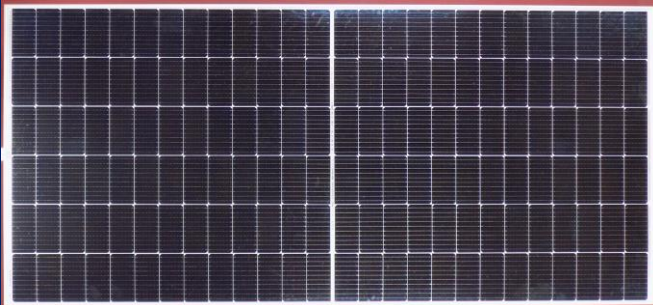




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Kunden-Referenz-Nr.: Client reference no.:	1433811	Auftragsdatum: Order date:	29-05-2023	
Auftraggeber: Client:	Swelect Energy Systems Limited. "SWELECT HOUSE" No.5 Sir P.S Sivasamy Salai, Mylapore, Chennai -600 004. India			
Prüfgegenstand: Test item:	Photovoltaic (PV) modules			
Bezeichnung / Typ-Nr.: Identification / Type no.:	SWM11BN8595			
Auftrags-Inhalt: Order content:	Testing against PID resistivity			
Prüfgrundlage: Test specification:	Solar Photovoltaic Modules IEC TS 62804-1:2015, IS17210(Part 1):2019 - Test methods for the detection of potential-induced degradation – Part 1: Crystalline silicon with following severities - Climatic conditions: 85°C and 85% RH - Duration: 96 hours			
Wareneingangsdatum: Date of sample receipt:	01-06-2023			
Prüfmuster-Nr.: Test sample no.:	Refer list of test samples			
Prüfzeitraum: Testing period:	01-06-2023 – 19-06-2023			
Ort der Prüfung: Place of testing:	#27/B, 2nd Cross Road, Electronics City Phase-1, 560100, Bengaluru, India			
Prüflaboratorium: Testing laboratory:	TUV Rheinland(India) Pvt. Ltd.,			
Prüfergebnis*: Test result*:	Pass			
geprüft von: tested by: Manoj Kulal		genehmigt von: authorized by: K. Ganesh Kamath		
Datum: Issue date: 26-12-2023		Ausstellungsdatum: Issue date: 26-12-2023		
Stellung / Position:	Engineer-Products(S&C)	Stellung / Position:	Sr.Manager-Products(S&C)	
Sonstiges / Other:	None			
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 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.</i>				

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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. <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>
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 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. <i>The decision rule for statements of conformity in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report</i>

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Produktbeschreibung
Product description

1	Produktdetails <i>Product details</i> <u>with Mono Half cut 91 x182mm(M10) cells:</u> SWM11BN8xxx(with xxx = 595-585 in step of 1 with 156 cells) xxx represents output power in Wp
2	Verwendete Materialien <i>Used materials</i> Refer constructional characteristics in the "List of test samples"
3	Adresse(n) der Fertigungsstätte(n) <i>Address(es) of the manufacturing site(s)</i> 1. Swelect HHV Solar Photovoltaics Private Limited.No. 169, 166, Sembagoundan Pudur, Kuppeplayam Village, Coimbatore North Taluk, Coimbatore District Tamil Nadu-641107
4	Zusammenfassung der Prüfergebnisse <i>Summary of test results</i> "According to the enquiry of the manufacturer for a testing against PID resistivity shall be performed according to IEC TS 62804 with following severities – - Negative potential of the specified maximum system voltage between the shorted output terminals and the frame(ground), - 1500V DC - Climatic conditions: 85°C and 85% RH - Duration: 96 hours Before and after the PID test, Visual inspection, maximum power determination, Ground continuity and documentation by electroluminescence imaging shall be performed. In line with the international standard for PV module type approval testing EN IEC 61215, two modules will be tested. Pass Criteria: A module design shall be judged to have passed the PID test , if each test sample meets all the following criteria: • The degradation of maximum output power does not exceed 5%. • No evidence of a major visual defect (as defined in IEC 61215:2021) All presented results are only valid for the exact tested module type and design (cell type, encapsulation material, glass type)

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—	Test specification		
Photovoltaic (PV) modules – Test methods for the detection of potential-induced degradation - Part 1: Crystalline silicon		IEC TS 62804-1:2015-08, Edition 1.0	—

—	Marking		
Name, monogram or symbol of manufacturer		On Type label and on module front	P
Type or model number		On Type label	P
Serial number		On laminate from front side	P
Polarity of terminals or leads		On JB and cable	P
Maximum system voltage		On Type label	P
Date and place of manufacture		Date and Manufacturing address mentioned on type label	P

-	List of test samples		
Sample No.	Sample S/N	Type/Model	Remarks/constructional characteristics (e.g. cell, back sheet, frame type)
A003485904-016	SW11823A10518	SWM11BN8595	Cell: 10bb, Mono crystalline Bifacial cell by United Renewable Energy Co., Ltd Back Cover: Cynagard 205A® by Cybrid Technologies EVA: F406PS-Front, F806PS -Back by Hangzhou First Applied Material Co., Ltd Front cover: AR Coated Solar Glass by Dongguan CSG Solar Glass Co., Ltd JB: Type: DSJB12y(y=b) by DhaSh PV Technologies Private Ltd. Frame: Jiangyin Optimal Metal Technology Co., Ltd
A003485904-017	SW11823A10513	SWM11BN8595	
A003485904-001	SW11923A12464	SWM11BN8595	

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Absatz <i>Clause</i>	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	Messergebnisse – Bemerkungen/ <i>Measuring results - Remarks</i>	Ergebnis <i>Result</i>

10.1	Visual inspection (Initial)		
Test date (DD/MM/YYYY)		01/06/2023	
Sample No.		Nature and position of initial findings	—
A003485904-001		No Major visual defects found	P
A003485904-016		No Major visual defects found	P
A003485904-017		No Major visual defects found	P
Supplementary information: - None			

10.2	Maximum power determination (Initial)						
Test date (DD/MM/YYYY)			07/06/2023				—
Module temperature [°C]			Corrected to 25				
Irradiance [W/m²]			1000				
Sample No.	P _{max} [W]	V _{mpp} [V]	I _{mpp} [A]	V _{oc} [V]	I _{sc} [A]	FF [%]	
A003485904-001	593.4	45.72	12.98	54.47	13.56	80.3	P
A003485904-016	592.1	45.67	12.97	54.39	13.55	80.4	P
A003485904-017	592.4	45.76	12.95	54.41	13.53	80.5	P
Supplementary information: - None							

10.3	Insulation test (Initial)					
Test date (DD/MM/YYYY)				07/06/2023		—
Maximum system voltage [V _{DC}]				1500		
High voltage applied [V _{DC}]				8000		
Insulation resistance measured at [V _{DC}]				1500		
Sample No.	Measured	Area	Result*	Dielectric breakdown		
	[GΩ]	[m²]	[GΩ × m²]	Yes (description)	No	
A003485904-001	41.2	2.81	115.77	--	No	P
A003485904-016	36.7	2.81	103.13	--	No	P
A003485904-017	40.7	2.81	114.37	--	No	P
* Minimum requirement acc. to the standard is 0.04 GΩ × m²						
Supplementary information: - None						

