Test Report

ICON SOLAR-EN POWER TECHNOLOGIES PVT LTD

REPORT NUMBER: 4786930293.1.1-NABL-S1

PROJECT NUMBER: 4786930293.1.1

Reviewed by signature:
12-LO-F0851, Issue 3.0

T1431, T1432, T2215,
T2216, T2233, T2234

Location (a)
UL India Lab,
UL India Pvt Limited,
Laboratory building,
Kalyani Platina
Campus, Sy.no.129/4,
EPIP Zone, Phase II,
Whitefield,
Bangalore – 560 066
P:91-80-41384400

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Location (b)
UL India Pvt Limited,
413 Sector-8, IMT
Manesar, Gurgaon.P:
91-124-22990246

General Details

Customer	**ICON SOLAR-EN POWER TECHNOLOGIES PVT LTD** 319-320, OFFIZO, 3RD FLOOR, MAGNETO MALL, G.E ROAD, RAIPUR, CHHATTISGARH 492001, INDIA		
Manufacturer	**ICON SOLAR-EN POWER TECHNOLOGIES PVT LTD** VILLAGE DIGHARI,MANDIR HASAUD,TEHSIL ARANG - 49441,RAIPUR,CHHATTISGARH(INDIA)		
Program	NABL		
Test Lab Location	(a) UL Bangalore	**Refer to Cover page for the Location address**	
Item Under Test	Poly-Crystalline Photovoltaic Module		
Type / Model	**310Wp / IS-EN 310W**		
Number of samples	1 sample of **310W of IS-EN 310W Model** representing the models as shown in the Table in the next sheet.		
Sample Identification	UL Sample Card No. 2156791		
Serial Number (If any)	ICON31036A0105191019		
Condition of IUT on receipt	Good		
Date of Receipt	04/07/2015		
Applicable Standard	**IEC 61701- Standard for SALT MIST CORROSION TESTING OF PHOTOVOLTAIC (PV) MODULES, First Edition, Issued on 1995**		
Date of Testing (Start date)	07/07/2015	**End Date**	11/07/2015
Lab general* ambient condition	**Temperature in °C**		25.6°C
	Relative humidity in %		49.2%RH
Date of Reporting	09/09/2015		
Test Result	**Pass**		
Test In-charge	Srimathy N		

Mahesh V Project Engineer	Ashish Mathur Lab Manager
Reviewed by	**Authorized signatory**

Model Name	Wattage (Wp)	Maximum System Voltage (V dc)	Open Circuit Voltage @ STC, (V dc)	Rated Voltage @ STC, (V dc)	Rated Current @ STC, (A)	Short Circuit Current @ STC, (A)	Rated Maximum Power at STC, (Watts)	Maximum Series Fuse, (A)
ISEN3	3	NA	10.3	6.4	0.53	0.57	3.4	NA
ISEN5	5	NA	16.1	12.2	0.5	0.50	5.6	NA
ISEN10	10	NA	23.3	18.2	0.6	0.65	10.9	NA
ISEN20	20	NA	23.3	18.7	1.1	1.20	20.7	NA
ISEN30	30	NA	23.3	18.7	1.6	1.79	30.9	NA
ISEN37	37	NA	23.3	18.7	2.0	2.18	37.6	NA
ISEN40	40	NA	23.3	18.7	2.1	2.32	40.1	NA
ISEN50	50	NA	23.3	18.4	2.8	3.01	51.0	5
ISEN60	60	NA	23.3	18.8	3.2	3.47	60.2	5
ISEN74	74	NA	23.3	18.2	4.1	4.46	74.9	10
ISEN75	75	NA	23.3	18.2	4.2	4.52	75.9	10
ISEN80	80	NA	23.3	18.7	4.3	4.68	80.8	10
ISEN100	100	600	23.3	18.0	5.6	6.07	100.9	10
ISEN120	120	600	23.3	18.7	6.4	6.98	120.6	10
ISEN125	125	600	23.3	18.2	6.9	7.49	125.6	15
ISEN130	130	600	23.3	18.9	6.9	7.49	130.5	15
ISEN135	135	600	22.3	18.1	7.4	7.8	135.5	15
ISEN145	145	1000	22.0	18.0	8.0	8.5	145.3	15
ISEN150	150	1000	44.46	36.22	4.15	4.37	150.3	15
ISEN150	150	1000	22.23	18.11	8.31	8.74	150.5	15
ISEN165	165	1000	24.64	20.08	8.23	8.67	165.3	15
ISEN170	170	1000	24.78	20.18	8.43	8.84	170.1	15
ISEN195	195	1000	29.48	24.04	8.12	8.59	195.2	15
ISEN200	200	1000	44.41	36.18	5.56	5.86	201.2	15
ISEN200	200	1000	29.64	24.14	8.31	8.74	200.6	15
ISEN205	205	1000	29.77	24.24	8.47	8.87	205.3	15

