

HIGHLY ACCELERATED LIFE AND EXTENDED RELIABILITY TESTING REPORT

Philadelphia Solar

SOLAR MODULE:
PS-MNG144(HCBF)-570W

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EVALUATION OF

PS-MNG144(HCBF)-570W

RENDERED by

Philadelphia Solar

Date of receipt of the test item: September 19, 2023

Date of performance of the test item: September 19, 2023 to March 28, 2024

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Executive Summary

Philadelphia Solar contracted Intertek Testing Services Shanghai (Intertek) to perform highly accelerated life testing (HALT) and extended reliability testing, on the model PS-MNG144(HCBF)-570W and crystalline silicon module and evaluate the characterization under HALT. The testing program is shown in page 9.

General Product Information

Description of module construction:					
Model	Size of Module (mm)	Cell technology	No. of cells		
PS-MNG144(HCBF)-570W	2278*1134*30	N Type, Bifacial Mono Crystalline Topcon solar cell with 16 busbars	144		

Product Electrical Rating:					
Model No.	Voc (V)	Isc (Amps)	Pmp (W)	Vmp (V)	Imp (Amps)
PS-MNG144(HCBF)-570W	51.37	14.02	570	43.15	13.25

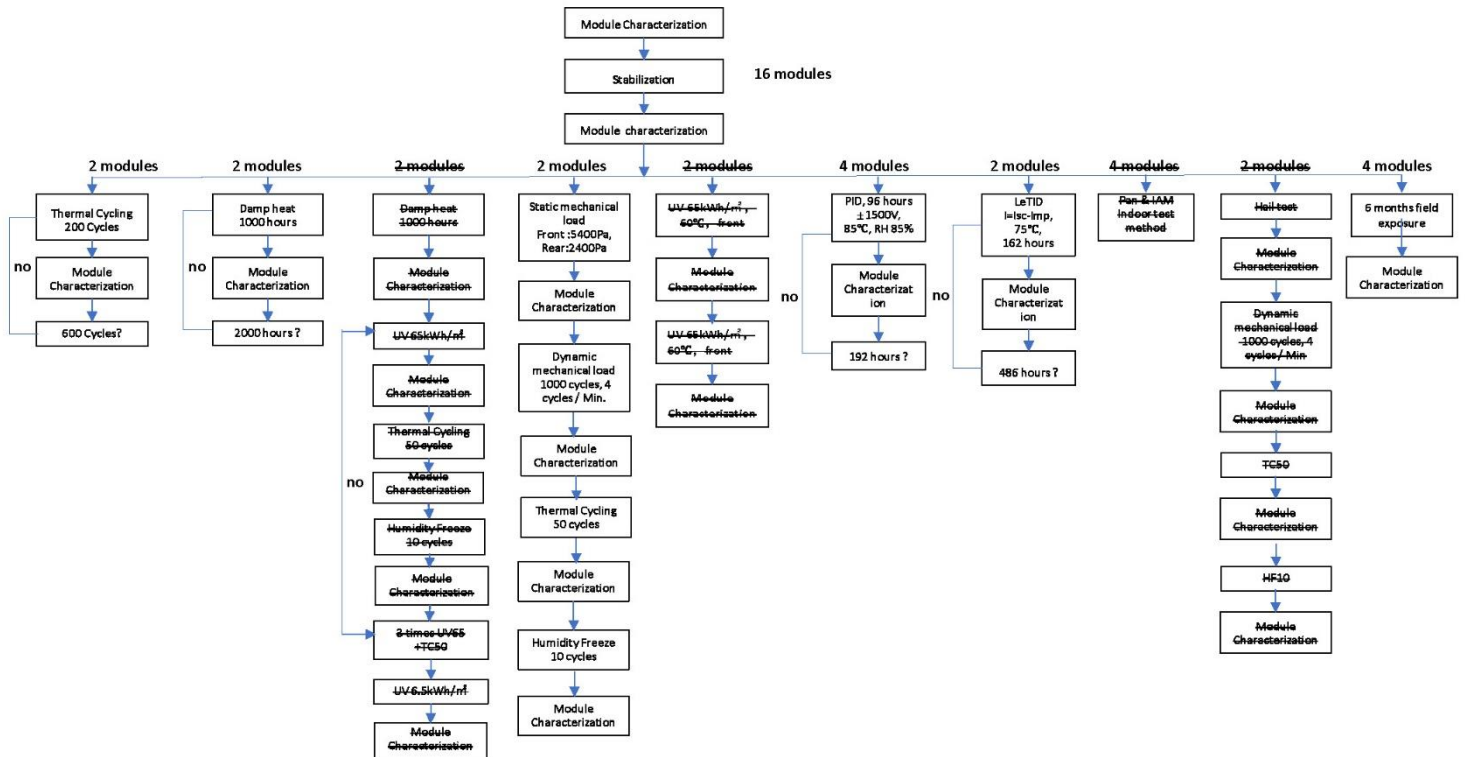
List of Test Samples

List of test samples			
Sample No.	Series No.	Type / model	Remark
0230919-21-2	PS080823BN1440000056	PS-MNG144(HCBF)-570W	Thermal Cycling Test
0230919-21-3	PS080823BN1440000113	PS-MNG144(HCBF)-570W	Thermal Cycling Test
0230919-21-4	PS080823BN1440000145	PS-MNG144(HCBF)-570W	Damp Heat Test
0230919-21-5	PS080823BN1440000140	PS-MNG144(HCBF)-570W	Damp Heat Test
0230919-21-8	PS080823BN1440000064	PS-MNG144(HCBF)-570W	Mechanical Stress Sequence
0230919-21-9	PS080823BN1440000107	PS-MNG144(HCBF)-570W	Mechanical Stress Sequence
0230919-21-10	PS080823BN1440000053	PS-MNG144(HCBF)-570W	PID
0230919-21-11	PS080823BN1440000116	PS-MNG144(HCBF)-570W	PID
0230919-21-12	PS080823BN1440000094	PS-MNG144(HCBF)-570W	PID
0230919-21-13	PS080823BN1440000142	PS-MNG144(HCBF)-570W	PID
0230919-21-14	PS080823BN1440000117	PS-MNG144(HCBF)-570W	LeTID
0230919-21-15	PS080823BN1440000158	PS-MNG144(HCBF)-570W	LeTID
0230919-21-22	PS080823BN1440000069	PS-MNG144(HCBF)-570W	Field Exposure
0230919-21-23	PS080823BN1440000150	PS-MNG144(HCBF)-570W	Field Exposure
0230919-21-24	PS080823BN1440000135	PS-MNG144(HCBF)-570W	Field Exposure
0230919-21-25	PS080823BN1440000072	PS-MNG144(HCBF)-570W	Field Exposure

Testing Standard Description

Tests performed (name of test and test clause)	
Tests	Standard
Visual inspection	IEC 61215-2: 2021 Ed. 1.0 Cl. 4.1 IEC TS 63209-1-2021, Cl. 5.3
Maximum power determination	IEC 61215-2: 2021 Ed. 1.0 Cl. 4.2
Insulation test	IEC 61215-2: 2021 Ed. 1.0 Cl. 4.3
Wet leakage current test	IEC 61215-2: 2021 Ed. 1.0 Cl. 4.15
Temperature cycling test	IEC TS 63209-1-2021, Cl. 6.3
Damp heat test	IEC TS 63209-1-2021, Cl. 6.5
Backsheet durability test	IEC TS 63209-1-2021, Cl. 6.5
UVID test	IEC 61215-2: 2021 Ed. 1.0 Cl. 4.10
Potential Induced Degradation test	IEC TS 62804-1:2015 Ed. 1.0
Mechanical Stress Sequence	IEC TS 63209-1-2021, Cl. 6.4
LeTID	IEC TS 63342: 2022
Bypass diode functionality test	IEC 61215-2: 2021 Ed. 2.0 Cl. 4.18.2
Stabilization	IEC 61215-2: 2021 Ed. 2.0 Cl.4.19
Hail Test	IEC 61215-2: 2021 Ed. 2.0 Cl.4.17
Field Exposure	IEC 61215-2: 2021 Ed. 2.0 Cl.4.8
Supplementary information: - This report is an extension test based on report 231000564SHA-001 due to component Solar cell modification: - Stabilization: test was performed under simulate irradiance, total irradiation for TC and DH samples should ≥ 40 kWh/m². - Low irradiance is 200W/m², - Performance at BNPI means module was measured on the front side at equivalent irradiance levels corresponding to $1000 \text{ W} \cdot \text{m}^{-2}$ on the front side plus 135 W/m^2 rear side irradiance levels G_{Ri}. The equivalent irradiance levels are determined as functions of the bifaciality coefficient φ according to the equation below: $G_{BNPI} = 1000 \text{ W} \cdot \text{m}^{-2} + \varphi \cdot 135 \text{ W} \cdot \text{m}^{-2}$ $\varphi = \text{Min}(\varphi_{ISC}, \varphi_{Pmax})$ - Static mechanical load test: fixed with 4 clamps at outer mounting hole location, distance from centerline of the mounting clamp to the short side is 569mm. Test load: front (downward) 5400Pa, rear (upward) 2400Pa, 3 cycles. - Dynamic mechanical load test: mounted as same as static mechanical load test, 1000 cycles, 4 cycles / Min. Both positive and negative load: 1000 Pa. - Potential Induced Degradation test: +1500V and -1500V, $85^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and Rh $85\% \pm 3\%$, 96 hours per cycle, 2 cycles. - Stabilization: indoor Method, irradiance 800~1000w/m². - Field Exposure: 4 modules were mounted on an open rack, tilt angle is 35 degrees, and connected to MPPT, 6 months test from September 28, 2023 to March 28, 2024.	

