Test Report

Performance Testing and Energy Rating
Reference no: ET-20231204-283-4A_V2

Prepared for Anhui Huasun Energy Co., Ltd.
06/05/2024

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TEST REPORT Crystalline Silicon Terrestrial Photovoltaic (PV) Modules - performance testing and energy rating -	
Applicant's name.....:	Anhui Huasun Energy Co., Ltd.
Address.....:	No. 99, Qingliu Road, Xuancheng Economic and Technological Development Zone, Xuanzhou District, Xuancheng City, Anhui Province, China
Test item description..... **:**	Photovoltaic (PV) Module(s)
Trade Mark .....:	HUASUN
Model/Type reference.....:	HSN-210-B132DS725
Manufacturer .....:	Anhui Huasun Energy Co., Ltd.
Test specification ..... **:**	
Standard .....:	Customized tests based on IEC 61853-1ed. 1 and IEC61853-2 ed.2
Non-standard test method.....:	N/A
Test Report Form No. .....:	VDE-PV-QT-001 modified
Test Report Form Originator.....:	VDE
Master TRF.....:	Dated 2014-04
Testing Laboratory.....:	Zhejiang HJE Co., Ltd.
Address.....:	3-4/F, Building 1, No. 3556, Linggongtang Road, Nanhu District, Jiaxing, Zhejiang, China
Tested by (name + signature):	Sun Xiang 
Reviewed by (name + signature):	D. Wen 

Summary of testing:	
Tests performed (name of test and test clause):	**Testing location:**
- Requested Energy rating measurement acc. To IEC 61853-1 ED.1. - Requested Energy rating measurement acc. To IEC 61853-2 ED.1. Except NOCT measurement.	See page 1

Testing

Date of receipt of test item : 2024/01/05

Date (s) of performance of tests : 2024/01/08 - 2024/01/10

Module group assignment:

Sample #	Sample Group ID	Sample S/N
1	A	SR measurement
2	B	HCB22404009000007
3	C	HCB22404009000008

Supplementary Information:

The sample #1 for SR measurement is a one-cell module encapsulated with same construction as full size module.

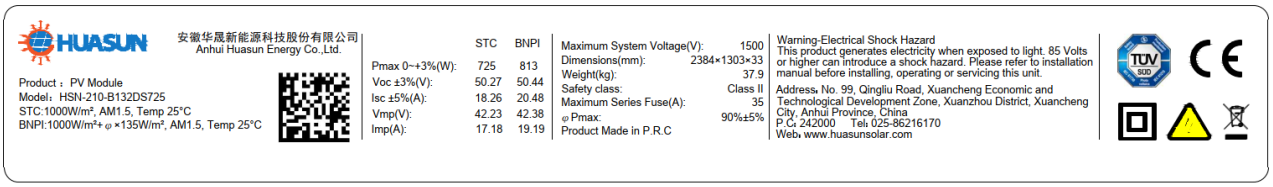
Test item particulars:	
Accessories and detachable parts included in the evaluation .....:	--
Options included .....:	--
Abbreviations used in the report:	
SR – Spectral response	Vmp – Maximum power voltage
QE – Quantum efficiency	Voc – Open circuit voltage
Imp – Maximum power current	FF – Fill Factor
Isc - Short circuit current	α – Current temperature coefficient
Pmp – Maximum power	β – Voltage temperature coefficient
NOCT – Nominal Operating Cell Temperature	δ – power temperature coefficient
STC – Standard Test Conditions	LIC- Low irradiance condition
HTC – High temperature condition	LTC – Low temperature condition
AOI – Angel of Incidence	
General remarks: N/A	

General product information and considerations:

Product Electrical Ratings:

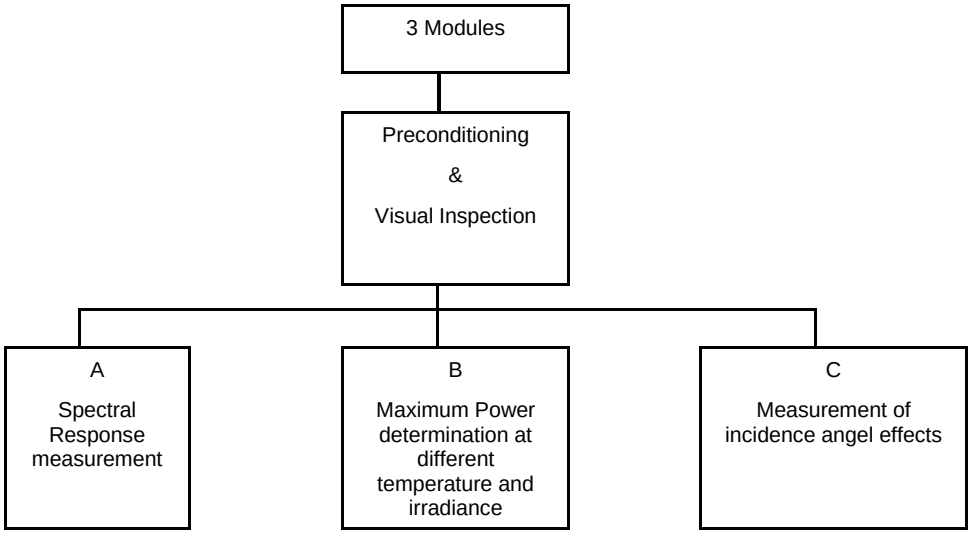
Module type	HSN-210-B132DS725
Isc (Adc)	18.26
Voc (Vdc)	50.27
Imp (Adc)	17.18
Vmp (Vdc)	42.23
Pmp (W)	725
Maximum system voltage (V)	1500
Series Fuse Rating (A)	35

Copy of marking plate



Photos of the module (front and back)

	TEST SEQUENCE



Customized tests based on IEC 61853-1, -2			
Clause	Requirement + Test	Result - Remark	Verdict
	Initial examination	All modules	P
10	Preconditioning:	20kwh/m^2	-
10.1	Visual inspection .....:	See table 10.1 Int	-
Group A	1 Module	Sample Group ID A	-
	Spectral Responsivity Measurement	See table 1.0	-
Group B	1 Module	Sample Group ID B	-
	Maximum power determination at different temperature and irradiance.....:	See table 2.0 - 2.6	-
Group C	1 Module	Sample Group ID C	-
	Measurement of incidence angel effects .....:	See table 3.0	-

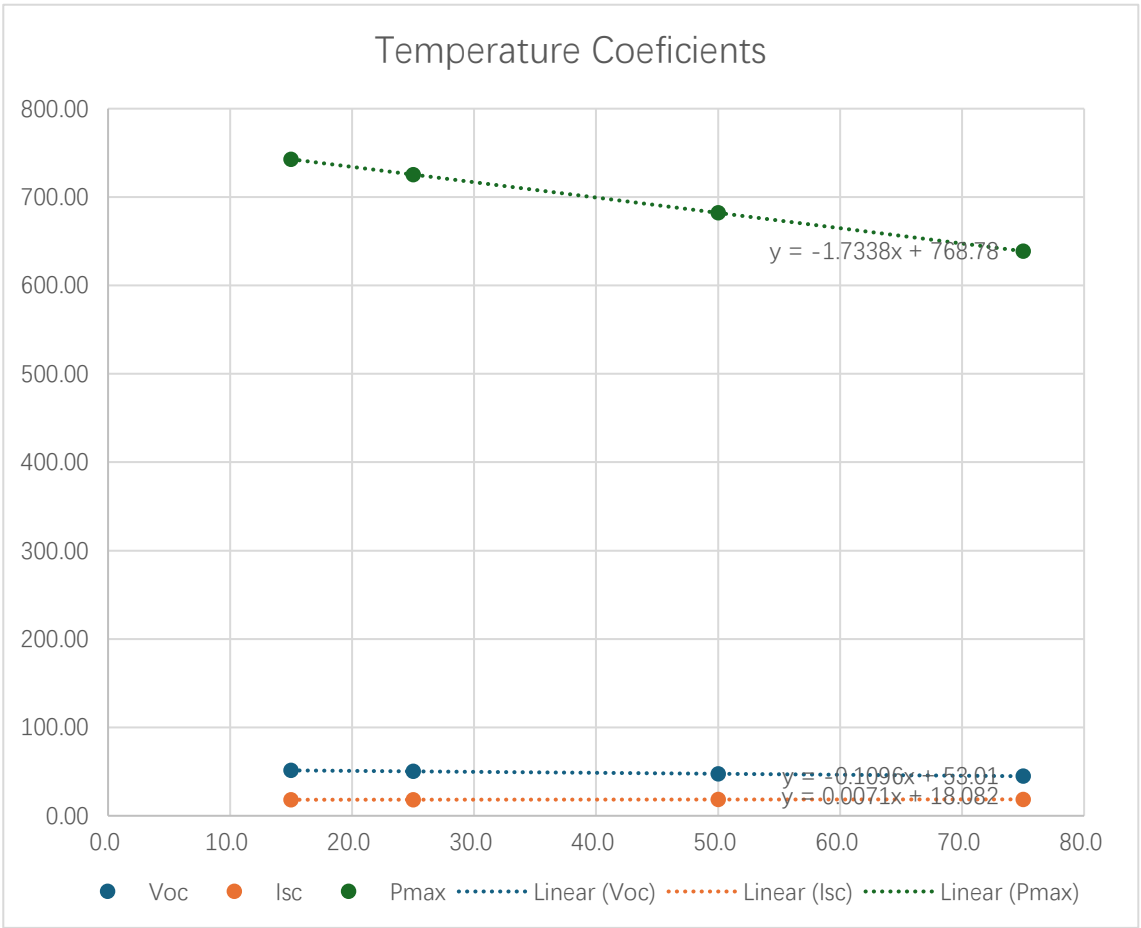
1.0.1	TABLE: Spectral Responsivity Measurement	P
Test Date [MM/DD/YYYY]..... :	01/08/2024	—
Ambient air temperature [°C] ..... :	25	—
Module temperature [°C] ..... :	25	—
Sample #	1	—

