

**Technical Report No.: 704062302116-01**

**Date: 2023-06-09**

- Client:** Shanghai JA Solar Technology Co., Ltd.  
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201401 Shanghai, PEOPLE'S REPUBLIC of CHINA  
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- Manufacturer:** Shanghai JA Solar Technology Co., Ltd.  
No. 118, Lane 3111, West Huancheng Road, Fengxian District,  
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Contact person: Ms. Wenli Gong
- Factory:**
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7. JA Solar New Energy Yangzhou Co., Ltd.

(Jingshan Park) (114922)

No. 123, Jinshan Road, Economic Development Zone, 225127 Yangzhou City, Jiangsu Province, PEOPLE'S REPUBLIC OF CHINA

Contact person: Ms. Xiaoqing Li

Test object: Product: Photovoltaic modules

Model: See clause 1.4

Test specification: IEC 61215-2:2016, Clause 4.1 Visual Inspection (MQT 01)  
IEC 61215-2:2016, Clause 4.6 Performance at STC (MQT 06)  
IEC 61215-2:2016, Clause 4.3 Insulation test (MQT 03)  
IEC 61215-2:2016, Clause 4.15 Wet leakage current test (MQT 15)  
IEC 61215-2:2016, Clause 4.17 Hail test (MQT 17)  
IEC 61215-2:2016, Clause 4.18 Bypass diode functionality test (MQT 18.2)  
IEC 61215-2:2016, Clause 4.19 Stabilization (MQT 19.1)

Purpose of examination: 

- Testing and evaluation (visual / partial) according to the test specification

Test result: The test results show that the presented product is in compliance with the above listed test specifications.

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## 1. Description of the test object

### 1.1 Picture(s)

N/A

### 1.2 Function

Manufacturer's specification for intended use:

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

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### 1.3 Consideration of the foreseeable use

- Not applicable
- Covered through the applied standard
- Covered by the following comment\*
- Covered by attached risk analysis

\*

## 1.4 Technical Data

Sample No.	Module serial No.	Model type	Remark/Constructional characteristics
Sample 1 (GDP230640-1)	2340105530759455	JAM54D41-440/LB	1762 x 1134 x 30 mm, 22 ± 3% Kg
Sample 2 (GDP230640-2)	2340105530759470	JAM54D41-440/LB	1762 x 1134 x 30 mm, 22 ± 3% Kg
Sample 3 (GDP230641-1)	2350105620829413	JAM54S31-415/LR	1762 x 1134 x 30 mm, 20 ± 3% Kg
Sample 4 (GDP230641-2)	2350105620829420	JAM54S31-415/LR	1762 x 1134 x 30 mm, 20 ± 3% Kg

Applicable Modules (due to same materials and similar construction):

JAM54D41-xxx/LB, xxx= 420 to 440 in steps of 5

JAM54D40-xxx/LB, xxx= 420 to 450 in steps of 5

JAM54S31-xxx/LR, xxx= 415 to 430 in steps of 5

JAM54S30-xxx/LR, xxx= 415 to 435 in steps of 5

xxx is standing for rated output power at STC

JAM54D41-xxx/LB, JAM54S31-xxx/LR series have the identical construction with JAM54D40-xxx/LB, JAM54S30-xxx/LR series, except for different color of substrate.

## 2. Order

### 2.1 Date of Purchase Order, Customer's Reference

The order dated 2023-04-28

### 2.2 Test Sample(s)

- Reception date(s): 2023-04-20
- Location(s) of reception: Yangzhou Opto-Electrical Products Testing Institute  
No. 10 West Kaifa Road, Yangzhou, 225009 Jiangsu,  
P. R. China
- Condition of test sample(s): In good condition

### 2.3 Testing

- Testing date(s): 2023-05-09 to 2023-06-08
- Location(s) of testing: Yangzhou Opto-Electrical Products Testing Institute  
No. 10 West Kaifa Road, Yangzhou, 225009 Jiangsu,  
P. R. China

## 2.4 Points of Non-Compliance or Exceptions of the Test Procedure

- N/A

## 3. Test Results

- “Decision rule according to IEC Guide 115:2021, clause 4.4.3, 4.5.1 was applied.”
- “Decision rule (based on ILAC-G8) for an upper specification limit (A lower limit or specification with an up-per and a lower limit is treated similarly.):
  - Compliance with the requirement: If a specification limit is not breached by a measurement result plus the expanded uncertainty with a 95% coverage probability, then compliance with the specification will be stated (e. g. Pass).