ISEN220	220	1000	33.19	27.06	8.15	8.61	220.5	15
ISEN225	225	1000	33.35	27.16	8.31	8.74	225.7	15
ISEN230	230	1000	33.46	27.25	8.45	8.84	230.3	15
ISEN250	250	1000	44.46	36.18	6.92	7.28	250.4	15
ISEN250	250	1000	37.05	30.12	8.31	8.75	250.3	15
ISEN255	255	1000	37.18	30.27	8.43	8.84	255.2	15
ISEN260	260	1000	37.28	30.58	8.51	8.93	260.2	15
ISEN265	265	1000	37.36	30.69	8.64	9.01	265.2	15
ISEN270	270	1000	40.58	33.08	8.17	8.62	270.3	15
ISEN275	275	1000	40.76	33.20	8.31	8.74	275.9	15
ISEN280	280	1000	40.89	33.29	8.43	8.84	280.6	15
ISEN300	300	1000	44.45	36.18	8.30	8.75	300.3	15
ISEN305	305	1000	44.59	36.33	8.40	8.83	305.2	15
ISEN310	310	1000	44.70	36.43	8.51	8.93	310.0	15
ISEN315	315	1000	44.85	36.52	8.63	9.02	315.2	15
ISEN320	320	1000	45.00	36.59	8.75	9.12	320.2	15
ISEN325	325	1000	45.02	36.73	8.85	9.16	325.1	15
ISEN330	330	1000	45.07	37.2	8.88	9.21	330.3	15

Note: According to the applicant declaration, Wattage of PV Module of lower rating and higher rating where the used Aluminum frame sections anodizing process remains same to include in the Report.

Letter of Declaration from the Aluminum frame vendor of the Applicant:

Ultra Aluminium (P) Ltd.

(Manufacturers of Aluminium Extrusions & Colouring)
(An ISO 9001 : 2008 Certified Company)

JAS-ANZ
Accr No M3111208

Dt. 18th June, 2015.

To,
Icon Solar En Power Technologies
319 - 320, 3rd Floor
Magneto Offizio
N.H.6, Labhandi
G. E. Road, Raipur
☎ : 09836280715

This is to certify here that, All the Aluminium Sections used from lower range to higher range will be going thru same Anodizing process.

This is for your kind information and record.

For. ULTRA ALUMINIUM PVT. LTD.

DIRECTOR

10, Gondwara, Industrial Area, Urla, Raipur - 493 221 (C.G.) India
Telefax : +91 771 4056605, Mob. : +91 73899 06156, Email : mail@ultraaluminium.com
www.ultraaluminium.com

Description of Item under Test (IUT)

1 Sample of crystalline photovoltaic module, Model IS-EN 310W was sent for testing representing the rest of the modules listed in cover page with same frame material and anodizing process as declared by client.

