PV magazine
Indoor Test Report

Supplier	SEG Solar INC
Product	SEG-BTC-600-BG
Date	17 February 2025
Version	1.1

Overview of the Indoor Test

Description

The Indoor Test is a series of inspection and tests designed to characterize the performance of the PV module products before they are installed in the outdoor field.

The tests are conducted at CEA's parent company's Intertek state of the art laboratory in Zhejiang, China.

The results of the inspections are used to derive a grade number for each test and an average grade for all tests, except UVID, which is optional.

The detailed methodology can be found in the Appendix of this report.

Tests

Visual inspection	Modules are inspected for visual defects according to widely accepted industry criteria.
EL inspection	Modules are inspected for EL defects (electroluminescence) according to widely accepted industry criteria.
Low irradiance Performance	The performance loss of a module in low irradiance conditions is measured.
Pmax Temperature Coefficient	The Pmax temperature coefficient is measured, which determines the performance loss at high temperatures.
PID (Potential Induced Degradation)	The sensitivity of a module to degradation due to voltage stress is measured in a special chamber.
UVID (optional) (Ultraviolet Induced Degradation)	The sensitivity of a module to degradation due to UV light is measured in a special chamber.
Bifaciality Ratio	The bifaciality ratio of all samples is measured to compare against nameplate.

Product and Sample Details

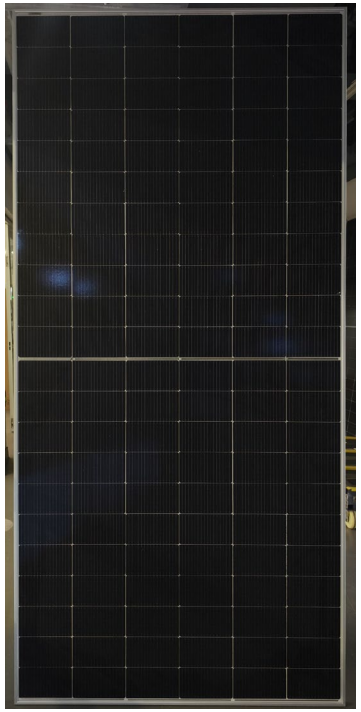
Test sample information

Sample #	Serial number
1	SEGCNQS6CW2410YP0040
2	SEGCNQS6CW2410YP0048
3	SEGCNQS6CW2410YP0049
4	SEGCNQS6CW2410YP0029
5	SEGCNQS6CW2410YP0044
6	SEGCNQS6CW2410YP0059
7	SEGCNQS6CW2410YP0066
8	SEGCNQS6CW2410YP0062

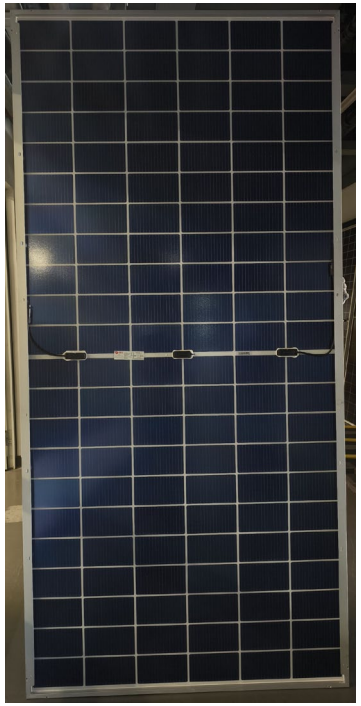
Product information

Model	SEG-BTC-600-BG
Cell technology	TOPCon
Cell number	132
Cell format	210x182 mm
Number of busbars	16
Junction box	IP68, 3 bypass diodes
Laminate construction	Glass
Bifaciality ratio	80±10%

Front side



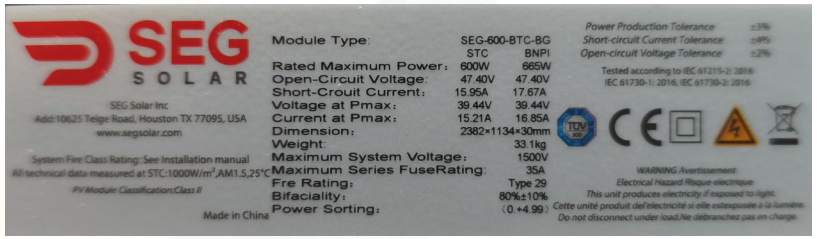
Rear side



Other information

Sample selection method	Sample provided by supplier, without random selection
Intertek lab report	Attached

Nameplate Label



Product Datasheet

SEG SOLAR

www.segsolar.com

ALPINE N Series

Half-Cell N-Type Bifacial Module

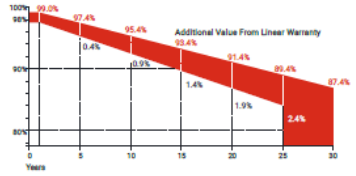
600-615Wp Module Power Output

22.77% Max Efficiency

Key Features

- High module conversion efficiency
- Better temperature coefficient
- Super multi busbar technology
- Low attenuation long warranty
- Superior load capacity
- Higher bifaciality
- USA based liability insurance
- Houston, Texas based company

Warranty



15 Years Guarantee on product material and workmanship

30 Years Linear power output warranty

Product Certification

IEC61215:2016; IEC 61730:2016; UL61215; UL61730	
IEC62804	PID
IEC61701	Salt Mist
IEC62716	Ammonia Resistance
IEC60068	Dust and Sand
IEC61215	Hailstone
Fire Type (UL61730): Type 29	
ISO14001:2015; ISO9001:2015; ISO45001:2018	

Intertek · PV CYCLE · CE · TÜV · DEKRA · CALIFORNIA ENERGY COMMISSION · FSEC

About SEG Solar

Founded in 2016, SEG is a leading vertically integrated PV manufacturer headquartered in Houston, Texas, U.S., and is dedicated to delivering reliable and cost-effective solar modules to the utility, commercial and residential markets. By the end of 2023, SEG has shipped over 5 GW of solar modules worldwide. The company is expected to exceed a production capacity of 5.5 GW by the end of 2024.

Download Datasheet

SEG SOLAR

ALPINE N Series SEG-XXX-BTC-BG-132Cells

Electrical Characteristics

Module Type	SEG-600-BTC-BG			SEG-605-BTC-BG			SEG-610-BTC-BG			SEG-615-BTC-BG		
	Front BTC	Front NOCT	Back BTC	Front BTC	Front NOCT	Back BTC	Front BTC	Front NOCT	Back BTC	Front BTC	Front NOCT	Back BTC
Maximum Power -Pmp(Wp)*	600	457	480	605	461	484	610	465	488	615	469	492
Open Circuit Voltage -Voc(V)	47.40	45.80	47.38	47.90	46.10	47.88	48.10	46.40	48.08	48.30	46.72	48.28
Short Circuit Current -Isc(A)	15.95	12.73	12.73	16.00	12.76	12.76	16.05	12.78	12.78	16.10	12.80	12.80
Maximum Power Voltage -Vmp(V)	39.44	37.70	39.42	39.60	38.00	39.58	39.77	38.30	39.75	39.96	38.60	39.94
Maximum Power Current -Imp(A)	15.21	12.12	12.18	15.28	12.13	12.23	15.34	12.14	12.28	15.39	12.15	12.32
Module Efficiency(%)	22.21			22.40			22.58			22.77		
Power Tolerance(W)	(0, +4.99)											
Maximum System Voltage	1500V DC											
Maximum Series Fuse Rating	35 A											
Bifaciality	80±10%											

STC: Irradiance 1000 W/m² module temperature 25°C AM=1.5 NOCT: Irradiance 800W/m² ambient temperature 20°C module temperature 45°C wind speed: 1m/s

*Measuring tolerance: ±3%

Mechanical Specifications

External Dimension	2382 x 1134 x 30 mm
Weight	33.1 kg
Solar Cells	N-Type 182 x 105 mm(132 pcs)
Front Glass	2.0 mm AR coating semi-tempered glass
Back Glass	2.0 mm Semi-tempered glass
Frame	Anodized aluminium alloy
Junction Box	IP68 / 3 diodes
Connector Type	PV-CO02-xy or MC4
Cable Type Cable Length	12 AWG PV Wire(UL) Portrait: 400 mm(+) / 200 mm(-) Landscape: 1200 mm(+) / 1200 mm(-) or customized length
Mechanical Load(Front)	5400 Pa / 113 psf*
Mechanical Load(Rear)	2400 Pa / 50 psf*

*Refer to SEG installation manual for details

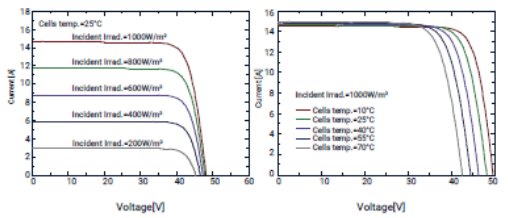
Temperature Characteristics

Pmax Temperature Coefficient	-0.30 %/°C
Voc Temperature Coefficient	-0.25 %/°C
Isc Temperature Coefficient	+0.046 %/°C
Operating Temperature	-40~+85 °C
Nominal Operating Cell Temperature (NOCT)	45±2 °C

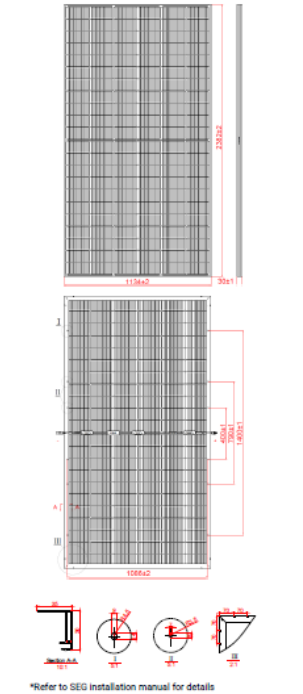
Packing Configuration

Container	40'HQ	40'HQ (for USA)
Pieces per Pallet	36	36
Pallets per Container	20	16
Pieces per Container	720	576

