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CEA I PV MAGAZINE PROGRAM TEST REPORT

SUPPLIER | Risen

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PHOTOVOLTAIC MARKETS & TECHNOLOGY

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.

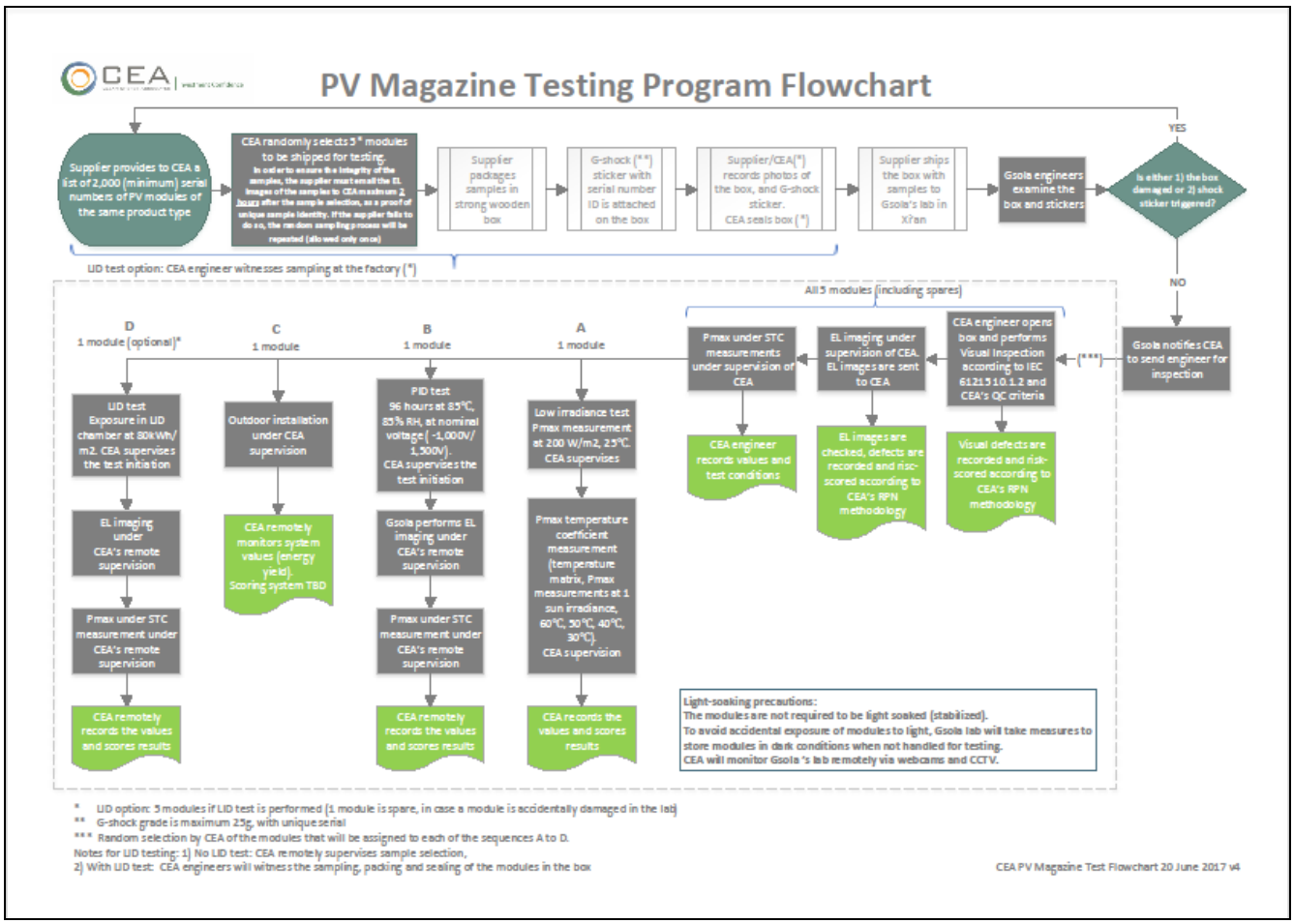


Figure 1 Test flowchart

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	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

	Score 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%

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.

