Solar PV Standard Plan – Simplified 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 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: __________________________________ Date: __________ Phone Number: __________________

Total # of Inverters installed: ____________ (If more than one inverter, complete and attach the “Supplemental Calculation Sheets” and the “Load Center Calculations” if a new load center is to be used.)

Inverter 1 AC Output Power Rating: ____________________ Watts

Inverter 2 AC Output Power Rating (if applicable): ____________ Watts

Combined Inverter Output Power Rating: __________________ ≤ 10,000 Watts

Location Ambient Temperatures (Check box next to which lowest expected temperature is used):

1) ☐ Lowest expected ambient temperature for the location \(T_L\) = Between -1 to -5 °C

☐ Lowest expected ambient temperature for the location \(T_L\) = Between -6 to -10 °C

Average ambient high temperature \(T_{H}\) = 47 °C

Note: For a lower \(T_L\) or a higher \(T_H\), use the Comprehensive Standard Plan
DC Information:

Module Manufacturer: __________________________  Model: __________________________

2) Module $V_{oc}$ (from module nameplate): _______ Volts

3) Module $I_{sc}$ (from module nameplate): _______ Amps

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

5) DC Module Layout

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

Total number of source circuits for inverter 1:

6) Are DC/DC Converters used?  □ Yes  □ No  If No, skip to STEP 7. If Yes, enter info below.

DC/DC Converter Model #: __________________________

Max DC Output Current: __________________________ Amps

Max # of DC/DC Converters in an Input Circuit: __________________________

DC/DC Converter Max DC Input Voltage: _______ Volts

Max DC Output Voltage: __________________________ Volts

DC/DC Converter Max DC Input Power: ____ ______ 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 Modules in Series Based on Module Rated VOC for 600 Vdc Rated Equipment (CEC 690.7)

<table>
<thead>
<tr>
<th>Max. Rated Module VOC (*1.12) (Volts)</th>
<th>Max. Rated Module VOC (*1.14) (Volts)</th>
<th>Max # of Modules for 600 Vdc</th>
</tr>
</thead>
<tbody>
<tr>
<td>29.24</td>
<td>29.24</td>
<td>18</td>
</tr>
<tr>
<td>30.96</td>
<td>30.96</td>
<td>17</td>
</tr>
<tr>
<td>32.89</td>
<td>32.89</td>
<td>16</td>
</tr>
<tr>
<td>35.09</td>
<td>35.09</td>
<td>15</td>
</tr>
<tr>
<td>37.59</td>
<td>37.59</td>
<td>14</td>
</tr>
<tr>
<td>40.49</td>
<td>40.49</td>
<td>13</td>
</tr>
<tr>
<td>43.86</td>
<td>43.86</td>
<td>12</td>
</tr>
<tr>
<td>47.85</td>
<td>47.85</td>
<td>11</td>
</tr>
<tr>
<td>52.63</td>
<td>52.63</td>
<td>10</td>
</tr>
<tr>
<td>58.48</td>
<td>58.48</td>
<td>9</td>
</tr>
<tr>
<td>65.79</td>
<td>65.79</td>
<td>8</td>
</tr>
<tr>
<td>76.53</td>
<td>76.53</td>
<td>7</td>
</tr>
<tr>
<td>89.29</td>
<td>89.29</td>
<td>6</td>
</tr>
</tbody>
</table>

Use for DC/DC converters. The value calculated below must be less than DC/DC converter max DC input voltage (STEP #6).
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, use Comprehensive Standard 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)
    For up to 8 conductors in roof-mounted conduit exposed to sunlight at least ½” from the roof covering (CEC 310)
    Note: For over 8 conductors in the conduit or mounting height of lower than ½” from the roof, use Comprehensive Plan.

