

## Technical Report No.: 704062200509-00

**Date: 2022-06-22**

Client:

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Contact person: Ms. Wenli Gong

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Report No.: 704062200509  
Rev.: 00  
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Page 1 of 15

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CHINA  
Contact person: Ms. Xiaoqing Li

Product: Crystalline Silicon Photovoltaic modules

Test object:

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)

Refer to Appendix 1

### 1.2 Function

Manufacturer's specification for intended use:

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

Manufacturer's specification for predictive use:

N/A

### 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.	Model serial No.	Model type	Remark/Constructional characteristics
Sample 1 (HA2022TL-320-001X)	2220209210199018	JAM78D40-600/GB	Mono, 156 pcs half-cells, 11 busbars, double glass
Sample 2 (HA2022TL-320-002X)	2220209210199016	JAM78D40-600/GB	Mono, 156 pcs half-cells, 11 busbars, double glass

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

JAM78D40-xxx/GB, JAM72D40-xxx/GB, JAM66D40-xxx/GB, JAM60D40-xxx/GB, JAM54D40-xxx/GB, xxx is standing for rated output power at STC

## 2. Order

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

The order dated 2022-03-17

### 2.2 Test Sample(s)

- Reception date(s): 2022-04-09
- Location(s) of reception: Changzhou HuaYang Inspection and Testing Technology Co., Ltd  
No.8 Lanxiang Road, Wujin Economic Development Zone, Changzhou, Jiangsu, China
- Condition of test sample(s): In good condition

### 2.3 Date(s) of Testing 2022-04-09 to 2022-04-15

### 2.4 Location(s) of Testing

Changzhou HuaYang Inspection and Testing Technology Co., Ltd  
No.8 Lanxiang Road, Wujin Economic Development Zone,  
Changzhou, Jiangsu, China

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

- Performance at STC (MQT 06) was conducted according to IEC 61215-2:2021 for bifacial modules.

## 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]..... :	2022-04-09	—
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
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]..... :	2022-04-09						—
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	13.764	54.801	13.078	45.975	601.273	79.71	—
2	13.687	54.805	13.018	46.210	601.555	80.20	—
Supplementary information: N/A							

TABLE 02.1: MQT 06.1 ini: Performance at STC before initial stabilization (single-side rear)							P
Test Date [YYYY-MM-DD]..... :	2022-04-09						—
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	10.499	54.307	10.019	46.059	461.471	80.93	—
2	10.468	54.402	9.909	46.410	459.888	80.76	—
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 .....			2022-04-09 / 2022-04-14		
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)	—	—	—	—	601.273	—	—
1	5	800~1000	50 ± 10	MPPT	599.382	—	—
2	5	800~1000	50 ± 10	MPPT	598.236	0.51	Yes
Initial (R)	—	—	—	—	461.471	—	—
1	5	800~1000	50 ± 10	MPPT	460.236	—	—
2	5	800~1000	50 ± 10	MPPT	458.683	0.61	Yes
Sample #	2	Test Date (YYYY-MM-DD) start/end .....			2022-04-09 / 2022-04-14		
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)	—	—	—	—	601.555	—	—
1	5	800~1000	50 ± 10	MPPT	599.632	—	—
2	5	800~1000	50 ± 10	MPPT	598.247	0.55	Yes
Initial (R)	—	—	—	—	459.888	—	—
1	5	800~1000	50 ± 10	MPPT	457.936	—	—
2	5	800~1000	50 ± 10	MPPT	456.694	0.70	Yes
Supplementary information: N/A							
<input type="checkbox"/> Other stabilization procedures							
Sample #	Test Date (YYYY-MM-DD) start/end						

Doc No.: ITC-TTW0902.02E - Rev. 10



Test method description:	
Supplementary information: see Annex 3 for verification of this alternative stabilization procedure	

