes ☐ No ☑ Existing Amps _____ New Amps _____

Electric Meter Relocation? Yes ☐ No ☑

Meter change out? Yes ☐ No ☑

Panel change out? Yes ☐ No ☑

VALUE OF CONSTRUCTION (*materials and labor*): $ 14,437.50

DESCRIPTION OF WORK *(Include KWh and number of solar panels):*

Install a 4.20kW Grid-Tied. Flush Roof Mounted PV System, Utilizing (10) 420WModules

JOBSITE SUPERVISOR CONTACT INFO: Name Daniel Weaver Phone 970-234-2686

SUBCONTRACTOR INFO:

Electrical Sandbox Solar Plumbing _____

Applicant: I hereby acknowledge that I have read this application and state that the above information is correct and agree to comply with all requirements contained herein and City of Fort Collins ordinances and state laws regulating building construction.

Applicant Signature _____ Type or Print Name Andrew Krueger

Phone # 970-673-7733 Email engineering@sandboxsolar.com

THIS APPLICATION EXPIRES 180 DAYS FROM APPLICATION DATE

Date: 01/29/25
Sandbox Solar
112 Racquette Dr. Unit C, Fort Collins, CO 80524
Subject: Structural Certification for Installation of Residential Solar

Project Address: 300 Peterson St, Fort Collins, CO 80524

Attn: To Whom It May Concern,
A field observation was performed to document the existing framing of the project address.
From the field observation, the existing roof structure was observed as:

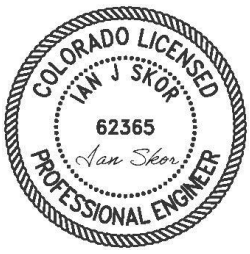
Roof 1: 2 x 12 Roofing supported by Rafters. The roof is sloped at approximately 45 degrees and has a max beam span of 18 ft between supports.

Roof 2: 2 x 12 Roofing supported by Rafters. The roof is sloped at approximately 45 degrees and has a max beam span of 18 ft between supports.

Design Criteria:
Code: 2021 IBC
Ult Wind Speed: 125 mph
Exposure Cat: C
Ground Snow: 35 psf
Min Roof Snow: 30 psf

After review of the field observation report and based on our structural capacity calculations, in accordance with applicable building codes, the existing roof framing supporting the proposed solar panel layout has been determined to be:

Roof 1: *Adequate to support the imposed loads. Therefore, no structural upgrades are required.*
Roof 2: *Adequate to support the imposed loads. Therefore, no structural upgrades are required.*



Ian Skor, Sandbox Solar LLC
Professional Engineer
ijskor@sandboxsolar.com

Sandbox Solar

Ian Skor, PE
Sandbox Solar
112 Racquette Dr
Fort Collins, CO 80524

Input Summary

Input	Value
Project Name	2069_Cross
Address	300 Peterson St, Fort Collins, CO 80524
Roof Number	001
Design Code	2021 IBC
Risk Category	Risk Category II
Number of Panels *Used in calculating the total additional weight due to PV panel installation (for seismic check)*	3
Area of one PV Panel	19sq.ft.
Panels Dead Load	3psf
Roofing Weight	3psf
Decking Weight	2psf
Framing Weight	0.6psf
Miscellaneous Additional Weight	1psf
Live Load	20psf
Basic Wind Speed *See Figures 26.5-1 to 26.5-2 of ASCE 7-16.*	125mi/h
Ground Elevation *(Optional) Ground elevation above mean sea level. For calculated Ground Elevation Factor Ke (default value is 1.0)*	4977ft
Exposure Category *Based on Section 26.7.3 of ASCE 7-16*	Exposure C
Building Width *Used when roof pitch angle is less than 7°, the wind load pressures will be calculated based on Section 29.4.3*	30ft
Building Length *Used when roof pitch angle is less than 7°, the wind load pressures will be calculated based on Section 29.4.3*	30ft
Ground Snow Load	35psf
Min. Roof Snow Load	30psf
Surface Roughness Category *B. Urban and suburban areas, wooded areas or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger.* *C. Open terrain with scattered obstructions having heights generally less than 30 feet. This category includes flat open country, and grasslands.* *D. Flat, unobstructed areas and water surfaces. This category includes smooth mud flats, salt flats and unbroken ice.* *Above the tree line in windswept mountainous areas* *In Alaska, in areas where trees do not exist within a 2-mi (3-km) radius of the site.*	Surface Roughness C
Roof Exposure *For determination of Exposure Factor C_e (Table 7.3-1 of ASCE 7-16)*	Fully exposed
Thermal Condition *For determination of Thermal Factor C_t (Table 7.3-2 of ASCE 7-16)*	Structures kept just above freezing and others with cold, ventilated roofs...
S_{DS} *Short-period Spectral Acceleration from Section 11.4.5 of ASCE 7-16*	0.33
Roof Profile *Used in calculating design wind pressures and snow load*	Gable
Roof Material	Composition Shingle
Rafter/Chord Span *Used in calculating applied shear and moment forces, and deflections (based on Table 3-22c of AISC-15)*	2 spans
Length of truss chord/rafter	18ft
Frame Spacing	2ft
Roof Angle/Slope *used in calculating wind and snow load*	45°
Mean roof height of the building, h *Mean roof height of the building*	30ft

Input	Value
Construction Type	Rafter
Section Size	2 x 12
Wood Specie	DOUGLAS FIR-LARCH (No.2)
Attachment Tributary Width *Spacing of attachment along the rails*	2.75ft
Attachment Spacing *Spacing of attachment between rails*	4ft
Fastener method	5/16 in. Lag Screw
Lag Penetration	3.67in
Ref. Withdrawal Value W	266lb/in
Ref. Lateral Value, Z	270lb
Show Calculation	Yes

Structural Engineering Design of Photovoltaic Panels

Project Information:

Parameter	Value
Project Name	2069_Cross
Address	300 Peterson St, Fort Collins, CO 80524
Roof Number	001
Number of PV Panels	3

Design Criteria:

Parameter	Value
Code	2021 IBC ASCE 7-16 NDS 2018
Live Load	20 psf
Basic Wind Speed	125 mph
Exposure Category	C
Ground Snow Load	35 psf

Roof Properties:

Parameter	Value
Roof Type	Composition Shingle
Roof Pitch Angle	45 °
Mean Roof Height	30 ft
Attachment Width	2.75 ft
Attachment Spacing	4 ft
Framing Type	Truss
Framing Size	2 x 12
Frame Spacing	2 ft
Section Thickness, b	1-1/2 in
Section Depth, d	11-1/4 in
Section Modulus, Sxx	31.64 in^3
Moment of Inertia Modulus, Ixx	178 in^4
Framing Span	18 ft
Deflection Limit D+L	1.8 in
Deflection Limit S or W	1.2 in
Attachments Pattern	Fully Staggered
Framing Upgrade	Adequate
Sister Size	NA
Wood Species	DOUGLAS FIR-LARCH (No.2)
F_b	900 psi
F_v	180 psi
E	1600000 psi

Parameter	Value
Snow Load Duration Factor, $C_{D,snow}$	1.15
Wind Load Duration Factor, $C_{D,wind}$	1.6
Temperature Factor, C_t	1
Wet Service Factor, C_M	1
Incising Factor, C_i	1
Size Factor, C_F	1
Beam Stability Factor, C_L	1
Flat Use Factor, C_{fu}	1.2
Repetitive Member Factor, C_r	1.15
$F'_{b,wind}$	1987.2 psi
$F'_{b,snow}$	1428.3 psi
$F'_{v,wind}$	288 psi
$F'_{v,snow}$	207 psi
$M_{allowable,wind}$	5239.584 lb-ft
$M_{allowable,snow}$	3765.951 lb-ft
$V_{allowable,wind}$	3240.96 lb
$V_{allowable,snow}$	2329.44 lb

Load Calculation:

Dead Load Calculations:

Parameter	Value
Panels Dead Load	3 psf
Roofing Weight	3 psf
Decking Weight	2 psf
Framing Weight	0.6 psf
Misc. Additional Weight	1 psf
Existing Dead Load	6.6 psf
Total Dead Load	9.6 psf

Snow Load Calculations:

Parameter	Value
Ground Snow Load p_g	35 psf
Min. Flat Snow Load p_m	20 psf
Importance Factor I_s	1
Surface Roughness Category	Surface Roughness C
Roof Exposure	Fully Exposed
Exposure Factor C_e	0.9
Thermal Factor C_t	1.1
Flat Roof Snow Load p_f	24.255 psf
Sloped Roof Factor C_s	1
Sloped Roof Snow Load p_s	30 psf
Specified Minimum Roof Snow Load p_{min}	30 psf

Wind Load Calculations:

Parameter	Value
Basic Wind Speed V	125 mph
Directionality Factor, K_d	0.85
Topographic Factor, K_{zt}	1
Ground Elevation Factor, K_e	0.835
Velocity Pressure Exposure Coefficient, K_z	0.982
Velocity Pressure, q_h	27.891 psf

Parameter	Value
Roof Profile	Gable
Array Edge Factor, γ_E	1.5
Solar Equalization Factor, γ_A	0.688
For Attachment	
Effective wind area of Attachment	11 sq.ft.
All Zones- $+GC_p$	0.883
All Zones - +p	25.447 psf
Zone 1 - $-GC_p$	-1.759
Zone 1 - -p	-50.655 psf
Zone 3r - $-GC_p$	-1.968
Zone 3r - -p	-56.691 psf
Zone 3e - $-GC_p$	-2.452
Zone 3e - -p	-70.613 psf
Zone 2n - $-GC_p$	-1.968
Zone 2n - -p	-56.691 psf
Zone 2r - $-GC_p$	-1.759
Zone 2r - -p	-50.655 psf
Zone 2e - $-GC_p$	-1.759
Zone 2e - -p	-50.655 psf
For Rafter	
Effective wind area of Rafter	108 sq.ft.
All Zones - $+GC_p$	0.5
All Zones - Downward Pressure	14.402 psf
Zone 1 - $-GC_p$	-0.8
Zone 1 - Uplift Pressure	-23.043 psf

Hardware Checks:

Lag Screw Checks:

Parameter	Value
Ref. Withdrawal Value, W	266 lb/in
Load Duration Factor (uplift), C_D	1.6
Wet Service Factor, C_M	1
Temperature Factor, C_t	1
End Grain Factor, C_{eg}	1
Adjusted Withdrawal Value, W'	425.6 lb/in
Lag Penetration, p	3.67 in
Allowable Withdrawal Force, W'p	1561.952 lb
Max. Applied Uplift Force	-466.044 lb
Uplift DCR	0.298
Ref. Lateral Value, Z	270 lb
Load Duration Factor (lateral), C_D	1.15
Wet Service Factor, C_M	1
Temperature Factor, C_t	1
End Grain Factor, C_{eg}	1
Geometry Factor, C_Δ	1
Adjusted Lateral Value, Z'	310.5 lb
Applied Lateral Force	308.016 lb
Angle of Resultant Force, α	56.539°
Adjusted of Interaction Lateral Value, Z'α	701.904 lb
Lateral DCR	0.439

Roof Framing Checks:

Force Checks:

LC1: D + S

Parameter	Value
Applied Moment	3207.6 lb-ft
Applied Shear	891 lb
Allowable Moment	3765.951 lb-ft
Allowable Shear	2329.44 lb
Moment DCR	0.852
Shear DCR	0.382

LC2: D + 0.6W

Parameter	Value
Applied Moment	1477.534 lb-ft
Applied Shear	410.426 lb
Allowable Moment	5239.584 lb-ft
Allowable Shear	3240.96 lb
Moment DCR	0.282
Shear DCR	0.127

LC3: D + 0.75(S + 0.6W)

Parameter	Value
Applied Moment	3125.05 lb-ft
Applied Shear	868.07 lb
Allowable Moment	5239.584 lb-ft
Allowable Shear	3240.96 lb
Moment DCR	0.596
Shear DCR	0.268

Deflection Checks (Service Level):

LC1: D + L

Parameter	Value
Deflection	0.204 in
Deflection Limit	1.8 in
Deflection DCR	0.113

LC2: D + S

Parameter	Value
Deflection	0.273 in
Deflection Limit	1.2 in
Deflection DCR	0.228

LC3: D + 0.6 W (downward)

Parameter	Value
Deflection	0.126 in
Deflection Limit	1.2 in
Deflection DCR	0.105

LC4: D + 0.6 W (upward)

Parameter	Value
Deflection	-0.029 in
Deflection Limit	1.2 in
Deflection DCR	0.024

Seismic Check:

Existing Weight:

Parameter	Value
Wall Weight	17 psf
Tributary Wall Area	1000 sq.ft.
Total Wall Weight	17000 lb
Roof Weight	7 psf
Roof Area	2400 sq.ft.
Total Roof Weight	16800 lb
Total Existing Weight	33800 lb

Additional PV Weight:

Parameter	Value
PV Panel Weight	57 lb
No. of Panels	3
Total Additional PV Weight	171 lb

Weight Increase:

Weight Increase $(W_{exisiting} + W_{PV})/W_{exisiting} =$ 0.506%

The increase in weight as a result of the solar system is less than 10% of the existing structure and therefore no further seismic analysis is required.

Results Summary

Result Name	Results
HARDWARE CHECK	
Uplift DCR	0.30
Lateral DCR	0.44
FORCE CHECKS	
Moment DCR LC1: D + S	0.85
Shear DCR LC1: D + S	0.38
Moment DCR LC2: D + 0.6W	0.28
Shear DCR LC2: D + 0.6W	0.13
Moment DCR LC3: D + 0.75(S + 0.6W)	0.60
Shear DCR LC3: D + 0.75(S + 0.6W)	0.27
DEFLECTION CHECKS	
Deflection DCR LC1: D + L	0.11
Deflection DCR LC2: D + S	0.23
Deflection DCR LC3: D + 0.6 W (downward)	0.11
Deflection DCR LC4: D + 0.6 W (upward)	0.02
SEISMIC CHECK	
Additional Weight from PV	0.51 %

Sandbox Solar

Ian Skor, PE
Sandbox Solar
112 Racquette Dr
Fort Collins, CO 80524

Input Summary

Input	Value
Project Name	2069_Cross
Address	300 Peterson St, Fort Collins, CO 80524
Roof Number	002
Design Code	2021 IBC
Risk Category	Risk Category II
Number of Panels *Used in calculating the total additional weight due to PV panel installation (for seismic check)*	9
Area of one PV Panel	19sq.ft.
Panels Dead Load	3psf
Roofing Weight	3psf
Decking Weight	2psf
Framing Weight	0.6psf
Miscellaneous Additional Weight	1psf
Live Load	20psf
Basic Wind Speed *See Figures 26.5-1 to 26.5-2 of ASCE 7-16.*	125mi/h
Ground Elevation *(Optional) Ground elevation above mean sea level. For calculated Ground Elevation Factor Ke (default value is 1.0)*	4977ft
Exposure Category *Based on Section 26.7.3 of ASCE 7-16*	Exposure C
Building Width *Used when roof pitch angle is less than 7°, the wind load pressures will be calculated based on Section 29.4.3*	30ft
Building Length *Used when roof pitch angle is less than 7°, the wind load pressures will be calculated based on Section 29.4.3*	30ft
Ground Snow Load	35psf
Min. Roof Snow Load	30psf
Surface Roughness Category *B. Urban and suburban areas, wooded areas or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger.* *C. Open terrain with scattered obstructions having heights generally less than 30 feet. This category includes flat open country, and grasslands.* *D. Flat, unobstructed areas and water surfaces. This category includes smooth mud flats, salt flats and unbroken ice.* *Above the tree line in windswept mountainous areas* *In Alaska, in areas where trees do not exist within a 2-mi (3-km) radius of the site.*	Surface Roughness C
Roof Exposure *For determination of Exposure Factor C_e (Table 7.3-1 of ASCE 7-16)*	Fully exposed
Thermal Condition *For determination of Thermal Factor C_t (Table 7.3-2 of ASCE 7-16)*	Structures kept just above freezing and others with cold, ventilated roofs...
S_{DS} *Short-period Spectral Acceleration from Section 11.4.5 of ASCE 7-16*	0.33
Roof Profile *Used in calculating design wind pressures and snow load*	Gable
Roof Material	Composition Shingle
Rafter/Chord Span *Used in calculating applied shear and moment forces, and deflections (based on Table 3-22c of AISC-15)*	2 spans
Length of truss chord/rafter	18ft
Frame Spacing	2ft
Roof Angle/Slope *used in calculating wind and snow load*	45°
Mean roof height of the building, h *Mean roof height of the building*	30ft

