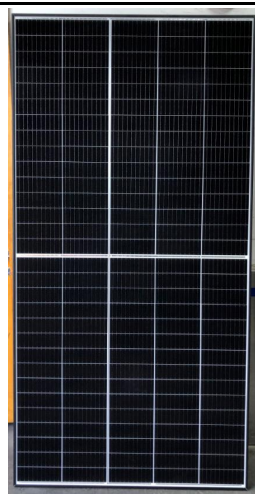




Prüfbericht-Nr.: Test report no.:	CN21CIN1 002	Auftrags-Nr.: Order no.:	244368380, 244373355	Seite 1 von 39 Page 1 of 39	
Kunden-Referenz-Nr.: Client reference no.:	2031058	Auftragsdatum: Order date:	21/10/2021, 10/11/2021		
Auftraggeber: Client:	Trina Solar Co., Ltd. No.2 TianHe Road, Trina PV Industrial Park, New District, Changzhou City, Jiangsu Province 213031, P. R. China				
Prüfgegenstand: Test item:	Photovoltaic (PV) module				
Bezeichnung / Typ-Nr.: Identification / Type no.:	N/A				
Auftrags-Inhalt: Order content:	Design qualification and type approval of photovoltaic (PV) modules				
Prüfgrundlage: Test specification:	Photovoltaic (PV) modules IEC 61215-1:2016; IEC 61215-1-1:2016; IEC 61215-2:2016; IEC 61730-1:2016; IEC 61730-2:2016; EN 61215-1:2016; EN 61215-1-1:2016; EN 61215-2:2017; EN IEC 61730-1:2018; EN IEC 61730-2:2018				
Wareneingangsdatum: Date of sample receipt:	05/11/2021, 10/11/2021				
Prüfmuster-Nr.: Test sample no.:	See clause 6				
Prüfzeitraum: Testing period:	09/11/2021 - 26/11/2021				
Ort der Prüfung: Place of testing:	TÜV Rheinland (Shanghai) Co., Ltd.				
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (Shanghai) Co., Ltd.				
Prüfergebnis*: Test result*:	Pass				
geprüft von: tested by:	 Signed by: Jamie Mao		genehmigt von: authorized by:	 Signed by: Lei C.L. Chen	
Datum: Date:	30/11/2021		Ausstellungsdatum: Issue date:	30/11/2021	
Stellung / Position:	Project Engineer		Stellung / Position:	Reviewer	
Sonstiges / Other:	- 35mm Hail test (MQT 17)				
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:	Prüfmuster vollständig und unbeschädigt Test item complete and undamaged				
* Legende:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	3 = befriedigend F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	4 = ausreichend N/A = nicht anwendbar	5 = mangelhaft N/T = nicht getestet
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good F(ail) = failed a.m. test specification(s)	3 = satisfactory F(ail) = failed a.m. test specification(s)	4 = sufficient N/A = not applicable	5 = poor N/T = not tested
<p>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. This test report only relates to the a. m. 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.</p>					

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Anmerkungen
Remarks

A	<p>Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben. Detaillierte Informationen bezüglich Prüfbedingungen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</p> <p><i>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</i></p>
B	<p>Wie vertraglich vereinbart, wurde dieses Dokument nur digital unterzeichnet. Der TÜV Rheinland hat nicht überprüft, welche rechtlichen oder sonstigen diesbezüglichen Anforderungen für dieses Dokument gelten. Diese Überprüfung liegt in der Verantwortung des Benutzers dieses Dokuments. Auf Verlangen des Kunden kann der TÜV Rheinland die Gültigkeit der digitalen Signatur durch ein gesondertes Dokument bestätigen. Diese Anfrage ist an unseren Vertrieb zu richten. Eine Umweltgebühr für einen solchen zusätzlichen Service wird erhoben.</p> <p><i>As contractually agreed, this document has been signed digitally only. 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.</i></p>
C	<p>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.</p> <p><i>Test clauses with remark of * are sub contracted to qualified subcontractors and described under the respective test clause in the report. Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i></p>

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Produktbeschreibung
Product description

I	General	
1	Product details	
1.1	-	
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):	<input type="checkbox"/> Class 0 <input checked="" type="checkbox"/> Class II <input type="checkbox"/> Class III
2	Used materials	
	See page 6-7	
3	Address(es) of the manufacturing site(s)	
	-	

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Produktbeschreibung
Product description

<p>4</p>	<p>Summary of test results</p> <p>All of the required tests of the standards IEC 61215 / EN 61215 and IEC 61730 / EN 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 61215 and IEC 61730/EN 61730, and it is recommended that certification should be granted.</p>
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5	Test specification		
	IEC 61215-1:2016; EN 61215-1:2016: Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1: Test requirements	applicable	—
	IEC 61215-1-1:2016; EN 61215-1-1:2016: Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1-1: Special requirements for testing of crystalline silicon photovoltaic (PV) modules	applicable	
	IEC 61215-2:2016; EN 61215-2:2017: Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 2: Test procedures	applicable	
	IEC 61730-1:2016; EN IEC 61730-1:2018: Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction	applicable	
	IEC 61730-2:2016; EN IEC 61730-2:2018: Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing	applicable	

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Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Bewertung
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6	List of test samples		
<input type="checkbox"/> The modules tested were taken at random from a production batch and subjected to manufacturer's normal quality control and inspection for safety testing			
<input checked="" type="checkbox"/> The modules tested were prototypes of a new design and not taken from a production batch.			
Module type: TSM-505DE18M.08(II) (BOM 1)			
Sample no.	Sample SN	Test sequence	Remarks / constructional characteristics (e.g. cell, backsheet, frame type)
1-1	A08210900500038	E2	<p>Front Cover: 3.2mm external AR-Coating glass from Trina Solar Co., Ltd. manufactured by Xinyi PV Products (Anhui) Holdings Ltd</p> <p>Rear cover: 0.305mm BEC-303 from Suzhou First PV Material Co., Ltd.</p> <p>Encapsulation material: F406P (between glass and solar cell) / F806P (between solar cell and backsheet) from Hangzhou First Applied Material Co., Ltd.</p> <p>Frame: 6005T6, Corner key type, black, W x H (mm): 30x35, Drawing No. TS-DR-18(35)-070-15, from Trina Solar Co., Ltd. manufactured by Hubei nangui Aluminum Industry Group Co., Ltd</p> <p>Adhesive of frame: HT906Z from Shanghai Huitian New Material Co., Ltd.</p> <p>Solar cell: TSC-D6EB-10BB, Bifacial Mono, 210mmx70mmx0.175mm from Trina Solar Co., Ltd.</p> <p>Cell connector: $\Phi=0.32$mm, Sn60%Pb40%, from Trina Solar Co., Ltd.</p> <p>String connector: 0.25x7.5mm, Sn60%Pb40%, from Trina Solar Co., Ltd.</p> <p>Fluxing agent: ANX-3012 from Wuxi Asahi</p> <p>Fixing tape: 631S#25 from TERAOKA Seisakusho Co., Ltd.</p> <p>Junction box: TS306x from Trina Solar Co., Ltd. manufactured by Suzhou Xtong Photovoltaic Technologies Co., Ltd.</p> <p>Adhesive of J-Box: HT906Z from Shanghai Huitian New Material Co., Ltd.</p> <p>Cable: 62930 IEC 131 1X4,0mm² HALOGEN FREE LOW SMOKE from Trina Solar Co., Ltd.</p> <p>Connector: TS4 from Trina Solar Co., Ltd.</p> <p>Bypass Diode: TM3045-25 from Trina Solar Co., Ltd. manufactured by SUZHOU UKT NEW ENERGY TECHNOLOGY CO., LTD</p> <p>Potting material: 1533 from TONSAN ADHESIVE INC.</p>