I-V Curve



Technical Drawing



*Refer to SEG installation manual for details

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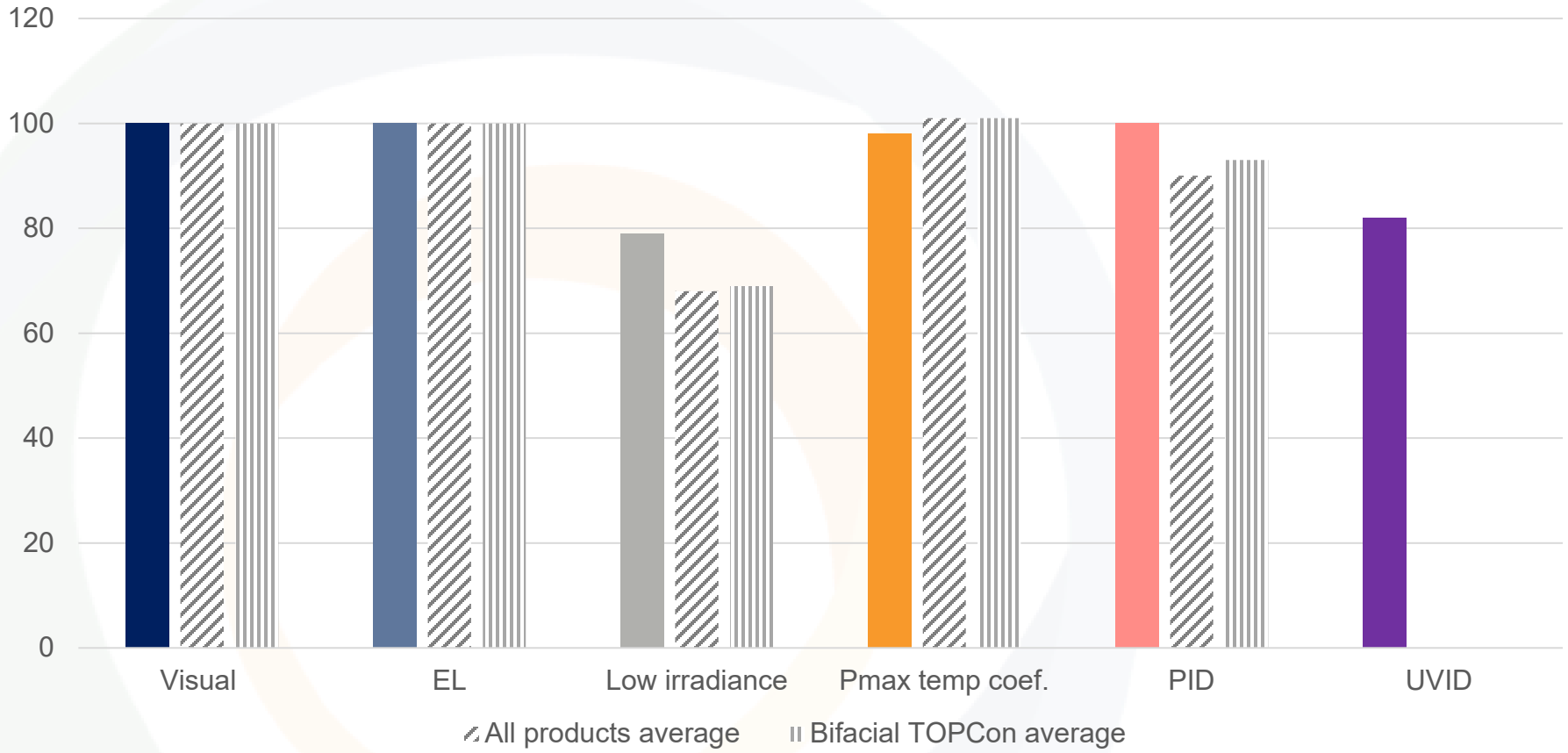
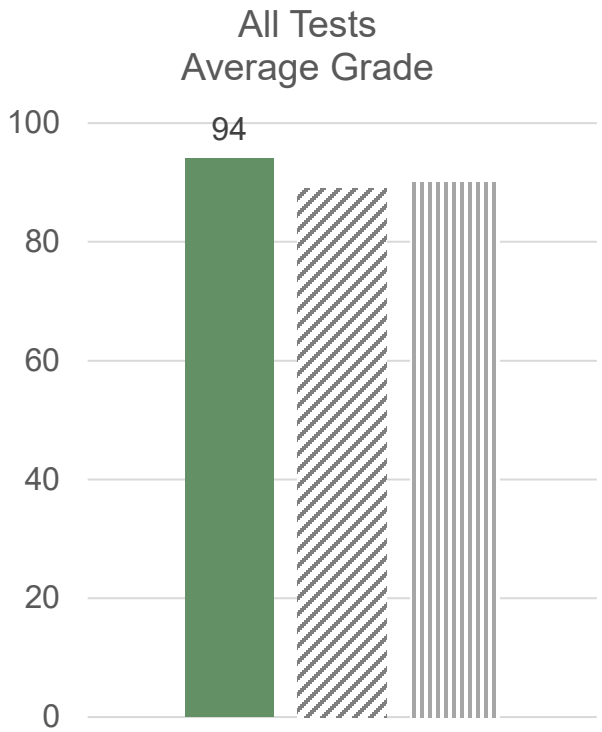
Specifications subject to technical changes SEG_DS_EN_2024V3.0 © Copyright 2024 SEG Solar

Test Grading Overview

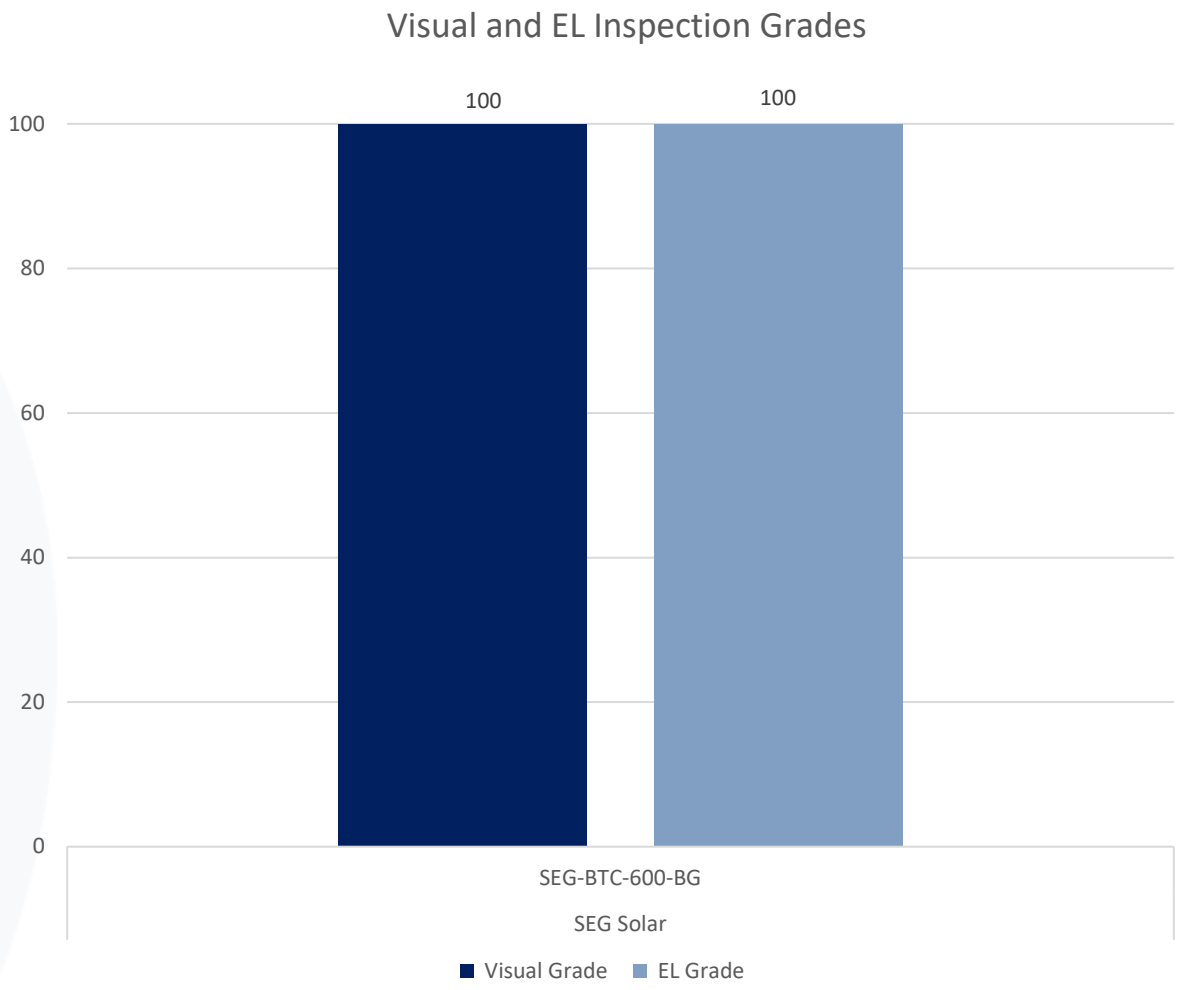




Individual test grades are compared to the average grades for products installed since 2022.
All products average: the average grade of all products.
Bifacial TOPCon average: the average grade of all Bifacial TOPCon products.
The All Tests Average Grade does **not** include the UVID test, as it is optional and not performed for all products.

Visual inspection and EL inspection

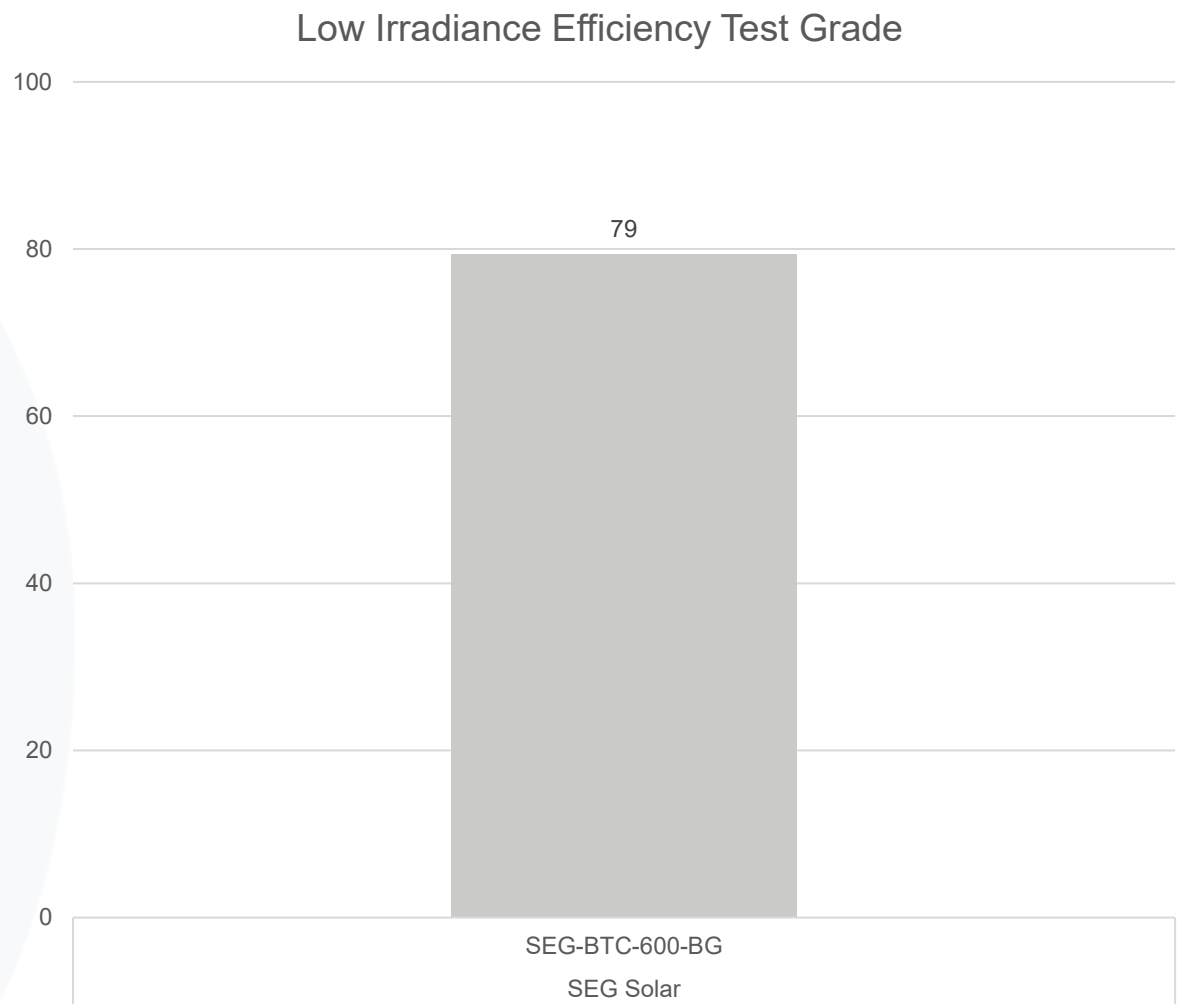
SEG-BTC-600-BG	Visual inspection	EL inspection
Sample 1	None	None
Sample 2	None	None
Sample 3	None	None
Sample 4	None	None
Sample 5	None	None
Sample 6	None	None
Sample 7	None	None
Sample 8	None	None
Score	0	0
Grade	**100**	**100**



