

<b>Prüfbericht-Nr.:</b> <i>Test report no.:</i>	<b>DE230QAC 002</b>	<b>Auftrags-Nr.:</b> <i>Order no.:</i>	30010 1715	Seite 1 von 16 Page 1 of 16
<b>Kunden-Referenz-Nr.:</b> <i>Client reference no.:</i>	2381951	<b>Auftragsdatum:</b> <i>Order date:</i>	2023-12-12	
<b>Auftraggeber:</b> <i>Client:</i>	Solar Fabrik GmbH (for add. information see page 3)			
<b>Prüfgegenstand:</b> <i>Test item:</i>	PV-module			
<b>Bezeichnung / Typ-Nr.:</b> <i>Identification / Type no.:</i>	MS5 HC V 300 BF-DG			
<b>Auftrags-Inhalt:</b> <i>Order content:</i>	RnD-mechanical load test (additional)			
<b>Prüfgrundlage:</b> <i>Test specification:</i>	following IEC 61215-2 Terrestrialphotovoltaik modules - Design qualification and type approval - Part 2: Test procedures			
<b>Wareneingangsdatum:</b> <i>Date of sample receipt:</i>	2023-12-14			
<b>Prüfmuster-Nr.:</b> <i>Test sample no.:</i>	see "List of test samples"			
<b>Prüfzeitraum:</b> <i>Testing period:</i>	2023-12-19 – 2024-01-13			
<b>Ort der Prüfung:</b> <i>Place of testing:</i>	Am Grauen Stein, 51105 Köln, Cologne			
<b>Prüflaboratorium:</b> <i>Testing laboratory:</i>	TÜV Rheinland Solar GmbH			
<b>Prüfergebnis*:</b> <i>Test result*:</i>	Siehe Sonstiges / See Other			
<b>geprüft von:</b> <i>tested by:</i>	X 	<b>genehmigt von:</b> <i>authorized by:</i>	X 	
<b>Datum:</b> <i>Date:</i> 2024-01-15	Signiert von: Juergen Sommer	<b>Ausstellungsdatum:</b> <i>Issue date:</i> 2024-01-15	Signiert von: Ulrich Fritsch	
<b>Stellung / Position:</b>	Sachverständige(r)/Expert	<b>Stellung / Position:</b>	Sachverständige(r)/Expert	
<b>Sonstiges / Other:</b>	RnD-result only			
<b>Zustand des Prüfgegenstandes bei Anlieferung:</b> <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>			
* 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				
<b>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.</b> <i>This test report only relates to the 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>				

V05

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**Anmerkungen**  
 Remarks

<b>A</b>	<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 Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</p> <p><i>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</i></p>																				
<b>B</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>																				
<b>C</b>	<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 subcontracted 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>																				
<b>D</b>	<p>Die Entscheidungsregel für Konformitätserklärungen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC GC8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird.</p> <p><i>The decision rule for statements of conformity in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance to ILAC GC8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report.</i></p>																				
<b>E</b>	<table border="1"> <thead> <tr> <th colspan="4">Revision History</th> </tr> <tr> <th>Revision</th> <th>Date</th> <th>Nature of changes</th> <th>Page</th> </tr> </thead> <tbody> <tr> <td>001</td> <td>15/01/2024</td> <td>Original issue</td> <td></td> </tr> <tr> <td>002</td> <td>15/01/2024</td> <td>Integration of transferability and limitations</td> <td>11</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Revision History				Revision	Date	Nature of changes	Page	001	15/01/2024	Original issue		002	15/01/2024	Integration of transferability and limitations	11				
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**Produktbeschreibung**  
*Product description*

