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CEA I PV MAGAZINE PROGRAM TEST REPORT

SUPPLIER | SolarSpace

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GSOLA 陕西众森电能科技有限公司
GSOLAR POWER CO.,LTD

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1. INTRODUCTION

As part of CEA's engagement in developing and supervising PV Magazine's test program at Gsola, CEA has developed a testing protocol and flowchart, a scoring system, a methodology and a reporting structure that it will be used to run this program. This report presents the test results and scoring grades for this product.

2. SCORING SYSTEM

2.1. Test flowchart and protocol

The following is a high-level flowchart of the testing procedure, describing the steps, and tests to be followed. Detailed checklists have been delivered to Gsola, that will also serve as records of the process.

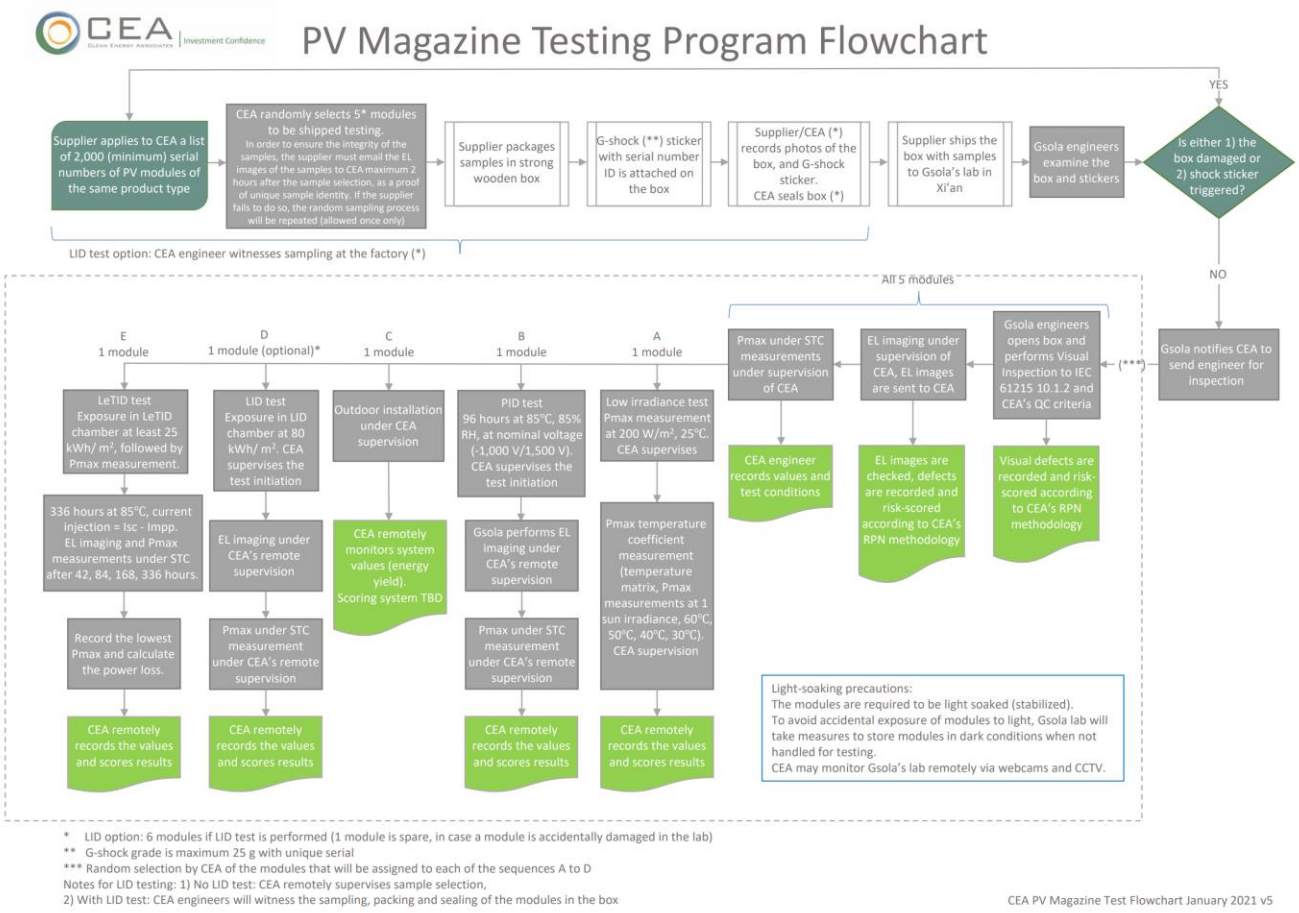


Figure 1 Test flowchart

2.2. Scoring methodology

For every product, 5 samples have been shipped to Gsola's lab to conduct the tests and inspections according to the above flowchart.

The following table describes the inspections and tests that have been applied on all products:

Table 1 Test/inspection grading system overview

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

Notes:

1. The RPN scoring method has been developed by CEA and is used to evaluate and create risk scores of Visual and EL defects.
2. The weights are used to calculate the average grade for tests 1-5.