All 6 modules of each product sample lot have undergone visual inspection, according to CEA's quality criteria for visual inspection.

Low irradiance efficiency loss test

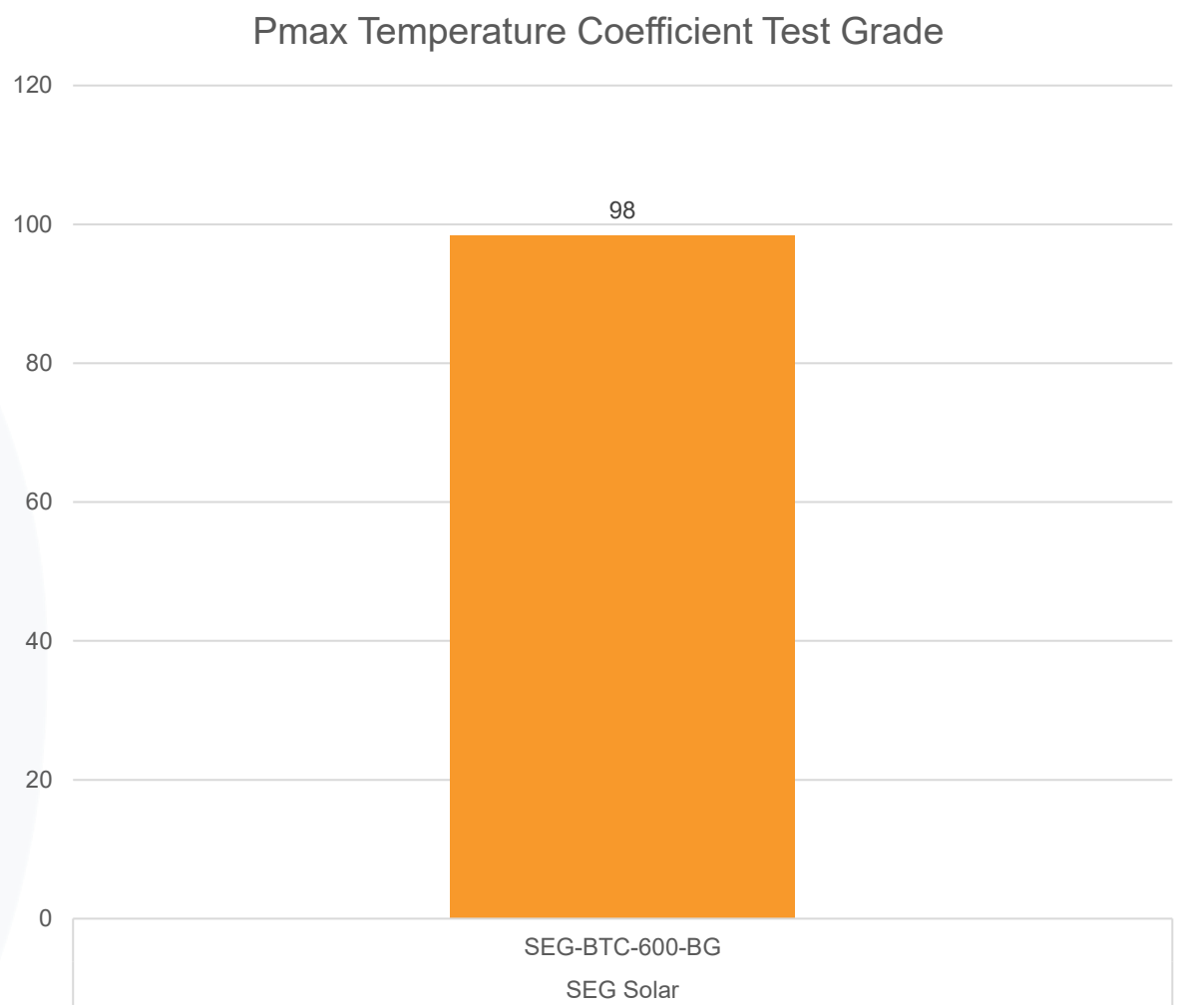
SEG-BTC-600-BG	Front side low irradiance efficiency loss (%)
Sample 1	
Sample 2	
Sample 3	
Sample 4	1.89
Sample 5	
Sample 6	
Sample 7	
Sample 8	
Grade	**79**



The efficiency loss is calculated by the following formula:
Efficiency loss = 1- [(Pmax at low irradiance conditions / Pmax at STC) * (1,000/200)]

Pmax temperature coefficient test

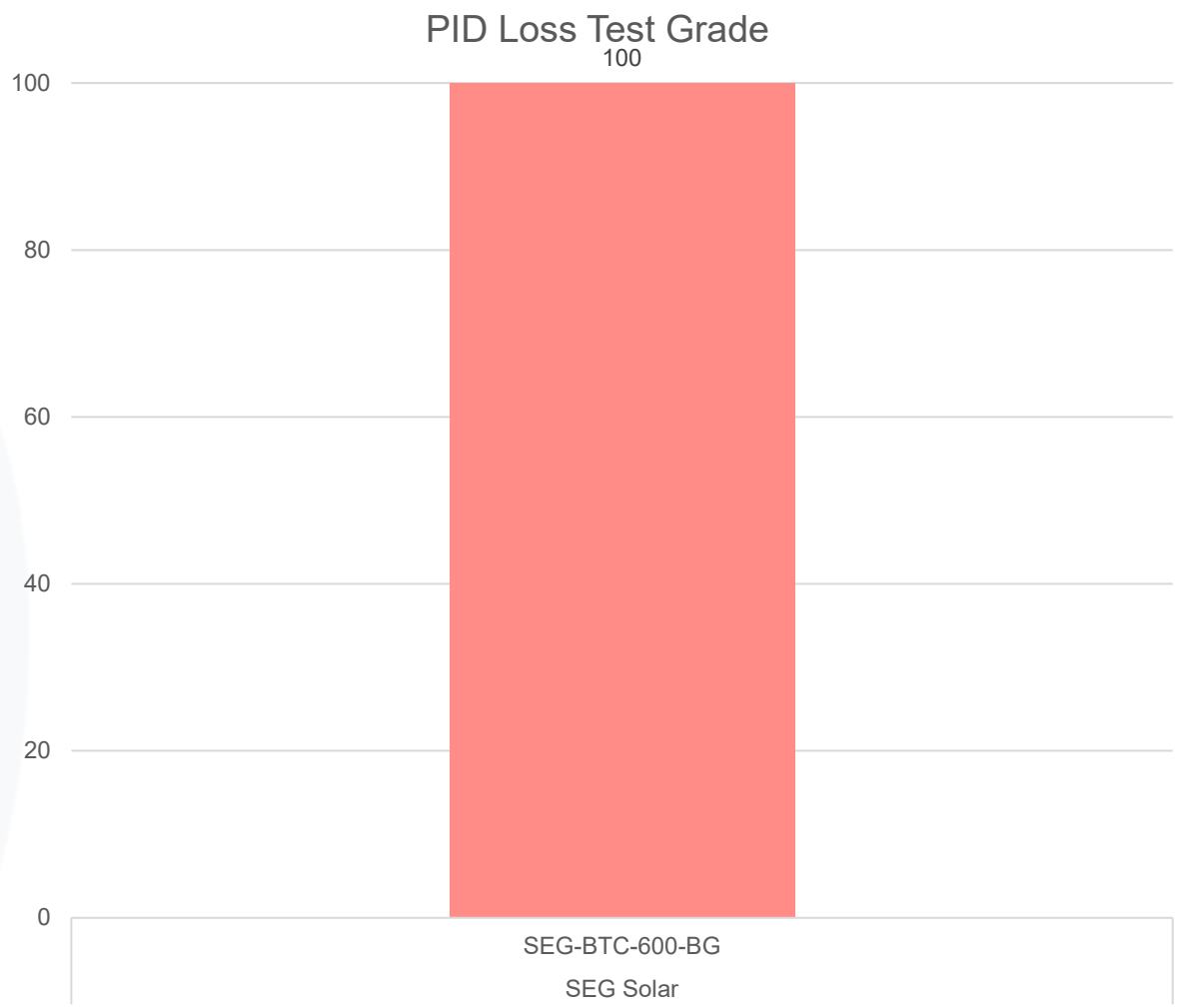
SEG-BTC-600-BG	Pmax Temperature coefficient (%/°C)
Sample1	
Sample2	
Sample3	
Sample4	-0.307
Sample5	
Sample6	
Sample 7	
Sample 8	
Grade	**98**



The Pmax Temperature Coefficient is measured according to IEC standards.

