





<b>Prüfbericht-Nr.:</b> Test report no.:	<b>CN236B78 001</b>	<b>Auftrags-Nr.:</b> Order no.:	244515531	Seite 1 von 18 Page 1 of 18
<b>Kunden-Referenz-Nr.:</b> Client reference no.:	2496578	<b>Auftragsdatum:</b> Order date:	16/05/2023	
<b>Auftraggeber:</b> Client:	<b>Sany Silicon Energy (Zhuzhou) Co., Ltd.</b> Room 518-50, Building 1, Longxin International, No.255, Tongxia Road, Tongtangwan Street, Shifeng District, 412005 Zhuzhou City, Hunan Province, P.R. China			
<b>Prüfgegenstand:</b> Test item:	Photovoltaic (PV) module			
<b>Bezeichnung / Typ-Nr.:</b> Identification / Type no.:	See module type designation on page 3			
<b>Auftrags-Inhalt:</b> Order content:	Dust and sand test for photovoltaic (PV) modules			
<b>Prüfgrundlage:</b> Test specification:	IEC 60068-2-68:1994 Environmental testing for electric and electronic products-Part 2: Test methods-Test L: Dust and sand			
<b>Wareneingangsdatum:</b> Date of sample receipt:	30/05/2023			
<b>Prüfmuster-Nr.:</b> Test sample no.:	Refer to page 5			
<b>Prüfzeitraum:</b> Testing period:	14/06/2023 - 17/06/2023			
<b>Ort der Prüfung:</b> Place of testing:	Refer to page 4			
<b>Prüflaboratorium:</b> Testing laboratory:	TÜV Rheinland (Shanghai) Co., Ltd.			
<b>Prüfergebnis*:</b> Test result*:	Pass			
<b>geprüft von:</b> tested by:	<input checked="" type="checkbox"/> 	<b>genehmigt von:</b> authorized by:	<input checked="" type="checkbox"/> 	
<b>Datum:</b> Date:	23/10/2023	<b>Ausstellungsdatum:</b> Issue date:	23/10/2023	
<b>Stellung / Position:</b>	Project Engineer	<b>Stellung / Position:</b>	Authorizer	
<b>Sonstiges /</b> Other:	<ul style="list-style-type: none"> <li>- Basic qualification for module types listed on page 3.</li> <li>- Valid only for the material combinations as listed in Constructional Data Form (CDF) No. CN236B78 001.</li> <li>- The required tests were performed according to the standard IEC 60068-2-68:1994 and the given pass criteria is according to IEC 61215-2:2016 &amp; IEC 61730-2:2016.</li> </ul> 			
<b>Zustand des Prüfgegenstandes bei Anlieferung:</b> Condition of the test item at delivery:	Prüfmuster vollständig und unbeschädigt Test item complete and undamaged			
* Legende:	P(ass) = entspricht o.g. Prüfgrundlage(n)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
* 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
<p><b>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.</b>  <i>This test report only relates to the above mentioned 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>				

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**Anmerkungen**  
Remarks

1	<p>Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben.</p> <p>Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</p> <p><i>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</i></p>
2	<p>Wie vertraglich vereinbart, wurde dieses Dokument nur digital unterzeichnet. Der TÜV Rheinland hat nicht überprüft, welche rechtlichen oder sonstigen diesbezüglichen Anforderungen für dieses Dokument gelten. Diese Überprüfung liegt in der Verantwortung des Benutzers dieses Dokuments. Auf Verlangen des Kunden kann der TÜV Rheinland die Gültigkeit der digitalen Signatur durch ein gesondertes Dokument bestätigen. Diese Anfrage ist an unseren Vertrieb zu richten. Eine Umweltgebühr für einen solchen zusätzlichen Service wird erhoben.</p> <p><i>As contractually agreed, this document has been signed digitally only. TÜV Rheinland has not verified and unable to verify which legal or other pertaining requirements are applicable for this document. Such verification is within the responsibility of the user of this document. Upon request by its client, TÜV Rheinland can confirm the validity of the digital signature by a separate document. Such request shall be addressed to our Sales department. An environmental fee for such additional service will be charged.</i></p>
3	<p>Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben.</p> <p>Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt.</p> <p><i>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report.</i></p> <p><i>Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i></p>
4	<p>Die Entscheidungsregel für Konformitätserklärungen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird.</p> <p><i>The decision rule for statements of conformity in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report.</i></p>

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**Produktbeschreibung**  
Product description

1	<b>Produktdetails</b> Product details	<p><b>New model types:</b></p> <p><b>Max. system voltage: up to 1500 VDC (Voc at STC):</b></p> <p><b>With ½ cut of mono c-Si cells:</b></p> <p><b>SYMN144TBDxxx (xxx=555-580, in steps of 5, 144 cells)</b></p> <p><b>SYMN120TBDxxx (xxx=455-475, in steps of 5, 120 cells)</b></p> <p><b>SYMN108TBDxxx (xxx=415-435, in steps of 5, 108 cells)</b></p> <p><b>xxx represents output power in Wp</b></p>											
2	<b>Verwendete Materialien</b> Used materials	see Constructional Data Form (CDF) no. CN236B78 001											
3	<b>Adresse(n) der Fertigungsstätte(n)</b> Address(es) of the manufacturing site(s)	<table border="1"> <tr> <td>Name / Description:</td> <td>Sany Silicon Energy (Zhuzhou) Co., Ltd.</td> </tr> <tr> <td>Street:</td> <td>Sany Energy Equipment Industrial Park, No.320 Qingshui Road, Shifeng District</td> </tr> <tr> <td>Postcode / City, Country:</td> <td>412005 / Zhuzhou City, Hunan Province, P.R. China</td> </tr> <tr> <td>Type of production:</td> <td>Crystalline PV-module</td> </tr> <tr> <td>Inspection report No. and date</td> <td>CN23RWL8 001 / 11/05/2023</td> </tr> </table>	Name / Description:	Sany Silicon Energy (Zhuzhou) Co., Ltd.	Street:	Sany Energy Equipment Industrial Park, No.320 Qingshui Road, Shifeng District	Postcode / City, Country:	412005 / Zhuzhou City, Hunan Province, P.R. China	Type of production:	Crystalline PV-module	Inspection report No. and date	CN23RWL8 001 / 11/05/2023	
Name / Description:	Sany Silicon Energy (Zhuzhou) Co., Ltd.												
Street:	Sany Energy Equipment Industrial Park, No.320 Qingshui Road, Shifeng District												
Postcode / City, Country:	412005 / Zhuzhou City, Hunan Province, P.R. China												
Type of production:	Crystalline PV-module												
Inspection report No. and date	CN23RWL8 001 / 11/05/2023												
4	<b>Sonstiges</b> Other	Test sample(s), as well sample information, description, product details and intended usage was provided by customer. Throughout this report a point is used as the decimal separator.											
5	<b>Prüfmusterbereitstellung</b> Test sample obtaining	<input checked="" type="checkbox"/> Sending by customer <input type="checkbox"/> Sampling by TÜV Rheinland Group  <input type="checkbox"/> others:											