Wave Length (nm)	Spectral Responsivity (a.u)	Wave Length (nm)	Spectral Responsivity (a.u)	Wave Length (nm)	Spectral Responsivity (a.u)
300	0.0061	570	0.6001	840	0.8772
310	0.0083	580	0.6127	850	0.8873
320	0.0110	590	0.6240	860	0.8966
330	0.0114	600	0.6356	870	0.9066
340	0.0145	610	0.6479	880	0.9135
350	0.0197	620	0.6564	890	0.9269
360	0.0401	630	0.6691	900	0.9353
370	0.0964	640	0.6800	910	0.9417
380	0.1927	650	0.6901	920	0.9460
390	0.2839	660	0.7015	930	0.9533
400	0.3346	670	0.7137	940	0.9643
410	0.3618	680	0.7249	950	0.9766
420	0.3821	690	0.7336	960	0.9853
430	0.4044	700	0.7431	970	0.9947
440	0.4198	710	0.7528	980	0.9974
450	0.4335	720	0.7613	990	1.0000
460	0.4520	730	0.7735	1000	0.9976
470	0.4726	740	0.7814	1010	0.9945
480	0.4867	750	0.7905	1020	0.9823
490	0.4993	760	0.7965	1030	0.9626
500	0.5153	770	0.8073	1040	0.9360
510	0.5282	780	0.8185	1050	0.8981
520	0.5413	790	0.8282	1060	0.8521
530	0.5529	800	0.8357	1070	0.7988
540	0.5668	810	0.8478	1080	0.7433
550	0.5769	820	0.8602	1090	0.6839
560	0.5895	830	0.8677	1100	0.6147

Supplementary information: N/A

2.0	TABLE: Maximum power determination (Front side)					P
Test Date [MM/DD/YYYY]..... :			01/09/2024			—
Irradiance [W/m2]..... :			1000			—
Sample #			2			—
Tem[°C]	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF [%]
15	51.37	18.19	43.11	17.23	742.78	79.50
25	50.27	18.26	42.23	17.18	725.44	79.03
50	47.53	18.44	39.93	17.08	682.09	77.83
75	44.79	18.62	37.37	17.09	638.75	76.60

Supplementary information: requested by customer, the temperature coefficient is generated by above measured data.



α [%/°C]	β [%/°C]	δ [%/°C]
0.039	-0.218	-0.239

2.1	TABLE: Maximum power determination (Front side)					P
Test Date [MM/DD/YYYY]..... :			01/09/2024			—
Irradiance [W/m²]..... :			1100			—
Sample #			2			—
Tem[°C]	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF [%]
25	50.42	20.05	42.25	18.87	797.18	78.87
50	47.67	20.24	39.82	18.82	749.55	77.70
75	44.92	20.44	37.85	18.54	701.92	76.45
Supplementary information: N/A						

2.2	TABLE: Maximum power determination (Front side)					P
Test Date [MM/DD/YYYY]..... :			01/09/2024			—
Irradiance [W/m²]..... :			800			—
Sample #			2			—
Tem[°C]	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF [%]
15	51.11	14.52	43.07	13.89	598.38	80.62
25	50.02	14.58	42.19	13.85	584.41	80.14
50	47.29	14.72	39.89	13.78	549.49	78.93
75	44.57	14.86	36.96	13.92	514.58	77.68
Supplementary information: N/A						

2.3	TABLE: Maximum power determination (Front side)					P
Test Date [MM/DD/YYYY]..... :			01/09/2024			—
Irradiance [W/m²]..... :			600			—
Sample #			2			—
Tem[°C]	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF [%]
15	50.95	10.90	43.10	10.44	450.12	81.03
25	49.87	10.95	42.06	10.45	439.62	80.54
50	47.15	11.05	39.77	10.39	413.35	79.32
75	44.43	11.16	37.69	10.27	387.08	78.07
Supplementary information: N/A						

