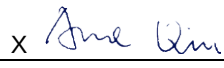


Prüfbericht-Nr.: Test report no.:	CN24C6YL 004	Auftrags-Nr.: Order no.:	190156467 190155197 244562269	Seite 1 von 128 Page 1 of 128
Kunden-Referenz-Nr.: Client reference no.:	2408971	Auftragsdatum: Order date:	16/04/2024 28/02/2024 29/11/2023	
Auftraggeber: Client:	Yingli Energy Development Co., LTD No. 3399, Chaoyang North Road, Baoding, 071051 Hebei, 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:	Design qualification and type approval of photovoltaic (PV) modules			
Prüfgrundlage: Test specification:	Photovoltaic (PV) modules IEC 61215-1:2021; IEC 61215-1-1:2021; IEC 61215-2:2021; IEC 61730-1:2023; IEC 61730-2:2023; EN IEC 61215-1:2021; EN IEC 61215-1-1:2021; EN IEC 61215-2:2021; EN IEC 61730-1:2018; EN IEC 61730-2:2018.			
Wareneingangsdatum: Date of sample receipt:	27/02/2024 20/04/2024			
Prüfmuster-Nr.: Test sample no.:	See clause 6			
Prüfzeitraum: Testing period:	06/03/2024 - 04/05/2024 22/04/2024 - 22/05/2024			
Ort der Prüfung: Place of testing:	Refer to page 9			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (Shanghai) Co., Ltd.			
Prüfergebnis*: Test result*:	Pass			
geprüft von: tested by:			genehmigt von: authorized by:	
Datum: Date:	09/06/2024	Signed by: Anne Qin	Ausstellungsdatum: Issue date:	09/06/2024
Stellung / Position:	Project Engineer		Stellung / Position:	Authorizer
Sonstiges / Other:	- Introduce to new model types as listed on page 3. - Update Fire Class A or C for both front and rear glasses with 1.6mm thickness. - Remove manufacturing site: Yingli Energy (YanTai) Co., Ltd. - Extension to alternative materials and combinations. - Refer to page 6-9 and Constructional Data Form (CDF) CN24C6YL 004 for more details.			
Zustand des Prüfgegenstandes bei Anlieferung: 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
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the 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>				

Prüfbericht-Nr.: CN24C6YL 004
Test report no.:

Seite 2 von 128
Page 2 of 128

Anmerkungen
Remarks

1	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. Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden. <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>
2	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 <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>
3	Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt. <i>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report.</i> <i>Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i>
4	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. <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>

Prüfbericht-Nr.: CN24C6YL 004
Test report no.:

Seite 3 von 128
Page 3 of 128

Produktbeschreibung
Product description

I	General
1	Module type designation New model types: Max. System Voltage: Up to 1500 VDC (Voc at STC): With half-cut (bifacial) N-type mono c-Si cell (under STC): YLxxxCF66 f/2 (xxx=685-715, in steps of 5, 132 cells) YLxxxCF60 f/2 (xxx=625-650, in steps of 5, 120 cells) With half-cut (bifacial) N-type mono c-Si cell (under BNPI): YLxxxCF66 f/2 (xxx=759, 765, 770, 776, 782, 787, 792, 132 cells) YLxxxCF60 f/2 (xxx=693, 698, 704, 709, 715, 721, 120 cells) Approved model types: Max. System Voltage: Up to 1500 VDC (Voc at STC): With half-cut (bifacial) N-type mono c-Si cell (under STC): YLxxxCF78 e/2 (xxx=585-635, in steps of 5, 156 cells) YLxxxCF72 e/2 (xxx=540-590, in steps of 5, 144 cells) YLxxxCF66 e/2 (xxx=495-535, in steps of 5, 132 cells) YLxxxCF60 e/2 (xxx=450-485, in steps of 5, 120 cells) YLxxxCF54 e/2 (xxx=405-440, in steps of 5, 108 cells) YLxxxCF72 g/2 (xxx=580-605, in steps of 5, 144 cells) YLxxxCF54 g/2 (xxx=435-450, in steps of 5, 108 cells) YLxxxCF72 h/2 (xxx=590-615, in steps of 5, 144 cells) YLxxxCF54 h/2 (xxx=445-460, in steps of 5, 108 cells) YLxxxCF66 i/2 (xxx=590-615, in steps of 5, 132 cells) YLxxxCF48 i/2 (xxx=430-445, in steps of 5, 96 cells) With half-cut (bifacial) N-type mono c-Si cell (under BNPI): YLxxxCF78 e/2 (xxx=648, 654, 660, 665, 671, 676, 682, 687, 693, 698, 704, 156 cells) YLxxxCF72 e/2 (xxx=598, 604, 610, 615, 621, 626, 632, 637, 643, 648, 654, 144 cells) YLxxxCF66 e/2 (xxx=549, 554, 560, 565, 571, 576, 582, 587, 593, 132 cells) YLxxxCF60 e/2 (xxx=499, 504, 510, 516, 521, 526, 532, 538, 120 cells) YLxxxCF54 e/2 (xxx=449, 455, 460, 465, 471, 477, 482, 488, 108 cells) YLxxxCF72 g/2 (xxx=643, 648, 654, 659, 665, 670, 144 cells) YLxxxCF54 g/2 (xxx=482, 488, 493, 499, 108 cells) YLxxxCF72 h/2 (xxx=654, 659, 665, 670, 676, 682, 144 cells) YLxxxCF54 h/2 (xxx=493, 499, 504, 510, 108 cells) YLxxxCF66 i/2 (xxx=654, 659, 665, 670, 676, 682, 132 cells) YLxxxCF48 i/2 (xxx=477, 482, 488, 493, 96 cells) xxx represents output power in Wp. Refer to Constructional Data Form (CDF) no. CN24C6YL 004 for electrical ratings.

Prüfbericht-Nr.: CN24C6YL 004
Test report no.:

Seite 4 von 128
Page 4 of 128

Produktbeschreibung
Product description

1.2	Product safety ratings																																									
	The modules are intended for a maximum operating altitude [meters above sea level] of [m]	≤ 2000 m above sea level																																								
	Recommended maximum series/parallel module configurations	Available in installation manual																																								
1.3	Classification, applications and intended use																																									
	The module has been evaluated for the following Class (IEC 61140):	☐ Class 0 ☒ Class II ☐ Class III																																								
2	Used materials See Constructional Data Form (CDF) no. CN24C6YL 004.																																									
3	Address(es) of the manufacturing site(s) <table border="1" data-bbox="277 1064 1522 1254"> <tr><td>Name / Description:</td><td>Yingli Energy Development (Tianjin) Co., LTD.</td></tr> <tr><td>Street:</td><td>No.5 Haihang East Road, Tianjin Ninghe Modern Industry Area</td></tr> <tr><td>Postcode / City, Country:</td><td>301500 / Tianjin, 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>15049639 012 / 06/11/2023</td></tr> </table> <table border="1" data-bbox="277 1288 1522 1478"> <tr><td>Name / Description:</td><td>Yingli Energy Development (Hengshui) Co., LTD.</td></tr> <tr><td>Street:</td><td>No.969 Wei17 Road, Hengshui Economic Development District</td></tr> <tr><td>Postcode / City, Country:</td><td>053000 / Hengshui, 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>15048485 011 / 08/08/2023</td></tr> </table> <table border="1" data-bbox="277 1512 1522 1702"> <tr><td>Name / Description:</td><td>Yingli Energy (Jiangxi) Co., Ltd.</td></tr> <tr><td>Street:</td><td>Dean Road, West District, Dean County Industrial Park</td></tr> <tr><td>Postcode / City, Country:</td><td>330400 / Jiujiang, 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>50205785 006 / 16/11/2023</td></tr> </table> <table border="1" data-bbox="277 1736 1522 1926"> <tr><td>Name / Description:</td><td>Yingli Energy Development (Lixian) Co., LTD.</td></tr> <tr><td>Street:</td><td>No.655, North Street YongSheng, Lixian Economic Development Zone</td></tr> <tr><td>Postcode / City, Country:</td><td>071400 / Baoding, 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>CN2264AP 002 / 21/06/2023</td></tr> </table>		Name / Description:	Yingli Energy Development (Tianjin) Co., LTD.	Street:	No.5 Haihang East Road, Tianjin Ninghe Modern Industry Area	Postcode / City, Country:	301500 / Tianjin, P. R. China	Type of production:	Crystalline PV-module	Inspection report No.and date	15049639 012 / 06/11/2023	Name / Description:	Yingli Energy Development (Hengshui) Co., LTD.	Street:	No.969 Wei17 Road, Hengshui Economic Development District	Postcode / City, Country:	053000 / Hengshui, P. R. China	Type of production:	Crystalline PV-module	Inspection report No.and date	15048485 011 / 08/08/2023	Name / Description:	Yingli Energy (Jiangxi) Co., Ltd.	Street:	Dean Road, West District, Dean County Industrial Park	Postcode / City, Country:	330400 / Jiujiang, P. R. China	Type of production:	Crystalline PV-module	Inspection report No.and date	50205785 006 / 16/11/2023	Name / Description:	Yingli Energy Development (Lixian) Co., LTD.	Street:	No.655, North Street YongSheng, Lixian Economic Development Zone	Postcode / City, Country:	071400 / Baoding, P. R. China	Type of production:	Crystalline PV-module	Inspection report No.and date	CN2264AP 002 / 21/06/2023
Name / Description:	Yingli Energy Development (Tianjin) Co., LTD.																																									
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Type of production:	Crystalline PV-module																																									
Inspection report No.and date	CN2264AP 002 / 21/06/2023																																									

Prüfbericht-Nr.: CN24C6YL 004
Test report no.:

Seite 5 von 128
Page 5 of 128

Produktbeschreibung
Product description

Name / Description:	Yingli New Energy (Ningxia) Co., Ltd.
Street:	No. 001 Shuangchuang Road, Clean Energy Industrial Park, Tongxin Industrial Park
Postcode / City, Country:	751300 / Ningxia, P. R. China
Type of production:	Crystalline PV-module
Inspection report No.and date	CN22R89P 004 / 06/06/2024

Name / Description:	Yingli Energy Development Co., LTD.
Street:	No.655, North Street YongSheng, Lixian Economic Development Zone
Postcode / City, Country:	071400 / Baoding, P. R. China
Type of production:	Crystalline PV-module
Inspection report No.and date	CN23D5XF 001 / 21/06/2023

Name / Description:	Yingli New Energy (HaiNing) Co., Ltd.
Street:	No.188, Chuangye Road, Tongyuan, Haiyan
Postcode / City, Country:	314000 / Jiaxing, P. R. China
Type of production:	Crystalline PV-module
Inspection report No.and date	60423296 004 / 07/11/2023

Prüfbericht-Nr.: CN24C6YL 004
Test report no.:

Seite 6 von 128
Page 6 of 128

Produktbeschreibung
Product description

4

Summary of test results

All of the required tests of the standards IEC 61215 / EN IEC 61215 and IEC 61730 / EN IEC 61730 were passed according to its regulations of the pass criteria. It is therefore declared, that the photovoltaic modules of the aforementioned types fulfil the requirements of the standards IEC 61215 / EN IEC 61215 and IEC 61730 / EN IEC 61730, and it is recommended that certification should be granted.

- Introduce to new model types as listed in section 1.1 based on previously approved model types. The differences are as below:

BOM 1: YL700CF66 f/2 (under STC) / YL776CF66 f/2 (under BNPI) (Median power), YL715CF66 f/2 (under STC) / YL792CF66 f/2 (under BNPI) (Higher power end) and YL685CF66 f/2 (under STC) / YL759CF66 f/2 (under BNPI) (Lower power end)

BOM 2: YL700CF66 f/2 (under STC) / YL776CF66 f/2 (under BNPI)

BOM 3: YL695CF66 f/2 (under STC) / YL770CF66 f/2 (under BNPI)

"YLxxxCF66 f/2" (2384*1303mm), and "YLxxxCF60 f/2" (2172*1303mm) series are introduced for the cell dimension 210mm*105mm*130μm±10% with 132pcs and 120pcs half-cut N-type solar cells. The minimum creepage distance is 10.9 mm for this series. The test results are documented in this test report.

- Fire test (MST 23) performed with Class A (Spread of flame test) + Class C (Burning brand test) on both front and rear glasses with 1.6mm thickness from Henan Huamei New Materials Technology Co., Ltd. Relevant tests were performed on representative model type YL440CF48 i/2 (under STC) / YL488CF48 i/2 (under BNPI) (BOM 4) and test results are documented in this report.

- Remove the manufacturing site: Yingli Energy (YanTai) Co., Ltd. Refer to declaration in Appendix E.

- Extension to alternative materials and modifications in below table. The relevant tests were performed on representative model type YL700CF66 f/2 (under STC) / YL776CF66 f/2 (under BNPI) (Median power), YL715CF66 f/2 (under STC) / YL792CF66 f/2 (under BNPI) (Higher power end) and YL685CF66 f/2 (under STC) / YL759CF66 f/2 (under BNPI) (Lower power end) (BOM 1) and test results are documented in this test report.

Object	Manufacturer / trademark	Type / model	Technical data / ratings
Solar cell	Yingli Energy Development Co., Ltd.	YL210*210-NM-18	210mm*105mm*130um±10%, 18 busbars, bifacial half-cut N-type mono c-Si cell
Frame parts	Chizhou An'an New Material Technology Co., Ltd.	Q523	Aluminium alloy: 6005-T6 Coating: AA10 Color: Silver Thickness = 33mm

Prüfbericht-Nr.: CN24C6YL 004
Test report no.:

Seite 7 von 128
Page 7 of 128

Produktbeschreibung
Product description

- The materials and combinations listed as below have been approved based on previous test report No. CN22YL16 according to standards IEC 61215: 2016 and IEC 61730: 2016. Gap tests with standard IEC 61215: 2021 and IEC 61730: 2023 were considered and 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	Yingli Energy Development Co., Ltd.	YL210*210-NM-18	210mm*105mm*130um±10%, 18 busbars, bifacial half-cut N-type mono c-Si cell	YL700CF66 f/2 (under STC) / YL776CF66 f/2 (under BNPI) (BOM 2)
Remark: The manufactory of this solar cell is ANHUI YINGFA DESHENG TECHNOLOGY CO., LTD.				
Front cover	Shanxi Rishengda New Material Technology Co., Ltd	ARC Tempered glass	Thickness = 2.0mm	
Rear cover	Shanxi Rishengda New Material Technology Co., Ltd	Glazed tempered glass with internal ceramic gridding layer ARC tempered glass	Thickness = 2.0mm	
String connector	Baoding Yitong PV Science & Technology Co., Ltd	Sn/Pb=60/40	(0.29±0.01) * (6±0.05) mm / (0.29±0.01) * (4±0.05) mm	
Encapsulation material	Hangzhou First PV Material Co., Ltd.	EP304(front side) + F406PS (rear side)	Thickness = (0.45-0.70) ± 0.1mm for each layer	
Object	Manufacturer / trademark	Type / model	Technical data / ratings	Representative model for testing
Solar cell	Yingli Energy Development Co., Ltd.	YL210*210-NM-18	210mm*105mm*130um±10%, 18 busbars, bifacial half-cut N-type mono c-Si cell	YL695CF66 f/2 (under STC) / YL770CF66 f/2 (under BNPI) (BOM 3)
Remark: The manufactory of this solar cell is Jiangsu Runergy Yueda PV Technology Co., Ltd.				
Front cover	HENAN ANCAI HI-TECH CO., LTD.	ARC Tempered glass	Thickness = 2.0mm	
Rear cover	HENAN ANCAI HI-TECH CO., LTD.	Glazed tempered glass with internal ceramic gridding layer ARC tempered glass	Thickness = 2.0mm	
String connector	Chanline Photovoltaic Electronics Co., Ltd.	Sn/Pb=60/40	(0.29±0.01) * (6±0.05) mm / (0.29±0.01) * (4±0.05) mm	
Fluxing agent	Yik Shing Tat Industrial Co., Ltd	GOLF 703	—	

Prüfbericht-Nr.: CN24C6YL 004
Test report no.:

Seite 8 von 128
Page 8 of 128

Produktbeschreibung
Product description

Object	Manufacturer / trademark	Type / model	Technical data / ratings	Representative model for testing
Front cover	Henan Huamei New Materials Technology Co., Ltd.	ARC Tempered glass	Thickness = 1.6mm	YL440CF48 i/2 (under STC) / YL488CF48 i/2 (under BNPI) (BOM 4)
Rear cover	Henan Huamei New Materials Technology Co., Ltd.	Glazed tempered glass with internal ceramic gridding layer ARC tempered glass	Thickness = 1.6mm	
Remark: - Fire test (MST23) performed with Class A (Spread of flame test) + Class C (Burning brand test) on the glass with 1.6mm thickness. - The rear glass with thickness 1.6mm is only used with YLxxxCF54 e/2, YLxxxCF54 g/2, YLxxxCF54 h/2 and YLxxxCF48 i/2 module type series.				
- No additional testing is considered necessary for the following modifications.				
Object	Manufacturer / trademark	Type / model	Technical data / ratings	
Rear cover 1	Henan Huamei New Materials Technology Co., Ltd.	Tempered glass	Thickness = 2.0mm	
Rear cover 2	Zhejiang Ninghai Kibing New Energy Management Co., Ltd	Tempered glass	Thickness = 2.0mm	
Rear cover 3	Henan Huamei New Materials Technology Co., Ltd.	Tempered glass	Thickness = 2.0mm	
Remark: The rear covers with tempered glass are extended based on above tested glazed tempered glass with internal ceramic gridding layer ARC tempered glass.				
String connector 1	Baoding Yitong PV Science & Technology Co., Ltd	Sn/Pb=60/40	(0.29±0.01) * (7±0.05) mm	
String connector 2	Chanline Photovoltaic Electronics Co.,Ltd.	Sn/Pb=60/40	(0.29±0.01) * (7±0.05) mm	
Remark: The string connector dimensions are extended based on above tested dimension (0.29±0.01) * (6±0.05) mm / (0.29±0.01) * (4±0.05) mm.				
Cell connector 1	Hebei Sizhuo New Energy Tech Co., Ltd.	Sn/Pb=60/40	Φ0.25mm / Φ0.27mm	
Cell connector 2	Hebei Bestze New Energy Materials Co., Ltd	Sn/Pb=60/40	Φ0.25mm / Φ0.27mm	
Cell connector 3	Baoding Yitong PV Science & Technology Co., Ltd	Sn/Pb=60/40	Φ0.25mm / Φ0.27mm	
Remark: The cell connector dimensions are extended based on previous test report No. CN22YL16 001-026 tested dimension Φ0.26mm.				

Prüfbericht-Nr.: CN24C6YL 004
Test report no.:

Seite 9 von 128
Page 9 of 128

Produktbeschreibung
Product description

Frame parts 1	CITIC Bohai Aluminium Industries Holding Co., Ltd.	Q523	Aluminium alloy: 6005-T6 Coating: AA10 Color: Silver & Black Thickness = 33mm
Frame parts 2	Shanxi Yongsheng Aluminium Co., Ltd.		
Frame parts 3	Zhenjiang Yachen New Material Co., Ltd		
Frame parts 4	Chizhou An'an New Material Technology Co., Ltd.		
Frame parts 5	Yingkou Ruida Aluminium Industry Co., Ltd.		
Remark: The thickness and color of frames are extended based on above tested frame with 33mm thickness and previously approved test report No. CN22YL16 001-026 tested thickness 30mm and 35mm with silver and black color. Refer to Appendix E for more details.			

This report have to be read in conjunction with Constructional Data Form (CDF) No. CN24C6YL 001-003 and test report No. CN24C6YL 004.

This test report includes history of reporting and certification, photo documentation and declaration in the appendix.

Throughout this report a point is used as the decimal separator.

Summary of test locations:

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

Prüfbericht-Nr.: CN24C6YL 004

Seite 10 von 128

Test Report No.:

Page 10 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

5	Test specification		
	IEC 61215-1:2021; EN 61215-1:2021: Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1: Test requirements	applicable	—
	IEC 61215-1-1:2021; EN 61215-1-1:2021: Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1-1: Special requirements for testing of crystalline silicon photovoltaic (PV) modules	applicable	
	IEC 61215-2:2021; EN 61215-2:2021: Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 2: Test procedures	applicable	
	IEC 61730-1:2023; EN IEC 61730-1:2018: Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction	applicable	
	IEC 61730-2:2023; EN IEC 61730-2:2018: Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing	applicable	

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 11 von 128
Page 11 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

6	List of test samples		
☐ The modules tested were taken at random from a production batch and subjected to manufacturer's normal quality control and inspection for safety testing			
☒ The modules tested were prototypes of a new design and not taken from a production batch.			
Module type: YL700CF66 f/2 (under STC) / YL776CF66 f/2 (under BNPI) (Median power) (BOM 1)			
Sample no.	Sample SN	Test sequence	Remarks / constructional characteristics (e.g. cell, backsheet, frame type)
1-1	240520050100010	A	Front cover: 2.0mm ARC Tempered glass from HENAN ANCAI HI-TECH CO., LTD.
1-2	240520050100011	B2	Rear cover: 2.0mm Glazed Tempered glass with internal ceramic gridding layer ARC Tempered glass from HENAN ANCAI HI-TECH CO., LTD.
1-3	240520050100012	B2	Encapsulation material: P507 (front side) + S201MT1 (rear side) from Shanghai HIUV New Materials Co., Ltd.
1-4	240520050100013	C1	Solar cell: YL210*210-NM-18 from Yingli Energy Development Co., Ltd.
1-5	240520050100014	C2	Frame: Q523 from Chizhou An'an New Material Technology Co., Ltd.
1-6	240520050100015	D1	Adhesive (frame): 1527 from H.B. Fuller (Suzhou) Advanced Material Co., Ltd
1-7	240520050100016	D2	String connector: (0.29±0.01) * (6±0.05) mm and (0.29±0.01) * (4±0.05) mm from Baoding Yitong PV Science & Technology Co., Ltd
1-8	240520050100017	E1	Cell connector: Φ0.26mm from Baoding Yitong PV Science & Technology Co., Ltd.
1-9	240520050100018	E2	Fluxing agent: WTO-PV112B from Shenzhen VITAL New Material Co., Ltd.
1-14	240520050100054	M	Fixing tape: FX-H21353 from Baoding Fanxing Plastic Technology Co.,Ltd.
1-15	240520050100053	H	Insulation tape: S201MT1 from Shanghai HIUV New Materials Co., Ltd.
			Light redirecting film (used on the internal rear cover): YKC-125 from Wuxi YKC New Material Co., Ltd.
			Junction box: FT50xy from Zhejiang Renhe Photovoltaic Technology Co., Ltd.
			Adhesive (junction box): 1527 from H.B. Fuller (Suzhou) Advanced Material Co., Ltd.
			Cable: 62930 IEC131 1x4.0mm² from Zhejiang Renhe Photovoltaic Technology Co., Ltd.
			Connectors: RHC2xyzu from Zhejiang Renhe Photovoltaic Technology Co., Ltd.
			Bypass diode: MK4050 from Zhejiang Renhe Photovoltaic Technology Co., Ltd.
			Potting material: 1527 from H.B. Fuller (Suzhou) Advanced Material Co., Ltd.

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 12 von 128
Page 12 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

<u>Module type: YL715CF66 f/2 (under STC) / YL792CF66 f/2 (under BNPI) (Higher power end) (BOM 1)</u>				
1-10	240520050100065	A+K1	Same as above	
1-11	240520050100066	A+K2		
<u>Module type: YL685CF66 f/2 (under STC) / YL759CF66 f/2 (under BNPI) (Lower power end) (BOM 1)</u>				
1-12	240520050100059	A+K3	Same as above	
1-13	240520050100060	A+K4		

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 13 von 128
Page 13 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

Module type: YL700CF66 f/2 (under STC) / YL776CF66 f/2 (under BNPI) (BOM 2)

2-1	240520050100001	A	Front cover: 2.0mm ARC Tempered glass from Shanxi Rishengda New Material Technology Co., Ltd
2-2	240520050100002	B2	Rear cover: 2.0mm Glazed Tempered glass with internal ceramic gridding layer ARC Tempered glass from Shanxi Rishengda New Material Technology Co.,Ltd
2-3	240520050100003	C1	Encapsulation material: EP304 (front side) + F406PS (back side) from Hangzhou First PV Material Co., Ltd.
2-4	240520050100004	C2	Solar cell: YL210*210-NM-18 from Yingli Energy Development Co., Ltd.
2-5	240520050100005	K1	Frame: Q523 from Chizhou An'an New Material Technology Co., Ltd.
2-6	240520050100006	K2	Adhesive (frame): 1527 from H.B. Fuller (Suzhou) Advanced Material Co., Ltd
2-7	240520050100007	K3	String connector: (0.29±0.01) * (6±0.05) mm and (0.29±0.01) * (4±0.05) mm from Baoding Yitong PV Science & Technology Co., Ltd
2-8	240520050100008	K4	Cell connector: Φ0.26mm from Baoding Yitong PV Science & Technology Co., Ltd.
2-9	240520050100009	H	Fluxing agent: WTO-PV112B from Shenzhen VITAL New Material Co., Ltd.
			Fixing tape: FX-H21353 from Baoding Fanxing Plastic Technology Co.,Ltd.
			Insulation tape: S201MT1 from Shanghai HIUV New Materials Co., Ltd.
			Light redirecting film (used on the internal rear cover): YKC-125 from Wuxi YKC New Material Co., Ltd.
			Junction box: S4xy from Jiangsu Holysun Electronics Technology Co., Ltd.
			Adhesive (junction box): HT906Z from Shanghai Huitian New Chemical Material Co., Ltd.
			Cable: 62930 IEC131 1x4.0mm ² from Jiangsu Holysun Electronics Technology Co., Ltd.
			Connectors: C2 from Jiangsu Holysun Electronics Technology Co., Ltd.
			Bypass diode: GFT4050SM Jiangsu Holysun Electronics Technology Co., Ltd.
			Potting material: 5299W-S from Shanghai Huitian New Chemical Material Co., Ltd.

