

PV DESIGN WORKSHEET WITH OPTIMIZERS

Based on the 2016 CEC

PROJECT ADDRESS: _____ PLAN CHECK# _____

Breaker maximum sizes: #14 – 15A, #12 – 20A, #10 – 30A, #8 – 50A, #6 – 60A, #4 – 80A

**** the maximum number of optimizers in a string shall not exceed 19 unless the designer provides the technical data to show otherwise****

Voc _____ Isc _____

Max. Inverter **input** Voltage for 240 V system: _____ Volts (see inverter specs.)

Max. Inverter **input** current for 240 V system: _____ Amps (see inverter specs.)

Table 310.15 (see Article 110.14C)

1. MAX PV VOLTAGE AND CURRENT CALCULATIONS:

	Wire Size	Max Ampacity
	14	20
a. Max PV system voltage (per NEC. 690.7):	12	25
Max. PV system voltage = Max. inverter input voltage= _____ V	10	35
	8	50
!!! Sec. 690.7C requires the Max PV voltage to be Less than 600 volts	6	65
b. Max PV current (NEC 690.8)		

Max. PV current = Max. output current rating for optimizers which cannot exceed the inverter input current rating = _____ A (exception: see footnotes for inverter. Some inverters limit input current even if the output current for the optimizers are greater)

2. DC CONDUCTOR AMPACITY CALCULATIONS: (array to combiner box) NEC310.16

- a. Expected wire temp. = _____ (41 deg. C or 105 deg. F. from table 310.15 (B) (2) (a)) *See Rule K
- b. Temp. correction = .58 (refer to table 310.15 (B) (2) (a)).
- c. # of current carrying conductors = _____
- d. Conduit fill de-rating: .80 (for more than 3 conductors per table 310.15(B)(3)(a)) If 3 or less: use "1"
- e. Circuit conductor size: _____ awg
- f. Circuit conductor ampacity (310.15(B)(16)): _____ amps
- g. Required Circuit conductor ampacity.
Max. **output** of optimizer current = _____ amps (see 1 b above)
- h. De-rated ampacity of circuit conductor per CEC 310.15 (B) (2) (a)
Temp. corr. (refer to table 310.15 (B) (2) (a)). x conduit fill corr. (per table 310.15(B)(3)(a)) x
circuit conductor ampacity (CEC 310.15 (B) (16) = _____ amps
.58 x _____ x _____ = _____ amps

Note: H must be larger than G Yes ___ No ___ (check one)

3. DC CONDUCTOR AMPACITY CALCULATIONS (from combiner box OR JUNCTION BOX to inverter)

- a. Ambient temp. adjustment, expose conduit (CEC 310.15 (B) (C) (3) + 22 degrees *See Rule K
Expected wire temp. (C deg.) (CEC table 310.15 (B) (3) (c)): 41 deg. + 22 deg. = 63 deg.
Temp. correction per table 310.15 (B) (2) (a): .58
of current carrying conductors: _____
Conduit fill correction (NEC 310.15 B 3 a) _____ .80 (for more than 3 conductors per table 310.15(B)(2)(a)) If 3 or less: use "1"
Circuit conductor size: _____ awg
Circuit conductor ampacity: _____ amps
- b. Required circuit conductor ampacity
Max. inverter **input** current = _____ amps.
- c. Derated ampacity of circuit conductor (NEC 310.15 B 2 (a))
Temp. correction (NEC table 310.15 B 2 (a)) x conduit fill correction (NEC 310.15B.3.a) x
circuit conductor ampacity = _____ amps
.87 x _____ x _____ = _____ amps

Note: C must be larger than B Yes ___ No ___ (check one)

