Product Service

TEST REPORT **PPP 59022B:2021** **TUV SUD Test Report for dust and sand testing of photovoltaic (PV) modules**	
Report No.: Date of issue: Project handler:	704062122412-01 2022-06-28 Guangxia Fu
TÜV SÜD Branch: Address: Testing location:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch. 3-13, No. 151 Heng Tong Road, 200070, Shanghai, P.R.China Changzhou HuaYang Inspection and Testing Technology Co., Ltd. NO.8 Lanxiang Road, Wujin Economic Development Zone, Changzhou, Jiangsu, China
Client: Client number: Address: Contact person:	Anhui Huasun Energy Co.,Ltd. 110450 No. 99, Qingliu Road, Xuancheng Economic and Technological Development Zone, Xuanzhou District, Xuancheng City, Anhui Province,China. Ms. Li Chen
Standard:	This TUV SUD test report form is based on the following requirements: PPP 59022B:2021 Rev. 00 2021
TRF number and revision*:*	TRF PPP 59022B:2021 Rev. 00
eDoc_ID:	
TRF originated by:	TUV SUD Product Service, Mr. Bo Xiangxi
Copyright blank test report:	This test report is based on the content of the standard (see above). The test report considered selected clauses of the a.m. standard(s) and experience gained with product testing. It was prepared by TUV SUD Product Service. TUV SUD Group takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.
General disclaimer:	This test report may only be quoted in full. Any use for advertising purposes must be granted in writing. This report is the result of a single examination of the object in question and is not generally applicable evaluation of the quality of other products in regular production.
Scheme: Non-standard test method: National deviations:	☒ TUV Mark ☐ without certification ☐ GS Mark ☐ NRTL Mark ☐ EU-Directive ☐ No ☒ Yes, see details under Summary of testing N/A
Number of pages *(Report)*: Number of pages *(Attachments)*:	24 5

Compiled by: (+ signature)	Guangxia Fu	Approved by: (+ signature)	Rongwei Jing

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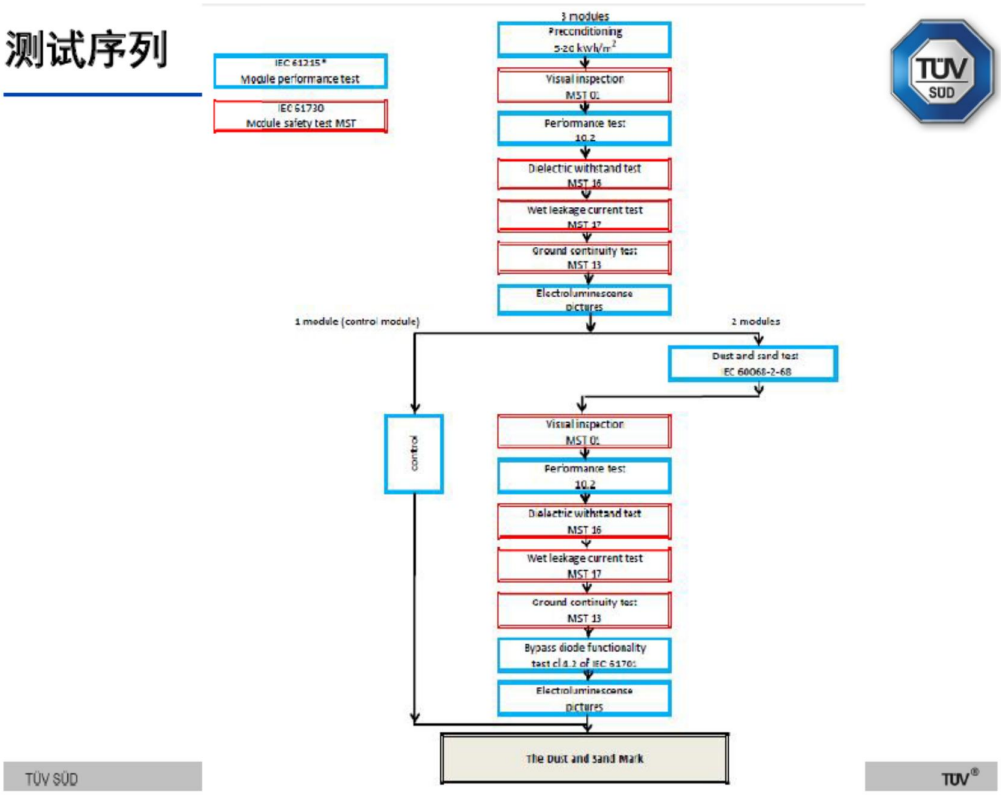
Test sample: Type of test object: Trademark: Model and/or type reference:	3 Mono-Crystalline Silicon Photovoltaic Module  Refer to P4
Rating(s):	Refer to P4
Manufacturer: Manufacturer number: Address:	Anhui Huasun Energy Co.,Ltd. 110450 No. 99, Qingliu Road, Xuancheng Economic and Technological Development Zone, Xuanzhou District, Xuancheng City, Anhui Province,China
Name and address of factory(ies) Anhui Huasun Energy Co.,Ltd. No. 99, Qingliu Road, Xuancheng Economic and Technological Development Zone, Xuanzhou District, Xuancheng City, Anhui Province,China. Customer No.: 110450	
Sub-contractors/ tests (clause): Name:	See page 8 test summary. See page 8 test summary.
Order description:	☒ Complete test according to TRF ☐ Partial test according to manufacturer's specifications ☐ Preliminary test ☐ Spot check ☐ Others:
Date of order: Date of receipt of test item: Date(s) of performance of test:	2022-04-25 2022-05-10 2022-05-11/2022-05-24
Test item particulars:	



Purpose of the product (Description of intended use):

The PV modules for electricity generation systems with max. voltage of 1500 DC

Characteristic data *(not shown on the marking plate)*:

Product Electrical Ratings:

Monoficial Module：

Module type				
Voc [V] /Tolerance±3%				
Vmp [V]				
Imax [Adc]				
Isc [Adc] /Tolerance±5%				
Pmp [W] /Tolerance 0~+3%				
Maximum system voltage [V]				
Maximum Over-Current Protection Rating [A]				
Note: Further qualification for higher and/or lower output power see annex 3				