Input	Value
Construction Type	Rafter
Section Size	2 x 12
Wood Specie	DOUGLAS FIR-LARCH (No.2)
Attachment Tributary Width *Spacing of attachment along the rails*	2.75ft
Attachment Spacing *Spacing of attachment between rails*	4ft
Fastener method	5/16 in. Lag Screw
Lag Penetration	3.67in
Ref. Withdrawal Value W	266lb/in
Ref. Lateral Value, Z	270lb
Show Calculation	Yes

Structural Engineering Design of Photovoltaic Panels

Project Information:

Parameter	Value
Project Name	2069_Cross
Address	300 Peterson St, Fort Collins, CO 80524
Roof Number	002
Number of PV Panels	9

Design Criteria:

Parameter	Value
Code	2021 IBC ASCE 7-16 NDS 2018
Live Load	20 psf
Basic Wind Speed	125 mph
Exposure Category	C
Ground Snow Load	35 psf

Roof Properties:

Parameter	Value
Roof Type	Composition Shingle
Roof Pitch Angle	45 °
Mean Roof Height	30 ft
Attachment Width	2.75 ft
Attachment Spacing	4 ft
Framing Type	Truss
Framing Size	2 x 12
Frame Spacing	2 ft
Section Thickness, b	1-1/2 in
Section Depth, d	11-1/4 in
Section Modulus, Sxx	31.64 in^3
Moment of Inertia Modulus, Ixx	178 in^4
Framing Span	18 ft
Deflection Limit D+L	1.8 in
Deflection Limit S or W	1.2 in
Attachments Pattern	Fully Staggered
Framing Upgrade	Adequate
Sister Size	NA
Wood Species	DOUGLAS FIR-LARCH (No.2)
F_b	900 psi
F_v	180 psi
E	1600000 psi

Parameter	Value
Snow Load Duration Factor, $C_{D,snow}$	1.15
Wind Load Duration Factor, $C_{D,wind}$	1.6
Temperature Factor, C_t	1
Wet Service Factor, C_M	1
Incising Factor, C_i	1
Size Factor, C_F	1
Beam Stability Factor, C_L	1
Flat Use Factor, C_{fu}	1.2
Repetitive Member Factor, C_r	1.15
$F'_{b,wind}$	1987.2 psi
$F'_{b,snow}$	1428.3 psi
$F'_{v,wind}$	288 psi
$F'_{v,snow}$	207 psi
$M_{allowable,wind}$	5239.584 lb-ft
$M_{allowable,snow}$	3765.951 lb-ft
$V_{allowable,wind}$	3240.96 lb
$V_{allowable,snow}$	2329.44 lb

Load Calculation:

Dead Load Calculations:

Parameter	Value
Panels Dead Load	3 psf
Roofing Weight	3 psf
Decking Weight	2 psf
Framing Weight	0.6 psf
Misc. Additional Weight	1 psf
Existing Dead Load	6.6 psf
Total Dead Load	9.6 psf

Snow Load Calculations:

Parameter	Value
Ground Snow Load p_g	35 psf
Min. Flat Snow Load p_m	20 psf
Importance Factor I_s	1
Surface Roughness Category	Surface Roughness C
Roof Exposure	Fully Exposed
Exposure Factor C_e	0.9
Thermal Factor C_t	1.1
Flat Roof Snow Load p_f	24.255 psf
Sloped Roof Factor C_s	1
Sloped Roof Snow Load p_s	30 psf
Specified Minimum Roof Snow Load p_{min}	30 psf

Wind Load Calculations:

Parameter	Value
Basic Wind Speed V	125 mph
Directionality Factor, K_d	0.85
Topographic Factor, K_{zt}	1
Ground Elevation Factor, K_e	0.835
Velocity Pressure Exposure Coefficient, K_z	0.982
Velocity Pressure, q_h	27.891 psf

Parameter	Value
Roof Profile	Gable
Array Edge Factor, γ_E	1.5
Solar Equalization Factor, γ_A	0.688
For Attachment	
Effective wind area of Attachment	11 sq.ft.
All Zones- $+GC_p$	0.883
All Zones - +p	25.447 psf
Zone 1 - $-GC_p$	-1.759
Zone 1 - -p	-50.655 psf
Zone 3r - $-GC_p$	-1.968
Zone 3r - -p	-56.691 psf
Zone 3e - $-GC_p$	-2.452
Zone 3e - -p	-70.613 psf
Zone 2n - $-GC_p$	-1.968
Zone 2n - -p	-56.691 psf
Zone 2r - $-GC_p$	-1.759
Zone 2r - -p	-50.655 psf
Zone 2e - $-GC_p$	-1.759
Zone 2e - -p	-50.655 psf
For Rafter	
Effective wind area of Rafter	108 sq.ft.
All Zones - $+GC_p$	0.5
All Zones - Downward Pressure	14.402 psf
Zone 1 - $-GC_p$	-0.8
Zone 1 - Uplift Pressure	-23.043 psf

Hardware Checks:

Lag Screw Checks:

Parameter	Value
Ref. Withdrawal Value, W	266 lb/in
Load Duration Factor (uplift), C_D	1.6
Wet Service Factor, C_M	1
Temperature Factor, C_t	1
End Grain Factor, C_{eg}	1
Adjusted Withdrawal Value, W'	425.6 lb/in
Lag Penetration, p	3.67 in
Allowable Withdrawal Force, W'p	1561.952 lb
Max. Applied Uplift Force	-466.044 lb
Uplift DCR	0.298
Ref. Lateral Value, Z	270 lb
Load Duration Factor (lateral), C_D	1.15
Wet Service Factor, C_M	1
Temperature Factor, C_t	1
End Grain Factor, C_{eg}	1
Geometry Factor, C_Δ	1
Adjusted Lateral Value, Z'	310.5 lb
Applied Lateral Force	308.016 lb
Angle of Resultant Force, α	56.539°
Adjusted of Interaction Lateral Value, Z'α	701.904 lb
Lateral DCR	0.439

Roof Framing Checks:

Force Checks:

LC1: D + S

Parameter	Value
Applied Moment	3207.6 lb-ft
Applied Shear	891 lb
Allowable Moment	3765.951 lb-ft
Allowable Shear	2329.44 lb
Moment DCR	0.852
Shear DCR	0.382

LC2: D + 0.6W

Parameter	Value
Applied Moment	1477.534 lb-ft
Applied Shear	410.426 lb
Allowable Moment	5239.584 lb-ft
Allowable Shear	3240.96 lb
Moment DCR	0.282
Shear DCR	0.127

LC3: D + 0.75(S + 0.6W)

Parameter	Value
Applied Moment	3125.05 lb-ft
Applied Shear	868.07 lb
Allowable Moment	5239.584 lb-ft
Allowable Shear	3240.96 lb
Moment DCR	0.596
Shear DCR	0.268

Deflection Checks (Service Level):

LC1: D + L

Parameter	Value
Deflection	0.204 in
Deflection Limit	1.8 in
Deflection DCR	0.113

LC2: D + S

Parameter	Value
Deflection	0.273 in
Deflection Limit	1.2 in
Deflection DCR	0.228

LC3: D + 0.6 W (downward)

Parameter	Value
Deflection	0.126 in
Deflection Limit	1.2 in
Deflection DCR	0.105

LC4: D + 0.6 W (upward)

Parameter	Value
Deflection	-0.029 in
Deflection Limit	1.2 in
Deflection DCR	0.024

Seismic Check:

Existing Weight:

Parameter	Value
Wall Weight	17 psf
Tributary Wall Area	1000 sq.ft.
Total Wall Weight	17000 lb
Roof Weight	7 psf
Roof Area	2400 sq.ft.
Total Roof Weight	16800 lb
Total Existing Weight	33800 lb

Additional PV Weight:

Parameter	Value
PV Panel Weight	57 lb
No. of Panels	9
Total Additional PV Weight	513 lb

Weight Increase:

Weight Increase $(W_{exisiting} + W_{PV})/W_{exisiting} =$ 1.518%

The increase in weight as a result of the solar system is less than 10% of the existing structure and therefore no further seismic analysis is required.

Results Summary

Result Name	Results
HARDWARE CHECK	
Uplift DCR	0.30
Lateral DCR	0.44
FORCE CHECKS	
Moment DCR LC1: D + S	0.85
Shear DCR LC1: D + S	0.38
Moment DCR LC2: D + 0.6W	0.28
Shear DCR LC2: D + 0.6W	0.13
Moment DCR LC3: D + 0.75(S + 0.6W)	0.60
Shear DCR LC3: D + 0.75(S + 0.6W)	0.27
DEFLECTION CHECKS	
Deflection DCR LC1: D + L	0.11
Deflection DCR LC2: D + S	0.23
Deflection DCR LC3: D + 0.6 W (downward)	0.11
Deflection DCR LC4: D + 0.6 W (upward)	0.02
SEISMIC CHECK	
Additional Weight from PV	1.52 %

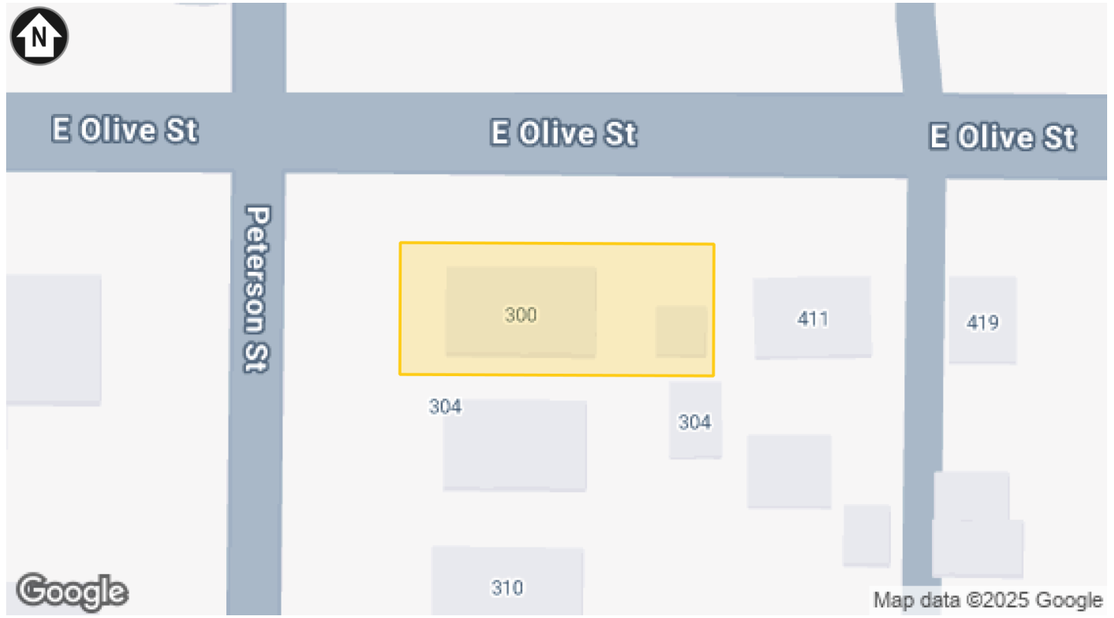
DIRECTORY OF PAGES

PROJECT DETAILS

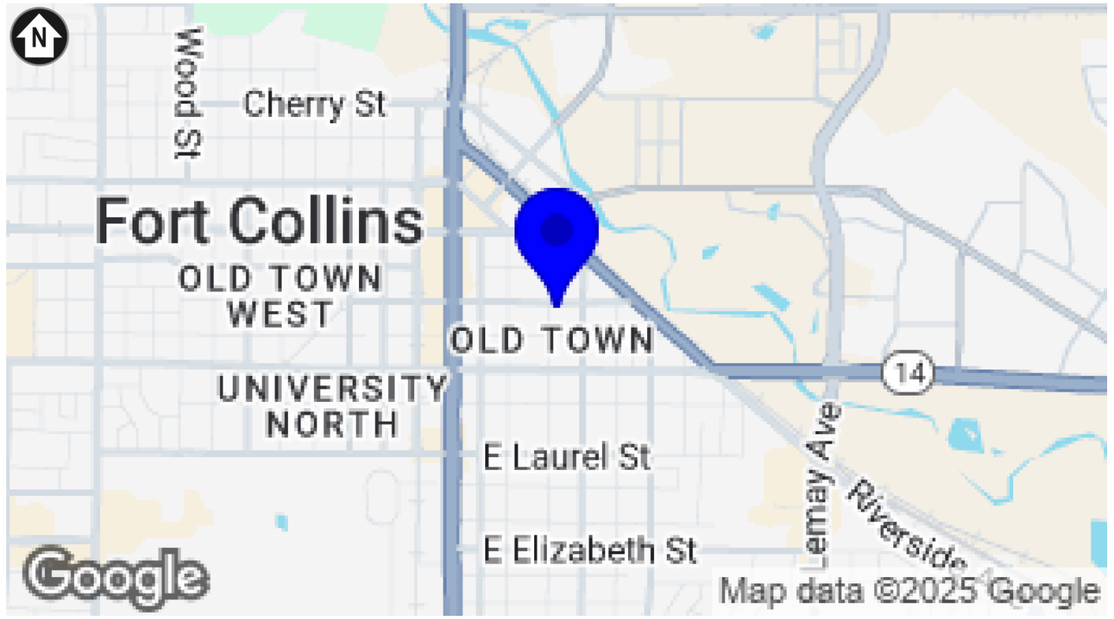
PROPERTY OWNER	KEVIN CROSS
PROPERTY ADDRESS	300 PETERSON ST, FORT COLLINS, CO 80524
APN	0045896
ZONING	RESIDENTIAL
USE AND OCCUPANCY CLASSIFICATION	ONE- OR TWO-FAMILY DWELLING GROUP (GROUP R3)
AHJ	CITY OF FORT COLLINS
UTILITY COMPANY	CITY OF FORT COLLINS - (CO)
ELECTRICAL CODE	2023 NEC (NFPA 70)
FIRE CODE	2021 IFC
OTHER BUILDING CODES	2021 IBC

CONTRACTOR INFORMATION

COMPANY	SANDBOX SOLAR
ADDRESS	112 RACQUETTE DR UNIT C, FORT COLLINS, CO 80524, FORT COLLINS, CO 80521
PHONE NUMBER	(970) 673-7733
CONTRACTOR SIGNATURE	



1 PV-1 PARCEL
SCALE: NTS



2 PV-1 LOCALE
SCALE: NTS

THIS DOCUMENT HAS BEEN PREPARED TO DESCRIBE THE DESIGN OF A PROPOSED PV SYSTEM WITH ENOUGH DETAIL TO DEMONSTRATE COMPLIANCE WITH APPLICABLE CODES AND REGULATIONS. THE DOCUMENT SHALL NOT BE RELIED UPON AS A SUBSTITUTE FOR FOLLOWING MANUFACTURER INSTALLATION INSTRUCTIONS. THE SYSTEM SHALL COMPLY WITH ALL MANUFACTURERS INSTALLATION INSTRUCTIONS, AS WELL AS ALL APPLICABLE CODES. NOTHING IN THIS DOCUMENT SHALL BE INTERPRETED IN A WAY THAT OVERRIDES THEM. CONTRACTOR IS RESPONSIBLE FOR VERIFICATION OF ALL DETAILS IN THIS DOCUMENT.

SCOPE OF WORK

THIS PROJECT INVOLVES THE INSTALLATION OF A GRID-INTERACTIVE PV SYSTEM. PV MODULES WILL BE MOUNTED USING A PREENGINEERED MOUNTING SYSTEM. THE MODULES WILL BE ELECTRICALLY CONNECTED WITH DC TO AC POWER INVERTERS AND INTERCONNECTED TO THE LOCAL UTILITY USING MEANS AND METHODS CONSISTENT WITH THE RULES ENFORCED BY THE LOCAL UTILITY AND PERMITTING JURISDICTION.

