

Community Development Department 14000 City Center Dr., Chino Hills, CA 91709

P: (909) 364-2740

E: communitydevelopment@chinohills.org

RESIDENTIAL ROOF-MOUNTED PHOTOVOLTAIC (PV) STANDARD PLANS FOR SIMPLIFIED CENTRAL/STRING INVERTER SYSTEMS

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 bus bar 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 (noninverter-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:	nature: Date:							
Total # of Inverters installed: Calculation Sheets" and the "Load C			complete and attach the "Supplemental center is to be used.)					
Inverter 1 AC Output Power Rati	ing:		Watts					
Inverter 2 AC Output Power Rati	ing (if applicable):		Watts					
Combined Inverter Output Powe		≤ 10,000 Watts						
Location Ambient Temperatures (Ch	eck box next to wh	nich lowest exp	ected temperature is used):					
1) Lowest expected ambient to	emperature for the	e location (T _L) =	Between -1° to -5° C					
☐ Lowest expected ambient to	emperature for the	e location (T_L) =	Between -6° to -10° C					
Average ambient high temper	rature $(T_H) = 47^{\circ} C$							
Note: For a lower T _L or a highe	er T _H , use the Com	prehensive Sta	ndard Plan					
DC Information:								
Module Manufacturer:		Model	:					
2) Module V _{oc} (from module namep	late): Volts	3) Module I _{sc} (from module nameplate): Amps					
4) Module DC output power unde	er standard test co	onditions (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,)		ber of r				lo	dentify	, by ta			ource c				of are	to be
						Con	nbine	r 1:								
						1										
		Combiner 2:														
Total number of source circuits for	or invert	er 1:														
6) Are DC/DC Converters (ısed?	□ Ye	es [J No	0	If No	o, skip	to S	Step	7. If	Yes er	nter i	nfo b	elov	٧.	
DC/DC Converter Model #:						DO	C/DC C	onve	rter N	/lax D(CInput	Voltag	e:		Volts	
Max DC Output Current:				ıps												
Max # of DC/DC Converters in a											: Input					5
7) Maximum 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 serie	s (ST	EP 5)			x 1.:	12 (If	-1 ≤ T,	≤ -5°C,	STEP 1	_) =			V
\square A2. Module V_{oc} (STEP 2) =																
Table 1. Maximum Number	of PV N	lodules	in Seri	es Ba	ased (on Mo	dule Ra	ated \	√ _{oc} for	· 600 \	/dc Rate	ed Equ	ipmeı	nt (CE	EC 690	.7)
Max. Rated Module V _{oc} (*1.12 (Volts	29.76				5.71	38.27				18.70	53.57	59.52			6.53	89.29
Max. Rated Module V _{oc} (*1.14 (Volts	29.24	30.96	32.8	9 35	5.09	37.59	40.49	43.	.86 4	47.85	52.63	58.48	65.7	79 7	75.19	87.72
Max # of Modules for 600 Vd		17	16	:	15	14	13	1	.2	11	10	9	8		7	6
Use for DC/DC converters. The va	lue calc	ulated b	elow r	nust k	be les	ss than	DC/DC	conv	verter	max E	OC inpu	t volta	ge (ST	EP 6)		
☐ B1. Module V _{oc} (STEP 2) =	×	# of mo	odules	per c	onve	rter (S	ΓΕΡ 6)		x 1.	.12 (If -	-1 ≤ T, ≤	≤ -5°C,	STEP :	L) =		V
☐ B2. Module V _{oc} (STEP 2) =																
Table 2. Largest Module V _{oc} t	or Single	e-Modu	le DC/	DC Co	onve	rter Co	nfigura	ations	s (with	n 80 V	AFCI C	ap) (CE	C 690	.7 ar	id 690	.11)
Max. Rated Module V _{oc} (*1.12 (Volts		33.0	35.7 3	8.4	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 _{oc} (*1.14 (Volts	29.8	32.5	35.1 3	7.7	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 Inpu (Step #6) (Volts	34	37	40	43	46	49	52	55	58	61	64	67	70	73	76	79
, , , , , , , , , , , , , , , , , , , ,						1										
8) Maximum System DC V Maximum System DC V	_							verte	er —	Only	/ requ	ired i	f Yes	in S	itep 6	5
9) Maximum Source Circu	it Curr	ent														
Is Module I _{sc} below 9.6			3)?	□ Ye	es	□ N	o (If N	lo, u	ise C	ompi	ehen	sive S	tand	ard	Plan)	