Bifacial Module：

	Module type	HS-210-B110DS560			
STC condition	Pmp [W] /Tolerance0~+3%	560			
	Voc [V] /Tolerance±3%	40.77			
	Isc [Adc] /Tolerance±5%	17.19			
	Vmp [V]	34.17			
	Imp [Adc]	16.39			
BNPI condition	Pmp [W] /Tolerance0~+3%	620			
	Voc [V] /Tolerance±3%	40.77			
	Isc [Adc] /Tolerance±5%	19.03			
bifaciality coefficient	φPmax	80%±5%			
	φVoc	N/A			
	φIsc	N/A			
	Maximum system voltage [V]	1500			
	Maximum Over-Current Protection Rating [A]	30			

Note: Further qualification for higher and/or lower output power see annex 3

Information for testing sample:

Sample #	Sample Group ID	Type/model	Sample S/N	Remark
HA2022L-613-001X	_	HS-210-B110DS560	HAA21L015390C09	(Control)
HA2022L-613-002X	_	HS-210-B110DS560	HCA22010300023	_
HA2022L-613-003X	_	HS-210-B110DS560	HCA22010300002	_

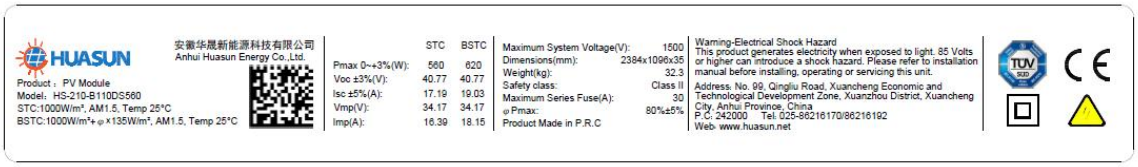
Attachments:

Annex 1: Product Description Sheet
Annex 2: List of measurement equipment
Annex 3: Statement of the estimated uncertainty of the test results
Annex 4: Photos of samples

If additional information is necessary, please provide

N/A

Copy of marking plate:



Pictures of the product:

See annex 4

Summary of testing:

Tests performed (name of test and test clause):

Initial measurements:

Preconditioning
MST 01: Visual inspection
10.2: Maximum power determination
MST 16: Dielectric withstand test
MST 17: Wet leakage current test
MST 13: Ground continuity test
Electroluminescence measurement

Dust and sand test

in accordance with IEC 60068-2-68:1994

Final measurements:

MST 01: Visual inspection
10.2: Maximum power determination
MST 16: Dielectric withstand test
MST 17: Wet leakage current test
MST 13: Ground continuity test
4.2 Bypass diode functionality test
Electroluminescence measurement

Additional information on Non-standard test method(s)

Sub clause:	N/A
Page:	N/A
Rational:	N/A

Possible test case verdicts:

test case does not apply to the test object:	N/A (not applicable / not included in the order)
test object does meet the requirement:	P (Pass)
test object does not meet the requirement:	F (Fail)

General remarks:

"(see remark #)" refers to a remark appended to the report.
"(see appended table)" refers to a table appended to the report.
*Throughout this report **a comma** is used as the decimal separator.*
The test results presented in this report relate only to the object tested.
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Clause	Requirement + Test	Result - Remark	Verdict
1	**Samples**		P
1.1	Three identical samples of the model of PV module or assembly of interest must be subjected to the testing sequences detailed as below.		P
1.2	Full-size sample or representative sample		P
1.3	PV module provided with means for grounding then they constitute a part of the test sample.		P
1.4	One sample serves as control module and repeatability of the its maximum power measurement must be better than ± 1 % during the whole test sequence.	See table 3.2 Initial and 5.2 Final	P
2	**Preconditioning**		P
2.1	All test samples must be preconditioned with either global or direct normal sunlight according to the specifications given in the latest version standard of IEC 61215		P
3	**Initial Measurements**	All samples	P
3.7	MQT 19.1: Initial stabilization	See table 3.7	P
3.1	MST 01: Visual inspection	See table 3.1	P
3.2	MQT 02: Maximum power determination	See table 3.2	P
3.3	MQT 03: Insulation test	See table 3.3	P
3.4	MST 17: Wet leakage current test	See table 3.4	P
3.5	MST 13: Continuity test of equipotential bonding	See table 3.5	P
3.6	Electroluminescence measurement	See table 3.6	–
4	**Dust and Sand test**	Two samples	P
4.1	Dust and sand test according to IEC 60068-2-68: 1994	See table 4.1	P
5	**Final Measurements**	Two samples	P
	After the dust and sand test the test samples shall be subjected to the following tests.		P
5.1	MST 01: Visual inspection	See table 5.1	P
5.2	MQT 02: Maximum power determination	See table 5.2	P
5.3	MQT 03: Insulation test	See table 5.3	P
5.4	MST 17: Wet leakage current test	See table 5.4	P
5.5	MST 13: Continuity test of equipotential bonding	See table 5.5	P
5.6	Electroluminescence measurement	See table 5.6	–

Clause	Requirement + Test	Result - Remark	Verdict
5.7	Bypass diode functionality test according to clause 6.8 of IEC 61701: 2020	See table 5.7	P
5.8	MQT 19.2: Final stabilization according to last version IEC 61215	See table 5.8	N/A
6	**Requirements**		P
6.1	After the dust and sand test, no evidence of major visual defects as described in IEC 61215-1 and IEC 61730-2	See table 5.1	P
6.2	After the dust and sand test the maximum power shall not decrease by more than 5% of the initial value.	See table 5.2	P
6.3	All pass fail criteria corresponding to tests MST 16, MST 17 and MST 13 must be fulfilled.	See table 5.3, 5.4 and 5.5	P
6.4	The requirement for the bypass diode thermal test must be also fulfilled.	See table 5.7	P

Clause	Requirement + Test	Result - Remark	Verdict

3.7 Initial	MQT 19.1 ini: Initial stabilization	P

TABLE 3.7.1: MQT 03.7 ini: Performance at STC before initial stabilization (Front) — P

Test Date [YYYY-MM-DD]……..: 2022-05-11 — —

Test method ..... : ☒ Simulator ☐ Natural sunlight — —

Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF[%]	Result
HA2022L-613-001X	41.066	17.036	34.465	16.323	562.580	41.066	—
HA2022L-613-002X	40.961	17.021	33.784	16.616	561.349	40.961	—
HA2022L-613-003X	41.016	17.134	34.153	16.463	562.253	41.016	—