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 14 von 128
Page 14 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

Module type: YL695CF66 f/2 (under STC) / YL770CF66 f/2 (under BNPI) (BOM 3)

3-1	240520050100045	A	Front cover: 2.0mm ARC Tempered glass from HENAN ANCAI HI-TECH CO., LTD. Rear cover: 2.0mm Glazed Tempered glass with internal ceramic gridding layer ARC Tempered glass from HENAN ANCAI HI-TECH CO., LTD.
3-2	240520050100046	B2	Encapsulation material: EP304 (front side) + F406PS (back side) from Hangzhou First PV Material Co., Ltd. Solar cell: YL210*210-NM-18 from Yingli Energy Development Co., Ltd.
3-3	240520050100047	C1	Frame: Q523 from Chizhou An'an New Material Technology Co., Ltd. Adhesive (frame): 1527 from H.B. Fuller (Suzhou) Advanced Material Co., Ltd
3-4	240520050100048	C2	String connector: (0.29±0.01) * (6±0.05) mm and (0.29±0.01) * (4±0.05) mm from Chanline Photovoltaic Electronics Co., Ltd. Cell connector: Φ0.26mm from Baoding Yitong PV Science & Technology Co., Ltd.
3-5	240520050100049	K1	Fluxing agent: GOLF 703 from Yik Shing Tat Industrial Co., Ltd Fixing tape: FX-H21353 from Baoding Fanxing Plastic Technology Co.,Ltd.
3-6	240520050100050	K2	Insulation tape: S201MT1 from Shanghai HIUV New Materials Co., Ltd. Light redirecting film (used on the internal rear cover): YKC-125 from Wuxi YKC New Material Co., Ltd.
3-7	240520050100051	K3	Junction box: S4xy from Jiangsu Holysun Electronics Technology Co., Ltd. Adhesive (junction box): HT906Z from Shanghai Huitian New Chemical Material Co., Ltd.
3-8	240520050100052	K4	Cable: 62930 IEC131 1x4.0mm ² from Jiangsu Holysun Electronics Technology Co., Ltd. Connectors: C2 from Jiangsu Holysun Electronics Technology Co., Ltd. Bypass diode: GFT4050SM Jiangsu Holysun Electronics Technology Co., Ltd.
3-9	240520050100071	H	Potting material: 5299W-S from Shanghai Huitian New Chemical Material Co., Ltd.

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 15 von 128
Page 15 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

Module type: YL440CF48 i/2 (under STC) / YL488CF48 i/2 (under BNPI) (BOM 4)

Sample no.	Sample SN	Test sequence	Remarks / constructional characteristics (e.g. cell, backsheet, frame type)
4-1	241301118403289	A+H	Front cover: 1.6mm ARC Tempered glass from Henan Huamei New Materials Technology Co., Ltd. Rear cover: 1.6mm Glazed Tempered glass with internal ceramic gridding layer ARC Tempered glass from Henan Huamei New Materials Technology Co., Ltd. Encapsulation material: P507 (front side) + S201MT1 (rear side) from Shanghai HIUV New Materials Co., Ltd. Solar cell: YL182.2*210-NM-16 from Yingli Energy Development Co., Ltd. Frame: Q568 from Yingkou Ruida Aluminium Industry Co., Ltd. Adhesive (frame): 1527 from H.B. Fuller (Suzhou) Advanced Material Co., Ltd
4-2	241301118403677	C1	String connector: (0.29±0.01) * (7±0.05) mm and (0.29±0.01) * (4±0.05) mm from Hebei Sizhuo New Energy Technology Co.,Ltd. Cell connector: Ø0.25mm from Hebei Sizhuo New Energy Technology Co.,Ltd. Fluxing agent: WTO-PV112B from Shenzhen VITAL New Material Co., Ltd. Fixing tape: FX-H21353 from Baoding Fanxing Plastic Technology Co.,Ltd. Insulation tape: S201MT1 from Shanghai HIUV New Materials Co., Ltd.
4-3	241301118405751	C2	Light redirecting film (used on the internal rear cover): YKC-125 from Wuxi YKC New Material Co., Ltd. Junction box: FT50xy from Zhejiang Renhe Photovoltaic Technology Co., Ltd. Adhesive (junction box): 1527 from H.B. Fuller (Suzhou) Advanced Material Co., Ltd. Cable: 62930 IEC131 1x4.0mm² from Zhejiang Renhe Photovoltaic Technology Co., Ltd. Connectors: RHC2xyzu from Zhejiang Renhe Photovoltaic Technology Co., Ltd. Bypass diode: MK4050 from Zhejiang Renhe Photovoltaic Technology Co., Ltd. Potting material: 1527 from H.B. Fuller (Suzhou) Advanced Material Co., Ltd.

Supplementary information: N/A

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 16 von 128
Page 16 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

II	IEC 61215-1:2021 and IEC 61730-1:2023 – Requirements for design construction
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7	Requirements for design and construction (Clause 5 of IEC 61215-1:2021 and IEC 61730-1:2023)
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7.1	General (Clause 5.1 of IEC 61730-1:2023)		
	Incorporation of a PV module into the final assembly does not require any alteration of the PV module from its originally evaluated form. (It is not provided in subassemblies).	PV modules are completely assembled.	P
	Product shipped from the factory	☒ completely assembled ☐ as subassemblies	N/A
	Equipotential bonding continuity is not interrupted by installation.	Confirmed by test MST 13	P
	Any adjustable or movable structural part is provided with a locking device.	No such parts.	N/A
	PV modules do not have accessible burrs, sharp edges or sharp points.	Compliance checked by tests MST 01 and MST 06	P
	Parts are prevented from loosening or turning if this results in a risk of fire, electric shock, or injury to persons.	Compliance checked by tests MST 01 and MST 33	P
	The modules are intended for a maximum operating altitude [meters above sea level] of [m]	≤ 2000 m above sea level	N/A
	Recommended maximum series/parallel module configurations	Available in installation manual	P
	The module has been evaluated for the following Class (IEC 61140):	☐ Class 0 ☒ Class II ☐ Class III	N/A

7.2	Marking and documentation (Clause 5.2 of IEC 61730-1:2023 and Clause 5 of IEC 61215-1:2021)		
7.2.1	Marking (Clause 5.2.2 of IEC 61730-1:2023 and Clause 5.1 of IEC 61215-1:2021)		
7.2.1.1	General (Clause 5.2.2.1 of IEC 61730-1:2023 and Clause 5.1 of IEC 61215-1:2021)		
	Each PV module includes the following clear and indelible markings:	Compliance checked by tests MST 01 and MST 05	P
	a) Name, registered trade name, or registered trade mark of manufacturer	Marked on type label	P
	b) Type or model number designation	Marked on type label	P
	c) Serial number (unless marked on other part of product)	Encapsulated inside module	P
	d) Date and place of manufacture; alternatively serial number assuring traceability of date and place of manufacture	Traceable from serial number (checked during factory inspection)	P
	e) Polarity of terminals or leads	“+” and “-” indicated on terminal	
	f) Maximum system voltage or “V _{sys} ”	Marked on type label	P

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 17 von 128
Page 17 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result
	g) Class of protection against electrical shock, in accordance with Clause 4 of IEC 61730-1:2023	Marked on type label	P
	h) Voltage at open-circuit or " V_{oc} " including manufacturing tolerances	Marked on type label	P
	i) Current at short-circuit or " I_{sc} " including manufacturing tolerances	Marked on type label	P
	j) Maximum power or " P_{max} " including manufacturing tolerances	Marked on type label	P
	k) Maximum overcurrent protection rating	Marked on type label	P
	l) Short-circuit current bifaciality coefficient ϕ_{Isc} Open-circuit voltage bifaciality coefficient ϕ_{Voc} Maximum power bifaciality coefficient ϕ_{Pmax}	Marked on type label	P
	m) Minimum radius of curvature	N/A	N/A
	All electrical data are shown at standard test conditions (STC) (1000 W/m ² , (25 ± 2) °C, AM 1.5 according to IEC 60904-3).	Marked on type label	P
	Description of measurement of BNPI (AM1.5, T=25°C, Irradiance = 1000W/m ² + $\phi \cdot 135W/m^2$)	Marked on type label	P
	PV connectors or wiring are marked with a symbol or/and hint „Do not disconnect under load“. Symbol or/and warning notice is imprinted or labelled close to connector.	 Symbol  / warning notice indicated on connectors	P
	For Class II and Class 0 PV modules, the  (IEC 60417-6042: Caution, risk of electric shock) symbol is applied near the PV module electrical connection means.	Electrical hazard symbol indicated on type label	P
	PV modules are marked to indicate the class.	☒ class II:  ☐ class III:  ☐ class 0: no symbol	P
	PV modules provided with terminals for field wiring rated only for use with copper wire are marked, at or adjacent to the terminals, with the statement "Use copper wire only", "Cu only", or the equivalent.	PV modules provided with terminals for field wiring rated for use with all types of wiring material, do not need to be marked.	N/A
	PV modules provided with terminals for field wiring rated only for use with a different specific wiring material are marked with a similar statement referring to the rated material.	PV modules provided with terminals for field wiring rated for use with all types of wiring material, do not need to be marked.	N/A
7.2.1.2	Symbols (Clause 5.2.2.2 of IEC 61730-1:2023)		
7.2.1.2.1	Equipotential bonding (Clause 5.2.2.2.1 of IEC 61730-1:2023)		
	A wiring terminal or bonding location for equipotential bonding is identified with:	 	P

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 18 von 128
Page 18 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result
	No other terminal or location is identified in this manner.	Mounting hole may not be used for bonding.	P
7.2.2	Documentation (Clause 5.2.3 of IEC 61730-1:2023 and Clause 5.2 of IEC 61215-1:2021)		
	Documentation concerning electrical and mechanical installation is provided.	Available in data sheet / installation manual	P
	The documentation states the class for protection against electrical shock under which the PV module was qualified and any specific limitations required for that class.	Available in data sheet / installation manual	P
	Environmental conditions to which the module has been qualified are stated.	N/A	N/A
	- concerning temperature range, typically -40 °C to +40 °C.	Available in data sheet / installation manual	P
	- concerning wind/snow load including safety factor.	Available in data sheet / installation manual	P
	The documentation contains the following information:	N/A	N/A
	- Name, registered trade name, or registered trade mark of manufacturer	Available in data sheet / installation manual	P
	- Type or model number designation	Available in data sheet / installation manual	P
	- Maximum system voltage or "V _{sys} "	Available in data sheet / installation manual	P
	- Class for protection against electrical shock, in accordance with Clause 4 of IEC 61730-1:2023	Available in data sheet / installation manual	P
	- Voltage at open-circuit or "V _{oc} " including manufacturing tolerances	Available in data sheet / installation manual	P
	- Current at short-circuit or "I _{sc} " including manufacturing tolerances	Available in data sheet / installation manual	P
	- Maximum power or "P _{max} " including manufacturing tolerances	Available in data sheet / installation manual	P
	- Short-circuit current bifaciality coefficient ϕ_{Isc} - Open-circuit voltage bifaciality coefficient ϕ_{Voc} - Maximum power bifaciality coefficient ϕ_{Pmax}	Available in data sheet / installation manual	P
	- Minimum radius of curvature	N/A	N/A
	- Maximum overcurrent protection rating (compliance verified by reverse current overload test (MST 26))	Available in data sheet / installation manual	P
	- Recommended maximum series / parallel PV module configurations	Available in data sheet / installation manual	P
	- Temperature coefficient for maximum output power	Available in data sheet / installation manual	P
	- Temperature coefficient for voltage at open-circuit	Available in data sheet / installation manual	P
	- Temperature coefficient for short-circuit current	Available in data sheet / installation manual	P

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 19 von 128
Page 19 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result
	- All electrical data are shown at standard test conditions (1000 W/m ² , (25 ± 2) °C, AM 1.5 according to IEC 60904-3).	Available in data sheet / installation manual	P
	- Description of measurement of BNPI (AM 1.5, T = 25 °C, Irradiance = 1000W/m ² + ϕ •135W/m ²)	Available in data sheet / installation manual	P
	- Performance at low irradiance (MQT 07) is specified.	Available in data sheet / installation manual	P
	Detailed wiring method for electrical installation is included in the documentation, containing	N/A	N/A
	- minimum cable diameters for PV modules intended for field wiring	Available in installation manual	P
	- any limitations on wiring methods and wire management that apply to the PV module junction box	Available in installation manual	P
	- size, type, material, and temperature rating of the conductors to be used	Junction boxes fulfill the requirements of IEC 62790	P
	- type of terminals for field wiring	Junction boxes fulfill the requirements of IEC 62790	P
	- specific PV connector model / types and manufacturer to which the PV module connectors can be mated	Available in installation manual	P
	- bonding to be used (if applicable) including all provided or specified hardware	Available in installation manual	P
	- type and ratings of bypass diode to be used (if applicable) as well as the installation instructions for those diodes	Junction boxes fulfill the requirements of IEC 62790	P
	The documentation includes	N/A	N/A
	- limitations to the mounting situation (e.g. slope, mounting means, cooling).	Available in installation manual	P
	- a statement indicating the fire rating(s)	☒ fire rating(s) and applied standards ☐ statement that resistance to external fire sources was not evaluated	P
	- a statement indicating the minimum mechanical means for securing the PV module	Available in installation manual	P
	- a statement indicating the maximum altitude the PV module is designed for	≤ 2000 m above sea level Available in installation manual	P
	The documentation for roof mounting includes	N/A	N/A
	- a statement indicating the minimum mechanical means for securing the PV module	Available in installation manual	P
	- specific parameter(s) when the fire rating is dependent on a specific mounting structure, specific spacing, or specific means of attachment to the roof or structure	Available in installation manual	P
	The documentation includes a statement advising that external or otherwise artificially concentrated sunlight shall	Available in installation manual	P

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 20 von 128
Page 20 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result
	not be directed onto the front or back face of the PV module (if not qualified for).		
	Assembly instructions are provided with a product shipped in subassemblies, and are detailed and adequate to the degree required to facilitate complete and safe assembly of the product.	No subassemblies	N/A
	The following or equivalent statement is included: "Under normal conditions, a photovoltaic module is likely to experience conditions that produce higher current and/or voltage than reported at standard test conditions. Accordingly, the values of <i>I</i> _{sc} and <i>V</i> _{oc} marked on this PV module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor current ratings, and size of controls (e.g. inverter) connected to the PV output." Safety factor may vary acc. to local conditions.	Available in installation manual	P
7.3	Electrical components and insulation (Clause 5.3 of IEC 61730-1:2023)		
7.3.1	Internal wiring (Clause 5.3.2 of IEC 61730-1:2023)		
	Internal wiring has sufficient current carrying capacity for the relevant application.	Verified by MST 14 and MST 26	P
7.3.2	Junction boxes for PV modules (Clause 5.3.5 of IEC 61730-1:2023)		
	Junction boxes for PV modules fulfil the requirements of IEC 62790:2020.	☒ IEC 62790:2020	P
7.3.3	External wiring (Clause 5.3.3 of IEC 61730-1:2023)		
	External wires and cables fulfil the requirements of IEC 62930:2017.	☒ IEC 62930:2017	P
7.3.4	Connectors (Clause 5.3.4 of IEC 61730-1:2023)		
	External DC connectors fulfil the requirements of IEC 62852:2014 + Amd. 1:2020.	☒ IEC 62852:2014	P
7.3.5	Frontsheets and backsheets (Clause 5.3.6 of IEC 61730-1:2023)		
	Frontsheet:		—
	Material of frontsheet:	☒ Glass ☐ Polymeric material ☐ Others	—
	Thermal index frontsheet (see also Clause 5.5.2.3.3 of IEC 61730-1:2023):	Not applicable for glass frontsheet	N/A
	Adhesion to encapsulant or glass is appropriate.	Compliance checked by IEC 61730-2:2023 tests listed in this report.	P
	Backsheet:		—
	Material of backsheet:	☒ Glass ☐ Polymeric material ☐ Others	—

Prüfbericht-Nr.: CN24C6YL 004

Test Report No.:

Seite 21 von 128

Page 21 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result
	Thermal index backsheet (see also Clause 5.5.2.3.3 of IEC 61730-1:2023):	Not applicable for glass frontsheet	N/A
	Adhesion to encapsulant or glass is appropriate.	Compliance checked by IEC 61730-2:2023 tests listed in this report.	P
7.3.6	Insulation barriers (Clause 5.3.7 of IEC 61730-1:2023)		
	Polymeric insulation barrier meets the relevant requirements of Clause 5.5.2 of IEC 61730-1:2023).	See 7.5.1 Part of IEC 62790:2020 qualification.	P
	Barrier is held in place while keeping its required electrical and mechanical properties.	Compliance checked by IEC 61730-2:2023 tests listed in this report.	P
	Removal of barrier is only possible by using a tool.	Tools are necessary for removal of the insulation barrier.	P
7.3.7	Electrical connections (Clause 5.3.8 of IEC 61730-1:2023)		
7.3.7.1	General (Clause 5.3.8.1 of IEC 61730-1:2023)		
	Terminations are so designed, that the contact pressure is not transmitted through insulating material except ceramic, mica or other adequate material.	Compliance checked by MST 01.	P
	Prevention are taken that connections do not become loose, e.g. by using a washer.	Verified by MST 01 / MST 13 / MST 33	P
7.3.7.2	Terminals for external cables and PV connector ribbons (Clause 5.3.8.2 of IEC 61730-1:2023)		
	Terminals for electrical connections are suitable for the type and range of conductor cross-sectional areas according to specification of the manufacturer. They meet the requirements of IEC 62790:2020	☒ IEC 62790:2020	P
	Insulated terminals are designed in a manner where a possible displacement that may result in a reduction of clearances and creepage distances is prevented.	Insulated terminals are qualified according to the related component standards. Part of IEC 62790:2020 qualification.	P
7.3.8	Encapsulant (Clause 5.3.9 of IEC 61730-1:2023)		
	Thermal properties are sufficient for intended application.	Compliance checked by IEC 61730-2:2023 tests listed in this report.	P
	The insulation properties according to Clause 5.5.2.3 of IEC 61730-1:2023 are met, if applicable.	Compliance checked by IEC 61730-2:2023 tests listed in this report.	P
7.3.9	Bypass diodes (Clause 5.3.10 of IEC 61730-1:2023)		
	Bypass diodes are rated to withstand the current and voltage for their intended use.	Compliance checked by MST 01, MST 07, MST 22 and MST 25 Datasheet values for bypass diode checked.	P

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 22 von 128
Page 22 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

7.4	Mechanical and electromechanical connections (Clause 5.4 of IEC 61730-1:2023)		
7.4.1	General (Clause 5.4.1 of IEC 61730-1:2023)		
	Type of connection:	☒ Connection within frame ☐ Mounting interfaces via adhesive ☒ Frame to clamp a mounting system ☒ Equipotential bonding ☒ Attachment of junction box ☐ Mechanical connections within the laminate	N/A
	Mechanical connections are durable to withstand the thermal, mechanical, and environmental stresses occurring in the application.	Compliance checked by inspection and by MST 13, MST 32, MST 34 and MST 37.	P
	Parts intended to be removed are only detachable with the aid of tools.	Tools are necessary for removal.	P
	A tool does not come into contact with the live parts when the lid is removed with it.	Compliance checked by the corresponding component standards.	P
	No friction occurs between surfaces as the sole means to inhibit the turning or loosening of a part, unless provisions to prevent unintended movement or rotation of the component are given.	No such parts.	N/A
7.4.2	Screw connections (Clause 5.4.2 of IEC 61730-1:2023)		
	Screws and mechanical connections withstand the mechanical stresses occurring in normal use.	No screw is used.	N/A
	Screws are not made of a material which is soft or liable to creep.	No screw is used.	N/A
	Screws used to provide mechanical stability and continuity for equipotential bonding withstand the mechanical stresses occurring in normal use.	No screw is used.	N/A
	At least one screw per electrical-mechanical connection ensures the electrical connection between the metallic components.	No screw is used.	N/A
	Screws used for mechanical and electrical connections with a nominal diameter of less than 3 mm are screwed into metal.	No screw is used.	N/A
	For screws used for mechanical and electrical connections two full threads are engaged into the metal.	No screw is used.	N/A
	Screwed and other fixed connections are in such a way that they do not come loose through torsion, bending stresses, vibration, etc.	No screw is used.	N/A
7.4.3	Rivets (Clause 5.4.3 of IEC 61730-1:2023)		
	Rivets which serve as electrical as well as mechanical connections are locked against loosening.	No rivet is used.	N/A
7.4.4	Thread-cutting screws (Clause 5.4.4 of IEC 61730-1:2023)		

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 23 von 128
Page 23 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result
	Thread-cutting and self-tapping screws are not used for interconnection of current-carrying parts made of a material which is soft or liable to creep.	No thread-cutting screw is used.	N/A
	No thread-forming or thread-cutting (self-tapping) screws (sheet metal screws) are used for the connection of current-carrying parts.	No thread-cutting screw is used.	N/A
	Thread-cutting (self-tapping) screws are not used if they are likely to be operated by the user or installer.	No thread-cutting screw is used.	N/A
	Thread-cutting and thread-forming screws, used to provide continuity for equipotential bonding, are such that it is not necessary to disturb the connection in normal use.	No thread-cutting screw is used.	N/A
	For equipotential bonding one screw is used if two full threads engage the metal.	No thread-cutting screw is used.	N/A
7.4.5	Form / press / tight fit (Clause 5.4.5 of IEC 61730-1:2023)		
	Form/press/tight fits of metallic components which are not separately equipotential bonded are electrically connected.	Compliance checked by inspection and tested by MST 32, MST 34 and MST 13 pre and post the MST 32 and MST 34 tests.	P
7.4.6	Connections by adhesives (Clause 5.4.6 of IEC 61730-1:2023)		
	Connections by adhesive for mounting means are sufficient.	Compliance checked by MST 34, MST 13, MST 32 for mounting adhesives.	P
	Fixing of junction box by adhesive is sufficient.	Compliance checked by MST 42, MST 17 for junction box adhesives.	P
	Adhesion of a polymer relied upon for insulation to another insulating layer is appropriate for the application.	Compliance checked by MST 34, MST 13, MST 32 for adhesives used for mounting means and MST 42, MST 17 for junction box adhesives.	P
	Requirements for adhesive materials are met.	See 7.5.2.2	P
	Connection by adhesive which is considered as cemented joint fulfills the requirements of Clause 5.6.4.2 IEC 61730-1:2023.	No cemented joints	N/A
7.4.7	Other connections (Clause 5.4.7 of IEC 61730-1:2023)		
	Other connections (such as welded or soldered) as well as materials and processes to create the connections are appropriate for the application and for the intended use.	Compliance checked by MST 01 and MST 13.	P
	Other connections which are relied upon for equipotential bonding fulfil the requirements of MST 13.	Compliance checked by MST 01 and MST 13.	P
7.5	Materials (Clause 5.5 of IEC 61730-1:2023)		
7.5.1	Polymeric materials (Clause 5.5.2 of IEC 61730-1:2023)		
7.5.1.1	General (Clause 5.5.2.1 of IEC 61730-1:2023)		

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 24 von 128
Page 24 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result
	Polymeric materials are able to durably and safely withstand the electrical, mechanical, thermal, environmental, and corrosive stresses occurring in the application.	Compliance checked by IEC/EN 61730-2 tests listed in this report and other environmental chamber tests including pre- and post-measurements and including assessment of creepages.	P
	Polymeric materials are resistant to electrical and mechanical property degradation.	Compliance checked by MST 37. Compliance checked by all tests including pre- and post-measurements and including assessment of creepages.	P
	Polymeric parts which ensure either the electrical or mechanical safety of the PV module or both, are resistant to electrical and mechanical property degradation. They comply with the requirements of the Materials creep test (MST 37) depending on their constructive function in the PV module.	Compliance checked by MST 37.	P
	Polymeric material used as a part of a cemented joint fulfills additionally the requirements of Clause 5.6.4.2 of IEC 61730-1:2023	No cemented joints	N/A
7.5.1.2	Endurance to weathering stress (Clause 5.5.2.2 of IEC 61730-1:2023)		
	Polymeric materials of the module and its components are durable to weathering stress.	Components are evaluated according to the relevant requirements in the applicable component standards. Compliance checked by IEC/EN 61730-2 tests listed in this report.	P
7.5.1.3	Polymeric materials used as electrical insulation (Clause 5.5.2.3 of IEC 61730-1:2023)		
7.5.1.3.1	General (Clause 5.5.2.3.1 of IEC 61730-1:2023)		
	Material relied upon for insulation is of adequate thickness, as described in Tables 3 and 4.	Components are evaluated according to the relevant requirement in the applicable component standard.	P
	The temperature limits of materials used as insulation are not less than the maximum measured operating temperature of the specific material in application, as measured during the temperature test (MST 21).	N/A	N/A
7.5.1.3.2	Endurance to electrical stress (Clause 5.5.2.3.2 of IEC 61730-1:2023)		
	Materials used as electrical insulation are in compliance with the insulation coordination requirements.	See 7.6.3	P
7.5.1.3.3	Endurance to thermal stress (Clause 5.5.2.3.3 of IEC 61730-1:2023)		
	Materials used as relied upon insulation have a electrical relative thermal endurance, relative thermal index or temperature index (RTE / RTI / TI) appropriate for the application, at least 90°C.	☒ TI ☐ RTE ☐ RTI	P
7.5.1.3.4	Polymeric insulating materials used as external parts (Clause 5.5.2.3.4 of IEC 61730-1:2023)		

Prüfbericht-Nr.: CN24C6YL 004

Test Report No.:

Seite 25 von 128

Page 25 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result
	External polymeric parts of the PV module whose deterioration could impair the safety meet the following additional requirements:	N/A	N/A
	- Ignitability test (MST 24) in final application (laminated or the PV module)	Compliance checked MST 24.	P
	- Peel test (MST 35) for proof of cemented joints	No cemented joints	N/A
	- Lap shear strength test (MST 36) for proof of cemented joints	No cemented joints	N/A
7.5.1.3.5	Polymeric insulating used for mechanical functions (Clause 5.5.2.4 of IEC 61730-1:2023)		
	Materials used for mechanical functions have a mechanical relative thermal endurance, relative thermal index or temperature index (RTE / RTI / TI) appropriate for the application, at least 90°C.	☐ TI ☐ RTE ☒ RTI	P
7.5.2	Metallic materials (Clause 5.5.3 of IEC 61730-1:2023)		
7.5.2.1	General (Clause 5.5.3.1 of IEC 61730-1:2023)		
	Metal parts are not in contact to other metal parts having a difference of their electrochemical potentials of more than 600 mV.	Compliance is checked by inspection.	P
	Iron or mild steel is plated, painted, or enamelled for protection against corrosion.	Compliance is checked by inspection.	P
	For iron or mild steel, corrosion protection is at least equivalent to a zinc coating of 0.015 mm thickness, and the manufacturer specified how they demonstrate this.	Compliance is checked by inspection.	P
7.5.2.2	Current carrying parts (Clause 5.5.3.2 of IEC 61730-1:2023)		
	Assessed parts:	N/A	N/A
	Current-carrying parts have sufficient mechanical strength and electrical conductivity.	Compliance checked by IEC 61730-2:2023 tests listed in this report.	P
	Current-carrying materials are protected against corrosion.	N/A	N/A
	The coating for protective coated metal is capable of preventing corrosion according to either one of the listed standards.	N/A	N/A
	Coated metal is not used if the current-carrying parts are stressed by abrasion.	N/A	N/A
7.5.2.3	Adhesives (Clause 5.5.4 of IEC 61730-1:2023)		
	Adhesives are appropriate for the application.	Compliance is checked by relevant tests of IEC 61730-2:2023, including MST 42, MST 34, MST 01, MST 11 and MST 17.	P
	Adhesives as part of the relied upon electrical insulation meet the requirements of Clause 5.5.2.3.3 of IEC 61730-1:2023.	See section 7.5.1.3.3	P
7.6	Protection against electric shock (Clause 5.6 of IEC 61730-1:2023)		