2.4	TABLE: Maximum power determination (Front side)					P
Test Date [MM/DD/YYYY]..... :			01/09/2024			—
Irradiance [W/m²]..... :			400			—
Sample #			2			—
Tem[°C]	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF [%]
15	50.03	7.26	42.58	7.03	299.19	82.36
25	48.96	7.29	41.55	7.03	292.21	81.87
50	46.29	7.36	39.39	6.97	274.75	80.61
Supplementary information: N/A						

2.5	TABLE: Maximum power determination (Front side)					P
Test Date [MM/DD/YYYY]..... :			01/09/2024			—
Irradiance [W/m²]..... :			200			—
Sample #			2			—
Tem[°C]	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF [%]
15	48.49	3.63	41.43	3.55	146.92	83.38
25	47.45	3.65	40.54	3.54	143.49	82.88
Supplementary information: N/A						

2.6	TABLE: Maximum power determination (Front side)					P
Test Date [MM/DD/YYYY]..... :			01/09/2024			—
Irradiance [W/m²]..... :			100			—
Sample #			2			—
Tem[°C]	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF [%]
15	46.64	1.82	41.34	1.72	71.16	83.96
25	45.65	1.82	40.50	1.72	69.50	83.47
Supplementary information: N/A						

3.0	TABLE: Measurement of incidence angle effects											P
Test Date [MM/DD/YYYY]..... :						01/10/2024						—
Sample #						3						—
θ	0	10	20	30	40	50	60	65	70	75	80	85
Isc (A)	18.26	17.98	17.16	15.81	13.99	11.74	9.13	7.72	6.06	4.39	2.71	0.93
θ	0	-10	-20	-30	-40	-50	-60	-65	-70	-75	-80	-85
Isc (A)	18.26	17.97	17.17	15.80	14.00	11.73	9.11	7.71	6.04	4.38	2.70	0.94
Supplementary information: N/A												

Annex 1: Product Description Sheet (Manufacturers and type references)

A1.1	MODULE TYPE/S
	HSN-210-B132DS725

A1.2	MODULE DESIGN	
	Module dimensions (L x W x H) [mm] ..... :	2384 x 1303 x 33
	Weights ..... :	37.9 kg
	Front/Rear cover bonding classification ..... :	☐ rigid/flexible ☒ rigid/rigid ☐ flexible/flexible

A1.3	SOLAR CELL	
	Cell type reference ..... :	HS-20BB G12, HJT, N type
	Cell dimensions L x W x T (± %) [mm] .....:	210 x 105 (half-cut)
	Cell thickness [µm] .....:	100±10
	Cell area [cm²] .....:	220.5

A1.4	IDENTIFICATION OF MATERIALS	
	Front cover ..... :	Ultra-white rolled toughened glass, 2.0mm, Hunan Kibing
	Rear cover ..... :	Ultra-white rolled toughened glass with white grid, 2.0mm, Hunan Kibing
	Encapsulation material front side ..... :	WT 11, Cybrid
	Encapsulation material back side ..... :	T 11, Cybrid
	Frame parts ..... :	Aluminum, 6005-T6, Nanjing Hongfa
	Mounting parts ..... :	N/A
	Adhesive for frame ..... :	HT906Z, Shanghai Huitian
	Edge sealing ..... :	PVS 101, KÖMMERLING
	Internal wiring ..... :	N/A
	Cell connector ..... :	Φ0.26mm, Suzhou Yourbest
	String connector ..... :	0.35x4mm & 0.35x6mm, Suzhou Yourbest
	Soldering material ..... :	Sn
	Fluxing agent ..... :	SF105, ASAHI
	Junction box ..... :	PV-HY02, Ningbo Huayu
	Cable ..... :	62930 IEC 131, Ningbo Huayu

	Connector..... :	PV-H4, Ningbo Huayu
	Bypass diode..... :	HY5050MK, Ningbo Huayu
	Potting material ..... :	5299W-S, Shanghai Huitian
	Adhesive for junction box ..... :	HT906Z, Shanghai Huitian
	Additional material (e. g. fixing tape, insulation tape) ..... :	Fixing tape: D60F6-2, Shanghai Shuxin

A1.5	**MODULE DESIGN - MINIMUM DISTANCES**	
	Between cells..... :	0.8mm
	Between cell and accessible surfaces ..... :	13±1mm
	Between any current carrying part and accessible surfaces..... :	12 mm