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**Produktbeschreibung**  
Product description

**6 Zusammenfassung der Prüfergebnisse**  
Summary of test results

According to the inquiry the resistance to dust and sand of photovoltaic (PV) modules should be accessed in accordance with IEC 60068-2-68:1994.

The tests documented within this test report were performed according to IEC 60068-2-68:1994, the related pass criteria is according to IEC 61215-2:2016 & IEC 61730-2:2016 which is listed as below:

- Visual inspection (MQT 01 / MST 01)
- Maximum power determination (MQT 02 / MST 02)
- Insulation test (MQT 03 / MST 16)
- Wet leakage current test (MST 17)
- Continuity test of equipotential bonding (MST 13)
- Bypass diode functionality test (MST 07)

- Basic qualification for model types listed in section 1. The relevant tests were performed on SYMN144TBDxxx with bill of materials as listed on page 5 as representative. The test results are documented within this test report.

- The differences of module types are as below:

1. SYMN144TBDxxx are for modules with 144 pcs half-cut 182mm Topcon solar cells;
2. SYMN120TBDxxx are for modules with 120 pcs half-cut 182mm Topcon solar cells;
3. SYMN108TBDxxx are for modules with 108 pcs half-cut 182mm Topcon solar cells

- The materials and combinations in below table have been approved on module in main license with certificate PV 50587008. No additional testing is considered necessary.

Object	Manufacturer	Type / model	Technical data / ratings
Cell connectors	Changzhou Sheng Yue metal new material Co., Ltd.	Sn60Pb40	Ø= 0.26±0.01mm
String connectors	Changzhou Sheng Yue metal new material Co., Ltd.	Sn60Pb40	T(mm) x L(mm): 0.3mm x 6.0mm 0.3mm x 4.0mm
Fluxing agent	Zhuhai Changxian New Materials Technology Co., Ltd	CX700	—
Fixing tape	Guangdong Sunrui New Material Co., Ltd.	HZ UV-100	Thickness= 100µm±40µm

The test report is valid only for the materials as listed in Constructional Data Form (CDF) No. CN236B78 001.

This test report includes measurement reports, EL images and photos in the appendix.

*Summary of test location:*

All tests were performed at China Testing & Certification International Group Co., Ltd., China Photovoltaic Product Test Center, with the address No.1, South side of Yanmi Road, economic development zone, Miyun District, Beijing, P.R. China.

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**Produktbeschreibung**  
*Product description*

**Setting of tasks:**

According to the IEC 60068-2-68:1994 standard, following measurements shall be performed for each combination:

- Initial visual inspection according to MQT01 of IEC 61215-2:2016 (3 PV modules)
- Initial maximum power determination according to MQT02 of IEC 61215-2:2016 (3 PV modules)
- Initial measurement of insulation test according to MQT03 of IEC 61215-2:2016 (3 PV modules)
- Initial measurement of wet leakage current test according to MQT15 of IEC 61215-2:2016 (3 PV modules)
- Initial ground continuity test according to MST 13 of IEC 61730-2:2016 (3 PV modules)
- Initial electroluminescence measurement (3 PV modules)
- Dust and sand test according to IEC60068-2-68:1994 (2 PV modules)  
(Test condition: Method Lc2; Chamber temperature: 41.8~43.5°C /42.1~43.3°C; Humidity: 4.5~5.7%/4.3~5.4%; Dust/sand type: Quart, 95% SiO<sub>2</sub>; Particle size: Average 0.5mm; Speed: 18.6~20.4m/s / 19.1~20.4m/s; Dust/sand concentration: 4.8-5.3g/m<sup>3</sup>; Duration: 240 min for front side and 240min for rear side)
- Final visual inspection according to MQT01 of IEC 61215-2:2016 (2 PV modules)
- Final maximum power determination according to MQT02 of IEC 61215-2:2016 (2 PV modules)
- Final measurement of insulation test according to MQT03 of IEC 61215-2:2016 (2 PV modules)
- Final measurement of wet leakage current test according to MQT15 of IEC 61215-2:2016 (2 PV modules)
- Final ground continuity test according to MST 13 of IEC 61730-2:2016 (2 PV modules)
- Final bypass diode functionality test according to MST 07 of IEC 61730-2:2016 (2 PV modules)
- Final electroluminescence measurement (2 PV modules)

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**Produktbeschreibung**  
*Product description*

**Reference standards are as follows:**

- IEC 60068-2-68:1994 Environmental testing for electric and electronic products-Part 2: Test methods-Test L: Dust and sand.
- IEC 61215-2:2016 Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval.
- IEC 61730-2:2016 Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing.

