

ABBREVIATIONS

| | |
|-----------------|---------------------------------|
| A | AMPERE |
| AC | ALTERNATING CURRENT |
| BLDG | BUILDING |
| CONC | CONCRETE |
| C | COMBINER BOX |
| D | DISTRIBUTION PANEL |
| DC | DIRECT CURRENT |
| EGC | EQUIPMENT GROUNDING CONDU |
| (E) | EXISTING |
| EMT | ELECTRICAL METALLIC TUBING CTOR |
| G | SOLAR GUARD METER |
| GALV | GALVANIZED |
| GEC | GROUNDING ELECTRODE CONDU |
| GND | GROUND |
| HDG | HOT DIPPED GALVANIZED |
| I | CURRENT |
| I _{mp} | CURRENT AT MAX POWER |
| INVS | INVERTERS |
| I _{sc} | SHORT CIRCUIT CURRENT |
| kVA | KILOVOLT AMPERE |
| kW | KILOWATT |
| LBW | LOAD BEARING WALL |
| MIN | MINIMUM |
| MINV | MICROINVERTER |
| (N) | NEW |
| NEC | NATIONAL ELECTRIC CODE |
| NIC | NOT IN CONTRACT |
| NTS | NOT TO SCALE |
| OC | ON CENTER |
| P | PANEL BOARD |
| PL | PROPERTY LINES |
| PV | PHOTOVOLTAIC |
| PVC | POLYVINYL CHLORIDE |
| S | SUBPANEL |
| SCH | SCHEDULE |
| SS | STAINLESS STEEL |
| SSD | SEE STRUCTURAL DRAWINGS |
| STC | STANDARD TESTING CONDITION: |
| SWH | SOLAR WATER HEATER |
| TYP | TYPICAL |
| UON | UNLESS OTHERWISE NOTED |
| UPS | UNINTERRUPTIBLE POWER SUPP |
| V | VOLT |
| V _{mp} | VOLTAGE AT MAX POWER |
| V _{oc} | VOLTAGE AT OPEN CIRCUIT |
| W | WATT |
| 3R | NEMA 3R, RAIN/TIGHT |

MECHANICAL

Solar Panel Parameters

Panel Dimensions = 66" X 40" x 1.38"
 Panel Configuration = 1 row X 7 and 1 row X 9 (16 panels total)
 Panel Weight = 43.65 lbs
 Array Length = Lower section: 30.2' Upper section: 23.6'
 Array Height = 11.00 ft
 Panel Area = 293.3 sqft

Notes:

Panel will be approx. 3.5" off the roof surface, conforming to the 3" to 6" guidelines.
 Panel area of 293.3 sqft is conservative, Renesola panels will be 281.7 sqft

Weight Parameters

Weight of Racks = 116 lbs
 Weight of Panels = 43.65 lbs * 16 = 699 lbs
 Weight of Microinverters = 3.5 lbs * 16 = 56lbs
 Weight of Engage Cable = 17 lbs (for 17 drop length)
 Total Weight = 116 + 699 + 56 + 17 = 888 lbs
 Weight at each attach point = 888 lb/28 = 31.7 lb/attach point
 Weight per square foot of roof area = 888 lb/293.3 = 3.0 lb/sqft

WIND LOADS, ASCE 7-05 calculations

MWFRS Parameters

Basic Wind speed (V) = 100 mph (min 85)
 Wind directionality factor (K_d) = 1.0 (recommended by Solar American Board, not covered in ASCE 7-05))
 Importance factor (I) = 1.00
 Mean building height = 25 ft.
 Ground snow load = 0 psf
 Occupancy category = II
 Roof zone = 2
 Topographic factor (K_{zt}) = 1
 Exposure category = B
 Surface roughness = B
 Adjustment factor = 1
 Velocity Pressure Coefficients, K_z = 0.70
 External pressure coefficient (from Figure 6-11C) = 0.5 (+GC_p), -0.9 (-GC_p)
 Internal pressure coefficient (GC_{pi}) = +/- 0.55 (from ASCE 7-05 Figure 6-5, "Partially Enclosed Buildings")
 Calculated velocity pressure q as described in ASCE 7-05 Section 6.5.10:
 $q = 0.00256 * K_z * K_{zt} * K_d * V^2 * I$ (in psf)
 $q = 0.00256 * 0.70 * 1 * 1 * 100 * 100 * 1.00 = 17.92\text{psf (18psf)}$

