CEA I PV MAGAZINE PROGRAM TEST REPORT

SUPPLIER | Akcome

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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.

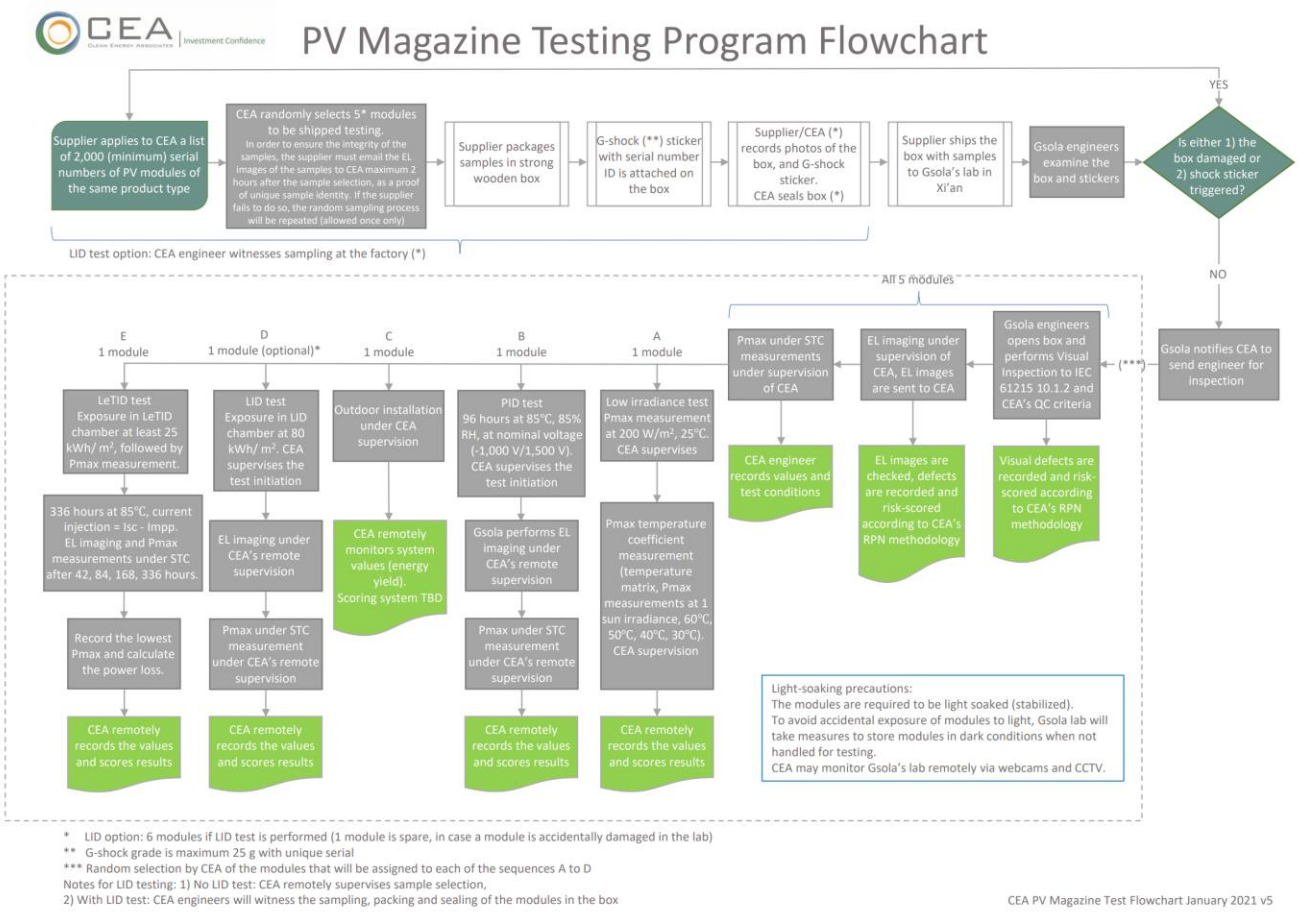

Figure 1 Test flowchart

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 SKA611HDGDC testing samples were selected according to method 3.

3. TEST 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	SKC3HE30423J240068
2	SKC3HE30423J240069
3	SKC3HE30423J240070
4	SKC3HE30423J240066
5	SKC3HE30423J240067

Table 4 Product information

Model	SKA611HDGDC
Cell technology	n-type HJT
Cell number	132
Cell format	210x210 mm
Number of busbars	18BB
Junction box	IP68, 3 bypass diodes
Laminate construction	Glass
Bifaciality ratio	90±5%

