



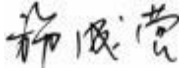




<b>TEST REPORT</b> <b>IEC 61215-series:2016</b> <b>Terrestrial photovoltaic (PV) modules – Design qualification and type approval</b>	
<b>Report Number</b> .....	TRPVM-2021-40271-1
<b>Date of issue</b> .....	2021-07-07
<b>Total number of pages</b> .....	92
<b>Name of Testing Laboratory preparing the Report</b> .....	TAIER LABS (JIAXING) CO., LTD. 
<b>Applicant's name</b> .....	Zhejiang Beyondsun Green Energy Technology Co., Ltd.
<b>Address</b> .....	No.888, Zhili Section of G318 Zhili Town, Huzhou City, Zhejiang province, China.
<b>Test specification:</b>	
<b>Standard</b> .....	<input checked="" type="checkbox"/> IEC 61215-1:2016 <input checked="" type="checkbox"/> IEC 61215-2:2016 <input checked="" type="checkbox"/> IEC 61215-1-1:2016 <input type="checkbox"/> IEC 61215-1-2:2016 <input type="checkbox"/> IEC 61215-1-3:2016 <input type="checkbox"/> IEC 61215-1-4:2016
<b>Test procedure</b> .....	VDE-scheme <input checked="" type="checkbox"/>
<b>Non-standard test method</b> .....	N/A
<b>Test Report Form No.</b> .....	IEC61215D_SE
<b>Test Report Form(s) Originator</b> ....	TÜV SÜD Product Service GmbH
<b>Master TRF</b> .....	2017-11-30
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<b>General disclaimer:</b>	
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<b>Test item description</b> ..... :	Photovoltaic (PV) Module(s)	
<b>Trade Mark</b> ..... :	 Beyondsun	
<b>Manufacturer</b> .....	Zhejiang Beyondsun Green Energy Technology Co., Ltd.	
<b>Model/Type reference</b> .....	TSHM535-144HV	
<b>Ratings</b> .....	See page 6	
<b>Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):</b>		
<input checked="" type="checkbox"/>	<b>CB Testing Laboratory:</b>	TAIER LABS (JIAXING) CO., LTD 
<b>Testing location/ address</b> ..... :		Building 7, 3556 Linggongtang Road, Nanhu, District, Jiaxing, Zhejiang
<b>Tested by (name, function, signature)</b> ..... :		Guangyuan Chen Testing Engineer (Authorization of test report) 
<b>Approved by (name, function, signature)</b> ... :		Chengying Shi Technical certification officer 
<input type="checkbox"/>	<b>Testing procedure: CTF Stage 1:</b>	
<b>Testing location/ address</b> ..... :		
<b>Tested by (name, function, signature)</b> ..... :		
<b>Approved by (name, function, signature)</b> ... :		
<input type="checkbox"/>	<b>Testing procedure: CTF Stage 2:</b>	
<b>Testing location/ address</b> ..... :		
<b>Tested by (name + signature)</b> .....		
<b>Witnessed by (name, function, signature) . :</b>		
<b>Approved by (name, function, signature)</b> ... :		
<input type="checkbox"/>	<b>Testing procedure: CTF Stage 3:</b>	
<input type="checkbox"/>	<b>Testing procedure: CTF Stage 4:</b>	
<b>Testing location/ address</b> ..... :		
<b>Tested by (name, function, signature)</b> ..... :		
<b>Witnessed by (name, function, signature) . :</b>		
<b>Approved by (name, function, signature)</b> ... :		
<b>Supervised by (name, function, signature) :</b>		

<b>List of Attachments (including a total number of pages in each attachment):</b>	
	attachment number / number of pages
Installation manual	See IEC 61730 part of this Report
Drawings mechanical	See IEC 61730 part of this Report
Circuit diagram	N/A
Photographs	See IEC 61730 part of this Report
Component datasheets / certificates	See IEC 61730 part of this Report
Others: Electrical ratings	See IEC 61730 part of this Report
Product Description Sheet (Manufacturers and type references)	Annex 1, _2_ pages
Test table for verifying other stabilization procedure	N/A
Lower and higher output power modules	Annex 3, _2_ pages
List of test equipment used	See IEC 61730 part of this Report

<b>Summary of testing:</b>																		
<p>Tests performed (name of test and test clause): IEC TS 62915:2018</p> <p>Clause 4.2.3 introduce new model types TSHMXXX-144HV and the 1000 V version THSMXXX-144V with the 182 x 91 mm cell type 182S-10BB, by Beyondsun. Due to identical outer cell surface as already approved, DH test deemed not to be necessary.</p> <p>Clause 4.2.2, introduce new encapsulation type F406P/TF8 by First, based on TÜV Rheinland report No. 60410450 002 (kept on file as TRPVM-2021-40271-2) for the new model type TSHMXXX-144HW and the 1000 V version TSHMXXX-144W with the 166 x 83 mm cell type 166S-9BB by Beyondsun</p> <p>Clause 4.2.6, modification to electrical termination for alternative J-box type listed below. They are already TÜV Rheinland tested and certified. No additional testing deemed to be necessary.</p> <table border="1"> <thead> <tr> <th>Type of J-box</th> <th>Type of diode</th> <th>Type of connector</th> <th>manufacturer</th> </tr> </thead> <tbody> <tr> <td rowspan="5">FT50xy</td> <td>FMK4530T</td> <td rowspan="5">05-6(1000V), 05-8(1500V), RHC2xyzu(y=M) (1500V)</td> <td rowspan="5">Renhe</td> </tr> <tr> <td>FMK4530B</td> </tr> <tr> <td>FMK5040D</td> </tr> <tr> <td>FMK4545D</td> </tr> <tr> <td>FMK5060D</td> </tr> <tr> <td rowspan="2">JM07w</td> <td>THY2550</td> <td rowspan="2">PV-JM608</td> <td rowspan="2">Jiaming</td> </tr> <tr> <td>THY4050</td> </tr> </tbody> </table> <p>Clause 4.2.13, increase of over current protection rating from 20 A to 25 A.</p> <p>The tests are representative for all module types listed in VDE license 40050436, using the same BOM from the 144 cells version down to the 72 cells version.</p> <p>The change of the manufacturers name from Zhejiang Trunsun Solar Co., Ltd. to Zhejiang Beyondsun Green Energy Technology Co., Ltd. is included in this project.</p>	Type of J-box	Type of diode	Type of connector	manufacturer	FT50xy	FMK4530T	05-6(1000V), 05-8(1500V), RHC2xyzu(y=M) (1500V)	Renhe	FMK4530B	FMK5040D	FMK4545D	FMK5060D	JM07w	THY2550	PV-JM608	Jiaming	THY4050	<p><b>Testing location:</b> See page 2.</p>
Type of J-box	Type of diode	Type of connector	manufacturer															
FT50xy	FMK4530T	05-6(1000V), 05-8(1500V), RHC2xyzu(y=M) (1500V)	Renhe															
	FMK4530B																	
	FMK5040D																	
	FMK4545D																	
	FMK5060D																	
JM07w	THY2550	PV-JM608	Jiaming															
	THY4050																	
<b>Summary of compliance with National Differences (List of countries addressed):</b>																		
N/A																		

**Copy of marking plate:**

**The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.**

(Note: The marking plate represents all models covered by this report except for difference in electrical ratings and model designation. See "General product information" for electrical ratings for all models. As there will be other lower wattages to be covered under same report which follows same back label format.)



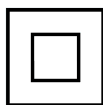
## Beyondsun Solar Module



<b>Solar Module Type</b>	<b>TSHM535-144HV</b>
Peak power (Pmax)	535W tolerance±3%
Open circuit voltage (Voc)	49.31V tolerance±3%
Short circuit current (Isc)	13.79A tolerance±4%
Max. power voltage (Vmp)	41.45V
Max. power current (Imp)	12.91A
Maximum System Voltage	1500VDC
PV Module Classification	Class II
Maximum Series Fuse	25 A



All technical data at standard test condition  
 $A_m=1.5$   $E=1000W/m^2$   $T_c=25^\circ C$



Zhejiang Beyondsun Green Energy Technology Co.,Ltd.

**Made in China**

No.888 Zhili Section of G318 Zhili Town, Huzhou City,

Zhejiang Province, China

[www.beyondsunpv.com](http://www.beyondsunpv.com)

[info@beyondsunpv.com](mailto:info@beyondsunpv.com)

Test item particulars..... :	
Accessories and detachable parts included in the evaluation .....	
Mounting system used..... :	Schletter
Other options included..... :	N/A
Possible test case verdicts:	
- test case does not apply to the test object..... :	N/A
- test object does meet the requirement .....	P (Pass)
- test object does not meet the requirement .....	F (Fail)
Abbreviations used in the report:	
Pmax – Maximum power	HF – Humidity Freeze
Vmp – Maximum power voltage	DH – Damp Heat
Imp – Maximum power current	TC – Thermal Cycling
Isc – Short circuit current	$\alpha$ – Current temperature coefficient
Voc – Open circuit voltage	$\beta$ – Voltage temperature coefficient
FF – Fill factor	$\delta$ – power temperature coefficient
STC – Standard Test Conditions (25°C, 1 000 W/m <sup>2</sup> )	NMOT – Nominal Module Operating Temperature (20°C, 800 W/m <sup>2</sup> )
MQT – Module Quality Tests	VFM <sub>rated</sub> – Rated diode(s) forward voltage
VFM – Measured diode(s) forward voltage	NP – Nameplate
$m_1$ – the measurement uncertainty in % of laboratory for Pmax	$m_2$ – the measurement uncertainty in % of laboratory for Voc
$m_3$ – the measurement uncertainty in % of laboratory for Isc	$t_1$ – the manufacturer's rated lower production tolerance in % for Pmax
$t_2$ – the manufacturer's rated upper production tolerance in % for Voc	$t_3$ – the manufacturer's rated upper production tolerance in % for Isc
r – Pmax measurement reproducibility	
Testing Dates (YYYY-MM-DD)	
Date of first test item received .....	2021-04-14
Dates of tests (beginning/end)..... :	2021-04-14 / 2021-06-18

<b>GENERAL REMARKS:</b>			
<p>"(See Enclosure #)" refers to additional information appended to the report.            "(See appended table)" refers to a table appended to the report.</p> <p><b>This TRF has been created in cooperation with CTL ETF-9 and German National Committee (DKE).            The originator's responsibility of this TRF in IEC EE CB Scheme has been assigned to TÜV SÜD            Product Service GmbH.</b></p> <p>Throughout this report a <input type="checkbox"/> comma / <input checked="" type="checkbox"/> point is used as the decimal separator.</p> <p>Conformity statement:            Conformity statement is decided in accordance with IEC Guide 115, Procedure 2 (Accuracy method).</p>			
Manufacturer's Declaration per sub-clause 4.2.5 of IEC EE 02:			
The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided.....		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> Not applicable	
When differences exist; they shall be identified in the General product information section.			
Name and address of factory (factories) .....		All listed in VDE license 40050436.	
<b>PRODUCT ELECTRICAL RATINGS:</b>			
Module type	TSHM535-144HV		
Voc [V] /Tolerance	49.31+/-3%		
Vmp [V]	41.45		
Imax [Adc]	12.91		
Isc [Adc] /Tolerance	13.79+/-4%		
Pmp [W] /Tolerance	535+/-3%		
Maximum system voltage [V]	1500		
Maximum Over-Current Protection Rating [A]	25		
Note: Electrical ratings for the complete series see attachment 6.			

**GENERAL PRODUCT INFORMATION AND OTHER REMARKS:**Modifications:

- Initial module design qualification
- Extension of module design qualification
- Original test report ref. No. .... : TRPVM-2019-40229-1

Model differences and modification:

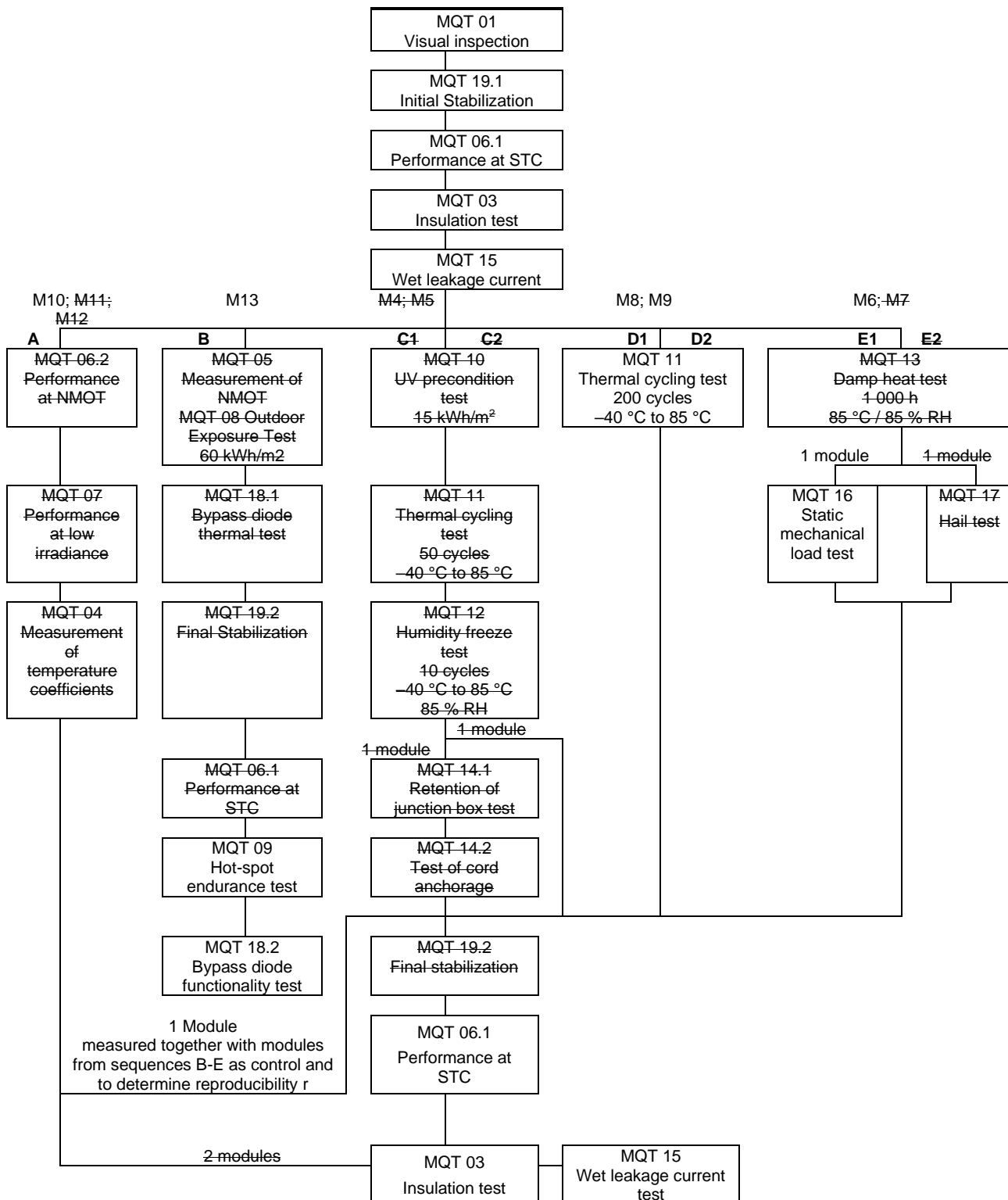
- |  |   |
|--|---|
| <input checked="" type="checkbox"/> Test programs for crystalline silicon PV modules   | <input type="checkbox"/> Test programs for thin-film PV modules   |
| <input type="checkbox"/> 4.2.1 Modification to frontsheet  | <input type="checkbox"/> 4.3.1 Modification to frontsheet   |
| <input checked="" type="checkbox"/> 4.2.2 Modification to encapsulation system   | <input type="checkbox"/> 4.3.2 Modification to encapsulation system   |
| <input checked="" type="checkbox"/> 4.2.3 Modification to cell technology  | <input type="checkbox"/> 4.3.3 Modification to front contact (e. g. TCO)  |
| <input type="checkbox"/> 4.2.4 Modification to cell and string interconnect material or technique  | <input type="checkbox"/> 4.3.4 Modification to cell technology  |
| <input type="checkbox"/> 4.2.5 Modification to backsheet   | <input type="checkbox"/> 4.3.5 Modification to cell layout  |
| <input checked="" type="checkbox"/> 4.2.6 Modification to electrical termination   | <input type="checkbox"/> 4.3.6 Modification to back contact   |
| <input type="checkbox"/> 4.2.7 Modification to bypass diode  | <input type="checkbox"/> 4.3.7 Modification to edge deletion  |
| <input type="checkbox"/> 4.2.8 Modification to electrical circuitry  | <input type="checkbox"/> 4.3.8 Modification to interconnect material or technique                                 |
| <input type="checkbox"/> 4.2.9 Modification to edge sealing  | <input type="checkbox"/> 4.3.9 Modification to backsheet  |
| <input type="checkbox"/> 4.2.10 Modification to frame and/or mounting structure  | <input type="checkbox"/> 4.3.10 Modification to electrical termination  |
| <input type="checkbox"/> 4.2.11 Change in PV module size   | <input type="checkbox"/> 4.3.11 Modification to bypass diode  |
| <input type="checkbox"/> 4.2.12 Higher or lower output power (by 10 % or more) with the identical design and size and using the identical cell process | <input type="checkbox"/> 4.3.12 Modification to edge sealing  |
| <input checked="" type="checkbox"/> 4.2.13 Increase of over-current protection rating  | <input type="checkbox"/> 4.3.13 Modification to frame and/or mounting structure                                   |
| <input type="checkbox"/> 4.2.14 Increase of system voltage   | <input type="checkbox"/> 4.3.14 Change in PV module size  |
| <input type="checkbox"/> 4.2.15 Change in cell fixing tape   | <input type="checkbox"/> 4.3.15 Higher or lower output power (by 10 % or more) with the identical design and size |
|  | <input type="checkbox"/> 4.3.16 Increase of over-current protection rating  |
|  | <input type="checkbox"/> 4.3.17 Increase of system voltage  |


Note: The clause references modifications extracted from IEC DTS 62915

<b>MODULE GROUP ASSIGNMENT:</b>				
Sample #	Sample Group ID	Type/model	Sample S/N	Remark
M10	A1	TSHM535-144HV	921617200300001	
M13	B	TSHM535-144HV	921617200300002	
M8	D1	TSHM535-144HV	921617200300003	
M9	D2	TSHM535-144HV	921617200300004	
M6	E1	TSHM535-144HV	921617200300005	
20	Lower 1	TSHM520-144HV	921617200300017	
21	Lower 2	TSHM520-144HV	921617200300022	
22	Higher 1	TSHM550-144HV	921617200300014	
23	Higher 2	TSHM550-144HV	921617200300019	
Supplementary information:				
Note (1)	Use the "General product information" field to give any information on model differences within a product type family covered by the test report and to describe the range of electrical and safety ratings, if the TRF covers a type family of modules.			
Note (3)	Use Annex 1 to list the used materials and components of the module (manufacturer/supplier and type reference).			
Note (4)	The module numbers/identifiers are set in accordance to IEC DTS 62915 Photovoltaic (PV) modules – Retesting for type approval, design and safety qualification, Annex A3			



<b>11</b>	<p><b>TEST FLOW (if it is not a full test, strikethrough non-performed test)</b></p> <p>Note: Deviations from test sequence are possible but must be documented.</p>
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IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
<b>5. MARKING AND DOCUMENTATION</b>			P
<b>5.1</b>	<b>Name Plate</b>		P
	All electrical data is shown as relative to standard test conditions (1 000 W/m <sup>2</sup> , 25 °C, AM 1,5 according to IEC TS 61836).		P
	International symbols are used where applicable.		P
	The module includes clear and indelible markings:		P
	a. Name, registered trade name or registered trade mark of manufacturer		P
	b. Type or model number designation	TSHM535-144HV	P
	c. Serial number (unless marked on other part of product)	On separate label	P
	d. Date and place of manufacture, alternatively serial number allowing to trace the date and place of manufacture;	Traceable by serial number	P
	e. Maximum system voltage	1500 VDC	P
	f. Class of protection against electrical shock	Class II	P
	g. Voltage at open-circuit or Voc including tolerances.	49.31+/-3%	P
	h. Current at short-circuit or Isc including tolerances	13.79+/-4%	P
	i. Module maximum power or Pmax including tolerances	535+/-3%	P
<b>5.2</b>	<b>Documentation</b>		P
5.2.1	Minimum requirements		P
	Modules are supplied with documentation describing the methods of electrical and mechanical installation as well as the electrical ratings of the module	See Installation Manual	P
	The documentation states the class of protection against electrical shock under which the module has been qualified and any specific limitations required for that class.	See Installation Manual	P
	The documentation assures that installers and operators receive appropriate and sufficient documentation for safe installation, use, and maintenance of the PV modules.	See Installation Manual	P
5.2.2	Information given in the documentation		P
	a. All information required under 5.1 e) to i)		P

IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
	b. Overcurrent protection device type and rating are e.g. given in IEC 60269-6	25 A see Marking Plate	P
	Maximum series/parallel module configuration is recommended	See Installation Manual	P
	c. Manufacturer's stated tolerance for Voc, Isc and maximum power output under standard test conditions	± 4%, for Isc, and +/-3% for Pmax and Voc, see Marking Plate	P
	d. Temperature coefficient for voltage at open-circuit	See module datasheet	P
	e. Temperature coefficient for maximum power	See module datasheet	P
	f. Temperature coefficient for short-circuit current	See module datasheet	P
	All electrical data mentioned above shown as relative to standard test conditions (1 000 W/m <sup>2</sup> , 25 °C, AM 1,5 according to IEC TS 61836)	See Marking Plate	P
	g. Nominal module operating temperature (NMOT) is specified	See module datasheet	P
	h. Performance at NMOT (MQT 06.2) is specified	See module datasheet	P
	i. Performance at low irradiance (MQT 07) is specified	See module datasheet	P
	International symbols used where applicable		P
	Compliance checked by inspection and MQT 04 through MQT 07		P
	The electrical documentation includes a detailed description of the electrical installation wiring method to be used		P
	j. The minimum cable diameters for modules intended for field wiring		N/A
	k. Any limitations on wiring methods and wire management that apply to the wiring compartment or box;		N/A
	l. The size, type, material and temperature rating of the conductors to be used		N/A
	m. Type of terminals for field wiring		N/A
	n. Specific PV connector model/types and manufacturer to which the module connectors are mated		P
	o. The bonding method(s) to be used (if applicable); all provided or specified hardware is identified in the documentation		N/A

IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
	p. The type and ratings of bypass diode to be used (if applicable)		N/A
	q. limitations to the mounting situation (e.g., slope, orientation, mounting means, cooling)		P
	r. A statement indicating the fire rating(s) and the applied standard and the limitations to that rating (e.g., installation slope, sub-structure or other applicable installation information)		P
	s. A statement indicating the design load per each mechanical means for securing the module as evaluated during the static mechanical load test according to MQT 16. At discretion of the manufacturer the test load and/or the safety factor $\gamma_m$ may be noted, too		P
	The installation instructions include relevant parameters specified by manufacturer or the following statement or the equivalent: <i>"Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of <math>I_{SC}</math> and <math>V_{OC}</math> marked on this module should be multiplied by a factor of 1,25 when determining component voltage ratings, conductor current ratings, and size of controls connected to the PV output."</i>		P
5.2.3	Assembly instructions		N/A
	Provided with a product shipped in subassemblies, detailed and adequate to the degree required to facilitate complete and safe assembly of the product		N/A
Supplementary information:			

7. PASS CRITERIA				P	
<b>7.2</b>	<b>Power output and electric circuitry</b>			P	
7.2.1	Verification of rated label values (Gate No. 1)			P	
	Manufacturer's tolerances and Laboratory uncertainties			P	
		$t_1$	$t_2$	$t_3$	—
	manufacturer's rated lower/upper production tolerance in %	±3.0	±3.0	±4.0	
		$m_1$	$m_2$	$m_3$	
	measurement uncertainty in % of laboratory	±2.6	±0.6	±2.4	
	Laboratory reproducibility r .....	0.33			

IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
	After stabilization, each individual module meets the requirements		P
	$P_{max}$ .....	See Table 03	P
	$V_{oc}$ .....	See Table 03	P
	$I_{sc}$ .....	See Table 03	P
	After stabilization the arithmetic average $\bar{P}_{max}$ of all modules meet the requirements.	See Table 03	P
7.2.2	Maximum power degradation during type approval testing (Gate #2)		P
	At the end of each test sequence or for sequence B after bypass diode test, each test sample meets the requirements for $P_{max}$		P
7.2.3	Electrical circuitry		P
	Samples do not exhibit an open-circuit during the tests		P
<b>7.3</b>	<b>Visual defects</b>		P
	There is no visual evidence of a major defect.		P
<b>7.4</b>	<b>Electrical safety</b>		P
	The insulation test (MQT 03) requirements are met after the tests		P
	The wet leakage current test (MQT 15) requirements met at the beginning and at the end of each sequence		P
	Specific requirements of the individual tests are met		P
Supplementary information:			

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict
<b>4. TESTING OVERVIEW</b>			P
	Initial examination	All modules	P
4.1	Visual inspection (MQT 01) .....	See Table 01	P
4.19.5	Initial stabilization (MQT 19.1) .....	See Table 02	P
4.6	Performance at STC (MQT 06.1)	See Table 03	P
4.3	Insulation test(MQT 03) .....	See Table 04	P
4.15	Wet leakage current test(MQT 15) .....	See Table 05	P
<b>Sequence A</b>	<b>1 Module</b>	Sample M10	P
<b>Sequence B</b>	<b>1 Module</b>	Sample M13	P
4.18.1	Bypass diode thermal test (MQT 18.1)		N/A
4.18.2	Bypass diode functionality test (MQT 18.2) .....		N/A
4.19.6	Final stabilization (MQT 19.2) .....		N/A
4.9	Hot spot endurance test (MQT 09) .....	See Table 13.1 - 13.5	P
<b>Sequence D</b>	<b>2 Modules</b>	Sample M8; M9	P
4.11	Thermal cycling test 200 cycles (MQT 11) .....	See Table 18.1 - 18.4	P
<b>Sequence E1</b>	<b>1 Module</b>	Sample M6	P
4.16	Static mechanical load test (MQT 16) .....	See Table 19.5 - 19.9	P
	Final measurement	All modules for Sequence A, D, E; Control module.	P
4.6	Performance at STC (MQT 06.1) .....	See Table 20.3	P
4.3	Insulation test(MQT 03) .....	See Table 21	P
4.15	Wet leakage current test(MQT 15) .....	See Table 22	P

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE 01: MQT 01 ini: Initial Visual inspection			P
Test Date [YYYY-MM-DD]..... :		2021-04-14	—
Sample #	Nature and position of initial findings – comments or attach photos		—
M10	No findings		P
M13	No findings		P
M8	No findings		P
M9	No findings		P
M6	No findings		P
Supplementary information:			

TABLE 02: MQT 19.1 ini: Initial stabilization							P
TABLE 02.1: MQT 06.1 ini: Performance at STC before initial stabilization							P
Test Date [YYYY-MM-DD]..... :		2021-04-27					—
Test method..... :		<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight					—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
M10	13.456	49.299	12.827	41.807	536.275	80.84	P
M13	13.468	49.287	12.818	41.748	535.143	80.62	P
M8	13.485	49.303	12.815	41.795	535.616	80.56	P
M9	13.436	49.308	12.803	41.812	535.299	80.80	P
M6	13.453	49.300	12.817	41.745	535.033	80.67	P
Supplementary information:							

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE 02.2: MQT 19.1 ini: Initial Stabilization procedure							P
Light exposure method .....					<input checked="" type="checkbox"/> Simulator	<input type="checkbox"/> Natural sunlight	
Abbreviation: Regarding light source "S" for Solar simulator and "N" for Natural sunlight							
Stabilization criterion x per IEC 61215-1-x .....					1.0%		
Sample #	M10	Test Date (YYYY-MM-DD) start/end .....			2021-04-27/2021-04-29		
Test cycle	Integrated irradiation (kWh/m <sup>2</sup> )	Irradiance (W/m <sup>2</sup> )	Module temperature (°C)	Resistive load	P <sub>max</sub> (W) at the end of cycle	(P <sub>max</sub> - P <sub>min</sub> ) / P <sub>average</sub> (%)	Stable (Yes/No)
Initial	20	—	—	—	536.275	—	—
1	5	1000	50	Yes	536.026	—	—
2	5	1000	50	Yes	535.221	<1.0	Yes
Sample #	M13	Test Date (YYYY-MM-DD) start/end .....			2021-04-27/2021-04-29		
Test cycle	Integrated irradiation (kWh/m <sup>2</sup> )	Irradiance (W/m <sup>2</sup> )	Module temperature (°C)	Resistive load	P <sub>max</sub> (W) at the end of cycle	(P <sub>max</sub> - P <sub>min</sub> ) / P <sub>average</sub> (%)	Stable (Yes/No)
Initial	20	—	—	—	535.143	—	—
1	5	1000	50	Yes	534.664	—	—
2	5	1000	50	Yes	534.268	<1.0	Yes
Sample #	M8	Test Date (YYYY-MM-DD) start/end .....			2021-04-27/2021-04-29		
Test cycle	Integrated irradiation (kWh/m <sup>2</sup> )	Irradiance (W/m <sup>2</sup> )	Module temperature (°C)	Resistive load	P <sub>max</sub> (W) at the end of cycle	(P <sub>max</sub> - P <sub>min</sub> ) / P <sub>average</sub> (%)	Stable (Yes/No)
Initial	20	—	—	—	535.616	—	—
1	5	1000	50	Yes	535.365	—	—
2	5	1000	50	Yes	534.498	<1.0	Yes
Sample #	M9	Test Date (YYYY-MM-DD) start/end .....			2021-04-27/2021-04-29		
Test cycle	Integrated irradiation (kWh/m <sup>2</sup> )	Irradiance (W/m <sup>2</sup> )	Module temperature (°C)	Resistive load	P <sub>max</sub> (W) at the end of cycle	(P <sub>max</sub> - P <sub>min</sub> ) / P <sub>average</sub> (%)	Stable (Yes/No)
Initial	20	—	—	—	535.299	—	—
1	5	1000	50	Yes	534.666	—	—
2	5	1000	50	Yes	534.562	<1.0	Yes



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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	M6	Test Date (YYYY-MM-DD) start/end .....			2021-04-27/2021-04-29		
Test cycle	Integrated irradiation (kWh/m <sup>2</sup> )	Irradiance (W/m <sup>2</sup> )	Module temperature (°C)	Resistive load	P <sub>max</sub> (W) at the end of cycle	(P <sub>max</sub> - P <sub>min</sub> ) / P <sub>average</sub> (%)	Stable (Yes/No)
Initial	20	—	—	—	535.033	—	—
1	5	1000	50	Yes	534.855	—	—
2	5	1000	50	Yes	534.572	<1.0	Yes

Supplementary information: 20 kWh/m<sup>2</sup> outdoor Initial stabilisation

TABLE 03: MQT 06.1 ini: Performance at STC after initial stabilization										P
Test Date [YYYY-MM-DD] .....					2021-04-29					—
P <sub>max</sub> (lab) lower limit (W) .....					See table below: P <sub>max</sub> [W] – Min calc.: 518.95					—
$\bar{P}_{max}$ (Lab) lower limit (W) .....					535					—
Voc(lab) upper limit (V) .....					See table below: Voc [V] Max. calc.: 50.789					—
Isc (lab) upper limit (A) .....					See table below: Isc [A] Max. calc.: 14.341					—
Test method .....					<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight					—
Sample #	Isc [A]		Voc [V]		Imp [A]	Vmp [V]	Pmax [W]		FF [%]	Result
	Meas.	Max. calc.	Meas.	Max. calc.			Meas.	Min. calc.		
M10	13.39	13.71	49.31	49.61	12.772	41.91	535.22	549.14	81.06	P
M13	13.40	13.72	49.30	49.60	12.779	41.81	534.27	548.16	80.85	P
M8	13.44	13.76	49.31	49.60	12.77	41.86	534.50	548.39	80.67	P
M9	13.44	13.75	49.26	49.56	12.79	41.80	534.56	548.46	80.83	P
M6	13.45	13.77	49.25	49.55	12.80	41.76	534.57	548.47	80.71	P
Average	—					534.60	548.52	—		P

Supplementary information: The limit values are calculated considering manufacturer's tolerances *t* of rated nameplate values and laboratory measurement uncertainties *m*.

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 04: MQT 03 ini: Initial Insulation test					P
Test Date [YYYY-MM-DD] .....		2021-04-30		—	
Test Voltage applied [V] .....		1500 / 8000		—	
Size of module [m <sup>2</sup> ] .....		2.56		—	
Required Resistance [MΩ] .....		15.6		—	
Sample #	Measured	Dielectric breakdown		Result	
	MΩ	Yes (description)	No		
M10	>1500	--	X	P	
M13	>1500	--	X	P	
M8	>1500	--	X	P	
M9	>1500	--	X	P	
M6	>1500	--	X	P	
Supplementary information:					

TABLE 05: MQT 15 ini: Initial Wet leakage current test					P
Test Date [YYYY-MM-DD] .....		2021-04-30		—	
Test Voltage applied [V] .....		1500		—	
Solution temperature [°C] .....		20		—	
Size of module [m <sup>2</sup> ] .....		2.56		—	
Sample #	Required Resistance [MΩ]	Measured [MΩ]		Result	
M10	>15.6	>1500		P	
M13	>15.6	>1500		P	
M8	>15.6	>1500		P	
M9	>15.6	>1500		P	
M6	>15.6	>1500		P	
Supplementary information:					

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE 13: MQT 09 - Hot-spot endurance test		P
Test Date [YYYY-MM-DD] start/end .....	2021-06-17	—
Sample #	M13	—
Procedure of technology .....	<input checked="" type="checkbox"/> wafer-based technologies (WBT) MQT 09.1 <input type="checkbox"/> monolithically integrated (MLI) thin film technologies MQT 09.2	—
Cell interconnection circuit .....	<input type="checkbox"/> S <input type="checkbox"/> SP <input checked="" type="checkbox"/> SPS	—
Type of light source .....	<input type="checkbox"/> Pulse Simulator <input checked="" type="checkbox"/> Steady state Simulator <input type="checkbox"/> Natural sunlight	—
Module temperature at thermal equilibrium [°C] .:	56.3	—

TABLE 13.1: MQT 09 - Hot-spot endurance test for WBT					P
Selected hot-spot cells .....	LOW	LOW	LOW	HIGH	—
	6-24	2-22	1-12	1-15	
Shading rate [%].....	10	10	10	10	—
Max. measured cell temperature in each cell [°C]:	108.1	81.0	118.4	112.8	—
Test duration of each shading [h] .....	1	1	1	1	—
Irradiance during shading [W/m <sup>2</sup> ] .....	1000	1000	1000	1000	—
Supplementary information:					

TABLE 13.3: MQT 01 - Visual inspection after hot-spot endurance test		P
Test Date [YYYY-MM-DD].....	2021-06-17	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M13	No findings	P
Supplementary information:		

TABLE 13.4: MQT 02 - Maximum power determination after hot-spot endurance test							P
Test Date [YYYY-MM-DD].....	2021-06-18						—
Module temperature [°C].....	25						—
Irradiance [W/m <sup>2</sup> ] .....	1000						—
Sample #	Isc [A]	Voc [V]	I <sub>mp</sub> [A]	V <sub>mp</sub> [V]	P <sub>max</sub> [W]	FF [%]	—
M13	13.54	49.29	12.76	41.76	532.84	79.86	P
Supplementary information:							

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE 13.5: MQT 03 - Insulation test after hot-spot endurance test				P
Test Date [YYYY-MM-DD].....:		2021-06-17		—
Test Voltage applied [V] .....		1500 / 8000		—
Size of module [m <sup>2</sup> ] .....		2.56		—
Required Resistance [MΩ].....:		15.6		—
Sample #	Measured	Dielectric breakdown		Result
	MΩ	Yes (description)	No	
M13	>1500	--	X	P
Supplementary information:				

TABLE 13.6: MQT 15 - Wet leakage current test after hot-spot endurance test				P
Test Date [YYYY-MM-DD].....:		2021-06-17		—
Test Voltage applied [V] .....		1500		—
Solution temperature [°C].....:		20		—
Size of module [m <sup>2</sup> ] .....		2.56		—
Sample #	Required Resistance [MΩ]	Measured [MΩ]		Result
M13	>15.6	>1500		P
Supplementary information:				

TABLE 13.7: MQT 18.2 - Bypass diode functionality test after Hot-spot endurance test				P
Test Date [YYYY-MM-DD].....:		2021-06-18		—
<input type="checkbox"/> Method A				—
<input checked="" type="checkbox"/> Method B				—
	IV curve after shading			Result
Diode 1	No findings			P
Diode 2	No findings			P
Diode 3	No findings			P
Supplementary information:				

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE 18: MQT 11 - Thermal cycling 200 test			P
Test Date [YYYY-MM-DD] start/end .....	2021-05-02/2021-06-16		—
Total cycles (200) .....	200		—
Applied current (A) .....	During the heat up cycle from – 40 °C to 80 °C	12.83/12.79	—
	Other stages	0.05	—
Sample #	Open circuits (yes/no)		—
M8	No		P
M9	No		P
Supplementary information:			

TABLE 18.1: MQT 01 - Visual inspection after thermal cycling 200 test			P
Test Date [YYYY-MM-DD] .....	2021-06-16		—
Sample #	Nature and position of initial findings – comments or attach photos		—
M8	No findings		P
M9	No findings		P
Supplementary information:			

TABLE 18.2: MQT 15 - Wet leakage current test after thermal cycling 200 test				P
Test Date [YYYY-MM-DD] .....	2021-06-16			—
Test Voltage applied [V] .....	1500			—
Solution temperature [°C] .....	21			—
Size of module [m <sup>2</sup> ] .....	2.56			—
Sample #	Required Resistance [MΩ]	Measured [MΩ]		Result
M8	>15.6	>1500		P
M9	>15.6	>1500		P
Supplementary information:				

TABLE 18.3: MQT 02 - Maximum power determination after thermal cycling 200 test							P
Test Date [YYYY-MM-DD] .....	2021-06-16						—
Module temperature [°C] .....	25						—
Irradiance [W/m <sup>2</sup> ] .....	1000						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
M8	13.41	49.25	12.73	41.81	532.21	80.59	P
M9	13.38	49.27	12.75	41.76	532.36	80.78	P
Supplementary information:							

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE 18.4: MQT 03 - Insulation test after after thermal cycling 200 test				P
Test Date [YYYY-MM-DD]..... :	2021-06-16			—
Test Voltage applied [V] .....	1500 / 8000			—
Size of module [m <sup>2</sup> ] .....	2.56			—
Required Resistance [MΩ]..... :	15.6			—
Sample #	Measured	Dielectric breakdown		Result
	MΩ	Yes (description)	No	
M8	>1500	--	X	P
M9	>1500	--	X	P
Supplementary information:				

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE 19.5: MQT 16 Static mechanical load test			P
Sample # :	M6		—
Design load(front side/ back side)..... :	3600/1600		—
Safety factors .....	1.5		—
Test Date [YYYY-MM-DD].....	2021-06-17		—
Mounting method .....	8 clamps, please refer to installation manual		—
Load applied to..... :	front side	back side	—
Mechanical load [Pa]..... :	5400	2400	—
First cycle time (start/end)..... :	09:19~10:19	10:26~11:26	—
Intermittent open-circuit (yes/no) .....	no	no	P
Second cycle time (start/end) .....	11:42~12:42	13:01~14:01	—
Intermittent open-circuit (yes/no) .....	no	no	P
Third cycle time (start/end) .....	14:08~15:08	15:11~16:11	—
Intermittent open-circuit (yes/no) .....	no	no	P
Supplementary information: may need to be performed with each mounting situation			

TABLE 19.6: MQT 01 - Visual inspection after static mechanical load test			P
Test Date [YYYY-MM-DD]..... :	2021-06-17		—
Sample #	Nature and position of initial findings – comments or attach photos		—
M6	No findings		P
Supplementary information:			

TABLE 19.7: MQT 15 - Wet leakage current test after static mechanical load test			P
Test Date [YYYY-MM-DD]..... :	2021-06-17		—
Test Voltage applied [V]..... :	1500		—
Solution temperature [°C]..... :	21		—
Size of module [m <sup>2</sup> ]..... :	2.56		—
Sample #	Required Resistance [MΩ]	Measured [MΩ]	Result
M6	>15.6	>1500	P
Supplementary information:			

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE 19.8: MQT 02 - Maximum power determination after static mechanical load test							P
Test Date [YYYY-MM-DD].....:		2021-06-17					—
Module temperature [°C].....:		25					—
Irradiance [W/m <sup>2</sup> ].....:		1000					—
Sample #	Isc [A]	Voc [V]	I <sub>mp</sub> [A]	V <sub>mp</sub> [V]	P <sub>max</sub> [W]	FF [%]	Result
M6	13.41	49.26	12.75	41.73	531.91	80.53	P
Supplementary information:							

TABLE 19.9: MQT 03 - Insulation test after after static mechanical load test					P
Test Date [YYYY-MM-DD]..... :		2021-06-17			—
Test Voltage applied [V] .....		1500 / 8000			—
Size of module [m <sup>2</sup> ] .....		2.56			—
Required Resistance [MΩ]..... :		15.6			—
Sample #	Measured		Dielectric breakdown		Result
	MΩ		Yes (description)	No	
M6	>1500		--	X	P
Supplementary information:					



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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 20.3: MQT 06.1: Final Performance at STC									P
Test Date [YYYY-MM-DD]..... :					See final measurements in related test sequence				—
Test method..... :					<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight				—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab_GateNo.1)	Power Degradation [%]	Result
M10	13.45	49.22	12.81	41.76	534.78	80.77	533,40	+0.26	P
M13*	13.54	49.29	12.76	41.76	532.84	79.86	532,45	+0.07	P
M8	13.41	49.25	12.73	41.81	532.21	80.59	532,68	0.09	P
M9	13.38	49.27	12.75	41.76	532.36	80.78	532,74	0.07	P
M6	13.41	49.26	12.75	41.73	531.91	80.53	532,75	0.16	P

Supplementary information: Pmax [W] (Lab\_GateNo.1) is calculated by considering the reproducibility *r* of control module. Date including uncertainty see table below. \* For information only.

Lab	m1	2,60 %	m2	0,60 %	m3	2,40 %
-----	----	--------	----	--------	----	--------

r	0,34 %
---	--------

Label	t1	3,00 %	t2	3,00 %	t3	4,00 %
P <sub>maxnameplate</sub> [W]	535,00					
P <sub>minnameplate</sub> [W]	518,95					
V <sub>OCnameplate</sub> [V]	49,31					
V <sub>OCmaxnameplate</sub> [V]	50,7893					
I <sub>scnameplate</sub> [A]	13,79					
I <sub>scmaxnameplate</sub> [A]	14,3416					
Number of samples	5					

Sample	M10	M13	M8	M9	M6
Power Gate 1	535,22	534,27	534,50	534,56	534,57
V <sub>OC</sub>	49,31	49,30	49,31	49,26	49,25
I <sub>sc</sub>	13,39	13,40	13,44	13,43	13,45
Power Gate 2	534,78	532,84	532,21	532,36	531,91

	Gate 1				
P <sub>maxlab</sub>	549,14	548,16	548,40	548,46	548,47
P <sub>max</sub> Deviation	5,82	5,63	5,67	5,69	5,69
P <sub>maxaverage</sub>	534,62				
P <sub>max(Lab)average</sub>	548,52				
V <sub>OClab</sub>	49,61	49,60	49,61	49,56	49,55
V <sub>OC</sub> Deviation	-2,33	-2,35	-2,33	-2,43	-2,45
I <sub>sc lab</sub>	13,711	13,722	13,763	13,752	13,773
I <sub>sc</sub> Deviation	-4,39	-4,32	-4,04	-4,11	-3,97
	Gate 2				
P <sub>max(Lab_GateNo.1)</sub>	533,40	532,45	532,68	532,74	532,75
P <sub>max(Lab_GateNo.1) degradation</sub>	0,26	0,07	-0,09	-0,07	-0,16
P <sub>max(Lab_GateNo.1)min</sub>	506,73	505,83	506,05	506,11	506,11
Power Gate 2 Deviation	5,54	5,34	5,17	5,19	5,10

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 21: MQT 03 fin: Final Insulation test					P
Test Date [YYYY-MM-DD] .....		See final measurements in related test sequence		—	
Test Voltage applied [V] .....		1500 / 8000		—	
Size of module [m <sup>2</sup> ] .....		2.56		—	
Required Resistance [MΩ] .....		15.6		—	
Sample #	Measured	Dielectric breakdown		Result	
	MΩ	Yes (description)	No		
M10	>1500	--	X	P	
M13	>1500	--	X	P	
M8	>1500	--	X	P	
M9	>1500	--	X	P	
M6	>1500	--	X	P	
Supplementary information:					

TABLE 22: MQT 15 fin: Final Wet leakage current test					P
Test Date [YYYY-MM-DD] .....		See final measurements in related test sequence		—	
Test Voltage applied [V] .....		1500		—	
Solution temperature [°C] .....		20		—	
Size of module [m <sup>2</sup> ] .....		2.56		—	
Sample #	Required Resistance [MΩ]	Measured [MΩ]		Result	
M10	>15.6	>1500		P	
M13	>15.6	>1500		P	
M8	>15.6	>1500		P	
M9	>15.6	>1500		P	
M6	>15.6	>1500		P	
Supplementary information:					

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

A1.1	MODULE TYPE/S
	TSHM535-144HV

A1.2	MODULE DESIGN
	Module dimensions (L x W x H) [mm] .....: 2256 x 1133 x 35
	Weights .....: Max 28.5 kg
	Front/Rear cover bonding classification .....: <input checked="" type="checkbox"/> rigid/flexible <input type="checkbox"/> rigid/rigid <input type="checkbox"/> flexible/flexible

A1.3	SOLAR CELL
	Cell type reference .....: 182S-10BB, Zhejiang Beyondsun PV Co., Ltd.
	Cell dimensions L x W x T ( $\pm$ %) [mm] .....: 182 x 91 +/-0.25
	Cell thickness [ $\mu$ m] .....: 190 $\pm$ 30
	Cell area [cm <sup>2</sup> ] .....: 165.075

A1.4	IDENTIFICATION OF MATERIALS
	Front cover.....: 3.2 mm, AR coated tempered glass, FLAT GLASS GROUP CO., LTD.
	Rear cover .....: Cynagard 205A(R), Cybrid Technologies Inc.
	Encapsulation material front side .....: F406P, Hangzhou First Applied Material Co., Ltd.
	Encapsulation material back side .....: F806P, Hangzhou First Applied Material Co., Ltd.
	Frame parts .....: Aluminum, 6005-T5, Huzhou beisheng aluminum technology Co., Ltd.
	Mounting parts .....: N/A
	Adhesive for frame .....: HT906Z, Shanghai Huitian New Chemical Material Co., Ltd.
	Edge sealing .....: N/A
	Internal wiring .....: N/A
	Cell connector .....: Diameter 0.3mm, Changzhou Greateen New Energy Technology Co., Ltd.

	String connector .....	0.4 x 4.0mm, Changzhou Greateen New Energy Technology Co., Ltd.
	Soldering material.....	SnPb
	Fluxing agent .....	SF56, ASAHI Solder Technology (Wuxi) Co., Ltd.
	Junction box.....	FT50xy, Zhejiang Renhe Photovoltaic Technology Co., Ltd.
	Cable .....	H1Z2Z2-K, 4mm <sup>2</sup> , Zhejiang Renhe Photovoltaic Technology Co., Ltd.
	Connector .....	05-8, Zhejiang Renhe Photovoltaic Technology Co., Ltd.

