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

Test Report

Photovoltaic Module Tests

according to Client's Requirements

TÜV Report No. CN24SZFK 002

Shanghai, December 2025

Test report No.: *Prüfbericht - Nr.:*	**CN24SZFK 002**		Page 2 / 17
Client (Customer No. + address): *Auftraggeber (Kunden-Nr. + Adresse):*	**LONGi Green Energy Technology Co., Ltd.** No. 388, Middle Hangtian Road, Chang'an District, Xi'an, Shaanxi, P.R. China		
Test Item: *Gegenstand der Prüfung:*	Photovoltaic (PV) Module(s)	**Date of receipt:** *Eingangsdatum:*	18/11/2024
Identification: *Bezeichnung:*	LR8-66HYD-645M		
Order No.: *Auftragsnummer:*	326068212	**Quotation No.:** *Angebotsnummer:*	P01730675
Testing location: *Prüfort:*	**TÜV Rheinland (Suzhou) Co., Ltd.** Building 14, Plainvim (Taicang) Modern Industrial Park, No. 525 South Lingang Road, Shaxi Town, Taicang, Suzhou, Jiangsu		
Test specification: *Prüfgrundlage:*	Refer to section 3 for test methodology		
Test Result: *Prüfergebnis:*	See section 5 for detailed results		

tested by / *geprüft:*			**reviewed by** / *kontrolliert:*		
12/12/2025	Project Engineer/ Daniel Wang Daniel Wang		12/12/2025	Reviewer/ Wenyao Lu Wenyao Lu	
Date *Datum*	**Title/Name** *Titel/Name*	**Signature** *Unterschrift*	**Date** *Datum*	**Title/Name** *Titel/Name*	**Signature** *Unterschrift*

Other Aspects / *Sonstiges:* N/A

Abkürzungen:	***P(ass)***	=	***entspricht Prüfgrundlage***	***Abbreviations:***	***P(ass)***	=	***passed***
	F(ail)	=	***entspricht nicht Prüfgrundlage***		***F(ail)***	=	***failed***
	N/A	=	***nicht anwendbar***		***N/A***	=	***not applicable***
	N/T	=	***nicht getestet***		***N/T***	=	***not tested***

This test report relates to the listed test samples. Without permission of the test centre this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any safety mark on this or similar products.

Dieser Prüfbericht bezieht sich nur auf die gelisteten Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.

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1 General Information

Date(s) of performance of tests： 26/11/2024 – 06/12/2024

Abbreviations used in this report:

Pmax	– Maximum power	Vmpp	– Maximum power point voltage
Impp	– Maximum power point current	Voc	– Open circuit voltage
Isc	– Short circuit current	FF	– Fill factor
VI	– Visual inspection	MPD	– Maximum power determination
EL	– Electroluminescence	INS	– Insulation test
WLC	– Wet leakage current test	HI	– Hail test

Possible test case verdicts:

- Test case does not apply to the test object.....: N/A
- Test object does meet the requirement .....: Pass (P)
- Test object does not meet the requirement .....: Fail (F)

Further Remarks

- The test verdicts presented in this report relate only to the test specimen.
- This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
- I-V curves are only included in this report if they show any deviations. If required, other I-V curves will be provided upon request.
- Any question in regard to this report, please contact TÜV Rheinland (Shanghai) Co., Ltd. within one week after report issued.
- Acceptance criteria mentioned in this report are provided by client.

2 Executive Summary

TÜV Rheinland has performed module tests for LONGi Green Energy Technology Co., Ltd. at TÜV Rheinland (Suzhou) Co., Ltd.

Table 1: Test result summary

Test	Quantity	Results	Report no.
VI	2	See section 5.1 for details	CN24SZFK 002
MPD	2	See section 5.2 for details	
EL	2	See section 5.3 for details	
INS	2	See section 5.4 for details	
WLC	2	See section 5.5 for details	
Hail	2	See section 5.6 for details	

3 Test Methodology

3.1 Visual inspection

The Visual inspection is performed in accordance with IEC 61215-2: 2021, MQT 01 and comprises the verification of the following:

- Front of the module
  - Inclusions in the laminate
  - Inclusions in the glass
  - Broken cells
  - Scratches, bubbles or defects in the glass that may compromise the performance or safety of the module
  - Bubbles
  - Yellowing
  - Condition of the frame
  - Condition of welded parts
- Back of the module
  - Scratches or cuts in the back sheet
  - Any kind of bubbles or delamination
  - Bumps or depressions on the back sheet

Table 2: Measuring equipment for visual inspection

Device	Index no.	Measured variable	Application
Ruler	PV-454	Measure defects	Visual inspection

3.2 Maximum power determination

Maximum power determination test is performed in accordance with IEC 61215-2: 2021, MQT 02. Power measurements are performed with an AAA pulsed solar simulator in a dark chamber designed to reduce the impact of indirect light. Temperature correction is applied by using the temperature coefficient which was provided by the manufacturer. The measurement reproducibility is confined within ±0.8%, k=2. The described experimental setup shows a combined expanded measurement uncertainty, which is less than ±2.5%, k=2 under the commonly referred Standard Test Condition (as detailed in IEC 61215: 1000W/m², 25°C and AM1.5G)

Table 3: Measuring equipment for maximum power determination

Device	Index no.	Measured variable	Application
Primary calibrated reference solar cell	PV-008	Global irradiance coplanar with specimen	Pulsed solar simulator measurements
Solar simulator	PV-481	Current, voltage, irradiance	Pulsed solar simulator measurements
IR-sensor	PV-209 PV-210 PV-216 PV-499	Specimen temperature	Pulsed solar simulator measurements

Table 4: Measurement related software for maximum power determination

Program	Version no.	Date	Application
PASAN SPROD Tester	STC V2.9.2	26.01.2018	Operating software pulsed solar simulator

Statement of the estimated uncertainty of the test verdicts

- The verdicts of performance rating are only related to the test samples that were subjected to the tests.
- The STC measurement was performed with a pulsed solar simulator of Class AAA according to IEC60904-9: 2020. The extended measurement uncertainty is:
  - Uncertainty in P_{MAX} within ± 2.5 %, k=2
  - Uncertainty in I_{SC} within ± 2.4 %, k=2
  - Uncertainty in V_{OC} within ± 0.9 %, k=2

3.3 Electroluminescence

The electroluminescence test makes cracks and other cell related defects visible.

This test is to be performed referring to standard IEC TS 60904-13: 2018.

3.4 Insulation test

This test is to be performed referring to standard IEC 61215-2: 2021, MQT 03.

Acceptance criteria:

Measured insulation resistance times the area of the module shall not be less than 40 MΩ·m².

3.5 Wet leakage current test

This test is to be performed referring to standard IEC 61215-2: 2021, MQT 15.

Acceptance criteria:

Measured insulation resistance times the area of the module shall not be less than 40 MΩ·m².

3.6 Hail test

This test is to be performed referring to standard IEC 61215-2: 2021, MQT 17.

4 Sampling and Test Assignment

4.1 Sampling procedure

☐	Random sampling from production (e.g. during factory audit (FA) or inline inspection)
☐	Random sampling from the warehouse, container or transportation boxes
☒	Modules have been submitted by the manufacturer/ client without random sampling by TÜV Rheinland

4.2 Module test assignment

Table 5: Module assignment

Module manufacturer	LONGi Green Energy Technology Co., Ltd.						
Module type	LR8-66HYD-645M						
Module technology	Mono-crystalline N-TOPCon Bifacial half-cell c-Si module, 132 pcs						
No.	**S/N**	**VI**	**MPD**	**EL**	**INS**	**WLC**	**Hail**
1	LRR011139241100400086	x	x	x	x	x	x
2	LRR011139241100400087	x	x	x	x	x	x
x: selected samples for test							
Supplementary information: N/A							

5 Test Results

5.1 Visual inspection

Test date [DD/MM/YYYY]	26/11/2024	
Sample #	Nature and position of findings	Verdict
1	No visual defect	P
2	No visual defect	P
Supplementary information: N/A.		

5.2 Maximum power determination

Test date [DD/MM/YYYY]			27/11/2024			
Module temperature [°C]			25 ± 1			
Irradiance [W/m²]			1000			
Illuminating direction			☒ Front		☐ Rear	
Sample #	Pmax [W]	Vmpp [V]	Impp [A]	Voc [V]	Isc [A]	FF [%]
1	651.2	42.28	15.402	49.22	16.181	81.8
2	650.5	42.22	15.408	49.15	16.180	81.8
Supplementary information: The non-illuminated side was covered with non-reflective background.						

