Solar PV Standard Plan – Simplified MicroInverter and ACM Systems for One- and Two Family Dwellings

This Standard Plan is intended to provide a simplified, “fill in the blanks” method of explaining the electrical configuration of a solar PV, Microinverter and ACM system for one- and two-family dwellings.

Scope

Use this plan ONLY for systems using utility-interactive Microinverters or AC Modules (ACM) not exceeding a combined system AC inverter output rating of 10kW, with a maximum of 3 branch circuits, one PV module per inverter, and with PV module ISC maximum of 10-A DC, installed on a 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 Amps or less. 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 CA Building Standards Codes and local amendments of the City of Carmel-by-the-Sea. Other articles of the CA Electrical Code (CEC) shall apply as specified in Article 690.3.

Manufacturer’s Specification Sheets

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. 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 systems shall be identified and listed for the application (CEC 690.4(D).Specifications on panels and racking systems shall demonstrate compliance with Carmel Municipal Code requirements for Class A roofing systems (CMC 15.08.120).

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Date:_____ Plan Check #: _____

Job Location: _____ APN#: _____

Contractor Name: _____ Phone#: _____

Signature: _____ Date: _____

Step 1. General Requirements and System Information

□ Microinverter
Number of PV modules installed: _____
Number of microinverters installed: _____

□ AC Module (ACM)
Number of ACMs installed: _____
Note: Listed Alternating-Current Module (ACM) is defined in CEC 690.2 and installed per CEC 690.6

□ Number of branch circuits, 1,2 or 3: _____
□ Actual number of microinverters or ACMs per branch circuit: 1)_____, 2) _____, 3) _____
□ Total AC system power rating = (Total number of microinverters or ACMs) X AC Inverter power output) = _____Watts
□ 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.
□ Average ambient high temperature for this plan = 47° C

Note: For lower expected ambient temperature or higher average ambient high temperatures, use Comprehensive Plan

Step 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 Step 2.4

□ (2.4) Maximum DC input voltage rating: _____ Volts (limited to 79 V, otherwise use Comprehensive Plan.
□ (2.5) Maximum AC output overcurrent protection device (OCPD) _____ Amps.
□ (2.6) Maximum number of microinverters or ACMs per branch circuit: _____

Step 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
□ (3.3) Adjusted PV module DC voltage at min. temperature (from Table 1) = _____ (≤ 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	34	37	40	43	46	49	52	55	58	61	64	67	70	73	76	79
Max. Module VOC @ STC, 1.12 (-1° to -5° C)	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 VOC @ STC, 1.14 (-6° to -10° C)	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

Step 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 the rooftop, ≤ 6 current carrying conductors (3 circuits) in a circular raceway. Otherwise use Comprehensive Plan.

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

Step 5. Solar Load Center (if used)

□ 5.1 Solar load center is to have a bus bar rating not less than 100 Amps. Otherwise use Comprehensive Plan

□ 5.2 Circuit Power (see Step 1) = _____ Watts

□ 5.3 Circuit Current (Circuit Power/AC Voltage) = _____ Amps

Table 4. Solar Load Center and Total Inverter Output OCPD and Conductor Size**				
Circuit Current	Circuit Power (Watts)	OCPD (Amps)	Minimum Conductor Size	Minimum Metal Conduit
24	5	3	1	½
28	6	3	8	¾
32	7	4	8	¾
36	8	4	8	¾
40	9	5	8	¾
41.6	≤	6	6	¾

Step 6. Point of Connection to Utility

□ 6.1 Load side connection only! Otherwise use the Comprehensive Plan.

□ 6.2 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)

□ 6.3 Per CEC 705.12(D)(2): (Combined inverter output OCPD size + Main OCPD size) ≤ (bus bar size X 100% or 120%)

Table 5. Maximum Combined Inverter Output CIrcuit OCPD									
Bus Bar Size	100	125	125	200	200	200	225	225	225
Main OCPD	100	100	125	150	175	200	175	200	225
Maximum Combined Inverter OCPD with 120% of bus	20	50	25	60†	60†	40	60†	60†	45
Maximum Combined Inverter OCPD with 100% of bus	0	25	0	50	25	0	50	25	0

