Test Report issued under the responsibility of:

NCB TÜV SÜD Product Service GmbH
Ridlerstr. 65
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Germany

TEST REPORT

IEC 61215-series:2016

Terrestrial photovoltaic (PV) modules – Design qualification and type approval

Report Number. ..... :	704061930402-17 Part 1 of 2
Date of issue ..... :	2022-10-28
Total number of pages ..... :	57
TÜV SÜD Branch ..... :	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
Applicant's name ..... :	Jolywood(Taizhou) Solar Technology Co., Ltd.
Address ..... :	Kaiyang Rd. Jiangyan Economic Development Zone 225500 Taizhou, Jiangsu, PEOPLE'S REPUBLIC OF CHINA
Test specification:	
Standard ..... :	☒ IEC 61215-1:2016 ☒ IEC 61215-2:2016 ☒ IEC 61215-1-1:2016 ☐ IEC 61215-1-2:2016 ☐ IEC 61215-1-3:2016 ☐ IEC 61215-1-4:2016
Test procedure ..... :	TÜV SÜD Mark
Non-standard test method ..... :	MQT 02, 06, 09, 11, 18 were performed considering the contribution from rear side irradiation. UV15 was also applied to module rear side in sequence C.
Test Report Form No. ..... :	IEC61215D_SE
Test Report Form(s) Originator .... :	TÜV SÜD Product Service GmbH
Master TRF ..... :	2017-11-30

This report is not valid as a CB Test Report unless signed by an approved CB Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.

General disclaimer:

The test results presented in this report relate only to the object tested.
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Test item description ..... :	Photovoltaic (PV) Module(s)
Trade Mark ..... :	中來光电 JOLYWOOD
Manufacturer ..... :	Jolywood(Taizhou) Solar Technology Co., Ltd.
Model/Type reference ..... :	See page 8 of this report
Ratings ..... :	See page 8 of this report

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):			
☒	**TÜV SÜD Branch:**	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch	
Testing location/address ..... :		No. 151 Heng Tong Road, Shanghai 200070, P. R. China	
☒	**Associated Testing Laboratory:**	Changzhou HuaYang Inspection and Testing Technology Co., Ltd.	
Testing location/address ..... :		NO.8 Lanxiang Road, Wujin Economic Development Zone, Changzhou, Jiangsu, China	
Tested by (name + signature) ..... :		Qiaoying Li	Qiaoying Li
Approved by (name + signature) ..... :		Guangxia Fu	Guangxia Fu
☐	**Testing procedure: TMP/CTF Stage 1:**		
Testing location/address ..... :			
Tested by (name + signature) ..... :			
Approved by (name + signature) ..... :			
☐	**Testing procedure: WMT/CTF Stage 2:**		
Testing location/address ..... :			
Tested by (name + signature) ..... :			
Witnessed by (name + signature) ..... :			
Approved by (name + signature) ..... :			
☐	**Testing procedure: SMT/CTF Stage 3 or 4:**		
Testing location/address ..... :			
Tested by (name + signature) ..... :			
Witnessed by (name + signature) ..... :			
Approved by (name + signature) ..... :			
Supervised by (name + signature) ..... :			

List of Attachments (including a total number of pages in each attachment):	
	attachment number / number of pages
Installation manual	N/A (No update)
Drawings mechanical	N/A
Circuit diagram	N/A
Photographs	Attachment No.1 / 9 pages
Component datasheets / certificates	Attachment No.1 / 35 pages
Others:	N/A
Product Description Sheet (Manufacturers and type references)	Annex 1, _3_ pages
Test table for verifying other stabilization procedure	Annex 2, _N/A_ pages
Lower and higher output power modules	Annex 3, _3_ pages
List of test equipment used	Annex 4, _N/A_ pages

Summary of testing:

Tests performed (name of test and test clause):	**Testing location:**
Based on previous project 70406193402-16, add following materials: 1) Substrate supplied by Chenzhou Kibing Photovoltaic & Electronic Glass Co., Ltd. Type: Heat strengthened glass with inside white ceramic glaze coating 2) Superstrate supplied by Chenzhou Kibing Photovoltaic & Electronic Glass Co., Ltd. 3) Frame supplied by Jolywood (Suzhou) Sunwatt Co., Ltd. Material Aluminum-Magnesium-Zinc (Al-Mg-Zn), Thickness: 30 mm 4) Half cut cell supplied by Jolywood (Taizhou) Solar Technology Co., Ltd. Mono-Si, NM1016B, N Type,182x91mm,16BB. 5). Adhesive MH3668 supplied by Jiangsu Minghao New Material Sci-tech Corporation. 6). Encapsulation SE-556 Thickness:0.45(-0.09/+0.35) mm supplied by Changzhou Sveck PV New Material Co., Ltd. 7). Cell connector Cross-sectional area φ0.25mm supplied by Suzhou Sanysolar MATERIALS Technology Co., Ltd. Full tests (except NMOT & MQT 19.2 final stabilization) according to IEC 61215-1:2016, IEC 61215-1-1:2016, IEC 61215-2:2016, IEC 61730-2:2016 were conducted on representative model JW-HD155N-570 Higher end power class tests JW-HD144N-580 Lower end power class tests JW-HD144N-525	Changzhou HuaYang Inspection and Testing Technology Co., Ltd. No.8 Lanxiang Road, Wujin Economic Development Zone, Changzhou, Jiangsu, China

Summary of compliance with National Differences (List of countries addressed):

The text of IEC 61215-1: 2016 was approved by CENELEC as EN 61215-1: 2016 without any modification.

The text of IEC 61215-1-1: 2016 was approved by CENELEC as EN 61215-1-1: 2016 without any modification.

The text of IEC 61215-2: 2016 was approved by CENELEC as EN 61215-2: 2017 without any modification

☒ **The product fulfils the requirements of** ____ IEC 61215-1: 2016, IEC 61215-1-1: 2016, IEC 61215-2: 2016 ____ **(insert standard number and edition and delete the text in parenthesis, leave it blank or delete the whole sentence, if not applicable)**

Copy of marking plate:

The artwork below may be only a draft. The use of certification marks on a product must be authorized by TÜV SÜD Product Service GmbH 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.)

中来光电 JOLYWOOD		Test Conditions	STC	Power Selection	0~+5W
		Rated Max Power (Pmax TOL±3%)	570W	Maximum Overcurrent Protection Rating	30A
Jolywood (Taizhou) Solar Technology Co.,Ltd.		Current at Pmax (Imp)	13.32A	Maximum System Voltage	1500V
Model Type	JW-HD144N-570	Voltage at Pmax (Vmp)	42.8V	PV Module Classification	Class II
Product Name	Solar Module	Short-Circuit Current (Isc TOL±5%)	14.24A		
Address:Kaiyang Rd.Jiangyan Economic Development Zone,Taizhou,Jiangsu,China		Open-Circuit Voltage (Voc TOL±4%)	51.08V		
		STC:AM=1.5 E=1000W/m² Tc=25℃			

Test item particulars..... :	N/A
Accessories and detachable parts included in the evaluation..... :	N/A
Mounting system used..... :	Refer to user 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	α – Current temperature coefficient
Voc – Open circuit voltage	β – Voltage temperature coefficient
FF – Fill factor	δ – power temperature coefficient
STC – Standard Test Conditions (25°C, 1 000 W/m²)	NMOT – Nominal Module Operating Temperature (20°C, 800 W/m²)
MQT – Module Quality Tests	$V_{FMrated}$ – 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..... :	2022-07-10
Dates of tests (beginning/end)..... :	2022-07-12 to 2022-10-24

GENERAL REMARKS:	
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report. **This TRF has been created in cooperation with CTL ETF-9 and German National Committee (DKE).** **The originator's responsibility of this TRF in IECEE CB Scheme has been assigned to TÜV SÜD Product Service GmbH.** Throughout this report a ☐ comma / ☒ point is used as the decimal separator.	
Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:	
The application for obtaining a TÜV SÜD 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 ..... :	☒ Yes ☐ Not applicable
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (factories) ..... :	1.Jolywood (Taizhou) Solar Technology Co., Ltd. No.11 Xingyuan Rd, Jiangyan High-tech Zone, Jiangyan District 225500 Taizhou, Jiangsu, PEOPLE'S REPUBLIC OF CHINA 2.FENGYANG JOY ENERGY TECHNOLOGY CO., LTD 88 East Yongqing Road, Economic Development Zone, Fengyang County, 233100 Chuzhou City, Anhui Province PEOPLE'S REPUBLIC OF CHINA 3. Changzhou RIX Photovoltaic Technology Co., Ltd. (117315) No.21 Changhu Road, Rulin Town, Jintan District 213200 Changzhou, Jiangsu Province, PEOPLE'S REPUBLIC OF CHINA

PRODUCT ELECTRICAL RATINGS:				
Module type	JW-HD144N-570	-	-	-
Voc [V] /Tolerance(±4%)	51.08	-	-	-
Isc [Adc] /Tolerance(±5%)	14.24	-	-	-
Vmp [V]	42.8	-	-	-
Imp [Adc]	13.32	-	-	-
Pmp [W] /Tolerance(±3%)	570	-	-	-
Maximum system voltage [V]	1500	-	-	-
Maximum Over-Current Protection Rating [A]	30	-	-	-
Note: Further qualification for higher and/or lower output power see annex 4				

GENERAL PRODUCT INFORMATION AND OTHER REMARKS:

Modifications:

☐ Initial module design qualification

☒ Extension of module design qualification

☒ Original test report ref. No. .....: 704061930402-16

Model differences and modification:

☒ Test programs for crystalline silicon PV modules

- ☒ 4.1.1 Modification to frontsheet
- ☒ 4.1.2 Modification to encapsulation system
- ☒ 4.1.3 Modification to cell technology
- ☒ 4.1.4 Modification to cell and string interconnect material or technique
- ☒ 4.1.5 Modification to backsheet
- ☐ 4.1.6 Modification to electrical termination
- ☐ 4.1.7 Modification to bypass diode
- ☐ 4.1.8 Modification to electrical circuitry
- ☐ 4.1.9 Modification to edge sealing
- ☒ 4.1.10 Modification to frame and/or mounting structure
- ☐ 4.1.11 Change in PV module size
- ☐ 4.1.12 Higher or lower output power (by 10 % or more) with the identical design and size and using the identical cell process
- ☐ 4.1.13 Increase of over-current protection rating
- ☐ 4.1.14 Increase of system voltage
- ☐ 4.1.15 Change in cell fixing tape