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 26 von 128
Page 26 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

7.6.1	General (Clause 5.6.1 of IEC 61730-1:2023)		
	Adequate protection against contact with hazardous live parts is provided and poses no risk of electric shock.	See section 7.6.2 - 7.6.4	P
7.6.2	Protection against accessibility to hazardous live parts (Clause 5.6.2 of IEC 61730-1:2023)		
7.6.2.1	General (Clause 5.6.2.1 of IEC 61730-1:2023)		
	Class of module	See safety ratings	N/A
	For Class 0 and Class II modules, adequate protection against accessibility to hazardous live parts (> Please select Voc) is provided.	Compliance is checked by MST 01 and MST 11.	P
	For Class 0 PV modules, accessible metal parts and accessible surfaces as well as live parts of different potential of the same circuit are separated by at least basic insulation.	Table 2 in Clause 5.6.2.3 of IEC 61730-1:2023	P
	For Class II PV modules, construction provides separation between accessible parts or accessible surfaces and hazardous live parts by double or reinforced insulation.	Table 2 in Clause 5.6.2.3 of IEC 61730-1:2023	P
	For Class II PV modules, live parts of different potential of the same circuit are separated by at least basic insulation.	Table 2 in Clause 5.6.2.3 of IEC 61730-1:2023	P
	For Class III PV modules, construction provides separation between accessible parts or accessible surfaces and hazardous live parts by at least functional insulation.	Table 2 in Clause 5.6.2.3 of IEC 61730-1:2023	P
	In Class III PV modules live parts of different polarity are separated by at least functional insulation.	Table 2 in Clause 5.6.2.3 of IEC 61730-1:2023	P
	Materials used for realizing protection against accessibility of hazardous live parts by means of enclosure, insulation barrier or relied upon insulation comply with the requirements of Clause 5.5.2 of IEC 61730-1:2023 due to their application.	See 7.5.1	N/A
7.6.2.2	Protection by means of enclosures and insulation barriers (Clause 5.6.2.2 of IEC 61730-1:2023)		
	Enclosures or insulation barriers are designed that, after mounting, the live parts are not accessible.	Encapsulant, glass, backsheet, junction box, cable and connectors acceptably insulate any live parts.	P
	The degree of protection of housing is not impaired by any possible deformation.	Encapsulant, glass, backsheet, junction box, cable and connectors acceptably insulate any live parts.	P
	Parts of enclosures and insulation barriers that provide protection are not removable without the use of a tool.	Tools are necessary for removal.	P
	Lids which are attached without screws have one or several detectable features, e.g. recesses.	Compliance verified by evaluation of components.	P
	Tools to open the lid do not come into contact with the live parts if lid is removed correctly.	Tools are necessary for removal.	P

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 27 von 128
Page 27 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result
	Insulation barriers are held in place and are not affected by influences expected during normal operation. Electrical and mechanical properties do not fall below the minimum acceptable values for the application.	Compliance checked by IEC/EN 61730-2 tests listed in this report.	P
	Parts are prevented from loosening or turning.	No such parts.	N/A
7.6.2.3	Protection by means of insulation of live parts (Clause 5.6.2.3 of IEC 61730-1:2023)		
	An insulation material providing the sole insulation between a live part and an accessible metal part, or between uninsulated live parts not of the same potential, is of adequate thickness and of a material appropriate for the application. For requirements see table 2 in Clause 5.6.2.3 of IEC 61730-1:2023 (7.6.2.1).	Compliance verified by evaluation of materials and components.	P
7.6.3	Insulation coordination (Clause 5.6.3 of IEC 61730-1:2023)		
	Components comply with the requirements for their relevant standards (Clause 5.6.3.1 of IEC 61730-1:2023).	Compliance verified by evaluation of materials and components.	P
	Pollution degree (Clause 5.6.3.2 of IEC 61730-1:2023):	See tables in 7.7	N/A
	Material group (Clause 5.6.3.3 IEC 61730-1:2023):	See tables in 7.7	N/A
	Clearance and creepage distance (Clause 5.6.3.4 of IEC 61730-1:2023):	See tables in 7.7	N/A
	Derating factor for altitude above 2000 m is considered.	N/A	N/A
7.6.4	Distance through insulation (Clause 5.6.4 of IEC 61730-1:2023)		
7.6.4.1	General (Clause 5.6.4.1 of IEC 61730-1:2023)		
	Polymeric materials for cemented insulation parts and insulation in thin layers withstand environmental, thermal, electrical and mechanical stresses as far as they occur.	See 7.5	N/A
	Distances through insulation (dti) of solid insulation comply with the minimum distance as required:	N/A	N/A
	System voltage	See safety ratings	N/A
	Distances through insulation (dti)	N/A	N/A
	The insulation fulfils the material classification as given in IEC 60216-1, IEC 60216-2 and IEC 60216-5 (RTE/TI/RTI).	See 7.3.5	P
7.6.4.2	Cemented joints (Clause 5.6.4.2 of IEC 61730-1:2023)		
	Cemented joints were considered as	☐ Edge seal ☐ Interface between junction box and mounting surface ☐ Others ☒ No cemented joints	—
	Distances along cemented joints comply with the minimum distances as required in table 3:	No cemented joints	N/A
	System voltage	No cemented joints	N/A
	Distance along cemented joints, req./meas. [mm]:	No cemented joints	N/A

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 28 von 128
Page 28 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result
	A distance can be considered as cemented joint if following requirements are met:	N/A	N/A
	- Neither cracks nor voids in the insulating compounds have been occurred which either by themselves or in combination reduces the distances through the cemented joint below the required values.	No cemented joints	N/A
	- No breakdown at MST 16 (initial and final tests) with a 1.35 times higher test voltage occurred.	No cemented joints	N/A
	- No breakdown at MST 17 (initial and final tests) with a 1.35 times higher test voltage occurred.	No cemented joints	N/A
	- The electrically insulating adhesive / sealant has a volume resistivity of bigger than $50 \times 10^6 \Omega \text{ cm}$ (dry) / bigger than $10 \times 10^6 \Omega \text{ cm}$ (wet)	No cemented joints	N/A
	- Peel test (MST 35) was passed (rigid / flexible)	No cemented joints	N/A
	- Lap shear strength test (MST 36) was passed (rigid / rigid)	No cemented joints	N/A
	Supplementary information: N/A		
7.6.4.3	Insulation in thin layers (Clause 5.6.4.3 of IEC 61730-1:2023)		
	Relied upon insulation in thin layers is applied at	☐ Backsheet ☐ Frontsheet ☐ Insulation within laminate ☒ Others	N/A
	Initial construction of insulation in thin layers complies with requirements concerning thickness under consideration of figure 4 as described in table 3 or 4.	Not applicable for glass backsheet	N/A
	Construction of insulation in thin layers complies with requirements concerning RTE/TI/RTI.	Not applicable for glass backsheet	N/A
	Insulation in thin layers provides sufficient dielectric strength:	N/A	N/A
	Test voltage for single-layer sheet and for entire multi-layer sheet providing relied upon insulation (2000V + 4 times system voltage): 8000V	Compliance is checked by MST 16.	N/A
	Single-layer sheet as well as entire multi-layer sheet in final application comply with following:	N/A	N/A
	Dielectric strength for basic insulation is provided after Cut susceptibility test (MST 12). Test voltage [V]: (1000V + 2 times system voltage)	Not applicable for glass backsheet	N/A

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 29 von 128
Page 29 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

7.7	Clearance and creepage distances (Clause 5.6.3.4 of IEC 61730-1:2023) and Evaluation of clearances, creepage distances and distance through functional insulation (MST 57 of IEC 61730-2:2023)
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Table 1: Design evaluation

Clearance (cl) and creepage distance (cr) at/of/between:	Line of table 3 or 4	Type of insulation	Pollution degree	CTI Material group	Working voltage [V]	Clearance cl [mm]		Creepage cr [mm]	
						Required	Design ^a	Required	Design
Position 1: Shortest distance string connector – module edge	1a	☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	1500	19.4	11.9±1.0	10.4	11.9±1.0
Position 2: Shortest distance cell – module edge	1a	☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	1500	19.4	11.9±1.0	10.4	11.9±1.0
Position 3: Cell to cell	2	☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	< 35	0.1	0.8±0.5	0.2	0.8±0.5
Position 4: String to string	2	☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	< 35	0.1	2.5±0.5	0.2	2.5±0.5
Position 5: E.g., distance between terminals in JB or between terminal and outer JB enclosure.	3	☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	< 35	0.5	N/A*	0.4	N/A*

Supplementary information:

*The junction box is potted and fulfils the requirements of IEC 62790.

^a List relevant position and test voltage for each clearance which is verified by Impulse voltage test according to IEC 60664-1.

Prüfbericht-Nr.: CN24C6YL 004

Seite 30 von 128

Test Report No.:

Page 30 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

7.7	Clearance and creepage distances (Clause 5.6.3.4 of IEC 61730-1:2023) and Evaluation of clearances, creepage distances and distance through functional insulation (MST 57 of IEC 61730-2:2023)
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Table 2: PV module evaluation MST 01 initial

Sample no.			1-4, 1-6, 1-8, 2-3, 3-3 and 4-2						
Clearance (cl) and creepage distance (cr) at/of/between:	Line of table 3or 4	Type of insulation	Pollution degree	CTI Material group	Working voltage [V]	Clearance cl [mm]		Creepage cr [mm]	
						Required	Measured ^a	Required	Measured
Position 1: Shortest distance string connector – module edge	1a	☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	1500	19.4	11.9	10.4	11.9
Position 2: Shortest distance cell – module edge	1a	☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	1500	19.4	11.9	10.4	11.9
Position 3: Cell to cell	2	☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	< 35	0.1	0.8	0.2	0.8
Position 4: String to string	2	☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	< 35	0.1	2.5	0.2	2.5
Position 5: E.g., distance between terminals in JB or between terminal and outer JB enclosure.	3	☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	< 35	0.5	N/A*	0.4	N/A*

Supplementary information:

*The junction box is potted and fulfils the requirements of IEC 62790.

^a List relevant position and test voltage for each clearance which is verified by Impulse voltage test according to IEC 60664-1.

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 31 von 128
Page 31 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

7.7	Clearance and creepage distances (Clause 5.6.3.4 of IEC 61730-1:2023) and Evaluation of clearances, creepage distances and distance through functional insulation (MST 57 of IEC 61730-2:2023)		
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Table 3: PV module evaluation MST 01 final

Sample no.			1-4, 1-6, 1-8, 2-3, 3-3 and 4-2						
Clearance (cl) and creepage distance (cr) at/of/between:	Line of table 3or 4	Type of insulation	Pollution degree	CTI Material group	Working voltage [V]	Clearance cl [mm]		Creepage cr [mm]	
						Required	Measured ^a	Required	Measured
Position 1: Shortest distance string connector – module edge		☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	1500	19.4	11.9	10.4	11.9
Position 2: Shortest distance cell – module edge		☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	1500	19.4	11.9	10.4	11.9
Position 3: Cell to cell		☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	< 35	0.1	0.8	0.2	0.8
Position 4: String to string		☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	< 35	0.1	2.5	0.2	2.5
Position 5: E.g., distance between terminals in JB or between terminal and outer JB enclosure. .		☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☒ I ☐ II ☐ IIIa	< 35	0.5	N/A*	0.4	N/A*

Supplementary information:

*The junction box is potted and fulfils the requirements of IEC 62790.

^a List relevant position and test voltage for each clearance which is verified by Impulse voltage test according to IEC 60664-1.

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 32 von 128
Page 32 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

8	Pass criteria (Clause 7 of IEC 61215-1:2021)		
8.1	Output power and electric circuitry (Clause 7.2 of IEC 61215-1:2021)		
8.1.1	Verification of rated label values (Gate #1) (STC) (Clause 7.2.1 of IEC 61215-1:2021)		
	After stabilization, each individual module shall meet: $P_{\max}(\text{Lab}) \cdot \left(1 + \frac{1.65}{2} \frac{ m_1 }{100}\right) \geq P_{\max}(\text{NP}) \cdot \left(1 - \frac{ t_1 }{100}\right)$ $\bar{P}_{\max}(\text{Lab}) \cdot \left(1 + \frac{1.65}{2} \frac{ m_1 }{100}\right) \geq P_{\max}(\text{NP})$	See table "Gate #1 evaluation"	P
	After stabilization, each individual module shall meet: $V_{\text{OC}}(\text{Lab}) \cdot \left(1 + \frac{1.65}{2} \frac{ m_2 }{100}\right) \leq V_{\text{OC}}(\text{NP}) \cdot \left(1 + \frac{ t_2 }{100}\right)$	See table "Gate #1 evaluation"	P
	After stabilization, each individual module shall meet: $I_{\text{SC}}(\text{Lab}) \cdot \left(1 + \frac{1.65}{2} \frac{ m_3 }{100}\right) \leq I_{\text{SC}}(\text{NP}) \cdot \left(1 + \frac{ t_3 }{100}\right)$	See table "Gate #1 evaluation"	P
	After stabilization, each individual module that is used for the qualification of low end power classes shall meet: $P_{\max}(\text{Lab}) \cdot \left(1 - \frac{1.65}{2} \frac{ m_1 }{100}\right) \leq P_{\max 4}(\text{NP}) \cdot \left(1 + \frac{ t_4 }{100}\right)$	See table "Gate #1 evaluation"	P
	m_1 [%] = measurement uncertainty of laboratory for $P_{\max}$ m_2 [%] = measurement uncertainty of laboratory for V_{OC} m_3 [%] = measurement uncertainty of laboratory for I_{SC} t_1 [%] = manufacturer's rated lower production tolerance for $P_{\max}$ t_2 [%] = manufacturer's rated upper production tolerance for V_{OC} t_3 [%] = manufacturer's rated upper production tolerance for I_{SC} t_4 [%] = manufacturer's rated upper production tolerance for $P_{\max 4}$ $P_{\max 4}$ = maximum rated nameplate power of lowest power class module NP = name plate		
—	Verification of rated label values (Gate #1) (BNPI) (Clause 7.2.1 of IEC 61215-1:2021)		
	After stabilization, each individual module shall meet: $P_{\max}(\text{BNPI})(\text{Lab}) \cdot \left(1 + \frac{1.65}{2} \frac{ m_1(\text{BNPI}) }{100}\right) \geq P_{\max}(\text{BNPI})(\text{NP}) \cdot \left(1 - \frac{ t_1(\text{BNPI}) }{100}\right)$ $\bar{P}_{\max}(\text{BNPI})(\text{Lab}) \cdot \left(1 + \frac{1.65}{2} \frac{ m_1(\text{BNPI}) }{100}\right) \geq P_{\max}(\text{BNPI})(\text{NP})$	See table "Gate #1 evaluation"	P
	After stabilization, each individual module shall meet: $V_{\text{OC}}(\text{BNPI})(\text{Lab}) \cdot \left(1 + \frac{1.65}{2} \frac{ m_2(\text{BNPI}) }{100}\right) \leq V_{\text{OC}}(\text{BNPI})(\text{NP}) \cdot \left(1 + \frac{ t_2(\text{BNPI}) }{100}\right)$	See table "Gate #1 evaluation"	P
	After stabilization, each individual module shall meet:	See table "Gate #1 evaluation"	P

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 33 von 128
Page 33 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

	$I_{SC(BNPI)}(Lab) \cdot \left(1 + \frac{1.65}{2} \frac{ m_3(BNPI) }{100}\right) \leq I_{SC(BNPI)}(NP) \cdot \left(1 + \frac{ t_3(BNPI) }{100}\right)$		
	After stabilization, each individual module that is used for the qualification of low end power classes shall meet: $P_{max(BNPI)}(Lab) \cdot \left(1 - \frac{1.65}{2} \frac{ m_1(BNPI) }{100}\right) \leq P_{max4(BNPI)}(NP) \cdot \left(1 + \frac{ t_4(BNPI) }{100}\right)$	See table "Gate #1 evaluation"	P
	$m_1(BNPI)$ [%] = measurement uncertainty of laboratory for $P_{max(BNPI)}$ $m_2(BNPI)$ [%] = measurement uncertainty of laboratory for $V_{OC(BNPI)}$ $m_3(BNPI)$ [%] = the measurement uncertainty of laboratory for $I_{SC(BNPI)}$ $t_1(BNPI)$ [%] = manufacturer's rated lower production tolerance for $P_{max(BNPI)}$ $t_2(BNPI)$ [%] = manufacturer's rated upper production tolerance for $V_{OC(BNPI)}$ $t_3(BNPI)$ [%] = manufacturer's rated upper production tolerance for $I_{SC(BNPI)}$ $t_4(BNPI)$ [%] = manufacturer's rated upper production tolerance for $P_{max4(BNPI)}$ $P_{max4(BNPI)}$ = maximum rated nameplate power of lowest power class module (under BNPI) NP = name plate		—

8.1.2	Maximum power degradation during type approval testing (Gate #2) (STC) (Clause 7.2.2 of IEC 61215-1:2021)		
	At the end of each test sequence, each test sample shall meet: $P_{max}(Lab_Gate\ 2) \geq 0.95 \times P_{max}(Lab_Gate\ 1) \cdot \left(1 - \frac{r}{100}\right)$	See table "Gate #2 evaluation"	P
	r = reproducibility		—
—	Maximum power degradation during type approval testing (Gate #2) (BNPI) (Clause 7.2.2 of IEC 61215-1:2021)		
	At the end of each test sequence, each test sample shall meet: $P_{max(BNPI)}(Lab_Gate\ 2) \geq 0.95 \times P_{max(BNPI)}(Lab_Gate\ 1) \cdot \left(1 - \frac{r_{(BNPI)}}{100}\right)$	See table "Gate #2 evaluation"	P
	$r_{(BNPI)}$ = reproducibility		—

8.1.3	Electrical circuitry (Clause 7.2.3 of IEC 61215-1:2021)		
	Samples are not permitted to exhibit an open-circuit during the tests.	No open-circuit during tests	P
8.2	Visual defects (Clause 7.3 of IEC 61215-1:2021)		
	There is no visual evidence of a major defect.	No major visual defect	P
8.3	Electrical safety (Clause 7.4 of IEC 61215-1:2021)		
	The insulation test (MQT 03) requirements are met at the beginning and the end of each sequence.	See tables below	P
	The wet leakage current test (MQT 15) requirements are met at the beginning and the end of each sequence.	See tables below	P
	Specific requirements of the individual tests are met.	See tables below	P

Supplementary information: N/A

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 34 von 128
Page 34 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

III	IEC 61215-2:2021 and IEC 61730-2:2023 – Test procedures
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9	Overview of tests and test results <u>Module type: YL700CF66 f/2 (under STC) / YL776CF66 f/2 (under BNPI) (Median power)</u> <u>YL715CF66 f/2 (under STC) / YL792CF66 f/2 (under BNPI) (Higher power end) YL685CF66 f/2</u> <u>(under STC) / YL759CF66 f/2 (under BNPI) (Lower power end) (BOM 1)</u>
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Initial examination	—	—
Visual inspection (MQT 01 / MST 01)	See table 9.1	P
Insulation test (MQT 03 / MST 16)	See table 9.2	P
Wet leakage current test (MQT 15 / MST 17)	See table 9.3	P
Accessibility test (MST 11)	See table 9.4	P
Continuity test of equipotential bonding (MST 13)	See table 9.5	P
Initial stabilization (MQT 19.1)	See table 9.6	P
Maximum power determination (MQT 02 / MST 03)	See table 9.7	P
Performance at STC and BNPI (MQT 06.1 / MST 03)	See table 9.8	P
Gate #1 evaluation	See table 9.9	P

Sequence A	—	—
Measurement of temperature coefficients (MQT 04)	See table 9.10	P
Performance at low irradiance (MQT 07)	See table 9.11	P

Sequence B1	—	—
Outdoor exposure test (MQT 08)	N/A	N/A

Sequence B2	—	—
Hot-spot endurance test (MQT 09 / MST 22)	See table 9.14	P
Reverse current overload test (MST 26)	See table 9.15	P

Sequence B3	—	—
Bypass diode thermal test (MQT 18.1 / MST 25)	N/A	N/A

Sequence C	—	—
UV preconditioning test (MQT 10 / MST 54)	N/A	N/A
Cyclic (dynamic) mechanical load test (MQT 20)	See table 9.18	P
Thermal cycling test (50 cycles) (MQT 11 / MST 51)	See table 9.19	P
Humidity-freeze test (MQT 12 / MST 52)	See table 9.20	P

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 35 von 128
Page 35 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

Sequence C1	—	—
Retention of junction box on mounting surface (MQT 14.1 / MST 42)	See table 9.21	P
Test of cord anchorage (MQT 14.2)	Junction box is approved according to IEC 62790	P

Sequence D	—	—
Thermal cycling test (200 cycles) (MQT 11 / MST 51)	See table 9.23	P

Sequence E	—	—
Damp heat test (MQT 13 / MST 53)	See table 9.24	P

Sequence E1	—	—
Static mechanical load test (MQT 16 / MST 34)	See table 9.25	P

Sequence E2	—	—
Hail test (MQT 17)	N/A	N/A

Sequence F	—	—
Materials creep test (MST 37)	N/A	N/A

Sequence G	—	—
Damp heat test (200h) (MST 53)	N/A	N/A
UV test (front side) (MST 54)	N/A	N/A
Humidity-freeze test (MST 52)	N/A	N/A
UV test (back side) (MST 54)	N/A	N/A
Humidity-freeze test (MST 52)	N/A	N/A
Insulation thickness test (MST 04)	Not applicable for glass backsheet	N/A

Sequence G1	—	—
Cold conditioning 1 (MST 55)	N/A	N/A
Dry heat conditioning (MST 56)	N/A	N/A
Humidity-freeze test 1 (MST 52)	N/A	N/A
Cold conditioning 2 (MST 55)	N/A	N/A
Humidity-freeze test 2 (MST 52)	N/A	N/A

Sequence H	—	—
Impulse voltage test (MST 14)	See table 9.40	P

Prüfbericht-Nr.: CN24C6YL 004

Test Report No.:

Seite 36 von 128

Page 36 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

Sequence M	—	—
Module breakage test (MST 32)	See table 9.41	P

Sequence I	—	—
Ignitability test (MST 24)	N/A	N/A

Sequence K	—	—
Potential induced degradation test (MQT 21)	See table 9.43	P

Sequence J	—	—
Fire test (MST 23)	N/A	N/A

Final measurements	—	—
Final stabilization (MQT 19.2 / MQT 19.3)	N/A	N/A
Maximum power determination (MQT 02 / MST 03)	See table 9.46	P
Performance at STC and BNPI (MQT 06.1 / MST 03)	See table 9.47	P
Gate #2 evaluation	See table 9.48	P
Bypass diode functionality test (MQT 18.2 / MST 07)	See table 9.49	P
Cut susceptibility test (MST 12)	Not applicable for glass backsheet	N/A
Accessibility test (MST 11)	See table 9.51	P
Continuity test of equipotential bonding (MST 13)	See table 9.52	P
Screw connections test (MST 33)	No screw connections	N/A
Durability of markings (MST 05)	See table 9.54	P
Sharp edge test (MST 06)	See table 9.55	P

Component tests	—	—
Peel test (MST 35)	No cemented joints	N/A
Lap shear strength test (MST 36)	No cemented joints	N/A

Supplementary information: See Appendix A: Test charts for more details.

Prüfbericht-Nr.: CN24C6YL 004

Test Report No.:

Seite 37 von 128

Page 37 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9	Overview of tests and test results Module type: YL700CF66 f/2 (under STC) / YL776CF66 f/2 (under BNPI) (BOM 2), YL695CF66 f/2 (under STC) / YL770CF66 f/2 (under BNPI) (BOM 3)		
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Initial examination	—	—
Visual inspection (MQT 01 / MST 01)	See table 9.1	P
Insulation test (MQT 03 / MST 16)	See table 9.2	P
Wet leakage current test (MQT 15 / MST 17)	See table 9.3	P
Accessibility test (MST 11)	See table 9.4	P
Continuity test of equipotential bonding (MST 13)	See table 9.5	P
Initial stabilization (MQT 19.1)	See table 9.6	P
Maximum power determination (MQT 02 / MST 03)	See table 9.7	P
Performance at STC and BNPI (MQT 06.1 / MST 03)	See table 9.8	P
Gate #1 evaluation	See table 9.9	P

Sequence A	—	—
Measurement of temperature coefficients (MQT 04)	N/A	N/A
Performance at low irradiance (MQT 07)	N/A	N/A

Sequence B1	—	—
Outdoor exposure test (MQT 08)	N/A	N/A

Sequence B2	—	—
Hot-spot endurance test (MQT 09 / MST 22)	N/A	N/A
Reverse current overload test (MST 26)	See table 9.15	P

Sequence B3	—	—
Bypass diode thermal test (MQT 18.1 / MST 25)	N/A	N/A

Sequence C	—	—
UV preconditioning test (MQT 10 / MST 54)	N/A	N/A
Cyclic (dynamic) mechanical load test (MQT 20)	See table 9.18	P
Thermal cycling test (50 cycles) (MQT 11 / MST 51)	See table 9.19	P
Humidity-freeze test (MQT 12 / MST 52)	See table 9.20	P

Prüfbericht-Nr.: CN24C6YL 004

Test Report No.:

Seite 38 von 128

Page 38 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

Sequence C1	—	—
Retention of junction box on mounting surface (MQT 14.1 / MST 42)	See table 9.21	P
Test of cord anchorage (MQT 14.2)	Junction box is approved according to IEC 62790	P

Sequence D	—	—
Thermal cycling test (200 cycles) (MQT 11 / MST 51)	N/A	N/A

Sequence E	—	—
Damp heat test (MQT 13 / MST 53)	N/A	N/A

Sequence E1	—	—
Static mechanical load test (MQT 16 / MST 34)	N/A	N/A

Sequence E2	—	—
Hail test (MQT 17)	N/A	N/A

Sequence F	—	—
Materials creep test (MST 37)	N/A	N/A

Sequence G	—	—
Damp heat test (200h) (MST 53)	N/A	N/A
UV test (front side) (MST 54)	N/A	N/A
Humidity-freeze test (MST 52)	N/A	N/A
UV test (back side) (MST 54)	N/A	N/A
Humidity-freeze test (MST 52)	N/A	N/A
Insulation thickness test (MST 04)	Not applicable for glass backsheet	N/A

Sequence G1	—	—
Cold conditioning 1 (MST 55)	N/A	N/A
Dry heat conditioning (MST 56)	N/A	N/A
Humidity-freeze test 1 (MST 52)	N/A	N/A
Cold conditioning 2 (MST 55)	N/A	N/A
Humidity-freeze test 2 (MST 52)	N/A	N/A

Sequence H	—	—
Impulse voltage test (MST 14)	See table 9.40	P

Prüfbericht-Nr.: CN24C6YL 004

Test Report No.:

Seite 39 von 128

Page 39 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

Sequence M	—	—
Module breakage test (MST 32)	N/A	N/A

Sequence I	—	—
Ignitability test (MST 24)	N/A	N/A

Sequence K	—	—
Potential induced degradation test (MQT 21)	See table 9.43	P

Sequence J	—	—
Fire test (MST 23)	N/A	N/A

Final measurements	—	—
Final stabilization (MQT 19.2 / MQT 19.3)	N/A	N/A
Maximum power determination (MQT 02 / MST 03)	See table 9.46	P
Performance at STC and BNPI (MQT 06.1 / MST 03)	See table 9.47	P
Gate #2 evaluation	See table 9.48	P
Bypass diode functionality test (MQT 18.2 / MST 07)	See table 9.49	P
Cut susceptibility test (MST 12)	Not applicable for glass backsheet	N/A
Accessibility test (MST 11)	See table 9.51	P
Continuity test of equipotential bonding (MST 13)	See table 9.52	P
Screw connections test (MST 33)	No screw connections	N/A
Durability of markings (MST 05)	See table 9.54	P
Sharp edge test (MST 06)	See table 9.55	P

Component tests	—	—
Peel test (MST 35)	No cemented joints	N/A
Lap shear strength test (MST 36)	No cemented joints	N/A

Supplementary information: See Appendix A: Test charts for more details.