5.3 Electroluminescence

Test date [DD/MM/YYYY]	27/11/2024
Current applied	Isc ± 5%
Sample #	Remarks
1	No significant defect
2	No significant defect
Supplementary information: Refer to Annex 2: EL Imaging.	

5.4 Insulation test

Test date [DD/MM/YYYY]				27/11/2024		
Maximum system voltage [VDC]				1500		
High voltage applied [VDC]				8000		
Insulation resistance measured at [VDC]				1500		
Sample #	Measured	Area	Result*	Dielectric breakdown		Verdict
	GΩ	m²	GΩ·m²	Yes (description)	No	
1	15.40	2.70	41.58	—	No	P
2	15.30	2.70	41.31	—	No	P
* Pass criteria: No dielectric breakdown, insulation resistance shall be greater than 40 MΩ·m².						

5.5 Wet leakage current test

Test date [DD/MM/YYYY]	27/11/2024			
Insulation resistance measured at [VDC]	1500			
Solution resistivity [Ω·cm]	< 3500			
Solution temperature [°C]	22 ± 2			
Sample #	Measured	Area	Result	Verdict
	MΩ	m²	MΩ·m²	
1	5370.0	2.70	14499.0	P
2	5750.0	2.70	15525.0	P
Pass criteria: No dielectric breakdown, insulation resistance shall be greater than 40 MΩ·m².				

5.6 Hail test

Test date [DD/MM/YYYY]	05/12/2024 for Sample # 2; 06/12/2024 for Sample # 1	
Ice ball diameter [mm]	45	
Ice ball mass [g]	43.9 ± 5 %	
Ice ball velocity [m/s]	30.7 ± 5 %	
Number of impact locations	11	
Sample #	—	Verdict
1	—	P
2	—	P
Supplementary information: N/A.		

5.6.1 Visual inspection after HI

Test date [DD/MM/YYYY]	05/12/2024 for Sample # 2; 06/12/2024 for Sample # 1	
Sample #	Nature and position of findings	Verdict
1	No visual defect	P
2	No visual defect	P

5.6.2 Maximum power determination after HI

Test date [DD/MM/YYYY]			06/12/2024					
Module temperature [°C]			25 ± 1					
Irradiance [W/m²]			1000					
Illuminating direction			☒ Front			☐ Rear		
Sample #	Pmax[W]	Vmpp [V]	Impp [A]	Voc [V]	Isc [A]	FF [%]	Degradation [%]	Verdict
1	651.5	42.45	15.346	49.26	16.171	81.8	0.05	P
2	650.0	42.17	15.413	49.13	16.167	81.8	-0.07	P
Supplementary information: The non-illuminated side was covered with non-reflective background.								

5.6.3 Electroluminescence after HI

Test date [DD/MM/YYYY]	06/12/2024
Current applied	Isc ± 5%
Sample #	Remarks
1	No significant defect
2	No significant defect
Supplementary information: Refer to Annex 2: EL Imaging.	

5.6.4 Insulation test after HI

Test date [DD/MM/YYYY]				06/12/2024		
Maximum system voltage [VDC]				1500		
High voltage applied [VDC]				8000		
Insulation resistance measured at [VDC]				1500		
Sample #	Measured	Area	Result*	Dielectric breakdown		Verdict
	GΩ	m²	GΩ·m²	Yes (description)	No	
1	15.20	2.70	41.04	—	No	P
2	15.10	2.70	40.77	—	No	P
* Pass criteria: No dielectric breakdown, insulation resistance shall be greater than 40 MΩ·m².						

5.6.5 Wet leakage current test after HI

Test date [DD/MM/YYYY]	06/12/2024			
Insulation resistance measured at [VDC]	1500			
Solution resistivity [Ω·cm]	< 3500			
Solution temperature [°C]	22 ± 2			
Sample #	Measured	Area	Result	Verdict
	MΩ	m²	MΩ·m²	
1	5300.0	2.70	14310.0	P
2	5620.0	2.70	15174.0	P
Pass criteria: No dielectric breakdown, insulation resistance shall be greater than 40 MΩ·m².				