Supplementary information: N/A

TABLE 3.7.2: MQT 19.1 ini: Initial Stabilization procedure(Front) — P

Light exposure method.....: ☒ Simulator ☐ Natural sunlight

Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight

Stabilization criterion x per IEC 61215-1-x .....: 1

Sample #	HA2022L-613-001X	Test Date (YYYY-MM-DD) start/end..... :			2022-05-12/2022-05-15		
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	($P_{max} - P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	562.580	—	—
1	5	Above 800	50	2.1	560.916	—	—
2	5	Above 800	50	2.1	559.513	0.55	Yes

Sample #	HA2022L-613-002X	Test Date (YYYY-MM-DD) start/end..... :			2022-05-12/2022-05-15		
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	($P_{max} - P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	561.349	—	—
1	5	Above 800	50	2.1	559.560	—	—
2	5	Above 800	50	2.1	558.568	0.50	Yes

Sample #	HA2022L-613-003X	Test Date (YYYY-MM-DD) start/end..... :			2022-05-12/2022-05-15		
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	($P_{max} - P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	562.253	—	—
1	5	Above 800	50	2.0	560.629	—	—
2	5	Above 800	50	2.0	559.522	0.49	Yes

Clause	Requirement + Test	Result - Remark	Verdict

☐ Other stabilization procedures	
Sample #	Test Date (YYYY-MM-DD) start/end
Test method description:N/A	

3.7 Initial	**MQT 19.1 ini: Initial stabilization**	P

TABLE 3.7.1: MQT 03.7 ini: Performance at STC before initial stabilization (Back) — P

Test Date [YYYY-MM-DD]……..:	2022-05-11
Test method ..... :	☒ Simulator ☐ Natural sunlight

Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF[%]	Result
HA2022L-613-001X	40.841	16.206	33.955	14.566	494.600	74.73	—
HA2022L-613-002X	40.821	16.102	33.100	14.962	495.237	75.35	—
HA2022L-613-003X	40.834	16.214	33.400	14.817	494.890	74.75	—

Supplementary information: N/A

TABLE 3.7.2: MQT 19.1 ini: Initial Stabilization procedure(Back) — P

Light exposure method.....:	☒ Simulator ☐ Natural sunlight
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight	
Stabilization criterion x per IEC 61215-1-x .....:	1

Sample #	HA2022L-613-001X	Test Date (YYYY-MM-DD) start/end ..... :	2022-05-12/2022-05-15

Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$(P_{max} - P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	494.600	—	—
1	5	Above 800	50	2.3	492.799	—	—
2	5	Above 800	50	2.3	491.739	0.58	Yes

Sample #	HA2022L-613-002X	Test Date (YYYY-MM-DD) start/end ..... :	2022-05-12/2022-05-15

Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$(P_{max} - P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	495.237	—	—
1	5	Above 800	50	2.3	493.720	—	—
2	5	Above 800	50	2.3	492.371	0.58	Yes

Clause	Requirement + Test	Result - Remark	Verdict

Sample #	HA2022L-613-003X	Test Date (YYYY-MM-DD) start/end..... :			2022-05-12/2022-05-15		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	494.890	—	—
1	5	Above 800	50	2.2	493.405	—	—
2	5	Above 800	50	2.2	492.192	0.55	Yes
☐ Other stabilization procedures							
Sample #	Test Date (YYYY-MM-DD) start/end						
Test method description:N/A							

3.1	TABLE: MST 01 Visual inspection (Initial)	P
Test Date [YYYY-MM-DD]……..…..:	2022-05-16	—
Sample No.	Nature and position of initial findings – comments or attach photos	Verdict
HA2022L-613-001X	No major visual defects	—
HA2022L-613-002X	No major visual defects	—
HA2022L-613-003X	No major visual defects	—
Supplementary information:N/A		

3.2 (Initial)	TABLE: MQT 02 Maximum power determination at STC condition(Front)					P
Test Date [YYYY-MM-DD]……..…..:		2022-05-16				—
Radiant Source……..:		☒ Solar simulator ☐ Natural Sunlight				—
Module temperature [°C] .....:		25				—
Irradiance [W/m^2] .....:		1000				—
Sample No.	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF[%]
HA2022L-613-001X	41.040	16.977	34.366	16.281	559.513	80.30
HA2022L-613-002X	40.935	17.008	33.732	16.559	558.568	80.23
HA2022L-613-003X	40.965	17.086	34.086	16.415	559.522	79.94
Supplementary information: N/A						

Clause	Requirement + Test	Result - Remark	Verdict

3.2 (Initial)	TABLE: MQT 02 Maximum power determination at STC condition(Back)						P
Test Date [YYYY-MM-DD]……..…..:			2022-05-16				—
Radiant Source……..:			☒ Solar simulator ☐ Natural Sunlight				—
Module temperature [°C] .....:			25				—
Irradiance [W/m²] .....:			1000				—
Sample No.	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF[%]	
HA2022L-613-001X	40.802	16.147	33.906	14.503	491.739	74.64	
HA2022L-613-002X	40.805	16.029	33.045	14.900	492.371	75.28	
HA2022L-613-003X	40.792	16.163	33.326	14.769	492.192	74.65	
Supplementary information: N/A							

3.2 (Initial)	TABLE: MQT 02 Maximum power determination at BNPI condition								P
Test Date [YYYY-MM-DD]……..…..:				2022-05-16					—
Radiant Source……..:				☒ Solar simulator ☐ Natural Sunlight					—
Module temperature [°C] .....:				25					—
Irradiance [W/m²] .....:				1119					—
Sample No.	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF[%]	φ_{Isc}	φ_{Voc}	φ_{Pmax}
HA2022L-613-001X	41.240	18.989	34.108	18.184	620.207	79.20	95.1%	99.4%	87.9%
HA2022L-613-002X	41.337	18.854	34.214	18.092	618.987	79.42	94.2%	99.7%	88.1%
HA2022L-613-003X	41.193	19.179	34.073	18.192	619.856	78.46	94.6%	99.6%	88.0%
Supplementary information: Frontside with equivalent irradiance (1000+φ*135)W/m2, 25 °C, AM 1.5; φ=0.88									

3.3	Table: MST 03 Insulation test (initial)				P
Test Date [YYYY-MM-DD]..... :			2022-05-16		—
Test Voltage applied [V] ..... :			8000/1500		—
Sample No.	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	

Clause	Requirement + Test	Result - Remark	Verdict

HA2022L-613-001X	>10000	15.33	No dielectric breakdown	X	P
HA2022L-613-002X	>10000	15.33	No dielectric breakdown	X	P
HA2022L-613-003X	>10000	15.33	No dielectric breakdown	X	P
Supplementary information: Size of module is 2.61 [m²], The maximum measuring limit of the equipment is 10000MΩ.					