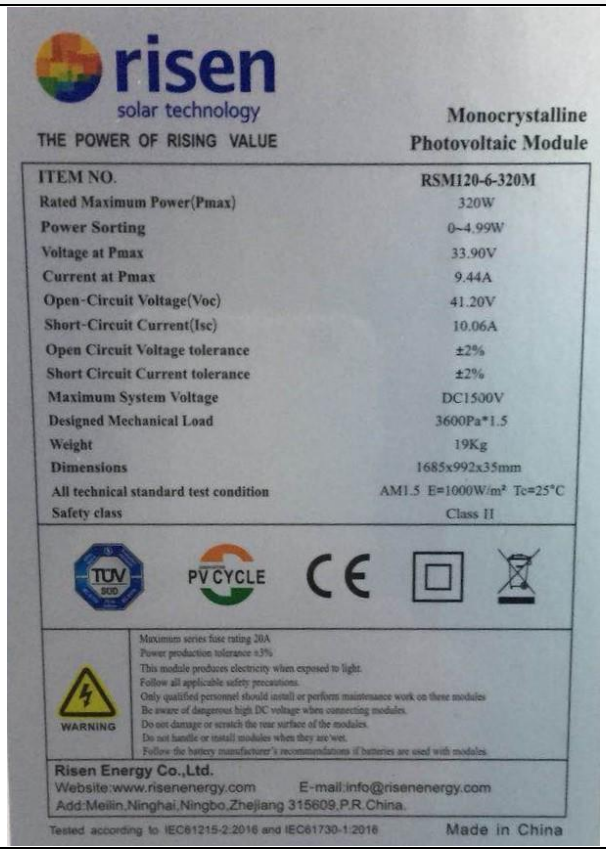
3. TEST DETAILS

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	Product code
1	441207I0806554	PVT 190218A-01
2	441207I0808491	PVT 190218A-02
3	441207I0806747	PVT 190218A-03
4	441207I0806753	PVT 190218A-04
5	441207I0806527	PVT 190218A-05

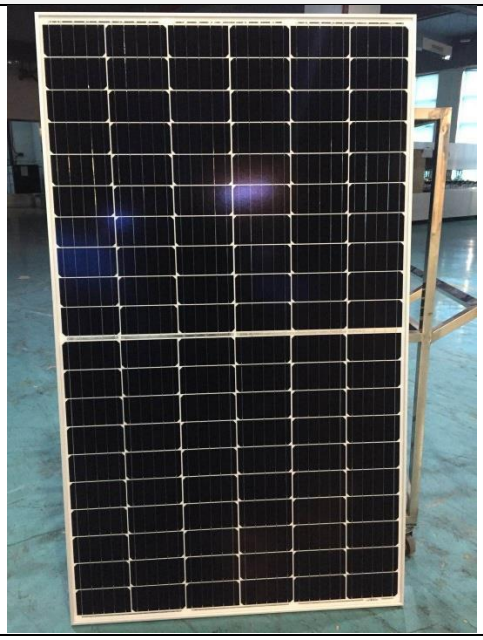
Table 4 Product information

Model	RSM120-6-320M	Label picture
Cell technology	Mono PERC	
Cell number	2 x 60	
Cell format	Half cut	
Number of busbars	5	
Junction box	Potted, IP67, 1500VDC, 3 Schottky bypass diodes	
Laminate construction	Framed, glass/white backsheet	

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

RSM120-6-320M	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 2.

Table 7 EL image inspection results

RSM120-6-320M	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Score	Grade
EL image inspection	None	None	None	None	None	0	100

