



# City of Kingsburg

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## SOLAR PV STANDARD PLAN – SIMPLIFIED MICROINVERTER AND ACM SYSTEMS FOR ONE- AND TWO-FAMILY DWELLINGS

SCOPE: Use this plan ONLY for electrical review of systems using utility-interactive Microinverters or AC Modules (ACM) not exceeding a combined system AC inverter output rating of 10 kW, with a maximum of 3 branch circuits, one PV module per inverter, and installed on the roof of a one- or two-family dwelling or accessory structure. The photovoltaic system must interconnect to a single-phase AC service panel of 120/240 Vac with service panel bus bar rating of 225 A or less. Plan also applies to supply side connections (between the meter and the service disconnects), where permitted by the local utility. This plan is not intended for bipolar systems, hybrid systems or systems that utilize storage batteries, charge controllers or trackers. Systems must be in compliance with current California Building Standards Codes and local amendments of the City of Kingsburg. Other articles of the California Electrical Code (CEC) shall apply as specified in section 690.3. For systems beyond this scope or the criteria in this plan, consult the City of Kingsburg Building Division for details regarding comprehensive process.

MANUFACTURER'S SPECIFICATION SHEETS MUST BE PROVIDED for proposed inverters, modules, combiner/junction boxes and racking systems. Installation instructions for bonding and grounding equipment shall be provided and the City of Kingsburg may require additional details. Listed and labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling (CEC 110.3). Equipment intended for use with PV system shall be identified and listed for the application CEC 690.4(D).

### 1) General Requirements and System Information

Microinverter

AC Module (ACM)

Number of PV modules installed: \_\_\_\_\_

Number of ACMs installed: \_\_\_\_\_

Number of Microinverters installed: \_\_\_\_\_

*Note: Listed Alternating-Current Module (ACM) is defined in CEC 690.2 and installed per CEC 690.6*

1.1) Number of Branch Circuits, 1, 2 or 3: \_\_\_\_\_

1.2) Actual Number of Microinverters or ACMs per branch circuit: 1 \_\_\_\_\_ 2 \_\_\_\_\_ 3 \_\_\_\_\_

1.3) Total AC system power rating = (Total Number of Microinverters or ACMs)\*(AC inverter power output) = \_\_\_\_\_ Watts

1.4) Lowest expected ambient temperature for this plan in Table 1: For -1° to -5°C use 1.12, or for -6° to -10°C use 1.14 correction factors.

### 2) Microinverter or ACM Information and Ratings

Microinverters with ungrounded DC inputs shall be installed in accordance with CEC 690.35.