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

Table 2 Detailed scoring system

	Grade range:	100	90	80	70	60	50	40	30	20	10	0
1	Visual inspection (RPN scores)	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)	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	≤ -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	≥ -0.300%	-0.343%	-0.382%	-0.417%	-0.448%	-0.475%	-0.498%	-0.517%	-0.532%	-0.543%	≤ -0.550%
5	PID loss	≤ 0.0%	0.7%	1.6%	2.7%	4.0%	5.5%	7.2%	9.1%	11.2%	13.5%	≥ 16.0%
6	LID loss (optional)	≤ -0.50%	0.35%	1.20%	2.05%	2.90%	3.75%	4.60%	5.45%	6.30%	7.15%	≥ 8.00%
7	LeTID	≤ 0%	0.30%	0.60%	0.90%	1.20%	1.50%	1.80%	2.10%	2.40%	2.70%	≥ 3.00%

Notes:

1. The Visual and EL Inspection RPN scores will be divided by the number of samples, to normalize the score, as the total number of samples may vary.
2. 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 and employed 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. In this sense, grades below 50 indicate a product performance that is below a generally acceptable threshold.

The scoring system shown in Table 2 is preliminary, and will be adjusted as the testing program develops, in order to better reflect the products standing per industry standards.

2.3. Selection methodology

We follow three testing sample selection methods:

1: Sample randomly selected by CEA from a large production lot

2: Sample purchased from the market by CEA

3: Sample provided by supplier, without random selection

The SS9-66HD-695N testing samples were selected according to method 3.

EST DETAILS

A sample lot consists of 5 modules, one of which has been used as a spare for the chamber and outdoor testing, in case a module is accidentally damaged during handling at the lab. Refer to Table 3 and Table 4 for test sample and product information.

Table 3 Test sample information

Sample #	Serial number
1	ND144252496613200031
2	ND144252496613200035
3	ND144252496613200043
4	ND144252496613200037
5	ND144252496613200044

Table 4 Product information

Model	SS9-66HD-695N
Cell technology	TOPCon
Cell number	132
Cell format	210x210 mm
Number of busbars	18BB
Junction box	IP68, 3 bypass diodes
Laminate construction	Glass
Bifaciality ratio	80±5%

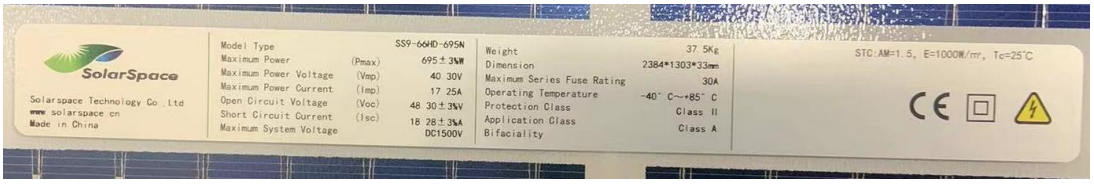
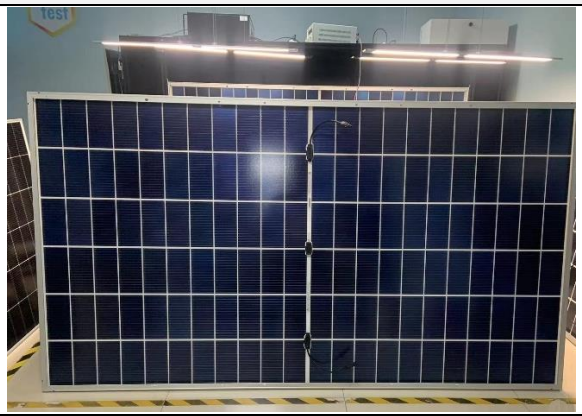


Figure 2 Product nameplate

2.4. Visual inspection

All 5 modules of each product sample lot have undergone visual inspection, according to CEA's quality criteria for visual inspection. The defects found has been evaluated according to CEA's scoring system. The scoring system is a modified version of CEA's proprietary RPN (risk priority number) system, based on the formula RPN score = Severity x Detectability.

Table 5 Product picture

Front Side	Rear Side
	

The following table shows the visual inspection results, normalized for the number of tested modules:

Table 6 Visual inspection results

SS9-66HD-695N	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Score	Grade
Visual inspection	None	None	None	None	None	0	100

2.5. EL image Inspection

The same sample lot was inspected for EL defects.
Table 7 shows the EL inspection results normalized for the number of tested modules. Visual and EL inspection scores are shown below in Figure 3.

Table 7 EL image inspection results

SS9-66HD-695N	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Score	Grade
EL image inspection	None	None	None	None	None	0	100

