Test Report issued under the responsibility of:

NCB TÜV SÜD Product Service GmbH
Ridlerstr. 65
D – 80339 München
Germany

TEST REPORT

IEC 61215-series:2016

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

Report Number. ..... :	704061806602-00 part 1 of 2
Date of issue..... :	2018-08-16
Total number of pages ..... :	58
TÜV SÜD Branch ..... :	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
Applicant's name..... :	Ningbo Ulica Solar Science&Technology Co.,Ltd
Address..... :	NO.181, SHANSHAN ROAD, WANGCHUN INDUSTRIAL DISTRICT, NINGBO, CHINA
Test specification:	
Standard ..... :	☒ IEC 61215-1:2016 ☒ IEC 61215-2:2016 ☒ IEC 61215-1-1:2016 ☐ IEC 61215-1-2:2016 ☐ IEC 61215-1-3:2016 ☐ IEC 61215-1-4:2016
Test procedure ..... :	TÜV SÜD Mark
Non-standard test method ..... :	N/A
Test Report Form No. ..... :	IEC61215D_SE
Test Report Form(s) Originator.... :	TÜV SÜD Product Service GmbH
Master TRF..... :	2017-11-30

If this Test Report Form is used by non-IECEE members, the IECEE/IEC logo and the reference to the CB Scheme procedure shall be removed.

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.
This report shall not be reproduced, except in full, without the written approval of the Issuing CB Testing Laboratory. The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report.

Test item description..... :	Photovoltaic (PV) Module(s)
Trade Mark..... :	utica solar LEADING IN TECHNOLOGY
Manufacturer..... :	Ningbo Ulica Solar Science&Technology Co.,Ltd NO.181, SHANSHAN ROAD, WANGCHUN INDUSTRIAL DISTRICT, NINGBO, CHINA
Model/Type reference..... :	See page 7 - 12 of this report
Ratings..... :	See page 7 - 12 of this report

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

☒	**TÜV SÜD Branch:**	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
Testing location/address.....:		No. 151 Heng Tong Road, Shanghai 200070, P. R. China
☒	**Associated Testing Laboratory:**	Yangzhou Opto-Electrical Products Testing Institute
Testing location/address.....:		No. 10 West Kaifa Road, Yangzhou, 225009 Jiangsu, P. R. China.
Tested by (name + signature) .....:		Ning Tang
Approved by (name + signature) .....:		Yaozhong Wu

☐	**Testing procedure: TMP/CTF Stage 1:**	
Testing location/address.....:		
Tested by (name + signature) .....:		
Approved by (name + signature) .....:		

☐	**Testing procedure: WMT/CTF Stage 2:**	
Testing location/address.....:		
Tested by (name + signature) .....:		
Witnessed by (name + signature) .....:		
Approved by (name + signature) .....:		

☐	**Testing procedure: SMT/CTF Stage 3 or 4:**	
Testing location/address.....:		
Tested by (name + signature) .....:		
Witnessed by (name + signature) .....:		
Approved by (name + signature) .....:		
Supervised by (name + signature).....:		

List of Attachments (including a total number of pages in each attachment):	
	attachment number / number of pages
Installation manual	Attachment No.3 / 26 pages
Drawings mechanical	Refer to Annex 2 of 704061800602-00 2 of 2
Circuit diagram	Refer to Annex 2 of 704061800602-00 2 of 2
Photographs	Attachment No.1 / 6 pages
Component datasheets / certificates	Attachment No.2 / 211 pages
Others:	
Product Description Sheet (Manufacturers and type references)	Annex 1, _3_ pages
Test table for verifying other stabilization procedure	Annex 2, _2_ pages
Lower and higher output power modules	Annex 3, _3_ pages
List of test equipment used	Annex 4, _2_ pages

Summary of testing:	
Tests performed (name of test and test clause):	**Testing location 1:**
Add below modules with 1500 V DC system voltage: UL-xxxM-72HV, xxx stands for power range from 330~375, in step of 5 W, 1956 x 992 x 46mm; UL-xxxM-60HV, xxx stands for power range from 275~310, in step of 5 W, 1650 x 992 x 46mm; UL-xxxM-54HV, xxx stands for power range from 245~280, in step of 5 W, 1479 x 992 x 46mm; UL-xxxM-48HV, xxx stands for power range from 220~250, in step of 5 W, 1321 x 992 x 46mm; All tests except final stabilization (MQT 19.2) according to IEC 61215-1:2016, IEC 61215-1-1:2016, IEC 61215-2 were conducted on model UL-360M-72HV. Add below new models with 1000V DC system voltage coverd by 1500 V DC system voltage modules: UL-xxxM-72, xxx stands for power range from 330~375, in step of 5 W, 1956 x 992 x 46mm; UL-xxxM-60, xxx stands for power range from 275~310, in step of 5 W, 1650 x 992 x 46mm; UL-xxxM-54, xxx stands for power range from 245~280, in step of 5 W, 1479 x 992 x 46mm; UL-xxxM-48, xxx stands for power range from 220~250, in step of 5 W, 1321 x 992 x 46mm; No additional tests considered necessary here.	Yangzhou Opto-Electrical Products Testing Institute No. 10 West Kaifa Road, Yangzhou, 225009 Jiangsu, P. R. China

Besides, 1.Add a new junction box: PV-ZH011-6, used in 1000 V DC system voltage modules, supplied by Zhejiang Zhonghuan Sunter PV Technology Co., Ltd, which has been verified, the details please refer to the junction box CDF 7040712115902-08 provided by TÜV SÜD. No additional tests considered necessary here. 2. Add a new junction box: JM13D-1, used in 1000 V DC system voltage modules, supplied by Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd, which has been verified, the details please refer to the junction box CDF 704071711905-00 provided by TÜV SÜD. No additional tests considered necessary here.	

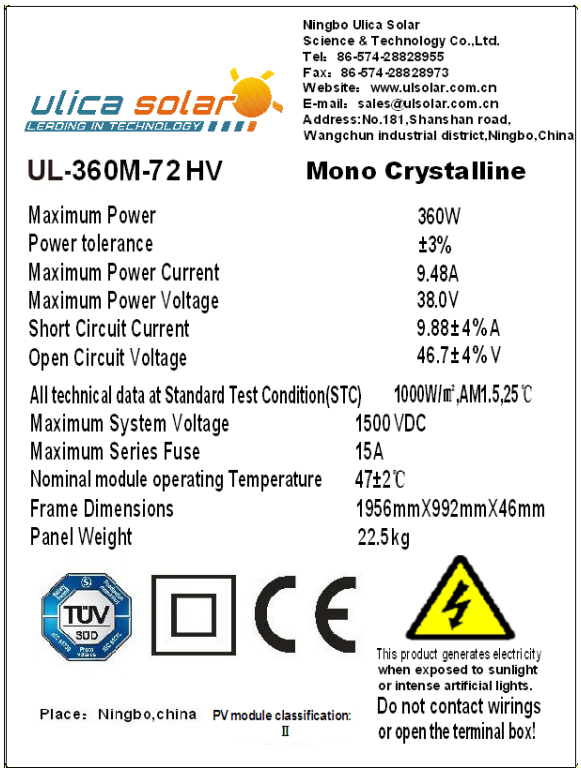
Summary of compliance with National Differences (List of countries addressed):

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 TÜV SÜD Product Service GmbH that own these marks.



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

Test item particulars.....:	N/A
Accessories and detachable parts included in the evaluation.....:	
Mounting system used.....:	Refer to user manual
Other options included.....:	N/A
Possible test case verdicts:	
- test case does not apply to the test object ..... :	N/A
- test object does meet the requirement ..... :	P (Pass)
- test object does not meet the requirement..... :	F (Fail)
Abbreviations used in the report:	
Pmax – Maximum power	HF – Humidity Freeze
Vmp – Maximum power voltage	DH – Damp Heat
Imp – Maximum power current	TC – Thermal Cycling
Isc – Short circuit current	α – Current temperature coefficient
Voc – Open circuit voltage	β – Voltage temperature coefficient
FF – Fill factor	δ – power temperature coefficient
STC – Standard Test Conditions (25°C, 1 000 W/m²)	NMOT – Nominal Module Operating Temperature (20°C, 800 W/m²)
MQT – Module Quality Tests	$V_{FMrated}$ – Rated diode(s) forward voltage
VFM – Measured diode(s) forward voltage	NP – Nameplate
m_1 – the measurement uncertainty in % of laboratory for Pmax	m_2 – the measurement uncertainty in % of laboratory for Voc
m_3 – the measurement uncertainty in % of laboratory for Isc	t_1 – the manufacturer's rated lower production tolerance in % for Pmax
t_2 – the manufacturer's rated upper production tolerance in % for Voc	t_3– the manufacturer's rated upper production tolerance in % for Isc
r – Pmax measurement reproducibility	
Testing Dates (YYYY-MM-DD)	
Date of first test item received..... :	2018-04-04
Dates of tests (beginning/end) ..... :	2018-04-04~2018-07-16

GENERAL REMARKS:	
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report. **This TRF has been created in cooperation with CTL ETF-9 and German National Committee (DKE).** **The originator's responsibility of this TRF in IECEE CB Scheme has been assigned to TÜV SÜD Product Service GmbH.** Throughout this report a ☐ comma / ☒ point is used as the decimal separator.	
Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:	
The application for obtaining a TÜV SÜD Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided..... :	☐ Yes ☒ Not applicable
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (factories)..... :	Ningbo Ulica Solar Science&Technology Co.,Ltd NO.181, SHANSHAN ROAD, WANGCHUN INDUSTRIAL DISTRICT, NINGBO, CHINA Factory No.: 83334

PRODUCT ELECTRICAL RATINGS:				
Module type	UL-330M-72HV/ UL-330M-72	UL-335M-72HV/ UL-335M-72	UL-340M-72HV/ UL-340M-72	UL-345M-72HV/ UL-345M-72
Voc [V] /Tolerance	46±4%	46.2±4%	46.3±4%	46.4±4%
Vmp [V]	37.4	37.5	37.6	37.7
Imax [Adc]	8.83	8.94	9.05	9.16
Isc [Adc] /Tolerance	9.27±4%	9.38±4%	9.49±4%	9.6±4%
Pmp [W] /Tolerance	330±3%	335±3%	340±3%	345±3%
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	15	15	15	15
Module type	UL-350M-72HV/ UL-350M-72	UL-355M-72HV/ UL-355M-72	UL-360M-72HV/ UL-360M-72	UL-365M-72HV/ UL-365M-72
Voc [V] /Tolerance	46.5±4%	46.6±4%	46.7±4%	46.8±4%
Vmp [V]	37.8	37.9	38	38.1
Imax [Adc]	9.27	9.37	9.48	9.59
Isc [Adc] /Tolerance	9.71±4%	9.77±4%	9.88±4%	9.93±4%
Pmp [W] /Tolerance	350±3%	355±3%	360±3%	365±3%
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	15	15	15	15
Module type	UL-370M-72HV/ UL-370M-72	UL-375M-72HV/ UL-375M-72	-	-
Voc [V] /Tolerance	46.9±4%	47±4%	-	-
Vmp [V]	38.2	38.3	-	-
Imax [Adc]	9.69	9.8	-	-
Isc [Adc] /Tolerance	9.97±4%	10.08±4%	-	-
Pmp [W] /Tolerance	370±3%	375±3%	-	-
Maximum system voltage [V]	1500	1500	-	-
Maximum Over-Current Protection Rating [A]	15	15	-	-
Module type	UL-275M-60HV/ UL-275M-60	UL-280M-60HV/ UL-280M-60	UL-285M-60HV/ UL-285M-60	UL-290M-60HV/ UL-290M-60
Voc [V] /Tolerance	38.4±4%	38.5±4%	38.6±4%	38.7±4%
Vmp [V]	31.2	31.3	31.4	31.5

Imax [Adc]	8.82	8.95	9.08	9.21
Isc [Adc] /Tolerance	9.25±4%	9.37±4%	9.5±4%	9.63±4%
Pmp [W] /Tolerance	275±3%	280±3%	285±3%	290±3%
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	15	15	15	15
Module type	UL-295M-60HV/ UL-295M-60	UL-300M-60HV/ UL-300M-60	UL-305M-60HV/ UL-305M-60	UL-310M-60HV/ UL-310M-60
Voc [V] /Tolerance	38.8±4%	38.9±4%	39.1±4%	39.2±4%
Vmp [V]	31.6	31.7	31.8	31.9
Imax [Adc]	9.34	9.47	9.59	9.72
Isc [Adc] /Tolerance	9.75±4%	9.87±4%	9.91±4%	10.01±4%
Pmp [W] /Tolerance	295±3%	300±3%	305±3%	310±3%
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	15	15	15	15
Maximum Over-Current Protection Rating [A]	15	15	15	15
Module type	UL-245M-54HV/ UL-245M-54	UL-250M-54HV/ UL-250M-54	UL-255M-54HV/ UL-255M-54	UL-260M-54HV/ UL-260M-54
Voc [V] /Tolerance	34.4±4%	34.5±4%	34.6±4%	34.7±4%
Vmp [V]	27.9	28	28.1	28.2
Imax [Adc]	8.79	8.93	9.08	9.22
Isc [Adc] /Tolerance	9.2±4%	9.34±4%	9.49±4%	9.62±4%
Pmp [W] /Tolerance	245±3%	250±3%	255±3%	260±3%
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	15	15	15	15
Module type	UL-265M-54HV/ UL-265M-54	UL-270M-54HV/ UL-270M-54	UL-275M-54HV/ UL-275M-54	UL-280M-54HV/ UL-280M-54
Voc [V] /Tolerance	34.8±4%	34.9±4%	35±4%	35.1±4%
Vmp [V]	28.3	28.4	28.5	28.6
Imax [Adc]	9.37	9.51	9.65	9.79
Isc [Adc] /Tolerance	9.77±4%	9.91±4%	9.94±4%	10.07±4%
Pmp [W] /Tolerance	265±3%	270±3%	275±3%	280±3%

Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	15	15	15	15
Module type	UL-220M-48HV/ UL-220M-48	UL-225M-48HV/ UL-225M-48	UL-230M-48HV/ UL-230M-48	UL-235M-48HV/ UL-235M-48
Voc [V] /Tolerance	30.8±4%	31±4%	31.1±4%	31.2±4%
Vmp [V]	25	25.2	25.3	25.4
Imax [Adc]	8.8	8.93	9.1	9.25
Isc [Adc] /Tolerance	9.27±4%	9.4±4%	9.53±4%	9.65±4%
Pmp [W] /Tolerance	220±3%	225±3%	230±3%	235±3%
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	15	15	15	15
Module type	UL-240M-48HV/ UL-240M-48	UL-245M-48HV/ UL-245M-48	UL-250M-48HV/ UL-250M-48	-
Voc [V] /Tolerance	31.3±4%	31.4±4%	31.5±4%	-
Vmp [V]	25.5	25.6	25.7	-
Imax [Adc]	9.41	9.57	9.73	-
Isc [Adc] /Tolerance	9.79±4%	9.88±4%	9.92±4%	-
Pmp [W] /Tolerance	240±3%	245±3%	250±3%	-
Maximum system voltage [V]	1500	1500	1500	-
Maximum Over-Current Protection Rating [A]	15	15	15	-
Note: Further qualification for higher and/or lower output power see annex 4				

GENERAL PRODUCT INFORMATION AND OTHER REMARKS:

Modifications:

☒ Initial module design qualification

☒ Extension of module design qualification

☐ Original test report ref. No. ..... : N/A

Model differences and modification:

☐ Test programs for crystalline silicon PV modules

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

☐ Test programs for thin-film PV modules

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

Note: The clause references modifications extracted from IEC 62915

MODULE GROUP ASSIGNMENT:

Sample #	Sample Group ID	Type/model	Sample S/N	Remark
M10	A1	UL-360M-72HV	U612MW1803T0013B	Control module
M11	A2	UL-360M-72HV	U612MW1803T0008B	—
M12	A3	UL-360M-72HV	U612MW1803T0007B	—
M13	B	UL-360M-72HV	U612MW1803T0006B	OD, BD,HS
M4	C1	UL-360M-72HV	U612MW1803T0022B	UV sequence
M5	C2	UL-360M-72HV	U612MW1803T0011B	UV sequence
M8	D1	UL-360M-72HV	U612MW1803T0029B	TC200
M9	D2	UL-360M-72HV	U612MW1803T0025B	TC200
M6	E1	UL-360M-72HV	U612MW1803T0026B	DH1000
M7	E2	UL-360M-72HV	U612MW1803T0009B	DH1000
Higher end power class	—	UL-375M-72HV	U612MW1803T0033B	—
Higher end power class	—	UL-375M-72HV	U612MW1803T0031B	—
Lower end power class	—	UL-330M-72HV	U612MW1803T0003A	—
Lower end power class	—	UL-330M-72HV	U612MW1803T0004A	—

