Technical Report No.: 704062302129-00

Date: 2023-08-21

Client:

Shanghai JA Solar Technology Co., Ltd.
No. 118, Lane 3111, West Huancheng Road, Fengxian District, 201401, Shanghai, PEOPLE'S REPUBLIC of CHINA
Contact person: Ms. Xueshan Yang

Manufacturer:

Shanghai JA Solar Technology Co., Ltd.
No. 118, Lane 3111, West Huancheng Road, Fengxian District, 201401, Shanghai, PEOPLE'S REPUBLIC of CHINA
Contact person: Ms. Xueshan Yang

Factory:

1. Shanghai JA Solar Technology Co., Ltd. (072092)
No. 118, Lane 3111, West Huancheng Road, Fengxian District, 201401, Shanghai, PEOPLE'S REPUBLIC of CHINA

2. Hefei JA Solar Technology Co., Ltd (079395)
No. 999, Changning Road, Hi-tech Zone, 230088 Hefei City, Anhui Province, PEOPLE'S REPUBLIC of CHINA

3. JA Solar (Xingtai) Co., Ltd (095903)
No. 1688, Chang An Road, Xingtai Economic Development Area, 054000 Xingtai City, Hebei Province,PEOPLE'S REPUBLIC OF CHINA

4. JA Solar New Energy Yangzhou Co., Ltd. (108746)
No.1, Jianhua Road, Economic Development Zone, 225000 Yangzhou City, Jiangsu Province, PEOPLE'S REPUBLIC OF CHINA

5. Yiwu JA Solar Technology Co., Ltd. (109998)
No.165, Tongze Road, Yiting Town, 322000 Yiwu City, Zhejiang Province, PEOPLE'S REPUBLIC OF CHINA

6. JA SOLAR VIET NAM COMPANY LIMITED (112017)
Lot G, Quang Chau Industrial Zone, Quang Chau Commune, Viet Yen Dist, 236110 Bac Giang Province, VIETNAM

7. JA Solar New Energy Yangzhou Co., Ltd. (Jingshan Park) (114922)

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TÜV SÜD Certification and Testing (China) Co., Ltd.
Shanghai Branch
SMN
No. 151 Heng Tong Road,
Shanghai 200070, P. R. China
Telephone: +86 21 6141-0100

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

8. Dongtai JA Solar Technology Co., Ltd. (121678)
No. 8 Zaofeng North Road, Dongtai High-tech Zone, Dongtai City, 224248 Yancheng City, Jiangsu Province, PEOPLE'S REPUBLIC OF CHINA

Test object:	Product: Photovoltaic modules Model: JAM66D45-605/LB
Test specification:	IEC 61853-1:2011 IEC 61853-2:2016 IEC 61215:2016 partial LID according to Client's requirements
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.

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

-

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.	Remark
HA2023TL-0806-001X	2370107240000407	—
HA2023TL-0806-002X	2370107240000550	—
HA2023TL-0806-003X	2370107240000543	—
HA2023TL-0806-004X	—	Small sample

2. Order

2.1 Date of Purchase Order, Customer's Reference

The order dated 2023-07-27

2.2 Test Sample(s)

- Reception date(s): 2023-07-24
- 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 Testing

- Testing date(s): 2023-07-28 to 2023-08-14
- Location(s) of testing: Changzhou HuaYang Inspection and Testing Technology Co., Ltd.
  No.8 Lanxiang Road, Wujin Economic Development Zone, Changzhou, Jiangsu, China

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

- N/A

3. Test Results

- “Decision rule according to IEC Guide 115:2023, clause 4.3 was applied.”

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Shanghai Branch
SMN
No. 151 Heng Tong Road,
Shanghai 200070, P. R. China
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3.1 Positive Test Results

3.1.1 Flash Tests According to Table 2 of the IEC 61853-1

To determine the relationship between efficiency and irradiance & temperature, PV modules are tested across a matrix of operating conditions according to the standard IEC 61853-1:2011, ranging in irradiance from 100 W/m^2 to 1100 W/m^2 and ranging in temperature from 15 °C to 75 °C.
To determine the temperature coefficients, PV modules are tested according to IEC 60891:2009, under irradiance 1000W/m^2 and ranging in temperature from 15 °C to 50 °C.
Based on the laboratory measurement data, PAN file can be optimized, then match ability between the resulting efficiencies in PVsyst software and the lab data can be compared.

