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Kunden-Referenz-Nr.: Client reference no.:	2496578	Auftragsdatum: Order date:	26/10/2023	
Auftraggeber: Client:	Sany Silicon Energy (Zhuzhou) Co., Ltd. Room 518-50, Building 1, Longxin International, No.255, Tongxia Road, Tongtangwan Street, Shifeng District, Zhuzhou City, 412005, Hunan Province, P.R. China			
Prüfgegenstand: Test item:	Photovoltaic (PV) module			
Bezeichnung / Typ-Nr.: Identification / Type no.:	See module type designation on page 3			
Auftrags-Inhalt: Order content:	System voltage durability qualification test for photovoltaic (PV) modules			
Prüfgrundlage: Test specification:	2 PfG 2387/01.18 System voltage durability qualification test for crystalline silicon modules and for thin film modules (Potential Induced Degradation (PID))			
Wareneingangsdatum: Date of sample receipt:	28/09/2023			
Prüfmuster-Nr.: Test sample no.:	Refer to page 10-11			
Prüfzeitraum: Testing period:	07/11/2023 - 26/12/2023			
Ort der Prüfung: Place of testing:	Refer to page 7			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (Shanghai) Co., Ltd.			
Prüfergebnis*: Test result*:	Pass			
geprüft von: tested by:	<input checked="" type="checkbox"/> 	genehmigt von: authorized by:	<input checked="" type="checkbox"/> 	
Datum: Date:	08/04/2024	Ausstellungsdatum: Issue date:	08/04/2024	
Stellung / Position:	Project Engineer	Stellung / Position:	Authorizer	
Sonstiges / Other:	<ul style="list-style-type: none"> - Introduce to new model types and extend to power ranges as listed in section 1 based on previously approved model types. - Valid in conjunction with TÜV Rheinland certificate PV 50587008. - Valid only for the material combinations as listed in Constructional Data Form (CDF) No. CN23SHR7 003 			
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:	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</p> <p>* 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>				
<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.</p> <p><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. Informationen zur Verifizierung der Authentizität unserer Dokumente erhalten Sie auf folgender Webseite: go.tuv.com/digital-signature</p> <p><i>As contractually agreed, this document has been signed digitally only. TUV 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, TUV 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. For information on verifying the authenticity of our documents, please visit the following website: go.tuv.com/digital-signature</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 basierend auf numerischen Messergebnissen 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. Zu weiteren Informationen bezüglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019.</p> <p><i>The decision rule for statements of conformity, based on numerical measurement results, 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. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019.</i></p> |

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Produktbeschreibung
Product description

1	<div>Produktdetails</div> <div>Product details</div>	<div>New model types:</div> <div>Max. system voltage: up to 1500 VDC (Voc at STC):</div> <div>With ½ cut of mono c-Si cells:</div> <div>SYMN144R01TBDxxx (xxx=590-620, in steps of 5, 144 cells)</div> <div>SYMN120R01TBDxxx (xxx=490-520, in steps of 5, 120 cells)</div> <div>SYMN108R01TBDxxx (xxx=440-470, in steps of 5, 108 cells)</div> <div>Extension power range for below model types:</div> <div>Max. system voltage: up to 1500 VDC (Voc at STC):</div> <div>With ½ cut of mono c-Si cells:</div> <div>SYMN144TBDxxx (xxx=585, 144 cells)</div> <div>SYMN120TBDxxx (xxx=480, 485, 120 cells)</div> <div>SYMN108TBDxxx (xxx=440, 108 cells)</div> <div>xxx represents output power in Wp</div> <div>Approved model types:</div> <div>SYMN156TBDxxx (xxx=615-635, in steps of 5, 156 cells)</div> <div>SYMN144TBDxxx (xxx=555-580, in steps of 5, 144 cells)</div> <div>SYMN120TBDxxx (xxx=455-475, in steps of 5, 120 cells)</div> <div>SYMN108TBDxxx (xxx=415-435, in steps of 5, 108 cells)</div> <div>xxx represents output power in Wp</div>										
2	<div>Verwendete Materialien</div> <div>Used materials</div>	Refer to Constructional Data Form (CDF) No. CN23SHR7 003										
3	<div>Adresse der Produktionsstandorte</div> <div>Address(es) of the manufacturing site(s)</div>	<table><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	<div>Sonstiges</div> <div>Other</div>	Test sample(s), as well sample information, description, product details and intended usage was provided by customer.										

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Produktbeschreibung <i>Product description</i>		
5	Prüfmusterbereitstellung: <i>Test sample obtaining:</i>	<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 Potential Induced Degradation of photovoltaic (PV) modules should be assessed in accordance with 2 PfG 2387/01.18. Test condition also fulfill the specification listed in IEC TS 62804-1:2015.

The tests of the requirements of 2 PfG 2387/01.18 were all fulfilled according to its regulations of the pass criteria. The above listed module types have been fully certified according to the IEC 61215/EN IEC 61215 and IEC 61730/EN IEC 61730 standards and it is the prerequisite to be certified Potential Induced Degradation.

Testing is performed according to IEC TS 62804-1:2015. Test duration is 288 hours.

- Introduce to new model types and extension power range as listed in section 1 based on previously approved model types. Relevant tests were performed on representative model types SYMN144R01TBDxxx and test results are documented in this report.

The differences are as below:

SYMN144R01TBDxxx series for module with 144pcs 182.2mm x 95.8mm mono c-Si solar cells under 1500V maximum system voltage.

SYMN120R01TBDxxx series for module with 120pcs 182.2mm x 95.8mm mono c-Si solar cells under 1500V maximum system voltage.

SYMN108R01TBDxxx series for module with 108pcs 182.2mm x 95.8mm mono c-Si solar cells under 1500V maximum system voltage.

- Extension to alternative materials and modifications in below table. The relevant tests were performed on representative models and test results are documented in this test report.

Object	Manufacturer / trademark	Type / model	Technical data / ratings	Representative model for testing
Solar cell	Sany Silicon Energy (Zhuzhou) Co., Ltd.	SYCN18A T16	N type mono c-Si cell with 16 dotted busbars 182.2mmx95.8mm±0.25mm Thickness=130µm±15µm	SYMN144R01 TBD595 (BOM1)
Encapsulation material	Nantong Golden Wrapping Materials Co., Ltd.	GW601 (near glass)	Thickness = 0.5mm±10% gram weight: 400g/m ² ±10%	
		GW801A (near back glass)	Thickness = 0.5mm±10% gram weight: 400g/m ² ±10%	

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Product description

	Frame parts	Jiangyin Chaoyang Photovoltaic Co., Ltd.	Anodized Aluminium Alloy 6005-T6 (Silver)	H(mm) x W(mm): 30x30mm (long frame) 30x15mm (short frame)	
	Adhesive (frame)	Jiangsu Tianchen New Materials CO., LTD	HT-8258	Color: White	
	Cell connectors	Suzhou bonide Photovoltaic Technology Co., Ltd	Sn60Pb40	Ø= 0.26±0.01mm	
	String connectors	Suzhou bonide Photovoltaic Technology Co., Ltd	Sn60Pb40	T(mm) x L(mm): 0.3±0.01mm x 6.0±0.05mm 0.3±0.01mm x 4.0±0.05mm	
	Fixing tape	SuZhou Rongzhi Electronic Technology Co., Ltd	D60F6-6	Thickness= 100µm±40µm	
	Remark: These encapsulation materials can only be used with solar cell SYCN182T16 & SYCN18AT16 from Sany Silicon Energy (Zhuzhou) Co., Ltd.				SYMN156TBD 620 (BOM2)
	Encapsulation material	CHANGZHOU BETTERIAL FILM TECHNOLOGIES CO., LTD	B602M (near glass)	Thickness = 0.5mm±10% gram weight: 400g/m²±10%	
			B601HP (near back glass)	Thickness = 0.5mm±10% gram weight: 400g/m²±10%	
	Frame parts	Jiangsu Jiachen Aluminium Technology Co., Ltd	Anodized Aluminium Alloy 6005-T6 (Silver)	H(mm) x W(mm): 1. 30x33mm (long frame) 30x18mm (short frame) 2. 30x30mm (long frame) 30x15mm (short frame)	
	Adhesive (frame)	Guangzhou Jointas Chemical Co., Ltd.	179W	Color: White	
	Front cover	CSG HOLDING CO., LTD.	Semi-tempered AR coated glass	Thickness =2.0mm±0.2mm	
	Rear cover	CSG HOLDING CO., LTD.	Semi-Tempered back glass	Thickness =2.0mm±0.2mm	
	Cell connectors	Jiangsu Xingdarui Optical Power Co. LTD	Sn60Pb40	Ø= 0.26±0.01mm	
	String connector	Jiangsu Xingdarui	Sn60Pb40	T(mm) x	

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Product description

	s	Optical Power Co. LTD		L(mm): 0.3±0.01mm x 6.0±0.05mm 0.3±0.01mm x 4.0±0.05mm	
	Fluxing agent	Shenzhen Tongfang Electronic New-Material CO., LTD	AATF9800 -MBB	-	
	Fixing tape	Guangdong Sunrui New Material Co., Ltd.	HZ UV-3	Thickness= 100µm±40µm	
	<p>Remark: These encapsulation materials can only be used with solar cell SYCN182T16 & SYCN18AT16 from Sany Silicon Energy (Zhuzhou) Co., Ltd.</p> <p>- Junction box type F20-01 X (Certificate No. R 50576603_CDF No. 01-ZQI-CN22LUL4 001) and F303x Plus (Certificate No. R 50603479_CDF No. 01-Wangander-CN234BDI 002) which has been certified according to standard IEC 62790:2020 including cables, connectors, bypass diodes, potting materials and junction box adhesives matching with backsheets of module. No additional testing is considered necessary.</p> <p>The test report is valid only for the materials as listed in Constructional Data Form (CDF) No. CN23SHR7 003.</p> <p>This test report includes a history of reporting and certification, electroluminescence images, measurement reports and photo documentation in the appendix.</p> <p>Throughout this report a point is used as the decimal separator.</p> <p><i>Summary of test locations:</i></p> <p>All the tests were performed at TÜV Rheinland (Suzhou) Co., Ltd., which is located at No.14 building and north half of No.10 workshop building, No.525, Yuewang Lingang South Road, Pingqian (Taicang) Modern Industrial Park, Shaxi Town, Taicang City, Jiangsu Province, P.R. China.</p>				

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Absatz Clause	Anforderungen - Prüfungen Requirements – Tests 2 PfG 2387/01.18	Messergebnisse – Bemerkungen Measuring results - Remarks	Ergebnis Result
7	Stress levels		
	Crystalline silicon modules		
	Test method chosen: Voltage: module rated system voltage and polarities.	1-A <input type="checkbox"/> 1-B <input checked="" type="checkbox"/> 1-1 <input type="checkbox"/> 1-C <input type="checkbox"/> N/A <input type="checkbox"/>	N/A
	Method 1-A: – Chamber air temperature: 60 °C ± 2°C, – Chamber relative humidity: 85 % ± 3% RH, – Test duration: 96 h dwell at above stated temperature and relative humidity	N/A	N/A
	Method 1-B: – Chamber air temperature: 85 °C ± 2°C, – Chamber relative humidity: 85 % ± 3% RH, – Test duration: 96 h dwell at above stated temperature and relative humidity	Test condition also fulfill the specification listed in IEC TS 62804-1:2015. Test duration: 288 hours dwell at above stated temperature and relative humidity	N/A
	Method 1-1 (Delamination): – Chamber air temperature: 85 °C ± 2°C, – Chamber relative humidity: 85 % ± 3% RH, – Test duration: 250 h dwell at above stated temperature and relative humidity	N/A	N/A
	Method 1-C: – Module temperature: 25 °C ± 1°C, – Relative humidity: < 60%rH. – Dwell duration: 168 h -- Cover the PV module surfaces with an electrically conductive medium (e.g. aluminum foil).	N/A	N/A
	The degradation of maximum STC output power between initial and final power measurement does not exceed 5 %.	See table “Maximum power determination”	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
	There is no visual evidence of a mayor defect as defined in IEC 61215-1:2016 Clause 8.	See table “Visual inspection”	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
	The wet leakage current test (IEC 61215-1:2016 MQT 15) requirements are met.	See table “Wet leakage current test”	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>

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Absatz Clause	Anforderungen - Prüfungen Requirements – Tests 2 PfG 2387/01.18	Messergebnisse – Bemerkungen Measuring results - Remarks	Ergebnis Result
	Thin film modules		
	Test method chosen: Voltage: module rated system voltage and polarities.	2-A <input type="checkbox"/> 2-B <input type="checkbox"/> 2-1 <input type="checkbox"/> N/A <input checked="" type="checkbox"/>	N/A
	Method 2-A : – Chamber air temperature: 85 °C ± 2°C, – Chamber relative humidity: 85 % ± 3% RH, – Test duration: 168 h dwell at above stated temperature and relative humidity,	N/A	N/A
	Method 2-B: – Chamber air temperature: 85 °C ± 2°C, – Chamber relative humidity: 85 % ± 3% RH, – Test duration: 1000 h dwell at above stated temperature and relative humidity,	N/A	N/A
	Method 2-1 (Delamination): – Chamber air temperature: 85 °C ± 2°C, – Chamber relative humidity: 85 % ± 3% RH, – Test duration: 1000 h dwell at above stated temperature and relative humidity	N/A	N/A
	The degradation of maximum STC output power between initial and final power measurement does not exceed 5 % + the maximum degradation of the reference modules. Positive degradation (annealing) of the reference module has been taken into account. Note: For thin film modules, a 10% power loss criterion after 1000 h under damp heat conditions is reasonable.	N/A	P <input type="checkbox"/> F <input type="checkbox"/> N/A <input checked="" type="checkbox"/> N/T <input type="checkbox"/>
	There is no visual evidence of a mayor defect as defined in IEC 61215-1:2016 Clause 8.	N/A	P <input type="checkbox"/> F <input type="checkbox"/> N/A <input checked="" type="checkbox"/> N/T <input type="checkbox"/>
	The wet leakage current test (IEC 61215-1:2016 MQT 15) requirements are met.	N/A	P <input type="checkbox"/> F <input type="checkbox"/> N/A <input checked="" type="checkbox"/> N/T <input type="checkbox"/>

