

**BUILDING & SAFETY**

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**Solar PV Standard Plan – Simplified
Central/String Inverter Systems for
One- and Two-Family Dwellings
(10 KW or Less)****FORM PV 3**

Use this plan ONLY for utility-interactive central/string inverter systems. This plan is not intended for bipolar systems, hybrid systems or systems that utilize storage batteries, charge controllers, trackers, more than two inverters or more than one DC combiner (non-inverter-integrated) per inverter. Systems must be in compliance with current 2013 California Building Standards Code and City of Fontana amendments. Other Articles of the 2013 California Electrical Code (CEC) shall apply as specified in 690.3.

MANUFACTURER'S SPECIFICATION SHEETS MUST BE PROVIDED for proposed inverter, modules, combiner/junction boxes and racking systems. Installation instructions for bonding and grounding equipment shall be provided, Building and Safety 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]).

Job Address: _____

Contractor/Owner Builder: _____

Signature: _____ Date: _____ Phone: _____

Inverter 1 AC Output Power Rating: _____ Watts

Inverter 2 AC Output Power Rating (Attach Form **PV 3S**): _____ Watts

Combined Inverter Output Power Rating: _____ ≤ 10,000 Watts Total Modules Proposed: _____

1) Main Panel Upgrade Required?: ☐ No ☐ Yes (if yes) Buss _____ Main _____

Module Manufacturer: _____ Model: _____

2) Module V_{oc} (from module nameplate): _____ Volts3) Module I_{sc} (from module nameplate): _____ Amps

4) Module DC output power under standard test conditions (STC) = _____ Watts (STC)

5) DC Module Layout

Identify each source circuit (string) for inverter 1 shown on the roof plan with a Tag (e.g., A, B, C...)	Number of modules per source circuit for inverter 1	Identify, by tag, which source circuits on the roof are to be paralleled (if none, put N/A)
		Combiner 1:
		Combiner 2:
Total number of source circuits for inverter 1: _____		

6) Are DC/DC Converters used (i.e. optimizers)? ☐ Yes ☐ No If No, skip to STEP 7. If Yes, enter info below.

DC/DC Converter Model #: _____	DC/DC Converter Max DC Input Voltage: _____ Volts
Max DC Output Current: _____ Amps	Max DC Output Current: _____ Volts
Max # of DC/DC Converters in an Input Circuit: _____	DC/DC Converter Max DC Input Power: _____ Watts

7) Max. System DC Voltage – Use A for systems without DC/DC converters, and B with DC/DC converters.

A. Module V_{OC} (STEP 2) = _____ x # in series (STEP 5) _____ x 1.12 = _____ V

Table 1. Maximum Number of PV Modules in Series Based on Module Rated VOC for 600 Vdc Rated Equipment (CEC 690.7)

Max. Rated Module Voc (*1.12) (Volts)	29.76	31.51	33.48	35.71	38.27	41.21	44.64	48.70	53.57	59.52	66.96	76.53	89.29
Max # of Modules for 600 Vdc	18	17	16	15	14	13	12	11	10	9	8	7	6

Use for DC/DC converters. The value calculated below must be less than DC/DC converter max DC input voltage (STEP #6).

B. Module V_{OC} (STEP 2) _____ x # of modules per converter (STEP 6) _____ x 1.12 = _____ V

Table 2. Largest Module VOC for Single Module DC/DC Converter Configurations (With 80V AFCI Cap) (CEC 690.7 and 690.11)

Max. Rated Module Voc (*1.12) (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
DC/DC Converter Max DC Input (STEP #6) (Volts)	34	37	40	43	46	49	52	55	58	61	64	67	70	73	76	79

8) Maximum System DC Voltage from DC/DC Converters to Inverter – Only required if Yes in STEP 6

Maximum System DC Voltage = _____ Volts

9) Maximum Source Circuit Current

Is Module I_{sc} below 9.6 Amps (STEP 3)? ☐ Yes ☐ No (if No, provide comprehensive plan)

10) Sizing Source Circuit Conductors

Source Circuit Conductor Size = Min. #10 AWG copper conductor, 90°C wet (USE-2, PV Wire, XHHW-2, THWN-2, RHW-2).
Maximum 8 conductors in roof-mounted conduit exposed to sunlight located minimum 1/2" from the roof covering (CEC 310)

11) Are PV source circuits combined prior to the inverter? ☐ Yes ☐ No

If No, use Single Line Diagram 1 and proceed to STEP 13.

