Notes from Chris about building application:

Since my roof is a truss design, I needed to have a structural analysis performed. From what I understand from both plan reviewer with the city and from the company I know who does solar installations, if your roof is a traditional rafter design, knowing the dimensions of the lumber selected (2x6, 2x8, etc) is sufficient. In short, a “traditional rafter roof” carries the load across the rafters to the walls. Think plank bridge laid across a creek. A truss roof is more complicated (Google it). The load is transferred through the joints between chords and webs to the walls. Typically, the members of a truss will be smaller and will have been built offsite by a truss company. I will let you make the decision from here.

The Engineering reports that make up the last 22 pages were created on Unirac’s racking system designer.

*Louisville-Jefferson County Metro Government*

**CONSTRUCTION REVIEW DIVISION**

**Department of Codes and Regulations**
444 S. 5th St. – Louisville, KY 40202
**Phone:** 502.574.3321 **Web Site:** louisvilleky.gov/government/construction-review

# BUILDING PERMIT APPLICATION

*I hereby certify that I am the owner of record or the owner of record authorizes the proposed work and that I have been authorized to make this application as their authorized agent. I understand that any false or inaccurate information on this application or the approved plans may result in revocation of the permit under Kentucky Building Code. No deviation of the approved plan is allowed without approval by this office.*

[redacted] 9/19/19

*Signature of Owner or Agent* *Date*

Location: [redacted] Dr. Subdivision Name: _____ Lot # _____

(street address is required for all applications) (If applicable) (If applicable)

***Please provide a brief description of your project below:**

☐ Commercial Project ☒ Residential Project

☐ Addition ☐ Alteration ☐ New ☐ Renovation

Install 12 Solar modules on garage roof, 30 modules on front slope of main roof and 18 modules on rear slope of main roof.

Estimated Cost: $ [redacted] Square Footage: 1057

(Do not include Electrical, Plumbing, HVAC or Land.) (Total Square Footage of Project)

Applicant: [redacted] Email: [redacted]

Applicant Type: ☐ Architect ☐ Engineer ☐ Contractor ☒ Other

Address: [redacted] Phone: _____

City: Louisville State: KY Zip: [redacted] Cell: [redacted]

Owner: Same Email: _____

Address: _____ Phone: _____

City: _____ State: _____ Zip: _____ Cell: _____

**Check all work types included in this project. A permit for each type checked will be required.**

☒ Electrical ☐ Fire Detection ☐ Fire Suppression ☐ Fireplace

☐ HVAC ☐ Mechanical Refrigeration ☐ Parking Lot/Landscaping ☐ Range Hood

☐ Sign ☐ Structure Moving ☐ Wrecking

**OFFICE USE ONLY**

**Reviews Required:**

☐ APCD ☐ Louisville Fire Prevention ☐ Health (On Site Sewer) ☐ Landscaping

☐ MSD (Sewer) ☐ MSD (Flood Plain) ☐ MSD (EPSC) ☐ Suburban Fire District

☐ PDS (Variance, Waiver, CUP, Plan Certain, etc.) ☐ PDS (Transportation) ☐ PDS (Landmark, Overlay)

Application Number: RES-ADD-19-[redacted] Reviewer: [signature]

*(* denotes a required field)*

*(1) The permit fees for new construction, additions, complete alterations of an entire building, tents and other temporary structures and change of Kentucky Building Code Use Group Classification permits shall be calculated according to the following table.*

| *Kentucky Building Code Occupancy type Permit Fee* | |
|---|---|
| **Kentucky Building Code Occupancy Type** | **Fee per Square Foot** |
| Assembly | $.15 |
| Business | $.14 |
| Educational | $.14 |
| Factory | $.13 |
| High Hazard | $.13 |
| Institutional | $.15 |
| Mercantile | $.14 |
| Residential- 1 & 2 Family | $.085 |
| Residential- Other | $.14 |
| Storage | $.12 |
| Utility; Miscellaneous | $.12 |
| Tents | Per schedule set by KBC Section 430 |

*(2) Square footage shall be based on the number of square feet on every floor, including basements, calculated to the outside of the exterior walls.*

*(3) The fee for partial alterations, structures other than buildings, or any type of work that the square feet cannot be calculated; the fee shall be calculated by a reasonable estimated cost to be submitted by the applicant and verified by the Department. The fee shall be $50 plus $2.50 per $1,000 of estimated cost. The Department may ask for factual verification of presented estimated costs, when appropriate.*

*(4) Any permit issued by the Department for which the Commonwealth of Kentucky is responsible for conducting the required building inspections, shall be ½ the normal amount.*

*(5) A plan review fee shall be charged for all applications that are reviewed without issuance of a building permit or requested refunds for issued permits. The plan review fee shall be a minimum $30 or one third (1/3) the normal permit fee, whichever is higher.*

*(6) Fast-track elective. For permit applicants seeking early site/ foundation, shell and/or phased approval prior to full review of complete set on construction documents, the fee for foundations as listed in subsection (A)(7) listed below shall apply; however, shell permits and phased work will be charged the full fee using the table listed in subsection (A)(1). The following interior finish work or phased work will be charged the full fee using the table listed in subsection (A)(1).*

*(7) The fee for a "foundation only" permit shall be $75 for single family dwellings & their accessory structures and $125 for all other uses.*

*(8) Permit fees for metro owned property projects may be waived by agreement of the Director of Public Works and Assets and the Director of Codes and Regulations.*

*(9) The administrative fee for a Certificate of Use and Occupancy without issuance of an associated building permit shall be $75.*

*(10) No building permit fee calculated under this section shall be less than $75*

*(11) The fee for any additional inspections not covered by the initial permit fee shall be $35. The Department shall have the right not to issue any additional permits to the applicant until the additional inspection fees have been paid in full. Before a building permit is issued by the Department for a one or two-family residential construction project or a multi-family residential construction project, the Department shall conduct a search of its records to determine if the applicant has any unresolved or uncured and outstanding Code violations. If the applicant has no such unresolved or uncured and outstanding Code violations, then the Department may issue the building permit, if otherwise appropriate. If the applicant has unresolved or uncured and outstanding Code violations prior to the issuance of a Certificate of Occupancy, the Department shall not issue a building permit until such time as all the outstanding Code violations are removed, cured or corrected by the applicant and all fines and/or fees paid in full.*