Testing Program



1. Stabilization

1.1. Initial Visual inspection

Test Date [YYYY-MM-DD]..... :	2023-09-19	—
Sample #	Nature and position of initial findings – comments or attach photos	—
0230919-21-2	No major visible defect	PASS
0230919-21-3	No major visible defect	PASS
0230919-21-4	No major visible defect	PASS
0230919-21-5	No major visible defect	PASS
0230919-21-8	No major visible defect	PASS
0230919-21-9	No major visible defect	PASS
0230919-21-10	No major visible defect	PASS
0230919-21-11	No major visible defect	PASS
0230919-21-12	No major visible defect	PASS
0230919-21-13	No major visible defect	PASS
0230919-21-14	No major visible defect	PASS
0230919-21-15	No major visible defect	PASS
0230919-21-22	No major visible defect	PASS
0230919-21-23	No major visible defect	PASS
0230919-21-24	No major visible defect	PASS
0230919-21-25	No major visible defect	PASS
Supplementary information: NA		

1.2. Performance at STC before initial stabilization (front side)

Test Date [YYYY-MM-DD]..... :	2023-09-20						—
Test method..... :	☒ Simulator ☐ Natural sunlight						—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Result
0230919-21-2	52.023	44.324	13.465	12.837	569.002	81.23	—
0230919-21-3	52.103	44.367	13.500	12.826	569.051	80.90	—
0230919-21-4	52.036	44.328	13.477	12.852	569.696	81.23	—
0230919-21-5	52.005	44.189	13.461	12.822	566.577	80.94	—
0230919-21-8	52.033	44.451	13.444	12.810	569.429	81.40	—
0230919-21-9	51.942	44.363	13.484	12.829	569.130	81.26	—
0230919-21-10	51.979	44.222	13.500	12.858	568.632	81.03	—
0230919-21-11	51.883	44.172	13.486	12.862	568.147	81.20	—
0230919-21-12	51.781	44.039	13.498	12.908	568.435	81.33	—
0230919-21-13	51.844	44.145	13.512	12.871	568.177	81.11	—

0230919-21-14	51.973	44.295	13.455	12.833	568.438	81.29	—
0230919-21-15	51.997	44.252	13.430	12.828	567.652	81.29	—
0230919-21-22	52.099	44.049	13.458	12.81	564.284	80.48	—
0230919-21-23	52.104	44.093	13.453	12.792	564.035	80.47	—
0230919-21-24	52.109	44.055	13.456	12.801	563.955	80.43	—
0230919-21-25	52.115	44.077	13.46	12.803	564.304	80.45	—
Supplementary information: NA							

1.3. Performance at STC before initial stabilization (back side)

Test Date [YYYY-MM-DD]				2023-09-20			—
Test method				☒ Simulator ☐ Natural sunlight			—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Result
0230919-21-2	51.547	45.101	10.309	9.187	414.334	77.97	—
0230919-21-3	51.539	45.198	12.054	9.109	411.697	66.27	—
0230919-21-4	51.400	45.495	10.958	9.009	409.885	72.77	—
0230919-21-5	51.574	44.823	10.863	9.305	417.077	74.45	—
0230919-21-8	51.555	44.947	10.750	9.200	413.530	74.61	—
0230919-21-9	51.496	45.068	10.779	9.251	416.923	75.11	—
0230919-21-10	51.632	44.741	10.789	9.173	410.423	73.68	—
0230919-21-11	51.466	44.906	10.649	9.290	417.198	76.12	—
0230919-21-12	51.432	44.925	10.584	9.246	415.373	76.31	—
0230919-21-13	51.521	44.907	10.656	9.285	416.959	75.95	—
0230919-21-14	51.470	44.766	10.947	9.174	410.683	72.89	—
0230919-21-15	51.525	44.939	10.961	9.246	415.503	73.57	—
0230919-21-22	51.687	45.7	10.729	9.07	414.498	74.74	—
0230919-21-23	51.699	45.725	10.771	9.066	414.528	74.44	—
0230919-21-24	51.693	45.743	10.733	9.063	414.571	74.72	—
0230919-21-25	51.712	45.709	10.681	9.072	414.652	75.07	—
Supplementary information: NA							

1.4. Performance at BNPI before initial stabilization

Test Date [YYYY-MM-DD]				2023-09-20			—
Test method				☒ Simulator ☐ Natural sunlight			—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Result
0230919-21-2	52.127	44.429	14.780	14.048	624.138	81.01	—

0230919-21-3	52.192	44.361	15.217	14.030	622.380	78.36	—
0230919-21-4	52.194	44.386	14.776	14.065	624.289	80.95	—
0230919-21-5	52.135	44.275	14.782	14.079	623.364	80.89	—
0230919-21-8	52.296	44.467	14.787	14.085	626.335	81.00	—
0230919-21-9	52.289	44.462	14.790	14.090	626.475	81.01	—
0230919-21-10	52.214	44.384	14.771	14.075	624.712	81.00	—
0230919-21-11	52.215	44.449	14.779	14.064	625.113	81.01	—
0230919-21-12	52.153	44.327	14.772	14.067	623.559	80.94	—
0230919-21-13	52.161	44.332	14.763	14.063	623.413	80.96	—
0230919-21-14	52.219	44.409	15.205	14.021	622.659	78.42	—
0230919-21-15	52.217	44.408	15.209	14.022	622.677	78.40	—
0230919-21-22	52.124	44.052	14.799	14.051	618.971	80.24	—
0230919-21-23	52.137	44.068	14.803	14.051	619.212	80.23	—
0230919-21-24	52.144	44.072	14.801	14.045	619.001	80.2	—
0230919-21-25	52.149	44.055	14.798	14.052	619.062	80.22	—
Supplementary information: NA							

1.5. Initial Stabilization procedure

Light exposure method				☒ Simulator ☐ Natural sunlight			
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Stabilization criterion x per IEC 61215-1-x				0.01			
Sample #	0230919-21-2	Test Date (YYYY-MM-DD) start/end			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin) / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	569.002	—	—
1	20	800-1000	50±10	Micro inverter	568.469	—	—
2	20	800-1000	50±10	Micro inverter	567.583	0.25	yes

Sample #	0230919-21-3	Test Date (YYYY-MM-DD) start/end :			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	569.051	—	—
1	20	800-1000	50±10	Micro inverter	568.724	—	—

2	20	800-1000	50±10	Micro inverter	567.436	0.28	yes
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Sample #	0230919-21-4	Test Date (YYYY-MM-DD) start/end :			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin) / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	569.696	—	—
1	20	800-1000	50±10	Micro inverter	568.733	—	—
2	20	800-1000	50±10	Micro inverter	568.728	0.17	yes

Sample #	0230919-21-5	Test Date (YYYY-MM-DD) start/end :			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin) / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	566.577	—	—
1	20	800-1000	50±10	Micro inverter	566.399	—	—
2	20	800-1000	50±10	Micro inverter	566.451	0.03	yes

Sample #	0230919-21-8	Test Date (YYYY-MM-DD) start/end :			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin) / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	569.429	—	—
1	5	800-1000	50±10	Micro inverter	569.278	—	—
2	5	800-1000	50±10	Micro inverter	568.995	0.08	yes

Sample #	0230919-21-9	Test Date (YYYY-MM-DD) start/end :			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin) / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	569.130	—	—
1	5	800-1000	50±10	Micro inverter	569.188	—	—
2	5	800-1000	50±10	Micro inverter	569.057	0.02	yes