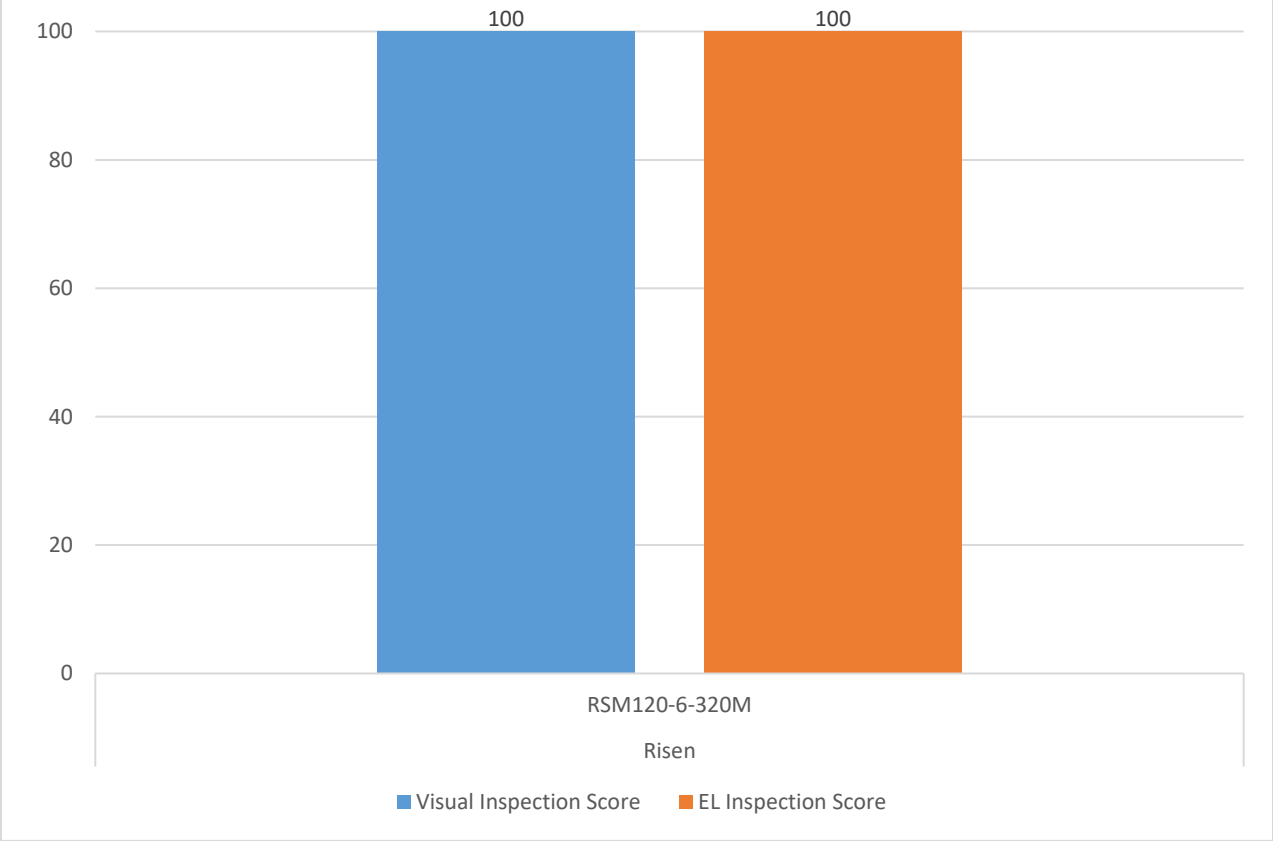


Figure 2 Visual and EL inspection results

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 3 show the low irradiance efficiency test results for the front side.

Table 8 Low irradiance test results

RSM120-6-320M	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Front side low irradiance efficiency loss (%)	4.46%					63