☐ Test programs for thin-film PV modules

- ☐ 4.2.1 Modification to frontsheet
- ☐ 4.2.2 Modification to encapsulation system
- ☐ 4.2.3 Modification to front contact (e. g. TCO)
- ☐ 4.2.4 Modification to cell technology
- ☐ 4.2.5 Modification to cell layout
- ☐ 4.2.6 Modification to back contact
- ☐ 4.2.7 Modification to edge deletion
- ☐ 4.2.8 Modification to interconnect material or technique
- ☐ 4.2.9 Modification to backsheet
- ☐ 4.2.10 Modification to electrical termination
- ☐ 4.2.11 Modification to bypass diode
- ☐ 4.2.12 Modification to edge sealing
- ☐ 4.2.13 Modification to frame and/or mounting structure
- ☐ 4.2.14 Change in PV module size
- ☐ 4.2.15 Higher or lower output power (by 10 % or more) with the identical design and size
- ☐ 4.2.16 Increase of over-current protection rating
- ☐ 4.2.17 Increase of system voltage

Note: The clause references modifications extracted from IEC 62915

MODULE GROUP ASSIGNMENT:

Sample #	Sample Group ID	Type/model	Sample S/N	Remark
M10(HA2022L-1415-001X)	A1	JW-HD144N-570	JW394622090288000296	Control module
M11(HA2022L-1415-002X)	A2	JW-HD144N-570	JW394622090288000182	—
M12(HA2022L-1415-003X)	A3	JW-HD144N-570	JW394622090288000122	—
M13(HA2022L-1415-004X)	B	JW-HD144N-570	JW394622090288000277	OD, BD,HS
M4(HA2022L-1415-005X)	C1	JW-HD144N-570	JW394622090287702529	UV sequence
M5(HA2022L-1415-006X)	C2	JW-HD144N-570	JW394622090287703078	UV sequence
M8(HA2022L-1415-007X)	D1	JW-HD144N-570	JW394622090287702644	TC200
M9(HA2022L-1415-008X)	D2	JW-HD144N-570	JW394622090287703009	TC200
M6(HA2022L-1415-009X)	E1	JW-HD144N-570	JW394622090287703146	DH1000/ML
M7(HA2022L-1415-0010X)	E2	JW-HD144N-570	JW394622090287703121	DH1000/Hail
HA2022L-1415-020X	Lower 1	JW-HD144N-525	JW990202210000101011	Lower end power class
HA2022L-1415-021X	Lower 2	JW-HD144N-525	JW990202210000101012	Lower end power class
HA2022L-1415-022X	Higher 1	JW-HD144N-580	JW990202210000101006	Higher end power class
HA2022L-1415-023X	Higher 2	JW-HD144N-580	JW990202210000101007	Higher end power class

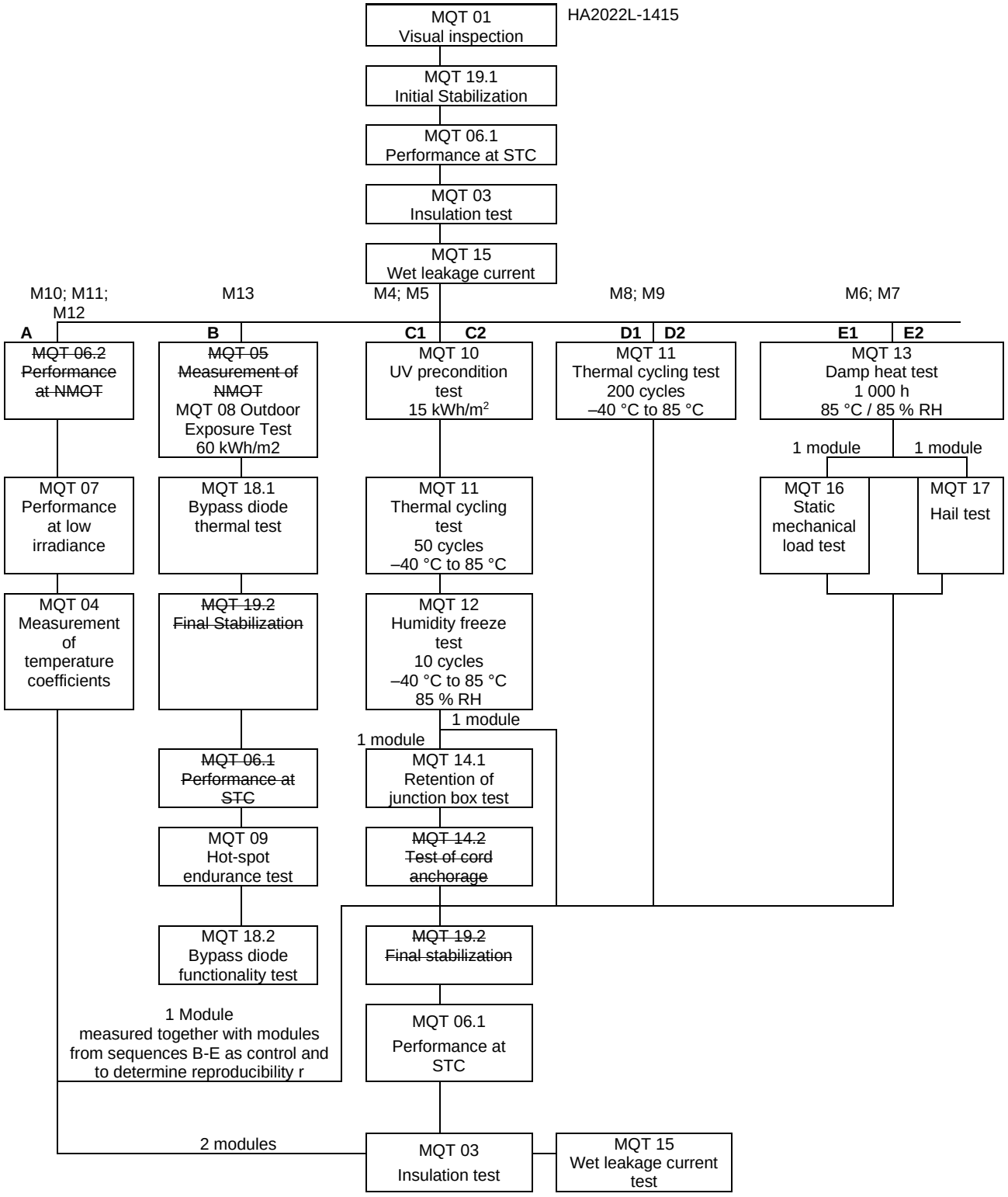
Supplementary information: N/A

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 62915 Photovoltaic (PV) modules – Retesting for type approval, design and safety qualification, Annex A3

11	**TEST FLOW (if it is not a full test, strikethrough non-performed test)** Note: Deviations from test sequence are possible but must be documented.



IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
5. MARKING AND DOCUMENTATION			P
5.1	**Name Plate**		
	All electrical data is shown as relative to standard test conditions (1 000 W/m², 25 °C, AM 1,5 according to IEC TS 61836).	Marked on label	P
	International symbols are used where applicable.	Marked on label	P
	The module includes clear and indelible markings:		—
	a. Name, registered trade name or registered trade mark of manufacturer	Jolywood(Taizhou) Solar Technology Co., Ltd. 	P
	b. Type or model number designation	JW-HD155N-570 for example	P
	c. Serial number (unless marked on other part of product)	Provided under superstrate near the top rail of frame	P
	d. Date and place of manufacture, alternatively serial number allowing to trace the date and place of manufacture;	serial number allowing to trace the date and place of manufacture	P
	e. Maximum system voltage	1500V DC	P
	f. Class of protection against electrical shock	Class II	P
	g. Voltage at open-circuit or Voc including tolerances.	51.08V ± 4% for example	P
	h. Current at short-circuit or Isc including tolerances	14.24A ± 5% for example	P
	i. Module maximum power or Pmax including tolerances	570W ± 3% for example	P
5.2	**Documentation**		
5.2.1	Minimum requirements		
	Modules are supplied with documentation describing the methods of electrical and mechanical installation as well as the electrical ratings of the module		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.		P
	The documentation assures that installers and operators receive appropriate and sufficient documentation for safe installation, use, and maintenance of the PV modules.		P
5.2.2	Information given in the documentation		P
	a. All information required under 5.1 e) to i)	Refer to manual document	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	Refer to manual document	P
	Maximum series/parallel module configuration is recommended		P
	c. Manufacturer's stated tolerance for Voc, Isc and maximum power output under standard test conditions		P
	d. Temperature coefficient for voltage at open-circuit		P
	e. Temperature coefficient for maximum power		P
	f. Temperature coefficient for short-circuit current		P
	All electrical data mentioned above shown as relative to standard test conditions (1 000 W/m^2, 25 °C, AM 1,5 according to IEC TS 61836)		P
	g. Nominal module operating temperature (NMOT) is specified		P
	h. Performance at NMOT (MQT 06.2) is specified		P
	i. Performance at low irradiance (MQT 07) is specified		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		—
	j. The minimum cable diameters for modules intended for field wiring		P
	k. Any limitations on wiring methods and wire management that apply to the wiring compartment or box;		P
	l. The size, type, material and temperature rating of the conductors to be used		P
	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	Refer to manual document	P
	p. The type and ratings of bypass diode to be used (if applicable)	Refer to manual document	P
	q. limitations to the mounting situation (e.g., slope, orientation, mounting means, cooling)	Refer to manual document	P

IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
	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 γ_m may be noted, too		P
	The installation instructions include relevant parameters specified by manufacturer or the following statement or the equivalent: "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 ISC and VOC 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."		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: N/A			

7. PASS CRITERIA					P
7.2	**Power output and electric circuitry**				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	4	5	
		m_1	m_2	m_3	
	measurement uncertainty in % of laboratory	2.12	0.98	2.26	
	Laboratory reproducibility r .....:	0.21			
	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

IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
	After stabilization the arithmetic average $\overline{P}\max$ 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
7.3	**Visual defects**		P
	There is no visual evidence of a major defect.		P
7.4	**Electrical safety**		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: N/A			