3.1.2 Testing raw date

Table 1: MQT 02 - Maximum power determination (Initial)(single side-front)						P
Test Date [YYYY-MM-DD]..... :			2023-07-28			—
Radiant Source..... :			☒ Solar simulator ☐ Natural Sunlight			—
Module temperature [°C] ..... :			25			—
Irradiance [W/m^2]..... :			1000			—
Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]
HA2023TL-0806-001X	47.943	40.247	15.750	15.155	609.963	80.78
HA2023TL-0806-002X	47.951	40.229	15.774	15.160	609.868	80.63
HA2023TL-0806-003X	47.987	40.233	15.745	15.164	610.101	80.75
Supplementary information: N/A						

Table 1: MQT 02 - Maximum power determination (Initial)(single side-rear)		P
Test Date [YYYY-MM-DD]..... :	2023-07-28	—
Radiant Source..... :	☒ Solar simulator ☐ Natural Sunlight	—
Module temperature [°C] ..... :	25	—
Irradiance [W/m^2]..... :	1000	—

Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]
HA2023TL-0806-001X	47.516	40.463	12.277	11.759	475.781	81.56
HA2023TL-0806-002X	47.462	40.912	12.320	11.631	475.844	81.38
HA2023TL-0806-003X	47.586	40.481	12.272	11.756	475.890	81.49
Supplementary information: N/A						

Table 2: Light exposure (60Kw·h)		P
Test Date [YYYY-MM-DD] start/end..... :	2023-07-28 / 2023-08-02	—
Radiant Source..... :	☒ Solar simulator ☐ Natural Sunlight	—
Sample # ..... :	HA2023TL-0806-001X HA2023TL-0806-002X HA2023TL-0806-003X	—
Total irradiation dosage [kWh/m^2] ..... :	60.0	—
Electrical load ..... :	☐Restive load ☒MPPT	—
Supplementary information: N/A		

Table 3: MQT 02 - Maximum power determination (after LID)(Single side-front)						P
Test Date [YYYY-MM-DD]..... :	2023-08-02					—
Radiant Source..... :	☒ Solar simulator ☐ Natural Sunlight					—
Module temperature [°C] ..... :	25					—
Irradiance [W/m^2]..... :	1000					—
Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]
HA2023TL-0806-001X	47.930	40.228	15.745	15.119	608.191	80.59
HA2023TL-0806-002X	47.939	40.204	15.746	15.126	608.106	80.56
HA2023TL-0806-003X	47.973	40.210	15.719	15.121	608.033	80.63
Supplementary information: Power Degradation [%] -0.291 / -0.289 / -0.339						

Table 3: MQT 02 - Maximum power determination (after LID)(Single side-rear)		—
Test Date [YYYY-MM-DD].....:	2023-08-02	—
Radiant Source.....:	☒ Solar simulator ☐ Natural Sunlight	—
Module temperature [°C] .....:	25	—
Irradiance [W/m^2].....:	1000	—

Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]
HA2023TL-0806-001X	47.501	40.442	12.265	11.730	474.395	81.43
HA2023TL-0806-002X	47.451	40.901	12.313	11.603	474.589	81.23
HA2023TL-0806-003X	47.570	40.459	12.260	11.722	474.253	81.32

Supplementary information: Power Degradation [%] -0.291 / -0.264 / -0.344

$\varphi = \text{Min}(\varphi_{Isc}, \varphi_{Pmax}) = 78.01\%$

$\varphi_{Isc} = I_{scr} / I_{scf}$

$\varphi_{Pmax} = P_{maxr} / P_{maxf}$

Table 4: Flash test data for each sample at the real irradiance and temperature conditions in table 2 of the IEC 61853-1

Test Date [YYYY-MM-DD] ..... :	2023-08-10
Radiant Source ..... :	☒ Solar simulator ☐ Natural Sunlight
Sample # ..... :	HA2023TL-0806-001X

T_{TARGET} [ºC]	IRR_{TARGET} [W/m²]	TACHIVED [ºC]	IRRACHIVED [W/m²]	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]
15	100	14.9	100.5	44.256	39.250	1.559	1.505	59.071	85.63
15	200	15.2	200.3	45.895	40.145	3.192	3.070	123.250	84.14
15	400	15.1	399.1	47.124	41.030	6.385	6.127	251.410	83.56
15	600	15.1	599.9	48.064	41.128	9.463	9.176	377.389	82.97
15	800	14.9	797.7	48.655	41.366	12.537	12.153	502.739	82.42
15	1000	15.5	998.9	49.072	41.475	15.649	15.118	627.024	81.65
25	100	25.2	100.3	44.164	38.422	1.547	1.495	57.425	84.04
25	200	24.9	200.8	45.310	39.284	3.176	3.050	119.818	83.25
25	400	25.1	400.7	46.462	39.614	6.352	6.140	243.244	82.42
25	600	25.1	600.2	46.960	39.887	9.472	9.164	365.536	82.18
25	800	24.8	801.3	47.411	40.075	12.652	12.170	487.723	81.31
25	1000	25.0	1001.6	47.930	40.228	15.745	15.119	608.191	80.59
25	1100	24.9	1102.3	48.132	40.319	17.298	16.541	666.914	80.1
50	400	50.1	399.4	43.559	36.987	6.423	6.101	225.656	80.65
50	600	50.2	598.9	44.090	37.086	9.640	9.144	339.125	79.79

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Shanghai 200070, P. R. China
Telephone: +86 21 6141-0100