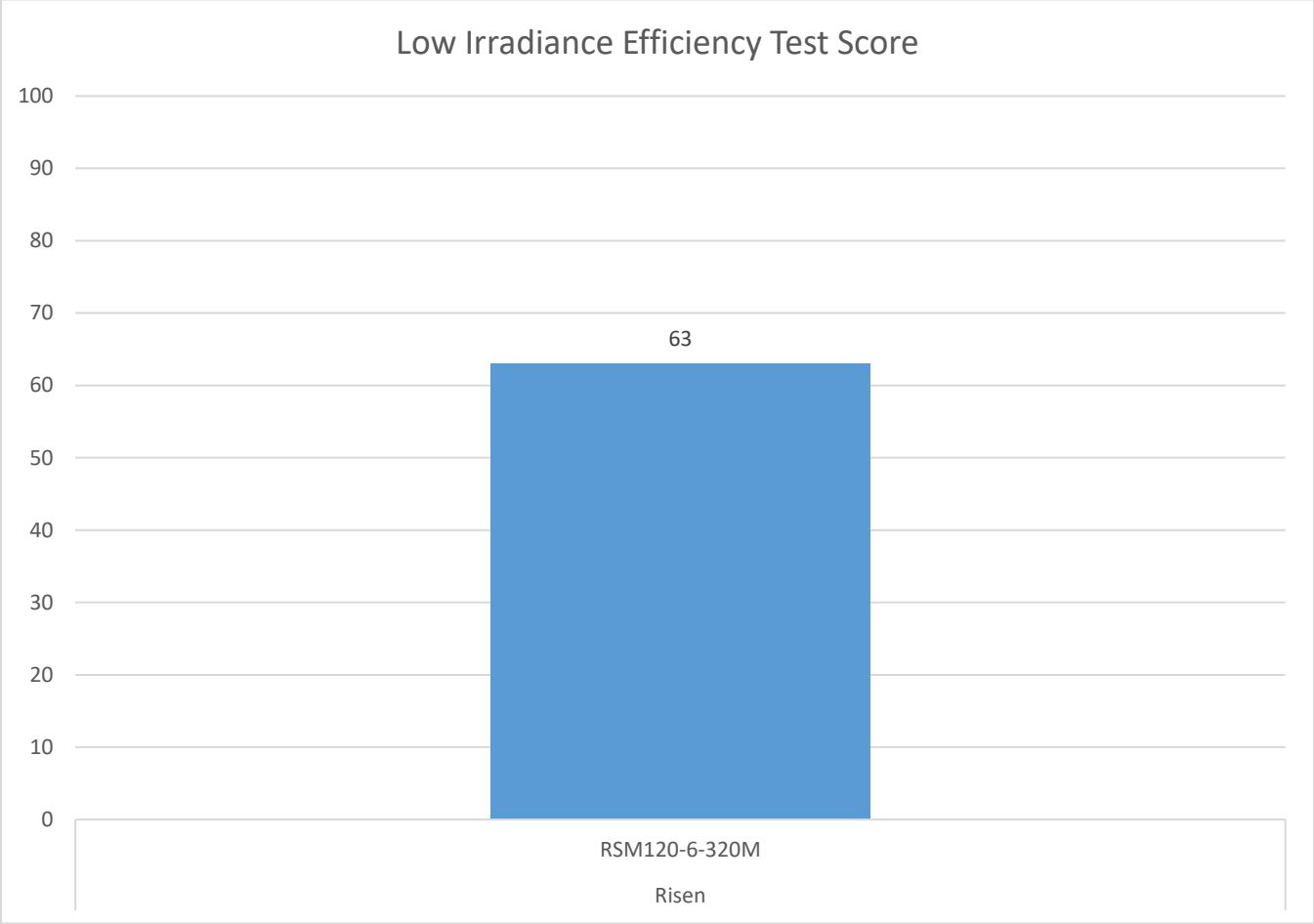


Figure 3 Low irradiance test result

3.4. Pmax temperature coefficient test

Table 9 and Figure 4 depict the Pmax temperature coefficient test results.

Table 9 Pmax temperature coefficient test result

RSM120-6-320M	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Pmax Temperature coefficient (%/°C)	-0.40%					74

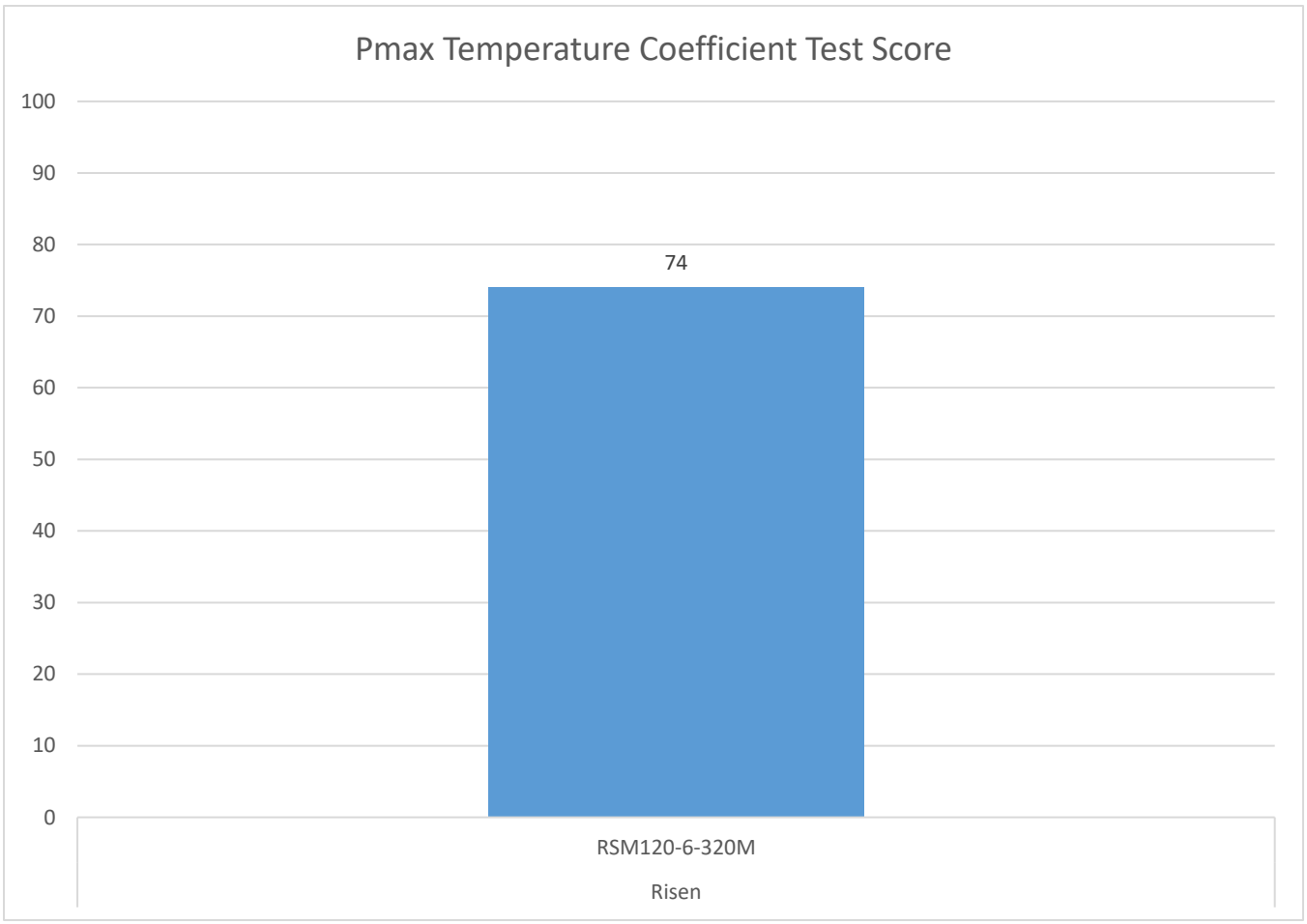


Figure 4 Pmax temperature coefficient test result

3.5. PID loss test

Table 10 and Figure 5 depicts the PID loss test results for the front side at **1500 V**:

Table 10 PID loss test result

RSM120-6-320M	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Front side PID loss (%)		1.81%				78

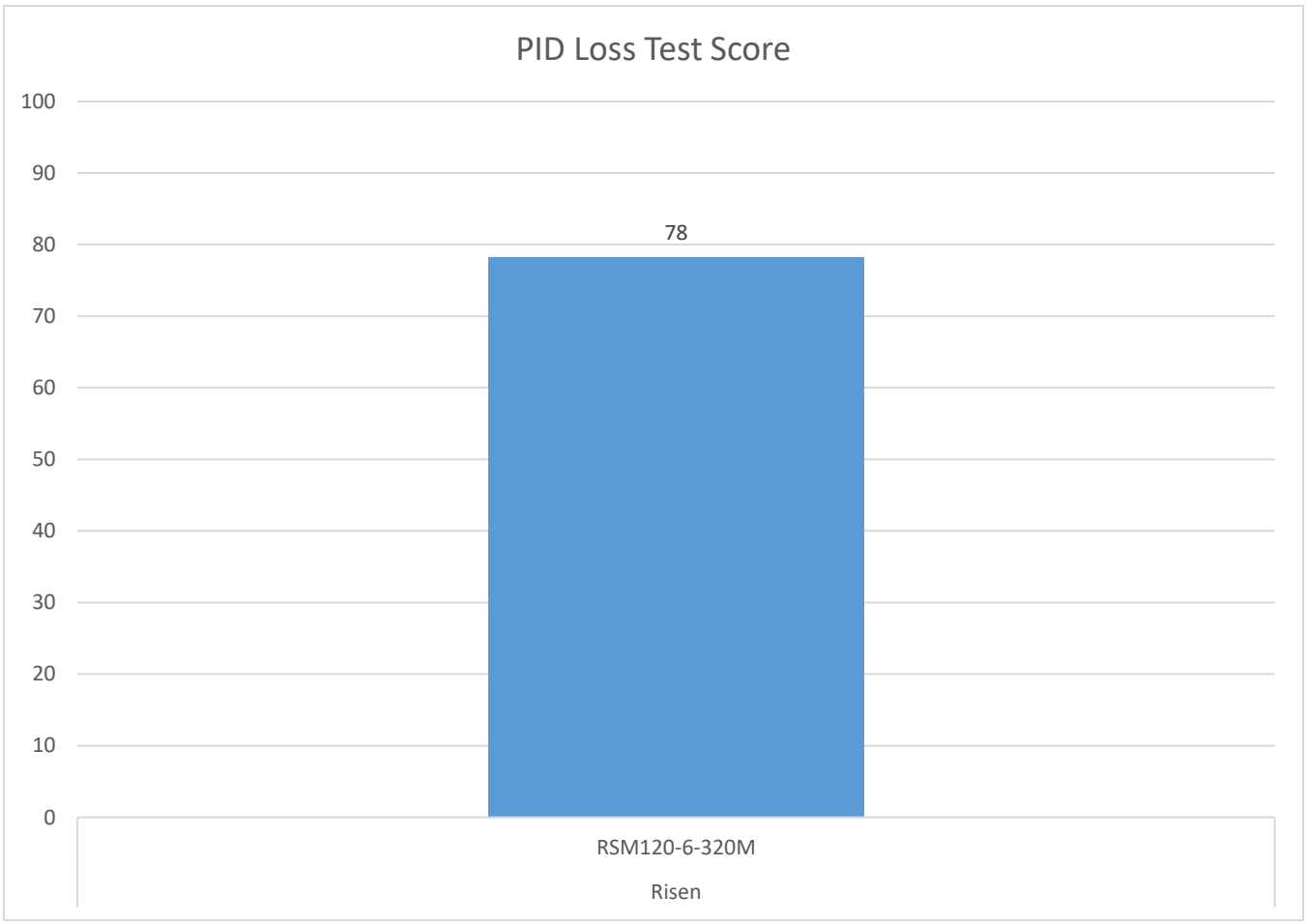


Figure 5 PID loss test result

3.6. Score overview

Figure 6 shows the overview of the test scores. Figure 7 shows the average score.