Sample #	0230919-21-10	Test Date (YYYY-MM-DD) start/end :			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin) / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	568.632	—	—

1	5	800-1000	50±10	Micro inverter	567.018	—	—
2	5	800-1000	50±10	Micro inverter	567.804	0.28	yes
Sample #	0230919-21-11	Test Date (YYYY-MM-DD) start/end :			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin) / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	568.147	—	—
1	5	800-1000	50±10	Micro inverter	566.991	—	—
2	5	800-1000	50±10	Micro inverter	567.364	0.20	yes
Sample #	0230919-21-12	Test Date (YYYY-MM-DD) start/end :			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin) / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	568.435	—	—
1	5	800-1000	50±10	Micro inverter	568.798	—	—
2	5	800-1000	50±10	Micro inverter	567.637	0.20	yes
Sample #	0230919-21-13	Test Date (YYYY-MM-DD) start/end :			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	(Pmax – Pmin) / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	568.177	—	—
1	5	800-1000	50±10	Micro inverter	568.548	—	—
2	5	800-1000	50±10	Micro inverter	567.279	0.22	yes
Sample #	0230919-21-14	Test Date (YYYY-MM-DD) start/end :			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin) / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	568.438	—	—
1	5	800-1000	50±10	Micro inverter	567.196	—	—
2	5	800-1000	50±10	Micro inverter	567.653	0.22	yes
Sample #	0230919-21-15	Test Date (YYYY-MM-DD) start/end :			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin) / Paverage (%)	Stable (Yes/No)

Initial	—	—	—	—	567.652	—	—
1	5	800-1000	50±10	Micro inverter	567.444	—	—
2	5	800-1000	50±10	Micro inverter	567.467	0.04	yes
Supplementary information: Integrated irradiation for TC sequence and DH sequence is no less than 40kWh/m ²							

1.6. Performance at STC after initial stabilization

Test Date [YYYY-MM-DD].....:				2023-10-08			—
Test method.....:				☒ Simulator ☐ Natural sunlight			—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Result
0230919-21-2	52.030	44.301	13.452	12.812	567.583	81.09	—
0230919-21-3	52.066	44.347	13.475	12.795	567.436	80.88	—
0230919-21-4	52.023	44.290	13.466	12.841	568.728	81.19	—
0230919-21-5	52.034	44.159	13.458	12.828	566.451	80.89	—
0230919-21-8	52.017	44.408	13.445	12.813	568.995	81.36	—
0230919-21-9	51.952	44.369	13.476	12.826	569.057	81.28	—
0230919-21-10	51.917	44.377	13.502	12.795	567.804	81.00	—
0230919-21-11	51.827	44.103	13.492	12.865	567.364	81.14	—
0230919-21-12	51.746	44.052	13.498	12.886	567.637	81.27	—
0230919-21-13	51.811	44.104	13.507	12.862	567.279	81.06	—
0230919-21-14	51.952	44.296	13.455	12.815	567.653	81.21	—
0230919-21-15	52.004	44.254	13.428	12.823	567.467	81.26	—
Supplementary information: NA							

1.7. Performance at STC after initial stabilization (back side)

Test Date [YYYY-MM-DD].....:				2023-10-08			—
Test method.....:				☒ Simulator ☐ Natural sunlight			—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Result
0230919-21-2	51.547	45.030	10.383	9.188	413.739	77.30	—
0230919-21-3	51.541	45.198	12.057	9.107	411.636	66.24	—
0230919-21-4	51.382	45.470	10.990	9.008	409.614	72.54	—
0230919-21-5	51.586	44.874	10.854	9.304	417.513	74.57	—
0230919-21-8	51.570	44.917	10.911	9.228	414.494	73.67	—
0230919-21-9	51.502	45.068	10.821	9.251	416.933	74.81	—
0230919-21-10	51.608	44.735	10.728	9.173	410.370	74.12	—
0230919-21-11	51.521	44.919	10.733	9.293	417.449	75.49	—

0230919-21-12	51.502	44.841	10.895	9.256	415.038	73.97	—
0230919-21-13	51.502	44.935	10.738	9.275	416.784	75.37	—
0230919-21-14	51.482	44.921	10.839	9.173	412.060	73.84	—
0230919-21-15	51.535	44.850	10.835	9.236	414.233	74.18	—
Supplementary information: NA							

1.8. Performance at BNPI after initial stabilization

Test Date [YYYY-MM-DD]..... :			2023-10-08				—
Test method			☒ Simulator ☐ Natural sunlight				—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Result
0230919-21-2	52.133	44.284	14.779	14.078	623.445	80.92	—
0230919-21-3	52.194	44.368	15.212	14.027	622.363	78.39	—
0230919-21-4	52.190	44.360	14.776	14.075	624.358	80.96	—
0230919-21-5	52.143	44.348	14.785	14.075	624.191	80.96	—
0230919-21-8	52.294	44.467	14.798	14.097	626.875	81.01	—
0230919-21-9	52.288	44.436	14.793	14.093	626.219	80.96	—
0230919-21-10	52.214	44.391	14.774	14.069	624.553	80.96	—
0230919-21-11	52.125	44.278	14.774	14.081	623.479	80.96	—
0230919-21-12	52.159	44.335	14.770	14.066	623.628	80.95	—
0230919-21-13	52.168	44.365	14.773	14.060	623.768	80.94	—
Supplementary information: NA							

1.9. Performance at Low irradiance (200w/m²) after initial stabilization

Test Date [YYYY-MM-DD]..... :		2023-10-08					—
Test method		☒ Simulator ☐ Natural sunlight					—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Result
0230919-21-2	49.770	42.915	2.682	2.575	110.506	82.79	—
0230919-21-3	49.978	42.842	2.685	2.568	110.018	81.99	—
0230919-21-4	48.690	42.444	2.685	2.587	109.803	83.99	—
0230919-21-5	48.583	42.282	2.682	2.579	109.045	83.69	—
0230919-21-8	49.907	42.766	2.681	2.580	110.336	82.46	—
0230919-21-9	49.567	42.726	2.686	2.565	109.592	82.32	—
0230919-21-10	49.059	42.795	2.691	2.576	110.240	83.50	—
0230919-21-11	48.416	42.224	2.690	2.586	109.191	83.84	—
0230919-21-12	48.315	41.938	2.690	2.592	108.703	83.64	—
0230919-21-13	48.445	42.333	2.692	2.589	109.600	84.04	—
0230919-21-14	49.512	42.483	2.681	2.574	109.351	82.38	—
0230919-21-15	49.434	42.849	2.676	2.584	110.722	83.70	—
Supplementary information: NA							

2. Thermal Cycling Test

2.1. Visual Inspection Results

Visual inspection was performed according to IEC 61215-2:2021 prior to and after HALT. No major visual defects were found throughout testing.

Visual Inspection Pass/Fail Results			
Model	Sample No.	Nature and position of initial findings	Pass/Fail
PS-MNG144(HCBF)-570W	0230919-21-2	No major visible defect	Pass
PS-MNG144(HCBF)-570W	0230919-21-3	No major visible defect	Pass

2.2. Insulation Test Data

Insulation test was performed according to IEC 61215-2:2021 prior to and after HALT. Insulation resistance shall be no less than 40 MΩ·m².

Insulation Test Data					
Size of the module: 2.58 [m²]					
Test Voltage applied: 8000, 1500[V]					
Data	Model	Sample No.	Insulation Resistance		Pass/Fail
			Measured [GΩ]	Required [MΩ]	
Pre-HALT Testing Data	PS-MNG144(HCBF)-570W	0230919-21-2	10	15.5	Pass
		0230919-21-3	10	15.5	Pass
Post-TC200 Testing Data		0230919-21-2	10	15.5	Pass
		0230919-21-3	10	15.5	Pass
Post-TC400 Testing Data		0230919-21-2	10	15.5	Pass
		0230919-21-3	10	15.5	Pass
Post-TC600 Testing Data		0230919-21-2	10	15.5	Pass
		0230919-21-3	10	15.5	Pass
Supplementary information: Maximum resistance measurement range is 10GΩ.					

2.3. Wet Leakage Current Test Data

IEC 61215-2:2021 Clause. 10.15 defines a passing insulation resistance for the type of module tested to be no less than 40 MΩ·m².