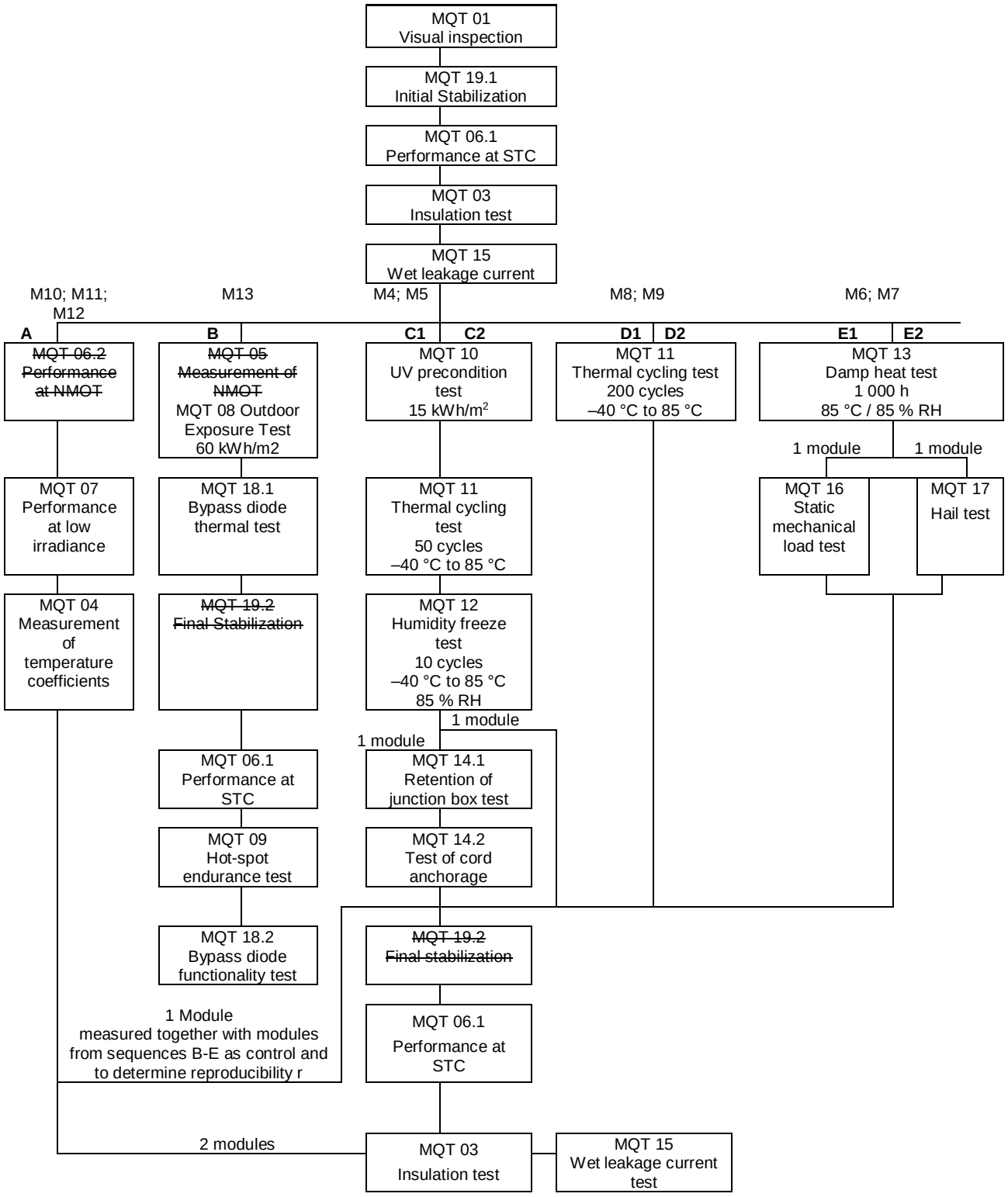
Supplementary information: N/A

Note (1) Use the “General product information” field to give any information on model differences within a product type family covered by the test report and to describe the range of electrical and safety ratings, if the TRF covers a type family of modules.

Note (3) Use Annex 1 to list the used materials and components of the module (manufacturer/supplier and type reference).

Note (4) The module numbers/identifiers are set in accordance to IEC 62915 Photovoltaic (PV) modules – Retesting for type approval, design and safety qualification, Annex A3

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



IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict
5. MARKING AND DOCUMENTATION			P
5.1	**Name Plate**		
	All electrical data is shown as relative to standard test conditions (1 000 W/m², 25 °C, AM 1,5 according to IEC TS 61836).	Marked on label	P
	International symbols are used where applicable.	Marked on label	P
	The module includes clear and indelible markings:		—
	a. Name, registered trade name or registered trade mark of manufacturer	Ningbo Ulica Solar Science&Technology Co.,Ltd	P
	b. Type or model number designation	UL-360M-72HV	P
	c. Serial number (unless marked on other part of product)	Provided under superstrate near the top rail of frame	P
	d. Date and place of manufacture, alternatively serial number allowing to trace the date and place of manufacture;	serial number allowing to trace the date and place of manufacture	P
	e. Maximum system voltage	1500V DC	P
	f. Class of protection against electrical shock	Class II	P
	g. Voltage at open-circuit or Voc including tolerances.	46.7±4%for example	P
	h. Current at short-circuit or Isc including tolerances	9.88±4% for example	P
	i. Module maximum power or Pmax including tolerances	360±3% for example	P
5.2	**Documentation**		
5.2.1	Minimum requirements		
	Modules are supplied with documentation describing the methods of electrical and mechanical installation as well as the electrical ratings of the module		P
	The documentation states the class of protection against electrical shock under which the module has been qualified and any specific limitations required for that class.		P
	The documentation assures that installers and operators receive appropriate and sufficient documentation for safe installation, use, and maintenance of the PV modules.		P
5.2.2	Information given in the documentation		P
	a. All information required under 5.1 e) to i)	Refer to manual document	P
	b. Overcurrent protection device type and rating are e.g. given in IEC 60269-6	Refer to manual document	P

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

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict
	r. A statement indicating the fire rating(s) and the applied standard and the limitations to that rating (e.g., installation slope, sub-structure or other applicable installation information)		P
	s. A statement indicating the design load per each mechanical means for securing the module as evaluated during the static mechanical load test according to MQT 16. At discretion of the manufacturer the test load and/or the safety factor γ_m may be noted, too		P
	The installation instructions include relevant parameters specified by manufacturer or the following statement or the equivalent: *"Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of I_{SC} and V_{OC} marked on this module should be multiplied by a factor of 1,25 when determining component voltage ratings, conductor current ratings, and size of controls connected to the PV output."*		P
5.2.3	Assembly instructions		N/A
	Provided with a product shipped in subassemblies, detailed and adequate to the degree required to facilitate complete and safe assembly of the product		N/A
Supplementary information: N/A			

7. PASS CRITERIA					P
7.2	**Power output and electric circuitry**				P
7.2.1	Verification of rated label values (Gate No. 1)				P
	Manufacturer's tolerances and Laboratory uncertainties				P
		t_1	t_2	t_3	—
	manufacturer's rated lower/upper production tolerance in %	3	4	4	
		m_1	m_2	m_3	
	measurement uncertainty in % of laboratory	1.9	0.43	1.8	
	Laboratory reproducibility r.....:	+0.28%			
	After stabilization, each individual module meets the requirements				P
	P_{max}	See Table 03			P
	V_{oc}	See Table 03			P
	I_{sc}:	See Table 03			P

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

4. TESTING OVERVIEW			
	Initial examination	All modules	P
4.1	Visual inspection (MQT 01)) ..... :	See Table 01	P
4.19.5	Initial stabilization (MQT 19.1)..... :	See Table 02	P
4.6	Performance at STC (MQT 06.1)	See Table 03	P
4.3	Insulation test (MQT 03) ..... :	See Table 04	P
4.15	Wet leakage current test (MQT 15) ..... :	See Table 05	P

Sequence A	**3 Modules**	Samples M10; M11; M12	P
4.6	Performance at NMOT (MQT 06.2)..... :	See Table 06	N/A
4.7	Performance at low irradiance (MQT 07)..... :	See Table 07	—
4.4	Measurement of temperature coefficients (MQT 04) ..... :	See Table 08	—

Sequence B	**3 Module**	Sample M13	P
4.5	Measurement of nominal module operating temperature (NMOT, °C) (MQT 05)..... :	—	N/A

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Clause	Requirement + Test	Result - Remark	Verdict
4.8	Outdoor exposure test (MQT 08) ..... :	See Table 10	P
4.18.1	Bypass diode thermal test (MQT 18.1)		P
	Maximum allowed junction temperature ..... :	200°C	—
	Calculated junction temperature ..... :	See table 4.18.1 B	—
	Final measurements ..... :	See Table 11	P
4.18.2	Bypass diode functionality test (MQT 18.2) ..... :	See Table 12	P
4.19.6	Final stabilization (MQT 19.2) ..... :	See Table 12.1 – 12.3	N/A
4.9	Hot spot endurance test (MQT 09)..... :	See Table 13.1 - 13.5	P
Sequence C	**2 Modules**	Samples M4; M5	P
4.10	UV preconditioning test (MQT 10)..... :	See Table 14.1 - 14.4	P
4.11	Thermal cycling test 50 cycles (MQT 11) ..... :	See Table 15.1 - 15.4	P
4.12	Humidity-freeze test (MQT 12)..... :	See Table 16.1 - 16.4	P
Sequence C1	**1 Module**	Sample M4	P
4.14	Robustness of terminations test (MQT 14)		—
4.14.2	Retention of junction box on mounting surface (MQT 14.1) ..... :	See Table 17.1 - 17.7	P
4.14.3	Test of cord anchorage (MQT 14.2)		N/A
4.14.3.1	This test omitted if junction box is qualified to IEC 62790..... :	See list of attachments	P
4.14.3.2.1	Junction boxes intended to be used with cables specified by the manufacturer……:	See Table 17.4	N/A
4.14.3.2.2	Junction boxes intended to be used with generic cables……..:	See Table 17.4	N/A
Sequence D	**2 Modules**	Sample M8; M9	P
4.11	Thermal cycling test 200 cycles (MQT 11) ..... :	See Table 18.1 - 18.2	P
Sequence E	**2 Modules**	Samples M6; M7	P
4.13	Damp heat test (MQT 13) ..... :	See Table 19.1 - 19.4	P
Sequence E1	**1 Module**	Sample M6	P
4.16	Static mechanical load test (MQT 16) ..... :	See Table 19.5 - 19.7	P

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Clause	Requirement + Test	Result - Remark	Verdict
Sequence E2	**1 Module**	Sample M7	P
4.17	Hail test (MQT 17)	See Table 19.8 - 19.10	—
	Final measurement	All modules for Sequence C, D, E; Control module for Sequence A	P
4.19.6	Final stabilization (MQT 19.2) ..... :	See Table 20.1 - 20.2	N/A
4.6	Performance at STC (MQT 06.1) ..... :	See Table 20.3	P
4.3	Insulation test(MQT 03) ..... :	See Table 21	P
4.15	Wet leakage current test(MQT 15) ..... :	See Table 22	P

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 01: MQT 01 ini: Initial Visual inspection		P
Test Date [YYYY-MM-DD]..... :	2018-04-04	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M10	No major visual defects found	P
M11	No major visual defects found	P
M12	No major visual defects found	P
M13	No major visual defects found	P
M4	No major visual defects found	P
M5	No major visual defects found	P
M8	No major visual defects found	P
M9	No major visual defects found	P
M6	No major visual defects found	P
M7	No major visual defects found	P
Supplementary information: N/A		

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 02: MQT 19.1 ini: Initial stabilization							P
TABLE 02.1: MQT 06.1 ini: Performance at STC before initial stabilization							P
Test Date [YYYY-MM-DD] ..... :	2018-04-04						—
Test method ..... :	☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
M10	9.728	47.879	9.245	39.319	363.513	78.05	—
M11	9.743	47.964	9.315	39.153	364.691	78.04	—
M12	9.627	47.952	9.227	39.193	361.634	78.34	—
M13	9.735	47.973	9.336	39.081	364.868	78.13	—
M4	9.758	47.907	9.302	39.083	363.545	77.77	—
M5	9.761	48.002	9.324	39.143	364.986	77.90	—
M8	9.794	47.993	9.356	39.054	365.398	77.74	—
M9	9.794	47.939	9.335	39.181	365.763	77.90	—
M6	9.810	47.940	9.299	39.344	365.867	77.80	—
M7	9.804	47.994	9.310	39.307	365.958	77.78	—
Supplementary information: N/A							

TABLE 02.2: MQT 19.1 ini: Initial Stabilization procedure							P
Light exposure method ..... :	☐ Simulator ☒ Natural sunlight						
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Stabilization criterion x per IEC 61215-1-x ..... :	1						
Sample #	M10	Test Date (YYYY-MM-DD) start/end ..... :			2018-04-04/ 2018-04-09		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	363.513	—	—
1	5	Above 500	N/A	4.4	363.375	—	—
2	5	Above 500	N/A	4.4	363.298	0.06	Yes

Sample #	M11	Test Date (YYYY-MM-DD) start/end ..... :			2018-04-04/ 2018-04-09		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	364.691	—	—
1	5	Above 500	N/A	4.4	364.539	—	—
2	5	Above 500	N/A	4.4	364.569	0.04	Yes

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	M12	Test Date (YYYY-MM-DD) start/end .....:			2018-04-04/ 2018-04-09		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	361.634	—	—
1	5	Above 500	N/A	4.4	361.640	—	—
2	5	Above 500	N/A	4.4	361.526	0.03	Yes

Sample #	M13	Test Date (YYYY-MM-DD) start/end ..... :			2018-04-04/ 2018-04-09		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	364.868	—	—
1	5	Above 500	N/A	4.4	364.866	—	—
2	5	Above 500	N/A	4.4	364.706	0.04	Yes

Sample #	M4	Test Date (YYYY-MM-DD) start/end .....:			2018-04-04/ 2018-04-09		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	363.545	—	—
1	5	Above 500	N/A	4.4	363.517	—	—
2	5	Above 500	N/A	4.4	363.538	0.01	Yes
Sample #	M5	Test Date (YYYY-MM-DD) start/end ..... :			2018-04-04/ 2018-04-09		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	364.986	—	—
1	5	Above 500	N/A	4.4	363.879	—	—
2	5	Above 500	N/A	4.4	363.752	0.34	Yes
Sample #	M8	Test Date (YYYY-MM-DD) start/end .....:			2018-04-04/ 2018-04-09		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	365.398	—	—
1	5	Above 500	N/A	4.4	365.461	—	—
2	5	Above 500	N/A	4.4	365.373	0.02	Yes

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	M9	Test Date (YYYY-MM-DD) start/end .....:			2018-04-04/ 2018-04-09		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	365.763	—	—
1	5	Above 500	N/A	4.4	365.712	—	—
2	5	Above 500	N/A	4.4	365.859	0.04	Yes
Sample #	M6	Test Date (YYYY-MM-DD) start/end .....:			2018-04-04/ 2018-04-09		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	365.867	—	—
1	5	Above 500	N/A	4.4	364.810	—	—
2	5	Above 500	N/A	4.4	364,.930	0.29	Yes
Sample #	M7	Test Date (YYYY-MM-DD) start/end .....:			2018-04-04/ 2018-04-09		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	($P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	365.958	—	—
1	5	Above 500	N/A	4.4	365.405	—	—
2	5	Above 500	N/A	4.4	365.319	0.17	Yes

Supplementary information: N/A

☐ Other stabilization procedures

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

Test method description: —

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

TABLE 03: MQT 06.1 ini: Performance at STC after initial stabilization		P
Test Date [YYYY-MM-DD] ..... :	2018-04-09	—
Pmax(lab) lower limit (W) ..... :	See table below: Pmax [W] – Min calc.	—

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Clause	Requirement + Test	Result - Remark	Verdict

$\bar{P}_{max}(Lab)$ lower limit (W) ..... :	352.941	—
Voc(lab) upper limit (V) ..... :	See table below: Voc [V] Max. calc.	—
Isc (lab) upper limit (A) ..... :	See table below: Isc [A] Max. calc.	—
Test method ..... :	☒ Simulator ☐ Natural sunlight	—

Sample #	Isc [A]		Voc [V]		Imp [A]	Vmp [V]	Pmax [W]		FF [%]	Result
	Meas.	Max. calc.	Meas.	Max. calc.			Meas.	Min. calc.		
M10	9.557	10.084	47.973	48.183	9.265	39.214	363.298	342.689	79.24	P
M11	9.750	10.084	47.950	48.183	9.328	39.083	364.569	342.689	77.98	P
M12	9.626	10.084	47.952	48.183	9.288	38.922	361.526	342.689	78.32	P
M13	9.739	10.084	47.953	48.183	9.363	38.953	364.706	342.689	78.09	P
M4	9.755	10.084	47.896	48.183	9.321	39.001	363.538	342.689	77.81	P
M5	9.631	10.084	47.995	48.183	9.309	39.075	363.752	342.689	78.69	P
M8	9.792	10.084	47.986	48.183	9.312	39.236	365.373	342.689	77.76	P
M9	9.793	10.084	47.930	48.183	9.311	39.294	365.859	342.689	77.94	P
M6	9.790	10.084	47.923	48.183	9.364	38.972	364.930	342.689	77.78	P
M7	9.793	10.084	47.966	48.183	9.313	39.225	365.319	342.689	77.77	P
Average	—						364.287	352.941	—	P

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

TABLE 04: MQT 03 ini: Initial Insulation test		P
Test Date [YYYY-MM-DD]..... :	2018-04-11	—
Test Voltage applied [V] ..... :	8000/1500	—
Size of module [m²] ..... :	1.94	—
Required Resistance [MΩ]..... :	20.62	—

Sample #	Measured	Dielectric breakdown		Result
	MΩ	Yes (description)	No	
M10	>5000	No dielectric breakdown	No	P
M11	>5000	No dielectric breakdown	No	P
M12	>5000	No dielectric breakdown	No	P
M13	>5000	No dielectric breakdown	No	P
M4	>5000	No dielectric breakdown	No	P
M5	>5000	No dielectric breakdown	No	P

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Clause	Requirement + Test	Result - Remark	Verdict

M8	>5000	No dielectric breakdown	No	P
M9	>5000	No dielectric breakdown	No	P
M6	>5000	No dielectric breakdown	No	P
M7	>5000	No dielectric breakdown	No	P
Supplementary information: the maximum resistance measurement range is 5000MΩ.				

