

**TÜV Rheinland (Shanghai) Co., Ltd.
Solar & Commercial Products**

Test Report

Photovoltaic Module Tests
according to IEC61215-2: 2016 and IEC CD 63342 TS: 2021

TÜV Report No. CN22PW6B 003

Shanghai, July 2022


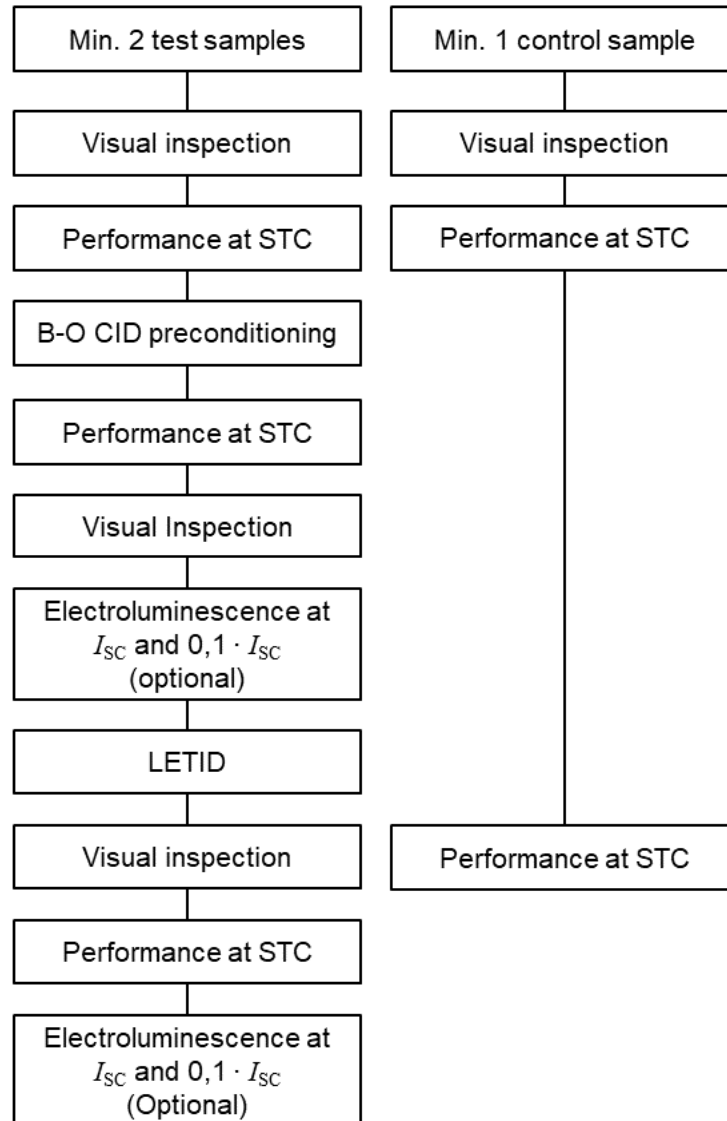
Prüfbericht-Nr.: <i>Test Report No.:</i>	CN22PW6B 003	Auftrags-Nr.: <i>Order No.:</i>	244420504	Seite 1 von 16 <i>Page 1 of 16</i>
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	2050703	Auftragsdatum: <i>Order date:</i>	25/04/2022	
Auftraggeber: <i>Client:</i>	LONGi Green Energy Technology Co., Ltd. No. 388, Middle Hangtian Road, Chang'an District Xi'an, Shaanxi, 710100 P. R. China			
Prüfgegenstand: <i>Test item:</i>	Photovoltaic (PV) Module(s)			
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	LR5-72HTH-575M			
Prüfgrundlage: <i>Test specification:</i>	IEC61215-2: 2016, IEC CD 63342 TS: 2021			
Wareneingangsdatum: <i>Date of receipt:</i>	12/05/2022			
Prüfmuster-Nr.: <i>Test sample No.:</i>	Refer to page 4			
Prüfzeitraum: <i>Testing period:</i>	13/05/2022 – 02/06/2022			
Ort der Prüfung: <i>Place of testing:</i>	Beijing TIRT Technology Service Co., Ltd., Suzhou Branch			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Shanghai) Co., Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von: <i>tested by:</i>	X <u>Brian Shi</u>	genehmigt von: <i>authorized by:</i>	X <u>Wengao Lu</u>	
Datum: <i>Date:</i>	01/07/2022	Ausstellungsdatum: <i>Issue date:</i>	01/07/2022	
Stellung / Position:	Project Engineer	Stellung / Position:	Reviewer	
Sonstiges / Other:	<p>- Test was performed in Beijing TIRT Technology Service Co., Ltd., Suzhou Branch and witnessed by Engineer from TÜV Rheinland.</p> 			
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt Test item complete and undamaged			
<p>* Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet <i>Legend: P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested</i></p>				
<p>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i></p>				
<p>TUV Rheinland (Shanghai) Co., Ltd. TÜV Rheinland Building, No. 177, Lane 777, West Guangzhong Road, Zhabei District Shanghai 200072, P. R. China</p>				

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Test Sequence

General information:

Pmpp	– Maximum power	Vmpp	– Maximum power voltage
Impp	– Maximum power current	Voc	– Open circuit voltage
Isc	– Short circuit current	FF	– Fill factor
STC	– Standard test conditions	EL	– Electroluminescence imaging
IV	– Current-voltage characteristics	B-O	– Boron Oxygen
LETID	– Light and elevated temperature induced degradation		