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Absatz Clause	Anforderungen - Prüfungen Requirements – Tests 2 PfG 2387/01.18	Messergebnisse – Bemerkungen Measuring results - Remarks	Ergebnis Result
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1	List of test samples		
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Sample no.	Sample SN	Remarks / constructional characteristics	
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Module type: SYMN144R01TBD595 (BOM1)

1-1	2310012120014	Front cover: 2.0mm Semi-tempered AR coated glass from Hunan Kibing Solar Technology Co., Ltd. Encapsulation material: GW601 (between glass and cell) / GW801A (between cell and back glass) from Nantong Golden Wrapping Materials Co., Ltd. Rear cover: 2.0mm Semi-Tempered back glass from Hunan Kibing Solar Technology Co., Ltd.	—
1-2	2310012120008	Solar Cell: SYCN18AT16 from Sany Silicon Energy (Zhuzhou) Co., Ltd. Frame: 30mm, 6005-T6 from Jiangyin Chaoyang Photovoltaic Co., Ltd. Adhesive of frame sealing: HT-8258 from Jiangsu Tianchen New Materials CO., LTD	
1-3	2310012120006	Cell connector: Ø0.26mm Sn60/Pb40 from Suzhou bonide Photovoltaic Technology Co., Ltd String connector: 6.0mm x 0.3mm, 4.0mm x 0.3mm Sn60/Pb40 from Suzhou bonide Photovoltaic Technology Co., Ltd Fluxing agent: CX700 from Zhuhai Changxian New Materials Technology Co., Ltd	
1-4	2310012120012	Fixing Tape: D60F6-6 from SuZhou Rongzhi Electronic Technology Co., Ltd Junction box: F303x Plus from ZHEJIANG FORSOL ENERGY CO., LTD Cable: 62930 IEC 131 1 x 4.0mm² from ZHEJIANG FORSOL ENERGY CO., LTD Connector: FC4 from ZHEJIANG FORSOL ENERGY CO., LTD	
1-5	2310012120009	Bypass diode: FSL-4050 from ZHEJIANG FORSOL ENERGY CO., LTD Adhesive of J-Box sealing: HT-8258 from Jiangsu Tianchen New Materials CO., LTD Potting Material in junction box: HT-6360 A/B from Jiangsu Tianchen New Materials CO., LTD	

Remark: Samples #1-1 was tested as reference module.

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Module type: SYMN156TBD620 (BOM2)

2-1	2310012085119	<p>Front cover: 2.0mm Semi-tempered AR coated glass from CSG HOLDING CO., LTD.</p> <p>Encapsulation material: B602M (between glass and cell) / B601HP (between cell and back glass) from CHANGZHOU BETTERIAL FILM TECHNOLOGIES CO., LTD</p>	—
2-2	2310012085228	<p>Rear cover: 2.0mm Semi-Tempered back glass from CSG HOLDING CO., LTD.</p> <p>Solar Cell: SYCN182T16 from Sany Silicon Energy (Zhuzhou) Co., Ltd.</p> <p>Frame: 30mm, 6005-T6 from Jiangsu Jiachen Aluminium Technology Co., Ltd</p> <p>Adhesive of frame sealing: 179W from Guangzhou Jointas Chemical Co., Ltd.</p>	
2-3	2310012085219	<p>Cell connector: Ø0.26mm Sn60/Pb40 from Jiangsu Xingdarui Optical Power Co. LTD</p> <p>String connector: 6.0mm x 0.3mm, 4.0mm x 0.3mm Sn60/Pb40 from Jiangsu Xingdarui Optical Power Co. LTD</p>	
2-4	2310012085210	<p>Fluxing agent: AATF9800-MBB from Shenzhen Tongfang Electronic New-Material CO., LTD</p> <p>Fixing Tape: HZ UV-3 from Guangdong Sunrui New Material Co., Ltd.</p> <p>Junction box: F20-01 X from Changshu Friends connector Technology CO., LTD</p> <p>Cable: 62930 IEC 131 1 x 4.0mm² from Changshu Friends connector Technology CO., LTD</p>	
2-5	2310012085256	<p>Connector: PV5e from Changshu Friends connector Technology CO., LTD</p> <p>Bypass diode: 30SQ045 from Changshu Friends connector Technology CO., LTD</p> <p>Adhesive of J-Box sealing: 179W from Guangzhou Jointas Chemical Co., Ltd.</p> <p>Potting Material in junction box: 162 A/B from Guangzhou Jointas Chemical Co., Ltd.</p>	

Remark: Samples #1 was tested as reference module.

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2	Visual inspection (initial)		
Test date (dd/mm/yyyy)		07/11/2023	
Sample no.	Nature and position of initial findings		—
1-1	No major visual defects		P
1-2	No major visual defects		P
1-3	No major visual defects		P
1-4	No major visual defects		P
1-5	No major visual defects		P
2-1	No major visual defects		P
2-2	No major visual defects		P
2-3	No major visual defects		P
2-4	No major visual defects		P
2-5	No major visual defects		P
Supplementary information: N/A			

Absatz <i>Clause</i>	Anforderungen - Prüfungen <i>Requirements – Tests</i> 2 PFG 2387/01.18	Messergebnisse – Bemerkungen <i>Measuring results - Remarks</i>	Ergebnis <i>Result</i>
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3	Maximum power determination (initial)					
Test date (dd/mm/yyyy)			07/12/2023			
Module temperature [°C]			25 ± 2			
Irradiance W/m ²			1000			
Sample no.	P _{max} [W]	V _{mpp} [V]	I _{mpp} [A]	V _{oc} [V]	I _{sc} [A]	FF [%]
1-1	594.7	43.81	13.574	51.72	14.349	80.1
1-2	600.2	44.07	13.621	51.88	14.405	80.3
1-3	600.2	43.88	13.678	51.84	14.416	80.3
1-4	600.2	43.94	13.660	51.84	14.405	80.4
1-5	601.1	43.99	13.664	51.89	14.388	80.5
2-1	616.2	47.85	12.878	56.33	13.644	80.2
2-2	616.8	47.69	12.934	56.08	13.633	80.7
2-3	616.6	47.49	12.983	55.90	13.655	80.8
2-4	617.2	47.56	12.979	56.04	13.658	80.6
2-5	617.6	47.62	12.969	56.12	13.658	80.6
Supplementary information: N/A						

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6	Wet leakage current test (Initial)			
Test date (dd/mm/yyyy)		08/12/2023		—
Insulation resistance measured at [V _{DC}]		1500		
Solution resistivity [Ω cm]		≤ 3500		
Solution temperature [°C]		22 ± 2		
Sample no.	R _{iso} [MΩ]	A [m²]	R _{iso} ·A [MΩ·m²]	Result
1-1	2680.0	2.70	7236.0	P
1-2	1980.0	2.70	5346.0	P
1-3	2520.0	2.70	6804.0	P
1-4	3160.0	2.70	8532.0	P
1-5	3080.0	2.70	8316.0	P
2-1	2160.0	2.80	6048.0	P
2-2	2280.0	2.80	6384.0	P
2-3	2410.0	2.80	6748.0	P
2-4	1960.0	2.80	5488.0	P
2-5	2880.0	2.80	8064.0	P
Supplementary information: Minimum requirement is 40 MΩ·m².				

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7	Electroluminescence images (Initial)		
Test date (dd/mm/yyyy)	08/12/2023	—	
Current applied	Isc ± 5%		
Sample No.	Remarks		
1-1	N/A		
1-2	N/A		
1-3	N/A		
1-4	N/A		
1-5	N/A		
2-1	N/A		
2-2	N/A		
2-3	N/A		
2-4	N/A		
2-5	N/A		
Supplementary information: N/A			

8	Continuity test of equipotential bonding (initial)		
Test date (dd/mm/yyyy)	08/12/2023	—	
Maximum overcurrent protection rating [A]	30		
Current applied [A]	75		
Duration of applied current [min]	2		
Location of designated point for equipotential bonding	Long side of the frame		
No. of other conductive parts tested	3		
Sample no.	Max. measured voltage [mV]	Max. calculated resistance [mΩ]	
1	72.9/75.2/77.9	1.17/1.20/1.25	P
2	63.3/68.4/72.2	1.11/1.10/1.16	P
3	75.2/79.1/68.2	1.20/1.27/1.09	P
4	79.2/78.4/72.8	1.27/1.25/1.16	P
5	74.2/78.1/67.2	1.21/1.26/1.10	P
Supplementary information: N/A			

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9	Potential Induced Degradation (PID) test		
Test date (dd/mm/yyyy)		14/12/2023 - 26/12/2023	
Test Condition		Method 1-B	—
Sample No.	Module rated system voltage and polarities		
1-2	+1500V		—
1-3	+1500V		—
1-4	-1500V		—
1-5	-1500V		—
2-2	+1500V		—
2-3	+1500V		—
2-4	-1500V		—
2-5	-1500V		—
Supplementary information: N/A			

10	Visual inspection (after PID test)		
Test date (dd/mm/yyyy)		26/12/2023	
Sample no.	Nature and position of initial findings		—
1-2	No major visual defects		P
1-3	No major visual defects		P
1-4	No major visual defects		P
1-5	No major visual defects		P
2-2	No major visual defects		P
2-3	No major visual defects		P
2-4	No major visual defects		P
2-5	No major visual defects		P
Supplementary information: N/A			

Absatz <i>Clause</i>	Anforderungen - Prüfungen <i>Requirements – Tests</i> 2 PFG 2387/01.18	Messergebnisse – Bemerkungen <i>Measuring results - Remarks</i>	Ergebnis <i>Result</i>
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11	Maximum power determination (after PID test)						
Test date (dd/mm/yyyy)		26/12/2023					—
Irradiance [W/m ²]		1000*					
Module temperature [°C]		25 ± 2					
Sample no.	Pmax [W]	Vmpp [V]	Impp [A]	Voc [V]	Isc [A]	FF [%]	Degradation [%]
1-2	596.4	43.72	13.641	51.84	14.370	80.1	-0.63
1-3	594.1	43.59	13.631	51.64	14.398	79.9	-1.01
1-4	591.7	43.49	13.605	51.76	14.370	79.6	-1.41
1-5	573.9	42.94	13.367	51.51	14.243	78.2	-4.52
2-2	615.0	47.45	12.963	56.07	13.592	80.7	-0.29
2-3	613.6	47.35	12.958	55.93	13.596	80.7	-0.49
2-4	612.0	47.28	12.944	56.17	13.597	80.6	-0.84
2-5	612.6	47.33	12.943	55.99	13.601	80.6	-0.81
*A pulse solar simulator class AAA conforming to the requirements of IEC 60904-9 is used.							
Supplementary information: <i>Negative</i> degradation means power <i>loss</i> .							

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12	Wet leakage current test (after PID test)			
Test date (dd/mm/yyyy)		26/12/2023		—
Insulation resistance measured at [V _{DC}]		1500		
Solution resistivity [Ω cm]		≤ 3500		
Solution temperature [°C]		22 ± 2		
Sample no.	R _{iso} [MΩ]	A [m²]	R _{iso} •A [MΩ•m²]	
1-2	3240.0	2.70	8748.0	P
1-3	2660.0	2.70	7182.0	P
1-4	2750.0	2.70	7425.0	P
1-5	2380.0	2.70	6426.0	P
2-2	3580.0	2.80	9666.0	P
2-3	2330.0	2.80	6524.0	P
2-4	3260.0	2.80	9128.0	P
2-5	3420.0	2.80	9576.0	P
Supplementary information: Minimum requirement is 40 MΩ•m².				

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13	Electroluminescence images (after PID test)		
Test date (dd/mm/yyyy)		26/12/2023	—
Current applied		Isc ± 5%	
Sample No.	Remarks		
2	N/A		—
3	N/A		—
4	N/A		—
5	N/A		—
Supplementary information: N/A			

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

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Appendix A: Abbreviations used in the report

PID	Potential Induced Degradation
STC	Standard Test Conditions
P_{max}	Maximum power
I_{mpp}	Maximum power point current
V_{mpp}	Maximum power point voltage
I_{sc}	Short circuit current
V_{oc}	Open circuit voltage
FF	Fill factor
α	Current temperature coefficient
β	Voltage temperature coefficient
γ	Power temperature coefficient
R_{iso}	Electrical insulation resistance
A	Module area

Appendix B: Statement of the estimated uncertainty of the test verdicts

- Electrical performance rating is outside the scope of 2 PfG 2387/01.18 qualification testing. The verdicts of performance rating are only related to the test samples that were subjected to the tests. They cannot be generalised to the modules from the series production.
- The calibration to STC was performed with a class A⁽⁺⁾A⁽⁺⁾A⁽⁺⁾ solar simulator. The extended measurement uncertainty is:
 - $2\sigma (P_{mpp}) \leq \pm 3.0 \%$
 - $2\sigma (I_{sc}) \leq \pm 2.8 \%$
 - $2\sigma (V_{oc}) \leq \pm 0.9 \%$
- Relative measurements were performed with a flash type solar simulator.
- The accuracy of measurement reproduction with the solar simulator is less than 0.8 %.

