Simplified Solar Permitting Guidelines

Improving Permit Review and Inspection for Small Solar Systems

SolSmart Training

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SIMPLIFIED PV PERMIT GUIDELINES

- The information in these guidelines are intended to provide a format whereby local jurisdictions and contractors can permit simple PV system installations where only a basic review is necessary.
- It is likely that most residential and some small commercial PV systems will comply with these simple criteria that address the requirements for PV systems in the building, electrical, and fire codes.

Guideline Contents

1. **Eligibility List** – Defines the size, electrical, structural, and fire safety requirements for solar installations to qualify for simplified permitting.
2. **Structural Review**– Enable applicants to "fill in the blanks" to explain the structural details of a rooftop solar PV system.
3. **Electrical Review**– Enable applicants to "fill in the blanks" to explain the electrical configuration of a solar PV system.

CURRENT LAWS, REGS & CODES

<u>This Guideline is not intended to create, explicitly or implicitly, any new requirements.</u>

- NEC Article 690, 705, and chapters 1-4
- IRC R331, R902, R905, R908
- IBC 1505, 1509, 1511
- IFC 605.11
- ASCE 7-10, 7-16

SIMPLIFIED PV PERMIT GUIDELINES

Required Information for Permit:

1. Permit application required by the local jurisdiction. Permit applications normally include information about the project scope, project location, and the installer.
2. Site plan showing location of major components on the property. This drawing need not be exactly to scale, but it should represent relative location of components at site (see supplied example site plan). PV arrays in compliance with IRC fire setback requirements need no separate fire service review (with Fire Service MOU).

SIMPLIFIED PV PERMIT GUIDELINES

Required Information for Permit (cont.):

3. Electrical worksheets showing PV array configuration, wiring system, overcurrent protection, inverter, disconnects, required signs, and ac connection to building (see supplied standard electrical diagram).
4. Specification sheets and installation manuals (if available) for all major PV system components such as, PV modules, dc-to-dc converters, inverters, and mounting systems.

Purposes of Simplified Permitting

- A simplified, expedited permit process for small solar PV systems simplifies and consolidates the structural, electrical and fire review of the PV system
- It can eliminate the need for detailed engineering studies and often avoids unnecessary delays
- It is not the intent of an expedited process to circumvent the engineering process
- It is to recognize the similarities among these smaller systems and establish guidelines to determine when a PV project is within the boundaries of typical, well-engineered systems that are clearly compliant with electrical and building codes.

Elements of Streamlined Inspection

- Use of a concise inspection list
- Enable inspection requests (phone, online, or email).
- Provide for on-site inspection during the next business day (where possible and no more than 5 days).
- Provide a scheduling time window for on-site inspection of no more than two hours. (phone and/or email confirmation)
- May include notification of the utility of successful completion.

The “Box” to Qualify Simple Permits

- PV system no larger than 15.36kW
- One- and two-family rooftop installations or structure of same construction.
- String inverter, dc converter, or microinverter
- Complies with eligibility checklist

High Level Analysis of Guideline

Small Residential PV Systems—Simple

- 15.36 kWac or less—no larger than 80A PV system circuit breaker connection
- String inverter, microinverter, or dc converter PV system options

Template For Submittal Requirements

Submittal Requirements Bulletin Solar Photovoltaic Installations In One- and Two-Family Dwellings (and like structures)

- Guides applicants through permitting process. Provides information about submittal requirements for plan review.

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

A PV project that conforms to all the items on this list is eligible for simplified permitting

Step 1: Structural PV Array Mounting Requirements Checklist—Items for both member- and sheathing-attached systems.

A. General Site and Array Requirements *(all square boxes must be checked; where slanted check box sub-options occur, one sub-option must be checked):*

☐ 1. Wind Exposure and Design Wind Speed (as defined by ASCE 7-10, select one below):

☐ *a. Member-Attached System*: *Exposure B or C and design wind speed does not exceed 150 mph.*

☐ *b. Sheathing-Attached System : see section E.7 for wind exposure and wind speed limits.*

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

A PV project that conforms to all the items on this list is eligible for simplified permitting

Step 1: Structural PV Array Mounting Requirements Checklist—Items for both member- and sheathing-attached systems.

☐ 2. The structure is not in Wind Exposure D (within 200 yards of a body water wider than a mile).

☐ 3. The structure is not on a hill with a grade steeper than 5%, where topographic effects can significantly increase wind loads.

☐ 4. Ground snow loads do not exceed 60 psf

☐ 5. Distributed weight of PV array is less than 4 lbs/ft^2 (less than 5 lbs/ft^2 for thermal systems).

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

B. Roof Information *(all must apply)*:

- ☐ 1. The array is mounted on a permitted one- or two-family roof structure or similar structure. *If roof not permitted, show compliance with International Residential Code (IRC) span tables.*
- ☐ 2. The roof is framed with wood rafters or trusses at no greater than 48” on center. Roof framing members run upslope/downslope. (not horizontal purlins)
- ☐ 3. The roof structure appears to be structurally sound, without signs of alterations or significant structural deterioration or sagging.
- ☐ 4. Sheathing: At least 7/16” or thicker plywood, or 7/16” or thicker oriented strand board (OSB).
- ☐ 5. If a composition shingle roof, the roof has a single roof overlay (no multiple shingle layers). *If not, show compliance with IRC span tables.*
- ☐ 6. Mean roof height is not greater than ☐ 40 ft (member-attached), ☐ 30 ft (sheathing-attached).
- ☐ 7. In areas of significant seismic activity (Seismic Category C, D, E or F), PV array covers no greater than half the total area of the roof (all roofs included).

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

C. Array Mounting Equipment Information *(all must be defined):*

- ☐ 1. Mounting Equipment Manufacturer _____
- ☐ 2. Product Name and Model#_____
- ☐ 3. UL2703 fire rating for the PV modules used in the project. Fire rating Class_____ (A, B, or C).
- ☐ 4. Specify anchor-to-roof sealing (e.g. flashing, or sealant compatible with roofing):_____

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

Member-Attached PV Array Requirements:

- ☐ 1. Array is set back from all roof edges and ridge by at least twice the gap under the modules (or more, where fire access pathways are required).
- ☐ 2. Array does not cantilever over the perimeter anchors more than 19".
- ☐ 3. Gap under modules (roof surface to underside of module) is no greater than 10".
- ☐ 4. Gaps between modules are (select one below):
  - ☐ *a. at least 0.25" on both short and long sides of modules, or*
  - ☐ *b. 0" on short side, and at least 0.50" on long sides.*

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

Member-Attached PV Array Requirements (cont):

- ☐ 5. Mounting rail orientation or rail-less module long edges (select one below):
  - ☐ *a. run perpendicular to rafters or trusses, and attached to them, or*
  - ☐ *b. run parallel to rafters and are spaced no more than 4'-0" apart, Ground Snow Load is no greater than 10 psf, and Design Wind Speed does not exceed 120 mph.*
- ☐ 6. The anchor/mount/stand-off spacing perpendicular to rafters or trusses (select one below):
  - ☐ *a. does not exceed 4'-0", and anchors in adjacent rows are staggered where rafters or trusses are at 24" or less on center (see Figure), or*
  - ☐ *b. does not exceed 4'-0", anchor layout is orthogonal, roof slope is 6:12 or less, Ground Snow Load is no greater than 10 psf, and Design Wind Speed does not exceed 120 mph, or*
  - ☐ *c. does not exceed 6'-0", anchor layout is orthogonal, roof slope is 6:12 or less, Ground Snow Load is zero, and Design Wind Speed does not exceed 120 mph.*

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

Member-Attached PV Array Requirements (cont):

- ☐ 7. Upslope/downslope anchor spacing follows manufacturer's instructions.
- ☐ 8. Anchor fastener is (select one below):
  - ☐ *a. 5/16" diameter lag screw with 2.5" embedment into structural member, or*
  - ☐ *b. fastener other than (a.) embedded in structural members in accordance with manufacturer's structural attachment details. Manufacturer's anchor layout requirements must not exceed the anchor spacing requirements shown in Items 5 and 6 above.*

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

Sheathing-Attached PV Array Requirements:

- ☐ 1. Array is set back from all roof edges and ridge by at least twice the gap under the modules (or more, where fire access pathways are required).
- ☐ 2. Array does not cantilever over the perimeter anchors more than 19”.
- ☐ 3. Gap under modules (roof surface to underside of module) is no greater than 5”.
- ☐ 4. Gap between modules is at least 0.75” on both short and long sides of modules.
- ☐ 5. Roof slope is 2:12 (9 degrees) or greater.