Prüfbericht-Nr.: CN24C6YL 004

Test Report No.:

Seite 40 von 128

Page 40 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9	Overview of tests and test results Module type: YL440CF48 i/2 (under STC) / YL488CF48 i/2 (under BNPI) (BOM 4)		
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Initial examination	—	—
Visual inspection (MQT 01 / MST 01)	See table 9.1	P
Insulation test (MQT 03 / MST 16)	See table 9.2	P
Wet leakage current test (MQT 15 / MST 17)	See table 9.3	P
Accessibility test (MST 11)	See table 9.4	P
Continuity test of equipotential bonding (MST 13)	See table 9.5	P
Initial stabilization (MQT 19.1)	See table 9.6	P
Maximum power determination (MQT 02 / MST 03)	See table 9.7	P
Performance at STC and BNPI (MQT 06.1 / MST 03)	See table 9.8	P
Gate #1 evaluation	See table 9.9	P

Sequence A	—	—
Measurement of temperature coefficients (MQT 04)	N/A	N/A
Performance at low irradiance (MQT 07)	N/A	N/A

Sequence B1	—	—
Outdoor exposure test (MQT 08)	N/A	N/A

Sequence B2	—	—
Hot-spot endurance test (MQT 09 / MST 22)	N/A	N/A
Reverse current overload test (MST 26)	N/A	N/A

Sequence B3	—	—
Bypass diode thermal test (MQT 18.1 / MST 25)	N/A	N/A

Sequence C	—	—
UV preconditioning test (MQT 10 / MST 54)	N/A	N/A
Cyclic (dynamic) mechanical load test (MQT 20)	See table 9.18	P
Thermal cycling test (50 cycles) (MQT 11 / MST 51)	See table 9.19	P
Humidity-freeze test (MQT 12 / MST 52)	See table 9.20	P

Prüfbericht-Nr.: CN24C6YL 004

Test Report No.:

Seite 41 von 128

Page 41 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

Sequence C1	—	—
Retention of junction box on mounting surface (MQT 14.1 / MST 42)	See table 9.21	P
Test of cord anchorage (MQT 14.2)	Junction box is approved according to IEC 62790	P

Sequence D	—	—
Thermal cycling test (200 cycles) (MQT 11 / MST 51)	N/A	N/A

Sequence E	—	—
Damp heat test (MQT 13 / MST 53)	N/A	N/A

Sequence E1	—	—
Static mechanical load test (MQT 16 / MST 34)	N/A	N/A

Sequence E2	—	—
Hail test (MQT 17)	N/A	N/A

Sequence F	—	—
Materials creep test (MST 37)	N/A	N/A

Sequence G	—	—
Damp heat test (200h) (MST 53)	N/A	N/A
UV test (front side) (MST 54)	N/A	N/A
Humidity-freeze test (MST 52)	N/A	N/A
UV test (back side) (MST 54)	N/A	N/A
Humidity-freeze test (MST 52)	N/A	N/A
Insulation thickness test (MST 04)	Not applicable for glass backsheet	N/A

Sequence G1	—	—
Cold conditioning 1 (MST 55)	N/A	N/A
Dry heat conditioning (MST 56)	N/A	N/A
Humidity-freeze test 1 (MST 52)	N/A	N/A
Cold conditioning 2 (MST 55)	N/A	N/A
Humidity-freeze test 2 (MST 52)	N/A	N/A

Sequence H	—	—
Impulse voltage test (MST 14)	See table 9.40	P

Prüfbericht-Nr.: CN24C6YL 004

Test Report No.:

Seite 42 von 128

Page 42 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

Sequence M	—	—
Module breakage test (MST 32)	N/A	N/A

Sequence I	—	—
Ignitability test (MST 24)	N/A	N/A

Sequence K	—	—
Potential induced degradation test (MQT 21)	N/A	N/A

Sequence J	—	—
Fire test (MST 23)	N/A	N/A

Final measurements	—	—
Final stabilization (MQT 19.2 / MQT 19.3)	N/A	N/A
Maximum power determination (MQT 02 / MST 03)	See table 9.46	P
Performance at STC and BNPI (MQT 06.1 / MST 03)	See table 9.47	P
Gate #2 evaluation	See table 9.48	P
Bypass diode functionality test (MQT 18.2 / MST 07)	See table 9.49	P
Cut susceptibility test (MST 12)	Not applicable for glass backsheet	N/A
Accessibility test (MST 11)	See table 9.51	P
Continuity test of equipotential bonding (MST 13)	See table 9.52	P
Screw connections test (MST 33)	No screw connections	N/A
Durability of markings (MST 05)	See table 9.54	P
Sharp edge test (MST 06)	See table 9.55	P

Component tests	—	—
Peel test (MST 35)	No cemented joints	N/A
Lap shear strength test (MST 36)	No cemented joints	N/A

Supplementary information: See Appendix A: Test charts for more details.

Prüfbericht-Nr.: CN24C6YL 004

Seite 43 von 128

Test Report No.:

Page 43 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.1	Visual inspection (initial) – MQT 01 / MST 01		
Test date (dd/mm/yyyy)		06/03/2024 for BOM 1 to 3, 22/04/2024 for BOM 4	—
Sample no.	Requirement	Nature and position of initial findings	
1-1	No major visual defects	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
1-6		No major visual defects	P
1-7		No major visual defects	P
1-8		No major visual defects	P
1-9		No major visual defects	P
1-10		No major visual defects	P
1-11		No major visual defects	P
1-12		No major visual defects	P
1-13		No major visual defects	P
1-14		No major visual defects	P
1-15		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
2-6		No major visual defects	P
2-7		No major visual defects	P
2-8		No major visual defects	P
2-9		No major visual defects	P
3-1		No major visual defects	P
3-2		No major visual defects	P
3-3		No major visual defects	P
3-4		No major visual defects	P
3-5		No major visual defects	P
3-6		No major visual defects	P
3-7		No major visual defects	P
3-8		No major visual defects	P
3-9		No major visual defects	P

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 44 von 128
Page 44 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

4-1		No major visual defects	P
4-2		No major visual defects	P
4-3		No major visual defects	P

Supplementary information: N/A

Prüfbericht-Nr.: CN24C6YL 004

Test Report No.:

Seite 45 von 128

Page 45 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.2	Insulation test (initial) – MQT 03 / MST 16					
Test date (dd/mm/yyyy)				17/03/2024 for BOM 1 to 3, 26/04/2024 for BOM 4		—
Maximum system voltage [V _{DC}]				1500		
Cemented joints?				☒ No ☐ Yes		
High voltage applied [V _{DC}]				8000		
Insulation resistance measured at [V _{DC}]				1500		
Sample no.	R _{iso} [GΩ]	A [m²]	R _{iso} ·A [GΩ·m²]	Dielectric breakdown		
				Yes (description)	No	
1-1	15.00	3.11	46.65	-	No	P
1-2	15.00	3.11	46.65	-	No	P
1-3	15.00	3.11	46.65	-	No	P
1-4	15.00	3.11	46.65	-	No	P
1-5	15.00	3.11	46.65	-	No	P
1-6	15.00	3.11	46.65	-	No	P
1-7	15.00	3.11	46.65	-	No	P
1-8	15.00	3.11	46.65	-	No	P
1-9	15.00	3.11	46.65	-	No	P
1-10	15.00	3.11	46.65	-	No	P
1-11	15.00	3.11	46.65	-	No	P
1-12	15.00	3.11	46.65	-	No	P
1-13	15.00	3.11	46.65	-	No	P
1-14	15.00	3.11	46.65	-	No	P
1-15	15.00	3.11	46.65	-	No	P
2-1	15.00	3.11	46.65	-	No	P
2-2	15.00	3.11	46.65	-	No	P
2-3	15.00	3.11	46.65	-	No	P
2-4	15.00	3.11	46.65	-	No	P
2-5	15.00	3.11	46.65	-	No	P
2-6	15.00	3.11	46.65	-	No	P
2-7	15.00	3.11	46.65	-	No	P
2-8	15.00	3.11	46.65	-	No	P
2-9	15.00	3.11	46.65	-	No	P
3-1	15.00	3.11	46.65	-	No	P
3-2	15.00	3.11	46.65	-	No	P

Prüfbericht-Nr.: CN24C6YL 004

Seite 46 von 128

Test Report No.:

Page 46 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

3-3	15.00	3.11	46.65	-	No	P
3-4	15.00	3.11	46.65	-	No	P
3-5	15.00	3.11	46.65	-	No	P
3-6	15.00	3.11	46.65	-	No	P
3-7	15.00	3.11	46.65	-	No	P
3-8	15.00	3.11	46.65	-	No	P
3-9	15.00	3.11	46.65	-	No	P
4-1	15.00	2.00	30.00	-	No	P
4-2	15.00	2.00	30.00	-	No	P
4-3	15.00	2.00	30.00	-	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.

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 47 von 128
Page 47 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.3	Wet leakage current test (initial) – MQT 15 / MST 17			
Test date (dd/mm/yyyy)		17/03/2024 for BOM 1 to 3, 26/04/2024 for BOM 4		—
Maximum system voltage [V _{DC}]		1500		
Cemented joints?		☒ No ☐ Yes		
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]	
1-1	15000.0	3.11	46650.0	P
1-2	15000.0	3.11	46650.0	P
1-3	15000.0	3.11	46650.0	P
1-4	15000.0	3.11	46650.0	P
1-5	15000.0	3.11	46650.0	P
1-6	15000.0	3.11	46650.0	P
1-7	15000.0	3.11	46650.0	P
1-8	15000.0	3.11	46650.0	P
1-9	15000.0	3.11	46650.0	P
1-10	15000.0	3.11	46650.0	P
1-11	15000.0	3.11	46650.0	P
1-12	15000.0	3.11	46650.0	P
1-13	15000.0	3.11	46650.0	P
1-14	15000.0	3.11	46650.0	P
1-15	15000.0	3.11	46650.0	P
2-1	15000.0	3.11	46650.0	P
2-2	15000.0	3.11	46650.0	P
2-3	15000.0	3.11	46650.0	P
2-4	15000.0	3.11	46650.0	P
2-5	15000.0	3.11	46650.0	P
2-6	15000.0	3.11	46650.0	P
2-7	15000.0	3.11	46650.0	P
2-8	15000.0	3.11	46650.0	P
2-9	15000.0	3.11	46650.0	P
3-1	15000.0	3.11	46650.0	P
3-2	15000.0	3.11	46650.0	P
3-3	15000.0	3.11	46650.0	P

Prüfbericht-Nr.: CN24C6YL 004

Seite 48 von 128

Test Report No.:

Page 48 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

3-4	15000.0	3.11	46650.0	P
3-5	15000.0	3.11	46650.0	P
3-6	15000.0	3.11	46650.0	P
3-7	15000.0	3.11	46650.0	P
3-8	15000.0	3.11	46650.0	P
3-9	15000.0	3.11	46650.0	P
4-1	15000.0	2.00	30000.0	P
4-2	15000.0	2.00	30000.0	P
4-3	15000.0	2.00	30000.0	P

Supplementary information:

Minimum requirement is 40 MΩ·m².

Insulation tester can measure up to 15000.0 MΩ.

Prüfbericht-Nr.: CN24C6YL 004

Seite 49 von 128

Test Report No.:

Page 49 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.4	Accessibility test (initial) – MST 11		
Test date (dd/mm/yyyy)		17/03/2024 for BOM 1 to 3, 26/04/2024 for BOM 4	—
Applied force [N]		10	
Sample no.	Contact with live electrical part?	R _{iso} [MΩ]	
1-4	☐ Yes ☒ No	500.0	P
1-6	☐ Yes ☒ No	500.0	P
1-8	☐ Yes ☒ No	500.0	P
2-3	☐ Yes ☒ No	500.0	P
3-3	☐ Yes ☒ No	500.0	P
4-2	☐ Yes ☒ No	500.0	P
Supplementary information: The resistance tester can measure up to 500.0 MΩ.			

9.5	Continuity test of equipotential bonding (initial) – MST 13		
Test date (dd/mm/yyyy)		17/03/2024 for BOM 1-3, 26/04/2024 for BOM 4	—
Maximum overcurrent protection rating [A]		30.0 for BOM 1-3, 35.0 for BOM 4	
Current applied [A]		75.0 for BOM 1-3, 87.5 for BOM 4	
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]	
1-4	—	<1.0	P
1-6	—	<1.0	P
1-8	—	<1.0	P
1-14	—	<1.0	P
2-3	—	<1.0	P
3-3	—	<1.0	P
4-2	—	<1.0	P
Supplementary information: N/A			

Prüfbericht-Nr.: CN24C6YL 004

Seite 50 von 128

Test Report No.:

Page 50 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.6	Initial stabilization – MQT 19.1				
☐ Simulator ☒ Natural sunlight ☐ Other stabilization procedures					
Test date (dd/mm/yyyy)			07/03/2024 - 17/03/2024 for BOM 1 to 3, 22/04/2024 - 25/04/2024 for BOM 4,		—
Irradiance [W/m²]			532.2 - 910.6 for BOM 1 to 3, 610.0 - 948.0 for BOM 4		
Module temperature [°C]			48.1 - 57.2 for BOM 1 to 3, 48.2 - 57.4 for BOM 4		
Sample no.	Test	Integrated irradiation [kWh/m²]	P _{max} [W]	Stabilization [%] *	
1-1	Initial	—	692.8	0.55	P
	Light-soaking 1	5	696.6		
	Light-soaking 2	5	694.7		
1-2	Initial	—	694.9	0.56	P
	Light-soaking 1	5	698.9		
	Light-soaking 2	5	696.7		
1-4	Initial	—	693.8	0.55	P
	Light-soaking 1	5	697.6		
	Light-soaking 2	5	695.7		
1-5	Initial	—	695.2	0.55	P
	Light-soaking 1	5	699.1		
	Light-soaking 2	5	697.3		
1-6	Initial	—	695.8	0.54	P
	Light-soaking 1	5	699.5		
	Light-soaking 2	5	697.5		
1-7	Initial	—	692.8	0.56	P
	Light-soaking 1	5	696.7		
	Light-soaking 2	5	694.9		
1-8	Initial	—	692.7	0.55	P
	Light-soaking 1	5	696.5		
	Light-soaking 2	5	694.6		
1-9	Initial	—	693.6	0.50	P
	Light-soaking 1	5	697.1		
	Light-soaking 2	5	695.6		

Prüfbericht-Nr.: CN24C6YL 004

Seite 51 von 128

Test Report No.:

Page 51 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

1-10	Initial	—	702.2	0.44	P
	Light-soaking 1	5	705.2		
	Light-soaking 2	5	704.5		
1-11	Initial	—	701.7	0.36	P
	Light-soaking 1	5	704.2		
	Light-soaking 2	5	704.0		
1-12	Initial	—	694.2	0.63	P
	Light-soaking 1	5	698.6		
	Light-soaking 2	5	696.8		
1-13	Initial	—	693.6	0.62	P
	Light-soaking 1	5	697.9		
	Light-soaking 2	5	696.3		
2-1	Initial	—	690.0	0.62	P
	Light-soaking 1	5	694.4		
	Light-soaking 2	5	692.8		
2-3	Initial	—	691.8	0.64	P
	Light-soaking 1	5	696.2		
	Light-soaking 2	5	694.6		
2-4	Initial	—	693.0	0.56	P
	Light-soaking 1	5	696.9		
	Light-soaking 2	5	695.1		
2-5	Initial	—	692.8	0.57	P
	Light-soaking 1	5	696.8		
	Light-soaking 2	5	694.7		
2-6	Initial	—	689.6	0.52	P
	Light-soaking 1	5	693.2		
	Light-soaking 2	5	691.4		
2-7	Initial	—	691.3	0.52	P
	Light-soaking 1	5	694.8		
	Light-soaking 2	5	693.0		
2-8	Initial	—	692.3	0.53	P
	Light-soaking 1	5	695.9		
	Light-soaking 2	5	694.1		
3-1	Initial	—	695.2	0.56	P
	Light-soaking 1	5	699.1		
	Light-soaking 2	5	697.2		

Prüfbericht-Nr.: CN24C6YL 004

Seite 52 von 128

Test Report No.:

Page 52 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

3-3	Initial	—	680.7	0.54	P
	Light-soaking 1	5	678.9		
	Light-soaking 2	5	682.5		
3-4	Initial	—	680.6	0.54	P
	Light-soaking 1	5	684.3		
	Light-soaking 2	5	682.7		
3-5	Initial	—	690.8	0.50	P
	Light-soaking 1	5	694.3		
	Light-soaking 2	5	692.8		
3-6	Initial	—	688.9	0.52	P
	Light-soaking 1	5	692.5		
	Light-soaking 2	5	690.6		
3-7	Initial	—	692.2	0.52	P
	Light-soaking 1	5	695.8		
	Light-soaking 2	5	694.0		
3-8	Initial	—	694.8	0.52	P
	Light-soaking 1	5	698.4		
	Light-soaking 2	5	696.5		
4-1	Initial	—	440.5	0.60	P
	Light-soaking 1	5	442.1		
	Light-soaking 2	5	443.1		
4-2	Initial	—	442.7	0.35	P
	Light-soaking 1	5	443.5		
	Light-soaking 2	5	444.2		
4-3	Initial	—	443.3	0.40	P
	Light-soaking 1	5	444.2		
	Light-soaking 2	5	445.1		

Supplementary information:

* Stabilization criterion: $(P_{\max} - P_{\min}) / P_{\text{avg}} \leq 1 \%$ for three consecutive measurements.

Initial measurement corresponds to MQT 02 of IEC/EN 61215.

Prüfbericht-Nr.: CN24C6YL 004

Seite 53 von 128

Test Report No.:

Page 53 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.7	Maximum power determination (initial) – MST 03		
Test date (dd/mm/yyyy)		17/03/2024 for BOM 1 to 3, 25/04/2024 for BOM 4	—
Irradiance [W/m²]		1000*	
Module temperature [°C]		25 ± 1	
Test method		☒ Simulator ☐ Natural sunlight	
Sample no.	Appearance of initial IV-curve		
1-2	No kinks or other unusual characteristics		P
1-3	No kinks or other unusual characteristics		P
1-4	No kinks or other unusual characteristics		P
1-6	No kinks or other unusual characteristics		P
1-8	No kinks or other unusual characteristics		P
1-15	No kinks or other unusual characteristics		P
2-2	No kinks or other unusual characteristics		P
2-3	No kinks or other unusual characteristics		P
2-9	No kinks or other unusual characteristics		P
3-2	No kinks or other unusual characteristics		P
3-3	No kinks or other unusual characteristics		P
3-9	No kinks or other unusual characteristics		P
4-1	No kinks or other unusual characteristics		P
4-2	No kinks or other unusual characteristics		P
Supplementary information: N/A			

Prüfbericht-Nr.: CN24C6YL 004

Test Report No.:

Seite 54 von 128

Page 54 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.8	Performance at STC (initial) – MQT 06.1
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9.8.1	Performance at STC (initial) (front side) – MQT 06.1						
Test date (dd/mm/yyyy)			17/03/2024 for BOM 1 to 3, 25/04/2024 for BOM 4				—
Test method			☒ Simulator ☐ Natural sunlight				
Illuminated side			☒ Front side ☐ Rear side				
Ambient temperature [°C]			25 ± 2				
Irradiance [W/m²]			1000*				
Module temperature [°C]			25 ± 0.2				
Spectral mismatch			N/A				
Sample no.	I _{sc} [A]	V _{oc} [V]	P _{max} [W]	I _{mpp} [A]	V _{mpp} [V]	FF [%]	
1-1	17.970	47.50	694.7	17.136	40.54	81.4	N/A
1-2	17.935	47.67	696.7	17.087	40.77	81.5	N/A
1-4	17.941	47.57	695.7	17.123	40.63	81.5	N/A
1-5	17.925	47.77	697.3	17.101	40.78	81.4	N/A
1-6	17.961	47.65	697.5	17.064	40.87	81.5	N/A
1-7	17.951	47.53	694.9	17.160	40.49	81.4	N/A
1-8	17.928	47.53	694.6	17.116	40.58	81.5	N/A
1-9	17.969	47.60	695.6	17.156	40.54	81.3	N/A
1-10	17.985	47.78	704.5	17.201	40.96	82.0	N/A
1-11	17.981	47.76	704.0	17.234	40.85	82.0	N/A
1-12	17.964	47.69	696.8	17.127	40.68	81.3	N/A
1-13	17.934	47.63	696.3	17.114	40.69	81.5	N/A
2-1	17.920	47.48	692.8	17.109	40.49	81.4	N/A
2-3	17.879	47.74	694.6	17.093	40.64	81.4	N/A
2-4	17.923	47.60	695.1	17.045	40.78	81.5	N/A
2-5	17.980	47.49	694.7	17.157	40.49	81.4	N/A
2-6	18.019	47.37	691.4	17.192	40.22	81.0	N/A
2-7	17.911	47.54	693.0	17.114	40.49	81.4	N/A
2-8	17.941	47.51	694.1	17.141	40.49	81.4	N/A
3-1	17.977	47.62	697.2	17.098	40.78	81.4	N/A
3-3	17.984	47.25	682.5	17.052	40.03	80.3	N/A
3-4	17.960	47.40	682.7	16.995	40.17	80.2	N/A
3-5	17.915	47.45	692.8	17.147	40.40	81.5	N/A
3-6	17.924	47.35	690.6	17.115	40.35	81.4	N/A

Prüfbericht-Nr.: CN24C6YL 004

Seite 55 von 128

Test Report No.:

Page 55 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

3-7	17.955	47.45	694.0	17.179	40.40	81.4	N/A
3-8	17.843	47.67	696.5	17.020	40.92	81.9	N/A
4-1	15.580	35.00	443.1	14.971	29.60	81.3	N/A
4-2	15.596	35.03	444.2	15.006	29.60	81.3	N/A
4-3	15.627	34.95	445.1	15.014	29.65	81.5	N/A

Supplementary information: The non-illuminated side was covered with non-reflective background and aperture.

*A pulse solar simulator class AAA conforming to the requirements of IEC 60904-9 is used.

Prüfbericht-Nr.: CN24C6YL 004

Seite 56 von 128

Test Report No.:

Page 56 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.8.2	Performance at STC (initial) (rear side) – MQT 06.1						
Test date (dd/mm/yyyy)			17/03/2024 for BOM 1 to 3, 25/04/2024 for BOM 4				—
Test method			☒ Simulator ☐ Natural sunlight				
Illuminated side			☐ Front side ☒ Rear side				
Ambient temperature [°C]			25 ± 2				
Irradiance [W/m²]			1000*				
Module temperature [°C]			25 ± 0.2				
Spectral mismatch			N/A				
Sample no.	I _{sc} [A]	V _{oc} [V]	P _{max} [W]	I _{mpp} [A]	V _{mpp} [V]	FF [%]	
1-1	13.811	47.10	541.3	13.278	40.77	83.2	N/A
1-2	14.053	47.30	544.4	13.338	40.81	81.9	N/A
1-4	13.810	47.20	542.1	13.204	41.06	83.2	N/A
1-5	13.661	47.37	537.8	13.192	40.77	83.1	N/A
1-6	13.785	47.26	544.3	13.343	40.80	83.5	N/A
1-7	13.841	47.13	541.2	13.305	40.68	83.0	N/A
1-8	13.772	47.13	539.8	13.194	40.91	83.2	N/A
1-9	13.837	47.21	541.7	13.224	40.97	82.9	N/A
1-10	13.739	47.23	543.2	13.280	40.91	83.7	N/A
1-11	13.684	47.32	542.8	13.304	40.80	83.8	N/A
1-12	13.926	47.33	544.6	13.319	40.89	82.6	N/A
1-13	13.715	47.24	543.8	13.298	40.90	83.9	N/A
2-1	13.889	47.08	538.2	13.109	41.06	82.3	N/A
2-3	13.332	47.34	536.5	13.098	40.96	85.0	N/A
2-4	13.703	47.15	540.4	13.292	40.66	83.7	N/A
2-5	13.807	47.07	540.6	13.293	40.67	83.2	N/A
2-6	14.105	47.00	550.0	13.608	40.42	83.0	N/A
2-7	13.771	47.14	542.3	13.306	40.76	83.5	N/A
2-8	13.822	47.10	540.8	13.283	40.71	83.1	N/A
3-1	13.841	47.22	539.4	13.095	41.19	82.5	N/A
3-3	13.840	46.87	531.3	13.176	40.33	81.9	N/A
3-4	13.689	47.03	530.3	13.133	40.38	82.4	N/A
3-5	13.717	47.04	534.3	13.058	40.92	82.8	N/A
3-6	13.700	46.96	536.4	13.096	40.96	83.4	N/A
3-7	13.823	47.28	544.0	13.342	40.77	83.2	N/A
3-8	13.851	47.32	544.7	13.300	40.96	83.1	N/A

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 57 von 128
Page 57 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

4-1	11.794	34.82	337.2	11.156	30.22	82.1	N/A
4-2	11.613	34.87	342.0	11.268	30.35	84.5	N/A
4-3	11.690	34.83	340.9	11.173	30.51	83.7	N/A

Supplementary information: The non-illuminated side was covered with non-reflective background and aperture.