	Bypass diode .....	FMK5040D, Zhejiang Renhe Photovoltaic Technology Co., Ltd.
	Potting material.....	5299W-S, Shanghai Huitian New Chemical Material Co., Ltd.
	Adhesive for junction box .....	HT906Z, Shanghai Huitian New Chemical Material Co., Ltd.
	Additional material (e. g. fixing tape, insulation tape).....	Insulation strip, BEC-201, Suzhou First PV Material Co., Ltd.

<b>A1.5</b>	<b>MODULE DESIGN - MINIMUM DISTANCES</b>	
	Between cells.....	0.7 mm
	Between cell and accessible surfaces.....	13.75 mm
	Between any current carrying part and accessible surfaces .....	13.75 mm

<b>A1.6</b>	<b>MODULE DESIGN - ELECTRICAL CONFIGURATION</b>	
	Total number of cells .....	144
	Serial-parallel connection of cells .....	SPS
	Cells per bypass diode .....	48
	No. of bypass diodes .....	3

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## Annex 3: Lower and higher output power modules

TABLE A.4.1 Performance at STC before initial stabilization							P
Test Date [YYYY-MM-DD].....:			2020-04-27				—
Test method.....:			<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight				—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
20	13.58	48.85	12.71	41.22	523.91	78.97	P
21	13.62	48.77	12.74	40.96	521.83	78.56	P
22	13.98	49.8	13.17	41.99	553.01	79.43	P
23	14.04	49.68	13.19	41.85	552.00	79.14	P
Supplementary information: The limit value is calculated through considering the tolerance of rated label values and lab measurement uncertainty.							

TABLE A.4.2: MQT 19.1 ini: Initial Stabilization procedure							P
Light exposure method .....			<input type="checkbox"/> Simulator <input checked="" type="checkbox"/> 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 #	20	Test Date (YYYY-MM-DD) start/end .....			2020-04-17/2020-04-20		
Test cycle	Integrated irradiation (kWh/m <sup>2</sup> )	Irradiance (W/m <sup>2</sup> )	Module temperature (°C)	Resistive load	P <sub>max</sub> (W) at the end of cycle	(P <sub>max</sub> – P <sub>min</sub> ) / P <sub>average</sub> (%)	Stable (Yes/No)
Initial	—	—	—	—	523.91	—	—
1	5	—	—	Yes	523.15	—	—
2	5	—	—	Yes	521.81	<1	Yes
Sample #	21	Test Date (YYYY-MM-DD) start/end .....			2020-04-17/2020-04-20		
Test cycle	Integrated irradiation (kWh/m <sup>2</sup> )	Irradiance (W/m <sup>2</sup> )	Module temperature (°C)	Resistive load	P <sub>max</sub> (W) at the end of cycle	(P <sub>max</sub> – P <sub>min</sub> ) / P <sub>average</sub> (%)	Stable (Yes/No)
Initial	—	—	—	—	521.83	—	—
1	5	—	—	Yes	520.89	—	—
2	5	—	—	Yes	518.94	<1	Yes



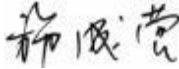
IEC 61215-2							
Sample #	22	Test Date (YYYY-MM-DD) start/end .....			2020-04-17/2020-04-20		
Test cycle	Integrated irradiation (kWh/m <sup>2</sup> )	Irradiance (W/m <sup>2</sup> )	Module temperature (°C)	Resistive load	P <sub>max</sub> (W) at the end of cycle	(P <sub>max</sub> - P <sub>min</sub> ) / P <sub>average</sub> (%)	Stable (Yes/No)
Initial	—	—	—	—	553.01	—	—
1	5	—	—	Yes	551.78	—	—
2	5	—	—	Yes	550.89	<1	Yes
Sample #	23	Test Date (YYYY-MM-DD) start/end .....			2020-04-17/2020-04-20		
Test cycle	Integrated irradiation (kWh/m <sup>2</sup> )	Irradiance (W/m <sup>2</sup> )	Module temperature (°C)	Resistive load	P <sub>max</sub> (W) at the end of cycle	(P <sub>max</sub> - P <sub>min</sub> ) / P <sub>average</sub> (%)	Stable (Yes/No)
Initial	—	—	—	—	552.00	—	—
1	5	—	—	Yes	550.56	—	—
2	5	—	—	Yes	549.77	<1	Yes
Supplementary information:							

TABLE A.4.3: MQT 6.1 Performance at STC after initial stabilization							P
Test Date [YYYY-MM-DD] .....		2021-04-20					—
		Higher end power class For module 20&21		Higher end power class For module 22&23		—	
P <sub>max</sub> (lab) (W) .....		≥ 504.4		≥ 533.5		—	
V <sub>oc</sub> (lab) (V) .....		≤ 50.33		≤ 51.25		—	
I <sub>sc</sub> (lab) (A) .....		≤ 14.13		≤ 14.56		—	
Test method .....		<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight					—
Sample #	I <sub>sc</sub> [A]	V <sub>oc</sub> [V]	I <sub>mp</sub> [A]	V <sub>mp</sub> [V]	P <sub>max</sub> [W]	FF [%]	Result
20	13.52	48.80	12.70	41.09	521.81	79.09	P
21	13.59	48.70	12.73	40.78	518.94	78.41	P
22	13.92	49.76	13.15	41.89	550.89	79.53	P
23	13.99	49.63	13.16	41.77	549.77	79.18	P
Supplementary information: The limit value is calculated through considering the tolerance of rated label values and lab measurement uncertainty.							

Test Report issued under the responsibility of:



<b>TEST REPORT</b> <b>IEC 61730-2</b> <b>PV Module Safety Qualification –</b> <b>Part 1: Requirements for construction and</b> <b>Part 2: Requirements for testing</b>	
Report Number.....	TRPVM-2020-40271-1
Date of issue.....	2021-07-07
Total number of pages.....	92
Name of Testing Laboratory preparing the Report .....	TAIER LABS (JIAXING) CO., LTD. 
Applicant's name .....	Zhejiang Beyondsun Green Energy Technology Co., Ltd.
Address.....	No.888, Zhili Section of G318 Zhili Town, Huzhou City, Zhejiang province, China.
<b>Test specification:</b>	
Standards .....	IEC 61730-2:2016 in conjunction with IEC 61730-1:2016
Test procedure .....	VDE-scheme <input checked="" type="checkbox"/>
Non-standard test method .....	N/A
Test Report Form No. ....	IEC61730_2E
Test Report Form(s) Originator ....	CTL ETF 9
Master TRF .....	Dated 2017-12
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<b>General disclaimer:</b>	
The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing CB Testing Laboratory. The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report.	

Test item description..... :	Photovoltaic (PV) Module(s)	
Trade Mark..... :	 Beyondsun	
Manufacturer..... :	Zhejiang Beyondsun Green Energy Technology Co., Ltd.	
Address..... :	No.888, Zhili Section of G318 Zhili Town, Huzhou City, Zhejiang province, China.	
Model/Type reference..... :	TSHM535-144HV	
Ratings..... :	See page 6	
<b>Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):</b>		
<input checked="" type="checkbox"/>	CB Testing Laboratory:	TAIER LABS (JIAXING) CO., LTD 
Testing location/address..... :		Building 7, 3556 Linggongtang Road, Nanhu, District, Jiaxing, Zhejiang
Tested by (name, function, signature)..... :		Guangyuan Chen Testing Engineer (Authorization of test report) 
Approved by (name, function, signature)..... :		Chengying Shi Technical certification officer 
<input type="checkbox"/>	Testing procedure: CTF Stage 1:	
Testing location/address..... :		
Tested by (name, function, signature)..... :		
Approved by (name, function, signature)..... :		
<input type="checkbox"/>	Testing procedure: CTF Stage 2:	
Testing location/address..... :		
Tested by (name, function, signature)..... :		
Witnessed by (name, function, signature)..... :		
Approved by (name, function, signature)..... :		
<input type="checkbox"/>	Testing procedure: CTF Stage 3 or 4:	
Testing location/address..... :		
Tested by (name, function, signature)..... :		
Witnessed by (name, function, signature)..... :		
Approved by (name, function, signature)..... :		
Supervised by (name, function, signature)..... :		



<b>List of attachments (including a total number of pages in each attachment):</b>																			
	attachment number / number of pages																		
Installation manual:	Attachment 5 / 11 pages																		
Drawings mechanical:	Attachment 2 / 3 pages																		
Circuit diagram:	Attachment 3 / 2 pages																		
Photographs:	Attachment 1 / 1 page																		
Component datasheets / certificates	Attachment 4 / 17 pages																		
Others: Electrical ratings	Attachment 6 / 4 pages																		
<b>Summary of testing:</b>																			
<p><b>Tests performed (name of test and test clause):</b> IEC TS 62915:2018</p> <p>Clause 4.2.3 introduce new model types TSHMXXX-144HV and the 1000 V version THSMXXX-144V with the 182 x 91 mm cell type 182S-10BB, by Beyondsun. Due to identical outer cell surface as already approved, DH test deemed not to be necessary.</p> <p>Clause 4.2.2, introduce new encapsulation type F406P/TF8 by First, based on TÜV Rheinland report No. 60410450 002 (kept on file as TRPVM-2021-40271-2) for the new model type TSHMXXX-144HW and the 1000 V version TSHMXXX-144W with the 166 x 83 mm cell type 166S-9BB by Beyondsun</p> <p>Clause 4.2.6, modification to electrical termination for alternative J-box type listed below. They are already TÜV Rheinland tested and certified. No additional testing deemed to be necessary.</p> <table border="1"> <thead> <tr> <th>Type of J-box</th> <th>Type of diode</th> <th>Type of connector</th> <th>manufacturer</th> </tr> </thead> <tbody> <tr> <td rowspan="5">FT50xy</td> <td>FMK4530T</td> <td rowspan="5">05-6(1000V), 05-8(1500V), RHC2xyzu(y=M) (1500V)</td> <td rowspan="5">Renhe</td> </tr> <tr> <td>FMK4530B</td> </tr> <tr> <td>FMK5040D</td> </tr> <tr> <td>FMK4545D</td> </tr> <tr> <td>FMK5060D</td> </tr> <tr> <td rowspan="2">JM07w</td> <td>THY2550</td> <td rowspan="2">PV-JM608</td> <td rowspan="2">Jiaming</td> </tr> <tr> <td>THY4050</td> </tr> </tbody> </table> <p>Clause 4.2.13, increase of over current protection rating from 20 A to 25 A.</p> <p>The tests are representative for all module types listed in VDE license 40050436, using the same BOM from the 144 cells version down to the 72 cells version. Creepage and clearance distances for the smaller modules are minimum the same as for the tested version.</p> <p>The change of the manufacturers name from Zhejiang Trunsun Solar Co., Ltd. to Zhejiang Beyondsun Green Energy Technology Co., Ltd. is included in this project.</p>		Type of J-box	Type of diode	Type of connector	manufacturer	FT50xy	FMK4530T	05-6(1000V), 05-8(1500V), RHC2xyzu(y=M) (1500V)	Renhe	FMK4530B	FMK5040D	FMK4545D	FMK5060D	JM07w	THY2550	PV-JM608	Jiaming	THY4050	<p><b>Test location:</b> See page 2.</p>
Type of J-box	Type of diode	Type of connector	manufacturer																
FT50xy	FMK4530T	05-6(1000V), 05-8(1500V), RHC2xyzu(y=M) (1500V)	Renhe																
	FMK4530B																		
	FMK5040D																		
	FMK4545D																		
	FMK5060D																		
JM07w	THY2550	PV-JM608	Jiaming																
	THY4050																		
<p><b>Summary of compliance with National Differences (List of countries addressed):</b></p> <p>N/A</p>																			

**Copy of marking plate:**

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.



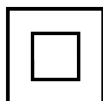
## Beyondsun Solar Module



Solar Module Type	TSHM535-144HV
Peak power (Pmax)	535W tolerance±3%
Open circuit voltage (Voc)	49.31V tolerance±3%
Short circuit current (Isc)	13.79A tolerance±4%
Max. power voltage (Vmp)	41.45V
Max. power current (Imp)	12.91A
Maximum System Voltage	1500VDC
PV Module Classification	Class II
Maximum Series Fuse	25 A



All technical data at standard test condition  
 $A_m=1.5$   $E=1000W/m^2$   $T_c=25^\circ C$



Zhejiang Beyondsun Green Energy Technology Co.,Ltd. **Made in China**  
 No.888 Zhili Section of G318 Zhili Town, Huzhou City,  
 Zhejiang Province, China  
[www.beyondsunpv.com](http://www.beyondsunpv.com) [info@beyondsunpv.com](mailto:info@beyondsunpv.com)

Test item particulars..... :	
Accessories and detachable parts included in the evaluation .....	
Mounting system used..... :	See Installation Manual
Other options included..... :	N/A
Possible test case verdicts:	
- test case does not apply to the test object..... :	N/A
- test object does meet the requirement .....	P (Pass)
- test object does not meet the requirement .....	F (Fail)
Abbreviations used in the report:	
Pmax – Maximum power	HF – Humidity Freeze
Vmp – Maximum power voltage	DH – Damp Heat
Imp – Maximum power current	TC – Thermal Cycling
Isc – Short circuit current	$\alpha$ – Current temperature coefficient
Voc – Open circuit voltage	$\beta$ – Voltage temperature coefficient
FF – Fill factor	$\delta$ – power temperature coefficient
STC – Standard Test Conditions (25°C, 1 000 W/m <sup>2</sup> )	NMOT – Nominal Module Operating Temperature (20°C, 800 W/m <sup>2</sup> )
MQT – Module Quality Tests	VFMrated – Rated diode(s) forward voltage
VFM – Measured diode(s) forward voltage	NP – Nameplate
$m_1$ – the measurement uncertainty in % of laboratory for Pmax	$m_2$ – the measurement uncertainty in % of laboratory for Voc
$m_3$ – the measurement uncertainty in % of laboratory for Isc	$t_1$ – the manufacturer's rated lower production tolerance in % for Pmax
$t_2$ – the manufacturer's rated upper production tolerance in % for Voc	$t_3$ – the manufacturer's rated upper production tolerance in % for Isc
r – Pmax measurement reproducibility	
Testing Dates (YYYY-MM-DD)	
Date of first test item received .....	2021-04-14
Dates of tests (beginning/end)..... :	2021-04-14 / 2021-06-18

<b>General remarks:</b>				
<p>"(See Enclosure #)" refers to additional information appended to the report.          "(See appended table)" refers to a table appended to the report.</p> <p>Throughout this report a <input type="checkbox"/> comma / <input checked="" type="checkbox"/> point is used as the decimal separator.</p> <p>The originator of this TRF acknowledges the contribution of CTL ETF-9, UL LLC, and VDE in creation of this TRF.</p> <p>Conformity statement:          Conformity statement is decided in accordance with IEC Guide 115, Procedure 2 (Accuracy method).</p>				
Manufacturer's Declaration per sub-clause 4.2.5 of IEC 60060-2:				
The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided..... :			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> Not applicable	
When differences exist; they shall be identified in the General product information section.				
Name and address of factory (factories)..... :			All listed in VDE license 40050436.	
<b>Product Electrical Ratings:</b>				
Module type	TSHM535-144HV			
Voc [V]/Tolerance	49.31+/-3%			
Vmp [V]	41.45			
Imp [A]	12.91			
Isc [A]/Tolerance	13.79+/-4%			
Pmp [W]/Tolerance	535+/-3%			
Maximum system voltage [V]	1500			
Maximum Over-Current Protection Rating [A]	25			
Note: Electrical ratings for the complete series see attachment 6.				

**Product Safety Ratings**

Maximum systems voltage (V <sub>sys</sub> ) .....	1500	V
Maximum over-current protection rating.....	25	A
Class in accordance with IEC 61140 .....	See clause 4.1	
Intended use (list details) .....	See clause 4.5	
The modules are intended for a maximum operating altitude [meters above sea level] of .....	≤ 2000	m
Recommended maximum series/parallel module configurations .....	See Installation Manual	

**General product information:**Modifications:

- Initial module design qualification
- Extension of module design qualification
- Original test report ref. no. ....: TRPVM-2019-40229-1

Model differences and modification:

- |  |   |
|--|---|
| <input checked="" type="checkbox"/> Test programs for crystalline silicon PV modules   | <input type="checkbox"/> Test programs for thin-film PV modules   |
| <input type="checkbox"/> 4.2.1 Modification to frontsheet  | <input type="checkbox"/> 4.3.1 Modification to frontsheet   |
| <input checked="" type="checkbox"/> 4.2.2 Modification to encapsulation system   | <input type="checkbox"/> 4.3.2 Modification to encapsulation system   |
| <input checked="" type="checkbox"/> 4.2.3 Modification to cell technology  | <input type="checkbox"/> 4.3.3 Modification to front contact (e. g. TCO)  |
| <input type="checkbox"/> 4.2.4 Modification to cell and string interconnect material or technique  | <input type="checkbox"/> 4.3.4 Modification to cell technology  |
| <input type="checkbox"/> 4.2.5 Modification to backsheet   | <input type="checkbox"/> 4.3.5 Modification to cell layout  |
| <input checked="" type="checkbox"/> 4.2.6 Modification to electrical termination   | <input type="checkbox"/> 4.3.6 Modification to back contact   |
| <input type="checkbox"/> 4.2.7 Modification to bypass diode  | <input type="checkbox"/> 4.3.7 Modification to edge deletion  |
| <input type="checkbox"/> 4.2.8 Modification to electrical circuitry  | <input type="checkbox"/> 4.3.8 Modification to interconnect material or technique                                 |
| <input type="checkbox"/> 4.2.9 Modification to edge sealing  | <input type="checkbox"/> 4.3.9 Modification to backsheet  |
| <input type="checkbox"/> 4.2.10 Modification to frame and/or mounting structure  | <input type="checkbox"/> 4.3.10 Modification to electrical termination  |
| <input type="checkbox"/> 4.2.11 Change in PV module size   | <input type="checkbox"/> 4.3.11 Modification to bypass diode  |
| <input type="checkbox"/> 4.2.12 Higher or lower output power (by 10 % or more) with the identical design and size and using the identical cell process | <input type="checkbox"/> 4.3.12 Modification to edge sealing  |
| <input checked="" type="checkbox"/> 4.2.13 Increase of over-current protection rating  | <input type="checkbox"/> 4.3.13 Modification to frame and/or mounting structure                                   |
| <input type="checkbox"/> 4.2.14 Increase of system voltage   | <input type="checkbox"/> 4.3.14 Change in PV module size  |
| <input type="checkbox"/> 4.2.15 Change in cell fixing tape   | <input type="checkbox"/> 4.3.15 Higher or lower output power (by 10 % or more) with the identical design and size |
|  | <input type="checkbox"/> 4.3.16 Increase of over-current protection rating  |
|  | <input type="checkbox"/> 4.3.17 Increase of system voltage  |

NOTE: The clause references for modifications are excerpted from IEC TS 62915

6 SAMPLING				
	<input checked="" type="checkbox"/>	The modules tested (modules and laminate) were taken at random from a production batch and subjected to manufacturer's normal quality control and inspection for safety testing		P
	<input type="checkbox"/>	The modules tested (modules and laminate) were prototypes of a new design and not taken from a production batch.		N/A
	<input checked="" type="checkbox"/>	Preconditioning of test samples was performed within IEC 61215 performance testing		P
	<input type="checkbox"/>	Preconditioning of test samples was performed separately from IEC 61215 performance testing		N/A
Supplementary information:				
Module group assignment:				
Sample #	Sample Group ID	Type/model	Sample S/N	Remark
M10	Control	TSHM535-144HV	921617200300001	
M13	F	TSHM535-144HV	921617200300002	
Remarks:				

- Note (1)** Use the "General product information" field to give any information on model differences within a product type family covered by the test report and describe the range of electrical and safety ratings, if the TRF covers a type family of modules.
- Note (2)** Use Annex 2 to list the used materials and components of the module (manufacturer/supplier and type reference)
- Note (3)** The module numbers/identifiers are set in accordance to IEC 62915 Photovoltaic (PV) modules – Retesting for type approval, design and safety qualification, Annex A3 of IEC 62915

IEC 61730-1			
Clause	Requirement + Test	Result - Remark	Verdict
<b>4 Classification, applications and intended use</b>			
<b>4.1 General</b>			
	The module has been evaluated for the following Class (IEC 61140).....:	<input type="checkbox"/> Class 0 <input checked="" type="checkbox"/> Class II <input type="checkbox"/> Class III	—
<b>4.5 Intended use</b>			
	PV modules are installed in the following special applications:		—
	Building attached PV (BAPV)	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no	—
	Building integrated PV (BIPV)	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no	—
	Applications in areas where snow and / or wind load exceeding loads as tested in IEC 61730-2 are expected	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no	—
	Applications at environmental temperature exceeding the limits indicated in of IEC 61730-1:2016	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no	—
	other (please specify)	<input type="checkbox"/> yes, as follows: <input checked="" type="checkbox"/> no	—
<b>5 Requirements for design and construction</b>			
<b>5.1 General</b>			
	Supplementary Information: See TRPVM-2019-40229-1.		P
<b>5.2 Marking and documentation</b>			
	Supplementary Information: See TRPVM-2019-40229-1.		P
<b>5.3 Electrical components and insulation</b>			
<b>5.3.2 Internal wiring</b>			
	Internal wiring has sufficient current carrying capacity for the relevant application.	See Table 34	P
<b>5.3.3 External wiring and cables</b>			
	External wires and cables fulfil the requirements of	<input type="checkbox"/> EN 50618 <input checked="" type="checkbox"/> IEC 62930	P
<b>5.3.4 Connectors</b>			
	External DC connectors fulfil the requirements of IEC 62852.	TÜV approved	P
<b>5.3.5 Junction boxes for PV modules</b>			
	Junction boxes for PV modules fulfil the requirements of IEC 62790.	TÜV approved	P

<b>IEC 61730-1</b>			
<b>Clause</b>	<b>Requirement + Test</b>	<b>Result - Remark</b>	<b>Verdict</b>
<b>5.3.6 Frontsheets and backsheets</b>			
	Supplementary Information: See TRPVM-2019-40229-1.		P
<b>5.3.7 Insulation barriers</b>			
	Supplementary Information: See TRPVM-2019-40229-1.		N/A
<b>5.3.8 Electrical connections</b>			
<b>5.3.8.1 General</b>			
	Supplementary Information: See TRPVM-2019-40229-1.		P
<b>5.3.8.2 Terminals for external cables and PV connector ribbons</b>			
	Supplementary Information: See TRPVM-2019-40229-1.		P
<b>5.3.8.3 Splices and connections inside a PV module</b>			
	Supplementary Information: See TRPVM-2019-40229-1.		P
<b>5.3.9 Encapsulants</b>			
	Supplementary Information: See TRPVM-2019-40229-1.		P
<b>5.3.10 Bypass diodes</b>			
	Supplementary Information: See TRPVM-2019-40229-1.		P
<b>5.4 Mechanical and electromechanical connections</b>			
	Supplementary Information: See TRPVM-2019-40229-1.		P
<b>5.5 Materials</b>			
	Supplementary Information: See TRPVM-2019-40229-1.		P
<b>5.6 Protection against electric shock</b>			
	Supplementary Information: See TRPVM-2019-40229-1.		P



IEC 61730-2			
Clause	Requirement + Test	Result - Remark	Verdict

### 8 Testing

#### Test sequences see IEC 61730-2

Deviations from test sequence are possible but must be documented. See also table 5-