PV SYSTEM

DESCRIPTION	NEW GRID-INTERACTIVE PHOTOVOLTAIC SYSTEM WITH NO ENERGY STORAGE
PV SYSTEM DC RATING	5.04KW
PV SYSTEM AC RATINGS	4.56KW, 19.0A
INVERTER(S)	12 X ENPHASE IQ8X-80-M-US
PV MODULE(S)	12 X REC SOLAR REC420AA PURE 2
PV ARRAY WIRING	(2) BRANCH OF 6 IQ8X-80-M-US MICROINVERTERS

INTERCONNECTION DETAILS

POINT OF INTERCONNECTION	NEW SUPPLY SIDE AC CONNECTION PER NEC 705.11(A)
UTILITY SERVICE	120/240V 1Φ
SERVICE DISCONNECT	125 A MAIN BREAKER IN MAIN BREAKER IN ENCLOSURE
INSIDE PANELBOARD	FUSED SQUARE D D222NRB DISCONNECT, 2-POLE, 60A, 240VAC

SITE DESIGN PARAMETERS

DRY BULB EXTREME LOW	-23°C (-10°F)
DRY BULB 2% HIGH	34°C (94°F)
DATA SOURCE	ASHRAE DATASET FORT COLLINS
WIND (ASCE 7-16)	125 MPH, EXPOSURE CATEGORY C, RISK CATEGORY II
GROUND SNOW LOAD	35 PSF

2069

SANDBOX SOLAR

GRID-TIED PV SYSTEM

CROSS RESIDENCE
300 PETERSON ST
FORT COLLINS, CO 80524

COLORADO LICENSED
IAN J SKOR
62365
Ian Skor
PROFESSIONAL ENGINEER

PROJECT SUMMARY

DOC ID: C687B8-1
DATE: 1/27/25
CREATOR: I.S.
REVIEWER:

REVISIONS

PV-1

1 PV-2 SITE PLAN
SCALE: 1" = 20'

GENERAL NOTES	
1	EQUIPMENT LIKELY TO BE WORKED UPON WHILE ENERGIZED SHALL BE INSTALLED IN LOCATIONS THAT SATISFY MIN. WORKING CLEARANCES PER NEC 110.26.
2	24/7 UNESCORTED KEYLESS ACCESS SHALL BE PROVIDED TO ALL CITY OF FORT COLLINS - (CO) EQUIPMENT.
3	CONTRACTOR SHALL USE ONLY COMPONENTS LISTED BY A NATIONALLY RECOGNIZED TESTING LABORATORY FOR THE INTENDED USE.
4	CONTRACTOR IS RESPONSIBLE FOR FURNISHING ALL EQUIPMENT, CABLES, ADDITIONAL CONDUITS, RACEWAYS, AND OTHER ACCESSORIES NECESSARY FOR A COMPLETE AND OPERATIONAL PV SYSTEM.
5	ALL EXPOSED PV ROOFTOP CONDUCTORS NOT UNDER THE ARRAY SHALL BE PROTECTED BY A RACEWAY WITH A LISTED JUNCTION BOX AT BOTH ENDS AND COMPLY WITH NEC 690.31(A).
6	ALL EMT CONDUIT FITTINGS SHALL BE LISTED AS WEATHERPROOF FITTINGS AND INSTALLED TO ENSURE A RAINTIGHT FIT, PER NEC 358.42.

ELECTRICAL

5 (E) UTILITY METER, OUTDOOR

4 (N) MAIN BREAKER IN ENCLOSURE, OUTDOOR
SITE OF SUPPLY-SIDE TAP

3 (E) MAIN LOAD CENTER (MLC), INDOOR

2 (N) AC COMBINER (C1), OUTDOOR

1 (N) VISIBLE-OPEN TYPE, LOCKABLE, READILY ACCESSIBLE, LABELED PV SYSTEM AC DISCONNECT LOCATED WITHIN 10 FT OF UTILITY METER (SW1), OUTDOOR

ROOFTOP

7 (N) PROPOSED ROOF-MOUNTED PV ARRAY. 12/12 (45.0°) SLOPED ROOF, (9) REC SOLAR REC420AA PURE 2 MODULES (BLACK FRAME, BLACK BACKSHEET), 180° AZIMUTH. (9) ENPHASE IQ8X-80-M-US MICROINVERTERS

8 (N) PROPOSED ROOF-MOUNTED PV ARRAY. 12/12 (45.0°) SLOPED ROOF, (3) REC SOLAR REC420AA PURE 2 MODULES (BLACK FRAME, BLACK BACKSHEET), 90° AZIMUTH. (3) ENPHASE IQ8X-80-M-US MICROINVERTERS

6 (N) TRANSITION BOX, OUTDOOR, OUTPUT CIRCUIT CONDUCTORS SHALL BE RUN IN EMT CONDUIT OVER ROOF NO CLOSER THAN 3/4" ABOVE ROOF SURFACE

2069

SANDBOX SOLAR

GRID-TIED PV SYSTEM

CROSS RESIDENCE
300 PETERSON ST
FORT COLLINS, CO 80524

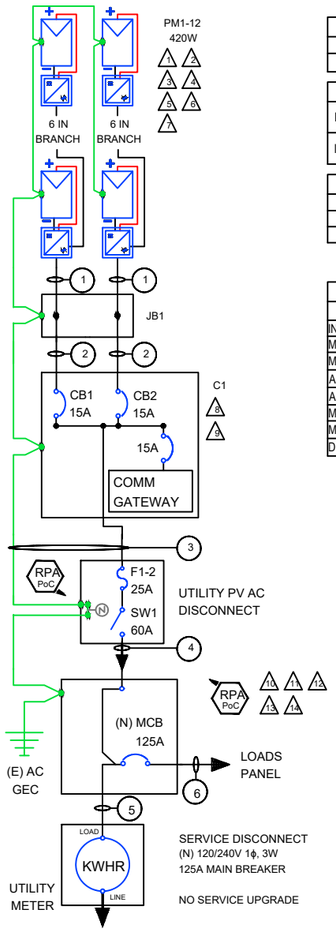
COLORADO LICENSED
IAN J SKOR
62365
Ian Skor
PROFESSIONAL ENGINEER

SITE PLAN

DOC ID: C687B8-1
DATE: 1/27/25
CREATOR: I.S.
REVIEWER:

REVISIONS

PV-2



MODULES										
REF.	QTY.	MAKE AND MODEL	PMAX	PTC	ISC	IMP	VOC	VMP	TEMP. COEFF. OF VOC	FUSE RATING
PM1-12	12	REC SOLAR REC420AA PURE 2	420W	403W	10.74A	9.96A	49.1V	42.2V	-0.1178V/°C (-0.24%/°C)	25A

INVERTERS									
REF.	QTY.	MAKE AND MODEL	AC VOLTAGE	GROUND	RATED POWER	MAX OUTPUT CURRENT	MAX INPUT CURRENT	MAX INPUT VOLTAGE	CEC WEIGHTED EFFICIENCY
I1-12	12	ENPHASE IQ8X-80-M-US	240V	NOT SOLIDLY GROUNDED	380W	1.58A	16.0A	80V	97.2%

DISCONNECTS				
REF.	QTY.	MAKE AND MODEL	RATED CURRENT	MAX RATED VOLTAGE
SW1	1	SQUARE D D222NRB OR EQUIV.	60A	240VAC

OCPDS			
REF.	QTY.	RATED CURRENT	MAX VOLTAGE
CB1-2	2	15A	240VAC
F1-2	2	25A	240VAC

PASS-THRU BOXES AND COMBINERS				
REF.	QTY.	MAKE AND MODEL	RATED CURRENT	MAX RATED VOLTAGE
JB1	1	TRANSITION BOX FOR 2 CIRCUITS	30A	240VAC / 600VDC
C1	1	ENPHASE IQ COMBINER 5 W/ IQ GATEWAY FOR PRODUCTION MONITORING	64A	240VAC

SYSTEM SUMMARY		
	BRANCH 1	BRANCH 2
INVERTERS PER BRANCH	6	6
MAX AC CURRENT	9.48A	9.48A
MAX AC OUTPUT	2,280W	2,280W
ARRAY STC POWER	5,040W	
ARRAY PTC POWER	4,840W	
MAX AC CURRENT	19A	
MAX AC POWER OUTPUT	4,560W	
DERATED AC POWER OUTPUT	4,560W	

1. RAPID SHUTDOWN DEVICES COMPLIANT WITH REQUIREMENTS AS PER NEC 690.12(B)(2). PV CIRCUIT CONDUCTORS LOCATED OUTSIDE THE ARRAY BOUNDARY (DEFINED AS 3 FEET FROM THE POINT OF PENETRATION INTO A BUILDING OR MORE THAN 3 FEET FROM AN ARRAY) SHALL BE LIMITED TO NOT MORE THAN 30V WITHIN 30 SECONDS OF RAPID SHUTDOWN INITIATION. CONDUCTORS LOCATED INSIDE OF THE ARRAY BOUNDARY SHALL BE LIMITED TO NOT MORE THAN 80 VOLTS WITHIN 30 SECONDS OF SHUTDOWN.
2. ENPHASE SYSTEM MEETS REQUIREMENTS FOR PV HAZARD CONTROL SYSTEM (PVHCS), AS PER NEC 690.12(B)(2).
3. THE DC AND AC CONNECTORS OF THE ENPHASE IQ8X-80-M-US AND ARE LISTED TO MEET REQUIREMENTS AS A DISCONNECT MEANS AS ALLOWED BY NEC 690.15(C). MATING CONNECTORS SHALL COMPLY WITH NEC 690.33.
4. THE ENPHASE IQ8X-80-M-US HAS A CLASS II DOUBLE-INSULATED RATING AND DOES NOT REQUIRE GROUNDING ELECTRODE CONDUCTORS (GEC) OR EQUIPMENT GROUNDING CONDUCTORS (EGC). THE RATING INCLUDES GROUND FAULT PROTECTION (GFP). TO SUPPORT GFP, USE ONLY PV MODULES EQUIPPED WITH DC CABLES LABELED PV WIRE OR PV CABLE.
5. MICROINVERTER BRANCH CIRCUIT CONDUCTORS ARE MANUFACTURED ENPHASE Q CABLES LISTED FOR USE IN 20A OR LESS CIRCUITS OF ENPHASE IQ MICROINVERTERS. THEY ARE ROHS, OIL RESISTANT, AND UV RESISTANT. THEY CONTAIN TWO 12 AWG CONDUCTORS OF TYPE THHN/THWN-2 DRY/WET AND CERTIFIED TO UL 3003 AND UL 9703.
6. ALL METAL ENCLOSURES, RACEWAYS, CABLES AND EXPOSED NONCURRENT-CARRYING METAL PARTS OF EQUIPMENT SHALL BE GROUNDED TO EARTH AS REQUIRED BY NEC 250.4(B) AND PART III OF ARTICLE 250 AND DC EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZED ACCORDING TO NEC 690.45. THE GROUNDING ELECTRODE SYSTEM SHALL ADHERE TO NEC 690.47(A) AND NEC 250.169 AND INSTALLED IN COMPLIANCE WITH NEC 250.64.
7. MAX DC VOLTAGE OF PV MODULE IS EXPECTED TO BE 54.8V AT -23°C (-23.33°C - 25°C) X -0.118V/C + 49.1V = 54.8V).
8. AC AGGREGATION PANEL BUSBAR AND THE OVERCURRENT PROTECTION PROTECTING THE BUSBAR SHALL BE SIZED IN ACCORDANCE WITH NEC 705.12(B)(3).
9. THE ENPHASE IQ COMBINER 5 CONTAINS A FACTORY-INSTALLED COMMUNICATIONS GATEWAY WITH AN OCPD RATED NO MORE THAN 15A.
10. PV SYSTEM DISCONNECT SHALL BE A VISIBLE KNIFE-BLADE TYPE DISCONNECT THAT IS ACCESSIBLE AND LOCKABLE BY THE UTILITY IN ACCORDANCE WITH NEC 690.13(E). THE DISCONNECT SHALL BE LOCATED WITHIN 10 FT OF UTILITY METER AND INSTALLED IN COMPLIANCE WITH NEC 705.20 AND GROUPED AS REQUIRED BY NEC 230.72.
11. PV SYSTEM DISCONNECT MEETS NEC 690.12(C) REQUIREMENT FOR A RAPID SHUTDOWN INITIATION DEVICE
12. POINT-OF-CONNECTION IS ON THE SUPPLY SIDE OF SERVICE DISCONNECT, INSIDE PANELBOARD ENCLOSURE USING UNUSED TERMINALS, TERMINALS THAT ARE SUITABLE FOR DOUBLE LUGGING, OR USING OTHER LOCALLY-APPROVED METHODS AND HARDWARE, IN COMPLIANCE WITH NEC 705.11(A). THE PANELBOARD SHALL HAVE SUFFICIENT SPACE TO ALLOW FOR ANY TAP HARDWARE AS REQUIRED BY NEC 110.3 AND NEC 312.8(A)
13. DEVICES FOR SPLICES AND TAPS INSTALLED ON SERVICE CONDUCTORS SHALL BE MARKED "SUITABLE FOR USE ON THE LINE SIDE OF THE SERVICE EQUIPMENT" OR EQUIVALENT AS REQUIRED BY NEC 230.46.

CONDUCTOR AND CONDUIT SCHEDULE W/ELECTRICAL CALCULATIONS

ID	TYP	CONDUCTOR	CONDUIT / CABLE	CURRENT-CARRYING CONDUCTORS IN CONDUIT/CABLE.	OCPD	EGC	TEMP. CORR. FACTOR	FILL FACTOR	CONT. CURRENT	MAX. CURRENT (125%)	BASE AMP.	DERATED AMP.	TERM. TEMP. RATING	AMP. @ TERM. TEMP. RATING	LEN.	V.D.
1	2	12 AWG THHN/THWN-2 IN ENPHASE Q CABLE, COPPER	CABLE	2	15A	6 AWG BARE, COPPER	0.96 (34°C)	1.0	9.48A	11.85A	30A	29A	90 °C	30A	78.7FT	0.61%
2	2	10 AWG THWN-2, COPPER	0.75" DIA. EMT	4	15A	10 AWG THWN-2, COPPER	0.96 (34°C)	0.8	9.48A	11.85A	40A	31A	75 °C	35A	69.8FT	0.34%
3	1	6 AWG THWN-2, COPPER	0.75" DIA. EMT	3	25A	10 AWG THWN-2, COPPER	0.96 (34°C)	1.0	18.96A (DERS) 0.02A (LOADS)	23.7A	75A	72A	75 °C	65A	48IN	0.03%
4	1	6 AWG THWN-2, COPPER	0.75" DIA. EMT	3	25A	N/A	0.96 (34°C)	1.0	18.96A (DERS) 0.02A (LOADS)	23.7A	75A	72A	75 °C	65A	49.8IN	0.03%
5	1	1 AWG THWN-2, COPPER	0.75" DIA. EMT	3	125A	N/A	0.96 (34°C)	1.0	100A	125A	145A	139.2A	75 °C	130A	49.8IN	0.03%
6	1	1 AWG THWN-2, COPPER	0.75" DIA. EMT	3	125A	N/A	0.96 (34°C)	1.0	100A	125A	145A	139.2A	75 °C	130A	49.8IN	0.03%

GENERAL ELECTRICAL NOTES

1. UTILITY HAS 24-HR UNRESTRICTED ACCESS TO ALL PHOTOVOLTAIC SYSTEM COMPONENTS LOCATED AT THE SERVICE ENTRANCE.
2. CONDUCTORS EXPOSED TO SUNLIGHT SHALL BE LISTED AS SUNLIGHT RESISTANT PER NEC ARTICLE 300.6 (C) (1) AND ARTICLE 310.10 (D).
3. CONDUCTORS EXPOSED TO WET LOCATIONS SHALL BE SUITABLE FOR USE IN WET LOCATIONS PER NEC ARTICLE 310.10 (C).