50	800	49.9	799.1	44.538	37.122	12.839	12.179	452.098	79.06
50	1000	50.1	997.5	45.024	37.383	15.995	15.061	563.019	78.18
50	1100	50.1	1098.7	45.251	37.465	17.565	16.489	617.753	77.72
75	600	74.9	600.3	41.370	33.995	9.662	9.178	312.011	78.06
75	800	75.2	802.1	41.724	34.101	12.885	12.193	415.783	77.34
75	1000	75.0	997.5	42.257	34.244	16.079	15.149	518.752	76.35
75	1100	75.1	1095.4	42.452	34.342	17.658	16.563	568.806	75.88
Supplementary information: N/A									

Table 4: Flash test data for each sample at the real irradiance and temperature conditions in table 2 of the IEC 61853-1

Test Date [YYYY-MM-DD] ..... :	2023-08-12
Radiant Source ..... :	☒ Solar simulator ☐ Natural Sunlight
Sample # ..... :	HA2023TL-0806-002X

T_{TARGET} [ºC]	IRR_{TARGET} [W/m²]	TACHIVED [ºC]	IRRACHIVED [W/m²]	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]
15	100	15.2	100.3	44.249	39.198	1.561	1.505	59.009	85.44
15	200	15.1	201.4	45.886	40.133	3.194	3.069	123.177	84.05
15	400	15.0	400.6	47.110	41.016	6.390	6.126	251.254	83.47
15	600	15.1	600.0	48.058	41.120	9.472	9.176	377.315	82.89
15	800	14.8	798.0	48.642	41.348	12.544	12.157	502.664	82.38
15	1000	15.2	998.4	49.068	41.466	15.680	15.120	626.961	81.49
25	100	25.0	100.1	44.135	38.394	1.548	1.494	57.372	83.97
25	200	25.0	199.6	45.300	39.593	3.178	3.025	119.774	83.19
25	400	24.8	400.0	46.452	39.597	6.358	6.151	243.560	82.47
25	600	24.8	599.2	46.948	39.865	9.483	9.169	365.542	82.11
25	800	25.0	798.1	47.418	40.062	12.655	12.173	487.678	81.27
25	1000	25.0	998.2	47.939	40.204	15.746	15.126	608.106	80.56
25	1100	24.9	1097.4	48.144	40.325	17.293	16.538	666.892	80.10
50	400	49.8	400.0	43.532	36.821	6.431	6.122	225.428	80.52
50	600	50.1	598.1	44.074	36.993	9.655	9.163	338.972	79.66

50	800	50.2	798.4	44.520	37.090	12.855	12.191	452.161	79.01
50	1000	50.2	1000.0	45.016	37.341	16.005	15.077	562.997	78.14
50	1100	49.9	1100.5	45.231	37.451	17.570	16.490	617.574	77.71
75	600	75.1	599.9	41.349	33.876	9.676	9.210	311.982	77.98
75	800	74.8	799.2	41.706	34.075	12.919	12.196	415.591	77.13
75	1000	75.0	996.6	42.271	34.234	16.088	15.151	518.687	76.27
75	1100	74.8	1097.5	42.429	34.322	17.694	16.571	568.768	75.76
Supplementary information: N/A									

Table 4: Flash test data for each sample at the real irradiance and temperature conditions in table 2 of the IEC 61853-1

Test Date [YYYY-MM-DD] ..... :	2023-08-14
Radiant Source ..... :	☒ Solar simulator ☐ Natural Sunlight
Sample # ..... :	HA2023TL-0806-003X

T_{TARGET} [ºC]	IRR_{TARGET} [W/m²]	TACHIVED [ºC]	IRRACHIVED [W/m²]	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]
15	100	15.1	99.8	44.271	39.238	1.557	1.505	59.048	85.69
15	200	15.2	200.1	45.932	40.129	3.184	3.070	123.184	84.22
15	400	15.0	401.0	47.151	41.025	6.378	6.126	251.333	83.57
15	600	14.8	599.0	48.079	41.109	9.450	9.178	377.304	83.04
15	800	15.1	800.2	48.671	41.331	12.539	12.163	502.694	82.37
15	1000	15.1	1000.5	49.085	41.454	15.660	15.126	627.017	81.57
25	100	25.0	99.8	44.176	38.416	1.545	1.494	57.403	84.11
25	200	24.9	201.3	45.325	39.249	3.173	3.052	119.784	83.29
25	400	25.0	399.4	46.511	39.600	6.334	6.141	243.197	82.55
25	600	25.2	596.9	47.010	39.871	9.572	9.165	365.429	81.21
25	800	24.9	797.8	47.438	40.063	12.630	12.170	487.572	81.38
25	1000	25.1	998.3	47.973	40.210	15.719	15.121	608.033	80.63
25	1100	25.1	1099.1	48.174	40.322	17.270	16.536	666.751	80.14
50	400	49.9	399.9	43.582	36.994	6.411	6.095	225.461	80.69
50	600	50.2	598.7	44.135	37.075	9.617	9.141	338.910	79.85