3.1 Positive Test Results

- See below details

TABLE 01: MQT 01 Visual inspection		P
Test Date [YYYY-MM-DD]..... :	2023-05-09 for sample #1, 2 2023-05-12 for sample #3, 4	—
Sample No.	Nature and position of initial findings – comments or attach photos	—
1	No major visual defects found	P
2	No major visual defects found	P
3	No major visual defects found	P
4	No major visual defects found	P
Supplementary information: N/A		

TABLE 02: MQT 19.1 ini: Initial stabilization							P
TABLE 02.1: MQT 06.1 ini: Performance at STC before initial stabilization (single-side front)							
Test Date [YYYY-MM-DD]..... :	2023-05-09 for sample #1, 2 2023-05-12 for sample #3, 4						—
Test method..... :	<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
1	13.942	38.789	13.206	32.890	434.361	80.32	—
2	13.925	38.979	13.217	32.890	434.702	80.09	—
3	13.931	37.653	13.212	31.451	415.538	79.22	—
4	13.910	37.600	13.217	31.459	415.801	79.50	—
Supplementary information: N/A							

TABLE 02: MQT 19.1 ini: Initial stabilization		P
TABLE 02.1: MQT 06.1 ini: Performance at STC before initial stabilization (single-side rear)		
Test Date [YYYY-MM-DD]..... :	2023-05-09	—
Test method..... :	<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight	—

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Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
1	10.267	38.345	9.689	33.090	320.600	81.44	—
2	10.375	38.463	9.796	32.994	323.222	81.00	—
Supplementary information: N/A							

TABLE 02.2: MQT 19.1 ini: Initial Stabilization procedure							P
Light exposure method.....					<input checked="" type="checkbox"/> Simulator	<input type="checkbox"/> 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 #	1	Test Date (YYYY-MM-DD) start/end.....			2023-05-09 / 2023-05-11		
Test cycle	Integrated irradiation (kWh/m <sup>2</sup> )	Irradiance (W/m <sup>2</sup> )	Module temperature (°C)	Resistive load	P <sub>max</sub> (W) at the end of cycle	P <sub>max</sub> – P <sub>min</sub> / P <sub>average</sub> (%)	Stable (Yes/No)
Initial	—	—	—	—	434.361	—	—
1	5	800~1000	50 ± 10	MPPT	433.022	—	—
2	5	800~1000	50 ± 10	MPPT	432.299	0.48	Yes
Initial (R)					320.600		
1	5	800~1000	50 ± 10	MPPT	319.784	—	—
2	5	800~1000	50 ± 10	MPPT	319.210	0.43	Yes
Sample #	2	Test Date (YYYY-MM-DD) start/end.....			2023-05-09 / 2023-05-11		
Test cycle	Integrated irradiation (kWh/m <sup>2</sup> )	Irradiance (W/m <sup>2</sup> )	Module temperature (°C)	Resistive load	P <sub>max</sub> (W) at the end of cycle	P <sub>max</sub> – P <sub>min</sub> / P <sub>average</sub> (%)	Stable (Yes/No)
Initial (F)	—	—	—	—	434.702	—	—
1	5	800~1000	50 ± 10	MPPT	434.598	—	—
2	5	800~1000	50 ± 10	MPPT	433.609	0.25	Yes
Initial (R)					323.222		
1	5	800~1000	50 ± 10	MPPT	322.372	—	—
2	5	800~1000	50 ± 10	MPPT	321.893	0.41	Yes
Sample #	3	Test Date (YYYY-MM-DD) start/end.....			2023-05-12 / 2023-05-15		
Test cycle	Integrated irradiation (kWh/m <sup>2</sup> )	Irradiance (W/m <sup>2</sup> )	Module temperature (°C)	Resistive load	P <sub>max</sub> (W) at the end of cycle	P <sub>max</sub> – P <sub>min</sub> / P <sub>average</sub> (%)	Stable (Yes/No)
Initial	—	—	—	—	415.538	—	—