**General information**

**Abbreviations used in the report:**

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		

**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)

**Date(s) of performance of tests.....:** 14/06/2023 - 17/06/2023

**General remarks:**

The test verdicts presented in this report relate only to the object tested.  
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.  
“(see Enclosure #)” refers to additional information appended to the report.  
“(see appended table)” refers to a table appended to the report.  
Throughout this report a point is used as the decimal separator.

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Absatz Clause	Anforderungen - Prüfungen / Requirements - Tests	Messergebnisse – Bemerkungen / Measuring results - Remarks	Ergebnis Result
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—	List of test samples Module type: SYMN144TBD565		
Sample no.	Sample SN	Remarks / constructional characteristics (e.g. cell, backsheet, frame type)	—
1	230401D230201	Front cover: 2.0mm External AR Coating Tempered Glass from Hunan Kibing Solar Technology Co., Ltd. Encapsulation material: EP304 (between glass and cell) / F406PS (between cell and back glass) from HANGZHOU FIRST APPLIED MATERIAL CO., LTD. Rear cover: 2.0mm Semi-Tempered back glass from Hunan Kibing Solar Technology Co., Ltd. Solar Cell: SYCN182T16 from Sany Silicon Energy (Zhuzhou) Co., Ltd. Frame: 30mm, 6005-T6 from CHANGSHU DONGNENG SOLAR TECHNOLOGY CO., LTD	
2	230401D230215	Adhesive of frame sealing: HT906Z from Shanghai Huitian New Material Co., Ltd. Cell connector: Φ0.26mm Sn60/Pb40 from Suzhou YourBest New-type Materials Co., Ltd. String connector: 6.0mm x 0.3mm, 4.0mm x 0.3mm Sn60/Pb40 from Suzhou YourBest New-type Materials Co., Ltd. Fluxing agent: SF180 from ASAHI SOLDER TECHNOLOGY(WUXI) CO., LTD Fixing Tape: D60F6-2 from SuZhou Rongzhi Electronic Technology Co., Ltd Junction box: 3Qxy from QC Solar (Suzhou) Corporation	
3	230401D230216	Cable: 62930 IEC 131 1 x 4.0mm2 from QC Solar (Suzhou) Corporation Connector: QC4.10-cds from QC Solar (Suzhou) Corporation Bypass diode: QCM4045 from QC Solar (Suzhou) Corporation Adhesive of J-Box sealing: HT906Z from Shanghai Huitian New Material Co., Ltd. Potting Material in junction box: 5299W-S from Shanghai Huitian New Material Co., Ltd.	
Remark: Sample # 1 was tested as reference module.			

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Absatz Clause	Anforderungen - Prüfungen / Requirements - Tests	Messergebnisse – Bemerkungen / Measuring results - Remarks	Ergebnis Result
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### Test sequence and test sample requirement



<b>Absatz</b> <i>Clause</i>	<b>Anforderungen - Prüfungen /</b> <i>Requirements - Tests</i>	<b>Messergebnisse –</b> <b>Bemerkungen /</b> <i>Measuring results - Remarks</i>	<b>Ergebnis</b> <i>Result</i>
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10.1	Visual inspection (Initial)-MQT 01/MST 01		
Test date (dd/mm/yyyy)		14/06/2023	
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			

10.2	Maximum power determination (Initial)-MQT 02/MST 03						
Test date (dd/mm/yyyy)			14/06/2023				—
Test method			<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight				
Ambient temperature [°C]			25 ± 2				
Irradiance [W/m²]			1000 ± 10				
Module temperature [°C]			25 ± 2				
Sample no.	P <sub>max</sub> [W]	V <sub>mpp</sub> [V]	I <sub>mpp</sub> [A]	V <sub>oc</sub> [V]	I <sub>sc</sub> [A]	FF [%]	
1	556.6	43.30	12.856	51.55	13.501	80.0	N/A
2	554.5	43.22	12.829	51.54	13.456	80.0	N/A
3	555.8	43.27	12.845	51.50	13.514	79.9	N/A
Supplementary information: N/A							

10.3	Insulation test (Initial)-MQT 03/MST 16					
Test date (dd/mm/yyyy)				14/06/2023		—
Maximum system voltage [V <sub>DC</sub> ]				1500		
High voltage applied [V <sub>DC</sub> ]				8000		
Insulation resistance measured at [V <sub>DC</sub> ]				1500		
Sample no.	R <sub>iso</sub> [GΩ]	A [m²]	R <sub>iso</sub> •A [GΩ•m²]	Dielectric breakdown		
				Yes (description)	No	
1	>15.00	2.58	>38.70	-	No	P
2	>15.00	2.58	>38.70	-	No	P
3	>15.00	2.58	>38.70	-	No	P
Supplementary information: Minimum requirement is 0.04 GΩ•m² for A > 0.1 m² and 0.4 GΩ for A ≤ 0.1 m². Insulation tester can measure up to 15.00 GΩ.						

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Absatz Clause	Anforderungen - Prüfungen / Requirements - Tests	Messergebnisse – Bemerkungen / Measuring results - Remarks	Ergebnis Result
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10.15	Wet leakage current test (Initial)-MST17			
Test date (dd/mm/yyyy)		14/06/2023		—
Insulation resistance measured at [V <sub>DC</sub> ]		1500		
Solution resistivity [Ω·cm]		≤ 3500		
Solution temperature [°C]		22 ± 2		
Sample no.	R <sub>iso</sub> [MΩ]	A [m²]	R <sub>iso</sub> ·A [MΩ·m²]	
1	>15000.0	2.58	>38700.0	P
2	>15000.0	2.58	>38700.0	P
3	>15000.0	2.58	>38700.0	P
Supplementary information: Minimum requirement is 40 MΩ·m². Insulation tester can measure up to 15000.0 MΩ.				