PID Test

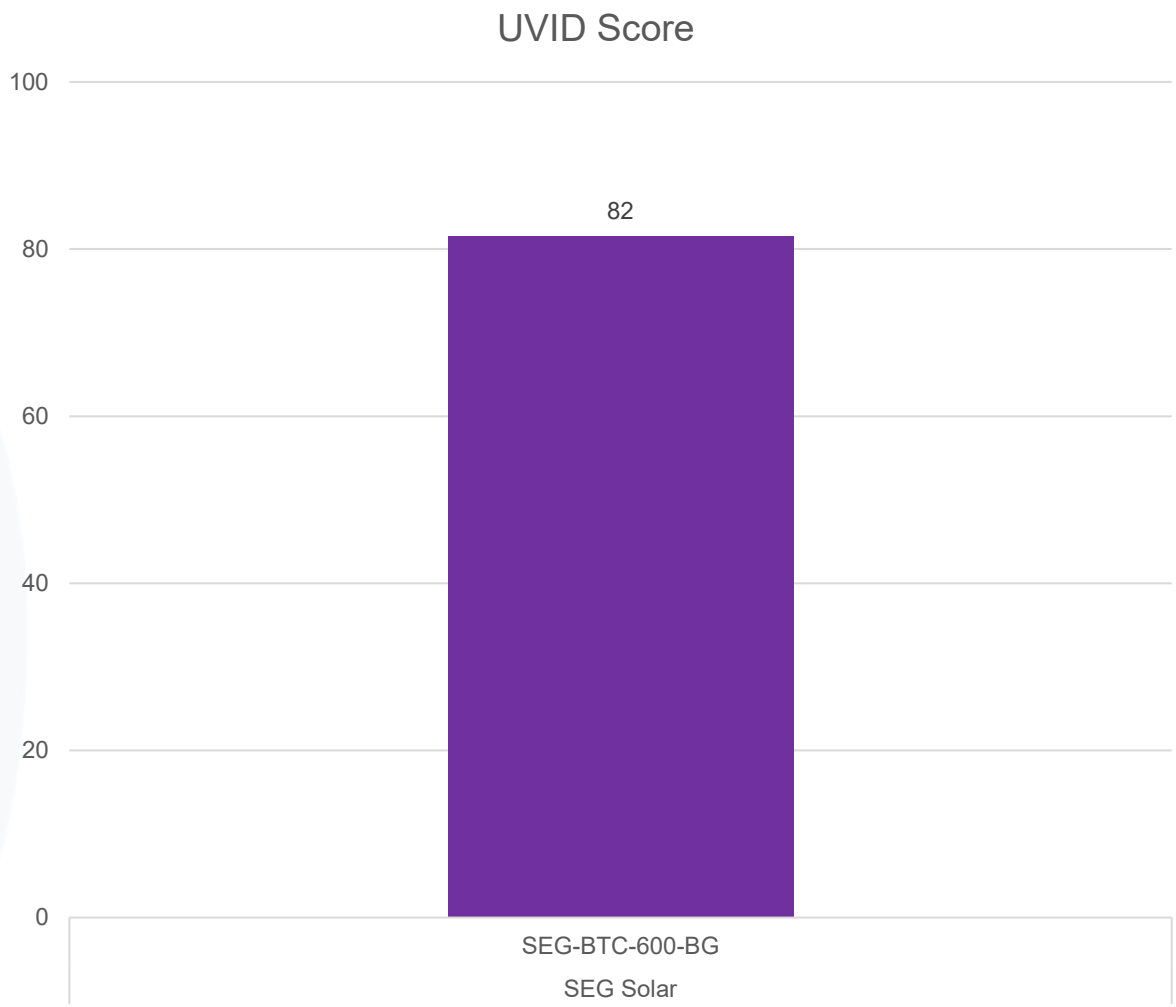
SEG-BTC-600-BG	Front side PID loss (%)
Sample 1	
Sample 2	
Sample 3	
Sample 4	
Sample 5	-0.14
Sample 6	
Sample 7	
Sample 8	
Grade	**100**



The PID loss is the front side power degradation after testing at 1500 V for 96 hours. After PID stressing, the sample is light soaked for one day outdoors to recover any PID-p (polarization) effect. The remaining degradation is due to other causes, such as sodium ion migration.

UVID Test

SEG-BTC-600-BG	UVID loss(%/°C)
Sample1	1.11
Sample2	
Sample3	
Sample4	
Sample5	
Sample6	
Sample 7	
Sample 8	
Grade	**82**



The UVID loss is the front side power degradation after exposing the sample to 120 kWh/m2 of UV irradiance.

Bifaciality Ratio

SEG-BTC-600-BG	Bifaciality ratio (%)
Sample 1	78.75%
Sample 2	78.55%
Sample 3	79.33%
Sample 4	78.64%
Sample 5	79.35%
Sample 6	79.15%
Sample 7	79.28%
Sample 8	77.98%
Nameplate	80±10%
Average	**78.87%**

The bifaciality ratio test result is not graded. The results are listed for informational purposes.

The bifaciality ratio is calculated from the following formula:

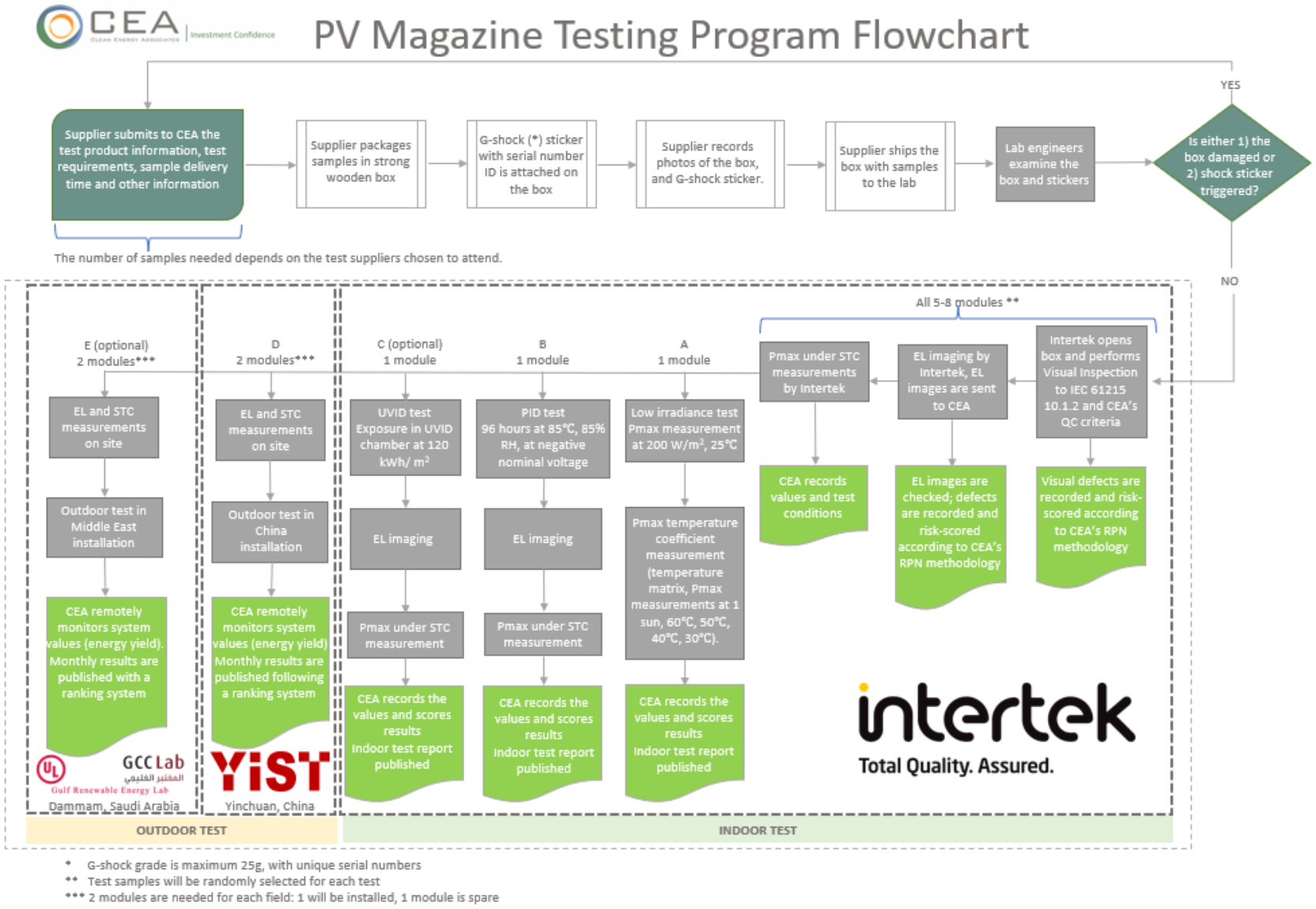
Bifaciality ratio = (Pmax rear surface / Pmax front surface) x 100%

Appendix
Methodology and Scoring System

Test Flowchart and Protocol

The flowchart is a high-level description of the testing procedure, describing the steps, and tests to be applied.

Detailed checklists and instructions created by CEA are delivered to all the testing partners.



Grading Methodology - 1

For every product, all samples are shipped to the Intertek laboratory and then 2 samples are shipped from the lab to each outdoor test field to conduct the tests and inspections according to the above flowchart.

The table describes the inspections and tests applied on all products.

Test/inspection grading system overview

	Test/inspection	# of samples	Method	Values	Average grade weight	Grades
1	Visual inspection	5-8	Inspection	RPN Scores	10%	1-100
2	EL image inspection	5-8	Inspection	RPN Scores	10%	1-100
3	Low irradiance efficiency loss	1	Test	%	25%	1-100
4	Pmax Temperature coefficient	1	Test	%/°C	25%	1-120
5	PID loss	1	Test	%	30%	1-100
6	UVID120 (optional)	1	Test	%	NA	1-100
7	Outdoor installation and yield measurement	2-4	Energy Yield Monitoring	Monthly kWh/kWp	NA	NA

The RPN (risk priority number) scoring method has been developed by CEA and is used to evaluate and create risk scores of Visual and EL defects.

The weights are used to calculate the average grade for tests 1-5.

Grading Methodology - 2

A number within the 1-100/120 range will be used to grade the results, so that the overall ranking of the products will reflect general industry practices and requirements:

Grading System

	Grade range:	120	100	90	80	70	60	50	40	30	20	10	0
1	Visual inspection (RPN scores)	NA	0	0.74	2.20	4.39	7.30	10.94	15.30	20.39	26.20	32.74	≥ 40
2	EL image (RPN scores)	NA	0.00	2.03	4.62	7.75	11.43	15.65	20.43	25.75	31.62	38.03	≥ 45.00
3	Low irradiance loss	NA	≤ -2.00%	-0.02%	1.78%	3.41%	4.87%	6.16%	7.27%	8.21%	8.98%	9.58%	≥ 10.00%
4	Pmax Temp. coefficient	≥ -0.200%	-0.300%	-0.343%	-0.382%	-0.417%	-0.448%	-0.475%	-0.498%	-0.517%	-0.532%	-0.543%	≤ -0.550%
5	PID loss	NA	≤ 0.0%	0.7%	1.6%	2.7%	4.0%	5.5%	7.2%	9.1%	11.2%	13.5%	≥ 16.0%
6	UVID120 (optional)	NA	≤ 0.00%	0.60%	1.20%	1.80%	2.40%	3.00%	3.60%	4.20%	4.80%	5.40%	≥ 6.00%

The Visual and EL Inspection RPN scores are divided by the number of samples, to normalize the score, as the total number of samples may vary.

