

HIGHLY ACCELERATED LIFE AND EXTENDED RELIABILITY TESTING REPORT

Philadelphia Solar

SOLAR MODULE:
PS-MNB144(HCBF)-580W

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Intertek Testing Services Zhejiang Ltd.

Building No.2, Juanhu Science and Technology Innovation Park, No. 500 East Shuiyueting Road, Haining City, Zhejiang Province China

EVALUATION OF

PS-MNB144(HCBF)-580W

RENDERED by

Philadelphia Solar

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

Date of performance of the test item: December 19, 2023 to June 19, 2024

Applicant:

Philadelphia Solar

Contact: Osama Arar

Phone: (+962) 6 4716 601 - Ext.420

Email: o.arar@philadelphia-solar.com

Manufacturer:

Philadelphia Solar

Contact: Osama Arar

Phone: (+962) 6 4716 601 - Ext.420

Email: o.arar@philadelphia-solar.com

Report Reference No.: 240300976SHA-002

Compiled by : Sherwin Zhu

Sherwin Zhu

Approved by : Ken Gu

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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-MNB144(HCBF)-580W 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-MNB144(HCBF)-580W	2277*1133*35	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-MNB144(HCBF)-580W	51.65	14.1	580	43.64	13.33

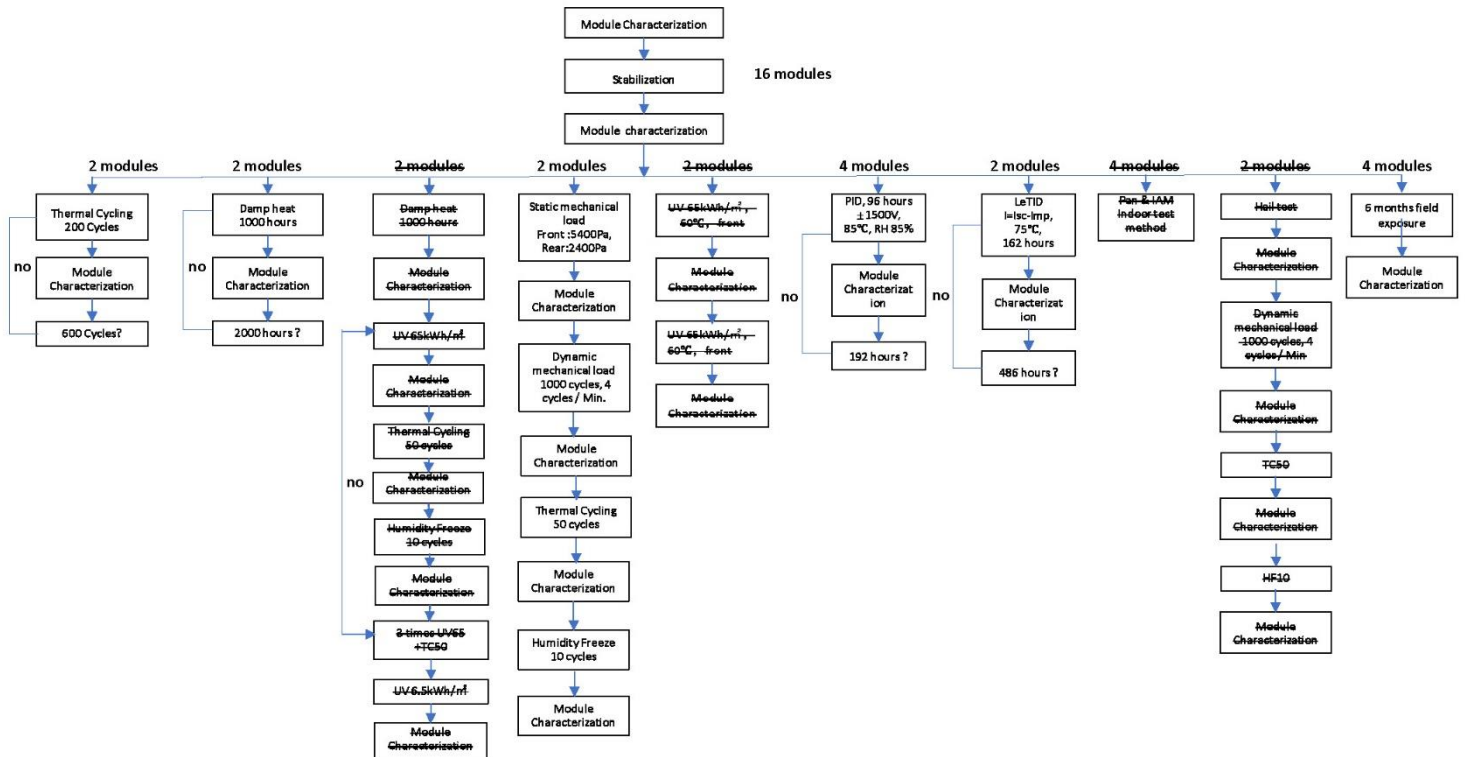
List of Test Samples

List of test samples			
Sample No.	Series No.	Type / model	Remark
0231219-06-02	PS111223BN144000418	PS-MNB144(HCBF)-580W	Thermal Cycling Test
0231219-06-03	PS111223BN144000438	PS-MNB144(HCBF)-580W	Thermal Cycling Test
0231219-06-04	PS111223BN144000436	PS-MNB144(HCBF)-580W	Damp Heat Test
0231219-06-05	PS111223BN144000437	PS-MNB144(HCBF)-580W	Damp Heat Test
0231219-06-08	PS111223BN144000444	PS-MNB144(HCBF)-580W	Mechanical Stress Sequence
0231219-06-09	PS111223BN144000451	PS-MNB144(HCBF)-580W	Mechanical Stress Sequence
0231219-06-10	PS111223BN144000422	PS-MNB144(HCBF)-580W	PID
0231219-06-11	PS111223BN144000459	PS-MNB144(HCBF)-580W	PID
0231219-06-12	PS111223BN144000419	PS-MNB144(HCBF)-580W	PID
0231219-06-13	PS111223BN144000434	PS-MNB144(HCBF)-580W	PID
0231219-06-14	PS111223BN144000424	PS-MNB144(HCBF)-580W	LeTID
0231219-06-15	PS111223BN144000442	PS-MNB144(HCBF)-580W	LeTID
0231219-06-22	PS111223BN144000408	PS-MNB144(HCBF)-580W	Field Exposure
0231219-06-23	PS111223BN144000422	PS-MNB144(HCBF)-580W	Field Exposure
0231219-06-24	PS111223BN144000434	PS-MNB144(HCBF)-580W	Field Exposure
0231219-06-25	PS111223BN144000419	PS-MNB144(HCBF)-580W	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 December 19, 2023 to June 19, 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	—
0231219-06-2	No major visible defect	PASS
0231219-06-3	No major visible defect	PASS
0231219-06-4	No major visible defect	PASS
0231219-06-5	No major visible defect	PASS
0231219-06-8	No major visible defect	PASS
0231219-06-9	No major visible defect	PASS
0231219-06-10	No major visible defect	PASS
0231219-06-11	No major visible defect	PASS
0231219-06-12	No major visible defect	PASS
0231219-06-13	No major visible defect	PASS
0231219-06-14	No major visible defect	PASS
0231219-06-15	No major visible defect	PASS
0231219-06-22	No major visible defect	PASS