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict
4. TESTING OVERVIEW			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
Sequence A	**3 Modules**	Samples M10, M11, M12	P
4.6	Performance at NMOT (MQT 06.2) :	See Table 06	—
4.7	Performance at low irradiance (MQT 07) :	See Table 07	—
4.4	Measurement of temperature coefficients (MQT 04) :	See Table 08	—
Sequence B	**1 Module**	Sample M13	P
4.5	Measurement of nominal module operating temperature (NMOT, °C) (MQT 05) :	—	—
4.8	Outdoor exposure test (MQT 08) :	See Table 10	P
4.18.1	Bypass diode thermal test (MQT 18.1)		P
	Maximum allowed junction temperature :	200°C	—
	Calculated junction temperature :	See table 4.18.1 B	—
	Final measurements :	See Table 11	N/A
4.18.2	Bypass diode functionality test (MQT 18.2) :	See Table 12	P
4.19.6	Final stabilization (MQT 19.2) :	See Table 12.1 – 12.3	N/A
4.9	Hot spot endurance test (MQT 09) :	See Table 13.1 - 13.7	P
Sequence C	**2 Modules**	Samples M4; M5	P
4.10	UV preconditioning test (MQT 10) :	See Table 14.1 - 14.4	P
4.11	Thermal cycling test 50 cycles (MQT 11) :	See Table 15.1 - 15.4	P
4.12	Humidity-freeze test (MQT 12) :	See Table 16.1 - 16.4	P
Sequence C1	**1 Module**	Sample M4	P
4.14	Robustness of terminations test (MQT 14)		—

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict
4.14.2	Retention of junction box on mounting surface (MQT 14.1) :	See Table 17.1 - 17.7	P
4.14.3	Test of cord anchorage (MQT 14.2)		N/A
4.14.3.1	This test omitted if junction box is qualified to IEC 00590 :	—	N/A
4.14.3.2.1	Junction boxes intended to be used with cables specified by the manufacturer……:	—	N/A
4.14.3.2.2	Junction boxes intended to be used with generic cables……:	—	N/A
Sequence D	**2 Modules**	Samples M8; M9	P
4.11	Thermal cycling test 200 cycles (MQT 11) :	See Table 18.1 - 18.4	P
Sequence E	**2 Modules**	Samples M6; M7	P
4.13	Damp heat test (MQT 13) .....:	See Table 19.1 - 19.4	P
Sequence E1	**1 Module**	Samples M6	P
4.16	Static mechanical load test (MQT 16) :	See Table 19.5 – 19.7	P
Sequence E2	**1 Module**	Samples M7	P
4.17	Hail test (MQT 17)	See Table 19.8 – 19.10	P
	Final measurement	See Table 20.3 – 22	P
4.19.6	Final stabilization (MQT 19.2) :	—	N/A
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] ..... :	2022-07-12	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M10	No major visual defects found	P
M11	No major visual defects found	P
M12	No major visual defects found	P
M13	No major visual defects found	P
M4	No major visual defects found	P
M5	No major visual defects found	P
M8	No major visual defects found	P
M9	No major visual defects found	P
M6	No major visual defects found	P
M7	No major visual defects found	P
Supplementary information: N/A		

TABLE 02: MQT 19.1 ini: Initial stabilization							—
TABLE 02.1: MQT 06.1 ini: Performance at STC before initial stabilization (Frontside)							—
Test Date [YYYY-MM-DD] ..... :	2022-07-12						—
Test method ..... :	☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
M10	13.727	51.455	13.161	42.644	561.248	79.46	—
M11	13.731	51.590	13.120	43.196	566.729	80.01	—
M12	13.680	51.599	13.006	43.402	564.495	79.97	—
M13	13.718	51.552	13.038	43.146	562.561	79.55	—
M4	13.708	51.563	13.050	43.222	564.062	79.80	—
M5	13.726	51.560	13.057	43.186	563.895	79.68	—
M8	13.706	51.510	13.114	42.912	562.733	79.70	—
M9	13.743	51.509	13.077	42.997	562.270	79.43	—
M6	13.702	51.533	13.108	42.882	562.109	79.60	—
M7	13.657	51.505	13.046	43.014	561.166	79.78	—
Supplementary information: N/A							

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 02: MQT 19.1 ini: Initial stabilization							—
TABLE 02.1: MQT 06.1 ini: Performance at STC before initial stabilization (Backside)							—
Test Date [YYYY-MM-DD] .....:	2022-07-12						—
Test method .....:	☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
M10	10.245	51.095	9.945	42.612	423.787	80.96	—
M11	10.224	51.127	9.750	43.387	423.007	80.93	—
M12	9.984	51.062	9.365	43.715	409.413	80.31	—
M13	9.992	51.054	9.320	44.048	410.513	80.47	—
M4	10.057	51.036	9.317	43.976	409.719	79.82	—
M5	10.025	51.042	9.358	44.105	412.737	80.66	—
M8	9.986	50.950	9.450	43.532	411.390	80.85	—
M9	10.129	51.025	9.382	43.700	409.978	79.32	—
M6	10.245	51.095	9.945	42.612	423.787	80.96	—
M7	10.224	51.127	9.750	43.387	423.007	80.93	—
Supplementary information: N/A							

TABLE 02.2: MQT 19.1 ini: Initial Stabilization procedure							P
Light exposure method.....:	☒ Simulator ☐ Natural sunlight						
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Stabilization criterion x per IEC 61215-1-x .....:	1						
Sample #	M10	Test Date (YYYY-MM-DD) start/end			2022-07-12/2022-07-26		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load(Ω)	P_{max} (W) at the end of cycle	$P_{max} – P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	561.248	—	—
1	5	800-1000	50±10	3.2	562.418	—	—
2	5	800-1000	50±10	3.2	563.978	0.49	Yes
3	—	—	—	—	—	—	—
Sample #	M11	Test Date (YYYY-MM-DD) start/end			2022-07-12/2022-07-26		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load(Ω)	P_{max} (W) at the end of cycle	$P_{max} – P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	566.729	—	—
1	5	800-1000	50±10	3.3	567.480	—	—
2	5	800-1000	50±10	3.3	568.965	0.39	Yes

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Clause	Requirement + Test	Result - Remark	Verdict

3	—	—	—	—	—	—	—
Sample #	M12	Test Date (YYYY-MM-DD) start/end			2022-07-12/2022-07-26		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load(Ω)	P_{max} (W) at the end of cycle	$P_{max} – P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	564.495	—	—
1	5	800-1000	50±10	3.3	565.388	—	—
2	5	800-1000	50±10	3.3	567.277	0.49	Yes
Sample #	M13	Test Date (YYYY-MM-DD) start/end			2022-07-12/2022-07-26		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load(Ω)	P_{max} (W) at the end of cycle	$P_{max} – P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	562.561	—	—
1	5	800-1000	50±10	3.3	563.466	—	—
2	5	800-1000	50±10	3.3	564.792	0.40	Yes
3	—	—	—	—	—	—	—
Sample #	M4	Test Date (YYYY-MM-DD) start/end			2022-07-12/2022-07-26		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load(Ω)	P_{max} (W) at the end of cycle	$P_{max} – P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	564.062	—	—
1	5	800-1000	50±10	3.3	564.852	—	—
2	5	800-1000	50±10	3.3	565.997	0.34	Yes
Sample #	M5	Test Date (YYYY-MM-DD) start/end			2022-07-12/2022-07-26		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load(Ω)	P_{max} (W) at the end of cycle	$P_{max} – P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	563.895	—	—
1	5	800-1000	50±10	3.3	564.477	—	—
2	5	800-1000	50±10	3.3	565.984	0.37	Yes
3	—	—	—	—	—	—	—
Sample #	M8	Test Date (YYYY-MM-DD) start/end			2022-07-12/2022-07-26		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load(Ω)	P_{max} (W) at the end of cycle	$P_{max} – P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	562.733	—	—
1	5	800-1000	50±10	3.3	563.418	—	—
2	5	800-1000	50±10	3.3	564.986	0.40	Yes

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	M9	Test Date (YYYY-MM-DD) start/end			2022-07-12/2022-07-26		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load(Ω)	P_{max} (W) at the end of cycle	$P_{max} – P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	562.270	—	—
1	5	800-1000	50±10	3.3	562.984	—	—
2	5	800-1000	50±10	3.3	564.129	0.33	Yes
3	—	—	—	—	—	—	—
Sample #	M6	Test Date (YYYY-MM-DD) start/end			2022-07-12/2022-07-26		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load(Ω)	P_{max} (W) at the end of cycle	$P_{max} – P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	562.109	—	—
1	5	800-1000	50±10	3.3	563.344	—	—
2	5	800-1000	50±10	3.3	564.445	0.41	Yes
Sample #	M7	Test Date (YYYY-MM-DD) start/end			2022-07-12/2022-07-26		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load(Ω)	P_{max} (W) at the end of cycle	$P_{max} – P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	561.166	—	—
1	5	800-1000	50±10	3.3	562.315	—	—
2	5	800-1000	50±10	3.3	563.509	0.42	Yes
3	—	—	—	—	—	—	—

Supplementary information: N/A

☐ Other stabilization procedures

Sample #	Test Date (YYYY-MM-DD) start/end

Test method description:

Supplementary information: see Annex 3 for verification of this alternative stabilization procedure

TABLE 03: MQT 06.1 ini: Performance at STC after initial stabilization (Frontside)		P
Test Date [YYYY-MM-DD]..... :	2022-07-26	—

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Clause	Requirement + Test	Result - Remark	Verdict

Pmax(lab) lower limit (W) ..... :	See table below: Pmax [W] – Min calc.	—
$\bar{P}_{max}(Lab)$ lower limit (W) ..... :	558.167	—
Voc(lab) upper limit (V) ..... :	See table below: Voc [V] Max. calc.	—
Isc (lab) upper limit (A) ..... :	See table below: Isc [A] Max. calc.	—
Test method..... :	☒ Simulator ☐ 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	13.836	14.560	51.452	52.402	13.179	42.794	563.978	541.422	79.22	P
M11	13.742	14.560	51.599	52.402	13.153	43.256	568.965	541.422	80.24	P
M12	13.746	14.560	51.604	52.402	13.113	43.262	567.277	541.422	79.97	P
M13	13.814	14.560	51.533	52.402	13.139	42.986	564.792	541.422	79.34	P
M4	13.816	14.560	51.576	52.402	13.090	43.238	565.997	541.422	79.43	P
M5	13.843	14.560	51.564	52.402	13.118	43.146	565.984	541.422	79.29	P
M8	13.790	14.560	51.498	52.402	13.107	43.107	564.986	541.422	79.56	P
M9	13.756	14.560	51.549	52.402	13.091	43.092	564.129	541.422	79.55	P
M6	13.785	14.560	51.456	52.402	13.155	42.906	564.445	541.422	79.58	P
M7	13.781	14.560	51.505	52.402	13.054	43.167	563.509	541.422	79.39	P
Average	—						565.406	558.167	—	P