Microinverter or ACM Manufacturer: \_\_\_\_\_

Model: \_\_\_\_\_

2.1) Rated (continuous) AC output power: \_\_\_\_\_ Watts

2.2 Nominal AC voltage rating: \_\_\_\_\_ Volts

2.3 Rated (continuous) AC output current: \_\_\_\_\_ Amps

**If installing ACMs, skip [Steps 2.4 & 2.5]**

2.4 Maximum DC input voltage rating: \_\_\_\_\_ Volts (limited to 79 V, otherwise this plan is not applicable)

2.5 Maximum input short circuit current: \_\_\_\_\_ Amps

2.6 Maximum AC output overcurrent protection device (OCPD): \_\_\_\_\_ Amps

2.7 Maximum number of microinverters or ACMs per branch circuit: \_\_\_\_\_

### 3. PV Module Information

**(If installing ACMs, skip to [Step 4])**

PV Module Manufacturer: \_\_\_\_\_

Model: \_\_\_\_\_

Module DC output power under standard test conditions (STC) = \_\_\_\_\_ Watts

3.1 Module  $V_{OC}$  at STC (from module nameplate): \_\_\_\_\_ Volts

3.2 Module  $I_{SC}$  at STC (from module nameplate): \_\_\_\_\_ Amps [cannot exceed Step 2.5]

3.3 Adjusted PV Module DC voltage at minimum temperature = [Table 1] \_\_\_\_\_ [cannot exceed Step 2.4]

Table 1. Module $V_{OC}$ at STC Based on Inverter Maximum DC Input Voltage Derived from CEC 690.7																
Microinverter Max. DC Input [Step 2.4] (Volts)	34	37	40	43	46	49	52	55	58	61	64	67	70	73	76	79
Max. Module $V_{OC}$ @ STC, 1.12 (-1° to -5° C) Correction Factor (Volts)	30.4	33.0	35.7	38.4	41.1	43.8	46.4	49.1	51.8	54.5	57.1	59.8	62.5	65.2	67.9	70.5
Max. Module $V_{OC}$ @ STC, 1.14 (-6° to -10° C) Correction Factor (Volts)	29.8	32.5	35.1	37.7	40.4	43.0	45.6	48.2	50.9	53.5	56.1	58.8	61.4	64.0	66.7	69.3

### 4. Branch Circuit Output Information

Fill in [Table 3] to describe the branch circuit inverter output conductor and OCPD size. Use [Table 2] for determining the OCPD and Minimum Conductor size.

Table 2. Branch Circuit OCPD and Minimum Conductor Size*				
Circuit Current (Amps)	Circuit Power (Watts)	OCPD (Amps)	Minimum Conductor Size (AWG)	Minimum Metal Conduit Size for 6 Current Carrying Conductors
12	2880	15	12	¾"
16	3840	20	10	¾"
20	4800	25	8	1"
24	5760	30	8	1"

\*CEC 690.8 and 210.19 (A)(1) factored in Table 2, conductors are copper, insulation must be 90° C wet-rated. Table 2 values are based on maximum ambient temperature of 69° C, which includes 22° C adder, exposed to direct sunlight, mounted >0.5 inches above rooftop, ≤ 6 current-carrying conductors (3 circuits) in a circular raceway. Otherwise, this plan is not applicable.

Table 3. PV Array Configuration Summary			
	Branch 1	Branch 2	Branch 3
Number of Microinverters or ACMS [Step 1]			
Selected Conductor Size [Table 2] (AWG)			
Selected Branch and Inverter Output OCPD [Table 2]			

## 5. Solar Load Center (if used)

- 5.1 Circuit Power see [Step 1.3] = \_\_\_\_\_ Watts
- 5.2 Circuit Current = (Circuit Power) / (AC voltage) = \_\_\_\_\_ Amps
- 5.3 Solar Load Center Bus Bar Rating (use Table 4) = Min. \_\_\_\_\_ Amps
- 5.4 Solar Load Center Feeder Breaker Rating (use Table 4) = \_\_\_\_\_ Amps

NOTE: If OCPDs of circuits other than for the inverter outputs are present, solar load center bus bar rating must be a minimum of 100 Amps, and the feeder breaker is limited to a maximum of 60 Amps.

Table 4. Solar Load Center and Total Inverter Output OCPD and Conductor Size**					
Circuit Current (Amps)	Circuit Power (Watts)	OCPD (Amps)	Min. Solar Load Center Bus Bar Rating (Amps)***	Minimum Conductor Size	Minimum Metal Conduit Size
24	5760	30	30	10	½"
28	6720	35	35	8	¾"
32	7680	40	40	8	¾"
36	8640	45	45	8	¾"
40	9600	50	50	8	¾"
41.6	≤ 10000	60	60	6	¾"

\*\*CEC 690.8 and 210.19(A)(1) factored in Table 4, conductors are copper, insulation must be 90° C wet-rated. Table 4 values are based on maximum ambient temperature of 47° C (no rooftop temperature adder in this calculation), ≤ 3 current carrying conductors in a circular raceway. Otherwise, this plan is not applicable.

\*\*\*Exception: listed combiners are permitted to be used when they're installed in accordance with their listing and the manufacturer's instructions.