1	<b>Auftraggeber</b> <i>Client</i>	Solar Fabrik GmbH Hermann-Niggemann-Str. 7 63846 Laufach Germany																															
2	<b>Produktdetails</b> <i>Product details</i>	<p style="text-align: center;"><b>Allgemeine Informationen ; General Information</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Brand name</td> <td style="width: 50%;">Solar Fabrik</td> </tr> <tr> <td>Type name</td> <td>MS5 HC V 300 BF-DG</td> </tr> <tr> <td>Product category</td> <td>PV-module</td> </tr> <tr> <td>Year of production</td> <td style="text-align: center;">- - -</td> </tr> <tr> <td>Power class [W]</td> <td style="text-align: center;">300</td> </tr> <tr> <td>Cell technology</td> <td style="text-align: center;">Mono</td> </tr> <tr> <td>Cell dimension (l / w) [mm]</td> <td style="text-align: center;">210 / 105 (half cut)</td> </tr> <tr> <td>No. of cells</td> <td style="text-align: center;">60</td> </tr> <tr> <td>Max. system voltage [V]</td> <td style="text-align: center;">1500</td> </tr> <tr> <td rowspan="2">Thickness of glazing [mm]</td> <td style="text-align: center;">2.0 (front)</td> </tr> <tr> <td style="text-align: center;">2.0 (back)</td> </tr> <tr> <td>Frame material</td> <td style="text-align: center;">Aluminium</td> </tr> <tr> <td>Thickness of frame [mm]</td> <td style="text-align: center;">30</td> </tr> <tr> <td colspan="2" style="text-align: center;"><b>Dimensionen ; Dimension</b></td> </tr> <tr> <td>Dimension (l / w / h) [mm]</td> <td style="text-align: center;">1650 / 880 / 30</td> </tr> <tr> <td>Gross area [m<sup>2</sup>]</td> <td style="text-align: center;">1.452</td> </tr> </table>	Brand name	Solar Fabrik	Type name	MS5 HC V 300 BF-DG	Product category	PV-module	Year of production	- - -	Power class [W]	300	Cell technology	Mono	Cell dimension (l / w) [mm]	210 / 105 (half cut)	No. of cells	60	Max. system voltage [V]	1500	Thickness of glazing [mm]	2.0 (front)	2.0 (back)	Frame material	Aluminium	Thickness of frame [mm]	30	<b>Dimensionen ; Dimension</b>		Dimension (l / w / h) [mm]	1650 / 880 / 30	Gross area [m <sup>2</sup> ]	1.452
Brand name	Solar Fabrik																																
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Gross area [m <sup>2</sup> ]	1.452																																
3	<b>Technische Dokumentation</b> <i>Technical documentation</i>	<ul style="list-style-type: none"> <li>- Datasheet "Mono_S5_Installer-Series_300W_HC_60" (01.08.2023)</li> <li>- Installation manual "Solar_Fabrik_Montageanleitung" (</li> </ul>																															
4	<b>Hersteller</b> <i>Manufacturer</i>	Solar Fabrik GmbH (see also Point 1)																															
5	<b>Sonstiges</b> <i>Other</i>	<ul style="list-style-type: none"> <li>- All samples were delivered by customer.</li> <li>- See also <i>Transferability and Limitations</i></li> </ul>																															
6	<b>Prüfmusterbereitstellung:</b> <i>Test sample obtaining</i>	<input checked="" type="checkbox"/> Sending by customer <input type="checkbox"/> Sampling by TÜV Rheinland Group <input type="checkbox"/> others:																															

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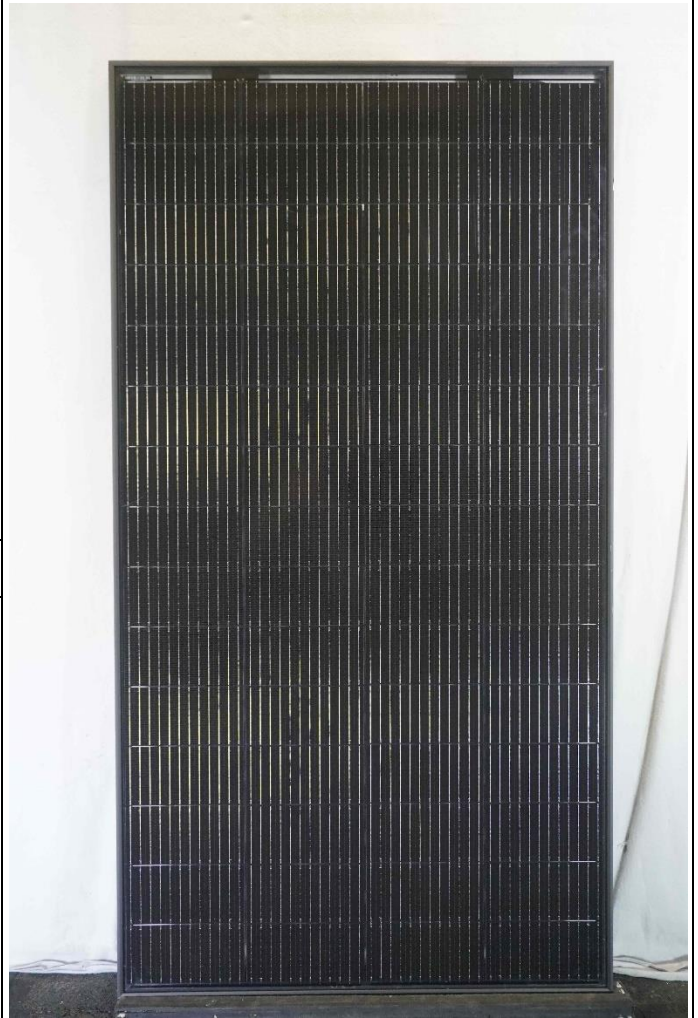
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**Produktbeschreibung**  
Product description