Wet Leakage Current Test Data					
Size of the module: 2.58 [m²]					
Test Voltage applied: 1500 [V]					
Data	Model	Sample No.	Insulation Resistance		Pass/Fail
			Measured [GΩ]	Required [MΩ]	
Pre-HALT Testing Data	PS-MNG144(HCBF)-570W	0230919-21-2	10	15.5	Pass
		0230919-21-3	10	15.5	Pass
Post-TC200 Testing Data		0230919-21-2	10	15.5	Pass
		0230919-21-3	10	15.5	Pass
Post-TC400 Testing Data		0230919-21-2	10	15.5	Pass
		0230919-21-3	10	15.5	Pass
Post-TC600 Testing Data		0230919-21-2	10	15.5	Pass
		0230919-21-3	10	15.5	Pass

Supplementary information: Maximum resistance measurement range is 10GΩ.

2.4. Maximum Power Determination Data at STC

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-2				Irradiance: 1000 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	52.030	44.301	13.452	12.812	567.583	81.09	—
Pre-HALT Testing Data-Rear Side	51.547	45.030	10.383	9.188	413.739	77.30	—
Pre-HALT Testing Data-BNPI	52.133	44.284	14.779	14.078	623.445	80.92	—
Post-TC200 Testing Data-Front Side	52.153	44.465	13.282	12.653	562.632	81.23	-0.87
Post-TC200 Testing Data-Rear Side	51.519	45.164	12.020	9.027	407.675	65.83	-1.47
Post-TC200 Testing Data-BNPI	52.300	44.490	14.642	13.934	619.925	80.95	-0.56
Post-TC400 Testing Data-Front Side	51.863	44.123	13.368	12.733	561.803	81.03	-1.02
Post-TC400 Testing Data-Rear Side	51.520	45.163	12.026	9.032	407.926	65.84	-1.40
Post-TC400 Testing Data-BNPI	52.242	44.453	14.650	13.933	619.385	80.93	-0.65
Post-TC600 Testing Data-Front Side	51.884	44.153	13.343	12.703	560.879	81.02	-1.18
Post-TC600 Testing Data-Rear Side	51.518	45.162	12.025	9.024	407.542	65.78	-1.50
Post-TC600 Testing Data-BNPI	52.250	44.465	14.614	13.899	618.006	80.93	-0.87

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-3				Irradiance: 1000 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]

Pre-HALT Testing Data-Front Side	52.066	44.347	13.475	12.795	567.436	80.88	—
Pre-HALT Testing Data-Rear Side	51.541	45.198	12.057	9.107	411.636	66.24	—
Pre-HALT Testing Data-BNPI	52.194	44.368	15.212	14.027	622.363	78.39	—
Post-TC200 Testing Data-Front Side	52.002	44.264	13.380	12.685	561.498	80.70	-1.05
Post-TC200 Testing Data-Rear Side	51.523	45.160	12.019	9.019	407.322	65.77	-1.05
Post-TC200 Testing Data-BNPI	52.152	44.354	15.146	13.887	615.943	77.98	-1.03
Post-TC400 Testing Data-Front Side	52.013	44.287	13.371	12.671	561.141	80.69	-1.11
Post-TC400 Testing Data-Rear Side	51.522	45.162	12.022	9.024	407.553	65.80	-0.99
Post-TC400 Testing Data-BNPI	52.169	44.372	15.143	13.878	615.804	77.95	-1.05
Post-TC600 Testing Data-Front Side	51.995	44.267	13.353	12.647	559.851	80.64	-1.34
Post-TC600 Testing Data-Rear Side	51.522	45.162	12.022	9.023	407.503	65.79	-1.00
Post-TC600 Testing Data-BNPI	52.140	44.344	15.126	13.852	614.234	77.88	-1.31

2.5. Performance at Low irradiance (200w/m²) Post HALT test

Test Date [YYYY-MM-DD]..... :		2023-10-08					—
Test method		☒ Simulator ☐ Natural sunlight					—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
0230919-21-2	49.096	42.671	2.660	2.559	109.195	83.61	-1.19
0230919-21-3	49.584	42.581	2.661	2.543	108.283	82.07	-1.58

2.6. Bypass diode functionality test

IEC 61215-2: 2021 ED. 2.0 CL. 4.18.2 defines this bypass diode functionality test is to verify that the bypass diode(s) of the test samples remain(s) functional following the HALT.

Bypass diode functionality test Data		
Sample No.	Diode No.	Pass/Fail

	D1	D2	D3	
0230919-21-2	Yes	Yes	Yes	Pass
0230919-21-3	Yes	Yes	Yes	Pass

3. Damp Heat Test

3.1. Visual Inspection Results

Visual inspection was performed according to IEC 61215-2:2021 prior to and after HALT. No major visual defects were found throughout testing.

Visual Inspection Pass/Fail Results			
Model	Sample No.	Nature and position of initial findings	Pass/Fail
PS-MNG144(HCBF)-570W	0230919-21-4	No major visible defect	Pass
PS-MNG144(HCBF)-570W	0230919-21-5	No major visible defect	Pass

3.2. Insulation Test Data

Insulation test was performed according to IEC 61215-2:2021 prior to and after HALT. Insulation resistance shall be no less than 40 MΩ·m².

Insulation Test Data					
Size of the module: 2.58 [m²]					
Test Voltage applied: 8000, 1500[V]					
Data	Model	Sample No.	Insulation Resistance		Pass/Fail
			Measured [GΩ]	Required [MΩ]	
Pre-HALT Testing Data	PS-MNG144(HCBF)-570W	0230919-21-4	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-5	10	15.5	Pass
Post-DH1000 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-4	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-5	10	15.5	Pass
Post-DH2000 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-4	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-5	10	15.5	Pass
Supplementary information: Maximum resistance measurement range is 10GΩ.					

3.3. Wet Leakage Current Test Data

IEC 61215-2:2021 Clause. 10.15 defines a passing insulation resistance for the type of module tested to be no less than 40 MΩ·m².

Wet Leakage Current Test Data					
Size of the module: 2.58 [m²]					
Test Voltage applied: 1500 [V]					
Data	Model	Sample No.	Insulation Resistance		Pass/Fail
			Measured [GΩ]	Required [MΩ]	
Pre-HALT Testing Data	PS-MNG144(HCBF)-570W	0230919-21-4	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-5	10	15.5	Pass
Post-DH1000 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-4	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-5	10	15.5	Pass
Post-DH2000 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-4	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-5	10	15.5	Pass

Supplementary information: Maximum resistance measurement range is 10GΩ.

3.4. Maximum Power Determination Data at STC

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-4				Irradiance: 1000 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	52.023	44.290	13.466	12.841	568.728	81.19	—
Pre-HALT Testing Data-Rear Side	51.382	45.470	10.990	9.008	409.614	72.54	—
Pre-HALT Testing Data-BNPI	52.190	44.360	14.776	14.075	624.358	80.96	—
Post-DH1000 Testing Data-Front Side	52.039	44.343	13.450	12.722	564.109	80.59	-0.81
Post-DH1000 Testing Data-Rear Side	51.516	45.164	12.024	9.030	407.831	65.84	-0.44
Post-DH1000 Testing Data-BNPI	52.203	44.452	15.281	13.926	619.018	77.60	-0.86
Post- DH2000 Testing Data-Front Side	51.464	43.793	13.453	12.779	559.631	80.84	-1.60
Post- DH2000 Testing Data-Rear Side	51.075	44.711	12.033	9.046	404.456	65.81	-1.26
Post- DH2000 Testing Data-BNPI	56.476	43.947	15.289	13.940	612.622	70.95	-1.88

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-5				Irradiance: 1000 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	52.034	44.159	13.458	12.828	566.451	80.89	—
Pre-HALT Testing Data-Rear Side	51.586	44.874	10.854	9.304	417.513	74.57	—
Pre-HALT Testing Data-BNPI	52.143	44.348	14.785	14.075	624.191	80.96	—

Post-DH1000 Testing Data-Front Side	52.080	44.439	13.384	12.714	564.982	81.06	-0.26
Post-DH1000 Testing Data-Rear Side	51.616	44.886	11.166	9.308	417.804	72.49	0.07
Post-DH1000 Testing Data-BNPI	52.148	44.308	14.770	14.062	623.069	80.90	-0.18
Post- DH2000 Testing Data-Front Side	51.552	43.891	13.418	12.813	562.376	81.31	-0.72
Post- DH2000 Testing Data-Rear Side	50.884	44.301	11.155	9.386	415.810	73.26	-0.41
Post- DH2000 Testing Data-BNPI	56.695	43.778	14.785	14.097	617.139	73.63	-1.13

3.5. Performance at Low irradiance (200w/m²) Post HALT test

Test Date [YYYY-MM-DD]..... :			2023-10-08				—
Test method			☒ Simulator ☐ Natural sunlight				—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
0230919-21-4	47.997	42.008	2.681	2.569	107.919	83.87	-1.72
0230919-21-5	48.251	41.897	2.675	2.578	108.010	83.68	-0.95

3.6. Bypass diode functionality test

IEC 61215-2: 2021 ED. 2.0 CL. 4.18.2 defines this bypass diode functionality test is to verify that the bypass diode(s) of the test samples remain(s) functional following the HALT.