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10.15	Wet leakage current test (Initial)			
Test date (DD/MM/YYYY)		07/06/2023		—
Insulation resistance measured at [V _{DC}]		1500		
Solution resistivity [Ω cm]		≤ 3500		P
Solution temperature [°C]		22 ± 2		P
Sample No.	Measured	Area	Result*	—
	[MΩ]	[m²]	[MΩ × m²]	
A003485904-001	8700.00	2.81	24447.00	P
A003485904-016	3000.00	2.81	8430.00	P
A003485904-017	7500.00	2.81	21075.00	P
* Minimum requirement acc. to the standard is 40 MΩ × m²				
Supplementary information: - None				

10.4	Ground continuity test (Initial)			
Test date (DD/MM/YYYY)		07/06/2023		—
Maximum over-current protection rating [A]		25		
Current applied [A]		62.5		
Location of designated grounding point		Right side Longer frame		
Location of second contacting point		Opposite frame		
Sample No.		Voltage [mV]	Resistance [mΩ]	
A003485904-001		198.90	3.18	P
A003485904-016		230.50	3.69	P
A003485904-017		241.80	3.87	P
Supplementary information: - None				

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Absatz <i>Clause</i>	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	Messergebnisse – Bemerkungen/ <i>Measuring results - Remarks</i>	Ergebnis <i>Result</i>

	Performance of PID Test				
Test Method		Chamber		—	
Module Temperature [°C]		85			
Relative Humidity [%]		85			
Grounding polarity		+ve			
Test date [DD/MM/YYYY]	Sample No.		Applied Voltage [V]	Duration[Hrs]	
14/06/2023 to 19/06/2023	A003485904-016		-1500	96	P
	A003485904-017		-1500	96	P
Supplementary information: - None					

10.1	Visual inspection after PID Cycle		
Test date (DD/MM/YYYY)		19/06/2023	
Sample No.		Nature and position of initial findings	—
A003485904-016		No Major visual defects found	P
A003485904-017		No Major visual defects found	P
Supplementary information: - None			

10.2	Maximum power determination after PID Cycle							
Test date (DD/MM/YYYY)		19/06/2023						—
Module temperature [°C]		Corrected to 25						
Irradiance [W/m²]		1000						
Sample No.	P _{max} [W]	V _{mpp} [V]	I _{mpp} [A]	V _{oc} [V]	I _{sc} [A]	FF [%]	Degradation [%]	
A003485904-016	586.75	45.50	12.90	54.29	13.51	80.02	-0.91	P
A003485904-017	587.31	45.58	12.88	54.30	13.51	80.07	-0.86	P
A003485904-001	593.40	45.72	12.98	54.47	13.56	80.32	Control	—
Supplementary information: - None								

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10.3	Insulation test after PID Cycle					
Test date (DD/MM/YYYY)				19/06/2023		—
Maximum system voltage [V _{DC}]				1500		
High voltage applied [V _{DC}]				8000		
Insulation resistance measured at [V _{DC}]				1500		
Sample No.	Measured	Area	Result*	Dielectric breakdown		
	[GΩ]	[m²]	[GΩ × m²]	Yes (description)	No	
A003485904-016	34.6	2.81	97.23	--	No	P
A003485904-017	40.1	2.81	112.68	--	No	P
* Minimum requirement acc. to the standard is 0.04 GΩ × m²						
Supplementary information: - None						

10.15	Wet leakage current test after PID Cycle			
Test date (DD/MM/YYYY)		19/06/2023		—
Insulation resistance measured at [V _{DC}]		1500		
Solution resistivity [Ω cm]		≤ 3500		P
Solution temperature [°C]		22 ± 2		P
Sample No.	Measured	Area	Result*	—
	[MΩ]	[m²]	[MΩ × m²]	
A003485904-016	2400.00	2.81	6744.00	P
A003485904-017	6800.00	2.81	19108.00	P
* Minimum requirement acc. to the standard is 40 MΩ × m²				
Supplementary information: - None				

Result:

1. The degradation of maximum output power does not exceed 5%
2. There is no evidence of a major local degradation in electroluminescence inspection.

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Annexure 1: Abbreviations used in the report

STC	Standard Test Conditions
P_{max}	Maximum power
I_{mp}	Maximum power point current
V_{mp}	Maximum power point voltage
I_{sc}	Short circuit current
V_{oc}	Open circuit voltage
FF	Fill factor
PID	Potentially induced degradation

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Annexure 2: Constructional Data Form for Photovoltaic Modules:

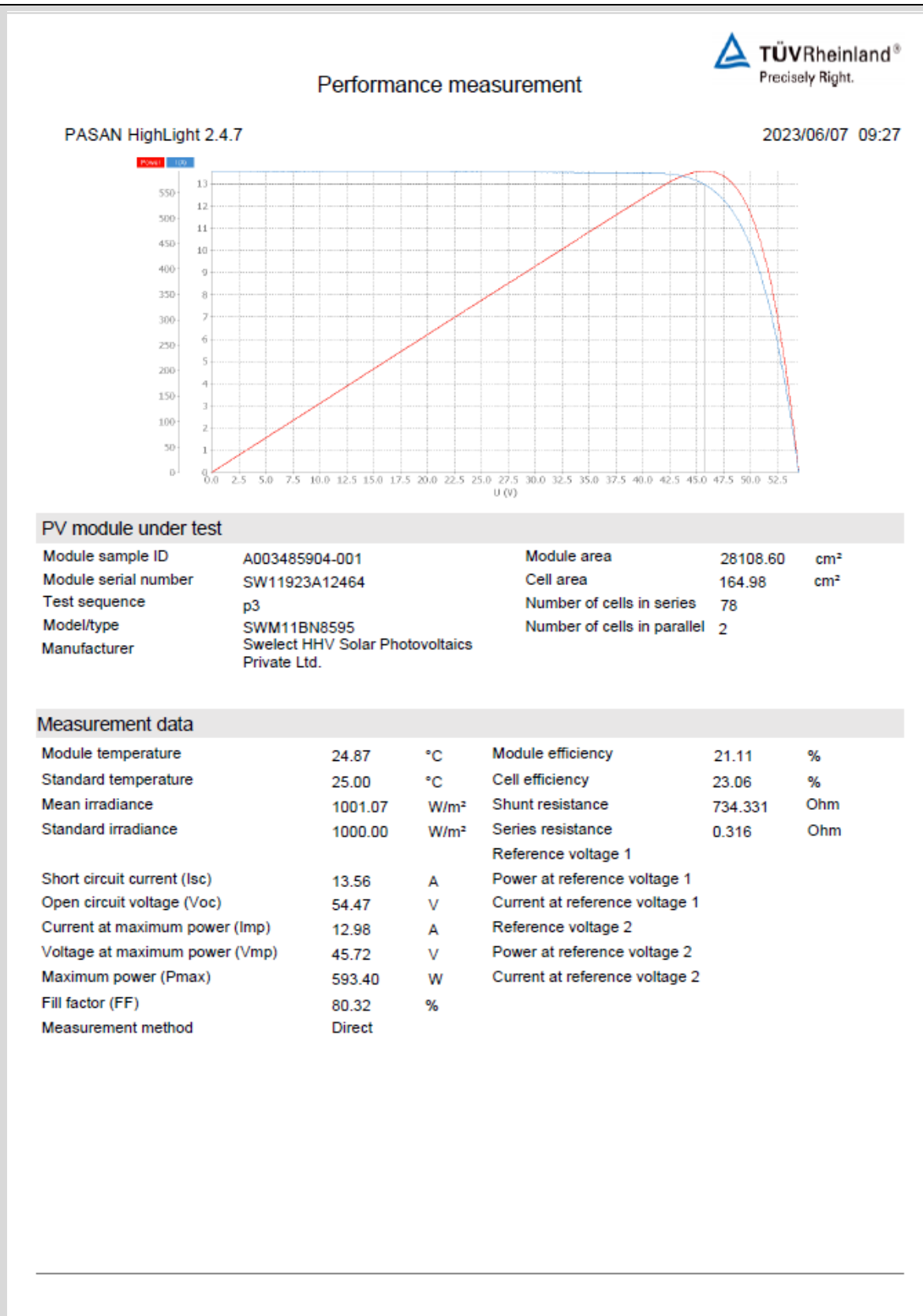
Module type: SWM11BN8595			
Object	Manufacturer /trademark	Type / model	Technical data / ratings
Front cover	Dongguan CSG Solar Glass Co., Ltd	AR Coated Solar Glass	3.2mm
Rear cover	Cybrid Technologies	Cynagard 205A®	Total thickness= 320µm
EVA	Hangzhou First PV Material Co., Ltd	F406PS (Front Side), F806PS (Back Side)	Thickness [mm]: 0.55mm±5%
Solar Cell	United Renewable Energy Co., Ltd	10bb, Mono crystalline Bifacial cell	Mono crystalline Bifacial – 182 x 91mm,
Junction box	DhaSh PV Technologies Private Ltd	DSJB12y	Max. voltage [V]: 1500 Max. current [A]: 25
Bypass diode	Taizhou Chuangda Electronic Co., Ltd	MK5045	Tj [°C]: 200
Cable	DhaSh PV Technologies Private Ltd	62930 IEC 131 1 x4mm ²	Max. voltage [V]: 1500 RTI [°C]: 120
Connector	DhaSh PV Technologies Private Ltd	DS01	Max. voltage [V]:1500 Max. current [A]: 40