Sample – cell (example)



Sample - front (example)



Sample – backside (example)



Junction box (example)



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Absatz Clause	Anforderungen - Prüfungen / Requirements - Tests	Messergebnisse – Bemerkungen/ Measuring results - Remarks	Ergebnis Result	
-	<b>Result summary table</b>			
Test	Date [DD Month YYYY]		Summary of main test results	—
	Start / initial / 1 <sup>st</sup>	End / final / 2 <sup>nd</sup>		
Insulation test	10 January 2024	15 January 2024	-	P
Wet leakage current test	10 January 2024	15 January 2024	-	P
Performance at STC	10 January 2024	12 January 2024	-	P
Electroluminescence images	10 January 2024	12 January 2024	-	P
Mechanical load***	Static	11 January 2024	+8100 / -3600 Pa	P***
Final inspection		15 January 2024	see <i>Final evaluation</i>	N/A***
Supplementary information: All results are related to the tested sample ***RnD-test only				

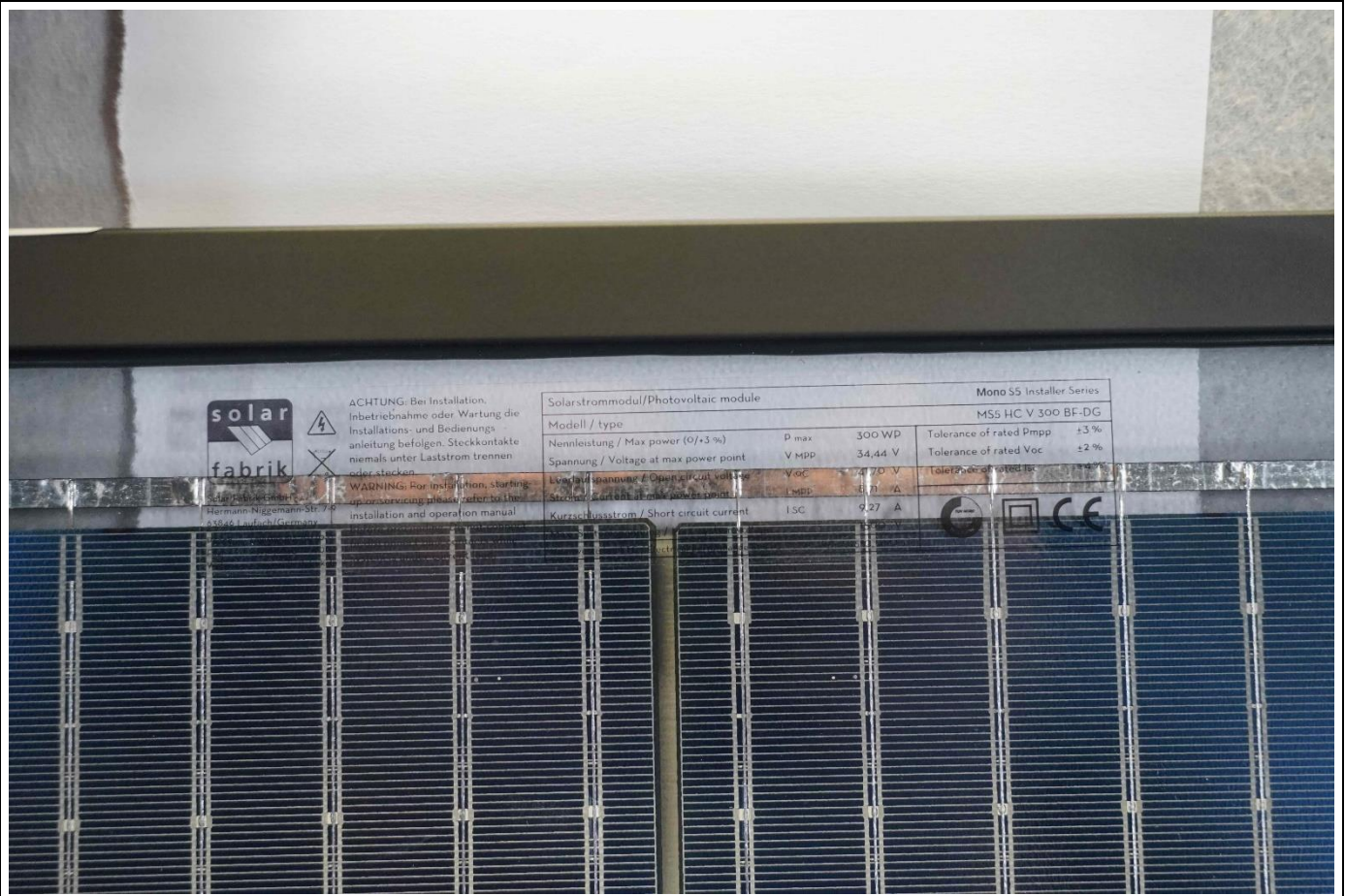
-	<b>Test description (short)</b>			
<p><b>RnD-mechanical load test:</b></p> <p>Finally possible limits for a <b>Static mechanical load</b> test acc. to IEC 61215 (MQT16) shall be defined. Therefor a <i>pre-test</i> with stepwise increased load was performed as <b>Test to failure*</b> (<i>documented in another report</i>), to define the (main) load values to confirm the values further might be used in this additional <i>Static mechanical load</i>.</p> <p>The mounting situation is defined by costumer/according to installation manual. Also the finally used load is defined/confirmed by costumer.</p> <p><i>*damage of module or limitation by test facility</i></p>				—