Bypass diode functionality test Data				
Sample No.	Diode No.			Pass/Fail
	D1	D2	D3	
0230919-21-4	Yes	Yes	Yes	Pass
0230919-21-5	Yes	Yes	Yes	Pass

4. Mechanical Stress Sequence

4.1. Visual Inspection Results

Visual inspection was performed according to IEC 61215-2:2021 prior to and after HALT. No major visual defects were found throughout testing.

Visual Inspection Pass/Fail Results			
Model	Sample No.	Nature and position of initial findings	Pass/Fail
PS-MNG144(HCBF)-570W	0230919-21-8	No major visible defect	Pass
PS-MNG144(HCBF)-570W	0230919-21-9	No major visible defect	Pass

4.2. Insulation Test Data

Insulation test was performed according to IEC 61215-2:2021 prior to and after HALT. Insulation resistance shall be no less than 40 MΩ·m².

Insulation Test Data					
Size of the module: 2.58 [m ²]					
Test Voltage applied: 8000, 1500[V]					
Data	Model	Sample No.	Insulation Resistance		Pass/Fail
			Measured [GΩ]	Required [MΩ]	
Pre-HALT Testing Data	PS-MNG144(HCBF)-570W	0230919-21-8	10	15.5	Pass
Pre-HALT Testing Data	PS-MNG144(HCBF)-570W	0230919-21-9	10	15.5	Pass
Post-SML Testing Data	PS-MNG144(HCBF)-570W	0230919-21-8	10	15.5	Pass
Post-SML Testing Data	PS-MNG144(HCBF)-570W	0230919-21-9	10	15.5	Pass
Post-DML 1000 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-8	10	15.5	Pass
Post-DML 1000 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-9	10	15.5	Pass
Post-TC50 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-8	10	15.5	Pass
Post-TC50 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-9	10	15.5	Pass
Post-HF10 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-8	10	15.5	Pass
Post-HF10 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-9	10	15.5	Pass
Supplementary information: Maximum resistance measurement range is 10GΩ.					

4.3. Wet Leakage Current Test Data

IEC 61215-2:2021 Clause. 10.15 defines a passing insulation resistance for the type of module tested to be no less than 40 MΩ·m².

Wet Leakage Current Test Data	
Size of the module: 2.58 [m ²]	
Test Voltage applied: 1500 [V]	

Data	Model	Sample No.	Insulation Resistance		Pass/Fail
			Measured [GΩ]	Required [MΩ]	
Pre-HALT Testing Data	PS-MNG144(HCBF)-570W	0230919-21-8	10	15.5	Pass
Pre-HALT Testing Data	PS-MNG144(HCBF)-570W	0230919-21-9	10	15.5	Pass
Post-SML Testing Data	PS-MNG144(HCBF)-570W	0230919-21-8	10	15.5	Pass
Post-SML Testing Data	PS-MNG144(HCBF)-570W	0230919-21-9	10	15.5	Pass
Post-DML 1000 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-8	10	15.5	Pass
Post-DML 1000 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-9	10	15.5	Pass
Post-TC50 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-8	10	15.5	Pass
Post-TC50 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-9	10	15.5	Pass
Post-HF10 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-8	10	15.5	Pass
Post-HF10 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-9	10	15.5	Pass
Supplementary information: Maximum resistance measurement range is 10GΩ.					

4.4. Maximum Power Determination Data at STC

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-8				Irradiance: 1000 / 200 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	52.017	44.408	13.445	12.813	568.995	81.36	—
Pre-HALT Testing Data-Rear Side	51.570	44.917	10.911	9.228	414.494	73.67	—
Pre-HALT Testing Data-BNPI	52.294	44.467	14.798	14.097	626.875	81.01	—
Post-SML Testing Data-Front Side	51.979	44.373	13.444	12.814	568.613	81.37	-0.07
Post-SML Testing Data-Rear Side	51.548	45.211	12.063	9.147	413.537	66.51	-0.23
Post-SML Testing Data-BNPI	52.289	44.465	14.786	14.078	626.000	80.97	-0.14
Post-DML1000 Testing Data-Front Side	51.994	44.375	13.445	12.808	568.366	81.31	-0.11
Post-DML1000 Testing Data-Rear Side	51.551	45.215	12.067	9.151	413.772	66.52	-0.17
Post-DML1000 Testing Data-BNPI	52.289	44.457	14.802	14.096	626.668	80.97	-0.03
Post-TC50 Testing Data-Front Side	51.955	44.357	13.476	12.780	566.862	80.96	-0.37
Post-TC50 Testing Data-Rear Side	51.551	45.215	12.060	9.148	413.646	66.54	-0.20

Post-TC50 Testing Data-BNPI	52.241	44.525	14.799	13.952	621.231	80.36	-0.90
Post-HF10 Testing Data-Front Side	51.955	44.271	13.279	12.627	559.030	81.03	-1.75
Post-HF10 Testing Data-Rear Side	51.324	44.369	11.014	9.175	407.082	72.01	-1.79
Post-HF10 Testing Data-BNPI	52.077	44.521	14.703	13.812	614.919	80.31	-1.91

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-9				Irradiance: 1000 / 200 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	51.952	44.369	13.476	12.826	569.057	81.28	—
Pre-HALT Testing Data-Rear Side	51.502	45.068	10.821	9.251	416.933	74.81	—
Pre-HALT Testing Data-BNPI	52.288	44.436	14.793	14.093	626.219	80.96	—
Post-SML Testing Data-Front Side	51.939	44.306	13.465	12.835	568.656	81.31	-0.07
Post-SML Testing Data-Rear Side	51.458	44.737	11.127	9.259	414.209	72.34	-0.65
Post-SML Testing Data-BNPI	52.273	44.431	14.797	14.089	625.972	80.93	-0.04
Post-DML1000 Testing Data-Front Side	51.883	44.287	13.481	12.835	568.438	81.27	-0.11
Post-DML1000 Testing Data-Rear Side	51.394	44.747	11.481	9.241	413.496	70.08	-0.82
Post-DML1000 Testing Data-BNPI	52.272	44.418	14.794	14.087	625.718	80.91	-0.08
Post-TC50 Testing Data-Front Side	52.020	44.339	13.370	12.745	565.090	81.25	-0.70
Post-TC50 Testing Data-Rear Side	51.553	45.213	12.065	9.151	413.752	66.52	-0.76
Post-TC50 Testing Data-BNPI	52.247	44.528	14.898	13.948	621.091	79.79	-0.82
Post-HF10 Testing Data-Front Side	51.948	44.239	13.277	12.628	558.652	81.00	-1.83
Post-HF10 Testing Data-Rear Side	51.551	45.211	12.067	9.147	413.531	66.48	-0.82
Post-HF10 Testing Data-BNPI	52.051	44.300	14.734	13.856	613.811	80.04	-1.98

4.5. Performance at Low irradiance (200w/m²) Post HALT test

Test Date [YYYY-MM-DD]..... :				2023-10-08			—
Test method				☒ Simulator ☐ Natural sunlight			—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
0230919-21-8	49.836	42.930	2.646	2.543	109.171	82.79	-1.06
0230919-21-9	49.762	42.669	2.646	2.537	108.251	82.21	-1.22

4.6. Bypass diode functionality test

IEC 61215-2: 2021 ED. 2.0 CL. 4.18.2 defines this bypass diode functionality test is to verify that the bypass diode(s) of the test samples remain(s) functional following the HALT.

Bypass diode functionality test Data				
Sample No.	Diode No.			Pass/Fail
	D1	D2	D3	
0230919-21-8	Yes	Yes	Yes	Pass
0230919-21-9	Yes	Yes	Yes	Pass

5. Potential Induced Degradation (PID) Test

5.1. Visual Inspection Results

Visual inspection was performed according to IEC 61215-2:2021 prior to and after HALT. No major visual defects were found throughout testing.