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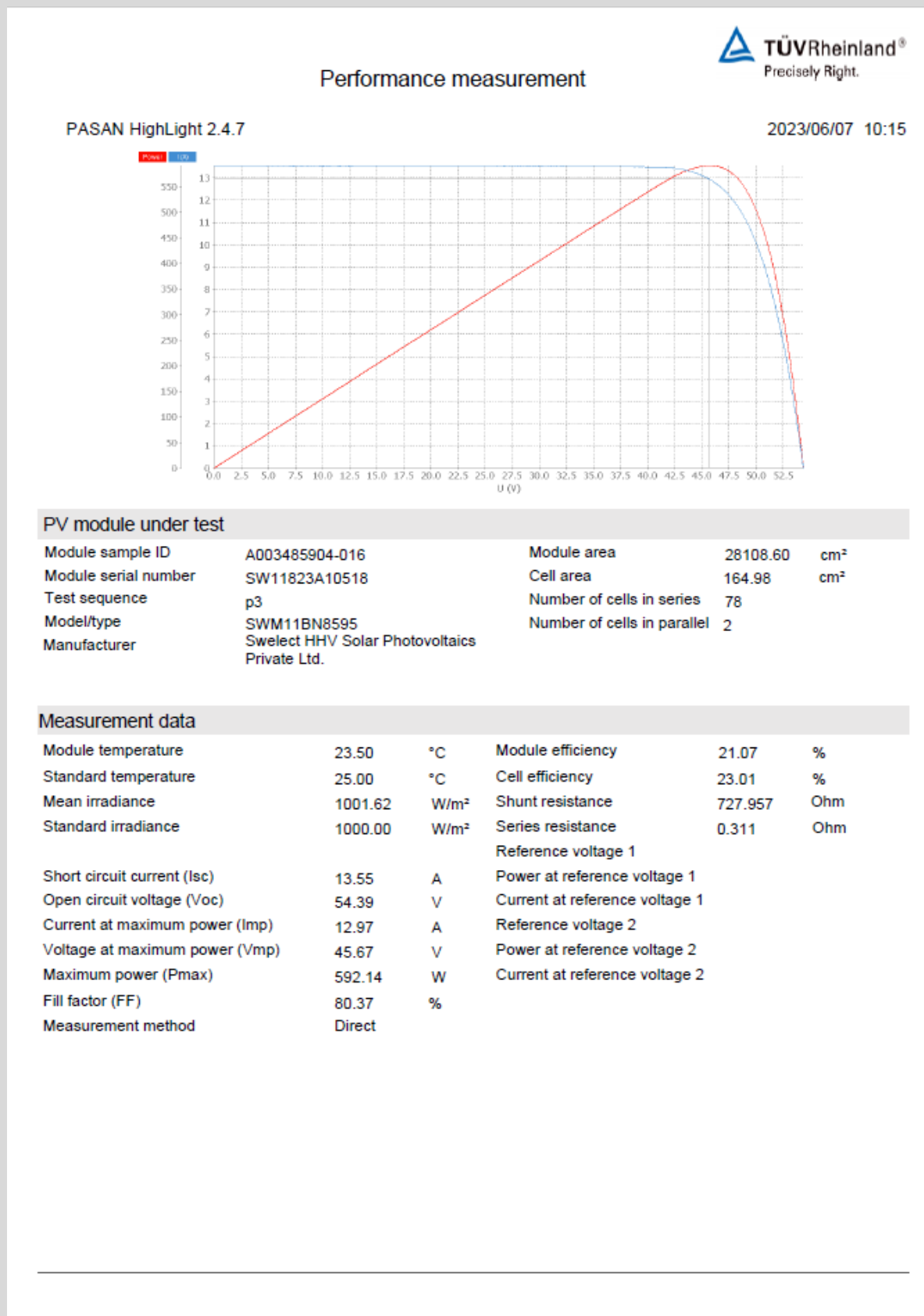
Annexure 3: Measurement reports: Initial



