

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

Test Report

Photovoltaic Module Tests
according to Client's Requirements

TÜV Report No. CN25B37N 001

Shanghai, September 2025

Test report No.: CN25B37N 001		Page 2 / 16	
<i>Prüfbericht - Nr.:</i>			
Client (Customer No. + address): <i>Auftraggeber</i> <i>(Kunden-Nr. + Adresse):</i>	Guangzhou Gokin Solar Technology Co., Ltd. North of Yanjiang Avenue, east of Hejin Avenue, Huadu District, Guangzhou, 510800 Guangdong P.R. China		
Test Item: <i>Gegenstand der Prüfung:</i>	Photovoltaic (PV) Module(s)	Date of receipt: <i>Eingangsdatum:</i>	26/08/2025
Identification: <i>Bezeichnung:</i>	GK-3-54HGDb-480M		
Order No.: <i>Auftragsnummer:</i>	326129930	Quotation No.: <i>Angebotsnummer:</i>	245880929
Testing location: <i>Prüfart:</i>	TÜV Rheinland (Suzhou) Co., Ltd. Building 14, Plainvim (Taicang) Modern Industrial Park, No. 525 South Lingang Road, Shaxi Town, Taicang, Suzhou, Jiangsu		
Test specification: <i>Prüfgrundlage:</i>	Refer to section 3 for test methodology		
Test Result: <i>Prüfergebnis:</i>	See section 5 for detailed results		
tested by / geprüft:		reviewed by / kontrolliert:	
11/09/2025	Project Engineer/ Susie Li	11/09/2025	Technical Reviewer/ Wen Yao Lu
			
Date <i>Datum</i>	Title/Name <i>Titel/Name</i>	Signature <i>Unterschrift</i>	Date <i>Datum</i>
Date <i>Datum</i>	Title/Name <i>Titel/Name</i>	Signature <i>Unterschrift</i>	Date <i>Datum</i>
Other Aspects / Sonstiges: N/A.			
			
Abkürzungen:		Abbreviations:	
P(ass) = entspricht Prüfgrundlage F(ail) = entspricht nicht Prüfgrundlage N/A = nicht anwendbar N/T = nicht getestet	P(ass) = passed F(ail) = failed N/A = not applicable 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.			

Table of Content

1	General Information	5
2	Executive Summary	6
3	Test Methodology.....	8
3.1	Visual inspection.....	8
3.2	Maximum power determination	8
3.3	Electroluminescence	9
3.4	Insulation test	9
3.5	Wet leakage current test.....	10
3.6	Hail test.....	10
4	Sampling and Test Assignment.....	11
4.1	Sampling procedure	11
4.2	Module test assignment.....	11
5	Test Results	12
5.1	Initial visual inspection.....	12
5.2	Initial maximum power determination	12
5.3	Initial electroluminescence	12
5.4	Initial insulation test	12
5.5	Initial wet leakage current test.....	13
5.6	Hail test (45mm)	13
5.6.1	Visual inspection after HI test	13
5.6.2	Maximum power determination after HI test.....	13
5.6.3	Electroluminescence after HI test.....	14
5.6.4	Insulation test after HI test	14
5.6.5	Wet leakage current test after HI test.....	14
6	Annex	15
6.1	Annex 1: Photos of test module	15
6.2	Annex 2: EL-imaging	16

List of Tables

Table 1: Test result summary	6
Table 2: BOM list	7
Table 3: Measuring equipment for visual inspection	8
Table 4: Measuring equipment for maximum power determination	9
Table 5: Measurement related software for maximum power determination	9
Table 6: Module assignment	11

1 General Information

Date(s) of performance of tests: 27/08/2025 – 04/09/2025

Abbreviations used in this report:

P _{max}	– Maximum power	V _{mpp}	– Maximum power point voltage
I _{mpp}	– Maximum power point current	V _{oc}	– Open circuit voltage
I _{sc}	– 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.
- Any question in regard to this report, please contact TÜV Rheinland (Shanghai) Co., Ltd. within one week after report issued.
- Acceptance criteria are mentioned in this report.