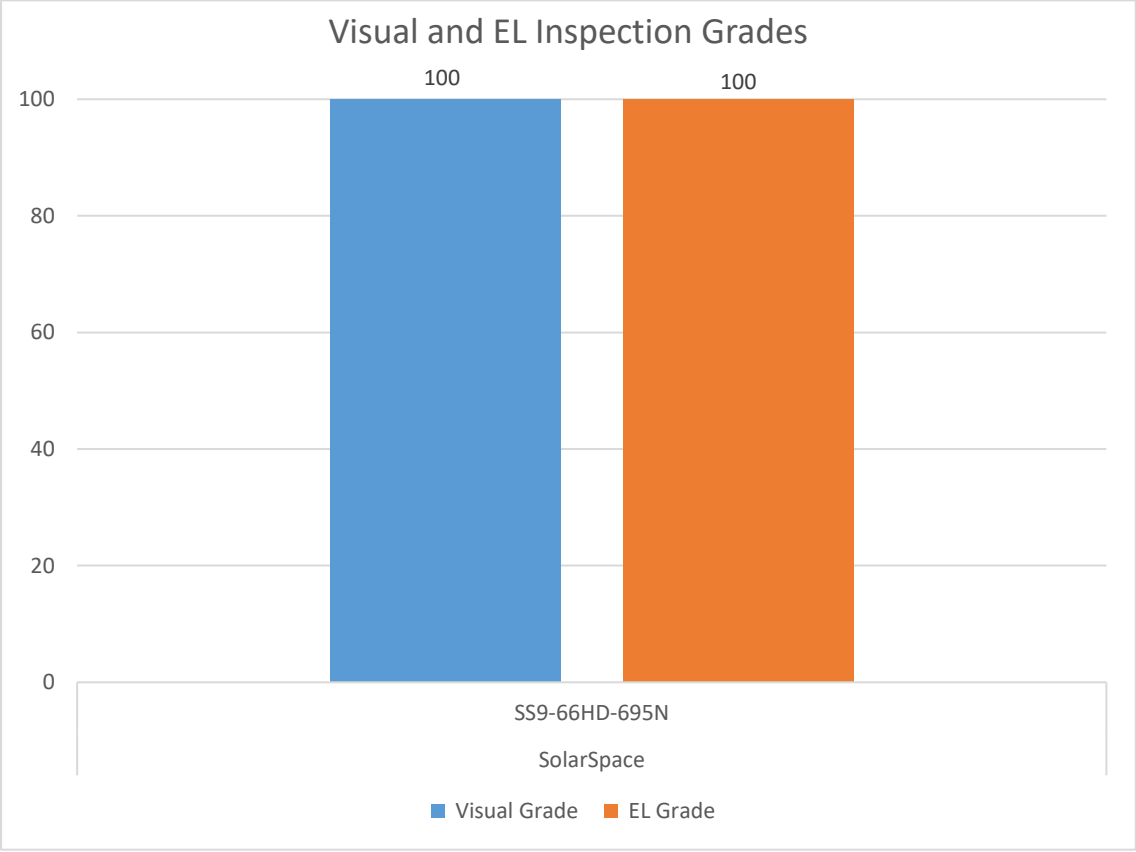


Figure 3 Visual and EL inspection results

2.6. Low irradiance efficiency loss test

The efficiency loss is calculated by the following formula:

Efficiency loss = 1- [(Pmax at low irradiance conditions / Pmax at STC) * (1,000/200)]

Table 8 and Figure 4 show the low irradiance efficiency test results for the front side.

Table 8 Low irradiance test results

SS9-66HD-695N	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Front side low irradiance efficiency loss (%)	3.50%					69