MST 13	Ground continuity test (Initial)-MST13		
Test date (dd/mm/yyyy)	14/06/2023		—
Maximum overcurrent protection rating [A]	25		
Current applied [A]	62.5		
Location of designated grounding point	Grounding point of the long edge		
Location of second contacting point	The greatest physical displacement of adjacent side		
Sample no.	Voltage [V]	Resistance [Ω]	
1	—	<0.001	P
2	—	<0.001	P
3	—	<0.001	P
Supplementary information: N/A			

—	EL-images (Initial)		
Test date [DD/MM/YYYY]		14/06/2023	—
Forward bias current [A].....:		13.500/13.460/13.510	—
Sample No	Remarks		—
1	N/A		N/A
2	N/A		N/A
3	N/A		N/A
Supplementary information: Refer to EL-images of the appendix for more details.			

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<b>Absatz</b> <i>Clause</i>	<b>Anforderungen - Prüfungen /</b> <i>Requirements - Tests</i>	<b>Messergebnisse –</b> <b>Bemerkungen /</b> <i>Measuring results - Remarks</i>	<b>Ergebnis</b> <i>Result</i>
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—	<b>Dust and sand test</b>			
Test Date [DD/MM/YYYY / DD/MM/YYYY] .....	15/06/2023 - 16/06/2023			—
Sample No.....	2, 3			—
Cell interconnection circuit.....	<input type="checkbox"/> S	<input checked="" type="checkbox"/> SP	<input type="checkbox"/> SPS	—
Chamber temperature [°C] .....	41.3~42.1 / 43.1~43.4			—
Chamber relative humidity [%].....	4.4~5.4 / 4.7~5.4			—
Method Lc1 or Lc2.....	Lc2			—
Dust/sand type and composition.....	Quartz, 95% SiO <sub>2</sub>			—
Particle size.....	Average 0.5mm			—
Dust/sand concentration [g/m <sup>3</sup> ] .....	4.8~5.3 / 5.1~5.2			—
Wind speed [m/s] .....	19.2~19.3 / 19.4~19.6			—
Duration [min] .....	240 min for front side + 240 min for rear side			—
Supplementary information: N/A				

10.1	Visual inspection (Final)-MQT 01/MST01		
Test date (dd/mm/yyyy)		17/06/2023	
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			

10.2	Maximum power determination (Final)-MQT 02/MST 03							
Test date (dd/mm/yyyy)				17/06/2023				—
Test method				<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight				
Ambient temperature [°C]				25 ± 2				
Irradiance [W/m²]				1000 ± 10				
Module temperature [°C]				25 ± 2				
Sample no.	P <sub>max</sub> [W]	V <sub>mpp</sub> [V]	I <sub>mpp</sub> [A]	V <sub>oc</sub> [V]	I <sub>sc</sub> [A]	FF [%]	Degradation [%]	
2	551.5	43.04	12.814	51.51	13.444	79.6	-0.54	P
3	552.0	42.93	12.860	51.48	13.478	79.6	-0.68	P
Supplementary information: N/A								

<b>Absatz</b> <i>Clause</i>	<b>Anforderungen - Prüfungen /</b> <i>Requirements - Tests</i>	<b>Messergebnisse –</b> <b>Bemerkungen /</b> <i>Measuring results - Remarks</i>	<b>Ergebnis</b> <i>Result</i>
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10.3	Insulation test (Final)-MQT 03/MST16					
Test date (dd/mm/yyyy)				17/06/2023		—
Maximum system voltage [V <sub>DC</sub> ]				1500		
High voltage applied [V <sub>DC</sub> ]				8000		
Insulation resistance measured at [V <sub>DC</sub> ]				1500		
Sample no.	R <sub>iso</sub> [GΩ]	A [m²]	R <sub>iso</sub> ·A [GΩ·m²]	Dielectric breakdown		
				Yes (description)	No	
2	>15.00	2.58	>38.70	-	No	P
3	>15.00	2.58	>38.70	-	No	P
Supplementary information: Minimum requirement is 0.04 GΩ·m² for A > 0.1 m² and 0.4 GΩ for A ≤ 0.1 m². Insulation tester can measure up to 15.00 GΩ.						

10.15	Wet leakage current test (Final)-MST17			
Test date (dd/mm/yyyy)		17/06/2023		—
Insulation resistance measured at [V <sub>DC</sub> ]		1500		
Solution resistivity [ $\Omega \cdot \text{cm}$ ]		$\leq 3500$		
Solution temperature [ $^{\circ}\text{C}$ ]		$22 \pm 2$		
Sample no.	R <sub>iso</sub> [M $\Omega$ ]	A [m <sup>2</sup> ]	R <sub>iso</sub> •A [M $\Omega \cdot \text{m}^2$ ]	
2	>15000.0	2.58	>38700.0	P
3	>15000.0	2.58	>38700.0	P
Supplementary information: Minimum requirement is 40 M $\Omega \cdot \text{m}^2$ . Insulation tester can measure up to 15000.0 M $\Omega$ .				