GROUNDING NOTES

1. ALL EQUIPMENT SHALL BE PROPERLY GROUNDED PER THE REQUIREMENTS OF NEC ARTICLES 250 & 690
2. PV MODULES SHALL BE GROUNDED USING MODULE LUGS OR RACKING INTEGRATED GROUNDING CLAMPS AS ALLOWED BY LOCAL JURISDICTION. ALL OTHER EXPOSED METAL PARTS SHALL BE GROUNDED USING UL-LISTED LAY-IN LUGS.
3. INSTALLER SHALL CONFIRM THAT MOUNTING SYSTEM HAS BEEN EVALUATED FOR COMPLIANCE WITH UL 2703 "GROUNDING AND BONDING" WHEN USED WITH PROPOSED PV MODULE.
4. IF THE EXISTING MAIN SERVICE PANEL DOES NOT HAVE A VERIFIABLE GROUNDING ELECTRODE, IT IS THE CONTRACTOR'S RESPONSIBILITY TO INSTALL A SUPPLEMENTAL GROUNDING ELECTRODE.
5. AC SYSTEM GROUNDING ELECTRODE CONDUCTOR (GEC) SHALL BE A MINIMUM SIZE #8AWG WHEN INSULATED, #6AWG IF BARE WIRE.
6. EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZED ACCORDING TO NEC ARTICLE 690.45, AND BE A MINIMUM OF #10AWG WHEN NOT EXPOSED TO DAMAGE, AND #6AWG SHALL BE USED WHEN EXPOSED TO DAMAGE
7. GROUNDING AND BONDING CONDUCTORS, IF INSULATED, SHALL BE COLOR CODED GREEN, OR MARKED GREEN IF #4AWG OR LARGER

1 PV-3 SINGLE-LINE DIAGRAM
SCALE: NTS

2069

GRID-TIED PV SYSTEM

CROSS RESIDENCE
300 PETERSON ST
FORT COLLINS, CO 80524

COLORADO LICENSED
IAN J SKOR
62365
Ian Skor
PROFESSIONAL ENGINEER

SINGLE-LINE DIAGRAM

PROJECT ID: C687B8-1
DATE: 1/27/25
CREATED BY: I.S.
CHECKED BY:

REVISIONS

PV-3

AC COMBINER

3

SW1 - DISCONNECT
(SQUARE D D222NRB)

1 4 5 6 7 8

UTILITY METER

2

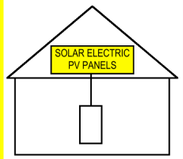
MAIN LOAD CENTER

1 2 7 8

1 SEE NOTE NO. 4 (SW1, MLC)

SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWITCH TO THE 'OFF' POSITION TO SHUT DOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN THE ARRAY.



NEC 690.12(D) AND IFC 1205.4.1

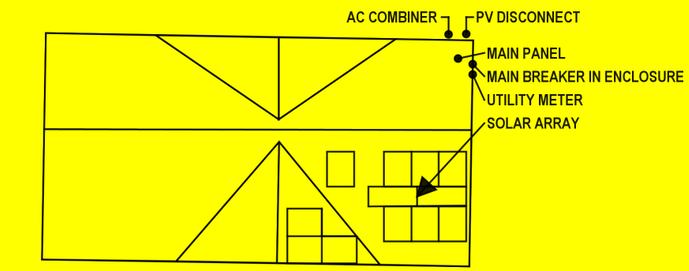
3 AC COMBINER PANEL (C1)

! WARNING !
EQUIPMENT FED BY MULTIPLE SOURCES. TOTAL RATING OF ALL OVERCURRENT DEVICES, EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE SHALL NOT EXCEED AMPACITY OF BUSBAR.

NEC 705.12(B)(3)

2 POINT-OF-INTERCONNECTION OR AT MAIN SERVICE DISCONNECT (MLC, UM)

! CAUTION: MULTIPLE SOURCES OF POWER !
POWER TO THIS BUILDING IS ALSO SUPPLIED FROM ROOF-MOUNTED SOLAR ARRAYS WITH SAFETY DISCONNECTS AS SHOWN



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NEC 690.56 AND NEC 705.10

4 EACH DISCONNECTING MEANS FOR PHOTOVOLTAIC EQUIPMENT (SW1)

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

NEC 690.13(B)

5 SEE NOTE NO. 5 (SW1)

RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

NEC 690.12(D)(2) AND IFC 1205.4.3

6 AC DISCONNECT (SW1)

MAXIMUM AC OPERATING CURRENT: 19.0A
MAXIMUM AC OPERATING VOLTAGE: 240V

7 ANY AC ELECTRICAL PANEL THAT IS FED BY BOTH THE UTILITY AND THE PHOTOVOLTAIC SYSTEM (SW1, MLC)

! CAUTION !
MULTIPLE SOURCES OF POWER

NEC 705.10

8 EMERGENCY CONTACT DETAILS (SW1, MLC)

IN CASE OF EMERGENCY
CONTACT SANDBOX SOLAR
(970) 673-7733

NEC 705.10

LABELING NOTES

1	ALL PLAQUES AND SIGNAGE REQUIRED BY 2023 NEC AND 2021 IFC WILL BE INSTALLED AS REQUIRED.
2	LABELS, WARNING(S) AND MARKING SHALL COMPLY WITH ANSI Z535.4, WHICH REQUIRES THAT DANGER, WARNING, AND CAUTION SIGNS USED THE STANDARD HEADER COLORS, HEADER TEXT, AND SAFETY ALERT SYMBOL ON EACH LABEL. THE ANSI STANDARD REQUIRES A HEADING THAT IS AT LEAST 50% TALLER THAN THE BODY TEXT, IN ACCORDANCE WITH NEC 110.21(B).
3	A PERMANENT PLAQUE OR DIRECTORY SHALL BE INSTALLED PROVIDING THE LOCATION OF THE SERVICE DISCONNECTING MEANS AND THE PHOTOVOLTAIC SYSTEM DISCONNECTING MEANS IF NOT IN THE SAME LOCATION IN ACCORDANCE WITH NEC 690.56.
4	LABEL(S) WITH MARKING, "TURN RAPID SHUTDOWN SWITCH TO THE 'OFF' POSITION TO SHUT DOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN THE ARRAY," SHALL BE LOCATED WITHIN 3 FT OF SERVICE DISCONNECTING MEANS. THE TITLE SHALL UTILIZE CAPITALIZED LETTERS WITH A MINIMUM HEIGHT OF 3/8". ALL TEXT SHALL BE LEGIBLE AND CONTRAST THE BACKGROUND. .
5	LABEL(S) WITH MARKING, "RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM," SHALL BE LOCATED WITHIN 3 FT OF RAPID SHUTDOWN SWITCH. THE LABEL SHALL HAVE 3/8" TALL LETTERS AND BE REFLECTIVE WITH WHITE TEXT ON A RED BACKGROUND.

2069

SANDBOX SOLAR

GRID-TIED PV SYSTEM

CROSS RESIDENCE
300 PETERSON ST
FORT COLLINS, CO 80524

SAFETY LABELS

DOC ID: C687B8-1
DATE: 1/27/25
CREATOR: I.S.
REVIEWER:

REVISIONS

PV-4

STRUCTURAL DESIGN PARAMETERS	
ELEVATION	4977 FT
SEISMIC	0.207 S_{DS}
WIND (ASCE 7-16)	125 MPH, EXPOSURE CATEGORY C, RISK CATEGORY II
GROUND SNOW LOAD	35 PSF

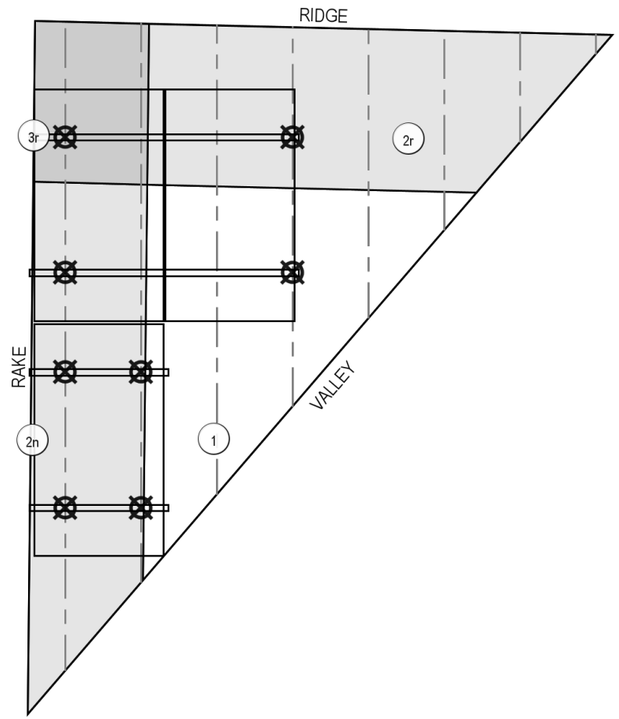
ROOF PROPERTIES	
ROOF MATERIAL	COMPOSITION SHINGLE (1 LAYER)
SLOPE	12/12 (45.0°)
MEAN ROOF HEIGHT	16.5FT
ROOF DECKING	15/32" OSB
CONSTRUCTION	RAFTERS (2X12 TOP-CHORD), 24IN OC

MODULE MECHANICAL PROPERTIES	
MODEL	REC SOLAR REC420AA PURE 2
DIMENSIONS (AREA)	73.4IN X 40.9IN X 1.2IN (20.8 SQ FT)
WEIGHT	47.6 LBS

MOUNTING SYSTEM PROPERTIES	
RAIL MODEL	UNIRAC NXT UMOUNT RLM1
ANCHOR MODEL	UNIRAC SBUTYLD1 (FLASHED), 2.5IN AIR GAP
FASTENING METHOD	2.5 INCH EMBEDMENT INTO RAFTERS OR DECKING WITH (2) 1/4IN DIA. FASTENERS
GROUNDING AND BONDING	INTEGRAL GROUNDING CERTIFIED TO UL 2703 REQUIREMENTS

DEAD LOAD CALCULATIONS			
LOAD	QTY	LBS	TOTAL LBS
MODULES	3	47.6	142.8
MICROINVERTERS	3	2.4	7.3
LINEAR FEET OF RAIL	22 FT	0.4	8.6
ANCHORS	8	0.3	2.4
MISC. HARDWARE		3.7	3.7
TOTAL ARRAY WEIGHT			164.8 LBS
AREA NAME	QTY	SQFT	TOTAL SQFT
MODULES	3	20.8	62.4
POINT LOAD (164.8 LBS / 8 ATTACHMENTS)			20.6 LBS
DIST. LOAD (164.8 LBS / 62.4 SQFT)			2.64 PSF

NOTES	
1	RAFTER LOCATIONS ARE APPROXIMATE. ANCHORS MAY BE FASTENED TO DECKING WHERE NEEDED. IN NO CASE SHALL THE ANCHOR SPACING EXCEED "MAX. ANCHOR SPACING"



ANCHOR PLACEMENT PARAMETERS (ASCE 7-16)				
WIND PRESSURE ZONE	MODULE WIND EXPOSURE	MAX. ALLOWABLE RAIL SPAN	MAX. ANCHOR SPACING	MAX. ALLOWABLE CANTILEVER
ZONES 1, 2N, 2R, 3R	NORMAL	72.0IN	72.0IN	24.0IN

DISTANCE α IS EQUAL TO 10% OF THE BUILDING'S LEAST HORIZONTAL DIMENSION ("LHD") OR 40% OF THE MEAN ROOF HEIGHT, WHICHEVER IS SMALLER, BUT NOT LESS THAN 4% OF THE LHD OR 3 FT. THESE SETBACKS ARE APPLIED TO THE BUILDING FOOTPRINT AND PROJECTED TO THE ROOF PLANES IN ACCORDANCE WITH GUIDANCE PROVIDED BY ASCE 7-16 FIGURES 30.3-2B–I.

α = MAX(MIN(0.4 * MEAN ROOF HEIGHT, 0.1 * LHD), 0.04 * LHD, 3 FT)

3.0 FT = MAX(MIN(0.4 * 16.5 FT, 0.1 * 28.3 FT), 0.04 * 28.3 FT, 3 FT)

1 / PV-5.1 ATTACHMENT PLAN (ORTHOGONAL PROJECTION)
SCALE: 1/4" = 1'

2069

SANDBOX SOLAR

GRID-TIED PV SYSTEM

CROSS RESIDENCE
300 PETERSON ST
FORT COLLINS, CO 80524

COLORADO LICENSED
IAN J SKOR
62365
Ian Skor
PROFESSIONAL ENGINEER

ATTACHMENT PLAN

DOC ID: C687B8-1
DATE: 1/27/25
CREATOR: I.S.
REVIEWER:

REVISIONS

PV-5.1

STRUCTURAL DESIGN PARAMETERS	
ELEVATION	4977 FT
SEISMIC	0.207 S_{DS}
WIND (ASCE 7-16)	125 MPH, EXPOSURE CATEGORY C, RISK CATEGORY II
GROUND SNOW LOAD	35 PSF

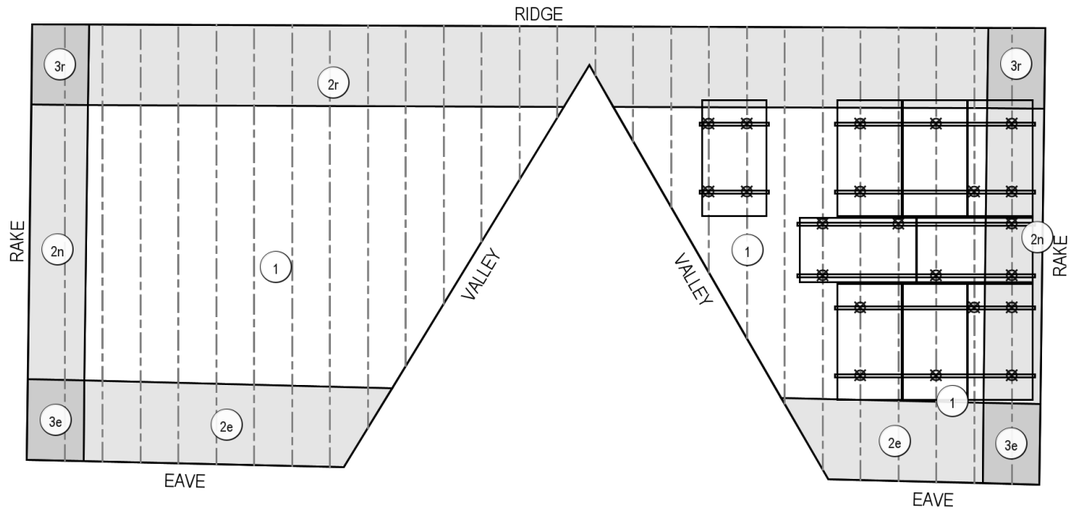
ROOF PROPERTIES	
ROOF MATERIAL	COMPOSITION SHINGLE (1 LAYER)
SLOPE	12/12 (45.0°)
MEAN ROOF HEIGHT	18.6FT
ROOF DECKING	15/32" OSB
CONSTRUCTION	RAFTERS (2X12 TOP-CHORD), 24IN OC

MODULE MECHANICAL PROPERTIES	
MODEL	REC SOLAR REC420AA PURE 2
DIMENSIONS (AREA)	73.4IN X 40.9IN X 1.2IN (20.8 SQ FT)
WEIGHT	47.6 LBS

MOUNTING SYSTEM PROPERTIES	
RAIL MODEL	UNIRAC NXT UMOUNT RLM1
ANCHOR MODEL	UNIRAC SBUTYLD1 (FLASHED), 2.5IN AIR GAP
FASTENING METHOD	2.5 INCH EMBEDMENT INTO RAFTERS OR DECKING WITH (2) 1/4IN DIA. FASTENERS
GROUNDING AND BONDING	INTEGRAL GROUNDING CERTIFIED TO UL 2703 REQUIREMENTS

DEAD LOAD CALCULATIONS			
LOAD	QTY	LBS	TOTAL LBS
MODULES	9	47.6	428.4
MICROINVERTERS	9	2.4	21.8
LINEAR FEET OF RAIL	75 FT	0.4	29.9
ANCHORS	22	0.3	6.6
MISC. HARDWARE		9.7	9.7
TOTAL ARRAY WEIGHT			496.5 LBS
AREA NAME	QTY	SQFT	TOTAL SQFT
MODULES	9	20.8	187.2
POINT LOAD (496.5 LBS / 22 ATTACHMENTS)			22.6 LBS
DIST. LOAD (496.5 LBS / 187.2 SQFT)			2.65 PSF

NOTES	
1	RAFTER LOCATIONS ARE APPROXIMATE. ANCHORS MAY BE FASTENED TO DECKING WHERE NEEDED. IN NO CASE SHALL THE ANCHOR SPACING EXCEED "MAX. ANCHOR SPACING"



ANCHOR PLACEMENT PARAMETERS (ASCE 7-16)				
WIND PRESSURE ZONE	MODULE WIND EXPOSURE	MAX. ALLOWABLE RAIL SPAN	MAX. ANCHOR SPACING	MAX. ALLOWABLE CANTILEVER
ZONES 1, 2E, 2N, 2R, 3R	NORMAL	72.0IN	72.0IN	24.0IN

DISTANCE α IS EQUAL TO 10% OF THE BUILDING'S LEAST HORIZONTAL DIMENSION ("LHD") OR 40% OF THE MEAN ROOF HEIGHT, WHICHEVER IS SMALLER, BUT NOT LESS THAN 4% OF THE LHD OR 3 FT. THESE SETBACKS ARE APPLIED TO THE BUILDING FOOTPRINT AND PROJECTED TO THE ROOF PLANES IN ACCORDANCE WITH GUIDANCE PROVIDED BY ASCE 7-16 FIGURES 30.3-2B–I.