If Yes, use Single Line Diagram 2 and proceed to STEP 12.

Is source circuit OCPD required? ☐ Yes ☐ No

Source circuit OCPD size (if needed): 15 Amps

12) Sizing PV Output Circuit Conductors – If a combiner box will NOT be used from [STEP 11],

Output Circuit Conductor Size = Min. #6 AWG copper conductor

13) Inverter DC Disconnect

Does the inverter have an integrated DC disconnect? ☐ Yes ☐ No If yes, proceed to STEP 14.

If no, the external DC disconnect to be installed is rated for _____ Amps (DC) and _____ Volts (DC)

14) Inverter information

Manufacturer: _____ Model: _____

Max. Continuous AC Output Current Rating: _____ Amps

Integrated DC Arc-Fault Circuit Protection? ☐ Yes ☐ No (If No is selected, provide comprehensive plan)

Grounded or Ungrounded System: ☐ Grounded ☐ Ungrounded

15) Sizing Inverter Output Circuit Conductors and OCPD

Inverter Output OCPD rating = _____ Amps (Table 3)

Inverter Output Circuit Conductor Size = _____ AWG (Table 3)

Table 3. Minimum Inverter Output OCPD and Circuit Conductor Size

Inverter Continuous Output Current Rating (Amps) (STEP#14)	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, 75°C, Copper)	14	12	10	10	8	8	6	6	6

16) Point of Connection to Main Service Panel:

☐ End Fed Service (Use Combined Value at 120% Buss) ☐ Center Fed Service (Use Combined Value at 100% Buss)

Bus Bar Rating: _____ Main OCPD: _____ Max Combined PV System OCPD @ 120% or 100%: _____

Table 4. Maximum Combined Supply OCPDs Based on Bus Bar Rating (Amps) per CEC 705.12(D)(2)

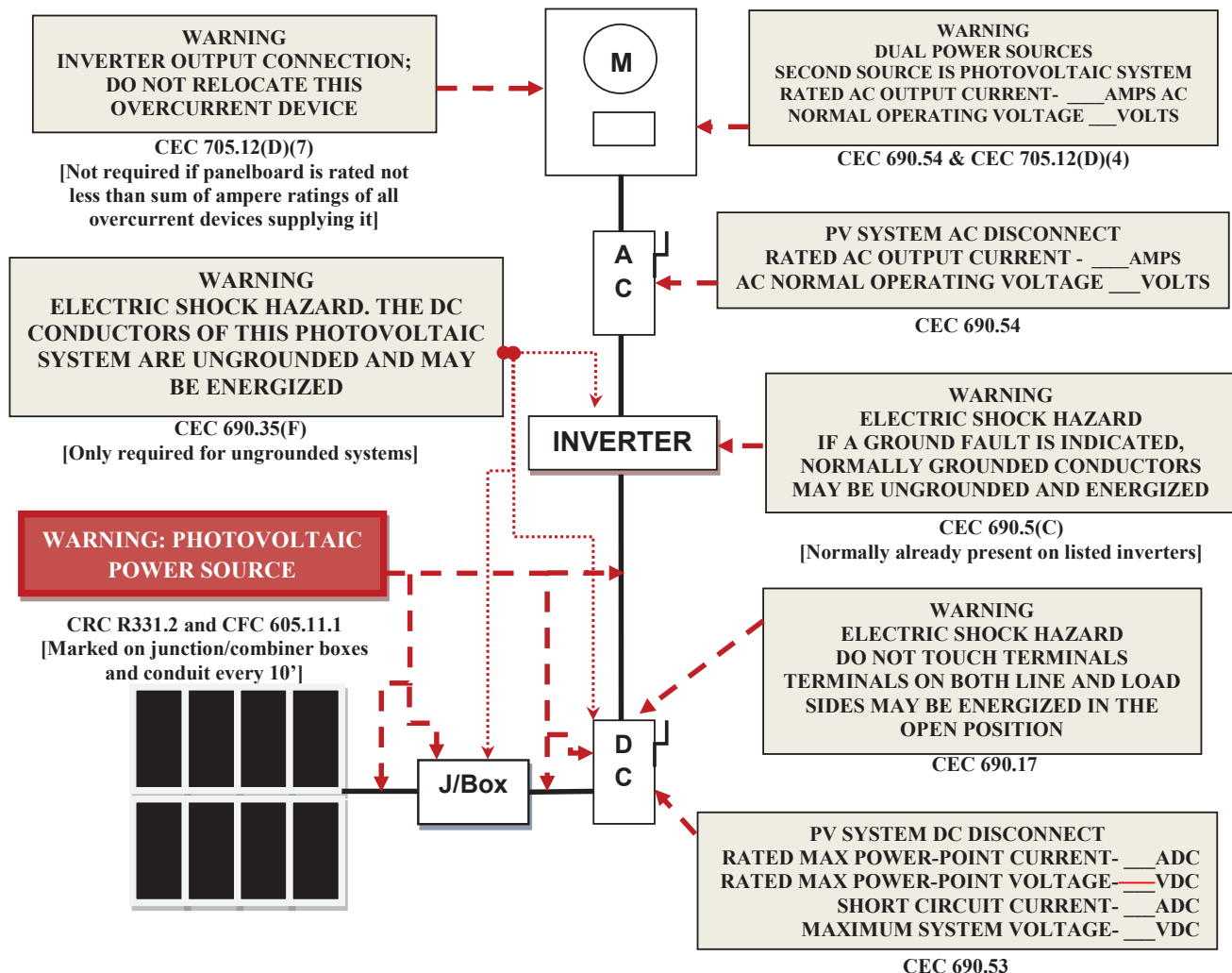
Bus bar Rating	100	125	125	200	200	200	225	225	225
Main OCPD	100	100	125	150	175	200	175	200	225
Max Combined PV System OCPD(s) at 120% of bus bar Rating	20	50	25	60*	60*	40	60*	60*	45
Max Combined PV System OCPD(s) at 100% of bus bar Rating	0	25	0	50	25	0	50	25	0