50	800	49.8	799.8	44.575	37.132	12.819	12.175	452.100	79.12
50	1000	50.1	998.5	45.051	37.395	15.972	15.055	562.971	78.24
50	1100	50.2	1099.7	45.259	37.482	17.547	16.476	617.536	77.76
75	600	75.1	598.3	41.375	34.009	9.668	9.174	312.004	78.00
75	800	75.3	802.3	42.741	34.114	12.579	12.184	415.653	77.31
75	1000	74.8	1001.1	42.261	34.251	16.089	15.145	518.715	76.29
75	1100	74.9	1098.6	45.458	34.349	16.505	16.557	568.703	75.80
Supplementary information: N/A									

Table 5: Temperature Coefficients Measurement Data at 1000 W/m²

Test Date [YYYY-MM-DD] ..... :	2023-08-10
Radiant Source ..... :	☒ Solar simulator ☐ Natural Sunlight
Sample # ..... :	HA2023TL-0806-001X

T_{TARGET} [ºC]	IRR_{TARGET} [W/m²]	$T_{ACHIVED}$ [ºC]	$IRR_{ACHIVED}$ [W/m²]	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]
15	1000	15.0	998.7	49.072	41.475	15.649	15.118	627.024	81.65
20	1000	20.1	1001.3	48.576	40.934	15.705	15.087	617.564	80.95
25	1000	25.1	1000.6	47.930	40.228	15.745	15.119	608.191	80.59
30	1000	30.1	999.6	47.303	39.608	15.794	15.147	599.929	80.30
35	1000	35.0	999.5	46.765	39.079	15.831	15.127	591.148	79.85
40	1000	39.9	1000.2	46.227	38.413	15.872	15.166	582.575	79.40
45	1000	45.0	1001.6	45.620	37.749	15.927	15.166	572.491	78.79
50	1000	50.1	999.5	45.024	37.383	15.995	15.061	563.019	78.18

Coefficients Determined by Laboratory Results

Serial Number	Alpha (α) ISC [%]	Beta (β) VOC [%]	Gamma (γ) PMAX [%]
HA2023TL-0806-001X	0.060	-0.242	-0.297
—	—	—	—
—	—	—	—
Average	—	—	—

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Shanghai Branch
SMN
No. 151 Heng Tong Road,
Shanghai 200070, P. R. China
Telephone: +86 21 6141-0100

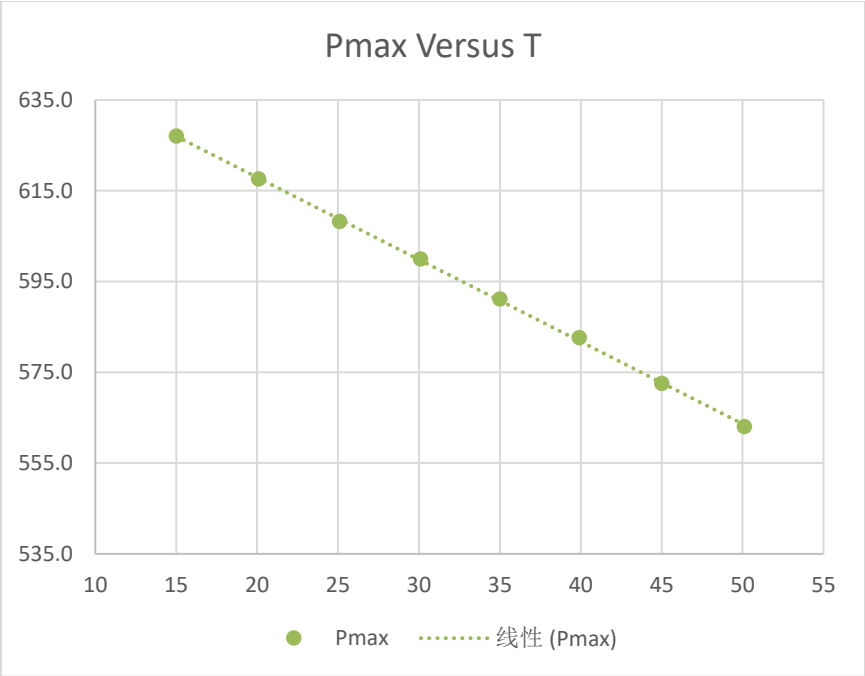

Figure 1: Plot of measured P_{MAX} versus temperature of flash-tests taken at 1000 W/m²