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

Sheathing-Attached PV Array Requirements (cont):

- ☐ 5. Roof framing and sheathing nailing options (select a, b, or c below):
  - ☐ a. *Manufactured Wood Trusses, or*
  - ☐ *b. Initially Dry Wood Rafters (lumber grade stamps are visible and state "S-DRY" (Surfaced Dry) or "KD" (Kiln-Dried), or*
  - ☐ *c. Initially Wet Wood Rafters meeting one of the field-verified sheathing nail options listed below. Note: If lumber stamps are not visible, or if lumber stamps state "S-GRN" (Surfaced Green), the lumber shall be assumed to have been initially "wet" (MC > 19%) at time of sheathing installation. (select I, ii, or iii below):*
    - ☐ *i. Deformed shank nails, 6d or greater, or*
    - ☐ *iii. 6d or 8d smooth shank common or box nails, nailed into dense lumber, either Douglas Fir (stamp: DF or DF-L) or Southern Pine (stamp: SPIB).*

*(**NOTE:** sheathing attached not allowed with Lower density lumber such as Spruce-Pine-Fir (stamp: S-P-F) and Hem-Fir (stamp: HF) with smooth shank nails.)*

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

Sheathing-Attached PV Array Requirements (cont):

- ☐ 6. Anchor location restrictions—all anchors must comply with at least one of the options below. Anchors verified to be in "Bands of Strength" are attached in the middle 16" wide strip centered between the long edges of sheathing panels (at least 16" from sheathing long edge). Check all boxes that apply to anchors in the array:

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING—Sheathing—No Bands of Strength

- ☐ *a. Some anchors are <u>not</u> within bands of strength, and all the following (i., ii. & iii.) apply:*
  - ☐ *i. Edge of array is more than 3 feet from any roof edge (Wind Zone 1), and*
  - ☐ *ii. Tributary area is 9 ft^2 or less (up to half the area of a 60 cell PV module), and*
  - ☐ *iii. Wind Exposure B only, and design wind speed does not exceed 120 mph.*

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING—Sheathing—Bands of Strength

- ☐ *b. All anchors are within bands of strength, and all of the following (i., ii. & iii.) apply:*
  - ☐ *i. Edge of array is more than 3 feet from any roof edge (Wind Zone 1), and*
  - ☐ *ii. Tributary area is 14 ft^2 or less (40”x48”).*
  - ☐ *iii. One of the two wind cases below (x. or y.) applies:*
    - ☐ x. *Exposure B, and design wind speed does not exceed 140 mph, or*
    - ☐ y. *Exposure C, and design wind speed does not exceed 120 mph.*

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING—Sheathing—Bands of Strength

- ☐ *c. All anchors are within bands of strength, and all the following (i., ii. & iii.) apply:*
  - ☐ *i. Edge of array meets E.1 and is within 3 feet of a roof edge (Wind Zone 2), and*
  - ☐ *ii. Tributary area including cantilevers is 9 ft^2 or less (32.5”X40”).*
  - ☐ *iii. Wind Exposure B only, and design wind speed does not exceed 120 mph.*
- ☐ *d. All anchors are within bands of strength, and all the following (i., ii. & iii.) apply:*
  - ☐ *i. Edge of array meets E.1 and is within 3 feet of a roof corner (Wind Zone 3), and*
  - ☐ *ii. Tributary area, including cantilevers, is 4.5 ft^2 or less (32.5”X20”).*
  - ☐ *iii. Wind Exposure B only, and design wind speed does not exceed 120 mph.*

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

- ☐ 8. Anchor-to-sheathing connection has an allowable stress design (ASD) uplift capacity of at least 166 lbs. under short duration loading, which corresponds to a mean ultimate tested uplift capacity of at least 520 lbs.

GENERAL STATEMENT FOR CHECKLIST:

If any structural item cannot be checked off, the building official may require the installer to provide structural calculations and/or details, stamped and signed by a design professional, addressing the unchecked item.

Table 1: Rooftop Structural Anchoring Rules' Summary of Options

Mount Substrate	Rule Section	Mount Spacing	Mount Layout	Snow Load	Roof Slope	Location in Allowed Zones	Max. Design Wind Speed	Allowed Exposure
Rafter-Attached	D.6.a	48" cross-slope[1]	staggered	60 psf	any	rafter centerline +/- 1/4"	150 mph	B & C
"	D.6.b	48" cross-slope[1]	orthogonal	10 psf	flat to 6:12	"	120 mph	"
"	D.6.c	72" cross-slope[1]	"	0 psf	"	"	120 mph	"
Sheathing-Attached	E.7.a	40"x33"	orthogonal	60 psf	2:12 to vert.	anywhere in Zone 1	120 mph	B
"	"	"	"	"	"	"	"	"
"	E.7.b.iii.x	40"x48"	"	"	"	bands of strength[2]	140 mph	B
"	E.7.b.iii.y	"	"	"	"	"	120 mph	B & C
"	E.7.c	40"x33"	"	"	"	"	"	B
"	E.7.d	20"x33"	"	"	"	"	"	"

[1] Cross-slope mount spacing may also be described as "left-to-right" spacing, or for south-facing sloped roofs, "east-to-west" spacing.

[2] "Bands of strength" are 16 inch wide swaths (8" to each side of centerline) located midway between the the long edges of sheathing panels. Both strength" typically run cross-slope, perpendicular to rafters.

[3] Moisture content of rafters when sheathing was nailed down. Dry = lumber with stamps noting Surface-Dried (SD, S-Dry) or Kiln-Dried (KD or K-D

[4] Soft= Spruce-Pine-Fir (SPF, G=0.42), Hem-Fir (HF, G=0.43). Med. = Douglas Fir (DF or DF-L, G=0.49) or Southern Pine (SPIB, G=0.55). "Either" = soft or m

[5] 6d common smooth or deformed shank; 8d box or common, smooth or deformed shank. "Any" indicates any sheathing nails or staples that were

" " indicates either Case (1) initially dry + either soft- or medium-density lumber (Rule E.6.a), or Case (2) initially either wet or dry + medium-dens

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

Step 2: Electrical PV System Requirements Checklist

For a simplified PV permit, following are the electrical requirements:

1. Major electrical components including PV modules, dc-to-dc converters, and inverters, are identified for use in PV systems.
2. Array mounting system UL2703 certified for bonding and grounding. Alternatively, the array mounting system may incorporate UL2703 grounding devices to bond separate exposed metal parts together or to the equipment grounding conductor.
3. The PV array consists of no more than 2 series strings per inverter input and no more than 4 series strings in total per inverter.

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

4. Field Installed PV array wiring meets the following requirements:
   a. All exposed PV source circuit wiring is 10 AWG PV Wire.
   b. All PV source circuit wiring in raceway is 10 AWG THWN-2, XHHW-2, or RHW-2.
   c. Any field-installed PV output circuit wiring is 6 AWG THWN-2, XHHW-2, or RHW-2.
   d. PV system circuits on buildings meet requirements for controlled conductors in 690.12.
5. The total inverter capacity has a continuous ac power output 15,360 Watts or less and meets the requirements of 705.12(D) where installed on the load side of the service disconnecting means (complies with Table 705.12(D) in Technical Appendix). (choose one below)
   - ☐ Load-side connection complying with Table 705.12(D)
   - ☐ Supply-side connection complying with 705.12(A)

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

6. Equipment is rated for the maximum dc voltage applied to the equipment (put N/A in all blanks that do not apply to the specific installation):

A. ASHRAE Extreme Annual Mean Minimum Design Dry Bulb Temperature (one source is www.solarabcs.org/permitting) =_____;

Table 690.7 (NEC) value_____

B. Max (temp adjusted) module Voc:

Rated Voc _____V x Table 690.7 value_____ =_____V

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

C. Dc-to-dc converter(s) or microinverter rated maximum input voltage:_____V

(must be greater than Max module Voc in (B.))

D. Maximum number of dc-to-dc converters allowed in series (up to 600Vdc):_____

E. Maximum voltage of dc-to-dc converter circuit with maximum number in (C.):_____V

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

F. Inverter(s) rated maximum input voltage:_____V (must be greater than 1)-4) below)

1) Inverter 1 input 1: Max module Voc (B.)_____V x # in series_____ = _____V

2) Inverter 1 input 2: Max module Voc (B.)_____V x # in series_____ = _____V

3) Inverter 2 input 1: Max module Voc (B.)_____V x # in series_____ = _____V

4) Inverter 2 input 2: Max module Voc (B.)_____V x # in series_____ = _____V

ELIGIBILITY CHECKLIST FOR SIMPLIFIED PV PERMITTING

7. One of the standard electrical diagrams can be used to accurately represent the PV system.

Fill out the appropriate standard electrical diagram completely. If the electrical system is more complex than the standard electrical diagram can effectively communicate, the project does not meet the requirements for a simplified permit application and additional information may be necessary for the jurisdiction to process the permit application.