TABLE 03: MQT 06.1 ini: Performance at STC after initial stabilization (single-side front)										P
Test Date [YYYY-MM-DD] .....					2022-04-14					—
Pmax(lab) lower limit (W) .....					See table below: Pmax [W] – Min calc.					—
$\bar{P}_{max}(Lab)$ lower limit (W) .....					587.544					—
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	13.718	14.259	54.766	55.845	13.026	45.928	598.236	569.918	79.63	P
2	13.632	14.259	54.773	55.845	12.958	46.169	598.247	569.918	80.12	P
Average	—						598.242	587.544	—	P
Supplementary information: The limit values are calculated considering manufacturer's tolerances $t$ of rated nameplate values and laboratory measurement uncertainties $m$ .										

TABLE 03: MQT 06.1 ini: Performance at STC after initial stabilization (single-side rear)										P
Test Date [YYYY-MM-DD] .....					2022-04-14					—
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					—
	Isc [A]		Voc [V]		Imp [A]	Vmp [V]	Pmax [W]		FF [%]	Result

Sample #	Meas.	Max. calc.	Meas.	Max. calc.			Meas.	Min. calc.		
1	10.455	-	54.269	-	9.968	46.016	458.683	-	80.84	—
2	10.423	-	54.383	-	9.849	46.369	456.694	-	80.57	—
Average	—						457.689	-	—	—

Supplementary information: The limit values are calculated considering manufacturer's tolerances  $t$  of rated nameplate values and laboratory measurement uncertainties  $m$ .

TABLE 03: MQT 06.1 ini: Performance at STC after initial stabilization (Equivalent irradiance)										P
Test Date [YYYY-MM-DD] .....					2022-04-14					—
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	15.180	-	54.882	-	14.348	45.963	659.468	-	79.16	—
2	15.105	-	54.923	-	14.277	46.192	659.465	-	79.49	—
Average	—						659.467	-	—	—

Supplementary information: The limit values are calculated considering manufacturer's tolerances  $t$  of rated nameplate values and laboratory measurement uncertainties  $m$ .  
1103 W/m<sup>2</sup> equivalent irradiance is the effective value calculated when backside irradiance is 135W/m<sup>2</sup>.

TABLE 04: MQT 03 ini: Initial Insulation test										P
Test Date [YYYY-MM-DD].....					2022-04-14					—
Test Voltage applied [V] .....					8000/1500					—
Size of module [m <sup>2</sup> ].....					2.80					—
Required Resistance [MΩ].....					14.29					—
Sample #	Measured				Dielectric breakdown					Result
	MΩ				Yes (description)			No		

1	25900	No dielectric breakdown	x	P
2	32300	No dielectric breakdown	x	P
Supplementary information: N/A				

<b>TABLE 05: MQT 15 ini: Initial Wet leakage current test</b>				P
Test Date [YYYY-MM-DD].....:		2022-04-14		—
Test Voltage applied [V].....:		1500		—
Solution temperature [°C].....:		22.7		—
Size of module [m²].....:		2.80		—
Sample #	Required Resistance [MΩ]	Measured [MΩ]		Result
1	14.29	5680		P
2	14.29	6320		P
Supplementary information: Solution resistivity 2216 [Ω·cm]				

<b>TABLE 06: MQT 17 - Hail impact test</b>								P
Test Date [YYYY-MM-DD].....:		2022-04-15						—
Sample #		2						—
Ice ball size [mm].....:	1	2	3	4	5	6	—	
	34.9	34.9	35.1	34.8	35.2	34.7		
	7	8	9	10	11	/		
	34.9	34.8	34.6	34.8	34.9	/		
Ice ball weight [g].....:	1	2	3	4	5	6	—	
	20.7	20.8	20.7	20.8	20.5	20.8		
	7	8	9	10	11	/		
	20.5	20.6	20.7	20.6	20.5	/		
Ice ball velocity [m/s].....:	1	2	3	4	5	6	—	
	27.2	26.8	26.9	27.1	27.3	26.7		
	7	8	9	10	11	/		
	26.8	26.9	26.8	26.8	26.7	/		
Number of impact locations .....		11						—
Supplementary information: (impact location descriptions)								