Aluminum Frame details:

1. Frame manufacturer Name: ULTRA Aluminum Pvt Ltd, Raipur, India
2. Anodizing process: Silver Anodizing
3. Anodizing thickness (Thickness of Aluminum Coating in microns): 15 microns

Test results:

Test No.	Test Name	Results
1	Visual Inspection Test (Before Salt Mist Test)	The Visual inspection before Salt mist test did not have any mechanical deterioration or corrosion on solar modules.
2	Maximum Power Determination (Before Salt Mist Test)	Maximum power attained :- 305.287 W
3	Insulation Test (Before Salt Mist Test)	1730 MΩ
4	Salt Mist Test (96 hours)	No mechanical deterioration or corrosion of module components was observed
5	Visual Inspection Test (After Salt Mist Test)	The Visual inspection after Salt mist test did not exhibit any mechanical deterioration or corrosion on solar modules.
6	Maximum Power Determination (After Salt Mist Test)	Maximum power attained :- 305.440 W
7	Insulation Test (After Salt Mist Test)	631 MΩ

Test methodology adopted as per IEC 61701 Ed: 1

Visual inspection (Before Salt Mist Test)

DATE: 2015/07/06

Test samples
One sample of the solar module was submitted for testing.

Test conditions

Carefully inspect each sample under an illumination of not less than 1000 lux for the following conditions:
1. No mechanical deterioration of module components which would significantly impair their Function during their intended life.
2. No mechanical corrosion of module components which would significantly impair their Function during their intended life.

Compliance Criteria – The Visual inspection before Salt mist test shall not exhibit any mechanical deterioration or corrosion on solar modules which would significantly impair their function during their intended life.

Result –

The Visual inspection before Salt mist test ~~did~~ /did not exhibit any mechanical deterioration or corrosion on solar modules.

Maximum power determination (Before Salt Mist Test)

DATE: 2015/07/06

Test samples
Sample after Visual Inspection was subjected to Maximum Power determination (Before Salt Mist Test).

Test configuration
The following equipment was used to perform I-V characteristic measurements in simulated sunlight (solar simulator):

a) Class A solar simulator in accordance with IEC 60904-9. The designated test area was greater than the area that is spanned by the test specimen.

b) A PV reference solar module in accordance with IEC 60904-2 was used to calibrate the sun simulator

c) The means for monitoring the temperature of the test specimen and the reference device to an accuracy of ±1 °C and repeatability of ±0.5 °C.

d) An irradiance sensor that tracks the instantaneous irradiance was placed in the test plane. This irradiance sensor was linear in the range of irradiances over which the measurements were taken.

e) The temperature of the reference device and the specimen was measured using instrumentation with accuracy of ±1 °C with repeatability of ±0.5 °C.

f) Equipment for measuring the current of the test specimen and reference device to an accuracy of ±0.2 % of the reading.

g) Equipment for measuring the voltage of the test specimen and reference device to an accuracy of ±0.2 % of the reading.

Compliance Criteria –
The Solar modules underwent the Maximum power determination test before Salt Mist Test, in order to record the Electrical data (Maximum Power) which was compared and analyzed for Percentage degradation after performing Salt Mist Test.

Result –

10.2	**TABLE: Maximum Power Determination (Initial)**				
Cell temperature (°C) :	25	—			
Irradiance (W/m^2) :	1000	—			
Initial examination					
Sample No.	Voc (V)	Vmp (V)	Isc (Amps)	Imp (Amps)	Pmp (W)
2156791	45.706	36.905	8.805	8.272	305.287

Lab Condition: - Temp: 25.4°C, Humidity: 50.8%RH

Insulation Test (Before Salt Mist Test)

DATE: 2015/07/06

Sample Requirements
Same Solar module from Maximum power determination test was submitted for this test.

Test configuration

a) Connect the shorted output terminals of the module to the positive terminal of a d.c. insulation tester with a current limitation.

b) Connect the exposed metal parts of the module to the negative terminal of the tester

c) Increase the voltage applied by the tester at a rate not exceeding 500 V/sec. to a maximum equal to 1000 V plus twice the maximum system voltage (i.e. the maximum system voltage marked on the module by the manufacturer). If the maximum system voltage does not exceed 50 V, the applied voltage shall be 500 V. Maintain the voltage at this level for 1 min.

d) Reduce the applied voltage to zero and short-circuit the terminals of the test equipment to discharge the voltage build-up in the module.

e) Remove the short circuit.

f) Increase the voltage applied by the test equipment at a rate not to exceed 500 V/sec. to 500 V or the maximum system voltage for the module, whichever is greater. Maintain the voltage at this level for 2 min. Then determine the insulation resistance.

g) Reduce the applied voltage to zero and short-circuit the terminals of the test equipment to discharge the voltage build-up in the module.

h) Remove the short circuit and disconnect the test equipment from the module.