2 Executive Summary

TÜV Rheinland has performed module tests for Guangzhou Gokin Solar Technology Co., Ltd. at TÜV Rheinland (Suzhou) Co., Ltd.

The results provided are related to PV modules tested for 1 pc module.

The BOM list is provided by client.

Table 1: Test result summary

Test	Quantity	Results	Report no.
VI	1	See section 5.1 for details	CN25B37N 001
MPD	1	See section 5.2 for details	
EL	1	See section 5.3 for details	
INS	1	See section 5.4 for details	
WLC	1	See section 5.5 for details	
HI	1	See section 5.6 for details	

Table 2: BOM list

Material	Type or model	Manufacturer
Solar Cell	GK-192G-20D1 Technology: Mono BC c-Si L (±0.25) x W (±0.25) x T (±0.015) [mm]: 182.2x192.5x0.125 Number of busbars: 20	Gokin Solar Co., Ltd.
Encapsulation Material	CO-556 (between front cover and cells) / SV-15296P (between cells and rear cover)	Changzhou Sveck Photovoltaic New Material Co., Ltd.
Front Cover	AR coating Semi-tempered glass Thickness [mm]: 2.0	Gokin Solar Co., Ltd.
Rear Cover	Semi-tempered photovoltaic glass Thickness [mm]: 2.0 Color: black ceramic grid	Gokin Solar Co., Ltd.
Frame	6005-T6	Gokin Solar Co., Ltd.
Adhesive of frame sealing	JD-615	Jiang Men Jia Di New Materials Co.,Ltd.
Tape for frame sealing (if applicable)	—	—
Junction box	GKxy (x=3 or 4, y=1)	Gokin Solar Co., Ltd.
Connector	PV-GK01 Max. voltage [V]: 1500 Max. current [A]: 41	Gokin Solar Co., Ltd.
Cable	62930 IEC 1x4,0mm ²	XinYa Electronic Co., Ltd.
Bypass Diode	30SQ045-SL Max. diode current [A]: 30 Tj [°C]: 200	Yangzhou Yangjie Electronic Co., Ltd.
Adhesive of J-Box sealing	JD-130	Jiang Men Jia Di New Materials Co.,Ltd.
Potting Material in junction box (if applicable)	—	—
Interconnector of cells	Sn60Pb40 Dimensions [mm]: 0.25x0.6mm	Suzhou YourBest New-type Materials Co., Ltd.
Interconnector of strings	Sn60Pb40 Dimensions [mm]: 4x0.35/ 6x0.35	Suzhou YourBest New-type Materials Co., Ltd.
Fluxing agent-1	AATF9800	SHENZHEN TONGFANG ELECTRONIC NEW MATERIAL CO., LTD
Fixing Tape (if applicable)	D60F6-2	Lu Qin New Materials Technology (Jiangsu) Co., Ltd.
Insulation tape (if applicable)	—	—
Label	JT18A	Suzhou Hanshan Paper Products Co., Ltd.

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 3: 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 $\pm 0.8\%$, $k=2$. The described experimental setup shows a combined expanded measurement uncertainty, which is less than $\pm 2.5\%$, $k=2$ under the commonly referred Standard Test Condition (as detailed in IEC 61215: 1000W/m², 25°C and AM1.5G)

Table 4: Measuring equipment for maximum power determination

Device	Index no.	Measured variable	Application
Primary calibrated reference solar cell	PV-012	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 5: 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 power measurement was performed with a pulsed solar simulator of Class AAA according to IEC60904-9:2020. The extended measurement uncertainty is:
 - o Uncertainty in P_{MAX} within $\pm 2.5 \%$, $k=2$
 - o Uncertainty in I_{SC} within $\pm 2.4 \%$, $k=2$
 - o Uncertainty in V_{OC} within $\pm 0.9 \%$, $k=2$

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.

The test sample is installed in a dark tunnel to prevent light entering the test area or reaching the test sample. A current close to the sample's rated I_{SC} for around 40 seconds is injected and then the EL image taken.