### 10 TEST PROCEDURES

#### 10.1 General: Safety qualification testing included the following Module Safety Tests (MST) of IEC 61730-2

##### Initial Testing

10.2	MST 01 – Visual inspection .....	See appended Table 6	P
10.3	MST 02 - Performance at STC .....	See appended Table 7	P
10.4	MST 03 – Maximum power determination .....	See appended Table 8	P
10.13	MST 16 – Insulation test.....	See appended Table 9	P
10.14	MST 17 – Wet leakage current test.....	See appended Table 10	P
10.11	MST 13 – Continuity test of equipotential bonding:		N/A
10.9	MST 11 – Accessibility test .....		N/A

##### Sequence A

10.26	MST 37 – Materials creep test .....		N/A
10.11	MST 13 – Continuity test of equipotential bonding:		N/A
10.9	MST 11 – Accessibility test .....		N/A

##### Sequence B

10.30	MST 53 – Damp heat test 200h .....		N/A
10.31	MST 54 – UV test 60kWh/m <sup>2</sup> .....		N/A
10.29	MST 52 – Humidity freeze test .....		N/A
10.31	MST 54 – UV test 60kWh/m <sup>2</sup> .....		N/A
10.29	MST 52 – Humidity freeze test .....		N/A

##### Sequence B1

10.32	MST 55 – Cold conditioning .....		N/A
10.33	MST 56 – Dry heat conditioning .....		N/A
10.29	MST 52 – Humidity freeze test .....		N/A
10.32	MST 55 – Cold conditioning .....		N/A
10.29	MST 52 – Humidity freeze test .....		N/A

<b>IEC 61730-2</b>			
<b>Clause</b>	<b>Requirement + Test</b>	<b>Result - Remark</b>	<b>Verdict</b>
<b>Sequence C</b>			
10.31	MST 54 – UV test 15kWh/m <sup>2</sup> ..... :		N/A
10.28	MST 51 – Thermal cycling 50 test..... :		N/A
10.29	MST 52 – Humidity freeze test..... :		N/A
10.27	MST 42 – Robustness of terminations test ..... :		N/A
<b>Sequence D</b>			
10.30	MST 53 – Damp heat test ..... :		N/A
10.23	MST 34 – Static mechanical load test..... :	See IEC 61215 report	P
<b>Sequence E</b>			
10.28	MST 51 – Thermal cycling 200 test..... :	See IEC 61215 report	P
<b>Sequence F</b>			
10.19	MST 25 – Bypass diode thermal test ..... :		N/A
10.15	MST 21 – Temperature Test ..... :	See appended Table 32	P
10.16	MST 22 – Hot-spot endurance Test ..... :	See IEC 61215 report	P
10.20	MST 26 – Reverse current overload test ..... :	See appended Table 34	P
<b>Sequence G</b>			
10.12	MST 14 – Impulse voltage test..... :		N/A
<b>Other tests</b>			
10.17	MST 23 – Fire Test..... :		N/A
10.18	MST 24 – Ignitability test..... :		N/A
10.21	MST 32 – Module breakage test ..... :		N/A
10.24	MST 35 – Peel test..... :		N/A
10.25	MST 36 – Lap shear strength test..... :		N/A

IEC 61730-2			
Clause	Requirement + Test	Result - Remark	Verdict

Final Testing			
10.10	MST 12 – Cut susceptibility test .....		N/A
10.11	MST 13 – Continuity test of equipotential bonding:		N/A
10.9	MST 11 – Accessibility test .....		N/A
10.4	MST 03 – Maximum power determination.....	See appended Table 42	P
10.1	MST 01 – Visual inspection.....	See appended Table 43	P
10.6	MST 05 – Durability of markings .....		N/A
10.7	MST 06 – Sharp edge test .....		N/A
10.8	MST 07 – Bypass diode functionality test .....	See appended Table 46	P
10.22	MST 33a – General screw connections test .....		N/A
10.22	MST 33b – Locking Screw connections test .....		N/A
10.5	MST 04 – Insulation thickness test.....		N/A
Supplementary information:			

Table 5: Overview of MST items for each test sample													
MST item	Sample No.												
	M10	M13											
Control module	X												
MST 01 – Visual inspection	X	X											
MST 02 – Performance at STC	X												
MST 03 – Maximum power determination		X											
MST 04 – Insulation thickness test													
MST 05 – Durability of markings													
MST 06 – Sharp edge test													
MST 07 – Bypass diode functionality test		X											
MST 11 – Accessibility test													
MST 12 – Cut susceptibility test													
MST 13 – Continuity test of equipotential bonding													
MST 14 – Impulse voltage test													
MST 16 – Insulation test		X											
MST 17 – Wet leakage current test		X											
MST 21 – Temperature Test		X											
MST 22 – Hot-spot endurance Test		X											
MST 23 – Fire Test													
MST 24 – Ignitability test													
MST 25 – Bypass diode thermal test													
MST 26 – Reverse current overload test		X											
MST 32 – Module breakage test													
MST 33 – Screw connections test													
MST 34 – Static mechanical load test													
MST 35 – Peel test													
MST 36 – Lap shear strength test:													
MST 37 – Materials creep test:													
MST 42 – Robustness of terminations test													
MST 51 – Thermal cycling test 50													
MST 51 - Thermal cycling test 200													
MST 52 – Humidity freeze test													
MST 53 – Damp heat test 200 h													
MST 53 – Damp heat test 1000 h													
MST 54 – UV test 15 KWh/m <sup>2</sup>													
MST 54 – UV test 60 KWh/m <sup>2</sup>													
MST 55 – Cold conditioning													
MST 56 – Dry heat conditioning													
<u>Legend:</u>													
X ..... Test performed,													


Table 6: MST 01 - Initial Visual inspection			
Test Date (YYYY-MM-DD) .....		2021-04-14	—
Sample # M10	Findings .....	<input type="checkbox"/> Yes..... <input checked="" type="checkbox"/> No	P
	Nature and position of findings – comments or attach photos	--	—
Sample # M13	Findings .....	<input type="checkbox"/> Yes..... <input checked="" type="checkbox"/> No	P
	Nature and position of findings – comments or attach photos	--	—
Supplementary information:			

Table 7: MST 02 - Performance at STC						
Sample .....		M10				—
Test Date [YYYY-MM-DD] .....		2021-04-29				—
Irradiance (W/m <sup>2</sup> ) .....		1000				—
Module temperature (°C) .....		25				—
Test method .....		<input checked="" type="checkbox"/> Simulator		<input type="checkbox"/> Natural sunlight		—
Rated Isc including manufacturing tolerances.....		14.34				—
Rated Voc including manufacturing tolerances ...		50.79				—
Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmp [W]	FF [%]	Result
13.71*	49.61*	12.77	41.91	535.22	81.06	P
Supplementary information: *Measurement uncertainty included.						

Table 8: MST 03 - Maximum power determination							
Test Date [YYYY-MM-DD] .....		2021-04-27				—	
Irradiance (W/m <sup>2</sup> ) .....		1000				—	
Module temperature (°C) .....		25				—	
Test method .....		<input checked="" type="checkbox"/> Simulator		<input type="checkbox"/> Natural sunlight		—	
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmp [W]	FF [%]	Result
M13	13.478	49.29	12.82	41.75	535.14	80.62	P
Supplementary information:							

Table 9: MST 16 - Initial Insulation test					
Test Date (YYYY-MM-DD).....		2021-04-30		—	
Test Voltage applied (V, DC) .....		1500 / 8000		—	
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
M13	>1500	>15.6	--	X	P
Supplementary information: Size of module [2.56 m <sup>2</sup> ]					

<b>Table 10: MST 17 - Initial Wet leakage current test</b>				
Test Date (YYYY-MM-DD) .....	:	2021-04-30	—	
Test Voltage applied (V, dc) .....	:	1500	—	
Solution resistivity ( $\Omega$ cm) .....	:	< 3500 $\Omega$ cm at $22 \pm 2^\circ\text{C}$	—	
Solution temperature ( $^\circ\text{C}$ ) .....	:	20	—	
Sample #		Measured ( $\text{M}\Omega$ )	Required ( $\text{M}\Omega$ )	Result
M13		>1500	>15.6	P
Supplementary information: Size of module [2.56 m <sup>2</sup> ]				

SEQUENCE F				
Sample #	M13			—
<b>Table 34: MST 26 - Reverse current overload test</b>				
Test Date (YYYY-MM-DD).....:	2021-06-18			—
Module over-current protection rating (A) .....	25			—
Test current (A) .....	33.75			—
Range of applied voltage (V) .....	57.06 – 51.27			—
Test duration .....	2 hours			—
Observations				Result
<input checked="" type="checkbox"/> No flaming of the module				P
<input checked="" type="checkbox"/> No flaming or charring of the cheesecloth				
<input checked="" type="checkbox"/> No flaming of the tissue paper				
<input checked="" type="checkbox"/> MST 17 requirements fulfilled (see appended Table MST17)				
Supplementary information: Max. measured temperature 75.2°C				
				
<b>MST 01: Visual inspection after Reverse current overload test</b>				
Test Date (YYYY-MM-DD) .....	2021-06-18			—
Findings.....:	<input type="checkbox"/> Yes..... <input checked="" type="checkbox"/> No			P
Nature and position of findings – comments or attach photos	--			—
<b>MST 16: Insulation test after Reverse current overload test</b>				
Test Date (YYYY-MM-DD) .....	2021-06-18			—
Test Voltage applied (V, DC) .....	1500 / 8000			—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
>1500	>15.6	--	X	
<b>MST 17: Wet leakage current test after Reverse current overload test</b>				
Test Date (YYYY-MM-DD) .....	2021-06-18			—
Test Voltage applied (V, dc) .....	1500			—
Solution resistivity (Ω cm) .....	< 3500 Ω cm at 22 ± 2°C			—
Solution temperature (°C) .....	20			—
Measured (MΩ)	Required (MΩ)		Result	
>1500	>15.6		P	
Supplementary information:				

<b>Table 32: MST 21 - Temperature Test</b>				
Reference solar irradiance (W/m <sup>2</sup> ) .....	1000 W/m <sup>2</sup>			—
Reference ambient temperature (°C) .....	40			—
<b>Module at MPP</b>				
Measuring location:	Component temperature T <sub>OBS</sub> (°C)	Normalized temperature T <sub>CON</sub> (°C)	Component temperature limit (°C)	—
PV module frontsheet above the centre cell	70.5	70.5	--	N/A
PV module backsheet below the centre cell	70.2	70.2	105	P
Terminal enclosure interior surface	64.6	64.6	85	P
Field wiring terminals	64.0	64.0	85	P
Insulation of the field wiring leads	63.4	63.4	85	P
External connector bodies	59.6	59.6	85	P
Bypass diode bodies	84.1	84.1	200	P
<b>MST 01: Visual inspection after Temperature Test</b>				—
Test Date (YYYY-MM-DD) .....	2021-04-30			—
Findings .....	<input type="checkbox"/> Yes..... <input checked="" type="checkbox"/> No			P
Nature and position of findings – comments or attach photos	--			—
<b>MST 16: Insulation test after Temperature Test</b>				—
Test Date (YYYY-MM-DD) .....	2021-04-30			—
Test Voltage applied (V, DC) .....	1500			—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
>1500	>15.6	--	X	P
<b>MST 17: Wet leakage current test after Temperature Test</b>				—
Test Date (YYYY-MM-DD) .....	2021-04-30			—
Test Voltage applied (V, dc) .....	1500			—
Solution resistivity (Ω cm) .....	< 3500 Ω cm at 22 ± 2°C			—
Solution temperature (°C) .....	22.3			—
Measured (MΩ)	Required (MΩ)		Result	
>1500	>15.6		P	
Supplementary information:				



Table 42: MST 03 - Maximum power determination final						
Test Date (YYYY-MM-DD) .....			2021-06-18		—	
Module temperature (°C) .....			25		—	
Irradiance (W/m <sup>2</sup> ) .....			1000		—	
Sample #	Isc (A)	Voc (V)	Imp (A)	Vmp (V)	Pmp (W)	FF (%)
M10	13.45	49.22	12.81	41.76	534.78	80.77
M13	13.54	49.29	12.76	41.76	532.84	79.86
Supplementary information:						

Table 43: MST 01 - Final Visual inspection				
Test Date (YYYY-MM-DD) .....		2021-06-18		—
Sample # M10	Findings .....	<input type="checkbox"/> Yes ..... <input checked="" type="checkbox"/> No		P
	Nature and position of findings – comments or attach photos	--		—
Sample # M13	Findings .....	<input type="checkbox"/> Yes ..... <input checked="" type="checkbox"/> No		P
	Nature and position of findings – comments or attach photos	--		—
Supplementary information:				

Table 46: MST 07 - Bypass diode functionality test				
Test Date (YYYY-MM-DD) .....		2021-06-18		—
<input type="checkbox"/> Method A				—
<input checked="" type="checkbox"/> Method B				—
Sample #	IV curve after shading			Result
	Diode 1 working properly	Diode 2 working properly	Diode 3 working properly	
M10	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	P
M13	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	P
Supplementary information:				

**ANNEX 1: LIST OF TEST EQUIPMENT USED:**

Measurement / testing	Equipment ID	Calibration due date
Solar Simulator	JXYQ-043	2022-05-06
Hi-pot tester	JXYQ-019	2022-04-28
Climatic Chamber	JXYQ-040	2022-04-28
Wet Leakage Test	JXYQ-019	2022-04-28
Visual inspection	JXYQ-024	2022-04-29
DC Power	JXYQ-016	2022-04-28
UV test chamber	JXYQ-036	2022-05-06
Climatic Chamber	JXYQ-038	2022-04-28
Climatic Chamber	JXYQ-039	2022-04-28
Climatic Chamber	JXYQ-041	2022-04-28
Steady solar simulator	JXYQ-023	2022-05-06
Peel tester	JXYQ-029	2022-04-28
Bypass diode test system	JXYQ-013	2022-04-28
Cut susceptibility tester	JXYQ-015	2022-04-28
Hail tester	JXYQ-009	2022-05-05
Impactor	JXYQ-047	2022-05-05
Impulsator	JXYQ-045	2022-04-28
Mechanical load tester	JXYQ-008	2022-04-28
Infrared imager	JXYQ-022	2022-04-29

Not: All measurement equipment has been provided with a valid calibration at the time of usage.

## Annex 2: Constructional details / Bill of Material (BOM)

5.3.2 Internal wiring		
Cell connector		
Manufacturer:	Type:	Material:
Changzhou Greateen New Energy Technology Co., Ltd	No type	Tin-coated copper ribbon
Thickness [µm]:	Dimension [mm]:	Coatings:
Diameter 300	Diameter 0.30	Sn/Pb
Supplementary Information:		
String connector		
Manufacturer:	Type:	Material:
Changzhou Greateen New Energy Technology Co., Ltd	No type	Tin-coated copper ribbon
Thickness [µm]:	Dimension [mm]:	Coatings:
400	0.4*4	Sn/Pb
Supplementary Information:		
5.3.3 External wiring and cables		
Cables		
Manufacturer:	Type:	Material:
Zhejiang Renhe Photovoltaic Technology Co.,Ltd.	H1Z2Z2-K	XLPE insulation and Tinned copper stranded wire
Diameter [mm²]:	Length [mm]:	Max. Temperature:
4.0	/	120°C
Certified: <input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	Standards:	Others:
Certifier and Cert. No. TUV R 50415465	<input type="checkbox"/> IEC 62930 <input checked="" type="checkbox"/> EN 50618	Max. 1500V DC
Supplementary Information:		
5.3.4 Connectors		
Manufacturer:	Type:	Class:
Zhejiang Renhe Photovoltaic Technology Co.,Ltd.	05-8	II
Max. Voltage:	Max. Current:	Max. Temperature:
1500V DC	30A	100°C
IP-rating:	Locked:	
IP68	<input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	
Certified: <input type="checkbox"/> Yes / <input type="checkbox"/> No	Standards:	Others:
Certifier and Cert. No. TUV R 50334688	<input checked="" type="checkbox"/> IEC 62852	
Supplementary Information:		
5.3.5 Junction boxes		
Manufacturer:	Type:	Class:
Zhejiang Renhe Photovoltaic Technology Co.,Ltd.	FT50xy	II
IP-rating:	Dimensions (l x w x h) [mm³]:	Weight [g]:
IP 68	/	/
Max. Voltage:	Max. Current:	Max. Temperature:
1500 VDC	25A	85°C
Electrical Termination cell side:	Electrical Termination cell side:	Number of Bypass Diodes
Soldered <input checked="" type="checkbox"/>	Soldered <input checked="" type="checkbox"/>	3
Crimped <input type="checkbox"/>	Crimped <input type="checkbox"/>	
Welded <input type="checkbox"/>	Welded <input type="checkbox"/>	
Screwless <input type="checkbox"/>	Screwless <input type="checkbox"/>	
Potted:	Certified: <input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	Standards:
<input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	Certifier and Cert. No. TUV R 50415465	<input checked="" type="checkbox"/> IEC 62790
Supplementary Information:		

5.3.6 Frontsheets and backsheets		
Frontsheet		
Used as: <input type="checkbox"/> Basic Insulation <input checked="" type="checkbox"/> Reinforced Insulation		
Total Dimensions (width x length) [mm]: 2251 x 1128		
Material:	Manufacturer:	Type:
Glass	FLAT GLASS GROUP CO., LTD	AR coated Tempered glass.
Thickness [mm]:	Heat strength.: <input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	Coating: <input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No
3.2	<input checked="" type="checkbox"/> Tempered <input type="checkbox"/> Heat strengthened <input type="checkbox"/> Annealed	Description Single side coating.
Structured: <input type="checkbox"/> Yes / <input checked="" type="checkbox"/> No	Certified: <input type="checkbox"/> Yes / <input checked="" type="checkbox"/> No	Standards:
Description	Certifier and Cert. No.	N/A
Supplementary Information:		
Backsheet		
Multi-layer <input checked="" type="checkbox"/>	Used as: <input type="checkbox"/> Basic Insulation <input checked="" type="checkbox"/> Reinforced Insulation	
Material:	Manufacturer:	Type:
PVDF+PET+ Primer coating	Cybrid Technologies Inc	Cynagard 205A(R)
Total Thickness [mm]:	No of layers:	
0.3115	3	
Layer No. 1 (air side)	Used as: <input type="checkbox"/> Basic Insulation <input type="checkbox"/> Reinforced Insulation	
Material:	Manufacturer:	Type:
PVDF	Cybrid Technologies Inc	HSMx
Thickness [mm]	Thermal Index:	Material Group:
0.0225	<input type="checkbox"/> RTE °C <input type="checkbox"/> TI 120 °C <input type="checkbox"/> RTI °C	<input type="checkbox"/> I <input type="checkbox"/> II <input type="checkbox"/> III
Colour:	Certified <input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	Standards:
White	Certifier and Cert. No.	
Layer No. 2	Used as: <input type="checkbox"/> Basic Insulation <input checked="" type="checkbox"/> Reinforced Insulation	
Material:	Manufacturer:	Type:
PET	SICHUAN DONGFANG INSULATING MATERAIL CO., LTD.	DS10
Thickness [mm]	Thermal Index:	Material Group:
0.275	<input type="checkbox"/> RTE °C <input type="checkbox"/> TI 105 °C <input type="checkbox"/> RTI °C	<input checked="" type="checkbox"/> I <input type="checkbox"/> II <input type="checkbox"/> III
Colour:	Certified <input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	Standards:
Transparent	Certifier and Cert. No. UL E199019	
Layer No. 3	Used as: <input type="checkbox"/> Basic Insulation <input type="checkbox"/> Reinforced Insulation	
Material:	Manufacturer:	Type:
Primer coating	Cybrid Technologies Inc	Cybrid-C
Thickness [mm]	Thermal Index:	Material Group:
0.004	<input type="checkbox"/> RTE °C <input type="checkbox"/> TI °C <input type="checkbox"/> RTI °C	<input type="checkbox"/> I <input type="checkbox"/> II <input type="checkbox"/> III
Colour:	Certified <input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	Standards:
White	Certifier and Cert. No.	
Supplementary Information:		

5.3.9 Encapsulants		
Used as: <input type="checkbox"/> Basic Insulation <input type="checkbox"/> Reinforced Insulation <input checked="" type="checkbox"/> N/A		
Total Dimensions (width x length) [mm]: 2246 X 1118		
Material: (Frontsheet side)	Manufacturer:	Type:
EVA	Hangzhou First Applied Material Co., Ltd.	F406P
Thickness [mm]	Thermal Index:	Material Group:
0.60	<input type="checkbox"/> RTE                      °C <input type="checkbox"/> TI                            °C <input type="checkbox"/> RTI                          °C	<input checked="" type="checkbox"/> I <input type="checkbox"/> II <input type="checkbox"/> III
Colour:	Certified <input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	Standards:
Transparent	Certifier and Cert. No.	UL E326347

Material: (Backsheet side)	Manufacturer:	Type:
EVA	Hangzhou First Applied Material Co., Ltd.	F806P
Thickness [mm]	Thermal Index:	Material Group:
0.60	<input type="checkbox"/> RTE                      °C <input type="checkbox"/> TI                            °C <input type="checkbox"/> RTI                          °C	<input type="checkbox"/> I <input type="checkbox"/> II <input checked="" type="checkbox"/> III
Colour:	Certified <input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	Standards:
Transparent	Certifier and Cert. No.	UL E334347
Supplementary Information:		

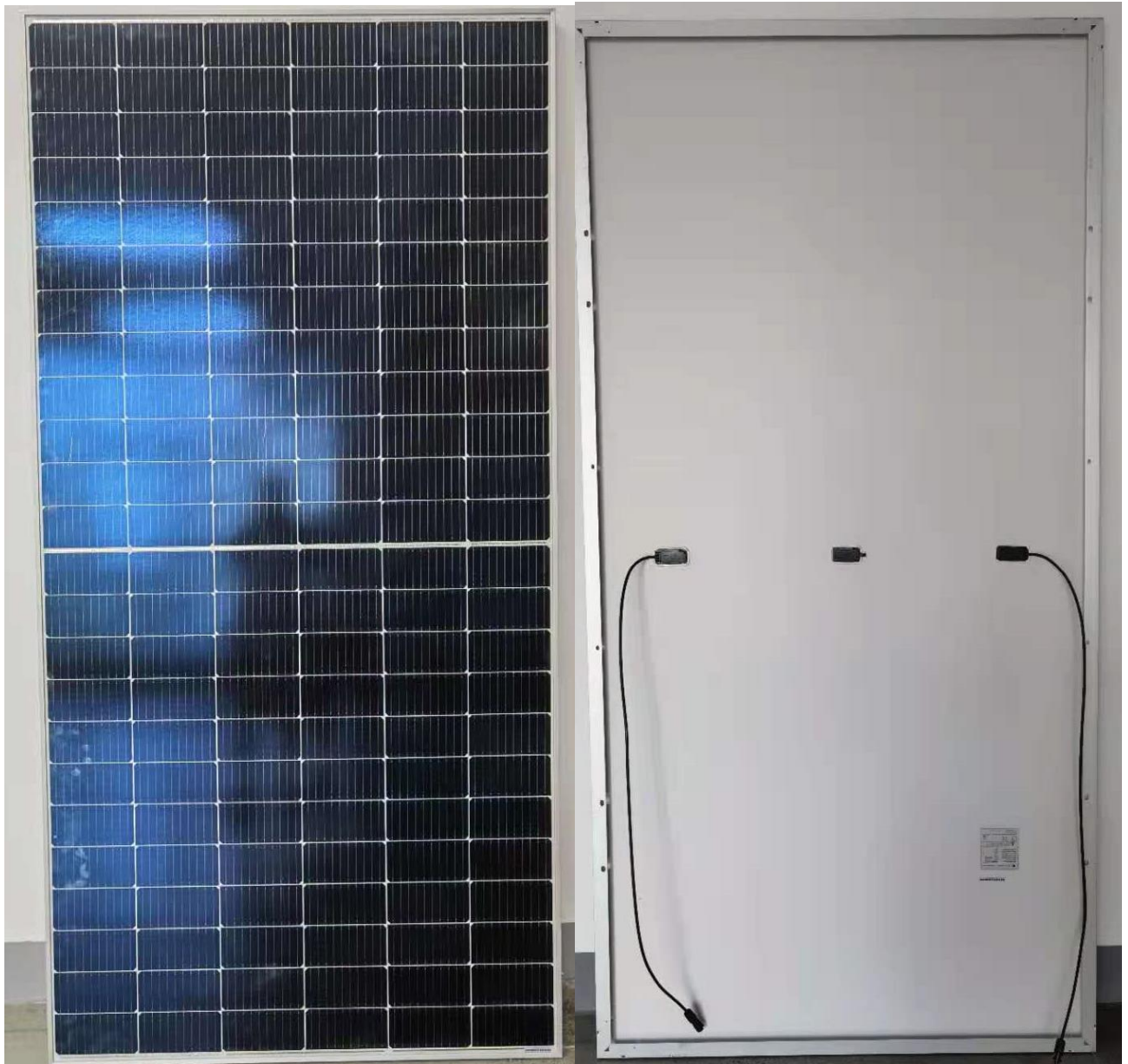
5.3.10 Bypass Diodes		
Manufacturer:	Type:	
HY Electronic Corp.	FMK5040D	
Nominal current of diode I <sub>F</sub> (A)	40	
R <sub>THJ-C</sub> (K/W) / R <sub>THJ-L</sub> (K/W)	1.5	
Max. T <sub>J</sub> (°C)	200	
Max. V <sub>F</sub> at I <sub>F</sub> (V)	0.55	
Supplementary Information:		