0231219-06-23	No major visible defect	PASS
0231219-06-24	No major visible defect	PASS
0231219-06-25	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
0231219-06-2	51.831	44.633	13.633	12.839	573.038	81.10	—
0231219-06-3	51.852	44.746	13.618	12.861	575.490	81.50	—
0231219-06-4	51.935	44.714	13.579	12.826	573.520	81.32	—
0231219-06-5	51.809	44.676	13.617	12.837	573.501	81.29	—
0231219-06-8	52.307	44.492	13.447	12.829	570.780	81.15	—
0231219-06-9	52.367	44.599	13.480	12.853	573.224	81.20	—
0231219-06-10	51.865	44.572	13.586	12.841	572.348	81.22	—
0231219-06-11	51.781	44.564	13.580	12.818	571.218	81.23	—
0231219-06-12	51.772	44.555	13.624	12.832	571.709	81.05	—
0231219-06-13	51.863	44.585	13.599	12.848	572.829	81.22	—

0231219-06-14	52.346	44.513	13.451	12.817	570.544	81.03	—
0231219-06-15	52.377	44.574	13.446	12.827	571.762	81.19	—
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
0231219-06-2	51.348	45.511	10.398	8.338	379.485	71.08	—
0231219-06-3	51.140	45.373	10.666	8.283	375.835	68.90	—
0231219-06-4	51.422	45.224	10.506	8.262	373.639	69.17	—
0231219-06-5	51.286	45.326	10.842	8.278	375.192	67.47	—
0231219-06-8	51.957	45.532	10.346	8.267	376.405	70.02	—
0231219-06-9	51.931	45.272	10.545	8.246	373.332	68.18	—
0231219-06-10	51.354	45.315	10.501	8.245	373.637	69.29	—
0231219-06-11	51.279	45.235	10.743	8.295	375.229	68.11	—
0231219-06-12	51.337	45.259	10.742	8.373	378.931	68.71	—
0231219-06-13	51.349	45.222	10.817	8.311	375.851	67.67	—
0231219-06-14	51.983	45.210	10.507	8.332	376.687	68.97	—
0231219-06-15	51.841	45.296	10.576	8.304	376.139	68.61	—
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
0231219-06-2	52.088	44.684	14.824	13.958	623.711	80.77	—
0231219-06-3	52.121	44.767	14.800	13.986	626.096	81.17	—
0231219-06-4	52.227	44.781	14.757	13.949	624.658	81.05	—
0231219-06-5	52.077	44.700	14.800	13.959	623.950	80.96	—
0231219-06-8	52.598	44.505	14.620	13.950	620.850	80.74	—
0231219-06-9	52.735	44.730	14.637	13.969	624.844	80.95	—
0231219-06-10	52.128	44.668	14.769	13.934	622.410	80.84	—
0231219-06-11	52.039	44.605	14.761	13.926	621.158	80.86	—
0231219-06-12	52.043	44.632	14.806	13.941	622.191	80.75	—

0231219-06-13	52.128	44.659	14.782	13.967	623.781	80.95	—
0231219-06-14	52.684	44.541	14.619	13.937	620.773	80.60	—
0231219-06-15	52.623	44.601	14.617	13.946	621.988	80.86	—
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 #	0231219-06-2	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	—	—	—	—	573.038	—	—
1	20	800-1000	50±10	Micro inverter	572.873	—	—
2	20	800-1000	50±10	Micro inverter	572.710	0.06	Yes

Sample #	0231219-06-3	Test Date (YYYY-MM-DD) start/end			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	575.490	—	—
1	20	800-1000	50±10	Micro inverter	574.834	—	—
2	20	800-1000	50±10	Micro inverter	574.072	0.25	Yes

Sample #	0231219-06-4	Test Date (YYYY-MM-DD) start/end			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	573.520	—	—
1	20	800-1000	50±10	Micro inverter	573.466	—	—
2	20	800-1000	50±10	Micro inverter	573.320	0.03	yes

Sample #	0231219-06-5	Test Date (YYYY-MM-DD) start/end			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)