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

TABLE 03: MQT 06.1 ini: Performance at STC after initial stabilization (Backside)		
Test Date [YYYY-MM-DD]..... :	2022-07-26	—
Pmax(lab) lower limit (W) ..... :	—	—
$\bar{P}_{max}(Lab)$ lower limit (W) ..... :	—	—
Voc(lab) upper limit (V) ..... :	—	—
Isc (lab) upper limit (A) ..... :	—	—
Test method..... :	☒ Simulator ☐ 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	10.315	—	51.080	—	10.016	42.409	424.764	—	80.62	—
M11	10.420	—	51.050	—	10.051	42.471	426.872	—	80.25	—

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Clause	Requirement + Test						Result - Remark			Verdict

M12	10.218	—	51.058	—	9.974	42.491	423.803	—	81.23	—
M13	10.276	—	51.105	—	9.843	43.163	424.856	—	80.90	—
M4	10.077	—	51.058	—	9.494	43.361	411.653	—	80.01	—
M5	10.044	—	51.039	—	9.386	43.888	411.927	—	80.35	—
M8	10.028	—	50.994	—	9.365	43.832	410.469	—	80.27	—
M9	10.060	—	50.958	—	9.434	43.870	413.856	—	80.73	—
M6	10.046	—	51.034	—	9.533	43.413	413.857	—	80.72	—
M7	10.157	—	51.005	—	9.433	43.582	411.096	—	79.35	—
Average	—						417.315	—	—	—

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

TABLE 03: MQT 06.1 ini: Performance at equivalent irradiance										—
Test Date [YYYY-MM-DD]..... :	2022-07-26									—
Pmax(lab) lower limit (W) ..... :	—									—
$\bar{P}_{max}(Lab)$ lower limit (W) ..... :	—									—
Voc(lab) upper limit (V) ..... :	—									—
Isc (lab) upper limit (A) ..... :	—									—
Test method..... :	☒ Simulator ☐ 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	15.214	—	51.526	—	14.503	42.796	620.683	—	79.18	—
M11	15.145	—	51.607	—	14.477	43.259	626.277	—	80.13	—
M12	15.113	—	51.740	—	14.498	43.049	624.137	—	79.82	—
M13	15.206	—	51.542	—	14.495	42.882	621.596	—	79.31	—
M4	15.219	—	51.583	—	14.416	43.217	623.007	—	79.36	—
M5	15.239	—	51.575	—	14.437	43.139	622.784	—	79.24	—
M8	15.179	—	51.539	—	14.426	43.101	621.760	—	79.48	—
M9	15.143	—	51.553	—	14.408	43.090	620.854	—	79.53	—
M6	15.153	—	51.478	—	14.482	42.881	621.011	—	79.61	—
M7	15.147	—	51.541	—	14.370	43.154	620.109	—	79.43	—
Average	—						622.222	—	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

Supplementary information: The Equivalent Irradiance (W/m^2) is 1101(=1000+135*P2/P1), P1 is the front Pmp at STC, P2 is the backside Pmp at STC.

TABLE 04: MQT 03 ini: Initial Insulation test				P
Test Date [YYYY-MM-DD].....:	2022-07-26			—
Test Voltage applied [V] .....:	8000/1500			—
Size of module [m^2].....:	2.58			—
Required Resistance [MΩ].....:	15.50			—
Sample #	Measured	Dielectric breakdown		Result
	MΩ	Yes (description)	No	
M10	>10000		X	P
M11	>10000		X	P
M12	>10000		X	P
M13	>10000		X	P
M4	>10000		X	P
M5	>10000		X	P
M8	>10000		X	P
M9	>10000		X	P
M6	>10000		X	P
M7	>10000		X	P
Supplementary information: the maximum resistance measurement range is 10000MΩ.				

TABLE 05: MQT 15 ini: Initial Wet leakage current test			P
Test Date [YYYY-MM-DD] ..... :	2022-07-26		—
Test Voltage applied [V]..... :	1500		—
Solution temperature [°C].....:	21.2		—
Size of module [m^2] .....:	2.58		—
Sample #	Required Resistance [MΩ]	Measured [MΩ]	Result
M10	15.50	3760	P
M11	15.50	4180	P
M12	15.50	4490	P
M13	15.50	5220	P
M4	15.50	3460	P
M5	15.50	2990	P
M8	15.50	4540	P

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Clause	Requirement + Test	Result - Remark	Verdict

M9	15.50	4670	P
M6	15.50	5260	P
M7	15.50	6470	P
Supplementary information: Solution resistivity 2154 [Ω·cm].			

TABLE 06: MQT 06.2 - Performance at NMOT							—
Test Date [YYYY-MM-DD] .....:	—						—
Module temperature (°C) .....:	—						
Test method .....:	☐ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
Supplementary information: N/A							

TABLE 07: MQT 07 - Performance at low irradiance						—
Test Date [YYYY-MM-DD] ..... :	2022-07-28					—
Test method ..:	☐ Outdoor measurement					—
	Ambient air temperature [°C]:					
	Irradiance [W/m²]:					
	Module temperature [°C]:					
	☒ Data corrected to a 25°C cell temperature and 200 W/m² irradiance					
	☐ Directly measured					—

Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]
M10	2.769	48.457	2.641	41.143	108.648	80.99
M11	2.779	48.610	2.554	42.899	109.554	81.09
M12	2.766	48.619	2.532	43.286	109.594	81.51
Supplementary information: N/A						

TABLE 08: MQT 04 - Measurement of temperature coefficients		—
Test Date [YYYY-MM-DD] .....:	2022-07-29/2022-08-01	—
Ambient air temperature [°C] high/low..... :	55/25	—
Irradiance [W/m²] high/low ..... :	1000	—

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Clause	Requirement + Test	Result - Remark	Verdict

Module temperature [°C] high/low ..... :		M10: 55.2/24.9 M11: 55.6/25.3 M12: 54.8/25.4		—
Sample #	α [%/°C]	β [%/°C]	δ [%/°C]	—
M10	0.049	-0.243	-0.326	—
M11	0.048	-0.251	-0.339	—
M12	0.051	-0.246	-0.337	—
Supplementary information: N/A				

TABLE 09: MQT 05 - Measurement of Nominal Module Operating Temperature (NMOT, °C)	—
Test Date [YYYY-MM-DD] .....:	—
Electrical load:	☐ Restive load ☐ MPPT
All details for the measurements are kept on file and are available on request.	
Sample #	—
Calculated u_0 [W/(m^2.°C)]	—
Calculated u_1 [W.s/(m^3.°C)]	—
Calculated NMOT	—
Supplementary information: —	

TABLE 10: MQT 08 - Outdoor exposure test		P
Test Date [YYYY-MM-DD] start/end.....:	2022-07-27/2022-08-25	—
Sample #	M13	—
Total irradiation dosage [kWh/m^2] .....:	60.0	—
Angle of tilt the test module .....:	37° angle	—
Electrical load:	☐ Restive load ☒ MPPT	—
Supplementary information: N/A		

Table 10.1: MQT 01: Visual inspection after outdoor exposure test		P
Test Date [YYYY-MM-DD] .....:	2022-08-25	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M13	No major visual defects found	P
Supplementary information: N/A		

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Clause	Requirement + Test	Result - Remark	Verdict

Table 10.2: MQT 15: Wet leakage current test after outdoor exposure test			P
Test Date [YYYY-MM-DD] .....:	2022-08-25		—
Test Voltage applied [V] .....:	8000/1500		—
Solution temperature [°C] .....:	22.9		—
Size of module [m²] .....:	2.58		—
Solution resistivity [Ω cm].....:	2439		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
M13	4710	15.50	P
Supplementary information: N/A			

Table 10.3: MQT 02 - Maximum power determination after outdoor exposure test - Optional						N/A
Test Date [YYYY-MM-DD].....:						—
Module temperature [°C].....:						—
Irradiance [W/m²) .....:						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]
—	—	—	—	—	—	—
Supplementary information: —						

Table 10.4: MQT 03 - Insulation test after outdoor exposure test - Optional					N/A
Test Date [YYYY-MM-DD].....:					—
Test Voltage applied [V] .....:					—
Size of module [m²] .....:					—
Required Resistance [MΩ].....:					—
Sample #	Measured	Required (MΩ)	Dielectric breakdown		Result
	(MΩ)	(MΩ)	Yes (description)	No	
—	—	—	—	—	—
Supplementary information: —					

TABLE 11: MQT 18: Bypass diode thermal test		P
Test Date [YYYY-MM-DD] start/end.....:	2022-08-31	—
Sample #	M13	—
Module temperature [°C].....:	75±5	—
Number of diodes in junction box .....:	3	—
Diode manufacturer.....:	QC Solar (Suzhou) Corporation	—
Diode type designation .....:	QCMK5045	—

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Clause	Requirement + Test	Result - Remark	Verdict

Max. permissible junction temperature T_{jmax} [°C] (according to diode datasheet) ..... :	200				—
Detailed description of sample preparation procedure ..... :	Standard production module				—
Step 1, Determination of *V*D versus *T*J characteristic					—
Diode 1	30 ± 2 °C	50 ± 2 °C	70 ± 2 °C	90 ± 2 °C	
Ambient temperature of the junction box ... :	30.1	50.3	70.2	90.7	
Pulsed current..... :	16.769	16.769	16.769	16.769	
Voltage drop [V] ..... :	0.4501	0.4354	0.4167	0.3957	
V_D versus T_J characteristic ..... :	V_D = -0.0009 T_J + 0.4789			—	
Diode 2	30 ± 2 °C	50 ± 2 °C	70 ± 2 °C	90 ± 2 °C	
Ambient temperature of the junction box ... :	30.1	50.3	70.2	90.7	
Pulsed current..... :	16.769	16.769	16.769	16.769	
Voltage drop [V] ..... :	0.4520	0.4371	0.4108	0.3941	
V_D versus T_J characteristic ..... :	V_D = -0.001 T_J + 0.4833			—	
Diode 3	30 ± 2 °C	50 ± 2 °C	70 ± 2 °C	90 ± 2 °C	
Ambient temperature of the junction box ... :	30.1	50.3	70.2	90.7	
Pulsed current..... :	16.769	16.769	16.769	16.769	
Voltage drop [V] ..... :	0.4588	0.4362	0.4157	0.4006	
V_D versus T_J characteristic ..... :	V_D = -0.001 T_J + 0.4862				—
Max. permissible junction temperature T_{jmax} [°C] (according to diode datasheet) ..... :	200				—
Step 2, Bypass diode thermal test					
	Diode 1	Diode 2	Diode 3		Result
Current flow applied [A] ..... :	16.769	16.769	16.769		—
Max. diode surface temperature allowed T_{jmax} [°C] :	200	200	200		—
Voltage drop [V] after 1h ..... :	0.3384	0.3254	0.3232		—
Calculated max. junction temperature T_{jcalc} [°C] .... :	155.213	158.102	167.627		—
T_{jcalc} < T_{jmax} (test passed)? yes/no ..... :	yes	yes	yes		P
Current flow (1.25 * Isc) [A] ..... :	20.961	20.961	20.961		—
Bypass diode remain(s) functional (yes/no) ..... :	yes	yes	yes		—

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Clause	Requirement + Test	Result - Remark	Verdict

Remarks: See Table 12 for the test details of bypass diode functionality test.