5.4.6 Adhesives		
For Junction Boxes		
Manufacturer:	Type:	
Shanghai Huitian New Chemical Material Co., Ltd.	HT906Z	
Additional function as: <input type="checkbox"/> Basic Insulation <input type="checkbox"/> Reinforced Insulation <input checked="" type="checkbox"/> N/A		
Thickness [mm]	Thermal Index:	Material Group:
N/A	<input type="checkbox"/> RTE °C <input type="checkbox"/> TI °C <input checked="" type="checkbox"/> RTI 105 °C	<input type="checkbox"/> I <input type="checkbox"/> II <input checked="" type="checkbox"/> III
Supplementary Information:		
For Frames / Backrails		
Additional function as: <input type="checkbox"/> Basic Insulation <input type="checkbox"/> Reinforced Insulation <input checked="" type="checkbox"/> N/A		
Manufacturer:	Type:	Material
Shanghai Huitian New Chemical Material Co., Ltd.	HT-906Z	Silicon
Additional function as: <input type="checkbox"/> Basic Insulation <input type="checkbox"/> Reinforced Insulation <input checked="" type="checkbox"/> N/A		
Thickness [mm]	Thermal Index:	Material Group:
N/A	<input type="checkbox"/> RTE °C <input type="checkbox"/> TI °C <input type="checkbox"/> RTI °C	<input type="checkbox"/> I <input type="checkbox"/> II <input checked="" type="checkbox"/> III
Supplementary Information:		
5.5.3 Metallic Materials		
Frame / Corner joint / Backrail:		
Manufacturer:	Type:	Dimension
Huzhou bei sheng aluminum technology Co., Ltd.	6005-T5	Aluminum
Supplementary Information:		
Others:		
Manufacturer:	Type:	Dimension
Supplementary Information:		

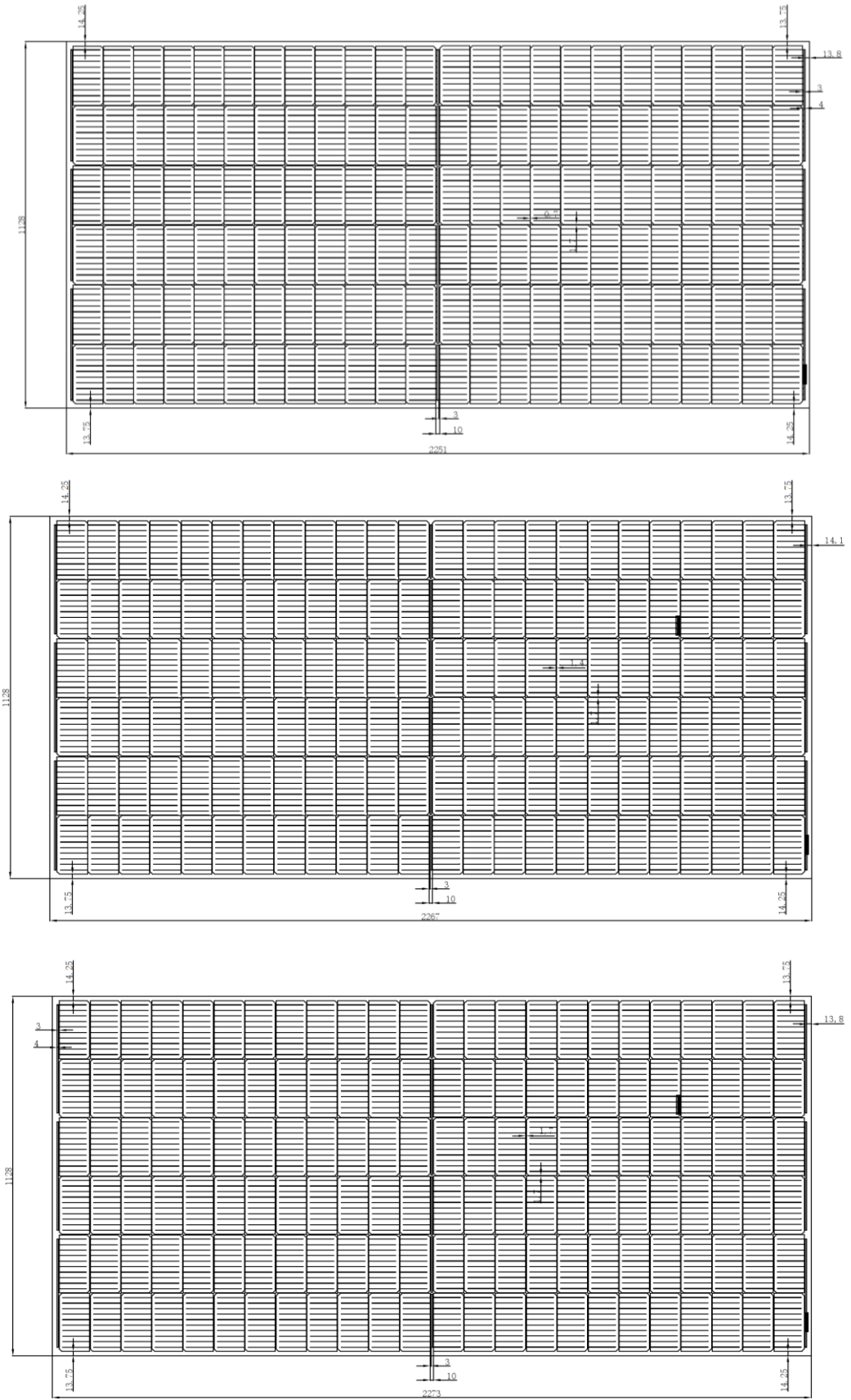
Cell		
Kind of cell	Manufacturer:	Type:
<input checked="" type="checkbox"/> cSi <input type="checkbox"/> CdTe <input type="checkbox"/> aSi <input type="checkbox"/> CiGs	Zhejiang Beyondsun PV Co., Ltd.	182S-10BB
Thickness [μm]:	Dimension [mm]:	Number of busbars:
190+/-30	182 x 91 ± 0.25	10
Supplementary Information:		

Cell fixing Tape				
Material	Manufacturer	Type	Ratings	Thickness[mm]
PET	3M	UV-1	/	0.060

ATTACHMENT 1: PHOTOGRAPH

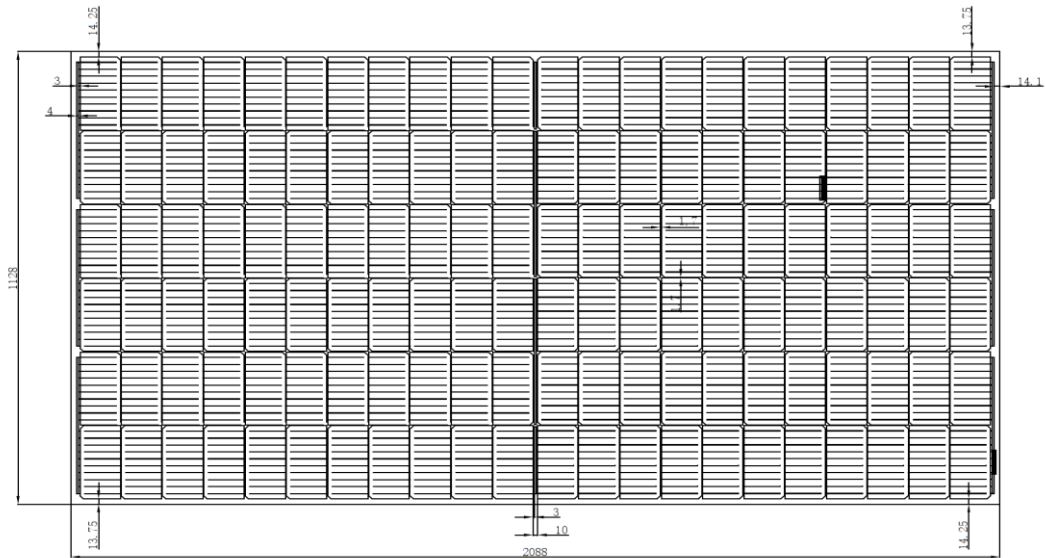


ATTACHMENT 2: MODULE DRAWING AND ELECTRICAL CIRCUIT  
TSHMXXX-144HV / TSHMXXX-144V

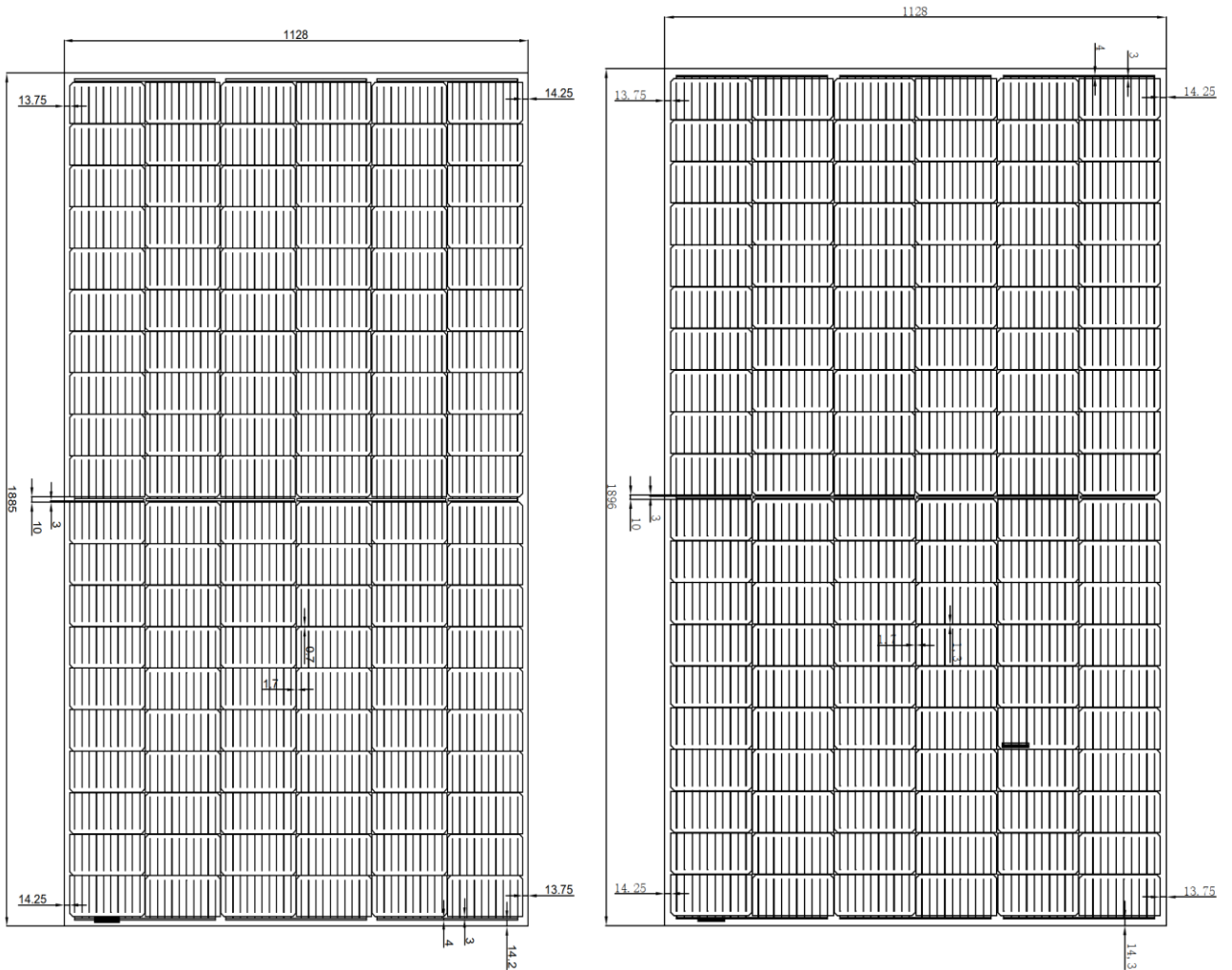




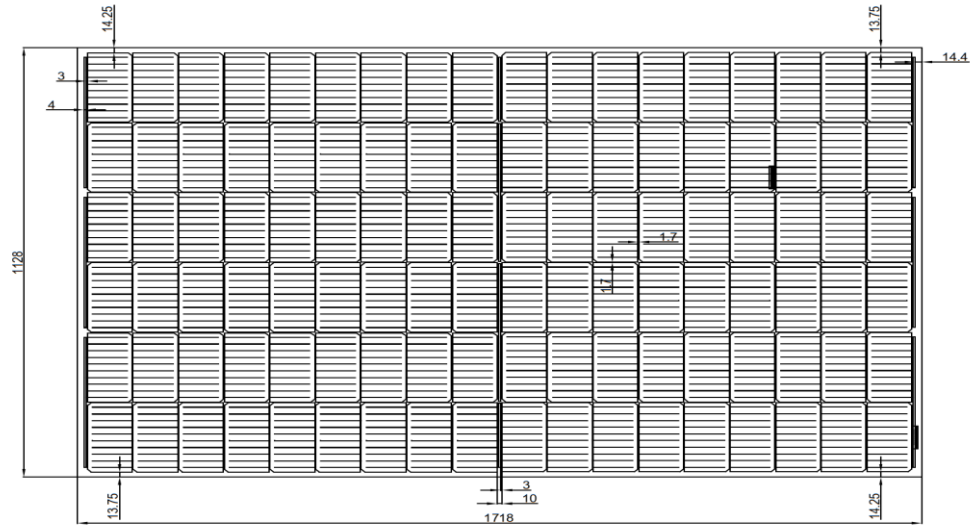
TSHMXXX-132HV / TSHMXXX-132V:



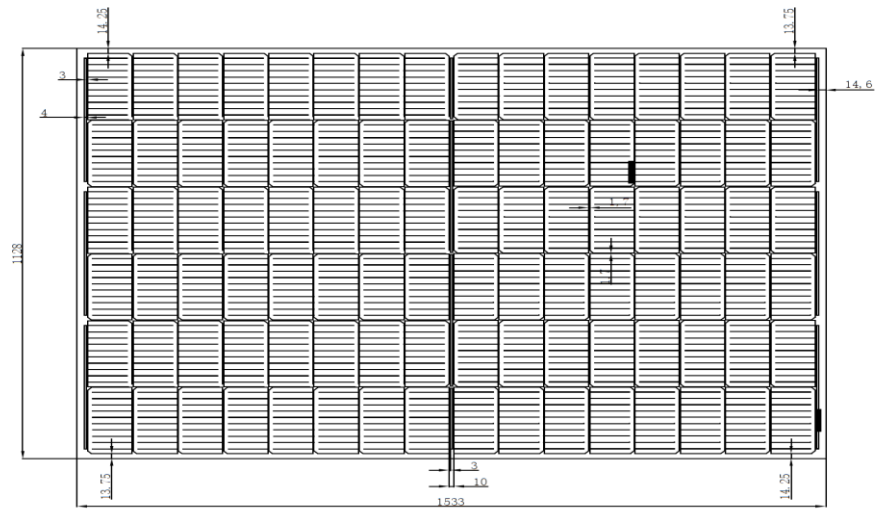
TSHMXXX-120HV / TSHMXXX-120V



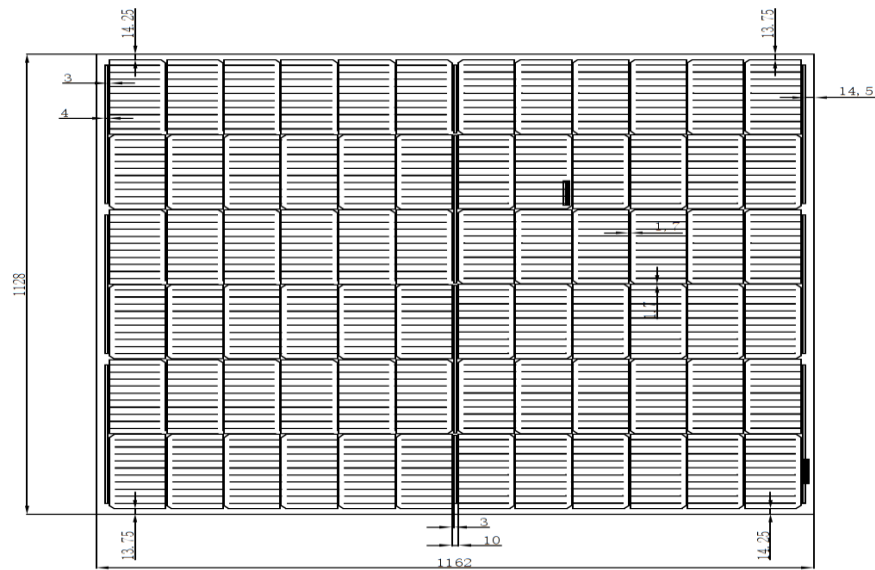
TSHMXXX-108HV / TSHMXXX-108V



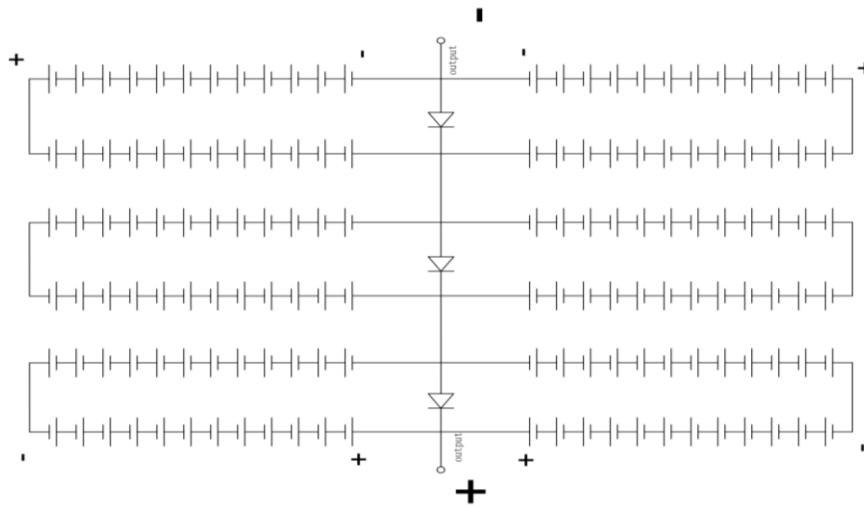
TSHMXXX-96HV / TSHMXXX-96V



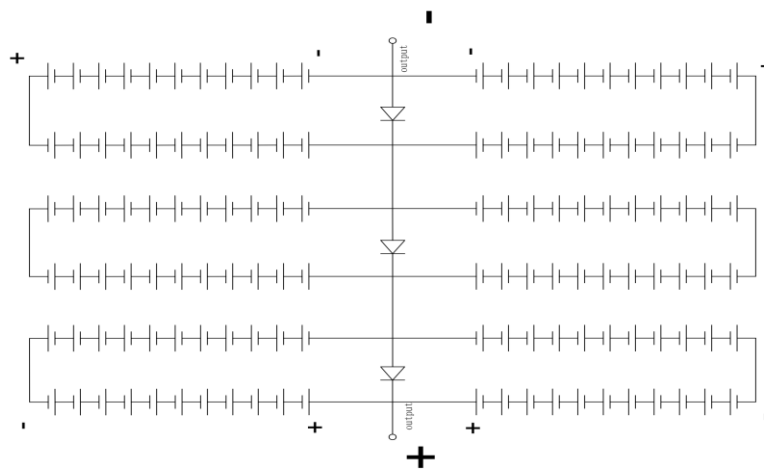
TSHMXXX-72HV / TSHMXXX-72V



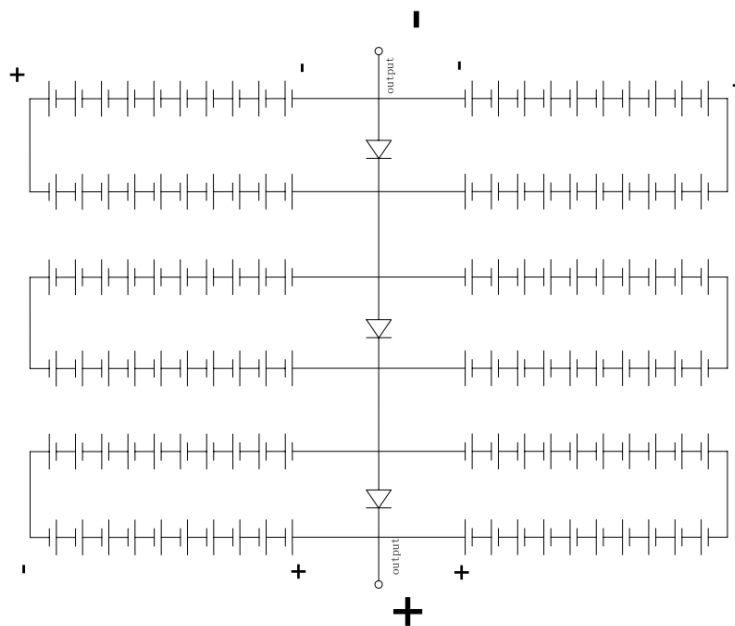
Attachment 3: ELECTRICAL CIRCUIT:  
TSHMXXX-144HV / TSHMXXX-144V