α = MAX(MIN(0.4 * MEAN ROOF HEIGHT, 0.1 * LHD), 0.04 * LHD, 3 FT)

3.0 FT = MAX(MIN(0.4 * 18.6 FT, 0.1 * 28.3 FT), 0.04 * 28.3 FT, 3 FT)

1 / PV-5.2 ATTACHMENT PLAN (ORTHOGONAL PROJECTION)
SCALE: 1/8" = 1'

2069

SANDBOX SOLAR

GRID-TIED PV SYSTEM

CROSS RESIDENCE
300 PETERSON ST
FORT COLLINS, CO 80524

COLORADO LICENSED
IAN J SKOR
62365
Ian Skor
PROFESSIONAL ENGINEER

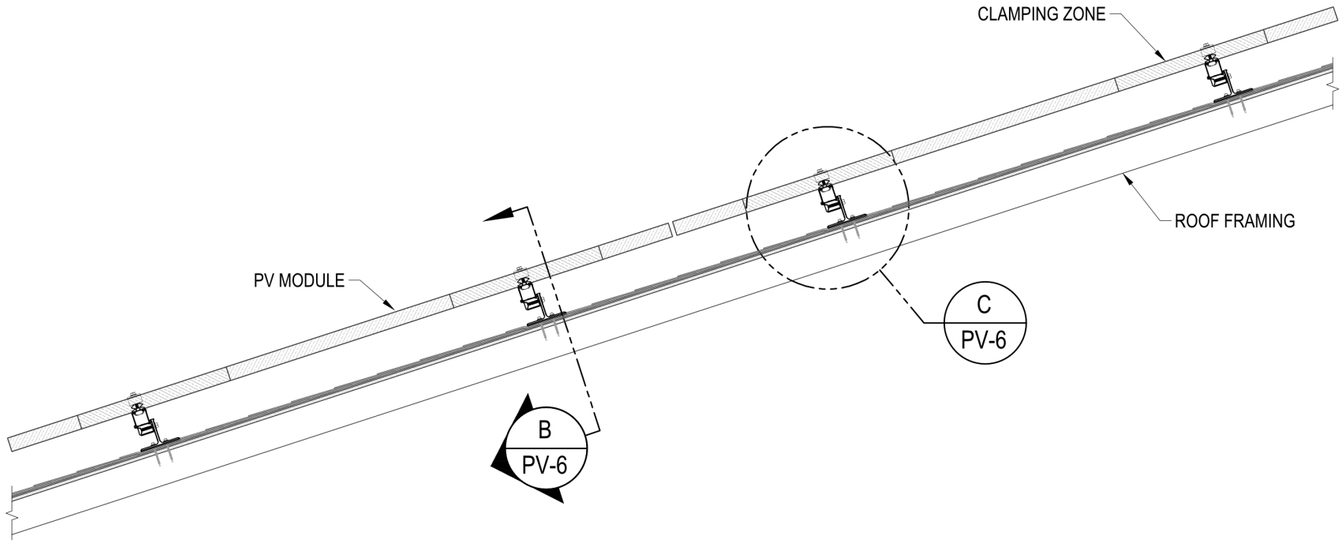
ATTACHMENT PLAN

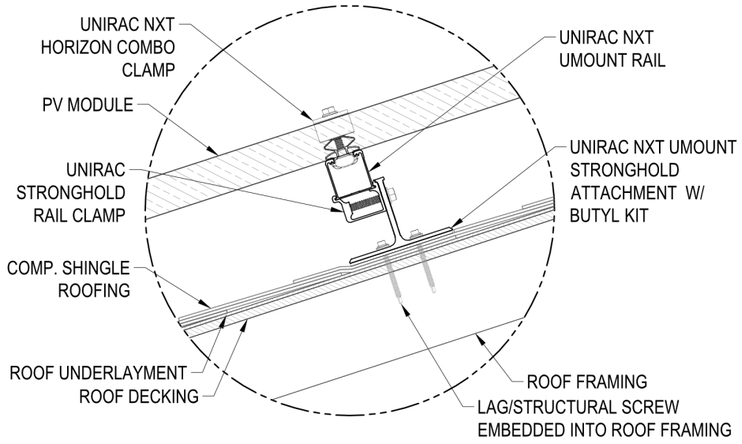
DOC ID: C687B8-1
DATE: 1/27/25
CREATOR: I.S.
REVIEWER:

REVISIONS

PV-5.2

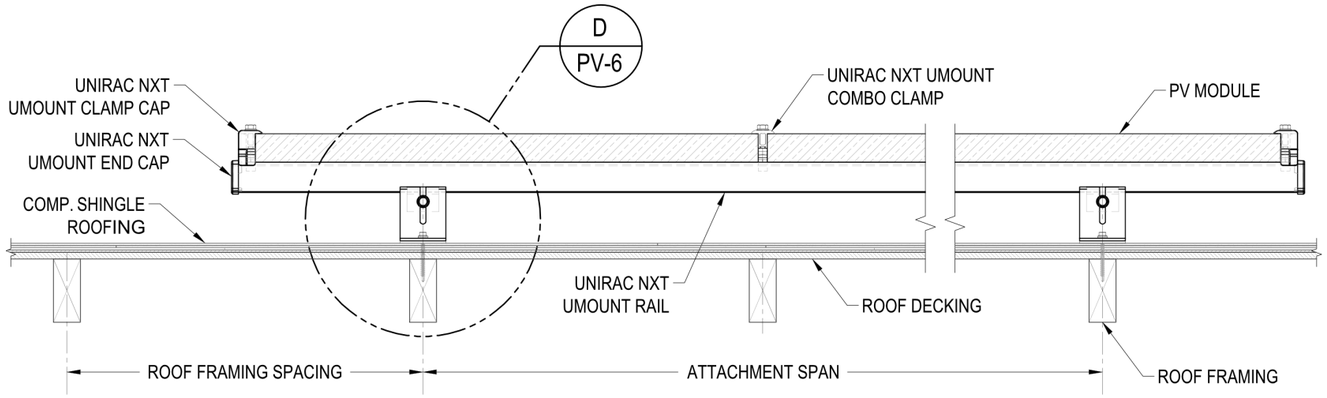
MOUNTING SYSTEM NOTES	
1	FLASHING SHALL BE APPLIED IN ACCORDANCE WITH MANUFACTURERS' INSTRUCTIONS.
2	IF THERE IS ANY CONFLICT BETWEEN WHAT IS DEPICTED HERE AND INSTRUCTIONS PROVIDED BY A MANUFACTURER, THE MANUFACTURER'S INSTRUCTIONS SHALL SUPERCEDE.





A PV-6 RACKING ELEVATION (TRANSVERSE VIEW)

SCALE: NTS

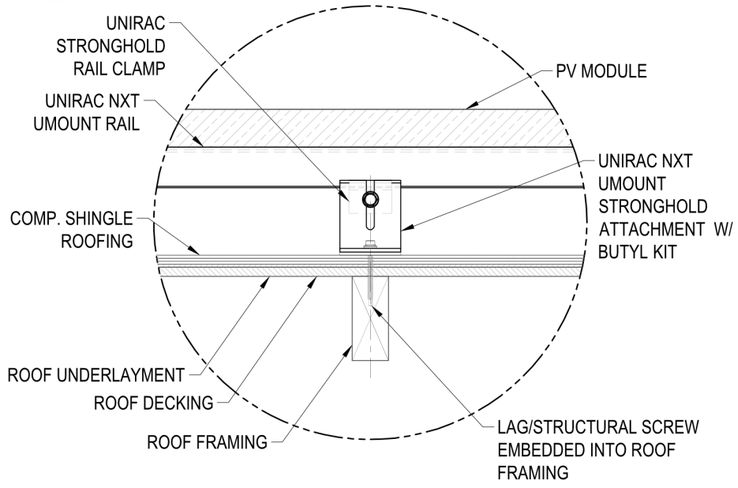


B PV-6 RACKING ELEVATION (LONGITUDINAL VIEW)

SCALE: NTS

C PV-6 ATTACHMENT DETAIL (TRANSVERSE VIEW)

SCALE: NTS



D PV-6 ATTACHMENT DETAIL (LONGITUDINAL VIEW)

SCALE: NTS

2069

SANDBOX SOLAR

GRID-TIED PV SYSTEM

CROSS RESIDENCE
300 PETERSON ST
FORT COLLINS, CO 80524

COLORADO LICENSED
IAN J SKOR
62365
Ian Skor
PROFESSIONAL ENGINEER

ATTACHMENT DETAILS

DOC ID: C687B8-1
DATE: 1/27/25
CREATOR: I.S.
REVIEWER:

REVISIONS

PV-6

1 PV-7 FIRE SAFETY PLAN
SCALE: 1" = 20'

GENERAL NOTES

1	AT LEAST TWO 3'-WIDE PATHWAYS ON SEPARATE ROOF PLANES, FROM LOWEST ROOF EDGE TO RIDGE, SHALL BE PROVIDED ON ALL BUILDINGS, WITH AT LEAST ONE PATHWAY ON THE STREET OR DRIVEWAY SIDE OF THE ROOF. FOR EACH ROOF PLANE WITH A PV ARRAY, AT LEAST ONE SUCH PATHWAY FROM LOWEST ROOF EDGE TO RIDGE SHALL BE PROVIDED ON THE SAME ROOF PLANE, OR ON AN ADJACENT ROOF PLANE, OR STRADDLING THE SAME AND ADJACENT ROOF PLANES. (IFC 1205.2.1.1)
2	FOR PV ARRAYS OCCUPYING 33% OR LESS OF THE PLAN VIEW TOTAL ROOF AREA, A MIN. 18"-WIDE SETBACK IS REQUIRED ON BOTH SIDES OF A HORIZONTAL RIDGE. (IFC 1205.2.1.2)
3	PV MODULES SHALL NOT BE PLACED BELOW AN EMERGENCY ESCAPE/RESCUE OPENING. A MIN. 3'-WIDE PATHWAY SHALL BE PROVIDED TO SUCH AN OPENING. (IFC 1205.2.2)
4	ROOF FACES WITH NO PV ARE DESIGNATED FOR FIRE VENTILATION AND ACCESS

1. 1.5' WIDE SMOKE-VENTILATION SETBACK, PER IFC 1205.2.1.2
2. ROOF ACCESS POINT
3. 3.0' WIDE FIRE ACCESS PATHWAY, PER IFC 1205.2.1.1
4. PV MODULES INSTALLED ON ROOF WITH UNIRAC NXT UMOUNT MOUNTING SYSTEM. THE MOUNTING SYSTEM IS UL 2703 CLASS A FIRE RATED ON THIS STEEP-SLOPED ROOF WHEN INSTALLED WITH TYPE 1, 2, 3, 10, 19, 22, 25, 29, OR 30 MODULES. THE REC SOLAR REC420AA PURE 2 IS UL 61730-1 CERTIFIED TYPE 2.
5. BUILDING IS 1-STORY, GROUP R3
6. TOTAL PLAN VIEW ARRAY AREA IS 176.9 SQ.FT, WHICH REPRESENTS 11.7% OF TOTAL PLAN VIEW ROOF AREA (1510.8 SQ.FT)
7. THIS SYSTEM UTILIZES MICROINVERTERS. THERE ARE NO DC CIRCUITS OUTSIDE OF THE ARRAY PERIMETER OR INSIDE THE BUILDING.
8. CABLES, WHEN RUN BETWEEN ARRAYS, SHALL BE ENCLOSED IN CONDUIT.

2069

SANDBOX SOLAR

GRID-TIED PV SYSTEM

CROSS RESIDENCE
300 PETERSON ST
FORT COLLINS, CO 80524

FIRE SAFETY PLAN

DOC ID: C687B8-1
DATE: 1/27/25
CREATOR: I.S.
REVIEWER:

REVISIONS

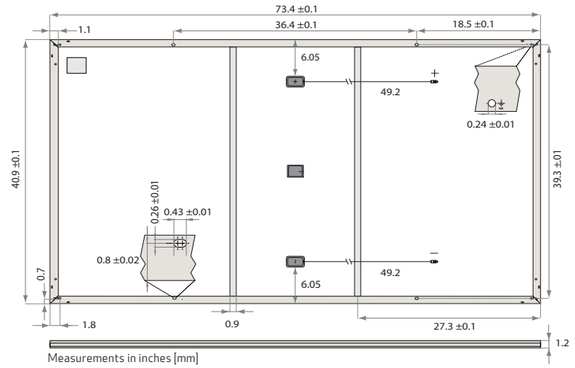
PV-7

REC ALPHA PURE 2 SERIES

PRODUCT SPECIFICATIONS

SOLAR'S MOST TRUSTED

GENERAL DATA	
Cell type:	132 half-cut REC heterojunction cells with lead-free, gapless technology, 6 strings of 22 cells in series
Glass:	0.12 in solar glass with anti-reflective surface treatment in accordance with EN 12150
Backsheet:	Highly resistant polymer (black)
Frame:	Anodized aluminum (black)
Junction box:	3-part, 3 bypass diodes, lead-free IP68 rated, in accordance with IEC 62790
Connectors:	Stäubli MC4 PV-KBT4/KST4 (12 AWG) in accordance with IEC 62852, IP68 only when connected
Cable:	12 AWG solar cable, 49.2 + 49.2 in in accordance with EN 50618
Dimensions:	73.4 x 40.9 x 1.2 in (20.88 sq-ft)
Weight:	47.6 lbs (21.6 kg)
Origin:	Made in Singapore



Measurements in inches [mm]

ELECTRICAL DATA	Product Code*: RECxxxAA PURE 2			
STC				
Power Output - P_{MAX} (Wp)	400	410	420	430
Watt Class Sorting - (W)	0/+10	0/+10	0/+10	0/+10
Nominal Power Voltage - V_{MPP} (V)	41.1	41.6	42.2	42.8
Nominal Power Current - I_{MPP} (A)	9.74	9.86	9.96	10.05
Open Circuit Voltage - V_{OC} (V)	48.5	48.8	49.1	49.3
Short Circuit Current - I_{SC} (A)	10.60	10.67	10.74	10.81
Power Density (W/ft²)	19.2	19.6	20.1	20.6
Panel Efficiency (%)	20.6	21.1	21.7	22.2
NMOT				
Power Output - P_{MAX} (Wp)	304	312	320	327
Nominal Power Voltage - V_{MPP} (V)	38.7	39.2	39.8	40.3
Nominal Power Current - I_{MPP} (A)	7.86	7.96	8.05	8.12
Open Circuit Voltage - V_{OC} (V)	45.7	45.8	46.0	46.2
Short Circuit Current - I_{SC} (A)	8.50	8.62	8.68	8.73

Values at standard test conditions (STC: air mass AM 1.5, irradiance 1075 W/sq ft (1000 W/m²), temperature 77°F (25°C), based on a production spread with a tolerance of P_{MAX}, V_{OC} & I_{SC} ±3% within one watt class. Nominal module operating temperature (NMOT: air mass AM 1.5, irradiance 800 W/m², temperature 68°F (20°C), windspeed 3.3 ft/s (1 m/s). * Where xxx indicates the nominal power class (P_{MAX}) at STC above.