*A pulse solar simulator class AAA conforming to the requirements of IEC 60904-9 is used.

Prüfbericht-Nr.: CN24C6YL 004

Seite 58 von 128

Test Report No.:

Page 58 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.8.3	Bifaciality Coefficients (initial)				
Sample no.		Φ_{Isc}	Φ_{Voc}	Φ_{Pmax}	—
1-1		0.77	0.99	0.78	N/A
1-2		0.78	0.99	0.78	N/A
1-4		0.77	0.99	0.78	N/A
1-5		0.76	0.99	0.77	N/A
1-6		0.77	0.99	0.78	N/A
1-7		0.77	0.99	0.78	N/A
1-8		0.77	0.99	0.78	N/A
1-9		0.77	0.99	0.78	N/A
1-10		0.76	0.99	0.77	N/A
1-11		0.76	0.99	0.77	N/A
1-12		0.78	0.99	0.78	N/A
1-13		0.76	0.99	0.78	N/A
2-1		0.78	0.99	0.78	N/A
2-3		0.75	0.99	0.77	N/A
2-4		0.76	0.99	0.78	N/A
2-5		0.77	0.99	0.78	N/A
2-6		0.78	0.99	0.80	N/A
2-7		0.77	0.99	0.78	N/A
2-8		0.77	0.99	0.78	N/A
3-1		0.77	0.99	0.77	N/A
3-3		0.77	0.99	0.78	N/A
3-4		0.76	0.99	0.78	N/A
3-5		0.77	0.99	0.77	N/A
3-6		0.76	0.99	0.78	N/A
3-7		0.77	1.00	0.78	N/A
3-8		0.78	0.99	0.78	N/A
4-1		0.76	0.99	0.76	N/A
4-2		0.74	1.00	0.77	N/A
4-3		0.75	1.00	0.77	N/A
Supplementary information: N/A					

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 59 von 128
Page 59 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.8.4	Performance at BNPI (initial) – MQT 06.1						
Test date (dd/mm/yyyy)			17/03/2024 for BOM 1 to 3, 25/04/2024 for BOM 4				—
Test method			☒ Simulator ☐ Natural sunlight				
Illuminated side			☒ Front side ☐ Rear side				
Ambient temperature [°C]			25 ± 2				
Irradiance [W/m²]			1000 + φ•135*				
Module temperature [°C]			25 ± 0.2				
Spectral mismatch			N/A				
Sample no.	I _{sc} [A]	V _{oc} [V]	P _{max} [W]	I _{mpp} [A]	V _{mpp} [V]	FF [%]	
1-1	19.784	47.65	765.1	18.894	40.50	81.2	N/A
1-2	19.765	47.83	767.6	18.868	40.68	81.2	N/A
1-4	19.770	47.73	766.4	18.904	40.54	81.2	N/A
1-5	19.748	47.92	767.6	18.869	40.68	81.1	N/A
1-6	19.783	47.80	768.2	18.883	40.68	81.2	N/A
1-7	19.779	47.68	765.5	18.881	40.54	81.2	N/A
1-8	19.751	47.68	764.9	18.911	40.45	81.2	N/A
1-9	19.796	47.76	766.0	18.894	40.54	81.0	N/A
1-10	19.947	47.79	778.5	18.871	41.26	81.7	N/A
1-11	19.959	47.89	779.7	18.843	41.38	81.6	N/A
1-12	19.796	47.84	767.4	18.840	40.73	81.0	N/A
1-13	19.754	47.78	766.8	18.871	40.64	81.2	N/A
2-1	19.734	47.64	763.2	18.867	40.45	81.2	N/A
2-3	19.696	47.90	764.5	18.697	40.89	81.0	N/A
2-4	19.745	47.75	765.5	18.882	40.54	81.2	N/A
2-5	19.807	47.65	765.2	18.916	40.45	81.1	N/A
2-6	19.848	47.53	760.9	18.964	40.12	80.7	N/A
2-7	19.732	47.70	763.4	18.851	40.50	81.1	N/A
2-8	19.764	47.66	764.5	18.790	40.69	81.2	N/A
3-1	19.796	47.79	768.2	18.883	40.68	81.2	N/A
3-3	19.753	47.40	749.5	18.703	40.07	80.1	N/A
3-4	19.799	47.55	752.3	18.748	40.12	79.9	N/A
3-5	19.749	47.64	753.7	18.697	40.31	80.1	N/A
3-6	19.759	47.51	761.3	18.844	40.40	81.1	N/A
3-7	19.798	47.61	765.1	18.893	40.49	81.2	N/A
3-8	19.661	47.82	767.3	18.860	40.68	81.6	N/A

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 60 von 128
Page 60 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

4-1	17.135	35.24	489.4	16.438	29.77	81.0	N/A
4-2	17.160	35.25	490.1	16.463	29.77	81.0	N/A
4-3	17.177	35.20	489.8	16.480	29.72	81.0	N/A

Supplementary information: The non-illuminated side was covered with non-reflective background and aperture.

*A pulse solar simulator class AAA conforming to the requirements of IEC 60904-9 is used. The bifaciality coefficient ϕ employed is the minimum value of ϕ_{isc} and ϕ_{pmax} as documented in table 9.8.3 for each test sample.

Prüfbericht-Nr.: CN24C6YL 004

Seite 61 von 128

Test Report No.:

Page 61 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.9	Gate #1 evaluation (STC)				
Manufacturer tolerances given on name plate	for $P_{\max}$	t_1 [%]	± 3	—	
	for V_{OC}	t_2 [%]	± 3		
	for I_{sc}	t_3 [%]	± 3		
	for $P_{\max4}$	t_4 [%]	± 3		
Measurement uncertainty of test laboratory	for $P_{\max}$	m_1 [%]	± 2.28 (for c-Si)		
	for V_{OC}	m_2 [%]	± 0.74 (for c-Si)		
	for I_{sc}	m_3 [%]	± 2.16 (for c-Si)		

9.9.1	Evaluation of output power for each module (STC)				
Sample no.	$P_{max, meas}$ [W]	$P_{max, meas, m1}$ [W]	$P_{max, NP}$ [W]	$P_{max, NP, t1}$ [W]	—
1-1	694.7	707.7	700.0	679.0	P
1-2	696.7	709.8	700.0	679.0	P
1-4	695.7	708.8	700.0	679.0	P
1-5	697.3	710.4	700.0	679.0	P
1-6	697.5	710.6	700.0	679.0	P
1-7	694.9	708.0	700.0	679.0	P
1-8	694.6	707.7	700.0	679.0	P
1-9	695.6	708.6	700.0	679.0	P
1-10	704.5	717.8	715.0	693.6	P
1-11	704.0	717.2	715.0	693.6	P
1-12	696.8	709.9	685.0	664.5	P
1-13	696.3	709.4	685.0	664.5	P
2-1	692.8	705.8	700.0	679.0	P
2-3	694.6	707.7	700.0	679.0	P
2-4	695.1	708.1	700.0	679.0	P
2-5	694.7	707.8	700.0	679.0	P
2-6	691.4	704.4	700.0	679.0	P
2-7	693.0	706.0	700.0	679.0	P
2-8	694.1	707.1	700.0	679.0	P
3-1	697.2	710.3	695.0	674.2	P
3-3	682.5	695.4	695.0	674.2	P
3-4	682.7	695.5	695.0	674.2	P
3-5	692.8	705.8	695.0	674.2	P
3-6	690.6	703.6	695.0	674.2	P
3-7	694.0	707.0	695.0	674.2	P

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 62 von 128
Page 62 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

3-8	696.5	709.6	695.0	674.2	P
4-1	443.1	451.5	440.0	426.8	P
4-2	444.2	452.6	440.0	426.8	P
4-3	445.1	453.5	440.0	426.8	P

Supplementary information:

Pass criteria follow requirements of section 7.2.1 of IEC/EN 61215-1.

$P_{\max, \text{meas}, m1}$ = Measured maximum STC power taking positive measurement uncertainty into account

$P_{\max, NP, t1}$ = Nominal maximum STC power taking negative rated production tolerance into account

Prüfbericht-Nr.: CN24C6YL 004

Test Report No.:

Seite 63 von 128

Page 63 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.9.2	Evaluation of output power for average of all modules (STC)			
Module type	$P_{\max, \text{meas, avg}}$ [W]	$P_{\max, \text{meas, avg, m1}}$ [W]	$P_{\max, \text{NP}}$ [W]	—
YL685CF66 f/2 (STC) (BOM 1_Lower power end)	696.6	709.0	685.0	P
YL700CF66 f/2 (STC) (BOM 1_Median power)	695.9	709.7	700.0	P
YL715CF66 f/2 (STC) (BOM 1_Higher power end)	704.3	717.5	715.0	P
YL700CF66 f/2 (BOM 2)	693.7	706.7	700.0	P
YL695CF66 f/2 (BOM 3)	690.9	703.9	695.0	P
YL440CF48 i/2 (BOM 4)	444.1	452.5	440.0	P
Supplementary information:				
Pass criteria follow requirements of section 7.2.1 of IEC/EN 61215-1.				
$P_{\max, \text{meas, avg, m1}}$ = Arithmetic average of meas. max. STC power taking positive measurement uncertainty into account				

9.9.3	Evaluation of open-circuit voltage for each module (STC)				
Sample no.	$V_{\text{oc, meas}}$ [V]	$V_{\text{oc, meas, m2}}$ [V]	$V_{\text{oc, NP}}$ [V]	$V_{\text{oc, NP, i2}}$ [V]	—
1-1	47.50	47.79	48.10	49.54	P
1-2	47.67	47.97	48.10	49.54	P
1-4	47.57	47.86	48.10	49.54	P
1-5	47.77	48.06	48.10	49.54	P
1-6	47.65	47.94	48.10	49.54	P
1-7	47.53	47.82	48.10	49.54	P
1-8	47.53	47.82	48.10	49.54	P
1-9	47.60	47.89	48.10	49.54	P
1-10	47.78	48.07	48.70	50.16	P
1-11	47.76	48.05	48.70	50.16	P
1-12	47.69	47.98	47.50	48.93	P
1-13	47.63	47.92	47.50	48.93	P
2-1	47.48	47.77	48.10	49.54	P
2-3	47.74	48.03	48.10	49.54	P
2-4	47.60	47.89	48.10	49.54	P
2-5	47.49	47.78	48.10	49.54	P
2-6	47.37	47.66	48.10	49.54	P
2-7	47.54	47.83	48.10	49.54	P
2-8	47.51	47.80	48.10	49.54	P
3-1	47.62	47.91	47.90	49.34	P

Prüfbericht-Nr.: CN24C6YL 004

Seite 64 von 128

Test Report No.:

Page 64 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

3-3	47.25	47.53	47.90	49.34	P
3-4	47.40	47.69	47.90	49.34	P
3-5	47.45	47.74	47.90	49.34	P
3-6	47.35	47.64	47.90	49.34	P
3-7	47.45	47.74	47.90	49.34	P
3-8	47.67	47.96	47.90	49.34	P
4-1	35.00	35.21	35.84	36.92	P
4-2	35.03	35.24	35.84	36.92	P
4-3	34.95	35.16	35.84	36.92	P

Supplementary information:

Pass criteria follow requirements of section 7.2.1 of IEC/EN 61215-1.

$V_{oc, meas, m2}$ = Measured open-circuit voltage taking positive measurement uncertainty into account

$V_{oc, NP, t2}$ = Nominal open-circuit voltage taking positive rated production tolerance into account

Prüfbericht-Nr.: CN24C6YL 004

Test Report No.:

Seite 65 von 128

Page 65 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.9.4	Evaluation of short-circuit current for each module (STC)				
Sample no.	$I_{sc,meas}$ [A]	$I_{sc,meas,m3}$ [A]	$I_{sc,NP}$ [A]	$I_{sc,NP,t3}$ [A]	—
1-1	17.970	18.290	18.300	18.849	P
1-2	17.935	18.255	18.300	18.849	P
1-4	17.941	18.261	18.300	18.849	P
1-5	17.925	18.244	18.300	18.849	P
1-6	17.961	18.281	18.300	18.849	P
1-7	17.951	18.271	18.300	18.849	P
1-8	17.928	18.247	18.300	18.849	P
1-9	17.969	18.289	18.300	18.849	P
1-10	17.985	18.305	18.420	18.973	P
1-11	17.981	18.301	18.420	18.973	P
1-12	17.964	18.284	18.180	18.725	P
1-13	17.934	18.254	18.180	18.725	P
2-1	17.920	18.239	18.300	18.849	P
2-3	17.879	18.198	18.300	18.849	P
2-4	17.923	18.242	18.300	18.849	P
2-5	17.980	18.300	18.300	18.849	P
2-6	18.019	18.340	18.300	18.849	P
2-7	17.911	18.230	18.300	18.849	P
2-8	17.941	18.261	18.300	18.849	P
3-1	17.977	18.297	18.260	18.808	P
3-3	17.984	18.304	18.260	18.808	P
3-4	17.960	18.280	18.260	18.808	P
3-5	17.915	18.234	18.260	18.808	P
3-6	17.924	18.243	18.260	18.808	P
3-7	17.955	18.275	18.260	18.808	P
3-8	17.843	18.161	18.260	18.808	P
4-1	15.580	15.858	15.520	15.986	P
4-2	15.596	15.874	15.520	15.986	P
4-3	15.627	15.905	15.520	15.986	P

Supplementary information:

Pass criteria follow requirements of section 7.2.1 of IEC/EN 61215-1.

$I_{sc,meas,m3}$ = Measured short-circuit current taking positive measurement uncertainty into account

$I_{sc,NP,t3}$ = Nominal short-circuit current taking positive rated production tolerance into account

Prüfbericht-Nr.: CN24C6YL 004

Seite 66 von 128

Test Report No.:

Page 66 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Result</i>

9.9.5	Evaluation of output power for lower end power class module (STC)				
Sample no.	$P_{\max, \text{meas}}$ [W]	$P_{\max, \text{meas}, m1}$ [W]	$P_{\max4, NP}$ [W]	$P_{\max, NP, t4}$ [W]	—
1-12	696.8	683.7	685.0	705.6	P
1-13	696.3	683.2	685.0	705.6	P

Supplementary information:

Pass criteria follow requirements of section 7.2.1 of IEC/EN 61215-1.

$P_{\max, \text{meas}, m1}$ = Measured maximum STC power taking negative measurement uncertainty into account

$P_{\max4, NP, t4}$ = Nominal maximum STC power taking positive rated production tolerance into account

Prüfbericht-Nr.: CN24C6YL 004

Seite 67 von 128

Test Report No.:

Page 67 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.9	Gate #1 evaluation (BNPI)				
Manufacturer tolerances given on name plate	for $P_{\max(\text{BNPI})}$	$t_{1(\text{BNPI})}$ [%]	± 3	—	
	for $V_{\text{OC}(\text{BNPI})}$	$t_{2(\text{BNPI})}$ [%]	± 3		
	for $I_{\text{SC}(\text{BNPI})}$	$t_{3(\text{BNPI})}$ [%]	± 3		
	for $P_{\max 4(\text{BNPI})}$	$t_{4(\text{BNPI})}$ [%]	± 3		
Measurement uncertainty of test laboratory	for $P_{\max(\text{BNPI})}$	$m_{1(\text{BNPI})}$ [%]	± 2.28 (for c-Si)		
	for $V_{\text{OC}(\text{BNPI})}$	$m_{2(\text{BNPI})}$ [%]	± 0.74 (for c-Si)		
	for $I_{\text{SC}(\text{BNPI})}$	$m_{3(\text{BNPI})}$ [%]	± 2.16 (for c-Si)		

9.9.6	Evaluation of output power for each module (BNPI)				
Sample no.	$P_{\max}(\text{BNPI}), \text{meas}$ [W]	$P_{\max}(\text{BNPI}), \text{meas}, m_1(\text{BNPI})$ [W]	$P_{\max}(\text{BNPI}), \text{NP}$ [W]	$P_{\max}(\text{BNPI}), \text{NP}, t_1(\text{BNPI})$ [W]	—
1-1	765.1	779.5	776.0	752.7	P
1-2	767.6	782.0	776.0	752.7	P
1-4	766.4	780.8	776.0	752.7	P
1-5	767.6	782.0	776.0	752.7	P
1-6	768.2	782.7	776.0	752.7	P
1-7	765.5	779.9	776.0	752.7	P
1-8	764.9	779.3	776.0	752.7	P
1-9	766.0	780.4	776.0	752.7	P
1-10	778.5	793.2	792.0	768.2	P
1-11	779.7	794.4	792.0	768.2	P
1-12	767.4	781.8	759.0	736.2	P
1-13	766.8	781.3	759.0	736.2	P
2-1	763.2	777.5	776.0	752.7	P
2-3	764.5	778.9	776.0	752.7	P
2-4	765.5	779.9	776.0	752.7	P
2-5	765.2	779.6	776.0	752.7	P
2-6	760.9	775.2	776.0	752.7	P
2-7	763.4	777.8	776.0	752.7	P
2-8	764.5	778.9	776.0	752.7	P
3-1	768.2	782.7	770.0	746.9	P
3-3	749.5	763.6	770.0	746.9	P
3-4	752.3	766.4	770.0	746.9	P
3-5	753.7	767.9	770.0	746.9	P
3-6	761.3	775.6	770.0	746.9	P
3-7	765.1	779.5	770.0	746.9	P

Prüfbericht-Nr.: CN24C6YL 004

Seite 68 von 128

Test Report No.:

Page 68 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

3-8	767.3	781.0	770.0	746.9	P
4-1	489.4	498.6	488.0	473.4	P
4-2	490.1	499.3	488.0	473.4	P
4-3	489.8	499.0	488.0	473.4	P

Supplementary information:

Pass criteria follow requirements of section 7.2.1 of IEC/EN 61215-1.

$P_{\max(\text{BNPI}),\text{meas},m1(\text{BNPI})}$ = Measured maximum BNPI power taking positive measurement uncertainty into account

$P_{\max(\text{BNPI}),NP,t1(\text{BNPI})}$ = Nominal maximum BNPI power taking negative rated production tolerance into account

Prüfbericht-Nr.: CN24C6YL 004

Seite 69 von 128

Test Report No.:

Page 69 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.9.7	Evaluation of output power for average of all modules (BNPI)			
Module type	$P_{\max(\text{BNPI}),\text{meas,avg}}$ [W]	$P_{\max(\text{BNPI}),\text{meas,avg,m1}(\text{BNPI})}$ [W]	$P_{\max(\text{BNPI}),\text{NP}}$ [W]	—
YL759CF66 f/2 (BNPI) (BOM 1_Lower power end)	767.1	781.6	759.0	P
YL776CF66 f/2 (BNPI) (BOM 1_Median power)	776.4	780.8	776.0	P
YL792CF66 f/2 (BNPI) (BOM 1_Higher power end)	779.1	793.8	792.0	P
YL776CF66 f/2 (BOM 2)	763.9	778.3	776.0	P
YL770CF66 f/2 (BOM 3)	759.6	773.8	770.0	P
YL488CF48 i/2 (BOM 4)	489.8	499.0	488.0	P

Supplementary information:

Pass criteria follow requirements of section 7.2.1 of IEC/EN 61215-1.

$P_{\max,\text{meas,avg,m1}}$ = Arithmetic average of meas. max. BNPI power taking positive measurement uncertainty into account

9.9.8	Evaluation of open-circuit voltage for each module (BNPI)				
Sample no.	$V_{\text{oc}(\text{BNPI}),\text{meas}}$ [V]	$V_{\text{oc}(\text{BNPI}),\text{meas,m2}(\text{BNPI})}$ [V]	$V_{\text{oc}(\text{BNPI}),\text{NP}}$ [V]	$V_{\text{oc}(\text{BNPI}),\text{NP,i2}(\text{BNPI})}$ [V]	—
1-1	47.65	47.94	48.10	49.54	P
1-2	47.83	48.12	48.10	49.54	P
1-4	47.73	48.02	48.10	49.54	P
1-5	47.92	48.21	48.10	49.54	P
1-6	47.80	48.09	48.10	49.54	P
1-7	47.68	47.97	48.10	49.54	P
1-8	47.68	47.97	48.10	49.54	P
1-9	47.76	48.05	48.10	49.54	P
1-10	47.79	48.08	48.70	50.16	P
1-11	47.89	48.18	48.70	50.16	P
1-12	47.84	48.13	47.50	48.93	P
1-13	47.78	48.07	47.50	48.93	P
2-1	47.64	47.93	48.10	49.54	P
2-3	47.90	48.19	48.10	49.54	P
2-4	47.75	48.04	48.10	49.54	P
2-5	47.65	47.94	48.10	49.54	P
2-6	47.53	47.82	48.10	49.54	P
2-7	47.70	47.99	48.10	49.54	P
2-8	47.66	47.95	48.10	49.54	P
3-1	47.79	48.08	47.90	49.34	P

Prüfbericht-Nr.: CN24C6YL 004

Seite 70 von 128

Test Report No.:

Page 70 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

3-3	47.40	47.69	47.90	49.34	P
3-4	47.55	47.84	47.90	49.34	P
3-5	47.64	47.93	47.90	49.34	P
3-6	47.51	47.80	47.90	49.34	P
3-7	47.61	47.90	47.90	49.34	P
3-8	47.82	48.11	47.90	49.34	P
4-1	35.24	35.45	35.84	36.92	P
4-2	35.25	35.47	35.84	36.92	P
4-3	35.20	35.41	35.84	36.92	P

Supplementary information:

Pass criteria follow requirements of section 7.2.1 of IEC/EN 61215-1.

$V_{oc(BNPI),meas,m2(BNPI)}$ = Measured open-circuit voltage taking positive measurement uncertainty into account

$V_{oc(BNPI),NP,t2(BNPI)}$ = Nominal open-circuit voltage taking positive rated production tolerance into account

Prüfbericht-Nr.: CN24C6YL 004

Test Report No.:

Seite 71 von 128

Page 71 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.9.9	Evaluation of short-circuit current for each module (BNPI)				
Sample no.	$I_{sc(BNPI),meas} [A]$	$I_{sc(BNPI),meas,m3(BNPI)} [A]$	$I_{sc(BNPI),NP} [A]$	$I_{sc(BNPI),NP,t3(BNPI)} [A]$	—
1-1	19.784	20.137	20.280	20.888	P
1-2	19.765	20.117	20.280	20.888	P
1-4	19.770	20.122	20.280	20.888	P
1-5	19.748	20.100	20.280	20.888	P
1-6	19.783	20.136	20.280	20.888	P
1-7	19.779	20.131	20.280	20.888	P
1-8	19.751	20.103	20.280	20.888	P
1-9	19.796	20.149	20.280	20.888	P
1-10	19.947	20.302	20.410	21.022	P
1-11	19.959	20.315	20.410	21.022	P
1-12	19.796	20.149	20.140	20.744	P
1-13	19.754	20.106	20.140	20.744	P
2-1	19.734	20.086	20.280	20.888	P
2-3	19.696	20.047	20.280	20.888	P
2-4	19.745	20.097	20.280	20.888	P
2-5	19.807	20.160	20.280	20.888	P
2-6	19.848	20.202	20.280	20.888	P
2-7	19.732	20.084	20.280	20.888	P
2-8	19.764	20.116	20.280	20.888	P
3-1	19.796	20.149	20.230	20.837	P
3-3	19.753	20.105	20.230	20.837	P
3-4	19.799	20.152	20.230	20.837	P
3-5	19.749	20.101	20.230	20.837	P
3-6	19.759	20.111	20.230	20.837	P
3-7	19.798	20.151	20.230	20.837	P
3-8	19.661	20.011	20.230	20.837	P
4-1	17.135	17.440	17.200	17.716	P
4-2	17.160	17.466	17.200	17.716	P
4-3	17.177	17.483	17.200	17.716	P

Supplementary information:

Pass criteria follow requirements of section 7.2.1 of IEC/EN 61215-1.

$I_{sc(BNPI),meas,m3(BNPI)}$ = Measured short-circuit current taking positive measurement uncertainty into account

$I_{sc(BNPI),NP,t3(BNPI)}$ = Nominal short-circuit current taking positive rated production tolerance into account

Prüfbericht-Nr.: CN24C6YL 004

Seite 72 von 128

Test Report No.:

Page 72 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.9.10	Evaluation of output power for lower end power class module (BNPI)				
Sample no.	$P_{\max(\text{BNPI}),\text{meas}} [\text{W}]$	$P_{\max(\text{BNPI}),\text{meas},\text{m1}(\text{BNPI})} [\text{W}]$	$P_{\max4(\text{BNPI}),\text{NP}} [\text{W}]$	$P_{\max(\text{BNPI}),\text{NP},\text{t4}(\text{BNPI})} [\text{W}]$	—
1-12	767.4	753.0	759.0	781.8	P
1-13	766.8	752.4	759.0	781.8	P
Supplementary information: Pass criteria follow requirements of section 7.2.1 of IEC/EN 61215-1. $P_{\max(\text{BNPI}),\text{meas},\text{m1}(\text{BNPI})}$ = Measured maximum BNPI power taking negative measurement uncertainty into account $P_{\max4(\text{BNPI}),\text{NP},\text{t4}(\text{BNPI})}$ = Nominal maximum BNPI power taking positive rated production tolerance into account					

9.10	Measurement of temperature coefficients – MQT 04				
Test date (dd/mm/yyyy)		18/03/2024		—	
Irradiance [W/m²]		1000 ± 10			
Module temperature [°C] low / high		25 / 55			
Sample no.	Coefficient	Calculated value			
1-1	α [%/K]	0.0382			
	β [%/K]	-0.2360			
	γ [%/K]	-0.2930			
Supplementary information: Temperature coefficients were measured with a solar simulator of class AAA acc. to IEC 60904-9. The non-illuminated side was covered with non-reflective background and aperture.					