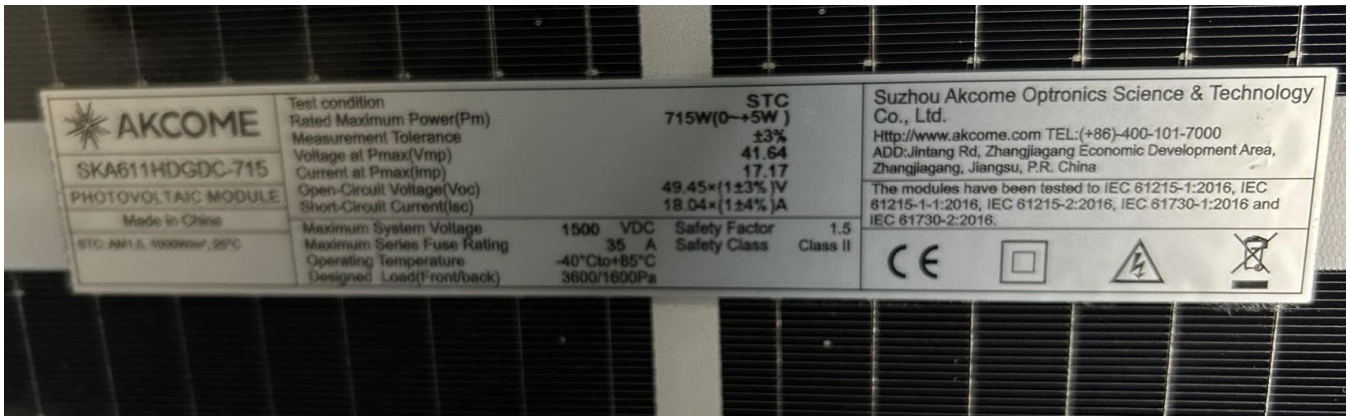

Figure 2 Product nameplate

3.1. 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

SKA611HDGDC	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Score	Grade
Visual inspection	None	None	None	None	None	0	100

3.2. 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

SKA611HDGDC	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Score	Grade
EL image inspection	None	None	None	None	None	0	100

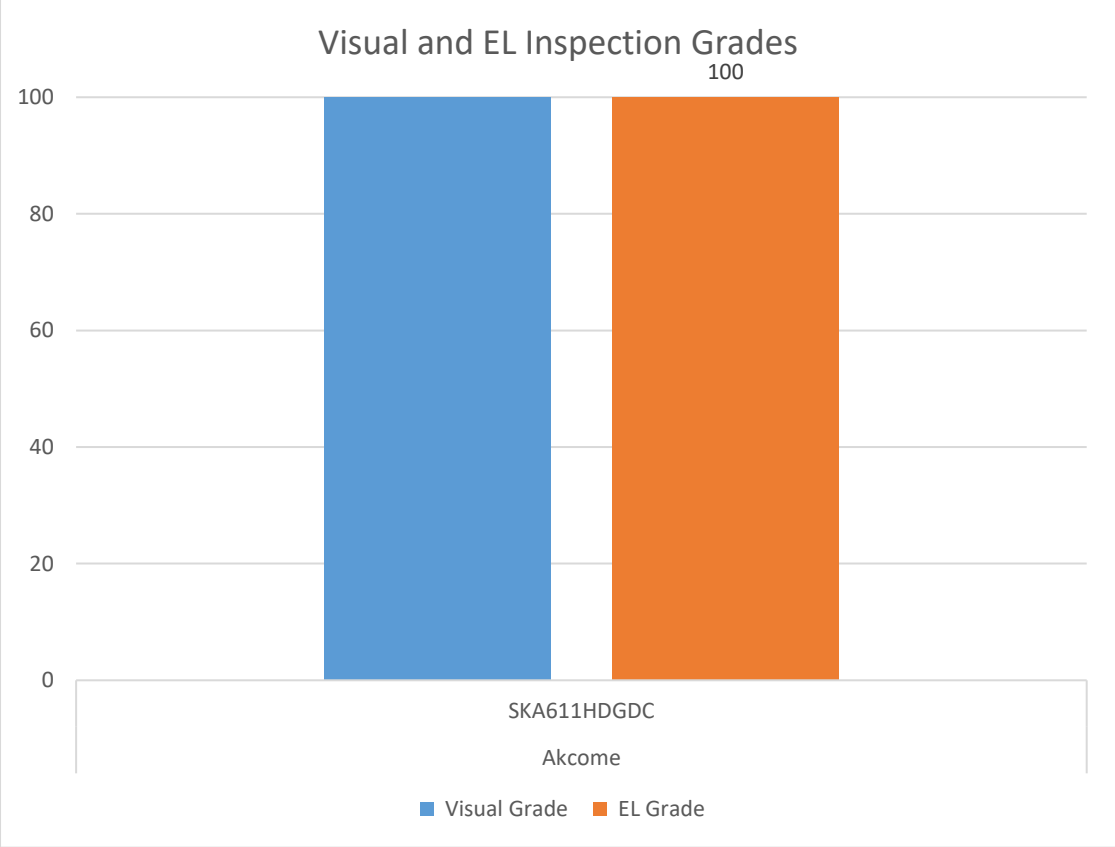

Figure 3 Visual and EL inspection results

3.3. 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

SKA611HDGDC	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Front side low irradiance efficiency loss (%)	2.30%					77