*LOUISVILLE FORWARD*
**DEPARTMENT OF CODES AND REGULATIONS**
**DIVISION OF CONSTRUCTION REVIEW**

GREG FISCHER
Mayor

ROBERT KIRCHDORFER
Director

# WORKER'S COMPENSATION AFFIDAVIT
## AFFIDAVIT PURSUANT TO KRS 198B.060(10)
## (APPLICABLE DURING LIFE OF COMPANY)

Permit Location: [redacted] Louisville, KY [redacted]

Comes the Applicant, [redacted]
and states Pursuant to KRS 198B.060(10) that all contractors and subcontractors employed or will be employed on any activity covered by any permit issued to this applicant by the Division of Construction Review of the Department of Codes & Regulations shall be in compliance with the Commonwealth of Kentucky requirements for Worker's Compensation Insurance (in accordance with KRS Chapter 342) and Unemployment Insurance (in accordance with KRS Chapter 341).

WITNESS, the signature of the Affiant this 19 day of September 2019

[redacted]

Affiant/Applicant Signature

Subscribed and sworn to before me by _____

Affiant/Applicant, on this _____ day of _____ 20___

My Commission Expires: _____

_____ Notary Public

State at Large Kentucky

# Array Details

- Certainteed
  - Power=285 +3%/-0% Watts 1439.12
  - Front Main Roof=30 modules (pounds from rack engineering report)
  - Garage=12 modules (573.68 pounds from rack engineering report)
  - Rear Main Roof=18 modules (863.30 pounds from rack engineering report)
  - Total=17,100 +3%/-0% Watts
- Inverters
  - Enphase IQ7 microinverter (1 per module)
- Racking System
  - Unirac Solar Mount Flush
- Surface Area: Front Main (529 sq ft), Rear Main (317 sq ft), Garage (211 sq ft) for a total of 1057 Sq Ft.

September 18, 2019

[redacted]

[redacted]

Louisville, KY[redacted]

KY ENGR PERMIT[redacted]

**RE: Structural Roof Framing Assessment for**
**New 17 kW Solar Array for**
**[redacted]Residence**

[redacted]

It is our understanding that the project will consist of a new 17 kW DC roof-mounted solar PV array at the referenced property. See Photo 1. We were provided with electronic copies of original building plans and solar installation document package which includes the PV layout and equipment, support rails, and all anchorage hardware used for the project. The purpose of this structural assessment is to determine the adequacy of the existing roof structure to support the loads imposed by the new array and racking system, and evaluate the proposed attachments for the new array. The solar array mounting assembly and panels have been designed by a specialty professional Engineer for the solar panel manufacturer in accordance with the Kentucky Building Code.

The new PV array will be located on the main high roof and southern side only of the garage roof, and supported on a flush-mounted UniRac racking system. The racking system will consist of SolarMount rails (2 rails per row of modules), supported on SolarMount L-foot attachments spaced at each end of the rails and a maximum of 4 feet on-center between. The intermediate rail clips are to be staggered by 2'-0" such that all the load does not bear on a single truss.

The solar array package states that the maximum uplift force for the railing clip is 103 pounds. The SolarMount attachment includes a 5/16-inch diameter x 3-1/2-inch long zinc plated steel lag bolt, which will be fastened into the center of the top chord of the existing roof trusses (field locate trusses from above during installation to insure lag bolts are properly installed into the truss chord member). We recommend that galvanized or stainless steel lag screws are used for longevity.

The roof system consists of one layer of asphalt shingle roofing supported on 1x roof sheathing, on engineered wood roof trusses with 2x6 chords, 2x4 webs, and plywood gusset plates spaced at 2 feet on-center. See photo #2. The home was constructed in the 1960's and appears to be in good

condition. The new flush roof-mounted solar PV array will have a total distributed array weight (modules, racking, and anchorage) of less than 2.8 psf.

We have evaluated the roof framing system to support the loads imposed by the proposed PV array and racking system. Based on the supplied information, the roof framing system, racking, and attachments appear to be adequate to support the new array per the requirements of the Kentucky Residential Building Code with the following comments:

1. At the main roof, one plywood gusset plate between the top chord and web member was observed to be missing at two different trusses. A ½"x24"x24" plywood gusset is to be installed were missing. Glue and fasten new plywood gusset to the both the top chord and web member with (6) #10 x 2 ½" wood screws typical spaced at 2-½" (staggered) and at 1-¼" clear to edges.

2. At both the main high roof and garage, a horizontal 2x4 SPF #2 brace is to be installed at the two taller interior truss web members either side of the ridge, at mid-height of the web member. The brace can be installed in pieces and overlap where spliced. The brace is to be fastened to each truss with (2) #10 x 3" screws. At each end of the run adjacent to the exterior walls, a diagonal member is to be installed extending from the brace to just below the top and bottom chord at roughly a 45-degree angle. See Truss Web Bracing Diagram (shows only single brace member).

The low profile of the array, and light mass loads, will have a negligible effect on the lateral load resisting system for wind and seismic loading on the building.

The findings and recommendations from our structural evaluation are based on information obtained from discussions, partial existing drawings, site notes and photos from my site visit on September 16th, 2019, and other supporting documents provided to us by the Owner. There is no claim, either stated or implied, that all conditions have been observed. If, during installation, any portion of any structural members, connections, roofing, decking, etc., are found to be damaged, deteriorated, or in otherwise questionable condition, please contact us to perform a site visit to observe the conditions and provide appropriate structural assessment and recommendations.

Please contact us should you have any questions or if we can provide additional assistance.

