

Commissioning
Technician

Project name: _____

Customer representative: _____

Address: _____

QA Inspection date: _____

QA Technician: _____

PV Modules and Module Wiring

- ☐ MC connections inspected for workmanship.
- ☐ Module cables a properly secured to module frame; no dangling wires
- ☐ Bend radius no greater than four times diameter of wire.
- ☐ No debris on module surface, such as foam pads, sealant residue, etc.
- ☐ No physical damage to module frames or laminates
- ☐ Module wiring enters a strain relief prior to landing on any terminal block.
- ☐ Ground wire and lug are securely attached to rails and to module frames.
- ☐ Array GEC connection For 2008 code
- ☐ Array GEC wire size, wire suport, wire type.
- ☐ String layout marked up on array layout and recorded.
- ☐ Confirm that Serial Numbers have been recorded.

Pass	Fail	Fixed

Mounting hardware

- ☐ All hardware is installed as designed and torque as needed.
- ☐ Confirm correct hardware stack up. Example: Lock washer where needed.
- ☐ Roof penetrations secured and flashed
- ☐ Racking properly secured to rafters / standing seam
- ☐ Confirm Balasting plan conforms to mfg complinace letter

Pass	Fail	Fixed

Building envelope penetrations

- ☐ All penetrations weather sealed or fire stopped Around the out side of conduit
- ☐ All conduit raceways filled with duct seal at first building penetration
- ☐ Signal wiring penetrations (DAS) sealed around the outside of conduit
- ☐ DC conduit labled "warning DC voltages"

Pass	Fail	Fixed

DC Source Circuit Junction Box 1 thru x

- ☐ Box securely fastened and sealed against the weather, with weep holes if needed
- ☐ Array wiring leading to box is neat and suported
- ☐ Field wiring routed neatly within
- ☐ Field wiring terminations are tight.
- ☐ Field wiring is properly polarity marked with colored tape or wire insulation color
- ☐ Wire identified with permanent markers/labels. (string numbers)
- ☐ Ground wire is securely attached
- ☐ Conduit connections are tight and bushings used if applicable
- ☐ Drip loop incorporated into wiring as it enters box
- ☐ locations marked on roof layout or conduit drawing
- ☐ Conductor are rated for location. THWN-2 typically.
- ☐ Label "warning: DC voltages"

Location/Name	Pass	Fail	Fixed

Source Circuit Fused combiner Box 1 thru x

- ☐ Box securely fastened and sealed against the weather
- ☐ Field wiring routed neatly within
- ☐ Field wiring terminations are tight.
- ☐ Field wiring is properly marked with colored tape or jacket color for polarity
- ☐ Wire identified with permanent labels. (String# one side.)
- ☐ Ground wire is securely attached
- ☐ Verify fuse combiner type and rating conforms to one line
- ☐ Conduit connections are tight and bushings used if applicable (Myers)
- ☐ Drip loop incorporated into wiring as it enters box
- ☐ Box cover is secure and tight
- ☐ locations marked on roof layout or conduit drawing
- ☐ Combiner Labeled to show which inverter or switch it goes to. Conforms to 3 line
- ☐ Warning label (do not remove fuses under load. DC Voltages present.)

Location/Name	Pass	Fail	Fixed

label 11

DC Disconnect Switch 1 thru x

<input type="checkbox"/>	Field wiring is neatly routed inside
<input type="checkbox"/>	Field wiring terminations are tight.
<input type="checkbox"/>	Wire identified with permanent markers/labels.
<input type="checkbox"/>	Verify fuses are installed (when fuses are used)
<input type="checkbox"/>	Verify fuse type and rating conform to one line (when used)
<input type="checkbox"/>	Ground wire is securely attached
<input type="checkbox"/>	Conduit connections are tight and bushings used if applicable
<input type="checkbox"/>	Box cover is secure and tight
<input type="checkbox"/>	Rating conforms to one line
<input type="checkbox"/>	labels in place
<input type="checkbox"/>	Confirm values on label conform to one line
<input type="checkbox"/>	Locking Seal installed if readily accessible

label 1

Location/Name	Pass	Fail	Fixed

AC Combiner Panel 1 thru x

<input type="checkbox"/>	Field wiring is neatly routed inside
<input type="checkbox"/>	Field wiring terminations are tight.
<input type="checkbox"/>	Field wiring is properly polarity marked with colored tape or jacket color
<input type="checkbox"/>	Wire identified with permanent markers/labels.
<input type="checkbox"/>	Ground wire is securely attached
<input type="checkbox"/>	Verify fuse type and rating conform to one line (when used)
<input type="checkbox"/>	Verify fuses are installed (when fuses are used)
<input type="checkbox"/>	Conduit connections are tight and bushings used if applicable
<input type="checkbox"/>	labels in place
<input type="checkbox"/>	Confirm values on label conform to one line
<input type="checkbox"/>	Combiner Rating conforms to one line
<input type="checkbox"/>	Properly accessible and lockable
<input type="checkbox"/>	Box cover is secure and tight
<input type="checkbox"/>	Locking Seal installed if readily accessible