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 $40 \text{ M}\Omega \cdot \text{m}^2$.

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.

Acceptance criteria:

Power degradation for each tested module ≤ 5%.

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 6: Module assignment

Module manufacturer	Gokin Solar Co., Ltd.
Module type	GK-3-54HGDb-480M
Module technology	½ cut GBC c-Si cell Bifacial Module, 108 pcs

Sample #	1	2	3	4	5	6	7	8	9	10	11
Sample number Test items	TPBCPK090212508011004753										
VI	x										
MPD	x										
EL	x										
INS	x										
WLC	x										
HI	x										
Legend:											
x	Selected sample for test										
Test sequence is required by client.											

5 Test Results

5.1 Initial visual inspection

Test date [DD/MM/YYYY]	27/08/2025	
Sample #	Nature and position of findings	Verdict
1	No visual defect	P
Supplementary information: N/A.		

5.2 Initial maximum power determination

Test date [DD/MM/YYYY]	29/08/2025					
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	478.7	34.68	13.804	40.33	14.652	81.0
Supplementary information: The non-illuminated side was covered with non-reflective background.						

5.3 Initial electroluminescence

Test date [DD/MM/YYYY]	29/08/2025
Current applied	Isc ± 5%
Sample #	Remarks
1	N/A
Supplementary information: Refer to Annex 2: EL-imaging.	

5.4 Initial insulation test

Test date [DD/MM/YYYY]	29/08/2025					
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	2.04	31.01	—	No	P
Pass criteria: No dielectric breakdown, insulation resistance shall be greater than 40 MΩ·m².						

5.5 Initial wet leakage current test

Test date [DD/MM/YYYY]	29/08/2025			
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	6280.0	2.04	12811.2	P
Pass criteria: No dielectric breakdown, insulation resistance shall be greater than 40 MΩ·m².				

5.6 Hail test (45mm)

Test date [DD/MM/YYYY]	03/09/2025	
Ice ball diameter [mm]	45	
Ice ball mass [g]	43.9 ± 2 %	
Ice ball velocity [m/s]	30.7 ± 5 %	
Number of impact locations	11	
Sample #	—	Verdict
1	—	P
Supplementary information: N/A.		

5.6.1 Visual inspection after HI test

Test date [DD/MM/YYYY]	03/09/2025	
Sample #	Nature and position of findings	Verdict
1	No visual defect	P
Supplementary information: N/A.		

5.6.2 Maximum power determination after HI test

Test date [DD/MM/YYYY]	03/09/2025		
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	478.4	34.81	13.743	40.29	14.671	80.9	-0.06	P
Supplementary information: The non-illuminated side was covered with non-reflective background.								

5.6.3 Electroluminescence after HI test

Test date [DD/MM/YYYY]	03/09/2025
Current applied	Isc $\pm$ 5%
Sample #	Remarks
1	N/A
Supplementary information: Refer to Annex 2: EL-imaging.	

5.6.4 Insulation test after HI test

Test date [DD/MM/YYYY]		04/09/2025				
Maximum system voltage [VDC]		1500				
High voltage applied [VDC]		8000				
Insulation resistance measured at [VDC]		1500				
Sample #	Measured	Area	Result	Dielectric breakdown		Verdict
	G Ω	m ²	G Ω ·m ²	Yes (description)	No	
1	12.60	2.04	25.70	—	No	P
Pass criteria: No dielectric breakdown, insulation resistance shall be greater than 40 M Ω ·m ² .						

5.6.5 Wet leakage current test after HI test

Test date [DD/MM/YYYY]	04/09/2025			
Insulation resistance measured at [VDC]	1000			
Solution resistivity [$\Omega\cdot\text{cm}$]	< 3500			
Solution temperature [$^{\circ}\text{C}$]	22 $\pm$ 2			
Sample #	Measured	Area	Result	Verdict
	M Ω	m ²	M $\Omega\cdot\text{m}^2$	
1	5130.0	2.04	10465.2	P
Pass criteria: No dielectric breakdown, insulation resistance shall be higher than 40 M $\Omega\cdot\text{m}^2$.				

