Test Report issued under the responsibility of:

TEST REPORT
IEC 61730-2
PV Module Safety Qualification – Part 1: Requirements for construction and Part 2: Requirements for testing

Report Number. ..... :	**CGCZJ-PVT-2024-255**
Date of issue ..... :	**2024-08-09**
Total number of pages ..... :	**84**
Name of Testing Laboratory preparing the Report ..... :	**Beijing CGC Certification Center Co., Ltd. Zhejiang Branch**
Applicant's name ..... :	**Zhe Jiang JEC New Energy Technology Co.,LTD**
Address ..... :	**Building 4, CETC Information Industrial Park of Jiaxing No. 587 Taoyuan Road, Gaozhao Street,Xiuzhou District Jiaxing City, Zhejiang Province, 314000, P.R. China**
Test specification:	
Standards ..... :	IEC 61730-2:2016 in conjunction with IEC 61730-1:2016
Test procedure ..... :	CB Scheme
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

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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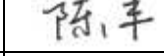
Test item description ..... :	Photovoltaic (PV) Module(s)
Trade Mark ..... :	/
Manufacturer ..... :	Zhe Jiang JEC New Energy Technology Co.,LTD
Address ..... :	Building 4, CETC Information Industrial Park of Jiaxing No. 587 Taoyuan Road, Gaozhao Street, Xiuzhou District Jiaxing City, Zhejiang Province, 314000, P.R. China
Model/Type reference ..... :	See page 9 of this report
Ratings ..... :	See page 9 of this report

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):

☒	CB Testing Laboratory:	Beijing CGC Certification Center Co., Ltd. Zhejiang Branch	
Testing location/address ..... :		1/F-2/F, west of Building 6, Jiaxing photovoltaic science and technology park, No.1288, Kanghe Road, Gaozhao Street, Xiuzhou District, Jiaxing City, Zhejiang Province, China	
☐	Associated CB Testing Laboratory:		
Testing location/address ..... :			
Tested by (name, function, signature) ..... :		Feng Chen Test engineer	
Approved by (name, function, signature) ..... :		Jack zhu, General Manager of lab	
☐	Testing procedure: CTF Stage 1:		
Testing location/address ..... :			
Tested by (name, function, signature) ..... :			
Approved by (name, function, signature) ..... :			
☐	Testing procedure: CTF Stage 2:		
Testing location/address ..... :			
Tested by (name, function, signature) ..... :			
Witnessed by (name, function, signature) ..... :			
Approved by (name, function, signature) ..... :			
☐	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) .....:		

List of attachments (including a total number of pages in each attachment):	
	attachment number / number of pages
Installation manual:	Attachment 1 / 15 pages
Drawings mechanical:	Attachment 2 / 23 pages
Circuit diagram:	Attachment 3 / 5 pages
Photographs:	Attachment 4 / 5 pages
Component datasheets / certificates	Refer to Annex 1.
Others:	N/A

Summary of testing:

Tests performed (name of test and test clause):	**Testing location:**
Basic qualification for: NES144-7-xxxM (xxx=540W-590W, in steps of 5) NES132-8-xxxM (xxx=640W-700W, in steps of 5) -Add below modules: a) NES108-7-xxxM (xxx=400W-445W, in steps of 5) b) NES120-7-xxxM (xxx=450W-490W, in steps of 5) c) NES132-7-xxxM (xxx=495W-540W, in steps of 5) e) NES80-8-xxxM (xxx=400W-435W, in steps of 5) f) NES100-8-xxxM (xxx=495W-540W, in steps of 5) g) NES110-8-xxxM (xxx=545W-595W, in steps of 5) h) NES120-8-xxxM (xxx=580W-635W, in steps of 5) Add above modules, all modules are identical to basic modules, except power rating and number of cells. According to IEC61215-1:2016, IEC61215-1-1:2016, IEC61215-2:2016, full tests were conducted on module NES144-7-xxxM. -Add 210*210 N-type cell Select NES132-8-670M perform relevant tests. - Addition of Type 182N 30mm thickness for correlation testing at NES144-7-xxxM. The following materials are also applicable for the above mentioned model types: 1) Solar cell: Type: CZJT-182M-16D1 Dimension: 182(±0.5) x 91(±0.5) x 0.13(±0.013) Manufacturer: Jie Tai	All tests were performed at Beijing CGC Certification Center Co., Ltd. Zhejiang Branch/1/F-2/F, west of Building 6, Jiaxing photovoltaic science and technology park, No.1288, Kanghe Road, Gaozhao Street, Xiuzhou District, Jiaxing City, Zhejiang Province, China expect for the following tests: - Fire test (MST 23) was performed at Zhejiang Gather Uni test technological Co., Ltd Address: First Floor,Building 3, No.473,Shuguang Road, Economic Development Zone, Jiaxing City, Zhejiang Province

Type: CZJT-210M-18D1 Dimension: 210(±0.5) x 105(±0.5) x 0.13(±0.013) Manufacturer: Jie Tai 2) cell connectors: Dimension: Ø =0.25mm/0.26mm/0.29mm/0.30mm Manufacturer: LAN XIN 3) string connectors: Dimension: 0.35x4mm; 0.35x6mm/0.3x8mm Manufacturer: LAN XIN 4) junction box: PV-ZPB090X Manufacturer: The 40th Institute of China Electronic Technology Group Corporation. Already passed IEC62970:2020,no additional testing required. 5) Frame: 6005-T5, Dimension: 30mm, 35mm Manufacturer: Suzhou Sentong Photovoltaic Co.，Ltd Refer to page 12-13 for the name of test and test clause.	
Summary of compliance with National Differences (List of countries addressed): N/A ☐ The product fulfils the requirements of _____ (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 the respective NCBs that own these marks.

Test item particulars..... :	N/A
Accessories and detachable parts included in the evaluation..... :	N/A
Mounting system used..... :	See to page 63
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	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..... :	2023-08-04
Dates of tests (beginning/end)..... :	2023-09-26-2024-01-04

General remarks:	
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report. Throughout this report a ☐ comma / ☒ point is used as the decimal separator. The originator of this TRF acknowledges the contribution of CTL ETF-9, UL LLC, and VDE in creation of this TRF.	
Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 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..... :	☐ Yes ☒ Not applicable
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (factories) ..... :	Zhejiang Shengqiang New Energy Co., Ltd 29 Jintang South Road, Eastern New Area, Wenling City, Taizhou City, Zhejiang Province, China

Product Electrical Ratings:				
Module type	NES144-7-565M	NES144-7-540M	NES144-7-590M	NES132-8-670M
Voc [V] /Tolerance	51.31/±3	50.26/±3	52.37/±3	46.7/±3
Vmp [V]	43.42	42.42	44.43	38.80
Imp [Adc]	13.01	12.73	13.28	17.27
Isc [Adc] /Tolerance	13.69/±4	13.44/±4	13.94/±4	18.19/±4
Pmp [W] /Tolerance	565/±3	540/±3	590/±3	670/±3
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	25	25	25	30
Module type	NES132-8-640M	NES132-8-700M	-	-
Voc [V] /Tolerance	45.5/±3	47.9/±3	-	-
Vmp [V]	37.60	40.00	-	-
Imp [Adc]	17.03	17.50	-	-
Isc [Adc] /Tolerance	17.89/±4	18.49/±4	-	-
Pmp [W] /Tolerance	640/±3	700/±3	-	-
Maximum system voltage [V]	1500	1500	-	-
Maximum Over-Current Protection Rating [A]	30	30	-	-
Remarks:				

Product Safety Ratings		
Maximum systems voltage (Vsys) ..... :	1500	V
Maximum over-current protection rating ..... :	30	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 ..... :		

General product information:

Modifications:

☒ Initial module design qualification

☐ Extension of module design qualification

☐ Original test report ref. no. ..... :

Model differences and modification:

☐ Test programs for crystalline silicon PV modules

- ☐ 4.2.1 Modification to frontsheet
- ☐ 4.2.2 Modification to encapsulation system
- ☐ 4.2.3 Modification to cell technology
- ☐ 4.2.4 Modification to cell and string interconnect material or technique
- ☐ 4.2.5 Modification to backsheet
- ☐ 4.2.6 Modification to electrical termination
- ☐ 4.2.7 Modification to bypass diode
- ☐ 4.2.8 Modification to electrical circuitry
- ☐ 4.2.9 Modification to edge sealing
- ☐ 4.2.10 Modification to frame and/or mounting structure
- ☐ 4.2.11 Change in PV module size
- ☐ 4.2.12 Higher or lower output power (by 10 % or more) with the identical design and size and using the identical cell process
- ☐ 4.2.13 Increase of over-current protection rating
- ☐ 4.2.14 Increase of system voltage
- ☐ 4.2.15 Change in cell fixing tape

☐ Test programs for thin-film PV modules

- ☐ 4.3.1 Modification to frontsheet
- ☐ 4.3.2 Modification to encapsulation system
- ☐ 4.3.3 Modification to front contact (e. g. TCO)
- ☐ 4.3.4 Modification to cell technology
- ☐ 4.3.5 Modification to cell layout
- ☐ 4.3.6 Modification to back contact
- ☐ 4.3.7 Modification to edge deletion
- ☐ 4.3.8 Modification to interconnect material or technique
- ☐ 4.3.9 Modification to backsheet
- ☐ 4.3.10 Modification to electrical termination
- ☐ 4.3.11 Modification to bypass diode
- ☐ 4.3.12 Modification to edge sealing
- ☐ 4.3.13 Modification to frame and/or mounting structure
- ☐ 4.3.14 Change in PV module size
- ☐ 4.3.15 Higher or lower output power (by 10 % or more) with the identical design and size
- ☐ 4.3.16 Increase of over-current protection rating
- ☐ 4.3.17 Increase of system voltage

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

6 SAMPLING			
	☒ 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
	☐ The modules tested (modules and laminate) were prototypes of a new design and not taken from a production batch.	—	N/A
	☒ Preconditioning of test samples was performed within IEC 61215 performance testing	—	P
	☐ 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
Module type: NES144-7-xxxM (Combination A)				
PVT230334319	Control	NES144-7-565M	CETC230700009	-
PVT230334307	A	NES144-7-565M	CETC230700015	-
PVT230334306	B	NES144-7-565M	CETC230700013	-
PVT230334307	B1	NES144-7-565M	CETC230700015	-
PVT230334314	C	NES144-7-565M	CETC230700011	-
PVT230334310	D	NES144-7-565M	CETC230700039	-
PVT230334312	E	NES144-7-565M	CETC230700038	-
PVT230334315	F	NES144-7-565M	CETC230700037	-
PVT230334324	G	NES144-7-565M	CETC230700003	-
PVT230334308	Ignitability	NES144-7-565M	CETC230700012	-
PVT230334318	Module-Break	NES144-7-565M	CETC230700014	-
PVT230334304	Fire test	NES144-7-565M	CETC230700017	-
PVT230334305	Fire test	NES144-7-565M	CETC230700018	-
Module type: NES144-7-xxxM (Combination B)				
PVT230334322	D	NES144-7-565M	CETC230700032	-
Module type: NES132-8-xxxM (Combination C)				
PVT230334337	D	NES132-8-670M	CETC230700054	-
PVT230334338	F	NES132-8-670M	CETC230700055	-
PVT230334340	E	NES132-8-670M	CETC230700057	-
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.