Central/String Inverter Standard Plans

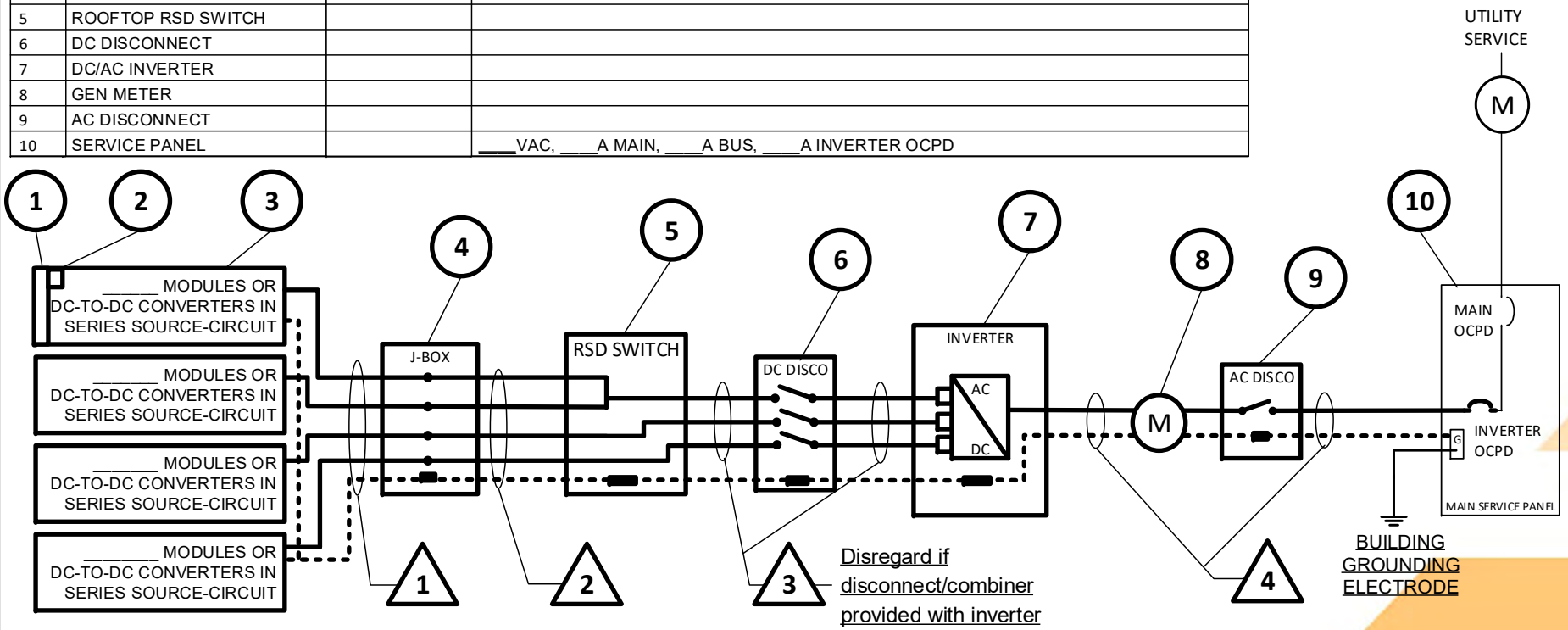
- Use this plan ONLY for central/string inverter systems with or without dc converters not exceeding 15.36kW on the roof of a one- or two-family dwelling or similar structure.
- The photovoltaic system must interconnect to the load side of a 120/240Vac service panel rated 400A or less (80-amp PV breaker or less).
- Not intended for more than two inverters, or more than one dc combiner per inverter (non-inverter-integrated).

Central/String Inverter Standard Plans

Manufacturer's specification sheets and installation instructions for:

- Inverter
- PV modules
- Added combiner box(es)
- Racking system (including bonding and grounding instructions).

EQUIPMENT SCHEDULE			
TAG	DESCRIPTION	PART NUMBER	NOTES (N/A IF NOT USED)
1	SOLAR PV MODULE		
2	DC-DC CONVERTER		
3	PV ARRAY OUTPUT 1		
	PV ARRAY OUTPUT 2		
	PV ARRAY OUTPUT 3		
4	J-BOX		
5	ROOFTOP RSD SWITCH		
6	DC DISCONNECT		
7	DC/AC INVERTER		
8	GEN METER		
9	AC DISCONNECT		
10	SERVICE PANEL		____VAC, ____A MAIN, ____A BUS, ____A INVERTER OCPD



FOR UNUSED SOURCE CIRCUITS PUT "N/A" in BLANK ABOVE

CONDUIT AND CONDUCTOR SCHEDULE					
TAG	DESCRIPTION OR CONDUCTOR TYPE	COND. GAUGE	NUMBER OF CONDUCTORS	CONDUIT TYPE	CONDUIT SIZE
1	USE-2 ☐ or PV WIRE ☐	10		N/A	N/A
	BARE COPPER EQ. GRD. COND. (EGC)	6		N/A	N/A
2	THWN-2 ☐ or XHHW-2 ☐ or RHW-2 ☐	10			
3	THWN-2 ☐ or XHHW-2 ☐ or RHW-2 ☐	10			
	INSULATED EGC	10			
4	THWN-2 ☐ or XHHW-2 ☐ or RHW-2 ☐				
	INSULATED EGC				

Contractor Name, Address and Phone:

_____
_____
_____
_____

One-Line Standard Electrical Diagram for Small-Scale, Single-Phase PV Systems

Site Name: _____

Site Address: _____

System AC Size: _____

Drawn By:			
Checked By:			
SIZE	FSCM NO	DWG NO	REV
		E1.1a	
SCALE	NTS	Date:	SHEET

Central/String Inverter Standard Plans

PV MODULE RATINGS @ STC (Guide Section ?)

MODULE MAKE	
MODULE MODEL	
MAX POWER-POINT CURRENT (I_{MP})	A
MAX POWER-POINT VOLTAGE (V_{MP})	V
OPEN-CIRCUIT VOLTAGE (V_{OC})	V
SHORT-CIRCUIT CURRENT (I_{SC})	A
MAX SERIES FUSE (OCPD)	A
MAXIMUM POWER (P_{MAX})	W
MAX VOLTAGE (TYP 600V_{DC})	V
VOC TEMP COEFF (mV/°C ☐ or %/°C ☐)	

NOTES FOR ALL DRAWINGS:

OCPD = OVERCURRENT PROTECTION DEVICE

NATIONAL ELECTRICAL CODE® REFERENCES SHOWN AS *(NEC XXX.XX)*

DC-TO-DC CONVERTER RATINGS (if used)

CONVERTER MAKE	
CONVERTER MODEL	
MAX CURRENT	A
MAX VOLTAGE	V
MAXIMUM POWER	W
MAX OUTPUT CIRCUIT V (TYP 600V_{DC})	V

INVERTER RATINGS (Guide Section 4)

INVERTER MAKE	
INVERTER MODEL	
MAX DC VOLT RATING	V
MAX POWER @ 40°C	W
NOMINAL AC VOLTAGE	V
MAX AC CURRENT	A
MAX OCPD RATING	A

NOTE FOR ARRAY CIRCUIT WIRING (Guide Section 4 and Appendix E):

LOWEST EXPECTED AMBIENT TEMPERATURE BASED ON ASHRAE MINIMUM MEAN EXTREME DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION.
LOWEST EXPECTED AMBIENT TEMP _____°C

NOTES FOR INVERTER CIRCUITS (Section 4?):

1) IF UTILITY REQUIRES A VISIBLE-BREAK SWITCH, DOES THIS SWITCH MEET THE REQUIREMENT? YES ☐ NO ☐ N/A ☐

2) IF GENERATION METER REQUIRED, DOES THIS METER SOCKET MEET THE REQUIREMENT? YES ☐ NO ☐ N/A ☐

3) SIZE INVERTER OUTPUT CIRCUIT (AC) CONDUCTORS ACCORDING TO INVERTER OCPD AMPERE RATING. (See Table xxx)

4) TOTAL OF _____ INVERTER OCPD(s), ONE FOR EACH INVERTER. DOES TOTAL SUPPLY BREAKERS COMPLY WITH 120% BUSBAR RULE IN 705.12(D)? YES ☐ NO ☐

SIGNS–SEE GUIDE SECTION 7

*SIGN FOR DC DISCONNECT

PHOTOVOLTAIC POWER SOURCE	
RATED MPP CURRENT	A
RATED MPP VOLTAGE	V
MAX SYSTEM VOLTAGE	V
MAX CIRCUIT CURRENT	A

WARNING: ELECTRICAL SHOCK HAZARD–LINE AND LOAD MAY BE ENERGIZED IN OPEN POSITION

SIGN FOR PV SYSTEM DISCONNECT

SOLAR PV SYSTEM DISCONNECT	
AC OUTPUT CURRENT	A
NOMINAL AC VOLTAGE	V

SIGN FOR DISTRIBUTION PANELS

THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR)

SIGN FOR NEC 705.12(D)(2)(3)(b) (if used)

WARNING:
INVERTER OUTPUT CONNECTION;
DO NOT RELOCATE THIS OVERCURRENT DEVICE.

SIGN FOR NEC 690.12 (for roof-mounted systems)

PHOTOVOLTAIC SYSTEM EQUIPPED WITH RAPID SHUTDOWN

*NOTE: MICROINVERTER AND AC MODULE SYSTEMS DO NOT NEED DC DISCONNECT SIGN SINCE 690.51 MARKING ON PV MODULE COVERS NEEDED INFORMATION

Contractor Name,
Address and Phone:
_____
_____
_____
_____

Notes for One-Line Standard Electrical Diagram for Single-Phase PV Systems

Site Name: _____
Site Address: _____
System AC Size: _____

Drawn By:	SIZE	FSCM NO	DWG NO	REV
			E1.2a	
Checked By:	SCALE NTS	Date:	SHEET	

Microinverter Standard Plans--Scope

- Use this plan ONLY for systems using microinverters or ac modules (ACM) not exceeding 15.36 kW, with no more than 4 output circuits, one PV module/microinverter, installed on the roof of a one- or two-family dwelling or similar structure.
- The PV system must interconnect to the load side of a 120/240Vac, service panel rated 400A or less (80-amp breaker or less).