Compliance Criteria –

For modules with an area greater than 0.1 m^2, there shall not be any dielectric breakdown or arc-over during Insulation test, and the measured insulation resistance shall not be less than 20.88 Mega Ohms.

Results –

Sample #	Length (m)	Width (m)	Area (L x W) m^2	Minimum Resistance 40Mohm*m^2/Area
2156791	1.958	0.982	1.920	20.83

The magnitude of the applied voltage and measured insulation resistance were as follows:

10.3	**Table: Insulation test**		
Module maximum system voltage rating (V, DC):		1000	—
Potential applied (V, DC) :		1000 / 3000	—
Initial Tests			
Sample #	Measured (MΩ)	Required (MΩ)	Result
2156791	1730	>20.88	P

For modules with an area greater than 0.1 m^2, there was no indication of dielectric breakdown or arc-over during Insulation test, and the measured insulation resistance was not less than 20.88MΩ

Lab Condition:-

Temp : 25.5°C
Humidity: 52.5%RH

Salt Mist Test (96 Hours)

Date: 2015/07/07 - 07/11/2015

Test samples

Same sample (PV Module) was used for evaluating the Salt Mist test.

Test configuration

The chamber for this test was constructed of such materials that would not influence the corrosive effects of the salt mist. The detailed construction of the chamber, including the method of producing the mist are as follows:
a) The conditions in the chamber were within the limits specified;
b) A sufficiently large volume with constant, homogeneous conditions (not affected by turbulence) is Available
c) No direct spray impinges upon the specimens under test;
d) Drops of liquid accumulating on the ceiling, the walls or other parts did not drip on the specimens;
e) The chamber was properly vented to prevent pressure build-up and allow uniform distribution of salt fog. The discharge end of the vent was protected from squalls which can cause strong air currents in the chamber.

Atomizer (s)

The atomizer(s) used were of such a design and construction as to produce a finely divided, wet, dense mist. The atomizer(s) was made of material that is non-reactive to the salt solution.

Salt solution Concentration

The salt used for the test was of high quality sodium chloride (NaCl) when dry, not more than 0.1% sodium iodide and not more than 0.3% of total impurities.
The salt solution concentration was 5 ± 1% by weight.

pH value

The pH value of the solution was 6.92 at a temperature of 35±2 degree C.