The correspondence of the scores/test results to the grades follows a binomial or linear relationship, anchored to certain key values that are generally accepted in the PV industry. For example, a PID loss of 5%, which is the pass/fail threshold of the related IEC standard, will give a grade close to 50. Grades below 50 indicate a product performance that is below a generally acceptable threshold.

Test Report

Applicant 1	: Clean Energy Associates (China) Limited Room 1206, 300 Yan'an West Road, Jing'an District, Shanghai, China
Applicant 2	: Pv magazine group GmbH & Co. KG Kurfürstendamm 64 | 10707 Berlin, Germany
Product	: Crystalline Silicon Terrestrial Photovoltaic Module
Manufacturer	: SEG SOLAR INC
Model No. of Manufacturer	: SEG-600-BTC-BG-210R
No. of Sample	: See the attached sheets
Date of receipt of test item	: 11/28/2024
Date (s) of performance of test	: 12/23/2024~02/11/2025
Date of issue	: 02/17/2025
Testing Laboratory	: Intertek Testing Services Zhejiang Ltd.
Location	: Building 2, Juanhu Science and Technology Innovation Park, No. 500 Shuiyueting East Road, Haining, Zhejiang, China
Service Requested	: Testing
Method	: See **General remarks** in next page
Result	: See the attached sheets
Conclusion	: The testing of submitted sample is **complied with** the above standards/requirements. See general remarks in page 2 for details.

********** End of page **********

Prepared and checked by:
Intertek Testing Services
Zhejiang

Andrew He
Engineer
PV Division

Reviewed by
Intertek Testing Services
Zhejiang

Ken Gu
Reviewer
PV Division

Test Report

GENERAL INFORMATION	
Test item particulars:	
Accessories and detachable parts included in the evaluation .....:	-
Options included .....:	-
Possible test case verdicts:	-
Abbreviations used in the report:	
Imp – Maximum power current	Voc – Open circuit voltage
Isc - Short circuit current	FF – Fill Factor
Pmp – Maximum power	α – Current temperature coefficient
Vmp – Maximum power voltage	β – Voltage temperature coefficient
STC – Standard Test Conditions	δ – power temperature coefficient
Possible test case verdicts: - test case does not apply to the test object .....:	N/A
- test object does meet the requirement.....:	Pass (P)
- test object does not meet the requirement.....:	Fail (F)

General remarks:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
"(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 point is used as the decimal separator.

Test method:

IEC 61215-2:2021 Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 2: Test procedures

- Power determination at STC
- Wet Leakage Test
- Insulation Test
- Electroluminescence (EL) Test
- Low Irradiance measurement at 200 W/m2
- Module Temperature Coefficient Test
- UV preconditioning test

IEC TS 62804-1 Photovoltaic (PV) modules – Test methods for the detection of potential-induced degradation

- Potential induced degradation test (PID)

.
According to the applicant's requirement ,this test report 250200025SHA-001A1 is issued to entirely replace the test report 250200025SHA-001 for correcting the manufacturer.

Test Report

General Product information:			
Sample assignment:			
Sample No.	SN	Model No.	Remarks
A241128-64-001	SEGCNQS6CW2410YP0040	SEG-600-BTC-BG-210R	Flash+EL
A241128-64-002	SEGCNQS6CW2410YP0048	SEG-600-BTC-BG-210R	Flash+EL
A241128-64-003	SEGCNQS6CW2410YP0049	SEG-600-BTC-BG-210R	Flash+EL
A241128-64-004	SEGCNQS6CW2410YP0029	SEG-600-BTC-BG-210R	Control
A241128-64-005	SEGCNQS6CW2410YP0044	SEG-600-BTC-BG-210R	LOW、Temperature Coefficient
A241128-64-006	SEGCNQS6CW2410YP0059	SEG-600-BTC-BG-210R	PID
A241128-64-007	SEGCNQS6CW2410YP0066	SEG-600-BTC-BG-210R	UV
A241128-64-008	SEGCNQS6CW2410YP0062	SEG-600-BTC-BG-210R	Flash+EL

Test Report

TABLE Potential induced degradation test (PID)						P
IEC 61215-2 MQT01 - Visual inspection (Initial)						P
Test Date [YYYY-MM-DD]:	2024-12-23					—
Sample#	Nature and position of initial findings – comments or attach photos					—
A241128-64-006	No major visual defect.					P
Supplementary information: N/A						
IEC 61215-2 MQT 02 – Maximum power determination (initial)						—
Test Date [YYYY-MM-DD]:	2024-12-23					—
Module temperature [°C]:	Corrected to 25					—
Irradiance [W/m^2] :	1000					—
Sample#	Voc [V]	Isc [A]	Pmp [W]	Vmp [V]	Imp [A]	FF [%]
A241128-64-004front	48.572	15.868	594.344	41.012	14.492	77.11
A241128-64-004rear	48.320	14.771	471.739	41.421	11.389	66.09
A241128-64-006front	48.633	15.935	594.889	41.110	14.470	76.76
A241128-64-006rear	48.378	14.793	470.844	41.420	11.367	65.79
Supplementary information: N/A						
IEC 61215-2 MQT 03 – Insulation test (initial)						P
Test Date [YYYY-MM-DD]..... :	2024-12-23					—
Test Voltage applied [V] ..... :	8000/1500					—

Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
A241128-64-006	>1000	14.8	-	No	P
Supplementary information: Size of module[m²]: 2.70					

IEC 61215-2 MQT 15 – Wet leakage current test (initial)			P
Test Date [YYYY-MM-DD]..... :	2024-12-23		—
Maximum system voltage (V)	1500		—
Test voltage applied Vtest (V d.c.)	1500		—
Solution resistivity (Ω·cm)	< 3500 Ω cm at 22 ± 2°C		P
Solution temperature (°C)	22 ± 2°C		P
Sample##	Measured[MΩ]	Required[MΩ]	—
A241128-64-006	>1000	14.8	P
Supplementary information: Size of module [m²]: 2.70			

IEC 61730-2 MST 13 – Ground continuity test (initial)		P
Test Date [YYYY-MM-DD]..... :	2024-12-23	—

Test Report

Maximum over-current protection rating (A) .....:	35	—
Current applied (A) .....:	87.5	—
Location of designated grounding point.....:	Frame	—
Location of second contacting point.....:	Frame	—
Sample# #	Resistance (mΩ)	—
A241128-64-006	20	P
EL Test (Initial)		—
Test Date [YYYY-MM-DD].....	2024-12-23	—
Please check attached photos for details.		
Supplementary information: N/A		

PID test		—
Test Date [MM/DD/YYYY] / start - end ... :	2024-12-23~2024-12-30	—
Total time .....:	96 hours	—
Voltage appled between current carry parts and grounding .....:	-1500	—
Temperature .....:	85℃±2℃	—
Humidity .....:	85%±3%	—
Supplementary information: N/A		

IEC 61215-2 MQT01 - Visual inspection (after PID test)		P
Test Date [YYYY-MM-DD]:	2024-12-30	—
Sample#	Nature and position of initial findings – comments or attach photos	—
A241128-64-006	No major visual defect.	P
Supplementary information: N/A		

IEC 61215-2 MQT 02 – Maximum power determination (after PID test)		—
Test Date [YYYY-MM-DD]:	2024-12-30	—
Module temperature [°C]:	Nature and position of initial findings – comments or attach photos	—
Irradiance [W/m^2]:	1000	—

Sample#	Pmp change rate after this test [%]	Voc [V]	Isc [A]	Pmp [W]	Vmp [V]	Imp [A]	FF [%]
A241128-64-004front	-	48.569	15.862	595.514	40.995	14.527	77.30
A241128-64-004rear	-	48.397	14.865	469.546	41.381	11.347	65.27
A241128-64-006front	-0.08	48.704	16.186	594.427	41.260	14.407	75.40
A241128-64-006rear	-0.47	48.439	15.002	468.643	41.307	11.345	64.49
Supplementary information: N/A							

IEC 61215-2 MQT 03 – Insulation test (after PID test)		P
Test Date [YYYY-MM-DD]..... :	2024-12-30	—

Test Report

Test Voltage applied [V] ..... :			8000/1500		—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
A241128-64-006	>1000	14.8	-	No	P
Supplementary information: Size of module[m²]: 2.70					
IEC 61215-2 MQT 15 – Wet leakage current test (after PID test)					P
Test Date [YYYY-MM-DD]..... :			2024-12-30		—
Maximum system voltage (V)			1500		—
Test voltage applied Vtest (V d.c.)			1500		—
Solution resistivity (Ω·cm)			< 3500 Ω cm at 22 ± 2°C		P
Solution temperature (°C)			22 ± 2°C		P
Sample##			Measured[MΩ]	Required[MΩ]	—
A241128-64-006			>1000	14.8	P
Supplementary information: Size of module [m²]: 2.70					
EL Test (after PID test)					—
Test Date [YYYY-MM-DD].....	2024-12-30				—
Please check attached photos for details.					
Supplementary information: N/A					

TABLE Performance at STC						P
IEC 61215-1 - Visual inspection						P
Test Date [YYYY-MM-DD]:	2024-12-23 for A241128-64-001, A241128-64-002,A241128-64-003 2025-02-11 for A241128-64-008					—
Sample#	Nature and position of initial findings – comments or attach photos					—
A241128-64-001	No major visual defect.					P
A241128-64-002	No major visual defect.					P
A241128-64-003	No major visual defect.					P
A241128-64-008	No major visual defect.					P
Supplementary information: N/A						
IEC 61215-2 MQT 06 – Performance at STC						—
Test Date [YYYY-MM-DD]:	2024-12-23 for A241128-64-001, A241128-64-002,A241128-64-003 2025-02-11 for A241128-64-008					—
Module temperature [°C]:	Corrected to 25					—
Irradiance [W/m²] :	1000					—
Sample#	Voc[V]	Isc [A]	Pmp [W]	Vmp [V]	Imp [A]	FF [%]
A241128-64-001front	48.641	16.033	597.034	41.128	14.517	76.56

Test Report

A241128-64-001rear	48.363	14.816	470.136	41.396	11.357	65.61
A241128-64-002front	48.591	15.875	597.008	41.073	14.535	77.39
A241128-64-002rear	48.318	14.814	468.925	41.387	11.330	65.51
A241128-64-003front	48.606	16.011	596.345	41.095	14.511	76.63
A241128-64-003rear	48.384	14.857	473.091	41.424	11.421	65.81
A241128-64-008front	48.411	16.869	600.607	41.266	14.554	73.55
A241128-64-008rear	48.210	15.781	468.365	41.184	11.373	61.56
Supplementary information: NA						