3 Diodes are considered as representative number. These diodes have to be selected as worst case. In case that additional bypass diodes tests are performed the results shall be listed in an attachment.

TABLE 11.1: MQT 01 - Visual inspection after bypass diode thermal test		P
Test Date [YYYY-MM-DD] ..... :	2022-08-31	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M13	no major defects	P
Supplementary information: N/A		

TABLE 11.2: MQT 15 - Wet leakage current test after bypass diode thermal test				P
Test Date [YYYY-MM-DD] ..... :		2022-08-31		—
Test Voltage applied [V] ..... :		1500		—
Solution temperature [°C] ..... :		22.5		—
Size of module [m²] ..... :		2.58		—
Required Resistance [MΩ] ..... :		< 3,500 Ω/ cm at 22 ± 2°C	2524	—
Sample #	Measured [MΩ]	Limit [MΩ]		Result
M13	4620	15.50		P
Supplementary information: N/A				

TABLE 11.3: MQT 02 – Max. power determination after bypass diode thermal test - Optional							N/A
Test Date [YYYY-MM-DD] ..... :							—
Module temperature [°C] ..... :							—
Irradiance [W/m²) ..... :							—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	—
—	—	—	—	—	—	—	—
Supplementary information: —							

TABLE 11.4: MQT 03 - Insulation test after bypass diode thermal test - Optional					N/A
Test Date [YYYY-MM-DD] ..... :					—
Test Voltage applied [V] ..... :					—
Size of module [m²] ..... :					—
Required Resistance [MΩ] ..... :					—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
—	—	—	—	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

Supplementary information: —

TABLE 12: MQT 18.2 - Bypass diode functionality test after bypass diode thermal test				P
Test Date [YYYY-MM-DD] .....:	2022-08-31			—
☐ Method A				—
Ambient temperature [°C] ……:				—
Current flow applied [A] ……..……:				—
Sample #	VFM	$V_{FMrated}$	VFM = (N × $V_{FMrated}$) ± 10 %	Result
M13			☐ Yes ☐ No	
Supplementary information: N/A				
☒ Method B				—
	IV curve after shading			Result
Diode 1	Turn on			P
Diode 2	Turn on			P
Diode 3	Turn on			P
Supplementary information: N/A				

TABLE 12.1: MQT 19.1 Fin: Final stabilization							N/A
TABLE 12.2: MQT 06.1: Performance at STC before final stabilization							
Test Date [YYYY-MM-DD] .....:							—
Test method .....:	☐ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	—
—	—	—	—	—	—	—	—
Supplementary information: —							

TABLE 12.3: MQT 19.1 Final Stabilization procedure							N/A
Light exposure method.....:	☐ Simulator ☐ Natural sunlight						—
Stabilization criterion x per IEC 61215-1-x ....:							—
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Sample #	M13	Test Date (YYYY-MM-DD) start/end .....:					
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—		—	—

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Clause	Requirement + Test	Result - Remark	Verdict

1							
2							
3							
4						—	—

Supplementary information:			
☐ Other stabilization procedures			
Sample #	M13	Test Date (YYYY-MM-DD) start/end ..... :	
Test method description:			
Supplementary information: See Annex 3 for verification of this alternative stabilization procedure			

TABLE 13: MQT 09 - Hot-spot endurance test		P
Test Date [YYYY-MM-DD] start/end .....:	2022-09-08/2022-09-09	—
Sample #	M13	—
Procedure of technology .....:	☒ wafer-based technologies (WBT) MQT 09.1 ☐ monolithically integrated (MLI) thin film technologies MQT 09.2	—
Cell interconnection circuit .....:	☐ S ☒ SP ☐ PS	—
Type of light source .....:	☒ Pulse Simulator ☒ Steady state Simulator ☐ Natural sunlight	—
Module temperature at thermal equilibrium [°C] .:	55.2/54.9/56.3/56.0	—

TABLE 13.1: MQT 09 - Hot-spot endurance test for WBT					—
Selected hot-spot cells.....:	LOW	LOW	LOW	HIGH	—
	170	189	216	1804	
Shading rate [%].....:	50	50	40	40	—
Max. measured cell temperature in each cell [°C]:	155.8	157.1	150.7	154.4	—
Test duration of each shading [h] .....:	1	1	1	1	—
Irradiance during shading [W/m²] ……. .....:	1225	1225	1225	1225	—

TABLE 13.2: MQT 09 - Hot-spot endurance test for MLI		N/A
Selected hot-spot cells.....:		—
Number of cells shaded .....:		—
Max. measured cell temperature [°C] .....:		—
Test duration during shading [h] .....:		—

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Clause	Requirement + Test	Result - Remark	Verdict

Irradiance during shading [W/m²] …… .....:		—
Supplementary information:		

TABLE 13.3: MQT 01 - Visual inspection after hot-spot endurance test		P
Test Date [YYYY-MM-DD].....:	2022-09-09	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M13	No major visual defects found	P
Supplementary information: N/A		

TABLE 13.4: MQT 02 - Maximum power determination after hot-spot endurance test							P
Test Date [YYYY-MM-DD].....:	2022-09-09						—
Module temperature [°C].....:	25						—
Irradiance [W/m²) .....:	1000						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	—
M13	13.611	51.490	12.926	43.093	557.036	79.48	—
Supplementary information: N/A							

TABLE 13.5: MQT 03 - Insulation test after hot-spot endurance test					P
Test Date [YYYY-MM-DD].....:	2022-09-09				—
Test Voltage applied [V] .....:	8000/1500				—
Size of module [m²] .....:	2.58				—
Required Resistance [MΩ].....:	15.50				—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
M13	>10000	15.50		X	P
Supplementary information: the maximum resistance measurement range is 10000MΩ.					

TABLE 13.6: MQT 15 - Wet leakage current test after hot-spot endurance test			P
Test Date [YYYY-MM-DD].....:	2022-09-09		—
Test Voltage applied [V] .....:	1500		—
Solution temperature [°C].....:	22.8		—
Size of module [m²]	2.58		—
Required Resistance [MΩ].....	15.50		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result

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Clause	Requirement + Test	Result - Remark	Verdict
M13	4340	15.50	P
Supplementary information: Solution resistivity 2164 [Ω·cm].			

TABLE 13.7: MQT 18.2 - Bypass diode functionality test after Hot-spot endurance test				P
Test Date [YYYY-MM-DD].....:	2022-09-09			—
☐ Method A				—
Ambient temperature [°C] .....:				—
Current flow applied [A] .....:				—
Sample #	VFM	$V_{FMrated}$	VFM = (N × $V_{FMrated}$) ± 10 %	Result
M13			☐ Yes ☐ No	
Supplementary information:				
☒ Method B				—
	IV curve after shading			Result
Diode 1	Turn on			P
Diode 2	Turn on			P
Diode 3	Turn on			P
Supplementary information: N/A				

TABLE 14: MQT 10 - UV preconditioning test		P
Test Date (YYYY-MM-DD) start/end.....:	2022-08-01/2022-08-05 (Frontside) 2022-08-05/2022-08-09 (Backside)	—
Module temperature [°C] .....:	60±5	—
UV irradiance (280-400nm) [W/m²] .....:	156.2	—
Ratio of UV irradiance (280-320nm) (%) .....:	4.6	P
UV dose (280-400nm) [kWh/ m²] .....:	15	—
Module operation condition .....:	☒ Short circuited ☐ Pmax	—
Supplementary information: Light sources not emitting a significant portion of light in the visible spectrum where the module exhibits a power equal to or larger than 20 % of its STC measured power. UV preconditioning test was performed on front side and rear side of the module		

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 14.1: MQT 01 - Visual inspection after UV preconditioning test		P
Test Date [YYYY-MM-DD] ..... :	2022-08-09	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M4	No major visual defects found	P
M5	No major visual defects found	P

TABLE 14.2: MQT 15 - Wet leakage current test after UV preconditioning test			P
Test Date [YYYY-MM-DD] ..... :	2022-08-09		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C] ..... :	22.3		—
Size of module [m²] ..... :	2.58		—
Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
M4	3550	15.50	P
M5	3240	15.50	P
Supplementary information: Solution resistivity 2249 [Ω·cm], the maximum resistance measurement range is 10000MΩ.			

TABLE 14.3: MQT 02 – Max. power determination after UV preconditioning test - Optional							N/A
Test Date [YYYY-MM-DD] ..... :	—						—
Module temperature [°C] ..... :	—						—
Irradiance [W/m²] ..... :	—						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
M4	—	—	—	—	—	—	—
M5	—	—	—	—	—	—	—
Supplementary information: —							

TABLE 14.4: MQT 03 - Insulation test after UV preconditioning test - Optional				N/A
Test Date [YYYY-MM-DD] ..... :	—			—
Test Voltage applied [V] ..... :	—			—
Size of module [m²]	—			—
Required Resistance [MΩ] ..... :	—			—
Sample #	Measured	Dielectric breakdown		Result
	[MΩ]	Yes (description)	No	
M4	—	—	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

M5	—	—	—	—
Supplementary information: N/A				

TABLE 15: MQT 11 - Thermal cycling 50 test			P
Test Date [YYYY-MM-DD] start/end.....:	2022-08-18/2022-08-27		—
Total cycles (50).....:	50		—
Applied current (A) .....:	During the heat up cycle from 40 °C to 80 °C	16.044/16.056	—
	Other stages	0.05	—

Sample #	Open circuits (yes/no)	—
M4	No	P
M5	No	P
Supplementary information: N/A		

TABLE 15.1: MQT 01 - Visual inspection after thermal cycling 50 test		P
Test Date [YYYY-MM-DD].....:	2022-08-27	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M4	No major visual defects found	P
M5	No major visual defects found	P
Supplementary information: N/A		

TABLE 15.2: MQT 15 - Wet leakage current test after thermal cycling 50 test			P
Test Date [YYYY-MM-DD] ..... :	2022-08-27		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C] ……..:	22.5		—
Size of module [m²]	2.58		—
Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
M4	3380	15.50	P
M5	3040	15.50	P
Supplementary information: Solution resistivity 2505 [Ω·cm], the maximum resistance measurement range is 10000MΩ.			