<b>MST 13</b>	<b>Ground continuity test (Final)-MST13</b>		
Test date (dd/mm/yyyy)	17/06/2023		—
Maximum overcurrent protection rating [A]	25		
Current applied [A]	62.5		
Location of designated grounding point	Grounding point of the long edge		
Location of second contacting point	The greatest physical displacement of adjacent side		
Sample no.	Voltage [V]	Resistance [ $\Omega$ ]	
2	—	<0.001	P
3	—	<0.001	P
Supplementary information: N/A			

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<b>Absatz</b> <i>Clause</i>	<b>Anforderungen - Prüfungen /</b> <i>Requirements - Tests</i>	<b>Messergebnisse –</b> <b>Bemerkungen /</b> <i>Measuring results - Remarks</i>	<b>Ergebnis</b> <i>Result</i>
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—	Bypass diode functional test (Final)-MST07			
Test date (dd/mm/yyyy)		17/06/2023		—
Number of diodes in junction box		3		
Diode manufacturer		QC Solar (Suzhou) Corporation		
Diode type designation		QCM4045		
Max. permissible junction temperature T <sub>jmax</sub> [°C] (according to diode datasheet)		110		
Sample no.	Diode 1	Diode 2	Diode 3	
2	working properly	working properly	working properly	P
3	working properly	working properly	working properly	P
Supplementary information: N/A				

—	EL-images (Final)		
Test date [DD/MM/YYYY]		17/06/2023	—
Forward bias current [A] ..... :		13.460/13.510	—
Sample No	Remarks		—
2	N/A		N/A
3	N/A		N/A
Supplementary information: Refer to EL-images of the appendix for more details.			

--- Ende des Prüfberichts / End of Test Report ---

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**ZUSATZ-DOKUMENTATION**  
ADDITIONAL DOCUMENTATION

**Appendix A: Measurement reports**

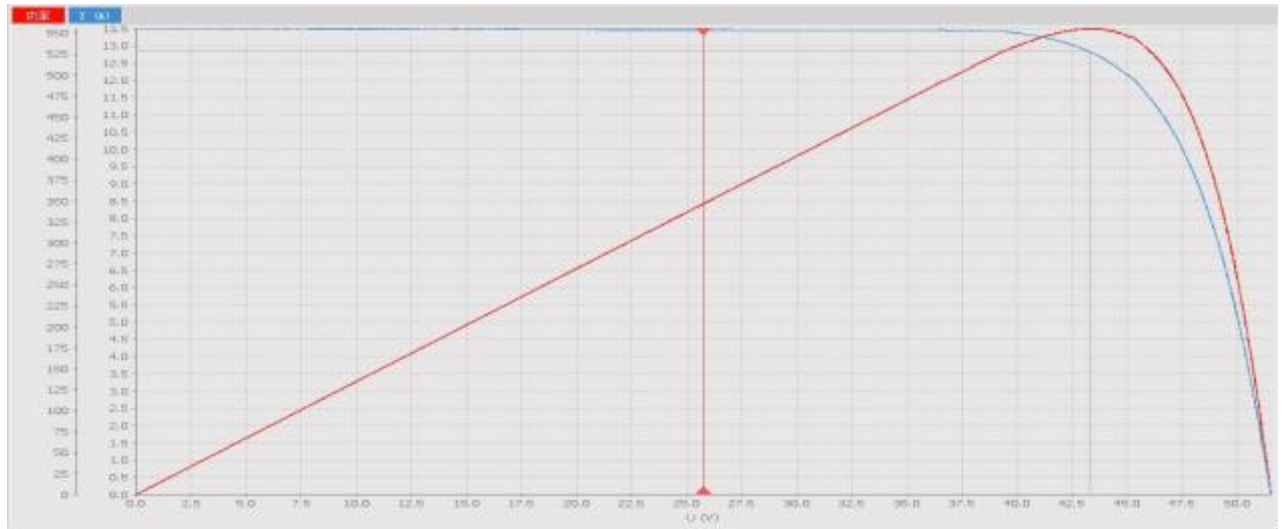


Fig. 1: IV-curves of serial no. 230401D230201 (initial)

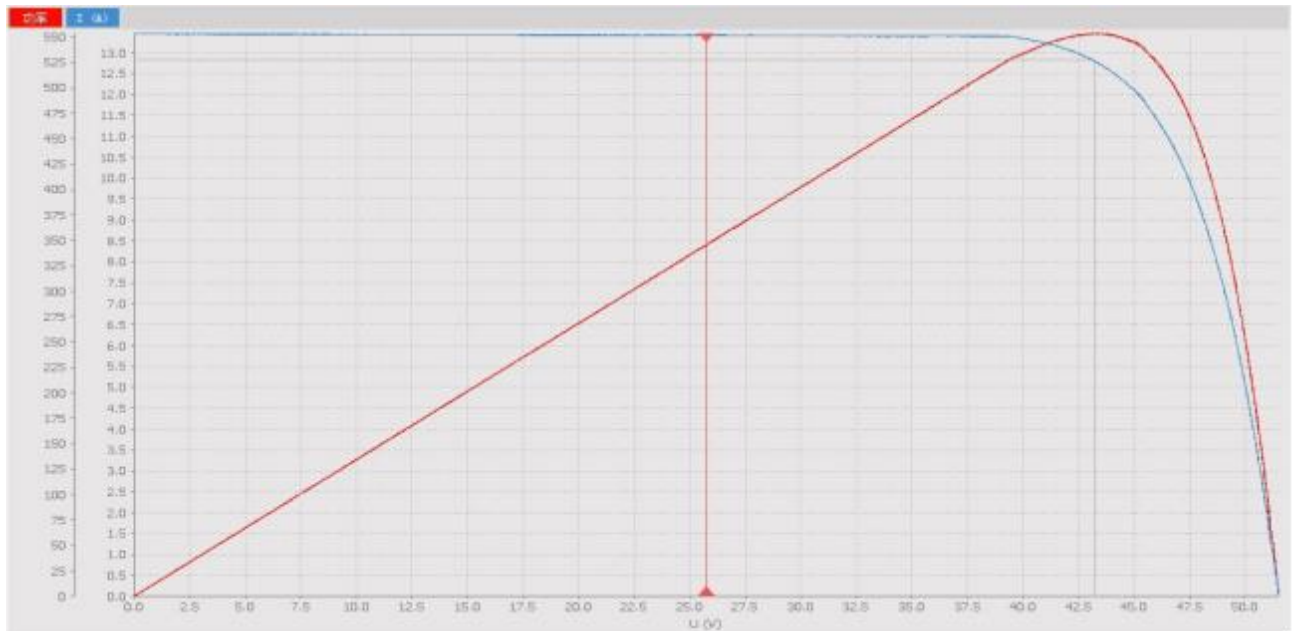


Fig. 2: IV-curves of serial no. 230401D230215 (initial)

