



Review of PV Commissioning Form

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Required Form



- As of January 2011
 - A new form was added to Final As Built Package
 - Form is called
 - **“PV Commissioning Form”**
(Or equivalent form)



Purpose



- The purpose of this form is to assist a NJ installer in commissioning (*to put into active service*) a Photovoltaic system
 - *During commissioning, you are insuring your system is operational and safe*



PV Commissioning Form



PV Commissioning Form
New Jersey's Clean Energy Program

Date: _____ Approval / Registration # _____

1. Customer Name: _____ Company: _____ Daytime Phone: _____ Installation Address: _____	Installer Name: _____ Installer Phone: _____ Installer Email: _____ Customer Type: _____
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2. Weather at Time of Inspection: Clear Haze Mixed Cloudy Overcast Temperature °F: _____

Total Array Output (kWdc) = _____ Total System Est Production kWh/Yr = _____ Total System Shading %: _____ Max. System Voltage: _____ Reference Temp: _____ °C (Record Low) _____ °C (Average High)

3. MODULES							4. STRING COMMISSIONING (use additional spreadsheet for more strings)							
Manufacturer	Model	STC watts (nameplate)	Qty	Orient.	Tilt	Array Est Production kWh/yr	Mod/String	ISC	VOC	IMP	Mod/String	ISC	VOC	IMP
#1	_____	_____	_____	_____	_____	_____	#1	_____	_____	_____	#7	_____	_____	_____
#2	_____	_____	_____	_____	_____	_____	#2	_____	_____	_____	#8	_____	_____	_____
#3	_____	_____	_____	_____	_____	_____	#3	_____	_____	_____	#9	_____	_____	_____
#4	_____	_____	_____	_____	_____	_____	#4	_____	_____	_____	#10	_____	_____	_____
							#5	_____	_____	_____	#11	_____	_____	_____
							#6	_____	_____	_____	#12	_____	_____	_____

5. INVERTERS (all readings to be taken at inverter)

Manufacturer	Model	Serial #	kWAC (nameplate)	IMP	VOC	AC Watts (instantaneous)	AC Volts	Number of Mod/String
#1	_____	_____	_____	_____	_____	_____	_____	_____
#2	_____	_____	_____	_____	_____	_____	_____	_____
#3	_____	_____	_____	_____	_____	_____	_____	_____
#4	_____	_____	_____	_____	_____	_____	_____	_____
#5	_____	_____	_____	_____	_____	_____	_____	_____
#6	_____	_____	_____	_____	_____	_____	_____	_____
#7	_____	_____	_____	_____	_____	_____	_____	_____

6. METER

Manufacturer	Model	Meter Serial Number	Meter Serial Number	Meter Register Read (kwh)	ANSI c.12 Meter	
#1	_____	_____	_____	_____	<input type="checkbox"/> YES	<input type="checkbox"/> NO
#2	_____	_____	_____	_____	<input type="checkbox"/> YES	<input type="checkbox"/> NO
#3	_____	_____	_____	_____	<input type="checkbox"/> YES	<input type="checkbox"/> NO



Section 1

Basic Information



- Date of commissioning
- Approval / Registration #
- Customer Name
 - Phone Number
 - Installation Address
- Installer Name
 - Phone Number
 - Email Address



Section 2



- At Installation Location:
 - Weather and Temperature observations
 - Both of which affect PV system function and anticipated production
 - Reference Temperature for calculations
 - Average high temperature
 - Record low temperature
 - The National Renewable Energy Laboratory (NREL) maintains data on a web site that shows the record lows for many locations in the US -
http://rredc.nrel.gov/solar/old_data/nsrdb/1961-990/redbook/sum2/state.html



Section 2



- As stated in 2008 NEC 690.7(A): ***the Maximum PV System Voltage shall be calculated as the sum of the rated open-circuit voltage of the series-connected PV modules corrected for the lowest expected ambient temperature.***

Typically, the open-circuit voltage temperature **coefficients** provided by the PV manufactures data sheets have one of the following units:

% / °C or V / °C



Section 2



- If the open-circuit voltage temperature coefficient is in units of $\%/^{\circ}\text{C}$, then use the following equation:
- Adj. Mod. Voc=
$$\text{Voc}(@\text{STC}) \times [1 + ((\text{coldest Temp C} - 25\text{C}) \times \text{Voc Temp Coeff} / 100)]$$



Section 2

Module Data Sheet



	(1) STC 1000W/m ²	(2) NOCT 800W/m ²
Maximum power (P _{max})	215W	154.8W
Voltage at P _{max} (V _{mpo})	29.1V	25.9V
Current at P _{max} (I _{mpo})	7.4A	5.92A
Short circuit current (I _{sc})	8.10A	6.56A
Open circuit voltage (V _{oc})	36.5V	33.2V
Module efficiency	12.9%	
Tolerance P _{max}	-3/+5%	
Nominal voltage	20V	
Efficiency reduction at 200W/m ²	<5% reduction (efficiency 12.2%)	
Limiting reverse current	8.10A	
Temperature coefficient of I _{sc}	0.105%/ °C	
Temperature coefficient of V _{oc}	-0.360%/ °C	
Temperature coefficient of P _{max}	-0.45%/ °C	



