SOLAR PV MICROINVERTER/ACM STANDARD PLAN - SIMPLIFIED

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

***SCOPE:** Use this plan ONLY for the electrical review of 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 a roof of a one or two family dwelling or accessory building. The specific structural and fire requirements are covered under a separate permit. The photovoltaic system must interconnect to the load side of a single-phase AC service panel of nominal 120/240 Vac with busbar rating of 225 A 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 California Building Codes and local amendments of the authority having jurisdiction (AHJ). Other articles of the California Electrical Code (CEC) shall apply as specified in section 690.3.*

***MANUFACTURER'S SPECIFICATION SHEETS MUST BE PROVIDED,** as necessary, for proposed microinverters, modules, ACMs, junction boxes, racking systems, and any additional equipment or systems for rapid shutdow . Installation instructions for bonding and grounding equipment shall be provided, and local AHJs 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 listed for the PV application (CEC 690.4[B]).*

Applicant and Site Information

Job Address: _____ **Permit #:** _____

Contractor/ Engineer Name: _____ **License # and Class:** _____

Signature: _____ **Date:** _____ **Phone Number:** _____

General Requirements and System Information

□ **Microinverter**
Number of PV modules installed: _____
Number of Microinverters installed: _____

□ **AC Module (ACM)**
Number of ACM's 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.**_____
1) Combined Inverter Output Rating =_____**Watts (≤ 10,000 Watts)**

Ambient Temperature Adjustment Factors

Select the box for the expected lowest ambient temperature (T_L) with the corresponding Ambient Temperature Correction Factor (C_F):

2) □ If T_L is greater than or equal to -5°C, C_F = 1.12 **□ If T_L is between -6°C and -10°C, C_F = 1.14**
Average ambient high temperature (T_H) ≤ 47° C **Note: For a lower T_L or a higher T_H use comprehensive standard plan.**

Microinverter or ACM Information and Ratings

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

Manufacturer:	**Model:**
3) Inverter Output Power: **Watts**	**4) Nominal AC voltage rating:** **Volts**
5) Inverter Output Current: **Amps.**	**Note: If installing ACMs, skip to STEP 7)**
6) Maximum DC input voltage rating:	**Volts (limited to 79 V, otherwise use comprehensive standard plan)**
7) Maximum AC output overcurrent protection device (OCPD):	**Amps**
8) Maximum number of Microinverters or ACMs per OCPD:	

Plan Reviewer Initials: _____

SOLAR PV MICROINVERTER/ACM STANDARD PLAN - SIMPLIFIED

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

PV Module Information

(If installing ACMs, skip this step)

Module Manufacturer:	**Module Model:**
9) Module Output Power (STC): **Watts**	**10) Module V_{oc} (STC):** **Volts**
11) Module I_{sc} (STC): **Amps**	
12) Is the Module I_{SC} below 9.6 Amps? □ Yes □ No. Note: **If No, use comprehensive standard plan**	

Table 1 -Module V_{oc} at STC Based on Inverter Maximum dc Input Voltage Derived from CEC 690.7

Microinverter Max. dc Input From STEP 6) (Volts)	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) 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 VOC @ 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

Adjusted PV Module DC voltage at minimum temperature = [Table 1]_____[cannot exceed step 10)]

Branch Circuit Output Information

13) Calculate the current for each branch circuit and write the results into the first line of [Table 3], for example; Branch current = (number of microinverters or ACMs) * (AC output power rating) / (AC Voltage).

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

Table 2 – Branch Circuit OCPD and Minimum Conductor Size*

Circuit Current from STEP 0 (Amps)	12	16	20	24	28	32	36	40	48
Minimum OCPD Size (Amps)	15	20	25	30	35	40	45	50	60
Minimum Conductor Size (AWG, 90° C, Copper)	14	12	10	10	8	8	6	6	6

*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^{O}C, which includes 22 ^{O}C adder, exposed to direct sunlight, mounted > 0.5 inches above rooftop, ≤ 6 current carrying conductors (3 circuits) in a circular raceway.