Step 7. Grounding and Bonding

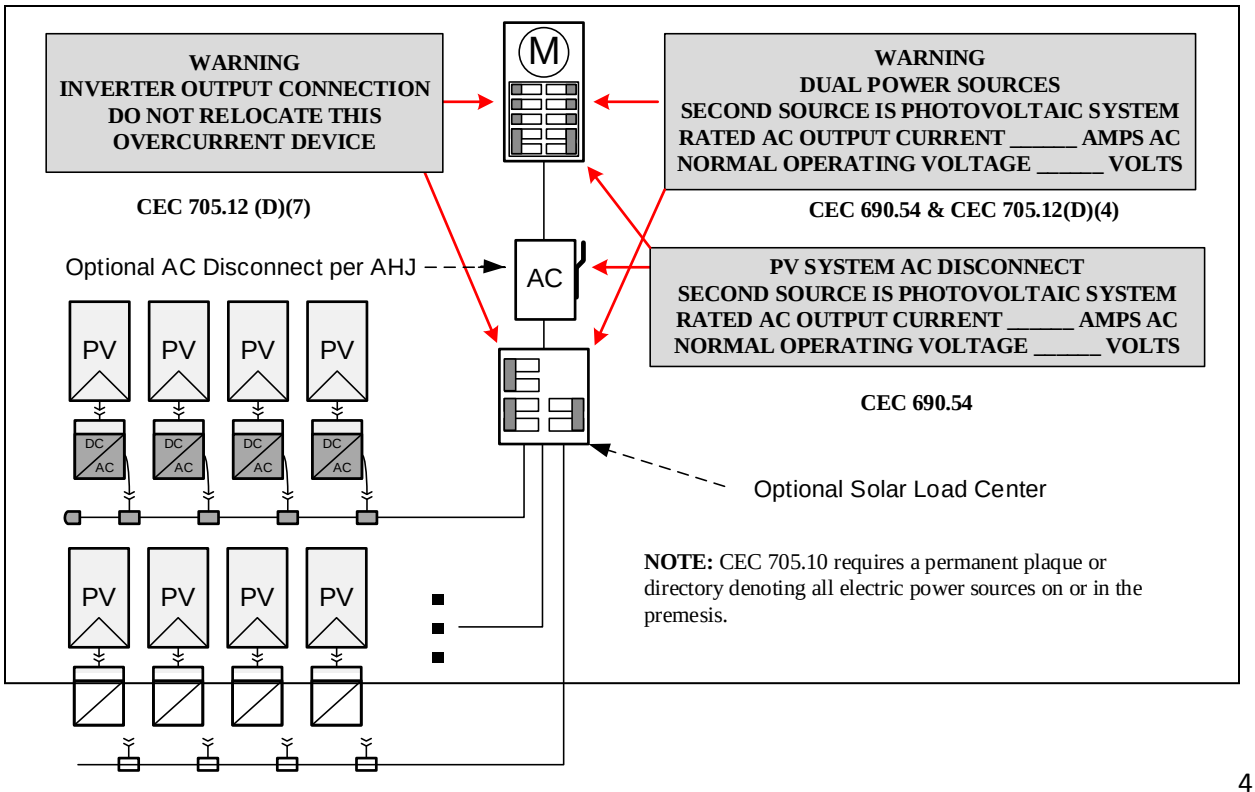
□ Check the boxes for whether the system is grounded or ungrounded □ Grounded □ Ungrounded

For microinverters with a grounded DC input, systems must follow the requirements of CEC 690.47 & 690.43.

For ACM systems and microinverters with ungrounded DC input, follow the requirements of CEC 690.43

Step 8. Markings

Informational note: ANSI Z535.4 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.



Solar PV Standard Plan – Simplified
Central/String Inverter Systems for One- and Two-Family Dwellings

Step 9. Single-Inverter Line Diagram

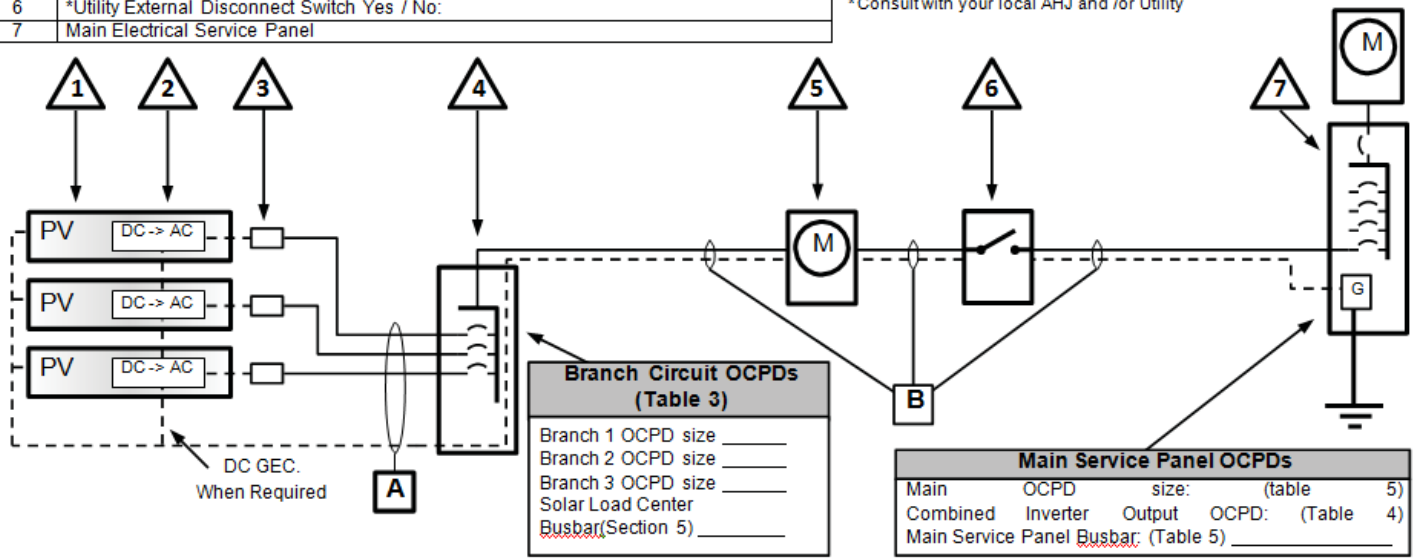
Equipment Schedule

TAG	DESCRIPTION: (Provide model # if provided)
1	Solar PV Module or ACM:
2	Microinverter (if not ACM):
3	Junction Box (es):
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 for Microinverters or ACMs

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):				

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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.