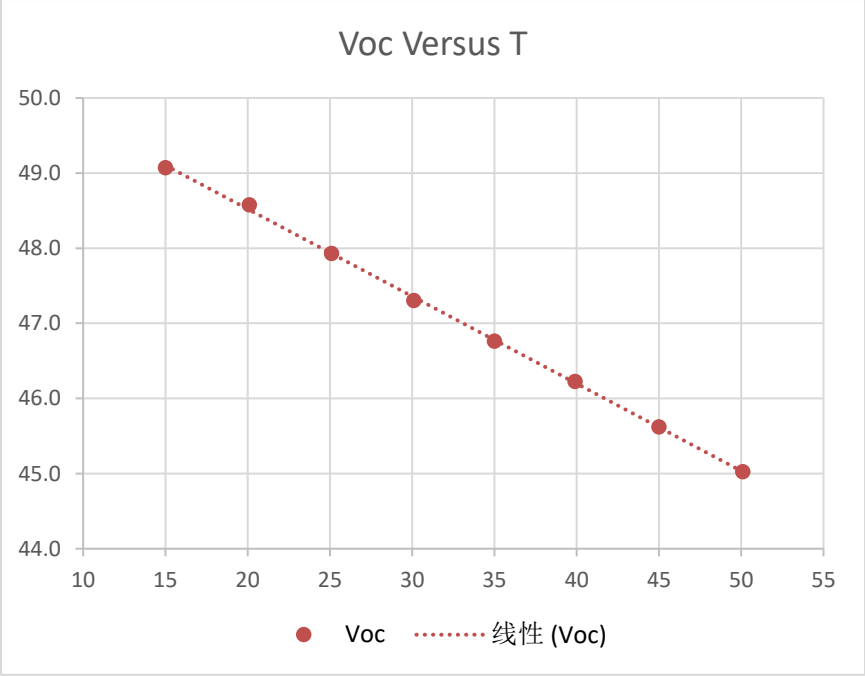

Figure 2:Plot of measured Voc versus temperature of flash-tests taken at 1000 W/m²

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Shanghai Branch
SMN
No. 151 Heng Tong Road,
Shanghai 200070, P. R. China
Telephone: +86 21 6141-0100

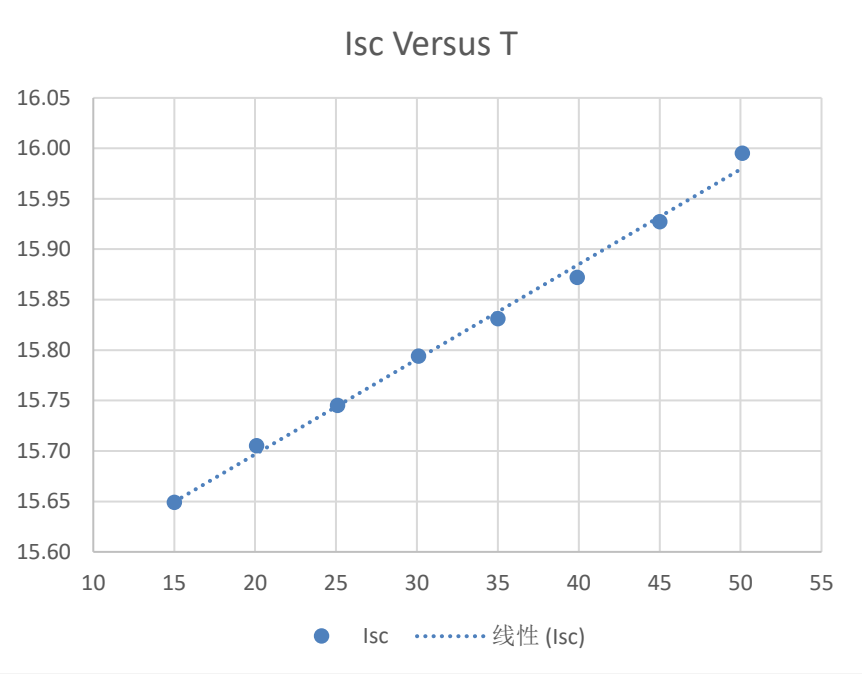
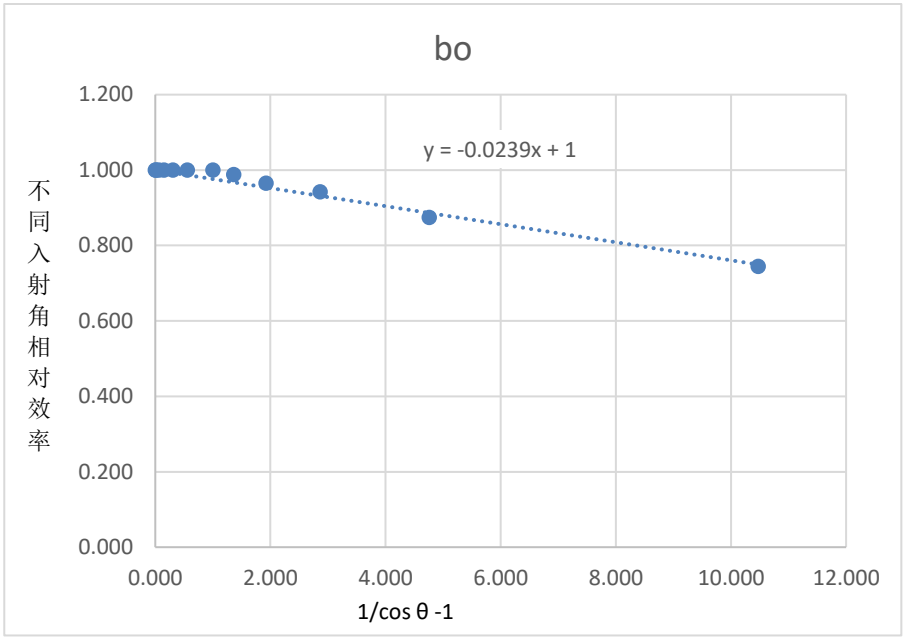