*This value has been lowered to 60 A from the calculated value to reflect 10kW AC size maximum. Reduction of the main breaker is not permitted with this plan. Otherwise, provide comprehensive plan).

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Markings

CEC Articles 690 and 705 and CRC Section R331 require the following labels or markings be installed at these components of the photovoltaic system:



Code Abbreviations:

California Electrical Code (CEC)
California Residential Code (CRC)
California Fire Code (CFC)

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.

CEC 705.12 requires a permanent plaque or directory denoting all electric power sources on or in the premises.

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Δ TAG	EQUIPMENT SCHEDULE	
1	SOLAR PV MODULE / STRING	
2	DC/DC CONVERTERS INSTALLED?	YES NO (STEP 6)
3	SOURCE CIRCUIT JUNCTION BOX INSTALLED?:	YES NO (STEP 11 & 12)
4	SEPARATE DC DISCONNECT INSTALLED?:	YES NO (STEP 13)
5	INTERNAL INVERTER DC DISCONNECT:	YES NO (STEP 14)
6	CENTRAL INVERTER	
7	LOAD CENTER INSTALLED?:	YES NO
8	PV PRODUCTION METER INSTALLED?:	YES NO
9	SEPARATE AC DISCONNECT INSTALLED?:	YES NO
10	CONNECT TO INVERTER #2	YES NO (PV3S FORM)