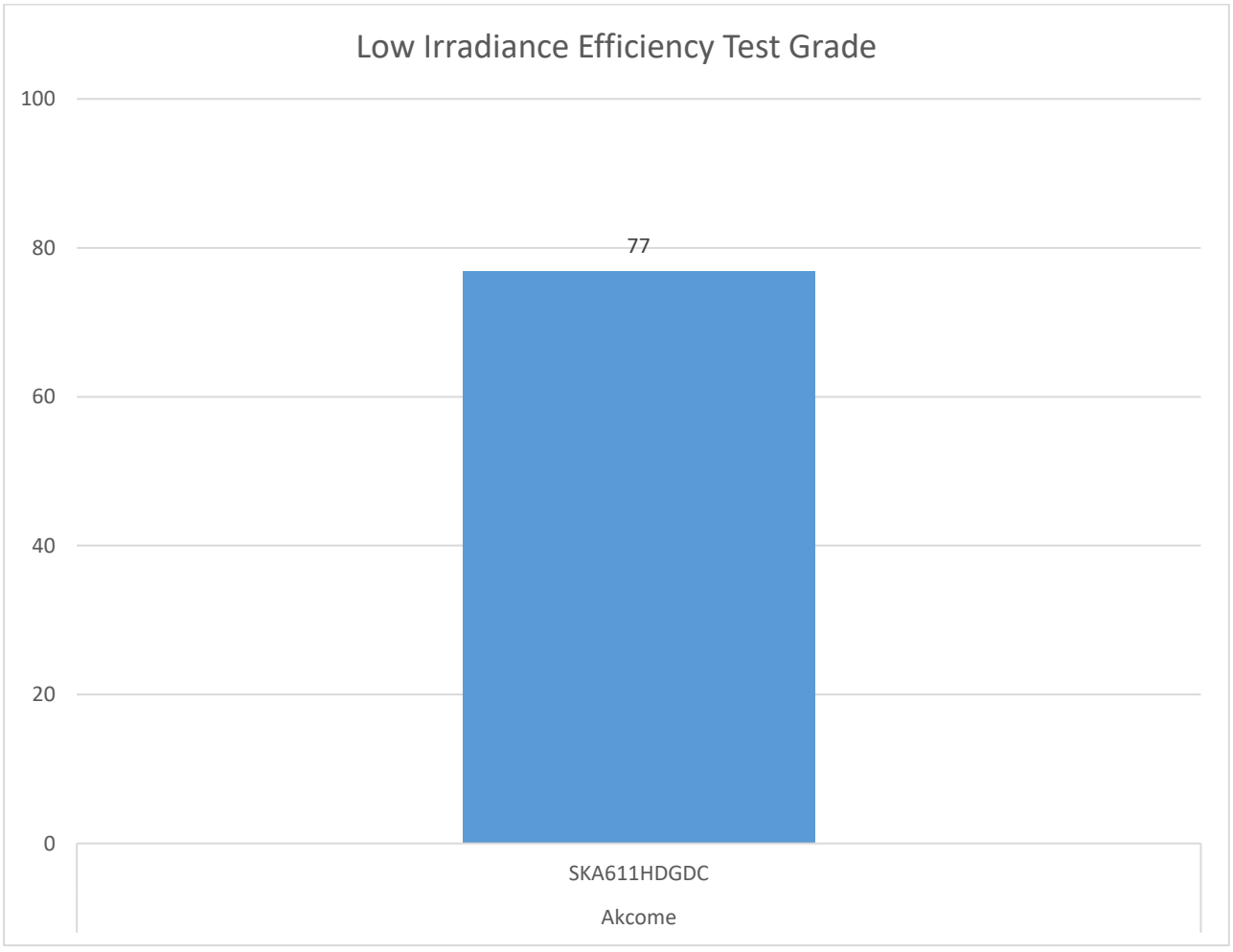

Figure 4 Low irradiance test result

3.4. Pmax temperature coefficient test

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

Table 9 Pmax temperature coefficient test result

SKA611HDGDC	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Pmax Temperature coefficient (%/°C)	-0.235%					114