TABLE 15.3: MQT 03 – Max. power determination after thermal cycling 50 test - Optional		N/A
Test Date [YYYY-MM-DD].....:	—	—
Module temperature [°C].....:	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

Irradiance [W/m²) .....:	—					—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]
M4	—	—	—	—	—	—
M5	—	—	—	—	—	—
Supplementary information: —						

TABLE 15.4: MQT 03 - Insulation test after thermal cycling 50 test - Optional				N/A
Test Date [YYYY-MM-DD] .....:	—			—
Test Voltage applied [V] .....:	—			—
Size of module [m²] .....:	—			—
Required Resistance [MΩ] .....:	—			—
Sample #	Measured	Dielectric breakdown		Result
	[MΩ]	Yes (description)	No	
M4	—	—	—	—
M5	—	—	—	—
Supplementary information: —				

TABLE 16: MQT 12 - Humidity freeze 10 test		P
Test Date [YYYY-MM-DD] start/end.....:	2022-08-30/2022-09-09	—
Total cycles (10) .....:	10	—
Applied current (A) .....:	0.05	—
Sample #	Open circuits (yes/no)	—
M4	No	P
M5	No	P
Supplementary information: N/A		

TABLE 16.1: MQT 01 - Visual inspection after humidity freeze 10 test		P
Test Date [YYYY-MM-DD] .....:	2022-09-09	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M4	No major visual defects found	P
M5	No major visual defects found	P
Supplementary information: N/A		

TABLE 16.2: MQT 15 - Wet leakage current test after humidity freeze 10 test	**P**

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Clause	Requirement + Test	Result - Remark	Verdict

Test Date [YYYY-MM-DD] .....:	2022-09-09	—
Test Voltage applied [V] .....:	1500	—
Solution temperature [°C]…….:	22.5	—
Size of module [m²] .....:	2.58	—
Required Resistance [MΩ].....:	15.50	—

Sample #	Measured [MΩ]	Limit [MΩ]	Result
M4	3050	15.50	P
M5	2870	15.50	P

Supplementary information: Solution resistivity 2581 [Ω·cm], the maximum resistance measurement range is 10000MΩ.

TABLE 16.3: MQT 02 - Maximum power determination after humidity freeze 10 test - Optional						N/A
Test Date [YYYY-MM-DD] .....:	—					—
Module temperature [°C].....:	—					—
Irradiance [W/m²) .....:	—					—

Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]
M4	—	—	—	—	—	—
M5	—	—	—	—	—	—

Supplementary information: —

TABLE 16.4: MQT 03 Insulation test after humidity freeze 10 test) -Optional					N/A
Test Date [YYYY-MM-DD] .....:	—				—
Test Voltage applied [V] .....:	—				—
Size of module [m²] .....:	—				—
Required Resistance [MΩ].....:	—				—

Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
M4	—	—	—	—	—
M5	—	—	—	—	—

Supplementary information: —

TABLE 17: MQT 14 - Robustness of terminations test		P
Test Date [YYYY-MM-DD] start/end.....:	2022-09-09	—

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 17.1: MQT 14.1 Retention of junction box on mounting surface		P
Sample #	M4	—
Supplementary information: N/A		

TABLE 17.2: MQT 01 - Visual inspection after retention of junction box on mounting surface		P
Test Date [YYYY-MM-DD] ..... :	2022-09-09	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M4	No major visual defects found	P
Supplementary information: N/A		

TABLE 17.3: MQT 15 - Wet leakage current test after retention of junction box on mounting surface			P
Test Date [YYYY-MM-DD] ..... :	2022-09-09		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C] ..... :	22.2		—
Size of module [m²]	2.58		—
Required Resistance [MΩ] ..... :	15.50		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
M4	3170	15.50	P
Supplementary information: Solution resistivity 2416[Ω·cm], the maximum resistance measurement range is 10000MΩ.			

TABLE 17.4: MQT 14.2 - Test of cord anchorage						N/A
Sample #	—					—
☐ Junction boxes intended to be used with cables specified by the manufacturer						—
	Cable diameter, [mm]	Tension Force, [N]	Permissible displacement, [mm]	Measured displacement, [mm]		Result
Pull test						
	Cable diameter, [mm]	Torque Force, [Nm]	Permissible angle [°]	Measured angle [°]		Result
Torque test						
☐ Junction boxes intended to be used with generic cables						—
	Anchorage diameter range [mm]	Test mandrel [mm]	Tension Force, [N]	Permissible displacement [mm]	Measured displacement [mm]	Result
Pull test	Min					

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Clause	Requirement + Test	Result - Remark	Verdict

	Anchorage diameter range [mm]		Test mandrel [mm]	Torque Force [Nm]	Permissible angle [°]	Measured angle [°]	Result
Torque test	Max						
Supplementary information:							

TABLE 17.5: MQT 01 - Visual inspection after retention of test of cord anchorage		N/A
Test Date [YYYY-MM-DD] ..... :		—
Sample #	Nature and position of initial findings – comments or attach photos	—
M4		
Supplementary information:		

TABLE 17.6: MQT 15 - Wet leakage current test after retention of test of cord anchorage			N/A
Test Date [YYYY-MM-DD] .....:	—		—
Test Voltage applied [V] .....:	—		—
Solution temperature [°C] ..... :	—		—
Size of module [m²].....	—		—
Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
M4	—	—	—
Supplementary information: —			

TABLE 17.7: MQT 03 - Insulation test after test of cord anchorage					N/A
Test Date [YYYY-MM-DD] .....:	—				—
Test Voltage applied [V] .....:	—				—
Size of module [m²].....:	—				—
Required Resistance [MΩ] .....:	—				—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
M4	—	—	—	—	—
Supplementary information: —					

TABLE 18: MQT 11 - Thermal cycling 200 test			P
Test Date [YYYY-MM-DD] start/end..... :	2022-08-18/2022-09-21		—
Total cycles (200) ..... :	200		—
Applied current (A) ..... :	During the heat up cycle from –	16.025/16.045	—

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Clause	Requirement + Test	Result - Remark	Verdict

	40 °C to 80 °C		
	Other stages	0.05	—

Sample #	Open circuits (yes/no)	—
M8	No	P
M9	No	P

Supplementary information: N/A

TABLE 18.1: MQT 01 - Visual inspection after thermal cycling 200 test		P
Test Date [YYYY-MM-DD] ..... :	2022-09-21	—

Sample #	Nature and position of initial findings – comments or attach photos	—
M8	No major visual defects found	P
M9	No major visual defects found	P

Supplementary information: N/A

TABLE 18.2: MQT 02 - Maximum power determination after thermal cycling 200 test		Optional
Test Date [YYYY-MM-DD] ..... :	—	—
Module temperature [°C] ..... :	—	—
Irradiance [W/m²) ..... :	—	—

Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—

Supplementary information: —

TABLE 18.3: MQT 03 - Insulation test after thermal cycling 200 test		P
Test Date [YYYY-MM-DD] ..... :	2022-09-21	—
Test Voltage applied [V] ..... :	8000/1500	—
Size of module [m²] ..... :	2.58	—
Required Resistance [MΩ] ..... :	15.50	—

Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
M8	>10000	15.50		X	P
M9	>10000	15.50		X	P

Supplementary information: the maximum resistance measurement range is 10000MΩ.

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 18.4: MQT 15 - Wet leakage current test after thermal cycling 200 test			P
Test Date [YYYY-MM-DD] ..... :	2022-09-21		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C] ..... :	23.3		—
Size of module [m²]..... :	2.58		—
Required Resistance [MΩ]..... :	15.50		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
M8	4350	15.50	P
M9	4480	15.50	P
Supplementary information: Solution resistivity 2349 [Ω·cm], the maximum resistance measurement range is 10000MΩ.			

TABLE 19: MQT 13 - Damp heat 1000 test		P
Test Date [YYYY-MM-DD] start/end .....:	2022-08-08/2022-09-19	—
Total hours (1000h) ..... :	1000	—
Sample #	Open circuits (yes/no)	—
M6	No	P
M7	No	P
Supplementary information: N/A		

TABLE 19.1: MQT 01 - Visual inspection after damp heat 1000 test		P
Test Date [YYYY-MM-DD].....:	2022-09-19	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M6	No major visual defects found	P
M7	No major visual defects found	P
Supplementary information: N/A		

TABLE 19.2: MQT 02 - Maximum power determination after damp heat 1000 test							Optional
Test Date [YYYY-MM-DD].....:	—						—
Module temperature [°C].....:	—						—
Irradiance [W/m²) .....:	—						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
Supplementary information: —							

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 19.3: MQT 03 - Insulation test after damp heat 1000 test					P
Test Date [YYYY-MM-DD]:			2022-09-19		—
Test Voltage applied [V]:			8000/1500		—
Size of module [m²]:			2.58		—
Required Resistance [MΩ]:			15.50		—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
M6	>10000	15.50		X	P
M7	>10000	15.50		X	P
Supplementary information: the maximum resistance measurement range is 10000MΩ.					

TABLE 19.4: MQT 15 - Wet leakage current test after damp heat 1000 test			P
Test Date [YYYY-MM-DD]:		2022-09-19	—
Test Voltage applied [V]:		1500	—
Solution temperature [°C]:		22.6	—
Size of module [m²]:		2.58	—
Required Resistance [MΩ]:		15.50	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
M6	5040	15.50	P
M7	5820	15.50	P
Supplementary information: Solution resistivity 2218 [Ω·cm], the maximum resistance measurement range is 10000MΩ.			