Sincerely,

[redacted]

Kentucky PE No. [redacted]

Module Plan

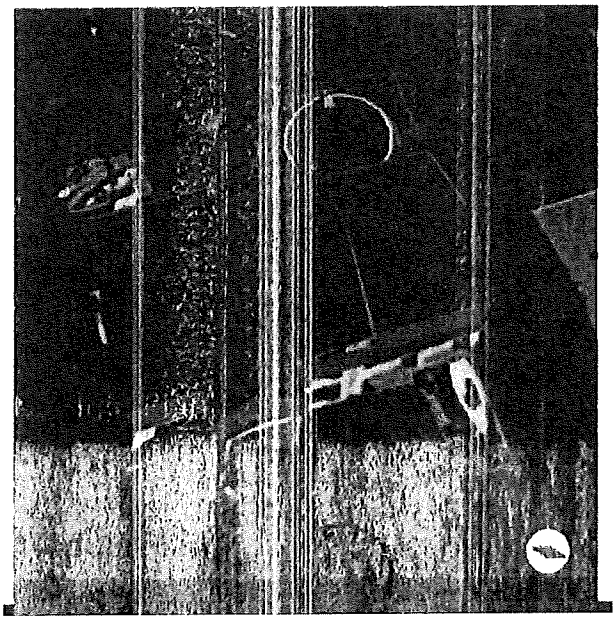


Photo #1: Overall of Home with array (from solar array mfr package)

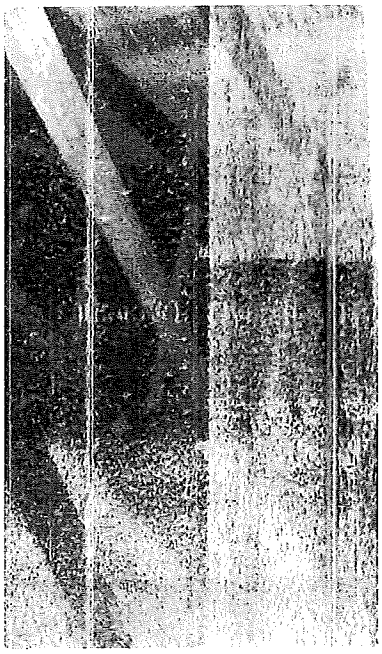
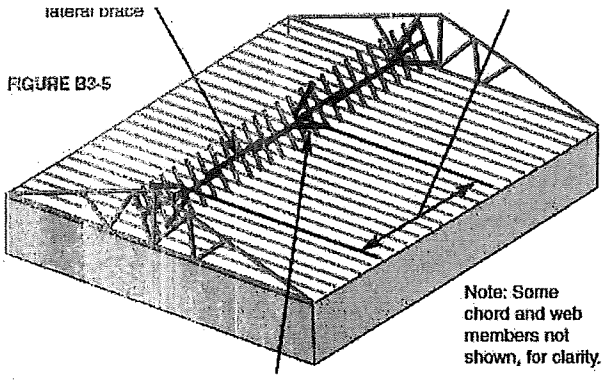


Photo #2: Interior of Attic Space (Garage)




Truss Web Bracing Diagram

UNIRAC

# U-BUILDER PROJECT REPORT

VERSION: 1.0

| PROJECT TITLE | PROJECT ID | CREATED |
|---|---|---|
| Rear Roof | [redacted] | Aug. 28, 2019, 4:18 p.m. |

| | | |
|---|---|---|
| NAME | | Designed by [redacted] |
| ADDRESS | [redacted], Louisville, [redacted] USA | SOLARMOUNT FLUSH |
| CITY, STATE | Louisville, KY | *Typical |
| MODULE | *Typical 200-270W 60 Cell | 18 - 200-270W 60 Cell |
| | | 317 ft$^2$ |
| | | 4.14 KW |

UNVALIDATED MODULE SIZE: The module selected was based on a typical or custom module size. DO NOT USE this information to purchase or install without verifying the exact module dimensions.

## BILL OF MATERIALS

LEGEND: ■ Base System Part ■ Accessory

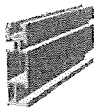
| PART NUMBER | PART TYPE | DESCRIPTION | QUANTITY | SUGGESTED QUANTITY | UNIT PRICE (USD) | TOTAL LIST PRICE (USD) |
|---|---|---|---|---|---|---|
| 320246M | Rail | SM RAIL 246" MILL | 6 | 6 | 58.03 | 348.18 |
| 303019M | Splice | BND SPLICE BAR PRO SERIES MILL | 4 | 4 | 4.74 | 18.96 |
| 302029C | Mid Clamp | SM BND MIDCLAMP DK SS | 28 | 28 | 2.39 | 66.92 |
| 302023C | End Clamp | SM ENDCLAMP D CLR AL | 16 | 16 | 2.04 | 32.64 |
| 008009P | Grounding Lug | ILSCO LAY IN LUG (GBL4DBT) | 4 | 4 | 5.75 | 23.00 |
| 004055M | Flashing | FLASHKIT PRO, MILL 10PK | 38 | 38 | 7.25 | 275.50 |
| LAGS | Lag Bolt | LAG BOLTS, 5/16 X 3.5" (See Distributor) | 38 | 38 | 0.00 | 0.00 |
| WASHERS | Washer | FLAT WASHER, 5/16" SS (See Distributor) | 38 | 38 | 0.00 | 0.00 |

| BASE SYSTEM PRICE | ACCESSORIES PRICE | TOTAL PRICE |
|---|---|---|
| $466.70 | $298.50 | $765.20 |
| $0.113 PER WATT | $0.072 PER WATT | $0.185 PER WATT |

This design is to be evaluated to the product appropriate Unirac Code Compliant Installation Manual which references International Building Code 2009, 2012, 2015, 2018 and ASCE 7-05, ASCE 7-10, ASCE 7-16 and California Building Code 2010, 2016. The installation of products related to this design is subject to requirements in the above mentioned installation manual.

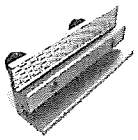
# DETAILED PARTS DESCRIPTION

QTY



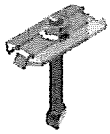
Rail 320246M SM RAIL 246" MILL — 6

Structural aluminum extrusion containing slots that accept module and roof attachment hardware, electrical bonding accessories, and splice bars.