Sampling procedure

<input type="checkbox"/>	Random sampling from production (e.g. during factory audit (FA) or inline inspection)
<input type="checkbox"/>	Random sampling from the warehouse, container or transportation boxes
<input checked="" type="checkbox"/>	Modules have been submitted by the manufacturer / client without random sampling by TÜV Rheinland

Module group assignment:

Sample no.	Serial no.	Module type	Remarks / constructional characteristics	Type of extra connectors used*	Test item
1	LRR00411122030110 0042	LR5-72HTH- 575M	half-cell mono c-Si module, 144 pcs	B	Control
2	LRR00411122030110 0043				MPD, B-O CID,
3	LRR00411122030110 0048				LETID, EL
Supplementary information: (*) A: Customer provided; B: TÜV Rheinland provided.					

Tables

Initial Visual inspection (according to IEC61215-2: 2016, MQT 01)

Test Date [DD/MM/YYYY]		13/05/2022	—
Sample no.	Requirement	Nature and position of initial findings	—
1	No major visual defects	No major visual defects	P
2		No major visual defects	P
3		No major visual defects	P
Supplementary information: N/A			

Initial Performance at STC (according to IEC61215-2: 2016, MQT 06)

Test Date [DD/MM/YYYY]		13/05/2022		—		
Test method		<input checked="" type="checkbox"/> indoor	<input type="checkbox"/> outdoor	—		
Irradiance [W/m ²]		1000		—		
Module temperature [°C]		25		—		
Sample no.	P _{mpp} [W]*	V _{mpp} [V]	I _{mpp} [A]	V _{oc} [V]	I _{sc} [A]	FF [%]
1	574.8	45.17	12.727	52.24	13.694	80.4
2	577.1	45.17	12.777	52.24	13.670	80.8
3	575.0	44.38	12.957	52.16	13.758	80.1
Supplementary information:						
*For module n (n= 1, 2, 3), measure initial electrical characteristics, P _{initial n} , I _{SC initial n} , and I _{MPP initial n} .						

B-O CID preconditioning (according to IEC CD 63342 TS: 2021)

Test Date [DD/MM/YYYY] start - end.....		13/05/2022- 14/05/2022	
Applied current [A]		I _{SC initial n}	
Test duration [Hrs]		24	
Module Temperature [°C]		30	
Relative humidity [%]		60	
Sample no.	Open circuits (yes/no)		—
2	no		—
3	no		—
Supplementary information: N/A			

Visual inspection after B-O CID test (according to IEC61215-2: 2016, MQT 01)

Test Date [DD/MM/YYYY]		19/05/2022	—
Sample no.	Requirement	Nature and position of initial findings	—
2	No major visual defects	No major visual defects	P

3	No major visual defects	No major visual defects	P
Supplementary information: N/A			

STC after B-O CID test (according to IEC61215-2: 2016, MQT 06)

Test Date [DD/MM/YYYY]		19/05/2022				—
Test method		<input checked="" type="checkbox"/> indoor		<input type="checkbox"/> outdoor		—
Irradiance [W/m ²]		1000				—
Module temperature [°C]		25				—
Sample no.	P _{max} [W]*	V _{mpp} [V]	I _{mpp} [A]	V _{oc} [V]	I _{sc} [A]	FF [%]
2	578.1	45.03	12.839	52.19	13.677	81.0
3	575.7	45.02	12.787	52.19	13.704	80.5
Supplementary information:						
*For module n (n= 2, 3), measure power output after B-O CID preconditioning, P _{BO n} .						

EL-images after B-O CID test

Test Date [DD/MM/YYYY]		19/05/2022		—
Current applied		I _{sc} ± 5%		—
Sample no.	Remarks			—
2	N/A			—
3	N/A			—
Supplementary information: Refer to Appendix 3: EL-images.				

Light and elevated temperature induced degradation test (according to IEC CD 63342 TS: 2021)

Test Date [DD/MM/YYYY] start - end		19/05/2022 - 02/06/2022		
Applied current [A]		2*(I _{sc initial n} - I _{MPP initial n})		
Test duration [Hrs]		First time 168h Second time 168h		
Module Temperature [°C]		75		
Sample no.	Open circuits (yes/no)			—
2	no			—
3	no			—
Supplementary information: N/A				

Visual inspection after LETID test (according to IEC61215-2: 2016, MQT 01)

Test Date [DD/MM/YYYY]		02/06/2022		—
Sample no.	Requirement	Nature and position of initial findings		—

2	No major visual defects	No major visual defects	P
3		No major visual defects	P
Supplementary information: N/A			

STC after LETID test (according to IEC61215-2: 2016, MQT 06)

Test Date [DD/MM/YYYY]		02/06/2022						—
Test method		<input checked="" type="checkbox"/> indoor		<input type="checkbox"/> outdoor				
Irradiance [W/m²]		1000						
Reproducibility r for Pmax [%]		0.5						
Module temperature [°C]		25						
Sample no.	P _{max} [W]*	V _{mpp} [V]	I _{mpp} [A]	V _{oc} [V]	I _{sc} [A]	FF [%]	Degradation [%]	
2	576.7	44.67	12.910	52.26	13.713	80.5	-0.25	
3	574.6	44.64	12.872	52.23	13.750	80.0	-0.18	
Supplementary information: For modules that exhibit a large degradation of 3 % in power after the 2 times 162 h (+16/-0 h), a third stress interval should not be added.								