Initial	—	—	—	—	573.501	—	—
1	20	800-1000	50±10	Micro inverter	572.786	—	—
2	20	800-1000	50±10	Micro inverter	572.554	0.17	yes
Sample #	0231219-06-8	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	—	—	—	—	570.780	—	—
1	5	800-1000	50±10	Micro inverter	570.634	—	—
2	5	800-1000	50±10	Micro inverter	570.553	0.04	yes
Sample #	0231219-06-9	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	—	—	—	—	573.224	—	—
1	5	800-1000	50±10	Micro inverter	573.151	—	—
2	5	800-1000	50±10	Micro inverter	573.758	0.11	yes
Sample #	0231219-06-10	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	—	—	—	—	572.348	—	—
1	5	800-1000	50±10	Micro inverter	572.231	—	—
2	5	800-1000	50±10	Micro inverter	572.040	0.05	yes
Sample #	0231219-06-11	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	—	—	—	—	571.218	—	—
1	5	800-1000	50±10	Micro inverter	571.057	—	—
2	5	800-1000	50±10	Micro inverter	570.882	0.06	yes
Sample #	0231219-06-12	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	—	—	—	—	571.709	—	—
1	5	800-1000	50±10	Micro inverter	571.707	—	—
2	5	800-1000	50±10	Micro inverter	571.613	0.02	yes
Sample #	0231219-06-13	Test Date (YYYY-MM-DD) start/end :			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	(Pmax – Pmin) / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	572.829	—	—
1	5	800-1000	50±10	Micro inverter	573.066	—	—
2	5	800-1000	50±10	Micro inverter	573.125	0.05	yes
Sample #	0231219-06-14	Test Date (YYYY-MM-DD) start/end			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	570.544	—	—
1	5	800-1000	50±10	Micro inverter	570.442	—	—
2	5	800-1000	50±10	Micro inverter	570.087	0.08	yes

Sample #	0231219-06-15	Test Date (YYYY-MM-DD) start/end :			2023-09-20 / 2023-10-08		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	571.762	—	—
1	5	800-1000	50±10	Micro inverter	571.692	—	—
2	5	800-1000	50±10	Micro inverter	571.237	0.09	yes

Supplementary information: Integrated irradiation for TC sequence and DH sequence is no less than 40kWh/m²

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
0231219-06-2	51.397	44.546	13.749	12.856	572.71	81.04	—
0231219-06-3	51.418	44.614	13.724	12.867	574.072	81.36	—
0231219-06-4	51.505	44.729	13.690	12.818	573.32	81.31	—

0231219-06-5	51.378	44.616	13.722	12.833	572.554	81.21	—
0231219-06-8	52.392	44.788	13.391	12.739	570.553	81.32	—
0231219-06-9	52.397	44.771	13.456	12.815	573.758	81.38	—
0231219-06-10	51.464	44.587	13.693	12.830	572.040	81.18	—
0231219-06-11	51.374	44.549	13.684	12.815	570.882	81.21	—
0231219-06-12	51.366	44.525	13.730	12.838	571.613	81.05	—
0231219-06-13	51.460	44.650	13.703	12.836	573.125	81.28	—
0231219-06-14	52.295	44.457	13.457	12.823	570.087	81.01	—
0231219-06-15	52.353	44.514	13.446	12.833	571.237	81.15	—
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
0231219-06-2	50.930	45.416	10.613	8.336	378.605	70.05	—
0231219-06-3	50.717	45.354	10.764	8.283	375.674	68.81	—
0231219-06-4	51.006	45.211	10.595	8.261	373.499	69.12	—
0231219-06-5	50.870	45.245	10.893	8.280	374.622	67.61	—
0231219-06-8	51.947	45.462	10.399	8.267	375.851	69.57	—
0231219-06-9	51.918	44.841	11.789	8.336	373.775	61.07	—
0231219-06-10	50.947	45.267	10.744	8.244	373.167	68.17	—
0231219-06-11	50.859	45.205	10.860	8.299	375.174	67.92	—
0231219-06-12	50.928	45.295	10.735	8.374	379.289	69.38	—
0231219-06-13	50.943	45.184	11.040	8.311	375.523	66.77	—
0231219-06-14	51.981	45.212	10.496	8.331	376.662	69.04	—
0231219-06-15	51.842	45.277	10.690	8.304	375.978	67.84	—
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
0231219-06-2	51.474	44.675	15.000	13.960	623.670	80.77	—
0231219-06-3	51.505	44.761	14.986	13.987	626.088	81.11	—
0231219-06-4	51.509	44.814	14.962	13.937	624.561	81.04	—