Table 3 - PV Array Configuration Summary

	Branch 1	Branch 2	Branch 3
Branch Current from STEP 13) (Amps),			
Selected Conductor Size [Table 2] (AWG)			
Selected Branch and Inverter Output OCPD [Table 2] (Amps)			

Subpanel (if used) and System OCPD

Subpanel (if used) is to have a busbar rating not less than 100 Amps, otherwise use comprehensive standard plan.
System Power see Step 1) =_____Watts
14) Circuit Current = (System Power) / (AC voltage) =_____Amps

Table 4 Minimum System OCPD and Circuit Conductor Size**

Circuit Current from STEP 14) (Amps)	12	16	20	24	28	32	36	40	48
Minimum OCPD Size (Amps)	15	20	25	30	35	40	45	50	60
Minimum Conductor Size (AWG, 90° C, Copper)	14	12	10	10	8	8	6	6	6

**CEC 690.8 and 210.19 (A)(1) Factored in Table , Conductors are copper, insulation must be 90°C wet-rated. Table values are based on maximum ambient temperature of 47^{O}C (no rooftop temperature adder in this calculation), ≤ 3 current carrying conductors in a circular raceway. Otherwise use Comprehensive Standard Plan.

Plan Reviewer Initials: _____

SOLAR PV MICROINVERTER/ACM STANDARD PLAN - SIMPLIFIED

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

Point of Connection to Utility:

Note: Only load side connections are permitted with this plan. For other connections use comprehensive standard plan.

15) Is the PV OCPD positioned at the opposite end from input feeder location or main OCPD location?

□ Yes, use [Table 5] third row, circle the Max Combined PV System OCPD(s) at 120% based on the Bus Bar and Main OCPD values.

□ No, use [Table 5] fourth row, circle the Max Combined PV System OCPD(s) at 100%, based on the Bus Bar and Main OCPD values.

Per 705.12(D)(2)(3): The value circled from [Table 5] should be equal to or greater than the value selected from [Table 4]

Table 5 - Maximum Combined Inverter Output Circuit OCPD

Busbar 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 120% of busbar rating (Amps)	20	50	25	60†	60†	40	60†	60†	45
Maximum Combined Inverter OCPD with 100% of busbar rating (Amps)	0	25	0	50	25	0	50	25	0

† This value has been lowered to 60 A from the calculated value to reflect the maximum system size of 10 kW AC.

Reduction of Main Breaker and/or interconnection to center-fed panelboards are not permitted with this plan.

Rapid Shutdown

16) The rapid shutdown initiation device shall be labeled according to CEC 690.56(C), and its location shall be shown on the site plan drawing. The rapid shutdown initiation device may be the inverter AC disconnect, inverter branch circuit disconnecting means (circuit breaker), service main disconnect, or a separate device as approved by the AHJ. The disconnecting means shall be identified for the purpose, suitable for their environment, and listed as a disconnecting means. A single rapid shutdown initiation device shall operate all disconnecting means necessary to control conductors in compliance with CEC 690.12.

Rapid shutdown shall be provided as required by CEC 690.12 with one of the following methods (Select one):

□ ACM or Microinverter mounted within, 3 m (10 ft) for exterior wiring, or 1.5 m (5 ft) for interior wiring, of the PV system. Reduction of the voltage for the inverter output circuit within the time required by CEC 690.12 shall be verified in the field, or the inverter output is listed to UL 1741 with rapid shutdown capability.

□ ACM, or Microinverter mounted within, 3 m (10 ft) for exterior wiring, or 1.5 m (5 ft) for interior wiring, of the PV modules. A remotely-controlled AC disconnecting means is required immediately adjacent to or as close as practicable to the inverter's output and located within 10 feet of the array.

