



Central/String Inverter Systems for One and Two Family Dwellings

SCOPE: Use this plan ONLY for utility-interactive central/string inverter systems not exceeding a system ac inverter output rating of 10kW on the roof of a one- or two-family dwelling or accessory structure. The photovoltaic system must interconnect to the load side of a single-phase ac service panel of nominal 120/240Vac with a busbar rating of 225A or less. 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 California Building Standards Codes and local amendments of the authority having jurisdiction (AHJ). Other Articles of the 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, 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 identified and listed for the application (CEC 690.4(D)).

Job Address:		Permit #:
Contractor/ Engineer Name:		License # and Class:
Signature:	Date:	Phone Number:
on pages 7 and 8 and the "Load Center Cal Inverter 1 AC Output P	culations" on page 8 if a newer Rating: cower Rating (if applicable tput Power Rating: cox next to which lowest extrature for the location (extrature for the location (extra to the lo	Watts
DC Information:		
Module Manufacturer:		Model:
2) Module V _{oc} (from module na	ameplate):Volts	3) Module I _{sc} (from module nameplate):Amps
4) Module dc output power und	der standard test conditio	ons (STC) = Watts (STC)
5) <u>DC Module Layout</u> Identify each source circuit (st for inverter 1 shown on the roo with a Tag (e.g. A,B,C,)		Identify, by tag, which source circuits on the roof are
		Combiner 1:
Total number of source circuits	for inverter 1:	Combiner 2:

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6) Are DC/DC Converters	used?	Yes /	No	If	"No,"	skip	to ST	EP#7.	If "Yes	," ente	r info	pelov	v.		
DC/DC Converter Model #	#:		_			(DC/D	C Conv	erter f	Max DO	Input	Volta	age:		_Volts
												Volts			
												Watts			
7) Max. System DC Voltage – Use A1 or A2 for systems without dc/dc converters, and B1 or B2 with dc/dc converters.															
□ A1. Module V _{oc} (STEP #2) = x # in series (STEP #5) x 1.12 (If -1≤T _L ≤-5°C, STEP#1) = V															
□ A2. Module V _{oc} (STEP #2) = x # in series (STEP #5) x 1.14 (If -6≤T _L ≤-10°C, STEP#1) = V															
Table 1. Maximum	Number of	PV Mod	ules in S	eries Ba	sed on	Modu	ıle Rat	ed Voc f	or 600V	dc Rated	Equipm	ent (C	EC 690	.7)	
Max. Rated Module Voc (*1.1	2)														
(Volt	29.76	31.51	33.48	35.71	38.2	27 4	1.21	44.64	48.70	53.57	59.52	66.	96 76	6.53	89.29
Max. Rated Module Voc (*1.1	Max Rated Module Vor (*1.14)											87.72			
(Volt	ts) 23.24	30.30	32.03	35.05	37	,,	0.43	45.00	47.03	32.03	30.40	05.	,,		07.72
Max # of Modules for 600V	dc 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).															
□ B1. Module V _{oc} (STEP #2) x # of modules per converter (STEP #6) x 1.12 (If -1≤T _L ≤-5°C, STEP#1) = V															
□ B2. Module V _{oc} (STEP #2) x # of modules per converter (STEP #6) x 1.14 (If -6≤T _L ≤-10°C, STEP#1) = V															
Table 2. Largest Mod	Table 2. Largest Module V∞ for Single-Module DC/DC Converter Configurations (With 80V AFCI Cap) (CEC 690.7 and 690.11)														
Max. Rated Module Voc						40000									
(*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
Max. Rated Module V∞	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
(*1.14) (Volts)	25.6 32.3	33.1	37.7	40.4	43.0	45.0	40.2	30.3	33.3	30.1	36.6	01.4	04.0	00.7	09.3
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 Circu	9) Maximum Source Circuit Current														
Is Module I _{sc} below 9.6 A	mps (STEF	P#3)? '	Yes /	No (if	"No,	" use	Com	prehen	sive St	andard	Plan)				
10) Sizing Source Circuit C	Conductor	5													
Source Circuit Conductor						_					-	_		-	RHW-2)
For up to 8 conductors in				-		_						_			-
Note: For over 8 conducto								than 3	½"from	the ro	of, use	Com	prehe	ensive	Plan.
11) Are PV source circuits						_									
If No, use Single Line Diag		_		_											
If Yes, use Single Line Diag					m 4 ai	na pr	ocee	1 to 51	EP#12.						
Is source circuit O	_														
Source circuit OCI		_			mps	-11 61	OT I		, ,	OTED !!	1				
12) Sizing PV Output Circu Output Circuit Condu								e used	from [SIEP#	11],				
13) Inverter DC Disconnec	ct														
Does the inverter have	e an integ	rated d	lc disco	onnect	? Yes	/ No									
If yes, proceed to															
If no, the external	dc discon	nect to	be ins	talled	is rate	ed for		An	nps (dc	and _		Volt	s (dc)		
14) Inverter information															
Manufacturer:														An	nps
Integrated DC Arc-Fault C Grounded or Ungrounded	ircuit Pro									nsive S	tandar	d Pla	n)		
	10 .		GRO					ROUN							