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

-	<b>Visual inspection (Initial)</b>		
Test date [DD/MM/YYYY]	19/12/2023		—
Sample No.	Nature and position of initial findings		—
HV2023003508	No visual defects		P
HV2023003509	No visual defects		P

Supplementary information: -

Type plate (example)



-	<b>List of test samples</b>		
Sample No.	Sample S/N	Remarks / constructional characteristics	—
HV2023003508	UOM86041082325435	Spare	
HV2023003509	UOM86041082325330	Static mechanical load	

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Absatz Clause	Anforderungen - Prüfungen / Requirements - Tests	Messergebnisse – Bemerkungen/ Measuring results - Remarks	Ergebnis Result					
-	<b>Maximum power determination (STC)</b>							
General; for all following measurements								
Module temperature [°C]		corrected to 25						
Irradiance [W/m <sup>2</sup> ]		1000						
Initial / Final*								
Test date [DD/MM/YYYY]		10/01/2024 and *12/01/2024						
Sample No.	P <sub>max</sub> [W]	V <sub>mpp</sub> [V]	I <sub>mpp</sub> [A]	V <sub>oc</sub> [V]	I <sub>sc</sub> [A]	FF [%]	Degradation [%]	—
HV2023003509	287.9	34.97	8.23	41.92	8.63	79.5	initial	
	284.4	34.55	8.23	41.55	8.64	79.2	(-)1.22	
Supplementary information: **if negative value								

-	<b>Insulation test (ISO)</b>						
General; for all following measurements							
Maximum system voltage [V <sub>DC</sub> ]				1500			
High voltage applied [V <sub>DC</sub> ]				1 <sup>st</sup>	4000		
				2 <sup>nd</sup>	8000		
Insulation resistance measured at [V <sub>DC</sub> ]				1000			
Initial / Final*							
Test date [DD/MM/YYYY]				10/01/2024 and *15/01/2024			
Sample No.	Measured	Area	Result*	Dielectric breakdown			
	[GΩ]	[m <sup>2</sup> ]	[GΩ × m <sup>2</sup> ]				
HV2023003509	1.0	1.45	1.5	-	x	P	
	1.0	1.45	1.5	-	x		
Supplementary information: **Minimum requirement acc. to the standard is 0.04 GΩ × m <sup>2</sup> .							

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Absatz Clause	Anforderungen - Prüfungen / Requirements - Tests	Messergebnisse – Bemerkungen/ Measuring results - Remarks	Ergebnis Result	
-	<b>Wet leakage current test (WL)</b>			
General; for all following measurements			—	
Insulation resistance measured at [V <sub>DC</sub> ]		1000		
Solution resistivity [ $\Omega$ cm]		< 3.500		
Solution temperature [°C]		22 ± 3		
Initial / Final*				
Test date [DD/MM/YYYY]		10/01/2024 and *15/01/2024		
Sample No.	Measured	Area		Result*
	[M $\Omega$ ]	[m <sup>2</sup> ]		[M $\Omega$ × m <sup>2</sup> ]
HV2023003509	1000	1.45		1450
	1000	1.45		1450
Supplementary information: **Minimum requirement acc. to the standard is 40 M $\Omega$ × m <sup>2</sup> .				