,	Sizing Source Circuit Conductors Source Circuit Conductor Size = Min. #10 AWG co THWN-2, RHW-2) For up to 8 conductors in roof-mounted conduit ex Note: For over 8 conductors in the conduit or mountir	posed t	to sunli	ght at	least ½	" from	the roc	of cove	ring (CE	
•	Are PV source circuits combined prior to the ir If No, use Single Line Diagram 1 and proceed to If Yes, use Single Line Diagram 2 with Single Line Is source circuit OCPD required?	o Step ne Dia{ es □	13. gram 4 I No		□ No		ep 12.			
-	Sizing PV Output Circuit Conductors — If a com Output Circuit Conductor Size = Min. #6 AWG				be use	d (Step	11),			
	Inverter DC Disconnect Does the inverter have an integrated DC discon If No, the external DC disconnect to be installe									
·	Inverter Information Manufacturer: Max. Continuous AC Output Current Rating: Integrated DC Arc-Fault Circuit Protection? Grounded or Ungrounded System?	s 🗆	ps No (If I	No is se				ive Star	ndard P	 rlan)
AC Inf	formation:									
	Sizing Inverter Output Circuit Conductors and Inverter Output OCPD rating = Amps (Tabl Inverter Output Circuit Conductor Size = A	e 3)	ble 3)							
	Table 3. Minimum Inverter	Output	OCPD ar	nd Circu	it Condı	uctor Siz	е			
	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), bus bar Rating, and Main OCPD as shown in Table 4.

If No, circle the Max Combined PV System OCPD(s) at 100% value as determined from Step 15 (or Step S20), bus bar 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 x (100% or 120%)]

Table 4. Maximum Combined Supply OCPE	s Based	on Bus	Bar Rat	ing (Am	ps) per	CEC 705	.12(D)(2	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% 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 10 kW AC size maximum.

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

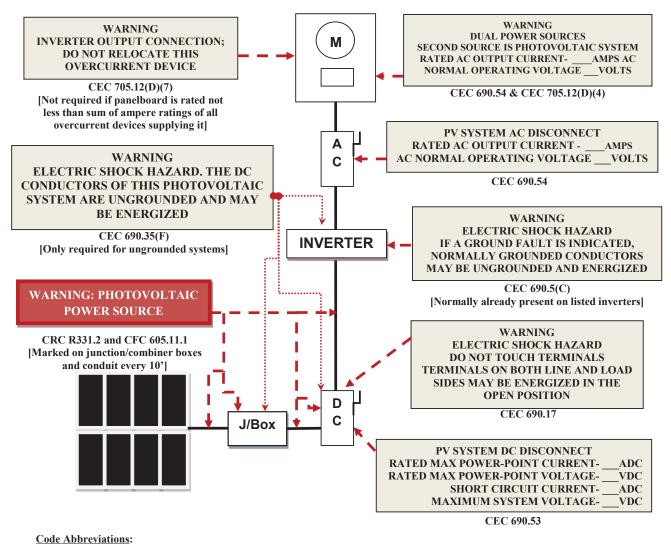
17 & 18 & 19) Labels and Grounding and Bonding

