



# Test Report

## RAYZON SOLAR PRIVATE LIMITED

REPORT NUMBER: 4790927511.4.1-OTHER-S1

PROJECT NUMBER: 4790927511.4.1

### Select the applicable test

#### locations:

**LOCATION 1:**

UL India Private Limited,  
Laboratory building, Kalyani Platina  
Campus, Sy.no.129/4, EPIP Zone,  
Phase II, Whitefield,  
Bangalore - 560 066  
P:91-80-41384400

**LOCATION 2:**

UL India Private Limited,  
Oak building, Kalyani Platina  
Campus, Sy.No.129/4,  
EPIP Zone, Phase II, Whitefield,  
Bangalore, Karnataka - 560 066

**LOCATION 3:**

UL India Private Limited, 30/A, I  
Stage, Vishveshwarya Industrial  
Estate, Doddanekkundi Industrial  
Area, Bangalore - 560048

**Other:**

**(#Refer Page no. for Test lab  
location)**



**TEST DISCIPLINE: ELECTRONICS**  
**PRODUCT GROUP: SOLAR PANEL**

**General details**

<b>Customer / Applicant</b>	Rayzon Solar Private Limited Block no 94/1/1F,94/1/3,102/1,103,104,105,109,110,118,119,120 Kim Mandvi Road, Nr. Hariya Talav B/H Aron Pipe, Karanj, Surat, Gujarat-394110, INDIA.		
<b>Manufacturer</b>	Rayzon Solar Private Limited Block no 94/1/1F,94/1/3,102/1,103,104,105,109,110,118,119,120 Kim Mandvi Road, Nr. Hariya Talav B/H Aron Pipe, Karanj, Surat, Gujarat-394110, INDIA.		
<b>Program</b>	<b>OTHER</b>		
<b>Item Under Test</b>	Photovoltaic Module		
<b>Model</b>	RSB545WC		
<b>Number of Samples</b>	01		
<b>UL. Sample Identification</b>	6271662	<b>Refer Summary of Test results for multiple samples</b>	
<b>Manufacturer Serial Number (if any)</b>	RSBL1M0060723159318		
<b>Condition of IUT on receipt</b>	Good		
<b>Date of Receipt</b>	15 July 2023		
<b>Applicable Standard</b>	CEC-300-2018-009-CMF, Guidelines for California's Solar Electric Incentive Programs IEC 61215, Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval, Edition 2, Issue Date 04/27/2005		
<b>Date of Testing (Start date)</b>	1 February 2024	<b>End Date</b>	19 February 2024
<b>UL general ambient condition</b>	<b>Temperature in °C</b>		(23 ±5)°C
	<b>Relative humidity in %</b>		<70 %
<b>Date of Issue</b>	21 March 2024		
<b>Test In-charge</b>	Mohan A		

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CIN: U74200KA1997PTC023189



Kantha Raju H S Senior Project Engineer	Moumita Debnath Engineering Leader
<b>Reviewed by</b>	<b>Authorized signatory</b>

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## General Remarks (If any)

UL Company did not select the sample(s), determine whether the sample(s) was representative of production samples, witness the production of the test sample(s), nor were we provided with information relative to the formulation or identification of component materials used in the test sample(s). The test results apply only to the actual samples tested.

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## Summary of Test Results

This report is prepared only for the additional performance testing (beyond UL 1703 or UL 61730-1 and UL 61730-2 PV module safety standards) required by the CEC guideline CEC-300-2018-009-CMF – Titled “GUIDELINES FOR CALIFORNIA’S SOLAR ELECTRIC INCENTIVE PROGRAMS, (SENATE BILL 1), SEVENTH EDITION” dated December 2018. This report does not include an evaluation of the provided samples’ compliance to UL 1703, UL 61730-1 or UL 61730-2.

Samples of the photovoltaic module type “RSB545WC” was submitted by the manufacturer for examination and test.

Based on CEC (California Energy Commission) Guidelines for California’s Solar Incentive Programs, seventh Edition, December 2018 requirements a reduced IEC 61215 test program was conducted on the above samples. Test results relate only to the items tested.