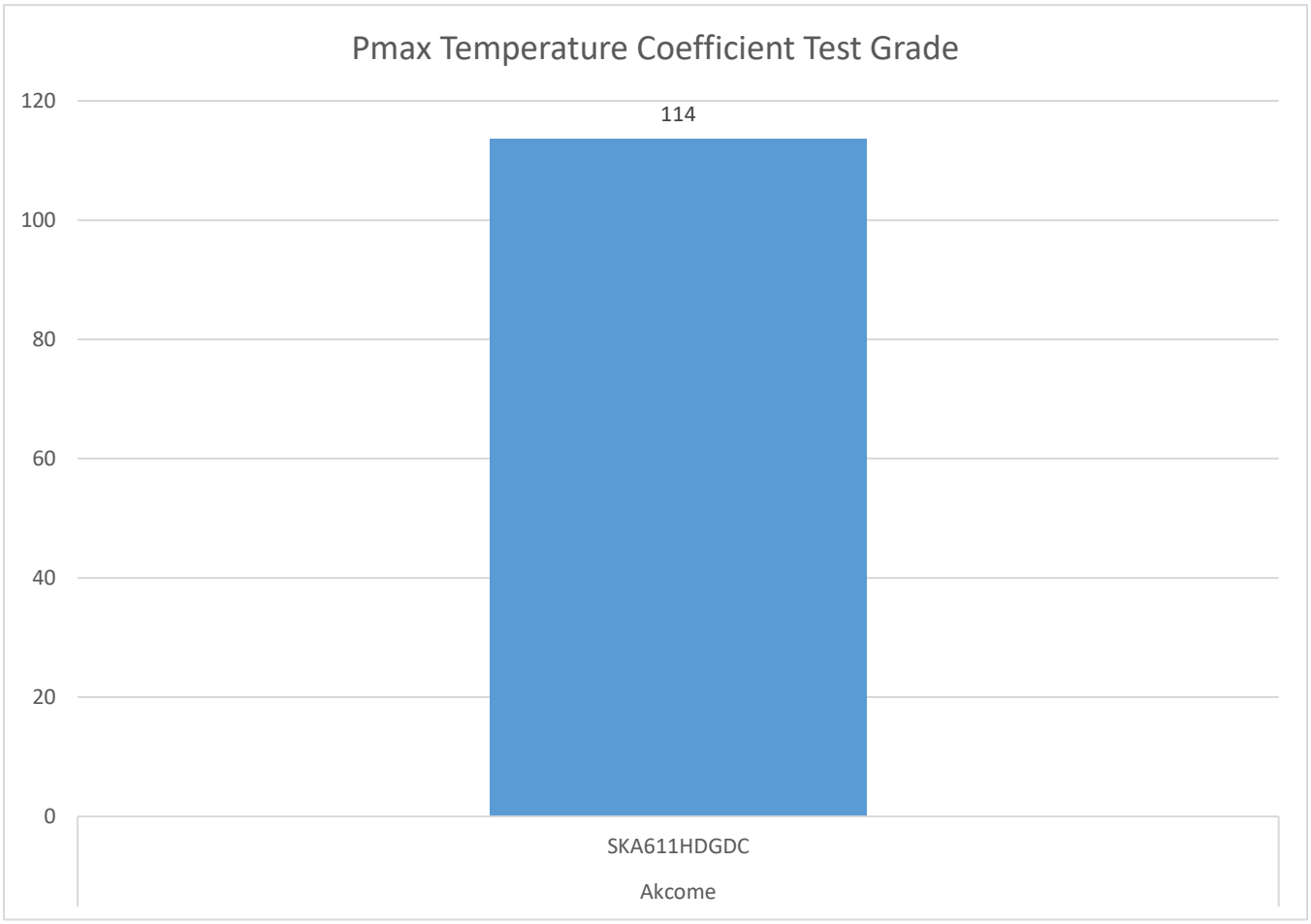

Figure 5 Pmax temperature coefficient test result

3.5. PID loss test

Table 10 and Figure 6 depicts the PID loss test results for the front side at **1500 V**:

Table 10 PID loss test result

SKA611HDGDC	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Front side PID loss (%)			1.27%			84

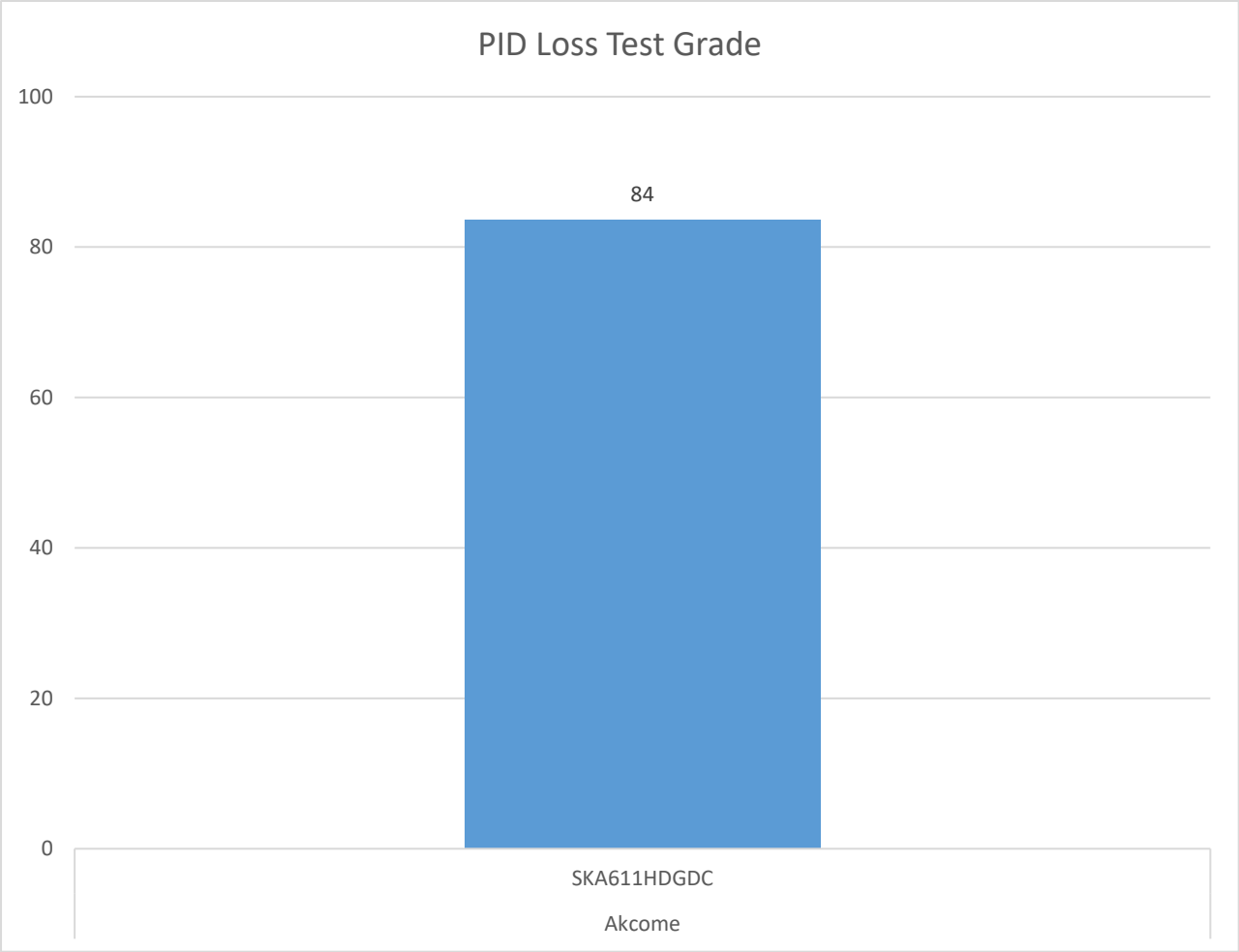

Figure 6 PID loss test result

3.6. LID loss test

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

Table 11 LID loss test result

SKA611HDGDC	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Front side LID loss (%)		-0.32%				98