0231219-06-5	51.459	44.706	14.976	13.945	623.428	80.90	—
0231219-06-8	52.672	44.801	14.525	13.856	620.771	81.14	—
0231219-06-9	52.677	44.790	14.609	13.941	624.425	81.14	—
0231219-06-10	51.507	44.864	14.943	13.965	626.526	81.40	—
0231219-06-11	51.529	44.769	14.878	13.966	625.244	81.56	—
0231219-06-12	51.449	44.696	14.972	13.972	624.493	81.07	—
0231219-06-13	51.515	44.712	14.959	13.951	623.771	80.94	—
0231219-06-14	52.672	44.537	14.620	13.937	620.721	80.61	
0231219-06-15	52.633	44.590	14.613	13.947	621.906	80.86	
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
0231219-06-2	49.441	42.579	2.676	2.555	108.778	82.23	—
0231219-06-3	49.492	42.720	2.665	2.544	108.676	82.39	—
0231219-06-4	49.184	42.423	2.673	2.552	108.242	82.34	—
0231219-06-5	49.402	42.545	2.670	2.550	108.470	82.23	—
0231219-06-8	49.465	42.599	2.673	2.554	108.810	82.29	—
0231219-06-9	49.514	42.624	2.670	2.553	108.822	82.32	—
0231219-06-10	49.511	42.624	2.670	2.552	108.787	82.30	—
0231219-06-11	49.402	42.508	2.671	2.553	108.520	82.25	—
0231219-06-12	49.443	42.566	2.677	2.557	108.841	82.23	—
0231219-06-13	49.508	42.649	2.666	2.549	108.734	82.40	—
0231219-06-14	49.431	42.756	2.677	2.559	109.394	82.67	—
0231219-06-15	49.574	42.859	2.677	2.564	109.880	82.79	—
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-MNB144(HCBF)-580W	0231219-06-2	No major visible defect	Pass
PS-MNB144(HCBF)-580W	0231219-06-3	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-MNB144(HCBF)-580W	0231219-06-2	10	15.5	Pass
		0231219-06-3	10	15.5	Pass
Post-TC200 Testing Data		0231219-06-2	10	15.5	Pass
		0231219-06-3	10	15.5	Pass
Post-TC400 Testing Data		0231219-06-2	10	15.5	Pass
		0231219-06-3	10	15.5	Pass
Post-TC600 Testing Data		0231219-06-2	10	15.5	Pass
		0231219-06-3	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 [m ²]					
Test Voltage applied: 1500 [V]					
Data	Model	Sample No.	Insulation Resistance		Pass/Fail
			Measured [GΩ]	Required [MΩ]	
Pre-HALT Testing Data	PS-MNB144(HCBF)-580W	0231219-06-2	10	15.5	Pass
		0231219-06-3	10	15.5	Pass
Post-TC200 Testing Data		0231219-06-2	10	15.5	Pass
		0231219-06-3	10	15.5	Pass
Post-TC400 Testing Data		0231219-06-2	10	15.5	Pass
		0231219-06-3	10	15.5	Pass
Post-TC600 Testing Data		0231219-06-2	10	15.5	Pass
		0231219-06-3	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-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-2				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	51.397	44.546	13.749	12.856	572.710	81.04	—
Pre-HALT Testing Data-Rear Side	50.930	45.416	10.613	8.336	378.605	70.05	—
Pre-HALT Testing Data-BNPI	51.474	44.675	15.000	13.960	623.670	80.77	—
Post-TC200 Testing Data-Front Side	52.522	44.736	13.484	12.831	574.023	81.05	0.23
Post-TC200 Testing Data-Rear Side	51.914	45.221	10.523	8.243	372.745	68.23	-1.55
Post-TC200 Testing Data-BNPI	52.696	44.786	14.488	13.775	616.945	80.81	-1.08
Post-TC400 Testing Data-Front Side	52.390	44.778	13.389	12.737	570.361	81.31	-0.41
Post-TC400 Testing Data-Rear Side	51.874	44.793	11.667	8.191	366.889	60.62	-3.09
Post-TC400 Testing Data-BNPI	52.646	44.760	14.264	13.612	609.289	81.14	-2.31
Post-TC600 Testing Data-Front Side	52.381	44.761	13.336	12.678	567.478	81.24	-0.91
Post-TC600 Testing Data-Rear Side	51.848	44.754	11.628	8.088	361.990	60.04	-4.39
Post-TC600 Testing Data-BNPI	52.632	44.781	14.124	13.475	603.436	81.17	-3.24

Maximum Power Determination Data at STC							
Model: PS-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-3				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	51.418	44.614	13.724	12.867	574.072	81.36	—
Pre-HALT Testing Data-Rear Side	50.717	45.354	10.764	8.283	375.674	68.81	—
Pre-HALT Testing Data-BNPI	51.505	44.761	14.986	13.987	626.088	81.11	—
Post-TC200 Testing Data-Front Side	52.509	44.761	13.308	12.718	569.273	81.46	-0.84
Post-TC200 Testing Data-Rear Side	51.661	45.301	10.528	8.198	371.386	68.28	-1.14
Post-TC200 Testing Data-BNPI	52.751	44.820	14.468	13.822	619.489	81.17	-1.05
Post-TC400 Testing Data-Front Side	52.377	44.765	13.297	12.629	565.317	81.17	-1.53
Post-TC400 Testing Data-Rear Side	51.876	44.799	11.678	8.199	367.323	60.63	-2.22
Post-TC400 Testing Data-BNPI	52.654	44.742	14.373	13.719	613.802	81.11	-1.96
Post-TC600 Testing Data-Front Side	52.365	44.762	13.231	12.540	561.290	81.02	-2.23
Post-TC600 Testing Data-Rear Side	51.850	44.762	11.629	8.106	362.831	60.17	-3.42
Post-TC600 Testing Data-BNPI	52.642	44.783	14.219	13.569	607.643	81.18	-2.95

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 [%]
0231219-06-2	46.751	40.257	2.712	2.582	103.931	81.98	0.37
0231219-06-3	47.221	40.643	2.711	2.576	104.685	81.79	0.24

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	
0231219-06-2	Yes	Yes	Yes	Pass
0231219-06-3	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-MNB144(HCBF)-580W	0231219-06-4	No major visible defect	Pass
PS-MNB144(HCBF)-580W	0231219-06-5	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-MNB144(HCBF)-580W	0231219-06-4	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-5	10	15.5	Pass
Post-DH1000 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-4	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-5	10	15.5	Pass
Post-DH2000 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-4	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-5	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-MNB144(HCBF)-580W	0231219-06-4	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-5	10	15.5	Pass
Post-DH1000 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-4	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-5	10	15.5	Pass
Post-DH2000 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-4	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-5	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-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-4				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	51.505	44.729	13.690	12.818	573.320	81.31	—
Pre-HALT Testing Data-Rear Side	51.006	45.211	10.595	8.261	373.499	69.12	—
Pre-HALT Testing Data-BNPI	51.509	44.814	14.962	13.937	624.561	81.04	—
Post-DH1000 Testing Data-Front Side	52.371	44.547	12.995	12.409	552.771	81.22	-3.58
Post-DH1000 Testing Data-Rear Side	51.943	45.131	10.285	7.967	359.564	67.31	-3.73
Post-DH1000 Testing Data-BNPI	52.643	44.654	14.122	13.491	602.437	81.03	-3.54
Post- DH2000 Testing Data-Front Side	52.283	44.757	12.912	12.019	537.955	79.68	-6.17
Post- DH2000 Testing Data-Rear Side	51.760	44.611	11.488	7.744	345.471	58.10	-7.50
Post- DH2000 Testing Data-BNPI	52.566	44.585	13.746	13.075	582.973	80.68	-6.66