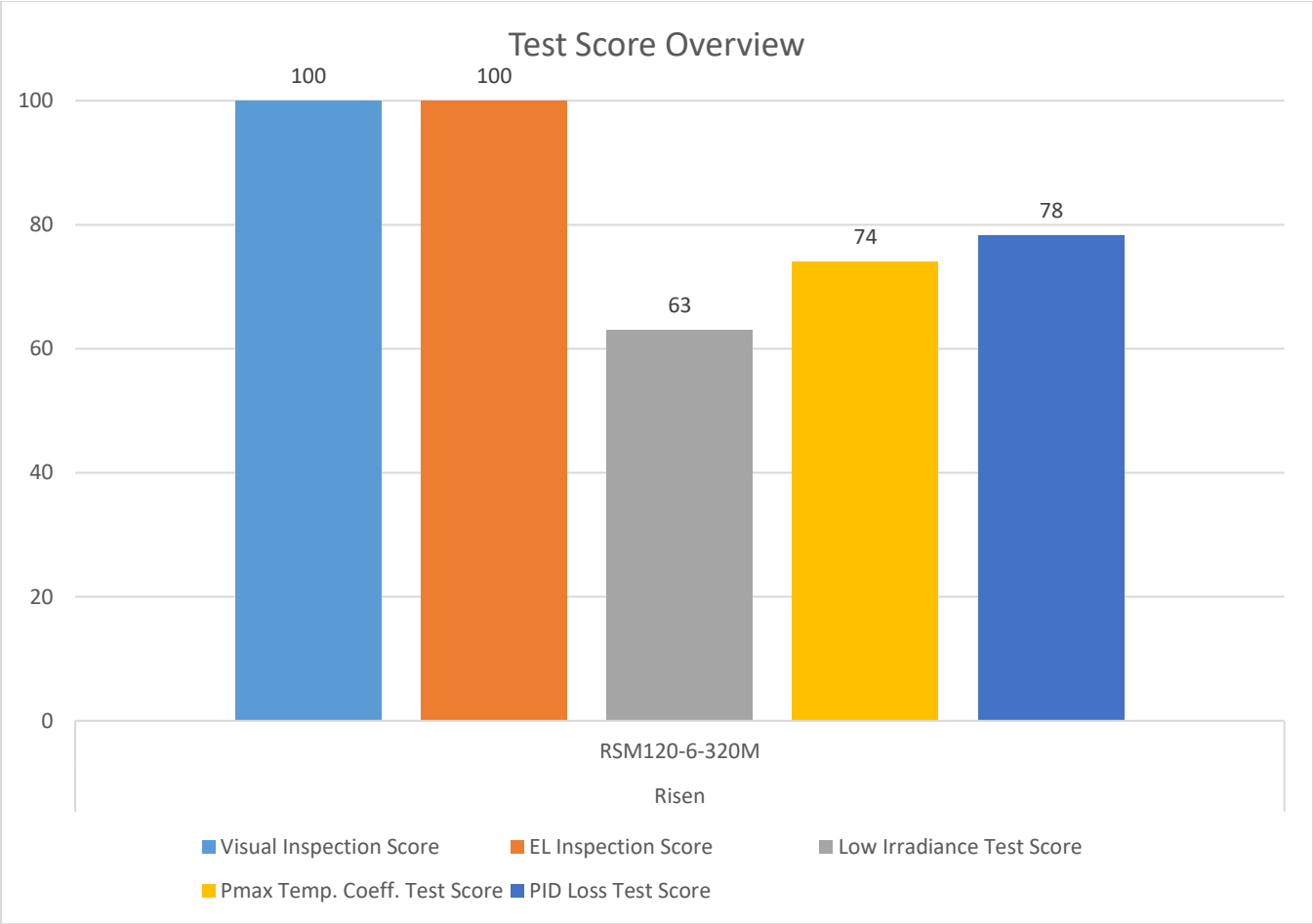


Figure 6 Test results overview

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

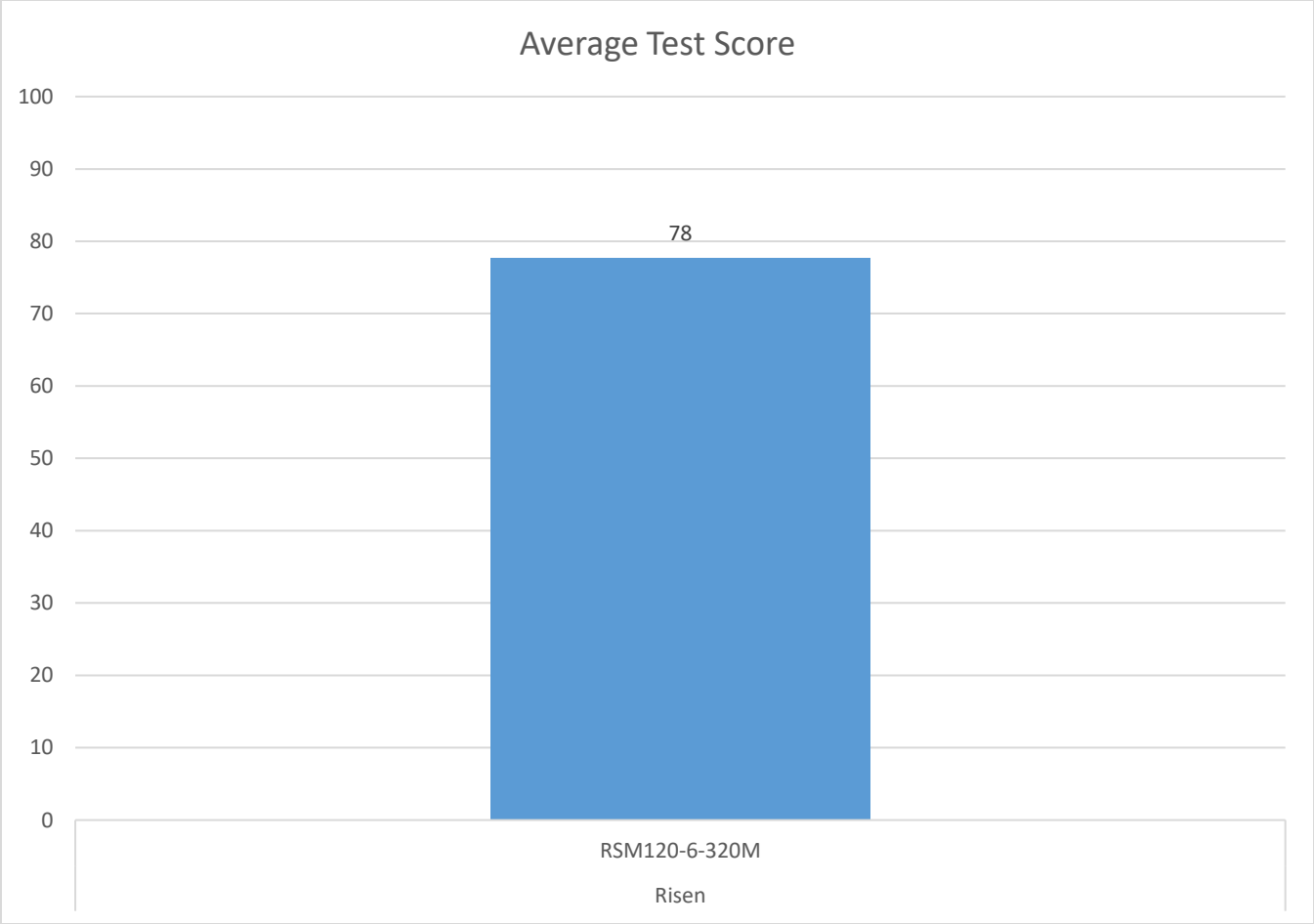


Figure 7 Average test score

Appendix 1 - RSM120-6-320M Datasheet

HIGH PERFORMANCE MONOCRYSTALLINE PERC MODULE

RSM120-6-300M-320M

120 CELL MONOCRYSTALLINE MODULE

300-320Wp POWER OUTPUT RANGE

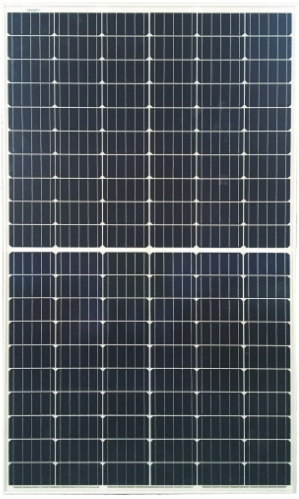
1500VDC MAXIMUM SYSTEM VOLTAGE

19.1% MAXIMUM EFFICIENCY

risen solar technology

About Risen Energy

Risen Energy is a leading, global tier 1 manufacturer of high-performance solar photovoltaic products and provider of total business solutions for residential, commercial and utility-scale power generation. The company, founded in 1986, and publicly listed in 2010, compels value generation for its chosen global customers. Techno-commercial innovation, underpinned by consummate quality and support, encircle Risen Energy's total Solar PV business solutions which are among the most powerful and cost-effective in the industry. With local market presence and strong financial bankability status, we are committed, and able, to building strategic, mutually beneficial collaborations with our partners, as together we capitalise on the rising value of green energy.