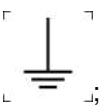
Note (2) Use Annex 2 to list the used materials and components of the module (manufacturer/supplier and type reference)

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 PART 1: REQUIREMENTS FOR CONSTRUCTION

4 Classification, applications and intended use			
4.1 General			
	The module has been evaluated for the following Class (IEC 61140)……:	☐ Class 0 ☒ Class II ☐ Class III	—
4.5 Intended use			
	PV modules are installed in the following special applications:		—
	Building attached PV (BAPV)	☐ yes ☒ no	—
	Building integrated PV (BIPV)	☐ yes ☒ no	—
	Applications in areas where snow and / or wind load exceeding loads as tested in IEC 61730-2 are expected	☐ yes ☒ no	—
	Applications at environmental temperature exceeding the limits indicated in of IEC 61730-1:2016	☐ yes ☒ no	—
	other (please specify)	☐ yes, as follows: ☒ no	—
5 Requirements for design and construction			
5.1 General			—
	PV module suitable for operation in outdoor non-weather protected locations, exposed to direct and indirect (albedo) solar radiation, in an environmental temperature range of at least –40°C to +40°C and up to 100 % relative humidity as well as rain.	Written in user manual	P
	Product shipped from the factory as	☒ completely assembled ☐ subassemblies	—
	The provided assemblies of the product do not involve any action that is likely to affect compliance with the requirements of the IEC 61730 series.		P
	Incorporation of a PV module into the final assembly does not require any alteration of the PV module from its originally evaluated form.		P
	Equipotential bonding continuity is not interrupted by installation		P
	Any adjustable or movable structural part are provided with a locking device		N/A
	PV modules have no accessible burrs, sharp edges or sharp points	See Table 45	P
	Parts are prevented from loosening or turning	See Table 47 and 48	P

5.2 Marking and documentation			
5.2.1	Instructions related to safety are in an official language of the country where the equipment is to be installed.	Written in user manual	P
5.2.2 Marking			
5.2.2.1 General			
	Each PV module includes the following clear and indelible markings:		—
	a) Name, registered trade name, or registered trade mark of manufacturer	Marked on nameplate	P
	b) Type or model number designation	Marked on nameplate	P
	c) Serial number	Marked on nameplate	P
	d) Date and place of manufacture; alternatively serial number assuring traceability of date and place of manufacture	Marked on nameplate	P
	e) Polarity of terminals or leads	Marked on nameplate	P
	f) “Maximum system voltage” or ”Vsys”	Marked on nameplate	P
	g) Class of protection against electrical shock, in accordance with Clause 4 of IEC 61730-1:2016	Marked on nameplate	P
	h) “Voltage at open-circuit” or “Voc” including manufacturing tolerances	Marked on nameplate	P
	i) “Current at short-circuit” or “Isc” including manufacturing tolerances	Marked on nameplate	P
	j) “PV module maximum power” or “Pmax” including manufacturing tolerances	Marked on nameplate	P
	k) “Maximum overcurrent protection rating”	See Table 34	P
	All electrical data are shown as relative to standard test conditions (STC) (1 000 W/m^2, (25 ± 2) °C, AM 1.5 according to IEC 60904-3).	Marked on nameplate	P
	International symbols are used where applicable.	Marked on nameplate	P
	PV connectors or wiring are marked in accordance to IEC 62852 with a symbol „Do not disconnect under load”.	Marked on connector	P
	Symbol or warning notice are imprinted or labelled close to connector	Marked on connector	P
	PV connectors are clearly marked indicating the terminal polarity.		P
	For Class II and Class 0 PV modules, the  (IEC 60417-6042: Caution, risk of electric shock) symbol is applied near the PV module electrical connection means.	Marked on nameplate	P

	PV modules are marked to indicate the class	☒ class II:  ☐ class III:  ☐ class 0: no symbol	P
	PV modules provided with a functional earth connection (see section 5.2.2.2.2)	—	—
	PV modules with terminals for field wiring rated only for use with copper wire are marked, at or adjacent to the terminals, with the statement "Use copper wire only", "Cu only", or the equivalent.	The junction box has passed all the tests required by IEC 62790: 2020	N/A
	PV modules with terminals for field wiring rated only for use with a different specific wiring material are marked with a similar statement referring to the rated material.	The junction box has passed all the tests required by IEC 62790: 2020	N/A
5.2.2.2 Symbols			
5.2.2.2.1 Equipotential bonding			
	Bonding conductor for equipotential bonding is identified with:	☒  ; ☐ 	P
	No other terminal or location is identified in this manner		P
5.2.2.2.2 Functional earthing			
	Field installed functional earthing conductor is identified with the symbol:		N/A
5.2.3 Documentation			
	Documentation concerning electrical and mechanical installation provided.	Written in user manual	P
	Class (see 5.2.2.1) is stated, including specific limitations required for that Class.	Written in user manual	P
	Environmental conditions to which the module has been qualified are stated.		—
	concerning temperature range, typically -40 °C to +40 °C	Written in user manual	P
	concerning wind/snow load including safety factor	Written in user manual	P
	Documentation for safe installation, use, and maintenance is available for installers and operators.	Written in user manual	P
	The documentation contains the following information:		—
	– Name, registered trade name, or registered trade mark of manufacturer	Written in user manual	P
	– Type or model number designation	Written in user manual	P
	– “Maximum system voltage” or ”Vsys”	Written in user manual	P
	– Class of protection against electrical shock	Written in user manual	P

	– “Voltage at open-circuit” or “Voc” including manufacturing tolerances at STC	Written in user manual	P
	– “Current at short-circuit” or “Isc” including manufacturing tolerances at STC	Written in user manual	P
	– “PV module maximum power” or “Pmax” including manufacturing tolerances at STC	Written in user manual	P
	– “Maximum overcurrent protection rating”	See Table 34	
	– Recommended maximum series / parallel PV module configurations	Written in user manual	P
	– Temperature coefficient for voltage at open-circuit	Written in user manual	P
	– Temperature coefficient for maximum power	Written in user manual	P
	– Temperature coefficient for short-circuit current	Written in user manual	P
	All electrical data shall be shown as relative to standard test conditions (1 000 W/m^2, (25 ± 2) °C, AM 1.5 according to IEC 60904-3).	Written in user manual	P
	International symbols are used	Written in user manual	P
	The electrical documentation includes a detailed description of the electrical installation wiring, including:		
	– Minimum cable diameters for PV modules intended for field wiring	The junction box has passed all the tests required by IEC 62790: 2020	P
	– Limitations on wiring methods and wire management that apply to the junction box for the PV module		P
	– Size, type, material, and temperature rating of the conductors		P
	– Type of terminals for field wiring		P
	– Specific PV connector model / types and manufacturer to which the PV module connectors can be mated		P
	– The bonding method(s), if applicable, is specified including all provided or specified hardware		P
	– The type and ratings of bypass diode to be used (if applicable)		P
	– Limitations to the mounting situation (e.g. slope, mounting means, cooling)	Written in user manual	P
	– A statement indicating	☒ fire rating(s) and applied standards ☐ statement regarding resistance to external fire sources not evaluated	P

	– Limitations regarding fire ratings (e.g. installation slope, sub structure or other applicable installation information)		P
	– A statement indicating the minimum mechanical means for securing the PV module	See Table 14	P
	– A statement indicating the maximum altitude		P
	The documentation for roof mounting includes:		—
	– A statement indicating the minimum mechanical means for securing the PV module to the roof	See Table 14	P
	– Specific parameter(s) when the fire rating is dependent on a specific mounting structure are provided e.g. specific spacing, or specific means of attachment to the roof or structure.		P
	A statement concerning artificially concentrated sunlight		P
	Assembly instructions are provided with a product shipped in subassemblies, and are detailed and adequate to the degree required to facilitate complete and safe assembly of the product		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

5.3 Electrical components and insulation			
5.3.2 Internal wiring			
	Internal wiring has sufficient current carrying capacity for the relevant application.	See Table 34	P
5.3.3 External wiring and cables			
	External wires and cables fulfil the requirements of	☐ EN 50618 ☒ IEC 62930.	P
5.3.4 Connectors			
	External DC connectors fulfil the requirements of IEC 62852.		P

5.3.5 Junction boxes for PV modules			
	Junction boxes for PV modules fulfil the requirements of IEC 62790.	1.Certificate No. 44 780 21 406749-177M1; 2. Certificate No.B 076061 0014 Rev.04	P
5.3.6 Frontsheets and backsheets			
	Frontsheet:		—
	Material Frontsheet:	☒ Glass ☐ Polymeric material ☐ Others.	—
	Polymeric frontsheets meet relevant requirements of section 5.5.2	See 5.5.2	P
	Polymeric frontsheets used as relied upon insulation fulfil requirements of		—
	-5.6.4.3 for insulation in thin layers	See 5.6.4.3	
	-5.5.2.3 for electrical insulation	See 5.5.2.3	
	Thermal index frontsheet (see also 5.5.2.3.3):	☒ TI : ☐ RTE : ☐ RTI :	—
	Adhesion to encapsulant or glass is appropriate	Compliance is checked by test sequences of IEC 61730-2 listed in this report.	P
	Backsheet:		—
	Material Backsheet:	☐ Glass ☒ Polymeric material ☐ Others.	—
	Polymeric backsheets meet relevant requirements of section 5.5.2	See 5.5.2	P
	Polymeric backsheets used as relied upon insulation fulfil requirements of		P
	-5.6.4.3 for insulation in thin layers	See 5.6.4.3	P
	-5.5.2.3 for electrical insulation	See 5.5.2.3	P
	Thermal index backsheet (see also 5.5.2.3.3):	☒ TI : ☐ RTE : ☐ RTI :	—
	Adhesion to encapsulant or glass is appropriate	Compliance is checked by test sequences of IEC 61730-2 listed in this report.	P
5.3.7 Insulation barriers			
	Polymeric insulation barrier meets the relevant requirements of 5.5.2	See 5.5.2	P
	Barrier held in place while keeping its required electrical and mechanical properties		P
	Removal of barrier only possible by using a tool		P

5.3.8 Electrical connections			
5.3.8.1 General			
	Terminations are so designed, that the contact pressure is not transmitted through insulating material except ceramic, mica or other adequate material. Compliance checked by MST 01		P
	Measures are taken to prevent connections becoming loose, e.g. by using a washer.	See Table 11 and Table 48	P
	End of a stranded conductor is not consolidated by soft soldering.		P
	Measures are taken to prevent contact stress impairing electrical conductivity.		P
5.3.8.2 Terminals for external cables and PV connector ribbons			
	Terminals for electrical connections are suitable for the type and range of conductor cross-sectional areas and meet the relevant requirements of IEC 62790.		P
	Insulated terminals are designed such that a reduction of clearances and creepage distances by displacement is prevented.		P
5.3.8.3 Splices and connections inside a PV module			
	Splices and connections are mechanically secured and provide electrical continuity.		P
	Electrical connections are soldered, welded, conductively adhered, crimped, or otherwise securely connected.		P
	A soldered or conductively adhered joint is additionally mechanically secured.		P
5.3.9 Encapsulants			
	Thermal properties are sufficient for intended application.		P
	The insulation properties according to 5.5.2.3 are met, if applicable.	See 5.5.2.3.2	P
5.3.10 Bypass diodes			
	Bypass diodes are rated to withstand the current and voltage for their intended use.	See Table 31 and Table 46	P

5.4 Mechanical and electromechanical connections			
5.4.1 General			
	Type of connection:	☒Connection within frame ☒ Mounting interfaces via adhesive ☒ frame to clamp a mounting system ☒ Equipotential bonding ☒ Attachment of junction box ☒ mechanical connections within the laminate:	P
	Mechanical connections are durable to withstand the thermal, mechanical, and environmental stresses occurring in the application.	See Table 38, Table 13 and Table 11	P
	Removable parts are only detachable with the aid of tools.		N/A
	Lids attached without screws have one or several detectable facilities for enabling tools.		N/A
	No contact of tools with the live parts when the lid is removed.		N/A
	No friction between surfaces as the sole means to inhibit the turning or loosening of a part, unless provisions to prevent unintended movement or rotation of the component is given.		N/A
5.4.2 Screw connections			
	Screws and mechanical connections withstand the mechanical stresses occurring in normal use.		N/A
	Screws are not made of a material which is soft or liable to creep.		N/A
	Screws used to provide mechanical stability and continuity for equipotential bonding withstand the mechanical stresses occurring in normal use.		N/A
	At least one screw per electrical- mechanical connection ensures the electrical connection between the metallic components		N/A
	Screws used for mechanical and electrical connections with a nominal diameter of less than 3 mm are screwed into metal.		N/A
	For screws used for mechanical and electrical connections two full threads are engaged into the metal.		N/A
	Screwed and other fixed connections are in such a way that they do not come loose through torsion, bending stresses, vibration, etc.		N/A
5.4.3 Rivets			
	Rivets which serve as electrical as well as mechanical connections are locked against loosening.		N/A

5.4.4 Thread-cutting screws			
	Thread-cutting and self-tapping screws are not used for interconnection of current-carrying parts made of a material which is soft or liable to creep.		N/A
	No thread-forming or thread-cutting (self-tapping) screws (sheet metal screws) are used for the connection of current-carrying parts.		N/A
	Thread-cutting (self-tapping) screws not be used if they are likely to be operated by the user or installer.		N/A
	Thread-cutting and thread-forming screws, used to provide continuity for equipotential bonding, are such that it is not necessary to disturb the connection in normal use.		N/A
	For equipotential bonding one screw is permitted if two full threads engage the metal		N/A
5.4.5 Form/press / tight fit			
	Form/press/tight fits of metallic components which are not separately equipotentially bonded are electrically connected.		N/A
	Requirements of MST 32 and MST 34 are met, continuity of equipotential bonding (MST 13) is provided before and after the MST 32 and MST 34 tests		N/A
5.4.6 Connections by adhesives			
	Connections by adhesive for mounting means are sufficient.	See Table 38, Table 39 and Table 11	P
	Fixing of junction box by adhesive is sufficient.	See Table 27, and Table 10	P
	Adhesion of a polymer relied upon for insulation to another insulating layer is appropriate for the application.		P
	Requirements for adhesive materials are met	See 5.5.4	P
	Connection by adhesive which is considered as cemented joint fulfils the requirements of 5.6.4.2.		N/A
5.4.7 Other connections			
	Other connections such as, welded or soldered, as well as Materials and processes for creating the connections are appropriate for the application and for the intended use.	See Table 6 and Table 43	P
	Other connections which are relied upon for equipotential bonding fulfil the requirements of (MST 13).	See Table 11	P
5.5 Materials			
5.5.2 Polymeric materials			
5.5.2.1 General			