IEC 61215-2 MQT 03 – Insulation test (initial)					P
Test Date [YYYY-MM-DD] .....:			2024-12-23 for A241128-64-001, A241128-64-002,A241128-64-003 2025-02-11 for A241128-64-008		—
Test Voltage applied [V] .....:			8000/1500		—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
A241128-64-001	>1000	14.8	-	No	P
A241128-64-002	>1000	14.8	-	No	P
A241128-64-003	>1000	14.8	-	No	P
A241128-64-008	>1000	14.8	-	No	P
Supplementary information: Size of module[m²]: 2.70					

IEC 61215-2 MQT 15 – Wet leakage current test (initial)			P
Test Date [YYYY-MM-DD] .....:	2024-12-23 for A241128-64-001, A241128-64-002,A241128-64-003 2025-02-11 for A241128-64-008		—
Maximum system voltage (V)	1500		—
Test voltage applied Vtest (V d.c.)	1500		—
Solution resistivity (Ω·cm)	< 3500Ω cm at 22 ± 2°C		P
Solution temperature (°C)	22 ± 2°C		P
Sample#	Measured[MΩ]	Required[MΩ]	—
A241128-64-001	>1000	14.8	P
A241128-64-002	>1000	14.8	P
A241128-64-003	>1000	14.8	P
A241128-64-008	>1000	14.8	P
Supplementary information: Size of module [m²]: 2.70			

Test Report

TABLE UV preconditioning test						P
IEC 61215-2 MQT01 - Visual inspection (Initial)						P
Test Date [YYYY-MM-DD]:	2024-12-23					—
Sample#	Nature and position of initial findings – comments or attach photos					—
A241128-64-007	No major visual defect.					P
Supplementary information: N/A						
IEC 61215-2 MQT 02 – Maximum power determination (initial)						—
Test Date [YYYY-MM-DD]:	2024-12-23					—
Module temperature [°C]:	Corrected to 25					—
Irradiance [W/m²] :	1000					—
Sample#	Voc [V]	Isc [A]	Pmp [W]	Vmp [V]	Imp [A]	FF [%]
A241128-64-004front	48.572	15.868	594.344	41.012	14.492	77.11
A241128-64-004rear	48.320	14.771	471.739	41.421	11.389	66.09
A241128-64-007front	48.608	15.909	595.306	41.089	14.488	76.98
A241128-64-007rear	48.367	14.894	471.951	41.405	11.398	65.52
Supplementary information: N/A						
IEC 61215-2 MQT 03 – Insulation test (initial)						P
Test Date [YYYY-MM-DD] .....:	2024-12-23					—
Test Voltage applied [V] .....:	8000/1500					—

Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
A241128-64-007	>1000	14.8	-	No	P
Supplementary information: Size of module[m²]: 2.70					

IEC 61215-2 MQT 15 – Wet leakage current test (initial)			P
Test Date [YYYY-MM-DD] .....:	2024-12-23		—
Maximum system voltage (V)	1500		—
Test voltage applied Vtest (V d.c.)	1500		—
Solution resistivity (Ω·cm)	< 3500 Ω cm at 22 ± 2°C		P
Solution temperature (°C)	22 ± 2°C		P
Sample##	Measured[MΩ]	Required[MΩ]	—
A241128-64-007	>1000	14.8	P
Supplementary information: Size of module [m²]: 2.70			

IEC 61215-2 MQT 10 UV preconditioning test		P
Sample#	A241128-64-007	
Test Date (YYYY-MM-DD) start/end.....	2024-12-23~2025-01-10	—

Test Report

Module temperature [°C]	60±5	—
UV irradiance (280-400nm) [W/m²]	220	—
UV dose (280-400nm) [kWh/ m²]	60	—
Module operation condition	■ Short circuited ☐ Pmax	—
Supplementary information:		

IEC 61215-2 MQT01 - Visual inspection (after UV 60KWh/m²)		P
Test Date [YYYY-MM-DD]:	2025-01-10	—
Sample#	Nature and position of initial findings – comments or attach photos	—
A241128-64-007	No major visual defect.	P
Supplementary information: N/A		

IEC 61215-2 MQT 02 – Maximum power determination (after UV 60KWh/m2)		—
Test Date [YYYY-MM-DD]:	2025-01-10	—
Module temperature [°C]:	Corrected to 25	—
Irradiance [W/m²]:	1000	—

Sample#	Pmp change rate [%]	Voc [V]	Isc [A]	Pmp [W]	Vmp [V]	Imp [A]	FF [%]
A241128-64-004front	-0.20	48.784	16.004	599.502	41.307	14.513	76.79
A241128-64-004rear	-0.34	48.661	14.848	470.774	41.301	11.399	65.16
A241128-64-007front	-0.87	48.586	15.683	590.140	40.906	14.427	77.45
A241128-64-007rear	-0.14	48.331	14.844	471.281	41.305	11.410	65.69
Supplementary information: N/A							

IEC 61215-2 MQT 15 – Wet leakage current test (after UV 60KWh/m2)			P
Test Date [YYYY-MM-DD] .....:	2025-01-10		—
Maximum system voltage (V)	1500		—
Test voltage applied Vtest (V d.c.)	1500		—
Solution resistivity (Ω·cm)	< 3500 Ω cm at 22 ± 2°C		P
Solution temperature (°C)	22 ± 2°C		P
Sample##	Measured[MΩ]	Required[MΩ]	—
A241128-64-007	>1000	14.8	P
Supplementary information: Size of module [m²]: 2.70			

EL Test (after UV 60KWh/m2)		—
Test Date [YYYY-MM-DD] :	2025-01-10	—
Please check attached photos for details.		
Supplementary information: N/A		

Test Report

IEC 61215-2 MQT 10 UV preconditioning test		P
Sample#	A241128-64-007	
Test Date (YYYY-MM-DD) start/end.....:	2025-01-12~2025-01-27	—
Module temperature [°C] ..... :	60±5	—
UV irradiance (280-400nm) [W/m²] ..... :	220	—
UV dose (280-400nm) [kWh/ m²] ..... :	60	—
Module operation condition ..... .:	■ Short circuited ☐ Pmax	—
Supplementary information:		

IEC 61215-2 MQT01 - Visual inspection (after UV 120KWh/m²)		P
Test Date [YYYY-MM-DD]:	2025-01-27	—
Sample#	Nature and position of initial findings – comments or attach photos	—
A241128-64-007	No major visual defect.	P
Supplementary information: N/A		

IEC 61215-2 MQT 02 – Maximum power determination (after UV 120KWh/m2) —

Test Date [YYYY-MM-DD]:	2025-01-27	—
Module temperature [°C]:	Corrected to 25	—
Irradiance [W/m²]:	1000	—

Sample#	Pmp change rate [%]	Total Pmp change rate [%]	Voc [V]	Isc [A]	Pmp [W]	Vmp [V]	Imp [A]	FF [%]
A241128-64-004front	-0.15	-0.34	48.750	15.922	598.630	41.194	14.532	77.12
A241128-64-004rear	0.00	-0.35	48.676	14.851	470.760	41.300	11.399	65.12
A241128-64-007front	-0.24	-1.11	48.402	15.227	588.707	40.915	14.388	79.88
A241128-64-007rear	0.45	0.30	48.347	14.296	473.380	41.587	11.383	68.49
Supplementary information: N/A								

IEC 61215-2 MQT 15 – Wet leakage current test (after UV 120KWh/m2)			P
Test Date [YYYY-MM-DD] .....:	2025-01-27		—
Maximum system voltage (V)	1500		—
Test voltage applied Vtest (V d.c.)	1500		—
Solution resistivity (Ω·cm)	< 3500 Ω cm at 22 ± 2°C		P
Solution temperature (°C)	22 ± 2°C		P
Sample##	Measured[MΩ]	Required[MΩ]	—
A241128-64-007	>1000	14.8	P
Supplementary information: Size of module [m²]: 2.70			

Test Report

EL Test (after UV 120KWh/m2)		—
Test Date [YYYY-MM-DD] :	2025-01-27	—
Please check attached photos for details.		
Supplementary information: N/A		

TABLE Performance at various irradiance								—
Test Date [YYYY-MM-DD] ..... :	2025-01-09							—
Test method ..... :	☒ Simulator ☐ Natural sunlight							—
Sample #	Irradiance [W/m²]	Loss of relative efficiency with respect to STC [%]	Voc [V]	Isc [A]	Pmp [W]	Vmp [V]	Imp [A]	FF [%]
A241128-64-005	1000(front)	-	48.510	15.848	593.988	40.970	14.498	77.26
	1000(rear)	-	48.458	14.700	471.330	41.424	11.378	66.17
	200(front)	-1.89	45.934	3.056	116.551	39.807	2.928	83.04
	200(rear)	-3.88	45.702	2.430	90.604	39.741	2.280	81.59

TABLE Temperature Coefficient(Pmp)		—
Test Date [YYYY-MM-DD]	2025-01-09	—
Test method	☒ Simulator ☐ Natural sunlight	—
Sample #	Temperature coefficient[%]	
A241128-64-005	-0.3071	

Test Report

Annex 1: List of measurement equipment

Clause	Measurement / testing	Testing / measuring equipment / material used, (Equipment ID)	Range used	Calibration due date
IEC 61215-2 MQT01	**Visual inspection**	Lamp	-	NA
		Digital Luxmeter EZ6330	-	2025-08-11
		Digital caliper, measuring tape EZ6286	-	2025-07-12
		Camera	-	NA
IEC 61215-2 MQT02	**Maximum power determination**	Solar Simulator EZ4446	-	2025-08-02
		Standard solar module EZ6770	-	2025-07-03
IEC 61215-2 MQT04	**Temperature Coefficient**	Solar Simulator EZ4446	-	2025-08-02
		Temperature control chamber EZ4446-4	-	2025-10-16
		Standard solar module EZ6770	-	2025-07-03
IEC 61215-2 MQT03	**Insulation test**	Comprehensive safety test instrument EZ1096	-	2025-07-08
IEC 61215-2 MQT15	**Wet leakage current test**	Comprehensive safety test instrument EZ1096	-	2025-07-08
		Conductivity meter EZ5723	-	2025-06-24
IEC TS 62804-1	**PID**	PID test system EZ6648	-	2025-09-02
		Climate chamber EZ6217	-	2025-12-15
IEC 61215-2 MQT 19	**UV test**	UV Chamber EZ6520	-	2025-07-19
IEC 61730-2 MST13	**Ground continuity test**	Comprehensive safety test instrument EZ1096	-	2025-07-08