Grounding and Bonding

17) Modules and racking system – Select one

□ Listed racking system listed to UL 2703 using the modules identified in the listing

□ See attached method subject to City of Los Angeles approval

Plan Reviewer Initials: _____

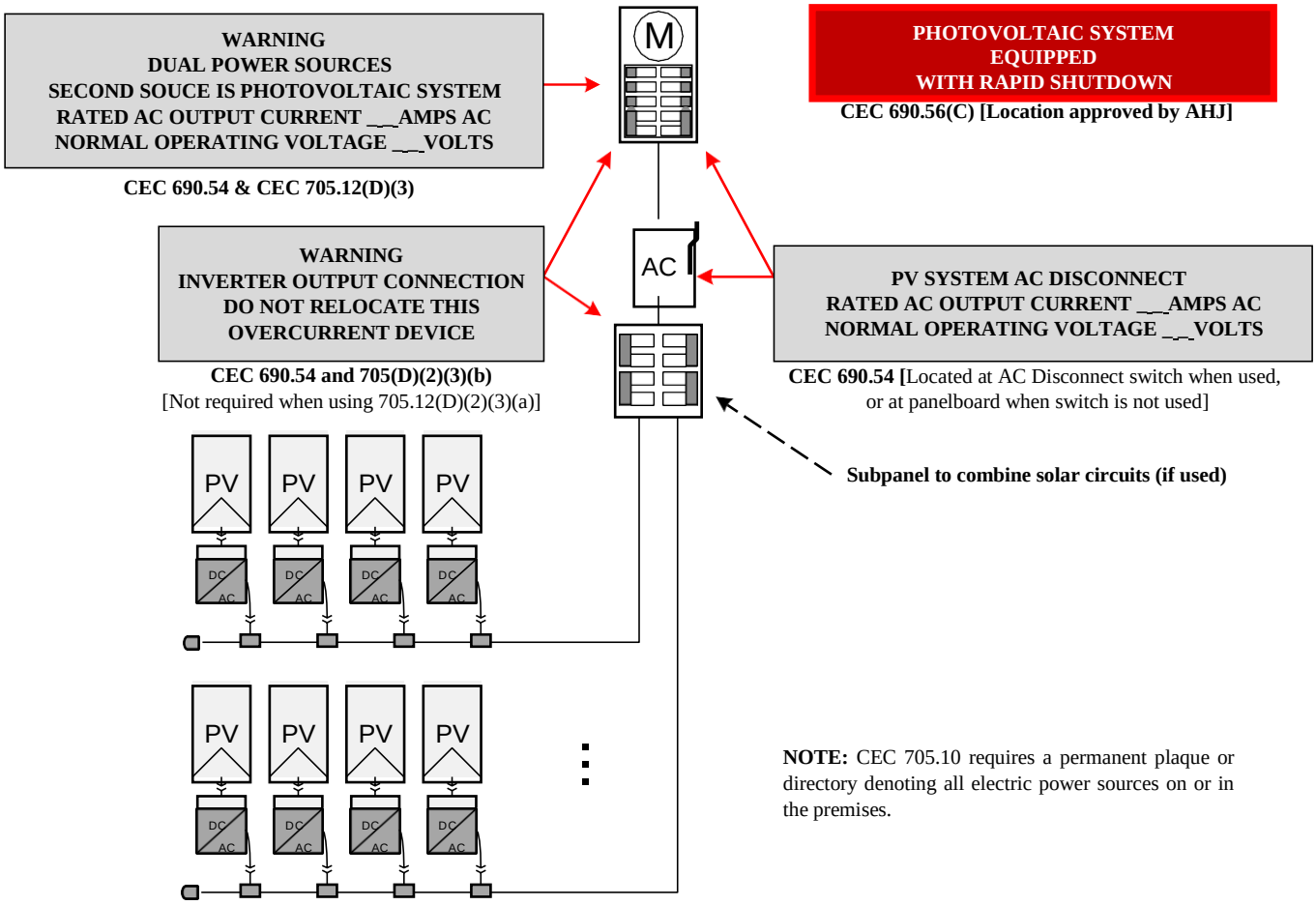
SOLAR PV MICROINVERTER/ACM STANDARD PLAN - SIMPLIFIED