	Polymeric materials are able to durably and safely withstand the electrical, mechanical, thermal, environmental, and corrosive stresses occurring in the application.	Assessed polymeric parts see Annex 2 (BOM). Test results see subsequent sections	P
	Polymeric materials are resistant to electrical and mechanical property degradation.	Test results see subsequent sections	P
	Polymeric parts which ensure either the electrical or mechanical safety of the PV module, or both, are resistant to electrical and mechanical property degradation.	Test results see subsequent sections	P
	They comply with the requirements of the materials creep test (MST 37) depending on their constructive function in the PV module.	See Table 13	P
	Polymeric material used as a part of a cemented joint fulfils additionally the requirements of 5.6.4.2.		N/A
5.5.2.2 Endurance to weathering stress			
	Polymeric materials of the module and its components are durable to weathering stress.	Test results see subsequent sections	P
5.5.2.3 Polymeric materials used as electrical insulation			
5.5.2.3.1 General			
	Material relied upon for insulation are of adequate thickness, as described in Tables 3 and 4.	See Table 49 and Annex 2 (BOM)	P
	The temperature limits of materials used as insulation are not less than the maximum measured operating temperature of the specific material in application, as measured during the temperature test (MST 21).	See Table 32	P
5.5.2.3.2 Endurance to electrical stress			
	Materials used as electrical insulation are in compliance with the insulation coordination requirements	See 5.6.3	P
5.5.2.3.3 Endurance to thermal stress			
	Materials used as relied upon insulation have a mechanical and electrical relative thermal endurance, relative thermal index or temperature index (RTE/RTI or TI) appropriate for the application, at least 90 °C.	☐ TI : ☐ RTE : ☐ RTI : Assessed polymeric parts see Annex 2 (BOM) See Table 32	P
5.5.2.3.4 Polymeric insulating materials used as external parts			
	External polymeric parts of the PV module meet the following requirements:		
	-flammability class minimum V-1	Assessed polymeric parts see Annex 2 (BOM)	N/A
	-ball pressure test with a temperature of 75 °C		N/A
	-ignitability test in final application	See Table 37	P
	-peel test of cemented joints	See Table 39	N/A
	-lap shear strength test		N/A
5.5.2.3.5 Polymeric insulating parts supporting live parts			

	External parts of insulating material supporting live parts including connections, and parts of polymeric material providing supplementary insulation or reinforced insulation, are sufficiently resistant to heat.	Assessed polymeric parts see Annex 2 (BOM)	P
	Polymeric parts which are not components of the laminate fulfil the requirements of ignitability test	Assessed polymeric parts see Annex 2 (BOM) See Table 37	P
	Other than elastomeric polymeric materials meet the following requirements:		
	-flammability class minimum HB		N/A
	-ball pressure test with a temperature of 125 °C		N/A
	-material creep test		N/A
5.5.2.4 Polymeric materials used for mechanical functions			
	Materials used for mechanical functions have a mechanical relative thermal endurance, relative thermal index or temperature index (RTE/RTI or TI) appropriate for the application, at least 90 °C.	☐ TI : ☐ RTE : ☐ RTI : Assessed polymeric parts see Annex 2 (BOM) See Table 32	P
5.5.3 Metallic materials			
5.5.3.1 General			
	Metal parts are not in contact to metal parts having a difference of their electrochemical potentials of more than 600 mV.	Assessed parts see Annex 2 (BOM)	P
	Iron or mild steel are plated, painted, or enamelled for protection against corrosion.		N/A
	Corrosion protection is at least equivalent to a zinc coating of 0.015 mm thickness	Assessed parts see Annex 2 (BOM) See Table 6	P
5.5.3.2 Current carrying parts			
	Assessed parts:	See Annex 2 (BOM)	P
	Current-carrying parts have sufficient mechanical strength and electrical conductivity.	See Table 32 See Table 34 See Table 11	P
	Current-carrying materials are protected against corrosion.		P
	The coating for protective coated metal is capable of preventing corrosion according to either one of the listed standards.	☐ ISO 1456 ☐ ISO 1461 ☐ ISO 2081 ☐ ISO 2093	N/A
	Coated metal not used if the current-carrying parts are stressed by abrasion.		N/A

5.5.4 Adhesives			
	Adhesives are appropriate for the application.	See Tables 40, Table 39, Table 27, Table 29, Table 12, and Table 10	P
	Adhesive as part of the relied upon electrical insulation meets the requirements of 5.5.2.3.3	See 5.5.2.3.3	N/A
5.6 Protection against electric shock			
5.6.1 General			
	Adequate protection against contact with hazardous live parts provided		P
	Specimen pose no risk of electric shock.		P
5.6.2 Protection against accessibility to hazardous live parts			
5.6.2.1 General			
	Class of module	See safety ratings	—
	For class 0 and Class II modules adequate protection against accessibility to hazardous live parts (> 35 V DC) provided.	See Table 12	P
Table 2 of 5.6.2.3	For Class 0 PV modules, accessible metal parts and accessible surfaces as well as live parts of different potential of the same circuit are separated by at least basic insulation.	Class II	N/A
	For Class II PV modules construction provide separation between accessible parts or accessible surfaces and hazardous live parts by double or reinforced insulation.		P
Table 2 of 5.6.2.3	For Class II PV modules, live parts of different potential of the same circuit are separated by double or reinforced insulation.		P
	For Class III PV modules separation between accessible parts or accessible surfaces and hazardous live parts by functional insulation.	Class II	N/A
Table 2 of 5.6.2.3	In Class III PV modules live parts of different polarity are separated by at least functional insulation.	Class II	N/A
	Materials used for realizing protection against accessibility of hazardous live parts by means of enclosure, insulation barrier or relied upon insulation comply with the requirements of 5.5.2 due to their application.	Class II	N/A
5.6.2.2 Protection by means of enclosures and insulation barriers			
	Enclosures or insulation barriers are so designed that, after mounting, the live parts are not accessible (even after possible deformation)		P
	Degree of protection of the housing is not impaired by any possible deformation.		P
	Parts of enclosures and insulation barriers that provide protection are not removable without the use of a tool.		P

	Lids which are attached without screws have one or several detectable features, e.g. recesses,		N/A
	Tool to open the lid do not come into contact with the live parts if lid is removed correctly.		N/A
	Insulation barrier are held in place and are not affected by influences expected during normal operation. Electrical and mechanical properties don't fall below the minimum acceptable values for the application.		P
	Parts are prevented from loosening or turning.		N/A
5.6.2.3 Protection by means of insulation of live parts			
	Insulation materials providing the sole insulation between a live part and an accessible metal part, or between uninsulated live parts not of the same potential, are of adequate thickness and of a material appropriate for the application.		P
	Requirements of Table 2	see 5.6.2.1 of this report	—
5.6.3 Insulation coordination			
5.6.3.1	Components comply with the requirements for their relevant standards	See Annex 2	P
5.6.3.2	Pollution degree	See Table 1, Table 2, Table 3	—
5.6.3.3	Material group	See Table 1, Table 2, Table 3	—
5.6.3.4	Clearance and creepage distance	See Table 1, Table 2, Table 3, Table 4	P
	Derating factor for altitude above 2000 m is considered		N/A
5.6.4 Distance through insulation (dti)			
5.6.4.1 General			
	Polymeric materials for cemented insulation parts and insulation in thin layers shall withstand environmental, thermal, electrical and mechanical stresses as far as they occur.	See 5.5.2	P
	Distances through insulation (dti) of solid insulation comply with the minimum distance as required:		P
	System voltage…….:	See safety ratings	—
	Distance through insulation req./meas. (mm):		P
	The insulation fulfils the material classification as given in IEC 60216-1, IEC 60216-2 and IEC 60216-5 (RTE/TI/RTI).	See annex 2	P
5.6.4.2 Cemented joints			
	Cemented joints were considered as	☐ Edge seal ☐ Interface between Junction Box and mounting surface ☐ others	—

	Distances along cemented joints comply with the minimum distances as required in table 3 or table 4:		N/A
	System voltage…….:	See safety ratings	—
	Distance along cemented joints req./meas. (mm):		N/A
	A distance can be considered as cemented joint if following requirements are met:		—
	-Neither cracks nor voids in the insulating compounds have been occurred which either by themselves or in combination reduces the distances through the cemented joint below the required values.		N/A
	-No breakdown at MST 16 (initial and final test)with a 1,35 times higher tests voltage:		N/A
	Test voltage (V):		—
	No breakdown at MST 17 (initial and final test)with a 1,35 times higher tests voltage:		N/A
	Test voltage (V):		—
	The electrically insulating adhesive/sealant have a volume resistivity:		—
	-of greater than 50 × 10^6 Ω cm (dry)		N/A
	-and greater than 10 × 10^6 Ω cm (wet).		N/A
	☐ rigid / rigid: lap shear test MST 36 ☐ rigid / flexible: Peel test MST 35	See Table 40 and Table 39	N/A
	Supplement information: Above mentioned tests have to be performed for each cemented joint. Also the materials and their properties have to be listed in annex 1		
5.6.4.3	**Insulation in thin layers**		
	Relied upon insulation in thin layers is applied at	☒ Backsheet ☐ Front sheet ☐ insulation within laminate ☐ others	—
	Initial Construction of Insulation in thin layers complies with requirements concerning thickness under consideration of figure 4 as described in table 3 or 4	See Annex 2	P
	Construction of Insulation in thin layers complies with requirements concerning RTE/TI/RTI	See Annex 2	P
	Insulation in thin layers provide sufficient dielectric strength:	See Annex 2	—
	Test voltage for single-layer sheet and for entire multi-layer sheet providing relied upon insulation (2000V + 4 times system voltage)…….:	See Annex 2	P
	Test voltage for each layer of a multi-layer providing relied upon insulation (1000V + 2 times system voltage)…….:	See Annex 2	N/A

	Informative parameter evaluated according to IEC 62788-2 are presented	See Annex 2	P
	Single-layer sheet as well as entire multi-layer sheet in final application comply with following:		—
	- Minimum thickness according to lines 1b) of Table 3 and Table 4, (not less than 30µm) req./meas. (mm),:	See Table 49	P
	- Dielectric strength for basic insulation is provided after cut susceptibility test (MST 12) (1000V + 2 times system voltage)	See Table 41	N/A
	Test voltage (V):		—

5.6.3.4: Clearance and creepage distances									
Table 1: Design evaluation									
Clearance (cl) and creepage distance (cr) at/of/between:	Line of table 3or 4	Type of insulation	Pollution degree	CTI Material group	Working voltage	Clearance cl (mm)		Creepage cr (mm)	
						Required	Design[a]	Required	Design[a]
Position 1:		☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	1500	19.4	13.0	10.4	13.0
Position 2:		☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	1500	19.4	13.0	10.4	13.0
Position 3:		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
Position 4:		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
Supplementary information see photographs/drawings/illustrations on annex xxxx									
[a] List relevant position and test voltage for each clearence which is verified by impulse voltage test according to IEC 60664-1:									

5.6.3.4: Clearance and creepage distances									
Table 2: PV module evaluation MST 01 initial									
Sample #: 1, 4, 5, 7, 9, 13, 14, 16									
Clearance (cl) and creepage distance (cr) at/of/between:	Line of table 3or 4	Type of insulation	Pollution degree	CTI Material group	Working voltage	Clearance cl (mm)		Creepage cr (mm)	
						Requir ed	Meas.[a] / sample #	Requir ed	Meas.[a] / sample #
Position 1:		☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	1500	19.4	13.0	10.4	13.0
Position 2:		☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	1500	19.4	13.0	10.4	13.0
Position 3:		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
Position 4:		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
Supplementary information see photographs/drawings/illustrations on annex xxxx									
[a] Report the smallest measured distance and sample #. List relevant position and test voltage for each clearence which is verified by impulse voltage test according to IEC 60664-1.									