Visual Inspection Pass/Fail Results			
Model	Sample No.	Nature and position of initial findings	Pass/Fail
PS-MNG144(HCBF)-570W	0230919-21-10	No major visible defect	Pass
PS-MNG144(HCBF)-570W	0230919-21-11	No major visible defect	Pass
PS-MNG144(HCBF)-570W	0230919-21-12	No major visible defect	Pass
PS-MNG144(HCBF)-570W	0230919-21-13	No major visible defect	Pass

5.2. Insulation Test Data

Insulation test was performed according to IEC 61215-2:2021 prior to and after HALT. Insulation resistance shall be no less than 40 MΩ·m².

Insulation Test Data					
Size of the module: 2.58 [m²]					
Test Voltage applied: 8000, 1500[V]					
Data	Model	Sample No.	Insulation Resistance		Pass /Fail
			Measured [GΩ]	Required [MΩ]	
Pre-HALT Testing Data	PS-MNG144(HCBF)-570W	0230919-21-10	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-11	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-12	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-13	10	15.5	Pass
Post-PID96 (-) Testing Data	PS-MNG144(HCBF)-570W	0230919-21-10	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-11	10	15.5	Pass
Post-PID96 (+) Testing Data	PS-MNG144(HCBF)-570W	0230919-21-12	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-13	10	15.5	Pass
Post-PID192 (-) Testing Dat	PS-MNG144(HCBF)-570W	0230919-21-10	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-11	10	15.5	Pass
Post-PID192 (+) Testing Data	PS-MNG144(HCBF)-570W	0230919-21-12	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-13	10	15.5	Pass
Supplementary information: Maximum resistance measurement range is 10GΩ.					

5.3. Wet Leakage Current Test Data

IEC 61215-2:2021 Clause. 10.15 defines a passing insulation resistance for the type of

module tested to be no less than 40 MΩ·m².

Wet Leakage Current Test Data					
Size of the module: 2.58 [m ²]					
Test Voltage applied: 1500 [V]					
Data	Model	Sample No.	Insulation Resistance		Pass/ Fail
			Measured [GΩ]	Required [MΩ]	
Pre-HALT Testing Data	PS-MNG144(HCBF)-570W	0230919-21-10	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-11	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-12	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-13	10	15.5	Pass
Post-PID96 (-) Testing Data	PS-MNG144(HCBF)-570W	0230919-21-10	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-11	10	15.5	Pass
Post-PID96 (+) Testing Data	PS-MNG144(HCBF)-570W	0230919-21-12	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-13	10	15.5	Pass
Post-PID192 (-) Testing Dat	PS-MNG144(HCBF)-570W	0230919-21-10	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-11	10	15.5	Pass
Post-PID192 (+) Testing Data	PS-MNG144(HCBF)-570W	0230919-21-12	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-13	10	15.5	Pass
Supplementary information: Maximum resistance measurement range is 10GΩ.					

5.4. Maximum Power Determination Data at STC

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-10				Irradiance: 1000 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	51.917	44.377	13.502	12.795	567.804	81.00	—
Pre-HALT Testing Data-Rear Side	51.608	44.735	10.728	9.173	410.370	74.12	—
Pre-HALT Testing Data-BNPI	52.214	44.391	14.774	14.069	624.553	80.96	—
Post-PID96 (-) Testing Data-Front Side	51.844	43.897	13.375	12.608	553.444	79.81	-2.53
Post-PID96 (-) Testing Data-Rear Side	51.371	45.019	10.687	9.072	408.397	74.39	-0.48
Post-PID96 (-) Testing Data-BNPI	52.160	44.106	14.540	13.750	606.452	79.96	-2.90
Post-PID192 (-) Testing Data-Front Side	51.894	44.034	13.253	12.532	551.850	80.24	-2.81
Post-PID192 (-) Testing Data-Rear Side	51.551	45.219	10.635	9.099	411.447	75.05	0.26

Post-PID192 (-) Testing Data-BNPI	52.180	44.142	14.555	13.759	607.347	79.97	-2.75
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Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-11				Irradiance: 1000 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	51.827	44.103	13.492	12.865	567.364	81.14	—
Pre-HALT Testing Data-Rear Side	51.521	44.919	10.733	9.293	417.449	75.49	—
Pre-HALT Testing Data-BNPI	52.125	44.278	14.774	14.081	623.479	80.96	—
Post-PID96 (-) Testing Data-Front Side	51.862	43.995	13.318	12.731	560.116	81.10	-1.28
Post-PID96 (-) Testing Data-Rear Side	51.453	45.189	10.501	9.098	411.145	76.09	-1.51
Post-PID96 (-) Testing Data-BNPI	52.583	44.893	14.604	13.920	624.918	81.38	0.23
Post-PID192 (-) Testing Data-Front Side	51.399	43.861	13.267	12.529	549.534	80.59	-3.14
Post-PID192 (-) Testing Data-Rear Side	50.917	45.090	10.725	9.096	410.139	75.11	-1.75
Post-PID192 (-) Testing Data-BNPI	51.560	43.879	14.571	13.777	604.521	80.47	-3.04

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-12				Irradiance: 1000 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	51.746	44.052	13.498	12.886	567.637	81.27	—
Pre-HALT Testing Data-Rear Side	51.502	44.841	10.895	9.256	415.038	73.97	—
Pre-HALT Testing Data-BNPI	52.159	44.335	14.770	14.066	623.628	80.95	—
Post-PID96 (-) Testing Data-Front Side	52.161	44.555	13.333	12.723	566.866	81.51	-0.14
Post-PID96 (-) Testing Data-Rear Side	51.760	45.006	11.170	9.202	414.125	71.63	-0.22

Post-PID96 (-) Testing Data-BNPI	52.187	44.388	14.512	13.857	615.108	81.22	-1.37
Post-PID192 (-) Testing Data-Front Side	51.928	44.296	13.226	12.630	559.473	81.46	-1.44
Post-PID192 (-) Testing Data-Rear Side	51.614	45.040	10.984	9.050	407.602	71.90	-1.79
Post-PID192 (-) Testing Data-BNPI	52.155	44.412	14.517	13.862	615.633	81.31	-1.28

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-13				Irradiance: 1000 [W/m²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	51.811	44.104	13.507	12.862	567.279	81.06	—
Pre-HALT Testing Data-Rear Side	51.502	44.935	10.738	9.275	416.784	75.37	—
Pre-HALT Testing Data-BNPI	52.168	44.365	14.773	14.060	623.768	80.94	—
Post-PID96 (-) Testing Data-Front Side	52.077	44.595	13.386	12.716	567.074	81.35	-0.04
Post-PID96 (-) Testing Data-Rear Side	51.659	45.150	10.978	9.259	418.046	73.71	0.30
Post-PID96 (-) Testing Data-BNPI	52.266	44.542	14.604	13.918	619.953	81.22	-0.61
Post-PID192 (-) Testing Data-Front Side	52.071	44.494	13.279	12.659	563.227	81.45	-0.71
Post-PID192 (-) Testing Data-Rear Side	51.703	45.212	10.688	9.136	413.035	74.75	-0.90
Post-PID192 (-) Testing Data-BNPI	52.278	44.558	14.589	13.909	619.766	81.26	-0.64

5.5. Performance at Low irradiance (200w/m²) Post HALT test

Test Date [YYYY-MM-DD]..... :			2023-10-08				—
Test method			☒ Simulator ☐ Natural sunlight				—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
0230919-21-10	49.323	42.655	2.642	2.525	107.704	82.65	-2.30
0230919-21-11	49.180	42.562	2.672	2.559	108.896	82.88	-0.27

0230919-21-12	48.991	42.395	2.650	2.543	107.800	83.03	-0.83
0230919-21-13	49.109	42.518	2.663	2.550	108.429	82.92	-1.07

5.6. Bypass diode functionality test

IEC 61215-2: 2021 ED. 2.0 CL. 4.18.2 defines this bypass diode functionality test is to verify that the bypass diode(s) of the test samples remain(s) functional following the HALT.

Bypass diode functionality test Data				
Sample No.	Diode No.			Pass/Fail
	D1	D2	D3	
0230919-21-10	Yes	Yes	Yes	Pass
0230919-21-11	Yes	Yes	Yes	Pass
0230919-21-12	Yes	Yes	Yes	Pass
0230919-21-13	Yes	Yes	Yes	Pass

6. Light and elevated temperature induced degradation (LeTID) test

6.1. Visual Inspection Results

Visual inspection was performed according to IEC 61215-2:2021 prior to and after HALT. No major visual defects were found throughout testing.