-	<b>Electroluminescence images (EL)</b>		
Analysis of electroluminescence images (see also Annex : Additional information)			
Initial / Final*			—
Test date [DD/MM/YYYY]		10/01/2024 and *12/01/2024	
Sample No.	Reverse current applied [A]	Attributes	
HV2023003509	10	No conspicuousness/findings	
	10	No conspicuousness/findings	
Supplementary information: -			

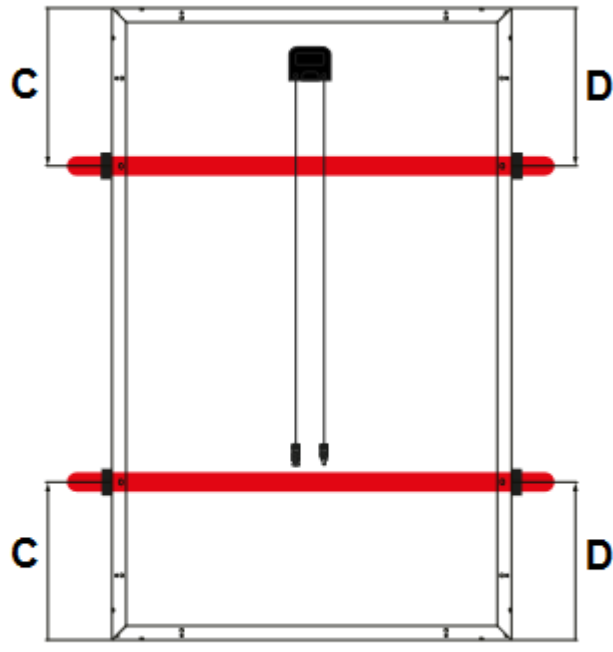


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-	<b>Mechanical load test (general)</b>		
Mounting method			
General	Mounted on 2 horizontal bars; crossing the length profile		
Width of clamps (if used) [mm]	65 - <i>given by lab</i>		
Fixation distance [mm] from corner	290 - <i>given by installation manual / mounting holes</i>		
Moment of force / Torque [Nm]	18 - <i>given by installation manual</i>		
Comment	The installation selected as estimated worst case/mainstream installation of module  The used module type is not part of installation manual.		
Test configuration	See drawing, as well as Annex		



Supplementary information: See photos in appendix.

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-	<b>Static mechanical load test (Static)</b>
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Test date (dd/mm/yyyy)	11/01/2024			—
Sample no	HV2023003509			
Test method	Static mechanical load			
Open circuits (yes/no)	no			
Load applied	cyclic (automated)			
Applied loads (+ = downwards / - = upwards)		Static time [min]	No. of cycles	
Test load [Pa]	resulting <i>Design load</i> * [Pa]	<i>per cycle</i>	<i>finished</i>	
-3600	-2400	60	3	-
+8100	+5400	60	3	-

Supplementary information: See photos in appendix.  
 \*Following IEC 61215/61730 a safety factor  $\gamma_m$  of at least 1.5 would have to be considered.

-	<b>Final inspection (general)</b>
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Test date [DD/MM/YYYY]	15/01/2024		—
Sample-No.	used for	Evaluation*	
HV2023003509	Static load	Test finished successful after 3 cycles +8100 Pa / -3600 Pa without any damages	P

Individual additional remarks:

- Torque for clamps = 18 Nm (used for all tests)
- The result can vary, depending on the finally used crossbar-profile.

Supplementary information: All results are related to the tested samples.  
 \* referred to measuring uncertainty and function  
 \*\*see also *Final evaluation* and *Annex : Additional information*

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<b>Absatz</b> <i>Clause</i>	<b>Anforderungen - Prüfungen /</b> <i>Requirements - Tests</i>	<b>Messergebnisse – Bemerkungen/</b> <i>Measuring results - Remarks</i>	<b>Ergebnis</b> <i>Result</i>
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-	<b>General remarks and subplementary information</b>		
	Measuring uncertainties		
	<b>All results only refer to the test samples that were subjected to testing.</b> The extended total measuring uncertainty is: $u(k=2) \leq \pm 5 \%$		—

-	<b>Transferability and limitations</b>		
	<ul style="list-style-type: none"> <li>• The type designation in the report refers to the actual module. The result is also applicable and valid for the other performance classes. The only requirement here is that the module dimensions and superstructures do not change (i.e. the class is determined purely by cell selection).</li> <li>• Ultimately, however, this statement is clearly limited to the assembly used in the test. This does not apply to other mountings or increased distances between the clamping positions.</li> </ul>		—