## 6. Point of Connection to Utility

- 6.1 Inverter(s) must be connected to either load or supply side of service disconnecting means. Either Step 6.2 or 6.3 below should be filled out, and either Single Line Diagram #1 or Single Line Diagram #2 should be filled out.
- 6.2 Load side connections only (Per 705.12(D)(2)(3)):  
 Is the PV OCPD positioned at the opposite end from input feeder location or main OCPD location?  
 Yes  No (If No, then use 100% row in Table 5)  
 (Combined inverter output OCPD size + Main OCPD size) ≤ [bus bar size × (100% or 120%)]

Table 5. Maximum Combined Inverter Output Circuit OCPD									
Bus Bar Size (Amps)	100	125	125	200	200	200	225	225	225
Main OCPD (Amps)	100	100	125	150	175	200	175	200	225
Maximum Combined Inverter OCPD with <b>120%</b> of bus bar rating (Amps)	20	50	25	60 <sup>†</sup>	60 <sup>†</sup>	40	60 <sup>†</sup>	60 <sup>†</sup>	45
Maximum Combined Inverter OCPD with <b>100%</b> of bus bar rating (Amps)	0	25	0	50	25	0	50	25	0

<sup>†</sup>This plan limits max system size to 10kW or less, so the OCPD size is limited to 60A. Reduction of Main Breaker is not permitted with this plan. Interconnection to center-fed panelboards may be permitted per Informational Bulletin.

6.3 Supply side connections only (Per 705.12(A)):

Only use this section for connections on the supply side of the service disconnecting means. Select one:

- Utility- and AHJ-approved meter socket adapter.

Adapter name/model: \_\_\_\_\_

- Service equipment listed for the purpose of PV interconnection.

Description / model number(s): \_\_\_\_\_

**7. Grounding and Bonding**

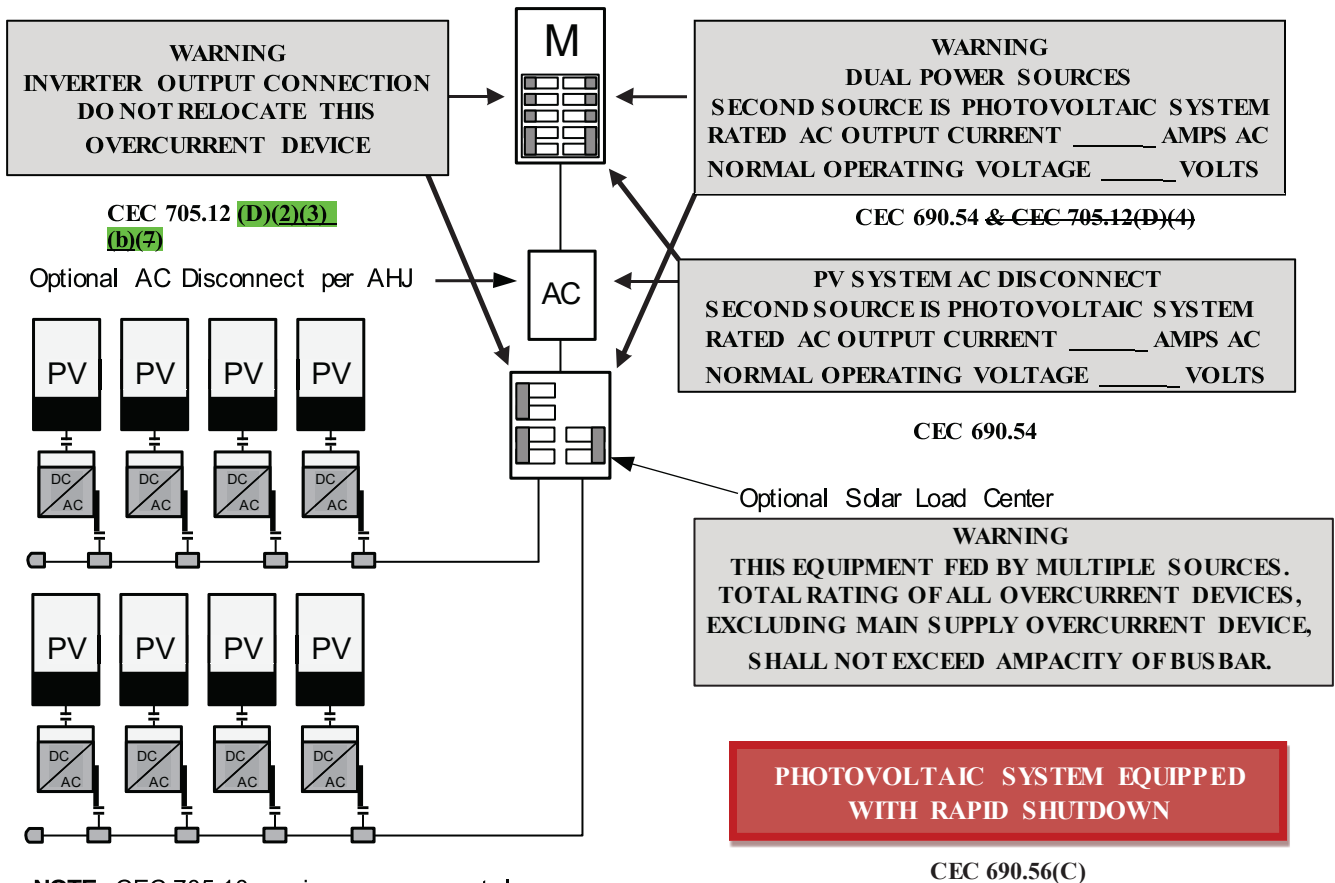
Check one of the boxes for whether system is grounded or ungrounded:  Grounded  Ungrounded