5.6.3.4: Clearance and creepage distances									
Table 3: PV module evaluation MST 01 final									
Sample #: 1, 4, 5, 7, 9, 13, 14, 16									
Clearance (cl) and creepage distance (cr) at/of/between:	Line of table 3or 4	Type of insulation	Pollution degree	CTI Material group	Working voltage	Clearance cl (mm)		Creepage cr (mm)	
						Required	Meas.[a]	Required	Meas.
Position 1:		☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	1500	19.4	13.0	10.4	13.0
Position 2:		☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	☒ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	1500	19.4	13.0	10.4	13.0
Position 3:		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
Position 4:		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
		☐ Functional ☐ Basic ☐ Suppl. ☐ Reinforced	☐ 1 ☐ 2 ☐ 3	☐ I ☐ II ☐ IIIa	N/A	N/A	N/A	N/A	N/A
Supplementary information see photographs/drawings/illustrations on annex xxxx									
[a] List relevant position and test voltage for each clearence which is verified by impulse voltage test according to IEC 60664-1:									

Table 4: 5.6.3.4 - Clearance evaluated by Impulse voltage test								
Test Date (YYYY-MM-DD)		2023-08-21						
Results								
☒ No evidence of dielectric breakdown or surface tracking observed								P
Supplementary information:								
Clearance (cl) at/of/between: Sample#	Line of table 3or 4	Type of insulation	Working voltage	Impulse voltage	Measured			Verdict
					Voltage Peak kV	T_1 µs	T_2 µs	--
Position 1:		☐ Functional ☐ Basic ☐ Suppl. ☒ Reinforced	1500V	16000V	16	1.427	43.55	P
Supplementary information:								

IEC 61730 PART 2: REQUIREMENTS FOR TESTING

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:	See appended Table 11	P
10.9	MST 11 – Accessibility test .....:	See appended Table 12	P
Sequence A			
10.26	MST 37 – Materials creep test.....:	See appended Table 13	P
10.11	MST 13 – Continuity test of equipotential bonding:	See appended Table 11	P
10.9	MST 11 – Accessibility test .....:	See appended Table 12	P
Sequence B			
10.30	MST 53 – Damp heat test 200h.....:	See appended Table 14	P
10.31	MST 54 – UV test 60kWh/m² .....:	See appended Table 15	P
10.29	MST 52 – Humidity freeze test .....:	See appended Table 16	P
10.31	MST 54 – UV test 60kWh/m² .....:	See appended Table 17	P
10.29	MST 52 – Humidity freeze test .....:	See appended Table 18	P
Sequence B1			
10.32	MST 55 – Cold conditioning.....:	See appended Table 19	P
10.33	MST 56 – Dry heat conditioning .....:	See appended Table 20	P
10.29	MST 52 – Humidity freeze test .....:	See appended Table 21	P
10.32	MST 55 – Cold conditioning.....:	See appended Table 22	P
10.29	MST 52 – Humidity freeze test .....:	See appended Table 23	P

Sequence C			
10.31	MST 54 – UV test 15kWh/m² .....:	See appended Table 24	P
10.28	MST 51 – Thermal cycling 50 test .....:	See appended Table 25	P
10.29	MST 52 – Humidity freeze test .....:	See appended Table 26	P
10.27	MST 42 – Robustness of terminations test.....:	See appended Table 27	P
Sequence D			
10.30	MST 53 – Damp heat test.....:	See appended Table 28	P
10.23	MST 34 – Static mechanical load test .....:	See appended Table 29	P
Sequence E			
10.28	MST 51 – Thermal cycling 200 test .....:	See appended Table 30	P
Sequence F			
10.19	MST 25 – Bypass diode thermal test.....:	See appended Table 31	P
10.15	MST 21 – Temperature Test.....:	See appended Table 32	P
10.16	MST 22 – Hot-spot endurance Test.....:	See appended Table 33	P
10.20	MST 26 – Reverse current overload test.....:	See appended Table 34	P
Sequence G			
10.12	MST 14 – Impulse voltage test .....:	See appended Table 35	P
Other tests			
10.17	MST 23 – Fire Test .....:	See appended Table 36	P
10.18	MST 24 – Ignitability test .....:	See appended Table 37	P
10.21	MST 32 – Module breakage test.....:	See appended Table 38	P
10.24	MST 35 – Peel test .....:	See appended Table 39	N/A
10.25	MST 36 – Lap shear strength test .....:	See appended Table 40	N/A
Final Testing			
10.10	MST 12 – Cut susceptibility test .....:	See appended Table 41	P
10.11	MST 13 – Continuity test of equipotential bonding:	See appended Table 11	P
10.9	MST 11 – Accessibility test.....:	See appended Table 12	P
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.....:	See appended Table 44	P
10.7	MST 06 – Sharp edge test.....:	See appended Table 45	P
10.8	MST 07 – Bypass diode functionality test.....:	See appended Table 46	P
10.22	MST 33a – General screw connections test.....:	See appended Table 47	N/A
10.22	MST 33b – Locking Screw connections test.....:	See appended Table 48	N/A

10.5	MST 04 – Insulation thickness test .....:	See appended Table 49	P
Supplementary information:			

Table 5: Overview of MST items for each test sample														
MST item	Sample No.													
	4	5	6	7	8	10	22	12	14	15	18	24		
Control module														
MST 01 – Visual inspection	X	X	X	X	X	X	X	X	X	X	X	X		
MST 02 – Performance at STC														
MST 03 – Maximum power determination			X	X		X	X	X	X	X		X		
MST 04 – Insulation thickness test			X											
MST 05 – Durability of markings			X	X		X	X	X	X	X				
MST 06 – Sharp edge test			X	X		X	X	X	X	X				
MST 07 – Bypass diode functionality test			X	X		X	X	X	X	X				
MST 11 – Accessibility test			X	X		X	X	X	X	X				
MST 12 – Cut susceptibility test			X	X		X	X	X	X	X				
MST 13 – Continuity test of equipotential bonding			X	X		X	X	X	X	X				
MST 14 – Impulse voltage test												X		
MST 16 – Insulation test			X	X								X		
MST 17 – Wet leakage current test			X	X										
MST 21 – Temperature Test										X				
MST 22 – Hot-spot endurance Test										X				
MST 23 – Fire Test	X	X												
MST 24 – Ignitability test					X									
MST 25 – Bypass diode thermal test										X				
MST 26 – Reverse current overload test										X				
MST 32 – Module breakage test											X			
MST 33 – Screw connections test														
MST 34 – Static mechanical load test						X	X							
MST 35 – Peel test														
MST 36 – Lap shear strength test:														
MST 37 – Materials creep test:				X										
MST 42 – Robustness of terminations test									X					
MST 51 – Thermal cycling test 50									X					
MST 51 - Thermal cycling test 200								X	X					
MST 52 – Humidity freeze test			X	X										
MST 53 – Damp heat test 200 h			X											
MST 53 – Damp heat test 1000 h						X	X							
MST 54 – UV test 15 KWh/m²									X					
MST 54 – UV test 60 KWh/m²			X											
MST 55 – Cold conditioning			X	X										
MST 56 – Dry heat conditioning				X										
Legend: X ……Test performed,														

Table 6: MST 01 - Initial Visual inspection			
Test Date (YYYY-MM-DD).....:			—
Sample # PVT23033 4304	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		—
Sample # PVT23033 4305	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		—
Sample # PVT23033 4306	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		—
Sample # PVT23033 4307	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		—
Sample # PVT23033 4308	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		—
Sample # PVT23033 4310	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		—
Sample # PVT23033 4312	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		—
Sample # PVT23033 4314	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		—
Sample # PVT23033 4315	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		—
Sample # PVT23033 4318	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		—
Sample # PVT23033 4322	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		—
Sample # PVT23033 4324	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		

Sample # PVT230334337	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		
Sample # PVT230334338	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		
Sample # PVT230334340	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		
Supplementary information: For creepage distances and clearances see Table 1, Table 2, Table 3 and Table 4			

Table 7: MST 02 - Performance at STC							
Test Date [YYYY-MM-DD]	2023-08-11; 2023-08-17; 2023-08-14; 2023-09-26						—
Irradiance (W/m²)	1000						—
Module temperature (°C)	25						—
Test method	☒ Simulator ☐ Natural sunlight						—
Rated Isc including manufacturing tolerances	13.69/18.19						—
Rated Voc including manufacturing tolerances ...	51.31/46.70						—
Sample	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmp [W]	FF [%]	Result
PVT230334310	13.527	52.28	12.884	44.36	571.54	80.81	N/A
PVT230334312	13.558	52.29	12.927	44.40	574.00	80.97	N/A
PVT230334314	13.565	52.21	12.918	44.15	570.31	80.53	N/A
PVT230334315	13.585	52.24	12.928	44.39	573.92	80.88	N/A
PVT230334322	13.517	52.17	12.848	44.19	567.69	80.50	N/A
PVT230334337	18.262	46.07	17.363	37.87	657.45	78.15	N/A
PVT230334338	18.251	46.03	17.336	37.79	655.13	77.98	N/A
PVT230334340	18.298	46.03	17.356	37.75	655.21	77.78	N/A
Supplementary information: —							

Table 8: MST 03 - Maximum power determination							
Test Date [YYYY-MM-DD]	2023-08-07						—
Irradiance (W/m²)	1000						—
Module temperature (°C)	25						—
Test method	☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmp [W]	FF [%]	Result
PVT230334306	13.590	52.15	12.916	44.25	571.47	80.64	N/A
PVT230334307	13.572	52.28	12.908	44.41	573.27	80.79	N/A
Supplementary information: —							

Table 9: MST 16 - Initial Insulation test					
Test Date (YYYY-MM-DD).....			2023-08-11; 2023-08-07; 2023-09-26		—
Test Voltage applied (V, DC)			1500/8000		—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
PVT230334306	29734	15.50	-	√	P
PVT230334307	30140	15.50	-	√	P
PVT230334310	>50000	15.50	-	√	P
PVT230334312	>50000	15.50	-	√	P
PVT230334314	>50000	15.50	-	√	P
PVT230334315	>50000	15.50	-	√	P
PVT230334322	38911	15.50	-	√	P
PVT230334337	>50000	12.90	-	√	P
PVT230334338	42831	12.90	-	√	P
PVT230334340	41815	12.90	-	√	P
Supplementary information: Size of module [m²]					

Table 10: MST 17 - Initial Wet leakage current test			
Test Date (YYYY-MM-DD)		2023-08-11; 2023-08-07; 2023-09-26	—
Test Voltage applied (V, dc)		1500	—
Solution resistivity (Ω cm)		< 3500 Ω cm at 22 ± 2°C	—
Solution temperature (°C)		22±2	—
Sample #	Measured (MΩ)	Required (MΩ)	Result
PVT230334306	3731	15.50	P
PVT230334307	3679	15.50	P
PVT230334310	26132	15.50	P
PVT230334312	28461	15.50	P
PVT230334314	27560	15.50	P
PVT230334315	24893	15.50	P
PVT230334322	27710	15.50	P
PVT230334337	35612	12.90	P
PVT230334338	38655	12.90	P
PVT230334340	34813	12.90	P
Supplementary information: Size of module [m²]			

Table 11: MST 13 - Continuity test of equipotential bonding		
Test Date Initial examination (YYYY-MM-DD)	2023-08-11; 2023-08-07; 2023-09-26	—
Test Date Final examination (YYYY-MM-DD)	2023-08-11; 2023-08-07; 2023-09-26	—
Maximum over-current protection rating (A)	25/30	—
Current applied (A)	62.5/75	—
Location of designated grounding point.....	E	—
Location of second contacting point	A: furthest point from E; B: closest point to E; C: middle point	—

Sample #	Position in test sequence:	Voltage [V]	Resistance [Ω]	
PVT23033 4306	Initial examination	203.25 220.50 225.74	2.71 2.94 3.01	P
	Preconditioning: MST 53, MST 54, MST 52, MST 54, MST 52, MST 12			—
	Final examination	233.25 256.50 261.75	3.11 3.42 3.49	P
PVT23033 4307	Initial examination	195.75 240.00 217.50	2.61 3.20 2.90	P
	Preconditioning: MST 55, MST 56, MST 52, MST 55, MST 52, MST12, MST 37, MST 13			—
	Final examination	282.00 273.75 278.25	3.76 3.65 3.71	P
PVT23033 4310	Initial examination	209.25 213.00 195.75	2.79 2.84 2.61	P
	Preconditioning: MST 53, MST 34, MST 12, MST 13			—
	Final examination	168.75 199.38 168.75	2.70 3.19 2.70	P
PVT23033 4322	Initial examination	109.38 95.63 102.50	1.75 1.53 1.64	P
	Preconditioning: MST 53, MST 34, MST 12, MST 13			—
	Final examination	139.38 131.88 133.75	2.23 2.11 2.14	P