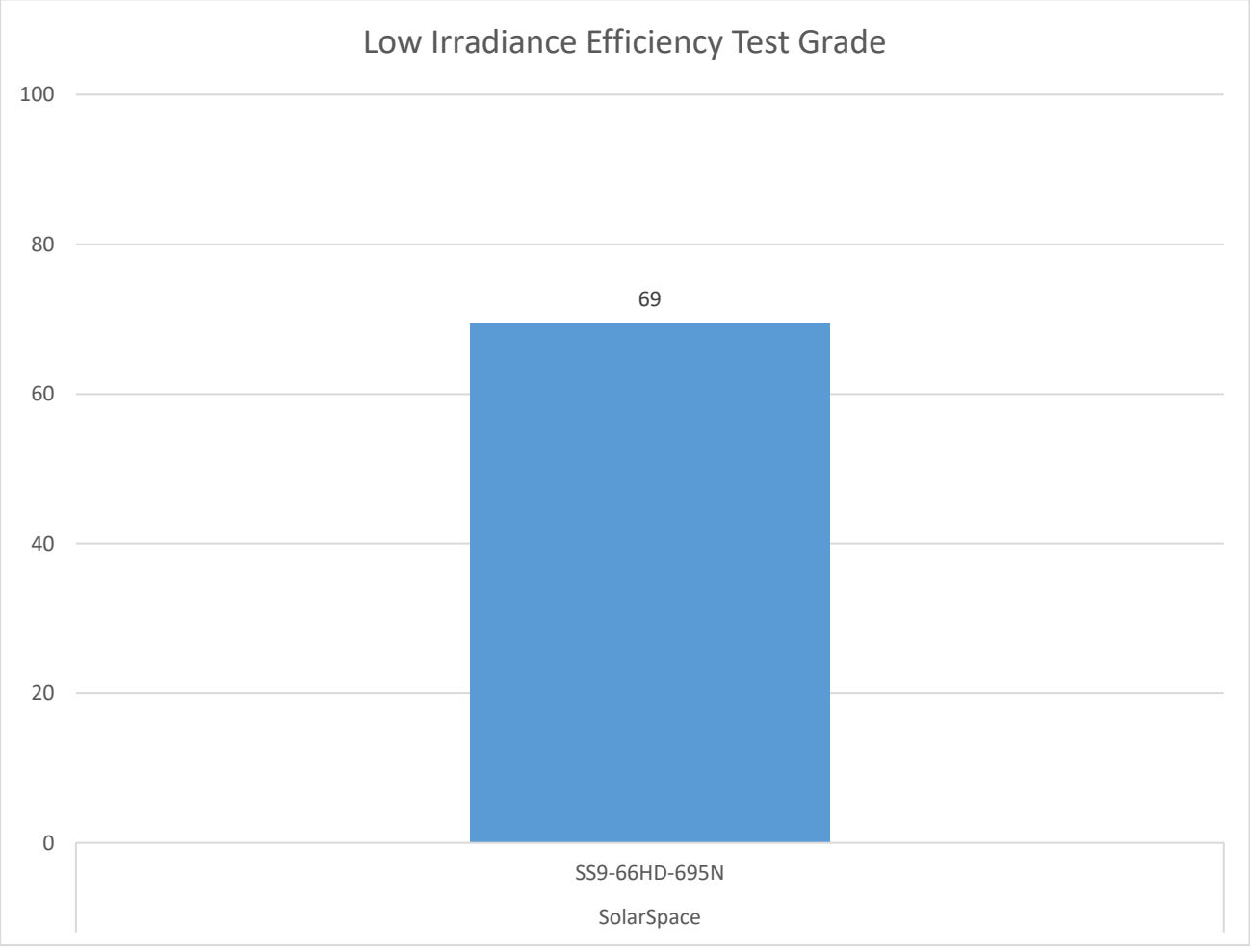


Figure 4 Low irradiance test result

2.7. Pmax temperature coefficient test

Table 9 and Figure 5 depict the Pmax temperature coefficient test results.

Table 9 Pmax temperature coefficient test result

SS9-66HD-695N	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Pmax Temperature coefficient (%/°C)	-0.282%					104

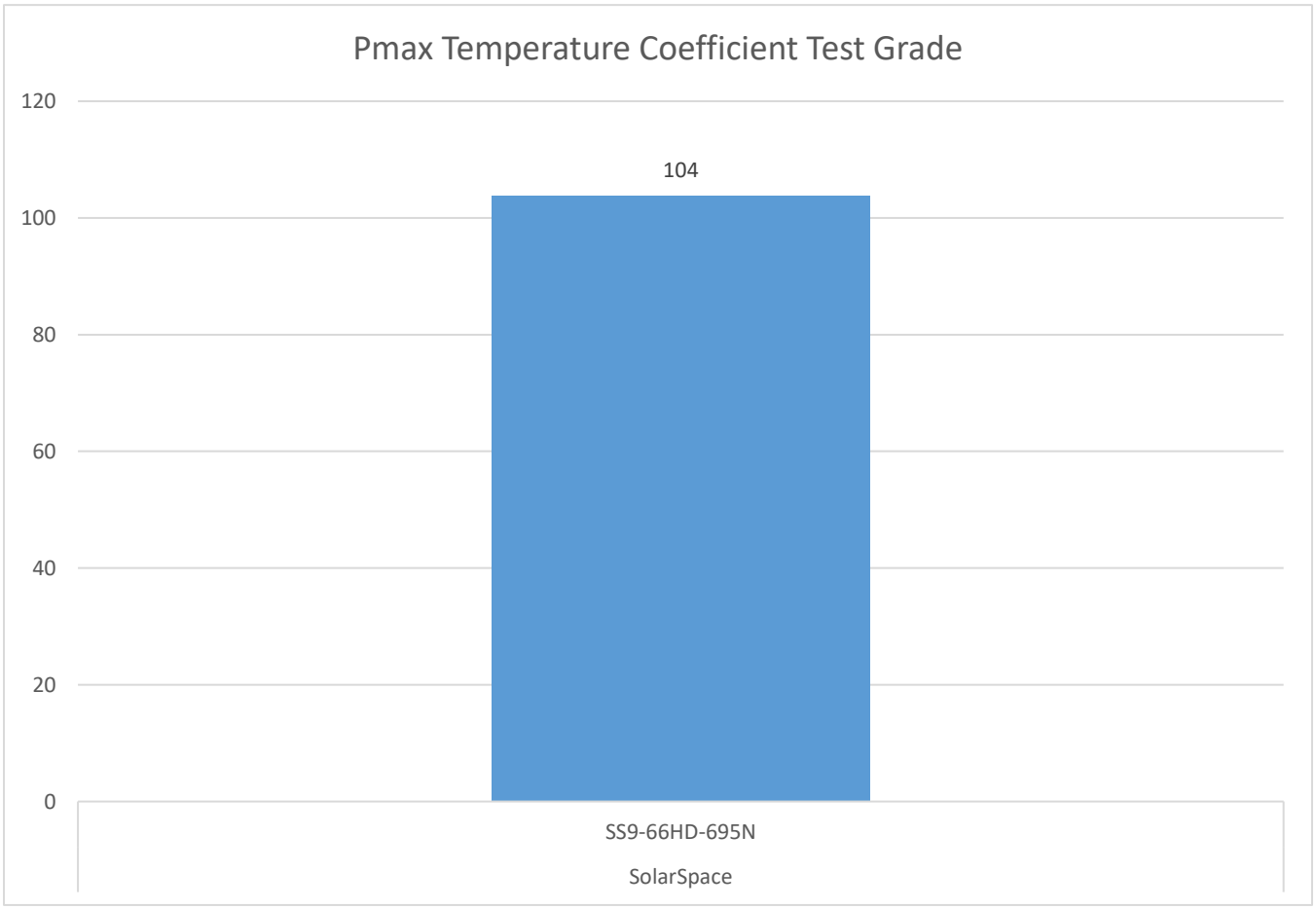


Figure 5 Pmax temperature coefficient test result

2.8. PID loss test

Table 10 and Figure 6 depicts the PID loss test results for the front side at 1500 V. After PID stressing the sample is light soaked for one day outdoors to recover any PID-p (polarization). The remaining degradation is considered to be due to Na ion migration.