Figure 3:Plot of measured Isc versus temperature of flash-tests taken at 1000 W/m²

Table 6: Measurement of incidence angle effects							
Test Date [YYYY-MM-DD] .....:	2023-08-11						
Radiant Source .....:	☒ Solar simulator ☐ Natural Sunlight						
Sample # .....:	HA2023TL-0806-004X						
Isc_80°/A:	1.038						—
Isc_-80°/A:	1.025						—
Isc_0°/A:	6.844						—
m=(Isc_80°/Isc_0°)/ cos 80°	0.873						—
n=(Isc_-80°/Isc_0°)/ cos 80°	0.862						—
DeviationΔ=|(m-n)/(m+n)|×100% ⩽2%	0.6						P
Module Angle	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	IAM value according to IEC61853-2
0	—	—	6.844	—	—	—	1.000
10	—	—	6.745	—	—	—	1.000
20	—	—	6.434	—	—	—	1.000
30	—	—	5.941	—	—	—	1.000

40	—	—	5.253	—	—	—	1.000
50	—	—	4.400	—	—	—	1.000
60	—	—	3.429	—	—	—	1.000
65	—	—	2.857	—	—	—	0.988
70	—	—	2.258	—	—	—	0.965
75	—	—	1.668	—	—	—	0.942
80	—	—	1.038	—	—	—	0.874
85	—	—	0.444	—	—	—	0.744
Fitted curve (bo)							

3.1.3 Testing data analysis

Table 7: Average PMAX Determined by Laboratory Results according to the IEC 61853-1 based on Table 2

Irradiance [W/m²]	Module Temperature			
	15 °C	25 °C	50 °C	75 °C
100	59.043	57.400	-	-
200	123.204	119.792	-	-
400	251.332	243.334	225.515	-
600	377.336	365.502	339.002	311.999
800	502.699	487.658	452.120	415.676

1000	627.001	608.110	562.996	518.718
1100	-	666.852	617.621	568.759

Table 8: PMAX Determined by Laboratory Results Scaled to Nameplate Power at STC				
Irradiance [W/m²]	**Module Temperature**			
	15 °C	**25 °C**	**50 °C**	**75 °C**
100	58.741	57.106	-	-
200	122.574	119.179	-	-
400	250.047	242.090	224.362	-
600	375.406	363.633	337.268	310.403
800	500.128	485.164	449.808	413.550
1000	623.794	605.000	560.117	516.065
1100	-	663.442	614.462	565.850

Table 9: Relative Efficiency by Laboratory Results Scaled to Nameplate vs. Irradiance at 25°C							
Serial Number	**Irradiance [W/m²]**						
	100	200	400	600	800	1000	1100
HA2023TL-0806-001X	94.42%	98.50%	99.99%	100.17%	100.24%	100.00%	99.69%
HA2023TL-0806-002X	94.35%	98.48%	100.13%	100.19%	100.25%	100.00%	99.70%
HA2023TL-0806-003X	94.41%	98.50%	99.99%	100.17%	100.24%	100.00%	99.69%
Average	94.39%	98.50%	100.04%	100.17%	100.24%	100.00%	99.69%

3.1.4 PAN File Creation

3.1.4.1. PAN File Creation Method

The PAN file contains a number of model parameters organized in different tabs within PVsyst. The parameters which affect the model results in forward bias (normal operation) are located in the tabs labeled “Basic Data” and “Model Parameters”. TUV-SUD’s approach to PAN file creation is as following:

1. Enter manufacturer specifications on the “Basic Data” tab.
2. Enter the relative efficiency test results in **Table 9** under different irradiance at 25°C into “Additional Data/Low-light data”, and optimized the Rserie; It is mentioned that the relative efficiency is calculated after scale the average measured PMAX lab data from **Table 7** to the manufacturer’s nameplate power. The scaled data is shown in **Table 8** and **Table 9**.
3. Define the Rsh, Rsh0 and Rexp (on the “Model parameters” tab) for default values.
4. Enter the Pmax, Isc, Voc temperature coefficient in **Table 5** into “Model parameters” tab.