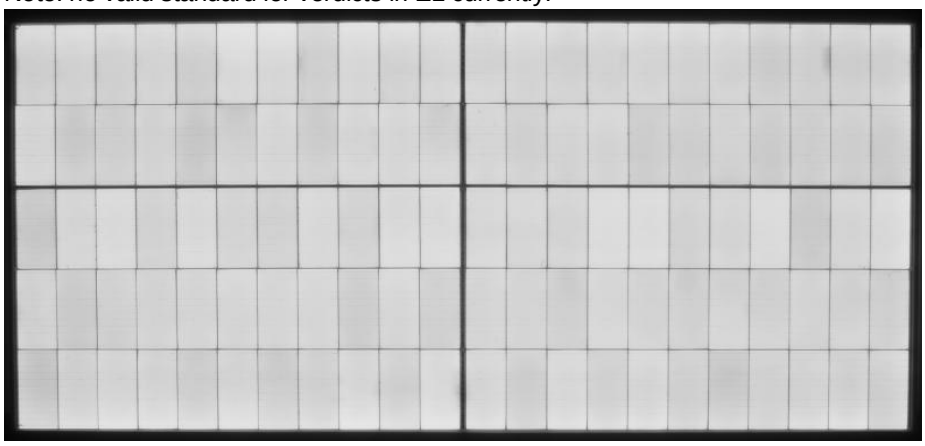
3.4	TABLE: MST 17 Wet leakage current test (Initial)		P
Test Date [YYYY-MM-DD]……..…..:	2022-05-16		—
Test voltage applied [V] ……..…..:	1500		—
Module maximum system voltage rating (V, DC) :	1500		—
Solution resistivity [Ω cm], < 3,500 Ω cm at 22 ± 3 ℃ :	2454		—
Sample No.	Measured [MΩ]	Limit [MΩ]	Result
HA2022L-613-001X	4650	15.33	P
HA2022L-613-002X	5720	15.33	P
HA2022L-613-003X	4580	15.33	P
Supplementary information: Size of module is 2.61 [m²].			

3.5	TABLE: MST 13 Continuity test of equipotential bonding (Initial)			P
Test Date [MM/DD/YYYY]……..…..:		2022-05-17		¾
Maximum over-current protection rating (A)…….:		30		¾
Current applied (A) ……..…..:		75		¾
Location of designated grounding point ……..…..:		Grounding point of the long edge		¾
Location of second contacting point……..…..:		The greatest physical displacement of adjacent side		¾
Sample No.	Position in test sequence:	Voltage (V)	Resistance (W)	Result
HA2022L-613-001X	Initial examination	0.116	0.002	P
HA2022L-613-002X	Initial examination	0.123	0.002	P
HA2022L-613-003X	Initial examination	0.113	0.002	P
Supplementary information: N/A				

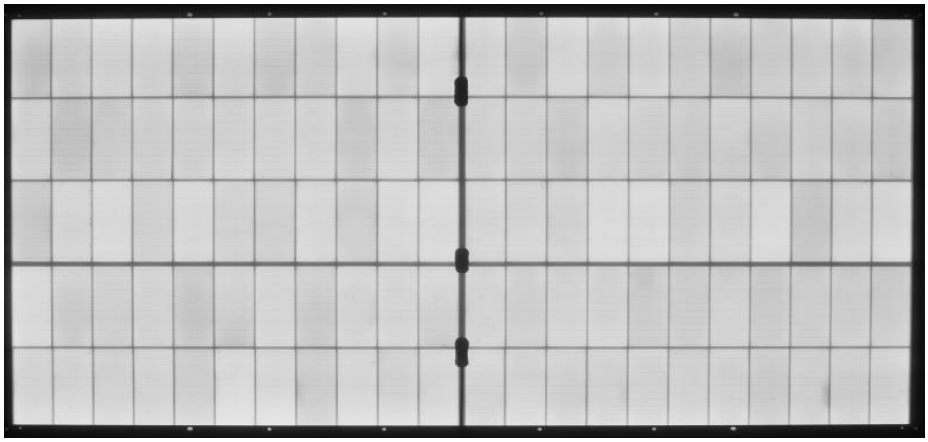
3.6	TABLE: Electroluminescence measurement (Initial)	—
Test Date [YYYY-MM-DD]……..…..:	2022-05-17	—
Sample No. …….. ……..…..:	HA2022L-613-001X ~ HA2022L-613-003X	—
Sample No.	Nature and position of initial findings – comments or attach photos	Result

Clause	Requirement + Test	Result - Remark	Verdict
HA2022L-613-001X	No major visual defects		—
HA2022L-613-002X	No major visual defects		—
HA2022L-613-003X	No major visual defects		—

Supplementary information: EL pictures
Note: no valid standard for verdicts in EL currently.