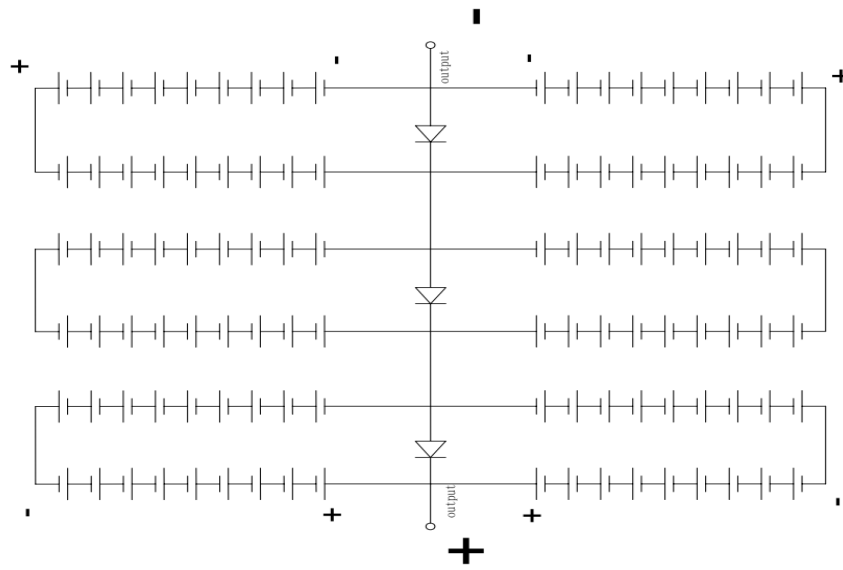
TSHMXXX-132HV / TSHMXXX-132V



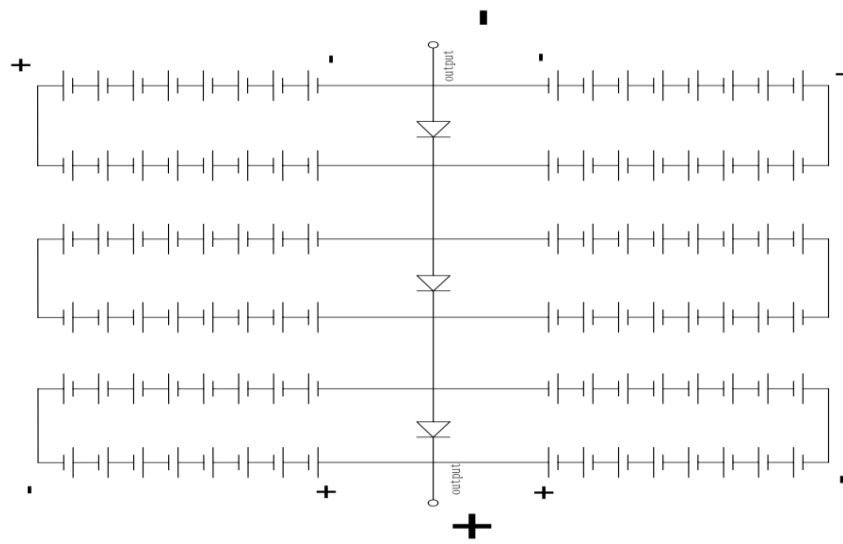
TSHMXXX-120HV / TSHMXXX-120V



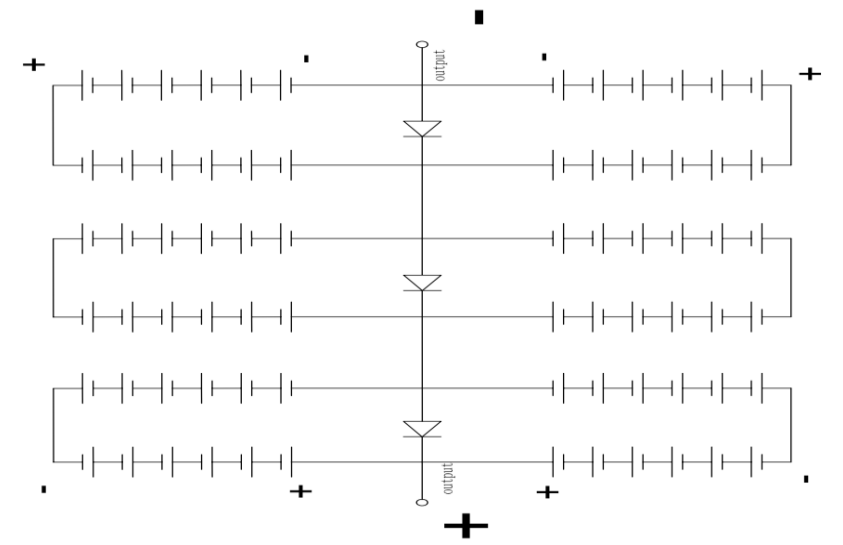
TSHMXXX-108HV / TSHMXXX-108V



TSHMXXX-96HV / TSHMXXX-96V



TSHMXXX-72HV / TSHMXXX-72V



ATTACHMENT 4: COMPONENT DATASHEET  
CELL:

# Beyondsun

**Zhejiang Beyondsun PV Co.,Ltd**

NO.800 ZHENBEI ROAD ZHILI TOWN, HUZHOU CITY, ZHEJIANG, CHINA

## Monocrystalline Bifacial halved-Cell (182 mm)

Company Zhejiang Beyondsun PV Co.,Ltd  
Type 182S-10BB

### ELECTRICAL PROPERTIES

Efficiency(%)	Pmpp(W)	Umpp(V)	Impp(A)	Uoc(V)	Isc(A)
22.8-22.9	7.53	0.594	12.675	0.690	13.306
22.7-22.8	7.49	0.593	12.640	0.689	13.266
22.6-22.7	7.46	0.592	12.604	0.688	13.226
22.5-22.6	7.43	0.591	12.570	0.687	13.187
22.4-22.5	7.39	0.59	12.535	0.686	13.147
22.3-22.4	7.36	0.589	12.500	0.685	13.108
22.2-22.3	7.33	0.588	12.465	0.684	13.068
22.1-22.2	7.30	0.587	12.430	0.683	13.028
22.0-22.1	7.26	0.586	12.395	0.682	12.988
21.9-22.0	7.23	0.585	12.360	0.681	12.948

\*\* STC conditions: 1000W/m2, AM1.5, 25±2°C

### Temperature Coefficients

Open-circuit voltage temperature coefficient	-0.30%/k
Short-circuit current temperature coefficient	+0.06%/k
Max. power temperature coefficient	-0.39%/k

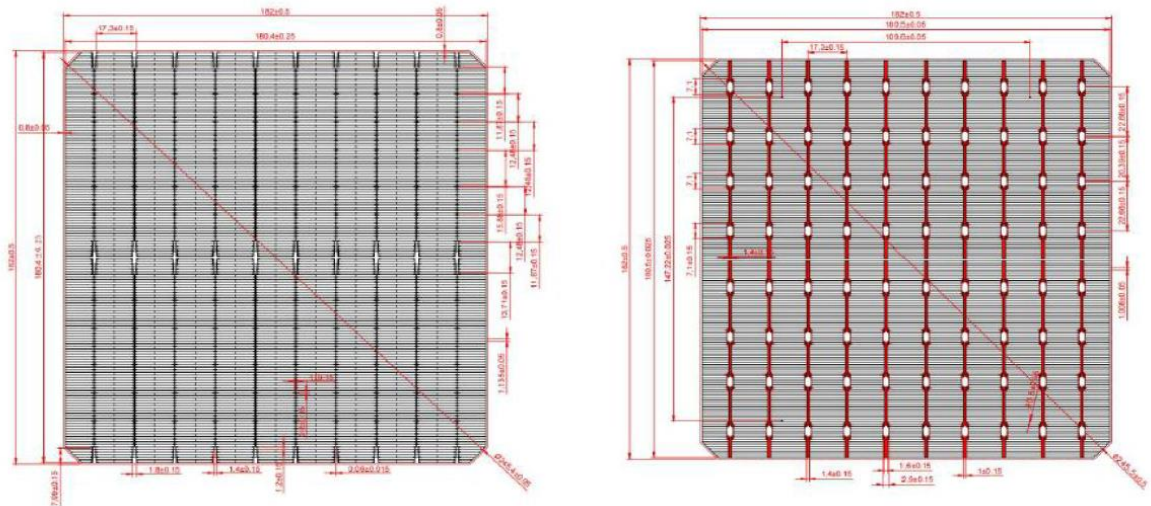
### Dimension Specification

Size	182mm*182mm±0.5mm
Thickness	175um±17.5um
Front Side(-)	Silicon nitride anti-reflection coating 1.4/1.0±0.1mm wide Bus bars(silver), 160 fingers
Back Side(+)	1.4/1.0±0.3mm wide Bus bars(silver), 180 fingers

**Zhejiang Beyondsun PV Co.,Ltd**

NO.800 ZHENBEI ROAD ZHILI TOWN, HUZHOU CITY, ZHEJIANG, CHINA

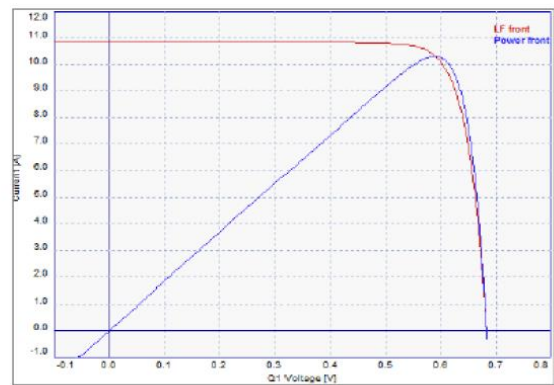
**Appearance**



**I-V Parameters in Low Irradiance**

Intensity(W/m <sup>2</sup> )	Uoc	Isc
1000	1	1
900	0.996	0.903
800	0.991	0.803
600	0.988	0.602
400	0.962	0.403
Relative value based on the Uoc and Isc under 1000W/m <sup>2</sup>		

**I-V Curve**



**Features**

- High efficiency solar cells with isotropy etched surface
- Low reverse current, high shunt resistance and high reliability
- 100% checked for reverse current and visual appearance
- Small light-induced degradation ; PID Free
- Calibration by Fraunhofer ISE

J-BOX:  
FT50xy**Zertifikat****Certificate**

**Zertifikat Nr. Certificate No.** R 50415465  
**Blatt Sheet** 0007

<b>Ihr Zeichen Client Reference</b>	<b>Unser Zeichen Our Reference</b>	<b>Ausstellungsdatum Date of Issue</b>
Z.S.X.	01-LXL-50172934 013	11.06.2021 (day/mo/yr)

**Genehmigungsinhaber License Holder**  
Zhejiang Renhe Photovoltaic  
Technology Co., Ltd.  
99#, Jing'er Road, Xinpu Town  
Cixi City  
315322 Zhejiang  
P.R. China

**Fertigungsstätte Manufacturing Plant**  
Zhejiang Renhe Photovoltaic  
Technology Co., Ltd.  
99#, Jing'er Road, Xinpu Town  
Cixi City  
315322 Zhejiang  
P.R. China

**Prüfzeichen Test Mark****Geprüft nach Tested acc. to**

IEC 62790:2014  
EN 62790:2015

**Zertifiziertes Produkt (Geräteidentifikation)**  
**Certified Product (Product Identification)**

**Lizenzentgelte - Einheit**  
**License Fee - Unit**

PV Komponente (elektrisch) für BOS (PV Components for BOS - electrical)  
as page 0001

**Addition**

Type Designation	: FT50xy (x=6; y=A, B, C, D, E or F) (ZJRH)	6
Rated Voltage	: 1000VDC for FT50xy (x=6; y=A, C or E) 1500VDC for FT50xy (x=6; y=B, D or F)	
Rated Current	: 30A	


6

**ANLAGE (Appendix): 1.11**

Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde und es bestätigt die Konformität des Produktes mit den oben genannten Standards und Prüfgrundlagen. Zusätzliche Anforderungen in Ländern, in denen das Produkt in Verkehr gebracht werden soll, müssen zusätzlich betrachtet werden. Die Herstellung des zertifizierten Produktes wird überwacht.  
This certificate is based on our Testing and Certification Regulation and states the conformity of the product with the standards and testing requirements as indicated above. Any additional requirements in countries where the product is going to be marketed have to be considered additionally. The manufacturing of the certified product is subject to surveillance.

**TÜV Rheinland LGA Products GmbH, Tillystraße 2, 90431 Nürnberg**  
Tel.: +49 221 806-1371 e-mail: cert-validity@de.tuv.com  
Fax: +49 221 806-3935 http://www.tuv.com/safety



<b>Produktsicherheit und –qualität</b> <i>Product Safety and Quality</i>			 <b>TÜVRheinland</b> <sup>®</sup> Precisely Right.
<b>Certificate No.</b> R 50415465 0001-0007	<b>Our Reference</b> 01-LXL-50172934 014	<b>Appendix No.</b> 1.12	
<b>Constructional Data Form (CDF)</b>			page 1 of 15

Applicant .....	Zhejiang Renhe Photovoltaic Technology Co., Ltd.
(full address) .....	99#, Jing'er Road, Xinpu Town, Cixi City, Zhejiang 315322, P. R. China.
Production factory 1 .....	Zhejiang Renhe Photovoltaic Technology Co., Ltd.
(full address).....	99#, Jing'er Road, Xinpu Town, Cixi City, Zhejiang 315322, P. R. China.
Production factory 2 .....	N/A
(full address).....	N/A
Type of appliance .....	Junction Box for PV Module
Trademark.....	ZJRH
Type name or model no. ....	FT50xy(x=1, 2, 3, 4, 5 or 6; y=A, B, C, D, E or F), see remark on page 14 for details.
Rated voltage.....	1000VDC for FT50xy(y=A, C or E); 1500VDC for FT50xy(y=B, D or F)
Rated impulse voltage .....	12kV for FT50xy(y=A, C or E); 16kV for FT50xy(y=B, D or F)
Max. working (module) voltage ...	100V
Rated current .....	16A for FT50xy(x=1); 18A for FT50xy(x=2); 20A for FT50xy(x=3); 25A for FT50xy(x=4); 28A for FT50xy(x=5); 30A for FT50xy(x=6)
Reverse current .....	41A
Standard .....	IEC 62790:2014; EN 62790:2015
Application class .....	Class A
Pollution degree .....	1 / 2 / 3 / 4 (after potting, inside of box)
Over voltage category .....	I / II / III / IV
Lower ambient temperature .....	-40°C
Upper ambient temperature .....	85°C
RTI housing material .....	110°C
Flammability class .....	5VA
Termination and connection .....	Crimped-type terminals for external flexible PV cable; Integration for internal connection with bypass diode; Soldered-type terminals for internal connection with PV Ribbon.
Cable diameter .....	5,3mm-7,2mm
Rated torque for cable gland .....	N/A
Wire cross section area or cross section range .....	1 x 4,0mm <sup>2</sup>
Degree of protection .....	IP65/IP68(1m,1h)

**TÜV Rheinland Group**

11.06.2021


Bright Liu

Date

Name

  
Signature



<b>Produktsicherheit und –qualität</b> <i>Product Safety and Quality</i>		 <b>TÜVRheinland®</b> Precisely Right.
<b>Certificate No.</b> R 50415465 0001-0007	<b>Our Reference</b> 01-LXL-50172934 014	<b>Appendix No.</b> 1.12
<b>Constructional Data Form (CDF)</b>		page 5 of 15

	2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	Technologies Inc.
	3. PV8101F, manufactured by DOW CORNING	
	11. 888A, manufactured by Chengdu Guibao Science and Technology Co., Ltd.	
	12. KDW1536 ,manufactured by LIYANG KANGDAWEI INDUSTRIAL CO.,LTD	
	1. TS1527, manufactured by TONSAN ADHESIVE, INC.	20. PVDF foil (Cynagard 2X5A(R)), manufactured by Cybrid Technologies Inc.
	2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	
	3. PV8101F, manufactured by DOW CORNING	
	12. KDW1536 ,manufactured by LIYANG KANGDAWEI INDUSTRIAL CO.,LTD	
	1. TS1527, manufactured by TONSAN ADHESIVE, INC.	21. PVDF foil (Cynagard 225A), manufactured by Cybrid Technologies Inc.
	2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	
	14. HT8258, manufactured by Jiangsu Tianchen New Materials Co., Ltd.	
	1. TS1527, manufactured by TONSAN ADHESIVE, INC.	22. PVDF foil (Cynagard 225B), manufactured by Cybrid Technologies Inc.
	2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	
	1. TS1527, manufactured by TONSAN ADHESIVE, INC.	23. Fluorine resin (FFC-JW30), manufactured by Jolywood(Suzhou) Sunwatt Co.,Ltd.
	2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	
	3. PV8101F, manufactured by DOW CORNING	
	5. GOLOHO63, manufactured by GOLOHO Chemical Industrial Limited	
	6. TS-688, manufactured by JIANGSU TIANSHENG NEW MATERIALS SCIENCE AND TECHNOLOGY CO.,LTD.	
	7. PV-804, manufactured by DOW CORNING	
	8. PV-8007, manufactured by DOW CORNING	
	9. RTV 3642, manufactured by Momentive Performance Materials	
	10. JS-606, manufactured by Hangzhou Zhijiang Silicone Chemicals CO., LTD.	
	1. TS1527, manufactured by TONSAN ADHESIVE, INC.	
	2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	24. Fluorine resin (FFC-JW3010(plus)), manufactured by Jolywood(Suzhou) Sunwatt Co.,Ltd.
	5. GOLOHO63, manufactured by GOLOHO Chemical Industrial Limited	

TÜV Rheinland Group


11.06.2021

Bright Liu

Date

Name

  
Signature

<b>Produktsicherheit und –qualität</b> <i>Product Safety and Quality</i>		 <b>TÜVRheinland®</b> Precisely Right.
<b>Certificate No.</b> R 50415465 0001-0007	<b>Our Reference</b> 01-LXL-50172934 014	<b>Appendix No.</b> 1.12
<b>Constructional Data Form (CDF)</b>		page 11 of 15

	Chemical Material Co., Ltd. 1. TS1527, manufactured by TONSAN ADHESIVE, INC. 2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	67. Modified PO-1 foil (MP Sheet PF D15), manufactured by DSM Sunshine Solar Technology (Suzhou) Co.,Ltd.
Potting material.....:	Type of potting material 1. 5299W-S, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.; 2. TS1521, manufactured by manufactured by TONSAN ADHESIVE, INC; 3. TS1533, manufactured by manufactured by TONSAN ADHESIVE, INC; 4. SKF323, manufactured by Guangzhou Baiyun Chemical Industry Co., Ltd; 5. KDW-3582, manufactured by Liyang Kangdawei Industrial Co., Ltd; 6. HT6360, manufactured by Jiangsu Tianchen New Materials Co., Ltd	<b>Type of Junction box</b> FT50xy(x=1, 2, 3, 4, 5 or 6; y=A, B, C, D, E or F)
Bypass-Diode .....	<b>Type name</b>	FMK4525A
	<b>Number</b>	1 diode for each box, total 3 diodes
	<b>Manufacturer</b>	Zhejiang Renhe Photovoltaic Technology Co., Ltd.
	<b>Chip dimension/data</b>	
	<b>Box type</b>	FT50xy(x=1)
Bypass-Diode .....	<b>Type name</b>	FMK4530A
	<b>Number</b>	1 diode for each box, total 3 diodes
	<b>Manufacturer</b>	Zhejiang Renhe Photovoltaic Technology Co., Ltd.
	<b>Chip dimension/data</b>	
	<b>Box type</b>	FT50xy(x=2)
Bypass-Diode .....	<b>Type name</b>	FMK4530B
	<b>Number</b>	1 diode for each box, total 3 diodes
	<b>Manufacturer</b>	Zhejiang Renhe Photovoltaic Technology Co., Ltd.
	<b>Chip dimension/data</b>	

TÜV Rheinland Group


11.06.2021

Bright Liu

Date

Name

  
Signature

<b>Produktsicherheit und –qualität</b> <i>Product Safety and Quality</i>		 <b>TÜVRheinland®</b> Precisely Right.
<b>Certificate No.</b> R 50415465 0001-0007	<b>Our Reference</b> 01-LXL-50172934 014	<b>Appendix No.</b> 1.12
<b>Constructional Data Form (CDF)</b>		page 12 of 15

	<b>Box type</b>	FT50xy(x=3)
	<b>Rated current of Box</b>	20A
Bypass-Diode .....	<b>Type name</b>	FMK4530T
	<b>Number</b>	1 diode for each box, total 3 diodes
	<b>Manufacturer</b>	Zhejiang Renhe Photovoltaic Technology Co., Ltd.
	<b>Chip dimension/data</b>	
	<b>Box type</b>	FT50xy(x=3)
	<b>Rated current of Box</b>	20A
Bypass-Diode .....	<b>Type name</b>	FMK5040D
	<b>Number</b>	1 diode for each box, total 3 diodes
	<b>Manufacturer</b>	Zhejiang Renhe Photovoltaic Technology Co., Ltd.
	<b>Chip dimension/data</b>	
	<b>Box type</b>	FT50xy(x=4)
	<b>Rated current of Box</b>	25A
Bypass-Diode .....	<b>Type name</b>	FMK3040P
	<b>Number</b>	1 diode for each box, total 3 diodes
	<b>Manufacturer</b>	Zhejiang Renhe Photovoltaic Technology Co., Ltd.
	<b>Chip dimension/data</b>	
	<b>Box type</b>	FT50xy(x=5)
	<b>Rated current of Box</b>	28A
Bypass-Diode .....	<b>Type name</b>	FMK5060D
	<b>Number</b>	1 diode for each box, total 3 diodes
	<b>Manufacturer</b>	Zhejiang Renhe Photovoltaic Technology Co., Ltd.
	<b>Chip dimension/data</b>	
	<b>Box type</b>	FT50xy(x=6)

TÜV Rheinland Group


11.06.2021

Bright Liu

Date

Name

  
Signature

<b>Produktsicherheit und –qualität</b> <i>Product Safety and Quality</i>	 <b>TÜVRheinland®</b> Precisely Right.	
<b>Certificate No.</b> R 50415465 0001-0007	<b>Our Reference</b> 01-LXL-50172934 014	<b>Appendix No.</b> 1.12
<b>Constructional Data Form (CDF)</b>		page 13 of 15

	<b>Rated current of Box</b>	30A
Bypass-Diode .....	<b>Type name</b>	FMK4545D
	<b>Number</b>	1 diode for each box, total 3 diodes
	<b>Manufacturer</b>	Zhejiang Renhe Photovoltaic Technology Co., Ltd.
	<b>Chip dimension/data</b>	
	<b>Box type</b>	FT50xy(x=6)
	<b>Rated current of Box</b>	25A
(Optional) Accessories.....	N/A	
Additional Information (e.g. system configuration, difference between models, construction materials, output voltage, etc.) Attachments: Data-Sheets of critical components		

<b>List of Critical Components</b>					
Ref.	Object / part No.	Manufacturer	Type	Technical data	Approval
1.0	Material of Box Body	SABIC JAPAN L L C	PPE+PS,	UL94V-0, 5VA	UL E207780
2.0	Material of Box Lid	SABIC JAPAN L L C	PPE+PS,	UL94V-0, 5VA	UL E207780
3.0	Material of Base	BASF Engineering Plastics (Shanghai) Co., Ltd.	PA66,	UL94V-0	UL E507491
		SABIC JAPAN L L C	PPE+PS,	UL94V-0, 5VA	UL E207780
4.0	Material of Fixing cable	SABIC JAPAN L L C	PPE+PS,	10,4 x 5,9mm	UL E207780
5.0	Carry Current Part	ChangZhou Star Sea Electronics Co.,Ltd.	Copper	Tin-plated	//
6.0	Soldering Material	Shanghai Zhong gang tin co., ltd		Melting temperature : 183°C	//
		Shaoxing Yuecheng Zhang Fu w elding material plant			
7.0	PV Cable	Zhejiang Renhe Photovoltaic Technology Co., Ltd.	H1Z2Z2-K 1x1,5...35mm <sup>2</sup>	1x4,0mm <sup>2</sup>	TUV R 50318681
		Trina Solar Co., Ltd.	H1Z2Z2-K 1x4,0mm <sup>2</sup>	1x4,0mm <sup>2</sup>	TUV R 50426462
		Trina Solar Co., Ltd.	62930 IEC 131 1X4mm <sup>2</sup>	1x4,0mm <sup>2</sup>	TUV R 50451199

TÜV Rheinland Group

11.06.2021

Bright Liu

Date

Name

  
Signature

Cable:

**Zertifikat****Certificate**

**Zertifikat Nr. Certificate No.** R 50452023  
**Blatt Sheet** 0001

<b>Ihr Zeichen Client Reference</b>	<b>Unser Zeichen Our Reference</b>	<b>Ausstellungsdatum Date of Issue</b>
Z.S.X.	01-SYF-15081600 012	16.01.2020 (day/mo/yr)

**Genehmigungsinhaber License Holder**  
 Zhejiang Renhe Photovoltaic  
 Technology Co., Ltd.  
 99#, Jing'er Road, Xinqu Town  
 Cixi City, Zhejiang 315322  
 P. R. China

**Fertigungsstätte Manufacturing Plant**  
 Refer to latest revision  
 of the annex list of factories

**Prüfzeichen Test Mark**

Type Approved  
 Safety  
 Regular Production  
 Surveillance

www.tuv.com  
 ID 1419075270

**Geprüft nach Tested acc. to**  
 IEC 62930:2017

**Zertifiziertes Produkt (Geräteidentifikation)**  
**Certified Product (Product Identification)**

**Lizenzentgelte - Einheit**  
**License Fee - Unit**

**Cable** (Electric Cables for Photovoltaic Systems)

Type Designation	: 376332	12
Code Designation	: 62930 IEC 131 Renhe	
Additional Marking	: HALOGEN FREE LOW SMOKE	
Scope of Sizes	: 1X1,5...35mm <sup>2</sup>	
Rated Voltage	: DC 1,5kV	
Max. Storage Temperature	: +45°C	
Min. Temperature for Installation and Handling:	: -25°C	
Max. Temperature at Conductor	: 120°C	

12

**ANLAGE (Appendix): 1.0**

Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde und es bestätigt die Konformität des Produktes mit den oben genannten Standards und Prüfgrundlagen. Zusätzliche Anforderungen in Ländern, in denen das Produkt in Verkehr gebracht werden soll, müssen zusätzlich betrachtet werden. Die Herstellung des zertifizierten Produktes wird überwacht.  
 This certificate is based on our Testing and Certification Regulation and states the conformity of the product with the standards and testing requirements as indicated above. Any additional requirements in countries where the product is going to be marketed have to be considered additionally. The manufacturing of the certified product is subject to surveillance.