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]	2022-09-23		—
Mounting method :	Installed with four clamps at longer frame		—
Load applied to :	Front side	Back side	—
Mechanical load [Pa]:	5400	2400	—
First cycle time (start/end):	08:15/09:15	09:40/10:40	—
Intermittent open-circuit (yes/no):	no	no	P
Second cycle time (start/end):	11:00/12:00	12:25/13:25	—
Intermittent open-circuit (yes/no):	no	no	P

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Clause	Requirement + Test	Result - Remark	Verdict

Third cycle time (start/end) .....:	13:40/14:40	15:15/16:15	—
Intermittent open-circuit (yes/no) .....:	no	No	P

Supplementary information:
Installed with four clamps at longer frame position as below：

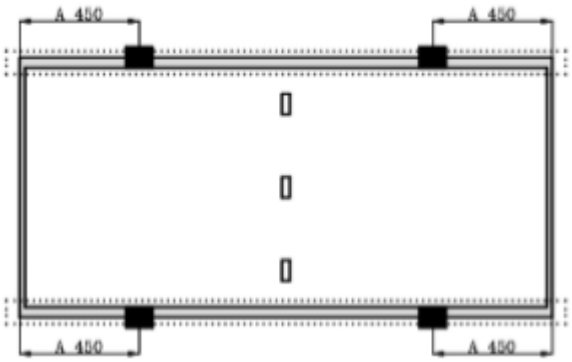

TABLE 19.6: MQT 01 - Visual inspection after static mechanical load test		P
Test Date [YYYY-MM-DD].....:	2022-09-23	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M6	No major visual defects found	P
Supplementary information: N/A		

TABLE 19.7: MQT 15 - Wet leakage current test after static mechanical load test			P
Test Date [YYYY-MM-DD].....:	2022-09-23		—
Test Voltage applied [V].....:	1500		—
Solution temperature [°C].....:	22.5		—
Size of module [m²].....:	2.58		—
Solution resistivity [Ω cm].....:	2284		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
M6	4850	15.50	P
Supplementary information: N/A			

TABLE 19.8: MQT 17 - Hail impact test							P
Test Date [YYYY-MM-DD].....:	2022-09-21						—
Sample #	M7						—
Ice ball size [mm].....:	1	2	3	4	5	6	—
	24.6	24.7	25.1	24.8	24.9	25.7	
	7	8	9	10	11	/	

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Clause	Requirement + Test	Result - Remark	Verdict

	25.9	24.9	25.4	25.3	25.6	/	
Ice ball weight [g] .....:	1	2	3	4	5	6	—
	7.38	7.36	7.50	7.53	7.29	7.54	
	7	8	9	10	11	/	
	7.62	7.58	7.38	7.36	7.21	/	
Ice ball velocity [m/s].....:	1	2	3	4	5	6	—
	22.4	22.5	23.9	23.0	22.8	23.1	
	7	8	9	10	11	/	
	22.4	22.8	22.5	22.4	23.5	/	
Number of impact locations .....:	11						—

Supplementary information: (impact location descriptions)

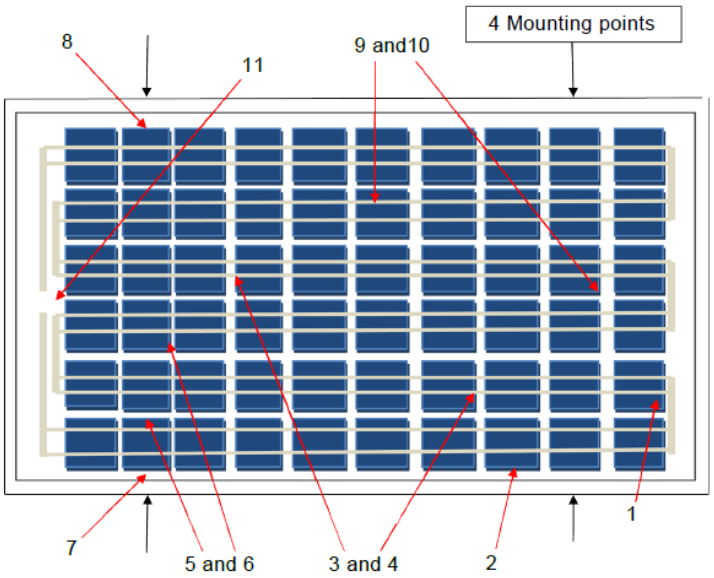

TABLE 19.9: MQT 01 - Visual inspection after hail impact test		P
Test Date [YYYY-MM-DD].....:	2022-09-21	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M7	No major visual defects found	P
Supplementary information: N/A		

TABLE 19.10: MQT 15 - Wet leakage current test after hail impact test		P
Test Date [YYYY-MM-DD].....:	2022-09-21	—
Test Voltage applied [V].....:	1500	—
Solution temperature [°C].....:	22.8	—

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Clause	Requirement + Test	Result - Remark	Verdict

Size of module [m²] ..... :	2.58	—

Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
M7	4890	15.50	P

Supplementary information: the Solution resistivity 2615[Ω cm]

TABLE 20: MQT 19.1 Fin: Final stabilization N/A

TABLE 20.1: MQT 06.1: Performance at STC before final stabilization

Test Date [YYYY-MM-DD] ..... :		—
Test method ..... :	☐ Simulator ☐ Natural sunlight	—

Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
M10							
M4							
M5							
M8							
M9							
M13							
M7							

Supplementary information:

TABLE 20.2: MQT 19.1 Final Stabilization procedure N/A

Light exposure method:	☐ Simulator ☐ Natural sunlight
Stabilization criterion x per IEC 61215-1-x :	

Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight

Sample #	M10	Test Date (YYYY-MM-DD) start/end..:	

Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} - P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—		—	—
1							
2							
3							
4						—	—

Sample #	M4	Test Date (YYYY-MM-DD) start/end	

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Clause	Requirement + Test	Result - Remark	Verdict

Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	(P_{max} – P_{min}) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—		—	—
1							
2							
3							
4						—	—
Sample #	M5	Test Date (YYYY-MM-DD) start/end					
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	(P_{max} – P_{min}) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—		—	—
1							
2							
3							
4						—	—
Sample #	M8	Test Date (YYYY-MM-DD) start/end..:					
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	(P_{max} – P_{min}) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—		—	—
1							
2							
3							
4						—	—
Sample #	M9	Test Date (YYYY-MM-DD) start/end					
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	(P_{max} – P_{min}) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—		—	—
1							
2							
3							
4						—	—

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	M13	Test Date (YYYY-MM-DD) start/end..... :					
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} - P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—		—	—
1							
2							
3							
4						—	—
Sample #	M7	Test Date (YYYY-MM-DD) start/end					
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} - P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—		—	—
1							
2							
3							
4						—	—
Supplementary information:							
☐ Other stabilization procedures							
Sample #	Test Date (YYYY-MM-DD) start/end						
M10							
M4							
M5							
M8							
M9							
M13							
M7							
Test method description:							
Supplementary information: see Annex 3 for verification of this alternative stabilization procedure							

TABLE 20.3: MQT 06.1: Final Performance at STC (Frontside)		P
Test Date [YYYY-MM-DD] ..... :	Different date	—
Test method	☒ Simulator ☐ Natural sunlight	—

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab_GateNo.1)	Power Degradation [%]	Result
M10	13.732	51.532	13.116	42.929	563.030	79.57	558.338	-0.17	P
M13	13.569	51.655	12.898	43.225	557.527	79.54	563.549	-1.07	P
M4	13.561	51.600	12.836	43.265	555.374	79.37	564.752	-1.66	P
M5	13.628	51.528	12.874	43.157	555.613	79.12	564.739	-1.62	P
M8	13.567	51.430	12.973	42.936	556.987	79.82	563.743	-1.20	P
M9	13.570	51.456	12.923	42.994	555.598	79.57	562.888	-1.30	P
M6	13.616	51.380	12.903	42.932	553.938	79.18	563.203	-1.86	P
M7	13.649	51.499	12.970	43.006	557.807	79.36	562.269	-1.01	P
Supplementary information: Pmax [W] (Lab_GateNo.1) is calculated by considering the reproducibility r of control module.									

TABLE 20.3: MQT 06.1: Final Performance at STC(Backside)									—
Test Date [YYYY-MM-DD] .....:	Different date								—
Test method	☒ Simulator ☐ Natural sunlight								—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab_GateNo.2)	Power Degradation [%]	Result
M10	10.292	51.040	10.008	42.374	424.066	80.73	420.516	-0.16	—
M13	10.092	51.171	9.583	43.679	418.588	81.06	423.921	-1.26	—
M4	9.934	51.075	9.206	44.167	406.599	80.14	410.747	-1.01	—
M5	9.932	51.053	9.200	44.051	405.259	79.93	411.021	-1.40	—
M8	9.975	51.046	9.193	44.139	405.758	79.69	409.566	-0.93	—
M9	9.841	51.064	9.184	44.433	408.055	81.20	412.946	-1.18	—
M6	9.825	51.100	9.273	43.834	406.485	80.66	412.947	-1.78	—
M7	10.074	51.017	9.383	43.494	408.106	79.41	410.192	-0.73	—
Supplementary information: Pmax [W] (Lab_GateNo.2) is calculated by considering the reproducibility *r* of control module.									
TABLE: Performance at equivalent irradiance									—
Test Date [YYYY-MM-DD] .....:	Different date								—
Test method	☒ Simulator ☐ Natural sunlight								—

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab_GateNo.2)	Power Degradation [%]	Result
M10	15.120	51.573	14.413	42.985	619.542	79.45	614.476	-0.18	—
M13	14.939	51.664	14.192	43.212	613.270	79.46	620.228	-1.12	—
M4	14.917	51.638	14.127	43.260	611.143	79.34	621.636	-1.69	—
M5	15.000	51.531	14.164	43.153	611.198	79.07	621.414	-1.64	—
M8	14.939	51.422	14.276	42.929	612.866	79.78	620.392	-1.21	—
M9	14.923	51.473	14.226	42.973	611.356	79.59	619.488	-1.31	—
M6	14.986	51.392	14.200	42.922	609.482	79.14	619.645	-1.86	—
M7	15.031	51.510	14.271	43.010	613.807	79.28	618.745	-1.02	—

Supplementary information: The Equivalent Irradiance (W/m^2) is 1101 (=1000+135*P2/P1), P1 is the front Pmp at STC, P2 is the backside Pmp at STC.

TABLE 22: MQT 15 fin: Final Wet leakage current test			P
Test Date [YYYY-MM-DD] ..... :	Different date		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C] ..... :	22 ± 2		—
Size of module [m^2] ..... :	2.58		—
Required Resistance [MΩ] ..... :	15.50		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
M10	3350	15.50	P
M13	4090	15.50	P
M4	4160	15.50	P
M5	3220	15.50	P
M8	2750	15.50	P
M9	4190	15.50	P
M6	4560	15.50	P
M7	4640	15.50	P
Supplementary information: Solution resistivity <3500 [Ω·cm].			