Prüfbericht-Nr.: CN24C6YL 004

Seite 73 von 128

Test Report No.:

Page 73 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.11	Performance at low irradiance – MQT 07
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9.11.1	Performance at low irradiance (front side)
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Test date (dd/mm/yyyy)			17/03//2024				—
Test method			☒ indoor		☐ outdoor		
Illuminated side			☒ Front side ☐ Rear side				
Ambient temperature [°C]			25 ± 2				
Irradiance [W/m²]			200*				
Module temperature [°C]			25 ± 0.2				
Sample no.	I _{sc} [A]	V _{oc} [V]	P _{max} [W]	I _{mpp} [A]	V _{mpp} [V]	FF [%]	N/A
1-1	3.641	44.72	128.2	3.440	37.27	78.7	

Supplementary information: *A pulse solar simulator class AAA conforming to the requirements of IEC 60904-9 is used. The non-illuminated side was covered with non-reflective background and aperture.

9.11.2	Performance at low irradiance (rear side)
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Test date (dd/mm/yyyy)			17/03//2024				—
Test method			☒ indoor		☐ outdoor		
Illuminated side			☐ Front side ☒ Rear side				
Ambient temperature [°C]			25 ± 2				
Irradiance [W/m²]			200*				
Module temperature [°C]			25 ± 0.2				
Sample no.	I _{sc} [A]	V _{oc} [V]	P _{max} [W]	I _{mpp} [A]	V _{mpp} [V]	FF [%]	N/A
1-1	2.876	44.23	101.2	2.714	37.28	79.5	

Supplementary information: *A pulse solar simulator class AAA conforming to the requirements of IEC 60904-9 is used. The non-illuminated side was covered with non-reflective background and aperture.

9.11.3	Bifaciality Coefficients at low irradiance
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Sample no.	Φ _{Isc}	Φ _{Voc}	Φ _{Pmax}	—
1-1	0.79	0.99	0.79	N/A

Supplementary information: N/A

Prüfbericht-Nr.: CN24C6YL 004

Seite 74 von 128

Test Report No.:

Page 74 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.14	Hot-spot endurance test (WBT) – MQT 09 / MST 22		
Test date (dd/mm/yyyy)	19/03/2024		
Sample no.	1-2		
Cell interconnection circuit	☐ S	☒ SP	☐ PS
Module temperature at thermal equilibrium [°C]	60.1- 61.2		
Cell of complete module with highest shunt resistance shaded			
Maximum measured cell temperature [°C]	143.4		
Shading rate [%]	61		
1 st worst case cell of complete module with lowest shunt resistance shaded			
Maximum measured cell temperature [°C]	142.1		
Shading rate [%]	57		
2 nd worst case cell of complete module with lowest shunt resistance shaded			
Maximum measured cell temperature [°C]	141.7		
Shading rate [%]	57		
Cell adjacent to module edge with lowest shunt resistance shaded			
Maximum measured cell temperature [°C]	139.8		
Shading rate [%]	56		
Supplementary information: The exposure was performed under G _E (an elevated irradiance level with an addition of $\phi \cdot 300 \text{W/m}^2$) according to standard 2PfG 2665/06.18.			

9.14.1	Visual inspection after Hot-spot endurance test – MQT 01 / MST 01		
Test date (dd/mm/yyyy)	22/03/2024		—
Sample no.	Requirement	Nature and position of findings	
1-2	No major visual defects	No major visual defects	P
Supplementary information: N/A			

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Result</i>

9.14.2	Insulation test after Hot-spot endurance test – MQT 03 / MST 16					
Test date (dd/mm/yyyy)				22/03/2024		—
Maximum system voltage [V _{DC}]				1500		
Cemented joints?				☒ No ☐ Yes		
High voltage applied [V _{DC}]				8000		
Insulation resistance measured at [V _{DC}]				1500		
Sample no.	R _{iso} [GΩ]	A [m²]	R _{iso} ·A [GΩ·m²]	Dielectric breakdown		P
				Yes (description)	No	
1-2	15.00	3.11	46.65	-	No	
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.						

9.14.3	Wet leakage current test after Hot-spot endurance test – MQT 15 / MST 17			
Test date (dd/mm/yyyy)		22/03/2024		—
Maximum system voltage [V _{DC}]		1500		
Cemented joints?		☒ No ☐ Yes		
Insulation resistance measured at [V _{DC}]		1500		
Solution resistivity [$\Omega \cdot \text{cm}$]		≤ 3500		
Solution temperature [$^{\circ}\text{C}$]		22 ± 2		
Sample no.	R _{iso} [M Ω]	A [m ²]	R _{iso} ·A [M $\Omega \cdot \text{m}^2$]	P
1-2	15000.0	3.11	46650.0	
Supplementary information:				
Minimum requirement is 40 M $\Omega \cdot \text{m}^2$.				
Insulation tester can measure up to 15000.0 M Ω .				

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Result</i>

9.14.4	Maximum power determination after Hot-spot endurance test – MQT 02 / MST 03						
Test date (dd/mm/yyyy)			22/03/2024				—
Test method			☒ Simulator ☐ Natural sunlight				
Ambient temperature [°C]			25 ± 2				
Irradiance [W/m²]			1000*				
Module temperature [°C]			25 ± 1				
Sample no.	I _{sc} [A]	V _{oc} [V]	P _{max} [W]	I _{mpp} [A]	V _{mpp} [V]	FF [%]	
1-2	17.928	47.67	694.2	17.045	40.73	81.2	N/A
Supplementary information: *A pulse solar simulator class AAA conforming to the requirements of IEC 60904-9 is used.							

9.14.5	Bypass diode functionality test after Hot-spot endurance test – MQT 18.2 / MST 07			
Test date (dd/mm/yyyy)		22/03/2024		—
Test method		☐ Method A ☒ Method B		
Sample no.	Diode 1	Diode 2	Diode 3	
1-2	working properly	working properly	working properly	P
Supplementary information: This test verifies that the sample shows the electrical characteristics of a functional photovoltaic device.				

9.15	Reverse current overload test – MST 26		
Test date (dd/mm/yyyy)		25/03/2024	—
Module over-current protection rating [A]		30	
Test current [A]		47.25	
Range of applied voltage [V]		58.7/ 54.2 for Sample #1-3, 59.2 / 53.8 for Sample #2-2, 59.9 / 54.4 for Sample #3-2	
Test duration [h]		2	
Sample no.	Maximum external module surface temperature during the test [°C]:		—
1-3	76.8		P
2-2	75.7		P
3-2	84.0		P
Supplementary information: N/A			

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Result</i>

9.15.1	Visual inspection after Reverse current overload test – MST 01		
Test date (dd/mm/yyyy)		25/03/2024	—
Sample no.	Requirement	Nature and position of findings	
1-3	No major visual defects	No major visual defects	P
2-2	No major visual defects	No major visual defects	P
3-2	No major visual defects	No major visual defects	P
Supplementary information: N/A			

9.15.2	Insulation test after Reverse current overload test – MST 16					
Test date (dd/mm/yyyy)				25/03/2024		—
Maximum system voltage [V _{DC}]				1500		
Cemented joints?				☒ No ☐ Yes		
High voltage applied [V _{DC}]				8000		
Insulation resistance measured at [V _{DC}]				1500		
Sample no.	R _{iso} [GΩ]	A [m²]	R _{iso} ·A [GΩ·m²]	Dielectric breakdown		
				Yes (description)	No	
1-3	15.00	3.11	46.65	-	No	P
2-2	15.00	3.11	46.65	-	No	P
3-2	15.00	3.11	46.65	-	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.						

Prüfbericht-Nr.: CN24C6YL 004

Seite 78 von 128

Test Report No.:

Page 78 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.15.3	Wet leakage current test after Reverse current overload test – MST 17			
Test date (dd/mm/yyyy)		25/03/2024		—
Maximum system voltage [V _{DC}]		1500		
Cemented joints?		☒ No ☐ Yes		
Insulation resistance measured at [V _{DC}]		1500		
Solution resistivity [$\Omega \cdot \text{cm}$]		≤ 3500		
Solution temperature [$^{\circ}\text{C}$]		22 ± 2		
Sample no.	R _{iso} [M Ω]	A [m ²]	R _{iso} · A [M $\Omega \cdot \text{m}^2$]	
1-3	15000.0	3.11	46650.0	P
2-2	15000.0	3.11	46650.0	P
3-2	15000.0	3.11	46650.0	P
Supplementary information:				
Minimum requirement is 40 M $\Omega \cdot \text{m}^2$.				
Insulation tester can measure up to 15000.0 M Ω .				

Prüfbericht-Nr.: CN24C6YL 004

Seite 79 von 128

Test Report No.:

Page 79 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.18	Cyclic (dynamic) mechanical load test – MQT 20		
Test date (dd/mm/yyyy)		24/03/2024 - 29/03/2024 for BOM 1 to 3, 26/04/2024 - 28/04/2024 for BOM 4	—
Mechanical pressure load applied [Pa]		1000	
Mechanical tensile load applied [Pa]		1000	
Total number of cycles		1000	
Frequency of cycles [cycles/minute]		3	
Mounting method		4 press block installation	
Sample no.	Open circuits (yes/no)		
1-4	No		P
1-5	No		P
2-3	No		P
2-4	No		P
3-3	No		P
3-4	No		P
4-2	No		P
4-3	No		P
Supplementary information: N/A			

9.18.1	Visual inspection after Cyclic (dynamic) mechanical load test – MQT 01		
Test date (dd/mm/yyyy)		30/03/2024 for BOM 1 to 3, 28/04/2024 for BOM 4	—
Sample no.	Requirement	Nature and position of findings	
1-4	No major visual defects	No major visual defects	P
1-5		No major visual defects	P
2-3		No major visual defects	P
2-4		No major visual defects	P
3-3		No major visual defects	P
3-4		No major visual defects	P
4-2		No major visual defects	P
4-3		No major visual defects	P
Supplementary information: N/A			

Prüfbericht-Nr.: CN24C6YL 004

Seite 80 von 128

Test Report No.:

Page 80 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.18.2 Insulation test after Cyclic (dynamic) mechanical load test – MQT 03

Test date (dd/mm/yyyy)				30/03/2024 for BOM 1 to 3, 28/04/2024 for BOM 4		—
Maximum system voltage [V _{DC}]				1500		
Cemented joints?				☒ No ☐ Yes		
High voltage applied [V _{DC}]				8000		
Insulation resistance measured at [V _{DC}]				1500		
Sample no.	R _{iso} [GΩ]	A [m²]	R _{iso} ·A [GΩ·m²]	Dielectric breakdown		
				Yes (description)	No	
1-4	15.00	3.11	46.65	-	No	P
1-5	15.00	3.11	46.65	-	No	P
2-3	15.00	3.11	46.65	-	No	P
2-4	15.00	3.11	46.65	-	No	P
3-3	15.00	3.11	46.65	-	No	P
3-4	15.00	3.11	46.65	-	No	P
4-2	15.00	2.00	30.00	-	No	P
4-3	15.00	2.00	30.00	-	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.

Prüfbericht-Nr.: CN24C6YL 004

Seite 81 von 128

Test Report No.:

Page 81 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.18.3 Wet leakage current test after Cyclic (dynamic) mechanical load test – MQT 15

Test date (dd/mm/yyyy)		30/03/2024 for BOM 1 to 3, 28/04/2024 for BOM 4		—
Maximum system voltage [V _{DC}]		1500		
Cemented joints?		☒ No ☐ Yes		
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]	
1-4	15000.0	3.11	46650.0	P
1-5	15000.0	3.11	46650.0	P
2-3	15000.0	3.11	46650.0	P
2-4	15000.0	3.11	46650.0	P
3-3	15000.0	3.11	46650.0	P
3-4	15000.0	3.11	46650.0	P
4-2	15000.0	2.00	30000.0	P
4-3	15000.0	2.00	30000.0	P

Supplementary information:

Minimum requirement is 40 MΩ·m².

Insulation tester can measure up to 15000.0 MΩ.

Prüfbericht-Nr.: CN24C6YL 004

Seite 82 von 128

Test Report No.:

Page 82 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.19	Thermal cycling test (50 cycles) – MQT 11 / MST 51		
Test date (dd/mm/yyyy)		31/03/2024 - 10/04/2024 for BOM 1 to 3, 29/04/2024 - 09/05/2024 for BOM 4	—
Total number of cycles		50	
Actual dwell duration at high and low temperatures		10 min / 10 min	
Sample no.	Open circuits (yes/no)		
1-4	No		P
1-5	No		P
2-3	No		P
2-4	No		P
3-3	No		P
3-4	No		P
4-2	No		P
4-3	No		P
Supplementary information: A single 5N weight was attached to the junction box. Impp (GBSI) (GBSI equals to 1000W/m² + φ•300W/m²) was applied. Impp@GE(an elevated irradiance level with an addition of φ•300W/m²) was applied according to standard 2PfG 2665/06.18.			

9.19.1	Visual inspection after Thermal cycling test (50 cycles) – MQT 01 / MST 01		
Test date (dd/mm/yyyy)		10/04/2024 for BOM 1 to 3, 09/05/2024 for BOM 4	—
Sample no.	Requirement	Nature and position of findings	
1-4	No major visual defects	No major visual defects	P
1-5		No major visual defects	P
2-3		No major visual defects	P
2-4		No major visual defects	P
3-3		No major visual defects	P
3-4		No major visual defects	P
4-2		No major visual defects	P
4-3		No major visual defects	P
Supplementary information: N/A			

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Result</i>

9.19.2	Insulation test after Thermal cycling test (50 cycles) – MQT 03 / MST 16					
Test date (dd/mm/yyyy)				10/04/2024 for BOM 1 to 3, 09/05/2024 for BOM 4		—
Maximum system voltage [V _{DC}]				1500		
Cemented joints?				☒ No ☐ Yes		
High voltage applied [V _{DC}]				8000		
Insulation resistance measured at [V _{DC}]				1500		
Sample no.	R _{iso} [GΩ]	A [m²]	R _{iso} ·A [GΩ·m²]	Dielectric breakdown		
				Yes (description)	No	
1-4	15.00	3.11	46.65	-	No	P
1-5	15.00	3.11	46.65	-	No	P
2-3	15.00	3.11	46.65	-	No	P
2-4	15.00	3.11	46.65	-	No	P
3-3	15.00	3.11	46.65	-	No	P
3-4	15.00	3.11	46.65	-	No	P
4-2	15.00	2.00	30.00	-	No	P
4-3	15.00	2.00	30.00	-	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.						

Prüfbericht-Nr.: CN24C6YL 004

Seite 84 von 128

Test Report No.:

Page 84 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.19.3 Wet leakage current test after Thermal cycling test (50 cycles) – MQT 15 / MST 17

Test date (dd/mm/yyyy)		10/04/2024 for BOM 1 to 3, 09/05/2024 for BOM 4		—
Maximum system voltage [V _{DC}]		1500		
Cemented joints?		☒ No ☐ Yes		
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]	
1-4	15000.0	3.11	46650.0	P
1-5	15000.0	3.11	46650.0	P
2-3	15000.0	3.11	46650.0	P
2-4	15000.0	3.11	46650.0	P
3-3	15000.0	3.11	46650.0	P
3-4	15000.0	3.11	46650.0	P
4-2	15000.0	2.00	30000.0	P
4-3	15000.0	2.00	30000.0	P

Supplementary information:

Minimum requirement is 40 MΩ·m².

Insulation tester can measure up to 15000.0 MΩ.

Prüfbericht-Nr.: CN24C6YL 004 Test Report No.:			Seite 85 von 128 Page 85 of 128
Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.20	Humidity-freeze test – MQT 12 / MST 52		
Test date (dd/mm/yyyy)		21/04/2024 - 01/05/2024 for BOM 1 to 3, 10/05/2024 - 20/05/2024 for BOM 4	—
Total number of cycles		10	
Sample no.	Open circuits (yes/no)		
1-4	No		P
1-5	No		P
2-3	No		P
2-4	No		P
3-3	No		P
3-4	No		P
4-2	No		P
4-3	No		P
Supplementary information: N/A			

9.20.1	Visual inspection after Humidity-freeze test – MQT 01 / MST 01		
Test date (dd/mm/yyyy)		01/05/2024 for BOM 1 to 3, 20/05/2024 for BOM 4	—
Sample no.	Requirement	Nature and position of findings	
1-4	No major visual defects	No major visual defects	P
1-5		No major visual defects	P
2-3		No major visual defects	P
2-4		No major visual defects	P
3-3		No major visual defects	P
3-4		No major visual defects	P
4-2		No major visual defects	P
4-3		No major visual defects	P
Supplementary information: N/A			

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Result</i>

9.20.2	Insulation test after Humidity-freeze test – MQT 03 / MST 16					
Test date (dd/mm/yyyy)				01/05/2024 for BOM 1 to 3, 20/05/2024 for BOM 4		—
Maximum system voltage [V _{DC}]				1500		
Cemented joints?				☒ No ☐ Yes		
High voltage applied [V _{DC}]				8000		
Insulation resistance measured at [V _{DC}]				1500		
Sample no.	R _{iso} [GΩ]	A [m²]	R _{iso} ·A [GΩ·m²]	Dielectric breakdown		
				Yes (description)	No	
1-4	15.00	3.11	46.65	-	No	P
1-5	15.00	3.11	46.65	-	No	P
2-3	15.00	3.11	46.65	-	No	P
2-4	15.00	3.11	46.65	-	No	P
3-3	15.00	3.11	46.65	-	No	P
3-4	15.00	3.11	46.65	-	No	P
4-2	15.00	2.00	30.00	-	No	P
4-3	15.00	2.00	30.00	-	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.						

Prüfbericht-Nr.: CN24C6YL 004

Seite 87 von 128

Test Report No.:

Page 87 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.20.3	Wet leakage current test after Humidity-freeze test – MQT 15 / MST 17			
Test date (dd/mm/yyyy)		01/05/2024 for BOM 1 to 3, 20/05/2024 for BOM 4		—
Maximum system voltage [V _{DC}]		1500		
Cemented joints?		☐ No ☒ Yes		
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]	
1-4	15000.0	3.11	46650.0	P
1-5	15000.0	3.11	46650.0	P
2-3	15000.0	3.11	46650.0	P
2-4	15000.0	3.11	46650.0	P
3-3	15000.0	3.11	46650.0	P
3-4	15000.0	3.11	46650.0	P
4-2	15000.0	2.00	30000.0	P
4-3	15000.0	2.00	30000.0	P
Supplementary information: Minimum requirement is 40 MΩ·m². Insulation tester can measure up to 15000.0 MΩ.				

9.21	Retention of junction box on mounting surface – MQT 14.1 / MST 42			
Test date (dd/mm/yyyy)		02/05/2024 for BOM 1 to 3, 21/05/2024 for BOM 4		—
Sample no.		1-4, 2-3, 3-3 and 4-2		
Applied force in all directions parallel to the mounting surface and parallel to the module edges [N]		40		
Applied force perpendicular to the mounting surface [N]		40		
Supplementary information: N/A				

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Result</i>

9.21.1	Visual inspection after Retention of junction box on mounting surface – MQT 01 / MST 01		
Test date (dd/mm/yyyy)		02/05/2024 for BOM 1 to 3, 21/05/2024 for BOM 4	—
Sample no.	Requirement	Nature and position of findings	
1-4	No major visual defects	No major visual defects	P
2-3	No major visual defects	No major visual defects	P
3-3	No major visual defects	No major visual defects	P
4-2	No major visual defects	No major visual defects	P
Supplementary information: N/A			

9.21.2	Insulation test after Retention of junction box on mounting surface – MQT 03 / MST 16					
Test date (dd/mm/yyyy)				02/05/2024 for BOM 1 to 3, 21/05/2024 for BOM 4		—
Maximum system voltage [V _{DC}]				1500		
Cemented joints?				☐ No ☒ Yes		
High voltage applied [V _{DC}]				10800		
Insulation resistance measured at [V _{DC}]				2025		
Sample no.	R _{iso} [GΩ]	A [m²]	R _{iso} ·A [GΩ·m²]	Dielectric breakdown		
				Yes (description)	No	
1-4	20.25	3.11	62.98	-	No	P
2-3	20.25	3.11	62.98	-	No	P
3-3	20.25	3.11	62.98	-	No	P
4-2	15.00	2.00	30.00	-	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.						

Prüfbericht-Nr.: CN24C6YL 004

Seite 89 von 128

Test Report No.:

Page 89 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.21.3	Wet leakage current test after Retention of junction box on mounting surface – MQT 15 / MST 17			
Test date (dd/mm/yyyy)		02/05/2024 for BOM 1 to 3, 21/05/2024 for BOM 4		—
Maximum system voltage [V _{DC}]		1500		
Cemented joints?		☐ No ☒ Yes		
Insulation resistance measured at [V _{DC}]		2025		
Solution resistivity [Ω·cm]		≤ 3500		
Solution temperature [°C]		22 ± 2		
Sample no.	R _{ISO} [MΩ]	A [m²]	R _{ISO} ·A [MΩ·m²]	
1-4	20250.0	3.11	62977.5	P
2-3	20250.0	3.11	62977.5	P
3-3	20250.0	3.11	62977.5	P
4-2	15000.0	2.00	30000.0	P
Supplementary information: Minimum requirement is 40 MΩ·m².				

9.22	Test of cord anchorage – MQT 14.2 / MST 42			
Remark: Test not required, since junction box is qualified in accordance with IEC 62790.				P

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Result</i>

9.23	Thermal cycling test (200 cycles) – MQT 11 / MST 51		
Test date (dd/mm/yyyy)		18/03/2024 – 27/04/2024	
Total number of cycles		200	
Actual dwell duration at high and low temperatures		10 min / 10 min	
Sample no.	Open circuits (yes/no)		
1-6	No		
1-7	No		
Supplementary information: A single 5N weight was attached to the junction box. I _{mp} (G _{BSI}) (G _{BSI} equals to 1000W/m ² + φ•300W/m ²) was applied.			

9.23.1	Visual inspection after Thermal cycling test (200 cycles) – MQT 01 / MST 01		
Test date (dd/mm/yyyy)		27/04/2024	—
Sample no.	Requirement	Nature and position of findings	
1-6	No major visual defects	No major visual defects	P
1-7		No major visual defects	P
Supplementary information: N/A			

9.23.2	Insulation test after Thermal cycling test (200 cycles) – MQT 03 / MST 16					
Test date (dd/mm/yyyy)				27/04/2024		—
Maximum system voltage [V _{DC}]				1500		
Cemented joints?				☒ No ☐ Yes		
High voltage applied [V _{DC}]				8000		
Insulation resistance measured at [V _{DC}]				1500		
Sample no.	R _{iso} [GΩ]	A [m²]	R _{iso} ·A [GΩ·m²]	Dielectric breakdown		
				Yes (description)	No	
1-6	15.00	3.11	46.65	-	No	P
1-7	15.00	3.11	46.65	-	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.						

Prüfbericht-Nr.: CN24C6YL 004

Seite 91 von 128

Test Report No.:

Page 91 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.23.3	Wet leakage current test after Thermal cycling test (200 cycles) – MQT 15 / MST 17			
Test date (dd/mm/yyyy)		27/04/2024		—
Maximum system voltage [V _{DC}]		1500		
Cemented joints?		☒ No ☐ Yes		
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]	
1-6	15000.0	3.11	46650.0	P
1-7	15000.0	3.11	46650.0	P
Supplementary information: Minimum requirement is 40 MΩ·m². Insulation tester can measure up to 15000.0 MΩ.				

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Result</i>

9.24	Damp heat test – MQT 13 / MST 53		
Test date (dd/mm/yyyy)		18/03/2024 - 29/04/2024	—
Total duration [h]		1000	
Sample no.	—		
1-8	—		N/A
1-9	—		N/A
Supplementary information: N/A			

9.24.1	Visual inspection after Damp heat test – MQT 01 / MST 01		
Test date (dd/mm/yyyy)		29/04/2024	—
Sample no.	Requirement	Nature and position of findings	
1-8	No major visual defects	No major visual defects	P
1-9		No major visual defects	P
Supplementary information: N/A			

9.24.2		Insulation test after Damp heat test – MQT 03 / MST 16				
Test date (dd/mm/yyyy)				29/04/2024		—
Maximum system voltage [V _{DC}]				1500		
Cemented joints?				☒ No ☐ Yes		
High voltage applied [V _{DC}]				8000		
Insulation resistance measured at [V _{DC}]				1500		
Sample no.	R _{iso} [GΩ]	A [m²]	R _{iso} ·A [GΩ·m²]	Dielectric breakdown		
				Yes (description)	No	
1-8	15.00	3.11	46.65	-	No	P
1-9	15.00	3.11	46.65	-	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.						

Prüfbericht-Nr.: CN24C6YL 004

Seite 93 von 128

Test Report No.:

Page 93 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.24.3	Wet leakage current test after Damp heat test – MQT 15 / MST 17			
Test date (dd/mm/yyyy)		29/04/2024		—
Maximum system voltage [V _{DC}]		1500		
Cemented joints?		☒ No ☐ Yes		
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]	
1-8	15000.0	3.11	46650.0	P
1-9	15000.0	3.11	46650.0	P
Supplementary information: Minimum requirement is 40 MΩ·m². Insulation tester can measure up to 15000.0 MΩ.				

9.21	Retention of junction box on mounting surface – MQT 14.1 / MST 42			
Test date (dd/mm/yyyy)		29/04/2024		—
Sample no.			1-8	
Applied force in all directions parallel to the mounting surface and parallel to the module edges [N]			40	
Applied force perpendicular to the mounting surface [N]			40	
Supplementary information: N/A				

9.21.1	Visual inspection after Retention of junction box on mounting surface – MQT 01 / MST 01		
Test date (dd/mm/yyyy)	29/04/2024		
Sample no.	Requirement	Nature and position of findings	—
1-8	No major visual defects	No major visual defects	P
Supplementary information: N/A			

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Result</i>

9.21.2	Insulation test after Retention of junction box on mounting surface – MQT 03 / MST 16					
Test date (dd/mm/yyyy)				29/04/2024		—
Maximum system voltage [V _{DC}]				1500		
Cemented joints?				☐ No ☒ Yes		
High voltage applied [V _{DC}]				10800		
Insulation resistance measured at [V _{DC}]				2025		
Sample no.	R _{iso} [GΩ]	A [m²]	R _{iso} ·A [GΩ·m²]	Dielectric breakdown		
				Yes (description)	No	
1-8	15.00	3.11	46.65	-	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.						