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AC Information:

15) Sizing Inverter Output Circuit Conductors and OCPD

Inverter Output OCPD rating = _____ Amps (Table 2)

Inverter Output Circuit Conductor Size = _____ AWG (Table 2)

Table 3. Minimum Invert	er Outp	it OCPD a	and Circu	it Conduc	tor 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 Utility

Only load side connections are permitted with this plan. Otherwise, use Comprehensive Standard Plan. Is the PV OCPD positioned at the opposite end from input feeder location or main OCPD location? Yes / No If Yes, circle the Max Combined PV System OCPD(s) at 120% value as determined from STEP 15 (or STEP S20), Busbar Rating, and Main OCPD as shown in Table 4.

<u>If No</u>, circle the Max Combined PV System OCPD(s) at 100% value as determined from STEP 15 (or STEP S20), Busbar Rating, and Main OCPD as shown in Table 4.

Per 705.12(D)(2): [Inverter output OCPD size [STEP #15 or S20] + Main OCPD Size]≤[Bus size × (100% or 120%)]

Table 4. Maximum Combined Supply O	CPDs Ba	sed on Bu	ısbar Rati	ing (Amps) per CEC	705.12(0)(2)		
Busbar 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 Busbar Rating	20	50	25	60*	60*	40	60*	60*	45
Max Combined PV System OCPD(s) at 100% of Busbar Rating	0	25	0	50	25	0	50	25	0

^{*}This value has been lowered to 60A from the calculated value to reflect 10kW ac size maximum.

Reduction of the main breaker is not permitted with this plan. Otherwise, use Comprehensive Standard Plan.

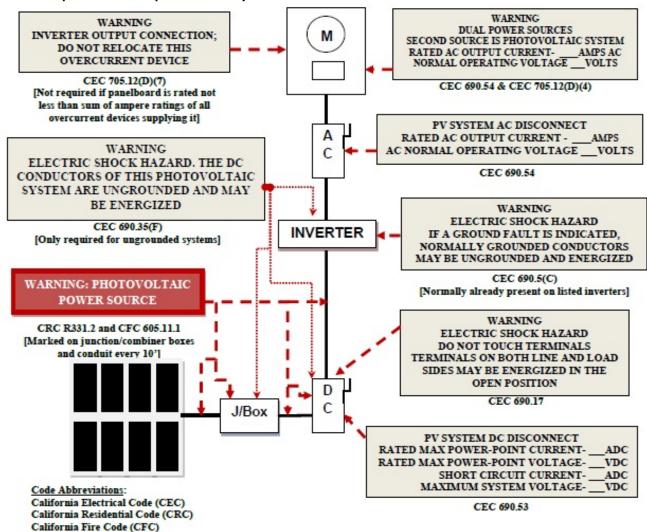
17 & 18 & 19) Labels and Grounding and Bonding

This content is covered by the labels on Page 4 and the Single Line Diagram(s). For background information, refer to the Comprehensive Standard Plan.