PVT23033 4312	Initial examination	147.00 159.75 141.00	1.96 2.13 1.88	P
	Preconditioning: MST 51, MST 12, MST 13			—
	Final examination	156.75 165.00 149.25	2.09 2.20 1.99	P
PVT23033 4314	Initial examination	193.50 179.25 184.50	2.58 2.39 2.46	P
	Preconditioning: MST 54, MST 51, MST 52, MST 42, MST 12, MST 13			—
	Final examination	317.25 301.50 312.75	4.23 4.02 4.17	P
PVT23033 4337	Initial examination	150.74 147.75 139.50	2.01 1.97 1.86	P
	Preconditioning: MST 53, MST 34, MST 12, MST 13			—
	Final examination	198.75 203.25 237.00	2.65 2.71 3.16	P
PVT23033 4338	Initial examination	195.00 225.00 228.00	2.60 3.00 3.04	P
	Preconditioning: MST 22, MST 26			—
	Final examination	301.50 309.00 315.75	4.02 4.12 4.21	P
PVT23033 4340	Initial examination	289.50 130.50 132.00	1.81 1.74 1.76	P
	Preconditioning: MST 51, MST 12, MST 13			—
	Final examination	249.75 265.50 234.00	3.33 3.54 3.12	P
Supplementary information: —				

Table 12: MST 11 - Accessibility test			
Test Date **Initial** examination (YYYY-MM-DD)....	2023-08-11; 2023-08-07; 2023-09-26		—
Test Date **Final** examination (YYYY-MM-DD).....	2023-08-11; 2023-08-07; 2023-09-26		—
Sample #	Position in test sequence:		
PVT230334306	Initial examination, access?	☐ Yes ☒ No	P
	Preconditioning: MST 53, MST 54, MST 52, MST 54, MST 52, MST 12, MST 13		—
	Final examination, access?	☐ Yes ☒ No	P
PVT230334307	Initial examination, access?	☐ Yes ☒ No	P
	Preconditioning: MST 55, MST 56, MST 52, MST 55, MST 52, MST12, MST 37, MST 13		—
	Final examination, access?	☐ Yes ☒ No	P
PVT230334310	Initial examination, access?	☐ Yes ☒ No	P
	Preconditioning: MST 53, MST 34, MST 12, MST 13		—
	Final examination, access?	☐ Yes ☒ No	P
PVT230334312	Initial examination, access?	☐ Yes ☒ No	P
	Preconditioning: MST 51, MST 12, MST 13		—
	Final examination, access?	☐ Yes ☒ No	P
PVT230334314	Initial examination, access?	☐ Yes ☒ No	P
	Preconditioning: MST 54, MST 51, MST 52, MST 42, MST 12, MST 13		—
	Final examination, access?	☐ Yes ☒ No	P
PVT230334322	Initial examination, access?	☐ Yes ☒ No	P
	Preconditioning: MST 53, MST 34, MST 12, MST 13		—
	Final examination, access?	☐ Yes ☒ No	P
PVT230334337	Initial examination, access?	☐ Yes ☒ No	P
	Preconditioning: MST 53, MST 34, MST 12, MST 13		—
	Final examination, access?	☐ Yes ☒ No	P
PVT230334338	Initial examination, access?	☐ Yes ☒ No	P
	Preconditioning: MST 22, MST 26		—
	Final examination, access?	☐ Yes ☒ No	P
PVT230334340	Initial examination, access?	☐ Yes ☒ No	P
	Preconditioning: MST 51, MST 12, MST 13		—
	Final examination, access?	☐ Yes ☒ No	P

SEQUENCE A				
Sample #	PVT230334307			—
Table 13: MST 37 - Materials creep test				
Test Date (YYYY-MM-DD) start/end.....:	2023-08-18-2023-08-26			—
Duration [h] .....:	200			—
Applied temperature [°C] .....:	105			—
MST 01: Visual inspection after materials creep test				—
Test Date (YYYY-MM-DD) .....:	2023-08-28			—
Findings ..... :	☐ Yes.....☒ No			P
Nature and position of findings – comments or attach photos	—			—
Supplementary information: For clearance and creepage distances see table 1,2,3				
MST 16: Insulation test after materials creep test				—
Test Date (YYYY-MM-DD) .....:	2023-08-28			—
Test Voltage applied (V, dc) .....:	1500/8000			—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
23134	15.50	-	√	P
MST 17: Wet leakage current test after materials creep test				—
Test Date (YYYY-MM-DD) .....:	2023-08-28			—
Test Voltage applied (V, dc) .....:	1500			—
Solution resistivity (Ω cm).....:	2857			—
Solution temperature (°C).....:	23.3			—
Measured(MΩ)	Required (MΩ)			Result
2131	15.50			P
Supplementary information: —				

SEQUENCE B				
Sample #	PVT230334306			—
Table 14: MST 53 - Damp heat test				
Test Date (YYYY-MM-DD) start/end.....:		2023-08-07-2023-08-15		—
Duration [h] .....:		200		—
MST 01: Visual inspection after Damp heat test				—
Test Date (YYYY-MM-DD) .....:		2023-08-15		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos		—		—
MST 16: Insulation test after Damp heat test				—
Test Date (YYYY-MM-DD) .....:		2023-08-15		—
Test Voltage applied (V, DC) .....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
21002	15.50	-	√	P
Supplementary information: —				

Table 15: MST 54 - UV test				
Test Date (YYYY-MM-DD) start/end.....:		2023-08-17-2023-09-03		—
Module temperature [°C] .....:		60.4		—
Irradiation total [kWh/ m²] .....:		60		—
Open circuits .....:		☐ Yes ☒ No		
MST 01: Visual inspection after UV test				—
Test Date (YYYY-MM-DD) .....:		2023-09-03		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos		—		—
MST 16: Insulation test after UV test				—
Test Date (YYYY-MM-DD) .....:		2023-09-03		—
Test Voltage applied (V, DC) .....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
19024	15.50	-	√	P
Supplementary information: —				

Table 16: MST 52 -Humidity freeze test				
Test Date (YYYY-MM-DD) start/end.....:		2023-09-04/2023-09-14		—
Total cycles (10) .....:		10		—
Open circuits .....:		☐ Yes ☒ No		
MST 01: Visual inspection after Humidity freeze test				—
Test Date (YYYY-MM-DD) .....:		2023-09-14		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos		—		—
MST 16: Insulation test after Humidity freeze test				—
Test Date (YYYY-MM-DD) .....:		2023-09-14		—
Test Voltage applied (V, DC) .....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
18979	15.50	-	√	P
Supplementary information: —				

Table 17: MST 54 - UV test				
Test Date (YYYY-MM-DD) start/end.....:		2023-09-14-2023-10-01		—
Module temperature [°C] .....:		60.2		—
Irradiation total [kWh/ m²] .....:		60		—
Open circuits .....:		☐ Yes ☒ No		
MST 01: Visual inspection after UV test				—
Test Date (YYYY-MM-DD) .....:		2023-10-01		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos		—		—
MST 16: Insulation test after UV test				—
Test Date (YYYY-MM-DD) .....:		2023-10-01		—
Test Voltage applied (V, DC) .....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
17348	15.50	-	√	P
Supplementary information: —				

Table 18: MST 52 - Humidity freeze test				
Test Date (YYYY-MM-DD) start/end.....:		2023-10-01-2023-10-11		—
Total cycles (10) .....:		10		—
Open circuits .....:		☐ Yes ☒ No		
MST 01: Visual inspection after Humidity freeze test				—
Test Date (YYYY-MM-DD) .....:		2023-10-11		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos		—		—
MST 16: Insulation test after Humidity freeze test				—
Test Date (YYYY-MM-DD) .....:		2023-10-11		—
Test Voltage applied (V, DC) .....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
16823	15.50	-	√	P
MST 17: Wet leakage current test after humidity freeze 10 test				—
Test Date (YYYY-MM-DD) .....:		2023-10-11		—
Test Voltage applied (V, dc) .....:		1500		—
Solution resistivity (Ω cm).....:		2778		—
Solution temperature (°C).....:		24.5		—
Measured (MΩ)		Required (MΩ)		Result
3118		15.50		P
Supplementary information: —				

SEQUENCE B1				
Sample #	PVT230334307			—
Table 19: MST 55 - Cold conditioning				
Test Date (YYYY-MM-DD) start/end.....:		2023-08-07		—
Temperature [°C] Duration [h] .....:		-40 / 48		—
MST 01: Visual inspection after Cold conditioning				—
Test Date (YYYY-MM-DD) .....:		2023-08-09		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos		—		—
MST 16: Insulation test after Cold conditioning				—
Test Date (YYYY-MM-DD) .....:		2023-08-09		—
Test Voltage applied (V, DC) .....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
28914	15.50	-	√	P
Supplementary information: —				

Table 20: MST 56 - Dry heat conditioning				
Test Date (YYYY-MM-DD) start/end.....:		2023-08-09-2023-08-18		—
Temperature [°C] Duration [h] ..... :		200		—
MST 01: Visual inspection after Dry heat conditioning				—
Test Date (YYYY-MM-DD) .....:		2023-08-18		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos		—		—
MST 16: Insulation test after Dry heat conditioning				—
Test Date (YYYY-MM-DD) .....:		2023-08-18		—
Test Voltage applied (V, DC) .....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
26819	15.50	-	√	P
Supplementary information: —				

Table 21: MST 52 - Humidity freeze test		
Test Date (YYYY-MM-DD) start/end.....:	2023-08-28-2023-09-07	—
Total cycles (10) ..... :	10	—

Open circuits ..... :		☐ Yes ☒ No		
MST 01: Visual inspection after Humidity freeze test				—
Test Date (YYYY-MM-DD) ..... :		2023-09-07		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos		—		—
MST 16: Insulation test after Humidity freeze test				—
Test Date (YYYY-MM-DD) ..... :		2023-09-07		—
Test Voltage applied (V, DC) ..... :		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
21144	15.50	-	√	P
Supplementary information: —				

Table 22: MST 55 - Cold conditioning				
Test Date (YYYY-MM-DD) start/end ..... :		2023-09-13		—
Temperature [°C] / Duration [h] ..... :		-40 / 48		—
MST 01: Visual inspection after Cold conditioning				—
Test Date (YYYY-MM-DD) ..... :		2023-09-15		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos		—		—
MST 16: Insulation test after Cold conditioning				—
Test Date (YYYY-MM-DD) ..... :		2023-09-15		—
Test Voltage applied (V, DC) ..... :		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
20134	15.50	-	√	P
Supplementary information: —				

Table 23: MST 52 - Humidity freeze test				
Test Date (YYYY-MM-DD) start/end.....:		2023-09-15-2023-09-25		—
Total cycles (10) .....:		10		—
Open circuits .....:		☐ Yes ☒ No		
MST 01: Visual inspection after Humidity freeze test				—
Test Date (YYYY-MM-DD) .....:		2023-09-25		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos		—		—
MST 16: Insulation test after Humidity freeze test				—
Test Date (YYYY-MM-DD) .....:		2023-09-25		—
Test Voltage applied (V, DC) .....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
19937	15.50	-	√	P
MST 17: Wet leakage current test after humidity freeze test				—
Test Date (YYYY-MM-DD) .....:		2023-09-25		—
Test Voltage applied (V, dc) .....:		1500		—
Solution resistivity (Ω cm).....:		3278		—
Solution temperature (°C).....:		22.3		—
Measured (MΩ)		Required (MΩ)		Result
1937		15.50		P
Supplementary information: —				

SEQUENCE C				
Sample #	PVT230334314			—
Table 24: MST 54 - UV test				
Test Date (YYYY-MM-DD) start/end.....:		2023-08-14–2023-08-18		—
Module temperature [°C] .....:		60		—
Irradiation total [kWh/ m²] .....:		15		—
Open circuits .....:		☐ Yes ☒ No		
MST 01: Visual inspection after UV test				—
Test Date (YYYY-MM-DD) .....:		2023-08-18		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos		—		—
MST 16: Insulation test after UV test				—
Test Date (YYYY-MM-DD) .....:		2023-08-18		—
Test Voltage applied (V, DC) .....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
25997	15.50	-	√	P
Supplementary information: —				

Table 25: MST 51 - Thermal cycling test				
Test Date (YYYY-MM-DD) start/end.....:		2023-08-18–2023-08-25		—
Total cycles (50) .....:		50		—
Applied current (A) .....:		During the heat up cycle from - 40 °C to 80 °C,112.918 A. Other stages, 0.05A;		—
Limiting voltage (V) .....:		50		—
Open circuits .....:		☐ Yes ☒ No		
MST 01: Visual inspection after Thermal cycling test				—
Test Date (YYYY-MM-DD) .....:		2023-08-25		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos		—		—
MST 16: Insulation test after Thermal cycling test				—
Test Date (YYYY-MM-DD) .....:		2023-08-25		—
Test Voltage applied (V, DC) .....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
23891	15.50	-	√	P
Supplementary information: —				