Table 10 PID loss test result

SS9-66HD-695N	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Front side PID loss (%)			0.79%			

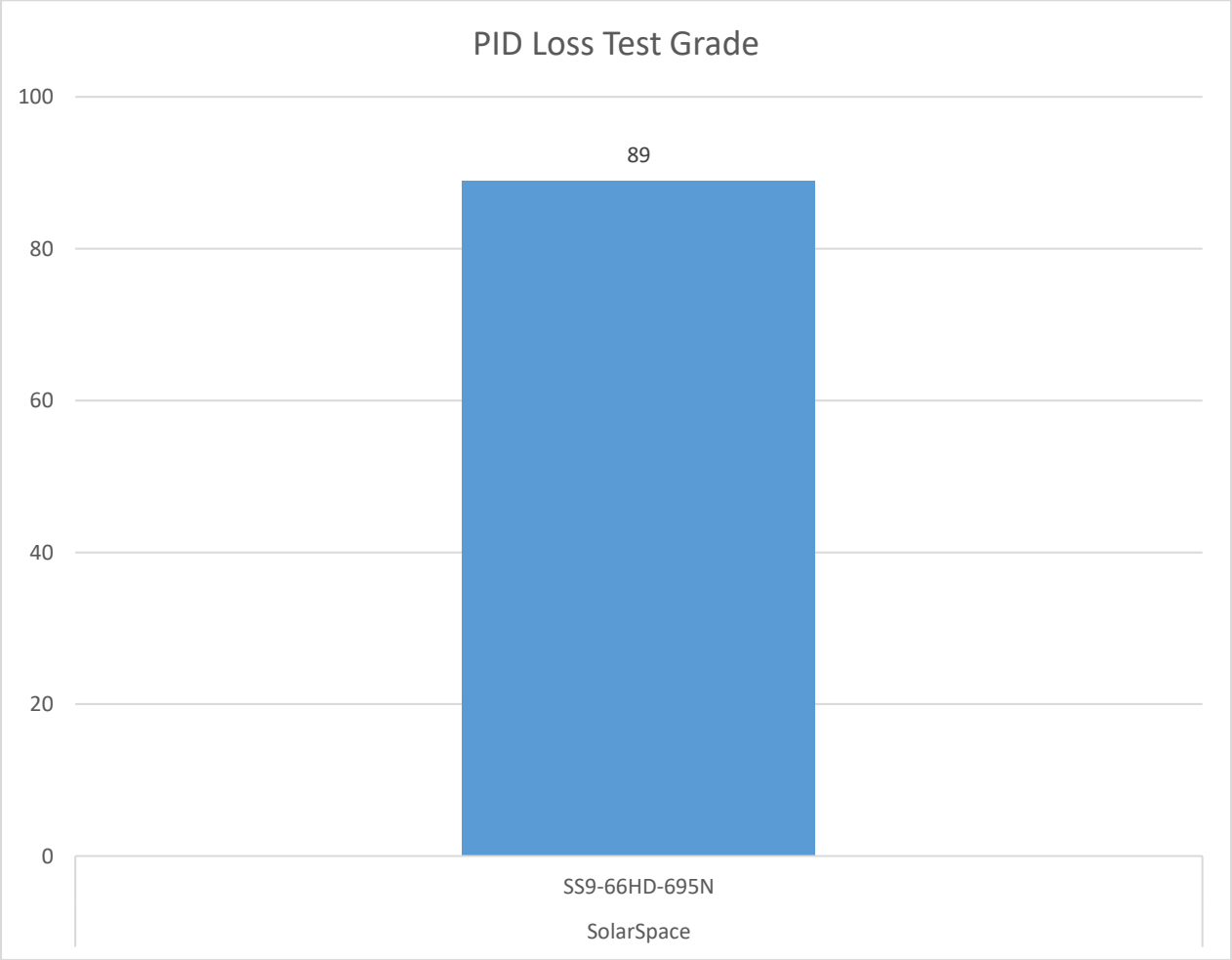


Figure 6 PID loss test result

2.9. LID loss test

Table 11 and Figure 7 depicts the LID loss test results for the front side:

Table 11 LID loss test result

SS9-66HD-695N	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Front side LID loss (%)		0.15%				92