MAXIMUM RATINGS	
Operational temperature:	-40 ... +85°C
System voltage:	1000 V
Test load (front):	+7000 Pa (146 lbs/ft²)*
Test load (rear):	-4000 Pa (83.5 lbs/ft²)*
Series fuse rating:	25 A
Reverse current:	25 A

*See installation manual for mounting instructions. Design load = Test load / 1.5 (safety factor)

WARRANTY	Standard	REC ProTrust	
Installed by an REC Certified Solar Professional	No	Yes	Yes
System Size	All	≤25 kW	25-500 kW
Product Warranty (yrs)	20	25	25
Power Warranty (yrs)	25	25	25
Labor Warranty (yrs)	0	25	10
Power in Year 1	98%	98%	98%
Annual Degradation	0.25%	0.25%	0.25%
Power in Year 25	92%	92%	92%

See warranty documents for details. Conditions apply

Available from:

Founded in 1996, REC Group is an international pioneering solar energy company dedicated to empowering consumers with clean, affordable solar power. As Solar's Most Trusted, REC is committed to high quality, innovation, and a low carbon footprint in the solar materials and solar panels it manufactures. Headquartered in Norway with operational headquarters in Singapore, REC also has regional hubs in North America, Europe, and Asia-Pacific.

CERTIFICATIONS	
IEC 61215:2016, IEC 61730:2016, UL 61730	
IEC 62804	PID
IEC 61701	Salt Mist
IEC 62716	Ammonia Resistance
UL 61730	Fire Type 2
IEC 62782	Dynamic Mechanical Load
IEC 61215-2:2016	Hailstone (35mm)
IEC 62321	Lead-free acc. to RoHS EU 863/2015
ISO 14001, ISO 9001, IEC 45001, IEC 62941	

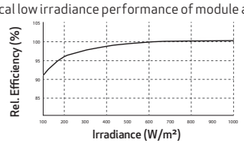
TEMPERATURE RATINGS*	
Nominal Module Operating Temperature:	44°C (±2°C)
Temperature coefficient of P_{MAX}:	-0.24 %/°C
Temperature coefficient of V_{OC}:	-0.24 %/°C
Temperature coefficient of I_{SC}:	0.04 %/°C

*The temperature coefficients stated are linear values

DELIVERY INFORMATION	
Panels per pallet:	33
Panels per 40 ft GP/high cube container:	792 (24 pallets)
Panels per 53 ft truck:	858 (26 pallets)

LOW LIGHT BEHAVIOUR

Typical low irradiance performance of module at STC:



REC Solar PTE. LTD.
20 Tuas South Ave. 14
Singapore 637312
post@recgroup.com
www.recgroup.com

Ref: PD-DS-AAPR Rev 1.4 08.23

ENPHASE

PRELIMINARY DATA SHEET

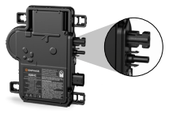
IQ8X Microinverter

Our newest IQ8 Series 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. IQ8X Microinverter is the latest addition to this family, designed to support PV modules with higher input DC voltage and cell counts, such as 96 cells, 80 half-cut cells, and 88 half-cut cells. 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 55 nm technology with high-speed digital logic and has superfast 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 IQ Battery, IQ Gateway, and the Enphase App monitoring and analysis software.

Enphase 25 year limited warranty

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



Connect PV modules quickly and easily to the IQ8 Series Microinverters that have integrated MC4 connectors.

UL CERTIFIED SAFETY

IQ8 Series Microinverters are UL listed as PV rapid shutdown equipment and conform with various regulations when installed according to the manufacturer's instructions.

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

Easy to install

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

High productivity and reliability

- Produces 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) and IEEE 1547:2018 (UL 1741-SB)

Note:

IQ8 Series Microinverters cannot be mixed together with previous generations of Enphase microinverters (IQ7 Series, IQ6 Series, and so on) in the same system.

IQ8X Microinverter

INPUT DATA (DC)		IQ8X-80-M-US
Commonly used module pairings [1]	W	320–540
Module compatibility		To meet compatibility, PV modules must be within Max. Input DC voltage and Max module I_{sc} listed below Module compatibility can be checked at https://enphase.com/installers/microinverters/calculator
MPPT voltage range	V	43-60
Operating range	V	25-79.5
Minimum and Maximum start voltage	V	30-79.5
Max. input DC voltage	V	79.5
Max. continuous operating DC current	A	10
Max. input DC short-circuit current	A	16
Max. module I_{sc}	A	13
Overvoltage class DC port		II
DC port backfeed current	mA	0
PV array configuration		Ungrounded array; no additional DC side protection required; AC side protection requires max 20 A per branch circuit

OUTPUT DATA (AC)		IQ8X-80-M-US @240 VAC	IQ8X-80-M-US @208 VAC
Peak output power	VA	384	366
Max. continuous output power	VA	380	360
Nominal grid voltage (L-L)	V	240, split-phase (L-L), 180°	208, single-phase (L-L), 120°
Minimum and Maximum grid voltage [2]	V	211-264	183-229
Max. continuous output current	A	1.58	1.73
Nominal frequency	Hz	60	
Extended frequency range	Hz	47-68	
AC short circuit fault current over three cycles	Arms	2.70	
Max. units per 20 A (L-L) branch circuit [3]		10	9
Total harmonic distortion	%	< 5	
Overvoltage class AC port		III	
AC port backfeed current	mA	18	
Power factor setting		1.0	
Grid-tied power factor (adjustable)		0.85 leading...0.85 lagging	
Peak efficiency	%	97.6	97.4
CEC weighted efficiency	%	97.2	96.9
Nighttime power consumption	mW	22	29

MECHANICAL DATA	
Ambient temperature range	-40°C to 65°C (-40°F to 149°F)
Relative humidity range	4% to 100% (condensing)
DC connector type	Stäubli MC4
Dimensions (H × W × D); Weight	212 mm (8.3") × 175 mm (6.9") × 30.2 mm (1.2"); 1.1 kg (2.43 lbs)
Cooling	Natural convection – no fans
Approved for wet locations; Pollution degree	Yes; 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, IEEE 1547:2018 (UL 1741-SB), 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 shutdown 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 the manufacturer's instructions.

(1) No enforced DC/AC ratio.
(2) Nominal voltage range can be extended beyond nominal if required by the utility.
(3) Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

IQ8X-MC4-DSH-00185-1.0-EN-US-2023-08-21

ENPHASE

DATASHEET

X-IQ-AM1-240-5
X-IQ-AM1-240-5C

IQ Combiner 5/5C

The IQ Combiner 5/5C consolidates interconnection equipment into a single enclosure and streamlines IQ Series Microinverters and IQ Gateway installation by providing a consistent, pre-wired solution for residential applications. IQ Combiner 5/5C uses wired control communication and is compatible with IQ System Controller 3/3G and IQ Battery 5P.

The IQ Combiner 5/5C, along with IQ Series Microinverters, IQ System Controller 3/3G, and IQ Battery 5P provides you with a complete grid-agnostic Enphase Energy System.

IQ Series Microinverters
The high-powered smart grid-ready IQ Series Microinverters (IQ6, IQ7, and IQ8 Series) dramatically simplify the installation process

IQ System Controller 3/3G
Provides microgrid interconnection device (MID) functionality by automatically detecting grid failures and seamlessly transitioning the home energy system from grid power to backup power

IQ Battery 5P
Fully integrated AC battery system. Includes six field-replaceable IQ8D-BAT Microinverters

IQ Load Controller
Helps prioritize essential appliances during a grid outage to optimize energy consumption and prolong battery life

Smart

- Includes IQ Gateway for communication and control
- Includes Enphase Mobile Connect (CELLMODEM-M1-06-SP-05), only with IQ Combiner 5C
- Supports flexible networking: Wi-Fi, Ethernet, or cellular
- Provides production metering (revenue grade) and consumption monitoring

Easy to install

- Mounts to one stud with centered brackets
- Supports bottom, back, and side conduit entry
- Supports up to four 2-pole branch circuits for 240 VAC plug-in breakers (not included)
- 80 A total PV branch circuits

Reliable

- Durable NRTL-certified NEMA type 3R enclosure
- 5-year limited warranty
- Two years labor reimbursement program coverage included for both the IQ Combiner SKUs
- UL1741 listed

Enphase 5 year limited warranty

5-year limited warranty

UL LISTED

IQ Combiner 5/5C

MODEL NUMBER	
IQ Combiner 5 (X-IQ-AM1-240-5)	IQ Combiner 5 with IQ Gateway printed circuit board for integrated revenue grade PV production metering (ANSIC12.20 ±0.5%), consumption monitoring (± 2.5%) and IQ Battery monitoring (±2.5%). Includes a silver solar shield to deflect heat
IQ Combiner 5C (X-IQ-AM1-240-5C)	IQ Combiner 5C with IQ Gateway printed circuit board for integrated revenue grade PV production metering (ANSI C12.20 ±0.5%), consumption monitoring (±2.5%) and IQ Battery monitoring (±2.5%). Includes Enphase Mobile Connect cellular modem (CELLMODEM-M1-06-SP-05)[1]. Includes a silver solar shield to deflect heat
WHAT'S IN THE BOX	
IQ Gateway printed circuit board	IQ Gateway is the platform for total energy management for comprehensive, remote maintenance and management of the Enphase IQ System
Busbar	125A busbar with support for 1 x IQ Gateway breaker and 4 x 20A breaker for installing IQ Series Microinverters and IQ Battery 5P
IQ Gateway breaker	Circuit breaker, 2-pole, 10 A/15 A
Production CT	Prewired revenue-grade solid core CT, accurate up to 0.5%
Consumption CT	Two consumption metering clamp CTs, shipped with the box, accurate up to 2.5%
IQ Battery CT	One battery metering clamp CT, shipped with the box, accurate up to 2.5%
CTRL board	Control board for wired communication with IQ System Controller 3/3G and the IQ Battery 5P
Enphase Mobile Connect (only with IQ Combiner 5C)	4G-based LTE-M1 cellular modem (CELLMODEM-M1-06-SP-05) with a 5-year T-Mobile data plan
Accessories kit	Spare control headers for CTRL board
ACCESSORIES AND REPLACEMENT PARTS (NOT INCLUDED, ORDER SEPARATELY)	
CELLMODEM-M1-06-SP-05	4G-based LTE-M1 cellular modem with a 5-year T-Mobile data plan
CELLMODEM-M1-06-AT-05	4G-based LTE-M1 cellular modem with a 5-year AT&T data plan
Circuit breakers (off-the-shelf)	Supports Eaton BR210, BR215, BR220, BR230, BR240, BR250, and BR260 circuit breakers Supports Eaton BR220B, BR230B, and BR240B circuit breakers compatible with hold-down kit
Circuit breakers (provided by Enphase)	BRK-10A-2-240V, BRK-15A-2-240V, BRK-20A-2P-240V, BRK-15A-2P-240V-B, and BRK-20A-2P-240V-B (More details in "Accessories" section)
XA-SOLARSHIELD-ES	Replacement solar shield for IQ Combiner 5/5C
XA-ENV2-PCBA-5	IQ Gateway replacement printed circuit board (PCB) for Combiner 5/5C
X-IQ-NA-HD-125A	Hold-down kit compatible with Eaton BR-B series circuit breakers (with screws)
ELECTRICAL SPECIFICATIONS	
Rating	80 A
System voltage	120/240 VAC, 60 Hz
Busbar rating	125 A
Fault curent rating	10 kAIC
Maximum continuous current rating (input from PV/storage)	64 A
Branch circuits (solar and/or storage)	Up to four 2-pole Eaton BR series distributed generation (DG) breakers only (not included)
Maximum total branch circuit breaker rating (input)	80 A of distributed generation/95 A with IQ Gateway breaker included
IQ Gateway breaker	10 A or 15 A rating GE/Siemens/Eaton included
Production metering CT	200 A solid core pre-installed and wired to IQ Gateway
Consumption monitoring CT (CT-200-CLAMP)	A pair of 200 A clamp-style current transformers is included with the box
IQ Battery metering CT	200 A clamp-style current transformer for IQ Battery metering, included with the box

[1] A plug-and-play industrial-grade cell modem for systems up to 60 microinverters. (Available in the US, Canada, Mexico, Puerto Rico, and the US Virgin Islands, where there is adequate cellular service in the installation area.)

IQC-5-5C-DSH-00007-1.0-EN-US-2023-07-12

MECHANICAL DATA	
Dimensions (WxHxD)	37.5 cm x 49.5 cm x 16.8 cm (14.75" x 19.5" x 6.63"). Height is 21.06" (53.5 cm) with mounting brackets
Weight	7.5 kg (16.5 lbs)
Ambient temperature range	-40°C to 46°C (-40°F to 115°F)
Cooling	Natural convection, plus heat shield
Enclosure environmental rating	Outdoor, NRTL-certified, NEMA type 3R, polycarbonate construction
Wire sizes	• 20 A to 50 A breaker inputs: 14 to 4 AWG copper conductors • 60 A breaker branch input: 4 to 1/0 AWG copper conductors • Main lug combined output: 10 to 2/0 AWG copper conductors • Neutral and ground: 14 to 1/0 copper conductors • Always follow local code requirements for conductor sizing
Communication (In-premise connectivity)	Built-in CTRL board for wired communication with IQ Battery 5P and IQ System Controller 3/3G. Integrated Power Line Communication for IQ Series Microinverters
Altitude	Up to 2,600 meters (8,530 feet)
COMMUNICATION INTERFACES	
Integrated Wi-Fi	802.11b/g/n (dual band 2.4 GHz/5 GHz), for connecting the Enphase cloud via the internet
Wi-Fi range (recommended)	10 m
Ethernet	Optional, 802.3, Cat5E (or Cat 6) UTP Ethernet cable (not included), for connecting to the Enphase Cloud via the internet
Mobile Connect	CELLMODEM-M1-06-SP-05 or CELLMODEM-M1-06-AT-05 (included with IQ Combiner 5C)
Digital I/O	Digital input/output for grid operator control
USB 2.0	For Mobile Connect
Access point (AP) mode	For connection between the IQ Gateway and a mobile device running the Enphase Installer App
Metering ports	Up to two Consumption CTs, one IQ Battery CT, and one Production CT
Power line communication	90–110 kHz
Web API	Refer to https://developer-v4.enphase.com
Local API	Refer to guide for local API
COMPLIANCE	
IQ Combiner	UL 1741, CAN/CSA C22.2 No. 107.1, Title 47 CFR, Part 15, Class B, ICES 003
IQ Gateway	UL 60601-1/CANCSA 22.2 No. 61010-1, IEEE 1547: 2018 (UL 1741-SB, 3rd Ed.) IEEE 2030.5/CSIP Compliant Production metering: ANSI C12.20 accuracy class 0.5 (PV production)
COMPATIBILITY	
IQ System Controller 3/3G	SC200D111C240US01, SC200G111C240US01
IQ Battery 5P	IQBATTERY-5P-1P-NA
Microinverter	IQ6, IQ7, and IQ8 Series Microinverters

Accessories

Enphase Mobile Connect

4G-based LTE-M1 cellular modem with a 5-year data plan
(CELLMODEM-M1-06-SP-05 for Sprint and CELLMODEM-M1-06-AT-05 for AT&T)

Circuit breakers

BRK-10A-2-240V Circuit breaker, 2-pole, 10 A, Eaton BR210
BRK-15A-2-240V Circuit breaker, 2-pole, 15 A, Eaton BR215
BRK-20A-2P-240V Circuit breaker, 2-pole, 20 A, Eaton BR220
BRK-15A-2P-240V-B Circuit breaker, 2-pole, 15 A, Eaton BR215B with hold-down kit support
BRK-20A-2P-240V-B Circuit breaker, 2-pole, 20 A, Eaton BR220B with hold-down kit support

CT-200-SOLID

200 A revenue grade solid core Production CT with <0.5% error rate (replacement SKU)

CT-200-CLAMP

200 A clamp-style consumption and battery metering CT with <2.5% error rate (replacement SKU)

IQC-5-5C-DSH-00007-1.0-EN-US-2023-07-12

Revision history

REVISION	DATE	DESCRIPTION
DSH-00007-1.0	May 2023	Initial release

Product data sheet
Characteristics

D222NRB
SWITCH FUSIBLE GD 240V 60A 2P NEMA3R

Green Premium Product

Product availability: Stock - Normally stocked in distribution facility

Main

Product	Single Throw Safety Switch
Current Rating	60 A
Certifications	UL listed file E2875
Enclosure Rating	NEMA 3R
Disconnect Type	Fusible disconnect switch
Factory Installed Neutral	Neutral (factory installed)
Short Circuit Current Rating	100 kA maximum depending on fuse H, K or R
Mounting Type	Surface
Number of Poles	2
Electrical Connection	Lugs
Duty Rating	General duty
Voltage Rating	240 V AC
Wire Size	AWG 12...AWG 3 aluminium AWG 14...AWG 3 copper