## Description of Item under Test (IUT)

### 1.1. Sample selection procedure

All the sample were selected and provided by client, UL LLC did not select the sample[s], determine whether the sample[s] was representative of production samples, witness the production of the test sample[s], nor were we provided with information relative to the formulation or identification of component materials used in the test sample[s].

The following procedure must be followed to select representative models for additional testing. It is based on the procedure from Appendix B of the document CEC-300-2018-009-CMF – Titled “GUIDELINES FOR CALIFORNIA’S SOLAR ELECTRIC INCENTIVE PROGRAMS, (SENATE BILL 1), SEVENTH EDITION” dated December 2018.

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**1.1.1. Grouping of Modules for Testing:**

For testing and reporting of performance values, families of similar modules may be grouped together to reduce the required number of tests. Module similarity for grouping of modules for testing shall be determined by the ISO/IEC 17025 accredited laboratory performing the additional testing as required on pages B-1 and B-2 of CEC-300-2018-009-CMF. IEC TS 62915, Photovoltaic (PV) Modules – Type approval, design and safety qualification – Retesting shall be used for guidance.

NRTL certification to UL 1703 or UL 61730-1 and UL 61730-2 of the PV models tested in this report was conducted by:

- UL Solutions, under file: E529329
- Other NRTL, as stated by the PV module manufacturer

Verification of module components is the responsibility of the NRTL that has certified the model to UL 1703 or UL 61730-1 and UL 61730-2.

The module manufacturer has identified the construction of each Main group selected for testing by entering component details in the table below. Component-level verification and factory surveillance is the responsibility of the accredited NRTL that certifies the PV model(s) to UL 1703 or UL 61730-1 and UL 61730-2. (If only one construction is used then there is only one Main group):

One samples of the photovoltaic module type “RSB545WC” was submitted by the manufacturer for examination and test.

<b>Main Group</b>	<b>1</b>
Construction item.	RSB545WC
Highest power model in group	RSB560WC
Module size	2278 X 1133 x 40 mm
Encapsulant	Front side (on top of the cells): Alishan Green Energy Private Limited, R/C(QIHE2. E522747) Type: Alishan Front EVA Thickness: 0.60 mm Rear side (on bottom of the cells): Manufactured by: Alishan Green Energy Private Limited, R/C(QIHE2. E522747) Type: Alishan FC Thickness: 0.60 mm
Substrate	Manufactured by: Jolywood (Suzhou) Sunwatt Co., Ltd.

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	Type: FFC-JW30(plus), FFC/PET/FFC, overall thickness - 0.315mm, Color: Transparent
Superstrate	Manufactured by: Flat (Hong Kong) Co Limited (FLAT), Type: AR Coated, Low iron, Tempered glass, Thickness: 3.2mm,
Cells	Manufactured by: Solar Space Technology (Laos) Sole Co.,Ltd (Solar Space), Type: M10 P-Type Bifacial Mono PERC solar cell, dimension: 182 (±0.5) X 91 (±0.5) mm
Number of cells	144
Number of strings	3
Tabbing	Interconnect wires - Solder plated copper wires used for cell-to-cell connections, 10 bus wires in parallel, each wire 0.32 mm diameter minimum. Solder composition 60Sn40Pb. End ribbons - Solder plated copper ribbons used for connections between interconnect ribbons and junction box. 6 mm wide, 0.35 mm min. thick. (Middle) and 4 mm wide, 0.30 mm. thick (Top and Bottom) Solder composition 60Sn40Pb.
Junction box	Junction Box: Manufactured by: Manufactured by Genx PV India Private Limited Type: GXSB-01 rated 1500 Vdc, 25 A max Potted with RTV "5299W-S" manufactured by SHANGHAI HUITIAN NEW MATERIAL CO LTD. Cabel: APAR Industries Limited, type PV Wire, 12 AWG, rated sunlight resistant, 90°C wet or dry, 2000 V. Outer diameter – 6.4 mm Connector: Genx PV India Private Limited, Type: GXC-01, IP68 rated 1500 Vdc, 30 A max. with 12 AWG cable Bypass diode: Manufactured by Genx PV India Private Limited, type "MK5045".