-	<b>Annex</b>		
	<ul style="list-style-type: none"> <li>• IV-curves and Electroluminescence</li> <li>• Additional photo documentation (Setup, Test and Damages)</li> </ul>		—

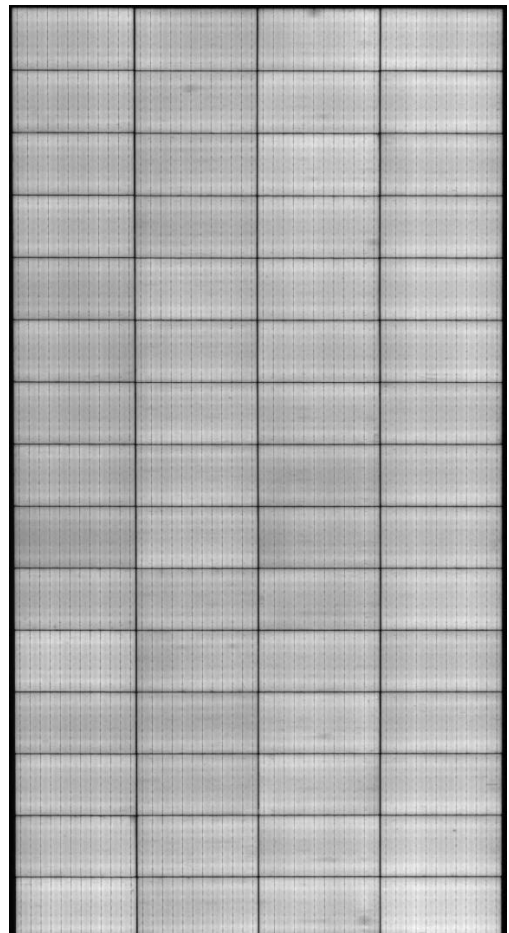
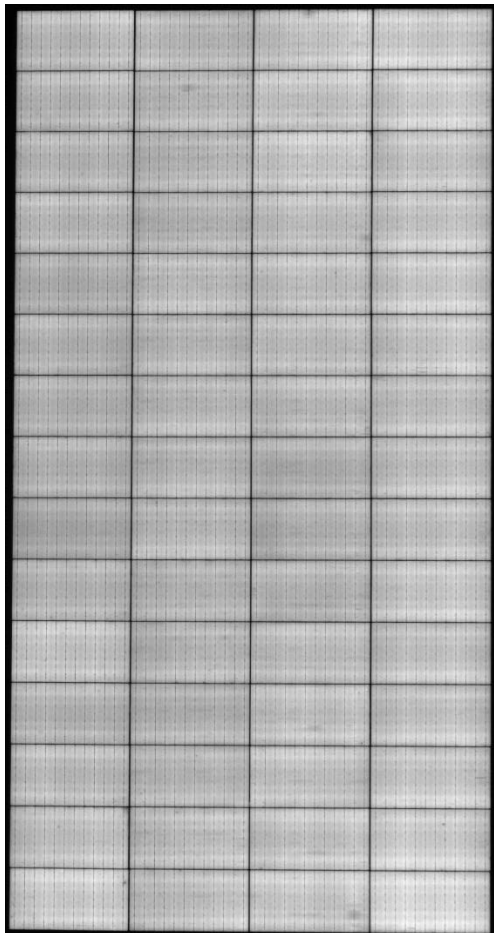
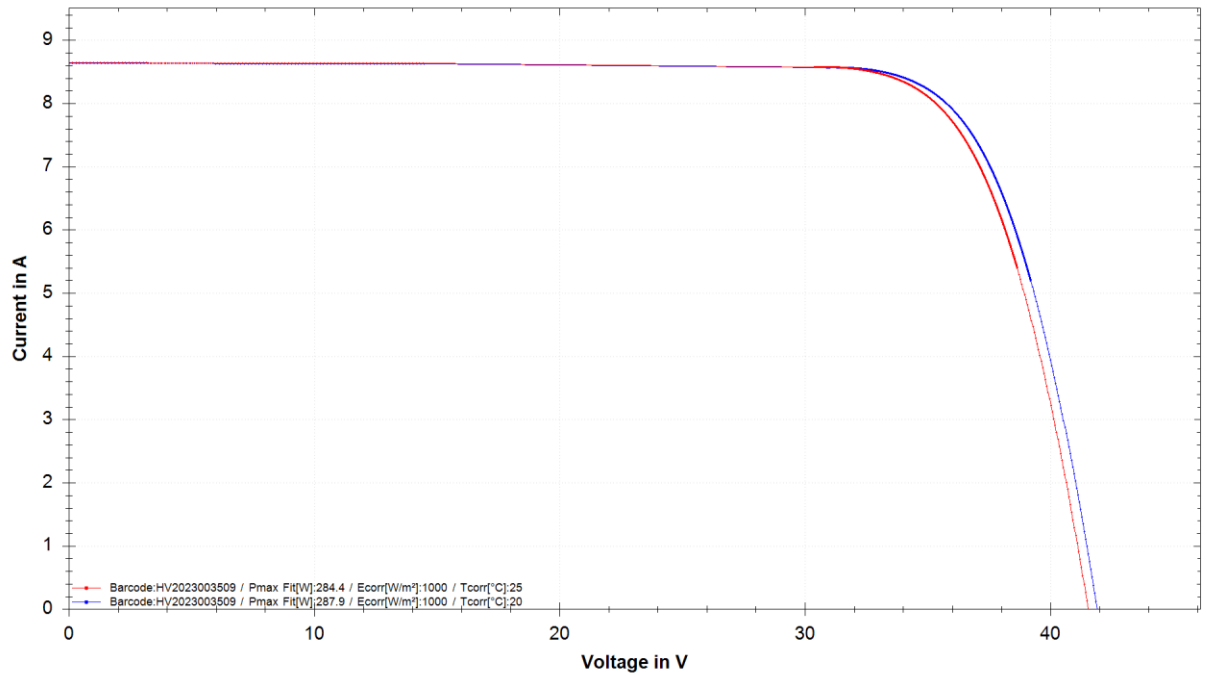
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- Annex: IV-Curve and Electroluminescence