Test Date [YYYY-MM-DD] .....					2023-05-11 for sample #1, 2 2023-05-15 for sample #3, 4					—
Pmax(lab) lower limit (W) .....					See table below: Pmax [W] – Min calc.					—
$\bar{P}_{max}(Lab)$ lower limit (W) .....					430.360 for sample #1, 2 405.908 for sample #3, 4					—
Voc(lab) upper limit (V) .....					See table below: Voc [V] Max. calc.					—
Isc (lab) upper limit (A) .....					See table below: Isc [A] Max. calc.					—
Test method .....					<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight					—
Sample #	Isc [A]		Voc [V]		Imp [A]	Vmp [V]	Pmax [W]		FF [%]	Result
	Meas.	Max. calc.	Meas.	Max. calc.			Meas.	Min. calc.		
1	13.940	14.614	38.607	39.631	13.200	32.750	432.299	417.449	80.33	P
2	13.929	14.614	38.866	39.631	13.202	32.844	433.609	417.449	80.10	P
Average	—						432.954	430.360	—	P
3	13.928	14.471	37.636	37.706	13.194	31.309	413.091	393.730	78.80	P
4	13.903	14.471	37.579	37.706	13.181	31.305	412.631	393.730	78.98	P
Average	—						412.862	405.908	—	P
Supplementary information: The limit values are calculated considering manufacturer's tolerances <b>t</b> of rated nameplate values and laboratory measurement uncertainties <b>m</b> .										

<b>TABLE 03: MQT 06.1 ini: Performance at STC after initial stabilization (single-side rear)</b>										P
Test Date [YYYY-MM-DD] .....					2023-05-11					—
Pmax(lab) lower limit (W) .....					See table below: Pmax [W] – Min calc.					—
$\bar{P}_{max}(Lab)$ lower limit (W) .....					-					—
Voc(lab) upper limit (V) .....					See table below: Voc [V] Max. calc.					—
Isc (lab) upper limit (A) .....					See table below: Isc [A] Max. calc.					—
Test method .....					<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight					—
Sample #	Isc [A]		Voc [V]		Imp [A]	Vmp [V]	Pmax [W]		FF [%]	Result
	Meas.	Max. calc.	Meas.	Max. calc.			Meas.	Min. calc.		
1	10.268	-	38.188	-	9.688	32.950	319.210	-	81.41	—
2	10.376	-	38.298	-	9.810	32.811	321.893	-	81.00	—