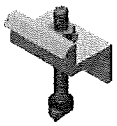
Splice 303019M BND SPLICE BAR PRO SERIES MILL — 4

Mill finished aluminum extrusion for joining adjacent lengths of rail to one another. Includes pre-assembled bolts. Uses 1/2" socket for 1-tool system install.



Mid Clamp 302029C SM BND MIDCLAMP DK SS — 28

Located between adjacent PV modules, mounts 38-41 mm (1.5-1.61 in) thick modules to rail by clamping module frame from above. Includes T bolt and nut. If mounting on short side of module frame, confirm this is acceptable with PV



End Clamp 302023C SM ENDCLAMP D CLR AL — 16

Mounts 38-40 mm (1.50-1.57 in) thick PV modules to rail by clamping module frame from above. Includes T bolt and nut. If mounting on short side of module frame, confirm this is acceptable with PV module manufacturer.

Grounding Lug 008009P ILSCO LAY IN LUG (GBL4DBT) — 4

For electrical bonding of PV modules and rails. Accepts 4-14 AWG copper wires. Tin plated copper body, 1/4" stainless steel fasteners.

Flashing 004055M FLASHKIT PRO, MILL 10PK — 38

FLASHKIT PRO is the complete attachment solution for composition shingle roofs. Featuring Unirac's patented SHED & SEAL technology, a weather proof system which provides the ultimate protection against roof leaks. Kitted in 10 packs for maximum convenience. Includes mill finish flashing and L-foot, lag with pre-assembled sealing washer, and 3/8" t-bolt and nut.

Lag Bolt LAGS LAG BOLTS, 5/16 X 3.5" (See Distributor) — 38

Zinc plated steel, 3-1/2" length, 2-1/2" threaded length, 5/16" shoulder diameter. Confirm that bolt strength and penetrating length can withstand the maximum loads of for your application.

Washer WASHERS FLAT WASHER, 5/16" SS (See Distributor) — 38

Stainless steel, fits under head of 5/16" bolt, 3/4" OD.

UNVALIDATED MODULE SIZE: The module selected was based on a typical or custom module size. DO NOT USE this information to purchase or install without verifying the exact module dimensions.

# ENGINEERING REPORT

## Plan review

| | |
|---|---|
| **AVERAGE PSF** | 2.72 lbs/ft$^2$ |
| **TOTAL NUMBER OF MODULES** | 18 |
| **TOTAL KW** | 4.14 KW |
| **TOTAL AREA** | ~317 ft$^2$ |

## Loads Used for Design

| | |
|---|---|
| **BUILDING CODE** | ASCE 7-10 |
| **WIND SPEED** | 115 mph |
| **GROUND SNOW LOAD** | 15 psf |
| **SEISMIC (SS)** | 0.20 |
| **ELEVATION** | 500 ft |
| **WIND EXPOSURE** | B |

## Loads Determined by Zip [redacted]

| | |
|---|---|
| **CITY, STATE** | Louisville, KY |
| **WIND SPEED** | 115 mph |
| **GROUND SNOW LOAD** | 15 psf |

## Inspection

| | |
|---|---|
| **PRODUCT** | SOLARMOUNT FLUSH |
| **MODULE MANUFACTURER** | *Typical |
| **MODEL** | 18 - 200-270W 60 Cell |
| **MODULE WATTS** | 230 watts |
| **MODULE LENGTH** | 64.57" |
| **MODULE WIDTH** | 39.29" |
| **MODULE THICKNESS** | 1.57" |
| **MODULE WEIGHT** | 41.20 lbs |
| **EXPANSION JOINTS** | Every 40' |
| **RAILS DIRECTION** | EW |
| **BUILDING HEIGHT** | 30 ft |
| **ROOF TYPE** | Shingle |
| **RAFTER SPACING** | 24" |
| **TOTAL WEIGHT** | 863.80 lbs |

## Array 1

| | | | |
|---|---|---|---|
| ROOF POINT LOAD UP | -103.0 lbs | DESIGN RAIL SPAN | 48" |
| ROOF POINT LOAD DOWN | 194.5 lbs | MAXIMUM RAIL SPAN | 106" |

| | | | |
|---|---|---|---|
| TOTAL NUMBER OF MODULES: | 18 | MAXIMUM RAIL CANTILEVER: | 16.00" |
| TOTAL KW: | 4.14 KW | ROOF PITCH: | 27° |
| ROWS/ COLUMNS: | 2 / 11 (with gaps) | | |
| NS DIMENSION: | ~ 10.84 ft | | |
| EW DIMENSION: | ~ 36.85 ft | | |

# INSTALLATION AND DESIGN PLAN

## Roof Area 1

**LEGEND**

**Module (Roof Zones)**

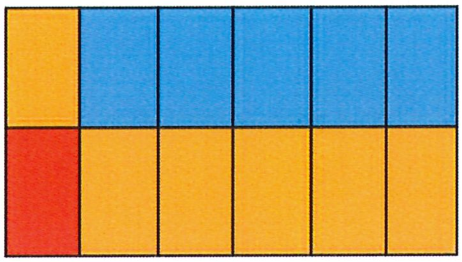
- Zone 1
- Zone 2
- Zone 3

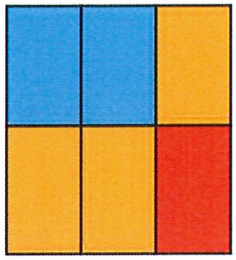
## ROOF AREA 1 / ARRAY 1

### LEGEND

**Module (Roof Zones)**

- Zone 1
- Zone 2
- Zone 3





| ROW | MODULES | ZONE | RAIL TYPE | SPLICES | ROOF ATTACHMENTS |
|---|---|---|---|---|---|
| 1 | 9 | 2 | ['SM RAIL 246" MILL \| 320246M \| $58.03 (3)'] | 2 | 18 |
| 2 | 9 | 3 | ['SM RAIL 246" MILL \| 320246M \| $58.03 (3)'] | 2 | 20 |

| | |
|---|---|
| DESIGN RAIL SPAN | 48" |
| MAXIMUM RAIL SPAN (ZONE 1*) | 106" |
| PREFERRED RAIL SPAN | 48" |
| MAXIMUM RAIL CANTILEVER | 16.00" |
| RAIL DIRECTION | EW |