Complementary

Width	189.23 mm (7.45 in)
Height	377.95 mm (14.88 in)
Depth	123.70 mm (4.87 in)
Tightening torque	3.95 N.M (35 lbf.in) 0.00…0.01 in² (2.08…5.26 mm²) AWG 14...AWG 10) 3.95 N.M (35 lbf.in) AWG 14...AWG 10) 5.08 N.M (45 lbf.in) 0.01 in² (8.37 mm²) AWG 8) 5.08 N.M (45 lbf.in) 0.02…0.03 in² (12.3…21.12 mm²) AWG 6...AWG 4) 5.65 N.m (50 lbf.in) 0.04 in² (26.67 mm²) AWG 3)

Ordering and shipping details

Category	00106 - D & DU SW,NEMA3R, 30-200A
Discount Schedule	DE1A
GTIN	00785901460640
Package weight(Lbs)	3.74 kg (8.25 lb(US))
Returnability	Yes
Country of origin	US

Offer Sustainability

Sustainable offer status	Green Premium product
California proposition 65	WARNING: This product can expose you to chemicals including: Lead and lead compounds which is known to the State of California to cause Carcinogen & Re-productive harm. For more information go to www.p65warnings.ca.gov
REACh Regulation	REACh Declaration
REACh free of SVHC	Yes
EU RoHS Directive	Compliant EU RoHS Declaration
Mercury free	Yes
RoHS exemption information	Yes
China RoHS Regulation	China RoHS Declaration
Environmental Disclosure	Product Environmental Profile
Circularity Profile	No need of specific recycling operations

Contractual warranty

Warranty	18 months

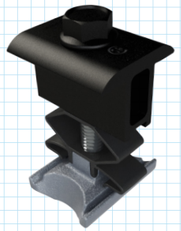
NXT UMOUNT™

UNIRAC®
BETTER SOLAR STARTS HERE

UNIRAC
25 YEAR
FULL-SYSTEM WARRANTY

DISCOVER YOUR **NXT** UMOUNT™

The culmination of over two decades of experience. Thoughtful design, rigorous engineering, world-class support, and a reliable supply chain are the foundation of what makes us confident that NXT UMOUNT™ is the NXT Level of DESIGN, SIMPLICITY, and VALUE.



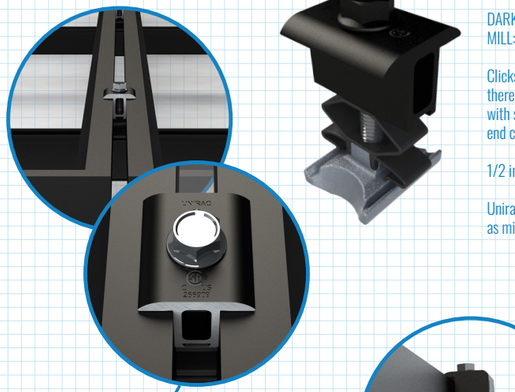
NEW NXT UMOUNT™ CLAMP

DARK: SHCLMPD2
MILL: SHCLMPM2

Clicks into rail anywhere (even where there are cables!) Self-standing clamp with spring combines as both mid and end clamp. Clamps 30-40 mm modules

1/2 inch module spacing for efficiency.

Unirac-quality bonding that works both as mid and end clamps.



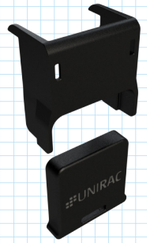
NXT UMOUNT™ COMBO CLAMP

DARK: CCLAMPD1
MILL: CCLAMPM1

Clicks into rail anywhere (even where there are cables!) Self-standing clamp with spring combines as both mid and end clamp. Clamps 30-40 mm modules

1/2 inch module spacing for efficiency.

Unirac-quality bonding that works both as mid and end clamps.



NXT UMOUNT™ CAP KIT

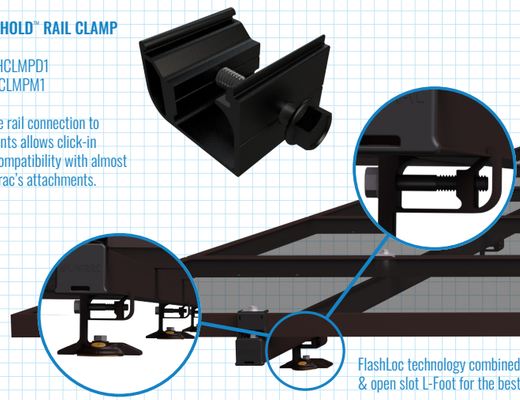
ENDCAPD1

Make the install look clean with the end cap kit designed to complement the module end clamp and rail ends.

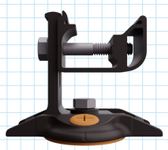
STRONGHOLD™ RAIL CLAMP

DARK: SHCLMPD1
MILL: SHCLMPM1

Adaptable rail connection to attachments allows click-in feature compatibility with almost all of Unirac's attachments.



FlashLoc technology combined with new features: click-in rail & open slot L-Foot for the best flash-less install experience.



STRONGHOLD™ ATTACHMENT KIT

DARK: SHCPKTD1
MILL: SHCPKTM1

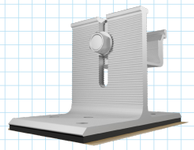
Rail clicks into the clamps attached to the STRONGHOLD™ base. Open slot in L-foot allows drop-in rail clamp.

Alternative attachment options:

SOLARHOOKS
All varieties

FLASHKIT PRO
DARK: 004055D
MILL: 004055M

FLASHLOC™ DUO
DARK: 004275D
MILL: 004275M



BUTYL™ ATTACHMENT KIT

DARK: SBUTYLD1
MILL: SBUTYLM1

BUTYL™ PADS

XTRABUTL-SH

DIRECT-TO-DECK SCREWS

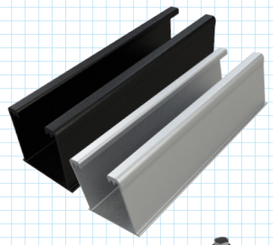
003250W

The pre-applied butyl pad removes the need for additional flashing. Just peel the liner, place the attachment, and fasten it to the roof. Butyl conforms to the screws and roof for a robust, dependable seal with no extra work!

NXT UMOUNT™ RAIL

DARK: 168RLD1
MILL: 168RLM1

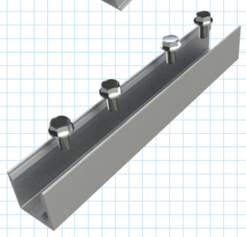
Strong, lightweight open channel rail with invisible, easy, unfailing and integrated wire management system.



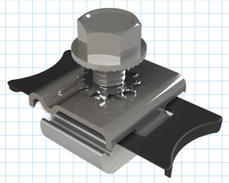
NXT UMOUNT™ RAIL SPLICE

RLSPLCM1

Structural internal splice that does not interfere with roof connection nor module connection.
Pre-assembled thread cutting bolts.



WIRE MANAGEMENT OPTONS



NXT UMOUNT™ MLPE & LUG CLAMP

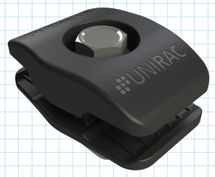
LUGMLPE1

Works as either MLPE Mount or Grounding Lug connection to the rail. Why source two parts when one can do the job?

NXT UMOUNT™ WIRE MANAGEMENT CLIP

WRMCLPD1

Aesthetic, yet functional accessory that works to help installers keep wires inside the rail. No zip-ties required. Optional zip tie loop for extra wire management capabilities!



NXT UMOUNT™ N/S WIRE MGMT CLIP

WRMCNSD1

An elegant solution to help installers get to the home run. The same hardware works to provide both easy entry to rail and adjustability for cable thickness.

FOR QUESTIONS OR CUSTOMER SERVICE VISIT UNIRAC.COM OR CALL 505-242-6411

14-July-2023

Unirac
1411 Broadway Blvd. NE
Albuquerque, NM 87101
Tel: 505 242 6411

Attn.: Engineering Department

Subject: Engineering Certification for the Unirac NXT UMOUNT System to Support Photovoltaic Panels.

The Unirac NXT UMOUNT Flush-to-Roof is an extruded aluminum rail system that is engineered to hold most framed solar modules to a roof structure and installed parallel to the roof surface.
We have reviewed the NXT UMOUNT system, a proprietary mounting system for rooftop solar photovoltaic (PV) panels installation, and the U-Builder 2.0 Online tool. This U-Builder 2.0 software includes analysis for the NXT UMOUNT rail and NXT UMOUNT hardware. All information, data, and analysis are in compliance with the following codes, city ordinances, and typical specifications:

Codes:

1. ASCE/SEI 7-10, 7-16 Minimum Design Loads for Buildings and Other Structures.
2. International Building Code, 2012-2021 Edition w/ Provisions from SEAOC PV-2 2017.
3. International Residential Code, 2012-2021 Edition w/ Provisions from SEAOC PV-2 2017.
4. AC428, Acceptance Criteria for Modular Framing Systems Used to Support Photovoltaic (PV) Panels, November 1, 2012 by ICC-ES.
5. Aluminum Design Manual 2015 & 2020 Edition.

The following are typical specifications to meet the above code requirements:

Design Criteria:
Ground Snow Load = 0 - 100 (psf)
Basic Wind Speed = 95 - 190 (mph)
Roof Mean Height = 0 - 60 (ft)
Roof Pitch = 0°-45°
Exposure Category = B, C & D

Attachment Spacing: Per U-Builder 2.0 Engineering report.

Cantilever: The maximum rail cantilever length is 1/3 of the adjacent span.

Clearance: 2” to 10” clear from the top of the roof to the top of the PV panel.

Tolerance(s): 1.0” tolerance for any specified dimension in this report is allowed for installation.

Installation Orientation: See NXT UMOUNT Installation Guide.
Landscape - PV Panel long dimension is parallel to ridge/eave line of the roof and the PV panel is mounted on the long side.

Portrait - PV Panel short dimension is parallel to ridge/eave line of the roof and the PV panel is mounted on the short side.

Engineering Alliance, Inc
https://www.eng-alliance.com

Components and Cladding Roof Zones:
The Components and Cladding Roof Zones shall be determined based on ASCE 7-10 & 7-16 Component and Cladding design.

Notes:

1. U-Builder 2.0 Online tool analysis is only for Unirac NXT UMOUNT systems and do not include roof capacity check.
2. Risk Category II per ASCE 7-16.
3. Topographic factor, kzt is 1.0.
4. Array Edge Factor Y_E = 1.5
5. Average parapet height is 0.0 ft.
6. Wind speeds are LRFD values.
7. Attachment spacing(s) apply to a seismic design category E or less.

Design Responsibility:
The U-Builder 2.0 design software is intended to be used under the responsible charge of a registered design professional where required by the authority having jurisdiction. In all cases, this U-Builder 2.0 software should be used under the direction of a design professional with sufficient structural engineering knowledge and experience to be able to:

- Evaluate whether the U-Builder 2.0 Software is applicable to the project, and
- Understand and determine the appropriate values for all input parameters of the U-Builder 2.0 software.

This letter certifies that the Unirac NXT UMOUNT system, when installed according to the U-Builder 2.0 engineering report and the manufacture specifications, is in compliance with the above codes and loading criteria.

This certification excludes evaluation of the following components:
1) The structure to support the loads imposed on the building by the array; including, but not limited to: strength and deflection of structural framing members, fastening and/or strength of roofing materials, and/or the effects of snow accumulation on the structure.
2) The attachment of the NXT UMOUNT Rails to the existing structure.
3) The capacity of the solar module frame to resist the loads.

This requires additional knowledge of the building and is outside the scope of the certification of this racking system.

Please feel free to call for any questions or clarifications.

Prepared By

Engineering Alliance, Inc
Sugar Land, TX

14-JUL-2023

4603 April Meadow Way, Sugar Land, TX 77479. Ph: 832 865 4757

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

SYSTEM LEVEL FIRE CLASSIFICATION

The system fire class rating requires installation in the manner specified in the NXT UMOUNT Installation Guide. NXT UMOUNT has been classified to the system level fire portion of UL 2703. NXT UMOUNT has achieved system level performance for steep sloped roofs and low sloped roofs. System level fire performance is inherent in the NXT UMOUNT design, and no additional mitigation measures are required. See table below for definition of steep sloped and low sloped roofs. The system is to be mounted over fire resistant roof covering rated for the application. There is no required minimum or maximum height limitation above the roof deck to maintain the system fire rating for NXT UMOUNT. Approved Module Types & System Level Fire Ratings are listed below:

Roof Type	Module Type	System Level Fire Rating	Rail Direction	Module Orientation
Steep Slope - roof pitches ≥ 2 in/ft	Type 1, 2, 3 with metal frame, 10 with metal frame, 19, 22, 25, 29, & 30	Class A	Parallel OR Perpendicular to Ridge	Landscape OR Portrait
Low Slope - roof pitches < 2in/ft	Type 1, 2, 29, & 30			

MECHANICAL LOAD TEST MODULES

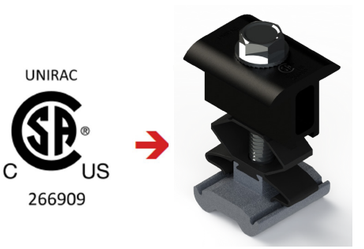
The modules selected for UL 2703 mechanical load testing were selected to represent the broadest range possible for modules on the market. The tests performed covers module frame thicknesses greater than or equal to 1.0 mm, single and double wall frame profiles (some complex frame profiles could require further analysis to determine applicability), and clear and dark anodized aluminum frames. PV modules may have a reduced load rating, independent of the NXT UMOUNT rating. Please consult the PV module manufacturer's installation guide for more information.

Tested Module	UL2703 Certification Load Ratings	Tested Loads	Tested Module Area
SunPower SPR-A440 -COM	Down: 50 psf, Up: 50 psf , Slope: 15 psf	Down: 75 psf, Up: 75 psf , Slope: 23 psf	21.86 sq ft
Jinko JKM-xxxM 72HL4-V	Down: 39.47 psf, Up: 22.28 psf, Slope: 8 psf	Down: 59.20 psf, Up: 33.42 psf, Slope: 12 psf	27.76 sq ft

UL2703 CERTIFICATION MARKING:

Unirac NXT UMOUNT is listed to UL 2703. Certification marking is embossed on all Combo Clamps as shown. Labels with additional certification information are provided with clamps and must be applied to the NXT UMOUNT Rail at the edge of the array.

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



Electrical Bonding and Grounding Test Modules
The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the NXT UMOUNT system.