label 7

Location/Name	Pass	Fail	Fixed

AC Disconnect Switch 1 thru x

<input type="checkbox"/>	Field wiring is neatly routed inside
<input type="checkbox"/>	Field wiring terminations are tight.
<input type="checkbox"/>	Field wiring is properly polarity marked with colored tape or jacket color
<input type="checkbox"/>	Wire identified with permanent markers/labels.
<input type="checkbox"/>	Ground wire is securely attached
<input type="checkbox"/>	Verify fuse type and rating conform to one line (when used)
<input type="checkbox"/>	Verify fuses are installed (when fuses are used)
<input type="checkbox"/>	Conduit connections are tight and bushings used if applicable
<input type="checkbox"/>	labels in place
<input type="checkbox"/>	Confirm values on label conform to one line
<input type="checkbox"/>	Disconnect Rating conforms to one line
<input type="checkbox"/>	Properly accessible and lockable
<input type="checkbox"/>	Box cover is secure and tight
<input type="checkbox"/>	Locking Seal installed

label 5 or 6

Location/Name	Pass	Fail	Fixed

kWh Meter

<input type="checkbox"/>	Verify all wire connections are tight
<input type="checkbox"/>	Field wiring is properly polarity marked with colored tape or jacket color
<input type="checkbox"/>	Ground wire is securely attached (equipment ground)
<input type="checkbox"/>	Conduit connections are tight and bushings used if applicable
<input type="checkbox"/>	label as solar array meter
<input type="checkbox"/>	Box cover is secure and tight
<input type="checkbox"/>	Neutral is NOT bonded to ground in customer owned equipment
<input type="checkbox"/>	Record Kw/h _____ 2nd register if applicable

Location/Name	Pass	Fail	Fixed

Service Panel

<input type="checkbox"/>	labels in place
<input type="checkbox"/>	Label to identify Breaker & Do not relocate

Label 4

label 2

Location/Name	Pass	Fail	Fixed

Inverter 1 thru x

- ☐ Working and ventilation Clearances per manufacture's specs
☐ Polarity correct for inverter connections
☐ Confirm Grounding Electrode Conductor lands on inverter where MFG requires
☐ Confirm Grounding Electrode Conductor is not choked
☐ Confirm Grounding Electrode Conductor is only irreversible connections
☐ verify inverter time and date are set correctly
☐ Record model # and Serial number of inverter
☐ Model #: _____ Serial #: _____
☐ Model #: _____ Serial #: _____
☐ Model #: _____ Serial #: _____
☐ Inverter location # matches that of 3-line
☐ Label warning about "if ground fault is indicated...
☐ Label with Date of Installation
☐ Label with sticker with service phone #

Location/Name	Pass	Fail	Fixed

Model #: _____ Serial #: _____
 Model #: _____ Serial #: _____
 Model #: _____ Serial #: _____

Location/Name	Pass	Fail	Fixed

Data Acquisition system

- ☐ Network connection confirmed
☐ Record Serial number of data logger Model# _____ Serial # _____
☐ Irradiance meter installed at same plane as array
☐ Irradiance meter extension wire is type K as per mfg recommendations
☐ Set device name as: Inv # MFG Model# S/N I.E Inv1 Satcon PVI50 JAK0827341
☐ Label the location of breaker / switch that feeds the logger, record here: _____

Pass	Fail	Fixed

Application Notes Checked

- ☐ Confirm all notes on electrical drawings have been conformed to.
☐ Confirm all notes on mechanical drawings have been conformed to.

Pass	Fail	Fixed

Site

- ☐ Clean and all waste removed.

Pass	Fail	Fixed

Electrical Checkout

Meg Ohm from Utility interconnection disconnect to external Utility disconnect. Record 1 min value.

Must be > 20M ohm in 1 min.

- ☐ L1 _____
☐ L2 _____
☐ L3 _____

Pass	Fail	Fixed

Meg Ohm reading from external Utility disconnect to Inverter service disconnect. Record 1 min value.

Must be > 20M ohm in 1 min.

- ☐ L1 _____
☐ L2 _____
☐ L3 _____

Pass	Fail	Fixed

Meg Ohm reading from inverter DC service disconnect to array disconnect. Record 1 min value.

- ☐ Ungrounded conductor _____
☐ Grounded conductor if you can easily lift both ends. _____

Meg Ohm reading from array disconnect to Fused combiner. Record 1 min value.

- ☐ Ungrounded conductor _____
☐ Grounded conductor if you can easily lift both ends. _____

AC Circuits before turn on

- ☐ Verify proper AC voltage at the AC disconnect _____
☐ Line 1 to Neutral _____
☐ Line 2 to Neutral _____
☐ Line 3 to Neutral _____
☐ Line 1 to 2 _____
☐ Line 2 to 3 _____
☐ Line 3 to 1 _____
☐ Phase rotation. _____

Pass	Fail	Fixed

+/- 8% of nominal is OK, nominal is 117 VAC for single phase (108 to 126 VAC ok).

The Following tests require that the system has been turned on.

Weather

	Temperature	
	Sky Conditions	
	Wind Speed	
	horizontal Irradiance	

DC Source Circuits

Step 1: Record open circuit voltages at combiner. Look for opens and reverse voltages.