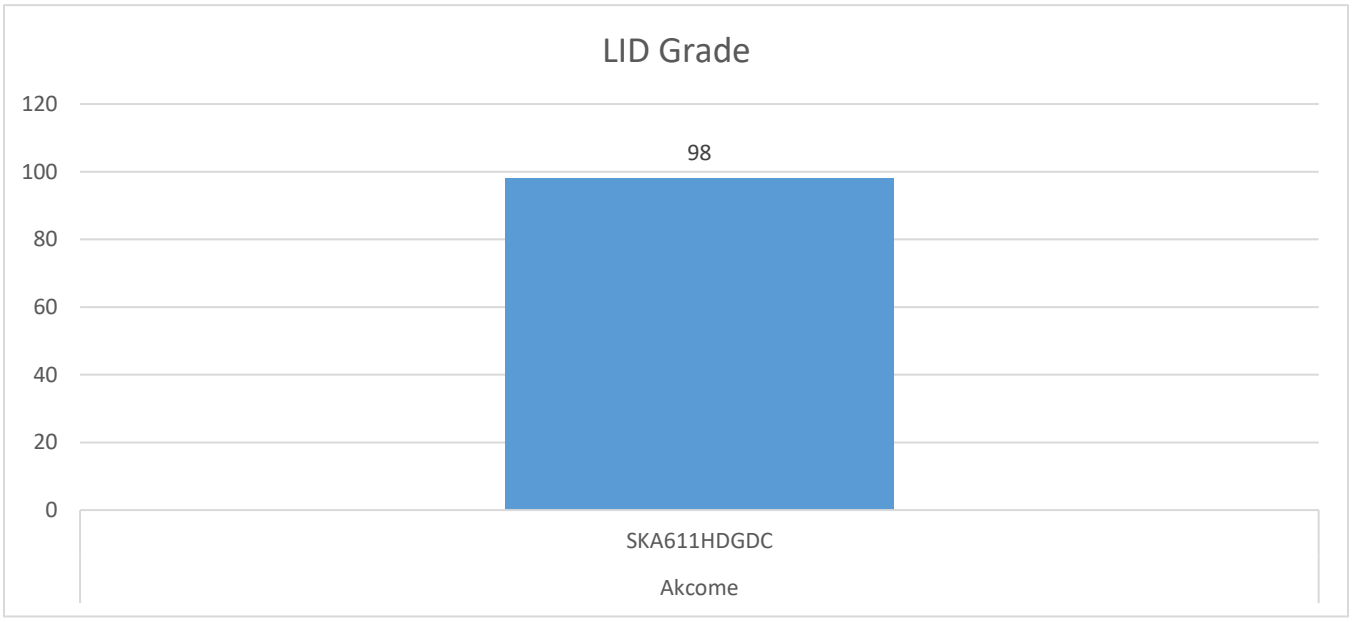

Figure 7 LID loss test result

3.7. LeTID loss test

Table 12 and Figure 8 depicts the LeTID loss test results:

Table 12 LeTID loss test result

SKA611HDGDC	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Front side LeTID loss (%)						