Evaluation of output power for each module

Sample no.	P _{BO n}	P _{BO nr}	P _{final n}	—
2	577.1	578.1	576.7	P
3	575.0	575.7	574.6	P
Supplementary information: Pass criteria follow requirements of section 8 of IEC CD 63342 TS: 2021.				
$P_{final n} \geq 0,97 \cdot P_{BO n} \cdot \left(1 - \frac{r[\%]}{100}\right)$				
P _{BO n} = Measured maximum STC power after B-O CID preconditioning				
P _{BO nr} = P _{BO n} taking reproducibility and degradation of 3% into account				
P _{final n} = Measured final maximum STC power				
n = 2, 3				

EL-images after LETID test

Test Date [DD/MM/YYYY]		02/06/2022		—
Current applied		I _{sc} ± 5%		—
Sample no.	Remarks			—
2	N/A			—
3	N/A			—
Supplementary information: Refer to Appendix 3: EL-images.				

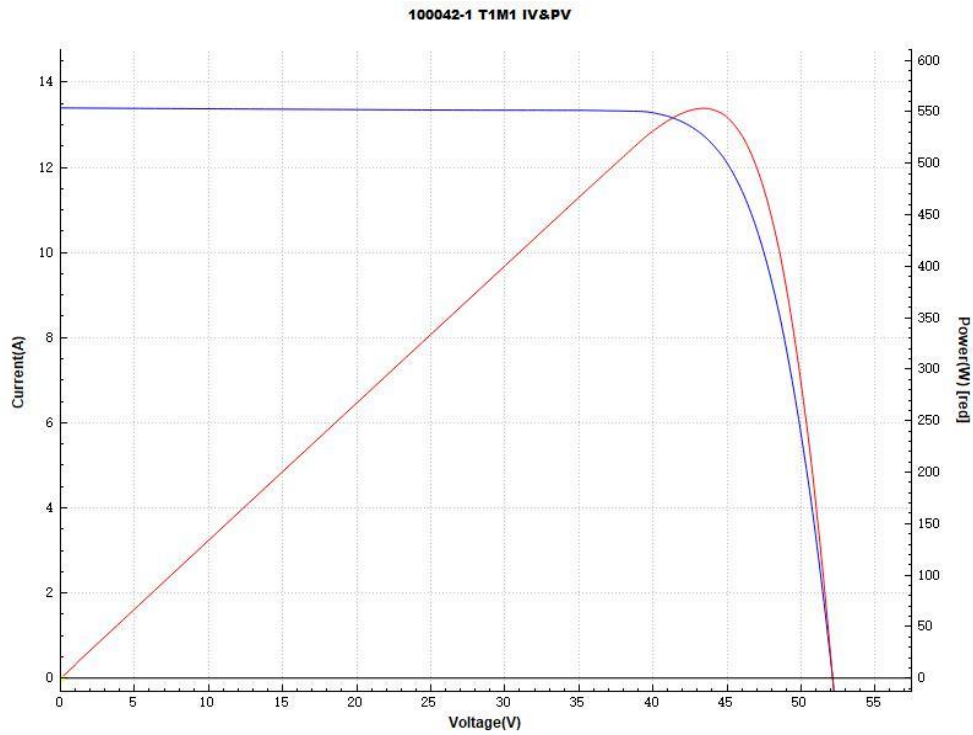
Appendix 1: Measuring equipment list

No.	Serial number	Name of instrument and equipment	Type	Period of validity
1	A030520200340	Hygrograph	CGP1W	2022.10.28
2	Z030520200341	Performance test system of PV module	GIV-20A2616	2022.11.18
3	Z030520200342	EL	LXG30	/
4	Z030520200348.01	Voltage-stabilized source	CH1	2022.10.28
5	Z030520200348.02	Voltage-stabilized source	CH2	2022.10.28
6	Z030520200348.03	Voltage-stabilized source	CH3	2022.10.28
7	Z030520200348.04	Voltage-stabilized source	CH4	2022.10.28
8	Z030520200348.05	Voltage-stabilized source	CH5	2022.10.28
9	Z030520200348.06	Voltage-stabilized source	CH6	2022.10.28
10	Z030520200348.07	Voltage-stabilized source	CH7	2022.10.28
11	Z030520200348.08	Voltage-stabilized source	CH8	2022.10.28
12	Z030520200348.09	Voltage-stabilized source	CH9	2022.10.28
13	Z030520200348.10	Voltage-stabilized source	CH10	2022.10.28
14	Z030520200348.11	Voltage-stabilized source	CH11	2022.10.28
15	Z030520200348.12	Voltage-stabilized source	CH12	2022.10.28
16	Z030520200348.13	DAQ Card	ADAM-4018+	2022.10.28
17	Z030520200348.14	Thermocouple	T Type	2022.10.28
18	Z030520200349.00	Current continuity monitoring system	ZW-JLY01-20	2022.10.28
19	Z030520200353	Inspection test table	/	/
20	Z030520200361	Environment test chamber	ZW-TC-20	2022.10.28