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The ratings of each model within the identified Main group shall be entered into the following table(s).

Main Group No.		[1]				
Model	Front Side Ratings Provided By The Manufacturer					
	Open Circuit Voltage at STC, (V dc)	Rated Voltage at STC, (V dc)	Max System Voltage, (V dc)	Rated Current at STC, (A dc)	Short Circuit Current at STC, A dc)	Rated Max Power at STC, (Watts)
RSB560WC	50.34	42.42	1500	13.21	13.77	560
RSB555WC	50.2	42.28	1500	13.13	13.71	555
RSB550WC	50.06	42.14	1500	13.06	13.65	550
RSB545WC	49.91	42.01	1500	12.98	13.59	545
RSB540WC	49.78	41.86	1500	12.91	13.53	540
RSB535WC	49.64	41.72	1500	12.83	13.47	535
RSB530WC	49.5	41.58	1500	12.76	13.41	530
RSB525WC	49.36	41.44	1500	12.68	13.35	525

Note: Tolerance for Isc, Voc is ±5%, and Pmax is -0%/+3%

1. For each Main group, the following tests (Test Lot 1) shall be performed on a model number (Model 2) that has an STC power rating that is within 95 percent (rounded to the nearest watt) of the highest STC power rating in the group (Model 1):
  - a. Nominal operating cell temperature (NOCT) determination
  - b. Temperature coefficient of short-circuit current
  - c. Temperature coefficient of open-circuit voltage
  - d. Temperature coefficient of maximum power

Test Lot 1		
Model 1	Rated Maximum Power at STC, (Watts)	Main Group Number
RSB545WC	545	1

Each Main group shall be split into subgroups according to the following criteria.

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2. To determine the model with lowest STC Maximum Power which can be included in the first subgroup of the Main group, following criteria apply:

$$\frac{\text{STC Maximum Power rating (Model 2)}}{\text{STC Maximum Power rating (Model 3)}} \leq 0.9$$

All of the models with Maximum Power ratings falling between Model 1 and Model 3 constitute the first subgroup.

Note: No further subgroup identified.

Enter those models in the table. (Create additional tables as needed).

Main Group:		<b>1</b>
Subgroup:		<b>1</b>
Model	Rated Maximum Power at STC, (Watts)	Identify Sample to be used for testing (Model 2)
RSB525WC	525	545
RSB530WC	530	
RSB535WC	535	
RSB540WC	540	
<b>RSB545WC</b>	<b>545</b>	
RSB550WC	550	
RSB555WC	555	
RSB560WC	560	

Each test model identified within each subgroup shall be selected for Test Lot 2.

Copy the models identified for testing into the following table.

Test Lot 2			
Model	Rated Maximum Power at STC, (Watts)	Main Group	Subgroup
RSB545WC	545	1	1

Each model identified for testing shall be subjected to the following tests (Test Lot 2):

- (10.6) Performance at Standard Test Conditions (STC)
- (10.6) Performance at Standard Test Conditions (NOCT)
- (10.7) Performance at Low Irradiance

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## Test Results:

### **2.1. Maximum Power Determination (IEC 61215 Clause 10.2)**

Test date [yyyy-mm-dd]: 2024-02-01

Model no.	Voc (V)	Vmp (V)	Isc (Amps)	Imp (Amps)	Pmp (W)
RSB545WC	49.89	42.05	13.64	13.01	547.11

### **2.2. Measurement of Temperature Coefficients (IEC 61215 Clause 10.4)**

Test date [yyyy-mm-dd]: 2024-02-02

Model tested / (S/N)	RSB545WC/ (RSBL1M0060723159318)
Short circuit current ( $\alpha_s$ ) (%/°C)	0.0213
Maximum Power Current ( $\alpha_m$ ) (%/°C)	-0.0033
Open circuit voltage ( $\beta_o$ ) (%/°C)	-0.2241
Maximum Power Voltage ( $\beta_m$ ) (%/°C)	-0.2953
Peak (max.) power ( $\delta$ ) (%/°C)	-0.2981