Design wind pressure as described in Seciton 6.5.12.2.1:

$$p = q * (GC_p - GC_{pi})$$

Design wind uplift pressure $p = 18 * (-0.9 - 0.55) = -26.1$ psf
 Design wind downward pressure $p = 18 * (0.5 + 0.55) = 18.9$ psf

Panel area X uplift pressure = uplift load for entire array: 293.3 * 26.1 = 7655 lbs.
 7655 lbs / 28 attach points = 273.4 lbs uplift force per attach point.

Uplift capacity of fasteners:

From Marks' Standard Handbook for Mechanical Engineers, latest edition, McGraw Hill:

Fastener capacity $P = 1800 * G^{3/2} * D^{3/4}$, where P=withdrawal resistance in lb/in, D=screw shank/nominal diameter in inches, and G=specific gravity (0.51 for Douglas Fir).

$P = 1800 * 0.51^{3/2} * 0.25^{3/4} = 232$ lb/inch, or 579 lbs for 2.5" thread penetration (2.1 x uplift)

Two lag screws/attachment, so 579 lbs x 2 = 1158 lbs. capacity per attachment point, safety factor = 4.2.

ELECTRICAL

- THIS SYSTEM IS GRID-INTERTIED VIA UL-LISTED POWER-CONDITIONING MICROINVERTERS (ONE PER SOLAR PANEL).
- THIS SYSTEM HAS NO BATTERIES OR UPS.
- PHOTOVOLTAIC SOURCE AND INVERTER INPUT CIRCUITS ARE UNGROUNDED.
- SOLAR MOUNTING FRAMES ARE TO BE GROUNDED.
- ALL WORK TO COMPLY WITH THE FOLLOWING:
 - 2008 NATIONAL ELECTRIC CODE
 - 2010 CALIFORNIA BUILDING AND ELECTRICAL CODES.
 - CALIFORNIA FIRE CODE, SECTION 605.11 (2013 EDITION)
 - NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) 70 ARTICAL 690, 2011 ED.
- CALCULATIONS:
 - Wire is #10 THWN-2, distance from array to panel is 80' (160' conductor path)
 - Maximum current from array inverters is 0.9A x 16 panels = 14.4A total
 - No conduit fill or temp corrections (3 current-carrying conductors, conduit not exposed to direct sunlight)
 - Wire = 1.24 ohms/1000 ft, 160' = 0.198 ohms, voltage drop = 2.86V at 14.4A (1.2%)
 - Circuit breaker is 20A (per CEC, >25% of maximum current, < corrected wire ampacity)
- BUS BAR RATING AND SOLAR SYSTEM CIRCUIT BREAKER LOCATION:
 - Panel and bus bar are rated at 200A capacity
 - Solar connection breaker size meets 690.64(B) requirements:
 200A main source breaker plus 20A solar breaker = 120A
 Allowable solar breaker size = 200A x 120% - 200A = 40A maximum breaker size
 Solar circuit break will be installed at the end of the bus bar opposite the service breaker

3440 WATT SOLAR POWER ARRAY

DOLD RESIDENCE

SOLAR ARRAY INSTALLATION

SUBSTANDARD CONSTRUCTION

| | | |
|--------|------------|-----------------|
| ENG: | DOLD | |
| DR: | DOLD | DATE: 1/20/2014 |
| SCALE: | 3/32"=1' | |
| REV: | | |
| B | SHEET: PG1 | A |