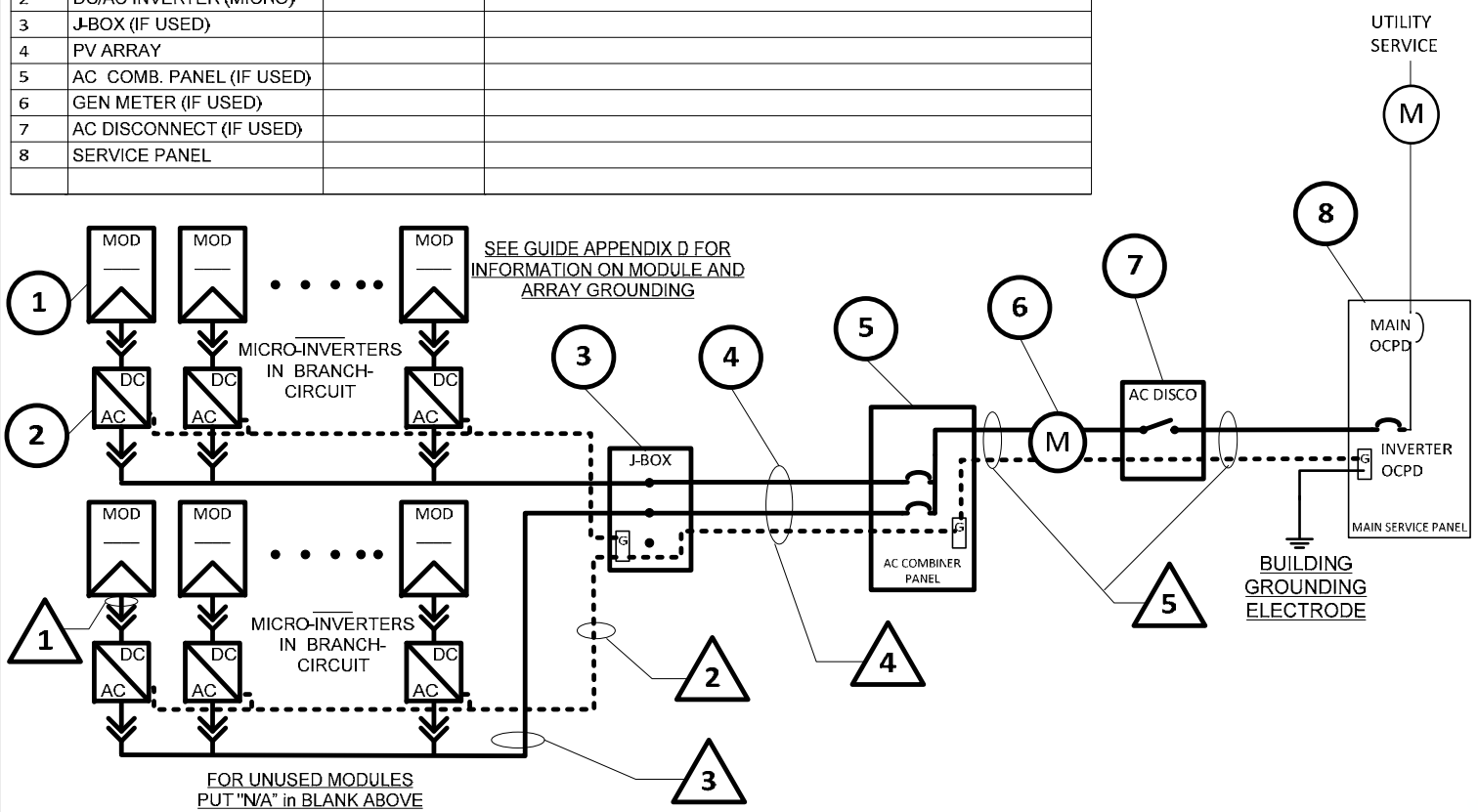
Microinverter Standard Plans

Manufacturer's specification sheets and/or installation instructions for:

- microinverter
- PV modules
- Racking system (including bonding and grounding instructions).

Microinverter Standard Plans

EQUIPMENT SCHEDULE			
TAG	DESCRIPTION	PART NUMBER	NOTES
1	PV DC or AC MODULE		
2	DC/AC INVERTER (MICRO)		
3	J-BOX (IF USED)		
4	PV ARRAY		
5	AC COMB. PANEL (IF USED)		
6	GEN METER (IF USED)		
7	AC DISCONNECT (IF USED)		
8	SERVICE PANEL		



CONDUIT AND CONDUCTOR SCHEDULE					
TAG	DESCRIPTION OR CONDUCTOR TYPE	COND. GAUGE	NUMBER OF CONDUCTORS	CONDUIT TYPE	CONDUIT SIZE
1	USE-2 ☐ or PV WIRE ☐	MFG	MFG Cable	N/A	N/A
2	GEC ☐ EGC ☐ X ALL THAT APPLY			N/A	N/A
3	EXTERIOR CABLE LISTED W/ INV.	MFG	MFG Cable	N/A	N/A
4	THWN-2 ☐ or XHHW-2 ☐ or RHW-2 ☐				
	GEC ☐ EGC ☐ X ALL THAT APPLY			SAME	SAME
	NO DC GEC IF 690.35 SYSTEM				
5	THWN-2 ☐ or XHHW-2 ☐ or RHW-2 ☐				
	GEC ☐ EGC ☐ X ALL THAT APPLY			SAME	SAME

Contractor Name, Address and Phone:	One-Line Standard Electrical Diagram for Micro-Inverter PV Systems Site Name: Site Address: System AC Size:			
Drawn By:	SIZE	FSCM NO	DWG NO	REV
			E1.1a	0
Checked By:	SCALE NTS	Date:	SHEET	

www.solsmart.org

Microinverter Standard Plans

PV MODULE RATINGS @ STC (Guide Section ?)

MODULE MAKE	
MODULE MODEL	
MAX POWER-POINT CURRENT (I_{MP})	A
MAX POWER-POINT VOLTAGE (V_{MP})	V
OPEN-CIRCUIT VOLTAGE (V_{OC})	V
SHORT-CIRCUIT CURRENT (I_{SC})	A
MAX SERIES FUSE (OCPD)	A
MAXIMUM POWER (P_{MAX})	W
MAX VOLTAGE (TYP 600V_{DC})	V
VOC TEMP COEFF (mV/°C ☐ or %/°C ☐)	

NOTES FOR ALL DRAWINGS:

OCPD = OVERCURRENT PROTECTION DEVICE

NATIONAL ELECTRICAL CODE® REFERENCES SHOWN AS *(NEC XXX.XX)*

DC-TO-DC CONVERTER RATINGS (if used)

CONVERTER MAKE	
CONVERTER MODEL	
MAX CURRENT	A
MAX VOLTAGE	V
MAXIMUM POWER	W
MAX OUTPUT CIRCUIT V (TYP 600V_{DC})	V

INVERTER RATINGS (Guide Section 4)

INVERTER MAKE	
INVERTER MODEL	
MAX DC VOLT RATING	V
MAX POWER @ 40°C	W
NOMINAL AC VOLTAGE	V
MAX AC CURRENT	A
MAX OCPD RATING	A

NOTE FOR ARRAY CIRCUIT WIRING (Guide Section 4 and Appendix E):

LOWEST EXPECTED AMBIENT TEMPERATURE BASED ON ASHRAE MINIMUM MEAN EXTREME DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION.
LOWEST EXPECTED AMBIENT TEMP _____°C

NOTES FOR INVERTER CIRCUITS (Section 4?):

1) IF UTILITY REQUIRES A VISIBLE-BREAK SWITCH, DOES THIS SWITCH MEET THE REQUIREMENT? YES ☐ NO ☐ N/A ☐

2) IF GENERATION METER REQUIRED, DOES THIS METER SOCKET MEET THE REQUIREMENT? YES ☐ NO ☐ N/A ☐

3) SIZE INVERTER OUTPUT CIRCUIT (AC) CONDUCTORS ACCORDING TO INVERTER OCPD AMPERE RATING. (See Table xxx)

4) TOTAL OF _____ INVERTER OCPD(s), ONE FOR EACH INVERTER. DOES TOTAL SUPPLY BREAKERS COMPLY WITH 120% BUSBAR RULE IN 705.12(D)?
YES☐ NO☐

SIGNS–SEE GUIDE SECTION 7

*SIGN FOR DC DISCONNECT

PHOTOVOLTAIC POWER SOURCE	
RATED MPP CURRENT	A
RATED MPP VOLTAGE	V
MAX SYSTEM VOLTAGE	V
MAX CIRCUIT CURRENT	A

WARNING: ELECTRICAL SHOCK HAZARD–LINE AND LOAD MAY BE ENERGIZED IN OPEN POSITION

SIGN FOR PV SYSTEM DISCONNECT

SOLAR PV SYSTEM DISCONNECT	
AC OUTPUT CURRENT	A
NOMINAL AC VOLTAGE	V

SIGN FOR DISTRIBUTION PANELS

THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR)

SIGN FOR NEC 705.12(D)(2)(3)(b) (if used)

WARNING:
INVERTER OUTPUT CONNECTION;
DO NOT RELOCATE THIS OVERCURRENT DEVICE.