**TÜV Rheinland LGA Products GmbH, Tillystraße 2, 90431 Nürnberg**  
 Tel.: +49 221 806-1371 e-mail: cert-validity@de.tuv.com  
 Fax: +49 221 806-3935 http://www.tuv.com/safety



**Bo Liu**

Connector:

**Zertifikat****Certificate**

Zertifikat Nr. *Certificate No.*      Blatt *Sheet*  
R 50473621                                      0001

Ihr Zeichen <i>Client Reference</i>	Unser Zeichen <i>Our Reference</i>	Ausstellungsdatum <i>Date of Issue</i>
Z.S.X.	01-LXL-50404015 001	31.08.2020 <i>(day/mo/yr)</i>

Genehmigungsinhaber <i>License Holder</i>	Fertigungsstätte <i>Manufacturing Plant</i>
Zhejiang Renhe Photovoltaic Technology Co., Ltd. 99#, Jing'er Road, Xinpu Town Cixi City 315322 Zhejiang P.R. China	Zhejiang Renhe Photovoltaic Technology Co., Ltd. 99#, Jing'er Road, Xinpu Town Cixi City 315322 Zhejiang P.R. China

Prüfzeichen *Test Mark*                                      Geprüft nach *Tested acc. to*  
 Bauart geprüft  
Sicherheit  
Regelmäßige  
Produktions-  
überwachung  
www.tuv.com  
ID 1111226293

IEC 62852:2014  
EN 62852:2015

Zertifiziertes Produkt (Geräteidentifikation) <i>Certified Product (Product Identification)</i>	Lizenzentgelte - Einheit <i>License Fee - Unit</i>
PV Komponente (elektrisch) für BOS (PV Components for BOS - electrical)	

PV Komponente (elektrisch) für BOS (PV Components for BOS - electrical)

Type Designation	: RHC2xyzu (x=S or L; y=N, M or T; z=V, A or C) (ZJRH)	13
Rated Voltage	: 1500VDC	
Rated Current	: 30A for RHC2xyzu (y=N); 35A for RHC2xyzu (y=M); 40A for RHC2xyzu (y=T)	
Ambient Temperature	: -40°C to +85°C	
Upper Limit Temperature	: 100°C	
Cross Section Range	: 1 x 2,5mm <sup>2</sup> for RHC2xyzu (y=N); 1 x 4,0mm <sup>2</sup> for RHC2xyzu (y=M); 1 x 6,0mm <sup>2</sup> for RHC2xyzu (y=T)	
Protection Degree	: IP65/IP68 (1m, 1h)	
Application Class	: Class A	

Remark: The labelling requirements acc. to EU Directive 2001/95 have to be observed for distribution within the EEA.

ANLAGE (Appendix): 1.0

Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde und es bestätigt die Konformität des Produktes mit den oben genannten Standards und Prüfgrundlagen. Zusätzliche Anforderungen in Ländern, in denen das Produkt in Verkehr gebracht werden soll, müssen zusätzlich betrachtet werden. Die Herstellung des zertifizierten Produktes wird überwacht.  
This certificate is based on our Testing and Certification Regulation and states the conformity of the product with the standards and testing requirements as indicated above. Any additional requirements in countries where the product is going to be marketed have to be considered additionally. The manufacturing of the certified product is subject to surveillance.

TÜV Rheinland LGA Products GmbH, Tillystraße 2, 90431 Nürnberg  
Tel.: +49 221 806-1371 e-mail: cert-validity@de.tuv.com  
Fax: +49 221 806-3935 http://www.tuv.com/safety

Zertifizierungsstelle  
  
 Dipl.-Ing. (FH) Bernd Schneider

J-BOX TYPE OF JM07w

**Zertifikat****Certificate**

Zertifikat Nr. *Certificate No.*      Blatt *Sheet*  
R 50385232                                      0003

Ihr Zeichen <i>Client Reference</i>	Unser Zeichen <i>Our Reference</i>	Ausstellungsdatum <i>Date of Issue</i>
W.F.A.	01-LXL-15105639 008	13.10.2020 <i>(day/mo/yr)</i>

Genehmigungsinhaber <i>License Holder</i>	Fertigungsstätte <i>Manufacturing Plant</i>
Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd. 158# Jinci Road Hangzhouwan New Zone Cixi 315300 Zhejiang P.R. China	Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd. 158# Jinci Road Hangzhouwan New Zone Cixi 315300 Zhejiang P.R. China

Prüfzeichen *Test Mark*                                      Geprüft nach *Tested acc. to*  
 Bauart geprüft  
 Sicherheit  
 Regelmäßige  
 Produktions-  
 überwachung  
 www.tuv.com  
 ID 1419049698  
 IEC 62790:2014  
 EN 62790:2015

Zertifiziertes Produkt (Geräteidentifikation)                                      Lizenzentgelte - Einheit  
*Certified Product (Product Identification)*                                      *License Fee - Unit*

PV-Anschlussdose (PV Components for BOS - electrical)

as page 0001

Change

Old Type Designation: 1) JM07 ; 2) JM07A ; 3) JM07L ; 4) JM07M

New Type Designation: 1) JM07w(w=Blank) ; 2) JM07w(w=A)  
 3) JM07w(w=L) ; 4) JM07w(w=M)

Protection Degree : IP65/IP68 (1m, 1h)


ANLAGE (Appendix): 1.6

Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde und es bestätigt die Konformität des Produktes mit den oben genannten Standards und Prüfgrundlagen. Zusätzliche Anforderungen in Ländern, in denen das Produkt in Verkehr gebracht werden soll, müssen zusätzlich betrachtet werden. Die Herstellung des zertifizierten Produktes wird überwacht.  
 This certificate is based on our Testing and Certification Regulation and states the conformity of the product with the standards and testing requirements as indicated above. Any additional requirements in countries where the product is going to be marketed have to be considered additionally. The manufacturing of the certified product is subject to surveillance.

TÜV Rheinland LGA Products GmbH, Tillystraße 2, 90431 Nürnberg

Tel.: +49 221 806-1371 e-mail: cert-validity@de.tuv.com  
 Fax: +49 221 806-3935 http://www.tuv.com/safety

Zertifizierungsstelle  
  
 Dipl.-Ing. (FH) Bernd Scheirer

<b>Produktsicherheit und –qualität</b> <i>Product Safety and Quality</i>		 <b>TÜVRheinland</b> <sup>®</sup> Precisely Right.
<b>Certificate No.</b> R 50385232 0001-0004	<b>Our Reference</b> 01-LXL-15105639 009	<b>Appendix No.</b> 1.7
<b>Constructional Data Form (CDF)</b>		page 1 of 10

Applicant .....	Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd.
(full address) .....	158# Jinci Road, Hangzhouwan New Zone, Cixi, Zhejiang 315300, P. R. China
Production factory 1 .....	Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd.
(full address).....	158# Jinci Road, Hangzhouwan New Zone, Cixi, Zhejiang 315300, P. R. China
Type of appliance.....	Junction Box for PV Module
Trademark .....	JMTHY
Type name or model no. ....	JM07w(w=Blank, A, L, M, R or S), see remark on page 10 for details.
Rated voltage.....	1500VDC for JM07, JM07L, JM07R and JM07S; 1000VDC for JM07A and JM07M
Rated impulse voltage.....	16kV for JM07, JM07L, JM07R and JM07S; 12kV for JM07A and JM07M
Max. working (module) voltage.....	100V
Rated current .....	20A for JM07, JM07A, JM07L and JM07M; 25A for JM07R and JM07S
Reverse current .....	30A
Standard .....	IEC 62790:2014; EN 62790:2015
Application class .....	Class A
Pollution degree .....	1 / 2 / 3 / 4 (after potting, inside of box)
Over voltage category .....	I / II / III / IV
Lower ambient temperature .....	-40°C
Upper ambient temperature .....	85°C
RTI housing material.....	110°C for 540Z(f1)
Flammability class.....	5VB
Termination and connection .....	Crimped-type terminals for external flexible PV Cable.; Soldered-type terminals for internal connection with bypass diode.; Soldered-type terminals for internal connection with PV ribbon.
Cable diameter.....	6,6±0,3mm
Rated torque for cable gland .....	N/A
Wire cross section area or cross section range .....	1 x 4,0mm <sup>2</sup>
Degree of protection.....	IP65/IP68(1m, 1h)
Rewire able .....	Yes / No

**TÜV Rheinland Group**

08.12.2020


Bright Liu

Date

Name

  
Signature



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	2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	LUCKY FILM Co., Ltd.
	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	29. PVF foil (TPEw), manufactured by Lucky Film Co., Ltd.
	2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	
	3. JS-606, manufactured by Hangzhou Zhijiang Silicone Chemicals CO., LTD.	
	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	30. PVDF foil(ZTT-KPE), manufactured by ZhongTian Photovoltaic Materials
	2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	
	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	31. Fluorine Polymer(FI HF32), manufactured by FUJIFILM Corporation
	2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	
	3. JS-606, manufactured by Hangzhou Zhijiang Silicone Chemicals CO., LTD.	
	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	32. FLUORIDE foil (FPE350Bw), manufactured by Lucky Film Co., Ltd.
	2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	
	3. JS-606, manufactured by Hangzhou Zhijiang Silicone Chemicals CO., LTD.	
	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	33. PVDF foil(Cynagard 205A(R)), manufactured by Cybrid Technologies Inc.
	2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	
	3. JS-606, manufactured by Hangzhou Zhijiang Silicone Chemicals CO., LTD.	
	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	34. PET foil (QL-W185-W75), manufactured by Toyo Aluminium K.K.
	8. Novasil® S 56, manufactured by Hermann Otto GmbH	
	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	35. PET foil (Filmback MLP), manufactured by Filmcutter Advanced Material SPA
	8. Novasil® S 56, manufactured by Hermann Otto GmbH	
	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	36. PET foil (Dymat PYE SPV (DTF Gen2)), manufactured by COVEME S.P.A.
	8. Novasil® S 56, manufactured by Hermann Otto GmbH	
	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	37. PET foil (Madico Reflektlight),

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<b>Constructional Data Form (CDF)</b>		page 7 of 10

	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	50. Fluorine resin (FFC-JW3020), manufactured by Jolywood (Suzhou) Sunwatt Co., Ltd.
	2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	
	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	51. PVDF foil (KPCw1), manufactured by Lucky Film Co., Ltd.
	2. HT906Z, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	
	11. HTPV358S, manufactured by Shanghai Huitian New Chemical Material Co., Ltd.	
	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	52. PVDF foil(KPCT1), manufactured by Lucky Film Co., Ltd
	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	53. PVDF foil(KPCT1M), manufactured by Lucky Film Co., Ltd
	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	54. PVDF foil(PV358S), manufactured by Chang Zhou Hui Tian New Material Co., Ltd
	1. TS1527, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	55. PET foil(dyMat HDPYE SPVL), manufactured by COVEME S.P.A
Potting material.....:	<b>Type of potting material</b>	<b>Type of Junction box</b>
	1. 5299W-S, manufactured by Shanghai Huitian New Chemical Material Co., LTD. 2. TS1521, manufactured by Beijing Tonsan New Material Technology Co., Ltd. 3. CV315, manufactured by Jiangsu Crevo Science & Technology Co., Ltd. 4. 1533, manufactured by Beijing Tonsan New Material Technology Co., Ltd.	JM07w(w=Blank, A, L, M, R or S)
Bypass-Diode.....:	<b>Type name</b>	THY2550(3)
	<b>Number</b>	1 diode in each box, total 3 diodes
	<b>Manufacturer</b>	Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd. OEM: Hangzhou Silan Microelectronics CO.,LTD.
	<b>Chip dimension/data</b>	Side: 102×102mil; Thickness: 0,29mm (Double chip) Forward voltage max. 459mV at 12,5A; Leakage current max. 24,111uA at 50V; I <sub>r</sub> =25A, T <sub>j</sub> =200°C
	<b>Box type</b>	JM07; JM07A; JM07L; JM07M
	<b>Rated current of</b>	20A

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<b>Constructional Data Form (CDF)</b>			page 8 of 10	

	Box	
Bypass-Diode.....:	<b>Type name</b>	THY2550(1)
	<b>Number</b>	1 diode in each box, total 3 diodes
	<b>Manufacturer</b>	Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd.
		OEM: PanJit International Inc.
	<b>Chip dimension/data</b>	Side: 216×108mil; Thickness: 0,28mm Forward voltage max. 488mV at 12,5A; Leakage current max. 96,748uA at 50V; $I_f=25A, T_j=200^{\circ}C$
	<b>Box type</b>	JM07; JM07A; JM07L; JM07M
	<b>Rated current of Box</b>	20A
Bypass-Diode.....:	<b>Type name</b>	THY2550(4)
	<b>Number</b>	1 diode in each box, total 3 diodes
	<b>Manufacturer</b>	Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd.
		OEM: Hangzhou Lion Microelectronics Co.,Ltd.
	<b>Chip dimension/data</b>	Side: 150mil×75mil×2; Thickness: 11mil Forward voltage max. 448mV at 12,5A; Leakage current max. 108,041uA at 45V; $I_f=25A, T_j=200^{\circ}C$
	<b>Box type</b>	JM07; JM07A; JM07L; JM07M
	<b>Rated current of Box</b>	20A
Bypass-Diode.....:	<b>Type name</b>	THY4050
	<b>Number</b>	1 diode in each box, total 3 diodes
	<b>Manufacturer</b>	Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd.
		OEM: Hangzhou Lion Microelectronics Co.,Ltd.
	<b>Chip dimension/data</b>	Side: 130mil×130mil×2; Thickness: 0,30mm Forward voltage max. 456mV at 20A; Leakage current max. 28,994uA at 50V; $I_f=40A, T_j=200^{\circ}C$
	<b>Box type</b>	JM07R; JM07S
	<b>Rated current of Box</b>	25A
(Optional) Accessories .....	N/A	
Additional Information (e.g. system configuration, difference between models, construction materials, output voltage, etc.) Attachments: Data-Sheets of critical components		

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Date

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Signature

Connector:


<b>Zertifikat</b>		<b>Certificate</b>			
<b>Zertifikat Nr. Certificate No.</b>	R 50334688	<b>Blatt Page</b>	0001		
<b>Ihr Zeichen Client Reference</b>	D.L.J.	<b>Unser Zeichen Our Reference</b>	01-LXL-15094989 001	<b>Ausstellungsdatum Date of Issue</b>	27.04.2016 (day/mo/yr)
<b>Genehmigungsinhaber License Holder</b>	Zhejiang Renhe Photovoltaic Technology Co., Ltd. 99#, Jing'er Road, Xinpu Town Cixi City, Zhejiang 315322 P.R. China		<b>Fertigungsstätte Manufacturing Plant</b>	Zhejiang Renhe Photovoltaic Technology Co., Ltd. 99#, Jing'er Road, Xinpu Town Cixi City, Zhejiang 315322 P.R. China	
<b>Prüfzeichen Test Mark</b>			<b>Geprüft nach Tested acc. to</b>	IEC 62852:2014	
<b>Zertifiziertes Produkt (Geräteidentifikation) Certified Product (Product Identification)</b>	<b>Steckverbinder (Connector for Photovoltaic System)</b>			<b>Lizenzentgelte - Einheit License Fee - Unit</b>	
Type Designation	: 05-6 ; 05-8 (ZJRH)			7	
Rated Voltage	: 1000VDC for 05-6; 1500V for 05-8				
Rated Current	: 30A				
Ambient Temperature	: -40°C to +85°C				
Upper Limit Temperature	: 100°C				
Cross Section Range	: 1 x 4,0mm <sup>2</sup> for 05-6 and 05-8 1 x 2,5mm <sup>2</sup> , 1 x 6,0mm <sup>2</sup> for 05-6				
Protection Degree	: IP67				
Application Class	: Class A				
Remark:	The labelling requirements acc. to EU Directive 2001/95 have to be observed for distribution within the EEA.				
				7	
<b>ANLAGE (Appendix): 1.0</b>					
<p>Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde und es bestätigt die Konformität des Produktes mit den oben genannten Standards und Prüfgrundlagen. Zusätzliche Anforderungen in Ländern, in denen das Produkt in Verkehr gebracht werden soll, müssen zusätzlich betrachtet werden. Die Herstellung des zertifizierten Produktes wird überwacht.</p> <p>This certificate is based on our Testing and Certification Regulation and states the conformity of the product with the standards and testing requirements as indicated above. Any additional requirements in countries where the product is going to be marketed have to be considered additionally. The manufacturing of the certified product is subject to surveillance.</p>					
<b>TÜV Rheinland LGA Products GmbH, Tillystraße 2, 90431 Nürnberg</b> Tel.: +49 221 806-1371 e-mail: cert-validity@de.tuv.com Fax: +49 221 806-3935 http://www.tuv.com/safety					
				 <b>Dipl.-Ing. (FH) Bernd Scheirer</b>	
					

**Zertifikat****Certificate**

Zertifikat Nr. *Certificate No.* Blatt *Sheet*  
R 50374980 0001

Ihr Zeichen <i>Client Reference</i>	Unser Zeichen <i>Our Reference</i>	Ausstellungsdatum <i>Date of Issue</i>
W.F.A.	01-LXL-15104098 001	11.04.2017 <i>(day/mo/yr)</i>

Genehmigungsinhaber <i>License Holder</i>	Fertigungsstätte <i>Manufacturing Plant</i>
Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd. 158# Jinci Road Hangzhouwan New Zone Cixi, 315300 P.R. China	Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd. 158# Jinci Road Hangzhouwan New Zone Cixi, 315300 P.R. China

Prüfzeichen <i>Test Mark</i>	Geprüft nach <i>Tested acc. to</i>
 <p>Bauart geprüft Sicherheit Regelmäßige Produktions- überwachung</p> <p>www.tuv.com ID 1419045741</p>	IEC 62852:2014
	EN 62852:2015

Zertifiziertes Produkt (Geräteidentifikation) <i>Certified Product (Product Identification)</i>	Lizenzentgelte - Einheit <i>License Fee - Unit</i>
<u>Steckverbinder</u> (Connector for Photovoltaic System)	

Type Designation	: PV-JM608 ; PV-JM608-1 (JMTHY)	7
Rated Voltage	: 1500VDC for PV-JM608 1000VDC for PV-JM608-1	
Rated Current	: 30A	
Ambient Temperature	: -40°C to +85°C	
Upper Limit Temperature:	100°C	
Cross Section Range	: 1 x 4,0mm <sup>2</sup>	
Protection Degree	: IP68 (1m, 1h)	
Application Class	: Class A	

Remark: The labelling requirements acc. to EU Directive 2001/95 have to be observed for distribution within the EEA.

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ANLAGE (Appendix): 1.0

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TÜV Rheinland LGA Products GmbH, Tillystraße 2, 90431 Nürnberg  
Tel.: +49 221 806-1371 e-mail: cert-validity@de.tuv.com  
Fax: +49 221 806-3935 http://www.tuv.com/safety



Dipl.-Ing. (FH) Bernd Scheirer

Attachment 5: Installation Manual:



For professional use only



## For Beyondsun Green Energy Single Glass PV Modules

Version: BS-HANDBOOK-EN-001 Ver: 2101

### 1. Safety Warning and Operation Notice



#### DANGER OF DEATH FROM ELECTRICAL SHOCK!

PV modules can generate electricity upon exposure to light. The voltage of a single module is less than 50 VDC, but the total voltage can be dangerously high when modules are connected together in series. The following must be fully understood and obeyed when handling the PV modules to avoid risk of arcing, fire and electric shock.

- a) Carefully read through these installation instructions before installing, operating or maintaining PV system. Failure to follow these instructions may result in bodily injury or damage to property.
- b) PV systems can produce high voltage and current which could cause serious injury or even death.
- c) The installation of PV modules should only be performed by qualified personnel.
- d) Do not wear metallic jewelry when installing. Do not touch live terminals with bare hands. Use insulated tools for electrical connections.
- e) Do not install PV modules at wet conditions.
- f) Do not use damaged nor defective modules. Even damage or defective modules can produce electricity. Keep damaged or defective modules covered to avoid exposure to light.
- g) Contact with electrically active parts of a PV module such as terminals, can result in burns sparks and lethal shock whenever the PV modules are connected or not.
- h) Use appropriate safety equipment when working on any wiring.
- i) Never disassemble nor break any part of the PV module, including nameplate.
- j) Keep children and other unqualified people away from the PV system.



## DANGER OF DEATH FROM ARCING!

- a) PV modules generate current under sunlight. A lethally strong arc may occur when breaking a connected module or a string of modules. Operation should be performed only by professional engineers equipped with professional tools.
- b) Never disconnect the PV module from the inverter when the inverter is still connected to the main grid, but remove the fuse from the AC side on the inverter before operation.
- c) Ensure cable and connectors are at perfect condition (no splitting, soiling, nor contamination).
- d) One should never touch the wet connectors, without using personal protective equipment or wearing insulating gloves.

### 1.1 General Safety

- e) All PV modules installation should be in accordance with applicable international and related local laws, codes and regulations.
- f) Artificial sunlight should not be concentrated upon the PV modules. Do not expose PV modules to sunlight concentrated with mirrors, lens or other means.
- g) The PV modules are rated as application class A. Modules rated for use in this application class may be used in systems operating at greater than 50V DC or 240W, where general contact access is anticipated. Modules qualified for safety through IEC 61730-1 and this part of IEC 61730 within this application class are considered to meet the requirements for safety class II.
- h) Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of  $I_{sc}$  and  $V_{oc}$  marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor ampacities, fuse sizes, and size of controls connected to the PV output.
- i) Only PV modules with the same cell type and size may be connected in series.
- j) Avoid any shade on the PV module surface. Shaded cells may become hot (hotspot phenomenon) resulting in permanent damage to the module or even fire hazard.
- k) Follow safety precautions of all other components used in the PV system.

### 1.2 Handling Safety





- a) Follow the unpacking instruction. Carry the module by at least two persons. Do not lay nor pile the PV module casually. Avoid any objects stacking or falling on the PV modules.
- b) Do not stand nor step on the PV module. The glass may be slippery, and there is a risk of injury or electric shock if glass is broken.
- c) Please handle PV modules with care, avoiding any bump or drop.
- d) Do not expose the PV module to excessive loads on the surface of the PV module nor twist the frame, otherwise, the glass and solar cells may break.
- e) Do not draw the cable of J-box excessively during installation. The cables should be in a relaxed state after connection.
- f) Do not touch the PV module with bare hands. The frame of the PV module has sharp edges and may cause injury.
- g) Wear suitable gloves, such as leather gloves with padding in the palm and finger areas.