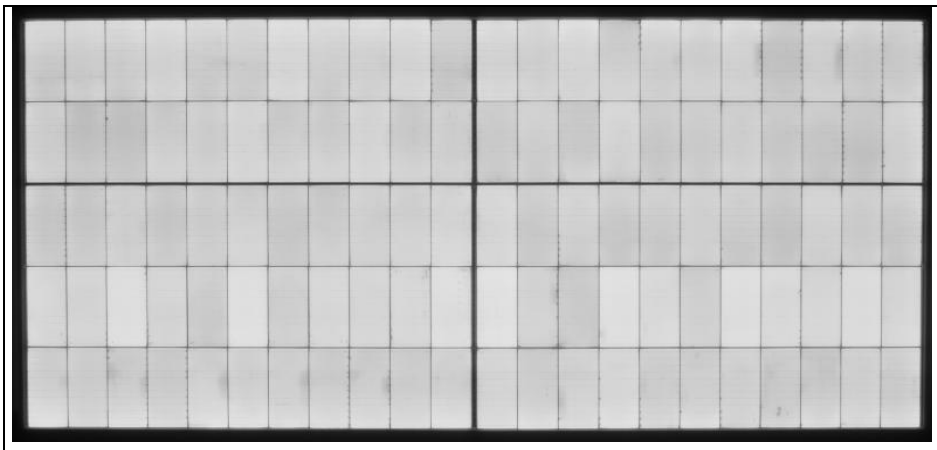


Sample HA2022L-613-001X-Front

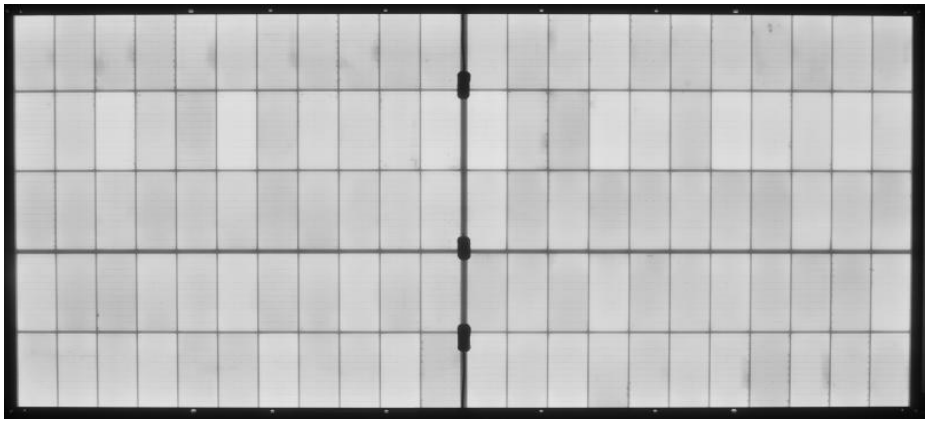


Sample HA2022L-613-001X-Rear

Clause	Requirement + Test	Result - Remark	Verdict

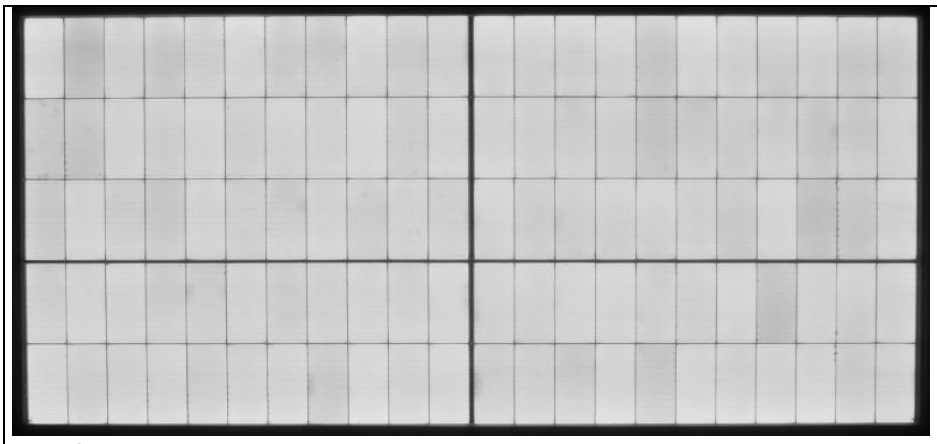


Sample HA2022L-613-002X-Front

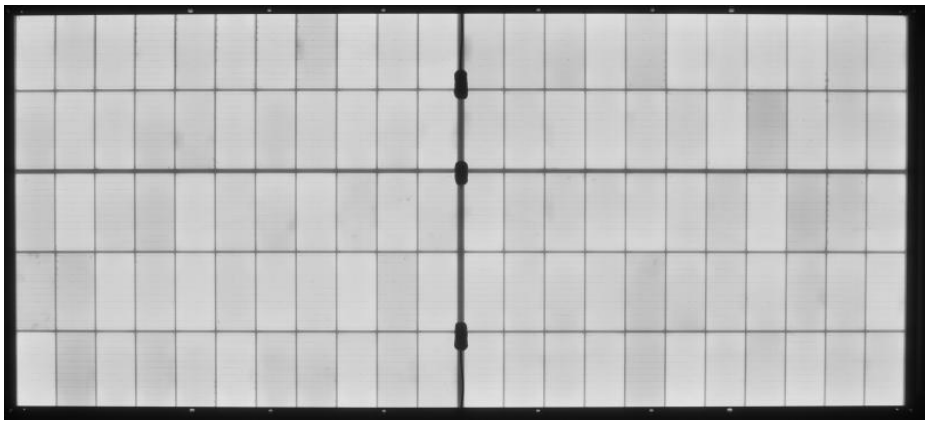


Sample HA2022L-613-002X-Rear

Clause	Requirement + Test	Result - Remark	Verdict



Sample HA2022L-613-003X-Front



Sample HA2022L-613-003X-Rear

4.1	TABLE: Dust and sand test		P
Test Date [YYYY-MM-DD]…….....:		2022-05-18 to 2022-05-21	¾
Sample No. ……... ……..... ……..... ……..:		HA2022L-613-001X HA2022L-613-002X	¾
Chamber temperature [°C] ….. ……..... ……... ……..:		40~60	P
Chamber relative humidity [%]….. ……..... ……... ……:		10%~25%	P
Chamber air pressure [kPa] .. …….. .. …….. .. ……:		N/A	¾
Method Lc1 or Lc2 ……..... ……..... :		Lc1	¾
Dust/sand type and composition.. ……..... …….....		Quartz, 95% SiO_2	¾
Particle size……..... ……..... ……..... ……..... ……..... ……:		0.149~0.850mm	¾
Dust/sand concentration…..... ……..... ……..... ……..... ……:		3.5-6.5g/m^3	¾
Wind speed [m/s] ……..... ……..... ……..... ……..... …:		15~20	—
Duration [min] ……..... ……..... ……..... ……..... …:		240 min for front side+240 min for rear side	¾
Supplementary information: N/A			

Clause	Requirement + Test	Result - Remark	Verdict

5.8 Final	**MQT 19.2 FINAL: Final stabilization**	N/A
TABLE 5.8.1: MQT 06.1 final Performance at STC before final stabilization		—
Test Date [YYYY-MM-DD]……:	—	—
Test method.....:	☐ Simulator ☐ Natural sunlight	—

Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
							—
							—
							—

TABLE 5.8.2: MQT 19.1 Final Stabilization procedure	N/A
Light exposure method .....:	☐ Simulator ☐ Natural sunlight
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight	
Stabilization criterion x per IEC 61215-1-x .....:	

Sample #		Test Date (YYYY-MM-DD) start/end.....:					
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	($P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—		—	—
1						—	—
2							
3							

Sample #		Test Date (YYYY-MM-DD) start/end.....:					
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	($P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—		—	—
1						—	—
2							
3							

Sample #		Test Date (YYYY-MM-DD) start/end .....:					
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	($P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—		—	—
1						—	—

Clause	Requirement + Test	Result - Remark	Verdict

2							
3							

☐ Other stabilization procedures

Sample #	Test Date (YYYY-MM-DD) start/end

Test method description:N/A

5.1	TABLE: MST 01 Visual inspection (Final)	P
Test Date [YYYY-MM-DD]……..…..:	2022-05-23	—

Sample No.	Nature and position of initial findings – comments or attach photos	Verdict
HA2022L-613-001X	No major visual defects	P
HA2022L-613-002X	No major visual defects	P
HA2022L-613-003X	No major visual defects	P

Supplementary information:N/A

5.2 (Final)	TABLE: MQT 02 Maximum power determination at STC condition(Front)	P
Test Date [YYYY-MM-DD]……..…..:	2022-05-23	—
Radiant Source……..:	☒ Solar simulator ☐ Natural Sunlight	—
Module temperature [°C] .....:	25	—
Irradiance [W/m^2] .....:	1000	—

Sample No.	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF[%]
HA2022L-613-001X	41.010	16.906	34.141	16.084	549.124	79.20
HA2022L-613-002X	40.894	16.848	33.603	16.275	546.889	79.38
HA2022L-613-003X	40.959	17.069	34.078	16.408	559.152	79.98

Pmp degradation [%] ≤5% ..... :	HA2022L-613-001X:-1.86 HA2022L-613-002X:-2.09 HA2022L-613-003X:-0.07	P

Supplementary information: N/A

Clause	Requirement + Test	Result - Remark	Verdict

5.2 (Final)	TABLE: MQT 02 Maximum power determination at STC condition(Back)						—
Test Date [YYYY-MM-DD]……..…..:				2022-05-23			—
Radiant Source……..…..:				☒ Solar simulator ☐ Natural Sunlight			—
Module temperature [°C] .....:				25			—
Irradiance [W/m²] .....:				1000			—
Sample No.	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF[%]	
HA2022L-613-001X	40.762	16.094	33.704	14.377	484.565	73.86	
HA2022L-613-002X	40.771	16.001	32.922	14.715	484.447	74.26	
HA2022L-613-003X	40.785	16.159	33.318	14.764	491.907	74.64	
Pmp degradation [%] ⩽5% ..... :				HA2022L-613-001X:-1.46 HA2022L-613-002X:-1.61 HA2022L-613-003X:-0.06			—
Supplementary information: N/A							

5.2 (Final)	TABLE: MQT 02 Maximum power determination at BNPI condition									—
Test Date [YYYY-MM-DD]……..…..:					2022-05-23					—
Radiant Source……..…..:					☒ Solar simulator ☐ Natural Sunlight					—
Module temperature [°C] .....:					25					—
Irradiance [W/m²] .....:					1119					—
Sample No.	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF[%]	φ_{Isc}	φ_{Voc}	φ_{Pmax}	
HA2022L-613-001X	41.154	18.832	34.050	17.843	607.548	78.390	95.2%	99.4%	88.2%	
HA2022L-613-002X	41.239	18.837	34.005	17.846	606.852	78.120	95.0%	99.7%	88.6%	
HA2022L-613-003X	41.184	19.174	34.069	18.178	619.306	78.430	94.7%	99.6%	88.0%	
Pmp degradation [%] ⩽5% ..... :					HA2022L-613-001X:-2.04 HA2022L-613-002X:-1.96 HA2022L-613-003X:-0.09					—
Supplementary information: Frontside with equivalent irradiance (1000+φ*135)W/m2, 25 °C, AM 1.5; φ=0.88										

5.3	Table: MST 03 Insulation test (Final)				P
Test Date [YYYY-MM-DD]..... :			2022-05-23		—
Test Voltage applied [V] ..... :			8000/1500		—
Sample No.	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	

Clause	Requirement + Test	Result - Remark	Verdict

HA2022L-613-001X	>10000	15.33	No dielectric breakdown	X	P
HA2022L-613-002X	>10000	15.33	No dielectric breakdown	X	P
HA2022L-613-003X	>10000	15.33	No dielectric breakdown	X	P
Supplementary information: Size of module is 2.61 [m²]. The maximum measuring limit of the equipment is 10000MΩ.					

5.4	TABLE: MST 17 Wet leakage current test (Final)		P
Test Date [YYYY-MM-DD]……..…..:	2022-05-23		—
Test voltage applied [V] ……..…..:	1500		—
Module maximum system voltage rating (V, DC) :	1500		—
Solution resistivity [Ω cm], < 3,500 Ω cm at 22 ± 3 ℃ :	2501		—
Sample No.	Measured [MΩ]	Limit [MΩ]	Result
HA2022L-613-001X	5720	15.33	P
HA2022L-613-002X	6530	15.33	P
HA2022L-613-003X	4960	15.33	P
Supplementary information: Size of module is 2.61 [m²].			