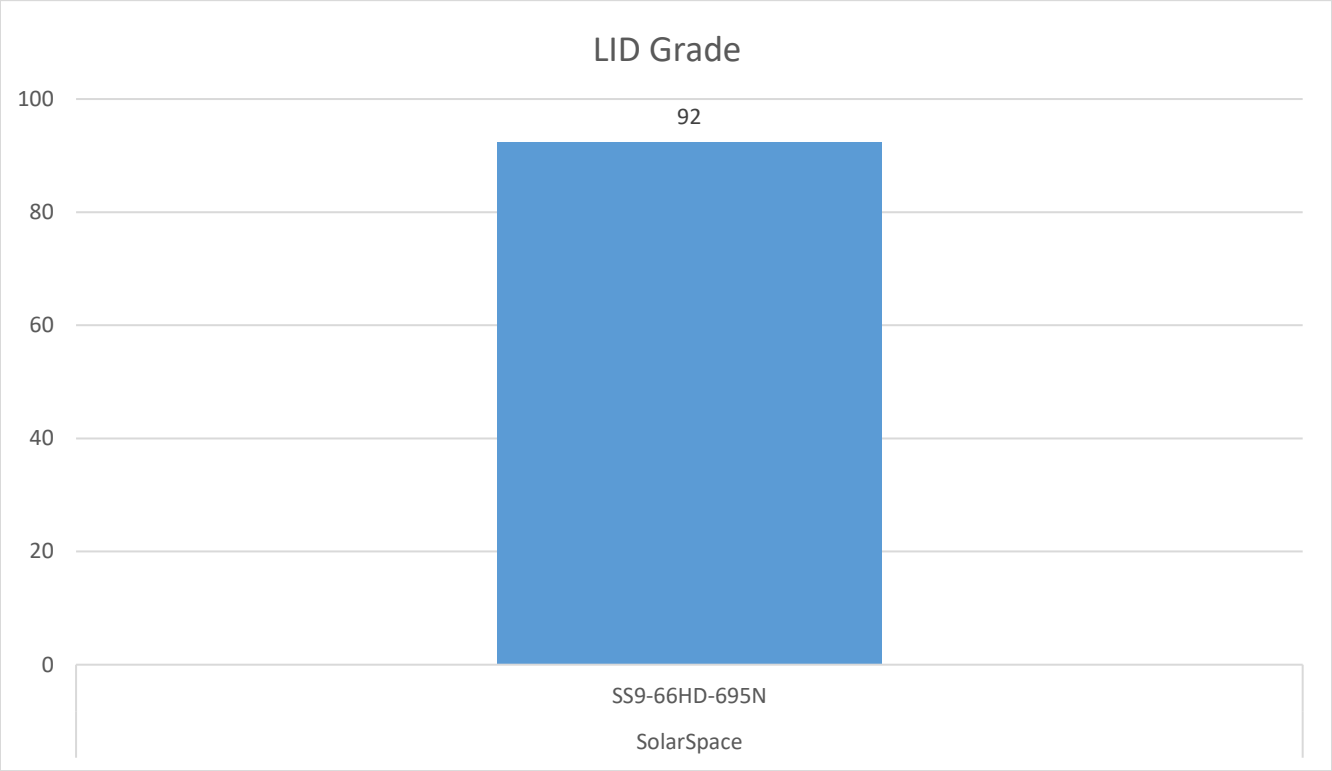


Figure 7 LID loss test result

2.10. Bifaciality ratio

The bifaciality ratio test result is not graded. We list the results here for informational purposes. The table below shows the bifaciality ratio results:

Table 12 Bifaciality ratio test results

SS9-66HD-695N	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Average
Bifaciality ratio (%)	79.37%	79.48%	79.66%	79.10%	80.70%	79.66%

The bifaciality ratio is calculated from the following formula:

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

2.11. Score overview

Figure 8 shows the overview of the test scores. Figure 9 shows the average score.