4. AC CONDUCTOR AMPACITY CALCULATION: (between inverter and main elect. Panel)

- A.**
Expected wire temp. (deg. C) = 41 deg. (310.15 B 2 a) * See Rule K
Temp. correction (NEC 310.15 B 2 a) = .87 (no rooftop adjustment if AC conductors are not of roof)
Circuit conductor size= _____ awg
of current carrying conductors = _____
Conduit fill (NEC 310.15 B.3.a = _____ .80 (for more than 3 conductors per table 310.15(B)(3)(a)) If 3 or less: use "1"
Circuit conductor ampacity = _____ amps
- Inverter Model # _____
Inverter maximum AC **Output** (for 240 V) _____ A
- B. (calculation B)**
Required conductor ampacity (NEC 690.8B):
Max. inverter **output** current = _____ amps
- C.**
Derated ampacity of circuit conductors (CEC table 310.15 (B) (2) (a)):
Temp. corr. (CEC 310.15 (B) (2) (a)) x conduit fill corr. (per table 310.15(B)(3)(a) x

Circuit conductor ampacity (table 310.15 (B) (16)=
.87 x _____ x _____ = _____ amps

Note: C must be larger B Yes ____ No ____ (check one)

RULES:

- A. AC BREAKER: to be no more than the next standard breaker size up from (calculation 4B).
- B. Bus Rating: Article 705.12D(2) states that the sum of the ampere ratings of the overcurrent devices n circuits supplying power to a busbar or conductor shall not exceed 120% of the rating of the busbar or conductor.
- C. AMPACITY CALCULATION FOR DC CONDUCTORS EXITING OPTIMIZERS - Module Wattage x # of otimizers shall me less than or equal to 5,200 Watts (max wattage rating for a standard solar edge converter). Example: To calculate the amperage the string, 5,200 W / 350 V = 14.9 A. So, size these conductors and derate for temperature so they do not exceed 14.9 A.
- D. Maximum of 18 inches can cantilever beyond the standoff connection
- E. AC BREAKER: to be rated to protect the conductor per table 310.16 and Art 240.4.D/240.6.A-
- F. CONDUIT(S) SHALL BE PAINTED TO MATCH SURFACE AND SHALL BE INSTALLED MORE THAN ½”(INCHES) ABOVE ROOF SURFACE
- G. ALL EQUIPMENT TO BE LISTED FOR THE PURPOSE.
- H. Provide SOLAR PANEL COPPER LAY-IN GROUNDING LUG, TIN PLATED, 14-4, STAINLESS STEEL SCREW, SUITABLE FOR DIRECT BURIAL
- I. Use #8 bond wire from Service panel to rooftop, then #6 on rooftop where exposed. (NEC 250.120).
- J. Prior to the installation of the solar panels, the Contractor shall schedule an anchorage inspection for all standoffs.
- K. The ASHRAE (90.1) 2% Temperature should be used for all starting ambient temperatures. This is the temperature that is likely exceeded during 14 hours (not necessarily continuous) over a summer month (June through August). The rooftop temperatures for conduit are then adjusted for rooftop conditions. For example in Ontario the 2% temperature is 37°C or 98.6°F. NEC table 310.15(B)(3)(c) then shows us we need to add 22°C or 40°F to conduit that is placed ½” to 3-1/2” above the roof surface. The rooftop temperature measurement then becomes 59°C or 138.2°F.
- L. **SMOKE DETECTORS SHALL BE INSTALLED:**
 - a- Centrally located in corridor (or area) leading to sleeping areas, and inside each sleeping room.
 - b On ceiling of upper level in close proximity to the stairway when sleeping areas are on an upper level.
 - c On each floor level and in basement.
 - d In the adjacent room (or area) where the ceiling height exceeds that of the hallway by 24" or more.
 - e Battery operated smoke detector permitted in existing construction.

CARBON MONOXIDE SHALL BE INSTALLED:

- a. Outside of each separate dwelling unit sleeping area in the immediate vicinity of the bedroom(s).
- b. On every level of a dwelling unit including basements.

- c. **Battery operated carbon monoxide detector permitted in existing construction.**
- d. **Where a fuel-burning appliance is located within a bedroom or its attachment bathroom, a carbon monoxide alarm shall be installed within the bedroom.**

Definitions:

Combiner box: used where long runs of wire occur in order to reduce cost of installing many smaller wires.

Junction box: used to change type of wire from "roof cable" to THWN-2