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Markings

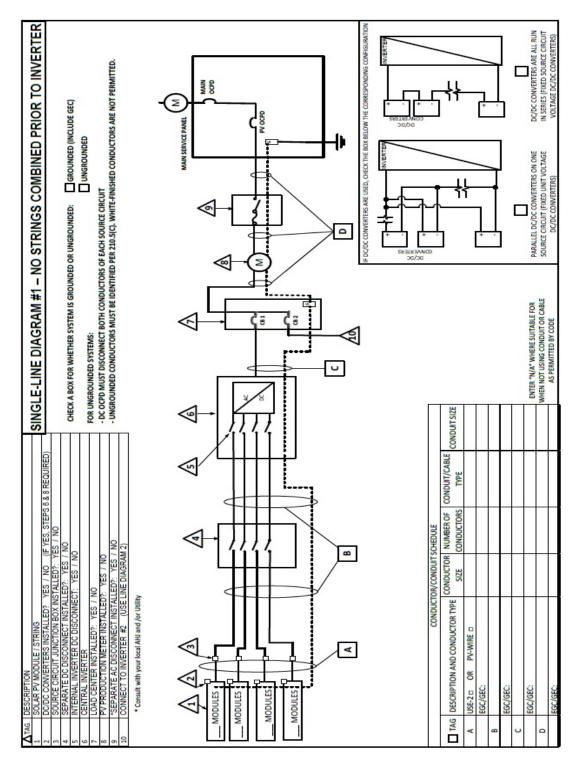
CEC Articles 690 and 705 and CRC Section R331 require the following labels or markings be installed at these components of the photovoltaic system:



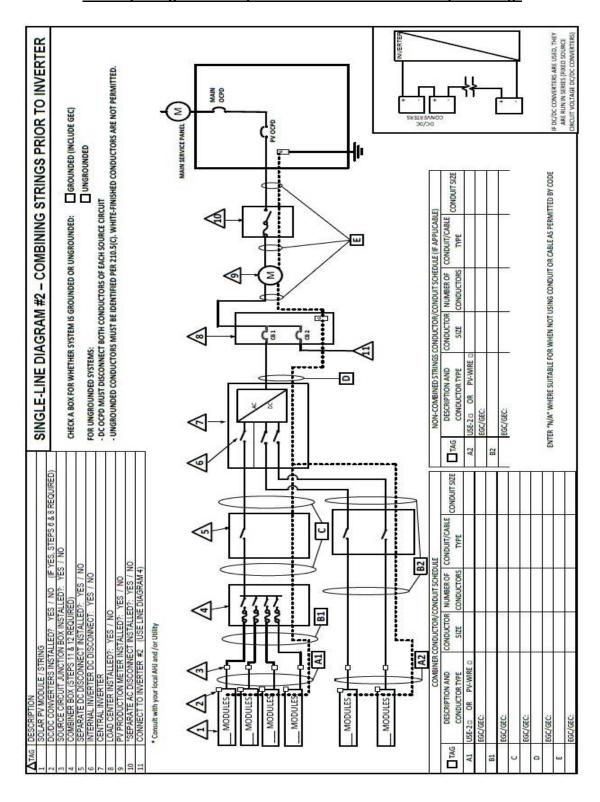
Informational note: ANSI Z535.4 provides guidelines for the design of safety signs and labels for application to products. A phenolic plaque with contrasting colors between the text and background would meet the intent of the code for permanency. No type size is specified, but 20 point (3/8") should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