6 Annex

6.1 Annex 1: Photos of test module



Figure 1: Front view of test module type GK-3-54HGDb-480M

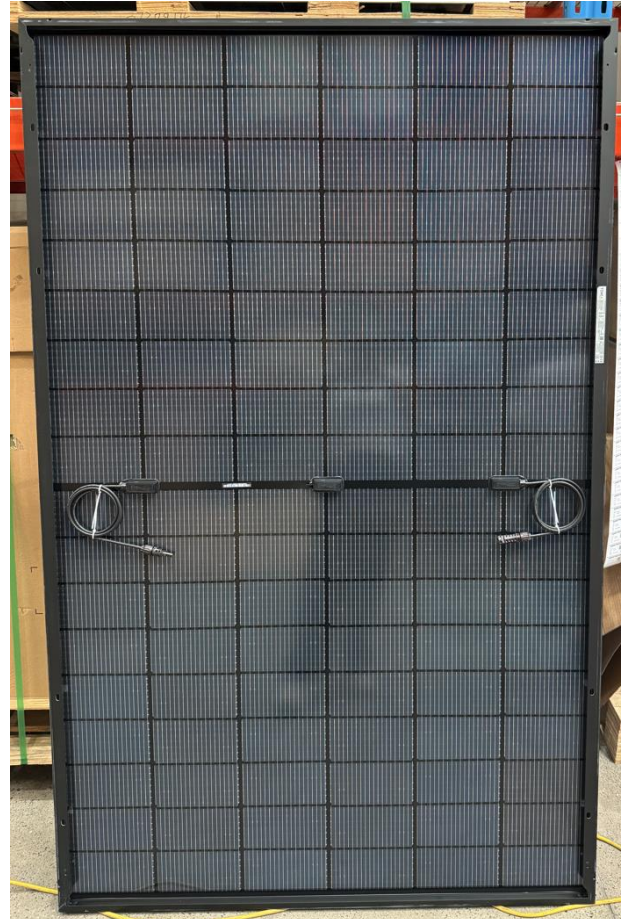


Figure 2: Rear view of test module type GK-3-54HGDb-480M

 高景太阳能 Gokin Solar	Type: GK-3-54HGDb-480M			Power Sorting [W]		0-1 S		Safety Information	WARNING-ELECTRICAL HAZARD This unit produces electricity when exposed to sunlight. Do not disconnect under load! Tested to IEC 61215:2021 and IEC 61708:2021 
		Maximum Power (P _{max}) [W]	480	520	Maximum series fuse [A]	30			
		Maximum Power Voltage (V _{mp}) [V]	33.84	33.85	Maximum system voltage [V]	1500			
		Maximum Power Current (I _{mp}) [A]	14.19	15.37	Min.Design Load [Pa]	+3600/-1600			
		Open Circuit Voltage (V _{oc}) [V]	40.76	40.73	Module(T _a) max[°C]	76			
		Short Circuit Current (I _{sc}) [A]	14.96	16.16	17.80				
Tolerance of P _{max} , I _{sc} and I _{oc} is ±1% STC: from 1000W/m², AM1.5, Cell 25°C; BNPI: from 1000W/m², rear 155W/m²; BS2: from 1000W/m², rear 300W/m²									
				Bifaciality coefficient:	$\frac{P_{max}(R_{cell})}{P_{max}(F_{cell})} \geq 70\%$			Gokin Solar Co., Ltd. Office 1102, No. 58 Huajin Street, Hengqin Free Trade Zone 519000 Zhuhai, Guangdong Province PEOPLE'S REPUBLIC OF CHINA Made in China in 2025.7.18	
				Connector Manufacturer:	Stäubli Electrical connectors AG				
				Connector Type:	EVO2A				