### **2.3. Measurement of Nominal Operating Cell Temperature (NOCT) (IEC 61215 Clause 10.5)**

Test date [yyyy-mm-dd]: 2024-02-03 to 2024-02-10

Model tested/ (S/N)	RSB545WC (RSBL1M0060723159318)
Nominal operating cell temperature (NOCT)	45.61°C

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**2.4. Performance at Standard Test Conditions (STC) (IEC 61215 Clause 10.6)**

Test date [yyyy-mm-dd]: 2024-02-19

TABLE: Performance at STC					
Model no.	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	Pmp (W)
RSB545WC	49.83	42.23	13.57	12.90	544.64

**2.5. Performance at Nominal Operating Cell Temperature (NOCT) (IEC 61215 Clause 10.6)**

Test date [yyyy-mm-dd]: 2024-02-19

TABLE: Performance at NOCT					
Model no.	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	Pmp (W)
RSB545WC	46.73	39.03	10.94	10.41	406.42

**2.6. Performance at Low Irradiance (IEC 61215 Clause 10.7)**

Test date [yyyy-mm-dd]: 2024-02-19

TABLE: Performance at Low Irradiance					
Model no.	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	Pmp (W)
RSB545WC	46.81	41.86	2.72	2.59	108.21

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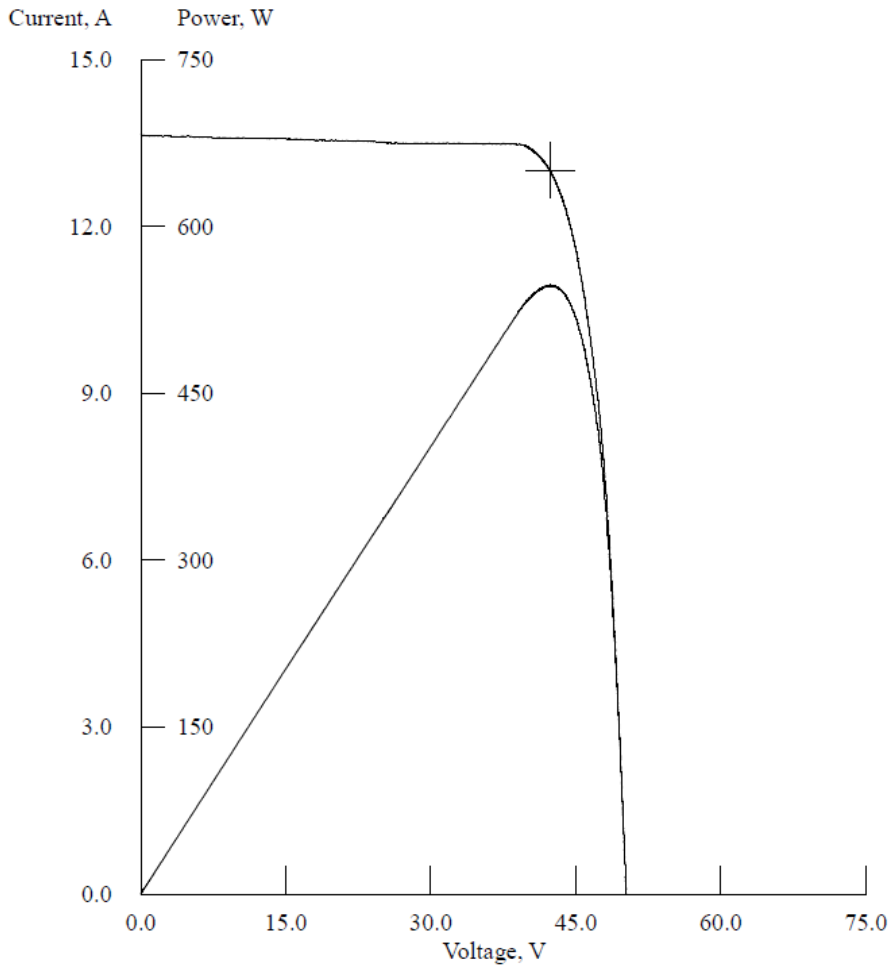
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## Appendix