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Appendix C: History of certification

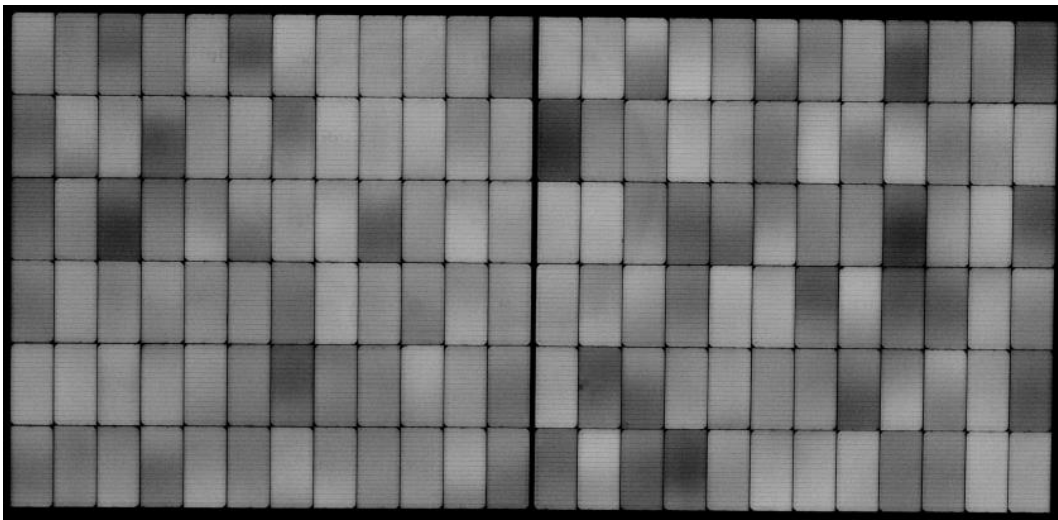
Subject	Module type	Report no.	Certificate no.	Date of issue
Basic certification	Max. system voltage: up to 1500 VDC (Voc at STC): With ½ cut of mono c-Si cells: SYMN144TBDxxx (xxx=555-580, in steps of 5, 144 cells) SYMN120TBDxxx (xxx=455-475, in steps of 5, 120 cells) SYMN108TBDxxx (xxx=415-435, in steps of 5, 108 cells)	CN23SHR7 001	PV 50606014 0001	09/11/2023
Introduce to new model types	New model types: Max. system voltage: up to 1500 VDC (Voc at STC): With ½ cut of mono c-Si cells: SYMN156TBDxxx (xxx=615-635, in steps of 5, 156 cells) Approved model types: SYMN144TBDxxx (xxx=555-580, in steps of 5, 144 cells) SYMN120TBDxxx (xxx=455-475, in steps of 5, 120 cells) SYMN108TBDxxx (xxx=415-435, in steps of 5, 108 cells)	CN23SHR7 002	PV 50606014 0002	10/11/2023
Remark: N/A				

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Appendix D: Electroluminescence Images of PID Testing
Model types: SYMN144R01TBD595 (BOM1)



Serial number 2310012120014 (before PID test)

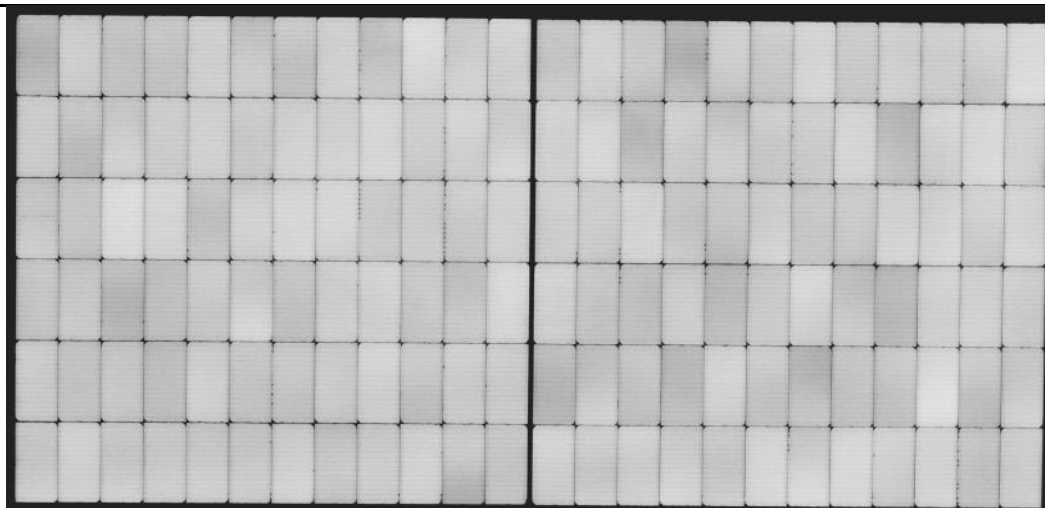
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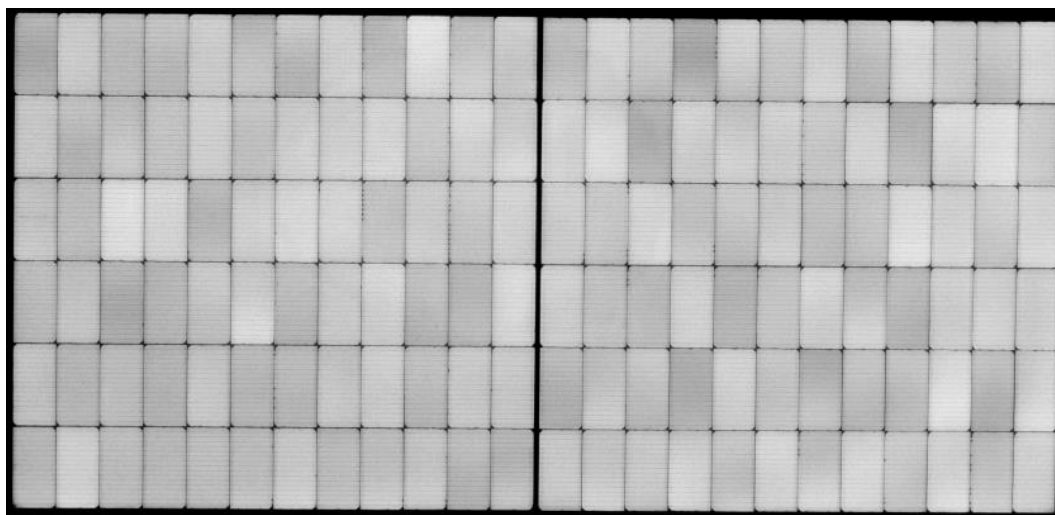
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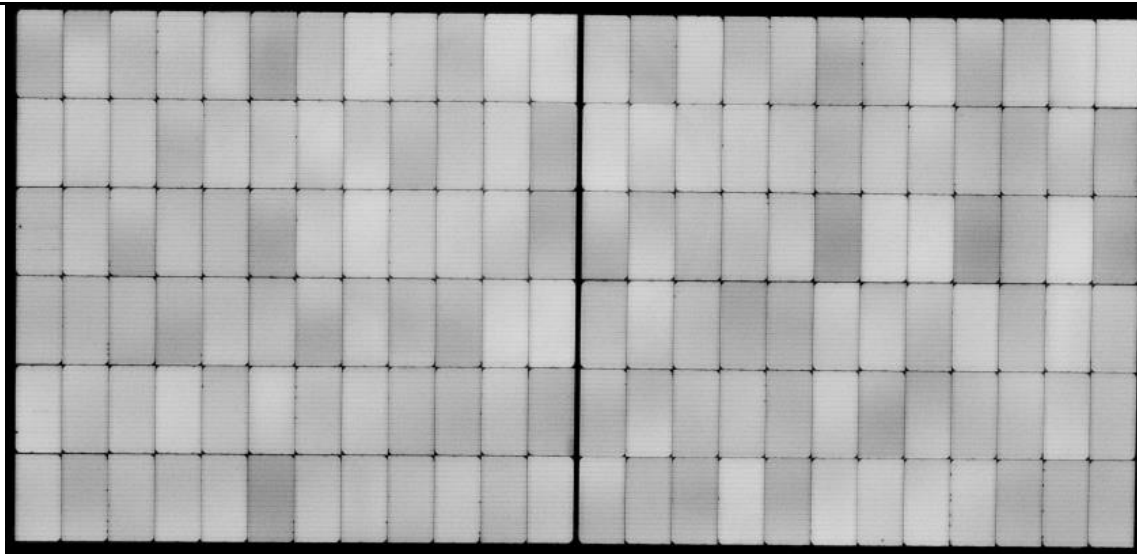


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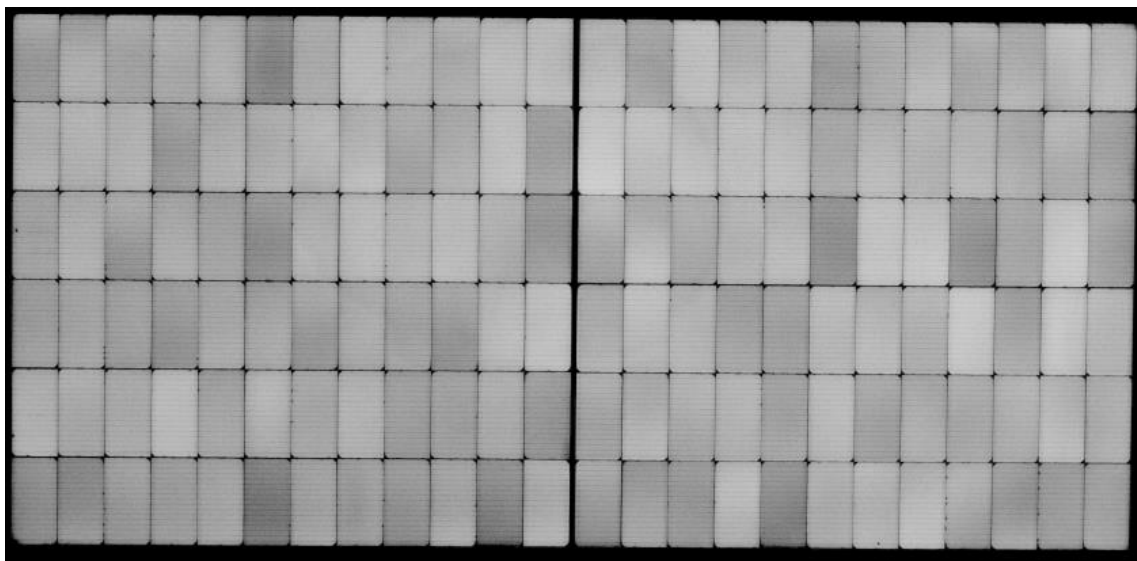
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Serial number 2310012120006 (before PID test)