Figure 3: Rating label of test module type GK-3-54HGDb-480M



Figure 4: Junction boxes of test module type GK-3-54HGDb-480M

6.2 Annex 2: EL-imaging

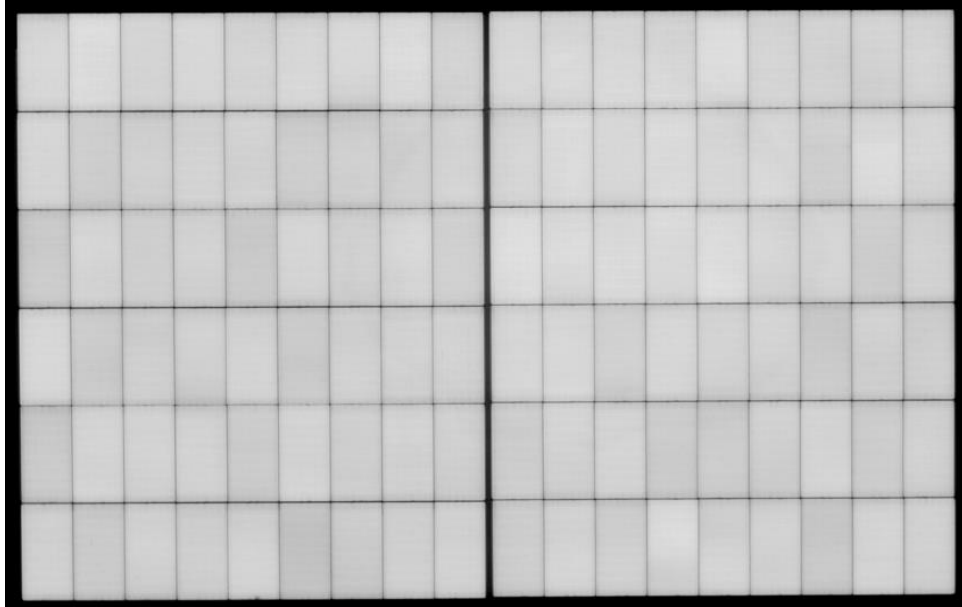


Figure 5: EL-image of sample #1 (initial)

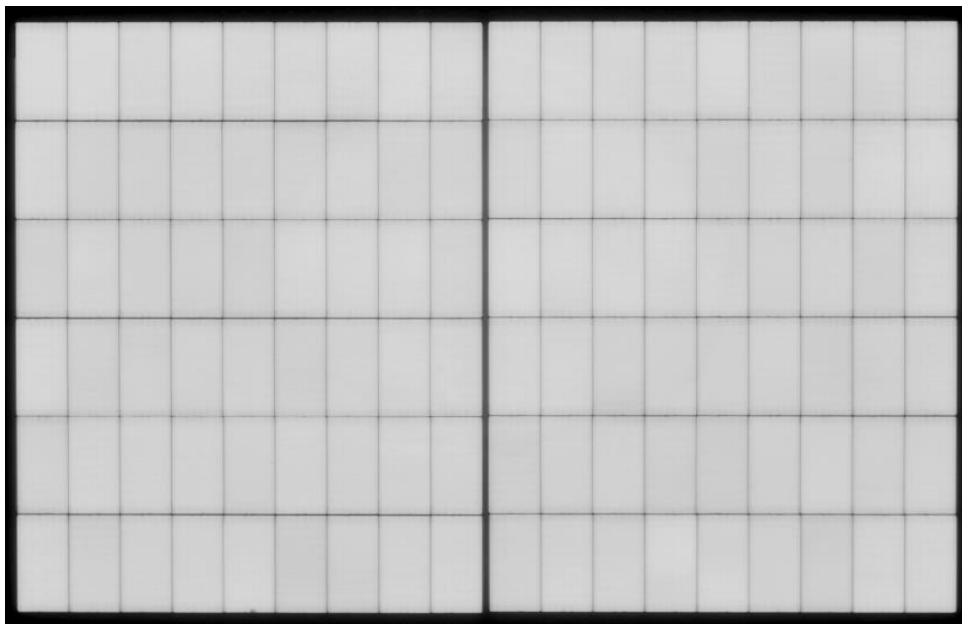


Figure 6: EL-image of sample #1 (after HI test)

End of Test Report