3.1.4.2. Optimized PAN File Results

TUV SUD Certification and Testing Co., Ltd Shanghai Branch (China)

PVsyst V7.4.0

PV module - JAM66D45-605/LB

Manufacturer	JA Solar	**Commercial data**	
Model	JAM66D45-605/LB	Availability :	Prod. Since 2023
		Data source :	TÜV SÜD

Specifications for the model (manufacturer or measurement data)

Reference temperature (TRef)	25 °C	Reference irradiance (GRef)	1000 W/m²
Open circuit voltage (Voc)	47.9 V	Short-circuit current (Isc)	16.00 A
Max. power point voltage (Vmpp)	39.6 V	Max. power point current (Impp)	15.28 A
=> maximum power (Pmpp)	605.1 W	Isc temperature coefficient (muIsc)	9.6 mA/°C

One-diode model parameters

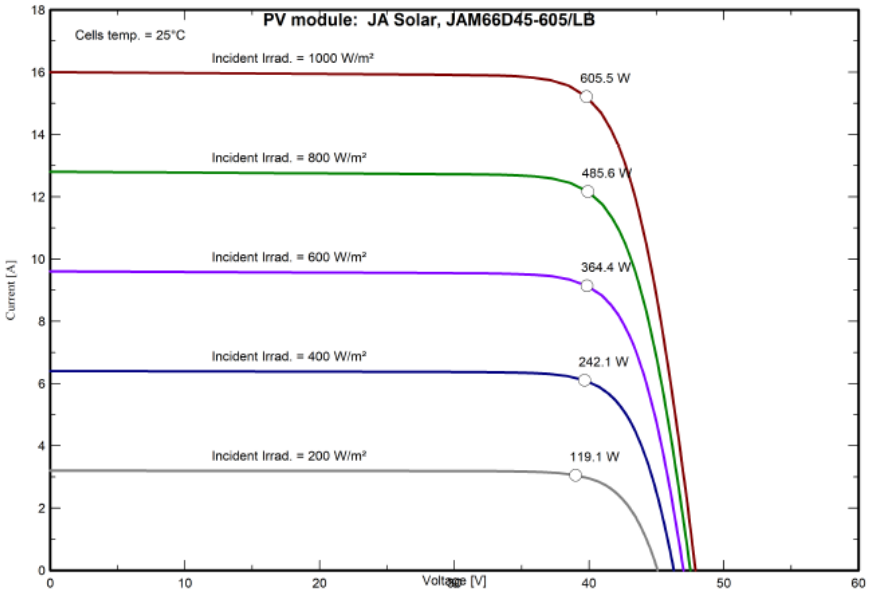
Shunt resistance (Rshunt)	350 Ω	Diode saturation current (IoRef)	0.021 nA
Serie resistance (Rserie)	0.17 Ω	Voc temp. coefficient (MuVoc)	-123 mV/°C
Specified Pmax temper. coeff. (muPMaxR)	-0.30 %/°C	Diode quality factor (Gamma)	1.03
		Diode factor temper. coeff. (muGamma)	0.000 1/°C

Reverse Bias Parameters, for use in behaviour of PV arrays under partial shadings or mismatch

Reverse characteristics (dark) (BRev)	3.20 mA/V²	(quadratic factor (per cell))	
Number of by-pass diodes per module	3	Direct voltage of by-pass diodes	-0.7 V

Model results for standard conditions (STC: T=25 ° C, G=1000 W/m² , AM=1.5)

Max. power point voltage (Vmpp)	39.8 V	Max. power point current (Impp)	15.31 A
Maximum power (Pmpp)	605.5 Wp	Power temper. coefficient (muPmpp)	-0.30 %/°C
Efficiency(/ Module area) (Eff_mod)	22.4 %	Fill factor (FF)	0.790
Efficiency(/ Cells area) (Eff_cells)	24.4 %		



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TÜV®

TÜV SÜD Certification and Testing (China) Co., Ltd.
Shanghai Branch
SMN
No. 151 Heng Tong Road,
Shanghai 200070, P. R. China
Telephone: +86 21 6141-0100

3.1.4.3. PAN File Result Verification

After creating the PAN file, a quality check is implemented in order to compare the PAN file model consistence with measurements from the laboratory. The laboratory test results scaled are plotted as efficiency vs. irradiance curves for each temperature of the IEC61853-1 test matrix, as shown in **Table 10**. Similarly, efficiency vs. irradiance curves are generated using PVsyst and the newly created PAN file, as shown in **Table 11**. Comparison between the model and the measurements is represented with the following graph and table, and the RMSE (Root Mean Square Error) of the optimized PAN file is reported, as shown in **Table 12 and Figure 4.**

Table 10: Efficiency Determined by Laboratory Results Scaled to Nameplate Power at STC

Irradiance [W/m²]	Module Temperature			
	15 °C	25 °C	50 °C	75 °C
100	21.75%	21.14%	-	-
200	22.69%	22.06%	-	-
400	23.14%	22.41%	20.77%	-
600	23.16%	22.44%	20.81%	19.15%
800	23.14%	22.45%	20.82%	19.14%
1000	23.09%	22.40%	20.74%	19.11%
1100	-	22.33%	20.68%	19.04%