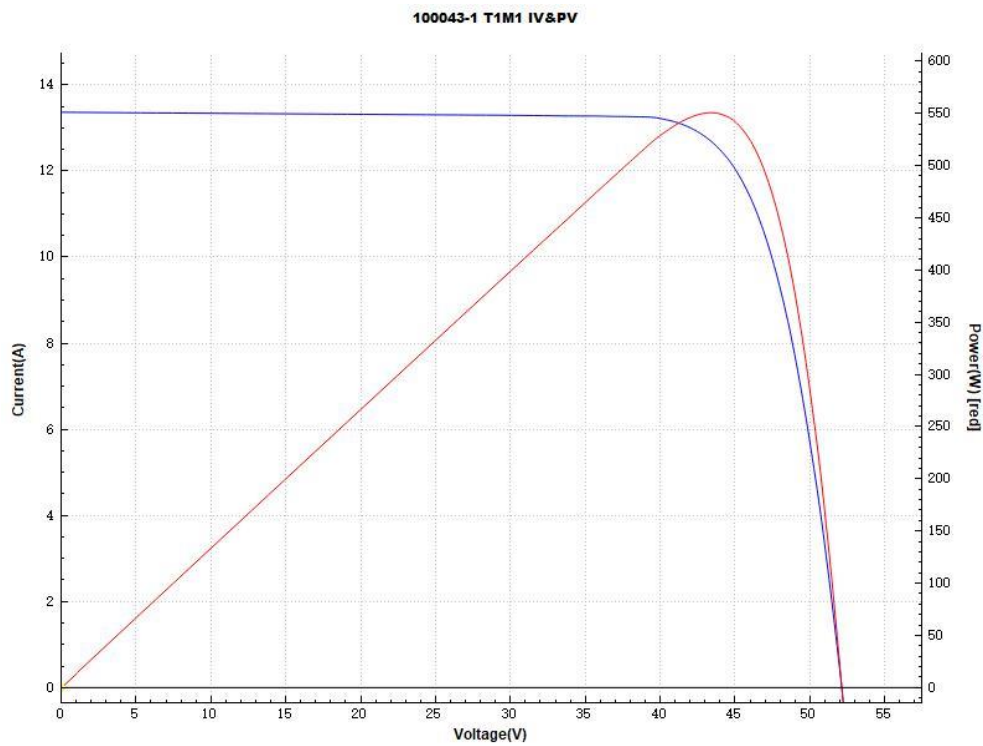
Appendix 2: Measurement report (I/V curves)