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

<u>SOLAR PV STANDARD PLAN – SIMPLIFIED</u> <u>Central/String Inverter Systems for One and Two Family Dwellings</u>



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<u>Supplemental Calculation Sheets for Inverter #2</u> (Only include if <u>no more than one</u> additional inverter is used)

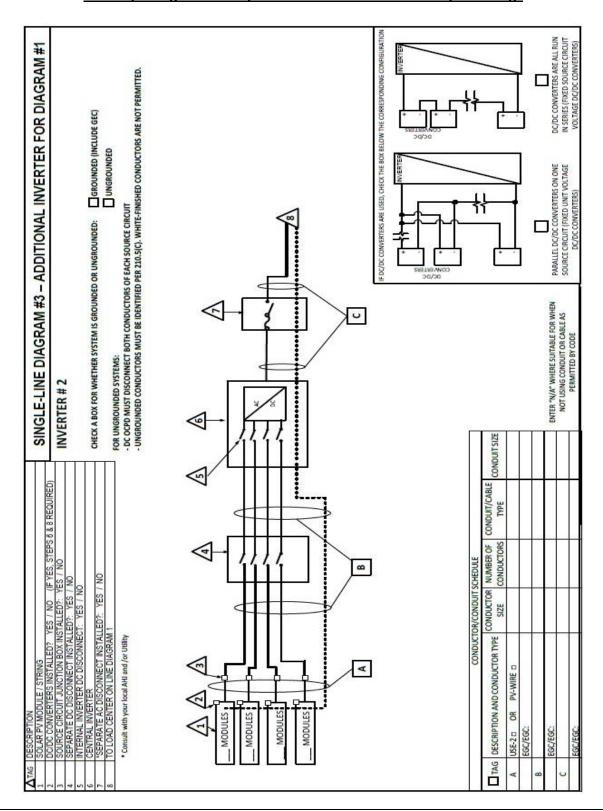
DC Information:

Module Manufacturer:						-		Me	odel:								
S2) Module V _{oc} (from module nameplate):Volts S3) Module I _{sc} (from module nameplate):Amps											nps						
S4) Module dc output po	ower u	ınder	standa	ard tes	t cond	ition	s (STC) =		Watt	s (STC)					
S5) 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)											
			7					Combiner 1:									
			17,					Combi	iner 2:								
			- 20														
Total number of source	circuit	s for i	inverte	er 1:		- 1											
S6) Are DC/DC Converters used? Yes / No If "No," skip to STEP#S7. If "Yes," enter info below.																	
DC/DC Converter Model	#:											Input	Volt	age:		Volts	
Max DC Output Current: Amps											ltage:					_Volts	
Max # of DC/DC Convert						_		_			Max DO	_		_		Watts	
S7) Max. System DC Vol																	
□ A1. Module V _{oc} (STEP																	
□ A2. Module V _{oc} (STEP	#52) =	_		_ X # II	series	(516	P#35	<u>'—</u>	x	1.14 (1	1-021	2-10 (, SIE	P#31)	_		
Table 1. Maximur	n Numb	ber of F	V Mod	ules in S	eries Ba	sed or	n Mod	ile Rate	ed Voc fo	r 600V	dc Rated	Equipn	nent (EC 690).7)		
Max. Rated Module Voc (*1.	12) olts) 2	9.76	31.51	33.48	35.71	38.	27 4	1.21	44.64	48.70	53.57	59.52	66.	96 7	6.53	89.29	
Max. Rated Module Voc (*1.	.14) olts) 2	9.24	30.96	32.89	35.09	37.	59 4	0.49	43.86	47.85	52.63	58.48	65.	79 7	5.19	87.72	
Max # of Modules for 600	Vdc	18	17	16	15	14	4	13	12	11	10	9	8	3	7	6	
Use for dc/dc converters																	
 □ B1. Module V_{oc} (STEP‡ □ B2. Module V_{oc} (STEP‡ 	#S2)	x	# of m	nodule	s per c	onve	rter (TED#	S6)	_ X 1.1	.2 (It -1	ST _L S-5	orc, S	TED#S	1) =	v	
Table 2. Largest Me																	
								33	1			, (
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	
Max. Rated Module Voc (*1.14) (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	
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	