For Microinverters with a grounded DC input, systems must follow the requirements of GEC (CEC 690.47) and EGC (CEC 690.43).

For ACM systems and Microinverters with ungrounded a DC input follow the EGC requirements of (CEC 690.43).

**8. Markings**

Informational note: ANSI Z535.4-2011 provides guidelines for the design of safety signs and labels for application to products. A phenolic plaque with contrasting colors between the text and background would meet the intent of the code for permanency. No type size is specified, but 20 point (3/8") should be considered the minimum.



**NOTE:** CEC 705.10 requires a permanent plaque or directory denoting all electric power sources on or in the premises.

# Solar PV Standard Plan — Simplified Microinverter & ACM Systems for One- and Two-Family Dwellings

### Equipment Schedule

TAG	DESCRIPTION: (Provide model # if provided)
1	Solar PV Module or ACM:
2	Microinverter (if not ACM):
3	Junction Box:
4	Solar Load Center, Yes / No:
5	Performance Meter Yes / No:
6	* Utility External Disconnect Switch Yes / No:
7	Main Electrical Service Panel

### Single-Line Diagram #1 for Microinverters or ACMs (Load Side Connection)

Check a box for dc system grounding:  Grounded,  Ungrounded  
 For ungrounded dc power systems, EGC is required  
 For grounded dc power systems, GEC & EGC are required  
 Refer to CEC 250.120 for EGC installation & Table 250.122 for sizing  
 \* Consult with your local AHJ and /or Utility

#### Branch Circuit OCPDs (Table 3)

Branch 1 OCPD size \_\_\_\_\_  
 Branch 2 OCPD size \_\_\_\_\_  
 Branch 3 OCPD size \_\_\_\_\_  
 Solar Load Center Busbar (Section 5) \_\_\_\_\_