a. Initial Performance at STC

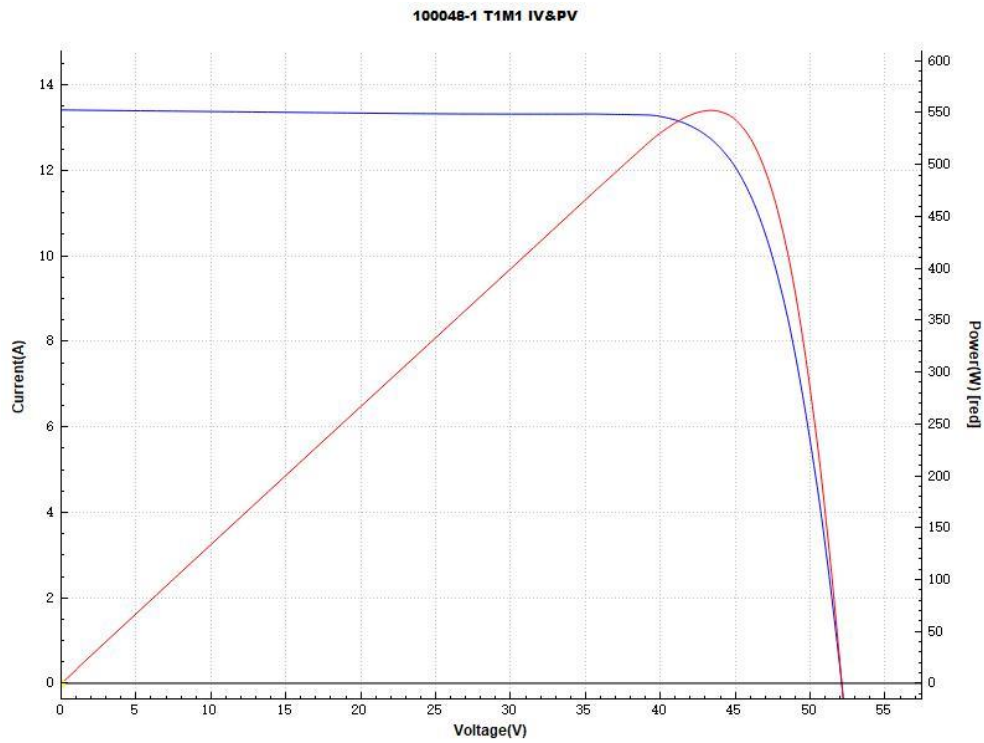
Serial number: LRR004111220301100042



Serial number: LRR004111220301100043

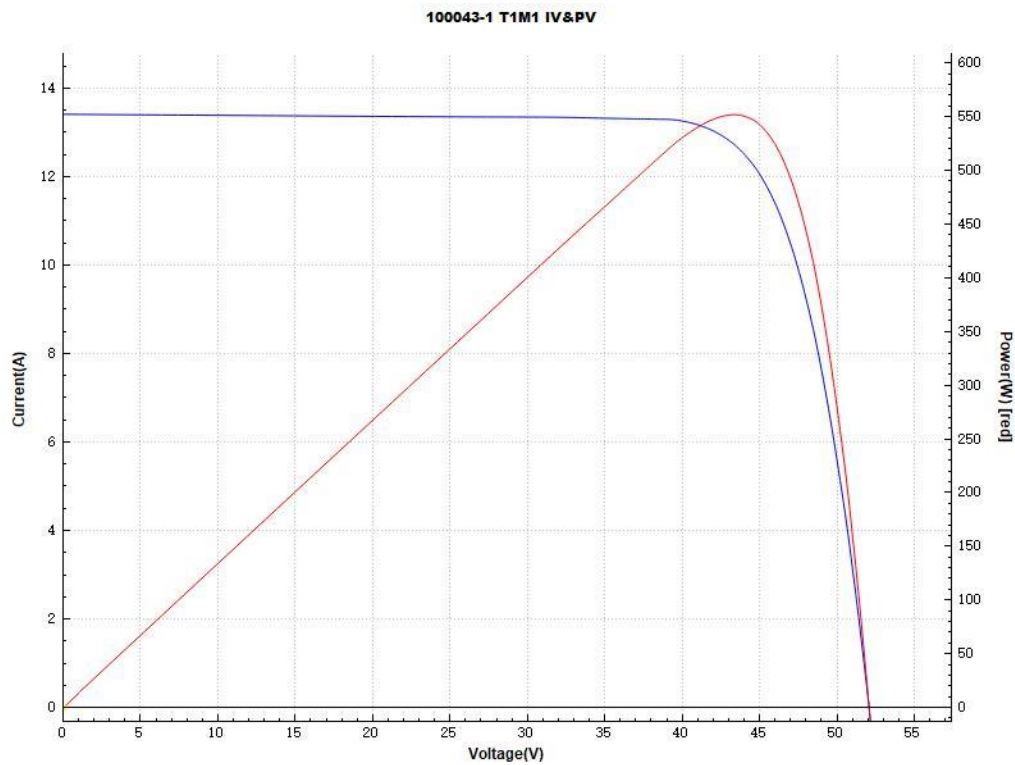


Serial number: LRR004111220301100048

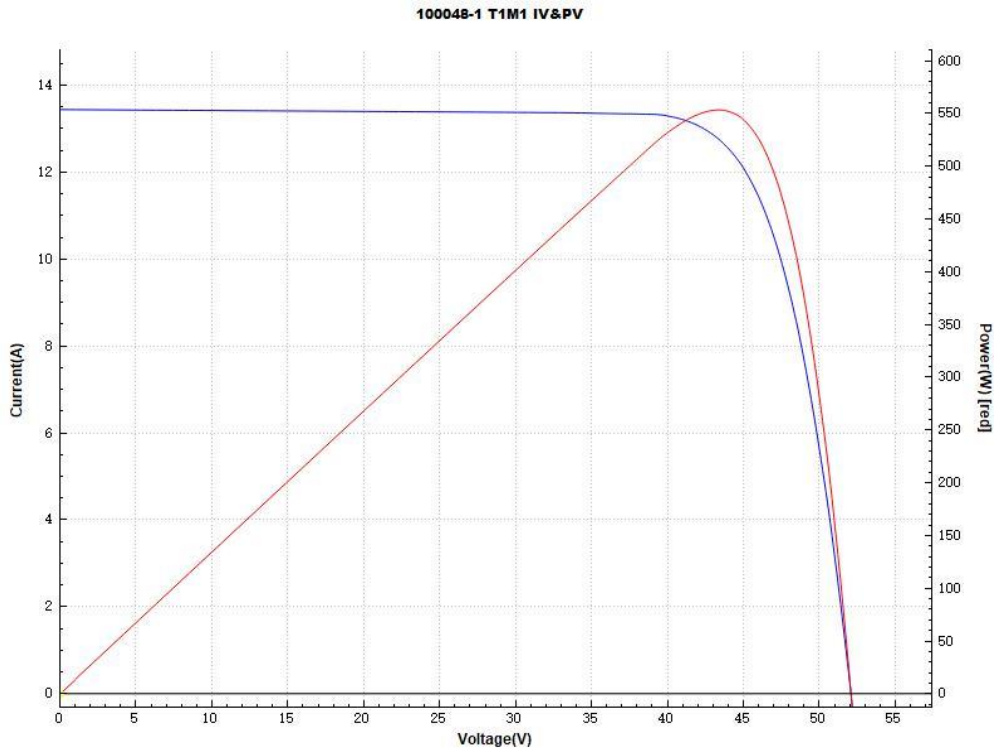


b. STC after B-O CID test

Serial number: LRR004111220301100043

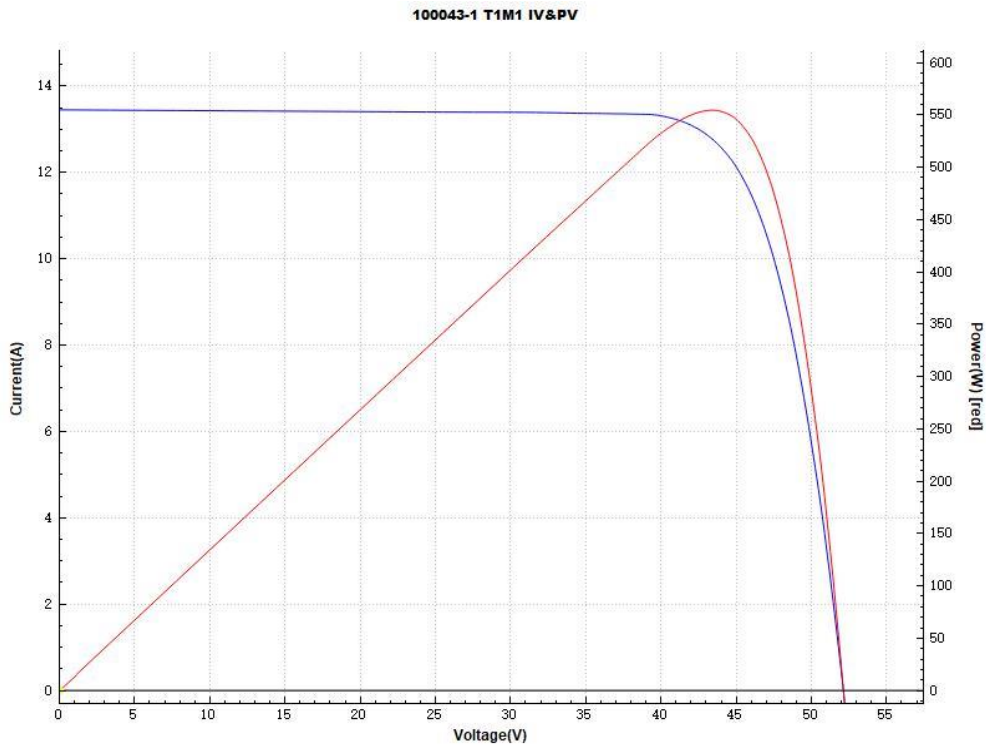


Serial number: LRR004111220301100048

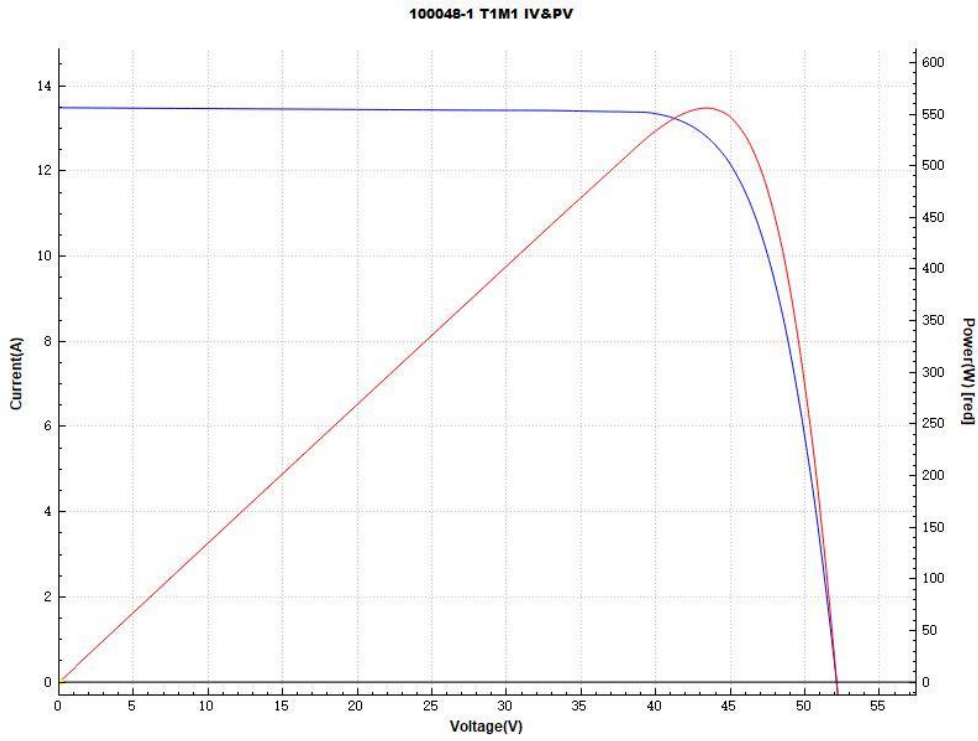


c. STC after LETID test

Serial number: LRR004111220301100043



Serial number: LRR004111220301100048



Appendix 3: EL-images

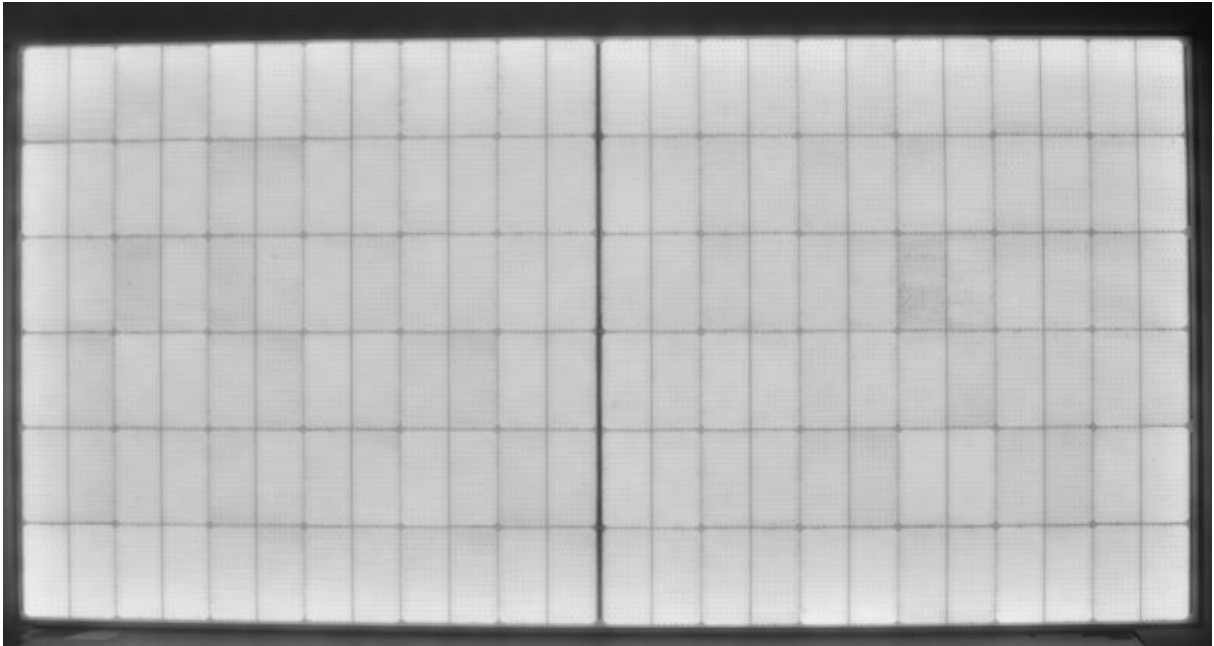