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S8) Maximum System DC Voltage from DC/DC Conv	erters	to Inve	rter – O	nly req	uired if	"Yes" ii	n STEP#	S6	
Maximum System DC Voltage = Volt									
S9) Maximum Source Circuit Current									
Is Module I _{sc} below 9.6 Amps (STEP#S3)? Yes / No	(if "1	No," use	Comp	rehensi	ve Stan	dard Pla	an)		
S10) Sizing Source Circuit Conductors:									
Source Circuit Conductor Size = Min. #10 AWG copp	er con	ductor,	90°C w	et (USE	-2, PV \	Nire, XI	HW-2,	THWN	-2, RHW-2)
For up to 8 conductors in roof-mounted conduit exp	osed to	sunlig	nt at lea	ast ½" fr	rom the	roof co	vering	(CEC 31	10)
Note: For over 8 conductors in the conduit or mount	ing hei	ght of I	ower th	an ½"fi	rom the	roof, u	se Com	prehen	sive Plan.
S11) Are PV source circuits combined prior to the in	verter	? Yes	/ No		170 170				
If No, use Single Line Diagram 1 with Single Line Diag	ram 3	and pro	ceed to	STEP#	S13.				
If Yes, use Single Line Diagram 2 with Single Line Diag	gram 4	and pro	oceed t	o STEP#	\$12.				
Is source circuit OCPD required? Yes / No)								
Source circuit OCPD size (if needed): 15	Amp)S							
S12) Sizing PV Output Circuit Conductors – If a Com				used fr	om [STI	EP#S11	,		
Output Circuit Conductor Size = Min. #6 AWG co	opper o	onduct	or						
S13) Inverter DC Disconnect	2 W	/ *!-							
Does the inverter have an integrated dc disconn	ect? Y	es / No							
If yes, proceed to STEP#S14. If no, the external dc disconnect to be install	ad is ra	ted for		Amne	(dc) and	d	Volts	(de)	
	cu is i	iteu ioi		Allips	(uc) and	u	voits	(uc)	
S14) Inverter information:		Any Co	ationa	- 400	utmut C	urrant	Patina		Amne
Manufacturer: Model: Integrated DC Arc-Fault Circuit Protection? Yes / No									_Amps
Grounded or Ungrounded System: GROUNI	-		UNGRO			e stanu	alu Fiai	")	
Grounded or original diseases system.	,,,,		ONOIN	JOINDL					
AC Information:									
S15) Sizing Inverter Output Circuit Conductors and O									
Inverter Output OCPD rating = Amps (Tal	_								
	•	able 3)							
Table 3. Minimum Invert	er Outpi	ut OCPD a	and Circu	it Condu	ctor 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
				7.					
L		. 6 - 1 -	1.11.						
<u>Load C</u>									
(Omit if a load center	will n	ot be	install	ed for	PV O	CPDs)			
S20) Load Center Output:									
Calculate the sum of the maximum ac outputs from	each i	nverter	-						
Inverter #1 Max Continuous AC Output Cu	rrent R	ating[S	TEP#S1	4]	×	1.25 =		Amp	5
Inverter #2 Max Continuous AC Output Cu									
Total inverter currents connected to load of	enter	(sum of	above)		=		Amp	is .
Conductor Size:AWG									
Overcurrent Protection Device: Amps									
Load center busbar rating:Amps									
The sum of the ampere ratings of overcurrent de			ts supp	lying p	ower to	o a bus	bar or	conduc	tor shall not
			ts supp	lying p	ower to	o a bus	bar or	conduc	tor shall not

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