Test Report issued under the responsibility of:

DEKRA

TEST REPORT
IEC 62716:2013
Photovoltaic (PV) modules - Ammonia corrosion testing

Report Number. .....:	**6208030A.51**
Date of issue .....:	**2024-12-23**
Total number of pages……:	**16**
DEKRA Branch .....:	**DEKRA Testing and Certification (Shanghai) Ltd.**
Applicant's name.....:	**Icon Solar- En Power Technologies Private Limited.**
Address .....:	**Village-Dighari, Teh – Arang, Dist, Raipur-493441, Chhattisgarh, India.**
Test specification:	
Standards.....:	IEC 62716:2013 EN 62716:2013
Test procedure .....:	DEKRA Type Approved Seal
Non-standard test method.....:	N/A
Test Report Form No.....:	AMM_A
Test Report Form(s) Originator ....:	DEKRA Testing and Certification (Shanghai) Ltd.
Master TRF.....:	2019-05-20

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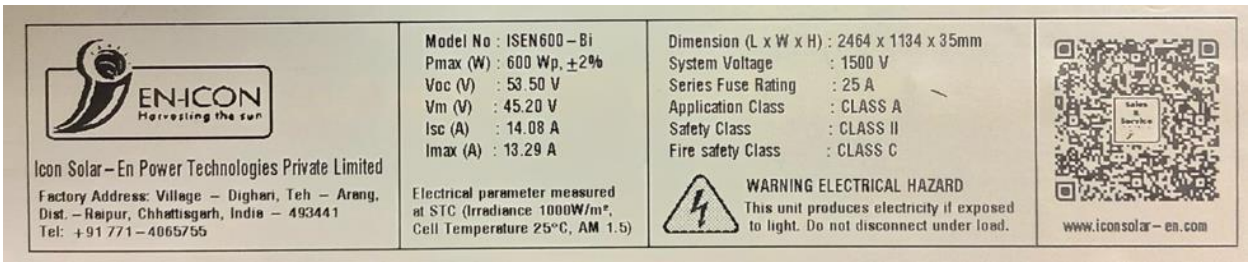
Test item description.....:	Photovoltaic (PV) Module(s)	
Trade Mark.....:	EN-ICON	
Manufacturer .....:	Icon Solar- En Power Technologies Private Limited.	
Model/Type reference.....:	ISENxxx-Bi (xxx=560-600, in steps of 5, 156 half cut cell) ISENxxx-Bi (xxx=520-555, in steps of 5, 144 half cut cell) ISENxxx-Bi (xxx=480-505, in steps of 5, 132 half cut cell) ISENxxx-Bi (xxx=420-460, in steps of 5, 120 half cut cell) ISENxxx-Bi (xxx=380-410, in steps of 5, 108 half cut cell)	
Ratings.....:	Refer to Annex 1 for more details.	
Testing procedure and testing location:		
☒ **DEKRA Branch**	DEKRA Testing and Certification (Shanghai) Ltd.	
Testing location/ address.....:	3F #250, Jiangchangsan Road, Building 16, Headquarter Economy Park Shibei Hi-Tech Park, Jing'an District, Shanghai, 200436, P.R. China	
☒ **Associated Testing Laboratory**	DEKRA Testing and Certification (Shanghai) Ltd.	
Testing location/ address.....:	No.16, Lane 1288, Luoning Road, Baoshan District, Shanghai, 200949, P.R.China	
Tested by (name, function, signature) .....:	Lee Huang	
Approved by (name, function, signature).....:	Kevin Lu	

List of attachments (including a total number of pages in each attachment):	
	attachment number / number of pages
Installation manual:	
Drawings mechanical:	
Circuit diagram:	
Photographs:	Annex 1 / 1 page
Component datasheets / certificates	
Others:	
IV curve for STC measurement	
EL-images	
List of measurement equipment	Annex 2 / 1 page
Statement of test uncertainty	Annex 3 / 1 page
History report	
Summary of testing:	
Tests performed (name of test and test clause): Visual inspection (MST 01) Maximum power determination (10.2) Dielectric withstand test (MST 16) Wet leakage current test (10.15) Ground continuity test (MST 13) Ammonia corrosion test Bypass diode functionality test (MST 07)	**Testing location:** DEKRA Testing and Certification (Shanghai) Ltd. No.16, Lane 1288, Luoning Road, Baoshan District, Shanghai, 200949, P.R. China

Copy of marking plate:

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.