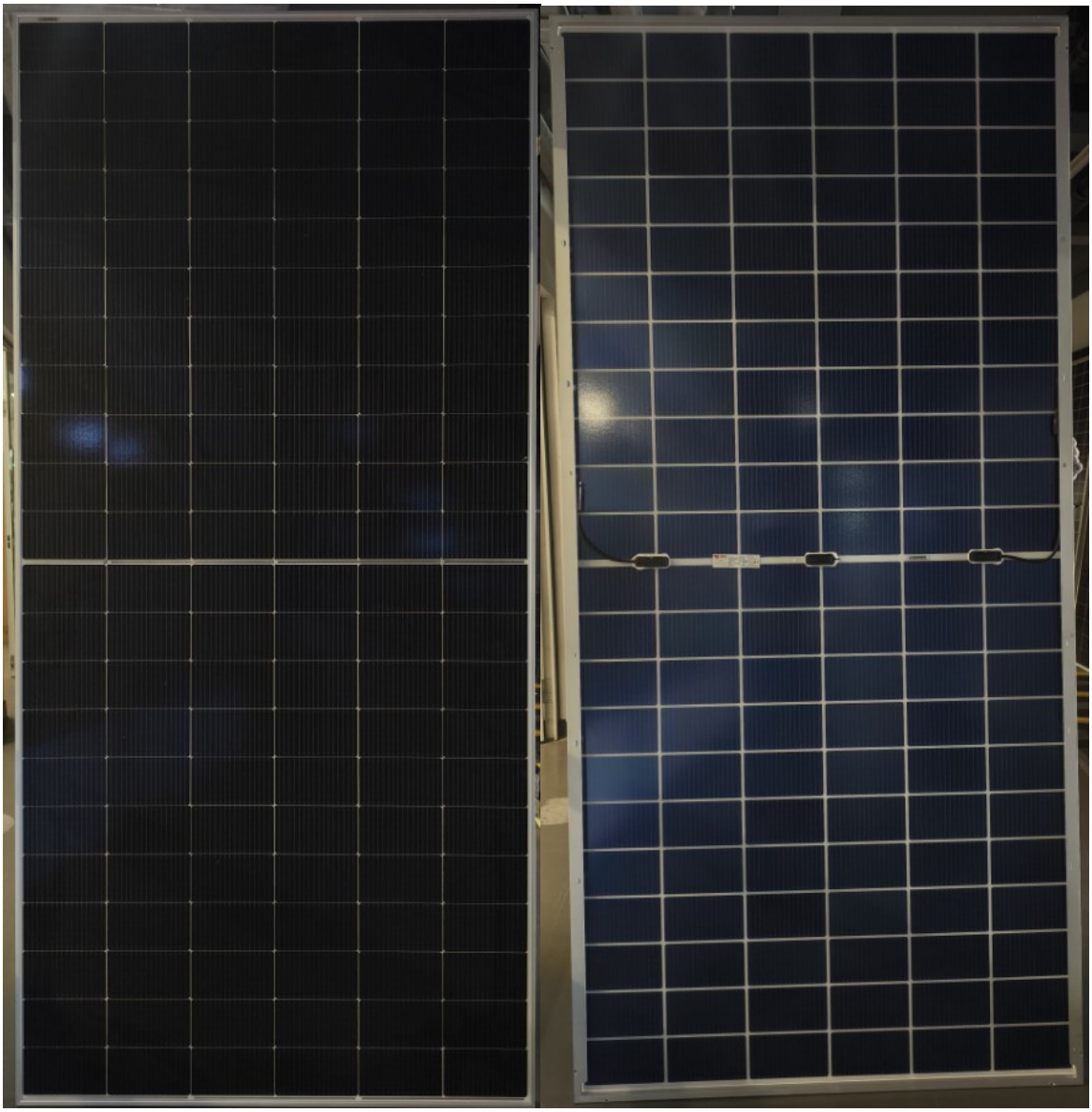
Test Report

Annex 2: Statement of the estimated uncertainty of the test results

Statement of the estimated uncertainty of the I/V test, K=2. U(Isc)=2.2% U(Voc)=1.04% U(Pmax)=2.4%