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Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Bewertung
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Module type: TSM-410NEG9.20 (BOM 2)			
2-1	A12211000200016	E2	<p>Front cover: 2.0mm external AR-Coating glass from Trina Solar Co., Ltd. manufactured by Xinyi PV Products (Anhui) Holdings Ltd</p> <p>Rear cover: 2.0mm tempered glass from Trina Solar Co., Ltd.</p> <p>Encapsulation material: B601hp (between glass & solar cell)/B601W (between solar cell and backsheet) from Changzhou Betterial Film Technologies Co.,Ltd</p> <p>Frame: 6005T6, Corner key type, thickness=30mm, Drawing No. TS-DR-G9(30)-070-03, from Trina Solar Co., Ltd.</p> <p>Adhesive of frame: HT906Z from Shanghai Huitian New Material Co., Ltd.</p> <p>Solar cell: TSC-D6GB-10BB, N-topcon-bifacial mono, 210mmx70mmx0.175mm (Φ: 295mm) from Trina Solar Co., Ltd.</p> <p>Cell connector: Φ=0.32mm, Sn60%Pb40%, from Trina Solar Co., Ltd.</p> <p>String connector: 0.4x6mm, 0.4x4mm, 0.4x8mm, Sn60%Pb40%, from Trina Solar Co., Ltd.</p> <p>Fluxing agent: ANX-3012 from Wuxi Asahi</p> <p>Fixing tape: 631S#25 from TERAOKA Seisakusho Co., Ltd.</p> <p>Junction box: TS306x from Trina Solar Co., Ltd. manufactured by QC Solar (Suzhou) Corporation</p> <p>Adhesive of J-Box: 1527 from TONSAN ADHESIVE INC.</p> <p>Cable: 62930 IEC 131 1X4,0mm² HALOGEN FREE LOW SMOKE from Trina Solar Co., Ltd.</p> <p>Connector: TS4 from Trina Solar Co., Ltd.</p> <p>Bypass Diode: TM3045-25 from Trina Solar Co., Ltd. from SUZHOU UKT NEW ENERGY TECHNOLOGY CO., LTD</p> <p>Potting material: 1533 from TONSAN ADHESIVE INC.</p>

Supplementary information: N/A

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Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Evaluation

II	IEC/EN 61215 Part 1 – Test requirements
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7	Marking and documentation (5)
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7.1	Name plate (5.1)
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	The module includes the following clear and indelible markings:		
	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 allowing to trace the date and place of manufacture	Traceable from serial number (checked during factory inspection)	P
	e) Maximum system voltage	Marked on type label	P
	f) Class for protection against electrical shock	Marked on type label	P
	g) Voltage at open-circuit or V_{oc} including tolerances	Marked on type label	P
	h) Current at short-circuit or I_{sc} including tolerances	Marked on type label	P
	i) Module maximum power or P_{max} including tolerances	Marked on type label	P
	All electrical data is shown at standard test conditions (1000 W/m ² , 25 °C, AM 1.5 according to IEC TS 61836).	Marked on type label	P

7.2	Documentation (5.2)
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7.2.1	Minimum requirements (5.2.1)
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	Modules are supplied with documentation describing the methods of electrical and mechanical installation as well as the electrical ratings of the module.	Available in installation manual	P
	The documentation states the class for protection against electrical shock under which the module has been qualified and any specific limitations required for that class.	Available in installation manual	P
	The documentation assures that installers and operators receive appropriate and sufficient documentation for safe installation, use and maintenance of the PV modules.	Available in installation manual	P

7.2.2	Information to be given in the documentation (5.2.2)
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	Maximum overcurrent protection rating (compliance is verified by reverse current overload test (MST 26)).	Available in installation manual	P
	Maximum series/parallel module configuration is recommended.	Available in installation manual	P
	Manufacturer's stated tolerance for V_{oc} , I_{sc} and maximum power output under standard test conditions	Marked on type label	P

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Absatz Clause	Photovoltaic (PV) modules Anforderungen - Prüfungen / Requirements - Tests	Messergebnisse - Bemerkungen Measuring results - Remarks	Bewertung Evaluation
	Temperature coefficient for maximum output power	Available in data sheet	P
	Temperature coefficient for voltage at open-circuit	Available in data sheet	P
	Temperature coefficient for short-circuit current	Available in data sheet	P
	All electrical data mentioned above is shown as relative to standard test conditions (1000 W/m ² , 25 °C, AM 1.5 according to IEC TS 61836).	Marked on type label	P
	Nominal module operating temperature (NMOT) is specified.	Available in data sheet	P
	Performance at NMOT (MQT 06.2) is specified.	Available in data sheet	P
	Performance at low irradiance (MQT 07) is specified.	Available in data sheet	P
	The electrical documentation includes a detailed description of the electrical installation wiring method to be used, including:	—	—
	The minimum cable diameters for modules intended for field wiring	Available in installation manual	P
	Any limitations on wiring methods and wire management that apply to the wiring compartment or box	Limitations are documented in installation manual.	P
	The size, type, material and temperature rating of the conductors to be used	Available in installation manual	P
	Type of terminals for field wiring	Junction box is approved according to IEC 62790	P
	Specific PV connector model/types and manufacturer to which the module connectors are mated.	Available in installation manual	P
	The bonding method(s) to be used (if applicable); all provided or specified hardware is identified in the documentation.	Available in installation manual	P
	The type and ratings of bypass diode to be used (if applicable)	Junction box is approved according to IEC 62790	P
	Limitations to the mounting situation (e.g., slope, orientation, mounting means, cooling)	No limitations indicated.	N/A
	A statement indicating the fire rating(s) and the applied standard as well as the limitations to that rating (e.g., installation slope, sub structure or other applicable installation information)	Available in installation manual	P
	A statement indicating the design load per each mechanical means for securing the module as evaluated during the static mechanical load test according to MQT 16. At discretion of the manufacturer the test load and/or the safety factor γ_m may be noted, too.	Available in installation manual	P