Possible test case verdicts:	
- test case does not apply to the test object..... :	N/A
- test object does meet the requirement ..... :	P (Pass)
- test object does not meet the requirement ..... :	F (Fail)
Abbreviations used in the report:	
Pmax – Maximum power	α – Current temperature coefficient
Vmp – Maximum power voltage	β – Voltage temperature coefficient
Imp – Maximum power current	δ – power temperature coefficient
Isc – Short circuit current	NMOT – Nominal Module Operating Temperature (20°C, 800 W/m²)
Voc – Open circuit voltage	VFMrated – Rated diode(s) forward voltage
FF – Fill factor	VFM – Measured diode(s) forward voltage
STC – Standard Test Conditions (25°C, 1 000 W/m²)	NP – Nameplate
t_1 – the manufacturer's rated lower production tolerance in % for Pmax	t_2 – the manufacturer's rated upper production tolerance in % for Voc
t_3– the manufacturer's rated upper production tolerance in % for Isc	r – Pmax measurement reproducibility
m_1 – the measurement uncertainty in % of laboratory for Pmax	m_2 – the measurement uncertainty in % of laboratory for Voc
m_3 – the measurement uncertainty in % of laboratory for Isc	
Testing Dates (YYYY-MM-DD)	
Date of first test item received..... :	2024-11-21
Dates of tests (beginning/end)..... :	2024-11-23 / 2024-12-20

GENERAL REMARKS:

According to the inquiry, test procedure was in accordance with IEC 62716:2013, EN 62716:2013.
Test procedure is according to client's requirements. Test results are documented within this test report.

Maximum System Voltage: 1500 V
Hours: 8h including heating up(1 test section), 16h including cooling(2 test section)
NH3 concentration: 6667ppm(1 test section), 0ppm(2 test section)
Temperature: 60°C(1 test section), 18°C -28°C(2 test section)
Relative humidity: nearly 100%(1 test section), max. 75%(2 test section)
Duration: 20 cycles = 480 hours (20 days)
Product material information is listed as below:

Material	**Manufacturer/ trademark**	**Type/model**
By Pass Diode	GENX PV INDIA PRIVATE LIMITED.	MK5045, Vrrm : 45V, If (av): 50 A.
Front Cover	BOROSIL RENEWABLES LTD.	AR Coated Tempered solar Glass, Thickness: 3.2mm, Light transmittance> 94%
Rear Cover	Alishan Green Energy Pvt. Ltd.	Model- ABS-KPC-T, voltage: 1500V.
Encapsulation Material (TOP)	Alishan Green Energy Pvt. Ltd.	Alishan FC (EVA), Gel Content> 75 %
Encapsulation Material (Bottom)	Alishan Green Energy Pvt. Ltd.	Alishan EPE, Gel Content> 75 %
Frame	Sudarshan Alluminium India Limited	Alloy 6063, T6, Thickness: 35 mm, Anodizing > 15 µ
Cell Connector	GEBA CABLES & WIRES INDIA PRIVATE LIMITED	Solder tin plated copper ribbon Sn60/Pb40, 0.32 mm round ribbon
String Connector	GEBA CABLES & WIRES INDIA PRIVATE LIMITED	Solder tin plated copper ribbon Sn60/Pb40, 6x0.4 mm & 4x0.4 mm
Junction Box	GENX PV INDIA PRIVATE LIMITED.	GXSB-01, Rated voltage: 1500V, rated current 25 A, IP 68.
Cable	VINDHYA TELELINK LTD.	1x4.0 mm2, Rated voltage: 1.8kv DC
Connector	GENX PV INDIA PRIVATE LIMITED.	GXC01, Rated Voltage: 1500V VDC, Rated current 35A, IP 68, MC4 Compatible.
Fluxing Agent	KESTER	952-S
Potting Material	FASTO ADVANCE MATERIALS INDIA PVT. LTD.	Fasto SP70

Adhesive for Junction Box	FASTO ADVANCE MATERIALS INDIA PVT. LTD.	Fasto SM30
Adhesive for Frame	FASTO ADVANCE MATERIALS INDIA PVT. LTD.	Fasto SM30
Solar Cell	Solar Space	182 x182 mm, Thickness 160± 16 µm. Mono PERC Bi- 10 bb

All tests were performed in this test report.