SIGN FOR NEC 690.12 (for roof-mounted systems)

PHOTOVOLTAIC SYSTEM EQUIPPED WITH RAPID SHUTDOWN

*NOTE: MICROINVERTER AND AC MODULE SYSTEMS DO NOT NEED DC DISCONNECT SIGN SINCE 690.51 MARKING ON PV MODULE COVERS NEEDED INFORMATION

Contractor Name, Address and Phone: _____	Notes for One-Line Standard Electrical Diagram for Single-Phase PV Systems Site Name: _____ Site Address: _____ System AC Size: _____			
Drawn By:	SIZE	FSCM NO	DWG NO E1.2a	REV
Checked By:	SCALE NTS	Date:	SHEET	

Structural Criteria for Residential Rooftop Solar

Roof Check

- Based on the housing stock and enforcement history—reasonable to assume that most dwelling roofs were built to the building code in effect.
  - Compliance check consists of contractor's visual roof audit checking for modification, unusual sagging, or deterioration.
- For AHJs with evidence of structurally deficient housing stock or poor compliance history, the AHJ may elect to add the rafter span check option.

Structural Criteria for Residential Rooftop Solar

Regional and Site Assumptions—jurisdictions know difficult areas

- Design Wind Speed no greater than 140 mph.
- Structure is not in Wind Exposure D (within 200 yards of the ocean or a large coastal bay).
- If in Wind Exposure C (within 500 yards of large open fields or grasslands), the structure is not on a hill with a grade steeper than 5%.

Array Weight Limits:

(panels + supports)

Toolkit covers both

Photovoltaic Arrays (4 psf max)

Typical: 2.5 to 3.5 psf

Solar Thermal Arrays (5 psf max)

Typical: 3.5 to 4.5 psf

Structural Criteria for Residential Rooftop Solar

Basic Assumption:
Roof is "Code Compliant"

- No second reroof overlays

- Reasonably sound, no decay, no unusual sagging
  = visual inspection

- Rafter Span Table Checks?
  - Pre-1960
    - larger lumber sizes, higher grade
  - Post-1960
    - modern lumber sizes, lower grade

Structural Criteria for Residential Rooftop Solar

"Pre-1960" Construction

Structural Criteria for Residential Rooftop Solar

"Carpenter Trusses"

Structural Criteria for Residential Rooftop Solar

Table 2. Roof Rafter Maximum Horizontal Span (feet - inches) [1]

Assumed Vintage	Nominal Size	Actual Size	Non-Tile Roof [2]			Tile Roof [3]		
			Rafter Spacing					
			16" o.c.	24" o.c.	32" o.c.	16" o.c.	24" o.c.	32" o.c.
Post-1960	2x4	1½"x3½"	9'-10"	8'-0"	6'-6"	8'-6"	6'-11"	5'-6"
	2x6	1½"x5½"	14'-4"	11'-9"	9'-6"	12'-5"	10'-2"	8'-0"
	2x8	1½"x7¼"	18'-2"	14'-10"	12'-0"	15'-9"	12'-10"	10'-3"
Pre-1960	2x4	1¾"x3¾"	11'-3"	9'-9"	7'-9"	10'-3"	8'-6"	6'-9"
	2x6	1¾"x5¾"	17'-0"	14'-0"	11'-3"	14'-9"	12'-0"	9'-9"
	2x8	1¾"x7¾"	22'-3"	18'-0"	14'-6"	19'-0"	15'-6"	12'-6"

Structural Summary Takeaway

1. Houses that were built in compliance with building structural codes, can support PV.
2. Single layer of roofing (no second layer of comp).
3. PV modules mounted within 2” and 10” of roof deck.
4. PV array distributed weight less than 4 lb/ft^2
5. Typical rafter or trusses, with supports 48” apart or closer (each anchor row mounted on alternating trusses) meet structural code requirements (represents most of housing stock).

Example 1—7.5kW Central Inverter PV System

PV System Components

PV Modules

Qty. 30, 285W, American Solar AS285

Inverter

Qty. 1, 7.5 kW, American Inverter AI-7500

Mounting System

OmniRack ModMount 5.0; sheathing attached;

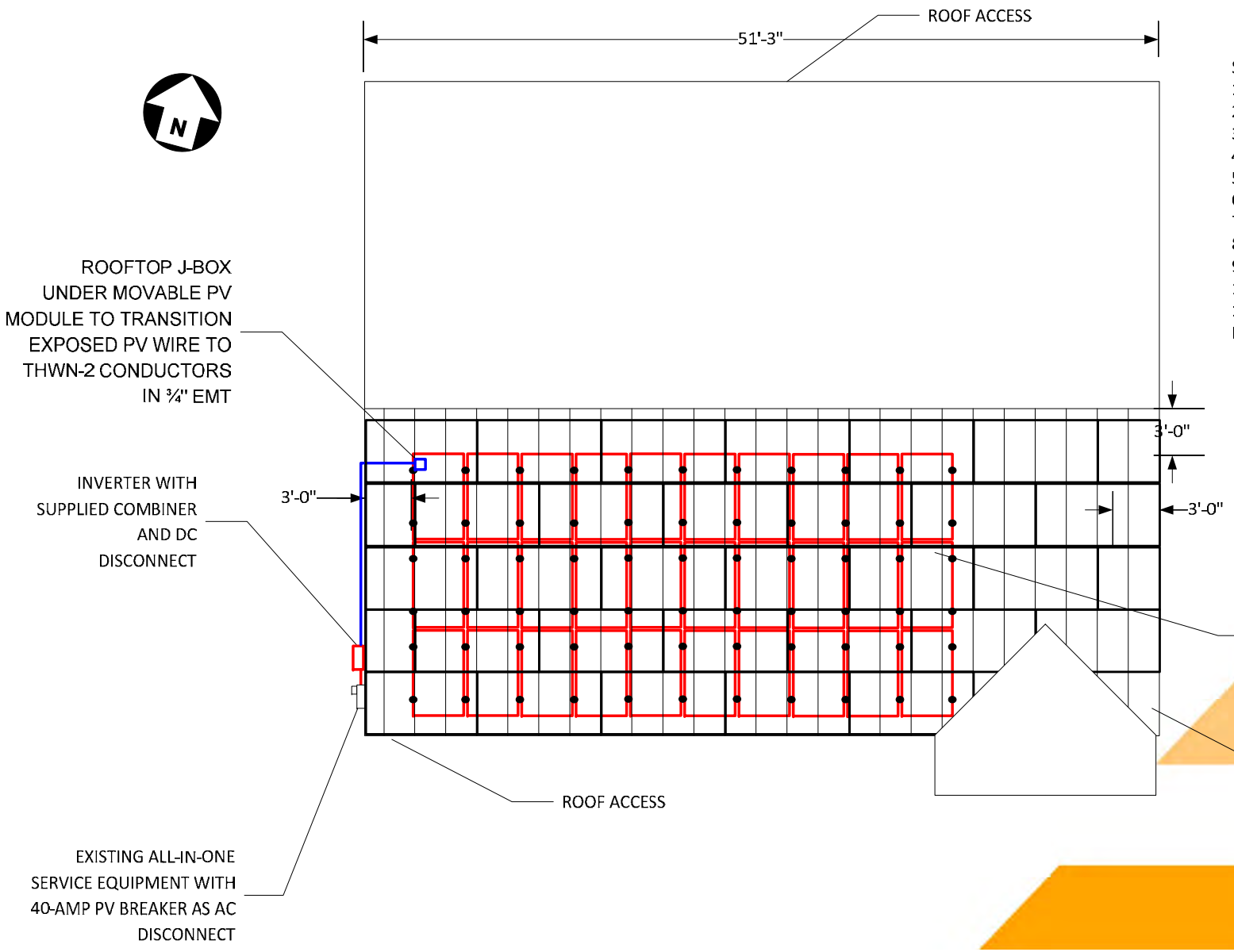
House

Roof Pitch 4:12; House built in 1988. Comp shingle roof. [structurally compliant]

Form Fill-Out Demonstration

Compliance Document
Standard Plan—Simplified Central Inverter
Structural Criteria—compliant