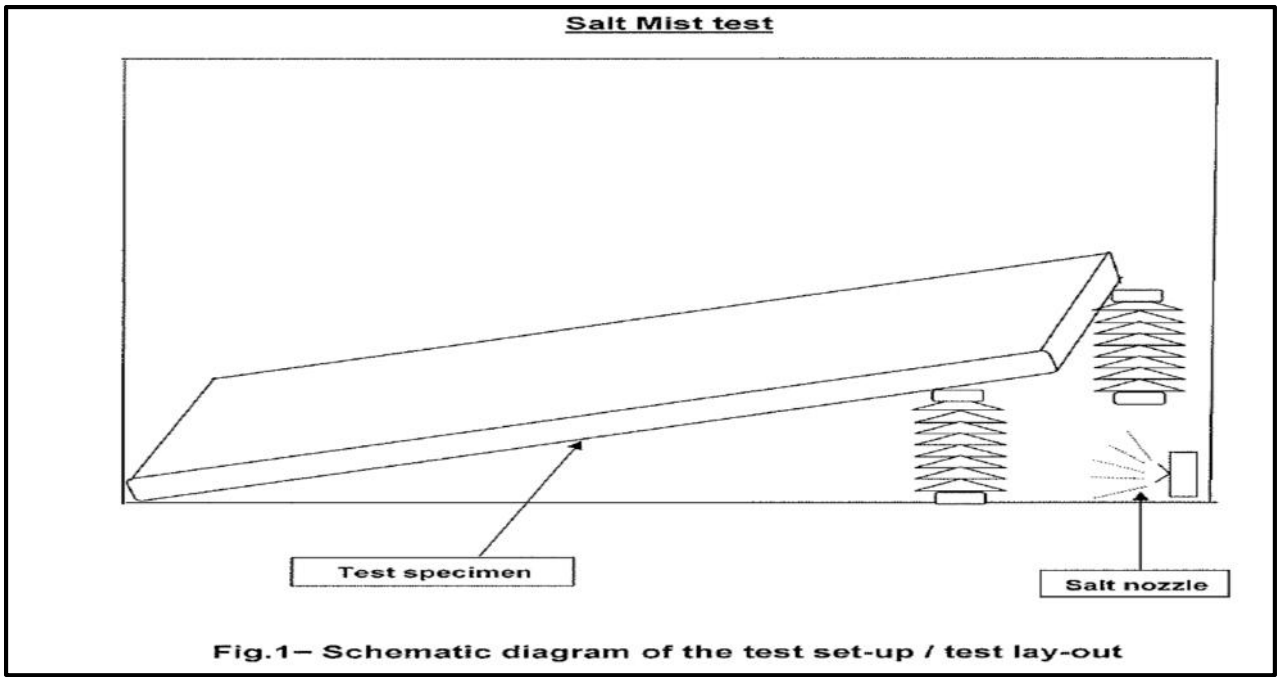


Fig.1– Schematic diagram of the test set-up / test lay-out

Compliance Criteria –

a) No mechanical deterioration or corrosion of module components which would significantly impair their function during their intended life.
b) The electrical performance (maximum power) shall not decrease by more than 5 % of the initial value.
c) The requirements of the insulation test shall meet.

Result –

Mechanical deterioration or corrosion of module frame components **was-not / ~~was~~** observed.

Sample	Temperature	Humidity	Date & Starting Time	Date & End Time
2156791	35 Deg	95%	03:00 PM 07/07/2015	03:00 PM 07/11/2015

Visual inspection (After Salt Mist Test)

Date: 2015/07/14

Test samples

The PV Module which underwent the salt mist test was put under Visual Inspection test to determine any changes in the module which can significantly impair their function during their intended life.

Test conditions

Carefully inspect each sample for the following conditions:

1. No mechanical deterioration of module components which would significantly impair their function during their intended life.
2. No mechanical corrosion of module components which Would significantly impair their function during their intended life.

Compliance Criteria – The Visual inspection after Salt mist test should not exhibit any mechanical deterioration or corrosion on solar modules which would significantly impair their function during their intended life.

Result –

The Visual inspection after Salt mist test ~~did~~ / did not exhibit any mechanical deterioration or corrosion on solar modules.

Maximum power determination (After Salt Mist Test)

Date: 2015/07/14

Test samples
The solar module which undergone the visual inspection test were selected for maximum power determination

Test configuration
The following equipment was used to perform I-V characteristic measurements in simulated sunlight (solar simulator):

a) Class A solar simulator in accordance with IEC 60904-9. The designated test area was equal greater than the area that is spanned by the test specimen.

b) A PV reference solar module in accordance with IEC 60904-2 was used to calibrate the sun simulator

c) The means for monitoring the temperature of the test specimen and the reference device to an accuracy of ±1 °C and repeatability of ±0.5 °C.

d) An irradiance sensor that tracks the instantaneous irradiance in the test plane. This irradiance sensor was linear in the range of irradiances over which the measurements are taken.

e) The temperature of the reference device and the specimen was measured using instrumentation with an accuracy of ±1 °C with repeatability of ±0.5 °C.

f) Equipment for measuring the current of the test specimen and reference device to an accuracy of ±0.2 % of the reading.

g) Equipment for measuring the voltage of the test specimen and reference device to an accuracy of ±0.2 % of the reading.

Compliance Criteria –

The Solar module had undergone the Maximum power determination test after Salt Mist Test, in order to record the Electrical data (Rated Maximum Power) which will be compared and analyzed for Percentage degradation after performing Salt Mist Test.