Visual Inspection Pass/Fail Results			
Model	Sample No.	Nature and position of initial findings	Pass/Fail
PS-MNG144(HCBF)-570W	0230919-21-14	No major visible defect	Pass
PS-MNG144(HCBF)-570W	0230919-21-15	No major visible defect	Pass

6.2. Insulation Test Data

Insulation test was performed according to IEC 61215-2:2021 prior to and after HALT. Insulation resistance shall be no less than 40 MΩ·m².

Insulation Test Data					
Size of the module: 2.58 [m ²]					
Test Voltage applied: 8000, 1500[V]					
Data	Model	Sample No.	Insulation Resistance		Pass/Fail
			Measured [GΩ]	Required [MΩ]	
Pre-HALT Testing Data	PS-MNG144(HCBF)-570W	0230919-21-14	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-15	10	15.5	Pass
Post-LeTID162 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-14	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-15	10	15.5	Pass
Post-LeTID324 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-14	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-15	10	15.5	Pass
Post-LeTID486 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-14	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-15	10	15.5	Pass
Supplementary information: Maximum resistance measurement range is 10GΩ.					

6.3. Wet Leakage Current Test Data

IEC 61215-2:2021 Clause. 10.15 defines a passing insulation resistance for the type of module tested to be no less than 40 MΩ·m².

Wet Leakage Current Test Data					
Size of the module: 2.58 [m ²]					
Test Voltage applied: 1500 [V]					
Data	Model	Sample No.	Insulation Resistance		Pass/Fail
			Measured [GΩ]	Required [MΩ]	
Pre-HALT Testing Data	PS-MNG144(HCBF)-570W	0230919-21-14	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-15	10	15.5	Pass
Post-LeTID162	PS-MNG144(HCBF)-570W	0230919-21-14	10	15.5	Pass

Testing Data	PS-MNG144(HCBF)-570W	0230919-21-15	10	15.5	Pass
Post-LeTID324 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-14	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-15	10	15.5	Pass
Post-LeTID486 Testing Data	PS-MNG144(HCBF)-570W	0230919-21-14	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-15	10	15.5	Pass
Supplementary information: Maximum resistance measurement range is 10GΩ.					

6.4. Maximum Power Determination Data at STC

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-14				Irradiance: 1000 [W/m²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	51.952	44.296	13.455	12.815	567.653	81.21	—
Pre-HALT Testing Data-Rear Side	51.482	44.921	10.839	9.173	412.060	73.84	—
Pre-HALT Testing Data-BNPI	52.219	44.396	15.207	14.020	622.432	78.38	—
Post-LeTID162 Testing Data-Front Side	52.058	44.337	13.477	12.837	569.161	81.12	0.27
Post-LeTID162 Testing Data-Rear Side	51.575	44.882	10.697	9.163	411.264	74.54	-0.19
Post-LeTID162 Testing Data-BNPI	52.218	44.396	15.223	14.065	624.426	78.55	0.32
Post-LeTID324 Testing Data-Front Side	52.146	44.573	13.482	12.853	572.920	81.49	0.93
Post-LeTID324 Testing Data-Rear Side	51.649	45.284	10.620	9.174	415.443	75.74	0.82
Post-LeTID324 Testing Data-BNPI	52.218	44.403	15.227	14.069	624.700	78.57	0.36
Post-LeTID486 Testing Data-Front Side	51.920	44.338	13.489	12.848	569.669	81.34	0.36
Post-LeTID486 Testing Data-Rear Side	51.584	44.675	11.509	9.160	409.229	68.93	-0.69
Post-LeTID486 Testing Data-BNPI	52.217	44.389	15.215	14.054	623.837	78.52	0.23

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-15				Irradiance: 1000 [W/m²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	52.004	44.254	13.428	12.823	567.467	81.26	—
Pre-HALT Testing Data-Rear Side	51.535	44.850	10.835	9.236	414.233	74.18	—
Pre-HALT Testing Data-BNPI	52.213	44.403	15.205	14.017	622.379	78.40	—
Post-LeTID162 Testing Data-Front Side	52.057	44.316	13.494	12.865	570.138	81.16	0.47
Post-LeTID162 Testing Data-Rear Side	51.580	45.232	10.365	9.225	417.280	78.05	0.74
Post-LeTID162 Testing Data-BNPI	52.219	44.399	15.219	14.051	623.870	78.50	0.24
Post-LeTID324 Testing Data-Front Side	52.159	44.635	13.470	12.861	574.073	81.71	1.16
Post-LeTID324 Testing Data-Rear Side	51.675	45.398	10.520	9.186	417.019	76.71	0.67
Post-LeTID324 Testing Data-BNPI	52.224	44.393	15.236	14.092	625.576	78.62	0.51
Post-LeTID486 Testing Data-Front Side	52.045	44.431	13.505	12.872	571.902	81.37	0.78
Post-LeTID486 Testing Data-Rear Side	51.569	44.773	10.939	9.198	411.808	73.00	-0.59
Post-LeTID486 Testing Data-BNPI	52.219	44.395	15.221	14.053	623.894	78.50	0.24

6.5. Performance at Low irradiance (200w/m²) Post HALT test

Test Date [YYYY-MM-DD]..... :				2023-10-08			—
Test method				☒ Simulator ☐ Natural sunlight			—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
0230919-21-14	48.351	42.289	2.689	2.584	109.275	84.05	-0.07
0230919-21-15	49.321	42.842	2.686	2.579	110.477	83.40	-0.22

6.6. Bypass diode functionality test

IEC 61215-2: 2021 ED. 2.0 CL. 4.18.2 defines this bypass diode functionality test is to verify that the bypass diode(s) of the test samples remain(s) functional following the HALT.

Bypass diode functionality test Data				
Sample No.	Diode No.			Pass/Fail
	D1	D2	D3	
0230919-21-14	Yes	Yes	Yes	Pass
0230919-21-15	Yes	Yes	Yes	Pass

7. Field Exposure

7.1. Visual Inspection Results

Visual inspection was performed according to IEC 61215-2:2021 prior to and after HALT. No major visual defects were found throughout testing.

Visual Inspection Pass/Fail Results			
Model	Sample No.	Nature and position of initial findings	Pass/Fail
PS-MNG144(HCBF)-570W	0230919-21-22	No major visible defect	Pass
PS-MNG144(HCBF)-570W	0230919-21-23	No major visible defect	Pass
PS-MNG144(HCBF)-570W	0230919-21-24	No major visible defect	Pass
PS-MNG144(HCBF)-570W	0230919-21-25	No major visible defect	Pass

7.2. Insulation Test Data

Insulation test was performed according to IEC 61215-2:2021 prior to and after HALT. Insulation resistance shall be no less than 40 MΩ·m².

Insulation Test Data					
Size of the module: 2.58 [m ²]					
Test Voltage applied: 8000, 1500[V]					
Data	Model	Sample No.	Insulation Resistance		Pass/Fail
			Measured [GΩ]	Required [MΩ]	
Pre-HALT Testing Data	PS-MNG144(HCBF)-570W	0230919-21-22	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-23	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-24	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-25	10	15.5	Pass
Post-6 months Field Exposure Testing Data	PS-MNG144(HCBF)-570W	0230919-21-22	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-23	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-24	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-25	10	15.5	Pass
Supplementary information: Maximum resistance measurement range is 10GΩ.					

7.3. Wet Leakage Current Test Data

IEC 61215-2:2021 Clause. 10.15 defines a passing insulation resistance for the type of module tested to be no less than 40 MΩ·m².

Wet Leakage Current Test Data					
Size of the module: 2.58 [m ²]					
Test Voltage applied: 1500 [V]					
Data	Model	Sample No.	Insulation Resistance		Pass/Fail
			Measured [GΩ]	Required [MΩ]	
Pre-HALT	PS-MNG144(HCBF)-570W	0230919-21-22	10	15.5	Pass

Testing Data	PS-MNG144(HCBF)-570W	0230919-21-23	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-24	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-25	10	15.5	Pass
Post-6 months Field Exposure Testing Data	PS-MNG144(HCBF)-570W	0230919-21-22	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-23	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-24	10	15.5	Pass
	PS-MNG144(HCBF)-570W	0230919-21-25	10	15.5	Pass
Supplementary information: Maximum resistance measurement range is 10GΩ.					