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Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Bewertung
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Evaluation
	The installation instructions include relevant parameters specified by manufacturer or the following statement or the equivalent: <i>"Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of Isc and Voc marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor current ratings, and size of controls connected to the PV output."</i>	Available in installation manual	P
7.2.3	Assembly instructions (5.2.3)		
	These 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
Supplementary information: N/A			

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Absatz Clause	Photovoltaic (PV) modules Anforderungen - Prüfungen / Requirements - Tests	Messergebnisse - Bemerkungen Measuring results - Remarks	Bewertung Evaluation
8	Pass criteria (7)		
8.1	Output power and electric circuitry (7.2)		
8.1.1	Verification of rated label values (Gate #1) (7.2.1)		
	After stabilization, each individual module shall meet: $P_{\max}(\text{Lab}) \cdot \left(1 + \frac{ m_1 [\%]}{100}\right) \geq P_{\max}(\text{NP}) \cdot \left(1 - \frac{ t_1 [\%]}{100}\right)$ $\bar{P}_{\max}(\text{Lab}) \cdot \left(1 + \frac{ m_1 [\%]}{100}\right) \geq P_{\max}(\text{NP})$	—	N/A
	After stabilization, each individual module shall meet: $V_{\text{OC}}(\text{Lab}) \cdot \left(1 + \frac{ m_2 [\%]}{100}\right) \leq V_{\text{OC}}(\text{NP}) \cdot \left(1 + \frac{ t_2 [\%]}{100}\right)$	—	N/A
	After stabilization, each individual module shall meet: $I_{\text{SC}}(\text{Lab}) \cdot \left(1 + \frac{ m_3 [\%]}{100}\right) \leq I_{\text{SC}}(\text{NP}) \cdot \left(1 + \frac{ t_3 [\%]}{100}\right)$	—	N/A
	m_1 = measurement uncertainty of laboratory for P_{\max} m_2 = measurement uncertainty of laboratory for V_{OC} m_3 = the 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} NP = name plate	—	—
8.1.2	Maximum power degradation during type approval testing (Gate #2) (7.2.2)		
	At the end of each test sequence, each test sample shall meet: $P_{\max}(\text{Lab_Gate \#2}) \geq 0.95 \times P_{\max}(\text{Lab_Gate \#1}) \cdot \left(1 - \frac{r[\%]}{100}\right)$	—	—
	r = reproducibility		—

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Absatz Clause	Photovoltaic (PV) modules Anforderungen - Prüfungen / Requirements - Tests	Messergebnisse - Bemerkungen Measuring results - Remarks	Bewertung Evaluation
8.1.3	Electrical circuitry (7.2.3)		
	Samples are not permitted to exhibit an open-circuit during the tests.	No open-circuit during tests	P
8.2	Visual defects (7.3)		
	There is no visual evidence of a major defect.	No major visual defect	P
8.3	Electrical safety (7.4)		
	The insulation test (MQT 03) requirements are met after the tests.	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			

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Test Report No.:			
Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Bewertung
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Evaluation

III	IEC/EN 61215 Part 2 – Test procedures Module type: TSM-505DE18M.08(II) (BOM 1) Module type: TSM-410NEG9.20 (BOM 2)
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9	Overview of tests and test results		
Test	Remarks	Result	
Visual inspection (MQT 01)	See table 9.1	P	
Maximum power determination (MQT 02)	N/A	N/A	
Insulation test (MQT 03)	See table 9.5	P	
Measurement of temperature coefficients (MQT 04)	N/A	N/A	
Measurement of nominal module operating temperature (NMOT) (MQT 05)	N/A	N/A	
Performance at STC (MQT 06.1)	See table 9.3	P	
Performance at NMOT (MQT 06.2)	N/A	N/A	
Performance at low irradiance (MQT 07)	N/A	N/A	
Outdoor exposure test (MQT 08)	N/A	N/A	
Hot-spot endurance test (MQT 09)	N/A	N/A	
UV preconditioning test (MQT 10)	N/A	N/A	
Thermal cycling test (50 cycles) (MQT 11)	N/A	N/A	
Thermal cycling test (200 cycles) (MQT 11)	N/A	N/A	
Humidity-freeze test (MQT 12)	N/A	N/A	
Damp heat test (MQT 13)	N/A	N/A	
Retention of junction box on mounting surface (MQT 14.1)	N/A	N/A	
Test of cord anchorage (MQT 14.2)	Junction box is approved according to IEC 62790	P	
Wet leakage current test (MQT 15)	See table 9.6	P	
Static mechanical load test (MQT 16)	N/A	N/A	
Hail test (MQT 17)	See table 9.22	P	
Bypass diode thermal test (MQT 18.1)	N/A	N/A	
Bypass diode functionality test (MQT 18.2)	N/A	N/A	
Initial stabilization (MQT 19.1)	N/A	N/A	
Final stabilization (MQT 19.2)	N/A	N/A	
Supplementary information: N/A			

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Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Bewertung
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9.1	Visual inspection (initial) – MQT 01		
Sample no.	Requirement	Nature and position of initial findings	—
1-1	No major visual defects	No major visual defects	P
2-1	No major visual defects	No major visual defects	P
Supplementary information: N/A			

9.3	Performance at STC (initial) – MQT 06.1						
Test method	<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight						—
Ambient temperature [°C]	25 ± 2						
Irradiance [W/m²]	1000*						
Module temperature [°C]	25 ± 0.2						
Spectral mismatch	N/A						
Sample no.	P _{max} [W]	V _{mpp} [V]	I _{mpp} [A]	V _{oc} [V]	I _{sc} [A]	FF [%]	—
1-1	508.3	43.31	11.736	52.04	12.262	79.6	—
2-1	416.3	35.95	11.581	42.50	12.114	80.9	—
Supplementary information: *A pulse solar simulator class AAA conforming to the requirements of IEC 60904-9 is used.							