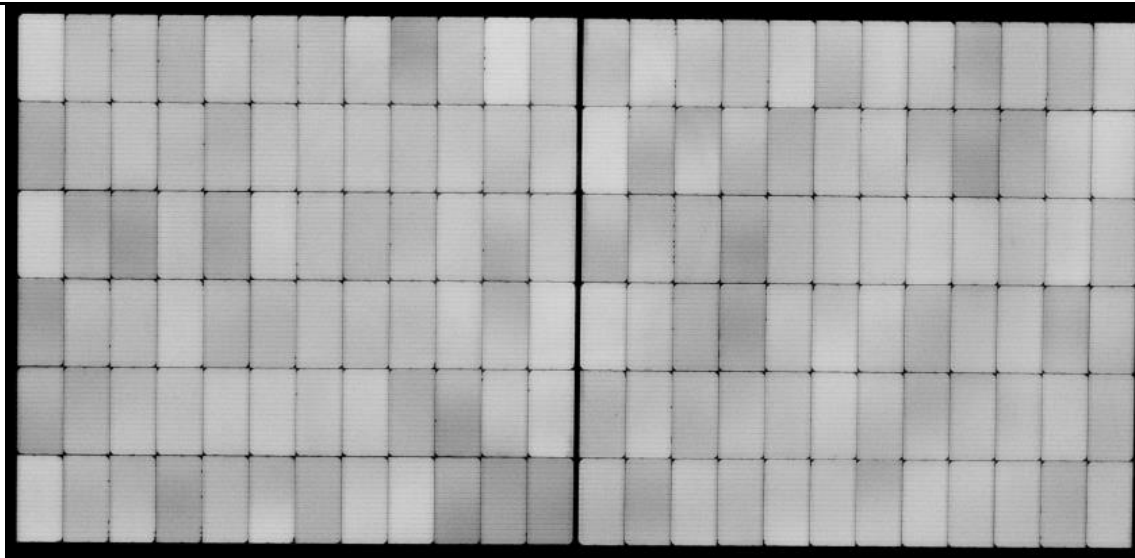


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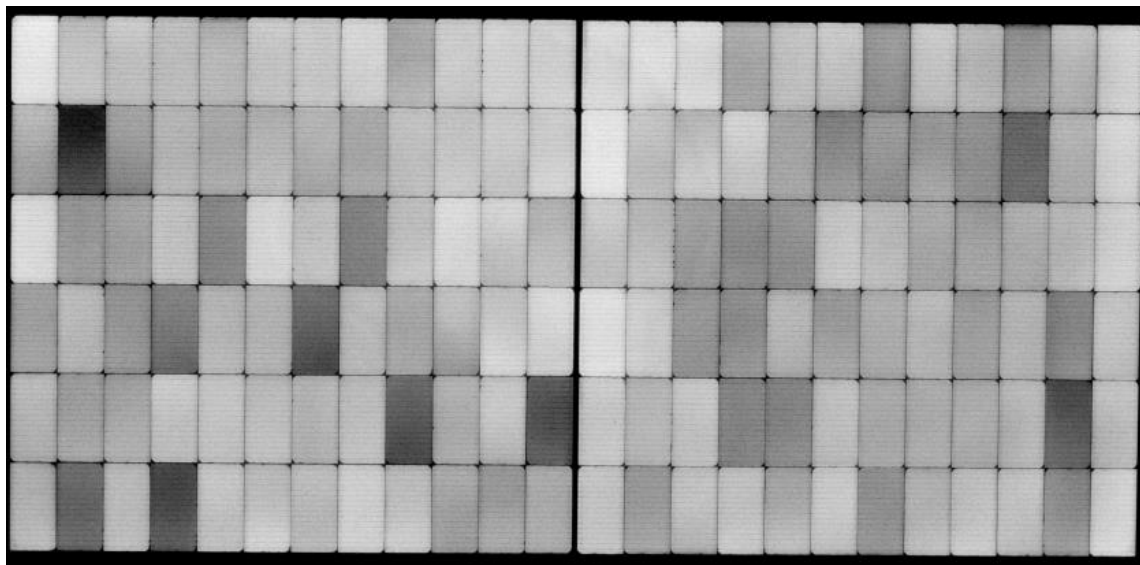
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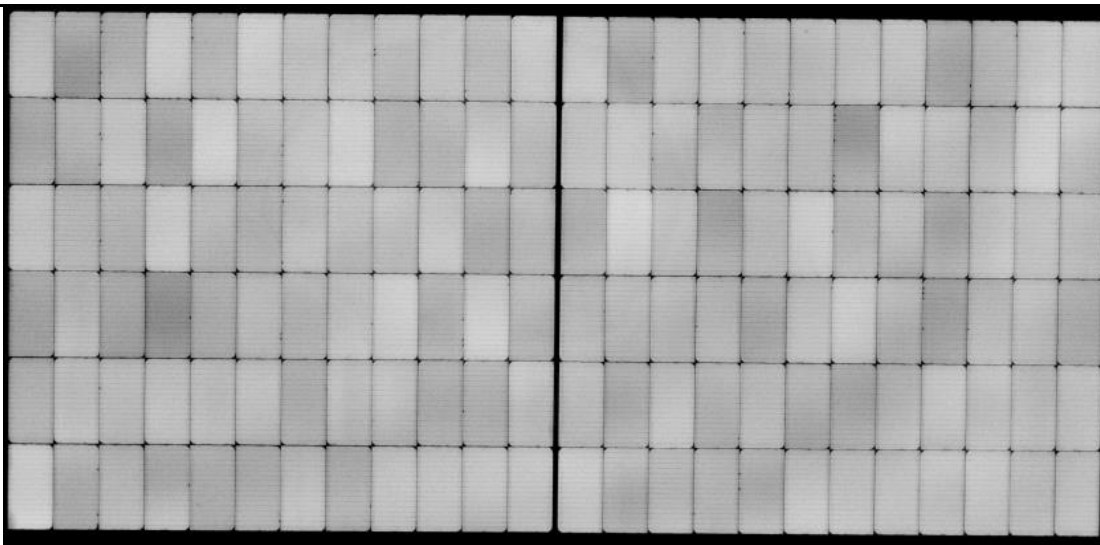


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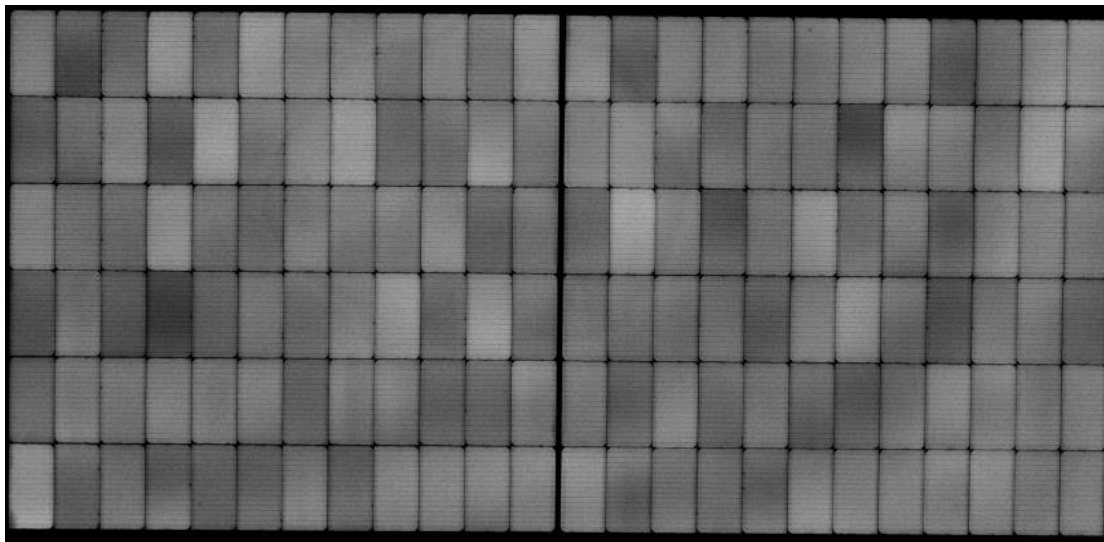
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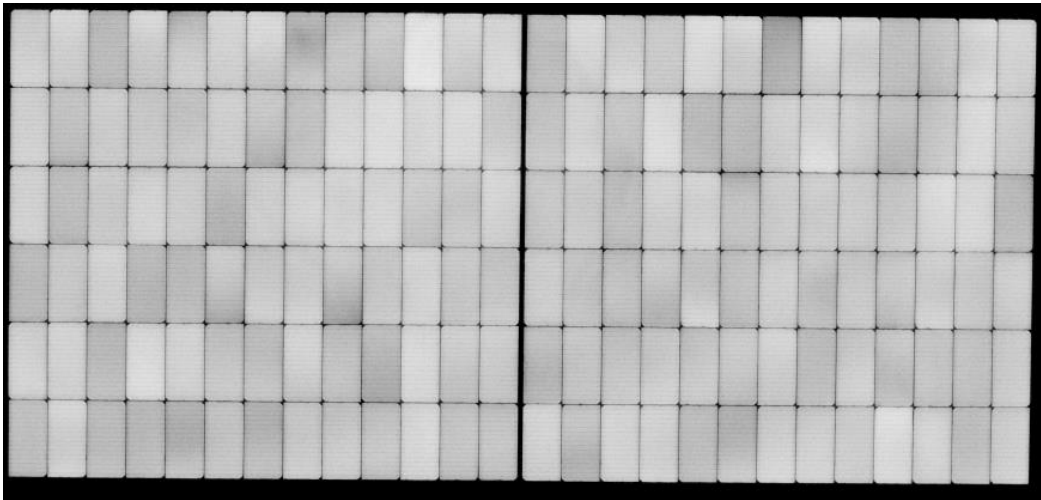
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Model types: SYMN156TBD620 (BOM2)



Serial number 2310012085119 (before PID test)

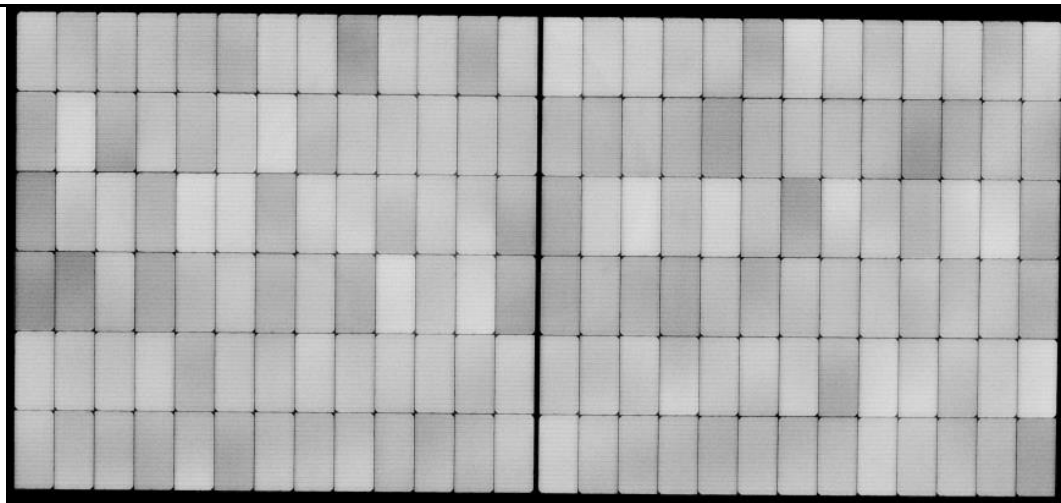
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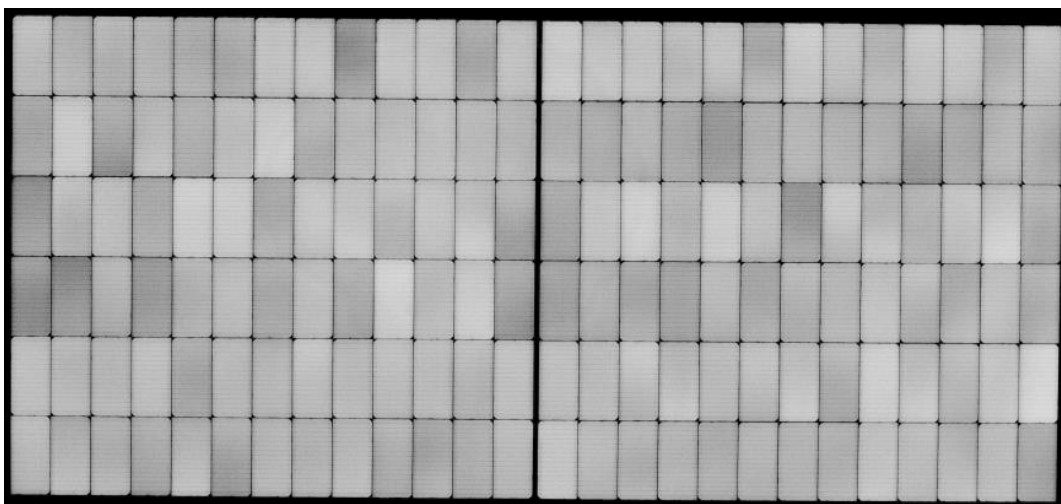
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Serial number 2310012085228 (before PID test)



Serial number 2310012085228 (after PID test)

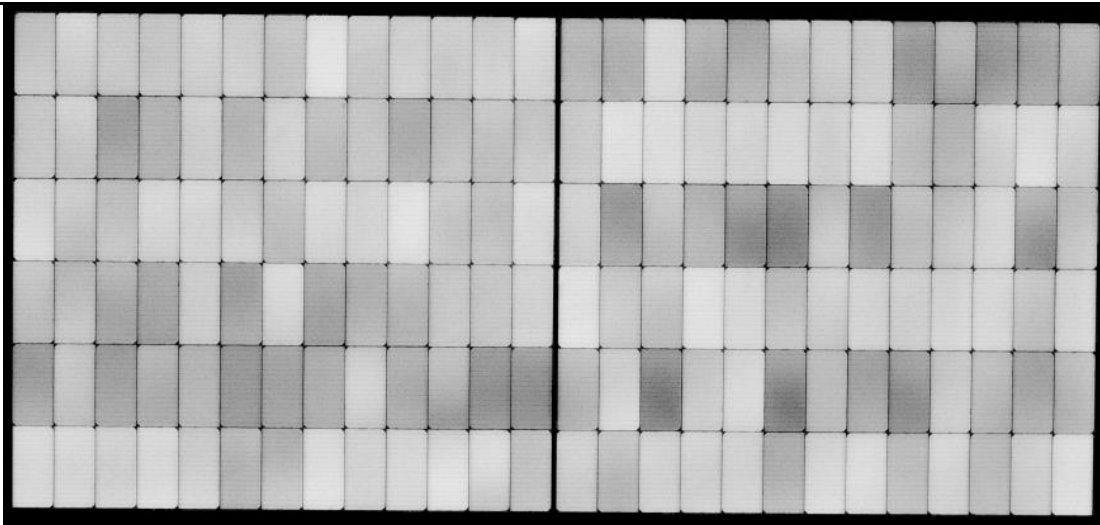
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Test report no.:

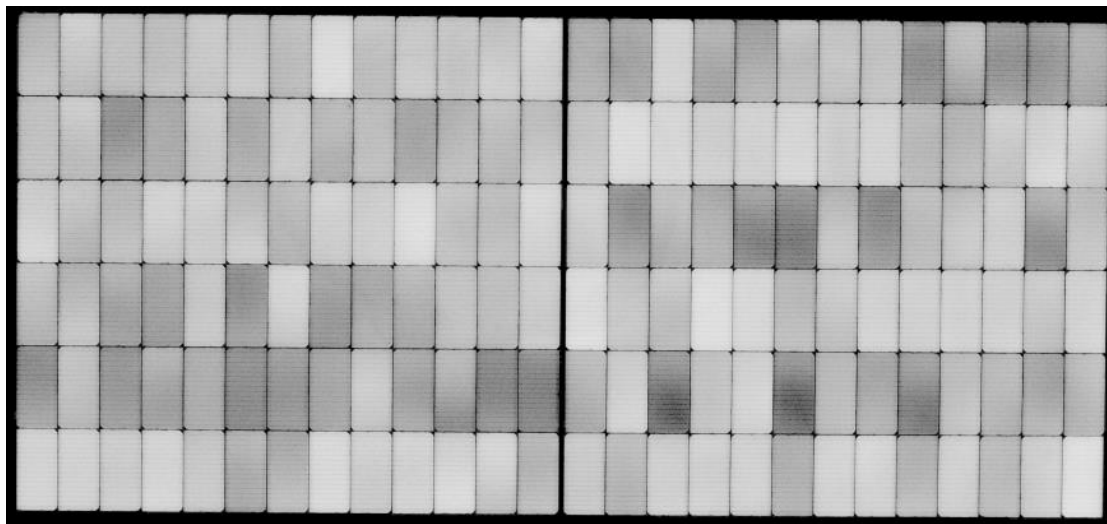
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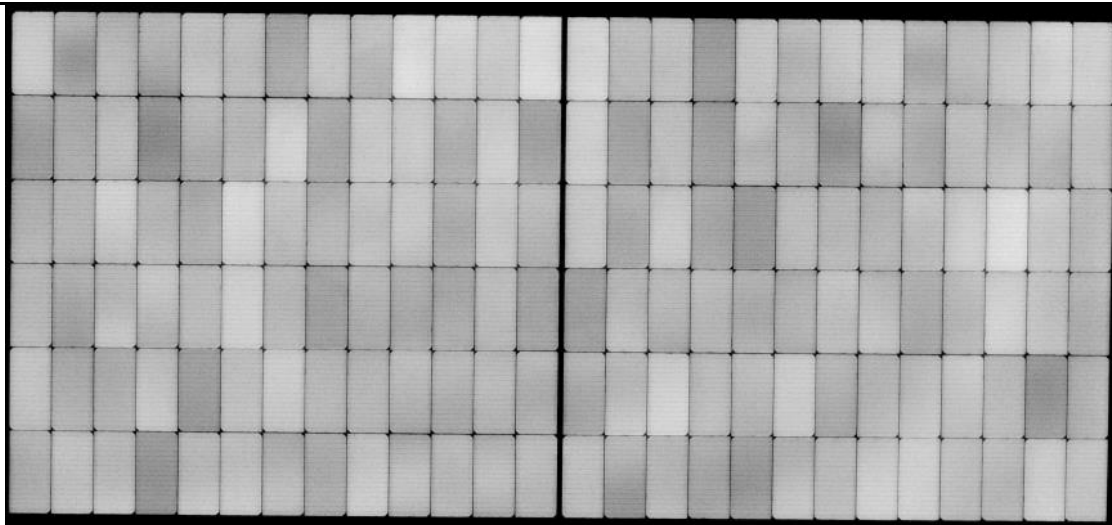


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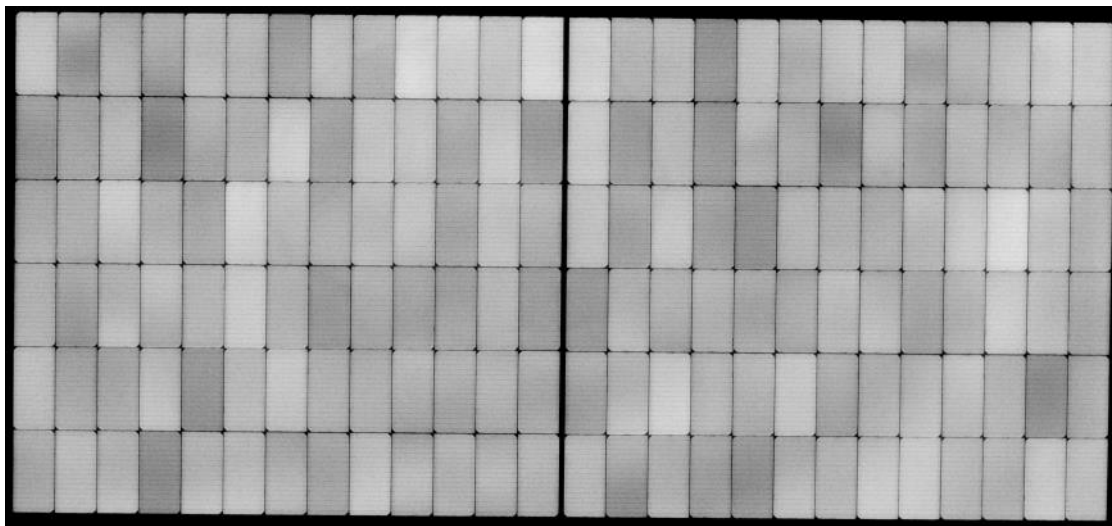
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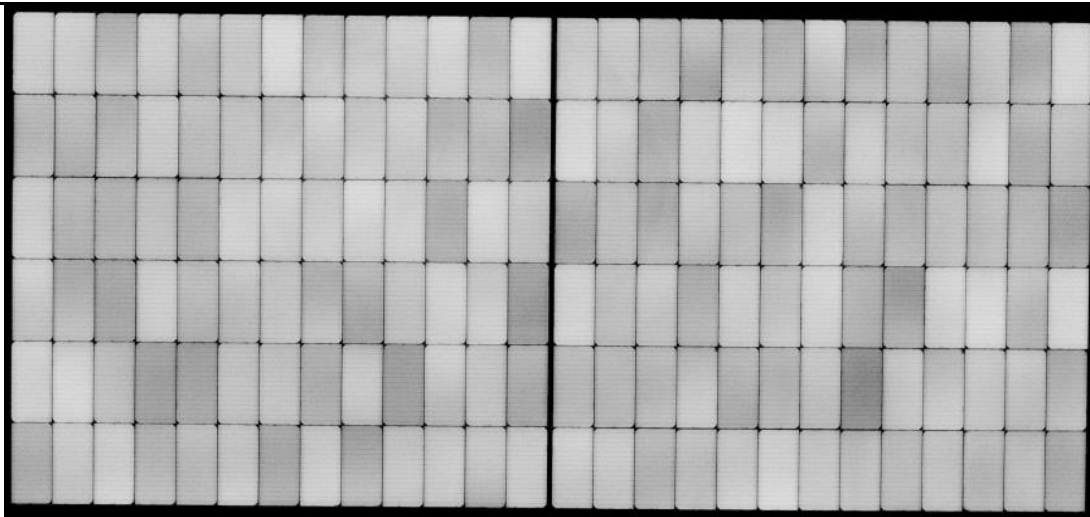


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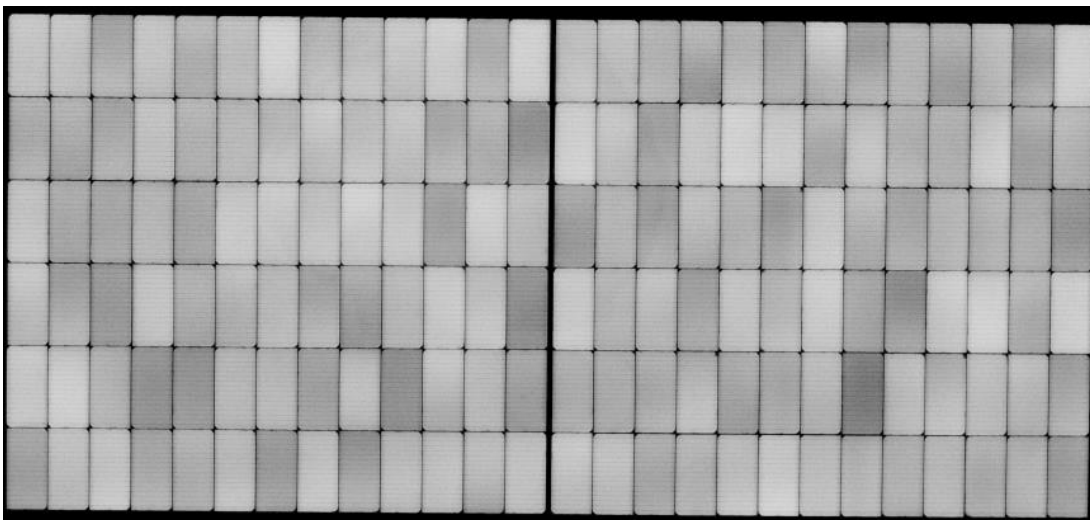
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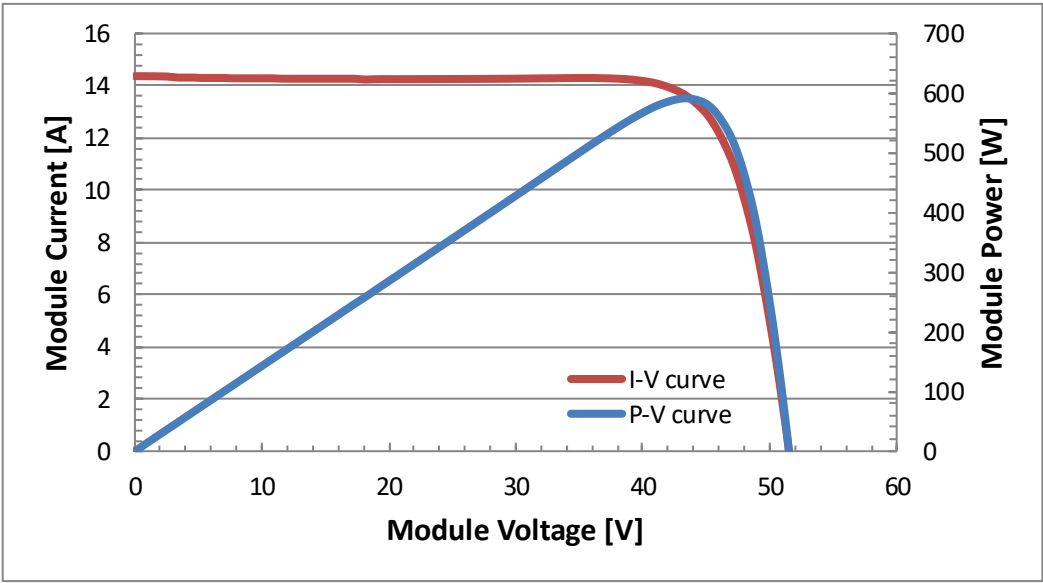
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Appendix E: Measurement Reports
Model types: SYMN144R01TBD595 (BOM1)



Serial number 2310012120014 (before PID test)