HV2023003509 – Static mechanical load – initial/final



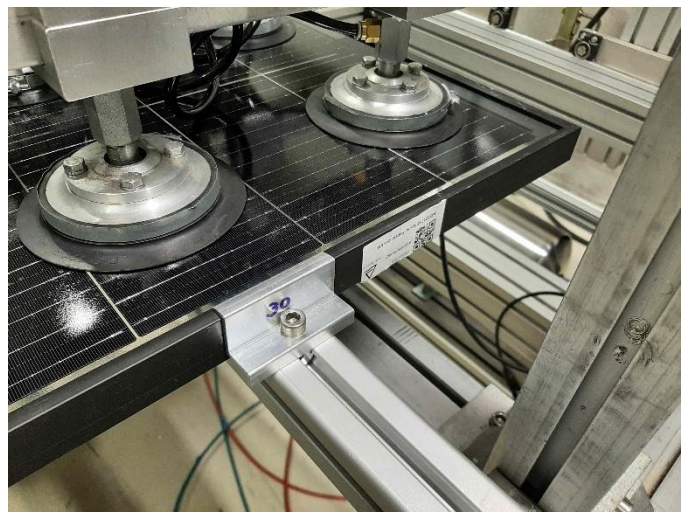
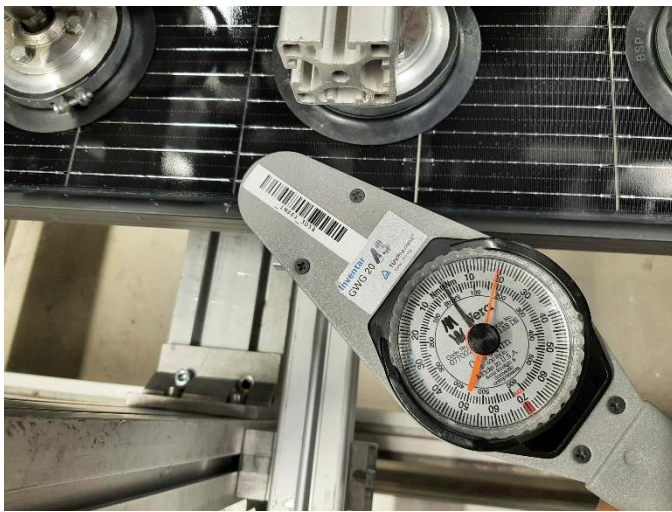
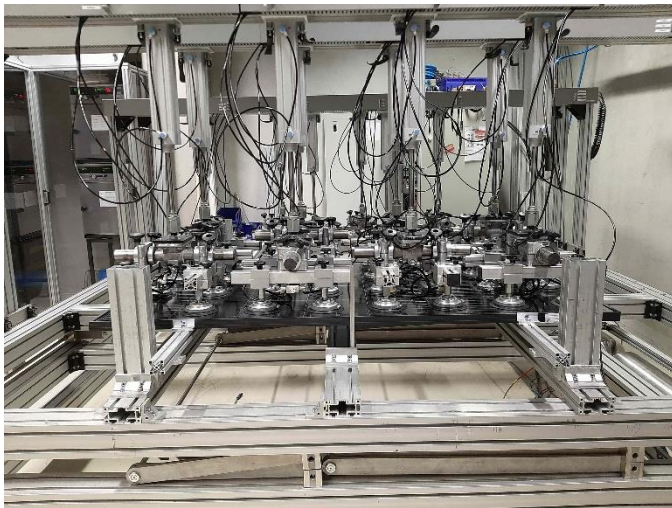
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- Annex: Additional photo documentation