11) Are PV source circuits combined prior to the inverter? ☐ Yes ☐ No
    If No, use Single Line Diagram 1 with Single Line Diagram 3 and proceed to STEP 13.
    If Yes, use Single Line Diagram 2 with Single Line Diagram 4 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, Comprehensive

---

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

<table>
<thead>
<tr>
<th>Max. Rated Module VOC (*1.12) (Volts)</th>
<th>30.4</th>
<th>33.0</th>
<th>35.7</th>
<th>38.4</th>
<th>41.1</th>
<th>43.8</th>
<th>46.4</th>
<th>49.1</th>
<th>51.8</th>
<th>54.5</th>
<th>57.1</th>
<th>59.8</th>
<th>62.5</th>
<th>65.2</th>
<th>67.9</th>
<th>70.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Rated Module VOC (*1.14) (Volts)</td>
<td>29.8</td>
<td>32.5</td>
<td>35.1</td>
<td>37.7</td>
<td>40.4</td>
<td>43.0</td>
<td>45.6</td>
<td>48.2</td>
<td>50.9</td>
<td>53.5</td>
<td>56.1</td>
<td>58.8</td>
<td>61.4</td>
<td>64.0</td>
<td>66.7</td>
<td>69.3</td>
</tr>
<tr>
<td>DC/DC Converter Max DC Input (STEP #6) (Volts)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Standard Plan)
Grounded or Ungrounded System: □ Grounded □ Ungrounded

AC Information:

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

<table>
<thead>
<tr>
<th>Inverter Continuous Output Current Rating (Amps) (STEP#14)</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>28</th>
<th>32</th>
<th>36</th>
<th>40</th>
<th>48</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum OCPD Size (Amps)</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>40</td>
<td>45</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Minimum Conductor Size (AWG, 75°C, Copper)</td>
<td>14</td>
<td>12</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

Integrated DC Arc-Fault Circuit Protection? □ Yes □ No (If No is selected, Comprehensive Standard Plan)
Grounded or Ungrounded System? □ Grounded □ Ungrounded

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 × (100% or 120%)]

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

<table>
<thead>
<tr>
<th>Bus bar Rating</th>
<th>100</th>
<th>125</th>
<th>125</th>
<th>200</th>
<th>200</th>
<th>200</th>
<th>225</th>
<th>225</th>
<th>225</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main OCPD</td>
<td>100</td>
<td>100</td>
<td>125</td>
<td>150</td>
<td>175</td>
<td>200</td>
<td>175</td>
<td>200</td>
<td>225</td>
</tr>
<tr>
<td>Max Combined PV System OCPD(s) at 120% of bus bar Rating</td>
<td>20</td>
<td>50</td>
<td>25</td>
<td>60*</td>
<td>60*</td>
<td>40</td>
<td>60*</td>
<td>60*</td>
<td>45</td>
</tr>
<tr>
<td>Max Combined PV System OCPD(s) at 100% of bus bar Rating</td>
<td>0</td>
<td>25</td>
<td>0</td>
<td>50</td>
<td>25</td>
<td>0</td>
<td>50</td>
<td>25</td>
<td>0</td>
</tr>
</tbody>
</table>

*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, 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.
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:

**WARNING**

**INVERTER OUTPUT CONNECTION; DO NOT RELOCATE THIS OVERCURRENT DEVICE**

CEC 705.12(D)(7)
[Not required if panelboard is rated not less than sum of ampere ratings of all overcurrent devices supplying it]

**WARNING**

**ELECTRIC SHOCK HAZARD. THE DC CONDUCTORS OF THIS PHOTOVOLTAIC SYSTEM ARE UNGROUNDED AND MAY BE ENERGIZED**

CEC 690.35(F)
[Only required for ungrounded systems]

**WARNING**

**PHOTOVOLTAIC POWER SOURCE**

CRC R331.2 and CFC 605.11.1
[Marked on junction/combiner boxes and conduit every 10']

**WARNING**

**DUAL POWER SOURCES SECOND SOURCE IS PHOTOVOLTAIC SYSTEM**

RATED AC OUTPUT CURRENT: ___ AMPS
AC NORMAL OPERATING VOLTAGE: ___ VOLTS

CEC 690.54 & CEC 705.12(D)(4)

**WARNING**

**ELECTRIC SHOCK HAZARD DO NOT TOUCH TERMINALS TERMINALS ON BOTH LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION**

CEC 690.5(C)
[Normally already present on listed inverters]

**WARNING**

**PHOTOVOLTAIC SYSTEM DC DISCONNECT**

RATED MAX POWER-POINT CURRENT: ___ ADC
RATED MAX POWER-POINT VOLTAGE: ___ VDC
SHORT CIRCUIT CURRENT: ___ ADC
MAXIMUM SYSTEM VOLTAGE: ___ VDC