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

A1.1	**MODULE TYPE/S**
	JW-HD144N-570

	MODULE DESIGN	
	Module dimensions (L x W x H) [mm] ..... :	2278*1134*30
	Weights..... :	32.5 kg
	Front/Rear cover bonding classification ..... :	☐ rigid/flexible ☒ rigid/rigid ☐ flexible/flexible

A1.3	**SOLAR CELL**	
	Cell type reference ..... :	Supplier: Jolywood (Taizhou) Solar Technology Co., Ltd. Model: NM1016B Cell type: N type
	Cell dimensions L x W x T (± %) [mm] ..... :	182x91±0.25mm
	Cell thickness [µm] ..... :	140±14
	Cell area [cm²] ..... :	165.07

A1.4	**IDENTIFICATION OF MATERIALS**	
	Front cover ..... :	Chenzhou Kibing Photovoltaic & Electronic Glass Co., Ltd. Material: Heat strengthened glass with external AR coating, Thickness: 2.0 (mm)
	Rear cover ..... :	Chenzhou Kibing Photovoltaic & Electronic Glass Co., Ltd. Material: Heat strengthened glass with inside white ceramic glaze, Thickness: 2.0 (mm), Thickness of glace: 25±10 µm
	Encapsulation material front side ..... :	Changzhou Sveck PV New Material Co., Ltd. Type: SE-556, Material: POE Thickness:0.45 (-0.09 ~ 0.35) mm
	Encapsulation material back side..... :	Changzhou Sveck PV New Material Co., Ltd. Type: SE-556, Material: POE Thickness:0.45 (-0.09 ~ 0.35) mm
	Frame parts ..... :	Jolywood (Suzhou) Sunwatt Co., Ltd. Material: Aluminum-Magnesium-Zinc (Al-Mg-Zn) Cross-section graph:30mm

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	Mounting parts..... :	N/A
	Adhesive for frame ..... :	Jiangsu Minghao New Material Sci-tech Corporation Model: MH3668
	Edge sealing..... :	N/A
	Internal wiring ..... :	N/A
	Cell connector ..... :	Suzhou Sanysolar MATERIALS Technology Co., Ltd. Model: Copper belt with tin plated, Cu(≥99.97%),Sn60Pb40 Cross-sectional area: φ0.25
	String connector ..... :	Suzhou Sanysolar MATERIALS Technology Co., Ltd. Model: Copper belt with tin plated, Cu(≥99.97%),Sn60Pb40 Cross-sectional area: 4.0/7.0mm*0.3mm
	Soldering material ..... :	N/A
	Fluxing agent..... :	Asahi solder Technology (Wuxi) Co., Ltd. Type: SF56
	Junction box ..... :	QC Solar (Suzhou) Corporation. Model: 3Qxy(x= 2 or 4 or 6; y=1), DC 1500V, 30 A or 25A, IP68, -40 °C to 85 °C
	Cable ..... :	QC Solar (Suzhou) Corporation. Type:H1Z2Z2-K 1*4.0mm², 1500 V DC, -40 to +90 °C
	Connector..... :	QC Solar (Suzhou) Corporation. Type: QC4.10-cd, 1500VDC, 41A, IP68, -40 °C to 85 °C
	Bypass diode..... :	QC Solar (Suzhou) Corporation. Type: QCMK5045 Max. peak reverse voltage 50 V, Max. average forward current 50A, Junction temperature in bypass mode 200 °C (t ⩽ 1 h)
	Potting material ..... :	H.B. Fuller (Suzhou) Advanced Material Co., Ltd Type: 1521, Material: Silicon
	Adhesive for junction box ..... :	Hangzhou Zhijiang Silicone Chemicals Co., Ltd Type: JS-606, Material: Silicon

	Additional material (e. g. fixing tape, insulation tape) ..... :	Fixing tape Supplier: Suzhou Rongzhi Electronic Technology Co.,Ltd. Model: D60F6-2

A1.5	**MODULE DESIGN - MINIMUM DISTANCES**	
	Between cells ..... :	1.0 mm
	Between cell and accessible surfaces ..... :	12.0 mm
	Between any current carrying part and accessible surfaces ..... :	11.2 mm

A1.6	**MODULE DESIGN - ELECTRICAL CONFIGURATION**	
	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 2: Test table for verifying other alternative stabilization procedure

Step 1: Alternative stabilization				N/A
Test Date (YYYY-MM-DD) start/end:				—
Test method description:				—
	Sample M10	Sample M11	Sample M12	—
Power before alternative stabilization (W)				—
Power after alternative stabilization (W)				—
Supplementary information:				

Step 2: Light exposure	
☐ Simulator ☐ Natural sunlight	
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight	
Sample M10	Test Date (YYYY-MM-DD) start/end.....:

Test cycle	Light source	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin) / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	—		—	—
1							—	—
2								

Supplementary information:

Sample M11	Test Date (YYYY-MM-DD) start/end.....:

Test cycle	Light source	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	Pmax – Pmin) / Paverage (%)	Stable (Yes/No)
Initial	—	—	—	—	—		—	—
1							—	—
2								

Supplementary information:

Sample M12	Test Date (YYYY-MM-DD) start/end.....:

Test cycle	Light source	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	Pmax (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	—		—	—
1							—	—
2								

Supplementary information:

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Step 3: Stabilization determination				
	Sample M10	Sample M11	Sample M12	Result
Stable power P_{max1} after alternative stabilization (W)				
Stable power P_{max2} after light exposure (W)				
Power change P_{max2} to P_{max1} (%)				
Allowed power change P_{max2} to P_{max1} (%)				
Is alternative stabilization method valid? (Yes/No)				
Supplementary information:				

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Annex 3: Lower and higher output power modules

TABLE A.4.1 Performance at STC before initial stabilization							—
Test Date [YYYY-MM-DD] ..... :	2022-07-12						—
Test method ..... :	☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
Lower 1	13.832	50.130	13.125	41.733	547.732	78.99	—
Lower 2	13.840	50.095	13.149	41.650	547.630	78.99	—
Higher 1	13.867	51.555	13.141	43.126	566.709	79.27	—
Higher 2	13.917	51.535	13.202	42.988	567.544	79.13	—
Supplementary information: N/A							

TABLE A.4.2: MQT 19.1 ini: Initial Stabilization procedure							P
Light exposure method	☒ Simulator ☐ Natural sunlight						—
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Stabilization criterion x per IEC 61215-1-x	1						—
Sample #	Lower 1		Test Date (YYYY-MM-DD) start/end		2022-07-12/2022-07-26		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load(Ω)	P_{max} (W) at the end of cycle	($P_{max} - P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	547.732	—	—
1	5	800-1000	50±10	3.2	548.341	—	—
2	5	800-1000	50±10	3.2	549.939	0.40	Yes
3	—	—	—	—	—	—	—
Sample #	Lower 2		Test Date (YYYY-MM-DD) start/end		2022-07-12/2022-07-26		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load(Ω)	P_{max} (W) at the end of cycle	($P_{max} - P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	547.630	—	—
1	5	800-1000	50±10	3.2	548.614	—	—
2	5	800-1000	50±10	3.2	549.620	0.36	Yes
3	—	—	—	—	—	—	—
Sample #	Higher 1		Test Date (YYYY-MM-DD) start/end		2022-07-12/2022-07-26		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load(Ω)	P_{max} (W) at the end of cycle	($P_{max} - P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)

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Initial	—	—	—	—	566.709	—	—
1	5	800-1000	50±10	3.3	568.161	—	—
2	5	800-1000	50±10	3.3	569.707	0.53	Yes
3	—	—	—	—	—	—	—

Sample #	Higher 2	Test Date (YYYY-MM-DD) start/end	2022-07-12/2022-07-26

Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load(Ω)	P_{max} (W) at the end of cycle	$P_{max} - P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	567.544	—	—
1	5	800-1000	50±10	3.3	568.746	—	—
2	5	800-1000	50±10	3.3	570.165	0.46	Yes
3						—	—

Supplementary information:

☐ Other stabilization procedures

Sample #	Test Date (YYYY-MM-DD) start/end .....:	
Low 1		
Low 2		
High 1		
High 2		

Test method description:

Supplementary information: see Annex 3 for verification of this alternative stabilization procedure

TABLE A.4.3: MQT 6.1 Performance at STC after initial stabilization			P
Test Date [YYYY-MM-DD]..... :	2022-07-26		—
	Lower end power class	Higher end power class	—
Pmax(lab) (W) ..... :	≥ 498.678 ,	≥ 550.920 ,	—
$\bar{P}_{max}(Lab)$ (W)	≥ 514.101 ,	≥ 567.959 ,	—
Voc(lab) (V) ..... :	≤ 50.259 ,	≤ 52.731 ,	—
Isc (lab) (A) ..... :	≤ 14.046 ,	≤ 14.549 ,	—
Test method .....:	☒ Simulator ☐ Natural sunlight		—

Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
Lower 1	13.836	50.079	13.213	41.621	549.939	79.37	—
Lower 2	13.832	50.088	13.201	41.636	549.620	79.33	—
Higher 1	13.946	51.559	13.208	43.132	569.707	79.23	—

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Higher 2	13.865	51.642	13.204	43.180	570.165	79.63	—
Supplementary information: N/A							

TABLE A.4.3: MQT 6.1 Performance at STC after initial stabilization(Backside)							P
Test Date [YYYY-MM-DD] ..... :	2022-07-26						—
	Lower end power class		Higher end power class				—
Pmax(lab) (W) ..... :	≥ __/__,		≥ __/__,				—
$\bar{P}_{max}(Lab)$ (W)	≥ __/__,		≥ __/__,				—
Voc(lab) (V) ..... :	≤ __/__,		≤ __/__,				—
Isc (lab) (A) ..... :	≤ __/__,		≤ __/__,				—
Test method ..... :	☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
Lower 1	10.285	49.595	9.726	41.980	408.310	80.05	—
Lower 2	10.324	49.648	9.703	42.076	408.280	79.66	—
Higher 1	10.209	51.031	9.750	42.993	419.172	80.46	—
Higher 2	10.138	51.050	9.616	43.599	419.249	81.01	—
Supplementary information: N/A							

TABLE A.4.3: MQT 6.1 Performance at equivalent irradiance							P
Test Date [YYYY-MM-DD] ..... :	2022-07-26						—
	Lower end power class		Higher end power class				—
Pmax(lab) (W) ..... :	≥ __/__,		≥ __/__,				—
$\bar{P}_{max}(Lab)$ (W)	≥ __/__,		≥ __/__,				—
Voc(lab) (V) ..... :	≤ __/__,		≤ __/__,				—
Isc (lab) (A) ..... :	≤ __/__,		≤ __/__,				—
Test method ..... :	☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
Lower 1	15.209	50.256	14.524	41.654	604.997	79.15	—
Lower 2	15.219	50.188	14.543	41.604	605.030	79.21	—
Higher 1	15.317	51.692	14.540	43.115	626.907	79.18	—
Higher 2	15.249	51.684	14.539	43.151	627.365	79.60	—
Supplementary information: The Equivalent Irradiance (W/m^2) is 1101(=1000+135*P2/P1), P1 is the front Pmp at STC, P2 is the backside Pmp at STC.							