Result –

10.2	**TABLE: Maximum Power Determination (After Salt Mist)**				
Cell temperature (°C) :	25	—			
Irradiance (W/m^2) :	1000	—			
Initial examination					
Sample No.	Voc (V)	Vmp (V)	Isc (Amps)	Imp (Amps)	Pmp (W)
2156791	45.845	36.790	8.850	8.302	305.440

Sample No.	Pmax(initial)	Pmax (after salt mist)	Degradation (%)
2156791	305.287	305.440	0.005%

The electrical performance (Maximum power) ~~was~~ / was not found to decrease by more than 5% of the initial value.

Insulation Test (After Salt Mist Test)

Date: 2015/07/14

Sample Requirements
Solar module was then submitted for this test.

Test configuration

a) Connect the shorted output terminals of the module to the positive terminal of a D.C. insulation tester with a current limitation.

b) Connect the exposed metal parts of the module to the negative terminal of the tester

c) Increase the voltage applied by the tester at a rate not exceeding 500 V./sec. to a maximum equal to 1000 V plus twice the maximum system voltage (i.e. the maximum system voltage marked on the module by the manufacturer). If the maximum system voltage does not exceed 50 V, the applied voltage shall be 500 V. Maintain the voltage at this level for 1 min.

d) Reduce the applied voltage to zero and short-circuit the terminals of the test equipment to discharge the voltage build-up in the module.

e) Remove the short circuit.

f) Increase the voltage applied by the test equipment at a rate not to exceed 500 V/sec. to 500 V or the maximum system voltage for the module, whichever is greater. Maintain the voltage at this level for 2 min. Then determine the insulation resistance.

g) Reduce the applied voltage to zero and short-circuit the terminals of the test equipment to discharge the voltage build-up in the module.

h) Remove the short circuit and disconnect the test equipment from the module

Compliance Criteria –

For modules with an area greater than 0.1 m^2, there should not be any dielectric breakdown or arc-over during Insulation test and the measured insulation resistance should not be less than 20.88MΩ

Results –

The magnitude of the applied voltage and measured insulation resistance were as follows:

10.3	**Table: Insulation test**		
Module maximum system voltage rating (V, DC):		1000	—
Potential applied (V, DC) :		1000 / 3000	—
Initial Tests			
Sample #	Measured (MΩ)	Required (MΩ)	Result
2156791	631	>20.88	P

For modules with an area greater than 0.1 m^2, there was no indication of dielectric breakdown or arc-over during Insulation test and the measured insulation resistance was not less than 20.88MΩ

Lab Condition:-
Temp : 24.8°C
Humidity: 53.7% RH

Summary of Test Results

Test Parameter	Standard & Clause Number	UL Sample Identification	Result
See table	IEC 61701, Ed. 1	2156791	**P**