TABLE 05: MQT 15 ini: Initial Wet leakage current test			P
Test Date [YYYY-MM-DD] ..... :	2018-04-11		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C] ..... :	22.5		—
Size of module [m²] ..... :	1.94		—
Sample #	Required Resistance [MΩ]	Measured [MΩ]	Result
M10	20.62	585.6	P
M11	20.62	486.5	P
M12	20.62	529.3	P
M13	20.62	738.1	P
M4	20.62	663.5	P
M5	20.62	798.0	P
M8	20.62	682.0	P
M9	20.62	568.2	P
M6	20.62	255.9	P
M7	20.62	426.8	P
Supplementary information: Solution resistivity 2718 [Ω·cm].			

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

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 07: MQT 07 - Performance at low irradiance							—
Test Date [YYYY-MM-DD].....:	2018-06-11						—
Test method.. :	☐ Outdoor measurement						—
	Ambient air temperature [°C]:	—					
	Irradiance [W/m^2]:	—					
	Module temperature [°C]:	—					
	☐ Data corrected to a 25°C cell temperature and 200 W/m^2 irradiance						
	☒ Directly measured						—

Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]
M10	1.830	44.254	1.923	38.233	69.243	81.37
M11	1.825	44.260	1.924	37.011	69.316	81.39
M12	1.832	44.274	1.927	38.211	69.172	81.09

Supplementary information: N/A

TABLE 08: MQT 04 - Measurement of temperature coefficients				—
Test Date [YYYY-MM-DD]..... :	2018-06-11			—
Ambient air temperature [°C] high/low..... :	25 / 25			—
Irradiance [W/m^2] high/low..... :	1000/1000			—
Module temperature [°C] high/low..... :	55 / 25			—
Sample #	α [%/°C]	β [%/°C]	δ [%/°C]	—
M10	0.046	-0.294	-0.380	—
M11	0.039	-0.281	-0.375	—
M12	0.045	-0.296	-0.394	—

Supplementary information: N/A

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

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Clause	Requirement + Test	Result - Remark	Verdict

Calculated NMOT	—
Supplementary information: —	

TABLE 10: MQT 08 - Outdoor exposure test		P
Test Date [YYYY-MM-DD] start/end..... :	2018-04-24/ 2018-05-14	—
Sample #	M13	—
Total irradiation dosage [kWh/m²] ..... :	⩾60	—
Angle of tilt the test module..... :	37° angle	—
Electrical load:	☒ Restive load ☐ MPPT	—
Supplementary information: N/A		

Table 10.1: MQT 01: Visual inspection after outdoor exposure test		P
Test Date [YYYY-MM-DD]..... :	2018-05-14	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M13	No major visual defects found	P
Supplementary information: N/A		

Table 10.2: MQT 15: Wet leakage current test after outdoor exposure test			P
Test Date [YYYY-MM-DD] .....:	2018-05-14		—
Test Voltage applied [V] .....:	1500		—
Solution temperature [°C] .....:	22.6		—
Size of module [m²] .....:	1.94		—
Required Resistance [MΩ].....:	20.62		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
M13	322.1	20.62	P
Supplementary information: Solution resistivity 2704 [Ω·cm].			

Table 10.3: MQT 02 - Maximum power determination after outdoor exposure test - Optional						—
Test Date [YYYY-MM-DD]..... :	2018-05-14					—
Module temperature [°C] ..... :	25					—
Irradiance [W/m²) ..... :	1000					—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]
M13	9.672	47.818	9.253	38.791	358.937	77.61
Supplementary information: N/A						

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Clause	Requirement + Test	Result - Remark	Verdict

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

TABLE 11: MQT 18: Bypass diode thermal test					P
Test Date [YYYY-MM-DD] start/end....:	2018-05-27				—
Sample #	M14				—
Module temperature [°C] ....:	75 ± 5				—
Number of diodes in junction box ....:	3				—
Diode manufacturer....:	Zhejiang Zhonghuan Sunter PV Technology Co., Ltd.				—
Diode type designation....:	20SQ045				—
Max. permissible junction temperature Tj_{max} [°C] (according to diode datasheet)....:	200				—
Detailed description of sample preparation procedure ....:	Standard production module				—
Step 1, Determination of *VD* versus *TJ* characteristic					—
	30 ± 2 °C	50 ± 2 °C	70 ± 2 °C	90 ± 2 °C	
Ambient temperature of the junction box... :	30.5	50.4	70.3	90.2	
Pulsed current .... :	9.671	9.683	9.702	9.711	
Voltage drop [V] .... :	0.416	0.387	0.356	0.328	
V_D versus T_J characteristic.... :	VD= -0.0015* TJ + 0.4647				—
Max. permissible junction temperature Tj_{max} [°C] (according to diode datasheet).... :	200				—
Step 2, Bypass diode thermal test					P
	Diode 1	Diode 2	Diode 3		Result
Current flow applied [A] ....:	9.68	9.68	9.68		—
Max. diode surface temperature Tj_{max} [°C] :	114.52	113.71	117.49		—
Voltage drop [V] after 1h....:	0.28	0.28	0.28		—
Calculated max. junction temperature Tj_{calc} [°C] ....:	123.13	123.13	123.13		P

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Clause	Requirement + Test	Result - Remark	Verdict

$Tj_{calc} < Tj_{max}$ (test passed)? yes/no .....:	yes	yes	yes	P
Current flow (1.25 * Isc) [A] .....:	12.10	12.10	12.10	—
Bypass diode remain(s) functional (yes/no) .....:	yes	yes	yes	P
Remarks: See Table 12 for the test details of bypass diode functionality test. 3 Diodes are considered as representative number. These diodes have to be selected as worst case. In case that additional bypass diodes tests are performed the results shall be listed in an attachment.				

TABLE 11.1: MQT 01 - Visual inspection after bypass diode thermal test		P
Test Date [YYYY-MM-DD].....:	2018-05-22	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M13	No major visual defects found	P
Supplementary information: N/A		

TABLE 11.2: MQT 15 - Wet leakage current test after bypass diode thermal test			P
Test Date [YYYY-MM-DD] .....:		2018-05-27	—
Test Voltage applied [V].....:		1500	—
Solution temperature [°C] .....:		22.4	—
Size of module [m²] .....:		1.94	—
Required Resistance [MΩ].....:		20.62	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
M13	268.3	20.62	P
Supplementary information: Solution resistivity 2704 [Ω·cm].			

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

TABLE 11.4: MQT 03 - Insulation test after bypass diode thermal test - Optional		N/A
Test Date [YYYY-MM-DD].....:	—	—
Test Voltage applied [V] .....:	—	—
Size of module [m²] .....:	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

Required Resistance [MΩ]..... :	—			—
Sample #	Measured	Required	Dielectric breakdown	Result
	MΩ	MΩ	Yes (description) / No	
—	—	—	— / —	—
Supplementary information: —				

TABLE 12: MQT 18.2 - Bypass diode functionality test after bypass diode thermal test				P
Test Date [YYYY-MM-DD] ..... :	2018-05-27			—
☐ Method A				N/A
Ambient temperature [°C] ……:	—			—
Current flow applied [A] ……...……:	—			—
Sample #	VFM	$V_{FMrated}$	VFM = (N × $V_{FMrated}$) ± 10 %	Result
M13	—	—	☐ Yes ☐ No	P
Supplementary information:				
☒ Method B				—
	IV curve after shading			Result
Diode 1	Turn on			P
Diode 2	Turn on			P
Diode 3	Turn on			P
Supplementary information: N/A				

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

TABLE 12.3: MQT 19.1 Final Stabilization procedure				N/A
Light exposure method ..... :	☐ Simulator ☐ Natural sunlight			—
Stabilization criterion x per IEC 61215-1-x... :	—			—
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight				
Sample #	M13	Test Date (YYYY-MM-DD) start/end ..... :	—	

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Clause	Requirement + Test	Result - Remark	Verdict

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

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

TABLE 13: MQT 09 - Hot-spot endurance test		P
Test Date [YYYY-MM-DD] start/end..... :	2018-07-11	—
Sample #	M13	—
Procedure of technology..... :	☒ wafer-based technologies (WBT) MQT 09.1 ☐ monolithically integrated (MLI) thin film technologies MQT 09.2	—
Cell interconnection circuit..... :	☒ S ☐ SP ☐ PS	—
Type of light source..... :	☒ Pulse Simulator ☒ Steady state Simulator ☐ Natural sunlight	—
Module temperature at thermal equilibrium [°C]. :	50.0/50.1/50.0/50.0	—

TABLE 13.1: MQT 09 - Hot-spot endurance test for WBT					—
Selected hot-spot cells .....:	LOW	LOW	LOW	HIGH	—
	/	/	/	/	
Shading rate [%] .....:	10	10	10	10	—
Max. measured cell temperature in each cell [°C]:	135.2	135.7	138.2	124.4	—
Test duration of each shading [h] .....:	1	1	1	1	—
Irradiance during shading [W/m²] ……. .....:	1000	1000	1000	1000	—

TABLE 13.2: MQT 09 - Hot-spot endurance test for MLI		N/A
Selected hot-spot cells ..... :	—	—
Number of cells shaded..... :	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

Max. measured cell temperature [°C] ..... :	—	—
Test duration during shading [h] ..... :	—	—
Irradiance during shading [W/m²] ..... :	—	—
Supplementary information: —		

TABLE 13.3: MQT 01 - Visual inspection after hot-spot endurance test		P
Test Date [YYYY-MM-DD] ..... :	2018-07-11	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M13	No major visual defects found	P
Supplementary information: N/A		

TABLE 13.4: MQT 02 - Maximum power determination after hot-spot endurance test							P
Test Date [YYYY-MM-DD] ..... :	2018-07-11						—
Module temperature [°C] ..... :	25						—
Irradiance [W/m^2] ..... :	1000						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	—
M13	9.757	47.725	9.240	38.721	357.781	76.83	P
Supplementary information: N/A							

TABLE 13.5: MQT 03 - Insulation test after hot-spot endurance test					P
Test Date [YYYY-MM-DD] ..... :	2018-07-11				—
Test Voltage applied [V] ..... :	8000/1500				—
Size of module [m²] ..... :	1.94				—
Required Resistance [MΩ] ..... :	20.62				—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
M13	>5000	20.62	No dielectric breakdown	No	P
Supplementary information: the maximum resistance measurement range is 5000MΩ.					

TABLE 13.6: MQT 15 - Wet leakage current test after hot-spot endurance test		**P**
Test Date [YYYY-MM-DD] ..... :	2018-07-11	—
Test Voltage applied [V] ..... :	1500	—
Solution temperature [°C] ..... :	22.5	—
Size of module [m²]	1.94	—

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Clause	Requirement + Test	Result - Remark	Verdict

Required Resistance [MΩ].....		20.62	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
M13	404.3	20.62	P
Supplementary information: Solution resistivity 2715 [Ω·cm].			

TABLE 13.7: MQT 18.2 - Bypass diode functionality test after Hot-spot endurance test				P
Test Date [YYYY-MM-DD]..... :		2018-07-11		—
☐ Method A				N/A
Ambient temperature [°C] ..... :		—		—
Current flow applied [A] ..... :		—		—
Sample #	VFM	$V_{FMrated}$	VFM = (N × $V_{FMrated}$) ± 10 %	Result
M13	—	—	☐ Yes ☐ No	—
Supplementary information: —				
☒ Method B				P
	IV curve after shading			Result
Diode 1	Turn on			P
Diode 2	Turn on			P
Diode 3	Turn on			P
Supplementary information: N/A				

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 14: MQT 10 - UV preconditioning test		P
Test Date (YYYY-MM-DD) start/end ..... :	2018-04-20/2018-04-23	—
Module temperature [°C] ..... :	60±5	—
UV irradiance (280-400nm) [W/m²] ..... :	166.67	—
Ratio of UV irradiance (280-320nm) (%) ..... :	7.67	P
UV dose (280-400nm) [kWh/ m²] ..... :	15	—
Module operation condition ..... .:	☒ Short circuited ☐ Pmax	—
Supplementary information: Light sources not emitting a significant portion of light in the visible spectrum where the module exhibits a power equal to or larger than 20 % of its STC measured power. UV preconditioning test was performed on front side of the module.		

TABLE 14.1: MQT 01 - Visual inspection after UV preconditioning test		P
Test Date [YYYY-MM-DD]..... :	2018-04-23	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M4	No major visual defects found	P
M5	No major visual defects found	P

TABLE 14.2: MQT 15 - Wet leakage current test after UV preconditioning test			P
Test Date [YYYY-MM-DD].....:	2018-04-23		—
Test Voltage applied [V] .....:	1500		—
Solution temperature [°C].....:	22.5		—
Size of module [m²] .....:	1.94		—
Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
M4	299.3	20.62	P
M5	341.7	20.62	P
Supplementary information: Solution resistivity 2714 [Ω·cm].			

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

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Clause	Requirement + Test	Result - Remark	Verdict

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

TABLE 15: MQT 11 - Thermal cycling 50 test			P
Test Date [YYYY-MM-DD] start/end ..... :	2018-04-26/2018-05-06		—
Total cycles (50) ..... :	50		—
Applied current (A) ..... :	During the heat up cycle from -40 °C to 80 °C	9.8	—
	Other stages	0.05	—
Sample #	Open circuits (yes/no)		—
M4	No		P
M5	No		P
Supplementary information: N/A			

TABLE 15.1: MQT 01 - Visual inspection after thermal cycling 50 test		P
Test Date [YYYY-MM-DD] ..... :	2018-05-06	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M4	No major visual defects found	P
M5	No major visual defects found	P
Supplementary information: N/A		

TABLE 15.2: MQT 15 - Wet leakage current test after thermal cycling 50 test			P
Test Date [YYYY-MM-DD] ..... :	2018-05-07		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C] ..... :	22.5		—
Size of module [m²]	1.94		—
Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
M4	332.7	20.62	P

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Clause	Requirement + Test	Result - Remark	Verdict
M5	364.8	20.62	P
Supplementary information: Solution resistivity 2714 [Ω·cm].			

TABLE 15.3: MQT 03 – Max. power determination after thermal cycling 50 test - Optional						N/A
Test Date [YYYY-MM-DD] ..... :	—					—
Module temperature [°C] ..... :	—					—
Irradiance [W/m²) ..... :	—					—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]
M4	—	—	—	—	—	—
M5	—	—	—	—	—	—
Supplementary information: —						

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

TABLE 16: MQT 12 - Humidity freeze 10 test		P
Test Date [YYYY-MM-DD] start/end ..... :	2018-05-07/2018-05-17	—
Total cycles (10) ..... :	10	—
Applied current (A) ..... :	0.05	—
Sample #	Open circuits (yes/no)	—
M4	No	P
M5	No	P
Supplementary information: N/A		

TABLE 16.1: MQT 01 - Visual inspection after humidity freeze 10 test		P
Test Date [YYYY-MM-DD] ..... :	2018-05-17	—
Sample #	Nature and position of initial findings – comments or attach photos	—

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Clause	Requirement + Test	Result - Remark	Verdict

M4	No major visual defects found	P
M5	No major visual defects found	P
Supplementary information: N/A		

TABLE 16.2: MQT 15 - Wet leakage current test after humidity freeze 10 test			P
Test Date [YYYY-MM-DD] ..... :	2018-05-17		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C]……..:	22.6		—
Size of module [m²] ..... :	1.94		—
Required Resistance [MΩ]..... :	20.62		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
M4	371.8	20.62	P
M5	284.5	20.62	P
Supplementary information: Solution resistivity 2714 [Ω·cm].			

TABLE 16.3: MQT 02 - Maximum power determination after humidity freeze 10 test -Optional						N/A
Test Date [YYYY-MM-DD] ..... :	—					—
Module temperature [°C] ..... :	—					—
Irradiance [W/m²) ..... :	—					—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]
—	—	—	—	—	—	—
—	—	—	—	—	—	—
Supplementary information: —						

TABLE 16.4: MQT 03 Insulation test after humidity freeze 10 test) -Optional					N/A
Test Date [YYYY-MM-DD] ..... :	—				—
Test Voltage applied [V] ..... :	—				—
Size of module [m²] ..... :	—				—
Required Resistance [MΩ]..... :	—				—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
—	—	—	—	—	—
—	—	—	—	—	—
Supplementary information: —					

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 17: MQT 14 - Robustness of terminations test		P
Test Date [YYYY-MM-DD] start/end..... :	2018-05-17	—

TABLE 17.1: MQT 14.1 Retention of junction box on mounting surface		P
Sample #	M4	—
Supplementary information: A force of 40N applied.		

TABLE 17.2: MQT 01 - Visual inspection after retention of junction box on mounting surface		P
Test Date [YYYY-MM-DD]..... :	2018-05-17	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M4	No major visual defects found	P
Supplementary information: N/A		

TABLE 17.3: MQT 15 - Wet leakage current test after retention of junction box on mounting surface			P
Test Date [YYYY-MM-DD].....:	2018-05-17		—
Test Voltage applied [V] .....:	1500		—
Solution temperature [°C].....:	22.5		—
Size of module [m²]	1.94		—
Required Resistance [MΩ].....:	20.62		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
M4	264.7	20.62	P
Supplementary information: Solution resistivity 2704 [Ω·cm].			