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Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Bewertung
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9.5	Insulation test (initial) – MQT 03					
Maximum system voltage [V _{DC}]			1500			—
High voltage applied [V _{DC}]			4000/8000			
Insulation resistance measured at [V _{DC}]			1500			
Sample no.	R _{iso} [GΩ]	A [m ²]	R _{iso} ·A [GΩ·m ²]	Dielectric breakdown		
				Yes (description)	No	
1-1	5.00	2.41	12.05	-	No	P
2-1	5.00	1.82	9.10	-	No	P
Supplementary information: Minimum requirement is 0.04 GΩ·m ² for A > 0.1 m ² and 0.4 GΩ for A ≤ 0.1 m ² . The resistance tester can measure up to 5.00 GΩ.						

9.6	Wet leakage current test (initial) – MQT 15				
Insulation resistance measured at [V _{DC}]		1500			—
Solution resistivity [Ω·cm]		≤ 3500			
Solution temperature [°C]		22 ± 2			
Sample no.	R _{iso} [MΩ]	A [m ²]	R _{iso} ·A [MΩ·m ²]		
1-1	3198.0	2.41	7707.2		P
2-1	5000.0	1.82	9100.0		P
Supplementary information: Minimum requirement is 40 MΩ·m ² . The resistance tester can measure up to 5000.0 MΩ.					

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

9.22	Hail test – MQT 17		
Ice ball diameter [mm]	35		—
Ice ball mass [g]	20.7 ± 2 %		
Ice ball velocity [m/s]	27.2 ± 5 %		
Number of impact locations	11		
Sample no.	—		P
1-1	—		
2-1	—		
Supplementary information: N/A			

9.22.1	Visual inspection after Hail test – MQT 01		
Sample no.	Requirement	Nature and position of findings	—
1-1	No major visual defects	No major visual defects	P
2-1	No major visual defects	No major visual defects	P
Supplementary information: N/A			

9.24	Performance at STC (final) – MQT 06.1						
Test method	<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight						
Ambient temperature [°C]	25 ± 2						
Irradiance [W/m²]	1000*						
Module temperature [°C]	25 ± 0.2						
Spectral mismatch	N/A						
Sample no.	P _{max} [W]	V _{mpp} [V]	I _{mpp} [A]	V _{oc} [V]	I _{sc} [A]	FF [%]	Degradation [%]
1-1	508.7	43.53	11.687	52.12	12.261	79.6	0.08
2-1	414.1	35.48	11.669	42.62	12.124	80.1	-0.53
Supplementary information: Negative degradation means power loss. *A pulse solar simulator class AAA conforming to the requirements of IEC 60904-9 is used.							

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9.26	Insulation test (final) – MQT 03					
Maximum system voltage [V _{DC}]				1500		—
High voltage applied [V _{DC}]				4000/8000		
Insulation resistance measured at [V _{DC}]				1500		
Sample no.	R _{iso} [GΩ]	A [m ²]	R _{iso} ·A [GΩ·m ²]	Dielectric breakdown		P
				Yes (description)	No	
1-1	5.00	2.41	12.05	-	No	
2-1	5.00	1.82	9.10	-	No	P
Supplementary information: Minimum requirement is 0.04 GΩ·m ² for A > 0.1 m ² and 0.4 GΩ for A ≤ 0.1 m ² . The resistance tester can measure up to 5.00 GΩ.						

9.27	Wet leakage current test (final) – MQT 15					
Insulation resistance measured at [V _{DC}]				1500		—
Solution resistivity [Ω/cm]				≤ 3500		
Solution temperature [°C]				22 ± 2		
Sample no.	R _{iso}	A	R _{iso} ·A	—		P
	[MΩ]	[m ²]	[MΩ·m ²]			
1-1	4545.0	2.41	10953.5			
2-1	3269.0	1.82	5949.6			P
Supplementary information: Minimum requirement is 40 MΩ·m ² .						

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IV	IEC/EN 61730 Part 1 – Requirements for construction		
10	Classification, applications and intended use		
10.1	General (4.1)		
	Product details	See 1	N/A
	Classification, applications and intended use	See 1.3	N/A
11	Requirements for design and construction (5)		
11.1	General (5.1)		
	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	<input checked="" type="checkbox"/> completely assembled <input type="checkbox"/> 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	P
11.2	Marking and documentation (5.2)		
	Instructions related to safety are in an official language of the country where the equipment is to be installed.	Marking and documentation are written in English.	P
11.2.1	Marking (5.2.2)		
11.2.1.1	General (5.2.2.1)		
	Each PV module includes the following clear and indelible markings:	Compliance checked by tests MST 01 and MST 05	N/A
	a) Name, registered trade name, or registered trade mark of manufacturer	See section 7.1	P
	b) Type or model number designation	See section 7.1	P
	c) Serial number	See section 7.1	P
	d) Date and place of manufacture; alternatively serial number assuring traceability of date and place of manufacture	See section 7.1	P
	e) Polarity of terminals or leads	“+” and “-” indicated on terminal	P

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	f) Maximum system voltage or "V _{sys} "	See section 7.1	P
	g) Class of protection against electrical shock, in accordance with Clause 4 of IEC/EN 61730-1	See section 7.1	P
	h) Voltage at open-circuit or "V _{oc} " including manufacturing tolerances	See section 7.1	P
	i) Current at short-circuit or "I _{sc} " including manufacturing tolerances	See section 7.1	P
	j) Maximum power or "P _{max} " including manufacturing tolerances	See section 7.1	P
	k) Maximum overcurrent protection rating	Maximum series fuse rating indicated	P
	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).	See section 7.1	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.	Connector fulfill the requirements of IEC 62852. Symbol or warning notice indicated on connector.	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.	<input checked="" type="checkbox"/> class II:  <input type="checkbox"/> class III:  <input type="checkbox"/> 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
11.2.1.2	Symbols (5.2.2.2)		
11.2.1.2.1	Equipotential bonding (5.2.2.2.1)		
	A wiring terminal or bonding location for equipotential bonding is identified with:		P
	No other terminal or location is identified in this manner.	Mounting hole may not be used for bonding.	P
11.2.1.2.2	Functional earthing (5.2.2.2.2)		
	Field installed functional earthing conductor is identified with the symbol:	No functional earthing.	N/A