CEC 690.53

**WARNING**

**ELECTRIC SHOCK HAZARD IF A GROUND FAULT IS INDICATED, NORMALLY GROUNDED CONDUCTORS MAY BE UNGROUNDED AND ENERGIZED**

CEC 690.17

**WARNING**

**ELECTRIC SHOCK HAZARD IF A GROUND FAULT IS INDICATED, NORMALLY GROUNDED CONDUCTORS MAY BE UNGROUNDED AND ENERGIZED**

CEC 690.5(C)
[Normally already present on listed inverters]

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

DESCRIPTION
SOLAR PV MODULE / STRING
DC/DC CONVERTERS INSTALLED?    YES  /  NO
SOLAR PV CIRCUIT JUNCTION BOX INSTALLED?    YES  /  NO
INTERNAL INVERTER DC DISCONNECT:  YES  /  NO
CENTRAL INVERTER LOAD CENTER INSTALLED?    YES  /  NO
PV PRODUCTION METER INSTALLED?    YES  /  NO
SEPARATE DC DISCONNECT INSTALLED?    YES  /  NO
SEPARATE AC DISCONNECT INSTALLED?    YES  /  NO

CHECK A BOX FOR WHETHER SYSTEM IS GROUNDED OR UNGROUNDED:  
GROUNDED (INCLUDE NEC)  
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.

* Consult with your local AHJ and/or Utility

CONDUCTOR/CONDUIT SCHEDULE

<table>
<thead>
<tr>
<th>TAG</th>
<th>DESCRIPTION AND CONDUCTOR TYPE</th>
<th>CONDUCTOR</th>
<th>NUMBER OF CONDUCTORS</th>
<th>CONDUIT/CABLE TYPE</th>
<th>CONDUIT SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>USE-2 □ OR PV-WIRE □</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EGC/GEC:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>EGC/GEC:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>EGC/GEC:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>EGC/GEC:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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)

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

MAIN SERVICE PANEL

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

* Consult with your local AHJ and/or Utility
Solar PV Standard Plan – Simplified
Central/String Inverter System for One- and Two-Family Dwellings

DESCRIPTION
SOLAR PV MODULE / STRING
DC/DC CONVERTERS INSTALLED?
YES / NO
(IF YES, STEPS 6 & 8 REQUIRED)

SOURCE CIRCUIT JUNCTION BOX INSTALLED?
YES / NO

SEPARATE DC DISCONNECT INSTALLED?
YES / NO

CENTRAL INVERTER
LOAD CENTER INSTALLED?
YES / NO

PV PRODUCTION METER INSTALLED?
YES / NO

* SEPARATE AC DISCONNECT INSTALLED?
YES / NO

CONNECT TO INVERTER 
#2
(USE LINE DIAGRAM 4)

TAG DESCRIPTION AND CONDUCTOR TYPE
CONDUCTOR SIZE
NUMBER OF CONDUCTORS
CONDUIT/CABLE TYPE
CONDUIT SIZE

A1 USE-2 □ OR PV-WIRE □
EGC/GEC:
B1
EGC/GEC:
C
EGC/GEC:
D
EGC/GEC:
E

COMBINER CONDUCTOR/CONDUIT SCHEDULE

NON-COMBINED STRINGS CONDUCTOR/CONDUIT SCHEDULE (IF APPLICABLE)

IF DC/DC CONVERTERS ARE USED, THEY ARE RUN IN SERIES (FIXED SOURCE CIRCUIT VOLTAGE DC/DC CONVERTERS)

* Consult with your local AHJ and/or Utility

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.

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

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

DC Information:

<table>
<thead>
<tr>
<th>Module Manufacturer: ________________________________       Model: ________________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>S2) Module $V_{oc}$ (from module nameplate): ____<em>Volts       S3) Module $I</em>{sc}$ (from module nameplate): _____Amps</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>S4) Module DC output power under standard test conditions (STC) = ________ Watts (STC)</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>S5) DC Module Layout</td>
</tr>
<tr>
<td>Identify each source circuit (string) for inverter 1 shown on the roof plan with a Tag (e.g., A, B, C ... )</td>
</tr>
<tr>
<td>Combiner 1:</td>
</tr>
<tr>
<td>Combiner 2:</td>
</tr>
<tr>
<td>Total number of source circuits for inverter 1:</td>
</tr>
<tr>
<td>S6) Are DC/DC Converters used?  □ Yes  □ No If No, skip to STEP#S7. If Yes, enter info below.</td>
</tr>
</tbody>
</table>
S7) 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 S2) = _________ x # in series (STEP S5) __________ x 1.12 (If $-1 \leq T_L \leq -5^\circ C$, STEP S1) = ______ V
   - A2. Module $V_{OC}$ (STEP S2) = _______ x # in series (STEP S5) _______ x 1.14 (If $-6 \leq T_L \leq -10^\circ C$, STEP S1) = ______ V