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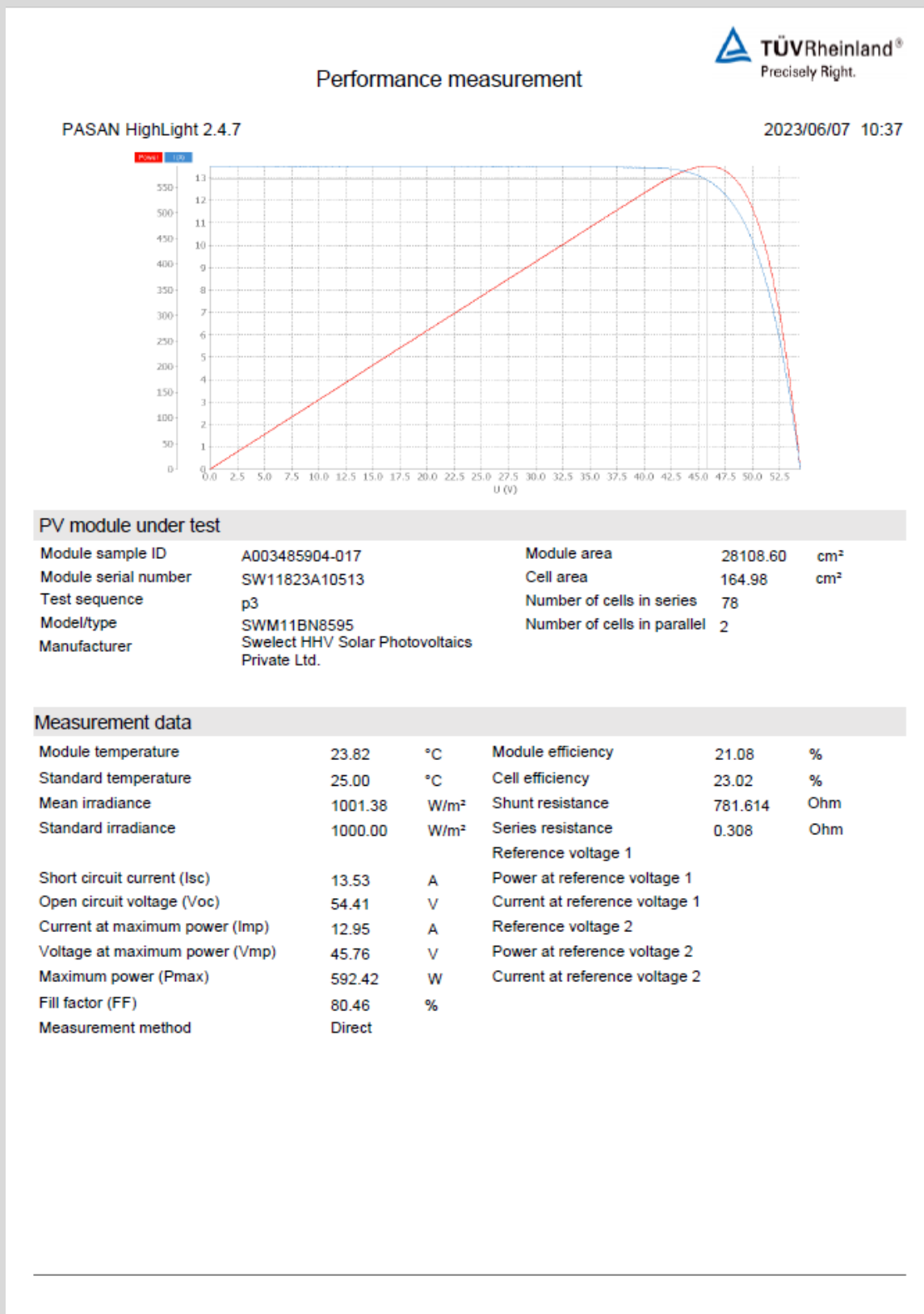
ZUSATZ-DOKUMENTATION ADDITIONAL DOCUMENTATION



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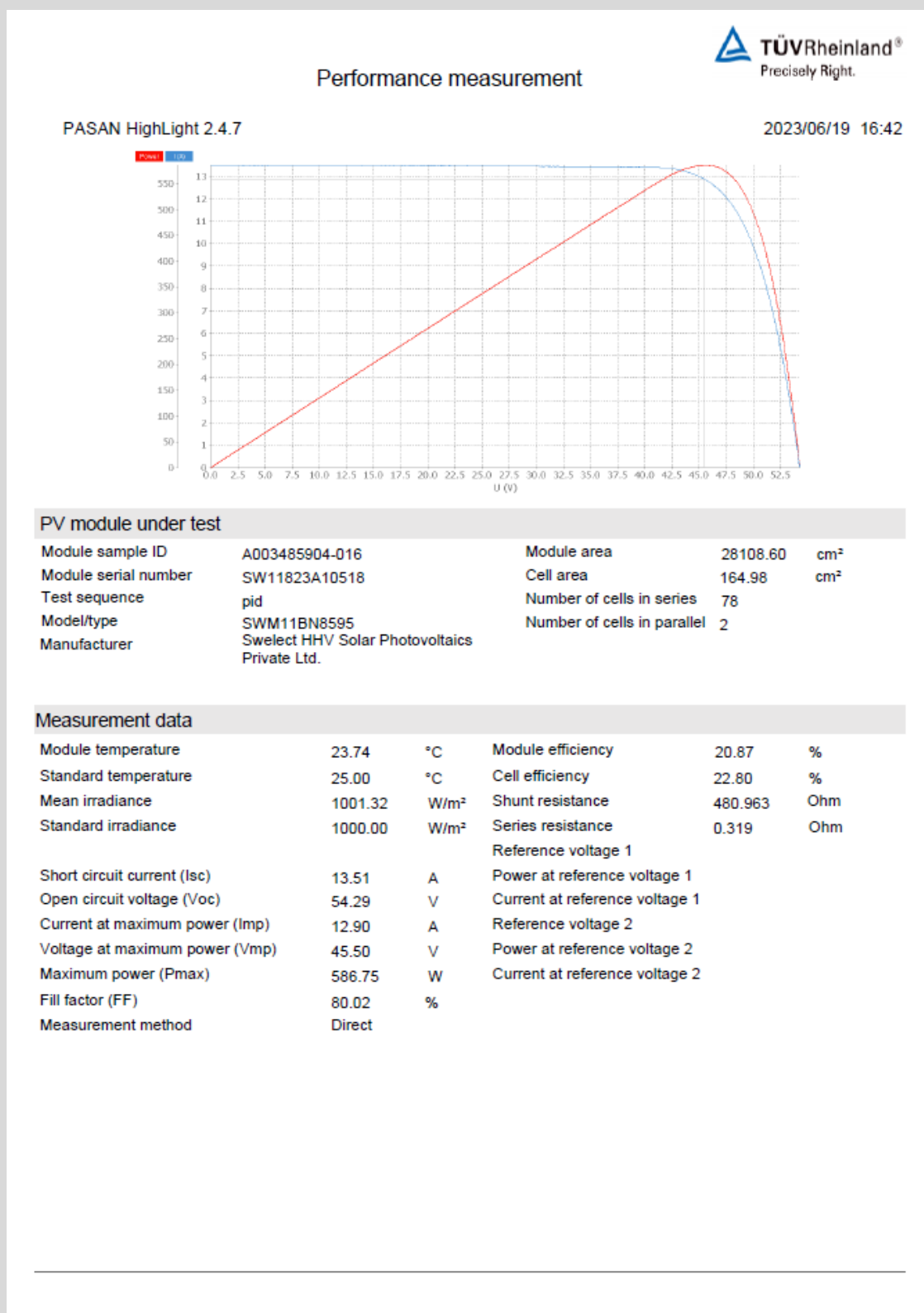