"(See Enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.

Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

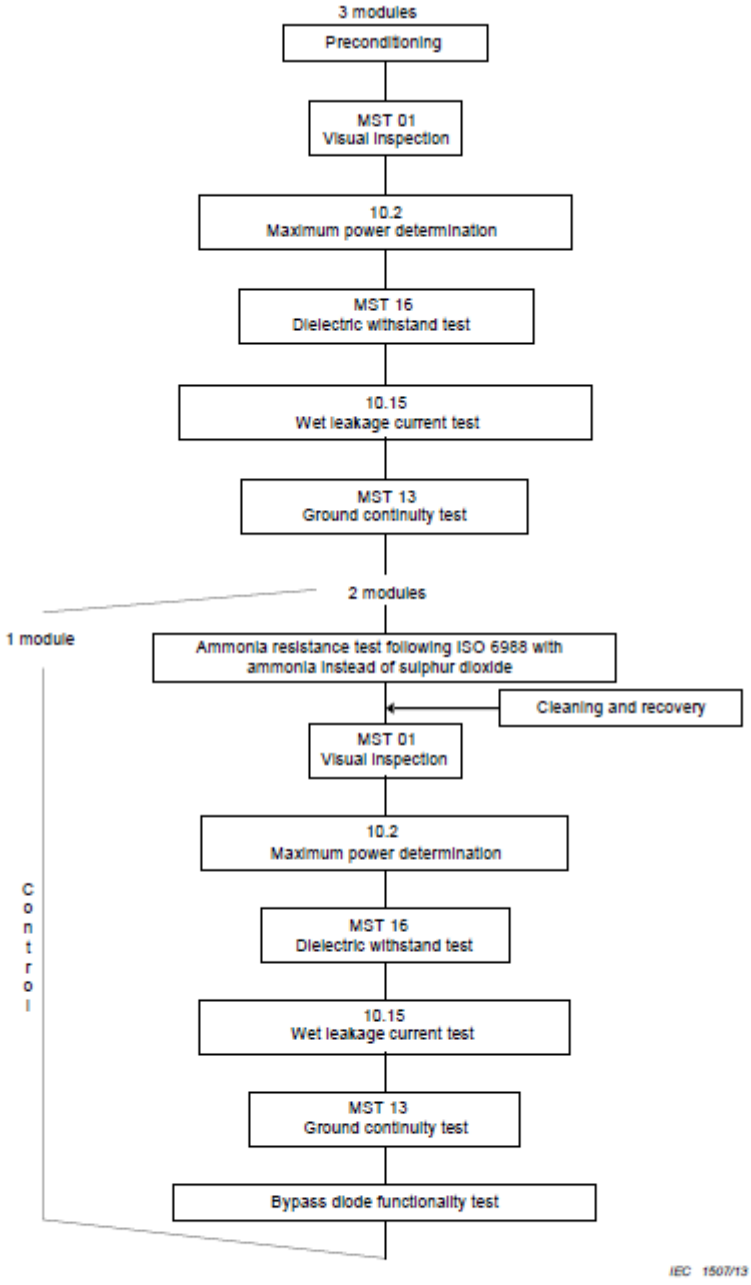
Name and address of factory (factories)..... :	Icon Solar- En Power Technologies Private Limited. Village-Dighari, Teh – Arang, Dist, Raipur-493441, Chhattisgarh, India.

PRODUCT ELECTRICAL RATINGS:

Module type	ISEN600-Bi	-	-	-
Voc [V]	53.50	-	-	-
Vmp [V]	45.20	-	-	-
Imax [Adc]	13.29	-	-	-
Isc [Adc]	14.08	-	-	-
Pmp [W]	600	-	-	-
Maximum system voltage [V]	1500	-	-	-
Maximum Over-Current Protection Rating [A]	25	-	-	-

Note:

TEST SEQUENCE:



NOTE 1 Preconditioning and tests 10.2 and 10.15 are taken from IEC 61215:2005. Tests MST 01, MST 13 and MST 16 are taken from IEC 61730-2:2004.