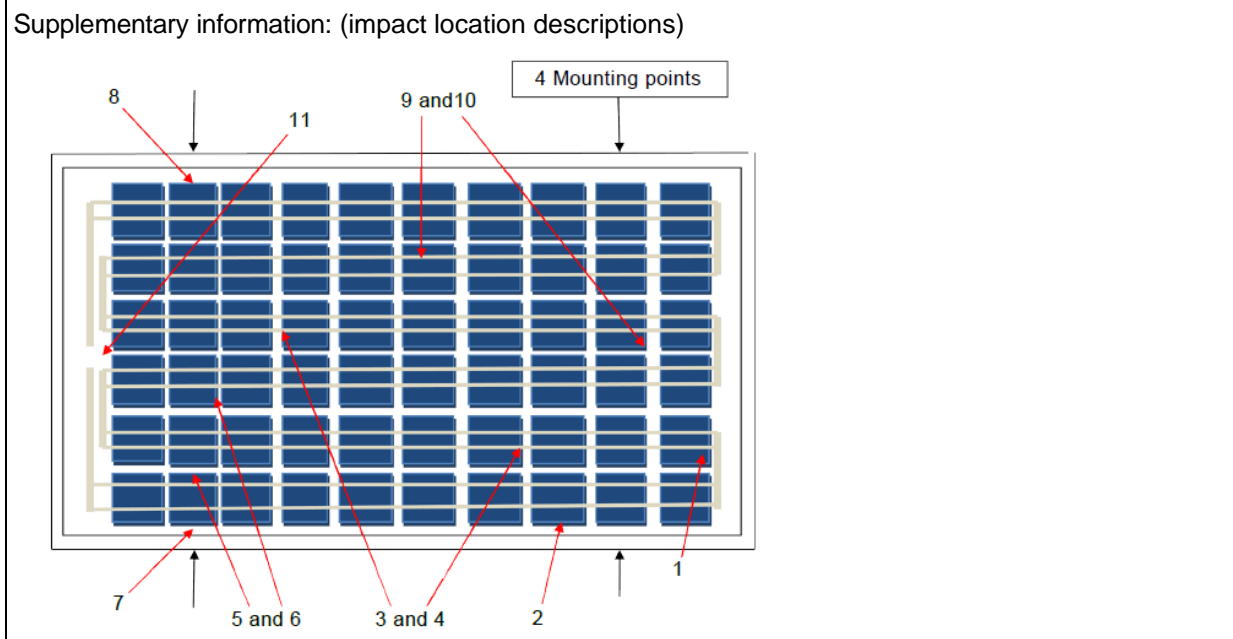
Average	—	320.552	-	—	—
Supplementary information: The limit values are calculated considering manufacturer's tolerances <b>t</b> of rated nameplate values and laboratory measurement uncertainties <b>m</b> .					

TABLE 04: MQT 03 ini: Initial Insulation test					P
Test Date [YYYY-MM-DD].....:		2023-06-03			—
Test Voltage applied [V] .....		8000/1500			—
Size of module [m²].....:		1.998			—
Required Resistance [MΩ].....:		20.020			—
Sample #	Measured	Dielectric breakdown		Result	
	MΩ	Yes (description)	No		
1	>2000	No dielectric breakdown	x	P	
2	>2000	No dielectric breakdown	x	P	
3	>2000	No dielectric breakdown	x	P	
4	>2000	No dielectric breakdown	x	P	
Supplementary information: the maximum measuring limit of the equipment is 2000 MΩ.					

TABLE 05: MQT 15 ini: Initial Wet leakage current test					P
Test Date [YYYY-MM-DD].....:		2023-06-03			—
Test Voltage applied [V].....:		1500			—
Solution temperature [°C].....:		23.1 for sample #1, 2 23.5 for sample #3, 4			—
Size of module [m²].....:		1.998			—
Sample #	Required Resistance [MΩ]	Measured [MΩ]		Result	
1	20.020	557.7		P	
2	20.020	543.6		P	
3	20.020	548.5		P	
4	20.020	556.9		P	
Supplementary information: Solution resistivity [Ω·cm] 2823 for sample #1, 2, 2823 for sample #3, 4					

TABLE 06: MQT 17 - Hail impact test			P
Test Date [YYYY-MM-DD].....:		2023-06-08	
Sample #	2		—

Ice ball size [mm] .....	1	2	3	4	5	6	—
	34.7	34.1	34.6	35.1	34.2	34.4	
	7	8	9	10	11	/	
Ice ball weight [g] .....	1	2	3	4	5	6	—
	20.7	20.1	19.6	20.5	19.7	19.8	
	7	8	9	10	11	/	
Ice ball velocity [m/s] .....	1	2	3	4	5	6	—
	27.3	26.4	27.5	26.1	26.8	27.2	
	7	8	9	10	11	/	
Ice ball velocity [m/s] .....	1	2	3	4	5	6	—
	26.2	27.7	27.2	27.3	26.4		
	26.2	27.7	27.2	27.3	26.4		
Number of impact locations .....	11						—