* Zone 2 and 3 Rail Spans must be independently verified

UNIRAC

# U-BUILDER PROJECT REPORT

VERSION: 1.0

| PROJECT TITLE | PROJECT ID | CREATED |
|---|---|---|
| Garage-Rev 2 | [redacted] | Aug. 29, 2019, 1:27 p.m. |

| | | |
|---|---|---|
| NAME | | Designed by [redacted] |
| ADDRESS | | SOLARMOUNT FLUSH |
| CITY, STATE | Louisville, KY | *Typical |
| MODULE | *Typical 200-270W 60 Cell | 12 - 200-270W 60 Cell |
| | | 211 ft$^2$ |
| | | 3.42 KW |

UNVALIDATED MODULE SIZE: The module selected was based on a typical or custom module size. DO NOT USE this information to purchase or install without verifying the exact module dimensions.

## BILL OF MATERIALS

LEGEND: ■ Base System Part ■ Accessory

| PART NUMBER | PART TYPE | DESCRIPTION | QUANTITY | SUGGESTED QUANTITY | UNIT PRICE (USD) | TOTAL LIST PRICE (USD) |
|---|---|---|---|---|---|---|
| 320246M | Rail | SM RAIL 246" MILL | 4 | 4 | 58.03 | 232.12 |
| 302029C | Mid Clamp | SM BND MIDCLAMP DK SS | 20 | 20 | 2.39 | 47.80 |
| 302023C | End Clamp | SM ENDCLAMP D CLR AL | 8 | 8 | 2.04 | 16.32 |
| 008009P | Grounding Lug | ILSCO LAY IN LUG (GBL4DBT) | 2 | 2 | 5.75 | 11.50 |
| 004055M | Flashing | FLASHKIT PRO, MILL 10PK | 24 | 24 | 7.25 | 174.00 |
| LAGS | Lag Bolt | LAG BOLTS, 5/16 X 3.5" (See Distributor) | 24 | 24 | 0.00 | 0.00 |
| WASHERS | Washer | FLAT WASHER, 5/16" SS (See Distributor) | 24 | 24 | 0.00 | 0.00 |

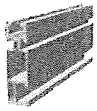
| BASE SYSTEM PRICE | ACCESSORIES PRICE | TOTAL PRICE |
|---|---|---|
| $296.24 | $185.50 | $481.74 |
| $0.087 PER WATT | $0.054 PER WATT | $0.141 PER WATT |

This design is to be evaluated to the product appropriate Unirac Code Compliant Installation Manual which references International

Building Code 2009, 2012, 2015, 2018 and ASCE 7-05, ASCE 7-10, ASCE 7-16 and California Building Code 2010, 2016. The installation of products related to this design is subject to requirements in the above mentioned installation manual.

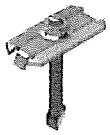
# DETAILED PARTS DESCRIPTION

QTY



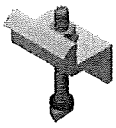
Rail 320246M SM RAIL 246" MILL — 4

Structural aluminum extrusion containing slots that accept module and roof attachment hardware, electrical bonding accessories, and splice bars.



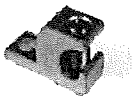
Mid Clamp 302029C SM BND MIDCLAMP DK SS — 20

Located between adjacent PV modules, mounts 38-41 mm (1.5-1.61 in) thick modules to rail by clamping module frame from above. Includes T bolt and nut. If mounting on short side of module frame, confirm this is acceptable with PV



End Clamp 302023C SM ENDCLAMP D CLR AL — 8

Mounts 38-40 mm (1.50-1.57 in) thick PV modules to rail by clamping module frame from above. Includes T bolt and nut. If mounting on short side of module frame, confirm this is acceptable with PV module manufacturer.



Grounding Lug 008009P ILSCO LAY IN LUG (GBL4DBT) — 2

For electrical bonding of PV modules and rails. Accepts 4-14 AWG copper wires. Tin plated copper body, 1/4" stainless steel fasteners.

Flashing 004055M FLASHKIT PRO, MILL 10PK — 24

FLASHKIT PRO is the complete attachment solution for composition shingle roofs. Featuring Unirac's patented SHED & SEAL technology, a weather proof system which provides the ultimate protection against roof leaks. Kitted in 10 packs for maximum convenience. Includes mill finish flashing and L-foot, lag with pre-assembled sealing washer, and 3/8" t-bolt and nut.

Lag Bolt LAGS LAG BOLTS, 5/16 X 3.5" (See Distributor) — 24

Zinc plated steel, 3-1/2" length, 2-1/2" threaded length, 5/16" shoulder diameter. Confirm that bolt strength and penetrating length can withstand the maximum loads of for your application.

Washer WASHERS FLAT WASHER, 5/16" SS (See Distributor) — 24

Stainless steel, fits under head of 5/16" bolt, 3/4" OD.

## Array 1

| | | | |
|---|---|---|---|
| ROOF POINT LOAD UP | -103.0 lbs | DESIGN RAIL SPAN | 48" |
| ROOF POINT LOAD DOWN | 194.5 lbs | MAXIMUM RAIL SPAN | 106" |

| | | | |
|---|---|---|---|
| TOTAL NUMBER OF MODULES: | 12 | MAXIMUM RAIL CANTILEVER: | 16.00" |
| TOTAL KW: | 3.42 KW | ROOF PITCH: | 27° |
| ROWS/ COLUMNS: | 2 / 6 (with gaps) | | |
| NS DIMENSION: | ~ 10.85 ft | | |
| EW DIMENSION: | ~ 20.06 ft | | |