NOTE 2 The control module should be used as a check every time the test modules are measured to evaluate the effect of the salt mist test.

Remark: Figure 1 of standard IEC 62716:2013

IEC 62716:2013			
Clause	Requirement + Test	Result - Remark	Verdict

MODULE GROUP ASSIGNMENT:			
Sample #	Type/model	Sample S/N	Remark
1	ISEN600-Bi	ICON600B1008102054	Control
2	ISEN600-Bi	ICON600B1008102060	Ammonia
3	ISEN600-Bi	ICON600B1008102027	Ammonia
Remarks:N/A			

TESTING OVERVIEW		—
Initial Visual inspection (MST 01)	See Table 01	P
Initial Maximum power determination (10.2)	See Table 02	—
Initial Dielectric withstand test (MST 16)	See Table 03	P
Initial Wet leakage current test (10.15)	See Table 04	P
Initial Ground continuity test (MST 13)	See Table 05	P
Ammonia corrosion test	See Table 06	—
Final Visual inspection (MST 01)	See Table 07	P
Final Maximum power determination (10.2)	See Table 08	P
Final Dielectric withstand test (MST 16)	See Table 09	P
Final Wet leakage current test (10.15)	See Table 10	P
Final Ground continuity test (MST 13)	See Table 11	P
Bypass diode functionality test (MST 07)	See Table 12	P

IEC 62716:2013			
Clause	Requirement + Test	Result - Remark	Verdict

Table 01: Initial Visual inspection			
Test Date (YYYY-MM-DD)..... :		2024-11-21	—
Sample # 1	Findings..... :	☐ Yes..... ☒ No	P
	Nature and position of findings – comments or attach photos	-	—
Sample # 2	Findings..... :	☐ Yes..... ☒ No	P
	Nature and position of findings – comments or attach photos	-	—
Sample # 3	Findings..... :	☐ Yes..... ☒ No	P
	Nature and position of findings – comments or attach photos	-	—
Supplementary information: N/A			

Table 02: Initial Maximum power determination							
Test Date [YYYY-MM-DD] ..... :			2024-11-23				—
Irradiance (W/m^2) ..... :			1000				—
Module temperature (°C) ..... :			25				—
Test method ..... :			☒ Simulator ☐ Natural sunlight				—
Sample #	I_{sc} [A]	V_{oc} [V]	I_{mp} [A]	V_{mp} [V]	P_{max} [W]	FF [%]	Result
1	14.092	53.482	13.300	45.185	600.980	79.74	—
2	14.090	53.505	13.290	45.233	601.163	79.74	—
3	14.089	53.494	13.297	45.229	601.396	79.79	—
Supplementary information: After Stabilization procedure							

Table 03: MST 16 - Initial Dielectric withstand test					
Test Date (YYYY-MM-DD)..... :			2024-11-23		—
Test Voltage applied (V, DC) ..... :			8000/1500		—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
1	>5000	14.33	-	No	P
2	>5000	14.33	-	No	P
3	>5000	14.33	-	No	P
Supplementary information: The insulation tester can measure up to 5000MΩ.					

IEC 62716:2013			
Clause	Requirement + Test	Result - Remark	Verdict

Table 04: Initial Wet leakage current test			
Test Date (YYYY-MM-DD) ..... :		2024-11-23	—
Test Voltage applied (V, dc) ..... :		1500	—
Solution resistivity (Ω cm)..... :		2612	—
Solution temperature (°C)..... :		23.1	—
Size of module [m²]..... :		2.79	—
Sample #	Required Resistance [MΩ]	Measured [MΩ]	Result
1	14.33	>5000	P
2	14.33	>5000	P
3	14.33	>5000	P
Supplementary information: The insulation tester can measure up to 5000MΩ.			