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

<table>
<thead>
<tr>
<th>Max. Rated Module VOC (*1.12) (Volts)</th>
<th>29.76</th>
<th>31.51</th>
<th>33.48</th>
<th>35.71</th>
<th>38.27</th>
<th>41.21</th>
<th>44.64</th>
<th>48.70</th>
<th>53.57</th>
<th>59.52</th>
<th>66.96</th>
<th>76.53</th>
<th>89.29</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Rated Module VOC (*1.14) (Volts)</td>
<td>29.24</td>
<td>30.96</td>
<td>32.89</td>
<td>35.09</td>
<td>37.59</td>
<td>40.49</td>
<td>43.86</td>
<td>47.85</td>
<td>52.63</td>
<td>58.48</td>
<td>65.79</td>
<td>75.19</td>
<td>87.72</td>
</tr>
<tr>
<td>Max # of Modules for 600 Vdc</td>
<td>18</td>
<td>17</td>
<td>16</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

Use for DC/DC converters. The value calculated below must be less than DC/DC converter max DC input voltage (STEP #S6).
   - B1. Module $V_{OC}$ (STEP#S2) _____ x # of modules per converter (STEP S6) _____ x 1.12 (If $-1 \leq T_L \leq -5^\circ C$, STEP S1) = _____ V
   - B2. Module $V_{OC}$ (STEP#S2) _____ x # of modules per converter (STEP S6) _____ x 1.14 (If $-6 \leq T_L \leq -10^\circ C$, STEP S1) = _____ V

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

<table>
<thead>
<tr>
<th>Max. Rated Module VOC (*1.12) (Volts)</th>
<th>30.4</th>
<th>33.0</th>
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<th>38.4</th>
<th>41.1</th>
<th>43.8</th>
<th>46.4</th>
<th>49.1</th>
<th>51.8</th>
<th>54.5</th>
<th>57.1</th>
<th>59.8</th>
<th>62.5</th>
<th>65.2</th>
<th>67.9</th>
<th>70.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Rated Module VOC (*1.14) (Volts)</td>
<td>29.8</td>
<td>32.5</td>
<td>35.1</td>
<td>37.7</td>
<td>40.4</td>
<td>43.0</td>
<td>45.6</td>
<td>48.2</td>
<td>50.9</td>
<td>53.5</td>
<td>56.1</td>
<td>58.8</td>
<td>61.4</td>
<td>64.0</td>
<td>66.7</td>
<td>69.3</td>
</tr>
<tr>
<td>DC/DC Converter Max DC Input (STEP #6) (Volts)</td>
<td>34</td>
<td>37</td>
<td>40</td>
<td>43</td>
<td>46</td>
<td>49</td>
<td>52</td>
<td>55</td>
<td>58</td>
<td>61</td>
<td>64</td>
<td>67</td>
<td>70</td>
<td>73</td>
<td>76</td>
<td>79</td>
</tr>
</tbody>
</table>

S8) Maximum System DC Voltage from DC/DC Converters to Inverter – Only required if Yes in STEP S6

Maximum System DC Voltage = _________________ Volts

S9) Maximum Source Circuit Current
Is Module ISC below 9.6 Amps (STEP S3)?  ☐ Yes  ☐ No  (if No, use Comprehensive Standard Plan)

S10) 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)
For up to 8 conductors in roof-mounted conduit exposed to sunlight at least ½" from the roof covering (CEC 310)
Note: For over 8 conductors in the conduit or mounting height of lower than ½" from the roof, use Comprehensive Plan.

S11) Are PV source circuits combined prior to the inverter?  ☐ Yes  ☐ No
If No, use Single Line Diagram 1 with Single Line Diagram 3 and proceed to STEP S13.
If Yes, use Single Line Diagram 2 with Single Line Diagram 4 and proceed to STEP S12.
   Is source circuit OCPD required?  ☐ Yes  ☐ No
   Source circuit OCPD size (if needed): 15 Amps

Page 10 of 14
S12) Sizing PV Output Circuit Conductors – If a Combiner box will NOT be used from [STEP#S11], Output Circuit Conductor Size = Min. #6 AWG copper conductor

S13) Inverter DC Disconnect

Does the inverter have an integrated DC disconnect? □ Yes □ No If yes, proceed to STEP S14.