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11.2.2	Documentation (5.2.3)		
	Documentation concerning electrical and mechanical installation is provided.	See section 7.2.1	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.	See section 7.2.1	P
	Environmental conditions to which the module has been qualified are stated.		N/A
	- concerning temperature range, typically -40 °C to +40 °C.	See section 7.2.1	P
	- concerning wind/snow load including safety factor.	See section 7.2.1	P
	The documentation contains the following information:		N/A
	- Name, registered trade name, or registered trade mark of manufacturer	Available in data sheet	P
	- Type or model number designation	Available in data sheet	P
	- Maximum system voltage or " V_{sys} "	Available in data sheet	P
	- Class for protection against electrical shock, in accordance with Clause 4 of IEC/EN 61730	Available in data sheet	P
	- Voltage at open-circuit or " V_{oc} " including manufacturing tolerances	Available in data sheet	P
	- Current at short-circuit or " I_{sc} " including manufacturing tolerances	Available in data sheet	P
	- Maximum power or " P_{max} " including manufacturing tolerances	Available in data sheet	P
	- Maximum overcurrent protection rating (compliance verified by reverse current overload test (MST 26))	Available in data sheet	P
	- Recommended maximum series / parallel PV module configurations	Available in installation manual	P
	- Temperature coefficient for maximum output power	Available in data sheet	P
	- Temperature coefficient for voltage at open-circuit	Available in data sheet	P
	- Temperature coefficient for short-circuit current	Available in data sheet	P
	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	P
	Detailed wiring method for electrical installation is included in the documentation, containing	—	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

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	- 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 (if applicable)	Junction boxes fulfill the requirements of IEC 62790	P
	The documentation includes		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)	<input checked="" type="checkbox"/> fire rating(s) and applied standards <input type="checkbox"/> 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
	- 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 not be directed onto the front or back face of the PV module (if not qualified for).	Available in installation manual	P
	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_{sc} and V_{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
11.3	Electrical components and insulation (5.3)		

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11.3.1	Internal wiring (5.3.2)		
	Internal wiring has sufficient current carrying capacity for the relevant application.	Verified by MST 14 and MST 26 Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	P
11.3.2	External wiring (5.3.3)		
	External wires and cables fulfil the requirements of IEC 62930 and/or EN 50618.	<input type="checkbox"/> EN 50618 <input checked="" type="checkbox"/> IEC 62930	P
11.3.3	Connectors (5.3.4)		
	External DC connectors fulfil the requirements of IEC 62852.	<input checked="" type="checkbox"/> IEC 62852	P
11.3.4	Junction boxes for PV modules (5.3.5)		
	Junction boxes for PV modules fulfil the requirements of IEC 62790.	<input checked="" type="checkbox"/> IEC 62790	P
11.3.5	Frontsheets and backsheets (5.3.6)		
	Frontsheet:		N/A
	Material of frontsheet:	<input checked="" type="checkbox"/> Glass <input type="checkbox"/> Polymeric material <input type="checkbox"/> Others	N/A
	Polymeric frontsheets meet relevant requirements of section 5.5.2.	Not applicable for glass frontsheet	N/A
	Polymeric frontsheets used as relied upon insulation fulfil requirements of		N/A
	- 5.6.4.3 for insulation in thin layers	Not applicable for glass frontsheet	N/A
	- 5.5.2.3 for electrical insulation	Not applicable for glass frontsheet	N/A
	Thermal index frontsheet (see also 5.5.2.3.3):	Not applicable for glass frontsheet	N/A
	Adhesion to encapsulant or glass is appropriate.	Compliance checked by IEC/EN 61730-2 tests listed in this report.	P
	Backsheet:		N/A
	Material of backsheet:	<input type="checkbox"/> Glass <input checked="" type="checkbox"/> Polymeric material <input type="checkbox"/> Others	N/A
	Polymeric backsheets meet relevant requirements of section 5.5.2.	See 11.5.1	P
	Polymeric backsheets used as relied upon insulation fulfil requirements of		N/A
	- 5.6.4.3 for insulation in thin layers	See 11.6.4.3	P
	- 5.5.2.3 for electrical insulation	See 11.5.1.3	P
	Thermal index backsheet (see also 5.5.2.3.3):	<input checked="" type="checkbox"/> TI <input type="checkbox"/> RTE <input type="checkbox"/> RTI	P

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	Adhesion to encapsulant or glass is appropriate.	Compliance checked by IEC/EN 61730-2 tests listed in this report.	P
11.3.6	Insulation barriers (5.3.7)		
	Polymeric insulation barrier meets the relevant requirements of 5.5.2.	See 11.5.1 Part of IEC 62790 qualification	P
	Barrier is held in place while keeping its required electrical and mechanical properties.	Compliance checked by IEC/EN 61730-2 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
11.3.7	Electrical connections (5.3.8)		
11.3.7.1	General (5.3.8.1)		
	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	P
	End of a stranded conductor is not consolidated by soft soldering.	Part of IEC 62790 qualification.	P
	Precautions are taken to prevent contact stress which might impair electrical conductivity.	Part of IEC 62790 qualification.	P
11.3.7.2	Terminals for external cables and PV connector ribbons (5.3.8.2)		
	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.	☒ IEC 62790	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 qualification.	P
11.3.7.3	Splices and connections inside a PV module (5.3.8.3)		
	Splices and connections inside a PV module are mechanically secured.	Part of IEC 62790 qualification.	P
	Electrical connections are soldered, welded, conductively adhered, crimped, or otherwise securely connected.	Compliance checked by IEC/EN 61730-2 tests listed in this report.	P
	A soldered or conductively adhered joint is additionally mechanically secured.	Part of IEC 62790 qualification.	P
11.3.8	Encapsulant (5.3.9)		
	Thermal properties are sufficient for intended application.	Compliance checked by IEC/EN 61730-2 tests listed in this report.	P

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	The insulation properties according to 5.5.2.3 are met, if applicable.	Compliance checked by IEC/EN 61730-2 tests listed in this report.	P
11.3.9	Bypass diodes (5.3.10)		
	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 Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details. Datasheet values for bypass diode checked.	P
11.4	Mechanical and electromechanical connections (5.4)		
11.4.1	General (5.4.1)		
	Type of connection:	<input checked="" type="checkbox"/> Connection within frame <input type="checkbox"/> Mounting interfaces via adhesive <input checked="" type="checkbox"/> Frame to clamp a mounting system <input checked="" type="checkbox"/> Equipotential bonding <input checked="" type="checkbox"/> Attachment of junction box <input type="checkbox"/> 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 Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	P
	Parts intended to be removed are only detachable with the aid of tools.	Tools are necessary for removal.	P
	Lids attached without screws have one or several detectable facilities for enabling tools.	Compliance checked by the corresponding component standards.	P
	A tool does not come into contact with the live parts when the lid is removed with it.	Compliance checked by IEC 62790 tests.	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
11.4.2	Screw connections (5.4.2)		
	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