Table 05: MST 13 – Initial Ground continuity test		
Test Date Initial examination (YYYY-MM-DD) ..... :	2024-11-23	—
Maximum over-current protection rating (A) ..... :	25	—
Current applied (A) ..... :	62.5	—
Location of designated grounding point..... :	The center of one longer side	—
No. of other conductive parts tested.....	The center of the other longer side The center of one shorter longer side The center of the other shorter side	—

Sample #	Resistance [mΩ]	Result
1	0.5654 0.5414 0.2545	P
2	0.5424 0.4434 0.2534	P
3	0.5384 0.4644 0.2543	P
Supplementary information: N/A		

IEC 62716:2013			
Clause	Requirement + Test	Result - Remark	Verdict

Table 06: Ammonia corrosion test		
Test Date (YYYY-MM-DD / YYYY-MM-DD):	2024-11-25 / 2024-12-15	—
NH3 concentration [ppm]	6667	
Temperature [°C]	60	
Relative humidity [%]	100	
Course of cycle	- exposure of NH3 for 8 hours and 60°C with nearly 100% condensation on the samples - drying for 16 hours at normal atmosphere (18°C - 28°C and max. 75% rel. humidity)	
Duration	20 cycles = 480 hours (20 days)	
Comment	According to DIN EN ISO 3231/DIN EN ISO 6988 DIN 50018	
Sample #	—	—
2	-	—
3	-	—
Supplementary information: N/A		

Table 07: Final Visual inspection			
Test Date (YYYY-MM-DD).....:		2024-12-19	—
Sample # 1	Findings.....:	☐ Yes..... ☒ No	P
	Nature and position of findings – comments or attach photos	-	—
Sample # 2	Findings.....:	☐ Yes..... ☒ No	P
	Nature and position of findings – comments or attach photos	-	—
Sample # 3	Findings.....:	☐ Yes..... ☒ No	P
	Nature and position of findings – comments or attach photos	-	—
Supplementary information: N/A			

IEC 62716:2013			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE 08: Final Maximum power determination								
Test Date [YYYY-MM-DD] ..... :	2024-12-19							—
Test method ..... :	☒ Simulator ☐ Natural sunlight							—
Irradiance [W/m²] ..... :	1000							—
Module temperature [°C] ..... :	25							—
Sample #	I_{sc} [A]	V_{oc} [V]	I_{mp} [A]	V_{mp} [V]	P_{max} [W]	FF [%]	Degradation [%]	Result
1	14.092	53.495	13.286	45.283	601.620	79.81	-0.11	P
2	14.041	53.487	13.253	45.084	597.519	79.56	-0.61	P
3	14.050	53.481	13.259	44.982	596.431	79.37	-0.83	P
Supplementary information: N/A								

Table 09: MST 16 - Final Dielectric withstand test					
Test Date (YYYY-MM-DD) ..... :	2024-12-19				—
Test Voltage applied (V, DC) ..... :	8000/1500				—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
1	>5000	14.33	-	No	P
2	>5000	14.33	-	No	P
3	>5000	14.33	-	No	P
Supplementary information: The insulation tester can measure up to 5000MΩ.					

Table 10: Final Wet leakage current test			
Test Date (YYYY-MM-DD) ..... :	2024-12-20		—
Test Voltage applied (V, dc) ..... :	1500		—
Solution resistivity (Ω cm) ..... :	2220		—
Solution temperature (°C) ..... :	22.8		—
Size of module [m²] ..... :	2.79		—
Sample #	Required Resistance [MΩ]	Measured [MΩ]	Result
1	14.33	>5000	P
2	14.33	>5000	P
3	14.33	>5000	P
Supplementary information: The insulation tester can measure up to 5000MΩ.			

IEC 62716:2013			
Clause	Requirement + Test	Result - Remark	Verdict

Table 11: MST 13 – Final Ground continuity test		
Test Date Final examination (YYYY-MM-DD) ..... :	2024-12-20	—
Maximum over-current protection rating (A) .....:	25	—
Current applied (A) .....:	62.5	—
Location of designated grounding point.....:	The center of one longer side	—
No. of other conductive parts tested.....	The center of the other longer side The center of one shorter longer side The center of the other shorter side	—

Sample #	Resistance [mΩ]	Result
1	0.5743 0.5562 0.2464	P
2	0.5587 0.4478 0.2454	P
3	0.5476 0.4743 0.2521	P