6 Annex

6.1 Annex 1: Photos of test module

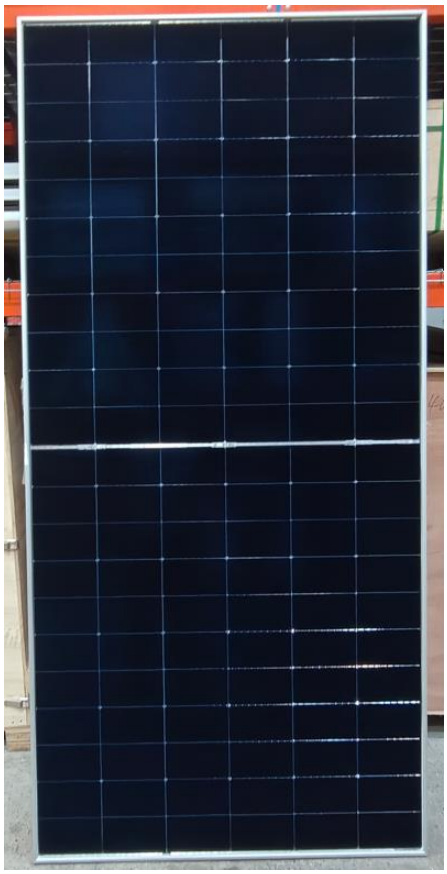

Figure 1: Front view of module LR8-66HYD-645M

Figure 2: Rear view of module LR8-66HYD-645M

Figure 3: Rating label of module type LR8-66HYD-645M

Figure 4: Junction boxes of module type LR8-66HYD-645M

6.2 Annex 2: EL-imaging

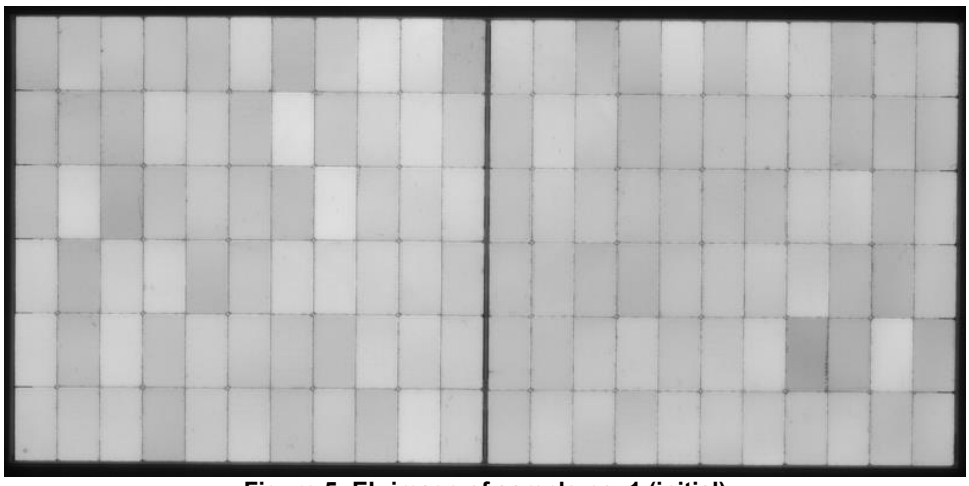

Figure 5: EL-image of sample no. 1 (initial)