**ZUSATZ-DOKUMENTATION**  
ADDITIONAL DOCUMENTATION

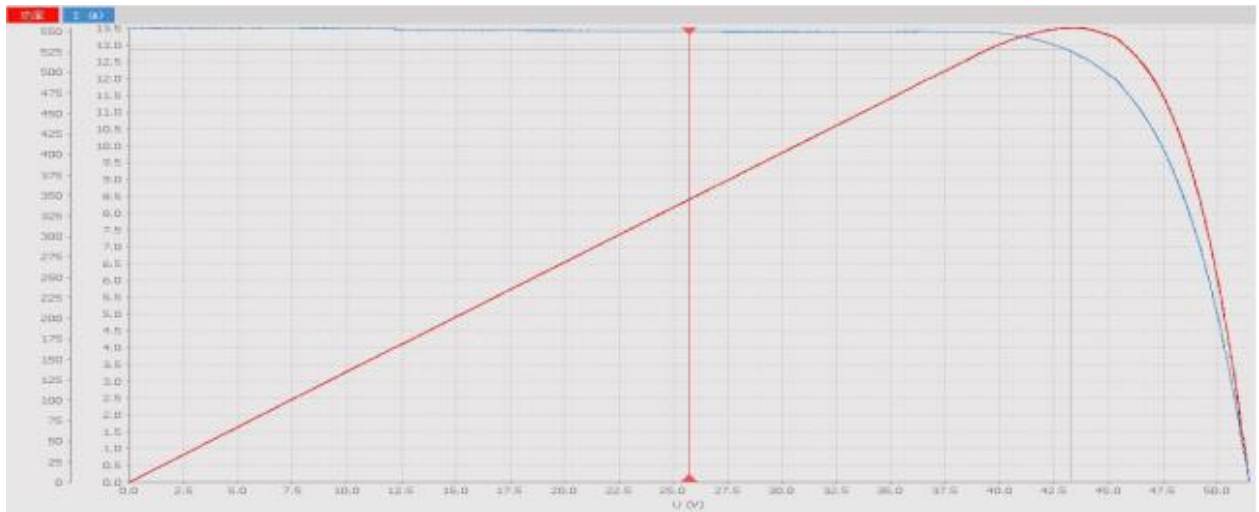


Fig. 3: IV-curves of serial no. 230401D230216 (initial)

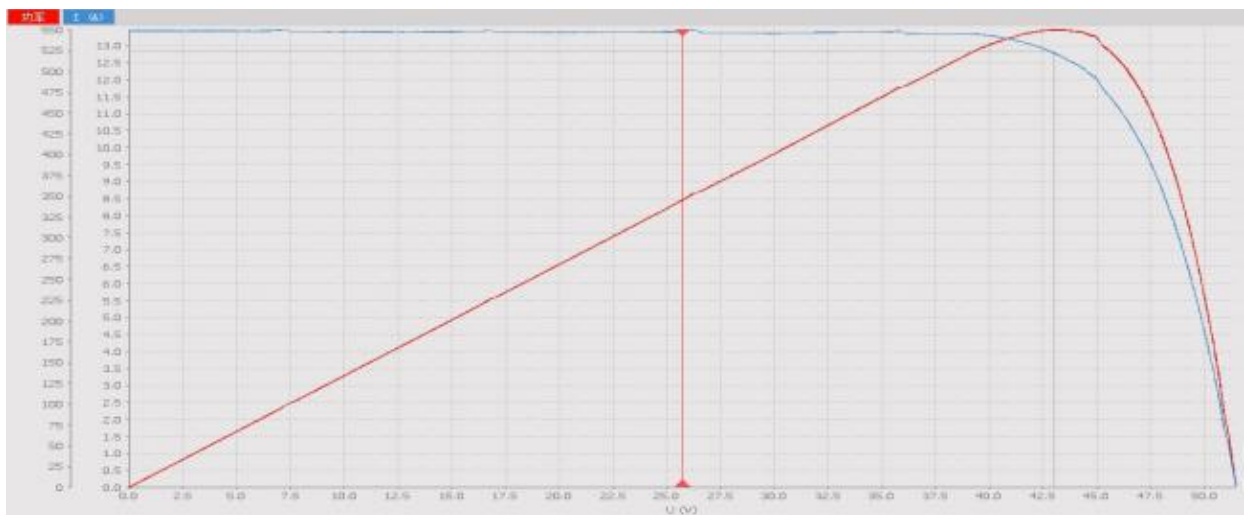


Fig. 4: IV-curves of serial no. 230401D230215 (final)