Maximum Power Determination Data at STC							
Model: PS-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-5				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	51.378	44.616	13.722	12.833	572.554	81.21	—
Pre-HALT Testing Data-Rear Side	50.870	45.245	10.893	8.280	374.622	67.61	—
Pre-HALT Testing Data-BNPI	51.459	44.706	14.976	13.945	623.428	80.90	—

Post-DH1000 Testing Data-Front Side	52.445	44.713	13.017	12.427	555.654	81.39	-2.95
Post-DH1000 Testing Data-Rear Side	51.837	45.205	10.500	8.037	363.311	66.75	-3.02
Post-DH1000 Testing Data-BNPI	52.651	44.741	14.150	13.505	604.222	81.10	-3.08
Post- DH2000 Testing Data-Front Side	52.289	44.786	12.918	12.030	538.759	79.76	-5.90
Post- DH2000 Testing Data-Rear Side	51.794	44.667	11.543	7.888	352.321	58.93	-5.95
Post- DH2000 Testing Data-BNPI	52.571	44.790	13.746	13.044	584.255	80.85	-6.28

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 [%]
0231219-06-4	46.973	40.468	2.657	2.526	102.229	81.90	-2.72
0231219-06-5	47.030	40.553	2.648	2.527	102.491	82.29	-2.35

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	
0231219-06-4	Yes	Yes	Yes	Pass
0231219-06-5	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-MNB144(HCBF)-580W	0231219-06-8	No major visible defect	Pass
PS-MNB144(HCBF)-580W	0231219-06-9	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-MNB144(HCBF)-580W	0231219-06-8	10	15.5	Pass
Pre-HALT Testing Data	PS-MNB144(HCBF)-580W	0231219-06-9	10	15.5	Pass
Post-SML Testing Data	PS-MNB144(HCBF)-580W	0231219-06-8	10	15.5	Pass
Post-SML Testing Data	PS-MNB144(HCBF)-580W	0231219-06-9	10	15.5	Pass
Post-DML 1000 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-8	10	15.5	Pass
Post-DML 1000 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-9	10	15.5	Pass
Post-TC50 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-8	10	15.5	Pass
Post-TC50 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-9	10	15.5	Pass
Post-HF10 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-8	10	15.5	Pass
Post-HF10 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-9	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-MNB144(HCBF)-580W	0231219-06-8	10	15.5	Pass
Pre-HALT Testing Data	PS-MNB144(HCBF)-580W	0231219-06-9	10	15.5	Pass
Post-SML Testing Data	PS-MNB144(HCBF)-580W	0231219-06-8	10	15.5	Pass
Post-SML Testing Data	PS-MNB144(HCBF)-580W	0231219-06-9	10	15.5	Pass
Post-DML 1000 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-8	10	15.5	Pass
Post-DML 1000 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-9	10	15.5	Pass
Post-TC50 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-8	10	15.5	Pass
Post-TC50 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-9	10	15.5	Pass
Post-HF10 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-8	10	15.5	Pass
Post-HF10 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-9	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-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-8				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	52.392	44.788	13.391	12.739	570.553	81.32	—
Pre-HALT Testing Data-Rear Side	51.947	45.462	10.399	8.267	375.851	69.57	—
Pre-HALT Testing Data-BNPI	52.672	44.801	14.525	13.856	620.771	81.14	—
Post-SML Testing Data-Front Side	52.391	44.772	13.392	12.742	570.462	81.31	-0.02
Post-SML Testing Data-Rear Side	51.920	44.863	11.756	8.364	375.223	61.47	-0.17
Post-SML Testing Data-BNPI	52.607	44.501	14.615	13.948	620.693	80.73	-0.01
Post-DML1000 Testing Data-Front Side	52.283	44.437	13.454	12.834	570.285	81.07	-0.05
Post-DML1000 Testing Data-Rear Side	51.919	44.860	11.769	8.364	375.202	61.41	-0.17
Post-DML1000 Testing Data-BNPI	52.672	44.795	14.518	13.851	620.474	81.14	-0.05
Post-TC50 Testing Data-Front Side	52.380	44.766	13.331	12.677	567.491	81.27	-0.54
Post-TC50 Testing Data-Rear Side	51.896	44.834	11.718	8.277	371.091	61.03	-1.27

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-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-9				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	52.397	44.771	13.456	12.815	573.758	81.38	—
Pre-HALT Testing Data-Rear Side	51.918	44.841	11.789	8.336	373.775	61.07	—
Pre-HALT Testing Data-BNPI	52.677	44.790	14.609	13.941	624.425	81.14	—
Post-SML Testing Data-Front Side	52.394	44.803	13.432	12.785	572.829	81.40	-0.16
Post-SML Testing Data-Rear Side	51.922	44.842	11.779	8.333	373.650	61.09	-0.03
Post-SML Testing Data-BNPI	52.670	44.682	14.602	13.951	623.364	81.05	-0.17
Post-DML1000 Testing Data-Front Side	52.317	44.460	13.488	12.873	572.329	81.10	-0.25
Post-DML1000 Testing Data-Rear Side	51.930	45.278	10.540	8.245	373.325	68.21	-0.12
Post-DML1000 Testing Data-BNPI	52.634	44.613	14.658	13.965	623.037	80.75	-0.22
Post-TC50 Testing Data-Front Side	52.387	44.797	13.378	12.721	569.872	81.32	-0.68
Post-TC50 Testing Data-Rear Side	51.893	44.827	11.714	8.266	370.544	60.96	-0.86
Post-TC50 Testing Data-BNPI	52.669	44.795	14.498	13.834	619.672	81.15	-0.7
Post-HF10 Testing Data-Front Side	52.377	44.768	13.295	12.633	565.561	81.22	-1.43
Post-HF10 Testing Data-Rear Side	51.865	44.780	11.655	8.160	365.429	60.45	-2.23
Post-HF10 Testing Data-BNPI	52.650	44.741	14.367	13.714	613.588	81.12	-1.74