TABLE 17.4: MQT 14.2 - Test of cord anchorage					N/A
Sample #	—				—
☐ Junction boxes intended to be used with cables specified by the manufacturer					—
	Cable diameter, [mm]	Tension Force, [N]	Permissible displacement, [mm]	Measured displacement, [mm]	Result
Pull test			2mm		
	Cable diameter, [mm]	Torque Force, [Nm]	Permissible angle [º]	Measured angle [º]	Result
Torque test			45°		
☐ Junction boxes intended to be used with generic cables					—

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Clause	Requirement + Test	Result - Remark	Verdict

	Anchorage diameter range [mm]		Test mandrel [mm]	Tension Force, [N]	Permissible displacement [mm]	Measured displacement [mm]	Result
Pull test	Min				2mm		
	Anchorage diameter range [mm]		Test mandrel [mm]	Torque Force [Nm]	Permissible angle [°]	Measured angle [°]	Result
Torque test	Max				45°		
Supplementary information: —							

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

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

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

TABLE 18: MQT 11 - Thermal cycling 200 test		P
Test Date [YYYY-MM-DD] start/end..... :	2018-04-20/2018-05-20	—

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Clause	Requirement + Test	Result - Remark	Verdict

Total cycles (200) ..... :	200		—
Applied current (A) ..... :	During the heat up cycle from – 40 °C to 80 °C	9.8	—
	Other stages	0.05	—

Sample #	Open circuits (yes/no)	—
M8	No	P
M9	No	P
Supplementary information: N/A		

TABLE 18.1: MQT 01 - Visual inspection after thermal cycling 200 test		P
Test Date [YYYY-MM-DD]..... :	2018-05-21	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M8	No major visual defects found	P
M9	No major visual defects found	P
Supplementary information: N/A		

TABLE 18.2: MQT 15 - Wet leakage current test after thermal cycling 200 test			P
Test Date [YYYY-MM-DD]..... :	2018-05-21		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C]..... :	22.6		—
Size of module [m²] ..... :	1.94		—
Required Resistance [MΩ]..... :	20.62		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
M8	339.2	20.62	P
M9	365.4	20.62	P
Supplementary information: Solution resistivity 2718 [Ω·cm].			

TABLE 19: MQT 13 - Damp heat 1000 test		P
Test Date [YYYY-MM-DD] start/end..... :	2018-04-18/2018-05-29	—
Total hours (1000h) ..... :	1000	—
Sample #	Open circuits (yes/no)	—
M6	No	P
M7	No	P
Supplementary information: N/A		

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 19.1: MQT 01 - Visual inspection after damp heat 1000 test		P
Test Date [YYYY-MM-DD]..... :	2018-05-29	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M6	No major visual defects found	P
M7	No major visual defects found	P
Supplementary information: N/A		

TABLE 19.2: MQT 15 - Wet leakage current test after damp heat 1000 test			P
Test Date [YYYY-MM-DD]..... :	2018-05-29		—
Test Voltage applied [V]..... :	1500		—
Solution temperature [°C]..... :	22.4		—
Size of module [m²] ..... :	1.94		—
Required Resistance [MΩ]..... :	20.62		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
M6	681.3	20.62	P
M7	574.6	20.62	P
Supplementary information: Solution resistivity 2704 [Ω·cm].			

TABLE 19.3: MQT 02 - Maximum power determination after damp heat 1000 test - Optional							N/A
Test Date [YYYY-MM-DD]..... :	—						—
Module temperature [°C] ..... :	—						—
Irradiance [W/m²) ..... :	—						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
Supplementary information: —							

TABLE 19.4: MQT 03 - Insulation test after damp heat 1000 test - Optional					N/A
Test Date [YYYY-MM-DD].....:	—				—
Test Voltage applied [V] .....:	—				—
Size of module [m²]	—				—
Sample #	Measured	Required Resistance	Dielectric breakdown		Result
	[MΩ]	[MΩ]	Yes (description)	No	
M6	—	—	—	No	—
M7	—	—	—	No	—

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Clause	Requirement + Test	Result - Remark	Verdict

Supplementary information: —

TABLE 19.5: MQT 16 Static mechanical load test			P
Sample # :	M6		—
Design load(front side/ back side) ..... :	3600 / 1600		—
Safety factors ..... :	1.5		—
Test Date [YYYY-MM-DD].....	2018-06-08		—
Mounting method..... :	According to the installing manual		—
Load applied to..... :	front side	back side	—
Mechanical load [Pa] ..... :	5400	2400	—
First cycle time (start/end)..... :	1 hour	1 hour	—
Intermittent open-circuit (yes/no)..... :	No	No	P
Second cycle time (start/end)..... :	1 hour	1 hour	—
Intermittent open-circuit (yes/no)..... :	No	No	P
Third cycle time (start/end) ..... :	1 hour	1 hour	—
Intermittent open-circuit (yes/no)..... :	No	No	P
Supplementary information: N/A			

TABLE 19.6: MQT 01 - Visual inspection after static mechanical load test		P
Test Date [YYYY-MM-DD]..... :	2018-06-11	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M6	No major visual defects found	P
Supplementary information: N/A		

TABLE 19.7: MQT 15 - Wet leakage current test after static mechanical load test			P
Test Date [YYYY-MM-DD]..... :	2018-06-11		—
Test Voltage applied [V]..... :	1500		—
Solution temperature [°C]..... :	22.6		—
Size of module [m²] ..... :	1.94		—
Required Resistance [MΩ]..... :	20.62		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
M6	293.3	20.62	P
Supplementary information: Solution resistivity 2713 [Ω·cm].			
TABLE 19.8: MQT 17 - Hail impact test			P
Test Date [YYYY-MM-DD]..... :	2018-05-31		—

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	M7						—
Ice ball size [mm]..... :	1	2	3	4	5	6	—
	25.0	25.1	24.9	25.0	25.1	24.9	
	7	8	9	10	11		
	24.9	25.0	25.1	25.0	25.0		
Ice ball weight [g]..... :	1	2	3	4	5	6	—
	7.53	7.59	7.47	7.53	7.59	7.47	
	7	8	9	10	11		
	7.47	7.53	7.59	7.53	7.53		
Ice ball velocity [m/s]..... :	1	2	3	4	5	6	—
	23.0	23.1	22.9	22.8	23.0	23.2	
	7	8	9	10	11		
	23.1	23.2	22.9	23.0	23.1		
Number of impact locations ..... :	11						—

Supplementary information: (impact location descriptions)

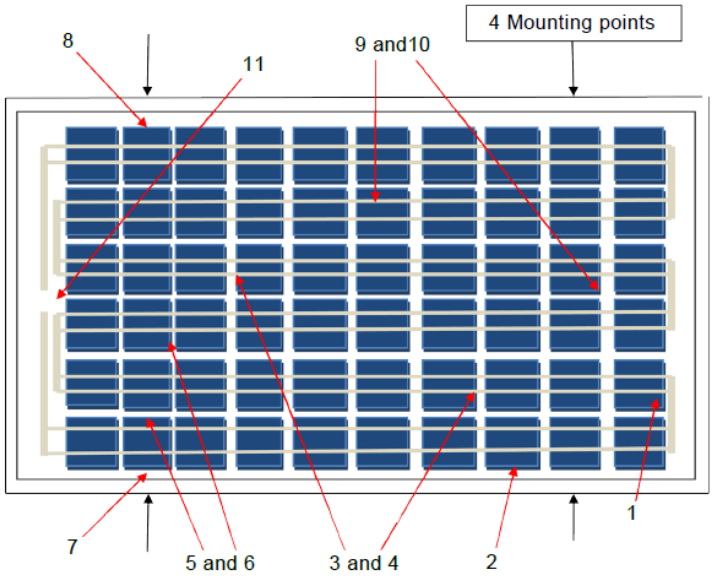

TABLE 19.9: MQT 01 - Visual inspection after hail impact test		P
Test Date [YYYY-MM-DD]..... :	2018-06-01	—
Sample #	Nature and position of initial findings – comments or attach photos	—
M7	No major visual defects found	P
Supplementary information: N/A		

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 19.10: MQT 15 - Wet leakage current test after hail impact test			P
Test Date [YYYY-MM-DD] ..... :	2018-06-01		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C] ..... :	22.5		—
Size of module [m²] ..... :	1.94		—
Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
M7	274.8	20.62	P
Supplementary information: Solution resistivity 2704 [Ω·cm].			

TABLE 20: MQT 19.1 Fin: Final stabilization							N/A
TABLE 20.1: MQT 06.1: Performance at STC before final stabilization							—
Test Date [YYYY-MM-DD] ..... :	—						—
Test method ..... :	☐ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
Supplementary information: —							

TABLE 20.2: MQT 19.1 Final Stabilization procedure							N/A
Light exposure method:		☐ Simulator ☐ Natural sunlight					
Stabilization criterion x per IEC 61215-1-x :		—					
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Sample #	M10	Test Date (YYYY-MM-DD) start/end..:		—			
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—

IEC 61215-2							
Clause	Requirement + Test				Result - Remark		Verdict
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Sample #	M4	Test Date (YYYY-MM-DD) start/end			—		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Sample #	M5	Test Date (YYYY-MM-DD) start/end			—		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Sample #	M8	Test Date (YYYY-MM-DD) start/end..:			—		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Sample #	M9	Test Date (YYYY-MM-DD) start/end			—		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—

IEC 61215-2							
Clause	Requirement + Test				Result - Remark		Verdict
4	—	—	—	—	—	—	—
Sample #	M6	Test Date (YYYY-MM-DD) start/end.....:			—		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Sample #	M7	Test Date (YYYY-MM-DD) start/end			—		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Supplementary information: —							
☐ Other stabilization procedures							
Sample #	Test Date (YYYY-MM-DD) start/end						
—	—						
—	—						
—	—						
—	—						
—	—						
—	—						
—	—						
Test method description: —							
Supplementary information: see Annex 3 for verification of this alternative stabilization procedure							

TABLE 20.3: MQT 06.1: Final Performance at STC									P
Test Date [YYYY-MM-DD]..... :	Different date								—
Test method	☒ Simulator ☐ Natural sunlight								—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation [%]	Result
M10	9.595	47.957	9.315	39.110	364.307	79.17	359.665	+0.28	P

IEC 61215-2									
Clause	Requirement + Test					Result - Remark			Verdict
M13	9.575	47.725	9.240	38.721	357.781	76.83	365.719	-2.17	P
M4	9.691	47.789	9.247	38.766	358.485	77.41	364.548	-1.66	P
M5	9.669	47.867	9.393	38.644	363.003	78.43	364.762	-0.48	P
M8	9.785	47.935	9.396	38.852	365.072	77.83	366.388	-0.36	P
M9	9.804	47.941	9.401	38.866	365.392	77.74	366.875	-0.40	P
M6	9.668	47.483	9.125	38.103	347.692	75.74	365.944	-4.99	P
M7	9.638	47.636	9.229	38.425	354.620	77.24	366.334	-3.20	P
Supplementary information: Pmax [W] (Lab_GateNo.1) is calculated by considering the reproducibility r of control module.									

TABLE 21: MQT 03 fin: Final Insulation test					P
Test Date [YYYY-MM-DD] ..... :			Different date		—
Test Voltage applied [V] ..... :			8000/1500		—
Size of module [m²] ..... :			1.94		—
Sample #	Required	Measured	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
M10	20.62	>5000	No dielectric breakdown	No	P
M13	20.62	>5000	No dielectric breakdown	No	P
M4	20.62	>5000	No dielectric breakdown	No	P
M5	20.62	>5000	No dielectric breakdown	No	P
M8	20.62	>5000	No dielectric breakdown	No	P
M9	20.62	>5000	No dielectric breakdown	No	P
M6	20.62	>5000	No dielectric breakdown	No	P
M7	20.62	>5000	No dielectric breakdown	No	P
Supplementary information: the maximum resistance measurement range of Yangzhou Opto-Electrical Products Testing Institute is 5000MΩ.					

TABLE 22: MQT 15 fin: Final Wet leakage current test		P
Test Date [YYYY-MM-DD] ..... :	Different date	—
Test Voltage applied [V] ..... :	1500	—
Solution temperature [°C] ..... :	22 ± 2	—
Size of module [m²] ..... :	1.94	—
Required Resistance [MΩ] ..... :	20.62	—

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

Sample #	Measured [MΩ]	Limit [MΩ]	Result
M10	473.6	20.62	P
M13	322.1	20.62	P
M4	264.7	20.62	P
M5	284.5	20.62	P
M8	339.2	20.62	P
M9	365.4	20.62	P
M6	293.3	20.62	P
M7	274.8	20.62	P
Supplementary information: Solution resistivity <3500 [Ω·cm].			

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

A1.1	MODULE TYPE/S
	UL-360M-72HV

A1.2	MODULE DESIGN	
	Module dimensions (L x W x H) [mm] ..... :	1956*992*46
	Weights..... :	23 kg
	Front/Rear cover bonding classification ..... :	☒ rigid/flexible ☐ rigid/rigid ☐ flexible/flexible

A1.3	SOLAR CELL	
	Cell type reference ..... :	**Ningbo Ulica Solar Science&Technology Co.,Ltd** Cell type: 156M-5BB, P type mono crystalline silicon
	Cell dimensions L x W x T (± %) [mm] .....:	156.75 x 156.75
	Cell thickness [µm].....:	200±20
	Cell area [cm²] .....:	244.32

A1.4	IDENTIFICATION OF MATERIALS	
	Front cover ..... :	**Henan Ancai Hi-tech Co., Ltd.** Type: tempered glass with AR coating Thickness: 3.2 mm
	Rear cover..... :	**Crown Advanced Materials Co.,Ltd** Type: Crown BE-xn, White, Material: PVDF /PET/PO Thickness: 22um/250um/50um, total: 350 ±10%um
	Encapsulation material front side..... :	**Shanghai HIUV New Materials Co., Ltd** Type: S201MT1, thickness:0.5mm±0.1mm
	Encapsulation material back side ..... :	**Shanghai HIUV New Materials Co., Ltd** Type: S201W, thickness:0.5mm±0.1mm
	Frame parts ..... :	**Wuxi Zhongde Aluminum Product Co,.Ltd** Anodized aluminum alloy, 6063-T5, silver colour, Cross-section graph: 46mm*35mm
	Mounting parts..... :	N/A

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	Adhesive for frame ..... :	**Hangzhou Zhijiang Silicone Chemicals Co., LTD** Type: JS-606
	Edge sealing..... :	N/A
	Internal wiring ..... :	N/A
	Cell connector..... :	**Suzhou Sanysolar Materials Technology Corporation** Cross section: 0.25 ×0.9 mm, Material: Base Cu ≥ 99.97%, Coating Sn60%Pb40%, 0.025±0.005 mm at each side.
	String connector..... :	**Suzhou Sanysolar Materials Technology Corporation** Cross section: 0.25 × 7 mm, Material: Base Cu ≥ 99.97%, Coating Sn60%Pb40%, 0.025±0.005 mm at each side.
	Soldering material..... :	N/A
	Fluxing agent ..... :	**ASAHI Solder Technology CO,LTD** Type: SF56
	Junction box..... :	**Zhejiang Zhonghuan Sunter PV Technology Co.,Ltd** Type: PV-ZH011-6B, DC 1500 V, 15A, IP 67, -40 °C to 85 °C TÜV Rheinland certified, No. R 50345461
	Cable..... :	**Zhejiang Zhonghuan Sunter PV Technology Co.,Ltd.** Type: H1Z2Z2-K 1×4mm^2, 1500V DC, -40 °C to 90 °C, TÜV Rheinland certified, No. R 50330654
	Connector ..... :	**Zhejiang Zhonghuan Sunter PV Technology Co.,Ltd.** Type: PV-ZH202B, DC 1500V, 30A, IP 67, -40 °C to 85 °C TUV SUD Certified, No. R 50350557
	Bypass diode ..... :	**Zhejiang Zhonghuan Sunter PV Technology Co.,Ltd.** Type: 20SQ045, Schottky, Max. peak reverse voltage 45 V, Max. average forward current 20 A, Max. junction temperature 200 °C.
	Potting material..... :	**Hangzhou Zhijiang Silicone Chemicals Co., LTD** Type: JS-1184, Rated V-0 at min. 3.0 mm thick, RTI=105, CTI=0, UL certified, No. E335227
	Adhesive for junction box ..... :	**Hangzhou Zhijiang Silicone Chemicals Co., LTD** Type: JS-606, Rated V-0, at min. 3.0 mm thick, RTI=105, UL certified, No. E335227

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	Additional material (e. g. fixing tape, insulation tape) ..... :	Fixing tape: **TERAOKA SEISAKOSHO Co., Ltd.** Type: 631S#38 Insulation sheet: **Crown Advanced Materials Co.,Ltd** Type: Crown BE-xn, White, Material: PVDF /PET/PO Thickness: 22um/250um/50um, total: 350 (-10%,+20%)um

A1.5	**MODULE DESIGN - MINIMUM DISTANCES**	
	Between cells..... :	1.5mm
	Between cell and accessible surfaces ..... :	17.75 mm
	Between any current carrying part and accessible surfaces..... :	17.25 mm

A1.6	**MODULE DESIGN - ELECTRICAL CONFIGURATION**	
	Total number of cells..... :	72
	Serial-parallel connection of cells ..... :	24
	Cells per bypass diode..... :	24
	No. of bypass diodes..... :	3

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

Annex 2: Test table for verifying other alternative stabilization procedure

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

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

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

Supplementary information: —

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

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

Supplementary information: —

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

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

Supplementary information: —

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Clause	Requirement + Test	Result - Remark	Verdict

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

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

Annex 3: Lower and higher output power modules

TABLE A.4.1 Performance at STC before initial stabilization							P
Test Date [YYYY-MM-DD].....:	2018-04-04						—
Test method .....:	☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
Low 1	9.235	45.906	8.739	38.045	332.467	78.42	—
Low 2	9.273	45.871	8.994	37.798	332.380	78.14	—
High 1	9.911	48.205	9.533	39.366	375.260	78.55	—
High 2	9.891	48.264	9.427	39.858	375.746	78.71	—
Supplementary information: The limit value is calculated through considering the tolerance of rated label values and lab measurement uncertainty.							