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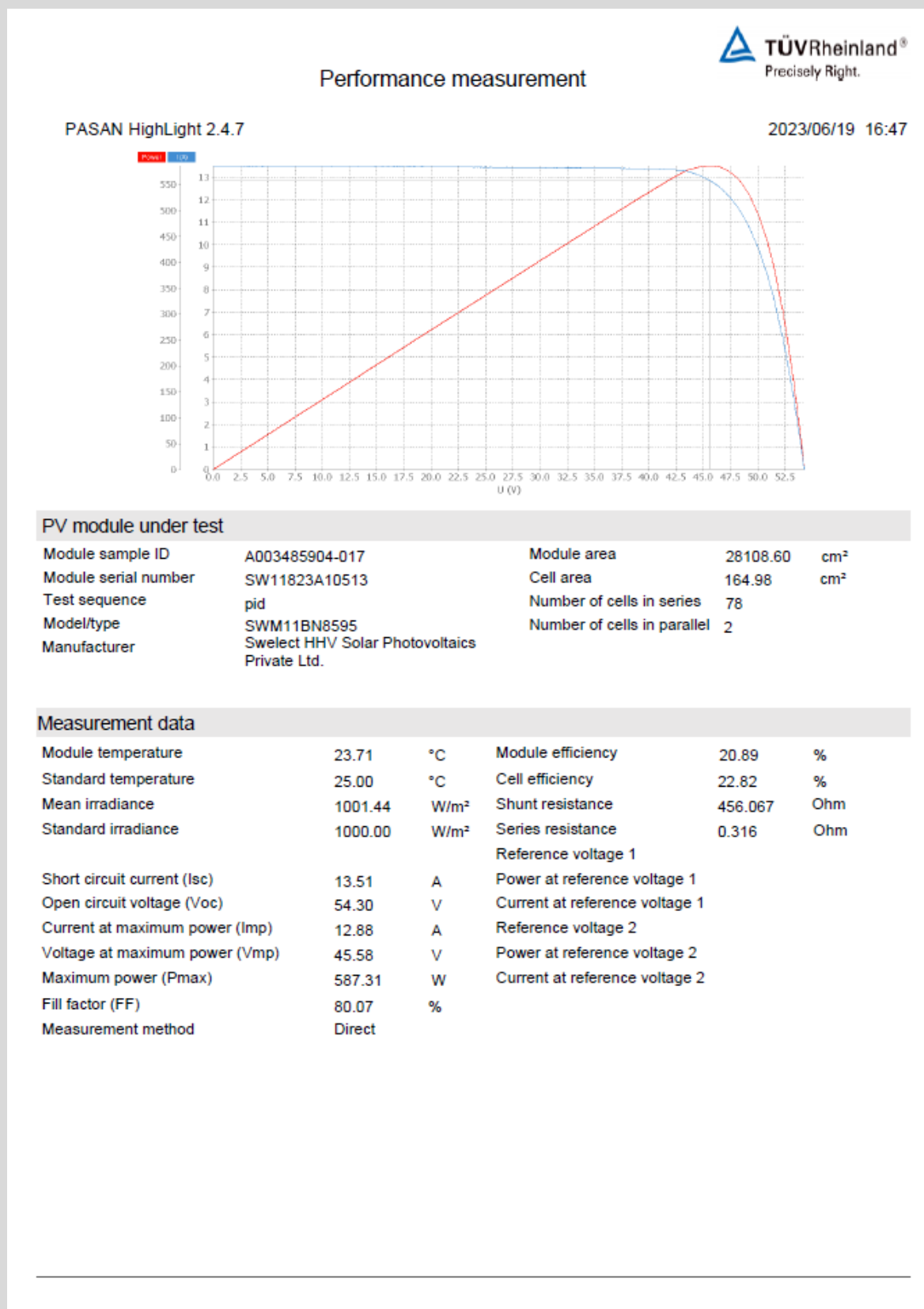
Measurement Reports after PID:



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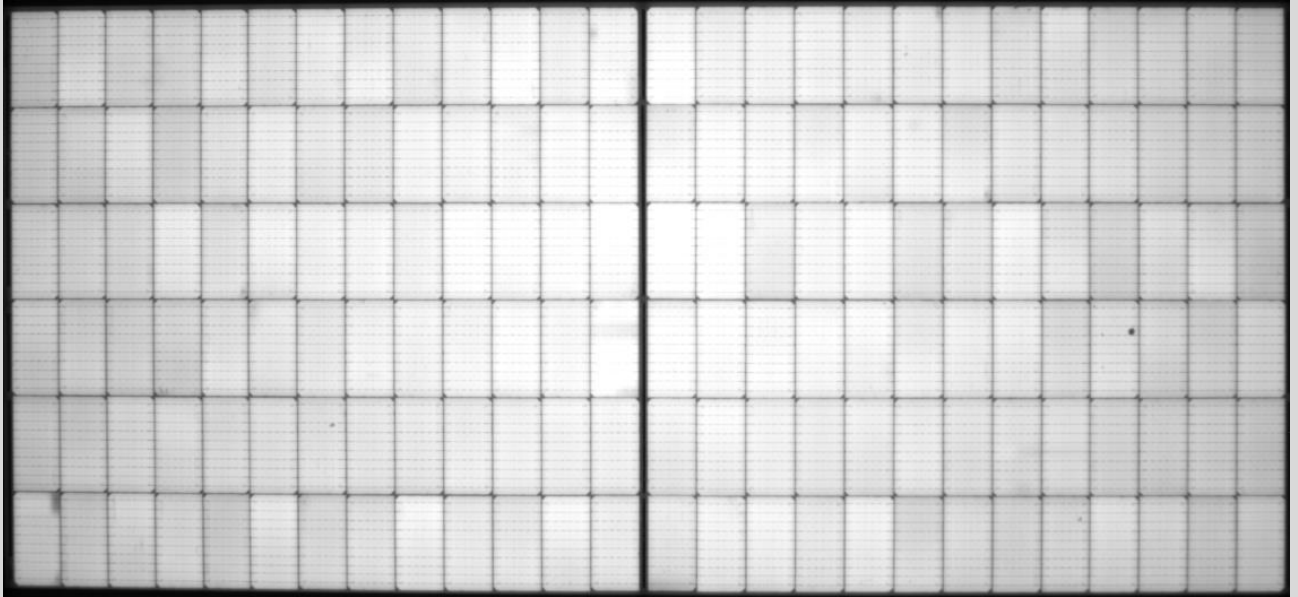
Prüfbericht-Nr.: IN23BUD4 001
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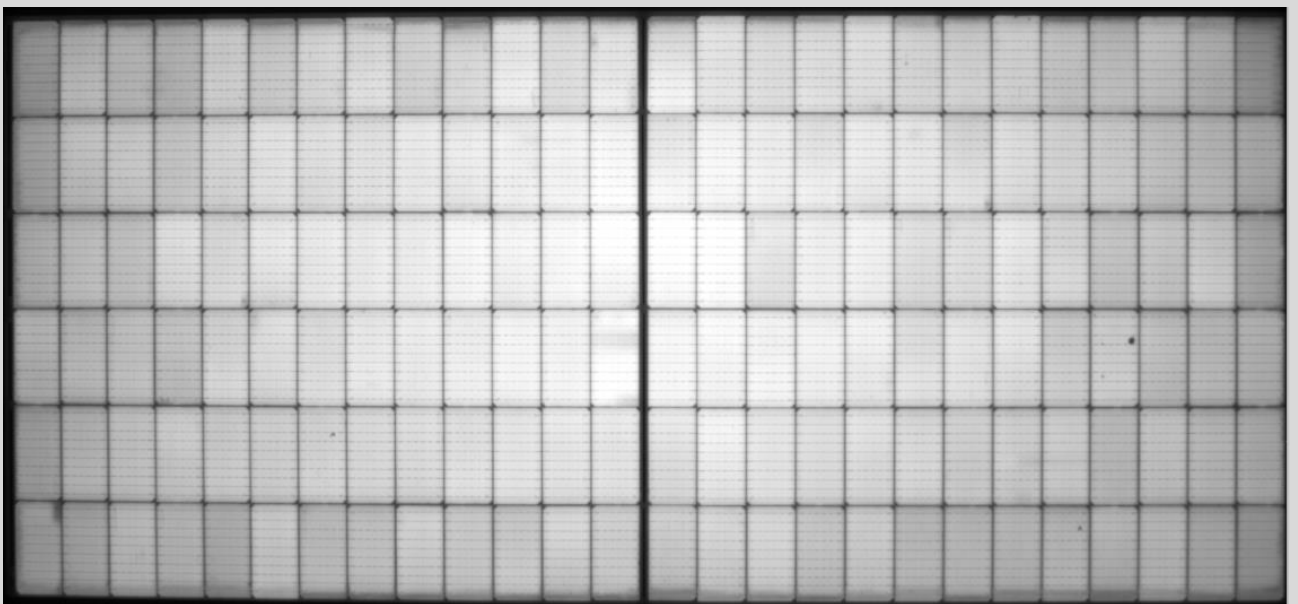
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Annexure 5: EL Images of Test samples:

A003485904-016 (Initial)



A003485904-016 (After- PID)

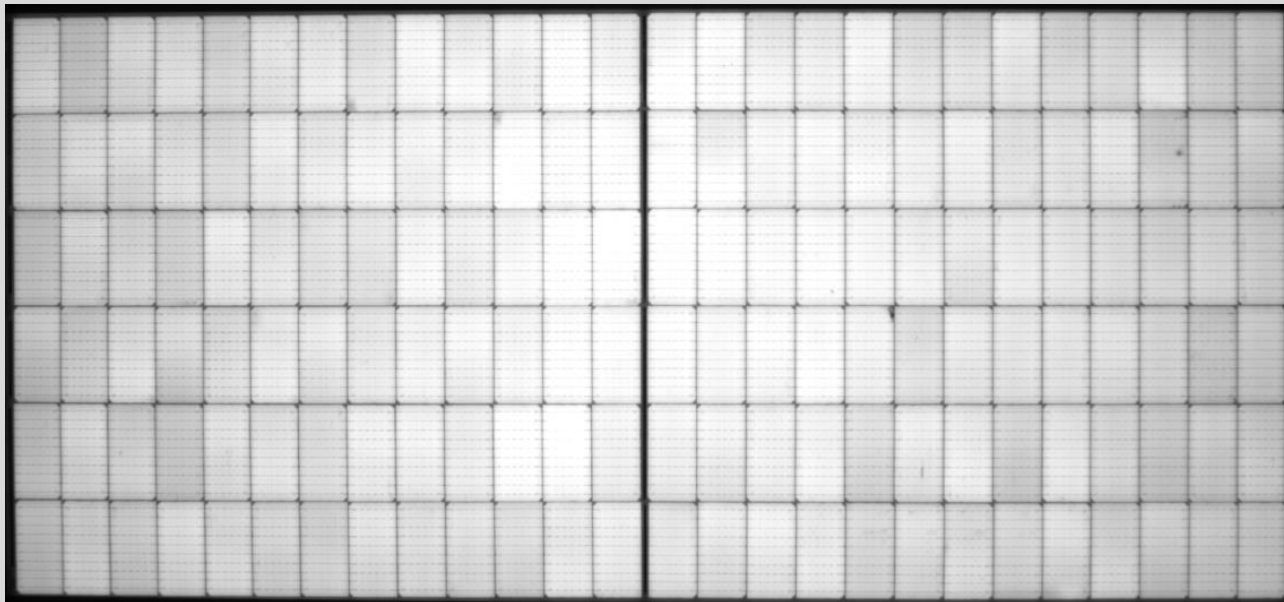


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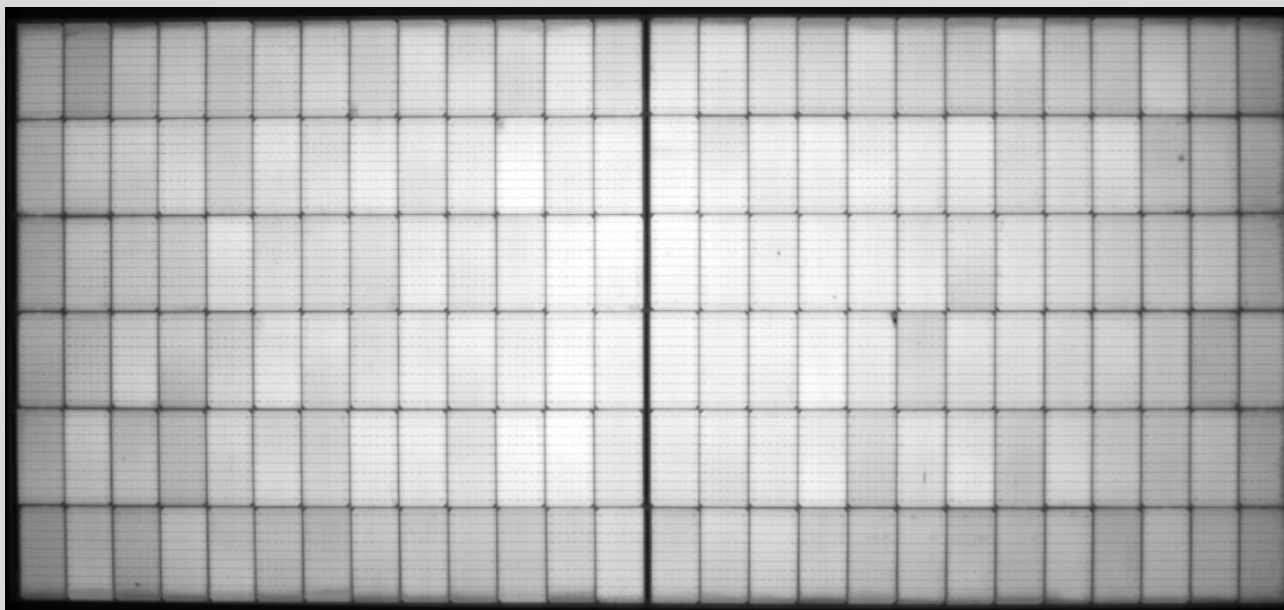
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A003485904-017 (Initial)



A003485904-017 (After- PID)