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 [%]
0231219-06-8	47.268	40.790	2.657	2.535	103.390	82.33	-1.45
0231219-06-9	47.290	40.818	2.658	2.536	103.507	82.35	-1.23

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	
0231219-06-8	Yes	Yes	Yes	Pass
0231219-06-9	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-MNB144(HCBF)-580W	0231219-06-10	No major visible defect	Pass
PS-MNB144(HCBF)-580W	0231219-06-11	No major visible defect	Pass
PS-MNB144(HCBF)-580W	0231219-06-12	No major visible defect	Pass
PS-MNB144(HCBF)-580W	0231219-06-13	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 [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-MNB144(HCBF)-580W	0231219-06-10	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-11	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-12	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-13	10	15.5	Pass
Post-PID96 (-) Testing Data	PS-MNB144(HCBF)-580W	0231219-06-10	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-11	10	15.5	Pass
Post-PID96 (+) Testing Data	PS-MNB144(HCBF)-580W	0231219-06-12	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-13	10	15.5	Pass
Post-PID192 (-) Testing Data	PS-MNB144(HCBF)-580W	0231219-06-10	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-11	10	15.5	Pass
Post-PID192 (+) Testing Data	PS-MNB144(HCBF)-580W	0231219-06-12	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-13	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	PS-MNB144(HCBF)-580W	0231219-06-10	10	15.5	Pass

Data	PS-MNB144(HCBF)-580W	0231219-06-11	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-12	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-13	10	15.5	Pass
Post-PID96 (-) Testing Data	PS-MNB144(HCBF)-580W	0231219-06-10	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-11	10	15.5	Pass
Post-PID96 (+) Testing Data	PS-MNB144(HCBF)-580W	0231219-06-12	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-13	10	15.5	Pass
Post-PID192 (-) Testing Dat	PS-MNB144(HCBF)-580W	0231219-06-10	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-11	10	15.5	Pass
Post-PID192 (+) Testing Data	PS-MNB144(HCBF)-580W	0231219-06-12	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-13	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-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-10				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	51.464	44.587	13.693	12.830	572.040	81.18	—
Pre-HALT Testing Data-Rear Side	50.947	45.267	10.744	8.244	373.167	68.17	—
Pre-HALT Testing Data-BNPI	51.507	44.864	14.943	13.965	626.526	81.40	—
Post-PID96 (-) Testing Data-Front Side	52.285	44.331	13.358	12.709	563.403	80.67	-1.51
Post-PID96 (-) Testing Data-Rear Side	51.832	45.295	10.426	8.233	372.931	69.01	-0.06
Post-PID96 (-) Testing Data-BNPI	52.616	44.376	14.532	13.817	613.142	80.19	-2.14
Post-PID192 (-) Testing Data-Front Side	52.353	44.784	13.168	12.446	557.377	80.85	-2.56
Post-PID192 (-) Testing Data-Rear Side	51.888	44.829	11.693	8.247	369.715	60.94	-0.93
Post-PID192 (-) Testing Data-BNPI	52.643	44.804	14.222	13.565	607.791	81.18	-2.99

Maximum Power Determination Data at STC							
Model: PS-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-11				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	51.374	44.549	13.684	12.815	570.882	81.21	—

Pre-HALT Testing Data-Rear Side	50.859	45.205	10.860	8.299	375.174	67.92	—
Pre-HALT Testing Data-BNPI	51.529	44.769	14.878	13.966	625.244	81.56	—
Post-PID96 (-) Testing Data-Front Side	52.233	44.293	13.436	12.750	564.749	80.47	-1.07
Post-PID96 (-) Testing Data-Rear Side	51.727	45.242	10.342	8.285	374.824	70.06	-0.09
Post-PID96 (-) Testing Data-BNPI	52.496	44.381	14.606	13.845	614.451	80.14	-1.73
Post-PID192 (-) Testing Data-Front Side	52.353	44.765	13.182	12.478	558.587	80.94	-2.15
Post-PID192 (-) Testing Data-Rear Side	51.891	44.833	11.706	8.260	370.323	60.96	-1.29
Post-PID192 (-) Testing Data-BNPI	52.635	44.833	14.190	13.524	606.328	81.18	-3.03

Maximum Power Determination Data at STC							
Model: PS-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-12				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	51.366	44.525	13.730	12.838	571.613	81.05	—
Pre-HALT Testing Data-Rear Side	50.928	45.295	10.735	8.374	379.289	69.38	—
Pre-HALT Testing Data-BNPI	51.449	44.696	14.972	13.972	624.493	81.07	—
Post-PID96 (-) Testing Data-Front Side	52.301	44.387	13.367	12.703	563.841	80.65	-1.36
Post-PID96 (-) Testing Data-Rear Side	51.836	45.116	10.802	8.371	377.661	67.45	-0.43
Post-PID96 (-) Testing Data-BNPI	52.622	44.440	14.527	13.801	613.317	80.23	-1.79
Post-PID192 (-) Testing Data-Front Side	52.351	44.774	13.167	12.451	557.475	80.87	-2.47
Post-PID192 (-) Testing Data-Rear Side	51.917	44.861	11.748	8.360	375.034	61.49	-1.12
Post-PID192 (-) Testing Data-BNPI	52.639	44.764	14.223	13.575	607.660	81.16	-2.70