### PIV Graphs:



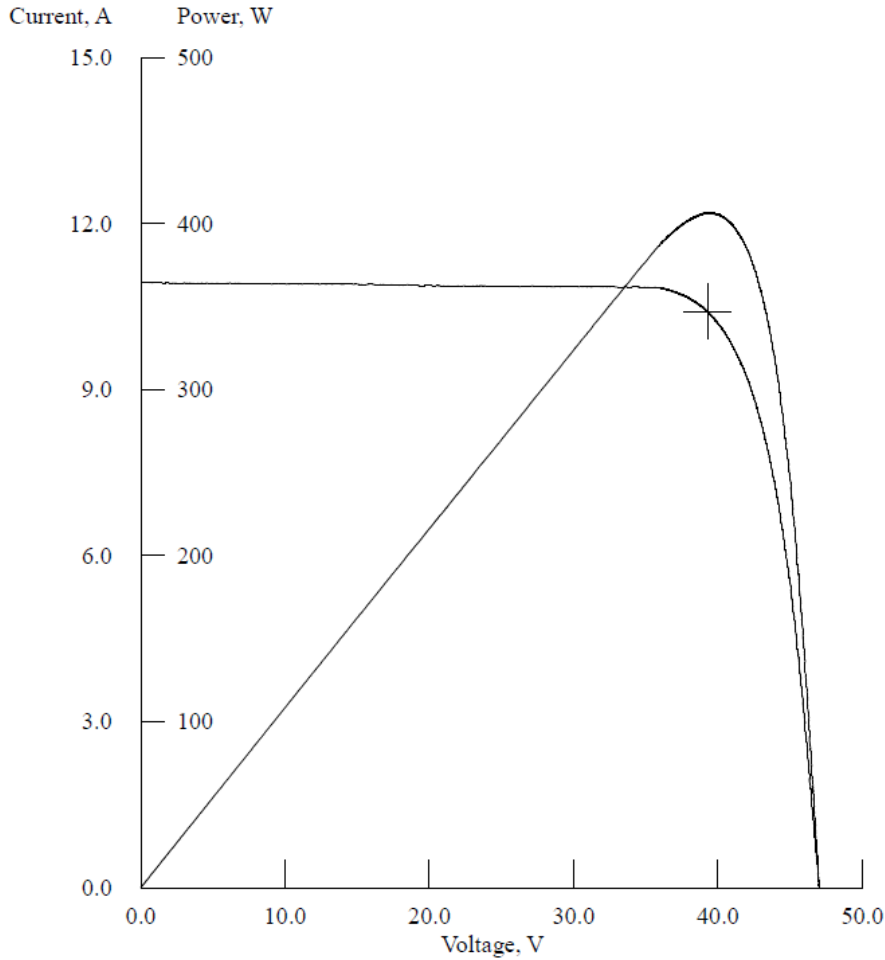
5600

Title: RAYZON SOLAR\_4790927511  
Comment: NITIAL PIV  
Operator: Admin  
ID: 6271662 (RSBL1M0060723159318)  
Module Type: ModuleType1  
10:02:17 01-02-2024  
Measured Temperature = 25.3°C  
Corrected Temperature = 25.0°C  
Irr Meas = 100.0mW/cm<sup>2</sup>  
Irr Corr = 100.0mW/cm<sup>2</sup>  
Voc = 49.89V  
Isc = 13.64A  
Pmax = 547.11W  
Vpm = 42.05V  
Ipm = 13.01A  
FF = 0.80  
Eff,m = 21.21%  
Eff,c = 23.22%  
Rs = 0.24 Ohm  
Rsh = 156.24 Ohm