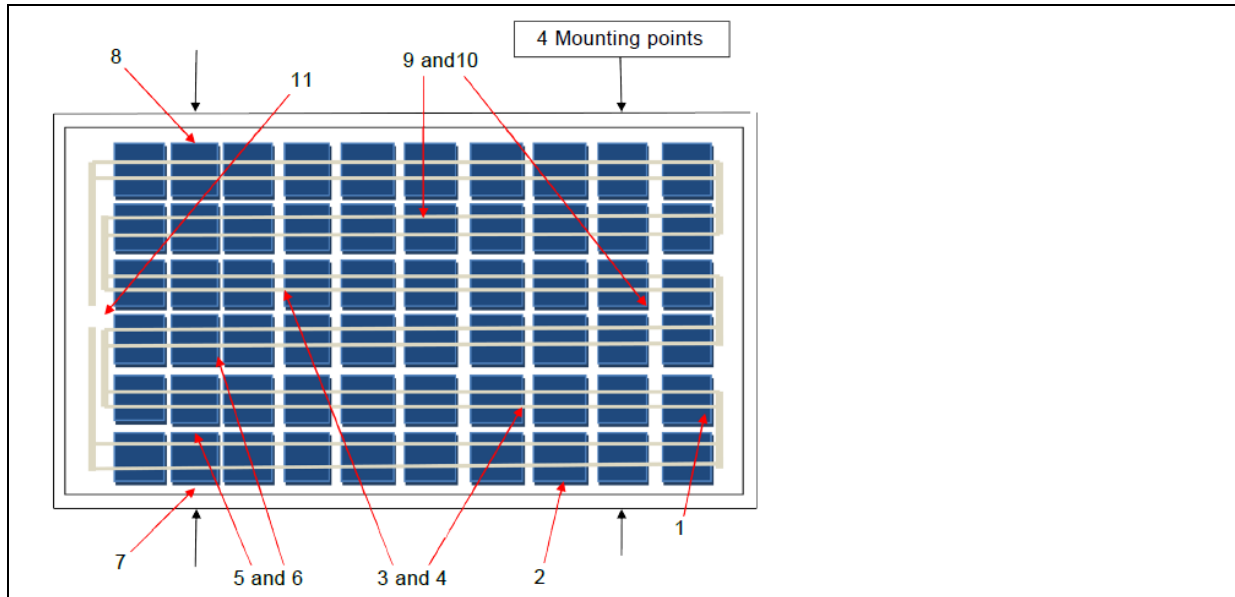


TABLE 07: MQT 01 - Visual inspection after hail impact test		P
Test Date [YYYY-MM-DD].....:	2022-04-15	—
Sample No.	Nature and position of initial findings – comments or attach photos	—
2	No major visual defects found	P
Supplementary information: N/A		

TABLE 08: MQT 03 - Insulation test after hail impact test				P
Test Date [YYYY-MM-DD].....:	2022-04-15		—	
Test Voltage applied [V] .....	8000/1500		—	
Size of module [m²].....:	2.80		—	
Required Resistance [MΩ].....:	14.29		—	
Sample #	Measured	Dielectric breakdown		Result
	MΩ	Yes (description)	No	
2	25900	No dielectric breakdown	x	P
Supplementary information: N/A				

TABLE 09: MQT 15 - Wet leakage current test after hail impact test		P
Test Date [YYYY-MM-DD].....:	2022-04-15	—

Test Voltage applied [V].....:	1500	—	
Solution temperature [°C].....:	21.8	—	
Size of module [m²].....:	2.80	—	
Sample #	Required Resistance [MΩ]	Measured [MΩ]	Result
2	14.29	5930	P
Supplementary information: Solution resistivity 2136 [Ω·cm]			

<b>TABLE 10.1: MQT 06.1 - Final Performance at STC (single-side front)</b>									P
Test Date [YYYY-MM-DD].....:		2022-04-15							—
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	13.716	54.763	13.022	45.926	598.069	79.62	598.236	-0.028	P
2	13.592	54.746	12.923	46.084	595.528	80.03	598.247	-0.454	P
Supplementary information: The IV curves didn't show any additional kinks or other unusual characteristics as compared to the initial IV curve.									