Table 26: MST 52 - Humidity freeze test				
Test Date (YYYY-MM-DD) start/end.....:		2023-08-25–2023-09-04		—
Total cycles (10) .....:		10		—
Open circuits .....:		☐ Yes ☒ No		
MST 01: Visual inspection after Humidity freeze test				—
Test Date (YYYY-MM-DD) .....:		2023-09-04		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos		—		—
MST 16: Insulation test after Humidity freeze test				—
Test Date (YYYY-MM-DD) .....:		2023-09-04		—
Test Voltage applied (V, DC) .....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
25646	15.50	-	√	P
MST 17: Wet leakage current test after humidity freeze test				—
Test Date (YYYY-MM-DD) .....:		2023-09-04		—
Test Voltage applied (V, dc) .....:		1500		—
Solution resistivity (Ω cm).....:		2801		—
Solution temperature (°C).....:		22.8		—
Measured (MΩ)		Required (MΩ)		Result
578		15.50		P
Supplementary information: —				

Table 27: MST 42 - Robustness of terminations test		
Test Date (YYYY-MM-DD) .....:	2023-09-19	—
MQT 14.1: Retention of junction box on mounting surface		
Supplementary information:		
MST 01: Visual inspection after retention of junction box on mounting surface		
Test Date (YYYY-MM-DD) .....:	2023-09-20	—
Findings ..... :	☐ Yes.....☒ No	P
Nature and position of findings – comments or attach photos	—	—
MST 17: Wet leakage current test after retention of junction box on mounting surface		
Test Date (YYYY-MM-DD) .....:	2023-09-20	—
Test Voltage applied [V] .....:	1500	—
Solution resistivity (Ω cm).....:	3030	—
Solution temperature (°C).....:	22.9	—
Measured [MΩ]	Required [MΩ]	Result
574	15.50	P
Supplementary information: —		

SEQUENCE D				
Sample #	PVT230334310; PVT230334322			—
Table 28: MST 53 - Damp heat test				
Test Date (YYYY-MM-DD) start/end.....:	2023-08-14–2023-09-25			—
Total hours (1000) .....:	1000			—
MST 01: Visual inspection after damp heat test				—
Test Date (YYYY-MM-DD) .....:	2023-09-25			—
Findings ..... :	☐ Yes.....☒ No			P
Nature and position of findings – comments or attach photos	—			—
MST 16: Insulation test after damp heat test				—
Test Date (YYYY-MM-DD) .....:	2023-09-25			—
Test Voltage applied (V, DC) .....:	1500/8000			—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
49462	15.50	-	√	P
49658	15.50	-	√	P
MST 17: Wet leakage current test after damp heat test				—
Test Date (YYYY-MM-DD) .....:	2023-09-25			—
Test Voltage applied (V, dc) .....:	1500			—
Solution resistivity (Ω cm).....:	2660			—
Solution temperature (°C).....:	22.6			—
Measured (MΩ)	Required (MΩ)			Result
25728	15.50			P
23744	15.50			P
Supplementary information: —				

Table 29: MST 34 - Static mechanical load test				
Test Date (YYYY-MM-DD) .....:	2023-09-26；2023-10-23			—
Mounting method .....:	PVT230334322：Long side 520mm block mounting PVT230334310：Block the outer four holes. The distance between the holes is 1400mm			—
Design Load [Pa] / Safety factor γm.....:	3600 / 1600；1.5			—
Load applied to.....:	front side	back side		—
Mechanical load [Pa].....:	5400	2400		—
First cycle time (start/end) .....:	1h	1h		—
Intermittent open-circuit (yes/no).....:	No	No		P
Second cycle time (start/end).....:	1h	1h		—
Intermittent open-circuit (yes/no).....:	No	No		P
Third cycle time (start/end) .....:	1h	1h		—
Intermittent open-circuit (yes/no).....:	No	No		P
Supplementary information: Maximum bending at module centre xx mm.				
MST 01: Visual inspection after Static mechanical load test				—
Test Date (YYYY-MM-DD) .....:	2023-09-25; 2023-10-23			—
Findings ..... :	☐ Yes.....☒ No			P
Nature and position of findings – comments or attach photos	—			—
MST 16: Insulation test after Static mechanical load test				—
Test Date (YYYY-MM-DD) .....:	2023-09-25; 2023-10-23			—
Test Voltage applied (V, DC) .....:	1500/8000			—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
45572	15.50	-	√	P
45765	15.50	-	√	P
MST 17: Wet leakage current test after Static mechanical load test				—
Test Date (YYYY-MM-DD) .....:	2023-09-25; 2023-10-23			—
Test Voltage applied (V, dc) ..... :	1500			—
Solution resistivity (Ω cm).....:	2625			—
Solution temperature (°C) ..... :	23.1			—
Measured (MΩ)	Required (MΩ)			Result
2352	15.50			P
21036	15.50			P

Supplementary information: —

SEQUENCE E				
Sample #	PVT230334312; PVT230334340			—
Table 30: MST 51 - Thermal cycling test				
Test Date (YYYY-MM-DD) start/end .....:	2023-08-14-2023-09-11; 2023-09-28-2023-10-26			—
Total cycles (200) .....:	200			—
Applied current (A) .....:	During the heat up cycle from –40 °C to 80 °C 12.911, 17.366 A Other stages 0.1A			—
Limiting voltage (V) .....:	50			—
Open circuits .....:	☐ Yes ☒ No			
MST 01: Visual inspection after Thermal cycling test				—
Test Date (YYYY-MM-DD) .....:	2023-09-11; 2023-10-26			—
Findings ..... :	☐ Yes.....☒ No			P
Nature and position of findings – comments or attach photos	—			—
MST 16: Insulation test after Thermal cycling test				—
Test Date (YYYY-MM-DD) .....:	2023-09-11; 2023-10-26			—
Test Voltage applied (V, DC) .....:	1500/8000			—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
47570	15.50	-	√	P
39751	12.90	-	√	P
MST 17: Wet leakage current test after Thermal cycling test				—
Test Date (YYYY-MM-DD) .....:	2023-09-11; 2023-10-26			—
Test Voltage applied (V, dc) .....:	1500			—
Solution resistivity (Ω cm) .....:	2688			—
Solution temperature (°C) .....:	22.4			—
Measured (MΩ)	Required (MΩ)			Result
27235	15.50			P
36672	12.90			P
Supplementary information: —				

SEQUENCE F					
Sample #	PVT230334316				—
Table 31: MST 25 - Bypass diode thermal test					
Test Date [YYYY-MM-DD] start/end .....:	2023-09-11				—
Module temperature [°C] .....:	75±5				—
Number of diodes in junction box .....:	3				—
Diode manufacturer .....:	Hangzhou Daoming Micro-electronics Co.Ltd				—
Diode type designation .....:	GFMK4045				—
Max. permissible junction temperature Tjmax [°C] (according to diode datasheet).....:	200				—
Step 1, Determination of *V*D versus *T*J characteristic					—
Ambient temperature of the junction box [°C]....:	30 ± 2	50 ± 2	70 ± 2	90 ± 2	—
Pulsed current .....:	13.589	13.589	13.589	13.589	—
Voltage drop [V] .....:	0.3995 0.4033 0.4049	0.3794 0.3830 0.3841	0.3516 0.3545 0.3561	0.3295 0.3325 0.3339	—
VD versus TJ characteristic.....:	VD = -0.0012TJ + 0.4381 (Diode 1) VD = -0.0012TJ + 0.4423 (Diode 2) VD = -0.0012TJ + 0.4438 (Diode 3)				
Max. permissible junction temperature Tj_{max} [°C] (according to diode datasheet) ..... :	200				
Step 2, Bypass diode thermal test					—
	Diode 1	Diode 2	Diode 3		Result
Current flow applied [A] .....:	13.589	13.589	13.589		—
Max. diode surface temperature allowed Tjmax [°C],.....:	200	200	200		—
Voltage drop [V] after 1h.....:	0.2885	0.2861	0.2925		—
Calculated max. junction temperature Tjcalc [°C] .....:	124.67	130.17	126.08		
Tjcalc < Tjmax (test passed)? yes/no.....:	yes	yes	yes		
Current flow (1.25 * Isc) [A].....:	16.99	16.99	16.99		—
Bypass diode remain(s) functional (yes/no).....:	yes	yes	yes		
Remarks: See Table 46 for the test details of bypass diode functionality test					
MST 01: Visual inspection after Bypass diode thermal test					
Test Date [YYYY-MM-DD].....:	2023-09-11				—
Findings ..... :	☐ Yes.....☒ No				P
Nature and position of findings – comments or attach photos	—				—

MST 16: Insulation test after Bypass diode thermal test				—
Test Date (YYYY-MM-DD) .....:		2023-09-11		—
Test Voltage applied (V, DC).....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
48772	15.50	-	√	P
MST 17: Wet leakage current test after Bypass diode thermal test				—
Test Date [YYYY-MM-DD]:.....		2023-09-11		—
Test Voltage applied [V]:.....		1500		—
Solution resistivity [Ω cm) .....:		3067		—
Solution temperature [°C] .....:		22.3		—
Measured [MΩ]		Required [MΩ]		Result
24175		15.50		P
Supplementary information: —				

Table 32: MST 21 - Temperature Test				
Sample #	PVT230334315			
Reference solar irradiance (W/m²) .....:	1000 W/m²			—
Reference ambient temperature (°C) .....:	44.34			—
Module at MPP				
Measuring location:	Component temperature T_{OBS} (°C)	Normalized temperature T_{CON} (°C)	Component temperature limit (°C)	—
PV module frontsheet above the centre cell	77.97	82.31	77.97	—
PV module backsheet below the centre cell	80.92	85.26	80.92	—
Terminal enclosure interior surface	77.02	81.36	77.02	—
Field wiring terminals	—	—	—	—
Insulation of the field wiring leads	67.51	71.85	67.51	—
External connector bodies	63.51	67.85	63.51	—
Bypass diode bodies	—	—	—	—
Sample #	PVT230334338			
Reference solar irradiance (W/m²) .....:	1000 W/m²			—
Reference ambient temperature (°C) .....:	45.37			—
Module at MPP				
Measuring location:	Component temperature T_{OBS} (°C)	Normalized temperature T_{CON} (°C)	Component temperature limit (°C)	—
PV module frontsheet above the centre cell	76.06	81.43	76.06	—
PV module backsheet below the centre cell	78.75	84.12	78.75	—
Terminal enclosure interior surface	75.04	80.41	75.04	—
Field wiring terminals	—	—	—	—
Insulation of the field wiring leads	64.23	69.60	64.23	—
External connector bodies	59.90	65.27	59.90	—
Bypass diode bodies	—	—	—	—

MST 01: Visual inspection after Temperature Test		—
Test Date (YYYY-MM-DD) .....:	2023-10-25	—
Findings ..... :	☐ Yes.....☒ No	P
Nature and position of findings – comments or attach photos	—	—
MST 16: Insulation test after Temperature Test		—
Test Date (YYYY-MM-DD) .....:	2023-10-25	—

Test Voltage applied (V, DC) .....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
24237	15.50	-	√	P
36128	15.50	-	√	P
MST 17: Wet leakage current test after Temperature Test				—
Test Date (YYYY-MM-DD) .....:		2023-10-25		—
Test Voltage applied (V, dc) .....:		1500		—
Solution resistivity (Ω cm).....:		2469		—
Solution temperature (°C).....:		22.7		—
Measured (MΩ)		Required (MΩ)		Result
16357		15.50		P
31940		15.50		P
Supplementary information: —				

Table 33: MST 22 - Hot-spot endurance test						
Test Date (YYYY-MM-DD) start/end.....:	2023-09-25					—
Cell interconnection circuit.....:	☐ S ☒ SP ☐ PS					—
Irradiance during each cycle…….....:	1000 W/m²					—
Module temperature at thermal equilibrium in each cycle [°C] .....:	52.31;55.34					—
Determination of worst case cell						—
Maximum measured cell temperature in each cycle [°C] .....:	PVT230334315: 152.70,147.99,148.70,118.02; PVT230334338: 139.8,130.2,133.1,116.7					—
Shading rate [%] or number of cells shaded.....:	PVT230334315: 15,17,15,10 PVT230334338: 16,16,15,11					—
Test hours for each cycle.....:	1h					—
MST 01: Visual inspection after hot-spot endurance test						—
Test Date (YYYY-MM-DD) .....:	2023-09-26; 2023-10-13					—
Findings ..... :	☐ Yes.....☒ No					P
Nature and position of findings – comments or attach photos	—					—
MST 02: Maximum power determination after hot-spot endurance test						—
Test Date [YYYY-MM-DD].....:	2023-09-26; 2023-10-13					—
Module temperature [°C] .....:	25.1					—
Irradiance [W/m²].....:	1000					—
Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmp [W]		FF [%]
13.596	52.26	12.930	44.38	573.81		80.75
18.204	45.97	17.289	37.79	653.31		78.07
MST 16: Insulation test after hot-spot endurance test						—
Test Date (YYYY-MM-DD) .....:	2023-09-26; 2023-10-13					—
Test Voltage applied [V] .....:	1500/8000					—
Measured	Required	Dielectric breakdown				Result
MΩ	MΩ	Yes (description)		No		
28124	15.50	-		√		P
41079	12.90	-		√		P
MST 17: Wet leakage current test after hot-spot endurance test						—
Test Date (YYYY-MM-DD) .....:	2023-09-26; 2023-10-13					—
Test Voltage applied [V] .....:	1500					—
Solution resistivity [Ω cm) .....:	2544					—
Solution temperature [°C] .....:	22.8					—
Measured [MΩ]		Required [MΩ]				Result