5.5	TABLE: MST 13 Continuity test of equipotential bonding (Final)			P
Test Date [YYYY-MM-DD]……..…..:		2022-05-24		¾
Maximum over-current protection rating (A).....:		30		¾
Current applied (A) .....:		75		¾
Location of designated grounding point .....:		Grounding point of the long edge		¾
Location of second contacting point.....:		The greatest physical displacement of adjacent side		¾
Sample No.	Position in test sequence:	Voltage (V)	Resistance (W)	Result
HA2022L-613-001X	Final examination	0.115	0.002	P
HA2022L-613-002X	Final examination	0.117	0.002	P
HA2022L-613-003X	Final examination	0.110	0.001	P
Supplementary information: N/A				

5.6	TABLE: Bypass diode functionality test (Final)	P
Sample No.	HA2022L-613-001X	—
Test Date [YYYY-MM-DD] .....:	2022-05-24	—
Module temperature [°C]..... :	25	—

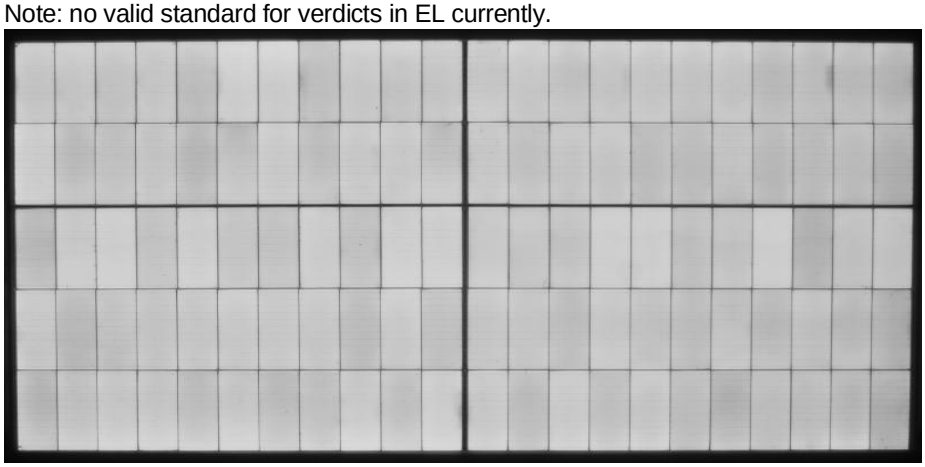
Clause	Requirement + Test	Result - Remark	Verdict

Number of diodes in junction box..... :	3						—
Diode manufacturer..... :	PAN JIT ELECTRONICS (WUXI) CO.,LTD.						—
Diode type designation ..... :	GF3045						—
Rated STC short-circuit current [A]..... :	17.19						—
Current flow (1.25 * Isc) [A] ..... :	21.487						—
Test duration (hour)	1						—
	D1	D2	D3	D4	D5	D6	Result
Diode functional? yes/no..... :	Yes	Yes	Yes				P
Sample No.	HA2022L-613-002X						—
Test Date [MM/DD/YYYY].....:	2022-05-24						—
Module temperature [°C]..... :	25						—
Number of diodes in junction box..... :	3						—
Diode manufacturer..... :	PAN JIT ELECTRONICS (WUXI) CO.,LTD.						—
Diode type designation ..... :	GF3045						—
Rated STC short-circuit current [A]..... :	17.19						—
Current flow (1.25 * Isc) [A] ..... :	21.487						—
Test duration (hour)	1						—
	D1	D2	D3	D4	D5	D6	Result
Diode functional? yes/no..... :	Yes	Yes	Yes				P
Supplementary information:N/A							

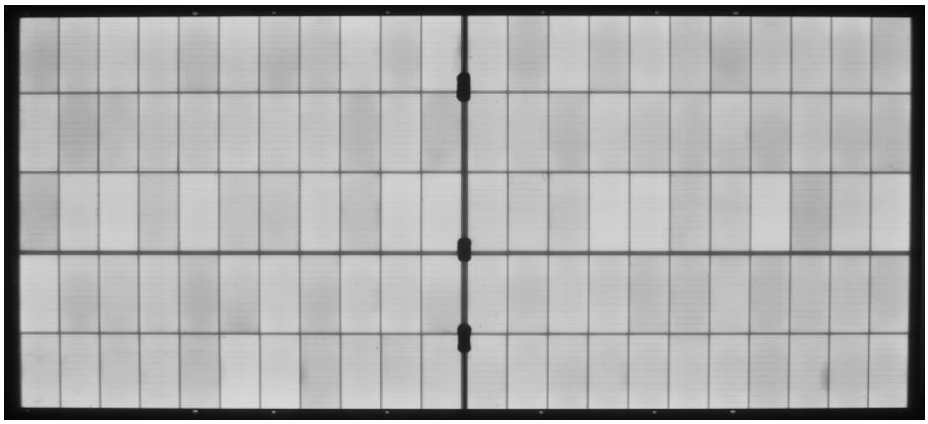
5.7	TABLE: Electroluminescence measurement (Final)	—
Test Date [YYYY-MM-DD]……....:	2022-05-24	—
Sample No. …….. ……..:	HA2022L-613-001X HA2022L-613-002X	—
Sample No.	Nature and position of initial findings – comments or attach photos	Result

Clause	Requirement + Test	Result - Remark	Verdict
HA2022L-613-001X	No major visual defects		—
HA2022L-613-002X	No major visual defects		—

Supplementary information: EL pictures
Note: no valid standard for verdicts in EL currently.