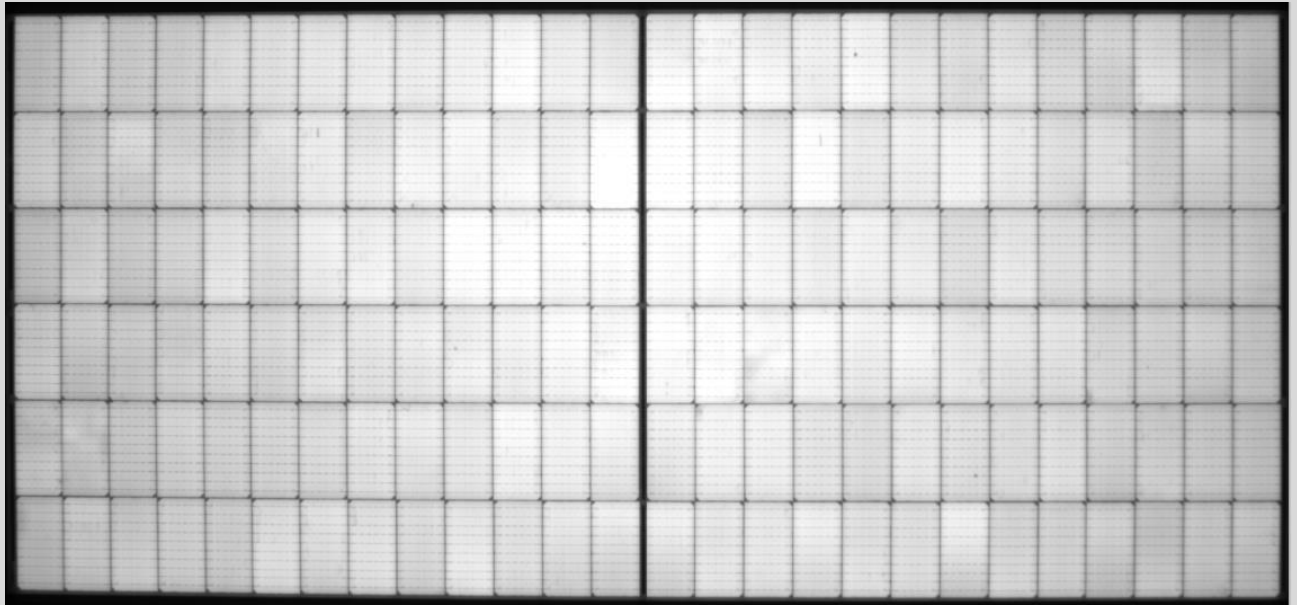


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A003485904-001 (Control)



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Annexure 6: Pictures of Test sample

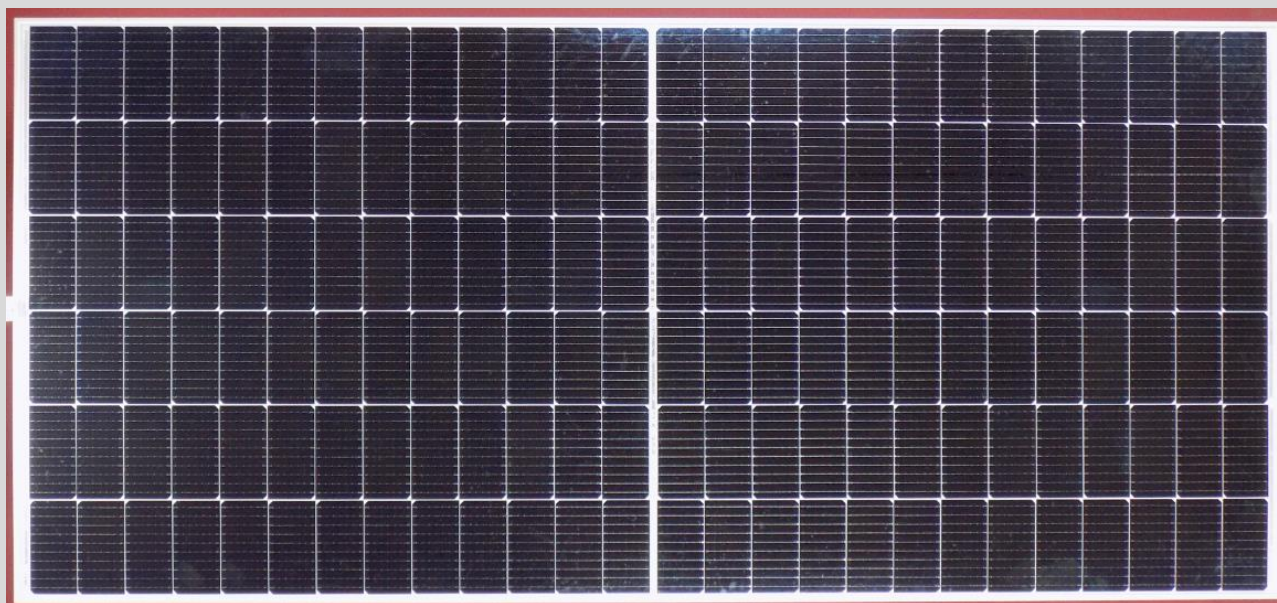


Fig.1:Front view of the module

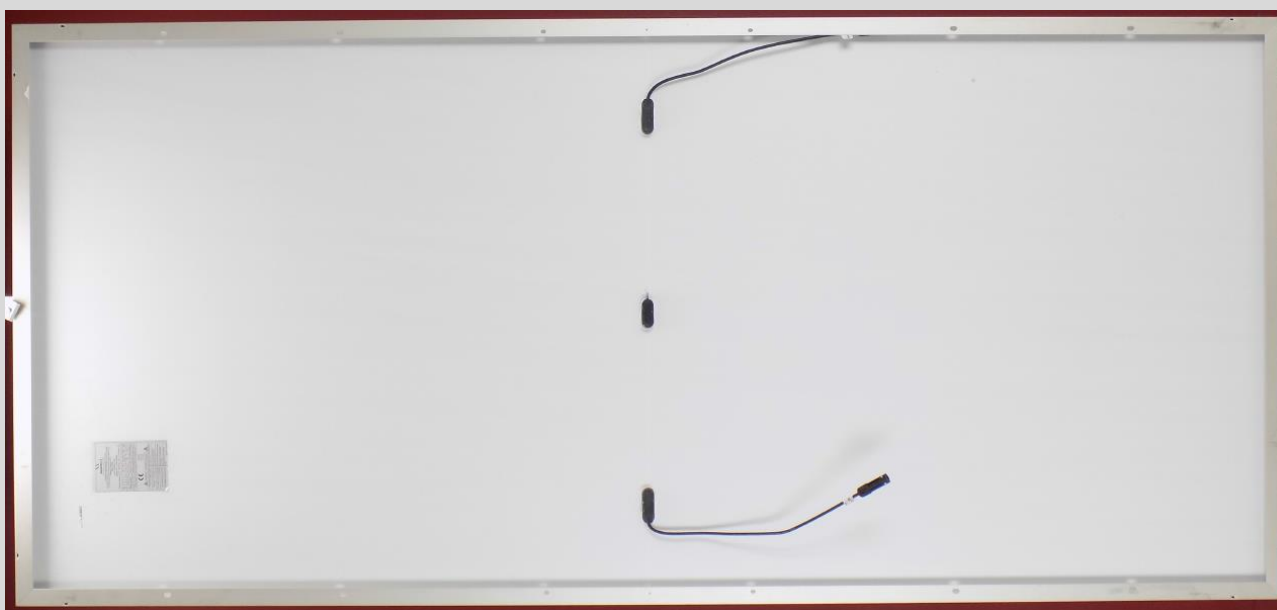


Fig.2:Rear view of the module

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Fig.3:Detail view of the Solar cell