TABLE A.4.2: MQT 19.1 ini: Initial Stabilization procedure							P
Light exposure method	☒ Simulator ☐ Natural sunlight						—
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Stabilization criterion x per IEC 61215-1-x ..	1						—
Sample #	Low 1	Test Date (YYYY-MM-DD) start/end .....:			2018-04-04 / 2018-04-09		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	332.467	—	—
1	5	800~1000	50 ± 10	4.1	331.358	—	—
2	5	800~1000	50 ± 10	4.1	331.664	0.33	Yes
—	—	—	—	—	—	—	—
Sample #	Low 2	Test Date (YYYY-MM-DD) start/end ..... :			2018-04-04 / 2018-04-09		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	332.380	—	—
1	5	800~1000	50 ± 10	4.1	331.716	—	—
2	5	800~1000	50 ± 10	4.1	331.707	0.20	Yes
—	—	—	—	—	—	—	—
Light exposure method	☒ Simulator ☐ Natural sunlight						—
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Stabilization criterion x per IEC 61215-1-x ..	1						—

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

Sample #	High 1	Test Date (YYYY-MM-DD) start/end .....:			2018-04-04 / 2018-04-09		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	375.260	—	—
1	5	800~1000	50 ± 10	4.1	374.916	—	—
2	5	800~1000	50 ± 10	4.1	374.969	0.09	Yes
3	—	—	—	—	—	—	—
Sample #	High 2	Test Date (YYYY-MM-DD) start/end .....:			2018-04-04 / 2018-04-09		
Test cycle	Integrated irradiation (kWh/m^2)	Irradiance (W/m^2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	375.746	—	—
1	5	800~1000	50 ± 10	4.1	374.533	—	—
2	5	800~1000	50 ± 10	4.1	374.719	0.32	Yes
3	—	—	—	—	—	—	—

Supplementary information: —

☐ Other stabilization procedures

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

Test method description: —

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

TABLE A.4.3: MQT 6.1 Performance at STC after initial stabilization							P
Test Date [YYYY-MM-DD] ..... :	2018-04-09						—
	Lower end power class				Higher end power class		—
Pmax(lab) (W) ..... :	≥ 314.132 ,				≥ 356.968 ,		—
$\bar{P}_{max}(Lab)$ (W)	≥ 323.529 ,				≥ 367.647 ,		—
Voc(lab) (V) ..... :	≤ 47.460 ,				≤ 48.492 ,		—
Isc (lab) (A) ..... :	≤ 9.461 ,				≤ 10.288 ,		—
Test method ..... :	☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result

IEC 61215-2							
Clause	Requirement + Test				Result - Remark		Verdict
Low 1	9.228	45.888	8.724	38.017	331.664	78.33	P
Low 2	9.276	45.806	8.832	37.558	331.707	78.07	P
High 1	9.899	48.168	9.436	39.740	374.969	78.64	P
High 2	9.824	48.240	9.447	39.664	374.719	79.07	P
Supplementary information: The limit value is calculated through considering the tolerance of rated label values and lab measurement uncertainty.							

Annex 4: List of measurement equipment

Clause	Measurement / testing	Testing / measuring equipment / material used, (Equipment ID)	Range used	Last Calibration date	Calibration due date
MQT01	—	SB08102	—	December -14-2017	December -14-2018
MQT01	—	SB08108	—	April -29-2018	April -29-2019
MQT01	—	SB08111	—	June-20-2018	June-20-2019
MQT01	—	SB08092	—	April -29-2018	April -29-2019
MQT01	—	SB08125	—	April -26-2018	April -26-2019
MQT02&MQT07&M0T04&MQT09	—	SB08001	—	April -07-2018	April -07-2019
MQT03&MQT15	—	SB10018	—	May -26-2018	May -26-2019
MQT15	—	SB08079	—	April-20-2018	April-20-2019
MQT15	—	SB08054	—	April-20-2018	April-20-2019
MQT04	—	SB10022	—	April -20-2018	April -20-2019
MQT08	—	SB08044	—	April -20-2018	April -20-2019
MQT08	—	SB08038	—	April-20-2018	April-20-2019
MQT18	—	SB10022	—	April-20-2018	April-20-2019
MQT18&MQT09	—	SB08037	—	December -28-2017	December -28-2018
MQT09	—	SB14002	—	May -23-2018	May -23-2019
MQT09	—	SB08002	—	May -23-2018	May -23-2019
MQT10	—	SB16003	—	April-20-2018	April-20-2019
MQT11(50)	—	SB08085	—	April -20-2018	April -20-2019
MQT11(50)	—	SB12002	—	December-14-2017	December-14-2018
MQT11(50)	—	SB12011	—	May -21-2018	May -21-2019
MQT11(50)	—	SB10013	—	May -23-2018	May -23-2019
MQT12	—	SB16004	—	May -30-2018	May -30-2019
MQT12	—	SB16006	—	December -14-2017	December -14-2018

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Clause	Measurement / testing	Testing / measuring equipment / material used, (Equipment ID)	Range used	Last Calibration date	Calibration due date
MQT12	—	SB16005	—	May -23-2018	May -23-2019
MQT11(200)	—	SB08085	—	April -20-2018	April -20-2019
MQT11(200)	—	SB08004	—	December-14-2017	December-14-2018
MQT11(200)	—	SB08005	—	December-14-2017	December-14-2018
MQT11(200)	—	SB08036	—	December -28-2017	December -28-2018
MQT14	—	SB08055	—	Mar -20-2018	Mar -20-2019
MQT14	—	SB08059	—	Mar -20-2018	Mar -20-2019
MQT13	—	SB08087	—	December -28-2017	December -28-2018
MQT16	—	SB01009	—	—	—
MQT16	—	SB10007	—	May -21-2018	May -21-2019
MQT17	—	SB08076	—	May -20-2018	May -20-2019
MQT17	—	SB08107	—	April -28-2018	April -28-2019
MQT17	—	SB08112	—	—	—
MQT17	—	SB08142	—	April -20-2018	April -20-2019
MQT17	—	SB08143	—	April -20-2018	April -20-2019

For equipments details, please refer equipments' list in YOT

Test Report issued under the responsibility of:

TÜV SÜD Product Service GmbH
Ridlerstr. 65
D – 80339 München
Germany

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

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Applicant's name..... :	Ningbo Ulica Solar Science&Technology Co.,Ltd
Address..... :	NO.181, SHANSHAN ROAD, WANGCHUN INDUSTRIAL DISTRICT, NINGBO, CHINA
Test specification:	
Standard ..... :	IEC 61730-1:2016 IEC 61730-2:2016
Test procedure ..... :	TÜV SÜD Mark
Non-standard test method ..... :	N/A
Test Report Form No. ..... :	IEC61730a
Test Report Form(s) Originator.... :	**TÜV SÜD Product Service GmbH**
Master TRF..... :	Dated 2016-12

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Test item description ..... :	Photovoltaic (PV) Module(s)
Trade Mark ..... :	ulica solar LEADING IN TECHNOLOGY
Manufacturer ..... :	Ningbo Ulica Solar Science&Technology Co.,Ltd
Address ..... :	NO.181, SHANSHAN ROAD, WANGCHUN INDUSTRIAL DISTRICT, NINGBO, CHINA
Model/Type reference ..... :	See page 8 of this report
Ratings ..... :	See page 8 of this report

Testing procedure and testing location:

☒	**TÜV SÜD Branch:**	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
Testing location/address .....:		No. 151 Heng Tong Road, Shanghai 200070, P. R. China
☒	**Associated Testing Laboratory:**	Yangzhou Opto-Electrical Products Testing Institute
Testing location/address .....:		No. 10 West Kaifa Road, Yangzhou, 225009 Jiangsu, P. R. China
Tested by (name + signature) .....:		Ning Tang
Approved by (name + signature) .....:		Yaozhong Wu

☐	**Testing procedure: TMP/CTF Stage 1:**	
Testing location/address .....:		
Tested by (name + signature) .....:		
Approved by (name + signature) .....:		

☐	**Testing procedure: WMT/CTF Stage 2:**	
Testing location/address .....:		
Tested by (name + signature) .....:		
Witnessed by (name + signature) .....:		
Approved by (name + signature) .....:		

☐	**Testing procedure: SMT/CTF Stage 3 or 4:**	
Testing location/address .....:		
Tested by (name + signature) .....:		
Witnessed by (name + signature) .....:		
Approved by (name + signature) .....:		
Supervised by (name + signature) .....:		

List of Attachments (including a total number of pages in each attachment):

N/A

Summary of testing:

Add below modules with 1500 V DC system voltage:

UL-xxxM-72HV, xxx stands for power range from 330~375, in step of 5 W, 1956 x 992 x 46mm;

UL-xxxM-60HV, xxx stands for power range from 275~310, in step of 5 W, 1650 x 992 x 46mm;

UL-xxxM-54HV, xxx stands for power range from 245~280, in step of 5 W, 1479 x 992 x 46mm;

UL-xxxM-48HV, xxx stands for power range from 220~250, in step of 5 W, 1321 x 992 x 46mm;

All tests except final stabilization (MQT 19.2) according to IEC 61730-2:2016 were conducted on model UL-360M-72HV.

Requirements verified according to IEC 61730-1：2016

Add below new models with 1000V DC system voltage coverd by 1500 V DC system voltage modules:

UL-xxxM-72, xxx stands for power range from 330~375, in step of 5 W, 1956 x 992 x 46mm;

UL-xxxM-60, xxx stands for power range from 275~310, in step of 5 W, 1650 x 992 x 46mm;

UL-xxxM-54, xxx stands for power range from 245~280, in step of 5 W, 1479 x 992 x 46mm;

UL-xxxM-48, xxx stands for power range from 220~250, in step of 5 W, 1321 x 992 x 46mm;

No additional tests considered necessary here.

Besides,

1.Add a new junction box: PV-ZH011-6, used in 1000 V DC system voltage modules, supplied by Zhejiang Zhonghuan Sunter

PV Technology Co., Ltd, which has been verified, the details please refer to the junction box CDF 7040712115902-08 provided by TÜV SÜD. No additional tests considered necessary here.

2. Add a new junction box: JM13D-1, used in 1000 V DC system voltage modules, supplied by Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd, which has been verified, the details please refer to the junction box CDF 704071711905-00 provided by TÜV SÜD. No additional tests considered necessary here.

Testing location:

Yangzhou Opto-Electrical Products Testing Institute
No. 10 West Kaifa Road, Yangzhou, 225009
Jiangsu, P. R. China

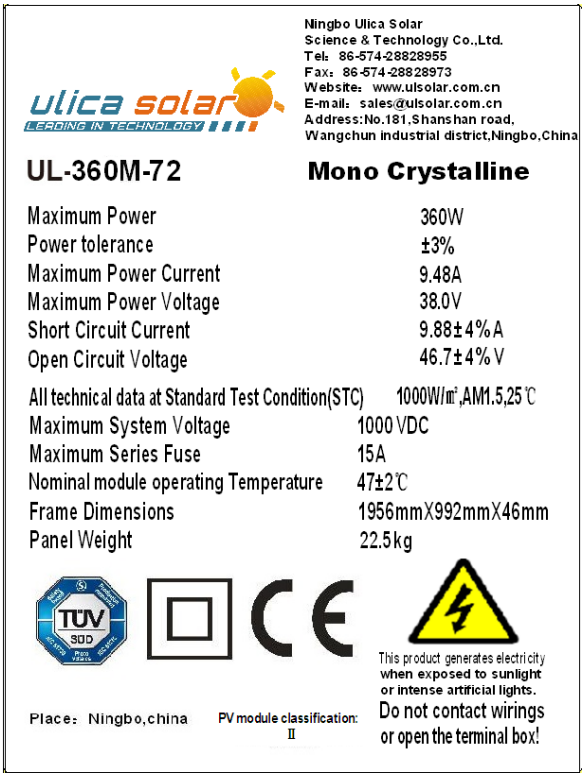
Summary of compliance with National Differences: N/A

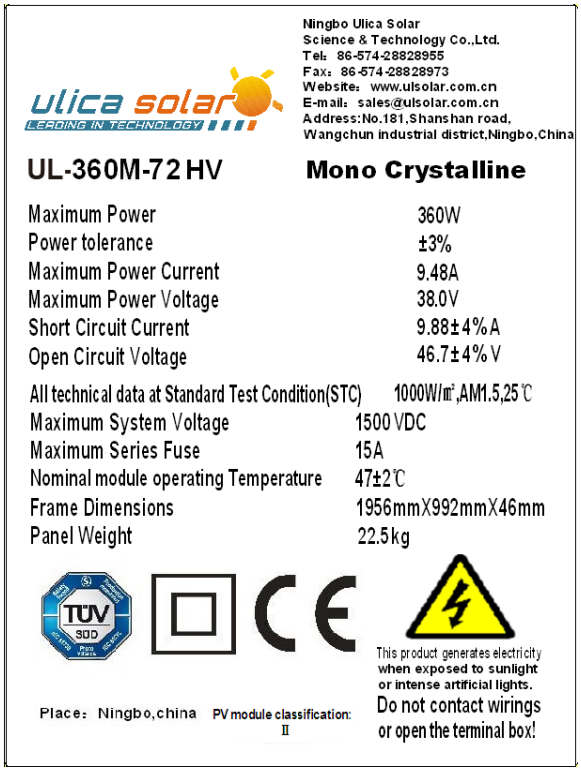
List of countries addressed

☐ **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 TÜV SÜD Product Service GmbH that own these marks.





Test item particulars .....:	
Accessories and detachable parts included in the evaluation.....:	N/A
Mounting system used.....:	Specified the user manual
Other options included .....:	N/A
Possible test case verdicts:	
- test case does not apply to the test object..... :	N/A
- test object does meet the requirement..... :	P (Pass)
- test object does not meet the requirement..... :	F (Fail)

Abbreviations used in the report:

Pmax	– Maximum power	PD	– Partial Discharge
Vmp	– Maximum power voltage	RTI	– Relative Thermal Endurance Index
Imp	– Maximum power current	STC	– Standard Test Conditions
Isc	– Short circuit current	TC	– Thermal Cycling
Voc	– Open circuit voltage	CTI	– Comparative Tracking Index
FF	– Fill factor	MST	– Module Safety Test
HF	– Humidity Freeze	DH	– Damp Heat
RTE	–Relative thermal endurance index	TI	– Temperature Index
P1	–Pollution degree 1	P2	–Pollution degree 2
P3	–Pollution degree 3		

Testing:	
Date of receipt of test item..... :	2018-04-04
Date (s) of performance of tests ..... :	2018-04-04~2018-07-30

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.**	
Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:	
The application for obtaining a TÜV SÜD Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided.....:	☐ **Yes** ☒ **Not applicable**
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (ies)..... :	Ningbo Ulica Solar Science&Technology Co.,Ltd NO.181, SHANSHAN ROAD, WANGCHUN INDUSTRIAL DISTRICT, NINGBO, CHINA Factory No.: 83334

General product information:

PV module type reference ..... : See page 7-12 in part 1 of this report

Product Electrical Ratings at STC

Nominal maximum power (Pmax, tolerance).....	See page 7-12 in part 1 of this report
Nominal open circuit voltage at (Voc, tolerance)	See page 7-12 in part 1 of this report
Nominal short circuit current at (Isc, tolerance)	See page 7-12 in part 1 of this report
Nominal maximum power voltage (Vmp)	See page 7-12 in part 1 of this report
Nominal maximum power current (Imp)	See page 7-12 in part 1 of this report

Product Safety Ratings

Maximum systems operating voltage.....	1500VDC
Maximum over-current protection rating.....	15 A
Safety class in accordance with IEC 61140	Class II
Fire safety class	Class C according to UL790
Recommended maximum series/parallel module configurations.....	Refer to manual document

Scope of Module Safety Qualification Testing:

☒ Initial module safety qualification

☒ Extension of module safety qualification

Original test report ref. no. ..... : N/A

Model differences and modification:

☐ Change in cell technology	☐ Change in cell interconnect materials/technique
☐ Modification to encapsulation system	☒ Modification to junction box/el. termination
☐ Modification to superstrate	☐ Change in el. circuit of an identical package
☐ Modification to backsheet/substrate	☐ Higher or lower output by 10 %
☐ Modification to frame/mounting structure	☐ Increase in module size
☐ Removal of frame	☐ Modification to bypass diode
☐ Modification to edge sealing	☐ Increased max system voltage
☐ Modification to cut cells	☐ Others

Module group assignment:

Sample #	Type/model	Sample S/N	Remark
GDP180175-1	UL-360M-72HV	U612MW1803T0013B	Control module
GDP180175-4	UL-360M-72HV	U612MW1803T0006B	BD, HS, TT, RC
GDP180175-5	UL-360M-72HV	U612MW1803T0022B	UV Sequence
GDP180175-7	UL-360M-72HV	U612MW1803T0029B	TC200 Sequence
GDP180175-9	UL-360M-72HV	U612MW1803T0026B	DH Sequence
GDP180175-11	UL-360M-72HV	U612MW1803T0014B	Sequence B
GDP180175-12	UL-360M-72HV	U612MW1803T0016B	Sequence B1

GDP180175-13	UL-360M-72HV	U612MW1803T0018B	Materials creep test
GDP180175-14	UL-360M-72HV	U612MW1804T0051D	Impulse voltage
GDP180175-15	UL-360M-72HV	U612MW1803T0019B	Ignitability test
GDP180175-16	UL-360M-72HV	U612MW1803T0028B	MB
GDP180175-18	UL-360M-72HV	U612MW1803T0021B	Fire test
GDP180175-19	UL-360M-72HV	U612MW1803T0027B	Fire test
GDP180175-20	UL-360M-72HV	U612MW1803T0023B	Fire test
Supplementary information: N/A			

Note (1) Use the “General product information” field to give any information on model differences within a product type family covered by the test report.