### 1.3 Installation Safety

- a) Always wear protective helmet, insulating gloves and safety shoes (with rubber soles).
- b) Due to risk of electrical shock, never perform work when PV modules are wet.
- c) Do not install PV modules at rainy, snowy or windy conditions.
- d) Ensure the connectors are fully and correctly connected. Connectors and cables should be fixed to the PV module frames, support structure or raceway to prevent movement. Keep connectors out of direct sunlight or water immersion.
- e) Do not touch the J-box and the end of the cables with bare hands during installation, regardless of whether the PV module is connected to the system or not.
- f) Do not unplug connectors if the system circuit has been connected to an operating load.
- g) When installing PV modules on roofs or other structures, appropriate safety practices and safety equipment should always be used to avoid injury.

### 1.4 Fire Safety

- a) The PV modules should never be installed near inflammable gas, hazardous chemicals or fire source.
- b) The PV modules have been rated as Fire Class C (unless specified). For roof PV project, the PV modules are to be mounted over a fire-resistant roof.
- c) There should be lightning protection devices in the PV system. The maximum fuse rating is 20A.



## 2. Mounting

### 2.1 Location Selection and Environment

- a) Do not install the PV module where could be flooded or immersed.
- b) Do not install the PV module in a flammable gas environment (such as gas station, storage tank etc.) nor near fire source.
- c) Temperature endurance range of the PV module is  $-40^{\circ}\text{C} \sim 85^{\circ}\text{C}$ , while the environmental temperature range of
- d)  $-20^{\circ}\text{C} \sim 45^{\circ}\text{C}$  is recommended for module installation.
- e) Unless specified, the maximum bearing load of PV module is 5400Pa for front side, and 2400Pa for backside. The natural environment condition should be fully considered to not to exceed the maximum pressure. The accumulated snow should be removed in time to prevent causing any damage to the PV modules.
- f) The PV module should not be installed in the environment of excessive salt fog, hail, sand and dust, smoke, active chemical atmosphere, acid rain etc.
- g) The PV module should be installed at least 200m away from the sea side. Corresponding measure should be adopted to avoid module corrosion and grounding failure for the distance of 200m~1000m away from sea side. Installation of 1km away from sea side is recommended.

### 2.2 General Installation

- a) Condition of site should be fully investigated to ensure it is suitable for PV system. The installation should be designed by qualified engineer, conforming to all relevant construction/electrical laws, regulations and codes. PV installation should be approved by relevant authorities.
- b) The PV module should be mounted on supporting structures. Other components of the PV system should not have any undesirable mechanical or electrical influence on the PV module.
- c) Bearing ability of the supporting structure should be enough to sustain the modules weight and wind/snow pressure, as well as the pressure from installers and apparatus. Design of supporting structure should guarantee that there will be no effect on the modules when hot swell happens.
- d) The PV module should be firmly fixed with bolts or clamps on the supporting structure. The interval between modules
- e) should be at least 10mm.
- f) Do not cause any damage of the PV modules during mounting. Do not drill holes on the frame. Otherwise, the warranty is not valid any more.
- g) Bending radius of the J-box cable should be more than 60mm.
- h) Module installation site should maintain good ventilation to facilitate the heat dissipation, which is in favor of the



power generation and fire safety.

- i) For PV installation on the ground, the modules are expected to be at least one meter high from the ground to avoid soil, grass and snow covering the bottom part of the modules.
- j) For PV installation on the rooftop, the structure and bearing ability of roof must be suitable. The fastness of installation should be guaranteed to avoid the module falling off from rooftop. There should be a gap of at least 5cm between the module and roof.



### CAUTION!

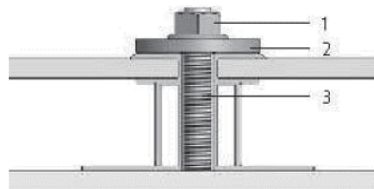
Roof structure will affect the fireproofing so it's necessary to earth ground fault circuit breaker. Unsuitable installation will bring on extra damages! When installing the module on a roof or building, do so in calm winds. Installing a module during strong winds may cause accidents!

- k) For the project on water surface, installation conditions should be provided in advance, so that the module manufacturer can choose the suitable materials to be in accord with the water surface installation conditions.

## 2.3 Installation Methods

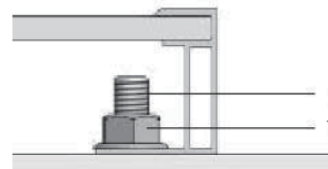
- a) PV modules can be mounted to the substructure by screwing (Example A) at the back side.

Example A: Clamping

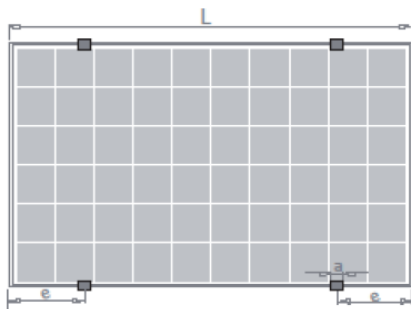


- 1) Stainless steel lock nut
- 2) Stainless steel washer
- 3) Stainless steel M6/ M8 bolt

Example B: Bolting



- b) Clamp fixing: Torque wrench is recommended for installation. The tightening torque (using stainless steel M6/ M8 bolts, stainless steel washer and stainless steel M6/ M8 nut ) should be around 15-20Nm)

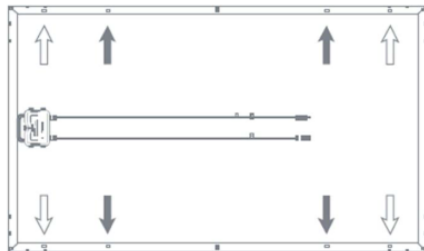


Front and back side 2400 Pa:  $L/8 \leq e \leq L/4$ ,  $a \geq 6\text{cm}$

Front side 5400 Pa, back side 2400 Pa:  $L/8 \leq e \leq L/6$ ,  $a \geq 6\text{cm}$



- c) Clamp fixing: Torque wrench is recommended for installation. The tightening torque (using stainless steel M6/ M8 bolts, stainless steel washer and stainless steel M6/ M8 nut) should be around 15-20Nm.



### 3. Electrical Installation

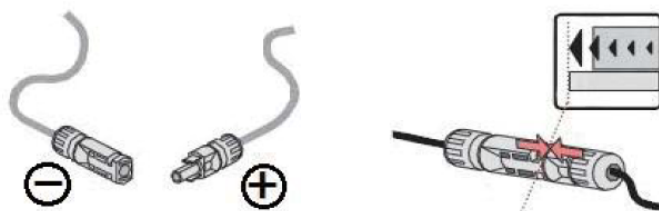
#### 3.1 Cables and Wiring

Correct wiring scheme

- a) When designing the system, avoid forming loops (to minimize risk in the event of an indirect lighting strike). Check that wiring is correct before starting up the generator. If the measured open circuit voltage (Voc) and short-circuit current (Isc) differ from the specifications, then there is a wiring fault.
- b) Use field wiring with suitable cross-sectional areas that are approved for use at the maximum short-circuit current of the PV module. Installer use only sunlight resistant cables qualified for direct current (DC) wiring in PV systems. The minimum wire size should be 4mm<sup>2</sup> and temperature rating is at -40°C to +85°C.
- c) Each module string should be equipped with fuse protector.

Cable standard	Test standard	Cable Size	Temperature Rating
	EN50618	≥4mm <sup>2</sup>	- 40°C to +85°C

- d) Correct connection of contact plug connectors. The plug connector has its own polarity. The terminals marked with "+" and "-" represent the positive and negative terminals of the power supply. Only those terminals indicated with "+" and "-" should be connected to the load. Make sure that the connection is safe and tight.





- e) Under normal conditions, a Module may produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of ISC and VOC marked on the Module should be multiplied by a factor of 1.25 when determining component voltage ratings, current ratings, fuse sizes, and size of controls connected to the PV output.
- f) To ensure proper system operation the correct cable connection polarity (Figures A & B) should be observed when connecting the modules to each other or to a load, such as inverter, a battery etc. If modules were not connected correctly, the bypass diode could be destroyed. PV modules can be wired in series to increase voltage. A series connection is made when the wire from the positive terminal of one module is connected to the negative terminal of the next module. Figure A shows modules connected in series. PV modules can be connected in parallel to increase current (Figure B). A parallel connection is made when the wire from the positive terminal of one module is connected to the positive terminal on the next module.

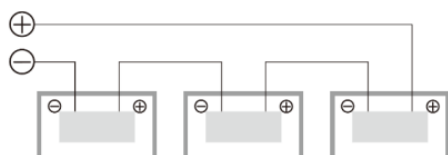


Figure A connection in series

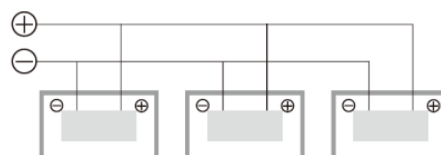


Figure B: connection in parallels

- k) The number of modules in series shall be calculated reasonably according to the system configuration and corresponding rules. The open circuit voltage under the condition of local minimum temperatures expected value cannot exceed the maximum module system voltage (according to IEC61730, the maximum system voltage of TRUNSUN's module are 1000 V and 1500 V, the client may calculate according to the actual voltage of module) and the required value of the other DC electrical components.

The maximum number of the modules can be installed in a string can be calculated based on below formula:  $N = V_{max} / V_{oc}(1 - \beta(25 - X))$ .

Voc: Open circuit voltage of each module (refer to product label or data sheet)

Vmax: Maximum system voltage

B: Thermal coefficient of open circuit voltage for the module (refer to data sheet)

X: The lowest expected ambient temperature for the installation location

N: The maximum number of modules in series



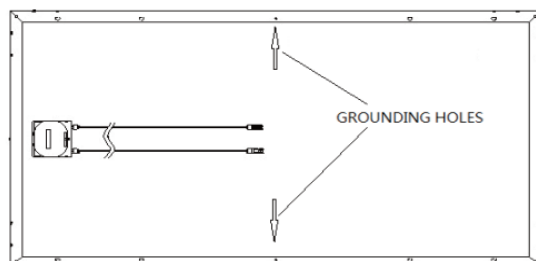
### CAUTION!

Connectors provided by different suppliers will not mutual match up. Different connectors provided by one supplier will not match up either. Only one type of the same connector from one supplier shall be used to ensure the reliability of electrical connection. The plug connector should not receive outer stress. Otherwise, it is only used to connect the circuit!

## 3.2 Grounding



- a) Grounding PV modules is necessary to reduce or eliminate shock and fire hazards. The installer of a PV system is responsible for grounding each module frame. It is recommended to ground each module frame at the provided grounding holes (4 mm or 5/32 inch diameter, marked with the grounding symbol).



- b) PV module frame is made of anodized aluminum. Corrosion can occur if PV module is subject to a salt-mist environment and is in contact with another type of metal (electrolytic corrosion). If condition permits, PVC washers may be placed between PV module frame and support structure to prevent this type of corrosion. All bolts, nuts, washers for grounding should be made of stainless steel, unless otherwise specified.

### 3.3 Electrical Configuration

PV modules connected in series should have similar current, and modules must not be connected together to create a voltage higher than the permitted system voltage. The maximum number of modules in series depends on system design, the type of inverter used and environmental conditions.

## 4. Cleaning and Maintenance

### 4.1 Cleaning

The amount of electricity generated by a solar module is proportional to the amount of light falling on it. A module with shaded cells will produce less energy and therefore it is important to keep modules clean. Appropriate maintenance measures shall be taken to keep the assembly free of snow, guano, seeds, pollen, leaves, branches, dust and stains, etc.

- Do not change the PV components optionally (diode, junction box, plug connectors).
- In most conditions, the normal rainwater can keep the module glass clean. Clean the glass surfaces with wet soft sponge or cloth if necessary. Use mild non-abrasive cleaning agent to remove stubborn dirt. If the module installation Angle with the ground is  $0^\circ$ , it required relatively frequent cleaning frequency. In general, if installation Angle is  $15^\circ$ , the module's self-cleaning ability is better than  $0^\circ$ .
- Do not use high pressure water spray nor chemicals to clean the PV modules.



- d) When cleaning PV modules, do NOT step on the modules; do NOT spray water on the backside of the module or the cables; do NOT clean the backside of the modules; keep the connectors clean and dry; prevent fire and electrical shock from occurring; do NOT use as steam cleaner.
- e) Modules can work effectively without cleaning, but removing dust from the glass surface can increase output power. Use a wet sponge or cloth to clean the surface of the glass. Wear rubber gloves for maintenance.
- f) The back surface of the module normally does not need to be cleaned but, in the event this is deemed necessary, avoid the use of any sharp projects that might damage the penetrating the substrate material.

## 4.2 Maintenance

- a) All fastenings should be kept tight and secured free of corrosion. It is recommended to perform a preventive inspection every six months without changing the components of the module. If electrical or mechanical properties are required for inspection or maintenance, qualified professionals should be advised to avoid any electric shock or loss of life.
- b) Inspect for loose or corroded electrical interfaces, loose connections between supports and components, connections between cables, connectors, and grounding. Check the grounding resistivity routinely.
- c) Replacement modules must be of same type. Do NOT touch live parts of cables and connectors. Use appropriate safety equipment (insulated tools, insulating gloves, etc.) when handling modules.
- d) All fastenings should be kept tight and secured free of corrosion. All cable connections should be secure, tight, clean and free of corrosion. Cables should be kept intact.
- e) PV module should not be discarded casually, but should be recycled by professional organization.
- f) Trim any vegetation which may shade the solar array, thus impacting performance.

## 5. Disclaimer

- a) Beyondsun Green Energy gives no warranty of any kind whatsoever, either explicitly or implicitly, with respect to the information contained herein.
- b) Beyondsun Green Energy have rights of modifying manual, PV products, specifications or the rights of the product information, without prior notice.
- c) This manual information based on reliable our knowledge and experience, including product specifications of the information and advice does not constitute any guarantee.



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## Attachment 6: Electrical ratings

TSHMxxx-144HW						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	Ipm (A)
TSHM435-144HW	435	1500	49,85	11,15	41,47	10,49
TSHM440-144HW	440	1500	50,05	11,22	41,67	10,56
TSHM445-144HW	445	1500	50,26	11,29	41,87	10,63
TSHM450-144HW	450	1500	50,43	11,36	42,06	10,70
TSHM455-144HW	455	1500	50,63	11,43	42,25	10,77
TSHM460-144HW	460	1500	50,84	11,50	42,44	10,84
TSHM465-144HW	465	1500	51,04	11,57	42,63	10,91
TSHMxxx-132HW						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	Ipm (A)
TSHM400-132HW	400	1500	45,72	11,18	38,03	10,52
TSHM405-132HW	405	1500	45,93	11,25	38,25	10,59
TSHM410-132HW	410	1500	46,14	11,32	38,47	10,66
TSHM415-132HW	415	1500	46,35	11,40	38,65	10,74
TSHM420-132HW	420	1500	46,56	11,47	38,86	10,81
TSHM425-132HW	425	1500	46,77	11,54	39,07	10,88
TSHMxxx-120HW						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	Ipm (A)
TSHM365-120HW	365	1500	41,55	11,17	34,57	10,56
TSHM370-120HW	370	1500	41,77	11,24	34,78	10,64
TSHM375-120HW	375	1500	42,00	11,31	34,99	10,72
TSHM380-120HW	380	1500	42,23	11,38	35,19	10,80
TSHM385-120HW	385	1500	42,45	11,46	35,39	10,88
TSHMxxx-108HW						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	Ipm (A)
TSHM330-108HW	330	1500	37,55	11,21	31,28	10,55
TSHM335-108HW	335	1500	37,72	11,31	31,46	10,65
TSHM340-108HW	340	1500	37,88	11,41	31,63	10,75
TSHM345-108HW	345	1500	38,03	11,51	31,80	10,85
TSHMxxx-96HW						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	Ipm (A)
TSHM290-96HW	290	1500	33,23	11,15	27,65	10,49
TSHM295-96HW	295	1500	33,43	11,25	27,86	10,59
TSHM300-96HW	300	1500	33,63	11,36	28,04	10,70
TSHM305-96HW	305	1500	33,83	11,46	28,22	10,81
TSHMxxx-72HW						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	Ipm (A)
TSHM220-72HW	220	1500	25,03	11,22	20,84	10,56
TSHM225-72HW	225	1500	25,22	11,36	21,04	10,70
TSHM230-72HW	230	1500	25,43	11,50	21,23	10,84
TSHMxxx-144W						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	Ipm (A)
TSHM435-144W	435	1000	49,85	11,15	41,47	10,49
TSHM440-144W	440	1000	50,05	11,22	41,67	10,56
TSHM445-144W	445	1000	50,26	11,29	41,87	10,63
TSHM450-144W	450	1000	50,43	11,36	42,06	10,70
TSHM455-144W	455	1000	50,63	11,43	42,25	10,77
TSHM460-144W	460	1000	50,84	11,50	42,44	10,84
TSHM465-144W	465	1000	51,04	11,57	42,63	10,91
TSHMxxx-132W						

Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM400-132W	400	1000	45,72	11,18	38,03	10,52
TSHM405-132W	405	1000	45,93	11,25	38,25	10,59
TSHM410-132W	410	1000	46,14	11,32	38,47	10,66
TSHM415-132W	415	1000	46,35	11,40	38,65	10,74
TSHM420-132W	420	1000	46,56	11,47	38,86	10,81
TSHM425-132W	425	1000	46,77	11,54	39,07	10,88
TSHMxxx-120W						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM365-120W	365	1000	41,55	11,17	34,57	10,56
TSHM370-120W	370	1000	41,77	11,24	34,78	10,64
TSHM375-120W	375	1000	42,00	11,31	34,99	10,72
TSHM380-120W	380	1000	42,23	11,38	35,19	10,80
TSHM385-120W	385	1000	42,45	11,46	35,39	10,88
TSHMxxx-108W						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM330-108W	330	1000	37,55	11,21	31,28	10,55
TSHM335-108W	335	1000	37,72	11,31	31,46	10,65
TSHM340-108W	340	1000	37,88	11,41	31,63	10,75
TSHM345-108W	345	1000	38,03	11,51	31,80	10,85
TSHMxxx-96W						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM290-96W	290	1000	33,23	11,15	27,65	10,49
TSHM295-96W	295	1000	33,43	11,25	27,86	10,59
TSHM300-96W	300	1000	33,63	11,36	28,04	10,70
TSHM305-96W	305	1000	33,83	11,46	28,22	10,81
TSHMxxx-72W						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM220-72W	220	1000	25,03	11,22	20,84	10,56
TSHM225-72W	225	1000	25,22	11,36	21,04	10,70
TSHM230-72W	230	1000	25,43	11,50	21,23	10,84
TSHMxxx-144HV						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM520-144HV	520	1500	48,86	13,59	40,98	12,69
TSHM525-144HV	525	1500	49,01	13,66	41,15	12,76
TSHM530-144HV	530	1500	49,16	13,72	41,31	12,83
TSHM535-144HV	535	1500	49,31	13,79	41,45	12,91
TSHM540-144HV	540	1500	49,46	13,86	41,61	12,98
TSHM545-144HV	545	1500	49,61	13,93	41,77	13,05
TSHM550-144HV	550	1500	49,76	14,00	41,93	13,12
TSHMxxx-132HV						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM480-132HV	480	1500	44,88	13,62	37,68	12,74
TSHM485-132HV	485	1500	45,03	13,70	37,83	12,82
TSHM490-132HV	490	1500	45,18	13,78	37,98	12,90
TSHM495-132HV	495	1500	45,34	13,86	38,14	12,98
TSHM500-132HV	500	1500	45,49	13,94	38,29	13,06
TSHMxxx-120HV						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM435-120HV	435	1500	40,64	13,59	34,23	12,71
TSHM440-120HV	440	1500	40,79	13,68	34,38	12,80
TSHM445-120HV	445	1500	40,94	13,77	34,53	12,89

TSHM450-120HV	450	1500	41,09	13,86	34,67	12,98
TSHM455-120HV	455	1500	41,24	13,95	34,82	13,07
TSHMxxx-108HV						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM390-108HV	390	1500	36,53	13,56	30,76	12,68
TSHM395-108HV	395	1500	36,68	13,66	30,91	12,78
TSHM400-108HV	400	1500	36,83	13,76	31,06	12,88
TSHM405-108HV	405	1500	36,98	13,86	31,21	12,98
TSHM410-108HV	410	1500	37,12	13,96	31,35	13,08
TSHMxxx-96HV						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM345-96HV	345	1500	32,52	13,56	27,28	12,65
TSHM350-96HV	350	1500	32,67	13,66	27,43	12,76
TSHM355-96HV	355	1500	32,82	13,76	27,59	12,87
TSHM360-96HV	360	1500	32,97	13,86	27,74	12,98
TSHM365-96HV	365	1500	33,12	13,96	27,89	13,09
TSHMxxx-72HV						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM260-72HV	260	1500	24,43	13,59	20,49	12,69
TSHM265-72HV	265	1500	24,58	13,72	20,66	12,83
TSHM270-72HV	270	1500	24,73	13,86	20,81	12,98
TSHM275-72HV	275	1500	24,88	14	20,97	13,12

TSHMxxx-144V						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM520-144V	520	1000	48,86	13,59	40,98	12,69
TSHM525-144V	525	1000	49,01	13,66	41,15	12,76
TSHM530-144V	530	1000	49,16	13,72	41,31	12,83
TSHM535-144V	535	1000	49,31	13,79	41,45	12,91
TSHM540-144V	540	1000	49,46	13,86	41,61	12,98
TSHM545-144V	545	1000	49,61	13,93	41,77	13,05
TSHM550-144V	550	1000	49,76	14,00	41,93	13,12

TSHMxxx-132V						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM480-132V	480	1000	44,88	13,62	37,68	12,74
TSHM485-132V	485	1000	45,03	13,70	37,83	12,82
TSHM490-132V	490	1000	45,18	13,78	37,98	12,90
TSHM495-132V	495	1000	45,34	13,86	38,14	12,98
TSHM500-132V	500	1000	45,49	13,94	38,29	13,06

TSHMxxx-120V						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM435-120V	435	1000	40,64	13,59	34,23	12,71
TSHM440-120V	440	1000	40,79	13,68	34,38	12,80
TSHM445-120V	445	1000	40,94	13,77	34,53	12,89
TSHM450-120V	450	1000	41,09	13,86	34,67	12,98
TSHM455-120V	455	1000	41,24	13,95	34,82	13,07

TSHMxxx-108V						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	lpm (A)
TSHM390-108V	390	1000	36,53	13,56	30,76	12,68
TSHM395-108V	395	1000	36,68	13,66	30,91	12,78
TSHM400-108V	400	1000	36,83	13,76	31,06	12,88
TSHM405-108V	405	1000	36,98	13,86	31,21	12,98
TSHM410-108V	410	1000	37,12	13,96	31,35	13,08

TSHMxxx-96V						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	Ipm (A)
TSHM345-96V	345	1000	32,52	13,56	27,28	12,65
TSHM350-96V	350	1000	32,67	13,66	27,43	12,76
TSHM355-96V	355	1000	32,82	13,76	27,59	12,87
TSHM360-96V	360	1000	32,97	13,86	27,74	12,98
TSHM365-96V	365	1000	33,12	13,96	27,89	13,09
TSHMxxx-72V						
Model	Max. Power	Max. system voltage	Voc (V)	Isc (A)	Vpm (V)	Ipm (A)
TSHM260-72V	260	1000	24,43	13,59	20,49	12,69
TSHM265-72V	265	1000	24,58	13,72	20,66	12,83
TSHM270-72V	270	1000	24,73	13,86	20,81	12,98
TSHM275-72V	275	1000	24,88	14	20,97	13,12

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