Sheathing Attached System

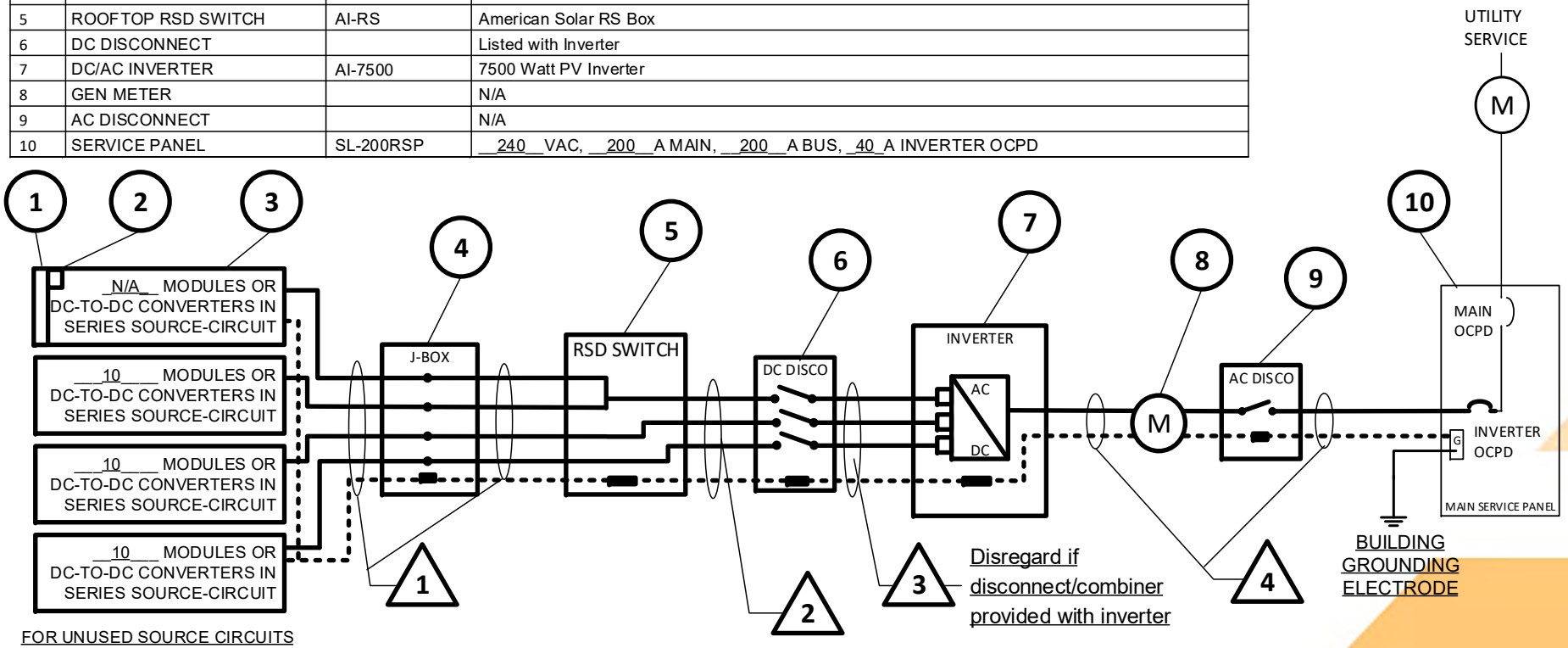


STRUCTURAL NOTES:

1. ROOF PITCH 4:12
2. ROOF COVERING: SINGLE OVERLAY ASPHALT SHINGLES
3. BLACK DOTS REPRESENT ANCHOR POINTS
4. MEAN ROOF HEIGHT LESS THAN 30'
5. ROOF STRUCTURE: TRUSS ON 24" CENTERS
6. ROOF DECK 7/16" OSB
7. MAXIMUM ANCHOR POINT DISTANCE: 48"
8. DWELLING IN WIND EXPOSURE B
9. PV MODULES MOUNTED 2" ABOVE ROOF COVERING
10. PV MODULES CERTIFIED TYPE 1 FOR FIRE PURPOSES
11. OMNIRACK MOD 5.0 LISTED CLASS A WITH TYPE 1 MODULES

EQUIPMENT SCHEDULE

TAG	DESCRIPTION	PART NUMBER	NOTES (N/A IF NOT USED)
1	SOLAR PV MODULE	AS-285	American Solar 285-Watt PV Modules
2	DC-DC CONVERTER		N/A
3	PV ARRAY OUTPUT 1		10 PV Modules in Series
	PV ARRAY OUTPUT 2		10 PV Modules in Series
	PV ARRAY OUTPUT 3		10 PV Modules in Series
4	J-BOX		N/A
5	ROOFTOP RSD SWITCH	AI-RS	American Solar RS Box
6	DC DISCONNECT		Listed with Inverter
7	DC/AC INVERTER	AI-7500	7500 Watt PV Inverter
8	GEN METER		N/A
9	AC DISCONNECT		N/A
10	SERVICE PANEL	SL-200RSP	__240__ VAC, __200__ A MAIN, __200__ A BUS, _40_ A INVERTER OCPD



FOR UNUSED SOURCE CIRCUITS PUT "N/A" in BLANK ABOVE

CONDUIT AND CONDUCTOR SCHEDULE

TAG	DESCRIPTION OR CONDUCTOR TYPE	COND. GAUGE	NUMBER OF CONDUCTORS	CONDUIT TYPE	CONDUIT SIZE
1	USE-2 ☐ or PV WIRE ☒	10	N/A	N/A	N/A
	BARE COPPER EQ. GRD. COND. (EGC)	6		N/A	N/A
2	THWN-2 ☒ or XHHW-2 ☐ or RHW-2 ☐	10	6	EMT	¾"
3	THWN-2 ☐ or XHHW-2 ☐ or RHW-2 ☐	10	N/A		
	INSULATED EGC	10	1		
4	THWN-2 ☒ or XHHW-2 ☐ or RHW-2 ☐	8	3	EMT	¾"
	INSULATED EGC	10	1		

Contractor Name, Address and Phone:

_____
_____
_____
_____

Drawn By:

Checked By:

One-Line Standard Electrical Diagram for Small-Scale, Single-Phase PV Systems

Site Name: _____

Site Address: _____

System AC Size: _____

SIZE	FSCM NO	DWG NO	REV
		E1.1a	

SCALE	NTS	Date:	SHEET

PV MODULE RATINGS @ STC (Guide Section ?)

MODULE MAKE	AMERICAN SOLAR
MODULE MODEL	AS-285
MAX POWER-POINT CURRENT (I_{MP})	9.20 A
MAX POWER-POINT VOLTAGE (V_{MP})	31.3 V
OPEN-CIRCUIT VOLTAGE (V_{OC})	39.7 V
SHORT-CIRCUIT CURRENT (I_{SC})	9.84 A
MAX SERIES FUSE (OCPD)	20 A
MAXIMUM POWER (P_{MAX})	285 W
MAX VOLTAGE (TYP 1000V_{DC})	1000 V

LOWEST EXPECTED AMBIENT TEMPERATURE BASED ON ASHRAE MINIMUM MEAN EXTREME DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION.
LOWEST EXPECTED AMBIENT TEMP _-15_ °C

NOTES FOR ALL DRAWINGS:

OCPD = OVERCURRENT PROTECTION DEVICE

NATIONAL ELECTRICAL CODE® REFERENCES SHOWN AS *(NEC XXX.XX)*

DC-TO-DC CONVERTER RATINGS (if used)

CONVERTER MAKE	
CONVERTER MODEL	
MAX CURRENT	A
MAX VOLTAGE	V
MAXIMUM POWER	W
MAX OUTPUT CIRCUIT V (TYP 600V_{DC})	V

INVERTER RATINGS (Guide Section 4)

INVERTER MAKE	AMERICAN INVERTER
INVERTER MODEL	AI-7500
MAX DC VOLT RATING	600 V
MAX POWER @ 40°C	7500 W
NOMINAL AC VOLTAGE	240 V
MAX AC CURRENT	31.25 A
MAX OCPD RATING	40 A

1) IF UTILITY REQUIRES A VISIBLE-BREAK SWITCH, DOES THIS SWITCH MEET THE REQUIREMENT? YES ☐ NO ☐ N/A ☒

2) IF GENERATION METER REQUIRED, DOES THIS METER SOCKET MEET THE REQUIREMENT? YES ☐ NO ☐ N/A ☒

3) SIZE INVERTER OUTPUT CIRCUIT (AC) CONDUCTORS ACCORDING TO INVERTER OCPD AMPERE RATING. (See Table xxx)

4) TOTAL OF ___1__ INVERTER OCPD(s), ONE FOR EACH INVERTER. DOES TOTAL SUPPLY BREAKERS COMPLY WITH 120% BUSBAR RULE IN 705.12(D)?
YES☒ NO ☐

SIGNS–SEE GUIDE SECTION 7

*SIGN FOR DC DISCONNECT

PHOTOVOLTAIC POWER SOURCE	
RATED MPP CURRENT	27.6 A
RATED MPP VOLTAGE	313 V
MAX SYSTEM VOLTAGE	461 V
MAX CIRCUIT CURRENT	36.9 A

WARNING: ELECTRICAL SHOCK HAZARD–LINE AND LOAD MAY BE ENERGIZED IN OPEN POSITION

SIGN FOR PV SYSTEM DISCONNECT

SOLAR PV SYSTEM DISCONNECT	
AC OUTPUT CURRENT	31 A
NOMINAL AC VOLTAGE	240 V

SIGN FOR DISTRIBUTION PANELS

THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR)

SIGN FOR NEC 705.12(D)(2)(3)(b) (if used)

WARNING:
INVERTER OUTPUT CONNECTION;
DO NOT RELOCATE THIS OVERCURRENT DEVICE.