Test Date [YYYY-MM-DD] .....	2023-06-08						—
Sample #	4						—
Ice ball size [mm] .....	1	2	3	4	5	6	—
	34.4	35.1	34.5	34.7	34.8	34.6	

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	7	8	9	10	11	/	
	35.0	35.1	34.4	34.8	34.5		
Ice ball weight [g] .....	1	2	3	4	5	6	—
	19.6	20.6	19.6	20.0	20.1	19.7	
	7	8	9	10	11	/	
Ice ball velocity [m/s].....	1	2	3	4	5	6	—
	26.8	26.2	27.0	27.1	26.9	27.0	
	7	8	9	10	11	/	
26.8	26.7	26.5	27.1	26.9			
Number of impact locations .....	11						—

Supplementary information: (impact location descriptions)

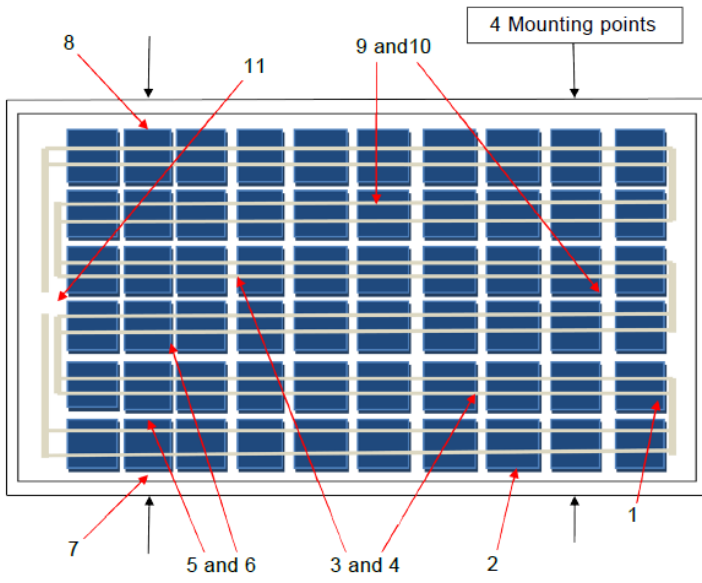


TABLE 07: MQT 01 - Visual inspection after hail impact test		P
Test Date [YYYY-MM-DD].....	2023-06-08	—
Sample No.	Nature and position of initial findings – comments or attach photos	—
2	No major visual defects found	P
4	No major visual defects found	P

Supplementary information: N/A

<b>TABLE 08: MQT 03 - Insulation test after hail impact test</b>				P
Test Date [YYYY-MM-DD].....:	2023-06-08			—
Test Voltage applied [V] .....	8000/1500			—
Size of module [m²].....:	1.998			—
Required Resistance [MΩ].....:	20.020			—
Sample #	Measured	Dielectric breakdown		Result
	MΩ	Yes (description)	No	
1	>2000	No dielectric breakdown	x	P
2	>2000	No dielectric breakdown	x	P
3	>2000	No dielectric breakdown	x	P
4	>2000	No dielectric breakdown	x	P

Supplementary information: the maximum measuring limit of the equipment is 2000 MΩ.