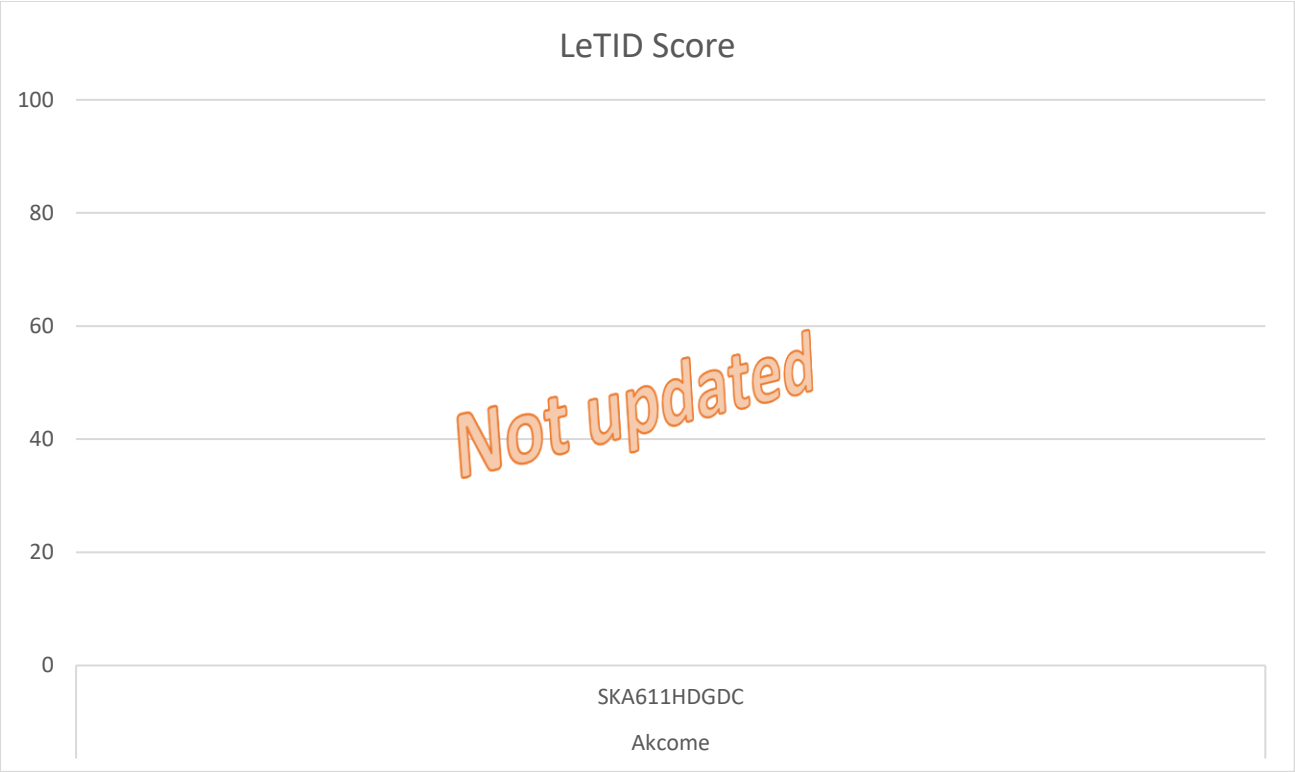

Figure 8 LeTID loss test result

3.8. 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 13 Bifaciality ratio test results

SKA611HDGDC	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Average
Bifaciality ratio (%)	85.92%	86.16%	86.46%	86.13%	86.27%	86.19%

The bifaciality ratio is calculated from the following formula:

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

3.9. Score overview

Figure 9 shows the overview of the test scores. Figure 10 shows the average score.