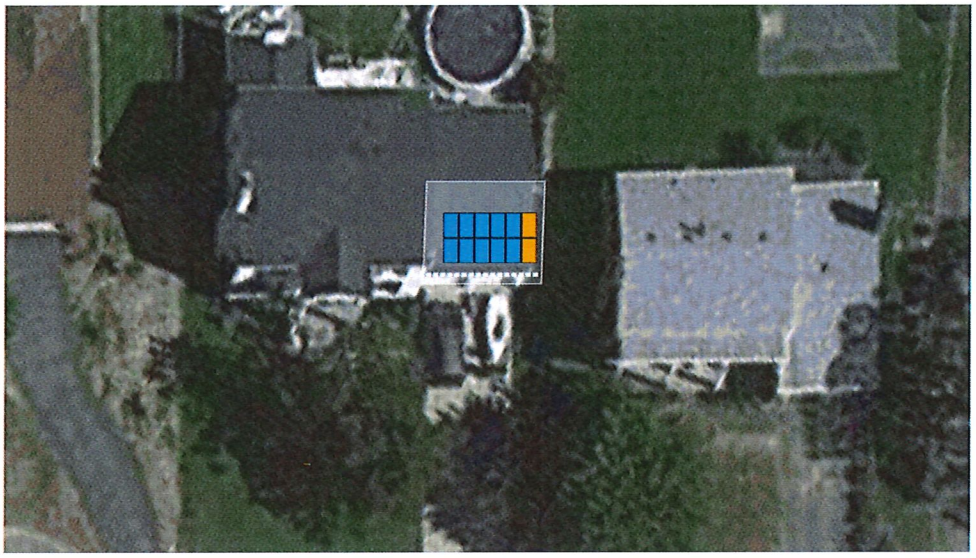
# INSTALLATION AND DESIGN PLAN

## Roof Area 1

**LEGEND**

**Module (Roof Zones)**

- Zone 1
- Zone 2
- Zone 3

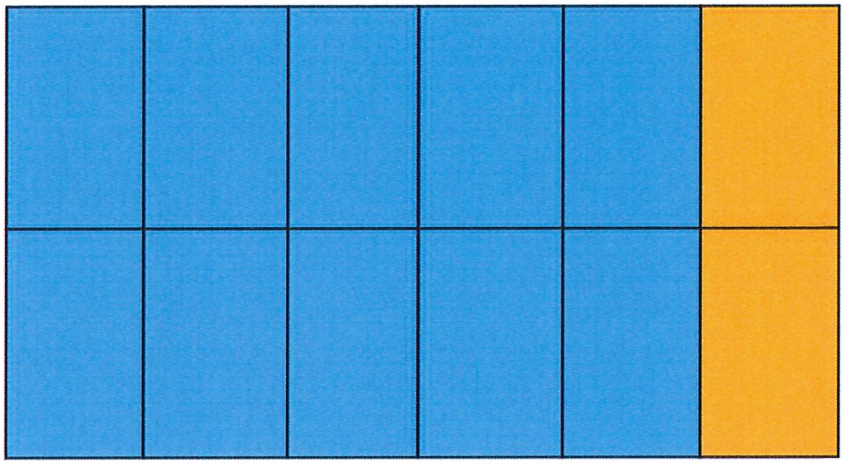


## ROOF AREA 1 / ARRAY 1

### LEGEND

**Module (Roof Zones)**

- Zone 1
- Zone 2
- Zone 3



| ROW | MODULES | ZONE | RAIL TYPE | SPLICES | ROOF ATTACHMENTS |
|---|---|---|---|---|---|
| 1 | 6 | 2 | ['SM RAIL 246" MILL \| 320246M \| $58.03 (2)'] | 0 | 12 |
| 2 | 6 | 2 | ['SM RAIL 246" MILL \| 320246M \| $58.03 (2)'] | 0 | 12 |

| | |
|---|---|
| DESIGN RAIL SPAN | 48" |
| MAXIMUM RAIL SPAN (ZONE 1*) | 106" |
| PREFERRED RAIL SPAN | 48" |
| MAXIMUM RAIL CANTILEVER | 16.00" |
| RAIL DIRECTION | EW |

* Zone 2 and 3 Rail Spans must be independently verified

UNIRAC

# U-BUILDER PROJECT REPORT

VERSION: 1.0

| PROJECT TITLE | PROJECT ID | CREATED |
|---|---|---|
| Front Roof-Rev 2 | [redacted] | Aug. 29, 2019, 1:53 p.m. |

| | | |
|---|---|---|
| NAME | | Designed by [redacted] |
| ADDRESS | [redacted] Louisville, KY [redacted] USA | SOLARMOUNT FLUSH |
| CITY, STATE | Louisville, KY | *Typical |
| MODULE | *Typical 200-270W 60 Cell | 30 - 200-270W 60 Cell |
| | | 529 ft² |
| | | 8.55 KW |

UNVALIDATED MODULE SIZE: The module selected was based on a typical or custom module size. DO NOT USE this information to purchase or install without verifying the exact module dimensions.

## BILL OF MATERIALS

LEGEND: ■ Base System Part ■ Accessory

| PART NUMBER | PART TYPE | DESCRIPTION | QUANTITY | SUGGESTED QUANTITY | UNIT PRICE (USD) | TOTAL LIST PRICE (USD) |
|---|---|---|---|---|---|---|
| 320168M | Rail | SM RAIL 168" MILL | 3 | 3 | 39.62 | 118.86 |
| 320246M | Rail | SM RAIL 246" MILL | 8 | 8 | 58.03 | 464.24 |
| 303019M | Splice | BND SPLICE BAR PRO SERIES MILL | 6 | 6 | 4.74 | 28.44 |
| 302030M | Mid Clamp | SM PRO SERIES MID - MILL | 50 | 50 | 2.10 | 105.00 |
| 302035M | End Clamp | SM PRO SERIES UNIV END | 20 | 20 | 2.52 | 50.40 |
| 008009P | Grounding Lug | ILSCO LAY IN LUG (GBL4DBT) | 5 | 5 | 5.75 | 28.75 |
| 004055M | Flashing | FLASHKIT PRO, MILL 10PK | 62 | 62 | 7.25 | 449.50 |
| LAGS | Lag Bolt | LAG BOLTS, 5/16 X 3.5" (See Distributor) | 62 | 62 | 0.00 | 0.00 |
| WASHERS | Washer | FLAT WASHER, 5/16" SS (See Distributor) | 62 | 62 | 0.00 | 0.00 |

UNVALIDATED MODULE SIZE: The module selected was based on a typical or custom module size. DO NOT USE this information to purchase or install without verifying the exact module dimensions.