Fig. 1: EL-image after B-O CID of sample with serial no. LRR004111220301100043

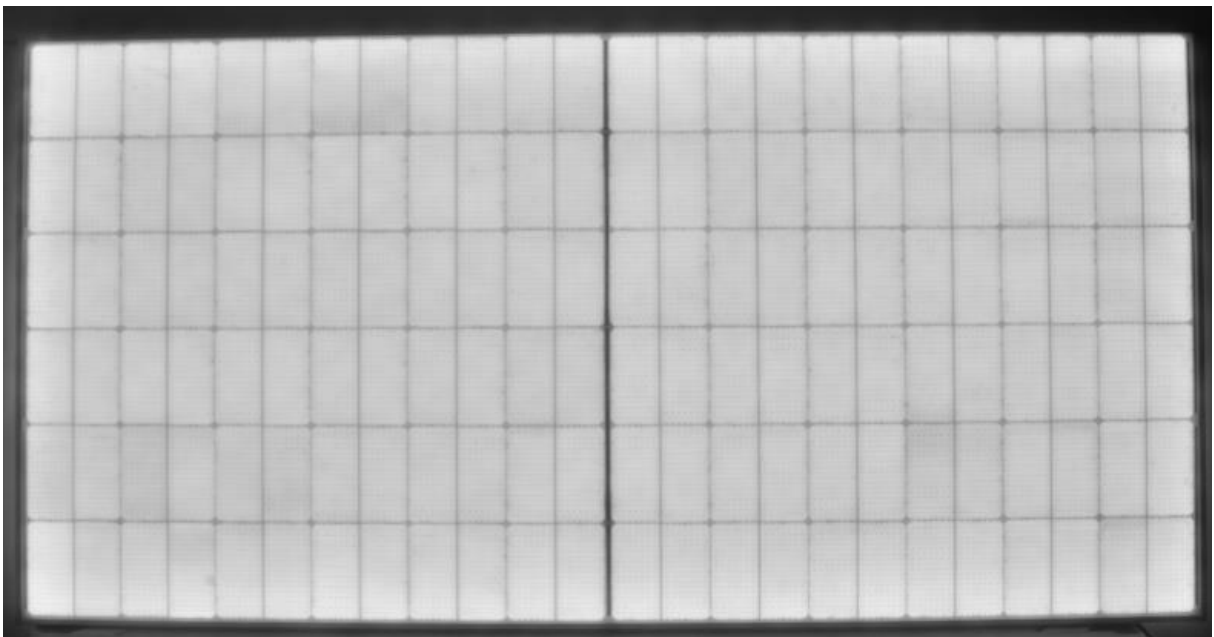


Fig. 2: EL-image after B-O CID of sample with serial no. LRR004111220301100048

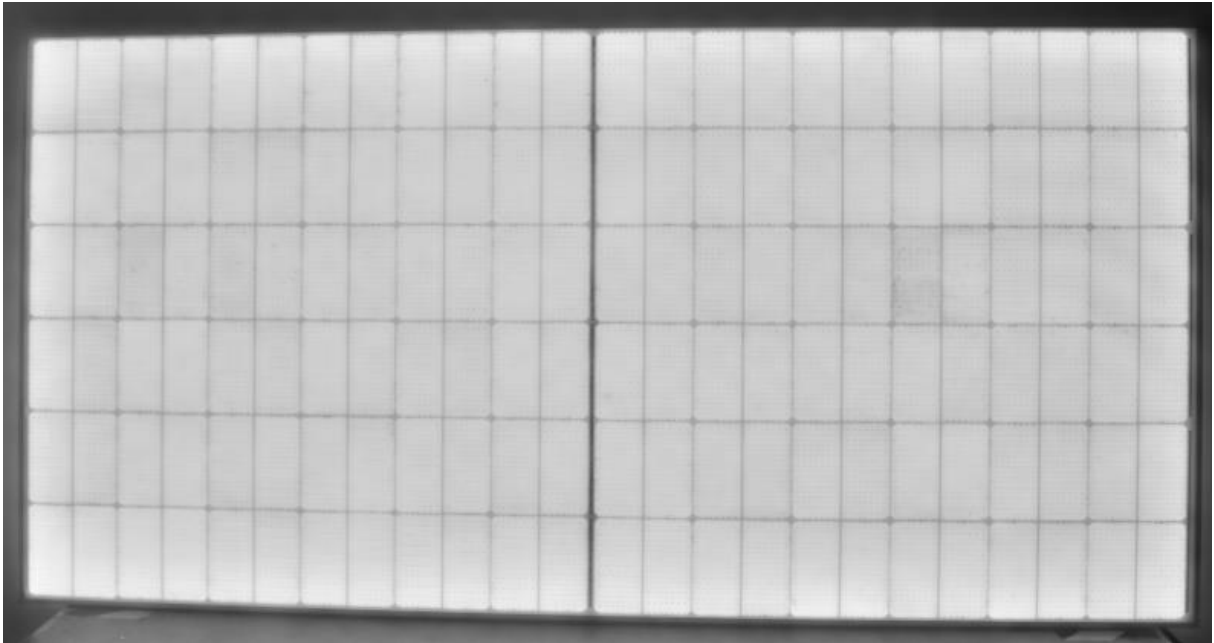


Fig.3: EL-image after LETID of sample with serial no. LRR004111220301100043

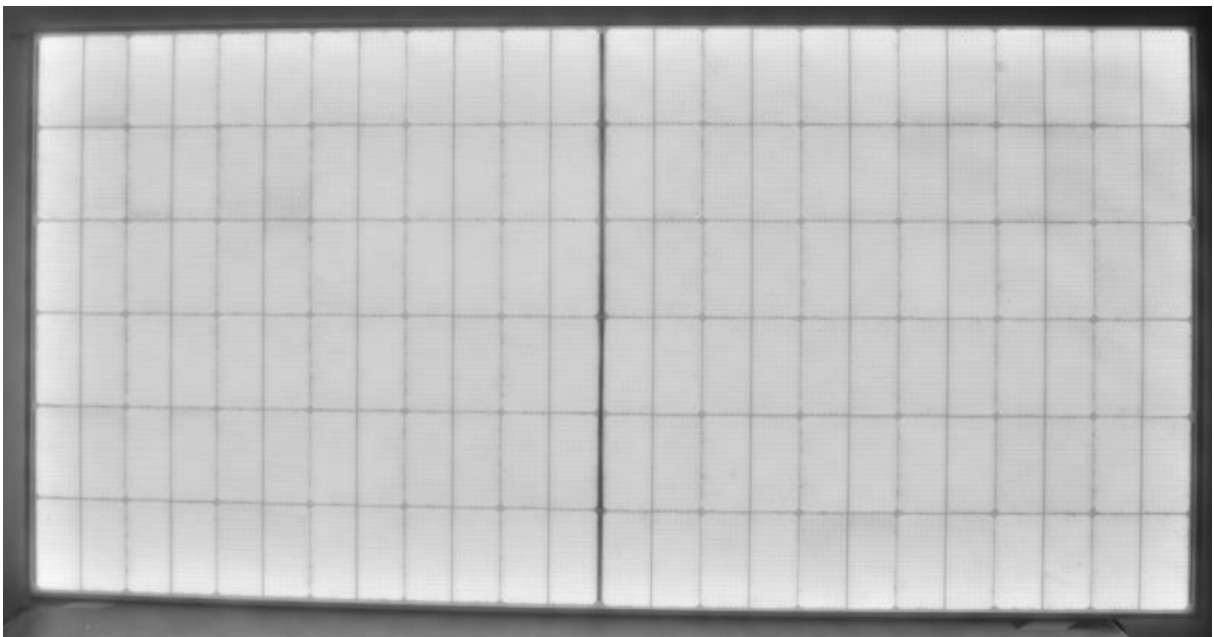


Fig.4: EL-image after LETID of sample with serial no. LRR004111220301100048

Appendix 4: Photos of the modules



Fig.5: front view of test module



Fig.6: rear view of test module



Fig.7: Label of test module



Fig.8: junction box of test module

Appendix 5: BOM information