Manufacture	Module Model / Series
Aionrise	AION60G1, AION72G1
Aleo	P-Series & S-Series
Aptos Solar	DNA-120-(MF/BF)10-xxxW DNA-120-MF10 DNA-120-(MF/BF)23 DNA-144-(MF/BF)23 DNA-120-(MF/BF)26 DNA-144-(MF/BF)26 DNA-108-(MF/BF)10-xxxW
Astronergy	CHSM6612 M, M/HV CHSM6612P Series CHSM6612P/HV Series CHSM72M-HC CHSM72M(DG)/F-BH
Auxin	AXN6M610T AXN6P610T AXN6M612T AXN6P612T
Axitec	AC-xxx(M/P)/60S, AC-xxx(M/P)/72S AC-xxxP/156-60S AC-xxxMH/120(S/V/SB/VB) AC-xxxMH/144(S/V/SB/VB)
Boviet	BVM6610, BVM6612
BYD	P6K & MHK-36 Series

Manufacture	Module Model / Series
Canadian Solar	CS1(H/K/U/Y)-MS CS3K-(MB/MB-AG/MS/P/P HE/PB-AG) CS3L-(MS/P), CS3N-MS CS3U-(MB/MB-AG/MS/P/P HE/PB/PB-AG) CS3W-(MB-AG/MS/P/P-PB-AG) CS3Y-MB-AG, CS5A-M CS6K-(M/MS/MS AllBlack/P/P HE) CS6P-(M/P), CS6R-MS CS6U-(M/P/P HE), CS6W-(MB-AG/MS) CS6X-P, CSX-P, CS7L-MB-AG CS7L-xxxMB-AG ELPS CS6(A/P)-MM
Centrosolar America	C-Series & E-Series
CertainTeed	CT2xxMxx-01, CT2xxPxx-01, CTxxxMxx-01 CTxxxPxx-01, CTxxxMxx-02, CTxxxMxx-03 CTxxxMxx-04, CTxxxHC11-04
Eco Solargy	Orion 1000 & Apollo 1000
ET Solar	ET AC Module, ET Module ET-M772BH520-550WW/WB
First Solar	FS-6XXX(A) FS-6XXX(A)-P, FS-6XXX(A)-P-I
Flextronics	FXS-xxxBB
Freedom Forever	FF-MP-BBB-xxx, FF-MP1-BBB-xxx
FreeVolt	PVGraf
GCL	GCL-P6 & GCL-M6 Series

Manufacture	Module Model / Series
Hansol	TD-AN3, TD-AN4 UB-AN1, UD-AN1
Hanwha SolarOne	HSL 60
Heliene	36M, 36P 60M, 60P, 72M & 72P Series 144HC M6 144HC M10 SL Bifacial
H-SAAE	HT60-156M-C HT60-156M(V)-C HT72-156(M/P) HT72-156P-C, HT72-156P(V)-C HT72-156M(PDV)-BF, HT72-156M(PD)-BF HT72-166M, HT72-18X
Hyperion Solar	HY-DH108P8(B), HY-DH108N8B HY-DH144P8
Hyundai	KG, MG, RW, TG, RI, RG, TI, KI, HI Series HiA-SxxxHG, HiD-SxxxRG(BK), HiN-SxxxXG(BK), HiS-S400PI, HiS-SxxxYH(BK), HiS-SxxxXG(BK)
ITEK	iT-SE Series
Japan Solar	JPS-60 & JPS-72 Series

- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
- Items in parenthesis are those that may or may not be present in a compatible module's model ID
- Slashes "/" between one or more items indicates that either of those items may be the one that is present in a module's model ID
- **Listed models can be used to achieve a Class A fire system rating, for steep slope or low slope applications, only when modules of fire typed mentioned in Appendix A, Page 26 are used.**

Electrical Bonding and Grounding Test Modules
The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the NXT UMOUNT system.

Manufacture	Module Model / Series
JA Solar	JAM54S31 xxx/MR JAM72D30MB, JAM78D10MB JAM72S30 /MR JAP6 60-xxx JAM6(K)-60/xxx, JAP6(k)-72-xxx/4BB JAP72S##-xxx/** JAP6(k)-60-xxx/4BB, JAP60S##-xxx/** JAM6(k)-72-xxx/**, JAM72S##-xxx/** JAM6(k)-60-xxx/**, JAM60S##-xxx/** i. ##: 01, 02, 03, 09, 10 ii. **: SC, PR, BP, HiT, IB, MW, MR ** = Backsheet, ## Cell technology
Jinko	JKM & JKMS Series JKMxxxM-72HL-V JKMxxxM-72HLM-TV JKMxxxM-72HL4-(T)V JKMxxxM-7RL3-V JKMxxxM-72HL4-TV
Kyocera	KD-F & KU Series
LA Solar	LSxxxHC(166) LSxxxBL LSxxxHC

Manufacture	Module Model / Series
LG Electronics	LGxxx(E1C/E1K/N1C/N1K/N2T/N2W/S1C/S2W/Q1C/Q1K)-A5 LGxxx(A1C/M1C/M1K/N1C/N1K/Q1C/Q1K/QAC/QAK)-A6 LGxxxN2W-B3 LGxxxN2T-B5 LGxxxN1K-B6
LG Electronics (Cont.)	LGxxx(N1C/N1K/N2T/N2W)-E6 LGxxx(N1C/N1K/N2W/S1C/S2W)-G4 LGxxxN2T-J5 LGxxx(N1K/N1W/N2T/N2W)-L5 LGxxx(M1C/N1C/Q1C/Q1K)-N5 LGxxx(N1C/N1K/N2W/Q1C/Q1K)-V5 LGxxxN3K-V6
LONGi	LR4-60(HPB/HPH) LR4-72(HPH) LR6-60 LR6-60(BK/HPB/HPH/HV/PB/PE/PH) LR6-72 LR6-72(BK/HV/PB/PE/PH) RealBlack LR4-60HPB RealBlack LR6-60HPB
Maxeon	SPR-MAX3-xxx-COM
Meyer Burger	Meyer Burger Black, Meyer Burger White Meyer Burger Glass
Mission Solar Energy	MSE Mono, MSE Perc MSExxx(SR8T/SR8K/SR9S/SX5T) MSExxx(SX5K/SX6W)

Manufacture	Module Model / Series
Mitrex	Mxxx-L3H, Mxxx-I3H
Mitsubishi	MJE & MLE Series
Neo Solar Power Co.	D6M Series
NE Solar	NESE xxx-72MHB-M10 NESE xxx-60MH-M6
Panasonic	VBHNxxxSA06/SA06B/SA11/SA11B VBHNxxxSA15/SA15B/SA16/SA16B, VBHNxxxKA, VBHNxxxKA03/04, VBHNxxxSA17/SA17G/SA17E/SA18/SA18E, VBHNxxxZA01/ZA02/ZA03/VBHNxxxZA04 EVPVxxx EVPVxxx(H/K/PK/HK)
Peimar	SGxxxM (FB/BF) SMxxxM
Phono Solar	PSxxxM1-20/U PSxxxM1H-20/U PSxxxM1-20UH PSxxxM1H-20UH PSxxxM4(H)-24/TH PSxxxM1-20/UH PSxxxM1H-20/UH PSxxxM-24/T PSxxxMH-24/T PSxxxM-24/TH PSxxxMH-24/TH
Prism Solar	P72 Series, P72X-xxx

- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
- Items in parenthesis are those that may or may not be present in a compatible module's model ID
- Slashes "/" between one or more items indicates that either of those items may be the one that is present in a module's model ID
- **Listed models can be used to achieve a Class A fire system rating, for steep slope or low slope applications, only when modules of fire typed mentioned in Appendix A, Page 26 are used.**

Electrical Bonding and Grounding Test Modules
The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the NXT UMOUNT system.

Manufacture	Module Model / Series
Q.Cells	Plus, Pro, Peak, G3, G4, Peak G5(SC) , G6(+)(SC)(AC), G7, G8(+), Plus, Pro, Peak L-G2, L-G4, L-G5 Peak L-G5, L-G6, L-G7, L-G8(BFF) Q.PEAK DUO(BLK)-G6+ Q.PEAK DUO BLK-G6+/TS
Q.Cells (Cont.)	Q.PEAK DUO (BLK)-G7 Q.PEAK DUO L-(G7/G7.1/G7.2/G7.3/G7.7) Q.PEAK DUO (BLK) G8(+) Q.PEAK DUO L-(G8/G8.1/G8.2/G8.3) Q.PEAK DUO L-G8.3 (BFF/BFG/BGT) Q.PEAK DUO (BLK) ML-G9(+) Q.PEAK DUO XL-(G9/G9.2/G9.3) Q.PEAK DUO XL-G9.3/BFG Q.PEAK DUO-G10+ Q.PEAK DUO BLK G10(+) Q.PEAK DUO BLK G10+ /AC Q.PEAK DUO (BLK) ML-G10(a)(+) Q.PEAK DUO BLK ML-G10+ / t Q.PEAK DUO XL-(G10/G10.2/G10.3/G10.c/G10.d) Q.PEAK DUO XL-G10.3/BFG Q.PEAK DUO XL-G10.d/BFG Q.PEAK DUO XL-G11S Q.PEAK DUO XL-(G11.2/G11.3) Q.PEAK DUO XL-G11.3/BFG

Manufacture	Module Model / Series
REC	RECxxxAA (BLK/Pure/Pure-R) RECxxxNP (N-PEAK) RECxxxNP2 (Black) RECxxxNP3 Black RECxxxPE, RECxxxPE72 RECxxxTP, RECxxxTP72 RECxxxTP2(M/BLK2) RECxxxTP2S(M)72 RECxxxTP3M (Black) RECxxxTP4 (Black)
Renesola	All 60-cell modules
Risen	RSM Series, RSM110-8-xxxBMDG
S-Energy	SN72 & SN60 Series
SEG Solar	SEG-xxx-BMD-HV SEG-xxx-BMD-TB
Seraphim	SEG-(6PA/6PB/6MA/6MA-HV/6MB/E01/E11) SRP-(6QA/6QB) SRP-xxx-6MB-HV, SRP-320-375-BMB-HV, SRP-xxx-BMC-HV, SRP-390-450-BMA-HV, SRP-xxx-BMZ-HV, SRP-390-405-BMD-HV
Sharp	NU-SA & NU-SC Series
Silfab	SLA-M, SLA-P, SLG-M, SLG-P & BC Series SILxxx(BG/BK/BL/HC/HC+/HL/HM/HN/ML/NL/NT/NX/NU)
Solar4America	S4Axxx-108MH10BB, S4Axxx-72MH5BB
SolarEver USA	SE-166*83-xxxM-120N SE-182*91-xxxM-108N

Manufacture	Module Model / Series
Solaria	PowerXT-xxxR-(AC/PD/BD) PowerXT-xxxC-PD PowerXT-xxxR-PM (AC) PowerX-400R
Solartech	STU HJT, STU PERC & Quantum PERC
SolarWorld	Sunmodule Protect, Sunmodule Plus/Pro
Sonali	SS-M-360 to 390 Series SS-M-390 to 400 Series SS-M-440 to 460 Series SS-M-430 to 460 BiFacial Series
Sun Edison	F-Series, R-Series
Suniva	MV Series & Optimus Series (35mm)
Sunmac Solar	M754SH-BB Series
SunPower	AC, X-Series, E-Series & P-Series SPR E20 435 COM (G4 Frame) Axxx-BLK-G-AC, SPR-Mxxx-H-AC
SunTech	STP, STPXXXS - B60/Wnhb
Talesun	TP572, TP596, TP654, TP660 TP672, Hipor M, Smart TD6I72M
Tesla	SC, SC B, SC B1, SC B2, TxxxS, TxxxH
Trina	PA05, PD05, DD05, DD06, DE06, DE09.05 PD14, PE14, DD14, DE14, DE15, DE15V(II) DEG15HC.20(II), DEG15MC.20(II) DEG15VC.20(II), DE18M(II), DEG18MC.20(II) DE19, DEG19C.20

- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
- Items in parenthesis are those that may or may not be present in a compatible module's model ID
- Slashes "/" between one or more items indicates that either of those items may be the one that is present in a module's model ID
- **Listed models can be used to achieve a Class A fire system rating, for steep slope or low slope applications, only when modules of fire typed mentioned in Appendix A, Page 26 are used.**

NXT UMOUNT™
COMPATIBLE MODULES
SYSTEM CERTIFICATION

Electrical Bonding and Grounding Test Modules
The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the NXT UMOUNT system.

Manufacture	Module Model / Series
TSMC	TS-150C2 CIGSw
Universal Solar	UNI4xx-144BMH-DG UNI5xx-144BMH-DG UNIxxx-108M-BB UNIxxx-120M-BB UNIxxx-120MH
Upsolar	UP-MxxxP, UP-MxxxM(-B)
URECO	D7Kxxx(H7A/H8A), D7Mxxx(H7A/H8A) FAKxxx(C8G/E8G), FAMxxxE7G-BB FAMxxxE8G(-BB), FBKxxxM8G F6MxxxE7G-BB FBMxxxMFG-BB
Vikram	Eldora, Somera, Ultima PREXOS VSMDHT.60.AAA.05 PREXOS VSMDHT.72.AAA.05
Vina	VNS-72M1-5-xxxW-1.5, VNS-72M3-5-xxxW-1.5, VNS-144M1-5-xxxW-1.5, VNS-144M3-5-xxxW-1.5, VNS-120M3-5-xxxW-1.0
VSUN	VSUNxxx-60M-BB, VSUNxxx-72MH VSUN4xx-144BMH, VSUN4xx-144BMH-DG VSUN5xx-144BMH-DG, VSUNxxx-108M-BB VSUNxxx-120M-BB, VSUNxxx-120BMH VSUNxxx-132BMH, VSUNxxx-108BMH
Waaree	Arka Series WSMDi
Winaico	WST & WSP Series

Manufacture	Module Model / Series
Yingli	YGE & YLM Series
Yotta Energy	YSM-B450-1
ZNShine Solar	ZXM6-72 Series, ZXM6-NH144 ZXM6-NHLDD144, ZXM7-SH108 Series

- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
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- **Listed models can be used to achieve a Class A fire system rating, for steep slope or low slope applications, only when modules of fire typed mentioned in Appendix A, Page 26 are used.**

STRONGHOLD™ | BUTYL

UNIRAC
BETTER SOLAR STARTS HERE

Unirac's STRONGHOLD™ Butyl is efficient, dependable, and optimized for UNIRAC's NXT UMOUNT™ system.

The pre-applied butyl pad removes the need for additional flashing. Just peel the liner, place the attachment, and fasten it to the roof. In addition, the butyl, used throughout the roofing and solar industries for its reliability, conforms to the screws and roof for a robust, dependable seal with no extra work! Couple this with the NXT UMOUNT™ system, and you have a highly reliable, easy-to-install system with integrated wire management.

KITTED WITH

- ONE (1) STRONGHOLD™ Butyl direct-to-deck attachment with pre-applied butyl patch (Extra patches for shimming available.)
- TWO (2) screws for rafter installation (Additional screws for direct-to-deck applications available.)
- ONE (1) NXT Rail Clamp

FOR QUESTIONS OR CUSTOMER SERVICE CONTACT: 505-242-6411 | SALES@UNIRAC.COM | WWW.UNIRAC.COM

STRONGHOLD™ | BUTYL

UNIRAC
BETTER SOLAR STARTS HERE

SIMPLIFIED FLASHLESS SOLUTION

- One-step Butyl application
- Reliable waterproofing without messy sealant
- Eliminate roof disturbance
- Minimize labor

OPTIMIZED FOR NXT UMOUNT, UNIRAC'S OPEN CHANNEL RAIL SYSTEM

- Open slot design for ease of rail connectivity with included STRONGHOLD™ NXT rail clamp
- STRONGHOLD™ Butyl combined with the NXT UMOUNT system make installation and wire management a breeze
- UL Certified with NXT UMOUNT

DUAL MOUNTING OPTIONS

- Pre-attached butyl pad: Simply peel, stick, and fasten with the two (2) included screws for rafter mount
- For direct-to-deck applications, additional decking screws are available

ADDITIONAL BENEFITS

- Mill and Dark Finishes
- Option for extra cross-course butyl patches
- Competitively priced with standard rafter attachments

UNIRAC CUSTOMER SERVICE MEANS THE HIGHEST LEVEL OF PRODUCT SUPPORT

UNMATCHED EXPERIENCE | CERTIFIED QUALITY | ENGINEERING EXCELLENCE | BANKABLE WARRANTY | DESIGN TOOLS | PERMIT DOCUMENTATION

TECHNICAL SUPPORT

UNIRAC's technical support team is dedicated to answering questions & addressing issues in real time. An online library of documents including engineering reports, stamped letters and technical data sheets greatly simplifies your permitting and project planning process.

CERTIFIED QUALITY PROVIDER

UNIRAC is the only PV mounting vendor with ISO certifications for 9001:2015, 14001:2015 and OHSAS 18001:2007, which means we deliver the highest standards for fit, form, and function. These certifications demonstrate our excellence and commitment to first class business practices.

BANKABLE WARRANTY

Don't leave your project to chance, UNIRAC has the financial strength to back our products and reduce your risk. Have peace of mind knowing you are receiving products of exceptional quality. STRONGHOLD™ products are covered by a twenty five (25) year limited product warranty.

PROTECT YOUR REPUTATION WITH QUALITY RACKING SOLUTIONS BACKED BY ENGINEERING EXCELLENCE AND A SUPERIOR SUPPLY CHAIN

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