# ENGINEERING REPORT

## Plan review

| | |
|---|---|
| **AVERAGE PSF** | 2.71 lbs/ft$^2$ |
| **TOTAL NUMBER OF MODULES** | 12 |
| **TOTAL KW** | 3.42 KW |
| **TOTAL AREA** | ~211 ft$^2$ |

## Loads Used for Design

| | |
|---|---|
| **BUILDING CODE** | ASCE 7-10 |
| **WIND SPEED** | 115 mph |
| **GROUND SNOW LOAD** | 15 psf |
| **SEISMIC (SS)** | 0.20 |
| **ELEVATION** | 500 ft |
| **WIND EXPOSURE** | B |

## Loads Determined by Zip

[redacted]

| | |
|---|---|
| **CITY, STATE** | Louisville, KY |
| **WIND SPEED** | 115 mph |
| **GROUND SNOW LOAD** | 15 psf |

## Inspection

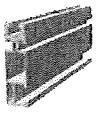
| | |
|---|---|
| **PRODUCT** | SOLARMOUNT FLUSH |
| **MODULE MANUFACTURER** | *Typical |
| **MODEL** | 12 - 200-270W 60 Cell |
| **MODULE WATTS** | 285 watts |
| **MODULE LENGTH** | 64.57" |
| **MODULE WIDTH** | 39.29" |
| **MODULE THICKNESS** | 1.57" |
| **MODULE WEIGHT** | 41.20 lbs |
| **EXPANSION JOINTS** | Every 40' |
| **RAILS DIRECTION** | EW |
| **BUILDING HEIGHT** | 30 ft |
| **ROOF TYPE** | Shingle |
| **RAFTER SPACING** | 24" |
| **TOTAL WEIGHT** | 573.68 lbs |

| BASE SYSTEM PRICE | $766.94 | ACCESSORIES PRICE | $478.25 | TOTAL PRICE | $1245.19 |
|---|---|---|---|---|---|
| | $0.090 PER WATT | | $0.056 PER WATT | | $0.146 PER WATT |

This design is to be evaluated to the product appropriate Unirac Code Compliant Installation Manual which references International Building Code 2009, 2012, 2015, 2018 and ASCE 7-05, ASCE 7-10, ASCE 7-16 and California Building Code 2010, 2016. The installation of products related to this design is subject to requirements in the above mentioned installation manual.

# DETAILED PARTS DESCRIPTION

QTY

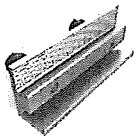


Rail 320168M SM RAIL 168" MILL — 3

Structural aluminum extrusion containing slots that accept module and roof attachment hardware, electrical bonding accessories, and splice bars.

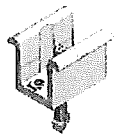
Rail 320246M SM RAIL 246" MILL — 8

Structural aluminum extrusion containing slots that accept module and roof attachment hardware, electrical bonding accessories, and splice bars.



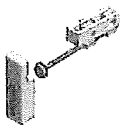
Splice 303019M BND SPLICE BAR PRO SERIES MILL — 6

Mill finished aluminum extrusion for joining adjacent lengths of rail to one another. Includes pre-assembled bolts. Uses 1/2" socket for i-tool system install.



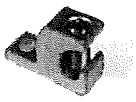
Mid Clamp 302030M SM PRO SERIES MID – MILL — 50

SOLARMOUNT Pro Series universal height mid clamps: Installed between modules and provide top-down clamping to secure module frame to SM rail. These pre-assembled, self-standing clamps will accommodate module frame heights from 30mm to 51mm. Mill finished (bare) aluminum.



End Clamp 302035M SM PRO SERIES UNIV END — 20

SOLARMOUNT Pro Series universal end clamps: Installed at the beginning and end of a row of modules. These clamps slide into the top rail channel and secure the module frame bottom-side return flange. Rail should be cut flush with the module frame for a clean look. End cap included for each clamp; end cap works on both SM standard and light rail profiles.



Grounding Lug 008009P ILSCO LAY IN LUG (GBL4DBT) — 5

For electrical bonding of PV modules and rails. Accepts 4-14 AWG copper wires. Tin plated copper body, 1/4" stainless steel fasteners.

Flashing 004055M FLASHKIT PRO, MILL 10PK — 62

FLASHKIT PRO is the complete attachment solution for composition shingle roofs. Featuring Unirac's patented SHED & SEAL technology, a weather proof system which provides the ultimate protection against roof leaks. Kitted in 10 packs for maximum convenience. Includes mill finish flashing and L-foot, lag with pre-assembled sealing washer, and 3/8" t-bolt and nut.

Lag Bolt LAGS LAG BOLTS, 5/16 X 3.5" (See Distributor) — 62

Zinc plated steel, 3-1/2" length, 2-1/2" threaded length, 5/16" shoulder diameter. Confirm that bolt strength and penetrating length can withstand the maximum loads of for your application.

Washer WASHERS FLAT WASHER, 5/16" SS (See Distributor) 62

Stainless steel, fits under head of 5/16" bolt, 3/4" OD.

UNVALIDATED MODULE SIZE: The module selected was based on a typical or custom module size. DO NOT USE this information to purchase or install without verifying the exact module dimensions.