20849	15.50	P
36252	12.90	P
Supplementary information: —		

Table 34: MST 26 - Reverse current overload test				
Test Date (YYYY-MM-DD)..... :		2023-10-08; 2023-10-25		—
Module over-current protection rating (A) .....:		PVT230334315:25 PVT230334338:30		—
Test current (A) .....:		33.75/40.50		—
Range of applied voltage (V).....:		PVT230334315：56.32-50.32. PVT230334338：50.6-56.4		—
Test duration .....:		2 hours		—
Observations				Result
☒ No flaming of the module				P
☒ No flaming or charring of the cheesecloth				
☒ No flaming of the tissue paper				
☒ MST 17 requirements fulfilled (see appended Table MST17)				
Supplementary information: N/A				
MST 01: Visual inspection after Reverse current overload test				—
Test Date (YYYY-MM-DD) .....:		2023-10-08; 2023-10-25		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos		—		—
MST 16: Insulation test after Reverse current overload test				—
Test Date (YYYY-MM-DD) .....:		2023-10-08; 2023-10-25		—
Test Voltage applied (V, DC) .....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
26152	15.50	-	√	P
39283	12.90	-	√	P
MST 17: Wet leakage current test after Reverse current overload test				—
Test Date (YYYY-MM-DD) .....:		2023-10-08; 2023-10-25		—
Test Voltage applied (V, dc) .....:		1500		—
Solution resistivity (Ω cm).....:		2915		—
Solution temperature (°C).....:		22.5		—
Measured (MΩ)		Required (MΩ)		Result
18151		15.50		P
35242		12.90		P
Supplementary information:				

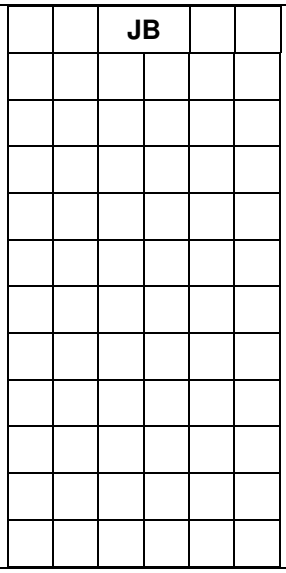
SEQUENCE G				
Sample #:	PVT230334324			—
Table 35: MST 14 - Impulse voltage test				
Test Date (YYYY-MM-DD) .....:		2023-08-21		—
Maximum system voltage (V).....:		1500		—
Required Impulse voltage (V) .....:		16000		—
Measured Impulse voltage (V).....:		16000		
T_1 (µs).....:		1.427		
T_2 (µs).....:		43.55		
Thickness of conductive foil (mm) .....:		0.06		—
Results				
☒ No evidence of dielectric breakdown or surface tracking observed ☒ No evidence of major visual defects (see table MST 01 below)				
MST 01: Visual inspection after Impulse voltage test				—
Test Date (YYYY-MM-DD).....:		2023-08-22		—
Findings ..... :		☐ Yes.....☒ No		P
Nature and position of findings – comments or attach photos				—
MST 16: Insulation test after Impulse voltage test				—
Test Date (YYYY-MM-DD) .....:		2023-08-22		—
Test Voltage applied (V, DC) .....:		1500/8000		—
Measured	Required	Dielectric breakdown		Result
MΩ	MΩ	Yes (description)	No	
8060	15.50	-	√	P
Supplementary information: —				

OTHER TESTS		
Sample #:	PVT230334304; PVT230334305	—
Table 36: MST 23 - Fire test		
Test Date (YYYY-MM-DD) ..... :	2023-09-25	—
Module fire resistance class (A, B, C) ..... :	C	—
No. of modules provided to create the test assembly ..... :	2	—
☒ The module complies with the requirements for the fire resistance class		—
Supplementary information: Meets UL 790 Class C test requirements.		

Sample #:	17	—
Table 37: MST 24 - Ignitability test		
Test Date (YYYY-MM-DD) ..... :	2023-09-18	—
Flame application point ..... :	—	—
Surface exposure ..... :	☒ Yes ☐ No	—
Backsheet foil exposure ..... :	☐ Yes ☒ No	—
Frame adhesive exposure ..... :	☐ Yes ☒ No	—
Edge exposure ..... :	☐ Yes ☒ No	—
Junction box adhesive exposure ..... :	☐ Yes ☒ No	—
Type label exposure ..... :	☐ Yes ☒ No	—
Backrail adhesive exposure ..... :	☐ Yes ☒ No	—
Ignition occurs ..... :	☐ Yes ☒ No	—
Flame spread less as 150 mm	☒ Yes ☐ No	—
Length of destroyed area ..... :	—	—
Supplementary information: —		

Sample #:	PVT230334318	—
Table 38: MST 32 - Module breakage test		
Test Date (YYYY-MM-DD) .....:	2023-08-07	—
Weight of impactor (kg).....:	45.5	—
Thickness of sample (mm) .....:	35	—
Mounting technique used .....:	Clamp mounting	—
Module breakage .....:	☒ No breakage	P
	☐ No separation from frame or mounting structure	—
	☐ Breakage occurred, no shear or opening large enough for a 76 mm diameter sphere to pass freely developed	—
	☐ Breakage occurred, no particles larger than 65 cm² ejected from sample	—
	☐ Continuity of equipotential bonding provided, see table 10.11	—
Nature and position of findings – comments or attach photos		Result
		P
Supplementary information: —		

Sample #:	—	—
Table 39: MST 35 - Peel test (only for cemented joints)		
Test Date (YYYY-MM-DD).....:	—	—
Location	☐ Flexible Frontsheet ☐ Flexible Backsheet ☐ Rigid Frontsheet ☐ Rigid Backsheet ☐ Other areas	—
Width of cemented joint	☐ ≤ 10 mm ☐ > 10mm	—

Description of area		—
Arithmetic mean M1 of adhesion force of unconditioned samples [N]	—	—
Arithmetic mean M2 of adhesion force of samples conditioned with sequence B [N]	—	—
Loss of adhesion force: $0.5 < \frac{\sum_1^n M2}{\sum_1^n M1}$	—	—
Supplementary information: —		

Sample #:	—	—
Table 40: MST 36 - Lap shear strength test (only for cemented joints)		
Test Date (YYYY-MM-DD).....:	—	—
Preconditioning:		
MST 53 Test Date (YYYY-MM-DD) start/end....:	—	—
MST 54 Test Date (YYYY-MM-DD) start/end....:	—	—
MST 52 Test Date (YYYY-MM-DD) start/end....:	—	—
MST 54 Test Date (YYYY-MM-DD) start/end....:	—	—
MST 52 Test Date (YYYY-MM-DD) start/end....:	—	—
Arithmetic mean M1 of adhesion force of unconditioned samples [N]	—	—
Arithmetic mean M2 of adhesion force of samples conditioned with sequence B [N]	—	—
Loss of adhesion force: $0.5 < \frac{\sum_1^n M2}{\sum_1^n M1}$	—	
Supplementary information: —		

Table 41: MST 12 - Cut susceptibility test				
Test Date (YYYY-MM-DD) .....:			2023-10-11; 2023-09-25; 2023-09-26; 2023-10-23; 2023-09-11; 2023-09-20; 2023-11-28; 2023-10-26	—
Applied force (N) .....:			8.9	—
MST 01 Visual inspection after cut test				—
Test Date (YYYY-MM-DD) .....:			2023-10-11; 2023-09-25; 2023-09-26; 2023-10-23; 2023-09-11; 2023-09-20; 2023-11-28; 2023-10-26	—
Sample # PVT230334306	Findings.....		☐ Yes .....☒ No	P
	Nature and position of findings – comments or attach photos			—
Sample # PVT230334307	Findings.....		☐ Yes .....☒ No	P
	Nature and position of findings – comments or attach photos			—
Sample # PVT230334310	Findings.....		☐ Yes .....☒ No	P
	Nature and position of findings – comments or attach photos			—
Sample # PVT230334312	Findings.....		☐ Yes .....☒ No	P
	Nature and position of findings – comments or attach photos			—
Sample # PVT230334322	Findings.....		☐ Yes .....☒ No	P
	Nature and position of findings – comments or attach photos			—
Sample # PVT230334337	Findings.....		☐ Yes .....☒ No	P
	Nature and position of findings – comments or attach photos			—
Sample # PVT230334340	Findings.....		☐ Yes .....☒ No	P
	Nature and position of findings – comments or attach photos			—
MST 16: Insulation test after cut test				—
Test Date (YYYY-MM-DD) .....:			2023-10-11; 2023-09-25; 2023-09-26; 2023-10-23; 2023-09-11; 2023-09-20; 2023-11-28; 2023-10-26	—
Test Voltage applied (V, DC) .....:			1500/8000	—
Sample #	Measured	Required	Dielectric breakdown	Result

	MΩ	MΩ	Yes (description)	No	
PVT230334306	14754	15.50	-	√	P
PVT230334307	18463	15.50	-	√	P
PVT230334310	35746	15.50	-	√	P
PVT230334312	36744	15.50	-	√	P
PVT230334314	20183	15.50	-	√	P
PVT230334322	27512	15.50	-	√	P
PVT230334337	38564	12.90	-	√	P
PVT230334340	20183	12.90	-	√	P

MST 17: Wet leakage current test after cut test			
Test Date (YYYY-MM-DD) .....:		2023-10-11; 2023-09-25; 2023-09-26; 2023-10-23; 2023-09-11; 2023-09-20; 2023-11-28; 2023-10-26	—
Test Voltage applied (V, dc) .....:		1500	—
Solution resistivity (Ω cm) .....:		< 3500 Ω cm at 22 ± 2°C	—
Solution temperature (°C) .....:		22 ± 2	—
Sample #	Measured (MΩ)	Required (MΩ)	Result
PVT230334306	2481	15.50	P
PVT230334307	1836	15.50	P
PVT230334310	16242	15.50	P
PVT230334312	21601	15.50	P
PVT230334314	489	15.50	P
PVT230334322	18361	15.50	P
PVT230334337	11467	12.90	P
PVT230334340	25263	12.90	P
Supplementary information: —			

Table 42: MST 03 - Maximum power determination final						
Test Date (YYYY-MM-DD) .....:	2023-10-11; 2023-09-25; 2023-10-09					—
Module temperature (°C) .....:	25					—
Irradiance (W/m²) .....:	1000					—
Sample #	Isc (A)	Voc (V)	Imp (A)	Vmp (V)	Pmp (W)	FF (%)
PVT230334306	13.392	51.91	10.247	39.42	403.95	58.11
PVT230334307	13.385	52.18	12.468	43.56	543.16	77.77
PVT230334315	13.543	52.25	12.873	44.52	573.12	80.99
Supplementary information: —						

Table 43: MST 01 - Final Visual inspection			
Test Date (YYYY-MM-DD) .....:		2023-10-11; 2023-09-25	—
Sample # PVT230334306	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		—
Sample # PVT230334307	Findings .....:	☐ Yes.....☒ No	P
	Nature and position of findings – comments or attach photos		—
Supplementary information: —			

Table 44: MST 05 - Durability of markings									
Test Date (YYYY-MM-DD) .....:	2023-10-11; 2023-09-25; 2023-09-26; 2023-10-23; 2023-09-11; 2023-09-20; 2023-11-28; 2023-10-26								—
Sample #	Markings legible		Not easily removable		No curling		Result		
PVT230334306	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P		
PVT230334307	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P		
PVT230334310	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P		
PVT230334312	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P		
PVT230334314	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P		
PVT230334315	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P		
PVT230334322	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P		
PVT230334337	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P		
PVT230334338	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P		
PVT230334340	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P		
Supplementary information: —									

Table 45: MST 06 - Sharp edge test				
Test Date (YYYY-MM-DD) .....:	2023-10-11; 2023-09-25; 2023-09-26; 2023-10-23; 2023-09-11; 2023-09-20; 2023-11-28; 2023-10-26			—
Sample #	Accessible surfaces free of sharp edges, burrs etc.			Result
PVT230334306	☒ Yes	☐ No		P
PVT230334307	☒ Yes	☐ No		P
PVT230334310	☒ Yes	☐ No		P
PVT230334312	☒ Yes	☐ No		P
PVT230334314	☒ Yes	☐ No		P
PVT230334315	☒ Yes	☐ No		P
PVT230334322	☒ Yes	☐ No		P
PVT230334337	☒ Yes	☐ No		P
PVT230334338	☒ Yes	☐ No		P
PVT230334340	☒ Yes	☐ No		P
Supplementary information: —				