SIGN FOR NEC 690.12 (for roof-mounted systems)

PHOTOVOLTAIC SYSTEM EQUIPPED WITH RAPID SHUTDOWN

*NOTE: MICROINVERTER AND AC MODULE SYSTEMS DO NOT NEED DC DISCONNECT SIGN SINCE 690.51 MARKING ON PV MODULE COVERS NEEDED INFORMATION

Contractor Name,
Address and Phone:
_____
_____
_____
_____

Notes for One-Line Standard Electrical Diagram for Single-Phase PV Systems

Site Name: _____
Site Address: _____
System AC Size: _____

Drawn By:	SIZE	FSCM NO	DWG NO	REV
			E1.2a	
Checked By:	SCALE NTS	Date:	SHEET	

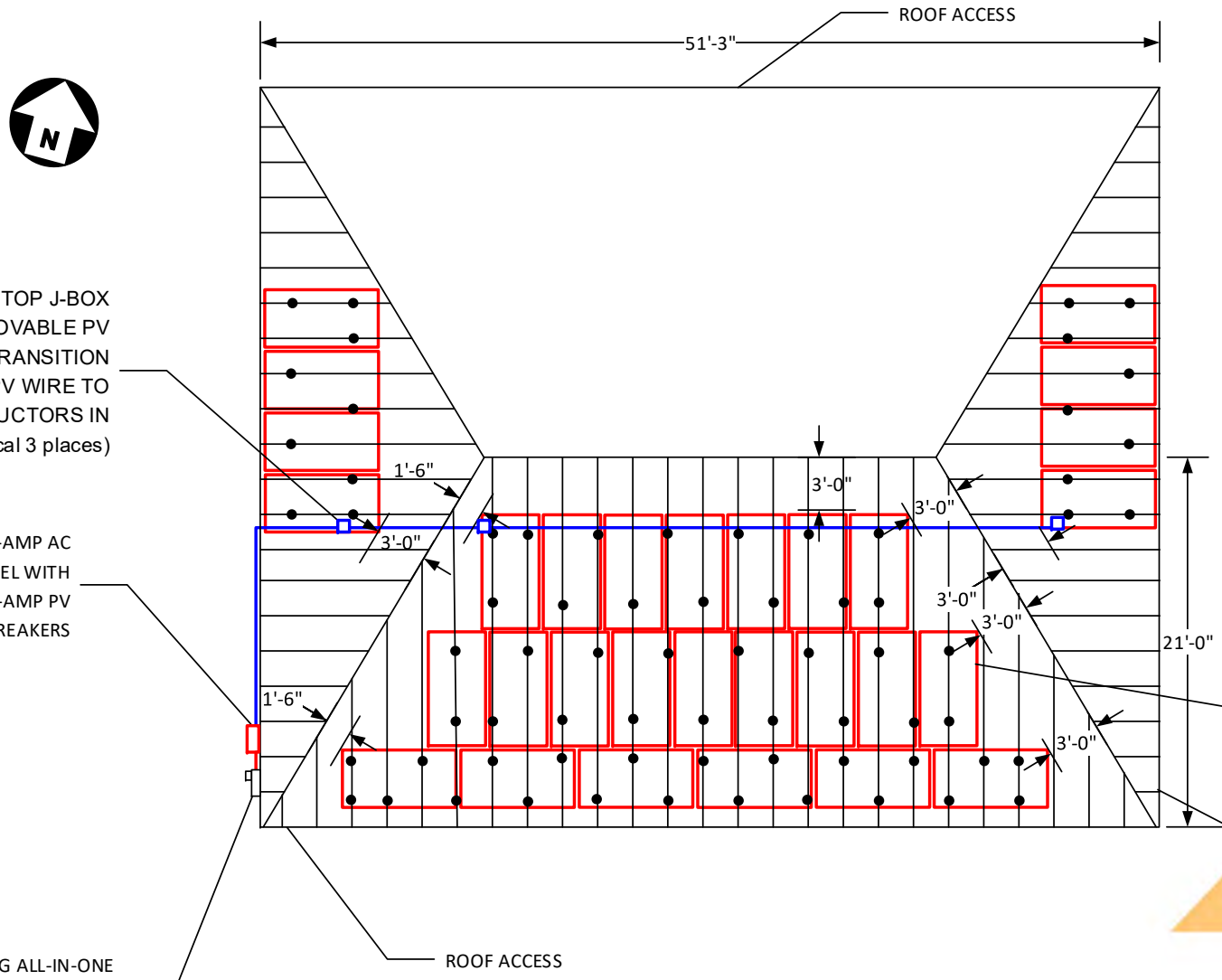
Example 2— 7.5kW Microinverter PV System

- PV System Components
  - PV Modules
    - Qty. 30, 285W, American Solar AS285
  - Inverters
    - Qty. 30, 250W, American Inverter AI-250
  - Mounting System
    - OmniRack ModMount 4.0; Maximum span 48”;
  - House
    - Roof Pitch 4:12; House built in 1988. Comp shingle roof. [structurally compliant]

Form Fill-Out Demonstration

Compliance Document
Standard Plan—Simplified Microinverter
Structural Criteria (compliant)

Member Attached System



ROOFTOP J-BOX UNDER MOVABLE PV MODULE TO TRANSITION EXPOSED PV WIRE TO THWN-2 CONDUCTORS IN ¾" EMT (typical 3 places)

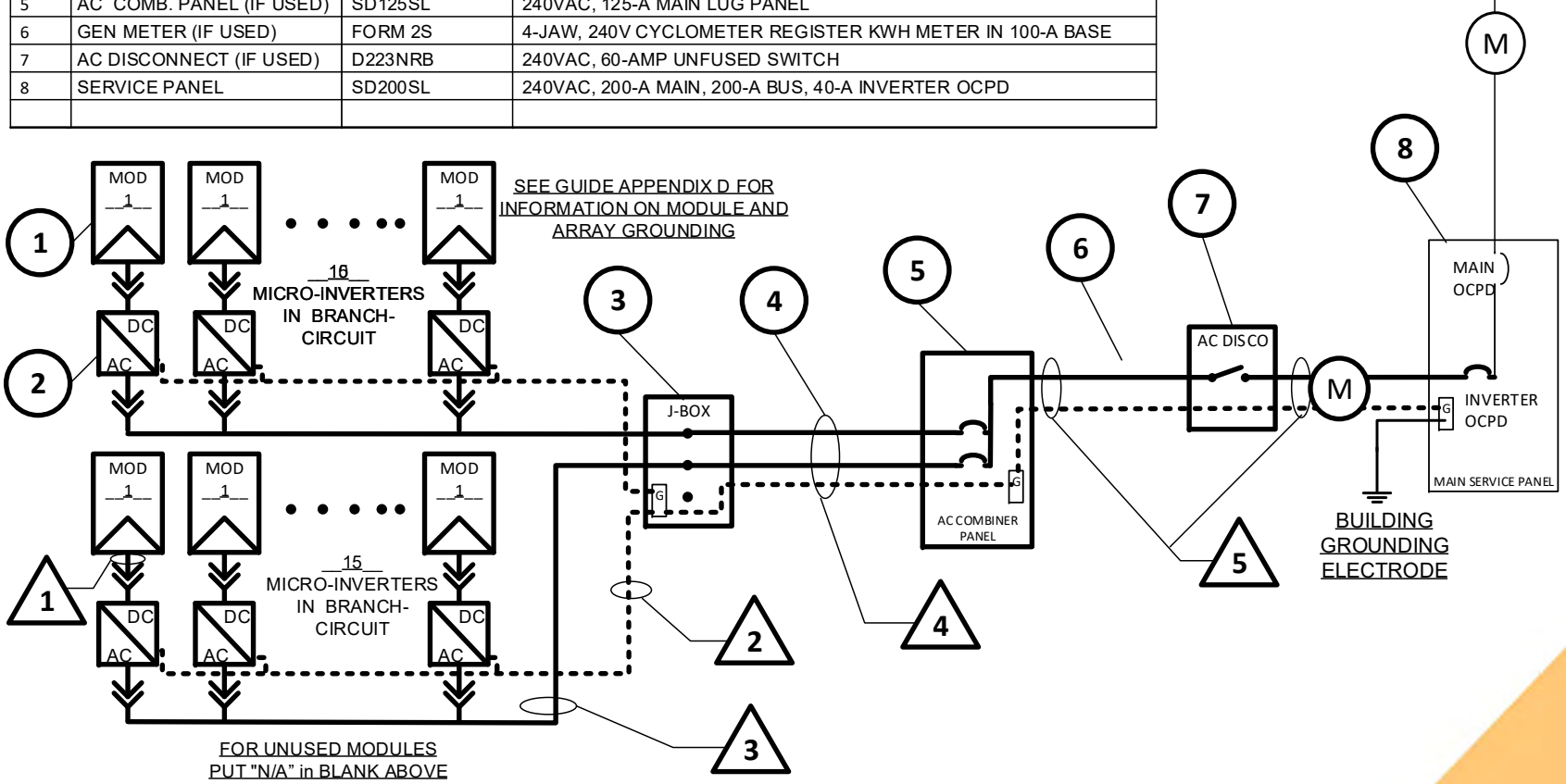
125-AMP AC SUBPANEL WITH TWO, 20-AMP PV BREAKERS