7.4. Maximum Power Determination Data at STC

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-22				Irradiance: 1000 [W/m²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	52.099	44.049	13.458	12.81	564.284	80.48	—
Pre-HALT Testing Data-Rear Side	51.687	45.7	10.729	9.07	414.498	74.74	—
Pre-HALT Testing Data-BNPI	52.124	44.052	14.799	14.051	618.971	80.24	—
Post-6 months Field Exposure Testing Data-Front Side	52.157	44.161	13.463	12.812	565.78	80.58	0.27
Post-6 months Field Exposure Testing Data-Rear Side	51.757	45.276	10.702	9.175	415.424	75	0.22
Post-6 months Field Exposure Testing Data-BNPI	52.259	44.242	14.811	14.079	622.888	80.48	0.63

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-23				Irradiance: 1000 [W/m²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	52.104	44.093	13.453	12.792	564.035	80.47	—
Pre-HALT Testing Data-Rear Side	51.699	45.725	10.771	9.066	414.528	74.44	—
Pre-HALT Testing Data-BNPI	52.137	44.068	14.803	14.051	619.212	80.23	—

Post-6 months Field Exposure Testing Data-Front Side	52.154	44.195	13.468	12.82	566.577	80.66	0.45
Post-6 months Field Exposure Testing Data-Rear Side	51.75	45.282	10.69	9.173	415.379	75.09	0.21
Post-6 months Field Exposure Testing Data-BNPI	52.258	44.267	14.804	14.074	623.041	80.53	0.62

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-24				Irradiance: 1000 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	52.109	44.055	13.456	12.801	563.955	80.43	—
Pre-HALT Testing Data-Rear Side	51.693	45.743	10.733	9.063	414.571	74.72	—
Pre-HALT Testing Data-BNPI	52.144	44.072	14.801	14.045	619.001	80.2	—
Post-6 months Field Exposure Testing Data-Front Side	52.152	44.189	13.469	12.82	566.481	80.65	0.45
Post-6 months Field Exposure Testing Data-Rear Side	51.74	45.276	10.681	9.171	415.233	75.14	0.16
Post-6 months Field Exposure Testing Data-BNPI	52.258	44.285	14.808	14.071	623.136	80.52	0.67

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-25				Irradiance: 1000 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	52.115	44.077	13.46	12.803	564.304	80.45	—
Pre-HALT Testing Data-Rear Side	51.712	45.709	10.681	9.072	414.652	75.07	—
Pre-HALT Testing Data-BNPI	52.149	44.055	14.798	14.052	619.062	80.22	—
Post-6 months Field Exposure Testing Data-Front Side	52.156	44.195	13.469	12.831	567.044	80.72	0.49
Post-6 months Field Exposure Testing Data-Rear Side	51.765	45.246	10.619	9.18	415.363	75.56	0.17
Post-6 months Field Exposure Testing Data-BNPI	52.259	44.258	14.803	14.072	622.792	80.51	0.60

7.5. Performance at Low irradiance (200w/m²) Before and Post HALT test

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-22				Irradiance: 200 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	49.113	42.326	2.675	2.566	108.596	82.67	—
Post-6 months Field Exposure Testing Data-Front Side	49.129	42.26	2.677	2.568	108.543	82.52	-0.05

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-23				Irradiance: 200 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	49.115	42.301	2.673	2.565	108.507	82.66	—
Post-6 months Field Exposure Testing Data-Front Side	49.137	42.341	2.678	2.569	108.79	82.67	0.26

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-24				Irradiance: 200 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	49.123	42.286	2.674	2.568	108.59	82.66	—
Post-6 months Field Exposure Testing Data-Front Side	49.14	42.358	2.675	2.568	108.771	82.75	0.17

Maximum Power Determination Data at STC							
Model: PS-MNG144(HCBF)-570W				Module temperature: 25 [°C]			
Sample No.: 0230919-21-25				Irradiance: 200 [W/m ²]			
Data	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Pmp degradation from Pre-HALT Testing Data [%]
Pre-HALT Testing Data-Front Side	49.119	42.316	2.674	2.567	108.612	82.69	—
Post-6 months Field Exposure Testing Data-Front Side	49.144	42.374	2.678	2.569	108.872	82.74	0.24

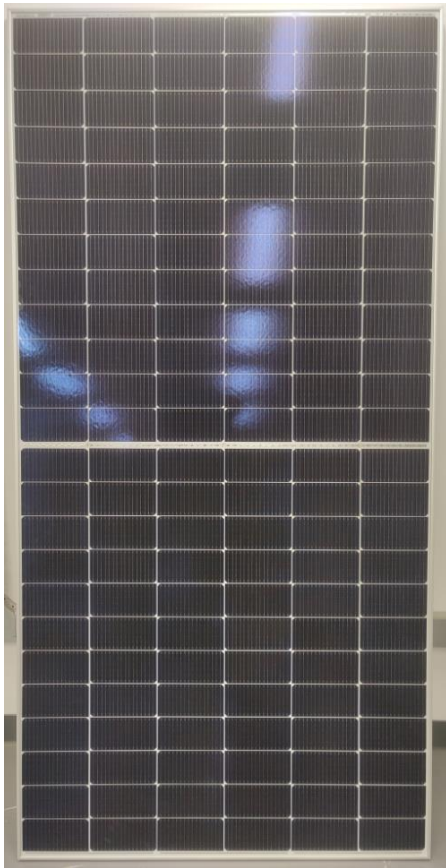
7.6. Bypass diode functionality test

IEC 61215-2: 2021 ED. 2.0 CL. 4.18.2 defines this bypass diode functionality test is to verify that the bypass diode(s) of the test samples remain(s) functional following the HALT.

Bypass diode functionality test Data				
Sample No.	Diode No.			Pass/Fail
	D1	D2	D3	
0230919-21-22	Yes	Yes	Yes	Pass
0230919-21-23	Yes	Yes	Yes	Pass
0230919-21-24	Yes	Yes	Yes	Pass
0230919-21-25	Yes	Yes	Yes	Pass

8. APPENDIX A – Photos

Module_PS-MNG144(HCBF)-570W



9. APPENDIX B – Product Description Sheet

A1.1	MODULE TYPE/S
	PS-M144(HCBF)-xxxW PS-M108(HCBF)-xxxW

A1.2	SOLAR CELL
	Cell type reference 1: M18216BTP10 Philadelphia Solar N type mono crystalline bifacial solar cell 182mm*91mm, 16 busbars
	Cell dimensions L x W (mm).....: 182*91
	Cell thickness (μm): 130μm±30μm

A1.3	IDENTIFICATION OF MATERIALS
	Front cover.....: tempered glass with AR coating Xinyi Solar (M)Sdn. Bhd. 2.0mm thickness
	Rear cover: tempered Pattern glass Xinyi Solar (M)Sdn. Bhd. 2.0mm thickness
	Encapsulate (upper side).....: EP304 HANGZHOU FIRST APPLIED MATERIAL CO., LTD Ethylene Vinyl Acetate (E/VAC), 0.5 mm thickness
	Encapsulate (lower side): F406PS HANGZHOU FIRST APPLIED MATERIAL CO., LTD Ethylene Vinyl Acetate (E/VAC), 0.5 mm thickness
	Frame: 6005-T6, anodized aluminum alloy Jiangsu Goodsun New Energy Co., Ltd.
	Adhesive for frame: HT906Z Shanghai Huitian New Material Co. LTD.
	Flux: Kester 952-S MacDermid Performance Solutions
	Fixing Tape: FF3665-T50 3M Company
	Adhesive for junction box: HT906Z Shanghai Huitian New Material Co. LTD.
	Potting material.....: 5299W-S Shanghai Huitian New Material Co. LTD.
	String Connector.....: Sn 60%/Pb 40 % Taicang Juren International Trade Co., LTD 5mm wide by 0.35m thick, 6mm wide by 0.35m thick
	Cell Connector: Sn 60%/Pb 40 % Taicang Juren International Trade Co., LTD Φ0.26mm

A1.4	IDENTIFICATION OF COMPONENTS	
	Junction box	PV-GZX306 NINGBO GZX PV TECHNOLOGY CO., LTD.
	Cable	H1Z2Z2-K NINGBO GZX PV TECHNOLOGY CO., LTD.
	Connector	PV-KBT4/6II-UR PV-KST4/6II-UR Stäubli Electrical Connectors AG
	Bypass diode	GF5045E NINGBO GZX PV TECHNOLOGY CO., LTD.

10. APPENDIX C – Statement of the estimated uncertainty of the test results

The result of performance rating is only related testing samples that were subject to the test. They cannot be generalized the module from the series production. The calibration to STC was performed with Class AAA solar simulator. The total measurement uncertainty is:

$P_m \leq \pm 2.4\%$

$I_{sc} \leq \pm 2.2\%$

$V_{oc} \leq \pm 1.04\%$

The accuracy of reproduction of the measurement with solar simulator is less than 1%.