<b>TABLE 10.2: MQT 06.1 - Final Performance at STC (single-side rear)</b>									P
Test Date [YYYY-MM-DD].....:		2022-04-15							—
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	10.454	54.263	9.963	46.012	458.411	80.81	458.683	-0.059	P
2	10.386	54.352	9.810	46.317	454.353	80.49	456.694	-0.513	P
Supplementary information: The IV curves didn't show any additional kinks or other unusual characteristics as compared to the initial IV curve.									

<b>TABLE 10.3: MQT 06.1 - Final Performance at STC (Equivalent irradiance)</b>									P
Test Date [YYYY-MM-DD].....:		2022-04-15							—
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	15.180	54.879	14.344	45.961	659.268	79.14	659.468	-0.030	P
2	15.096	54.864	14.251	46.133	657.457	79.38	659.465	-0.304	P

Supplementary information: The IV curves didn't show any additional kinks or other unusual characteristics as compared to the initial IV curve.  
1103 W/m<sup>2</sup> equivalent irradiance is the effective value calculated when backside irradiance is 135W/m<sup>2</sup>.

TABLE 13.7: MQT 18.2 - Bypass diode functionality test				P
Test Date [YYYY-MM-DD].....:			2022-04-15	—
<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.				

3.2 Points of Non-Compliance according to the test specification

- None



## 4. Remarks

### 4.1 General

N/A

### 4.2 Factory surveillance cycle

Your production facility is currently on a

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

surveillance cycle.

### 4.3 Additional information for routine tests to be performed by the factory(ies)

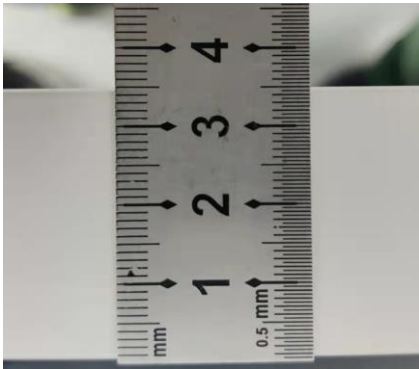
**Routine tests for electrical appliances / equipment:**

N/A



5. Documentation

Appendix 1: Photos of JAM78D40-600/GB



Appendix 2: List of measurement equipment

No.	Test Item	Main testing Equipment	Calibrate until
1	Visual inspection	Illumination photometer HYJC-YS-070	2022-06-30
2	Performance at STC	Reference cell HYJC-YS-097	2022-08-10
3	Performance at STC Bypass diode functionality test	Module pulse simulator HYJC-YS-021	2022-08-31
4	Insulation test Wet leakage current test	Programmable control voltage insulation meter HYJC-YS-155	2022-09-08
5	Wet leakage current test	Conductance meter HYJC-YS-171	2022-09-08
6	Hail test	Hail tester HYJC-YS-036	2022-09-08
7	Stabilization	level C steady state simulator HYJC-YS-006	2022-06-30

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 3: Statement of the estimated uncertainty of the test results

The measurement uncertainty is  $U(P_{max})=2.12\%$ ,  $U(V_{oc})=0.98\%$ ,  $U(I_{sc})=2.26\%$  (K=2).

6. Summary

“The test specifications are met”

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

Tested by:

Rongwei Jing *Ting Rongwei*  
*printed name, function & signature*

Approved by:

Guangxia Fu  
*printed name, function & signature*