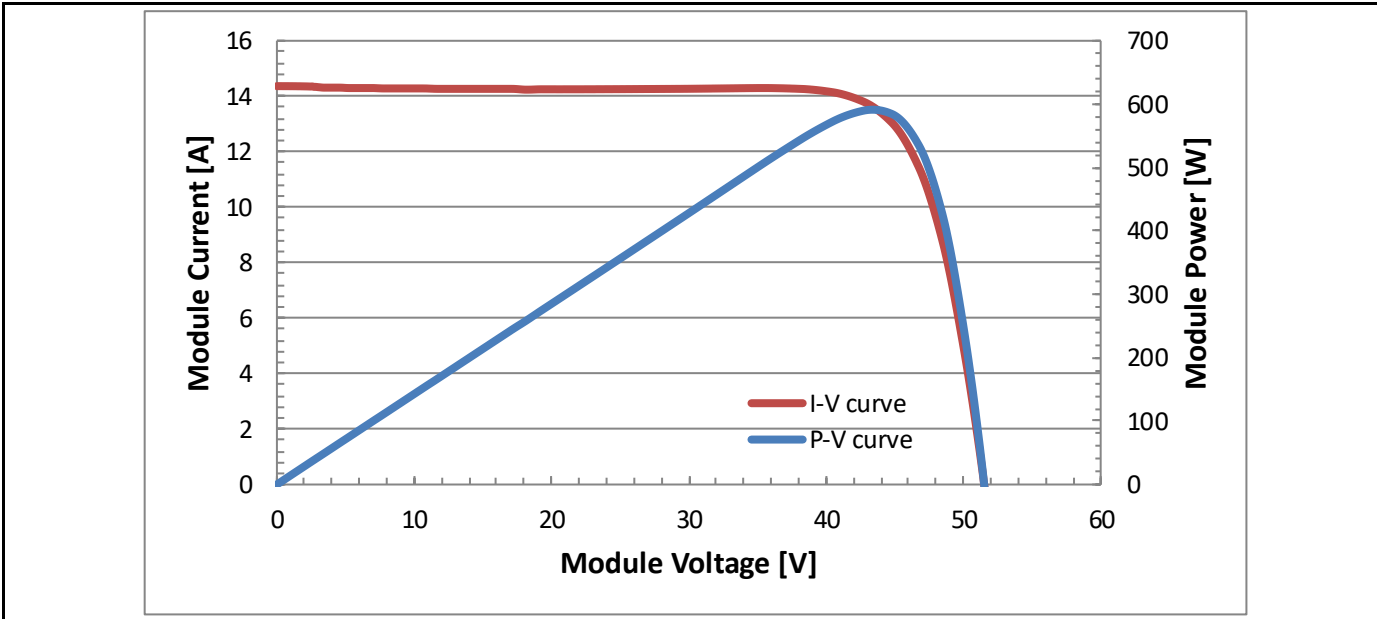
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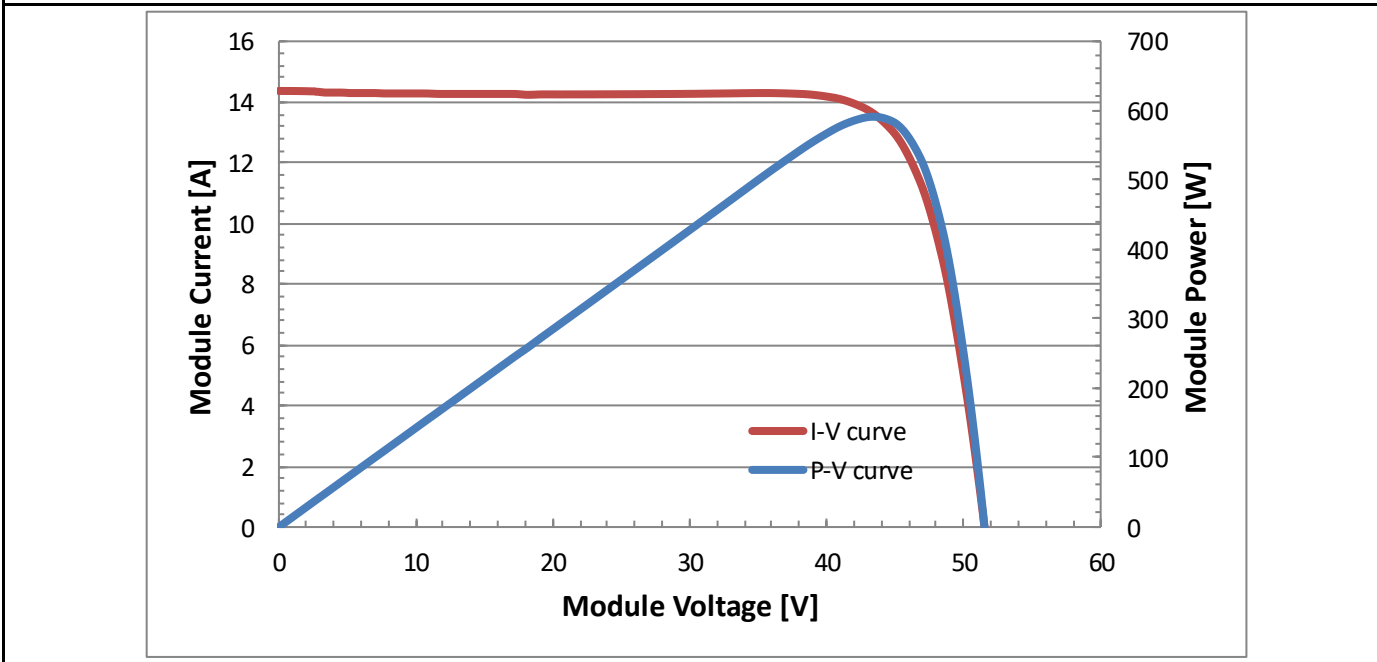
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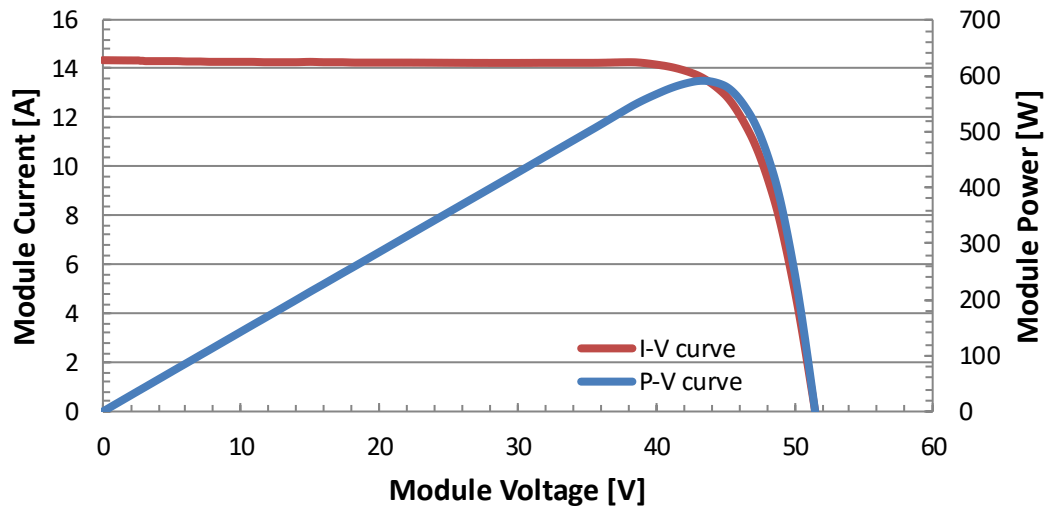


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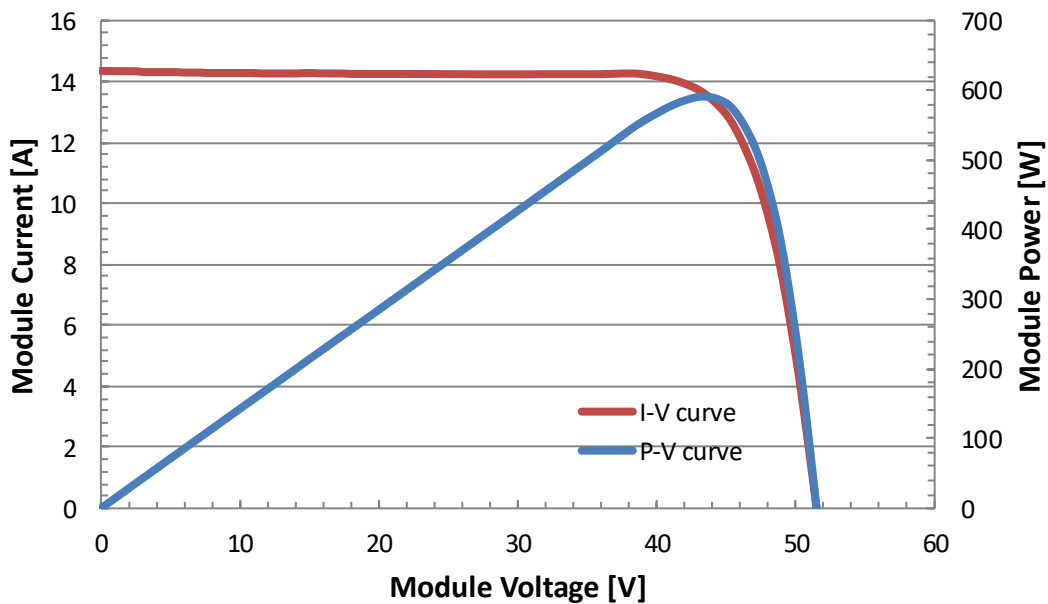
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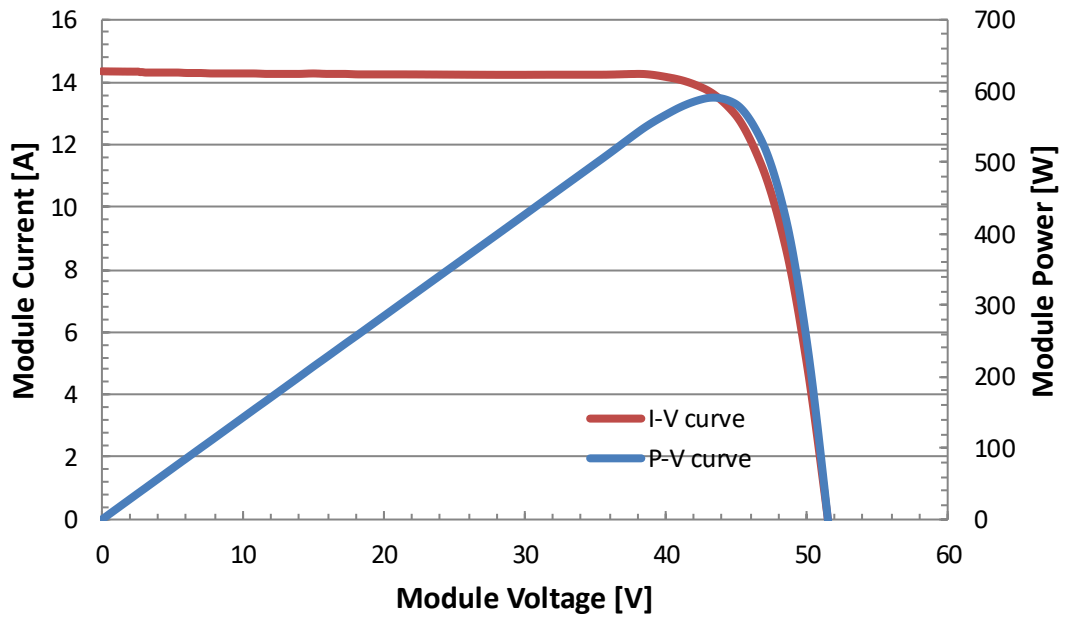


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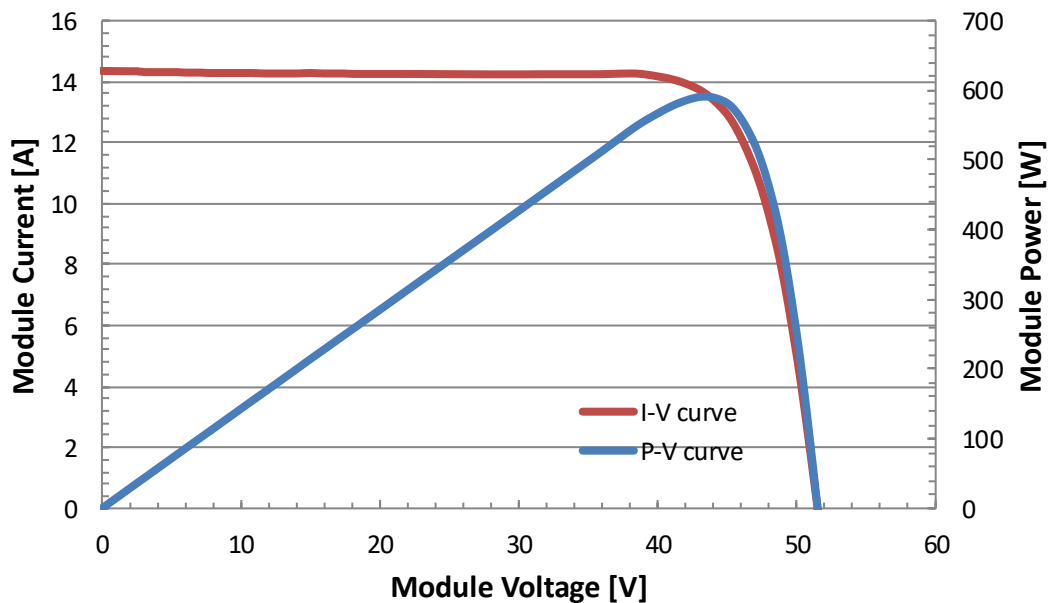
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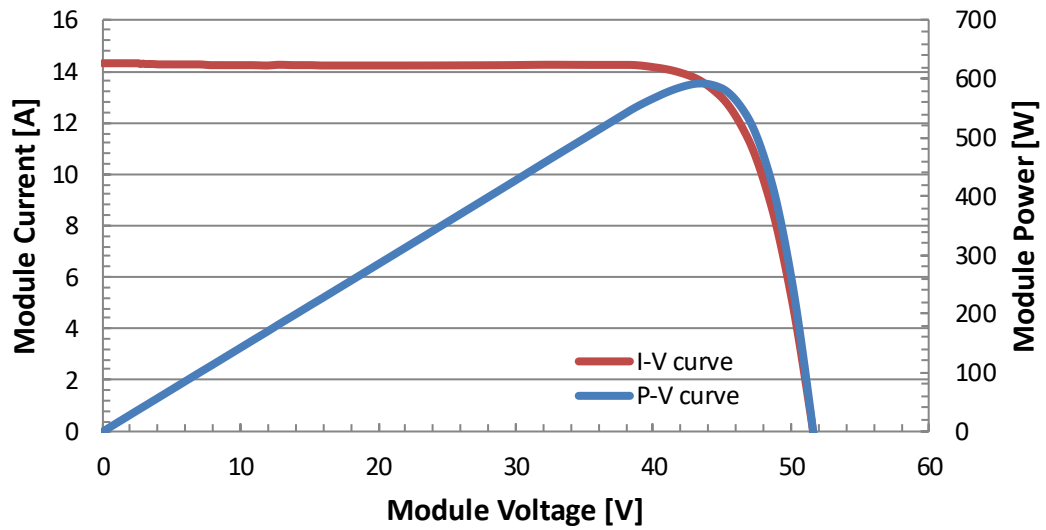