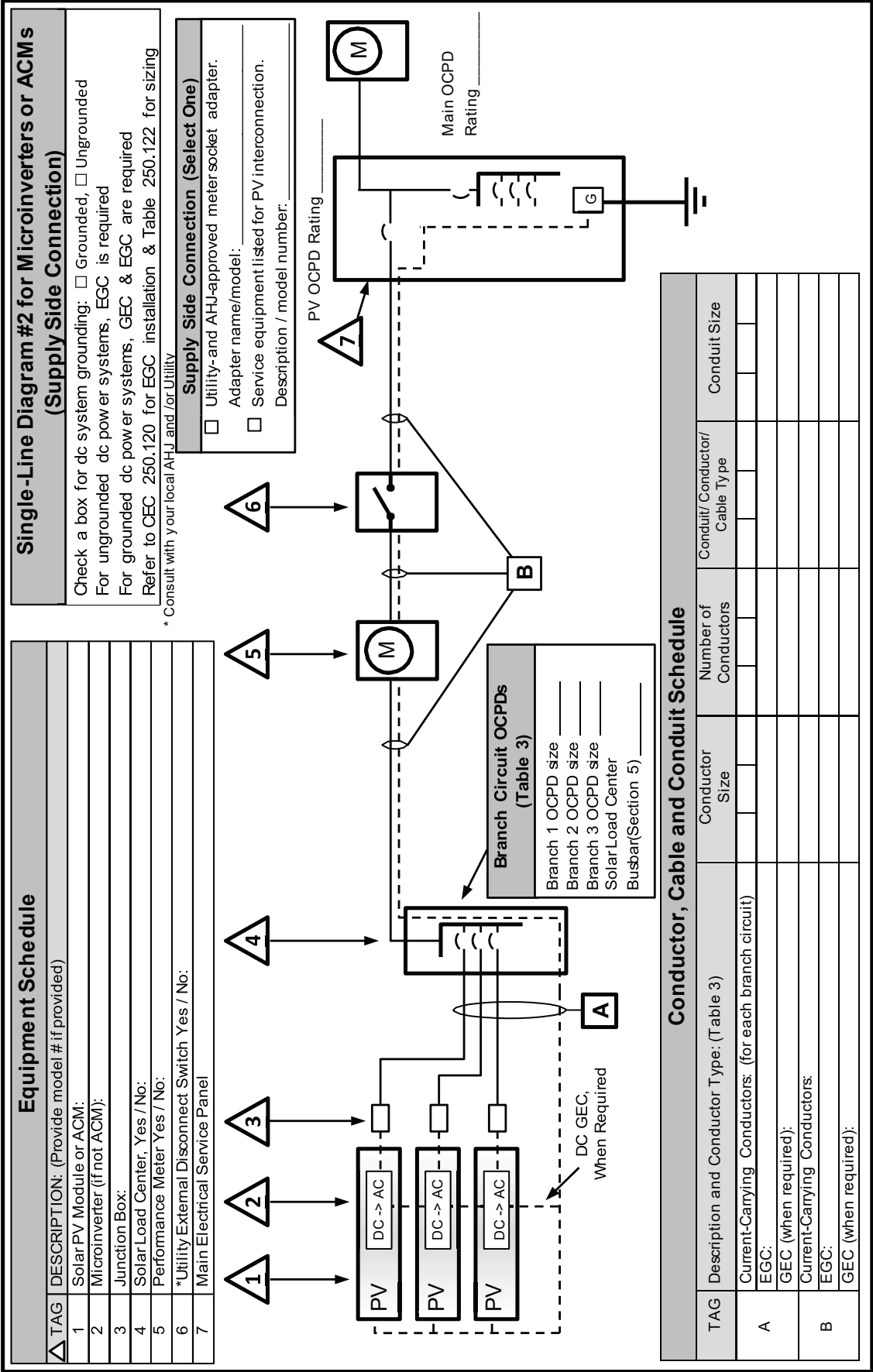
#### Main Service Panel OCPDs

Main OCPD size: (table 5) \_\_\_\_\_  
 Combined Inverter Output OCPD: (Table 4) \_\_\_\_\_  
 Main Service Panel Busbar: (Table 5) \_\_\_\_\_

### Conductor, Cable and Conduit Schedule

TAG	Description and Conductor Type: (Table 3)	Conductor Size	Number of Conductors	Conduit/Conductor/Cable Type	Conduit Size
A	Current-Carrying Conductors: (for each branch circuit)				
	EGC:				
	GEC (when required):				
B	Current-Carrying Conductors:				
	EGC:				
	GEC (when required):				