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	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
11.4.3	Rivets (5.4.3)		
	Rivets which serve as electrical as well as mechanical connections are locked against loosening.	No rivet is used.	N/A
11.4.4	Thread-cutting screws (5.4.4)		
	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
11.4.5	Form / press / tight fit (5.4.5)		
	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. Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	P
11.4.6	Connections by adhesives (5.4.6)		
	Connections by adhesive for mounting means are sufficient.	Compliance checked by MST 34, MST 13, MST 32 for mounting adhesives. Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	P

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	Fixing of junction box by adhesive is sufficient.	Compliance checked by MST 42, MST 17 for junction box adhesives. Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	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. Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	P
	Requirements for adhesive materials are met.	See 11.5.2.2	P
	Connection by adhesive which is considered as cemented joint fulfills the requirements of 5.6.4.2.	No cemented joints	N/A
11.4.7	Other connections (5.4.7)		
	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. Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	P
	Other connections which are relied upon for equipotential bonding fulfil the requirements of MST 13.	Compliance checked by MST 01 and MST 13. Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	P
11.5	Materials (5.5)		
11.5.1	Polymeric materials (5.5.2)		
11.5.1.1	General (5.5.2.1)		
	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

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	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. Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	P
	Polymeric material used as a part of a cemented joint fulfills additionally the requirements of 5.6.4.2.	See 11.6.4.2 No cemented joints	N/A
11.5.1.2	Endurance to weathering stress (5.5.2.2)		
	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
11.5.1.3	Polymeric materials used as electrical insulation (5.5.2.3)		
11.5.1.3.1	General (5.5.2.3.1)		
	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. Compliance checked by MST 04. Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	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).	See MST 21 Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	P
11.5.1.3.2	Endurance to electrical stress (5.5.2.3.2)		
	Materials used as electrical insulation are in compliance with the insulation coordination requirements.	See 11.6.3	P
11.5.1.3.3	Endurance to thermal stress (5.5.2.3.3)		
	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.	<input checked="" type="checkbox"/> TI <input type="checkbox"/> RTE <input type="checkbox"/> RTI Compliance is checked with temperature test (MST 21). Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	P
11.5.1.3.4	Polymeric insulating materials used as external parts (5.5.2.3.4)		
	External polymeric parts of the PV module whose deterioration could impair the safety meet the following additional requirements:	—	N/A
	- Flammability class minimum V-1 according to IEC 60695-11-10	Part of IEC 62790 qualification.	P

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	- Ball pressure test according to IEC 60695-10-2 with a temperature of 75°C (not applicable to insulation in thin layers)	Part of IEC 62790 qualification.	P
	- Ignitability test (MST 24) in final application (laminated or the PV module)	See section 12.10	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
11.5.1.3.5 Polymeric insulating parts supporting live parts (5.5.2.3.5)			
	External parts of insulating material supporting live parts including connections, and parts of polymeric material providing supplementary insulation or reinforced insulation, are sufficiently resistant to heat.	Part of IEC 62790 qualification.	P
	Other than elastomeric polymeric materials meet the following requirements:		N/A
	- Flammability class minimum HB	Part of IEC 62790 qualification.	P
	- Ball pressure test with a temperature of 125°C	Part of IEC 62790 qualification.	P
	- Material creep test (MST 37)	N/A	N/A
11.5.1.3.6 Polymeric materials used for mechanical functions (5.5.2.4)			
	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.	<input type="checkbox"/> TI <input type="checkbox"/> RTE <input checked="" type="checkbox"/> RTI Compliance is checked with Temperature test (MST 21). Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	P
11.5.2 Metallic materials (5.5.3)			
11.5.2.1 General (5.5.3.1)			
	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
11.5.2.2 Current carrying parts (5.5.3.2)			
	Assessed parts:	—	N/A
	Current-carrying parts have sufficient mechanical strength and electrical conductivity.	Compliance checked by IEC/EN 61730-2 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

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Absatz Clause	Photovoltaic (PV) modules Anforderungen - Prüfungen / Requirements - Tests	Messergebnisse - Bemerkungen Measuring results - Remarks	Bewertung Evaluation
	Coated metal is not used if the current-carrying parts are stressed by abrasion.	N/A	N/A
11.5.2.3	Adhesives (5.5.4)		
	Adhesives are appropriate for the application.	Compliance is checked by relevant tests of IEC 61730-2, including MST 42, MST 34, MST 01, MST 11 and MST 17. Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	P
	Adhesives as part of the relied upon electrical insulation meet the requirements of 5.5.2.3.3.	See section 11.5.1.3.3	P
11.6	Protection against electric shock (5.6)		
11.6.1	General (5.6.1)		
	Adequate protection against contact with hazardous live parts is provided and poses no risk of electric shock.	See section 11.6.2 – 11.6.4	P
11.6.2	Protection against accessibility to hazardous live parts (5.6.2)		
11.6.2.1	General (5.6.2.1)		
	Class of module	See safety ratings	N/A
	For Class 0 and Class II modules, adequate protection against accessibility to hazardous live parts (> 35 V DC) is provided.	Compliance is checked by MST 01 and MST 11. Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	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 of 5.6.2.3	N/A
	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 of 5.6.2.3	N/A
	For Class II PV modules, live parts of different potential of the same circuit are separated by at least basic insulation.	Table 2 of 5.6.2.3	N/A
	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 of 5.6.2.3	N/A
	In Class III PV modules live parts of different polarity are separated by at least functional insulation.	Table 2 of 5.6.2.3	N/A
	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 5.5.2 due to their application.	See 11.5.1	N/A
11.6.2.2	Protection by means of enclosures and insulation barriers (5.6.2.2)		

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	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
	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
11.6.2.3	Protection by means of insulation of live parts (5.6.2.3)		
	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 5.6.2.3 (11.6.2.1).	Compliance verified by evaluation of materials and components.	P
11.6.3	Insulation coordination (5.6.3)		
	Components comply with the requirements for their relevant standards (5.6.3.1).	Compliance verified by evaluation of materials and components.	P
	Pollution degree (5.6.3.2):	See tables in 11.7	N/A
	Material group (5.6.3.3):	See tables in 11.7	N/A
	Clearance and creepage distance (5.6.3.4):	See tables in 11.7	N/A
	Derating factor for altitude above 2000 m is considered.	N/A	N/A
11.6.4	Distance through insulation (5.6.4)		
11.6.4.1	General (5.6.4.1)		
	Polymeric materials for cemented insulation parts and insulation in thin layers withstand environmental, thermal, electrical and mechanical stresses as far as they occur.	See 11.5	N/A
	Distances through insulation (dti) of solid insulation comply with the minimum distance as required:	—	N/A
	System voltage	See safety ratings	N/A
	Distances through insulation (dti)	—	N/A