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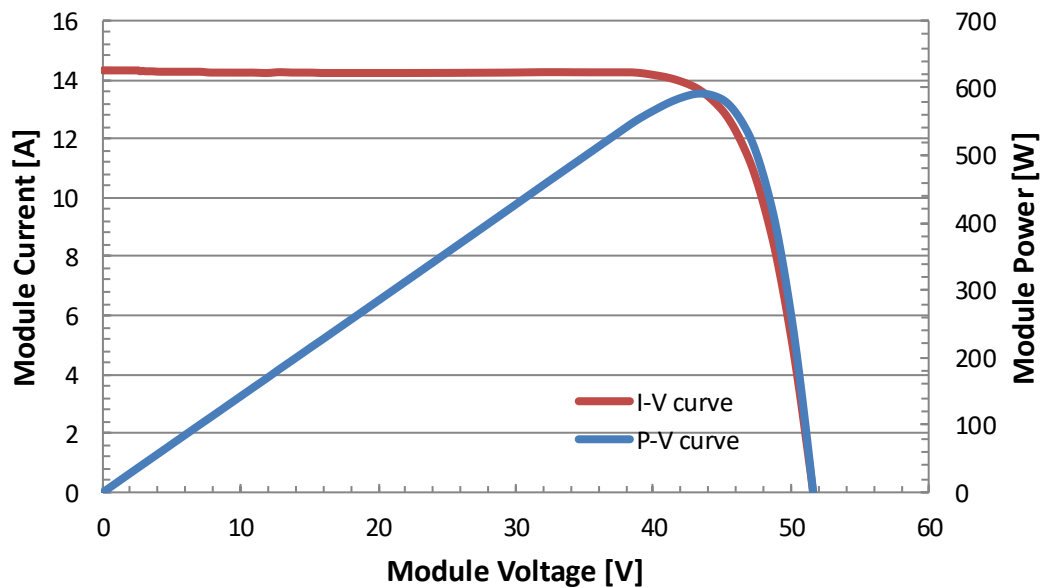
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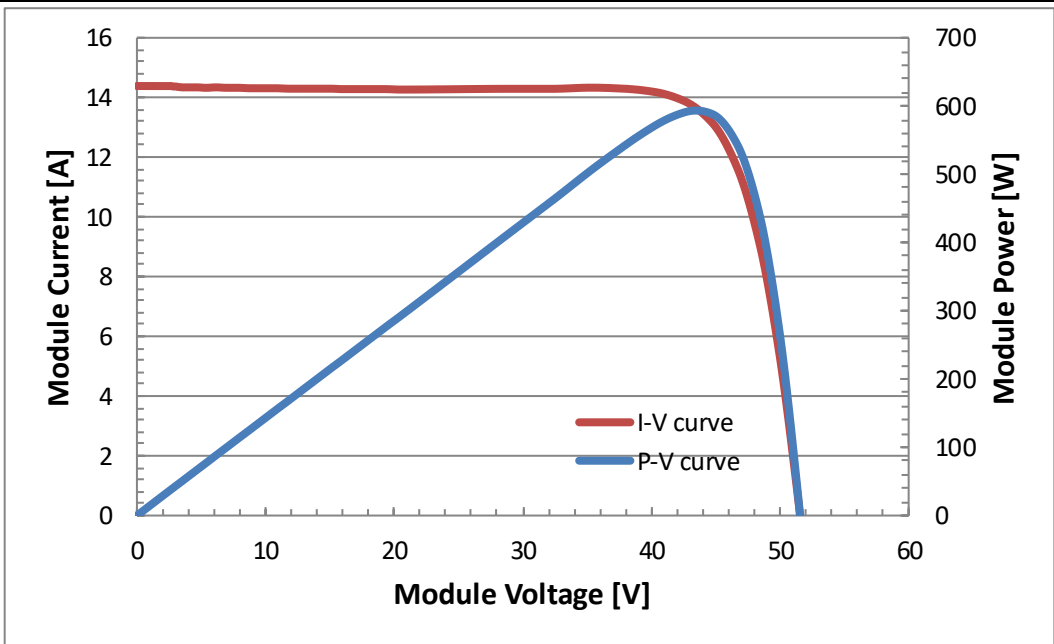
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Model types: SYMN156TBD620 (BOM2)



Serial number 2310012085119 (before PID test)

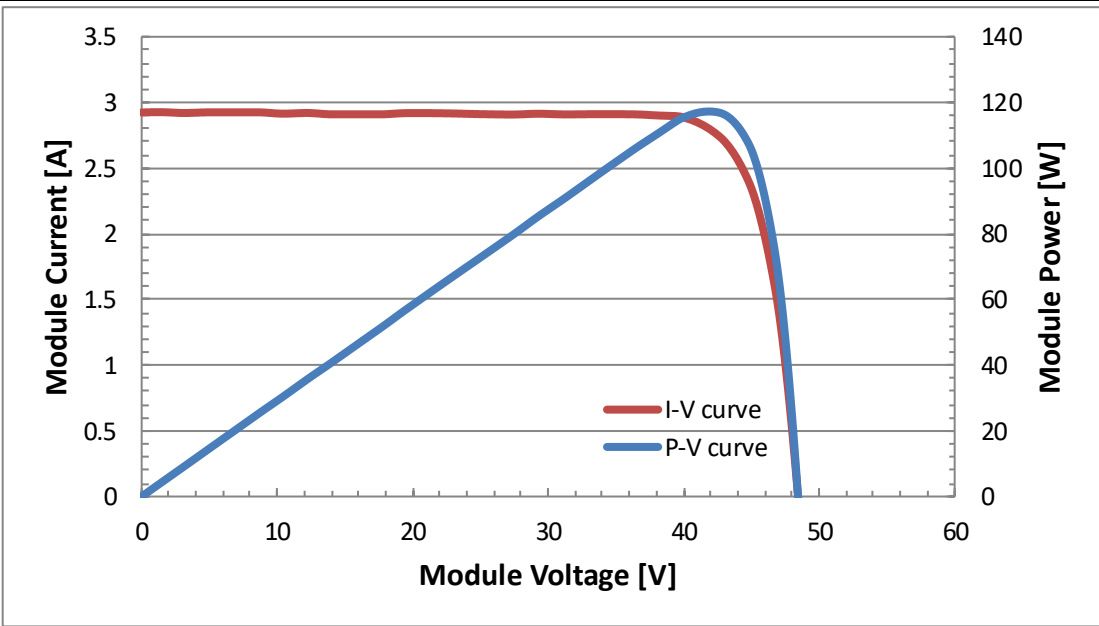
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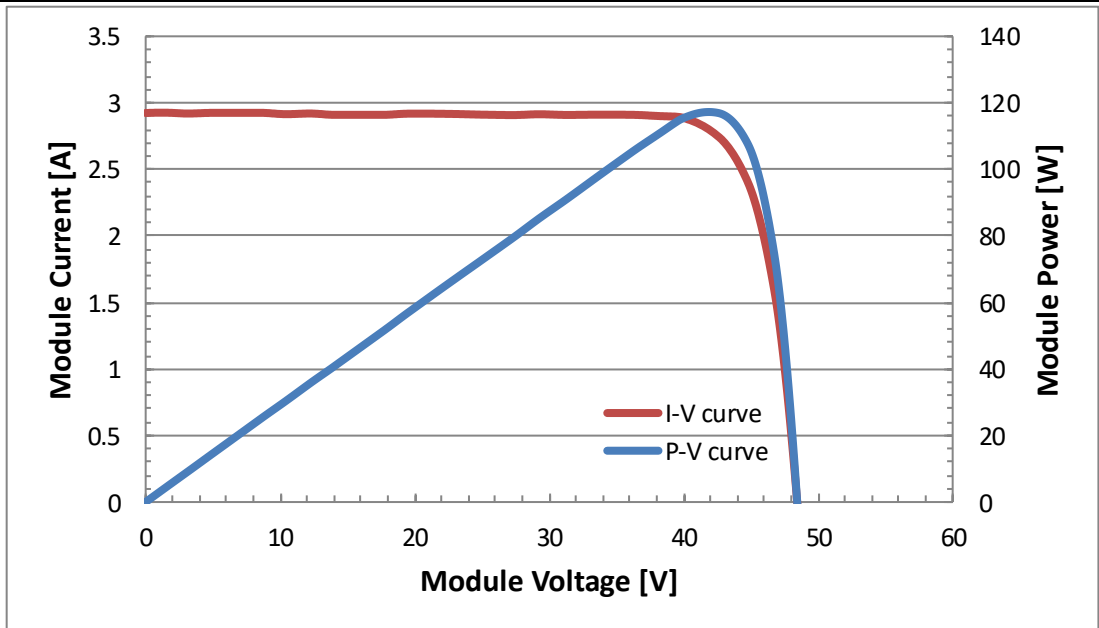
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Serial number 2310012085228 (before PID test)

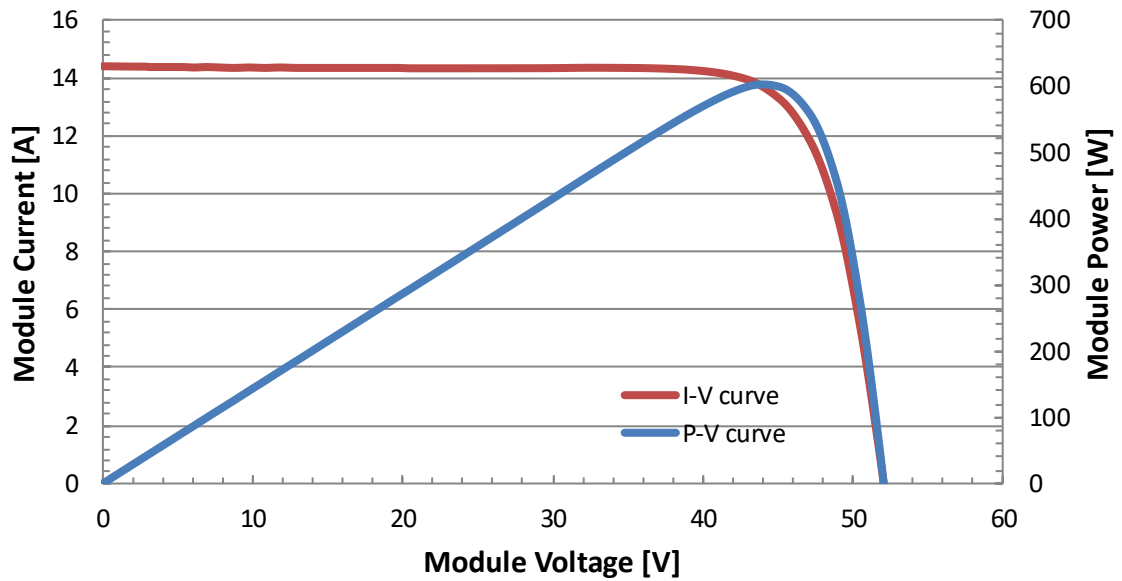


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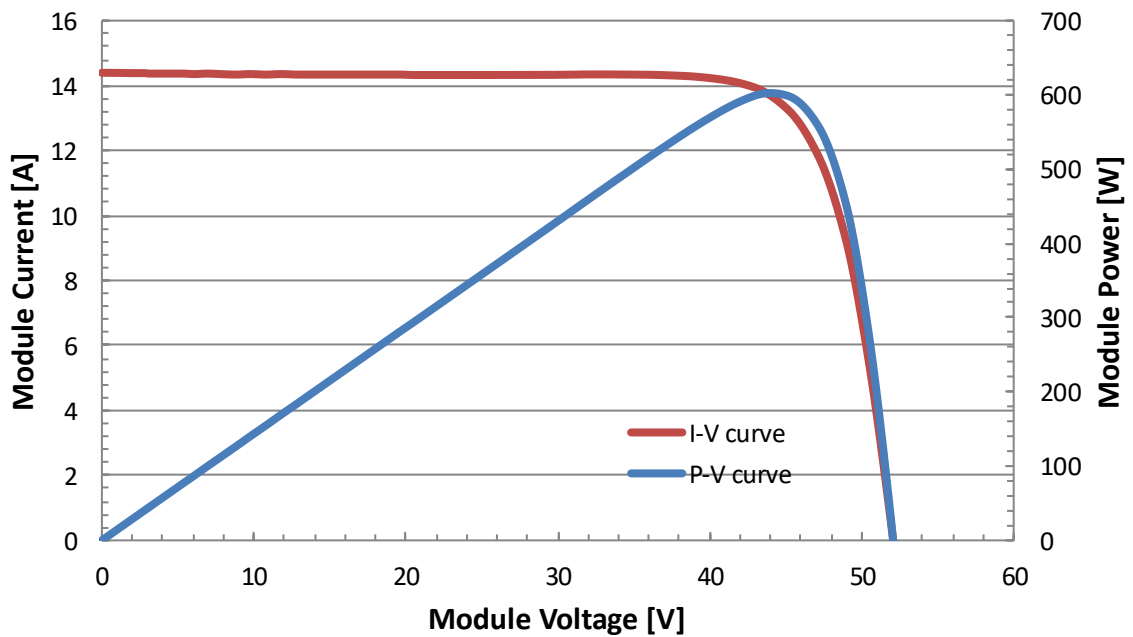
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Serial number 2310012085219 (before PID test)