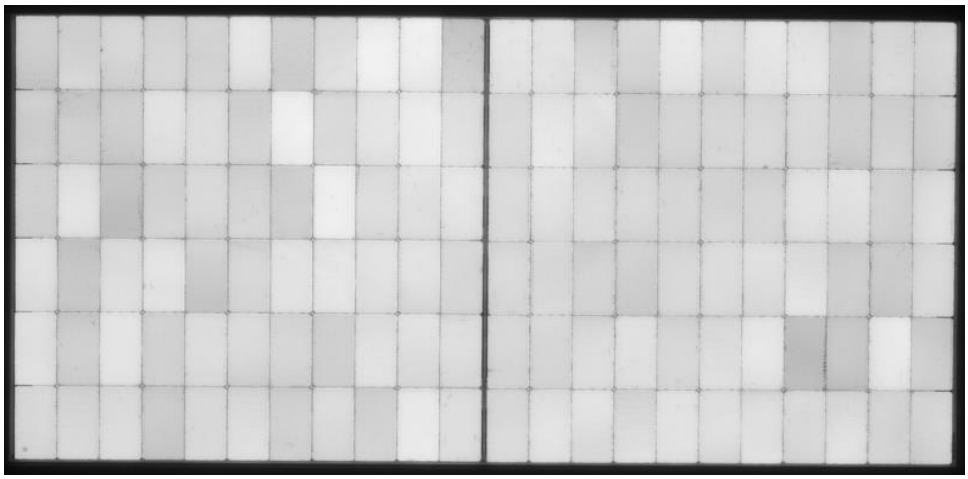

Figure 6: EL-image of sample no. 1 (after Hail test)

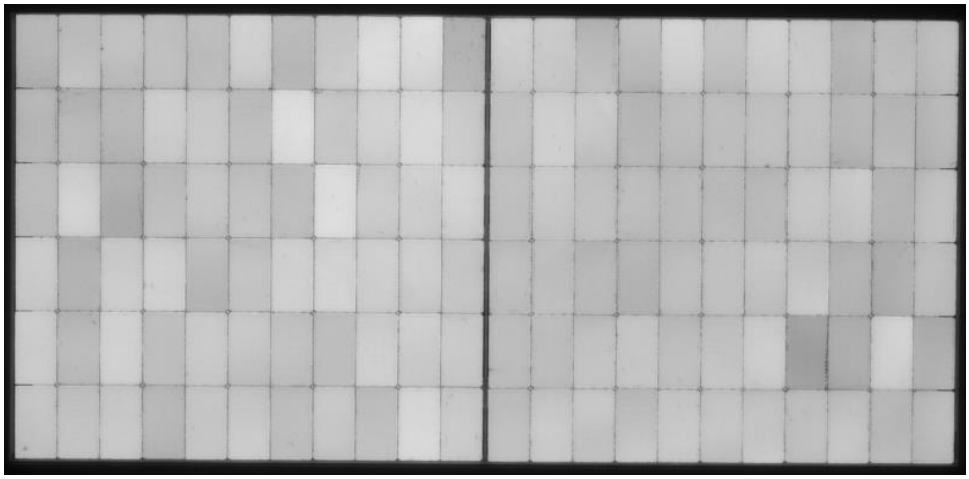

Figure 7: EL-image of sample no. 2 (initial)

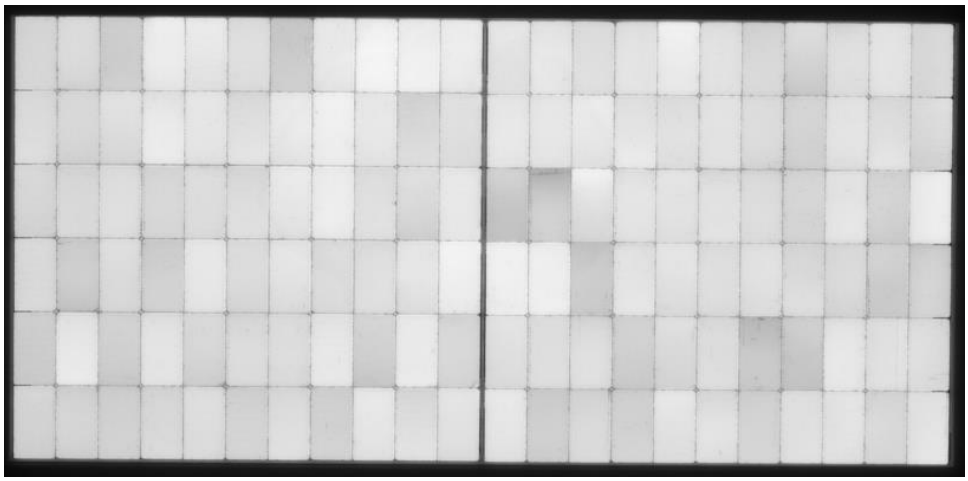

Figure 8: EL-image of sample no. 2 (after Hail test)

End of Test Report CN24SZFK 002