Supplementary information: N/A

Table 12: Bypass diode functionality test							
Test Date (YYYY-MM-DD)..... :	2024-12-20						—
Sample #	IV curve after shading						Result
	Diode 1 working properly		Diode 2 working properly		Diode 3 working properly		
1	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P
2	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P
3	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P

Supplementary information: N/A

Annex 1: Photographs of test sample

Module type: ISEN600-Bi

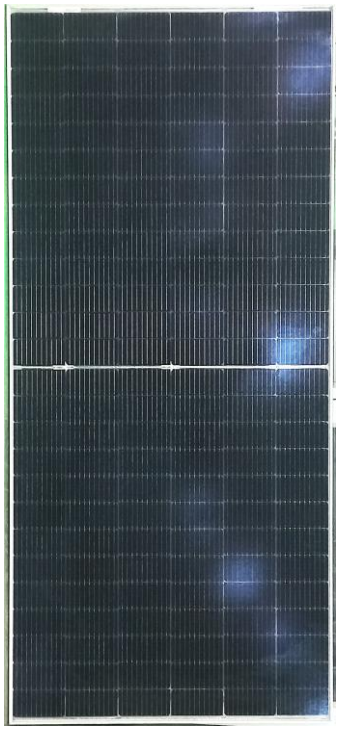


Fig. 1: front view of test sample

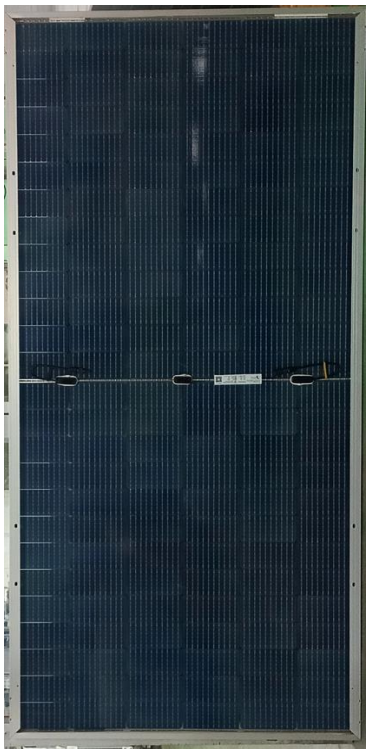


Fig. 2: rear view of test sample

Fig. 3: view of type label

Annex 2: List of measurement equipment

Measurement / testing	Testing / measuring equipment / material used, (Equipment ID)	Range used	Last Calibration date	Calibration due date
Visual inspection test	Visual inspection bench BS-PV 010	-	-	-
	Illumination photometer BS-PV 036	2000lx	2024-02-27	2025-02-26
Maximum power determination test	Pulse solar simulator BS-PV 057	A+AA+	2024-07-29	2025-07-28
	Electrical Load BS-PV 057-02	-15V~420V -50A~50A	2024-07-29	2025-07-28
	Reference Module BS-PV 057-05	-	2024-07-08	2025-07-09
Dielectric withstand test	Insulation tester BS-PV 090	Test voltage: 0~10kV Result range: 0~50000MΩ	2024-05-22	2025-05-21
Wet leakage current test	Water tank BS-PV 047-01	22 ± 2°C	2024-05-22	2025-05-21
	Insulation resistance tester BS-PV 090	Test voltage: 0~10kV Result range: 0~50000MΩ	2024-05-22	2025-05-21
	Conductivity meter BS-PV 047-02	0~1999μs/cm, 10.0~40.0°C	2024-05-22	2025-05-21
Ground continuity test	Ground Resistance Tester BS-PV 025	10~60A	2024-03-27	2025-03-26
Ammonia resistance test	Ammonia test Chamber BS-PV 112	30~60°C 45%~98%RH 0~6667ppm	2024-06-24	2025-06-23
Bypass diode functionality test	Pulse solar simulator BS-PV 057	A+AA+	2024-07-29	2025-07-28

Annex 3: Statement of test uncertainty

The total measuring uncertainty of Pmpp is ≤ 2.47%

The total measuring uncertainty of Isc is ≤ 2.35%

The total measuring uncertainty of Voc is ≤ 0.84%