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

Markings

Labels shall be applied in the field as shown below

CA Electrical Code (CEC) Articles 690 and 705 and CA Residential code (CRC) Section R331 require the following labels or markings to be installed at these components of the photovoltaic system



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

Plan Reviewer Initials: _____

SOLAR PV MICROINVERTER/ACM STANDARD PLAN - SIMPLIFIED

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

Single-Inverter Line Diagram

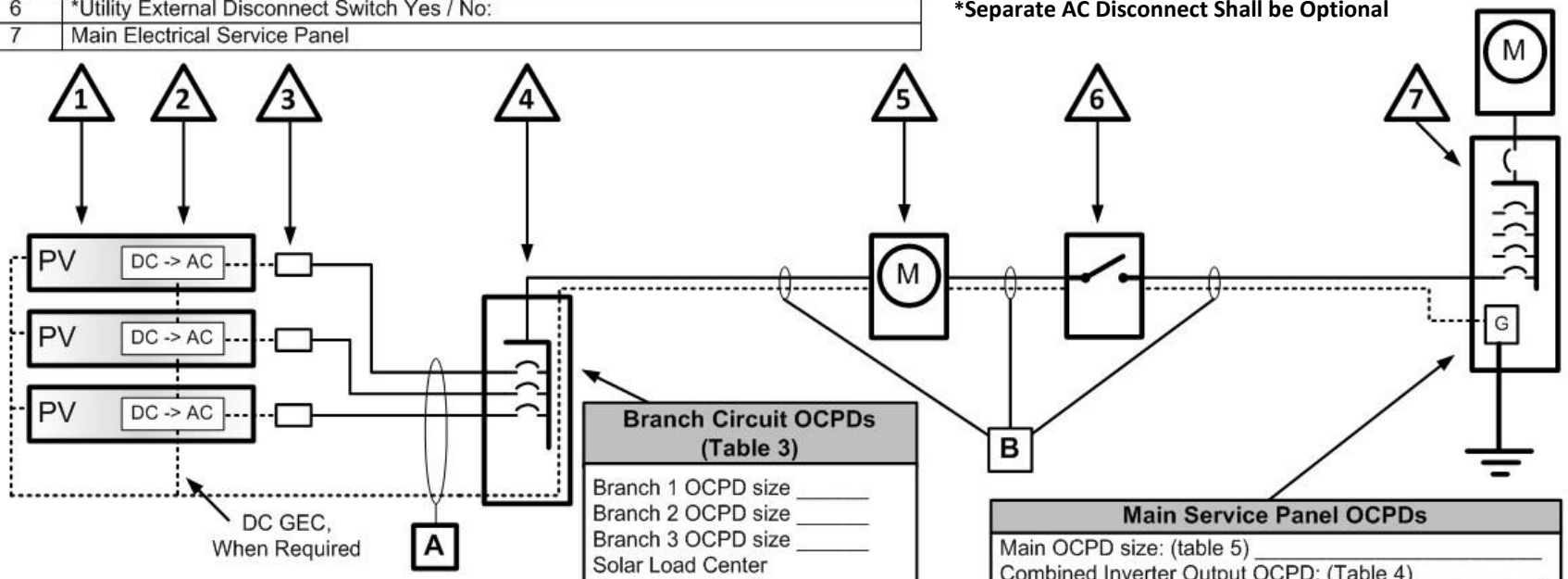
Equipment Schedule

△ TAG	DESCRIPTION: (Provide model # if provided)
1	Solar PV Module or ACM:
2	Microinverter (if not ACM):
3	Junction Box (es):
4	Subpanel 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

***Separate AC Disconnect Shall be Optional**



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):				

Plan Reviewer Initials: _____