Step 2: Record Max Power Point Current at fused combiner. Look for balanced output.

String	Voc DC	Imp DC	Voc DC	Imp DC	Voc DC	Imp DC	Voc DC	Imp DC
1			21		41		61	
2			22		42		62	
3			23		43		63	
4			24		44		64	
5			25		45		65	
6			26		46		66	
7			27		47		67	
8			28		48		68	
9			29		49		69	
10			30		50		70	
11			31		51		71	
12			32		52		72	
13			33		53		73	
14			34		54		74	
15			35		55		75	
16			36		56		76	
17			37		57		77	
18			38		58		78	
19			39		59		79	
20			40		60		80	

Residential Expected Array Performance

Array power at STC from electrical drawing (1 or 3 line)		Watts						
Plane of array Irradiance now.		W/m2						
Module cell temp now.		deg C						
800-1000W/m2 = 25C above ambient								
400-799W/m2 = 15C above ambient								
200-399W/m2 = 5C above ambient								
Temp Correction = .005 * (cell temp now - 25C)								
(Pe) Expected AC output = System Size * .89 * (Irradiance now /1000) * (1-temp correction)								
System Size * .89 * (Irradiance now /1000) * (1-temp correction)		Watts						
Inverter output reading (Watts)	Pinv	Watts						
Variation predicted vs inverter within 10%	Pinv/Pe	<table border="1"> <tr> <th>Pass</th> <th>Fail</th> <th>Fixed</th> </tr> <tr> <td></td> <td></td> <td></td> </tr> </table>	Pass	Fail	Fixed			
Pass	Fail	Fixed						

Temp Conversion

10 F	-12 C
20 F	-7 C
30 F	-1 C
40 F	4 C
50 F	10 C
60 F	16 C
70 F	21 C
80 F	27 C
90 F	32 C
100 F	38 C
110 F	43 C
120 F	49 C
130 F	54 C
140 F	60 C

C= (F-32) * 5/9

Commercial Array Expected Performance

		Example with formula	Inv 1	Inv 2	Inv 3	Inv 4	Inv 5
<input type="checkbox"/>	Array power @ STC	Pstc (Watts)	70760				
<input type="checkbox"/>	Module Temp Coeff Power	Ct (%/Deg C)	-0.28%				
<input type="checkbox"/>	Module Cell Temp now	Tc (deg C)	35				
<input type="checkbox"/>	Efficiency after cell temp derate	$Kt = 1 + (Ct \times (Tc - 25))$	0.972				
<input type="checkbox"/>	Irradiance now	I (W/m2)	250				
<input type="checkbox"/>	Shading loss Percentage		3%				
<input type="checkbox"/>	Irradiance as a fraction of STC irradiance	$ki = I / Istc$	0.250				
<input type="checkbox"/>	DC to AC efficiency*	Ks (Typically .89 * (1-shading loss))	86%				
<input type="checkbox"/>	Power Expected	$Pe = Pstc \times Ki \times Kt \times Ks$	14,776 W				
<input type="checkbox"/>	Inverter output reading (Watts)	Pinv	14,500 W				
<input type="checkbox"/>	Variation predicted vs inverter within 10%	Pinv/Pe	98%				
<input type="checkbox"/>	Indicate pass or fail for each inverter		Pass				

*Includes (inv, soiling, voltage drop, module tolerance, module mismatch)

DC Combined Circuits at Max Power Point.

	Vmp	Imp	Pmp (V*A)
<input type="checkbox"/> Input 1			
<input type="checkbox"/> input 2			
<input type="checkbox"/> input 3			
<input type="checkbox"/> input 4			
<input type="checkbox"/> input 5			
<input type="checkbox"/> input 6			

Total PV amps (sum of all inputs)

MPP voltage

Total DC Input Power (Volts times Amps, not inverter display)

☐ Inverter output reading (Watts)

	Amps
	Volts
	Watts
	Watts

Pass	Fail	Fixed

☐ Inverter efficiency: DC power/AC power (should be >90%)*

*If irradiance has not varied significantly from time of DC measurements.

Data Acquisition System

	Handheld	Logger
<input type="checkbox"/> Irradiance reading matches that of handheld unit +/-5%		
<input type="checkbox"/> Cell Temp reading matched that of hand held +/-5%		
<input type="checkbox"/> Ambient Temp reading matched that of hand held +/-5%		
<input type="checkbox"/> Can read each inverter on DAS website		
<input type="checkbox"/> sum of inverter power outputs on DAS matches revenue grade kWh meter output +/-2%		
<input type="checkbox"/> power production has proper polarity		
<input type="checkbox"/> Each inverter reads appropriate power		
<input type="checkbox"/> DAS power reading		Watts
<input type="checkbox"/> Inverter power reading		Watts
<input type="checkbox"/> Inverter vs. DAS reading (Within 7%)		
<input type="checkbox"/> Inverters shown on DAS Asset Details as Inv#, MGF, model number, +SN		
<input type="checkbox"/> Record the time inverter takes to reconnect after ac loss		

Pass	Fail	Fixed

Pass	Fail	Fixed