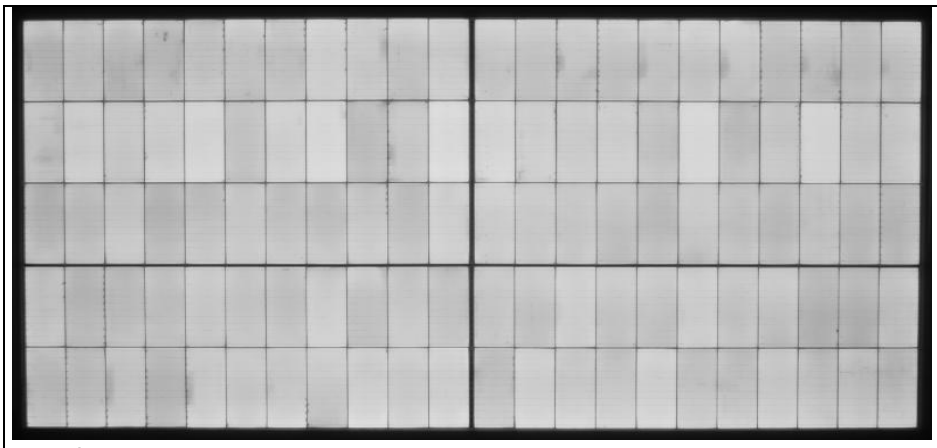


Sample HA2022L-613-001X-Front

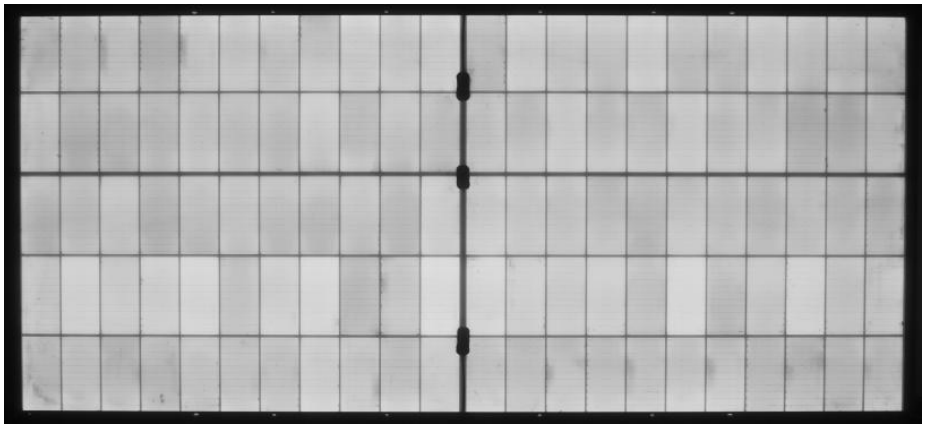


Sample HA2022L-613-001X-Rear

Clause	Requirement + Test	Result - Remark	Verdict



Sample HA2022L-613-002X-Front



Sample HA2022L-613-002X-Rear

Product Service

Annex 1: Product Description Sheet (Manufacturers and type references)

A1.1	MODULE TYPE/S
	HSP-210-B110DS560

A1.2	MODULE DESIGN	
	Module dimensions (L x W x H) [mm]:	2384 x 1096 x 35
	Weights:	32.3 kg(approx)
	Front/Rear cover bonding classification:	☐ rigid/flexible ☒ rigid/rigid ☐ flexible/flexible

A1.3	SOLAR CELL	
	Cell type reference:	Anhui Huasun Energy Co.,Ltd. Cell type: HS-15BB G12, HJT,N type, mono-si
	Cell dimensions L x W x T (± %) [mm]:	210x105mm, (Half cut)
	Cell thickness [µm]:	140±14
	Cell area [cm²]:	220.5

A1.4	IDENTIFICATION OF MATERIALS	
	Front cover:	WuJiang CSG Glass Co., Ltd. Type: Ultra-white rolled toughened glass Thickness: 2.0mm Color:transparent
	Rear cover:	WuJiang CSG Glass Co., Ltd. Type: Ultra-white rolled toughened glass with white grid Thickness: 2.0mm
	Encapsulation material front side:	Shanghai HIUV New Materials Co., Ltd. Type: P507 Thickness:0.8mm
	Encapsulation material back side:	Shanghai HIUV New Materials Co., Ltd Type: P507 Thickness:0.8mm
	Frame parts:	Anhui ShengXin New Material Co., LTD. Material: 6005-T6 Thickness: 35x30mm
	Mounting parts:	N/A
	Adhesive for frame:	Shanghai Huitian New Material Co., Ltd. Type: HT906Z

	Edge sealing.....:	N/A
	Internal wiring .....:	N/A
	Cell connector.....:	Telison New Materials Co.,Ltd JinTan Branch. Dimension: Φ0.30 mm.
	String connector.....:	Telison New Materials Co.,Ltd JinTan Branch. Type: 0.35*4mm/0.35*8mm
	Soldering material.....:	N/A
	Fluxing agent.....:	Shenzhen Wise New Electronic Materials Co.,Ltd. Type: WS-867-MS
	Junction box .....:	Ningbo huayu Photovoltaic Technology Co.,Ltd. Type: PV-HY02
	Cable.....:	Ningbo huayu Photovoltaic Technology Co.,Ltd. Type: H1Z2Z2-K, 1500V DC
	Connector.....:	Ningbo huayu Photovoltaic Technology Co.,Ltd. Type: PV-H4,35A,1500V,IP68
	Bypass diode.....:	PAN JIT ELECTRONICS (WUXI) CO.,LTD. Type: GF3045
	Potting material.....:	Shanghai Huitian New Material Co.,Ltd. Type: 5299W-S
	Adhesive for junction box .....:	Shanghai Huitian New Material Co., Ltd. Type: HT906Z
	Additional material (e. g. fixing tape, insulation tape).....:	Fixing tap: SHANGHAI SHUXIN INDUSTRAIL CO.,TD Type: D60F6-2 Rating label: Suzhou Meixinda Packaging Materials Co.,Ltd. Type:PET

A1.5	MODULE DESIGN - MINIMUM DISTANCES	
	Between cells .....:	0.8 mm
	Between cell and accessible surfaces .....:	12 mm
	Between any current carrying part and accessible surfaces.....:	11.3 mm

A1.6	MODULE DESIGN - ELECTRICAL CONFIGURATION	
	Total number of cells.....:	110
	Serial-parallel connection of cells .....:	SP
	Cells per bypass diode.....:	44/44/22
	No. of bypass diodes .....:	3

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	Visual inspection table HYJC-YS-033	/	2021.07.01	2022.06.30
	Illumination photometer HYJC-YS-070	/	2021.07.01	2022.06.30
Maximum power determination	Module pulse simulator HYJC-YS-021	AAA	2021.12.09	2022.12.08
Insulation test	Programmable control voltage insulation meter HYJC-YS-155	/	2021.07.01	2022.06.30
Wet leakage current test	Programmable control voltage insulation meter HYJC-YS-155	/	2021.07.01	2022.06.30
	Conductance meter HYJC-YS-171	/	2021.07.01	2022.06.30
Dust and sand test	Dust test chamber HYJC-YS-169	/	2021.07.01	2022.06.30
Bypass diode functionality test	Voltage-stabilized source HYJC-YS-166	/	2021.07.01	2022.06.30
Continuity Test of Equipotential Bonding	Ground continuity chamber HYJC-YS-093	100A	2021.07.01	2022.06.30

Annex 3: Statement of the estimated uncertainty of the test results

Statement of the estimated uncertainty of the I/V test.
P_{max} measurement uncertainty: 2.12%
V_{oc} measurement uncertainty: 0.98%
Isc measurement uncertainty: 2.26%

Annex 4: Photos of module

END OF REPORT