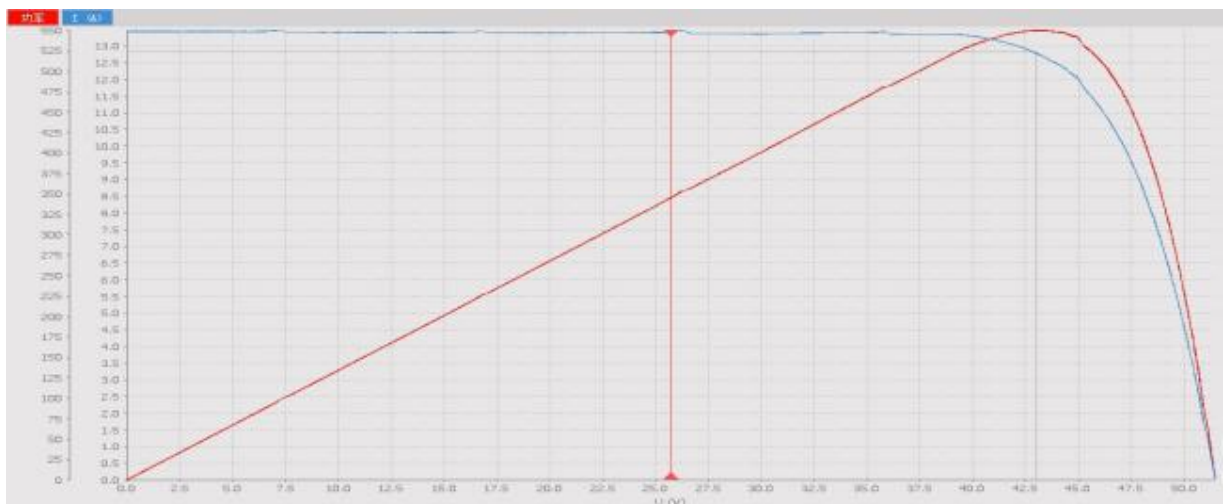


Fig. 5: IV-curves of serial no. 230401D230216 (final)

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**ZUSATZ-DOKUMENTATION**  
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**Appendix B: EL-images**

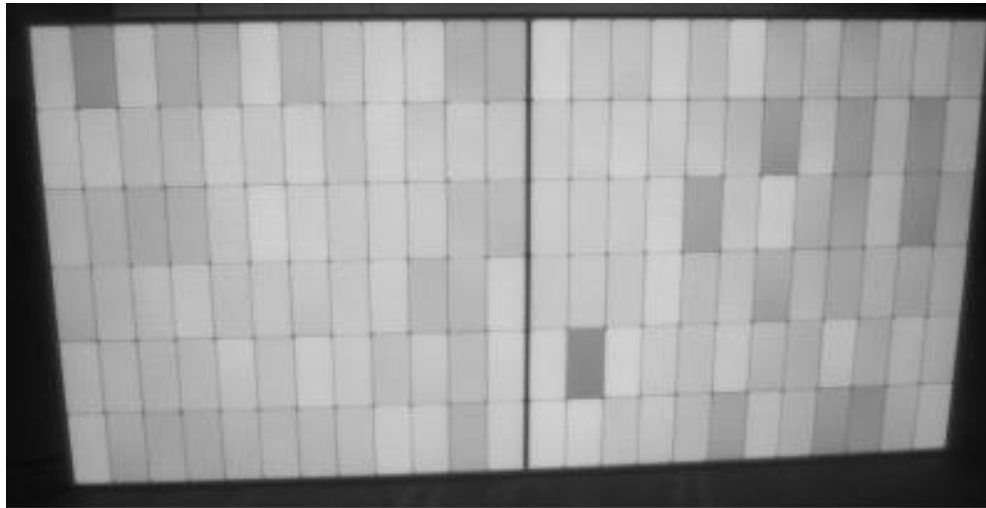


Fig. 6: EL image of serial no. 230401D230201 (initial)

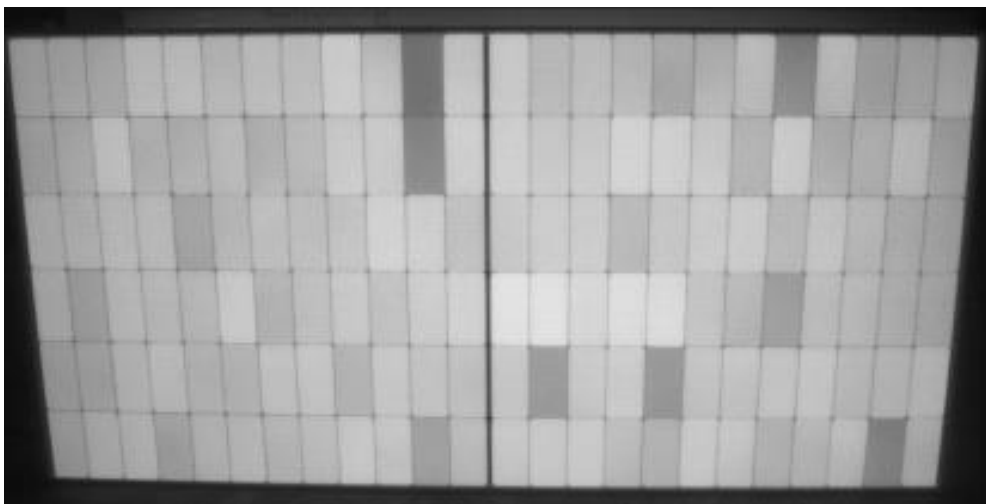
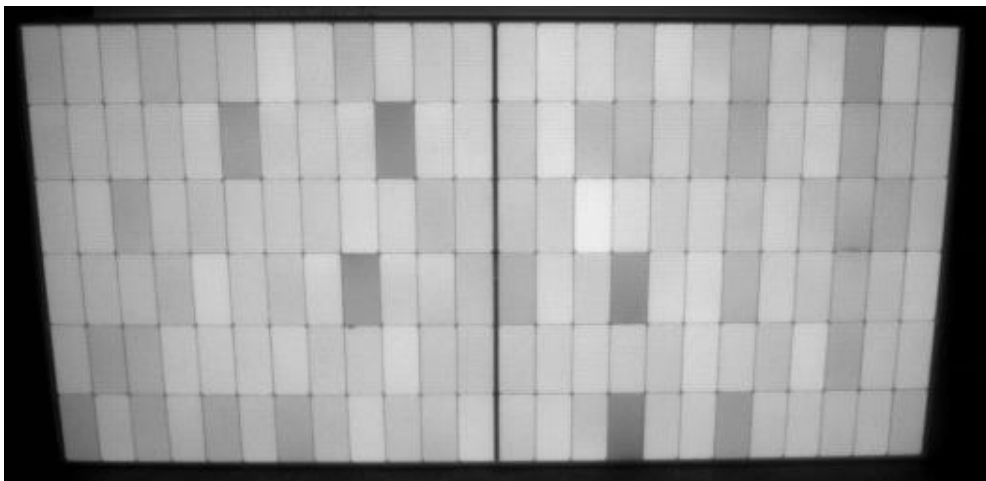