Maximum Power Determination Data at STC							
Model: PS-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-13				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	51.460	44.650	13.703	12.836	573.125	81.28	—
Pre-HALT Testing Data-Rear Side	50.943	45.184	11.040	8.311	375.523	66.77	—
Pre-HALT Testing Data-BNPI	51.515	44.712	14.959	13.951	623.771	80.94	—
Post-PID96 (-) Testing Data-Front Side	52.240	44.315	13.403	12.731	564.195	80.58	-1.56
Post-PID96 (-) Testing Data-Rear Side	51.711	45.200	10.424	8.300	375.170	69.60	-0.09
Post-PID96 (-) Testing Data-BNPI	52.493	44.322	14.567	13.841	613.452	80.22	-1.65
Post-PID192 (-) Testing Data-Front Side	52.347	44.742	13.140	12.411	555.307	80.73	-3.11
Post-PID192 (-) Testing Data-Rear Side	51.896	44.832	11.708	8.264	370.511	60.98	-1.33
Post-PID192 (-) Testing Data-BNPI	52.633	44.817	14.166	13.504	605.202	81.17	-2.98

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 [%]
0231219-06-10	46.828	40.307	2.674	2.536	102.237	81.65	-2.21
0231219-06-11	47.093	40.340	2.671	2.500	100.854	80.17	-4.18
0231219-06-12	46.389	40.030	2.666	2.544	101.853	82.35	-3.28
0231219-06-13	46.099	39.772	2.661	2.534	100.798	82.18	-3.55

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	
0231219-06-10	Yes	Yes	Yes	Pass
0231219-06-11	Yes	Yes	Yes	Pass
0231219-06-12	Yes	Yes	Yes	Pass
0231219-06-13	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-MNB144(HCBF)-580W	0231219-06-14	No major visible defect	Pass
PS-MNB144(HCBF)-580W	0231219-06-15	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-MNB144(HCBF)-580W	0231219-06-14	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-15	10	15.5	Pass
Post-LeTID162 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-14	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-15	10	15.5	Pass
Post-LeTID324 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-14	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-15	10	15.5	Pass
Post-LeTID486 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-14	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-15	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-MNB144(HCBF)-580W	0231219-06-14	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-15	10	15.5	Pass
Post-LeTID162	PS-MNB144(HCBF)-580W	0231219-06-14	10	15.5	Pass

Testing Data	PS-MNB144(HCBF)-580W	0231219-06-15	10	15.5	Pass
Post-LeTID324 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-14	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-15	10	15.5	Pass
Post-LeTID486 Testing Data	PS-MNB144(HCBF)-580W	0231219-06-14	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-15	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-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-14				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	52.295	44.457	13.457	12.823	570.087	81.01	—
Pre-HALT Testing Data-Rear Side	51.981	45.212	10.496	8.331	376.662	69.04	—
Pre-HALT Testing Data-BNPI	52.672	44.537	14.620	13.937	620.721	80.61	—
Post-LeTID162 Testing Data-Front Side	52.279	44.485	13.462	12.853	571.787	81.25	0.30
Post-LeTID162 Testing Data-Rear Side	51.814	45.265	10.461	8.356	378.243	69.78	0.42
Post-LeTID162 Testing Data-BNPI	52.597	44.502	14.631	13.973	621.829	80.80	0.18
Post-LeTID324 Testing Data-Front Side	52.250	44.622	13.587	12.836	572.782	80.68	0.47
Post-LeTID324 Testing Data-Rear Side	51.722	44.857	11.834	8.348	374.447	61.18	-0.59
Post-LeTID324 Testing Data-BNPI	52.674	44.790	14.600	13.931	623.982	81.14	0.53
Post-LeTID486 Testing Data-Front Side	52.396	44.779	13.429	12.778	572.186	81.32	0.37
Post-LeTID486 Testing Data-Rear Side	51.913	44.844	11.767	8.332	373.628	61.17	-0.81
Post-LeTID486 Testing Data-BNPI	52.549	44.728	14.620	13.936	623.342	81.13	0.42

Maximum Power Determination Data at STC							
Model: PS-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-15				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	52.353	44.514	13.446	12.833	571.237	81.15	—
Pre-HALT Testing Data-Rear Side	51.842	45.277	10.690	8.304	375.978	67.84	—
Pre-HALT Testing Data-BNPI	52.633	44.590	14.613	13.947	621.906	80.86	—
Post-LeTID162 Testing Data-Front Side	52.433	44.817	13.457	12.838	575.350	81.54	0.72
Post-LeTID162 Testing Data-Rear Side	51.898	45.227	10.657	8.338	377.116	68.18	0.30
Post-LeTID162 Testing Data-BNPI	52.724	44.805	14.636	13.967	625.797	81.10	0.63
Post-LeTID324 Testing Data-Front Side	52.319	44.778	13.567	12.818	573.982	80.87	0.48
Post-LeTID324 Testing Data-Rear Side	51.769	44.854	11.836	8.335	373.851	61.01	-0.57
Post-LeTID324 Testing Data-BNPI	52.616	44.834	14.601	13.930	624.536	81.29	0.42
Post-LeTID486 Testing Data-Front Side	52.392	44.805	13.458	12.809	573.917	81.40	0.47
Post-LeTID486 Testing Data-Rear Side	51.915	44.842	11.785	8.333	373.664	61.07	-0.62
Post-LeTID486 Testing Data-BNPI	52.668	44.746	14.609	13.955	624.452	81.16	0.41

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 [%]
0231219-06-14	47.001	40.495	2.711	2.582	104.572	82.07	-0.13
0231219-06-15	47.322	40.828	2.725	2.596	105.998	82.18	0.09