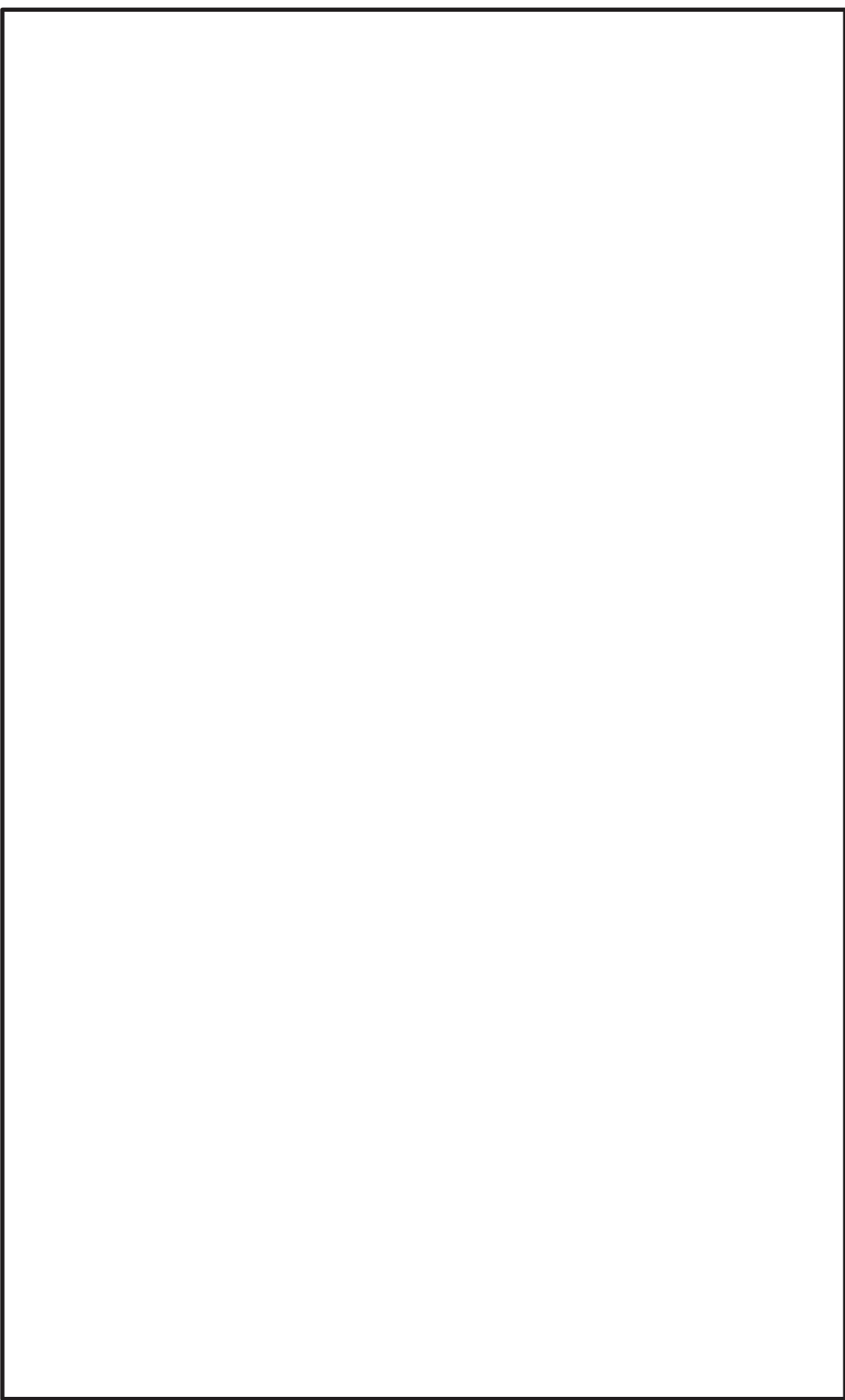
# Solar PV Standard Plan — Simplified Microinverter & ACM Systems for One- and Two-Family Dwellings



# **SOLAR PV STANDARD PLAN — SIMPLIFIED**

Microinverter and ACM Systems for One- and Two-Family Dwellings

**ROOF LAYOUT PLAN**



Items required: roof layout of all panels, modules, clear access pathways and approximate locations of electrical disconnecting means and roof access points.