Note (2) Use the “General product information” field to describe the range of electrical and safety ratings, if the TRF covers a type family of modules.

Note (3) Use Annex 1 to list the used materials and components of the module (manufacturer/supplier and type reference)

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict

4	**Classification, applications and intended use**		**P**
	The PV modules shall be classified according to IEC 61140 (Class 0, II, III) .....:	Class II	—
	The PV modules are marked in accordance with 5.2.2.		P

5	**Requirements for design and construction**		**P**
5.1	**General**		**P**
	All PV modules are 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.		P
	Compliance is verified by evaluation of materials, components and PV module construction as well as tests specified in IEC 61730-2.		P
	The provided assemblies of the product don't 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 doesn't require any alteration of the PV module from its originally evaluated form.		N/A
	All PV module mounting and wiring methods specified in the installation instructions are evaluated for compliance with the IEC 61730 series.		P
	Compliance with the IEC 61730 series assesses the impact of the mounting and wiring methods on the safety of the PV modules, but does not assess the safety or suitability of the mounting or wiring methods for their intended use, see IEC 61215. These are subject to additional requirements or local code requirements.		N/A
	The construction of a PV module is such that equipotential bonding continuity, if applicable, is not interrupted by installation.		P
	Any adjustable or movable structural part is provided with a locking device to reduce the likelihood of unintentional movement, if any such movement may result in a risk of fire, electric shock, or injury to persons.		N/A
	PV modules don't have accessible burrs, sharp edges or sharp points that can cause injury to users or service persons. Edges and points that appear to be sharp by inspection, comply with the sharp edge test (MST 06).		P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	Parts are prevented from loosening or turning if such loosening or turning may result in a risk of fire, electric shock, or injury to persons. Compliance for components is verified by specific tests described in the relevant standards or screw connection test (MST 33).		P
Supplementary information:			

5.2	**Marking and documentation**		**P**
5.2.1	**General**		
	Instructions related to safety are in an official language of the country where the equipment is to be installed.	In English	P
5.2.2	**Marking**		P
5.2.2.1	**General**		P
	Each PV module shall include the following clear and indelible markings		—
	a) Name, registered trade name, or registered trade mark of manufacturer	Name: Ningbo Ulica Solar Science&Technology Co.,Ltd **Trade mark:** ulica solar LEADING IN TECHNOLOGY	P
	b) Type or model number designation;	UL-360M-72HV	P
	c) Serial number	For example U612MW1803T0013B	P
	d) Date and place of manufacture; alternatively serial number assuring traceability of date and place of manufacture	serial number allowing to trace the date and place of manufacture;	P
	e) Polarity of terminals or leads	"+" and "-"	P
	f) "Maximum system voltage" or "V_{sys}"	1500V DC	P
	g) Class of protection against electrical shock, in accordance with Clause 4 of IEC 61730-1:2016	Class II	P
	h) "voltage at open-circuit" or "V_{oc}" including manufacturing tolerances;	46.7± 4% for example	P
	i) "Current at short-circuit;" or "I_{sc}" including manufacturing tolerances;	9.88 ± 4% for example	P
	j) "PV module maximum power" or "P_{max}" including manufacturing tolerances;	360 ± 3% for example	P
	k) Compliance "Maximum overcurrent protection rating", is verified by reverse current overload test (MST 26).	15A	P
	All electrical data is shown as relative to standard test conditions (STC) (1 000 W/m², (25 ± 2) °C, AM 1.5 according to IEC 60904-3).		P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	International symbols is used where applicable		P
	Compliance is verified according to visual inspection (MST 01) and durability of markings (MST 05).		P
	PV connectors or wiring is marked in accordance to IEC 62852 with a symbol “Do not disconnect under load”, as given in Annex A in standards IEC 61730-1:2016. Symbol or warning notice is imprinted or labelled close to connector. PV connectors is 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 shall be applied near the PV module electrical connection means.	marked on label	P
	PV modules shall be marked to indicate the classes as follows: Class II:  Class 0: No symbol Class III: 		P
	PV modules provided with a functional earth connection are provided with a symbol according to 5.2.2.2.2, Figure 3: 		N/A
	PV modules provided 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.		N/A
	PV modules provided with terminals for field wiring rated only for use with a different specific wiring material is marked with a similar statement referring to the rated material.		N/A
	PV modules provided with terminals for field wiring rated for use with all types of wiring material do not need to be marked.		N/A
5.2.2.2	**Symbols**		
5.2.2.2.1	**Equipotential bonding**		
	A wiring terminal or bonding location of a PV module intended to accommodate a field installed bonding conductor for equipotential bonding is identified with the appropriate symbol IEC 60417-5021 (DB:2002-10) (IEC 61730-1:2016 Figure 2)). Alternatively IEC 60417-5017 (IEC 61730-1:2016, Figure 1) can be used. No other terminal or location is identified in this manner.		P
5.2.2.2.2	**Functional earthing**		

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	A wiring terminal or bonding location of a PV module intended to accommodate a field installed functional earthing conductor is identified with the appropriate symbol (IEC 60417-5018 (DB: 2002-10) (IEC 61730-1:2016 Figure 3).		N/A
5.2.3	**Documentation**		P
	PV modules are supplied with documentation describing the methods of electrical and mechanical installation as well as the electrical ratings of the PV module.		P
	The documentation states the Class under which the PV module was qualified and any specific limitations required for that Class.		P
	The documentation states the environmental conditions to which the module has been qualified, which by default includes a temperature range of –40 °C to +40 °C and wind/snow load including safety factor.	Designed load: Positive: 3600 Pa Negative: 1600 Pa Safety factor for both side: 1.5	P
	It is ensured that appropriate documentation for safe installation, use, and maintenance is available to installers and operators.		P
	Environmental conditions to which a PV module has been qualified may include IEC 61701 or IEC 62716		N/A
	The documentation shall contain the following information:		—
	all information required by 5.2.2.1 with exception of c), d) and e);		P
	recommended maximum series/parallel PV module configurations;	Refer to manual document	P
	the current rating of overcurrent protection, as determined in MST 26.	15 A	P
	manufacturer's stated tolerance for V_{oc}, I_{sc} and maximum power output P_{max} under standard test conditions;	Pmax:±3% Voc: ±4%, Isc:±4%	P
	temperature coefficient for voltage at open-circuit	Refer to IEC61215 report	P
	temperature coefficient for maximum power;	Refer to IEC61215 report	P
	temperature coefficient for short-circuit current.	Refer to IEC61215 report	P
	All electrical data is shown as relative to standard test conditions (1 000 W/m², (25 ± 2) °C, AM 1,5 according to IEC 60904-3).	—	P
	International symbols are used where applicable	—	P
	The electrical documentation includes a detailed description of the electrical installation wiring method to be used. This description includes:		—
	the minimum cable diameters for PV modules intended for field wiring	Refer to manual document	P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	any limitations on wiring methods and wire management that apply to the junction box for the PV module		P
	the size, type, material, and temperature rating of the conductors to be used		P
	type of terminals for field wiring		N/A
	specific PV connector model/types and manufacturer to which the PV module connectors can be mated		P
	the bonding method(s) to be used (if applicable) are specified. All provided or specified hardware are identified in the documentation		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)		P
	a statement indicating the fire rating(s) and the applied standard, or a statement that resistance to external fire sources was not evaluated, as well as the limitations to that rating (e.g. installation slope, sub structure or other applicable installation information);		P
	a statement indicating the minimum mechanical means for securing the PV module (as evaluated during the mechanical load test (MST 34));		P
	a statement indicating the maximum altitude the PV module is designed for. De-ratings can be applied.	Up to 2000m	P
	The documentation for roof mounting shall include:		—
	a statement indicating the minimum mechanical means for securing the PV module to the roof (as evaluated during the mechanical load test according (MST 34);		P
	details of the specific parameter(s) when the fire rating is dependent on a specific mounting structure, specific spacing, or specific means of attachment to the roof or structure.		P
	The documentation includes a statement advising that external or otherwise artificially concentrated sunlight shall not be directed onto the front or back face of the PV module (if not qualified for).		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 to specifications set forth in the IEC 61730 standard series.	—	N/A

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	To facilitate proper system sizing the manufacturer includes relevant parameters in the installation instructions that allow system layout based not only on STC values given in the documentation. For example a safety factor for V_{OC} and I_{SC} of 1,25 is recommended since irradiance is often higher then 1 000 W/m² and temperature below 25 °C may raise V_{OC}.		P
	The following or equivalent statement are included: "Under normal conditions, a photovoltaic module is likely to experience conditions that produce higher current and/or voltage than reported at standard test conditions. Accordingly, the values of I_{SC} *and* V_{OC}. marked on this PV module should be multiplied by a factor of 1,25 when determining component voltage ratings, conductor current ratings, and size of controls (e.g. inverter) connected to the PV output."		P
Supplementary information:			

5.3	**Electrical components and insulation**		P
5.3.1	**General**		—
	PV modules consist of the following electrical components and insulation:		P
	the internal wiring, e.g. solar cell and cell interconnects (see 5.3.2)		P
	external wiring and output cables (see 5.3.3)		P
	connectors (see 5.3.4)		P
	junction boxes for PV modules (see 5.3.5)		P
	frontsheet and backsheet (see 5.3.6)		P
	insulation barriers (see 5.3.7)		P
	electrical connections (see 5.3.8)		P
	encapsulant (see 5.3.9)		P
	bypass diodes (see 5.3.10)		P
5.3.2	**Internal wiring**		P
	Internal wiring has sufficient current carrying capacity for the relevant application.		P
	Depending on the pollution degree at the place where the internal wiring is located precautions against corrosion have to be taken		P
	In case that insulation for the internal wiring is necessary it fulfils the relevant requirements for the relevant application according to 5.5.2.3		P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	Compliance is checked by inspection and by reverse current overload test (MST 26).		P
5.3.3	**External wiring and cables**		P
	External wires and cables shall fulfil the requirements of EN 50618	Certificate according to EN50618 is provided	P
5.3.4	**Connectors**		P
	External DC connectors fulfil the requirements of IEC 62852.	Certificate according to IEC 62852 is provided	P
	Connectors are marked in accordance with 5.2.2.		P
5.3.5	**Junction boxes for PV modules**		P
	Junction boxes for PV modules fulfil the requirements of IEC 62790	Certificate according to IEC 62790 is provided	P
5.3.6	**Frontsheets and backsheets**		P
	Front- and backsheets are typically compositions of layered materials, such as films, adhesives or coatings, in which at least one material layer delivers the relied upon electrical insulation and other layers may provide extended protection of the relied upon insulation against the environmental factors.		P
	Layers of frontsheets and backsheets which are relied upon for insulation withstand all relevant mechanical, electrical, thermal, and environmental stresses, with compliance demonstrated at the material or component level.		P
	Layers which represent a part of a tracking path (creepage) are classified into a material group (see 5.6.3.3).		P
	In general polymeric frontsheets and backsheets meet the relevant requirements of section 5.5.2, with compliance demonstrated by the tests in IEC 61730-2.		P
	If these sheets are used as relied upon insulation they at a minimum fulfil the requirements of 5.6.4.3 for insulation in thin layers.		P
	In addition, polymeric front- and backsheets used as relied upon insulation meet the requirements of 5.5.2.3.		P
	The values for TI or RTE (RTI) according to 5.5.2.3.3 are evaluated under consideration of particular requirements for flexible multilayer sheets given in IEC 60216-2. Relevant RTI values evaluated in accordance to UL 746B are accepted as an alternative to RTE.	TI is 113°C@20000h	P
	Adhesion of the front- and backsheet, e.g. to the encapsulant or glass, are appropriate.Compliance is checked by passing the IEC 61730-2 test sequence.		P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
5.3.7	**Insulation barriers**		N/A
	An insulation barrier withstand all relevant mechanical, electrical, thermal, and environmental stresses.		N/A
	In general a polymeric insulation barrier meet the relevant requirements of 5.5.2.		N/A
	It is held in place and is not adversely affected to the extent that its required electrical and mechanical properties fall below the minimum acceptable values for the application.		N/A
	The removal of the insulation barrier is only possible by using a tool.		N/A
	Compliance is checked by passing the IEC 61730-2 test sequence.		N/A
5.3.8	**Electrical connections**		P
5.3.8.1	**General**		—
	Electrical connections are designed that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with suitable characteristics, unless there is sufficient resiliency in the metallic parts to compensate for any shrinkage or yielding of the insulating material.		P
	Prevention is taken that connections do not become loose, e.g. by using a washer.		P
	Compliance is checked by visual inspection (MST 01), continuity test of equipotential bonding (MST 13) and screw connection test (MST 33), if applicable.		P
	The end of a stranded conductor is not consolidated by soft soldering in places where the conductor is subject to contact pressure unless the method of clamping is designed so as to reduce the likelihood of a bad contact or if the soldered portion is maintained outside the contact area of the connection.		P
	Precautions are taken that under operation clamping units or other terminations are prevented from thermal and mechanical stress which might impair electrical conductivity.		P
5.3.8.2	**Terminals for external cables and PV connector ribbons**		N/A
	Terminals for electrical connections are suitable for the type and range of conductor cross-sectional areas according to specification of the manufacturer.		N/A
	They meet the requirements of IEC 62790.		N/A
	Insulated terminals is designed in a manner where a possible displacement that may result in a reduction of clearances and creepage distances is prevented		N/A

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
5.3.8.3	**Splices and connections inside a PV module**		P
	Splices and connections inside a PV module other than those for terminals of external cables and PV connector ribbons are mechanically secured and shall provide electrical continuity.		P
	Electrical connections is 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**		P
	The technical properties of encapsulant are suitable for the intended application. In particular:		—
	the rated operating temperature range include the temperature range of the intended application;		P
	the material group, the insulation resistance and the dielectric strength is suitable for the intended application.		P
	Compliance is checked by passing the IEC 61730-2 test sequence.		P
5.3.10	**Bypass diodes**		P
	Bypass diodes is rated to withstand the current and voltage for their intended use.	—	P
	Compliance is checked by bypass diode thermal test (MST 25), hot-spot endurance test (MST 22), bypass diode functionality test (MST 07) and visual inspection (MST 01).	—	P
Supplementary information:			

5.4	**Mechanical and electromechanical connections**		P
5.4.1	**General**		—
	Typically found in a PV module are the following mechanical connections:		P
	connections within a frame		N/A
	PV module mounting interfaces such as frame or backrail to glass or backsheet via adhesive (silicone, rubber, etc.);		P
	frame to clamp of a mounting system;	frame to clamp	P
	means for equipotential bonding;		P
	means for the attachment of junction box to the PV modules (silicone, tape, etc.);		P
	mechanical connections within the laminate		P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	Mechanical connections are able to durably withstand the thermal, mechanical, and environmental stresses occurring in the application without decreasing the integrity of the connection below safe levels.		P
	Compliance is checked by inspection and during the mechanical load test (MST 34), module breakage test (MST 32), materials creep test (MST 37) and, if applicable, continuity of equipotential bonding tests (MST 13).		P
	Individual material requirements are given in 5.5		P
	Parts intended to be removed is only detachable with the aid of tools.		P
	Lids that are attached without screws has one orseveral detectable facilities, e.g. recesses, which enable tools to be deployed in order to remove them. If the lid is removed correctly, the tool shall not come into contact with the active parts.		P
	For mechanical connections friction between surfaces, such as simple spring pressure, is not acceptable as the sole means to inhibit the turning or loosening of a part. Physical properties or constructions that provide an interference or form fit to prevent unintended movement or rotation of the component comply with this requirement.		N/A
5.4.2	**Screw connections**		P
	Screws and mechanical connections, the failure of which might cause the PV module to become unsafe, withstand the mechanical stresses occurring in normal use.		P
	Screws are not made of a material which is soft or liable to creep.		P
	Screws which are operated for maintenance purposes are not insulating material if their replacement by a metal screw could impair supplementary or reinforced insulation.		P
	Screws used to provide mechanical stability and continuity for equipotential bonding, e.g. fixing screws in frames and other components, comply with the requirement in the first paragraph of this subclause. At least one screw per electrical mechanical connection shall ensure the electrically connection between the metallic components. Compliance is checked by inspection and by test for general screw connection (MST 33a).		N/A
	Screws used for mechanical and electrical connections with a nominal diameter of less than 3 mm is screw into metal.	Only found in junction box, which is certified according to IEC 62790	P
	For screws used for mechanical and electrical connections two full threads engage into the metal.	Only found in junction box, which is certified according to IEC 62790	P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	Screwed and other fixed connections between different parts of the PV module are made in such a way that they do not come loose through torsion, bending stresses, vibration, etc.,as may occur in normal use. Compliance is checked by inspection and by test for locking screws (MST 33b).	Only found in junction box, which is certified according to IEC 62790	P
5.4.3	**Rivets**		N/A
	Rivets which serve as electrical as well as mechanical connections are locked against loosening. A noncircular shank or an appropriate notch may be sufficient.		N/A
5.4.4	**Thread-cutting screws**		N/A
	Thread-cutting screws and self-tapping screws are not be used for the interconnection of current-carrying parts made of metal which is soft or liable to creep, such as zinc or aluminum.		N/A
	Thread-forming screws (sheet metal screws) are not be used for the connection of current carrying parts, unless they clamp these parts directly in contact with each other, and are provided with suitable locking means.		N/A
	Thread-cutting (self-tapping) screws are not be used for the connection of current-carrying parts unless they generate a full form standard machine screw thread. However, screws of the latter type shall 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 engaged the metal.		N/A
5.4.5	**Form/press/tight fit**		P
	Form/press/tight fits of metallic components not separately equipotentially bonded is electrically connected.		N/A
	Compliance is checked by inspection and module breakage test (MST 32) and static mechanical load test (MST 34) and test of continuity of equipotential bonding (MST 13) pre and post the MST 32 and MST 34 tests.		P
5.4.6	**Connections by adhesives**		P
	Compliance is checked with mechanical load test (MST 34), test of continuity of equipotential bonding (MST 13) and module breakage test (MST 32) for mounting means adhesives and with robustness of termination test (MST 42 and MST 17) for junction-box adhesives.		P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	Adhesion of a polymer relied upon for insulation to another insulating layer is appropriate for the application.	Verified by IEC 61215/61730-2 tests	P
	If the connection by adhesive should be considered as cemented joint the requirements according to 5.6.4.2 are applied. A peel test (MST 35) and a lap shear test (MST 36) are applied in 5.6.4.2 for verification of cemented joints.		N/A
5.4.7	**Other connections**		P
	Other connections such as, for example, welded or soldered, are investigated by visual inspection (MST 01).	—	P
	Other connections which are relied upon for equipotential bonding are checked with test of continuity of equipotential bonding (MST 13).	—	P
	Materials and processes for creating the connections are appropriate for the intended use.	Verified by IEC 61215/61730-2 tests	P
Supplementary information:			