Table 11: Efficiency Generated Using PVsyst and the Newly Created PAN file

Irradiance [W/m²]	Module Temperature			
	15 °C	25 °C	50 °C	75 °C
100	22.18%	21.47%	-	-
200	22.73%	22.05%	-	-
400	23.08%	22.41%	20.68%	-
600	23.14%	22.48%	20.78%	18.99%
800	23.11%	22.47%	20.79%	19.01%
1000	23.06%	22.42%	20.74%	18.98%
1100	-	22.37%	20.70%	18.95%

Table 12: Comparison Result Between the Optimized PVsyst Model and the Measurements

RMSE	NRMSE(Average)
0.0013159	0.0061277

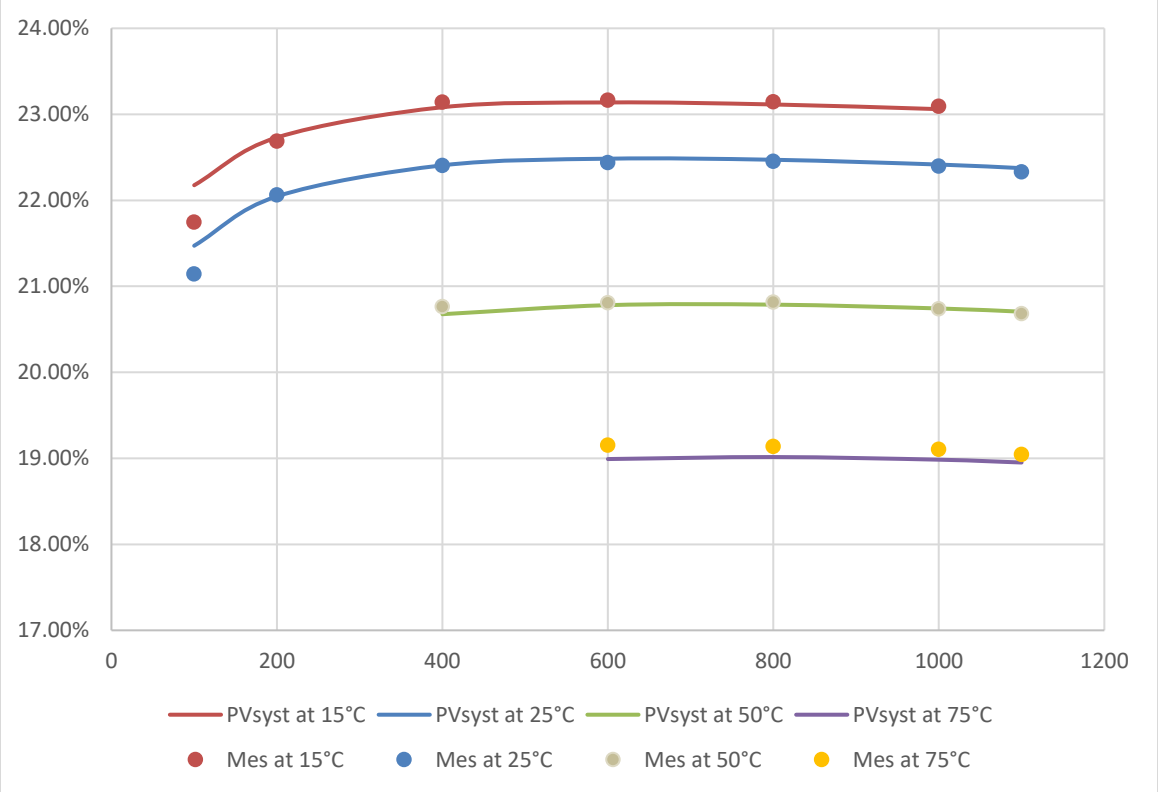

Figure 4:Comparison of PVsyst Model, Using the Optimized PAN file, to the Laboratory Testing Results

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

Description	Equipment ID	Date of calibration
Module pulse simulator	HYJC-YS-021	2023-03-07
Reference cell	HYJC-YS-097	2023-03-07

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

The measurement uncertainty is U(Pmax)=1.98%, U(Voc)=1.01%, U(Isc)=1.99% (K=2).

7. Summary

Below parameters are measured on three representative PV modules:
- The relative efficiency test results under different irradiance at 25°C
- Performance at the real irradiance and temperature conditions in table 2 of the IEC 61853-1

Based on the test results, PANFILE are optimized in Pvsyst. Efficiency vs. irradiance curves are generated using PVsyst and the newly created PAN file, which is highly matched with the test results in lab.
According to the customer's requirements, the PAN Files of JAM66D45-595/LB, JAM66D45-600/LB, JAM66D45-610/LB and JAM66D45-615/LB were extended based on the measured parameter model of JAM66D45-605/LB.

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

TÜV SÜD Certification and Testing (China) Co., Ltd.
Shanghai Branch
SMN
No. 151 Heng Tong Road,
Shanghai 200070, P. R. China
Telephone: +86 21 6141-0100