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	The insulation fulfils the material classification as given in IEC 60216-1, IEC 60216-2 and IEC 60216-5 (RTE/TI/RTI).	See 11.3.5	P
11.6.4.2	Cemented joints (5.6.4.2)		
	Cemented joints were considered as	<input type="checkbox"/> Edge seal <input type="checkbox"/> Interface between junction box and mounting surface <input type="checkbox"/> Others <input checked="" type="checkbox"/> No cemented joints	N/A
	Distances along cemented joints comply with the minimum distances as required in table 3:	—	N/A
	System voltage	No cemented joints	N/A
	Distance along cemented joints, req./meas. [mm]:	No cemented joints	N/A
	A distance can be considered as cemented joint if following requirements are met:	No cemented joints	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
11.6.4.3	Insulation in thin layers (5.6.4.3)		
	Relied upon insulation in thin layers is applied at	<input checked="" type="checkbox"/> Backsheet <input type="checkbox"/> Frontsheet <input type="checkbox"/> Insulation within laminate <input type="checkbox"/> Others <input type="checkbox"/> N/A	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.	Backsheet fulfill the requirements of 2 PfG 1793/11.2017 / IEC TS 62788-2:2017.	P
	Construction of insulation in thin layers complies with requirements concerning RTE/TI/RTI.	Backsheet fulfill the requirements of 2 PfG 1793/11.2017 / IEC TS 62788-2:2017.	P
	Insulation in thin layers provides sufficient dielectric strength:	—	N/A

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Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Bewertung
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Evaluation
	Test voltage for single-layer sheet and for entire multi-layer sheet providing relied upon insulation (2000V + 4 times system voltage):	Backsheet fulfill the requirements of 2 PfG 1793/11.2017 / IEC TS 62788-2:2017.	P
	Single-layer sheet as well as entire multi-layer sheet in final application comply with following:	—	N/A
	Dielectric strength for basic insulation is provided after Cut susceptibility test (MST 12). Test voltage [V]: (1000V + 2 times system voltage)	See table 12.28.2 Refer to report No. 50087483 001 to 061 and 50119949 001 to 021 for more details.	P

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

V	IEC/EN 61730 Part 2 – Requirements for testing <u>Module type: TSM-505DE18M.08(II) (BOM 1)</u> <u>Module type: TSM-410NEG9.20 (BOM 2)</u>
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12	Overview of tests and test results
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Test	Remarks	Result
Visual inspection (MST 01)	N/A	N/A
Performance at STC (MST 02)	N/A	N/A
Maximum power determination (MST 03)	N/A	N/A
Insulation thickness test (MST 04)	N/A	N/A
Durability of markings (MST 05)	N/A	N/A
Sharp edge test (MST 06)	N/A	N/A
Bypass diode functionality test (MST 07)	N/A	N/A
Accessibility test (MST 11)	N/A	N/A
Cut susceptibility test (MST 12)	N/A	N/A
Continuity test for equipotential bonding (MST 13)	N/A	N/A
Impulse voltage test (MST 14)	N/A	N/A
Insulation test (MST 16)	N/A	N/A
Wet leakage current test (MST 17)	N/A	N/A
Temperature test (MST 21)	N/A	N/A
Hot-spot endurance test (MST 22)	N/A	N/A
Fire test (MST 23)	N/A	N/A
Ignitability test (MST 24)	N/A	N/A
Bypass diode thermal test (MST 25)	N/A	N/A
Reverse current overload test (MST 26)	N/A	N/A
Module breakage test (MST 32)	N/A	N/A
Screw connections test (MST 33)	No screw connections	N/A
Static mechanical load test (MST 34)	N/A	N/A
Peel test (MST 35)	No cemented joints	N/A
Lap shear strength test (MST 36)	No cemented joints	N/A
Materials creep test (MST 37)	N/A	N/A
Robustness of terminations test (MST 42)	N/A	N/A
Thermal cycling (TC50) (MST 51a)	N/A	N/A
Thermal cycling test (TC200) (MST 51b)	N/A	N/A
Humidity-freeze test (MST 52a)	N/A	N/A
Humidity-freeze test (MST 52b)	N/A	N/A

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Absatz	Photovoltaic (PV) modules	Messergebnisse - Bemerkungen	Bewertung
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Evaluation
	Damp heat test (1000h) (MST 53a)	N/A	N/A
	Damp heat test (200h) (MST 53b)	N/A	N/A
	UV test (15 kWh/m ²) (MST 54a)	N/A	N/A
	UV test (60 kWh/m ²) (MST 54b)	N/A	N/A
	Cold conditioning (MST 55)	N/A	N/A
	Dry heat conditioning (MST 56)	N/A	N/A
Supplementary information: N/A			

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FOTO-DOKUMENTATION
 PHOTO DOCUMENTATION

Appendix A: Photos

Module type: TSM-505DE18M.08(II) (BOM 1)

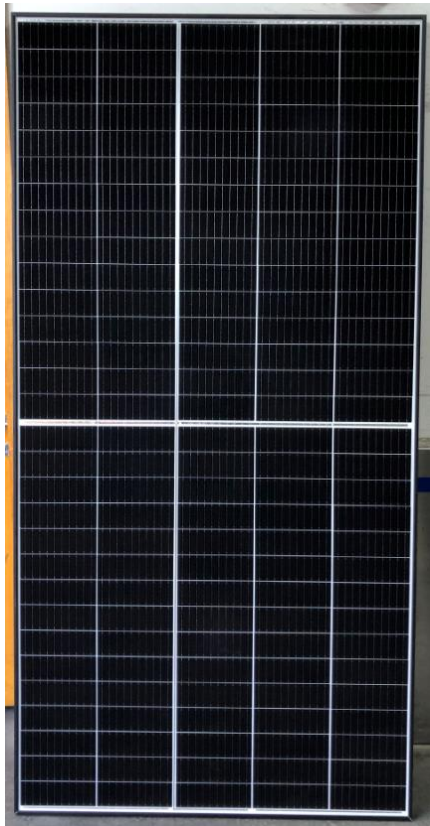


Fig. 1: front view of test sample



Fig. 2: rear view of test sample

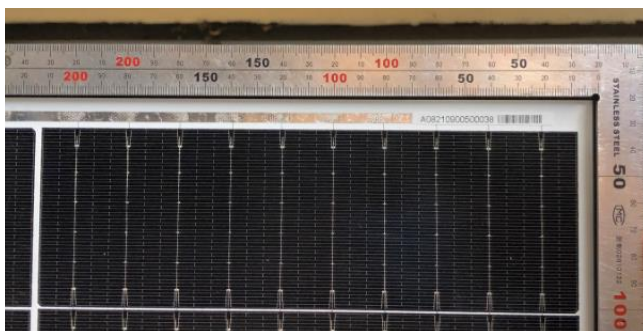


Fig. 3: detail view of solar cell



Fig. 4: detail view of type label

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Fig. 5: detail view of closed junction box