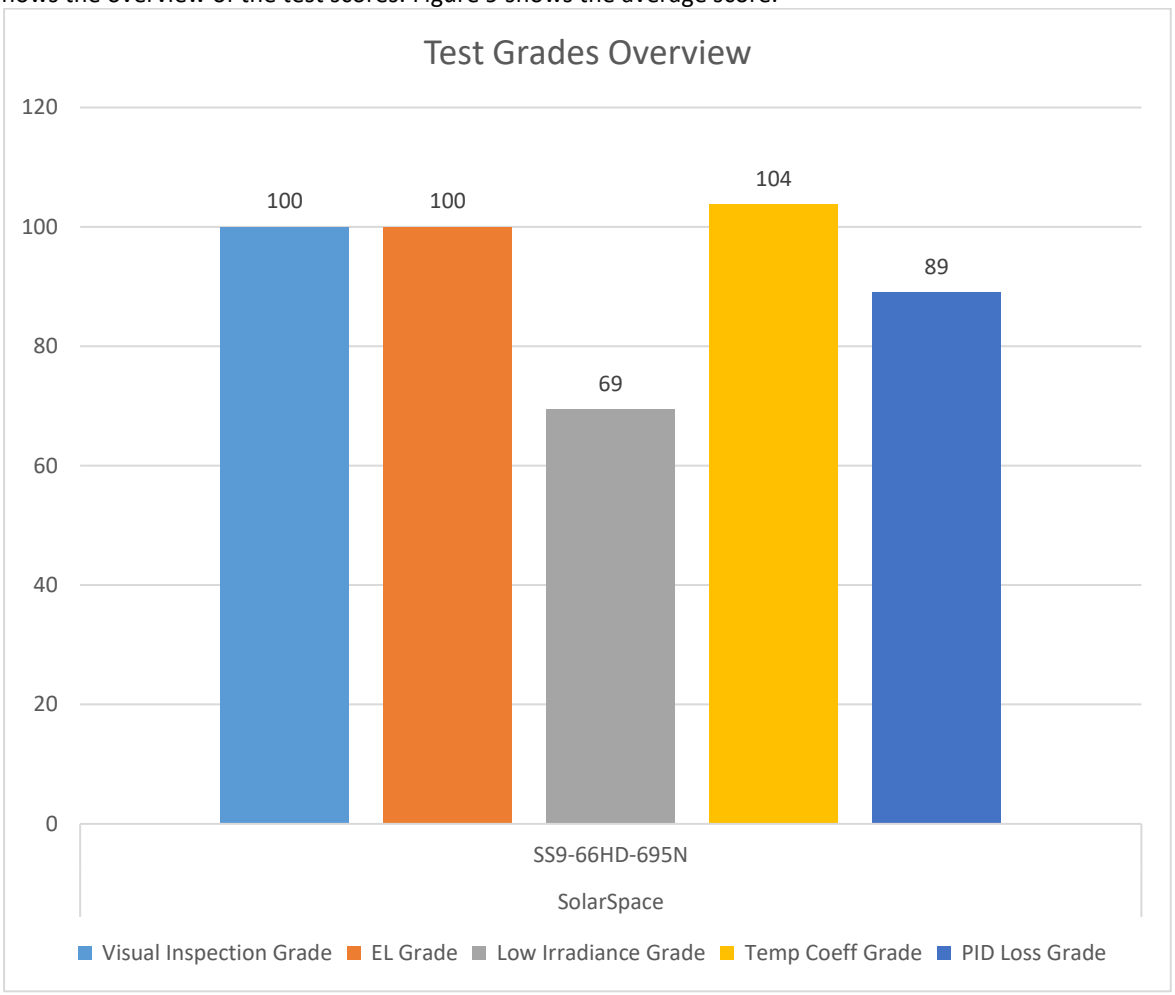


Figure 8 Test results overview

NOTE: The Average grade does **NOT** include the LID test, as it is optional and not performed for all products.

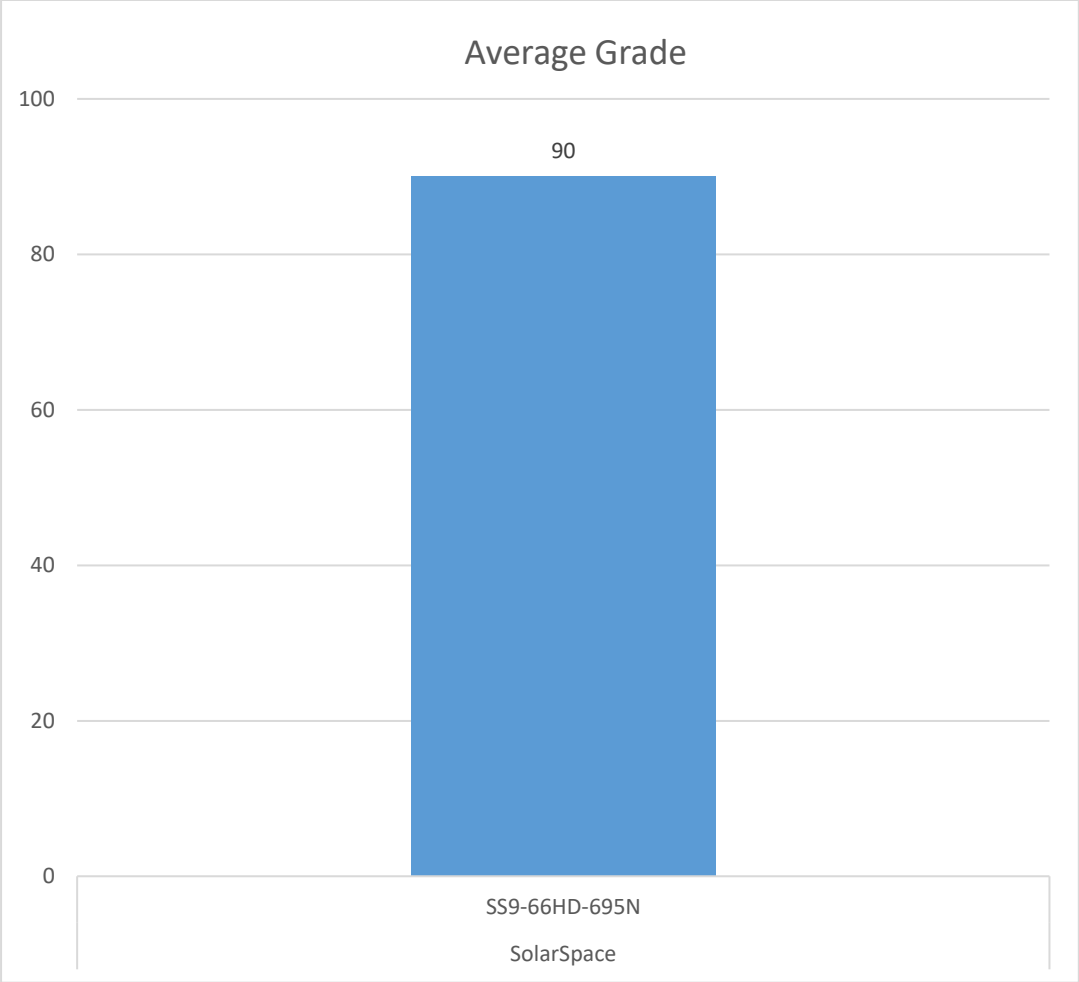


Figure 9 Average test grade

Appendix 1 – SS9-66HD-695N Datasheet

Lumina II

High Power Output
With 210 large wafer technology and slicing technology, multi-grid technology, high-density module packaging to ensure higher power output of modules

High Reliability
Excellent harsh tests results and advanced half-cell tech improve product reliability for long-term life cycle

Extra power generation
N-type wafers and cells bring ultralow LID&LeTID degradation, less than 1% 1st year degradation guaranteed, in addition lower temperature coefficient and better weak-light response provide extra power generation

High ROI
Bifacial power generation reduces BOS and system LCOE dramatically, promoting the project ROI

SolarSpace Technology Co., Ltd. was established in 2011, as a world leading solar cell and module manufacturer, concentrating on high efficient solar-technology production with 58.75GW+ capacity of solar cell and 5.7GW capacity of solar module in China and overseas.