EXISTING ALL-IN-ONE SERVICE EQUIPMENT WITH 40-AMP PV BREAKER AS AC DISCONNECT

30 AMERICAN SOLAR AS 285 MODULES EACH CONNECTED TO AN AMERICAN INVERTER AS-250 MICROINVERTER IN TWO CIRCUITS OF 15 MICROINVERTERS EACH ON EXISTING ROOF STRUCTURE

STRUCTURAL NOTES:
1. ROOF PITCH 4:12
2. ROOF COVERING: SINGLE LAYER ASPHALT SHINGLES
3. BLACK DOTS REPRESENT ANCHOR POINTS
4. MEAN ROOF HEIGHT LESS THAN 30'
5. ROOF STRUCTURE: 2x6 RAFTERS ON 24" CENTERS WITH MIDSPAN SUPPORT—MAX SPAN 11'6".
6. ROOF DECK 7/16" OSB
7.MAXIMUM ANCHOR POINT HORIZONTAL DISTANCE: 72"
8. DWELLING IN WIND EXPOSURE B
9. ANCHORS ARE 5/16" LAG SCREWS WITH 2.5 EMBEDMENT IN STRUCTURE
10. EACH ANCHOR FLASHED WITH "ANCHOR-FLASH" ALUMINUM FLASHING
11. ALL MODULE RAILS RUN PERPENDICULAR TO RAFTERS
12. PV MODULES MOUNTED 5" ABOVE ROOF COVERING
13. PV MODULES CERTIFIED TYPE 1 FOR FIRE PURPOSES
14. OMNIRACK MOD 3.0 LISTED CLASS A WITH TYPE 1 MODULES

EQUIPMENT SCHEDULE			
TAG	DESCRIPTION	PART NUMBER	NOTES
1	PV DC or AC MODULE	AS 285	AMERICAN SOLAR, QUANTITY - 20 (SEE NOTES SHEET FOR DETAILS)
2	DC/AC INVERTER (MICRO)	AI-250	250 WATT, SINGLE PHASE (SEE NOTES SHEET FOR DETAILS)
3	J-BOX (IF USED)		6"x6"x4" NEMA 4, PVC JUNCTION BOX
4	PV ARRAY	N/A	2,20-A AC CIRCUITS WITH 15 MICRO-INVERTERS PER CIRCUIT
5	AC COMB. PANEL (IF USED)	SD125SL	240VAC, 125-A MAIN LUG PANEL
6	GEN METER (IF USED)	FORM 2S	4-JAW, 240V CYCLOMETER REGISTER KWH METER IN 100-A BASE
7	AC DISCONNECT (IF USED)	D223NRB	240VAC, 60-AMP UNFUSED SWITCH
8	SERVICE PANEL	SD200SL	240VAC, 200-A MAIN, 200-A BUS, 40-A INVERTER OCPD



CONDUIT AND CONDUCTOR SCHEDULE					
TAG	DESCRIPTION OR CONDUCTOR TYPE	COND. GAUGE	NUMBER OF CONDUCTORS	CONDUIT TYPE	CONDUIT SIZE
1	USE-2 ☐ or PV WIRE ☐	MFG	MFG Cable	N/A	N/A
2	GEC ☒ EGC ☒ X ALL THAT APPLY	6 AWG	1 BARE CU	N/A	N/A
3	EXTERIOR CABLE LISTED W/ INV.	MFG	MFG Cable	N/A	N/A
4	THWN-2 ☒ or XHHW-2 ☐ or RHW-2 ☐	12 AWG	2-B, 2-R, 2-W	EMT	¾"
	GEC ☒ EGC ☒ X ALL THAT APPLY	8 AWG	1 GREEN	SAME	SAME
	NO DC GEC IF 690.35 SYSTEM				
5	THWN-2 ☒ or XHHW-2 ☐ or RHW-2 ☐	10 AWG	1-R, 1-B, 1-W	EMT	¾"
	GEC ☒ EGC ☒ X ALL THAT APPLY	8 AWG	1 GREEN	SAME	SAME

Contractor Name, Address and Phone:

Bill and Ted's Solar
456 Excellent Drive
San Dimas, CA
800-555-1212

Drawn By: Bill

Checked By: Ted

One-Line Standard Electrical Diagram for Micro-Inverter or AC Module PV Systems

Site Name: John and Jane Homeowner

Site Address: 12 Sunnyside St, Philadelphia, PA

System AC Size: 7.5 KW

SIZE	FSCM NO	DWG NO	REV
		E1.1a	0

SCALE	NTS	Date:	SHEET

PV MODULE RATINGS @ STC (Guide Section ?)

MODULE MAKE	AMERICAN SOLAR
MODULE MODEL	AS-285
MAX POWER-POINT CURRENT (I_{MP})	9.20 A
MAX POWER-POINT VOLTAGE (V_{MP})	31.3 V
OPEN-CIRCUIT VOLTAGE (V_{OC})	39.7 V
SHORT-CIRCUIT CURRENT (I_{SC})	9.84 A
MAX SERIES FUSE (OCPD)	20 A
MAXIMUM POWER (P_{MAX})	285 W
MAX VOLTAGE (TYP 1000V_{DC})	1000 V

LOWEST EXPECTED AMBIENT TEMPERATURE BASED ON ASHRAE MINIMUM MEAN EXTREME DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION.
LOWEST EXPECTED AMBIENT TEMP __-15_ °C

NOTES FOR ALL DRAWINGS:

OCPD = OVERCURRENT PROTECTION DEVICE

NATIONAL ELECTRICAL CODE® REFERENCES SHOWN AS *(NEC XXX.XX)*

DC-TO-DC CONVERTER RATINGS (if used)

CONVERTER MAKE	
CONVERTER MODEL	
MAX CURRENT	A
MAX VOLTAGE	V
MAXIMUM POWER	W
MAX OUTPUT CIRCUIT V (TYP 600V_{DC})	V

INVERTER RATINGS (Guide Section 4)

INVERTER MAKE	AMERICAN INVERTER
INVERTER MODEL	AI-250
MAX DC VOLT RATING	60 V
MAX POWER @ 40°C	250 W
NOMINAL AC VOLTAGE	240 V
MAX AC CURRENT	1.04 A
MAX OCPD RATING	20 A

1) IF UTILITY REQUIRES A VISIBLE-BREAK SWITCH, DOES THIS SWITCH MEET THE REQUIREMENT? YES ☐ NO ☐ N/A ☒

2) IF GENERATION METER REQUIRED, DOES THIS METER SOCKET MEET THE REQUIREMENT? YES ☐ NO ☐ N/A ☒

3) SIZE INVERTER OUTPUT CIRCUIT (AC) CONDUCTORS ACCORDING TO INVERTER OCPD AMPERE RATING. (See Table xxx)

4) TOTAL OF __1__ INVERTER OCPD(s), ONE FOR EACH INVERTER. DOES TOTAL SUPPLY BREAKERS COMPLY WITH 120% BUSBAR RULE IN 705.12(D)?
YES☒ NO ☐

SIGNS–SEE GUIDE SECTION 7

*SIGN FOR DC DISCONNECT

PHOTOVOLTAIC POWER SOURCE	
RATED MPP CURRENT	
RATED MPP VOLTAGE	
MAX SYSTEM VOLTAGE	
MAX CIRCUIT CURRENT	

WARNING: ELECTRICAL SHOCK HAZARD–LINE AND LOAD MAY BE ENERGIZED IN OPEN POSITION

SIGN FOR PV SYSTEM DISCONNECT

SOLAR PV SYSTEM DISCONNECT	
AC OUTPUT CURRENT	31 A
NOMINAL AC VOLTAGE	240 V

SIGN FOR DISTRIBUTION PANELS

THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR)

SIGN FOR NEC 705.12(D)(2)(3)(b) (if used)

WARNING:
INVERTER OUTPUT CONNECTION;
DO NOT RELOCATE THIS OVERCURRENT DEVICE.

SIGN FOR NEC 690.12 (for roof-mounted systems)

PHOTOVOLTAIC SYSTEM EQUIPPED WITH RAPID SHUTDOWN

*NOTE: MICROINVERTER AND AC MODULE SYSTEMS DO NOT NEED DC DISCONNECT SIGN SINCE 690.51 MARKING ON PV MODULE COVERS NEEDED INFORMATION

Contractor Name, Address and Phone:

_____
_____
_____
_____

Notes for One-Line Standard Electrical Diagram for Single-Phase PV Systems

Site Name: _____
Site Address: _____
System AC Size: _____

Drawn By:	SIZE	FSCM NO	DWG NO	REV
			E1.2a	
Checked By:	SCALE NTS	Date:	SHEET	