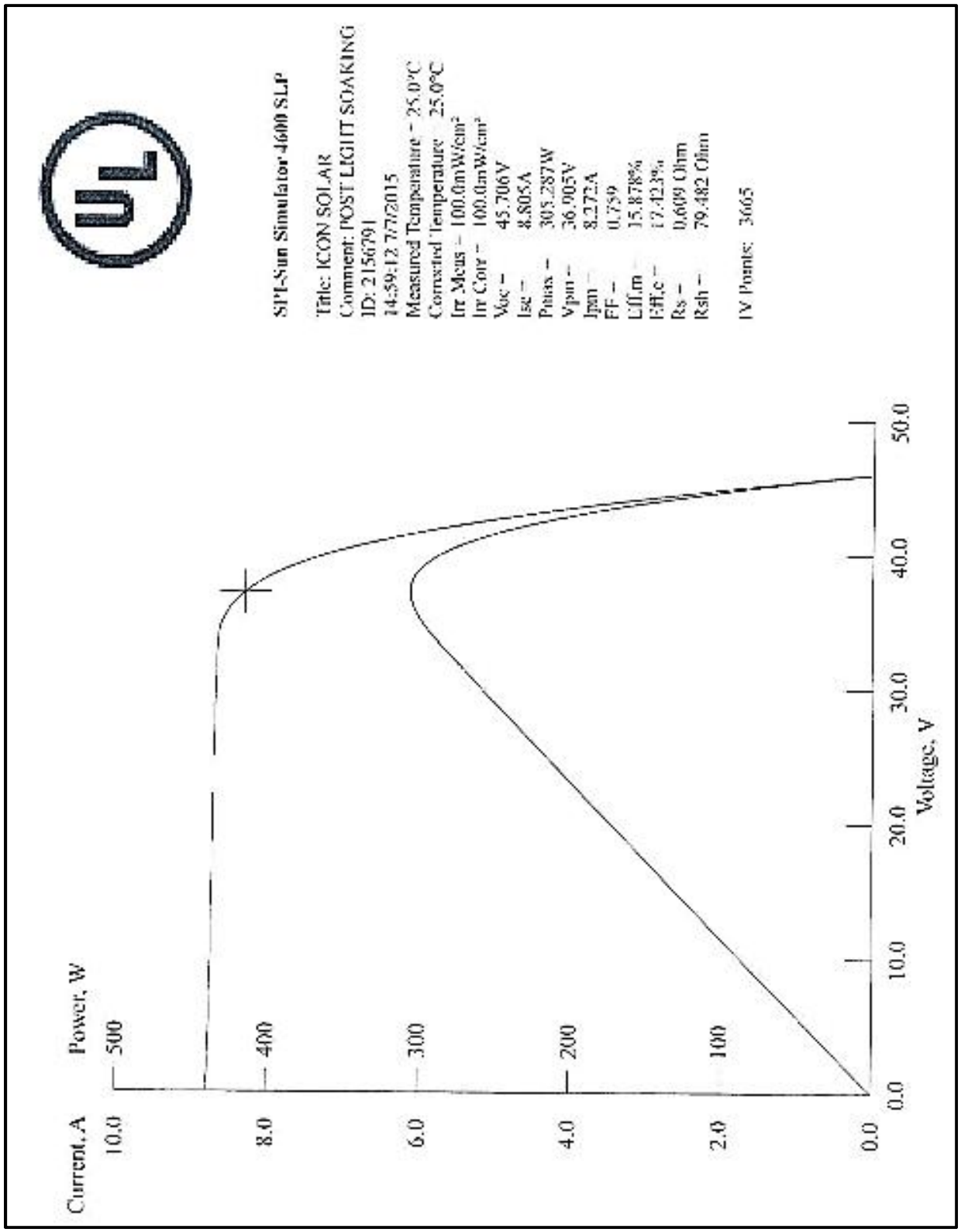
P: Meets the requirements F: Does not meet the requirement NA: Not applicable

Equipment and Calibration details:

Local ID	Equipment Type	Test Title	Last Cal	Next Cal
SSC01	SALT SPRAY CHAMBER (PV LAB)	CORROSSION TEST	02/12/2015	02/12/2016
SSC01	SALT SPRAY CHAMBER (PV LAB)	CORROSSION TEST	02/12/2015	02/12/2016
SSC01	SALT SPRAY CHAMBER (PV LAB)	CORROSSION TEST	02/12/2015	02/12/2016
SSC01	SALT SPRAY CHAMBER (PV LAB)	CORROSSION TEST	02/12/2015	02/12/2016
FST01	FLASH SOLAR SIMULATOR (PV LAB)	INITIAL PIV MEASUREMENT	01/10/2015	01/10/2016
H08	Temperature & Humidity Recorder (PV LAB)	INITIAL PIV MEASUREMENT	05/30/2015	05/30/2016
REF300	REFERENCE MODULE (PV LAB)	INITIAL PIV MEASUREMENT		
SSS01	FLASH SOLAR SIMULATOR (PV LAB)	INITIAL PIV MEASUREMENT		
TP12	Measuring Tape	INITIAL PIV MEASUREMENT	03/07/2015	03/07/2016
DI03	Dieelctric Tester (PV Lab)	POST SALT MIST IR TEST	06/16/2015	06/16/2016
H11	Temperature & Humidity Recorder (PV LAB)	POST SALT MIST IR TEST	05/30/2015	05/30/2016
RT02	Insulation Resistance Tester (PV LAB)	POST SALT MIST IR TEST	02/23/2015	02/23/2016