Table 46: MST 07 - Bypass diode functionality test		
Test Date (YYYY-MM-DD) .....:	2023-10-11; 2023-09-25; 2023-09-26; 2023-10-23; 2023-09-11; 2023-09-20; 2023-11-28; 2023-10-26	—

☐ **Method A**								—
Ambient temperature [°C] .....:		—						—
Current flow applied [A] .....:		—						—

Sample #	VFM	VFMrated	VFM = (N × VFMrated) ± 10 %	Result
—	—	—	—	—

☒ **Method B**								—

Sample #	IV curve after shading						Result
	Diode 1 working properly		Diode 2 working properly		Diode 3 working properly		
PVT230334306	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P
PVT230334307	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P
PVT230334312	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P
PVT230334314	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P
PVT230334337	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P
PVT230334340	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P
PVT230334322	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P
PVT230334310	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P
PVT230334315	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	P

Supplementary information: —

Table 47: MST 33a - Test for general screw connections			
Test Date (YYYY-MM-DD) ..... :		—	—
Sample #	Thread diameter [mm]	Torque [Nm]	Result
—	—	—	—
Supplementary information:			

Table 48: MST 33b - Test for locking screws			
Test Date (YYYY-MM-DD) ..... :		—	—
Sample #	Thread diameter [mm]	Torque [Nm]	Result
—	—	—	—
Supplementary information: —			

Sample #	PVT230334306	—
Table 49: MST 04 - Insulation thickness test		
Test Date (YYYY-MM-DD) ..... :	2023-10-11	—
Max. System voltage ..... :	1500	—
Thickness of insulation acc. datasheet ..... :	/	—
Required thickness of insulation..... :	300 μ m	—
Measurement uncertainty ..... :	±1μm	—
Location	Measured thickness (including uncertainty)	Result
1	328.7	P
2	329.6	P
3	327.3	P
Supplementary information: —		

ANNEX 1: LIST OF TEST EQUIPMENT USED:

A completed list of used test equipment shall be provided in the Test Reports when a Manufacturer Testing Laboratory according to CTF stage 1 or CTF stage 2 procedure has been used.
Note: This page may be removed when CTF stage 1 or CTF stage 2 are not used. See also clause 4.8 in OD 2020 for more details.

Clause	Measurement / testing	Testing / measuring equipment / material used, (Equipment ID)	Range used	Last Calibration date	Calibration due date
1	Visual inspection	Illuminator	—	2023-12-17	2024-12-18
2		Steel measuring tape	—	2023-11-19	2024-11-20
3	Performance at STC	highlight Solar Simulator	—	2024-05-11	2025-05-10
4		Reference cell	—	2024-05-11	2025-05-10
5		Temperature and humidity meter	—	2023-12-17	2024-12-18
6	Insulation test	Temperature and humidity meter	—	2023-12-17	2024-12-18
7		AC/DC insulated withstand voltage tester	—	2023-11-18	2024-11-19
8	Wet leakage current test	AC/DC insulated withstand voltage tester	—	2023-11-18	2024-11-19
9		Conductivity meter	—	2023-12-18	2024-12-17

10	Damp-Heat test	Constant temperature and humidity climate chamber	—	2024-04-20	2025-04-21
11	Thermal cycling test	Climate chamber	—	2024-04-20	2025-04-21
12	Humidity-freeze test	Climate chamber	—	2024-04-20	2025-04-21
13	UV preconditioning test	UV test equipment	—	2023-08-05	2024-08-06
14	Reverse Current overload test	current	—	2023-4-27	2024-04-26
15		temperature	—	2023-4-27	2024-04-26
16	Hot-spot endurance test	Steady-state environmental	—	2023-08-15	2024-08-16
17	Outdoor exposure test	Steady-state environmental simulation chamber	—	2023-08-15	2024-08-16
18	Bypass diode thermal testing	Bypass diode thermal test system	—	2023-04-25	2024-04-26
19	Bypass diode functionality test	highlight Solar Simulator	—	2023-05-09	2024-05-10
20	Robustness of termination test	Termination stability measurement	—	2023-07-12	2024-07-13
21	Cut susceptibility test	Stopwatch	—	2023-07-01	2024-07-02

ANNEX 2: CONSTRUCTIONAL DETAILS / BILL OF MATERIAL (BOM)

5.3.2 Internal wiring		
Cell connector		
Manufacturer:	Type:	Material:
Lanxin	-	Copper
Thickness [µm]:	Dimension [mm]:	Coatings:
-	0.26	Alloy(Sn, Pb)
Supplementary Information:		
String connector		
Manufacturer:	Type:	Material
Lanxin	-	Copper
Thickness [µm]:	Dimension [mm]:	Coatings:
-	0.35x4mm ; 0.35x6mm/ 0.3x8mm	Alloy(Sn, Pb)
Supplementary Information:		
5.3.3 External wiring and cables		
Cables		
Manufacturer:	Type:	Material:
Ningbo Kibor Wire & Cable Co., Ltd.	62930 IEC 131 1x4,0mm²	Stranded tinned copper
Diameter [mm²]:	Length [mm]:	Max. Temperature:
4mm²	-	-
Certified: ☒ Yes / ☐ No	Standards:	Others:
Certifier and Cert. No.	☒ IEC 62930 ☐ EN 50618	
Supplementary Information:		
5.3.4 Connectors		
Manufacturer:	Type:	Class:
The 40th Institute of China Electronic Technology Group Corporation	PV-ZPJ030A	Class II
Max. Voltage:	Max. Current:	Max. Temperature:
1500V	38A	-
IP-rating:	Locked:	
IP 68	☒ Yes / ☐ No	
Certified: ☐ Yes / ☐ No	Standards:	Others:
Certifier and Cert. No.	☒ IEC 62852	
Supplementary Information:		
5.3.5 Junction boxes		
Manufacturer:	Type:	Class:
The 40th Institute of China Electronic Technology Group Corporation	PV-ZPB090X	Class II
IP-rating:	Dimensions (l x w x h) [mm²]:	Weight [g]:
IP 68	-	-
Max. Voltage:	Max. Current:	Max. Temperature:
1500V	30	-
Electrical Termination cell side:	Electrical Termination cell side:	Number of Bypass Diodes
Soldered ☒ Crimped ☐ Welded ☐ Screwed ☐	Soldered ☒ Crimped ☐ Welded ☐ Screwed ☐	

Screwless ☐	Screwless ☐	
Potted:	Certified: ☒ Yes / ☐ No	Standards:
☒ Yes / ☐ No	Certifier and Cert. No.	☒ IEC 62790
Supplementary Information:		

5.3.6 Frontsheets and backsheets		
Frontsheet		
Used as: ☐ Basic Insulation ☒ Reinforced Insulation		
Total Dimensions (width x length) [mm]: 2279x1134		
Material:	Manufacturer:	Type:
Glass	CSG	-
Thickness [mm]:	Heat strength.: ☐ Yes / ☐ No	Coating: ☐ Yes / ☐ No
3.2	☒ Tempered ☐ Heat strengthened ☐ Annealed	Description
Structured: ☐ Yes / ☒ No	Certified: ☐ Yes / ☒ No	Standards:
Description	Certifier and Cert. No.	
Backsheet		
Used as: ☐ Basic Insulation ☒ Reinforced Insulation		
Multi-layer ☐	Used as: ☐ Basic Insulation ☐ Reinforced Insulation	
Material:	Manufacturer:	Type:
FFC（EVA side）;	jolywood	FFC-JW3010(plus)
Total Thickness [mm]:	No of layers:	
-	-	
Layer No. 1 (air side)	Used as: ☐ Basic Insulation ☐ Reinforced Insulation	
Material:	Manufacturer:	Type:
FFC	jolywood	FFC-JW3010(plus)
Thickness [mm]	Thermal Index:	Material Group:
-	☐ RTE °C ☐ TI °C ☐ RTI °C	☐ I ☐ II ☐ III
Colour:	Certified ☒ Yes / ☐ No	Standards:
-	Certifier and Cert. No. No.B 096222 0001 Rev.02	
Supplementary Information:		
5.3.7 Insulation barriers / Edge sealant		
Used as: ☐ Functional ☐ Basic Insulation ☐ Reinforced Insulation		
Total Dimensions (width x length) [mm]:		
Material:	Manufacturer:	Type:
Thickness [mm]	Thermal Index:	Material Group:
	☐ RTE °C ☐ TI °C ☐ RTI °C	☐ I ☐ II ☐ III
Colour:	Certified ☐ Yes / ☐ No	Standards:
	Certifier and Cert. No.	
Supplementary Information:		
5.3.9 Encapsulants		
Used as: ☐ Basic Insulation ☐ Reinforced Insulation ☒ N/A		
Total Dimensions (width x length) [mm]: 2279x1134		
Material: (Frontsheet side)	Manufacturer:	Type:
POE	tianyang	JCC-305P
Thickness [mm]	Thermal Index:	Material Group:
0.45~0.55	☐ RTE °C ☐ TI °C	☐ I ☐ II

	☐ RTI °C	☐ III
Colour:	Certified ☒ Yes / ☐ No	Standards:
-	Certifier and Cert. No. SHMR230500974903	

Material: (Backsheet side)	Manufacturer:	Type:
EVA	tianyang	305T
Thickness [mm]	Thermal Index:	Material Group:
0.45~0.55	☐ RTE °C ☐ TI °C ☐ RTI °C	☐ I ☐ II ☐ III
Colour:	Certified ☒ Yes / ☐ No	Standards:
-	Certifier and Cert. No. SHMR230500974903	
Supplementary Information:		

5.5.2.3 Polymeric materials used as electrical insulation		
Location:		
Application ☐ External part ☐ Support of live parts ☐ Mechanical functions		
Used as: ☐ Functional ☐ Basic Insulation ☐ Reinforced Insulation		
Material:	Manufacturer:	Type:
Flammability class:		
Thickness [mm]	Thermal Index:	Material Group:
	☐ RTE °C ☐ TI °C ☐ RTI °C	☐ I ☐ II ☐ III
Colour:	Certified ☐ Yes / ☐ No	Standards:
	Certifier and Cert. No.	
Supplementary Information:		
Location:		
Application ☐ External part ☐ Support of live parts ☐ Mechanical functions		
Used as: ☐ Functional ☐ Basic Insulation ☐ Reinforced Insulation		
Material:	Manufacturer:	Type:
Flammability class:		
Thickness [mm]	Thermal Index:	Material Group:
	☐ RTE °C ☐ TI °C ☐ RTI °C	☐ I ☐ II ☐ III
Colour:	Certified ☐ Yes / ☐ No	Standards:
	Certifier and Cert. No.	
Supplementary Information:		

5.3.10 Bypass Diodes		
Manufacturer:	Type:	
Hangzhou Daoming Micro-electronics Co.,LTD	GFMK4045	
Nominal current of diode I_F (A)	25	
R_{THJ-C} (K/W) / R_{THJ-L} (K/W)	-	
Max. T_J (°C)	200	
Max. V_F at I_F (V)	-	

Supplementary Information:

5.4.6 Adhesives		
For Junction Boxes		
Manufacturer:	Type:	
Huitian	HT906Z	J-Box adhesive
Huitian	5299W-S	Potting
Additional function as: ☐ Basic Insulation ☐ Reinforced Insulation ☒ N/A		
Thickness [mm]	Thermal Index:	Material Group:
	☐ RTE °C ☐ TI °C ☒ RTI 105 °C	☒ I ☐ II ☐ III
Supplementary Information:		
For Frames / Backrails		
Additional function as: ☐ Basic Insulation ☐ Reinforced Insulation ☒ N/A		
Manufacturer:	Type:	
Huitian	HT906Z	
Additional function as: ☐ Basic Insulation ☐ Reinforced Insulation ☒ N/A		
Thickness [mm]	Thermal Index:	Material Group:
	☐ RTE °C ☐ TI °C ☒ RTI °C	☒ I ☐ II ☐ III
Supplementary Information:		

5.5.3 Metallic Materials		
Frame / Corner joint / Backrail:		
Manufacturer:	Type:	Dimension
Sentong	6063-T5	30mm
Supplementary Information:		
Others:		
Manufacturer:	Type:	Dimension
-	-	-
Supplementary Information:		

Cell		
Kind of cell	Manufacturer:	Type:
☒ cSi ☐ CdTe ☐ aSi ☐ CiGs	Jietai	CZJT-182M-16D1
Thickness [µm]:	Dimension [mm]:	Number of busbars:
130µm±13µm	182x91±0.5	-
Supplementary Information:		

Cell fixing Tape						
No.	Material	Manufacturer	Type		Ratings	
1		Dongguan XiongFei Electronic	YX008	-	8	

		Material Co., Ltd.				