Model type: LR5-72HTH-575M

Material	Type or model	Manufacturer
Solar Cell	M10P0B	LONGi Solar Technology Co., Ltd
EVA	TF4/F806W	Hangzhou First Applied Material Co., Ltd
Glass	3.2mm	Xinyi Solar (Hong Kong) Limited
Backsheet	BEC-306D	Suzhou First PV Material Co., Ltd
Frame	6005-T6	LONGi Green Energy Technology Co., Ltd
Adhesive of frame sealing	1527	TONSAN ADHESIVE INC
Tape for frame sealing (if applicable)	/	/
Junction box	PV-LR04A	LONGi Green Energy Technology Co., Ltd
Connector	PV-LR5	LONGi Green Energy Technology Co., Ltd
Cable	H1Z2Z2-K 1x4mm ²	LONGi Green Energy Technology Co., Ltd
Bypass Diode	30SQ045-SL	LONGi Green Energy Technology Co., Ltd
Adhesive of J-Box sealing	1521	TONSAN ADHESIVE INC
Potting Material in junction box (if applicable)	1527	TONSAN ADHESIVE INC
Interconnector of cells	0.25*0.6	LONGi Green Energy Technology Co., Ltd
Interconnector of strings	0.3*7mm 0.3*4mm	LONGi Green Energy Technology Co., Ltd
Fluxing agent-1	SF56	Singapore Asahi Chemical and Solder Industries Pte Ltd
Fixing Tape (if applicable)	UV-1	3M
Insulation tape (if applicable)	BEC-201	Suzhou First PV Material Co., Ltd
Lable	SRT901-ZF-4-ZXZ01	BEIJING COMPO ADVANCED TECHNOLOGY CO.,LTD

- The BOM listed above is provided by the client.

End of Test Report