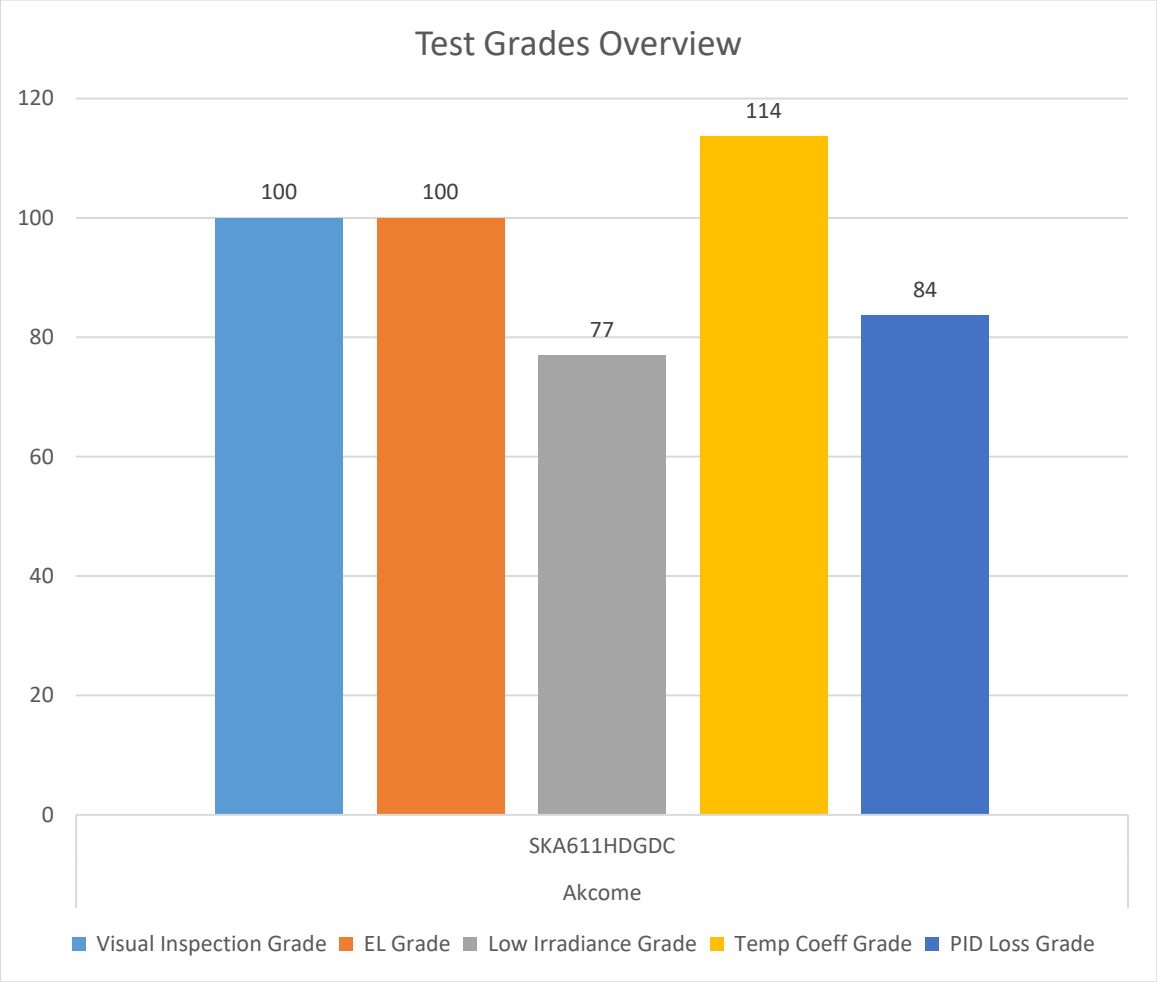

Figure 9 Test results overview

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

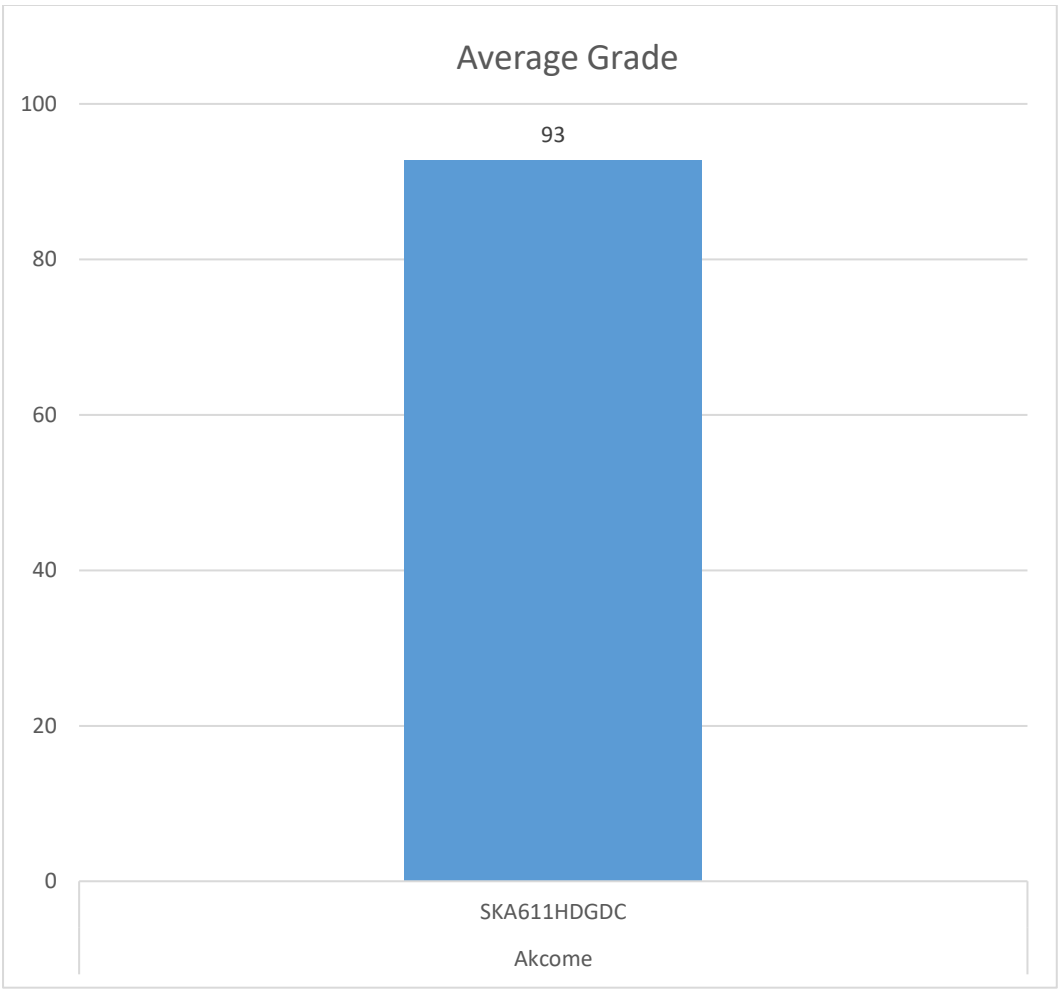

Figure 10 Average test grade

Appendix 1 – SKA611HDGDC Datasheet

INFINITE

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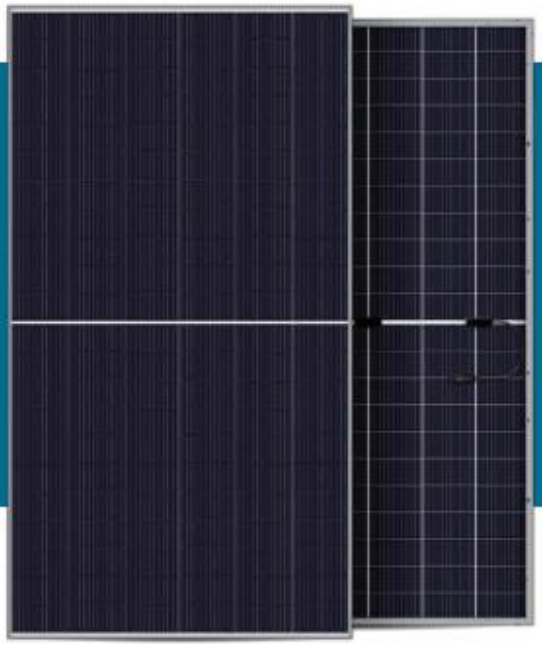
AK iPower

N-Type HJT Module



710-730W
Max. Power Output

0~+3%
Power Tolerance

23.18%
Module Efficiency

HJT Half-cut Bifacial Dual-Glass Module(MBB)
Module type: SKA611HDGDC

Product advantages

N-type HJT technology for lower LCOE
The lower temperature coefficient and better low irradiance performance of HJT technology can effectively reduce LCOE.

Fire class A, harsh environment adaptability
The module adopt a double glass structure, which can adapt to all kinds of harsh environment, and the fire rating can reach Class A.

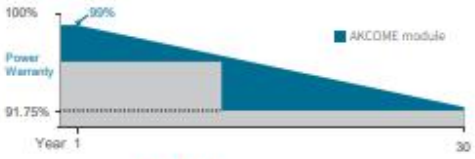
30-year power warranty
The average life of dual-glass module is 30 years, 5 years longer than that of single-glass modules.