Fig. 6: detail view of connector



Fig. 7: detail view of cable

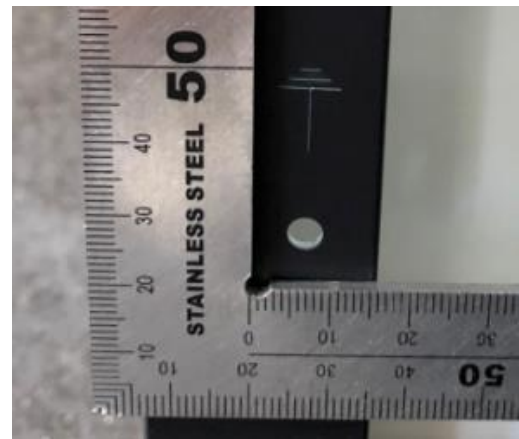


Fig. 8: detail view of equipotential bonding hole and symbol

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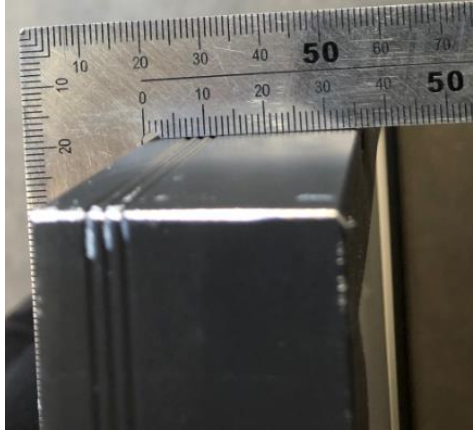


Fig. 9: detail view of frame corner

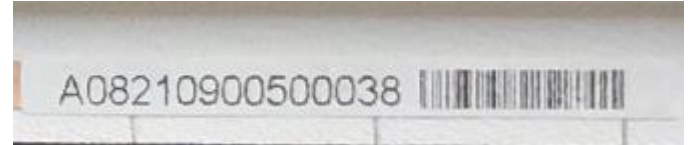


Fig. 10: detail view of serial number label

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FOTO-DOKUMENTATION
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Module type: TSM-410NEG9.20 (BOM 2)

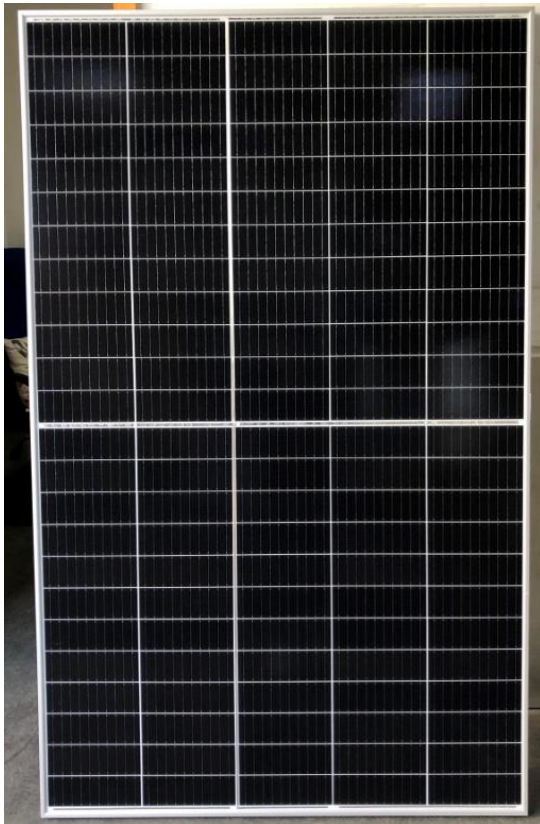


Fig. 11: front view of test sample



Fig. 12: rear view of test sample

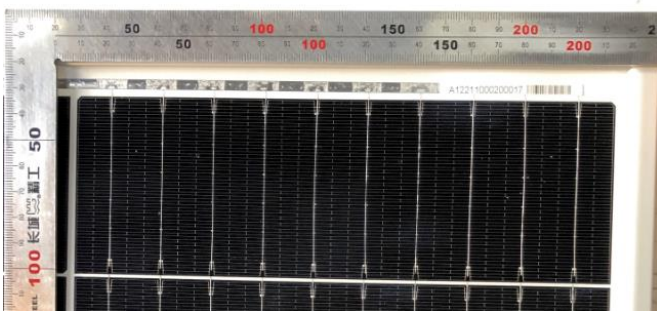


Fig. 13: detail view of solar cell



Fig. 14: detail view of type label

FOTO-DOKUMENTATION
PHOTO DOCUMENTATION



Fig. 15: detail view of closed junction box



Fig. 16: detail view of connector



Fig. 17: detail view of cable

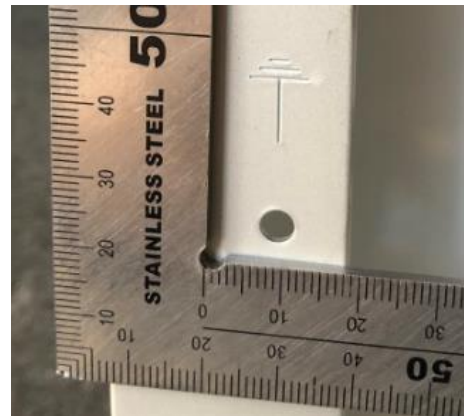


Fig. 18: detail view of equipotential bonding hole and symbol

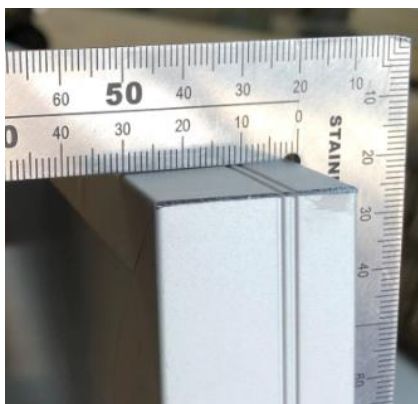


Fig. 19: detail view of frame corner



Fig. 20: detail view of serial number label