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

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

Markings

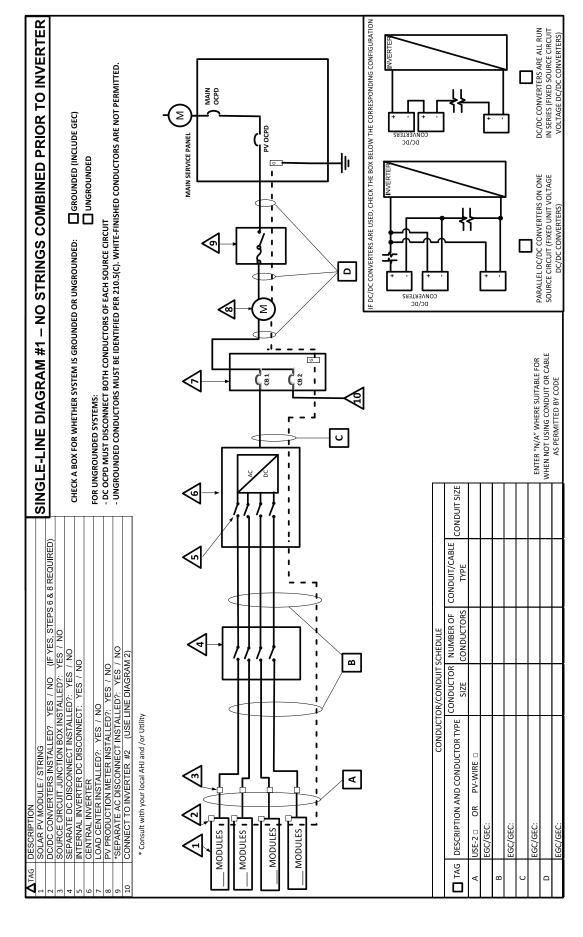
CEC Articles 690 and 705 and CRC Section R331 require the following labels or markings be installed at these components of the photovoltaic system:

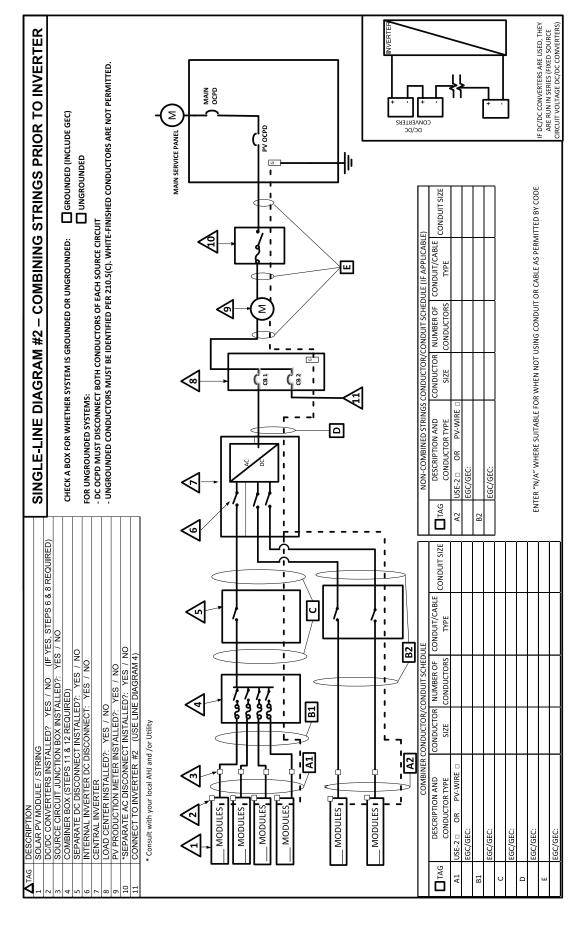


California Electrical Code (CEC)
California Residential Code (CRC)
California Fire Code (CFC)

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.





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

Supplemental Calculation Sheets for Inverter #2 (Only include if <u>second</u> inverter is used)

DC Information:

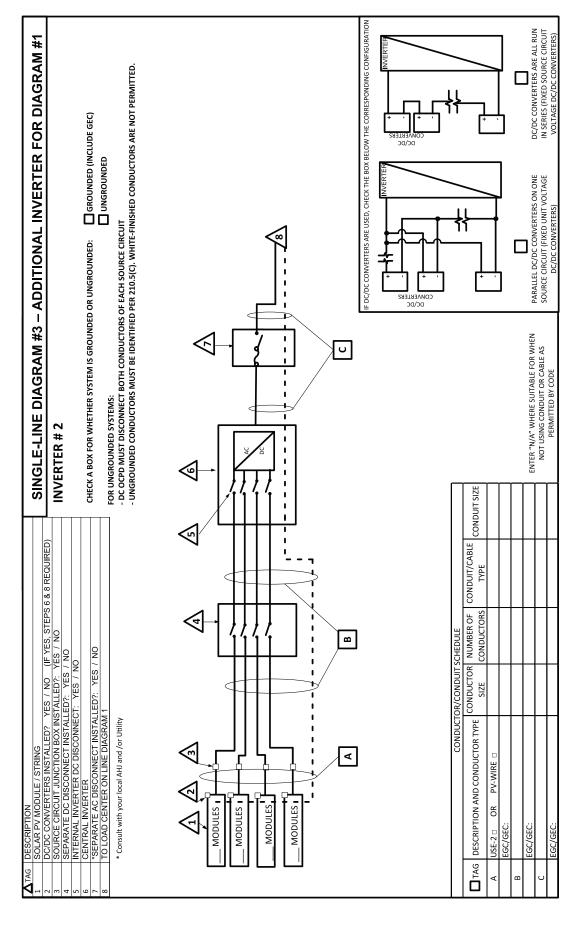
Module Manufacturer: _		Model:							
S2) Module V _{oc} (from module nameplate): Volts									
S4) Module DC output p	ower under standard test c	onditions (STC) = Watts (STC)							
S5) DC Module Layout									
Identify each source circuit (string) for inverter 1 shown on the roof plan with a Tag (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 paralleled (if none, put N/A)	be						
		Combiner 1:							
		Combiner 2:							
Total number of source circuits	for inverter 1:								
	rs used?	If No, skip to Step S7. 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							

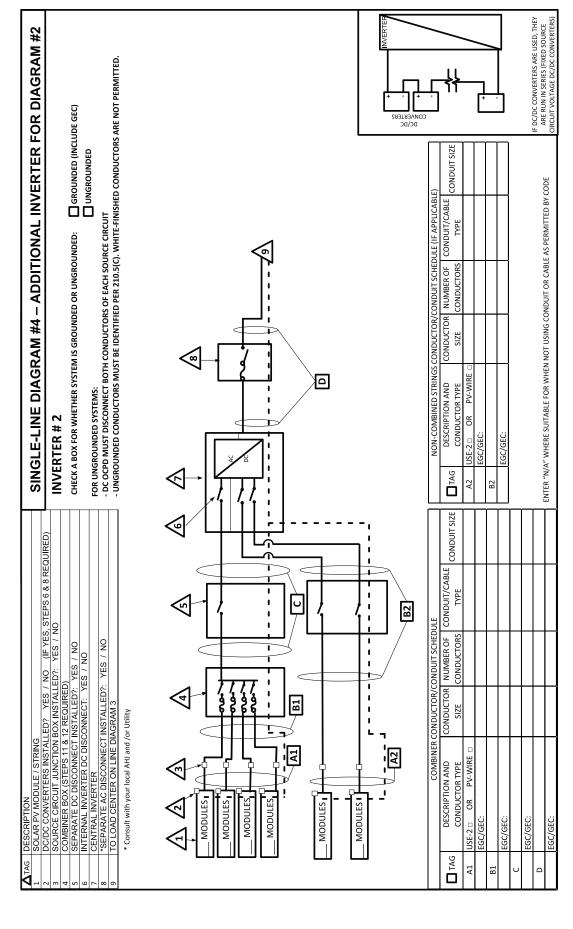
	67) Maximum System DC Vo	Itage ·	— Use	A1 or	· A2 f	or syst	ems w	ithout	DC/D	OC con	verters	, and B	1 or B	2 with	DC/D	C Con	verters.
ı	☐ A1. Module V _{oc} (STEP S2) =		x # in series (STEP S5) x 1.12 (If -1 \leq T _L \leq -5°C, STEP S1) =							V							
-	A2. Module V _{oc} (STEP S2) =		x # in series (STEP S5) x 1.14 (If $-6 \le T_L \le -10^{\circ}$ C, STEP S1) =								V						
	Table 1. Maximum Number c	of PV M	odules	in Se	ries E	Based (on Mo	dule R	ated	V _{oc} fo	r 600 V	/dc Rat	ed Equ	ıipme	nt (CE	C 690	.7)
	Max. Rated Module V _{oc} (*1.12) (Volts)	29.76	31.51	33.4	48	35.71	38.27	41.2	1 44	4.64	48.70	53.57	59.52	2 66.	96 7	6.53	89.29
	Max. Rated Module V _{oc} (*1.14) (Volts)	29.24	30.96	32.	89	35.09	37.59	40.49	9 43	3.86	47.85	52.63	58.48	65.	79 7	5.19	87.72
į	Max # of Modules for 600 Vdc	18	17	16	5	15	14	13	:	12	11	10	9	8		7	6
ı	Jse for DC/DC converters. The valu	ue calcu	lated b	elow	mus	t be le	ss than	DC/D	C con	ıverteı	r max E	C inpu	t volta	ge (ST	EP S6).	
I	■ B1. Module V _{oc} (STEP S2) =	>	۴ of m	odule	es pe	r conv	erter (STEP S	6)		x 1.12 (If -1 ≤ ¯	Γ _∟ ≤ -5°	C, STE	P S1)	=	V
[B2. Module V _{oc} (STEP S2) =	;	u# of m	odule	es pe	r conv	erter (STEP S	6)	>	x 1.14 (If -6 ≤ ¯	Γ _∟ ≤ -1(°C, ST	EP S1) =	V
	Table 2. Largest Module V _{oc} fo	r Single	-Modu	le DC	/DC	Conve	rter Cc	nfigur	ation	ıs (wit	h 80 V	AFCI C	ap) (Cl	EC 690).7 an	d 690	.11)
	Max. Rated Module V _{oc} (*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 _{oc} (*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
	S8) Maximum System DC V Maximum System DC V	_							nver	rter -	– On	ly req	uired	l if Y€	es in	Step	S6
	S9) Maximum Source Circuit Current																
	Is Module I _{sc} below 9.6 Amps (Step S3)? ☐ Yes ☐ No (If No, use Comprehensive Standard Plan)																
Sí	LO) Sizing Source Circuit Co																
	Source Circuit Conductor THWN-2, RHW-2)	Size =	Min. #	‡10 A	WG	copp	er coi	nduct	or, 9	0° C ر	wet (L	JSE-2,	PV W	ire, X	(HHW	<i>l</i> -2,	
	For up to 8 conductors in	roof-m	ounte	d cor	ndui	t expo	osed to	o sunl	ight	at lea	ast ½"	from	the ro	of co	verin	g (CE	C 310)
	Note: For over 8 conductor								_								-
	Plan.																
S:	11) Are PV source circuits c								Ye	s [□ No						
	If No, use Single Line Diag If Yes, use Single Line D								/ an	nd nr	0000	to S	tan S	12			
	Is source circuit	_			_		-	-	4 ai	ια μι	ocee	1 10 3	tep 3	12.			
	Source circuit O																
Sí	L2) Sizing PV Output Circuit	Cond	uctors	— I	f a c	omb	iner b	ox w	ill No	OT be	e used	d (Ste	p S11	.),			
	Output Circuit Conductor	Size =	Min.	#6 A\	WG	coppe	er con	ducto	r								
Sí	13) Inverter DC Disconnect								_				_	_			
	Does the inverter have ar If No, the external DC d	_															s (DC)
	the external be a	.555111		- 50			5 1 0				_′'''	ים, כיק	J, 411	<u> </u>			(30)