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	
0231219-06-14	Yes	Yes	Yes	Pass
0231219-06-15	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-MNB144(HCBF)-580W	0231219-06-22	No major visible defect	Pass
PS-MNB144(HCBF)-580W	0231219-06-23	No major visible defect	Pass
PS-MNB144(HCBF)-580W	0231219-06-24	No major visible defect	Pass
PS-MNB144(HCBF)-580W	0231219-06-25	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-MNB144(HCBF)-580W	0231219-06-22	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-23	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-24	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-25	10	15.5	Pass
Post-6 months Field Exposure Testing Data	PS-MNB144(HCBF)-580W	0231219-06-22	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-23	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-24	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-25	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-MNB144(HCBF)-580W	0231219-06-22	10	15.5	Pass

Testing Data	PS-MNB144(HCBF)-580W	0231219-06-23	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-24	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-25	10	15.5	Pass
Post-6 months Field Exposure Testing Data	PS-MNB144(HCBF)-580W	0231219-06-22	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-23	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-24	10	15.5	Pass
	PS-MNB144(HCBF)-580W	0231219-06-25	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-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-22				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	52.382	44.731	13.446	12.831	573.958	81.49	—
Pre-HALT Testing Data-Rear Side	51.837	44.882	11.589	8.334	374.030	62.26	—
Pre-HALT Testing Data-BNPI	52.671	44.784	14.612	13.939	624.245	81.11	—
Post-6 months Field Exposure Testing Data-Front Side							
Post-6 months Field Exposure Testing Data-Rear Side							
Post-6 months Field Exposure Testing Data-BNPI							

Maximum Power Determination Data at STC							
Model: PS-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-23				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	52.388	44.815	13.459	12.804	573.813	81.38	—
Pre-HALT Testing Data-Rear Side	51.836	44.881	11.601	8.334	374.023	62.20	—
Pre-HALT Testing Data-BNPI	52.669	44.767	14.611	13.940	624.058	81.09	—

Post-6 months Field Exposure Testing Data-Front Side							
Post-6 months Field Exposure Testing Data-Rear Side							
Post-6 months Field Exposure Testing Data-BNPI							

Maximum Power Determination Data at STC							
Model: PS-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-24				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	52.390	44.795	13.461	12.814	574.006	81.39	—
Pre-HALT Testing Data-Rear Side	51.839	44.875	11.608	8.332	373.896	62.13	—
Pre-HALT Testing Data-BNPI	52.668	44.779	14.603	13.933	623.913	81.12	—
Post-6 months Field Exposure Testing Data-Front Side							
Post-6 months Field Exposure Testing Data-Rear Side							
Post-6 months Field Exposure Testing Data-BNPI							

Maximum Power Determination Data at STC							
Model: PS-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-25				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	52.386	44.738	13.460	12.821	573.608	81.35	—
Pre-HALT Testing Data-Rear Side	51.838	44.872	11.611	8.333	373.928	62.12	—
Pre-HALT Testing Data-BNPI	52.666	44.763	14.607	13.934	623.734	81.08	—
Post-6 months Field Exposure Testing Data-Front Side							
Post-6 months Field Exposure Testing Data-Rear Side							
Post-6 months Field Exposure Testing Data-BNPI							

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

Maximum Power Determination Data at STC							
Model: PS-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-22				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							—
Post-6 months Field Exposure Testing Data-Front Side							

Maximum Power Determination Data at STC							
Model: PS-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-23				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							—
Post-6 months Field Exposure Testing Data-Front Side							

Maximum Power Determination Data at STC							
Model: PS-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-24				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							—
Post-6 months Field Exposure Testing Data-Front Side							

Maximum Power Determination Data at STC							
Model: PS-MNB144(HCBF)-580W				Module temperature: 25 [°C]			
Sample No.: 0231219-06-25				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							—
Post-6 months Field Exposure Testing Data-Front Side							

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	
0231219-06-22	Yes	Yes	Yes	Pass
0231219-06-23	Yes	Yes	Yes	Pass
0231219-06-24	Yes	Yes	Yes	Pass
0231219-06-25	Yes	Yes	Yes	Pass

8. APPENDIX A – Photos

Module_PS-MNB144(HCBF)-580W



9. APPENDIX B – Product Description Sheet

A1.1	MODULE TYPE/S
	PS-MNB144(HCBF)-xxxW

A1.2	SOLAR CELL
	Cell type reference 1: PSMT18216BB Philadelphia Solar N type mono crystalline bifacial solar cell 182mm*91mm, 16 busbars 140μm
	Cell dimensions L x W (mm): 182*91
	Cell thickness (μm): 140μm

A1.3	IDENTIFICATION OF MATERIALS
	Front cover.....: tempered glass with AR coating CSG Glass Co., Ltd. 3.20mm thickness
	Rear cover: Cynagard 455A(R)P Cybrid Technologies Inc Fluorine resin /PET /Fluorine resin /Fluorine resin mesh
	Encapsulate (upper side).....: SE-556 Changzhou Sveck Pv New Material Co.,Ltd Polyolefin (POE) thickness 0.55mm
	Encapsulate (lower side): SV-15297P Changzhou Sveck Pv New Material Co.,Ltd Ethyl-Vinyl-acetate (EVA), thickness 0.55mm
	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 0.4m thick, 6mm wide by 0.4m thick

	Cell Connector	Sn 60%/Pb 40 % Taicang Juren International Trade Co., LTD Φ0.27mm
A1.4	IDENTIFICATION OF COMPONENTS	
	Junction box	JM37xy ZHEJIANG JIANGMING TIANHEYUAN PHOTOVOLTAIC TECHNOLOGY CO LTD
	Cable	62930 IEC 131 ZHEJIANG JIANGMING TIANHEYUAN PHOTOVOLTAIC TECHNOLOGY CO LTD
	Connector	PV-KBT4/6II-UR PV-KST4/6II-UR Stäubli Electrical Connectors AG
	Bypass diode	MK5050 ZHEJIANG JIANGMING TIANHEYUAN PHOTOVOLTAIC 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%.