Fig. 7: EL image of serial no. 230401D230215 (initial)



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Fig. 8: EL image of serial no. 230401D230216 (initial)

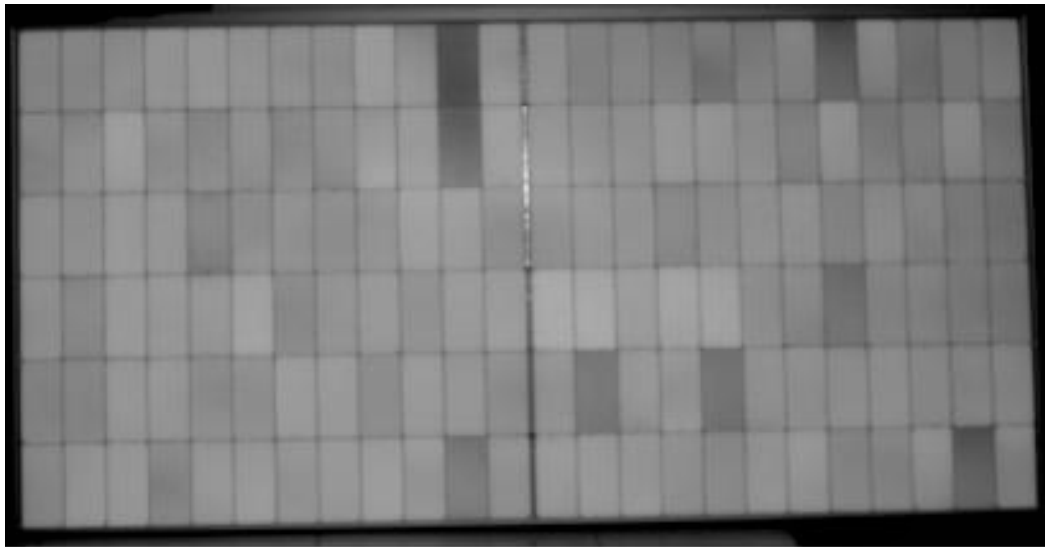


Fig. 9: EL image of serial no. 230401D230215 (final)

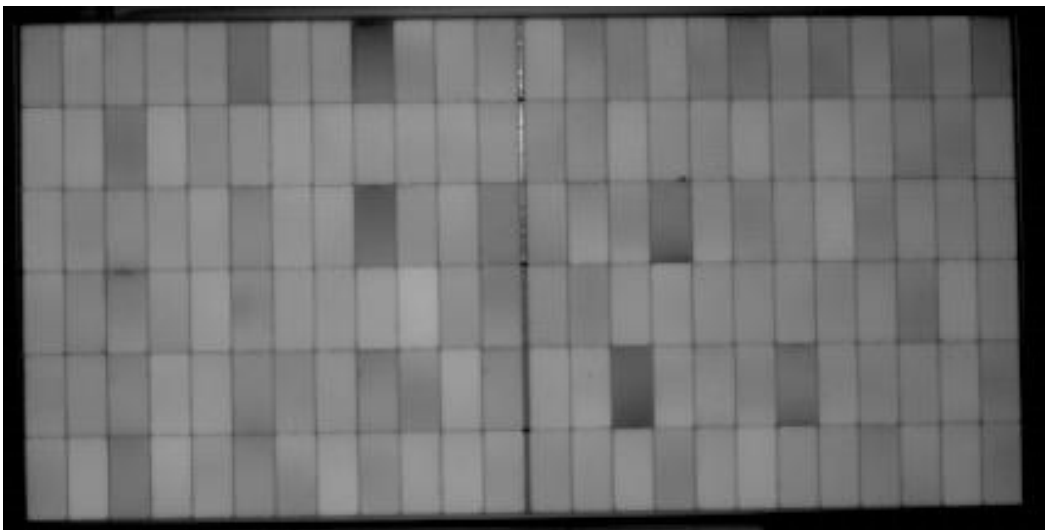


Fig. 10: EL image of serial no. 230401D230216 (final)

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FOTO-DOKUMENTATION  
PHOTO DOCUMENTATION

Appendix C: Photos



Fig. 11: front view of test sample



Fig. 12: rear view of test sample



**PV MODULE**  
Sany Silicon Energy (Zhuzhou) Co., LTD  
Sany Energy Equipment Industrial Park,  
No.320 Qingshui Road, Shifeng District,  
Zhuzhou City, Hunan Province  
412005 China  
www.sanygroup.com/

**SYM144TBD565**  
Max. power (P<sub>max</sub>)  
Max. power tolerance  
Voltage at max. power (V<sub>mpp</sub>)  
Current at max. power (I<sub>mpp</sub>)  
Open-circuit voltage (V<sub>oc</sub>)  
Short-circuit current (I<sub>sc</sub>)  
Maximum system voltage

565W  
±3%  
42.14V  
13.41A  
50.87V ±3%  
14.19A ±3%  
1500VDC

bifaciality  
Series Fuse Rating  
operating temperature range  
protect rage  
module wprotecteight  
module size  
STC  
80 ± 5%  
30A  
40°C ~ +85°C  
II  
32.0(kg)  
2278 × 1134 × 30(mm)  
1000W/m², AM1.5, 25°C



warning

Only the professionals can install and maintain the components Be careful of the dangerous high DC voltage when connecting the components Never damage or scratch the back of the assembly

Fig. 13: detail view of type label



Fig. 14: detail view of closed junction box