5.5	**Materials**		P
5.5.1	**General**		P
	General compliance is checked with tests in accordance to IEC 61730-2.		P
5.5.2	**Polymeric materials**		P
5.5.2.1	**General**		P
	Polymeric materials are able to durably and safely withstand the electrical, mechanical, thermal, environmental, and corrosive stresses occurring in the application, and are resistant to electrical and mechanical property degradation.		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 and comply with the requirements of the materials creep test (MST 37) depending on their constructive function in the PV module.		P
	Polymeric materials used in PV modules as part of a cemented joint additionally comply with 5.6.4.2.		N/A
5.5.2.2	**Endurance to weathering stress**		P
	Polymeric materials are durable to weathering stress occurring in the application		P
	Components are evaluated to the relevant requirement in the applicable component standard.		P
5.5.2.3	**Polymeric materials used as electrical insulation**		P
5.5.2.2	**Endurance to electrical stress**		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Materials used as electrical insulation withstand electrical stresses which occur in the application both in the unconditioned and preconditioned cases.		P
	If relevant for clearance and creepage distance evaluation insulating materials are assigned a materials group designation based on a CTI rating.		P
	Insulating materials between conductive parts of different polarity or between conductive parts and accessible surfaces are assessed according to their material group designation based on their CTI rating (see B.2.2.4.2), if those materials are a part of a creepage distance.		P
	CTI rating is required from each surface, on which tracking could occur, e.g. at inner front and/ or backsheet layer surface to encapsulant, if applicable. See Clause B.9. Figures B.2, B.3 and B.4.		P
	Whenever electrical stress is present through a material layer (not along an interface or surface) the concept of distance through insulation is applicable and CTI is not required.		P
	Additionally, the following PV module tests apply: – Insulation test (MST 16) before and after preconditioning, and – Impulse voltage test (MST 14).		P
5.5.2.3.3	**Endurance to thermal stress – RTE (RTI) or TI (mechanical/electrical)**		P
	Materials used as relied upon insulation have a minimum relative thermal endurance, relative thermal index or temperature index (RTE/RTI or TI) in accordance with IEC 60216-5 or IEC 60216-1 equal to or greater than the maximum normalized operating temperature of the material as measured in the particular mounting situation (e.g. roof mounted) during the temperature test (MST 21), or 90 °C, whichever is higher. For open rack mounted PV modules, the normalized measured maximum PV module operating temperature can be assumed to be 90 °C, so the insulation RTE/RTI or TI rating shall be at least 90 °C. To ensure that the electrical and mechanical properties are provided through the expected lifetime the TI and RTE (RTI) values have to be evaluated as mechanical and electrical ones according to IEC 60216-2. Relevant RTI values evaluated in accordance to UL 746B are accepted as an alternative to RTE.	TI is 113°C@20000h for backsheet RTI(Str) for frame adhesive is 105°C	P
5.5.2.3.4	**Polymeric insulating materials used as external parts**		P
	External polymeric parts of the PV module whose deterioration could impair the safety meet the following additional requirements:		—

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	a) flammability class minimum V-1 according to IEC 60695-11-10 (not applicable to insulation in thin layers; those are covered only by MST 24);	Junction box meet the IEC 62790 requirements Connector meet the IEC 62852 requirements Cable meet the EN50618 requirements	N/A
	b) ball pressure test according to IEC 60695-10-2 with a temperature of 75 °C (not applicable to insulation in thin layers);	Junction box meet the IEC 62790 requirements Connector meet the IEC 62852 requirements Cable meet the EN50618 requirements	N/A
	c) ignitability test (MST 24) in final application (laminated or the PV module);		P
	d) peel test for proof of cemented joints according to IEC 61730-2 (MST 35), where applicable;		N/A
	e) lap shear strength test (MST 36), where applicable.		N/A
5.5.2.3.5	**Polymeric insulating parts supporting live parts**		P
	Polymeric parts which are not components of the laminate whose deterioration could impair the safety of the PV module are evaluated with the module level ignitability test MST 24.		P
	Other than elastomeric polymeric materials (e.g. duroplastic) shall meet the following additional requirements:		—
	a) Flammability class minimum HB according to IEC 60695-11-10.	Junction box meet the IEC 62790 requirements Connector meet the IEC 62852	N/A
	b) Ball pressure test according to IEC 60695-10-2 with a temperature of 125 °C.	Junction box meet the IEC 62790 requirements Connector meet the IEC 62852	N/A
	c) Materials creep test (MST 37).	Junction box meet the IEC 62790 requirements Connector meet the IEC 62852	N/A
5.5.2.4	**Polymeric materials used for mechanical functions**		P
	Materials used for mechanical functions have a minimum mechanical relative thermal endurance, relative thermal index or temperature index (RTE/RTI or TI) in accordance with IEC 60216-5 or IEC 60216-1 equal to or greater than the maximum normalized operating temperature of the material as measured in the particular mounting situation (e.g. roof mounted) during the temperature test (MST 21), or 90 °C, whichever is higher.	RTI(Str) for adhesive is 105°C	P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
5.5.3	**Metallic materials**		P
5.5.3.1	**General**		P
	In accordance with IEC 60950-1 metal parts designed for applications in climates with wet or humid ambient conditions are not in contact to metal parts that have a difference of their electrochemical potentials of more than 600 mV.		P
	Larger electrochemical potential differences are permissible if the contact points of these materials are designed to remain dry.		N/A
	Electrochemical potentials for specific material combinations are taken into consideration.	Junction box meet the IEC 62790 requirements	N/A
	Iron or mild steel as a part of the product are plated, painted, or enamelled for protection against corrosion.	Junction box meet the IEC 62790 requirements	N/A
	The corrosion protection at a minimum shall be at least equivalent to a zinc coating of 0,015 mm thickness.		N/A
	Simple sheared or cut edges and punched holes are not required to be additionally protected, provided these features do not affect the mechanical bonding, mounting or structural performance of the PV module.		P
	Compliance is checked by inspection.		P
5.5.3.2	**Current carrying parts**		P
	Under normal operation current-carrying parts have a sufficient mechanical strength and electrical conductivity.		P
	If environmental conditions may cause corrosion current-carrying materials (metal, polymeric based, etc.) are protected against corrosion, e.g. by coating.		P
	In case of current-carrying parts consisting of corrosion protective coated metal the coating are capable of preventing corrosion according to either one of ISO 1456, ISO 1461, ISO 2081 or ISO 2093.		N/A
	If the current-carrying parts may be stressed by abrasion, coated metal parts are not allowed.		N/A
	Other materials are protected accordingly.		N/A
5.5.4	**Adhesives**		P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	Adhesives are appropriate for the application. Compliance is checked by relevant tests of IEC 61730-2, including lap shear strength test (MST 36), peel test (MST 35), robustness of terminations test (MST 42), mechanical load test (MST 34), and visual inspection (MST 01), accessibility test (MST 11), wet leakage current test (MST 17) pre- and post- test sequences, where applicable.		P
	If an adhesive is part of the relied upon electrical insulation it has to meet the requirements of 5.5.2.3.3.		N/A
Supplementary information: Specific requirements for adhesives are under consideration.			

5.6	**Protection against electric shock**		P
5.6.2	**Protection against accessibility to hazardous live parts**		
5.6.2.1	**General**		
	PV modules are constructed to provide adequate protection against accessibility to hazardous live parts (> 35 V DC).		P
	For Class 0 PV modules, accessible parts shall be separated from hazardous live parts by at least basic insulation.		N/A
	Class II PV modules shall be so constructed and enclosed that only parts separated from hazardous live parts by double or reinforced insulation are accessible.		P
	In Class III PV modules live parts are not considered as hazardous, so a separation from accessible parts is not needed.		N/A
	To ensure sufficient functionality and protection against hazardous lighting arc, live parts of different polarity are separated by at least functional insulation.		N/A
	Compliance is checked by visual inspection (MST 01) and by accessibility test (MST 11).		P
	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.		P
5.6.2.2	**Protection by means of enclosures and insulation barriers**		P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	Enclosures or insulation barriers are so designed that, after mounting, the live parts are not accessible. This requirement is fulfilled even if there is any deformation of the housing and/or cover as a result of mechanical and thermal stress, which can occur during normal use. Furthermore, the degree of protection of the housing is not be impaired by this possible deformation.		P
	Parts of enclosures and insulation barriers that provide protection in accordance with these requirements are not removable without the use of a tool. Lids which are attached without screws have one or several detectable features, e.g. recesses, which enable tools to be deployed in order to remove them. If the lid is removed correctly the tool may not come into contact with the live parts.		P
	An insulation barrier is held in place and is not adversely affected by influences expected during normal operation to the extent that its necessary electrical and mechanical properties fall below the minimum acceptable values for the application.		N/A
	Parts shall be prevented from loosening or turning if such loosening or turning may result in a risk of fire, electric shock, or injury to persons.		P
5.6.2.3	**Protection by means of insulation of live parts**		P
	An insulation material providing the sole insulation between a live part and an accessible metal part, or between uninsulated live parts not of the same potential, is of adequate thickness and of a material appropriate for the application. If the maximum power dissipation between two neighbouring cells is less than 15 W (based on solar cell rating), neighbouring solar cells connected in series have no special insulation requirements		P
	Required type of insulation as defined in IEC 61140 is as below:		—
	For class 0, Protection required against direct contact is required. Besides, basic insulation between live parts and accessible metal parts, basic insulation between live parts and accessible surfaces, and basic insulation between live parts of different potential of the same circuit are required		N/A
	For class II, Protection required against direct contact is required. Besides, reinforce insulation between live parts and accessible metal parts, reinforce insulation between live parts and accessible surfaces, and basic insulation between live parts of different potential of the same circuit are required		P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	For class III, Protection required against direct contact is not required. Besides, function insulation between live parts and accessible metal parts, function insulation between live parts and accessible surfaces, and function insulation between live parts of different potential of the same circuit are required		N/A
Supplementary information:			
5.6.3	**Insulation coordination**		P
5.6.3.2	**Pollution degree**	Macro-environment for an entire PV module is P3. For parts enclosed or encapsulated, P1.	—
5.6.3.3	**Material groups**		—
5.6.3.4	**Clearances (cl) and creepage distances (cr)**		P
	Minimum clearances (cl) and creepage distances (cr) between internal live parts and outer accessible surfaces	16.50mm	P
	Minimum clearances (cl) and creepage distances (cr) between live parts of different potential inside a PV module	1.5mm	P
	Minimum clearances (cl) and creepage distances (cr) between terminals of different polarity of rewireable junction boxes		N/A
Supplementary information:			
5.6.4	**Distance through insulation (dti)**		P
5.6.4.2	**Cemented joints**		—
	Distance through cemented joints		—
	Dry volume resistivity as measured according to IEC 62788-1-2 , method A.		—
	Wet volume resistivity as measured according to IEC 62788-1-2 , method A.		—
5.6.4.3	**Insulation in thin layers**		P
	a) Single-layer sheet providing relied upon insulation		—
	Thickness of single layer		—
	RTI / RTE / TI as defined in 5.5.2.3.3		—
	Dielectric strength for reinforced insulation		—
	b) Multi-layer sheets providing relied upon insulation if single layers are characterized individually :		—
	Thickness of each layer, and sum thickness		—
	RTI / RTE / TI for each layer as defined in 5.5.2.3.3		—
	Dielectric strength for basic insulation for each layer		—

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	c) Multi-layer sheets providing relied upon insulation if single layers are not characterized individually:		
	Thickness of combined thickness of all layers	390.5 to 411.3µm	P
	RTI / RTE / TI for combined layers as defined in 5.5.2.3.3	113°C	P
	Dielectric strength of entire multi-layer sheet providing relied upon insulation fulfill requirements for reinforced insulation.	No test dielectric breakdown at 8000V test voltage	P
Supplementary information:			

IEC 61730-2: Part 2: Requirements for testing			
Clause	Requirement + Test	Result - Remark	Verdict
10	**Test Procedures**		
	Safety qualification testing includes the following Module Safety Tests (MST) of IEC 61730-2:		
10.2	MST 01 – Visual inspection ..... :	see table 10.2	P
10.3	MST 02 – Performance at STC ..... :	see table 10.3	P
10.4	MST 03 – Maximum power determination ..... :	Same as table 10.3	P
10.5	MST 04 – Insulation thickness test ..... :	see table 10.5	P
10.6	MST 05– Durability of markings..... :	see table 10.6	P
10.7	MST 06– Sharp edge test..... :	see table 10.7	P
10.8	MST 07– Bypass diode functionality test..... :	see table 10.8	P
10.9	MST 11 – Accessibility test..... :	see table 10.9	P
10.10	MST 12 – Cut susceptibility test..... :	see table 10.10	P
10.11	MST 13 – Continuity test of equipotential bonding:	see table 10.11	P
10.12	MST 14 – Impulse voltage test ..... :	see table 10.12	P
10.13	MST 16 – insulation test..... :	see table 10.13	P
10.14	MST 17 – Wet leakage current test..... :	see table 10.14	P
10.15	MST 21 – Temperature test..... :	see table 10.15	P
10.16	MST 22 – Hot-spot test..... :	see report no.: 704061800602-00 part 1 of 2	P
10.17	MST 23 – Fire test..... :	see table 10.17	P
10.18	MST 24 – Ignitability test ..... :	see table 10.18	P
10.19	MST 24 5– Bypass diode thermal test ..... :	see report no.:	P
10.20	MST 26 – Reverse current overload Test..... :	see table 10.20	P
10.21	MST 32 – Module breakage test..... :	see table 10.21	P
10.22	MST 33 – Screw connections test..... :	see table 10.22	N/A
10.23	MST 34 – Static mechanical load test..... :	see report no.: 704061800602-00 part 1 of 2	P
10.24	MST 35 – Peel test..... :	~~see table 10.24~~	N/A
10.25	MST 36 – Lap shear strength test..... :	~~see table 10.25~~	N/A
10.26	MST 37 – Materials creep test..... :	see table 10.26	P
10.27	MST 42 – Robustness of terminations test..... :	see report no.: 704061800602-00 part 1 of 2	P
10.28	MST 51 – Thermal cycling test ..... :	see report no.: 704061800602-00 part 1 of 2 and table 10.28	P
10.29	MST 52 – Humidity freeze test..... :	see report no.: 704061800602-00 part 1 of 2 and table 10.29	P

IEC 61730-2: Part 2: Requirements for testing			
Clause	Requirement + Test	Result - Remark	Verdict
10.30	MST 53 – Damp heat test..... :	see report no.: 704061800602-00 part 1 of 2 and table 10.30	P
10.31	MST 54 – UV preconditioning test ..... :	see report no.: see report no.: 704061800602-00 part 1 of 2 and table 10.31	P
10.32	MST 55 – Cold conditioning..... :	see table 10.32	P
10.33	MST 56 – Dry heat conditioning..... :	see table 10.33	P
Supplementary information:			

IEC 61730-2: Part 2: Requirements for testing			
Clause	Requirement + Test	Result - Remark	Verdict

10.2	TABLE: Visual Inspection - MST 01 (Initial)	P
Test Date [YYYY-MM-DD] .....:	2018-04-04	—
Sample No.	Nature and position of findings	—
GDP180175-1	No major visual defects found	P
GDP180175-4	No major visual defects found	P
GDP180175-5	No major visual defects found	P
GDP180175-7	No major visual defects found	P
GDP180175-9	No major visual defects found	P
GDP180175-11	No major visual defects found	P
GDP180175-12	No major visual defects found	P
GDP180175-13	No major visual defects found	P
GDP180175-14	No major visual defects found	P
GDP180175-15	No major visual defects found	P
GDP180175-16	No major visual defects found	P
GDP180175-18	No major visual defects found	P
GDP180175-19	No major visual defects found	P
GDP180175-20	No major visual defects found	P
Supplementary information: N/A		

10.3	TABLE: Performance at STC – MST 02					P
Test Date [YYYY-MM-DD]..... :		2018-04-04				—
Irradiance (W/m^2)		1000				—
Module temperature (°C)		25				—
Test method .....:		☒ Simulator	☐ Natural sunlight			—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]
GDP180175-1	47.879	39.319	9.728	9.245	363.513	78.05
GDP180175-4	47.973	39.081	9.735	9.336	364.868	78.13
GDP180175-5	47.907	39.083	9.758	9.302	363.545	77.77
GDP180175-7	47.993	39.054	9.794	9.356	365.398	77.74
GDP180175-9	47.940	39.344	9.810	9.299	365.867	77.80
GDP180175-11	47.884	39.259	9.773	9.267	363.824	77.74
GDP180175-12	47.939	38.816	9.783	9.371	363.745	77.56