9.21.3	Wet leakage current test after Retention of junction box on mounting surface – MQT 15 / MST 17			
Test date (dd/mm/yyyy)		29/04/2024		—
Maximum system voltage [V _{DC}]		1500		
Cemented joints?		☐ No ☒ Yes		
Insulation resistance measured at [V _{DC}]		2025		
Solution resistivity [$\Omega \cdot \text{cm}$]		≤ 3500		
Solution temperature [$^{\circ}\text{C}$]		22 ± 2		
Sample no.	R _{iso} [M Ω]	A [m ²]	R _{iso} · A [M $\Omega \cdot \text{m}^2$]	P
1-8	15000.0	3.11	46650.0	
Supplementary information: Minimum requirement is 40 M $\Omega \cdot \text{m}^2$. Insulation tester can measure up to 15000.0 M Ω .				

Prüfbericht-Nr.: CN24C6YL 004

Seite 95 von 128

Test Report No.:

Page 95 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.25	Static mechanical load test – MQT 16 / MST 34			
Test date (dd/mm/yyyy)		30/04/2024		—
Load direction applied		Positive (downward)	Negative (upward)	
Design load [Pa]		3600	1600	
Safety factor γ_m		1.5	1.5	
Test load [Pa]		5400	2400	
Mounting method		4 press block installation		
Sample no.	Open circuits (yes/no)			—
1-8	No			P
Supplementary information: Load was applied sand bags. 1 cycle = 1 hour pressure load + 1 hour tensile load (total 3 cycles) 1 st cycle = 5400Pa + 2400Pa 2 nd cycle = 5400Pa + 2400Pa 3 rd cycle = 5400Pa + 2400Pa See photos in Appendix D for detailed mounting method.				

9.25.1	Visual inspection after Static mechanical load test – MQT 01 / MST 01		
Test date (dd/mm/yyyy)		30/04/2024	
Sample no.		Requirement	Nature and position of findings
1-8		No major visual defects	No major visual defects
Supplementary information: N/A			

9.25.2	Insulation test after Static mechanical load test – MQT 03 / MST 16					
Test date (dd/mm/yyyy)				30/04/2024		—
Maximum system voltage [V _{DC}]				1500		
Cemented joints?				☒ No ☐ Yes		
High voltage applied [V _{DC}]				8000		
Insulation resistance measured at [V _{DC}]				1500		
Sample no.	R _{iso} [GΩ]	A [m²]	R _{iso} ·A [GΩ·m²]	Dielectric breakdown		P
				Yes (description)	No	
1-8	15.00	3.11	46.65	-	No	
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.						

Prüfbericht-Nr.: CN24C6YL 004

Seite 96 von 128

Test Report No.:

Page 96 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.25.3	Wet leakage current test after Static mechanical load test – MQT 15 / MST 17			
Test date (dd/mm/yyyy)		30/04/2024		—
Maximum system voltage [V _{DC}]		1500		
Cemented joints?		☒ No ☐ Yes		
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]	P
1-8	15000.0	3.11	46650.0	
Supplementary information:				
Minimum requirement is 40 MΩ·m².				
Insulation tester can measure up to 15000.0 MΩ.				

9.40	Impulse voltage test – MST 14		
Test date (dd/mm/yyyy)		22/03/2024 - 23/03/2024 for BOM 1 to 3, 22/05/2024 for BOM 4	—
Maximum system voltage [V]		1500	
Rated impulse voltage [V]		16000	
Impulse test voltage [V]		19680	
Lab altitude [m]		Less than 2000	
Sample no.	Test results		
1-15	No evidence of dielectric breakdown or surface tracking observed		P
2-9	No evidence of dielectric breakdown or surface tracking observed		P
3-9	No evidence of dielectric breakdown or surface tracking observed		P
4-1	No evidence of dielectric breakdown or surface tracking observed		P
Supplementary information: N/A			

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Result</i>

9.40.1	Visual inspection after Impulse voltage test – MST 01		
Test date (dd/mm/yyyy)		23/03/2024 for BOM 1 to 3, 22/05/2024 for BOM 4	—
Sample no.	Requirement	Nature and position of findings	
1-15	No major visual defects	No major visual defects	P
2-9	No major visual defects	No major visual defects	P
3-9	No major visual defects	No major visual defects	P
4-1	No major visual defects	No major visual defects	P
Supplementary information: Test sample was covered with conductive foil.			

9.40.2		Insulation test after Impulse voltage test – MST 16				
Test date (dd/mm/yyyy)				23/03/2024 for BOM 1 to 3, 22/05/2024 for BOM 4		—
Maximum system voltage [V _{DC}]				1500		
Cemented joints?				☒ No ☐ Yes		
High voltage applied [V _{DC}]				8000		
Insulation resistance measured at [V _{DC}]				1500		
Sample no.	R _{iso} [GΩ]	A [m²]	R _{iso} ·A [GΩ·m²]	Dielectric breakdown		
				Yes (description)	No	
1-15	15.00	3.11	46.65	-	No	P
2-9	15.00	3.11	46.65	-	No	P
3-9	15.00	3.11	46.65	-	No	P
4-1	15.00	2.00	30.00	-	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.						

Prüfbericht-Nr.: CN24C6YL 004

Seite 98 von 128

Test Report No.:

Page 98 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.41	Module breakage test – MST 32		
Test date (dd/mm/yyyy)		30/04/2024	—
Weight of impactor [kg]		45.5 ± 0.5	
Drop height [mm]		300	
Mounting technique used		4 press block installation	
Sample no.	Test results		P
1-14	☒	No breakage occurred	
	☐	PV module separated from the mounting structure or from the framing	
	☐	Breakage occurred, but no shear or opening large enough for a 76 mm diameter sphere to pass freely has developed and no particles larger than 65 cm² have been ejected from the sample.	
Supplementary information: N/A			

Prüfbericht-Nr.: CN24C6YL 004

Seite 99 von 128

Test Report No.:

Page 99 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.43	Potential induced degradation test – MQT 21		
Test date (dd/mm/yyyy)		03/04/2024 - 08/04/2024	—
Chamber air temperature [°C]		84.7-85.4 for Sample #1-10, #1-11, #2-5, #2-6, #3-5 and #3-6, 84.7-85.1 for Sample #1-12, #1-13, #2-7, #2-8, #3-7 and #3-8	
Chamber relative humidity [%]		84.6-85.3 for Sample #1-10, #1-11, #2-5, #2-6, #3-5 and #3-6, 84.6-85.4 for Sample #1-12, #1-13, #2-7, #2-8, #3-7 and #3-8	
Test duration [h]		96	
Sample no.	—		
1-10	+1500		N/A
1-11	+1500		N/A
1-12	-1500		N/A
1-13	-1500		N/A
2-5	+1500		N/A
2-6	+1500		N/A
2-7	-1500		N/A
2-8	-1500		N/A
3-5	+1500		N/A
3-6	+1500		N/A
3-7	-1500		N/A
3-8	-1500		N/A
Supplementary information: N/A			

Prüfbericht-Nr.: CN24C6YL 004

Seite 100 von 128

Test Report No.:

Page 100 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.43.1	Visual inspection after Potential induced degradation test – MQT 01		
Test date (dd/mm/yyyy)		08/04/2024	—
Sample no.	Requirement	Nature and position of findings	
1-10	No major visual defects	No major visual defects	P
1-11		No major visual defects	P
1-12		No major visual defects	P
1-13		No major visual defects	P
2-5		No major visual defects	P
2-6		No major visual defects	P
2-7		No major visual defects	P
2-8		No major visual defects	P
3-5		No major visual defects	P
3-6		No major visual defects	P
3-7		No major visual defects	P
3-8		No major visual defects	P
Supplementary information: N/A			

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Result</i>

9.43.2	Insulation test after Potential induced degradation test – MQT 03					
Test date (dd/mm/yyyy)				08/04/2024		—
Maximum system voltage [V _{DC}]				1500		
Cemented joints?				☒ No ☐ Yes		
High voltage applied [V _{DC}]				8000		
Insulation resistance measured at [V _{DC}]				1500		
Sample no.	R _{iso} [GΩ]	A [m²]	R _{iso} ·A [GΩ·m²]	Dielectric breakdown		
				Yes (description)	No	
1-10	15.00	3.11	46.65	-	No	P
1-11	15.00	3.11	46.65	-	No	P
1-12	15.00	3.11	46.65	-	No	P
1-13	15.00	3.11	46.65	-	No	P
2-5	15.00	3.11	46.65	-	No	P
2-6	15.00	3.11	46.65	-	No	P
2-7	15.00	3.11	46.65	-	No	P
2-8	15.00	3.11	46.65	-	No	P
3-5	15.00	3.11	46.65	-	No	P
3-6	15.00	3.11	46.65	-	No	P
3-7	15.00	3.11	46.65	-	No	P
3-8	15.00	3.11	46.65	-	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.						

Prüfbericht-Nr.: CN24C6YL 004

Seite 102 von 128

Test Report No.:

Page 102 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.43.3	Wet leakage current test after Potential induced degradation test – MQT 15			
Test date (dd/mm/yyyy)		08/04/2024		—
Maximum system voltage [V _{DC}]		1500		
Cemented joints?		☒ No ☐ Yes		
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]	
1-10	15000.0	3.11	46650.0	P
1-11	15000.0	3.11	46650.0	P
1-12	15000.0	3.11	46650.0	P
1-13	15000.0	3.11	46650.0	P
2-5	15000.0	3.11	46650.0	P
2-6	15000.0	3.11	46650.0	P
2-7	15000.0	3.11	46650.0	P
2-8	15000.0	3.11	46650.0	P
3-5	15000.0	3.11	46650.0	P
3-6	15000.0	3.11	46650.0	P
3-7	15000.0	3.11	46650.0	P
3-8	15000.0	3.11	46650.0	P
Supplementary information:				
Minimum requirement is 40 MΩ·m².				
Insulation tester can measure up to 15000.0 MΩ.				

Prüfbericht-Nr.: CN24C6YL 004

Seite 103 von 128

Test Report No.:

Page 103 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.46	Maximum power determination (final) – MST 03		
Test date (dd/mm/yyyy)		22/03/2024 for Sample #1-2, 25/03/2024 for Sample #1-3, #2-2 and #3-2, 02/05/2024 for Sample #1-4, #2-3 and #3-3, 27/04/2024 for Sample #1-6, 01/05/2024 for Sample #1-8, 01/05/2024 for Sample #4-2	—
Irradiance [W/m²]		1000*	
Module temperature [°C]		25 ± 1	
Test method		☒ Simulator ☐ Natural sunlight	
Sample no.	Appearance of final IV-curve		
1-2	No kinks or other unusual characteristics		P
1-3	No kinks or other unusual characteristics		P
1-4	No kinks or other unusual characteristics		P
1-6	No kinks or other unusual characteristics		P
1-8	No kinks or other unusual characteristics		P
2-2	No kinks or other unusual characteristics		P
2-3	No kinks or other unusual characteristics		P
3-2	No kinks or other unusual characteristics		P
3-3	No kinks or other unusual characteristics		P
4-2	No kinks or other unusual characteristics		P

Supplementary information: *A pulse solar simulator class AAA conforming to the requirements of IEC 60904-9 is used.

Prüfbericht-Nr.: CN24C6YL 004

Seite 104 von 128

Test Report No.:

Page 104 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.47	Performance at STC (final) – MQT 06.1
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9.47.1	Performance at STC (final) – MQT 06.1							
Test date (dd/mm/yyyy)			22/03/2024 for Sample #1-2, 02/05/2024 for Sample #1-4, #1-5, #2-3, #2-4, #3-3and #3-4, 27/04/2024 for Sample #1-6 and #1-7, 01/05/2024 for Sample #1-8 and #1-9, 08/04/2024 for Sample #1-10 to #1-13, #2-5 to #2-8 and #3-5 to #3-8					—
Test method			☒ Simulator ☐ Natural sunlight					
Illuminated side			☒ Front side ☐ Rear side					
Ambient temperature [°C]			25 ± 2					
Irradiance [W/m²]			1000 ± 10					
Module temperature [°C]			25 ± 0.2					
Spectral mismatch			N/A					
Sample no.	I _{sc} [A]	V _{oc} [V]	P _{max} [W]	I _{mpp} [A]	V _{mpp} [V]	FF [%]	Degra- dation [%]	
1-2	17.928	47.67	694.2	17.045	40.73	81.2	-0.36	P
1-4	17.900	47.47	687.8	16.975	40.52	80.9	-1.15	P
1-5	17.912	47.64	688.2	17.085	40.28	80.6	-1.31	P
1-6	17.897	47.59	688.0	16.993	40.48	80.8	-1.37	P
1-7	17.870	47.42	684.5	16.966	40.34	80.8	-1.50	P
1-8	17.827	47.41	684.7	16.944	40.41	81.0	-1.42	P
1-9	17.866	47.47	685.7	16.966	40.42	80.9	-1.42	P
1-10	17.923	47.58	691.2	16.984	40.70	81.1	-1.89	P
1-11	17.920	47.61	692.3	17.058	40.59	81.1	-1.65	P
1-12	17.913	47.56	689.9	16.996	40.59	81.0	-0.99	P
1-13	17.924	47.52	689.8	17.01	40.55	81.0	-0.94	P
2-3	17.794	47.63	686.2	16.921	40.55	81.0	-1.21	P
2-4	17.833	47.49	686.6	16.956	40.49	81.1	-1.22	P
2-5	17.921	47.44	690.3	17.057	40.47	81.2	-0.65	P
2-6	17.968	47.31	687.1	17.055	40.29	80.8	-0.63	P
2-7	17.834	47.48	685.7	16.961	40.43	81.0	-1.05	P
2-8	17.869	47.43	686.3	17.015	40.34	81.0	-1.12	P
3-3	17.898	47.12	674.9	16.933	39.86	80.0	-1.12	P
3-4	17.902	47.30	677.6	16.924	40.04	80.0	-0.74	P
3-5	17.866	47.39	688.3	17.014	40.46	81.3	-0.64	P

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 105 von 128
Page 105 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

3-6	17.880	47.30	686.2	17.02	40.32	81.1	-0.63	P
3-7	17.919	47.40	689.2	17.071	40.38	81.1	-0.68	P
3-8	17.779	47.63	690.3	16.997	40.61	81.5	-0.89	P
4-2	15.539	34.80	440.8	14.918	29.55	81.5	-0.78	P
4-3	15.538	34.86	441.9	14.906	29.64	81.6	-0.73	P

Supplementary information:

Negative degradation means power loss.

Prüfbericht-Nr.: CN24C6YL 004
Test Report No.:

Seite 106 von 128
Page 106 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.47.2	Bifaciality Coefficients (final)			
Sample no.	Φ_{isc}	Φ_{Voc}	Φ_{Pmax}	—
1-10	0.76	0.99	0.78	N/A
1-11	0.76	0.99	0.78	N/A
1-12	0.77	0.99	0.78	N/A
1-13	0.76	0.99	0.78	N/A
2-5	0.77	0.99	0.78	N/A
2-6	0.78	0.99	0.79	N/A
2-7	0.77	0.99	0.78	N/A
2-8	0.77	0.99	0.78	N/A
3-5	0.77	0.99	0.77	N/A
3-6	0.76	0.99	0.78	N/A
3-7	0.76	0.99	0.77	N/A
3-8	0.77	0.99	0.78	N/A
Supplementary information: N/A				

Prüfbericht-Nr.: CN24C6YL 004

Seite 107 von 128

Test Report No.:

Page 107 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.47.3	Performance at BNPI (final) – MQT 06.1						
Test date (dd/mm/yyyy)		22/03/2024 for Sample #1-2, 02/05/2024 for Sample #1-4, #1-5, #2-3, #2-4, #3-3 and #3-4, 27/04/2024 for Sample #1-6 and #1-7, 01/05/2024 for Sample #1-8 and #1-9, 08/04/2024 for Sample #1-10 to #1-13, #2-5 to #2-8 and #3-5 to #3-8					
Test method		☒ Simulator ☐ Natural sunlight					
Illuminated side		☒ Front side ☐ Rear side					
Ambient temperature [°C]		25 ± 2					
Irradiance [W/m²]		1000 + $\varphi \cdot 135^*$					
Module temperature [°C]		25 ± 0.2					
Spectral mismatch		N/A					
Sample no.	I _{sc} [A]	V _{oc} [V]	P _{max} [W]	I _{mpp} [A]	V _{mpp} [V]	FF [%]	Degradation [%]
1-2	19.748	47.82	764.6	18.751	40.78	81.0	-0.39
1-4	19.758	47.61	758.9	18.751	40.48	80.7	-0.98
1-5	19.704	47.78	759.6	18.700	40.62	80.7	-1.05
1-6	19.701	47.72	757.1	18.678	40.53	80.5	-1.45
1-7	19.702	47.56	755.9	18.694	40.43	80.7	-1.26
1-8	19.658	47.54	754.8	18.656	40.46	80.8	-1.32
1-9	19.677	47.58	756.2	18.690	40.46	80.8	-1.28
1-10	19.702	47.66	758.0	18.693	40.55	80.7	-2.64
1-11	19.767	47.59	760.7	18.817	40.43	80.9	-2.44
1-12	19.788	47.45	756.1	18.808	40.20	80.5	-1.47
1-13	19.661	47.61	755.6	18.709	40.38	80.7	-1.47
2-3	19.601	47.76	755.5	18.668	40.47	80.7	-1.18
2-4	19.670	47.62	756.8	18.731	40.40	80.8	-1.14
2-5	19.694	47.56	755.8	18.715	40.38	80.7	-1.23
2-6	19.690	47.53	748.9	18.512	40.45	80.0	-1.58
2-7	19.711	47.44	756.4	18.777	40.28	80.9	-0.92
2-8	19.763	47.54	759.9	18.797	40.43	80.9	-0.61
3-3	19.665	47.25	741.1	18.633	39.78	79.8	-1.12
3-4	19.713	47.39	743.8	18.609	39.97	79.6	-1.13
3-5	19.690	47.53	748.9	18.512	40.45	80.0	-0.64
3-6	19.711	47.44	756.4	18.777	40.28	80.9	-0.65
3-7	19.706	47.75	761.1	18.729	40.64	80.9	-0.52

Prüfbericht-Nr.: CN24C6YL 004

Seite 108 von 128

Test Report No.:

Page 108 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

3-8	19.747	47.70	759.9	18.724	40.59	80.7	-0.96	P
4-2	17.028	35.15	484.4	16.434	29.48	80.9	-1.17	P
4-3	17.049	35.08	485.0	16.368	29.63	81.1	-0.99	P

Supplementary information:

Negative degradation means power loss.

The non-illuminated side was covered with non-reflective background and aperture.

*A pulse solar simulator class AAA conforming to the requirements of IEC 60904-9 is used. The bifaciality coefficient ϕ employed for sample no. 1-11 to 1-14 is the minimum value of ϕ_{ISC} and ϕ_{Pmax} as documented in table 9.47.2 for each test sample. The bifaciality coefficient ϕ employed for other samples is the minimum value of ϕ_{ISC} and ϕ_{Pmax} as documented in table 9.8.3 for each test sample.

Prüfbericht-Nr.: CN24C6YL 004

Seite 109 von 128

Test Report No.:

Page 109 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.48	Gate #2 evaluation		
Reproducibility r for P _{max} [%]	0.221 for Sample #1-2, 0.151 for Sample #1-4 and #1-5, 0.095 for Sample #1-6 and #1-7, 0.021 for Sample #1-8 and #1-9, 0.273 for Sample #1-10 to #1-13, 0.122 for Sample #2-3 and #2-4, 0.219 for Sample #2-5 to #2-8, 0.056 for Sample #3-3 and #3-4, 0.309 for Sample #3-5 to #3-8, 0.118 for Sample #4-2 and #4-3	—	
Reproducibility r _(BNPI) for P _{max(BNPI)} [%]	0.227 for Sample #1-2, 0.111 for Sample #1-4 and #1-5, 0.024 for Sample #1-6 and #1-7, 0.157 for Sample #1-8 and #1-9, 0.244for Sample #1-10 to #1-13, 0.244 for Sample #2-3 and #2-4, 0.203 for Sample #2-5 to #2-8, 0.233 for Sample #3-3 and #3-4, 0.119 for Sample #3-5 to #3-8, 0.004 for Sample #4-2 and #4-3	—	

Prüfbericht-Nr.: CN24C6YL 004

Seite 110 von 128

Test Report No.:

Page 110 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.48.1	Evaluation of output power for each module			
Sample no.	P _{max,meas,Gate #1} [W]	P _{max,meas,Gate #1,r} [W]	P _{max,meas,Gate #2} [W]	—
1-2	696.7	660.4	694.2	P
1-4	695.7	660.0	687.8	P
1-5	697.3	661.5	688.2	P
1-6	697.5	662.0	688.0	P
1-7	694.9	659.5	684.5	P
1-8	694.6	659.7	684.7	P
1-9	695.6	660.6	685.7	P
1-10	704.5	658.6	691.2	P
1-11	704.0	660.7	692.3	P
1-12	696.8	660.1	689.9	P
1-13	696.3	659.7	689.8	P
2-3	694.6	659.1	686.2	P
2-4	695.1	659.5	686.6	P
2-5	694.7	658.6	690.3	P
2-6	691.4	655.4	687.1	P
2-7	693.0	656.9	685.7	P
2-8	694.1	657.9	686.3	P
3-3	682.5	648.0	674.9	P
3-4	682.7	648.2	677.6	P
3-5	692.8	656.1	688.3	P
3-6	690.6	654.0	686.2	P
3-7	694.0	657.2	689.2	P
3-8	696.5	659.6	690.3	P
4-2	444.2	421.5	440.8	P
4-3	445.1	422.5	441.9	P

Supplementary information:

Pass criteria follow requirements of section 7.2.1 of IEC/EN 61215-1.

P_{max,meas,Gate #1} = Measured initial maximum STC power

P_{max,meas,Gate #1,r} = Measured initial maximum STC power taking reproducibility and degradation of 5% into account

P_{max,meas,Gate #2} = Measured final maximum STC power

Prüfbericht-Nr.: CN24C6YL 004

Seite 111 von 128

Test Report No.:

Page 111 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.48.2	Evaluation of output power for each module			
Sample no.	$P_{\max(\text{BNPI}),\text{meas,Gate \#1}(\text{BNPI})}$ [W]	$P_{\max(\text{BNPI}),\text{meas,Gate \#1,r}(\text{BNPI})}$ [W]	$P_{\max(\text{BNPI}),\text{meas,Gate \#2}(\text{BNPI})}$ [W]	—
1-2	767.6	727.6	764.6	P
1-4	766.4	727.3	758.9	P
1-5	767.6	728.4	759.6	P
1-6	768.2	727.0	757.1	P
1-7	765.5	726.5	755.9	P
1-8	764.9	725.5	754.8	P
1-9	766.0	726.6	756.2	P
1-10	778.5	725.5	761.5	P
1-11	779.7	727.6	761.1	P
1-12	767.4	727.3	759.9	P
1-13	766.8	726.7	758.0	P
2-3	764.5	724.5	755.5	P
2-4	765.5	725.5	756.8	P
2-5	765.2	725.5	760.7	P
2-6	760.9	721.5	756.1	P
2-7	763.4	723.8	755.6	P
2-8	764.5	724.9	755.8	P
3-3	749.5	710.4	741.1	P
3-4	752.3	713.0	743.8	P
3-5	753.7	715.1	748.9	P
3-6	761.3	722.4	756.4	P
3-7	765.1	726.0	759.9	P
3-8	767.3	728.1	760.6	P
4-2	490.1	465.6	484.4	P
4-3	489.8	465.3	485.0	P

Supplementary information:

Pass criteria follow requirements of section 7.2.1 of IEC/EN 61215-1.

$P_{\max(\text{BNPI}),\text{meas,Gate \#1}(\text{BNPI})}$ = Measured initial maximum BNPI power

$P_{\max(\text{BNPI}),\text{meas,Gate \#1,r}(\text{BNPI})}$ = Measured initial maximum BNPI power taking reproducibility and degradation of 5% into account

$P_{\max(\text{BNPI}),\text{meas,Gate \#2}(\text{BNPI})}$ = Measured final maximum BNPI power

Prüfbericht-Nr.: CN24C6YL 004

Seite 112 von 128

Test Report No.:

Page 112 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.49	Bypass diode functionality test (final) – MQT 18.2 / MST 07			
Test date (dd/mm/yyyy)		24/03/2024 for Sample #1-2, 25/03/2024 for Sample #1-3, #2-2 and #3-2, 04/05/2024 for Sample #1-4, #2-1, #2-3, #3-1 and #3-3, 29/04/2024 for Sample #1-6, 03/05/2024 for Sample #1-1 and #1-8		—
Test method		☐ Method A ☒ Method B		
Sample no.	Diode 1	Diode 2	Diode 3	
1-1	working properly	working properly	working properly	P
1-2	working properly	working properly	working properly	P
1-3	working properly	working properly	working properly	P
1-4	working properly	working properly	working properly	P
1-6	working properly	working properly	working properly	P
1-8	working properly	working properly	working properly	P
2-1	working properly	working properly	working properly	P
2-2	working properly	working properly	working properly	P
2-3	working properly	working properly	working properly	P
3-1	working properly	working properly	working properly	P
3-2	working properly	working properly	working properly	P
3-3	working properly	working properly	working properly	P
4-2	working properly	working properly	working properly	P
Supplementary information:				
This test verifies that the sample shows the electrical characteristics of a functional photovoltaic device.				

Prüfbericht-Nr.: CN24C6YL 004

Seite 113 von 128

Test Report No.:

Page 113 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.51	Accessibility test (final) – MST 11		
Test date (dd/mm/yyyy)		02/05/2024 for Sample #1-4, #2-3 and #3-3, 27/04/2024 for Sample #1-6, 01/05/2024 for Sample #1-8,	—
Applied force [N]		10	
Sample no.	Contact with live electrical part?	R _{iso} [MΩ]	
1-4	☐ Yes ☒ No	500.0	P
1-6	☐ Yes ☒ No	500.0	P
1-8	☐ Yes ☒ No	500.0	P
2-3	☐ Yes ☒ No	500.0	P
3-3	☐ Yes ☒ No	500.0	P
4-2	☐ Yes ☒ No	500.0	P
Supplementary information: The resistance tester can measure up to 500.0 MΩ.			