Double-sided power generation, higher income
The dual-glass module has a bifaciality of up to 90% and a power generation gain of 7%-30% on the back side.

LINEAR PERFORMANCE WARRANTY

15 Years product warranty on materials and workmanship

30 Years linear power output warranty



30 years decay≤ **0.25%** annually on average

CERTIFICATES

ISO 9001: 2015
Quality Management System

IEC 61215 / IEC 61730

ISO 14001: 2015
Environmental Management System

ISO 45001 : 2018
Safety Managemnet System

*Certification requirements vary in different markets, please consult with Akcome Optronics sales team for appropriate certification.

INFINITE

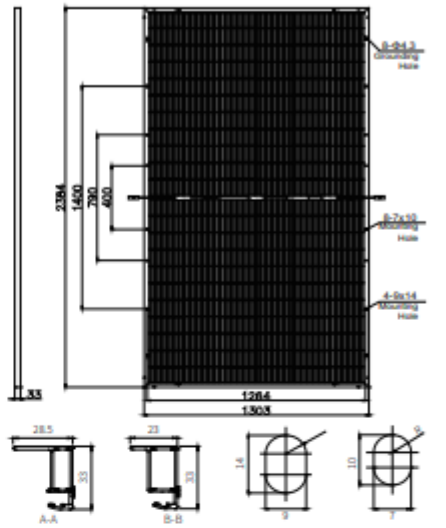
AKCOME

ELECTRICAL PARAMETERS @ STC

Max. Power Output Pmax (W)	710	715	720	725	730
Power Tolerance	0~+3%	0~+3%	0~+3%	0~+3%	0~+3%
Max. Power Voltage Vmp (V)	41.59	41.64	41.69	41.77	41.86
Max. Power Current Imp (A)	17.07	17.17	17.27	17.36	17.44
Open Circuit Voltage Voc (V)	49.40	49.45	49.51	49.61	49.71
Short Circuit Current Isc (A)	17.94	18.04	18.14	18.23	18.32
Module Efficiency(%)	22.86	23.02	23.18	23.34	23.50

*STC (Standard Test Condition): Irradiance 1000W/m², Cell Temperature 25°C, Air Mass 1.5
*Measurement Tolerance (±3.0%)

ASSEMBLY DRAWING (Unit:mm)



ELECTRICAL PARAMETERS @ STC (Reference to 710W front)

Power Gains	5%	10%	15%	20%	25%
Max. Power Output Pmax (W)	746	781	817	852	888
Max. Power Voltage Vmp (V)	41.59	41.59	41.59	41.59	41.59
Max. Power Current Imp (A)	17.92	18.78	19.63	20.48	21.34
Open Circuit Voltage Voc (V)	49.40	49.40	49.40	49.40	49.40
Short Circuit Current Isc (A)	18.83	19.73	20.63	21.52	22.42

MECHANICAL PARAMETERS

Cell Type	HJT 210x105mm
Number of Cells	132pcs(6x22)
Dimensions(L*W*H)	2384x1303x33mm
Weight	38.3kg
Frame	Anodised Aluminum
Junction Box	IP68, 3 bypass diodes
Cable,Length	4.0mm², 300mm

OPERATING CONDITION

Maximum System Voltage(V)	1500(DC)
Operating Temperature(℃)	-40~+85
Max.Wind Load /Snow Load(Pa)	2400/5400
Max.Series Fuse Rating(A)	35
Fire Rating	Class A
Bifaciality	90±5%
NOCT	45℃

TEMPERATURE COEFFICIENTS

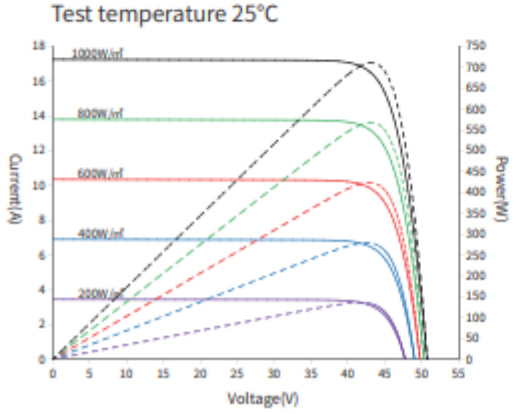
Temperature Coefficients of Pmp	-0.24%/℃
Temperature Coefficients of Voc	-0.22%/℃
Temperature Coefficients of Isc	+0.047%/℃

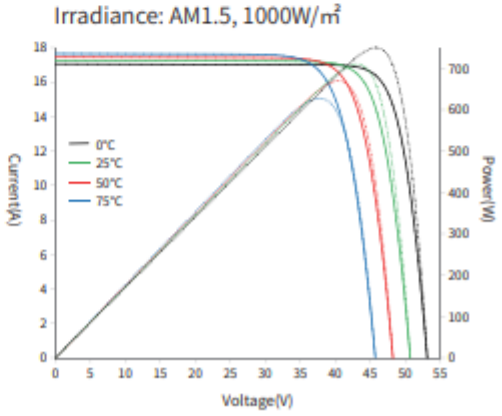
PACKAGE INFORMATION

Container 40'HQ	594pcs
Quantity / Pallet	33pcs

Size: 1310×1100×2520mm; Net weight: 1263.9kg; Gross weight: 1307.4kg

I-V CURVES





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