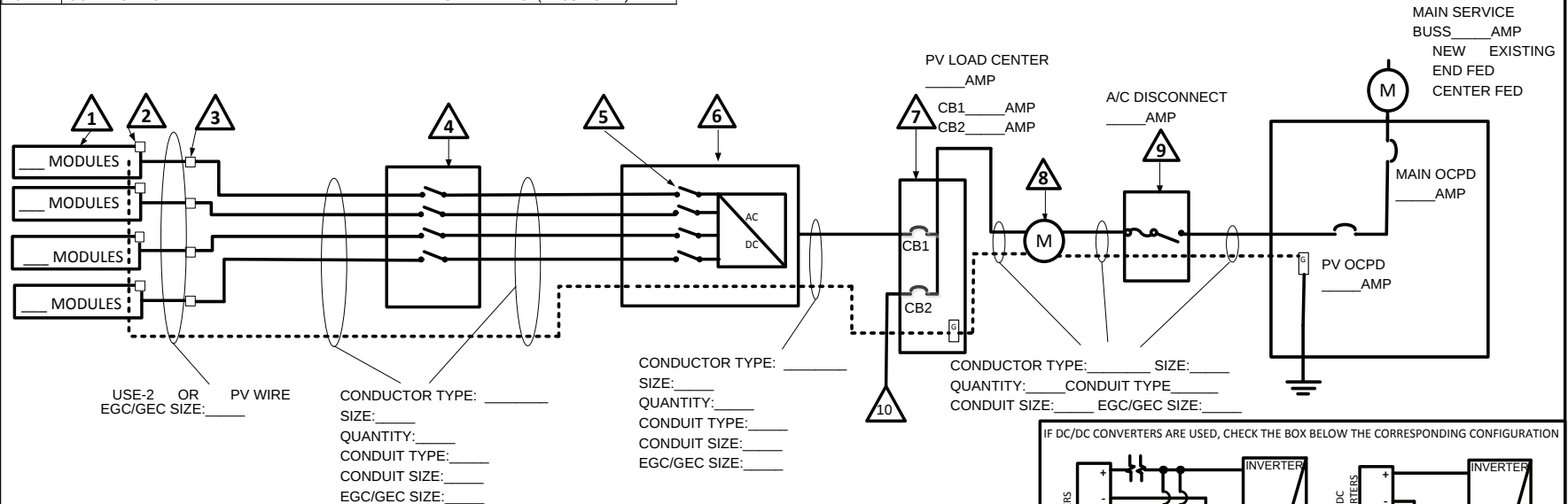
SINGLE-LINE DIAGRAM #1 – NO STRINGS COMBINED PRIOR TO INVERTER

CHECK A BOX FOR WHETHER SYSTEM IS GROUNDED OR UNGROUNDED: ☐ GROUNDED (INCLUDE GEC) ☐ UNGROUNDED

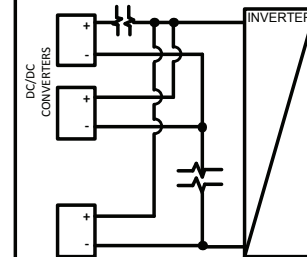
FOR UNGROUNDED SYSTEMS:

- DC OCPD MUST DISCONNECT BOTH CONDUCTORS OF EACH SOURCE CIRCUIT

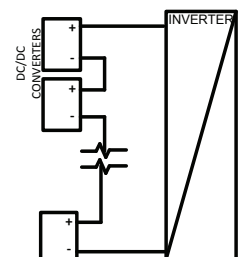
- UNGROUNDED CONDUCTORS MUST BE IDENTIFIED PER 210.5(C). WHITE-FINISHED CONDUCTORS ARE NOT PERMITTED.



IF DC/DC CONVERTERS ARE USED, CHECK THE BOX BELOW THE CORRESPONDING CONFIGURATION



☐ PARALLEL DC/DC CONVERTERS ON ONE SOURCE CIRCUIT (FIXED UNIT VOLTAGE DC/DC CONVERTERS)



☐ DC/DC CONVERTERS ARE ALL RUN IN SERIES (FIXED SOURCE CIRCUIT VOLTAGE DC/DC CONVERTERS)