9.52	Continuity test of equipotential bonding (final) – MST 13		
Test date (dd/mm/yyyy)		02/05/2024 for Sample #1-4, #2-3 and #3-3, 27/04/2024 for Sample #1-6, 01/05/2024 for Sample #1-8, 30/04/2024 for Sample #1-14,	—
Maximum overcurrent protection rating [A]		35.0	
Current applied [A]		87.5	
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]	
1-4	—	<1.0	P
1-6	—	<1.0	P
1-8	—	<1.0	P
1-14	—	<1.0	P
2-3	—	<1.0	P
3-3	—	<1.0	P
4-2	—	<1.0	P
Supplementary information: N/A			

Prüfbericht-Nr.: CN24C6YL 004

Seite 114 von 128

Test Report No.:

Page 114 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.54	Durability of markings – MST 05		
Test date (dd/mm/yyyy)		24/03/2024 for Sample #1-2, 27/03/2024 for Sample #1-3, #2-2 and #3-2, 04/05/2024 for Sample #1-4, #2-1, #2-3, #3-1 and #3-3, 29/04/2024 for Sample #1-6, 03/05/2024 for Sample #1-1 and #1-8, 22/05/2024 for Sample #4-2	—
Duration of rubbing with water [s]		15	
Duration of rubbing with petroleum spirits [s]		15	
Sample no.	Comments		
1-1	The marking is legible; the marking plate is not removable and without curling.		P
1-2	The marking is legible; the marking plate is not removable and without curling.		P
1-3	The marking is legible; the marking plate is not removable and without curling.		P
1-4	The marking is legible; the marking plate is not removable and without curling.		P
1-6	The marking is legible; the marking plate is not removable and without curling.		P
1-8	The marking is legible; the marking plate is not removable and without curling.		P
2-1	The marking is legible; the marking plate is not removable and without curling.		P
2-2	The marking is legible; the marking plate is not removable and without curling.		P
2-3	The marking is legible; the marking plate is not removable and without curling.		P
3-1	The marking is legible; the marking plate is not removable and without curling.		P
3-2	The marking is legible; the marking plate is not removable and without curling.		P
3-3	The marking is legible; the marking plate is not removable and without curling.		P
4-2	The marking is legible; the marking plate is not removable and without curling.		P
Supplementary information: N/A			

Prüfbericht-Nr.: CN24C6YL 004

Seite 115 von 128

Test Report No.:

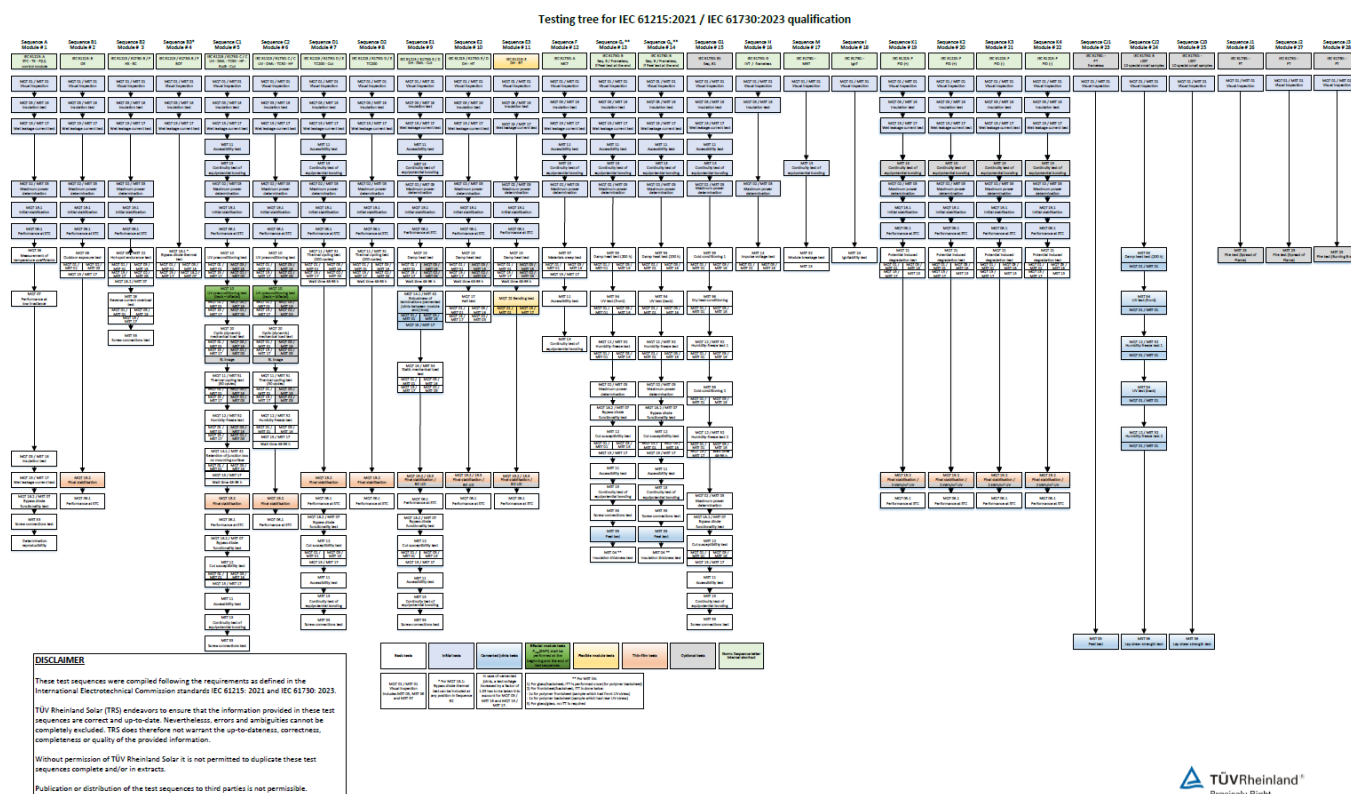
Page 115 of 128

Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Ergebnis
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Result

9.55	Sharp edge test – MST 06		
Test date (dd/mm/yyyy)		24/03/2024 for Sample #1-2, 27/03/2024 for Sample #1-3, #2-2 and #3-2, 04/05/2024 for Sample #1-4, #2-1, #2-3, #3-1 and #3-3, 29/04/2024 for Sample #1-6, 03/05/2024 for Sample #1-1 and #1-8, 22/05/2024 for Sample #4-2	—
Sample no.	Comments		
1-1	The accessible PV module surfaces are smooth and free from sharp edges.		P
1-2	The accessible PV module surfaces are smooth and free from sharp edges.		P
1-3	The accessible PV module surfaces are smooth and free from sharp edges.		P
1-4	The accessible PV module surfaces are smooth and free from sharp edges.		P
1-6	The accessible PV module surfaces are smooth and free from sharp edges.		P
1-8	The accessible PV module surfaces are smooth and free from sharp edges.		P
2-1	The accessible PV module surfaces are smooth and free from sharp edges.		P
2-2	The accessible PV module surfaces are smooth and free from sharp edges.		P
2-3	The accessible PV module surfaces are smooth and free from sharp edges.		P
3-1	The accessible PV module surfaces are smooth and free from sharp edges.		P
3-2	The accessible PV module surfaces are smooth and free from sharp edges.		P
3-3	The accessible PV module surfaces are smooth and free from sharp edges.		P
4-2	The accessible PV module surfaces are smooth and free from sharp edges.		P
Supplementary information: N/A			

Appendix A: Test charts

Acc. to IEC 61215:2021 / IEC 61730:2023:



ANLAGE zum Prüfbericht-Nr.: CN24C6YL 004
APPENDIX to test report no.:

Seite 117 von 128
Page 117 of 128

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

Appendix B: Abbreviations used in the report

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
S	Series connection
SP	Series-parallel connection
PS	Parallel-series connection
R_{iso}	Electrical insulation resistance
A	Module area
BNPI	Bifacial nameplate irradiance
BSI	Bifacial stress irradiance
G_{BNPI}	Equivalent bifacial nameplate irradiance
aBSI	Applied bifacial stress irradiance
φ	Bifaciality refers to the ratios between the main I-V characteristics of the rear side and the front side of a bifacial device, typically at Standard Test Conditions (STC) unless otherwise specified. It is quantified with reference to bifaciality coefficients, namely as φ.
φ_{Pmax}	Maximum power bifaciality coefficient
φ_{Voc}	Open-circuit voltage bifaciality coefficient
φ_{Isc}	Short-circuit current bifaciality coefficient

Statement of the estimated uncertainty of the test verdicts

Test location: China Testing & Certification International Group Co., Ltd., China Photovoltaic Product Test Center

- Electrical performance rating is outside the scope of IEC 61215:2021 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 AAA solar simulator. The extended measurement uncertainty is:
 - $2\sigma (P_{mpp}) \leq \pm 2.28 \%$
 - $2\sigma (I_{SC}) \leq \pm 2.18 \%$
 - $2\sigma (V_{OC}) \leq \pm 0.74 \%$
- The reproducibility parameter r with the solar simulator is recorded within this test report.
- Relative measurements were performed with a flash type solar simulator.

ANLAGE zum Prüfbericht-Nr.: CN24C6YL 004
APPENDIX to test report no.:

Seite 118 von 128
Page 118 of 128

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

Appendix C: History of reporting and certification

Project no.	Report no.	Certificate no.	Date of issue	Remarks
244530936	CN24C6YL 001	PV 50619799 0001	21/02/2024	Basic qualification
244562285	CN24C6YL 002	PV 50619799 0002	05/03/2024	- Introduce to new model types. - Extension power range. - Extension to alternative materials and combinations.
244558681	CN24C6YL 003	Declaration	12/03/2024	- Extension to alternative materials and combinations.

ANLAGE zum Prüfbericht-Nr.: CN24C6YL 004
APPENDIX to test report no.:

Seite 119 von 128
Page 119 of 128

FOTO-DOKUMENTATION
PHOTO DOCUMENTATION

Appendix D: Photos

Module type: YL700CF66 f/2 (under STC) / YL776CF66 f/2 (under BNPI) (Median power) YL715CF66 f/2 (under STC) / YL792CF66 f/2 (under BNPI) (Higher power end) YL685CF66 f/2 (under STC) / YL759CF66 f/2 (under BNPI) (Lower power end) (BOM 1)



Fig. 1: front view of test sample



Fig. 2: rear view of test sample

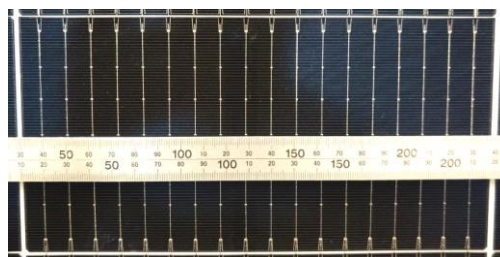


Fig. 3: detail view of solar cell

	Yingli Energy Development Co., LTD. No.3399, Chaoyang North Road, Baoding, 071051, Hebei, China TEL: +86(312)8922216 FAX: +86(312)8631900 yinglisolar.com Made in China Tested to IEC 61215:2021 and IEC 61730:2023	YL685CF66 f/2 STC BNPI Maximum Power: 685 W 759 W Voltage at Pmax(Vmp): 40.10 V 40.10 V Current at Pmax(Imp): 17.09 A 18.94 A Open Circuit Voltage(Voc): 47.50 V 47.50 V Short Circuit Current(Isc): 18.18 A 20.14 A	Isc(BSI): 22.54 A Fuse Rating: 35 A Maximum System Voltage: 1500 V Power Selection: 0/+5 W Min. Design Load (Pa): ±1600 Module (T98)max(°C): 70	STC: 1000 W/m², AM=1.5, Tc=25°C, BNPI: front 1000 W/m², rear 135 W/m² BSI: front 1000 W/m², rear 300 W/m² Front and rear side of the module. Measurement tolerance: Pmax ±3%, Voc ±3% and Isc ±3%; gPmax=80%, gIsc=80% and gVoc=99% with tolerance ±5% for reference. Connector, see manual for designated connectors Manufacturer: Yingli Energy Development Co., LTD. Type: RHC2	        
	Yingli Energy Development Co., LTD. No.3399, Chaoyang North Road, Baoding, 071051, Hebei, China TEL: +86(312)8922216 FAX: +86(312)8631900 yinglisolar.com Made in China Tested to IEC 61215:2021 and IEC 61730:2023	YL700CF66 f/2 STC BNPI Maximum Power: 700 W 776 W Voltage at Pmax(Vmp): 40.55 V 40.55 V Current at Pmax(Imp): 17.27 A 19.14 A Open Circuit Voltage(Voc): 48.10 V 48.10 V Short Circuit Current(Isc): 18.30 A 20.28 A	Isc(BSI): 22.69 A Fuse Rating: 35 A Maximum System Voltage: 1500 V Power Selection: 0/+5 W Min. Design Load (Pa): ±1600 Module (T98)max(°C): 70	STC: 1000 W/m², AM=1.5, Tc=25°C, BNPI: front 1000 W/m², rear 135 W/m² BSI: front 1000 W/m², rear 300 W/m² Front and rear side of the module. Measurement tolerance: Pmax ±3%, Voc ±3% and Isc ±3%; gPmax=80%, gIsc=80% and gVoc=99% with tolerance ±5% for reference. Connector, see manual for designated connectors Manufacturer: Yingli Energy Development Co., LTD. Type: RHC2	
	Yingli Energy Development Co., LTD. No.3399, Chaoyang North Road, Baoding, 071051, Hebei, China TEL: +86(312)8922216 FAX: +86(312)8631900 yinglisolar.com Made in China Tested to IEC 61215:2021 and IEC 61730:2023	YL715CF66 f/2 STC BNPI Maximum Power: 715 W 792 W Voltage at Pmax(Vmp): 41.00 V 41.00 V Current at Pmax(Imp): 17.44 A 19.32 A Open Circuit Voltage(Voc): 48.70 V 48.70 V Short Circuit Current(Isc): 18.42 A 20.41 A	Isc(BSI): 22.84 A Fuse Rating: 35 A Maximum System Voltage: 1500 V Power Selection: 0/+5 W Min. Design Load (Pa): ±1600 Module (T98)max(°C): 70	STC: 1000 W/m², AM=1.5, Tc=25°C, BNPI: front 1000 W/m², rear 135 W/m² BSI: front 1000 W/m², rear 300 W/m² Front and rear side of the module. Measurement tolerance: Pmax ±3%, Voc ±3% and Isc ±3%; gPmax=80%, gIsc=80% and gVoc=99% with tolerance ±5% for reference. Connector, see manual for designated connectors Manufacturer: Yingli Energy Development Co., LTD. Type: RHC2	

Fig. 4: detail view of type label

FOTO-DOKUMENTATION
PHOTO DOCUMENTATION



Fig. 5: detail view of closed junction box



Fig. 6: detail view of connector



Fig. 7: detail view of cable

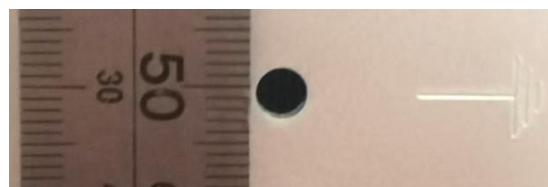


Fig. 8: detail view of equipotential bonding hole and symbol



Fig. 9: detail view of frame corner



Fig. 10: detail view of mechanical load mounting

ANLAGE zum Prüfbericht-Nr.: CN24C6YL 004
APPENDIX to test report no.:

Seite 121 von 128
Page 121 of 128

FOTO-DOKUMENTATION
PHOTO DOCUMENTATION

Module type: YL700CF66 f/2 (under STC) / YL776CF66 f/2 (under BNPI) (BOM 2)



Fig. 11: front view of test sample



Fig. 12: rear view of test sample

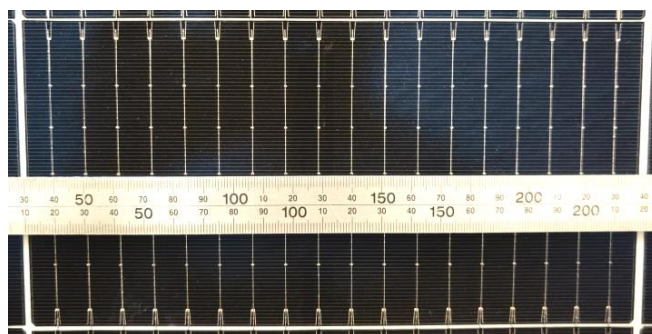


Fig. 13: detail view of solar cell



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Tested to IEC 61215:2021 and IEC 61730:2023

	YL700CF66 f/2	STC	BNPI
Maximum Power:	700 W	776 W	
Voltage at Pmax(Vmp):	40.55 V	40.55 V	
Current at Pmax(Imp):	17.27 A	19.14 A	
Open Circuit Voltage(Voc):	48.10 V	48.10 V	
Short Circuit Current(Isc):	18.30 A	20.28 A	

Isc(BSI):	22.69 A
Fuse Rating:	35 A
Maximum System Voltage:	1500 V
Power Selection:	0/+5 W
Min. Design Load (Pa):	±1600
Module (T98)max(°C):	70

STC: 1000 W/m², AM=1.5, Tc=25°C, BNPI: front 1000 W/m², rear 135 W/m²
BSI: front 1000 W/m², rear 300 W/m²
Front and rear side of the module.
Measurement tolerance: Pmax ±3%, Voc ±3% and Isc ±3%;
φPmax=80%, φIsc=80% and φVoc=99% with tolerance ±5% for reference.
Connector, see manual for designated connectors
Manufacturer: Yingli Energy Development Co., LTD.
Type: RHC2



Fig. 14: detail view of type label

ANLAGE zum Prüfbericht-Nr.: CN24C6YL 004
APPENDIX to test report no.:

Seite 122 von 128
Page 122 of 128

FOTO-DOKUMENTATION
PHOTO DOCUMENTATION



Fig. 15: detail view of closed junction box



Fig. 16: detail view of connector



Fig. 17: detail view of cable

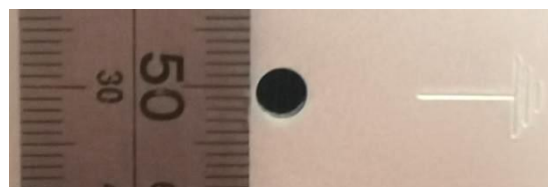


Fig. 18: detail view of equipotential bonding hole and symbol



Fig. 19: detail view of frame corner



Fig.20: detail view of mechanical load mounting

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Module type: YL695CF66 f/2 (under STC) / YL770CF66 f/2 (under BNPI) (BOM 3)



Fig. 21: front view of test sample



Fig. 22: rear view of test sample

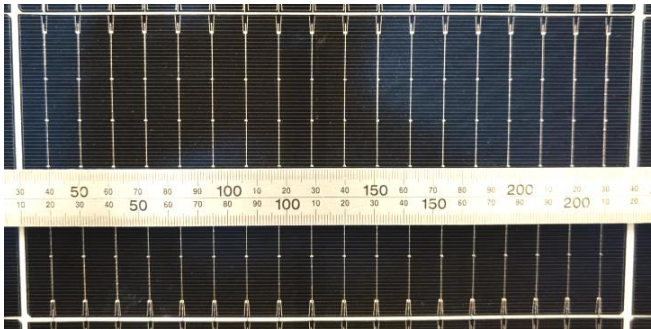


Fig. 23: detail view of solar cell



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 yinglisolar.com Made in China
 Tested to IEC 61215:2021 and IEC 61730:2023

YL695CF66 f/2 STC BNPI
 Maximum Power: 695 W 770 W
 Voltage at Pmax(Vmp): 40.40 V 40.40 V
 Current at Pmax(Imp): 17.21 A 19.07 A
 Open Circuit Voltage(Voc): 47.90 V 47.90 V
 Short Circuit Current(Isc): 18.26 A 20.23 A

Isc(BSI): 22.64 A
 Fuse Rating: 35 A
 Maximum System Voltage: 1500 V
 Power Selection: 0/+5 W
 Min. Design Load (Pa): ±1600
 Module (T98)max(°C): 70

STC: 1000 W/m², AM=1.5, Tc= 25 °C, BNPI:front 1000 W/m², rear 135 W/m²
 BSI: front 1000 W/m², rear 300 W/m²
 Front and rear side of the module.
 Measurement tolerance: Pmax ±3%, Voc±3% and Isc ±3%;
 qPmax=80%, qIsc= 80% and qVoc=99% with tolerance ±5% for reference.
 Connector, see manual for designated connectors
 Manufacturer: Yingli Energy Development Co., LTD.
 Type: RHC2



Fig. 24: detail view of type label

ANLAGE zum Prüfbericht-Nr.: CN24C6YL 004
APPENDIX to test report no.:

Seite 124 von 128
Page 124 of 128

FOTO-DOKUMENTATION
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Fig. 25: detail view of closed junction box



Fig. 26: detail view of connector



Fig. 27: detail view of cable

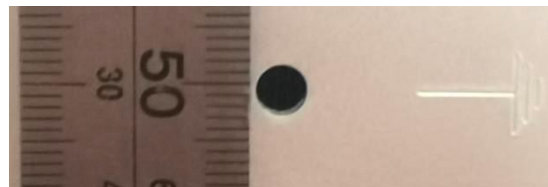


Fig. 28: detail view of equipotential bonding hole and symbol



Fig. 29: detail view of frame corner



Fig.30: detail view of mechanical load mounting

ANLAGE zum Prüfbericht-Nr.: CN24C6YL 004
APPENDIX to test report no.:

Seite 125 von 128
Page 125 of 128

FOTO-DOKUMENTATION
PHOTO DOCUMENTATION

Module type: YL440CF48 i/2 (under STC) / YL488CF48 i/2 (under BNPI) (Higher power end) (BOM 4)



Fig. 31 front view of test sample

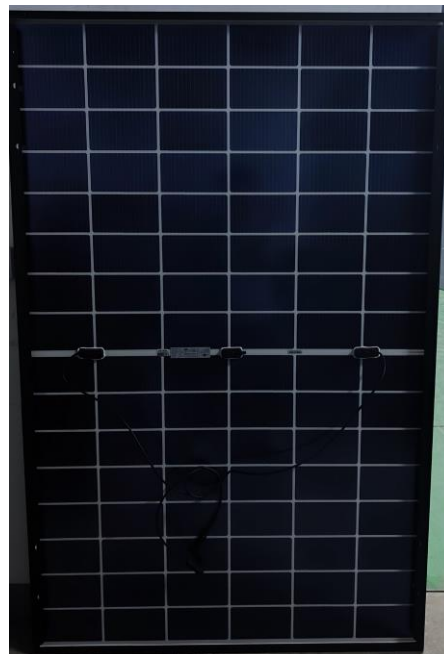


Fig. 32 rear view of test sample

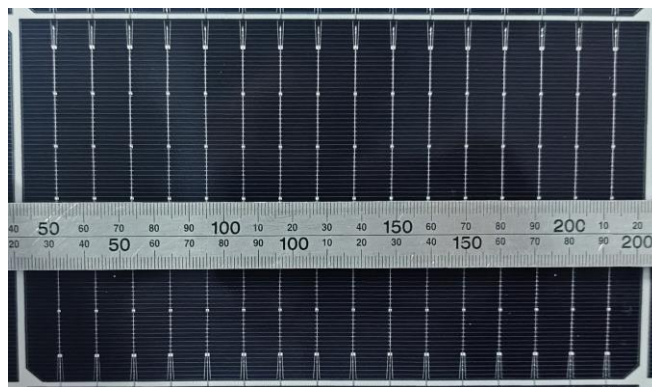


Fig. 33: detail view of solar cell



Made in China

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yinglisolar.com
Tested to IEC 61215:2021 and IEC 61730:2023

	YL440CF48 i/2	STC	BNPI		Isc(BSI): 19.17 A
Maximum Power:	440 W		488 W	Fuse Rating:	30 A
Voltage at Pmax(Vmp):	29.68 V		29.68 V	Maximum System Voltage:	1500 V
Current at Pmax(Imp):	14.83 A		16.43 A	Power Selection:	0/+5 W
Open Circuit Voltage(Voc):	35.84 V		35.84 V	Min. Design Load (Pa):	±1600
Short Circuit Current(Isc):	15.52 A		17.20 A	Module (T98)max(°C):	70

STC: 1000 W/m², AM=1.5, Tc= 25°C, BNPI: front 1000 W/m², rear 135 W/m²
BSI: front 1000 W/m², rear 300 W/m²
Front and rear side of the module.
Measurement tolerance: Pmax ±3%, Voc±3% and Isc ±3%;
φ Pmax=80%, φ Isc= 80% and φ Voc=99% with tolerance ±5% for reference.
Connector, see manual for designated connectors
Manufacturer: Zhejiang Renhe Photovoltaic Technology Co., Ltd.
Type: EVO2



Fig. 34: detail view of type label

ANLAGE zum Prüfbericht-Nr.: CN24C6YL 004
APPENDIX to test report no.:

Seite 126 von 128
Page 126 of 128

FOTO-DOKUMENTATION
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Fig. 35: detail view of closed junction box



Fig. 36: detail view of connector



Fig. 37: detail view of cable



Fig. 38: detail view of equipotential bonding hole and symbol

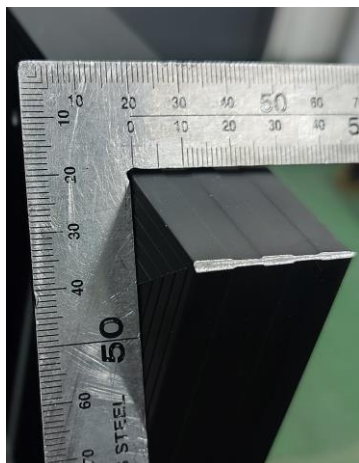


Fig. 39: detail view of frame corner

N/A

N/A

ANLAGE zum Prüfbericht-Nr.: CN24C6YL 004
APPENDIX to test report no.:

Seite 127 von 128
Page 127 of 128

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

Appendix E: Declaration

Declaration

Dear TUV Rheinland team,

Due to our business development, we declared that our manufactory sites of Yingli Energy (YanTai) Co., Ltd. have been removed from our factory list.

Yingli Energy Development Co., LTD.

May 2024

Company seal and legally binding signature



zhigang Lin

ANLAGE zum Prüfbericht-Nr.: CN24C6YL 004
APPENDIX to test report no.:

Seite 128 von 128
Page 128 of 128

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

英利能源发展有限公司 Yingli Energy Development Co., Ltd.
河北省 保定市 高新区 向阳北大街 2599 号
No. 2599, Xiangyang North Street, High Tech Zone,
Baoding City, Hebei +86 0312 8929996



Declaration

Dear TUV Rheinland team,

For Frame type Q523 we declared that the material, specification and design are all the same according to Yingli's requirements for the following frame manufacturer:

CITIC Bohai Aluminium Industries Holding Company Limited

SHANXI YONGSHENG ALUMINUM CO.,LTD

ZhenJiang YaChen New Material Co.,Ltd

Chizhou An'an New Material Technology Co., Ltd

Yingkou Ruida aluminium industry Co.,Ltd

And also for silver frame and black frame, they are just different colors, it's the same everywhere else.

Yingli Energy Development Co., LTD

May, 2024


Company seal and legally binding signature