S14) Inverter Information Manufacturer: Max. Continuous AC Output Current Rating:	Δι		odel: _						
Integrated DC Arc-Fault Circuit Protection? Grounded or Ungrounded System? Grounded Grounde	Yes [□ No (I			ed, Con	nprehe	nsive S	tandar	d Plan)
AC Information:									
S15) Sizing Inverter Output Circuit Conductors and Inverter Output OCPD rating = Amps (Ta Inverter Output Circuit Conductor Size =	ble 3))						
Table 3. Minimum Inverter	Output	OCPD aı	nd Circu	it Condı	uctor Siz	e			
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

Load Center Calculations (Omit if a load center will not be installed for PV OCPDs)

S20) Load Center Output: Calculate the sum of the maximum AC outputs from each inverter.		
Inverter #1 Max Continuous AC Output Current Rating [STEP S14]	× 1.25 =	Amps
Inverter #2 Max Continuous AC Output Current Rating [STEP S14]	× 1.25 =	· Amps
Total inverter currents connected to load center (sum of above)	=	Amps
Conductor Size: AWG Overcurrent Protection Device: Amps Load center bus bar rating: Amps The sum of the ampere ratings of overcurrent devices in circuits supplyi shall not exceed 120 percent of the rating of the bus bar or conductor.	ng power to a bus	bar or conductor





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.