ISO9001
ISO14001
OHSAS18001

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KEY SALIENT FEATURES

- **Global, Tier 1 bankable brand, with independently certified state-of-the-art automated manufacturing**
- **Industry leading lowest thermal co-efficient of power**
- **Industry leading 12 years product warranty**
- **Excellent low irradiance performance**
- **Excellent PID resistance**
- **Positive tight power tolerance**
- **Dual stage 100% EL Inspection warranting defect-free product**
- **Module Imp binning radically reduces string mismatch losses**
- **Warranted reliability and stringent quality assurances well beyond certified requirements**
- **Certified to withstand severe environmental conditions**
  - **Anti-reflective & anti-soiling surface minimise power loss from dirt and dust**
  - **Severe salt mist, ammonia & blown sand resistance, for seaside, farm and desert environments**
  - **Excellent mechanical load 2400Pa & snow load 5400Pa resistance**

LINEAR PERFORMANCE WARRANTY

12 year Product Warranty / 25 year Linear Power Warranty

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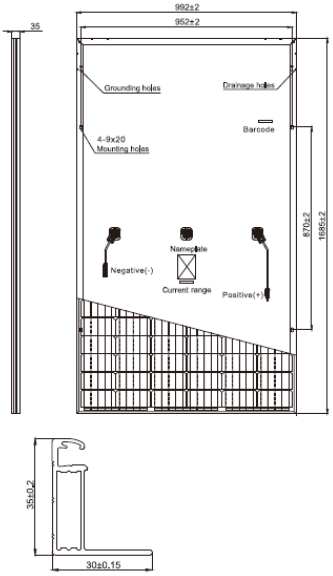
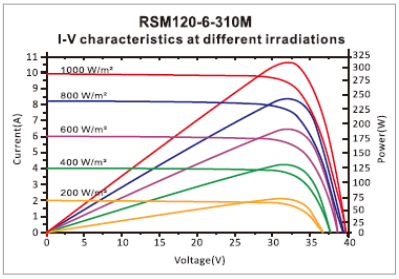
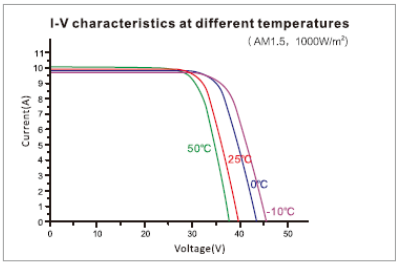
Dimensions of PV Module

Unit: mm







Our Partners:

ELECTRICAL DATA (STC)

Model Number	RSM120-6-300M	RSM120-6-305M	RSM120-6-310M	RSM120-6-315M	RSM120-6-320M
Rated Power in Watts-Pmax(Wp)	**300**	**305**	**310**	**315**	**320**
Open Circuit Voltage-Voc(V)	39.40	39.50	39.70	39.80	40.00
Short Circuit Current-Isc(A)	9.70	9.80	9.90	10.00	10.10
Maximum Power Voltage-Vmpp(V)	33.00	33.20	33.35	33.55	33.70
Maximum Power Current-Impp(A)	9.10	9.20	9.30	9.40	9.50
Module Efficiency (%)	17.9	18.2	18.5	18.8	19.1

STC: Irradiance 1000 W/m², Cell Temperature 25°C, Air Mass AM1.5 according to EN 60904-3.

ELECTRICAL DATA (NMOT)

Model Number	RSM120-6-300M	RSM120-6-305M	RSM120-6-310M	RSM120-6-315M	RSM120-6-320M
Maximum Power-Pmax (Wp)	224.5	228.3	231.8	235.7	239.3
Open Circuit Voltage-Voc (V)	36.30	36.40	36.50	36.60	36.8
Short Circuit Current-Isc (A)	7.95	8.04	8.12	8.20	8.28
Maximum Power Voltage-Vmpp (V)	30.20	30.40	30.50	30.70	30.90
Maximum Power Current-Impp (A)	7.43	7.51	7.59	7.67	7.75

NMOT: Irradiance at 800 W/m², Ambient Temperature 20°C, Wind Speed 1 m/s.

MECHANICAL DATA

Solar cells	Monocrystalline 156.75×78.375mm, 5BB
Cell configuration	120 cells (6×10+6×10)
Module dimensions	1685×992×35mm
Weight	19kg
Superstrate	3.2 mm, High Transmission, Low Iron, Tempered ARC Glass
Substrate	White Back-sheet
Frame	Anodized Aluminium Alloy type 6063T5, Silver Color
J-Box	Potted, IP67, 1500VDC, 3 Schottky bypass diodes
Cables	4.0mm² (12AWG), Positive(+)270mm, Negative(-)100mm
Connector	Risen Twinsel PV-SY02, IP67

TEMPERATURE & MAXIMUM RATINGS

Nominal Module Operating Temperature (NMOT)	45°C±2°C
Temperature Coefficient of Voc	-0.29%/°C
Temperature Coefficient of Isc	0.05%/°C
Temperature Coefficient of Pmax	-0.39%/°C
Operational Temperature	-40°C~+85°C
Maximum System Voltage	1500VDC
Max Series Fuse Rating	20A
Limiting Reverse Current	20A

PACKAGING CONFIGURATION

	40ft	20ft
Number of modules per container	780	360
Number of modules per pallet	30	30
Number of pallets per container	26	12
Packaging box dimensions (LxWxH) in mm	1715×1105×1130	1715×1105×1130
Box gross weight[kg]	615	615

CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

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REM120-M-5BB-EN-H1-1-2019