Fig.4: Detail view of Junction Box

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PHOTO-DOCUMENTATION

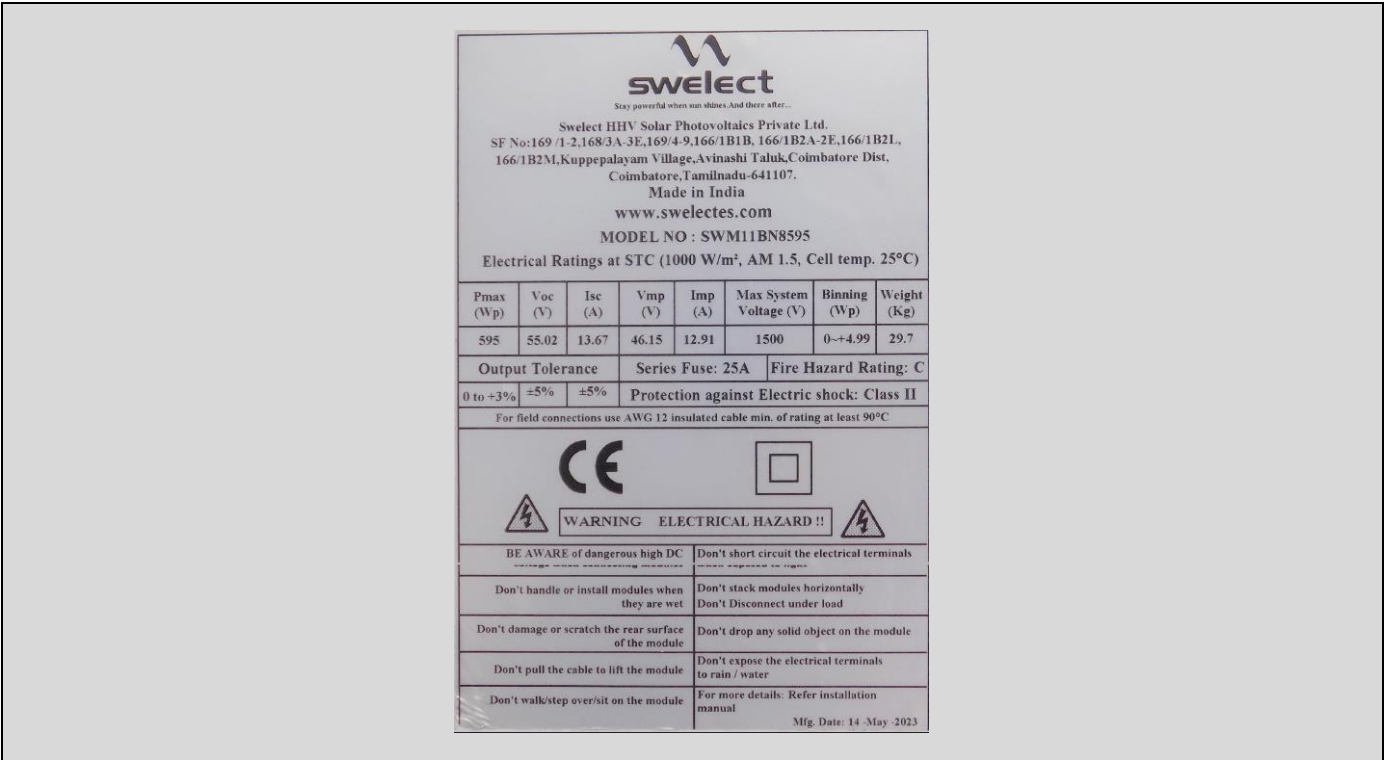


Fig.5: detail view of the Type label

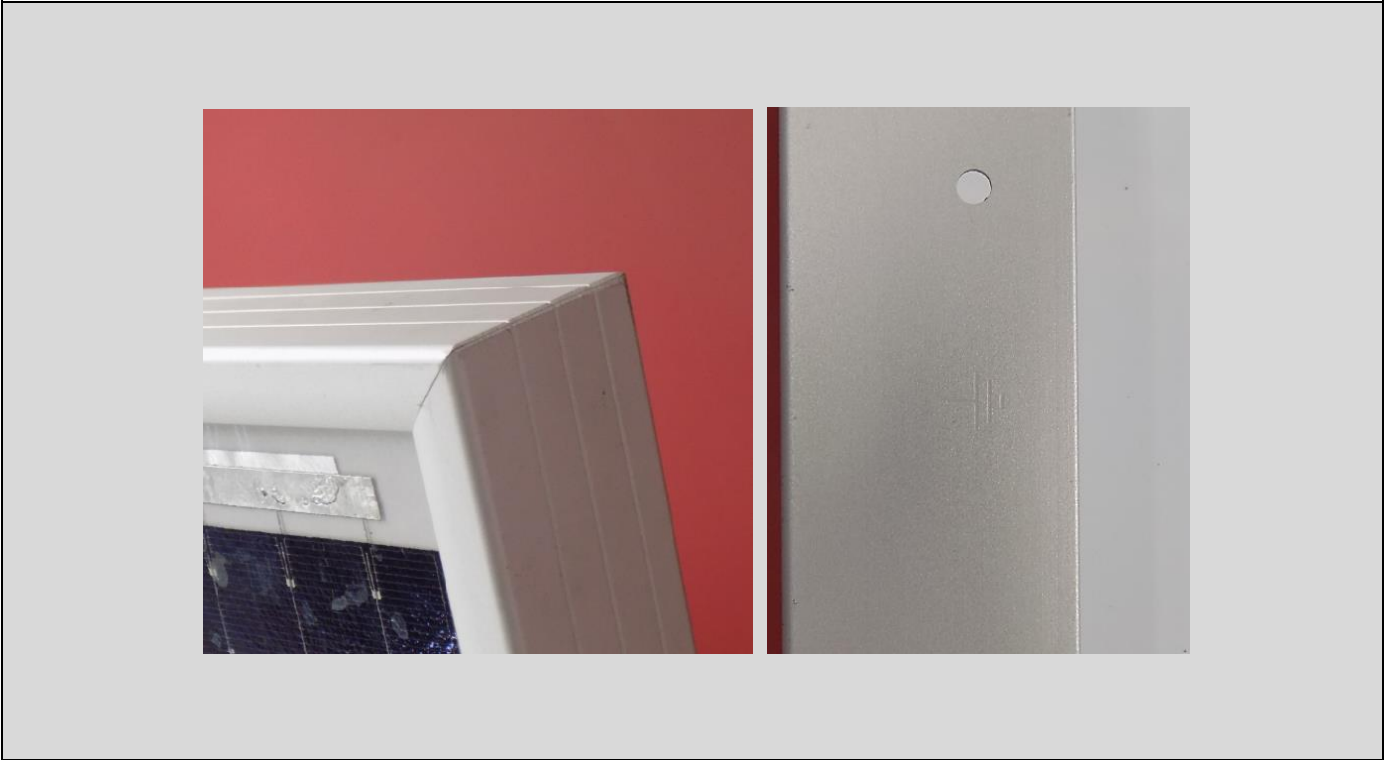


Fig.6: detail view of the frame with ground mark

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Fig.7:Detail view of the markings inside laminate