Test Report

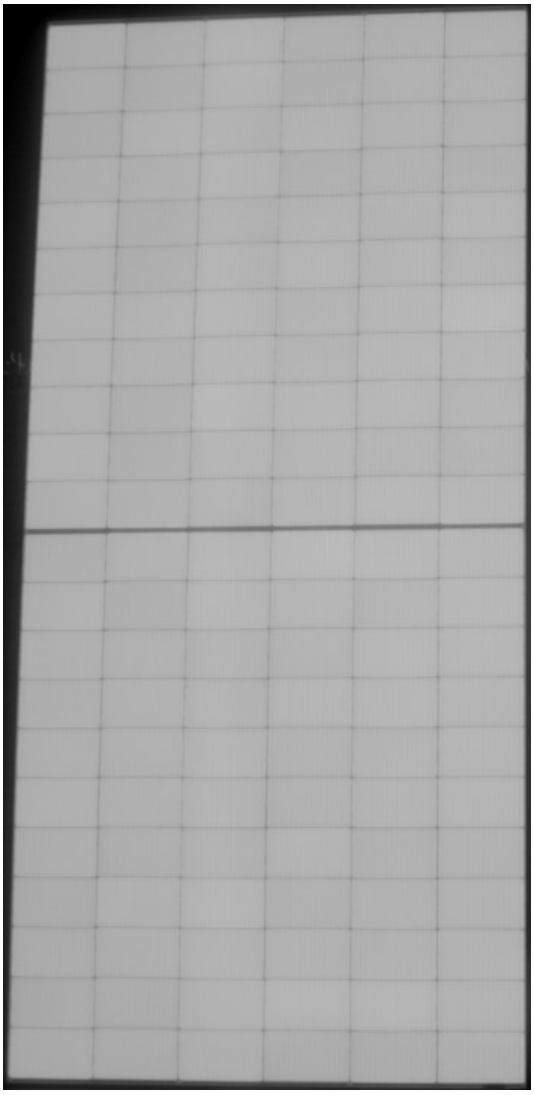
Annex 3: Photos of module



Test Report

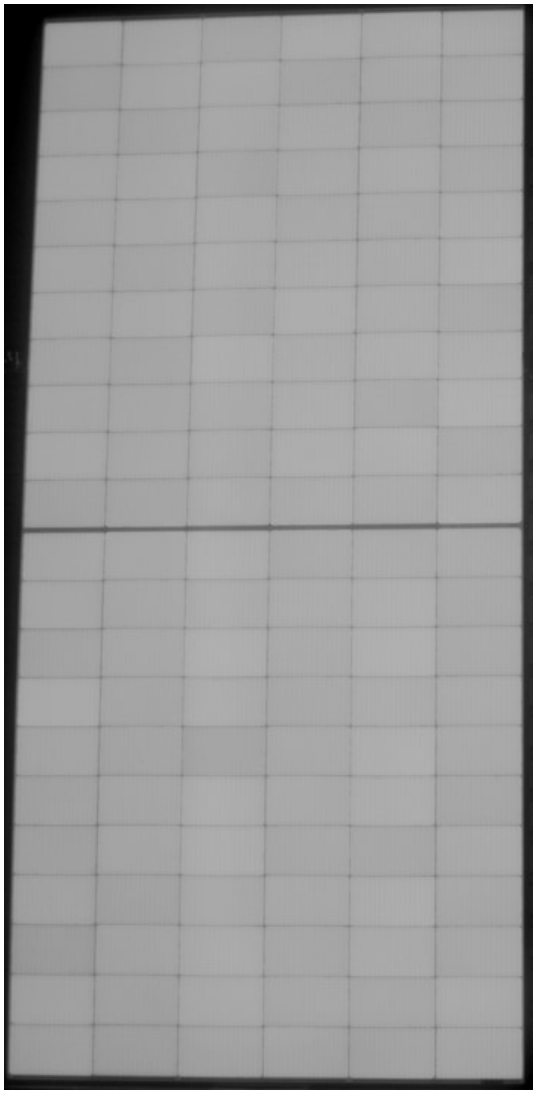
Annex 4: Photo of EL test

Sample# A241128-64-001
As received



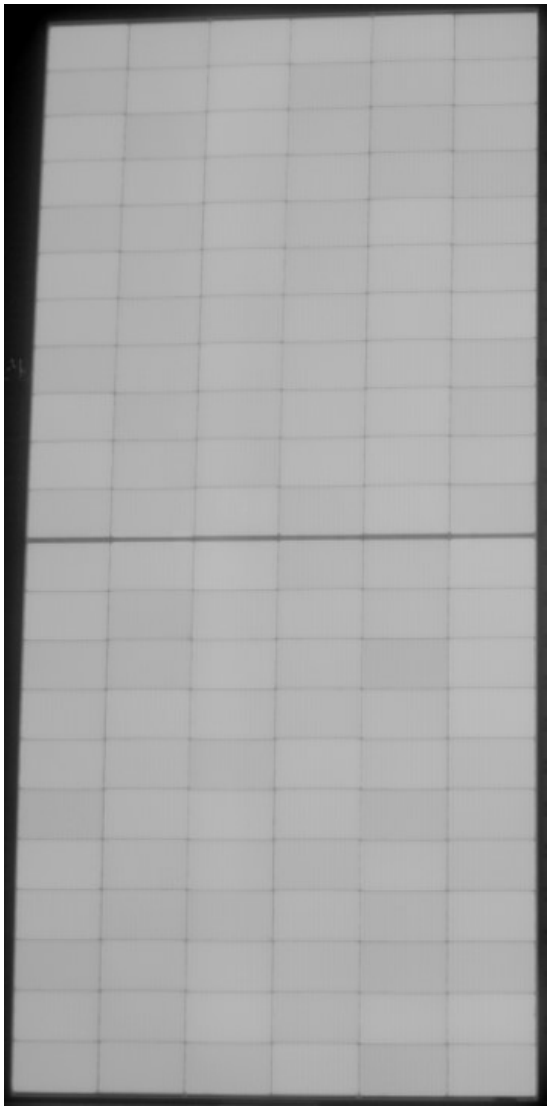
Test Report

Sample# A241128-64-002
As received



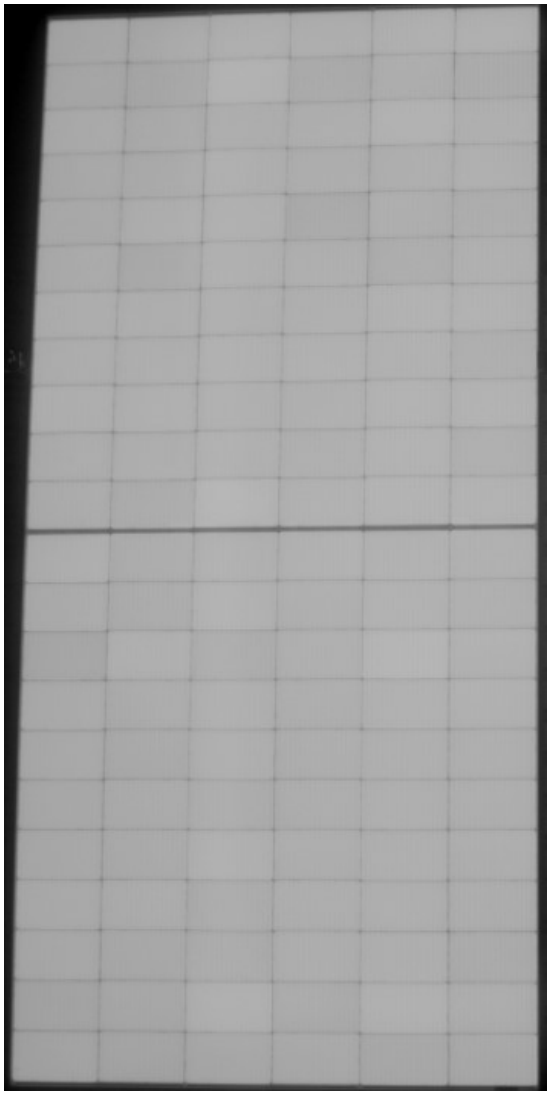
Test Report

Sample# A241128-64-003
As received

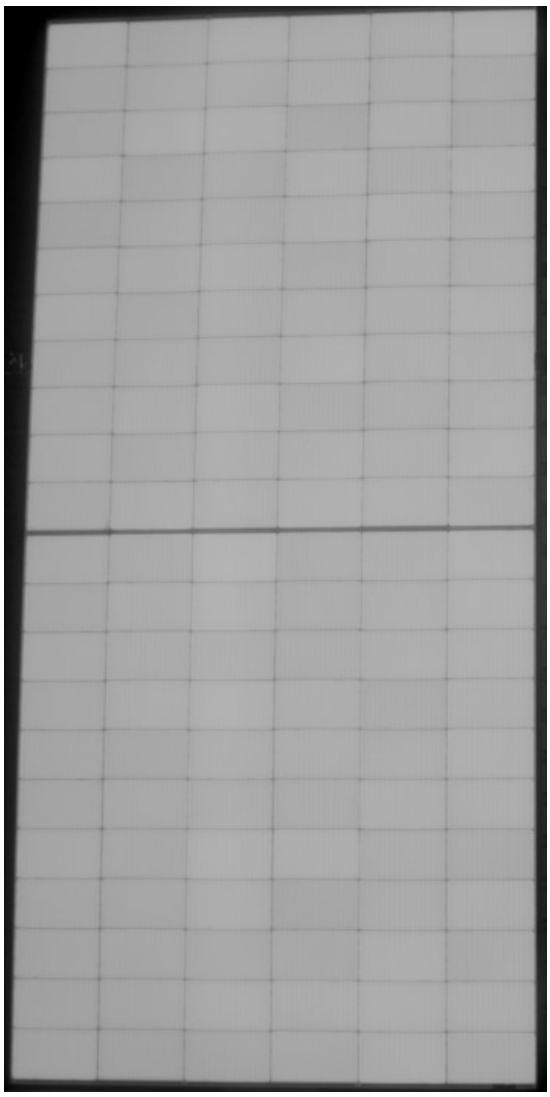
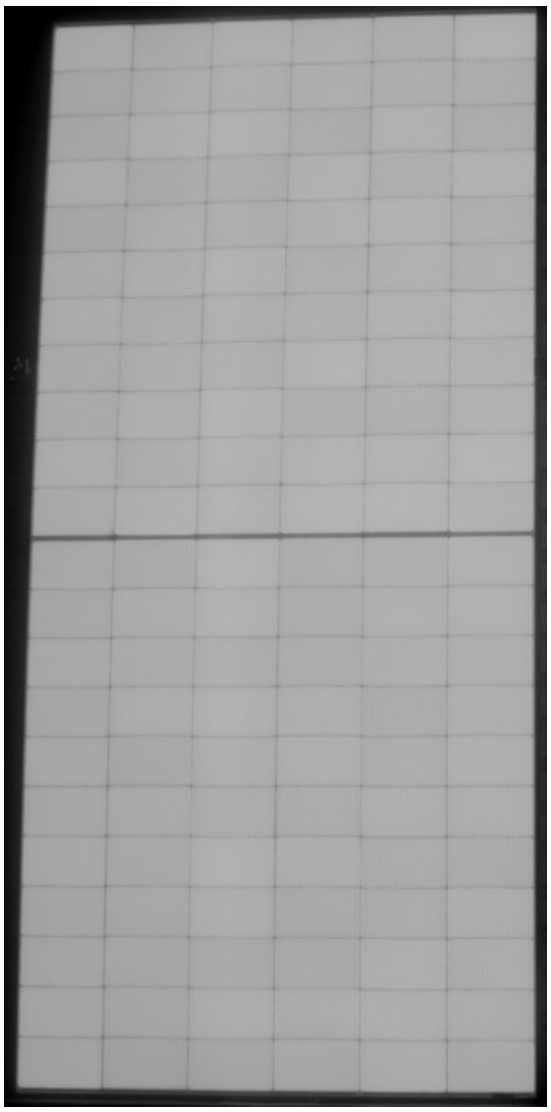


Test Report

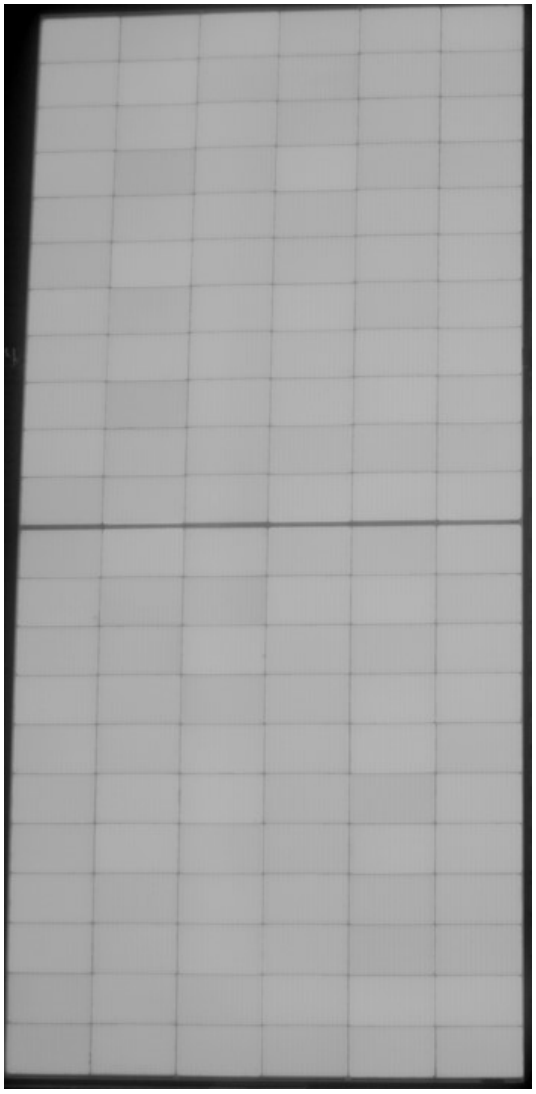
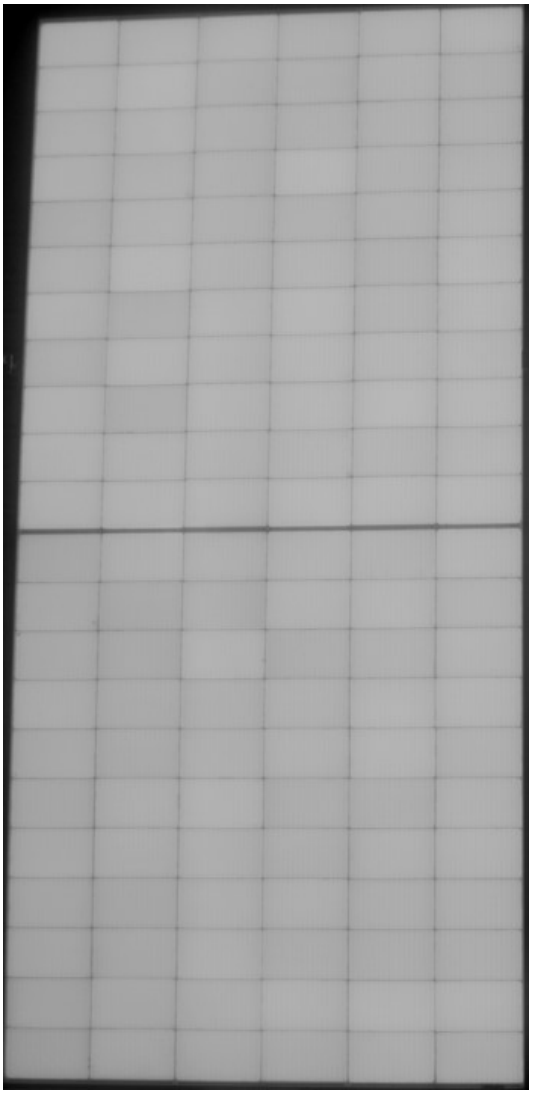
Sample# A241128-64-005
As received



Test Report

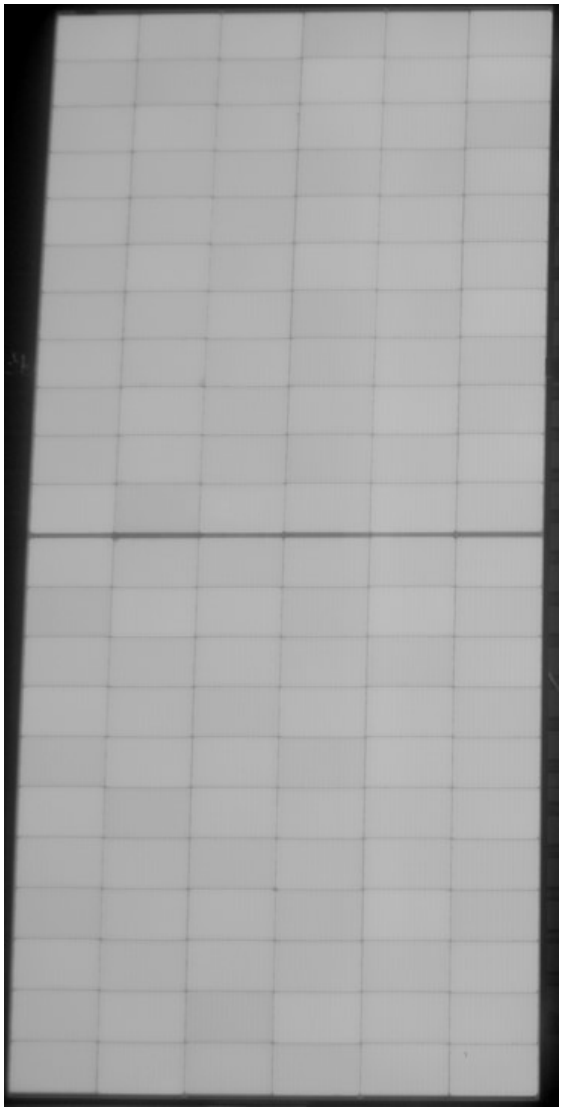
Sample# A241128-64-006	
Before PID	After PID
	

Test Report

Sample# A241128-64-007	
Before UV	After UV
	

Test Report

Sample# A241128-64-008
As received



-- END OF REPORT --

Thank You

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