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

S14) Inverter information:
Manufacturer: _________________________________ Model: _________________________________

Max. Continuous AC Output Current Rating: _______ Amps
Integrated DC Arc-Fault Circuit Protection? □ Yes □ No (If No is selected, Comprehensive Standard Plan)
Grounded or Ungrounded System: □ GROUNDED □ UNGROUNDED

AC Information:

S15) 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

<table>
<thead>
<tr>
<th>Inverter Continuous Output Current Rating (Amps) (STEP 14)</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>28</th>
<th>32</th>
<th>36</th>
<th>40</th>
<th>48</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum OCPD Size (Amps)</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>40</td>
<td>45</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Minimum Conductor Size (AWG, 75°C, Copper)</td>
<td>14</td>
<td>12</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

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 supplying power to a bus bar or conductor shall not exceed 120 percent of the rating of the bus bar or conductor.
Solar PV Standard Plan – Simplified
Central/String Inverter System for One- and Two-Family Dwellings

**DESCRIPTION**

- SOLAR PV MODULE / STRING
- DC/DC CONVERTERS INSTALLED? YES / NO
- SOURCE CIRCUIT JUNCTION BOX INSTALLED? YES / NO
- SEPARATE DC DISCONNECT INSTALLED? YES / NO
- INTERNAL INVERTER DC DISCONNECT: YES / NO
- CENTRAL INVERTER
- SEPARATE AC DISCONNECT INSTALLED: YES / NO
- TO LOAD CENTER ON LINE DIAGRAM

---

**SINGLE-LINE DIAGRAM #3 – ADDITIONAL INVERTER FOR DIAGRAM #1**

**INVERTER # 2**

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.

---

**CONDUCTOR/CONDUIT SCHEDULE**

<table>
<thead>
<tr>
<th>TAG</th>
<th>DESCRIPTION AND CONDUCTOR TYPE</th>
<th>CONDUCTOR SIZE</th>
<th>NUMBER OF CONDUCTORS</th>
<th>CONDUIT/CABLE TYPE</th>
<th>CONDUIT SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>USE-2 □ OR PV-WIRE □</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EGC/EGC:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>EGC/EGC:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>EGC/EGC:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

DESCRIPTION
SOLAR PV MODULE / STRING
DC/DC CONVERTERS INSTALLED?
YES / NO
(IF YES, STEPS 6 & 8 REQUIRED)
SOURCE CIRCUIT JUNCTION BOX INSTALLED?
YES / NO
SEPARATE DC DISCONNECT INSTALLED?
YES / NO
INTERNAL INVERTER DC DISCONNECT?
YES / NO
SEPARATE AC DISCONNECT INSTALLED?
YES / NO
TO LOAD CENTER ON LINE DIAGRAM
3

SINGLE-LINE DIAGRAM #4 – ADDITIONAL INVERTER FOR DIAGRAM #2

INVERTER # 2
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-FI NISHED CONDUCTORS ARE NOT PERMITTED.

* Consult with your local AHJ and /or Utility

COMBINER CONDUCTOR/CONDUIT SCHEDULE

<table>
<thead>
<tr>
<th>TAG</th>
<th>DESCRIPTION AND CONDUCTOR TYPE</th>
<th>CONDUCTOR SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>USE-2 □ OR PV-WIRE □</td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>EGC/GEC:</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>EGC/GEC:</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>EGC/GEC:</td>
<td></td>
</tr>
</tbody>
</table>

NON-COMBINED STRINGS CONDUCTOR/CONDUIT SCHEDULE (IF APPLICABLE)

<table>
<thead>
<tr>
<th>TAG</th>
<th>DESCRIPTION AND CONDUCTOR TYPE</th>
<th>CONDUCTOR SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>USE-2 □ OR PV-WIRE □</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>EGC/GEC:</td>
<td></td>
</tr>
</tbody>
</table>

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

IF DC/DC CONVERTERS ARE USED, THEY ARE RUN IN SERIES (FIXED SOURCE CIRCUIT VOLTAGE DC/DC CONVERTERS)
Items required: roof layout of all panels, modules, clear access pathways and approximate locations of electrical disconnecting means and roof access points.