Load Voltage: 5.400 V  
IV Points: 3752

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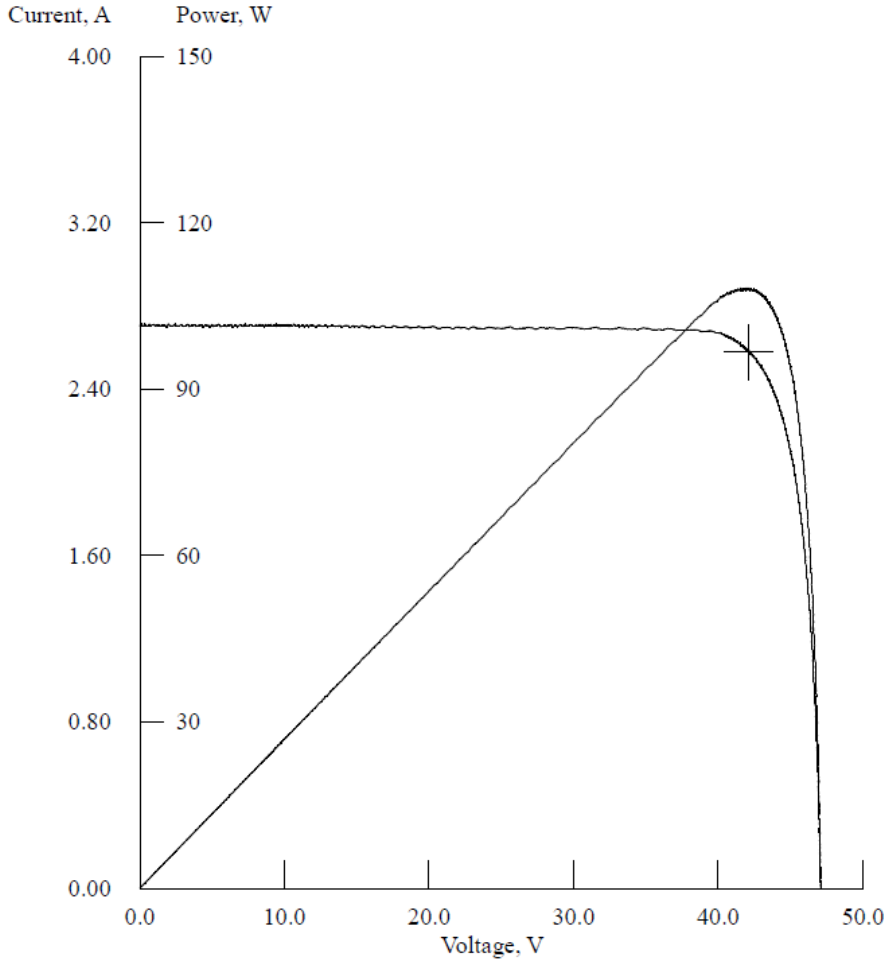
5600

Title: RAYZON SOLAR\_4790927511  
Comment: PIV@NOCT  
Operator: Admin  
ID: 6271662  
Module Type: ModuleType1  
11:28:45 19-02-2024  
Measured Temperature = 46.7°C  
Irr Meas = 80.0mW/cm<sup>2</sup>  
Irr Corr = 80.0mW/cm<sup>2</sup>  
Voc = 46.73V  
Isc = 10.94A  
Pmax = 406.42W  
Vpm = 39.03V  
Ipm = 10.41A  
FF = 0.79  
Eff.m = 19.69%  
Eff.c = 21.56%  
Rs = 0.33 Ohm  
Rsh = 244.63 Ohm