A1.6	**MODULE DESIGN - ELECTRICAL CONFIGURATION**	
	Total number of cells..... :	132 (half-cut)
	Serial-parallel connection of cells ..... :	SP
	Cells per bypass diode..... :	44 (half-cut)
	No. of bypass diodes..... :	3

Annex 2: List of measurement equipment

Clause	Measurement / testing	Testing / measuring equipment / material used, (Equipment ID)	Range used	Last Calibration date	Calibration due date
IEC61853-1: 2011	Maximum Power determination at different temperature and irradiance	Solar simulator (GIV-30AC)	Full spectrum	2023-11-10	2024-11-09
IEC61853-2: 2016	Measurement of incidence angel effects	Solar simulator (GIV-30AC)	Full spectrum	2023-11-10	2024-11-09
IEC61853-2: 2016	Spectral Response measurement	Spectral response tester	Full spectrum	/	/

Supplementary information	
Test location	HJE
Temperature	(23 - 25) °C
Humidity	(37 - 42)%

Annex 3: Statement of the estimated uncertainty of the test results

Statement of the estimated uncertainty of I/V test, K=2.
U(Isc)=2.6%
U(Voc)=0.8%
$U(P_{max})$=2.5%

Appendix 1

PVSYST V6.84	VDE Global Services (Shanghai) Co., Ltd. (China)	06/05/24	Page 1/1

Characteristics of a PV module

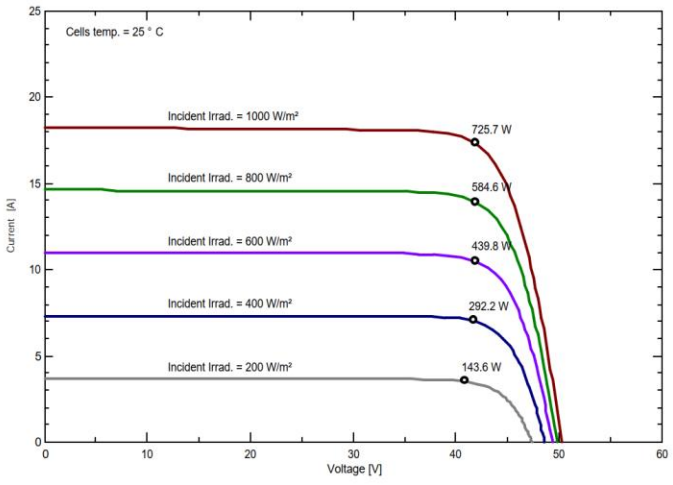
Manufacturer, model : **HUASUN, HSN-210-B132DS-725 20240506**

Availability : Prod. Since 2024

Data source : VDE Renewables

STC power (manufacturer)	**Pnom**	**725 Wp**		**Technology**		**HIT**	
Module size (W x L)		1.303 x 2.384	m²	Rough module area	Amodule	3.11	m²
Number of cells		2 x 66		Sensitive area (cells)	Acells	N/A	m²
Specifications for the model (manufacturer or measurement data)							
Reference temperature	TRef	25	° C	Reference irradiance	GRef	1000	W/m²
Open circuit voltage	Voc	50.3	V	Short-circuit current	Isc	18.26	A
Max. power point voltage	Vmpp	42.2	V	Max. power point current	Impp	17.18	A
=> maximum power	Pmpp	725.5	W	Isc temperature coefficient	muIsc	7.1	mA/° C
One-diode model parameters							
Shunt resistance	Rshunt	200	ohm	Diode saturation current	IoRef	0.020	nA
Serie resistance	Rserie	0.15	ohm	Voc temp. coefficient	MuVoc	-97	mV/° C
				Diode quality factor	Gamma	1.08	
Specified Pmax temper. coeff.	muPMaxR	-0.24	%/° C	Diode factor temper. coeff.	muGamma	0.000	1/° C
Reverse Bias Parameters, for use in behaviour of PV arrays under partial shadings or mismatch							
Reverse characteristics (dark)	BRev	3.20	mA/V²	(quadratic factor (per cell))			
Number of by-pass diodes per module		3		Direct voltage of by-pass diodes		-0.7	V
Model results for standard conditions (STC: T=25° C, G=1000 W/m² , AM=1.5)							
Max. power point voltage	Vmpp	42.0	V	Max. power point current	Impp	17.29	A
Maximum power	Pmpp	725.7	Wc	Power temper. coefficient	muPmpp	-0.24	%/° C
Efficiency(/ Module area)	Eff_mod	23.4	%	Fill factor	FF	0.791	
Efficiency(/ Cells area)	Eff_cells	N/A	%				

PV module: HUASUN, HSN-210-B132DS-725 20240506



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