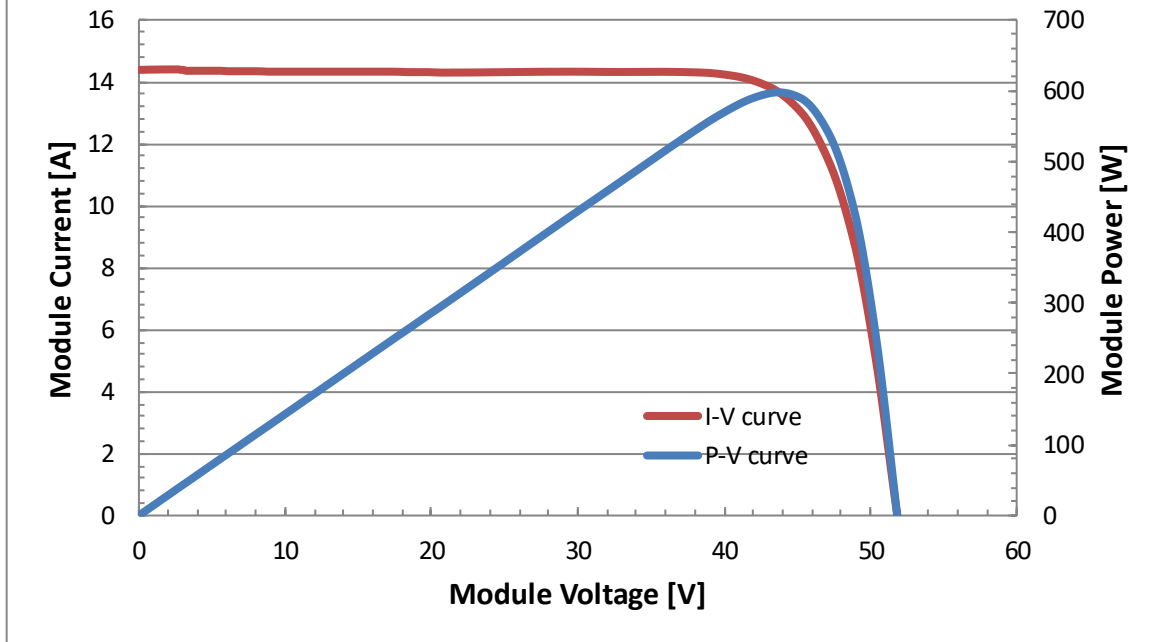


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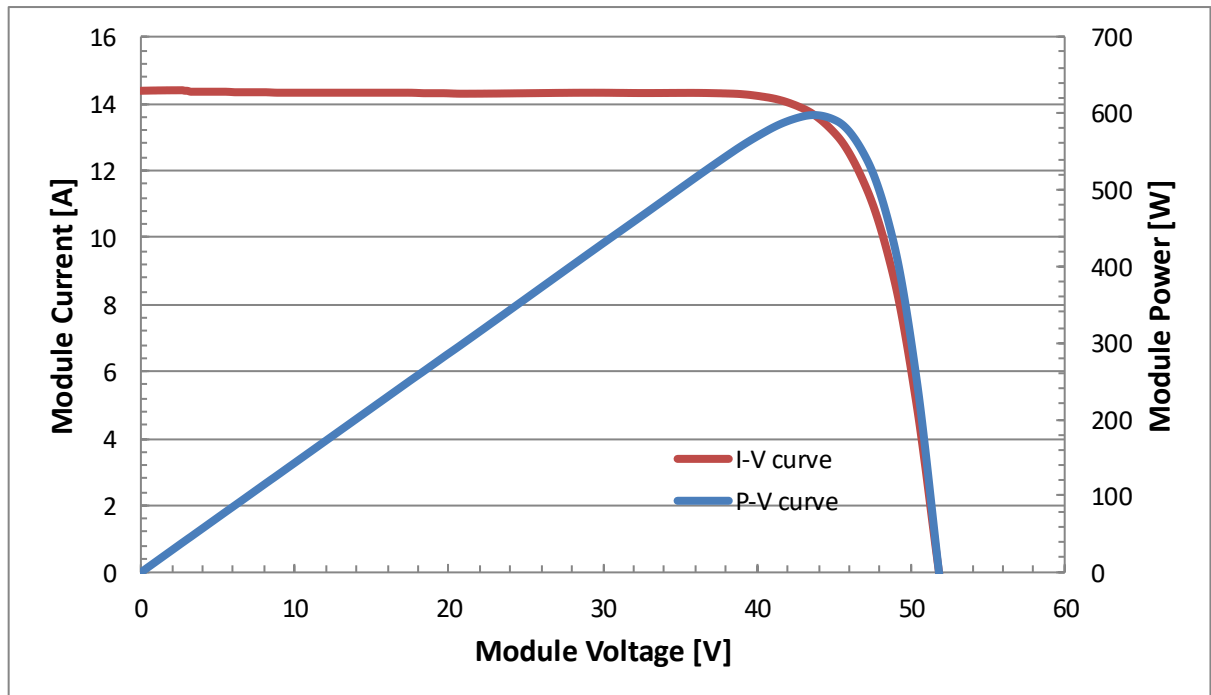
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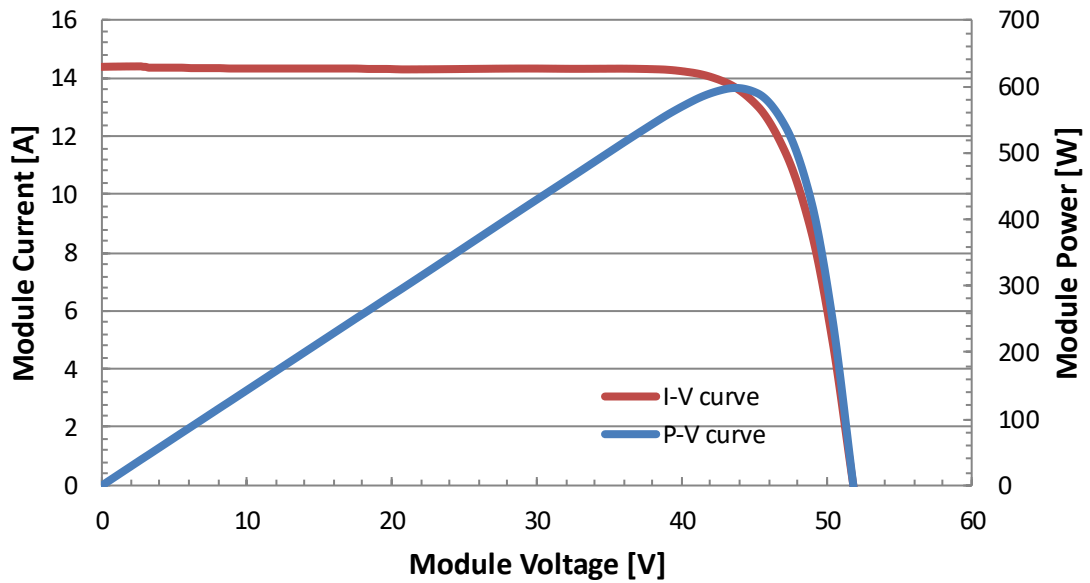


Serial number 2310012085210 (after PID test)

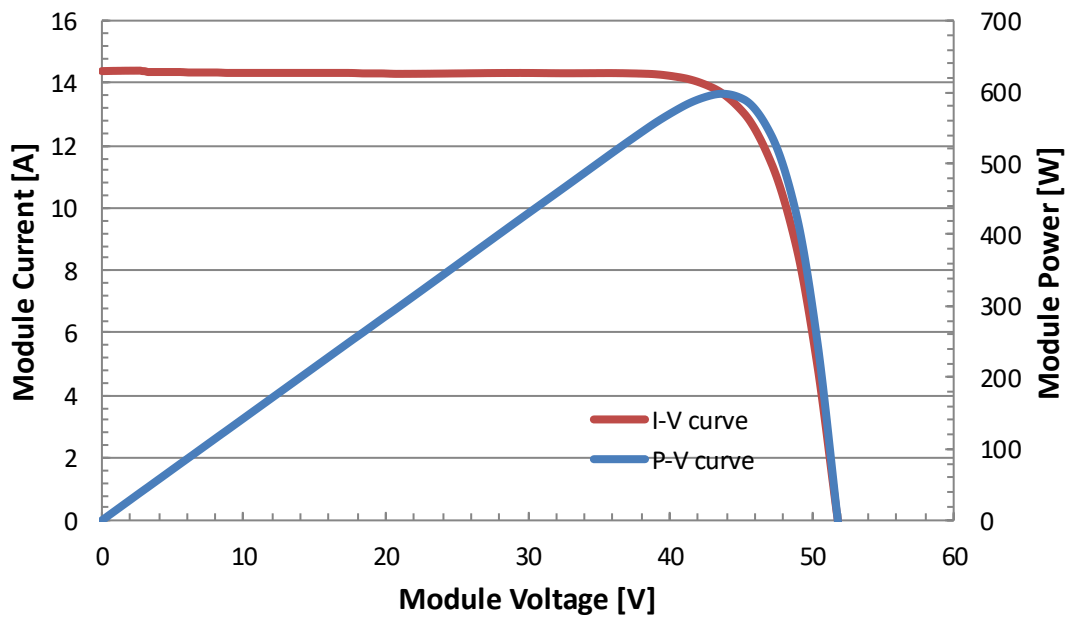
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ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION



Serial number 2310012085256 (before PID test)



Serial number 2310012085256 (after PID test)

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FOTO-DOKUMENTATION
PHOTO DOCUMENTATION

Appendix F: Photos
Model types: SYMN144R01TBD595 (BOM1)



Fig. 1: front view of test sample



Fig. 2: rear view of test sample

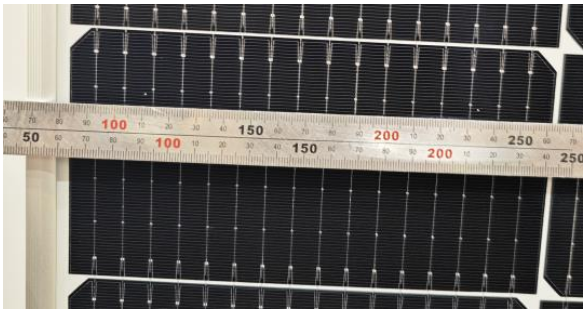


Fig. 3: detail view of solar cell

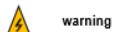


PV MODULE
Sany Silicon Energy (Zhuzhou) Co., LTD
Sany Energy Equipment Industrial Park,
No.320 Qingshui Road, Shifeng District,
Zhuzhou City, Hunan Province
412005 China
www.sanygroup.com/

SYMN144R01TBD595

Max. power (Pmax) 566W
Max. power tolerance ±3%
Voltage at max. power (Vmp) 42.85V
Current at max. power (Imp) 13.85A
Open-circuit voltage (Voc) 51.34V±3%
Short-circuit current (Isc) 14.50A±3%
Maximum system voltage 1500VDC

bifaciality 80±5%
Series Fuse Rating 30A
operating temperature range 40°C ~ +86°C
protect rage II
module wprotectsight 33.5(kg)
module size 2382×1134×30(mm)
STC 1000W/m², AM1.5, 25°C



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. 4: detail view of type label

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Fig. 5: view of closed junction box



Fig. 6: view of cables



Fig. 7: view of connections

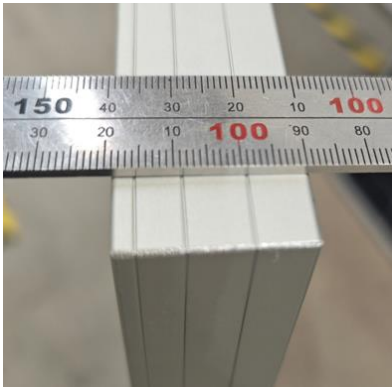


Fig. 8: view of frame corner



Fig. 9: view of grounding mark

N/A

N/A

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Module type: SYMN156TBD620 (BOM2)



Fig. 10: front view of test sample



Fig. 11: rear view of test sample

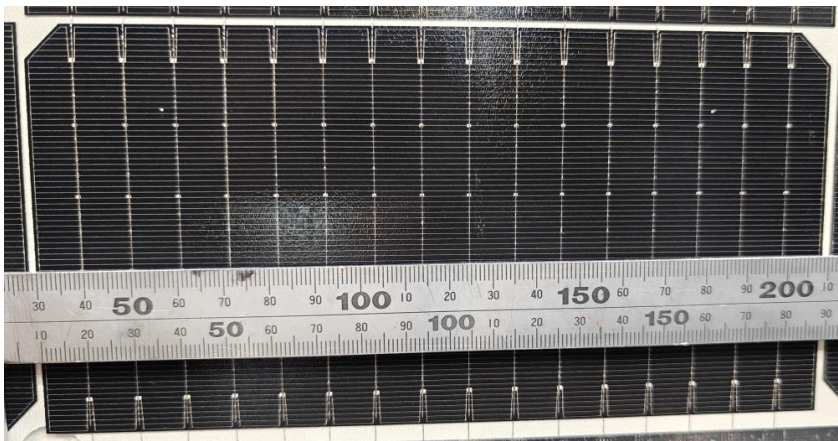


Fig. 12: detail view of solar cell

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PHOTO DOCUMENTATION



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
<https://www.sanyglobal.com/product/>

SYMN156TBD 620
Max. power (Pmax) 620W
Max. power tolerance +3%
Power sorting 0~4.99W
Voltage at max. power(Vmpp) 46.97V
Current at max. power(Imp) 13.20A
Open-circuit voltage(Voc) 55.67V±3%
Short-circuit current(Isc) 13.78A±3%

Series Fuse Rating 30A
Maximum system voltage 1500VDC
operating temperature range 40°C ~ +85°C
protect rage II
module wprotecteight 34.6(kg)
module size 2465×1134×30(mm)
STC 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
Certified in accordance with IEC 61215:2016 and IEC 61730:2016
MADE IN CHINA

Fig. 13: detail view of type label



Fig. 14: view of closed junction box



Fig. 15: view of cables



Fig. 16: view of connections



Fig. 17: view of frame corner



Fig. 18: view of grounding mark