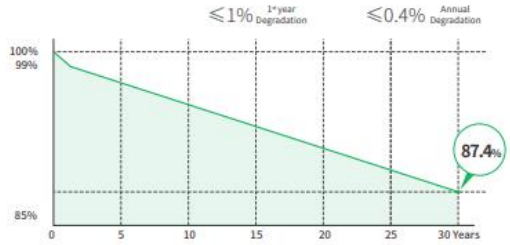
*Please refer to SolarSpace for details

SS9-66HD 685-705N

N-TOPCon Bifacial Dual Glass Module

705W
Maximum Power Output

22.70%
Maximum Module Efficiency



15 Years Product Warranty **30** Years Linear Power Warranty

Comprehensive Certificates

- IEC61215 • IEC61730
- IEC61701:Salt mist corrosion test • IEC62716:Ammonia corrosion test
- IEC60068:Dust and Sand test
- ISO9001:2015: Quality Management System
- ISO14001:2015: Environment Management System
- ISO45001:2018: Occupational Health and Safety Management Systems

N-TOPCon Bifacial Dual Glass Module SS9-66HD 685-705N

Electric Characteristics(STC)

Module Type	SS9-66HD -685N	SS9-66HD -690N	SS9-66HD -695N	SS9-66HD -700N	SS9-66HD -705N
Maximum Power (Pmax) [W]	685	690	695	700	705
Open-Circuit Voltage (Voc)[V]	47.60	47.80	48.00	48.20	48.40
Maximum Power Voltage (Vmp) [V]	39.90	40.10	40.30	40.50	40.70
Short-Circuit Current (Isc)[A]	18.20	18.24	18.28	18.32	18.36
Maximum Power Current (Imp) [A]	17.18	17.21	17.25	17.29	17.33
Module Efficiency	22.05%	22.21%	22.37%	22.53%	22.70%

Irradiation 1000W/m², Cell Temperature 25°C, AM=1.5

Bifacial Output-Rearside Power Gain (695W)

Power Gain	5%	10%	15%	20%	25%
Maximum Power (Pmax) [W]	730	765	799	834	869
Open-Circuit Voltage (Voc)[V]	47.90	47.90	47.90	48.00	48.00
Maximum Power Voltage (Vmp) [V]	40.30	40.30	40.30	40.40	40.40
Short-Circuit Current (Isc)[A]	18.84	19.56	20.25	20.98	21.69
Maximum Power Current (Imp) [A]	18.12	18.99	19.83	20.65	21.51

Electric Characteristics (NMOT)

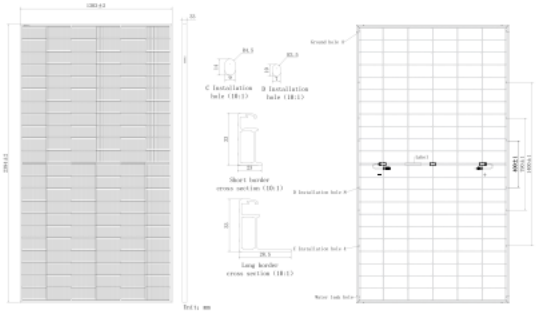
Module Type	SS9-66HD -685N	SS9-66HD -690N	SS9-66HD -695N	SS9-66HD -700N	SS9-66HD -705N
Maximum Power (Pmax) [W]	522	526	530	534	538
Open-Circuit Voltage (Voc)[V]	45.10	45.30	45.50	45.70	45.90
Maximum Power Voltage (Vmp) [V]	37.20	37.40	37.60	37.80	38.00
Short-Circuit Current (Isc)[A]	14.68	14.72	14.76	14.80	14.84
Maximum Power Current (Imp) [A]	14.04	14.07	14.10	14.13	14.16

Irradiance 800 W/m², Ambient Temperature 20 °C, Wind Speed 1 m/s, AM=1.5

Temperature coefficients

Temperature coefficient of Isc	+0.045%/°C
Temperature coefficient of Voc	-0.260%/°C
Temperature coefficient of Pmax	-0.290%/°C
NMOT	45±2°C

Engineering Design

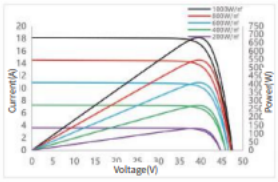


Mechanical Characteristics

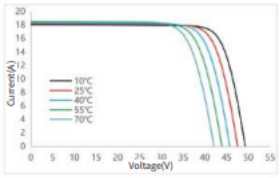
Cell Type	N-TOPCon
Number of Cells	132(6x22)
Dimensions	2384X1303X33mm
Weight	37.5kg
Glass	Front glass, 2.0mm coated semi-tempered glass
	Back Glass, 2.0mm glazed semi-tempered glass
Frame	Anodized Aluminum Alloy
Output Cables	4mm²(IEC),12AWG(UL) 300mm(including connector) or Customized Length
Junction Box	IP68 Rated, 3 diodes
Connector	MC4-EVO2 or MC4 Compatible
Packaging	33 Pieces/Pallet, 594 pieces/40' container

Characteristics

I-V/P-V Curve at Different Irradiation
SS9-66HD-695N



I-V Curve at Different Temperature
SS9-66HD-695N



Operating Conditions

Maximum System Voltage	1500V DC (IEC)
Power Tolerance	0~+3%
Operating Temperature	-40°C~+85°C
Maximum Series Fuse Rating	30A
Mechanical Load Front Rear	5400Pa
Mechanical Load Back Rear	2400Pa
Bifaciality	80±5%

SolarSpace
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