Example of set-up



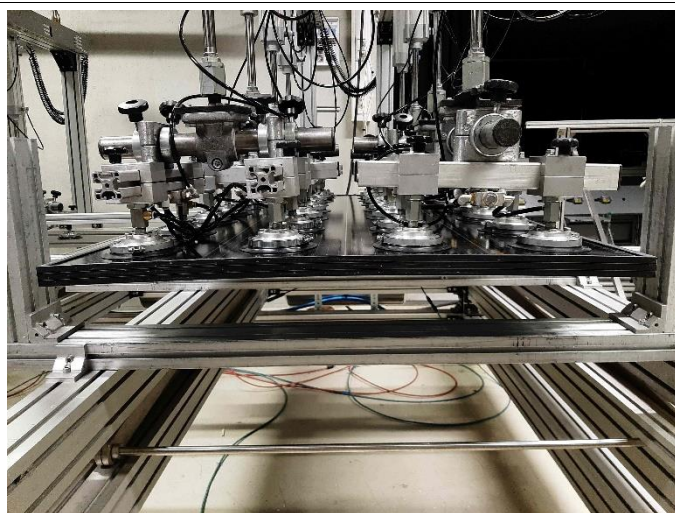
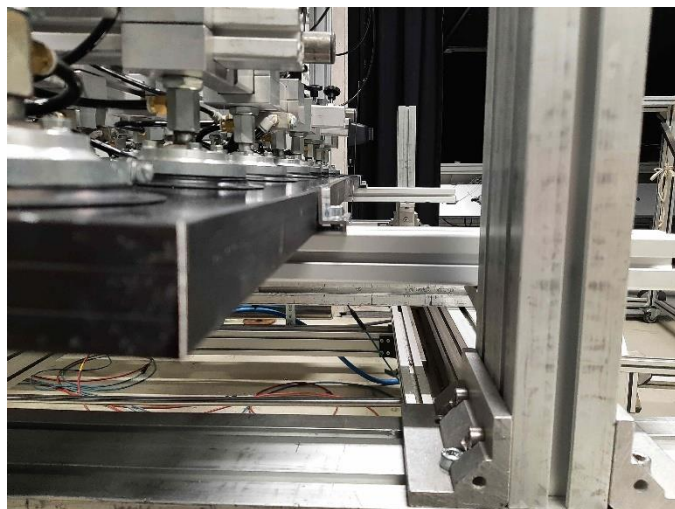
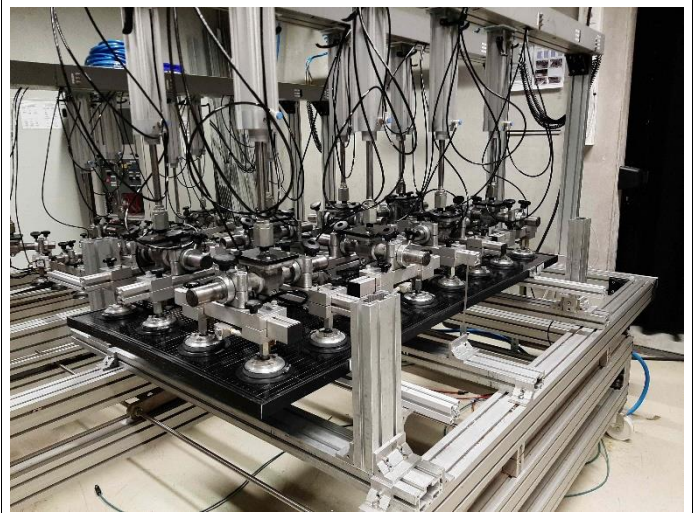
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-      **Annex: Additional photo documentation**

Example of -3600 Pa (Static mechanical load)



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Absatz Clause	Anforderungen - Prüfungen / Requirements - Tests	Messergebnisse – Bemerkungen/ Measuring results - Remarks	Ergebnis Result
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-      **Annex: Additional photo documentation**

Example of +8100 Pa (Static mechanical load)



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--- End of report ---