<b>TABLE 09: MQT 15 - Wet leakage current test after hail impact test</b>				P
Test Date [YYYY-MM-DD].....:	2023-06-08			—
Test Voltage applied [V].....:	1500			—
Solution temperature [°C].....:	22.8 for sample #1, 2 22.9 for sample #3, 4			—
Size of module [m²].....:	1.998			—
Sample #	Required Resistance [MΩ]	Measured [MΩ]		Result
1	20.020	537.2		P
2	20.020	549.5		P
3	20.020	544.7		P
4	20.020	554.3		P

Supplementary information: Solution resistivity [Ω·cm] 2762 for sample #1, 2, 2883 for sample #3, 4

<b>TABLE 10.1: MQT 06.1 - Final Performance at STC (single-side front)</b>		P
Test Date [YYYY-MM-DD].....:	2023-06-08	
Test method.....:	<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight	

Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab_GateNo.1)	Power Degradation [%]	Result
1	13.930	38.577	13.214	32.421	428.411	79.72	432.299	-0.16	P
2	13.921	38.824	13.122	32.599	427.764	79.15	433.609	-1.35	P
3	13.926	37.593	13.161	31.018	408.228	77.98	413.091	-0.31	P
4	13.905	37.570	13.188	30.978	408.538	78.20	412.631	-0.99	P

Supplementary information: The IV curves didn't show any additional kinks or other unusual characteristics as compared to the initial IV curve.

TABLE 10.1: MQT 06.1 - Final Performance at STC (single-side rear)									P
Test Date [YYYY-MM-DD].....:					2023-06-08				—
Test method.....:					<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight				—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab_GateNo.1)	Power Degradation [%]	Result
1	10.255	38.166	9.623	32.726	314.922	80.46	319.210	-0.19	P
2	10.384	38.266	9.773	32.514	317.759	79.97	321.893	-1.28	P

Supplementary information: The IV curves didn't show any additional kinks or other unusual characteristics as compared to the initial IV curve.

TABLE 13.7: MQT 18.2 - Bypass diode functionality test					P
Test Date [YYYY-MM-DD].....:				2023-06-08	—
<input type="checkbox"/> Method A					—
Ambient temperature [°C] .....					—
Current flow applied [A] .....					—
Sample #	VFM	VFMrated	VFM = (N × VFMrated) ± 10 %		Result
			<input type="checkbox"/> Yes <input type="checkbox"/> No		—
Supplementary information:					
<input checked="" type="checkbox"/> Method B					—
	IV curve after shading				Result
Diode 1	Turn on				P
Diode 2	Turn on				P

Diode 3	Turn on	P
Supplementary information: performed on sample 1, 2, 3, 4.		

**3.2 Points of Non-Compliance according to the test specification**

- None

**4. Test History**

N/A

**5. Remarks**

**5.1 General**

N/A

**5.2 Factory surveillance cycle**

Your production facility is currently on the following surveillance cycle.

- Annual (12 month)
- Bi-Annual (6 month)
- Quarterly (3 month)
- N/A

**5.3 Additional information for routine tests to be performed by the factory(ies)**

**Routine tests for electrical appliances / equipment:**

N/A

6. Documentation

Appendix 1: List of measurement equipment

No.	Test Item	Main testing Equipment	Calibrate until
1	Visual inspection	Illuminance Meter SB08125	2023-08-25
2	Performance at STC	Reference cell SB08100	2023-02-24
3	Performance at STC Bypass diode functionality test	Pulsed Solar Simulator SB18003	2023-08-22
4	Insulation test Wet leakage current test	Electrical Safety Compliance Analyzer SB23003	2023-04-27
5	Wet leakage current test	Conductance meter SB16001	2023-10-10
6	Hail test	Hail tester SB08076	2023-08-08
7	Stabilization	level C steady state simulator SB17012	2023-11-04
All equipment used for tests having a significant effect on the accuracy or validity of the result of the test is calibrated before being put into service.			

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

The measurement uncertainty is  $U(P_{max})=2.24\%$ ,  $U(V_{oc})=1.10\%$ ,  $U(I_{sc})=1.84\%$  ( $K=2$ ).

7. Summary

“The test specifications are met”

**TÜV SÜD Certification and Testing (China)Co., Ltd. Shanghai Branch**

Tested by: Rongwei Jing

*printed name, function & signature*

Approved by:

Guangxia Fu



*printed name, function & signature*