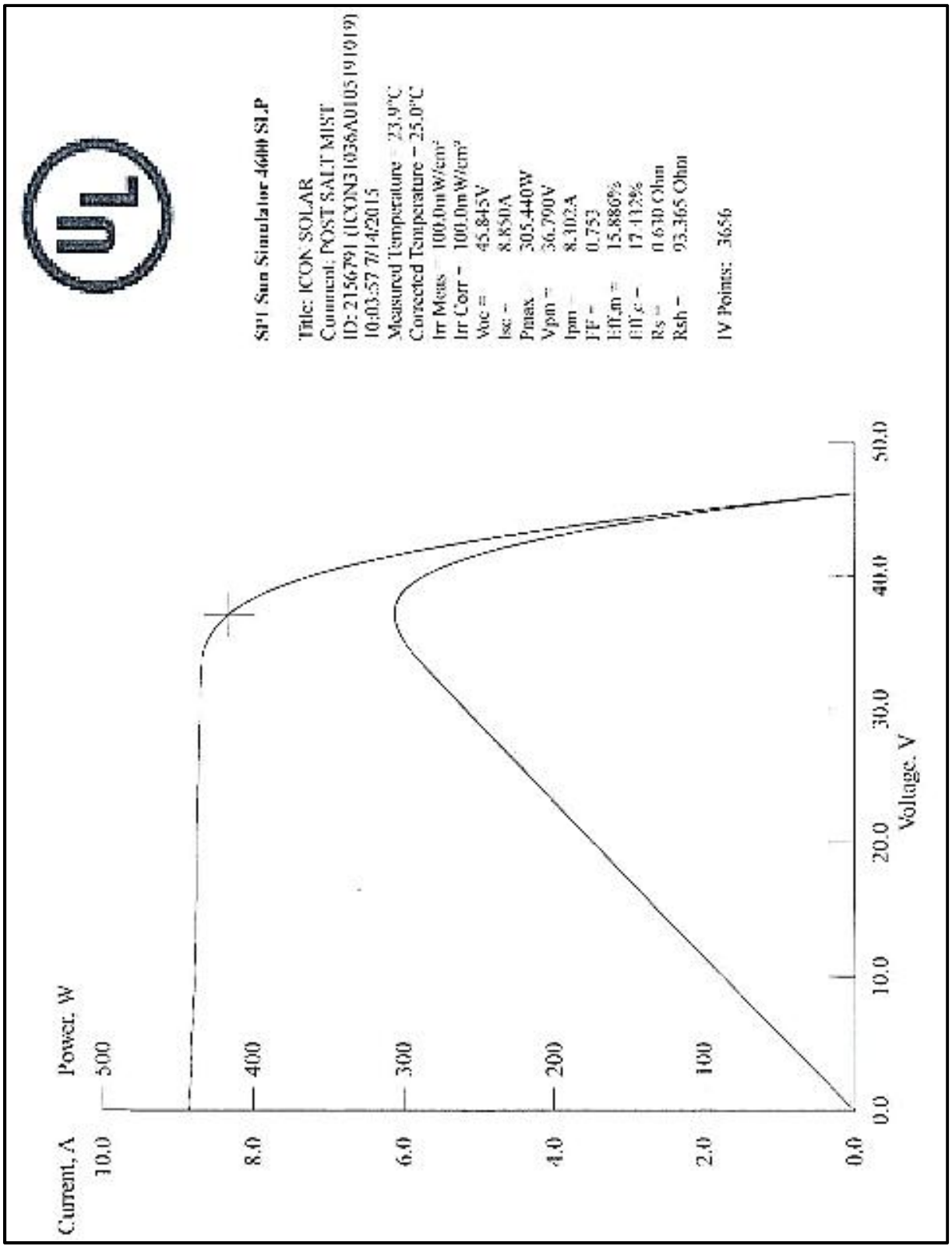
Test PIV Graphs

Graph of Maximum power determination Initial measurement before Salt Mist test



Test PIV Graphs

Graph of Maximum power determination after Salt Mist test



Photographs

******End of the Report******