Load Voltage: 4.500 V  
IV Points: 3777

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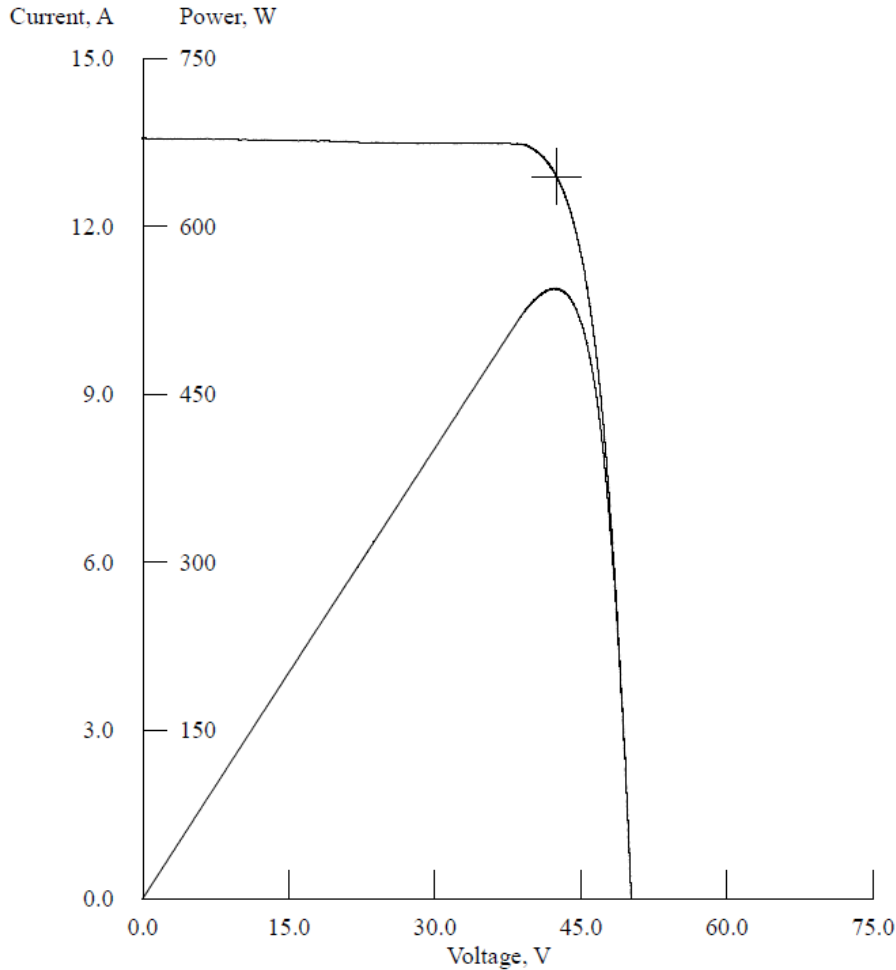


5600

Title: RAYZON SOLAR\_4790927511  
Comment: PIV@LOW IRR  
Operator: Admin  
ID: 6271662  
Module Type: ModuleType1  
12:22:31 19-02-2024  
Measured Temperature = 24.3°C  
Corrected Temperature = 25.0°C  
Irr Meas = 20.0mW/cm<sup>2</sup>  
Irr Corr = 20.0mW/cm<sup>2</sup>  
Voc = 46.81V  
Isc = 2.72A  
Pmax = 108.21W  
Vpm = 41.86V  
Ipm = 2.59A  
FF = 0.85  
Eff.m = 20.97%  
Eff.c = 22.96%  
Rs = 0.41 Ohm  
Rsh = 391.61 Ohm  
Load Voltage: 2.100 V  
IV Points: 3598

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5600

Title: RAYZON SOLAR\_4790927511  
Comment: PIV@STC  
Operator: Admin  
ID: 6271662  
Module Type: ModuleType1  
12:20:40 19-02-2024  
Measured Temperature = 24.5°C  
Corrected Temperature = 25.0°C  
Irr Meas = 100.0mW/cm<sup>2</sup>  
Irr Corr = 100.0mW/cm<sup>2</sup>  
Voc = 49.83V  
Isc = 13.57A  
Pmax = 544.64W  
Vpm = 42.23V  
Ipm = 12.90A  
FF = 0.81  
Eff.m = 21.11%  
Eff.c = 23.12%  
Rs = 0.25 Ohm  
Rsh = 542.22 Ohm

Load Voltage: 5.300 V  
IV Points: 3673

\*\*\*\*\*End of Report\*\*\*\*\*

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