ENTER "N/A" WHERE SUITABLE FOR WHEN NOT USING CONDUIT OR CABLE AS PERMITTED BY CODE

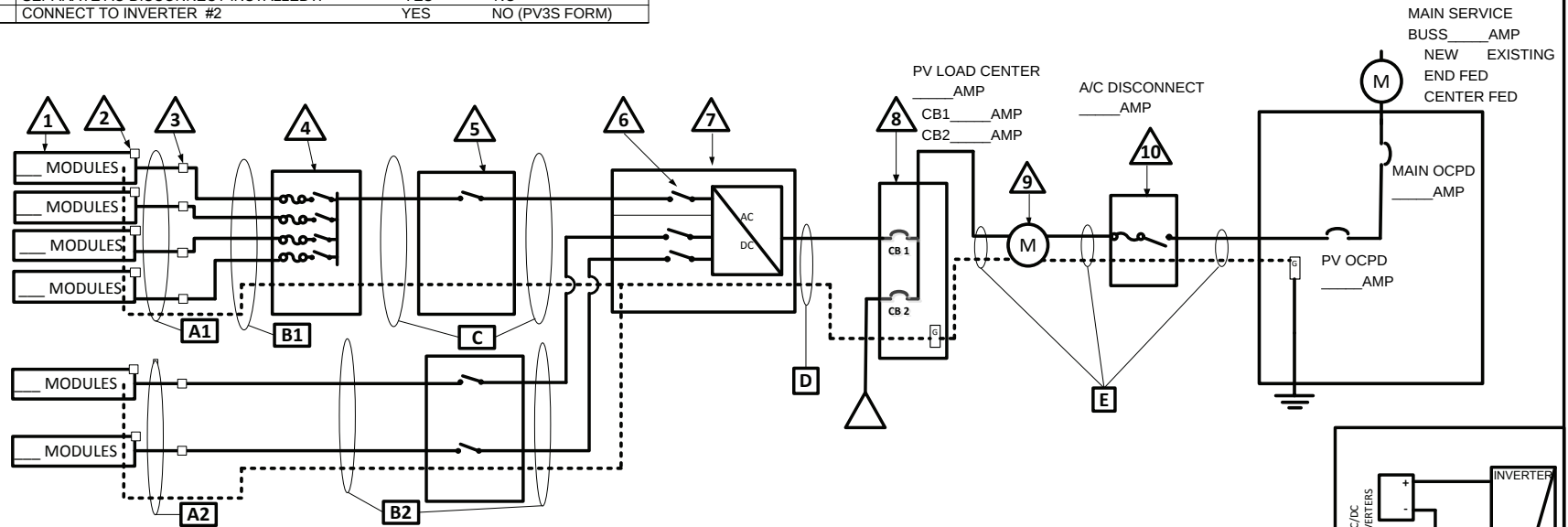
Solar PV Standard Plan — Simplified Central/String Inverter Systems for One- and Two-Family Dwellings

Δ TAG	EQUIPMENT	SCHEDULE	
1	SOLAR PV MODULE / STRING		
2	DC/DC CONVERTERS INSTALLED?	YES	NO (STEP 6)
3	SOURCE CIRCUIT JUNCTION BOX INSTALLED?:	YES	NO (STEP 11& 12)
4	COMBINER BOX	YES	NO (STEPS 11 & 12)
5	SEPARATE DC DISCONNECT INSTALLED?:	YES	NO (STEP 13)
6	INTERNAL INVERTER DC DISCONNECT:	YES	NO (STEP 14)
7	CENTRAL INVERTER		
8	LOAD CENTER INSTALLED?:	YES	NO
9	PV PRODUCTION METER INSTALLED?:	YES	NO
10	SEPARATE AC DISCONNECT INSTALLED?:	YES	NO
11	CONNECT TO INVERTER #2	YES	NO (PV3S FORM)

SINGLE-LINE DIAGRAM #2 – COMBINING STRINGS PRIOR TO INVERTER

CHECK A BOX FOR WHETHER SYSTEM IS GROUNDED OR UNGROUNDED: ☐ GROUNDED (INCLUDE GEC) ☐ UNGROUNDED

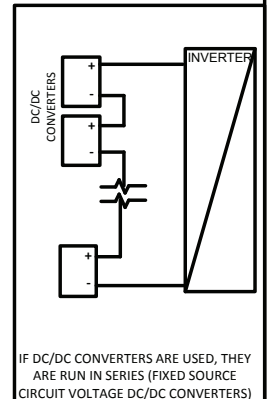
FOR UNGROUNDED SYSTEMS:
- DC OCPD MUST DISCONNECT BOTH CONDUCTORS OF EACH SOURCE CIRCUIT
- UNGROUNDED CONDUCTORS MUST BE IDENTIFIED PER 210.5(C). WHITE-FINISHED CONDUCTORS ARE NOT PERMITTED.



COMBINER/CONDUCTOR CONDUIT SCHEDULE					
☐ TAG	CONDUCTOR TYPE	SIZE	QUANTITY	CONDUIT TYPE	CONDUIT SIZE
A1	USE-2 OR PV-WIRE				
	EGC/GEC				
B1					
	EGC/GEC				
C					
	EGC/GEC				
E					
	EGC/GEC				
D					
	EGC/GEC				

NON-COMBINED STRINGS CONDUCTOR/CONDUIT SCHEDULE (IF APPLICABLE)					
☐ TAG	CONDUCTOR TYPE	SIZE	QUANTITY	CONDUIT TYPE	CONDUIT SIZE
A2	USE-2 OR PV-WIRE				
	EGC/GEC				
B2					
	EGC/GEC				

ENTER "N/A" WHERE SUITABLE FOR WHEN NOT USING CONDUIT OR CABLE AS PERMITTED BY CODE



SOLAR PV STANDARD PLAN

Roof Layout Diagram for One- and Two-Family Dwellings



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