Section 2



Sunny Boy

5000-US

208 V AC
240 V AC
277 V AC

Sunny Boy

6000-US

208 V AC
240 V AC
277 V AC

	208 V AC 240 V AC 277 V AC	208 V AC 240 V AC 277 V AC
Input (DC)		
Max. recommended PV power (@ module STC)	6250 W	7500 W
Max. DC power (@ $\cos \phi = 1$)	5300 W	6350 W
Max. DC voltage	600 V	600 V
DC nominal voltage	310 V	310 V
MPP voltage range	250 V – 480 V	250 V – 480 V
Min. DC voltage / start voltage	250 V / 300 V	250 V / 300 V



Section 2

Circuit Requirements

[2008 NEC] 690.7 Maximum Voltage.



***** Original method, no longer most accurate *****

- The rated Voc is measured at **25°C (77°F)** and is printed on the back of the module and in the technical literature of the module.
- To use the table, all one has to do is to determine the lowest expected temperature, look up the factor from the table for that temperature (which ranges between **1.02** at 24°C to **1.25** at -40°C),
- and multiply the factor by the rated Voc.



Section 2



- Total Array Output (kWdc)
 - Module wattage x amount of modules **$240 \times 50 = 12,000 \text{ watts} \quad (12 \text{ kW})$**

Or $12,000 / 1000 = 12 \text{ kW}$

1000 watts equals 1 kilowatt



Section 2



PVwatts

- Total System **Estimated kWh Production**
 - Enter correct DC rating (system size)
 - Make necessary changes to default page
 - Shading percentage
 - Inverter efficiency percentage
 - Module power tolerance percentage
 - Click “calculate”
 - AC Energy (kWh) column is the estimated production per year



Section 2



Shading

- Total System Shading %
 - Conduct shading analysis (4 corners of array)
 - Use program approved shading tool to establish **percentage** amount of shading on site
- Solmetric
- Pathfinder
- *Need to make a decision on Pathfinder software conclusions.*



Section 3



- Module Nameplate Information
 - Manufacturer *(Sanyo)*
 - Model *(HIT 220)*
 - STC watts *(220)*
 - Quantity *(40@ / 10@)*
 - Orientation *(180° / 90°)*
 - Tilt *(35° / 15°)*
 - Array Estimated Production (if multiple arrays)



Section 4



String Commissioning

- Document number of Modules per string
 - i.e. (14)



Multi-Meter:



Your multi-meter needs to be rated at 600V minimum and be capable of measuring DC voltage and current.



Section 4

Inspect fuses



- Open all the circuits in the combiner
 - Perform a visual inspection of the fuses make sure they look OK
 - Verify that the rating of the fuse corresponds to the rating specified by the module manufacturer.



Virtual Inspection



DC Source Circuit Over Current Protection

Module Isc x 1.56 = Series “string” fuse size

Note: Double check voltage rating and range.



Isc 8.35 amp



156%



13 amps Minimum

NEC 690.8 & 240.6 Next Standard Size

****The Maximum Series Fuse Size is Listed on the Back of the Module****



Section 4

Polarity and Labels



- Check polarity for all the strings by measuring the voltage differential of the positive end (fused) to negative.
- Also make sure that all strings are properly labeled indicating polarity and string number.



Section 4

String Voc



- Open circuit voltage
 - Voltage reading with multi-meter at combiner
 - Onsite, actual reading
- With your inverter still off and all DC circuits open, measure the voltage between the positive and the negative ends of each string.
 - This is perhaps your best indicator to know that all strings are wired correctly.



Section 4

String Imp



- Amperage maximum power (*operating current*)
 - Reinstall fuses
- Measure the current of every string by clamping your multi-meter around the lead cable.
- Similar to Voc, the current should not fluctuate much between strings in a day with a clear sky or steady state sky conditions.
 - In overcast days this step can get a little tricky but always make sure that all strings are producing a reasonable amount of energy.



Section 4

String Vmp

(optional step)



- Voltage maximum power
 - Reinstall fuses
 - Inverter powered on
 - Measure the voltage from negative to fuse while system is operational.



Section 4

Torque Test



- Check torque for all the connections.
- Close all the fused circuits, turn on your disconnects and restart you inverters.
 - *Will take about 5 minutes for you inverter to sample the grid and restart*



Section 4



Reason to check torque



Section 5



- Inverters
 - Basic information off **nameplate**
 - Manufacturer
 - Model #
 - Serial #
 - kWAC



Section 5



- Inverters (cont.)

- **AC watts** (*on site verification*)

- With inverter operational, read the output screen showing instantaneous watts and document



Section 5



- Inverters (cont.)
 - **AC volts** (*on site verification*)
 - Take a reading to verify the amount of voltage is feeding the inverter



Section 6



- **Meter**

- Manufacturer
- Model
- Serial Number
- Meter Register Read kWh
- Verify that meter is ANSI c.12 compliant



Documentation:



- Document all readings
- and findings
- Date your report
- Take pictures of the condition you left the combiner box.





Your solar array has been commissioned successfully!