# ENGINEERING REPORT

## Plan review

| | |
|---|---|
| **AVERAGE PSF** | **2.72 lbs/ft$^2$** |
| **TOTAL NUMBER OF MODULES** | 30 |
| **TOTAL KW** | 8.55 KW |
| **TOTAL AREA** | ~529 ft$^2$ |

## Loads Used for Design

| | |
|---|---|
| **BUILDING CODE** | ASCE 7-10 |
| **WIND SPEED** | 115 mph |
| **GROUND SNOW LOAD** | 15 psf |
| **SEISMIC (SS)** | 0.20 |
| **ELEVATION** | 500 ft |
| **WIND EXPOSURE** | B |

## Loads Determined by Zip

| | |
|---|---|
| **CITY, STATE** | Louisville, KY |
| **WIND SPEED** | 115 mph |
| **GROUND SNOW LOAD** | 15 psf |

## Inspection

| | |
|---|---|
| **PRODUCT** | SOLARMOUNT FLUSH |
| **MODULE MANUFACTURER** | *Typical |
| **MODEL** | 30 - 200-270W 60 Cell |
| **MODULE WATTS** | 285 watts |
| **MODULE LENGTH** | 64.57" |
| **MODULE WIDTH** | 39.29" |
| **MODULE THICKNESS** | 1.57" |
| **MODULE WEIGHT** | 41.20 lbs |
| **EXPANSION JOINTS** | Every 40' |
| **RAILS DIRECTION** | EW |
| **BUILDING HEIGHT** | 30 ft |
| **ROOF TYPE** | Shingle |
| **RAFTER SPACING** | 24" |
| **TOTAL WEIGHT** | 1439.12 lbs |

## Array 1

| | | | |
|---|---|---|---|
| ROOF POINT LOAD UP | -103.0 lbs | DESIGN RAIL SPAN | 48" |
| ROOF POINT LOAD DOWN | 194.5 lbs | MAXIMUM RAIL SPAN | 106" |

| | | | |
|---|---|---|---|
| TOTAL NUMBER OF MODULES: | 30 | MAXIMUM RAIL CANTILEVER: | 16.00" |
| TOTAL KW: | 8.55 KW | ROOF PITCH: | 27° |
| ROWS/ COLUMNS: | 3 / 12 (with gaps) | | |
| NS DIMENSION: | ~ 16.31 ft | | |
| EW DIMENSION: | ~ 40.21 ft | | |

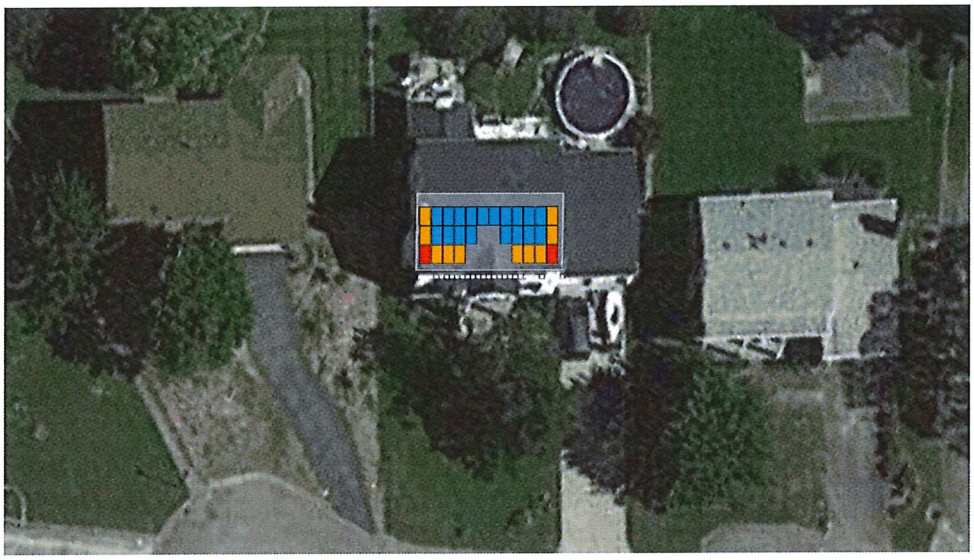
# INSTALLATION AND DESIGN PLAN

## Roof Area 1

**LEGEND**

**Module (Roof Zones)**

- Zone 1
- Zone 2
- Zone 3

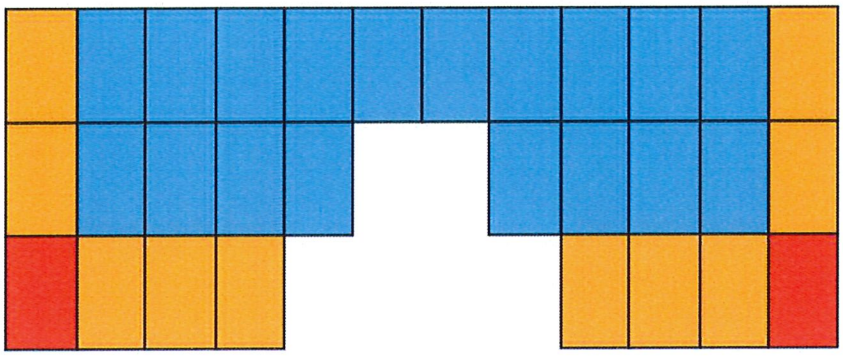


## ROOF AREA 1 / ARRAY 1

### LEGEND

**Module (Roof Zones)**

- Zone 1
- Zone 2
- Zone 3



| ROW | MODULES | ZONE | RAIL TYPE | SPLICES | ROOF ATTACHMENTS |
|---|---|---|---|---|---|
| 1 | 12 | 2 | ['SM RAIL 246" MILL \| 320246M \| $58.03 (4)'] | 2 | 22 |
| 2 | 10 | 2 | ['SM RAIL 168" MILL \| 320168M \| $39.62 (2)', 'SM RAIL 246" MILL \| 320246M \| $58.03 (2)'] | 2 | 20 |
| 3 | 8 | 3 | ['SM RAIL 168" MILL \| 320168M \| $39.62 (1)', 'SM RAIL 246" MILL \| 320246M \| $58.03 (2)'] | 2 | 20 |

| | |
|---|---|
| DESIGN RAIL SPAN | 48" |
| MAXIMUM RAIL SPAN (ZONE 1*) | 106" |
| PREFERRED RAIL SPAN | 48" |
| MAXIMUM RAIL CANTILEVER | 16.00" |
| RAIL DIRECTION | EW |

* Zone 2 and 3 Rail Spans must be independently verified