IEC 61730-2: Part 2: Requirements for testing						
Clause	Requirement + Test			Result - Remark		Verdict
GDP180175-13	47.851	38.934	9.783	9.344	363.778	77.71
GDP180175-14	48.148	38.826	9.616	9.181	365.622	78.97
Supplementary information: N/A						

10.9	TABLE: Accessibility Test - MST 11 (Initial)		P
	Test Date [YYYY-MM-DD]……:	2018-04-04	—
	Maximum system voltage [V_{DC}] .....:	1500	—
Sample No.	Result [MΩ]		—
GDP180175-5	>5000		P
GDP180175-7	>5000		P
GDP180175-9	>5000		P
GDP180175-11	>5000		P
GDP180175-12	>5000		P
GDP180175-13	>5000		P
Supplementary information: The maximum resistance measurement is 5000MΩ			

10.11	TABLE: Continuity Test of Equipotential Bonding - MST 13 (Initial)		P
	Test Date [YYYY-MM-DD]……:	2018-04-04 for GDP180175-16 2018-04-04 for others	—
	Maximum system voltage [V_{DC}] .....:	1500	—
	Current applied [A].....:	50	—
	Location of designated grounding point.....:	On the middle of the longest frame	—
	Location of second contacting point.....:	On the other middle of the longest frame	—
Sample No.	Voltage [V_{DC}]	Resistance [Ω]	—
GDP180175-5	0.20	0.004	P
GDP180175-7	0.20	0.004	P
GDP180175-9	0.20	0.004	P
GDP180175-11	0.20	0.004	P
GDP180175-12	0.20	0.004	P
GDP180175-13	0.20	0.004	P
GDP180175-16	0.25	0.006	
Supplementary information: N/A			

10.13	TABLE: Insulation Test - MST 16 (Initial)	P

IEC 61730-2: Part 2: Requirements for testing			
Clause	Requirement + Test	Result - Remark	Verdict

	Test Date [YYYY-MM-DD].....:	2018-04-11	—
	Maximum system voltage [V_{DC}] .....:	1500	—
	Test voltage applied V_{TEST} [V_{DC}] .....:	8000/1500	—
	Module area A [m²] .....:	1.92 for GDP180175-14 1.94 for others	—

Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
GDP180175-1	☐	>5000	>9700	P
GDP180175-4	☐	>5000	>9700	P
GDP180175-5	☐	>5000	>9700	P
GDP180175-7	☐	>5000	>9700	P
GDP180175-9	☐	>5000	>9700	P
GDP180175-11	☐	>5000	>9700	P
GDP180175-12	☐	>5000	>9700	P
GDP180175-13	☐	>5000	>9700	P
GDP180175-14	☐	>5000	>9600	P
Supplementary information: the maximum resistance measurement range is 5000MΩ				

10.14	**TABLE: Wet Leakage Current Test - MST 17 (Initial)**		**P**
	Test Date [YYYY-MM-DD].....:	2018-04-11	—
	Maximum system voltage [V_{DC}] .....:	1500	—
	Test voltage applied V_{TEST} [V_{DC}] .....:	1500	—
	Module area A [m²] .....:	1.92 for GDP180175-14 1.94 for others	—
	Resistivity of wetting agent [Ω·cm] .....:	2718	—
	Average wetting agent temperature [°C] .....:	22.5	—

Sample No.	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
GDP180175-1	585.6	1136.06	P
GDP180175-4	738.1	1431.91	P
GDP180175-5	663.5	1287.19	P
GDP180175-7	682.0	1323.08	P
GDP180175-9	255.9	496.45	P
GDP180175-11	576.3	1118.02	P
GDP180175-12	449.2	871.45	P
GDP180175-13	543.6	1054.58	P

IEC 61730-2: Part 2: Requirements for testing			
Clause	Requirement + Test	Result - Remark	Verdict

GDP180175-14	462.5	888.00	P
Supplementary information: N/A			

10.17	**TABLE: Fire Test - MST 23**		**P**
	Test Date [YYYY-MM-DD]……:	2018-06-14	—
	Module fire resistance class.....:	C	—
	No. of modules provided to create the test assembly.....:	3	—
	Testing method.....:	UL790	—
Sample No.	Observations		—
GDP180175-18	☒ Modules comply with the requirements for the fire resistance class		P
GDP180175-19			
GDP180175-20			
Supplementary information: GDP180175-20 is for the burning brand test, GDP180175-18, GDP180175-19 are for the spread-of-flame test			

10.18	**TABLE: Ignitability Test- MST 24**		**P**
	Test Date [YYYY-MM-DD]……:	2018-07-12	—
	Testing operation.....:	☒ Surface exposure ☐ Edge exposure	—
Sample No.	Observations		—
GDP180175-15	☐ Ignition occurs; ☐ the flame tip reaches a height of 150 mm above the flame application point with 20s		P
Supplementary information: No ignition			

10.21	**TABLE: Module Breakage Test - MST 32**		**P**
	Test Date [YYYY-MM-DD]……:	2018-06-27	—
	Weight of impactor [kg].....:	45.5	—
	Thickness of sample [mm].....:	46mm	—
	Mounting technique used.....:	According user manual	—
Sample No.			—
GDP180175-16	☒ No break occurred		
	☐ The PV module separate from the mounting structure or from the framing		

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	☐ Breakage occurred, but no shear or opening large enough for a 76 mm diameter sphere to pass freely has developed.		
	☐ Breakage occurred, but no particles larger than 65 cm² have been ejected from the sample.		
Supplementary information: N/A			
10.13	**TABLE: Continuity Test of Equipotential Bonding - MST 13**		**P**
	Test Date [YYYY-MM-DD]……:	2018-06-27	—
	Maximum system voltage [V_{DC}] .....:	1500	—
	Current applied [A].....:	50	—
	Location of designated equipotential bonding point:	On the middle of the longest frame	—
	Location of second contacting point.....:	On the other middle of the longest frame	—
Sample No.	Voltage [V_{DC}]	Resistance [Ω]	—
GDP180175-16	0.40	0.008	P
Supplementary information:N/A			

10.24	**TABLE: Peel test - MST 35**		N/A
Sample #	(unconditioned / after sequence B)		—
Width of cemented joint	≤ 10 mm / > 10 mm		—
Location of test strip	Top left / Top right / Left Top / Right Top / Left middle / Right middle / Left bottom / Right bottom / Bottom left / Bottom right		—
Interface of test strip	☐ Interface between flexible backsheet and cemented joint material ☐ Interface between rigid backsheet and cemented joint material		—
Force-deflexion graph	Test strip [Top left] ---Force-deflexion graph----		
	Test strip [Top right] ---Force-deflexion graph----		
Arithmetic mean M1 of adhesion force of unconditioned samples [N]		—	—

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

10.24	**TABLE: Lap shear strength test - MST 36**		N/A
Sample #			—
Width of cemented joint	25 mm		—
Number of test coupons	20 (10 unconditioned / 10 conditioned with sequence B)		—
Force-deflexion graph	Test coupon 1 ---Force-deflexion graph----		
	Test coupon 2 ---Force-deflexion graph----		
Arithmetic mean M1 of breaking force of unconditioned samples [N]		—	—
Arithmetic mean M2 of adhesion force of samples conditioned with sequence B [N]		—	—
Pass criteria:Loss of breaking force: $0.5 < \frac{\sum_1^{10} M2}{\sum_1^{10} M1}$			—
Supplementary information: —			

10.26A	**TABLE: Materials Creep Test- MST 37**		**P**
	Test Date [YYYY-MM-DD] start/end .....:	2018-04-20/2018-04-28	—
	Module temperature [°C].....:	105±5	—
	Mounting technique used.....:	Be mounted vertically in the test chamber.	—
Sample No.		GDP180175-13	—

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Minimum cl and cr	Meet the cr and cl distances as specified in either Table 3 or Table 4 of IEC 61730-1:2016	P
Between internal live parts and outer accessible surfaces after MST 37	☒**Yes** ☐ **No**	P
Between live parts of different potential inside a PV module after MST 37	☒**Yes** ☐ **No**	P
Between terminals of different polarity of rewireable junction boxes after MST 37	☐**Yes** ☐ **No**	N/A

(10.2 Visual inspection after Materials Creep Test MST37)		P
Test Date [YYYY-MM-DD]..... :	2017-09-26	—
Sample #	Nature and position of initial findings – comments or attach photos	—
GDP180175-13	No major visual defects found	P
Supplementary information: N/A		

(10.13 Insulation Test after Materials Creep Test MST37)				**P**
Test Date [YYYY-MM-DD]……..:	2018-04-28			—
Maximum system voltage [V_{DC}]……..:	1500			—
Test voltage applied V_{TEST} [V_{DC}]……:	8000/1500			—
Module area A [m²]……..:	1.94			—
Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
GDP180175-13	☐	＞5000	＞9700	P
Supplementary information: N/A				

(10.14 Wet leakage current test after Materials Creep Test MST37)			**P**
Test Date [YYYY-MM-DD]..... ……..:	2018-04-28		—
Test Voltage applied [V] ..... ……..:	1500		—
Solution resistivity [Ω cm)……..:	< 3500Ω cm at 22 ± 2°C	2718	P
Solution temperature [°C]…….....:	22.6		P
Sample #	Measured [MΩ]	Insulation resistance x A [MΩ·m²]	Result
GDP180175-13	329.6	639.42	P
Supplementary information: N/A			

(10.9 Accessibility Test after Materials Creep Test MST37)		**P**
Test Date [YYYY-MM-DD]……:	2018-04-28	—
Maximum system voltage [V_{DC}]……:	1500	—
Sample No.	Result [MΩ]	—
GDP180175-13	>5000	P
Supplementary information: the maximum resistance measurement range is 5000MΩ		

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Clause	Requirement + Test	Result - Remark	Verdict

(10.11 Continuity Test of Equipotential Bonding after Materials Creep Test)			**P**
Test Date[YYYY-MM-DD]……..……..:	2018-04-28		—
Maximum system voltage [V_{DC}] .....……..:	1500		—
Current applied [A] ..... ……...:	50		—
Location of designated equipotential bonding point……...:	On the middle of the longest frame		—
Location of second contacting point ..... ……..:	On the other middle of the longest frame		—
Sample No.	Voltage [V_{DC}]	Resistance [Ω]	—
GDP180175-13	0.20	0.004	P
Supplementary information: N/A			

10.30 B	**TABLE: Damp heat 200 test- MST53**		P
Test Date [YYYY-MM-DD] start/end..... :	2018-04-18/2018-04-26		—
Total hours (200)…… :	200		—
(10.2 Visual inspection after MST53)			P
Test Date [YYYY-MM-DD]..... :	2018-04-26		—
Sample #	Nature and position of initial findings – comments or attach photos		—
GDP180175-11	No major visual defects found		P
Supplementary information: N/A			
10.31 B	**TABLE: UV preconditioning test- MST54**		P
Test Date (YYYY-MM-DD) start/end .....:	2018-04-27/2018-05-15		—
Module temperature [°C] ..... :	60±5		—
UV irradiance (280-400nm) [w/m²] ..... :	136.36		—
Ratio of UV irradiance (280-320nm) (%) ..... :	7.66		P
UV irradiation (280-400nm) [kWh/ m²] ..... :	60		—
Module operation condition ..... .:	☒ Short circuited ☐ Pmax		—
Supplementary information: Front was exposed			
(10.2 Visual inspection after MST 54)			P
Test Date [YYYY-MM-DD]..... :	2018-05-15		—
Sample #	Nature and position of initial findings – comments or attach photos		—
GDP180175-11	No major visual defects found		P
Supplementary information: N/A			

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Clause	Requirement + Test	Result - Remark	Verdict

10.29 B	**TABLE: Humidity freeze 10 test- MST52**		P
Test Date [YYYY-MM-DD] start/end..... :		2018-05-16/2018-05-26	—
Total cycles (10) ..... :		10	—
Applied current (A) ..... :		0.05	—
Sample #	Open circuits (yes/no)		—
GDP180175-11	No		P
Supplementary information: N/A			
(10.2 Visual inspection after MST 52)			P
Test Date [YYYY-MM-DD]..... :		2018-05-26	—
Sample #	Nature and position of initial findings – comments or attach photos		—
GDP180175-11	No major visual defects found		P
Supplementary information: N/A			
10.31 B	**TABLE: UV preconditioning test- MST54**		P
Test Date (YYYY-MM-DD) start/end .....:		2018-05-26/2018-06-04	—
Module temperature [°C] ..... :		60±5	—
UV irradiance (280-400nm) [w/m²] ..... :		267.86	—
Ratio of UV irradiance (280-320nm) (%) ..... :		7.67	P
UV irradiation (280-400nm) [kWh/ m²] ..... :		60	—
Module operation condition ..... .:		☒ Short circuited ☐ Pmax	—
Supplementary information: back was exposed			
(10.2 Visual inspection after MST 54)			P
Test Date [YYYY-MM-DD]..... :		2018-06-04	—
Sample #	Nature and position of initial findings – comments or attach photos		—
GDP180175-11	No major visual defects found		P
Supplementary information: N/A			
10.29 B	**TABLE: Humidity freeze 10 test- MST52**		P
Test Date [YYYY-MM-DD] start/end..... :		2018-06-05/2018-06-15	—
Total cycles (10) ..... :		10	—
Applied current (A) ..... :		0.05	—
Sample #	Open circuits (yes/no)		—
GDP180175-11	No		P
Supplementary information: N/A			
(10.2 Visual inspection after MST 52)			P
Test Date [YYYY-MM-DD]..... :		2018-06-15	—
Sample #	Nature and position of initial findings – comments or attach photos		—

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GDP180175-11	No major visual defects found			P
Supplementary information: N/A				
(10.13 Insulation Test after MST52)				**P**
Test Date [YYYY-MM-DD]……:			2018-06-15	—
Maximum system voltage [V_{DC}]……...:			1500	—
Test voltage applied V_{TEST} [V_{DC}]……..:			8000/1500	—
Module area A [m²]……..:			1.94	—
Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
GDP180175-11	☐	>5000	>9700	P
Supplementary information: the maximum resistance measurement range is 5000MΩ				
(10.14 Wet leakage current test after MST52)				**P**
Test Date [YYYY-MM-DD]……..……...:		2018-06-15		—
Test Voltage applied [V] ..... ……..:		1500		—
Solution resistivity [Ω cm)……:		2713		P
Solution temperature [°C]……...:		22.6		P
Sample #	Measured [MΩ]	Insulation resistance x A [MΩ·m²]		Result
GDP180175-11	417.5	809.95		P
Supplementary information: Size of module 1.94[m²].				

10.32 B1	**TABLE: Cold Conditioning - MST55**		P
Test Date [YYYY-MM-DD] start/end..... :	2018-04-18/2018-04-20		—
Total hours (48h)……:	48		—
Module temperature (-40±3°C)……..:	-40±3°C		—
(10.2 Visual inspection after MST55)			P
Test Date [YYYY-MM-DD]..... :	2018-04-20		—
Sample #	Nature and position of initial findings – comments or attach photos		—
GDP180175-12	No major visual defects found		P
Supplementary information: N/A			
(10.13 Insulation Test after MST55)			**P**
Test Date [YYYY-MM-DD]……:		2018-04-20	—
Maximum system voltage [V_{DC}]……...:		1500	—
Test voltage applied V_{TEST} [V_{DC}]……..:		8000/1500	—
Module area A [m²]……..:		1.94	—

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Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
GDP180175-12	☐	>5000	>9700	P
Supplementary information: N/A				

10.33 B1	**TABLE: Dry Heat Conditioning- MST56**	P
Test Date [YYYY-MM-DD] start/end..... :	2018-04-20/2018-04-28	—
Total hours (200)……..:	200	—
Module temperature (°C)……...:	105±5	—
(10.2 Visual inspection after MST56)		P
Test Date [YYYY-MM-DD]..... :	2018-04-28	—
Sample #	Nature and position of initial findings – comments or attach photos	—
GDP180175-12	No major visual defects found	P
Supplementary information: N/A		

(10.13 Insulation Test after MST56)		**P**
Test Date [YYYY-MM-DD]……..:	2018-04-28	—
Maximum system voltage [V_{DC}]……...:	1500	—
Test voltage applied V_{TEST} [V_{DC}]……..:	8000/1500	—
Module area A [m²]……..:	1.94	—

Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
GDP180175-12	☐	>5000	>9700	P
Supplementary information: the maximum resistance measurement range is 5000MΩ				

10.29 B1	**TABLE: Humidity freeze 10 test- MST52**	P
Test Date [YYYY-MM-DD] start/end..... :	2018-04-28/2018-05-08	—
Total cycles (10) ..... :	10	—
Applied current (A) ..... :	0.05	—
Sample #	Open circuits (yes/no)	—
GDP180175-12	No	P
Supplementary information: N/A		

(10.2 Visual inspection after MST 52)		P
Test Date [YYYY-MM-DD]..... :	2018-05-08	—
Sample #	Nature and position of initial findings – comments or attach photos	—
GDP180175-12	No major visual defects found	P
Supplementary information: N/A		

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10.32 B1	**TABLE: Cold Conditioning - MST55**		P
Test Date [YYYY-MM-DD] start/end..... :	2018-05-08/2018-05-10		—
Total hours (48)……..:	48		—
Module temperature (-40±3°C)……...:	-40±3°C		—
(10.2 Visual inspection after MST55)			P
Test Date [YYYY-MM-DD]..... :	2018-05-10		—
Sample #	Nature and position of initial findings – comments or attach photos		—
GDP180175-12	No major visual defects found		P
Supplementary information: N/A			
(10.13 Insulation Test after MST55)			P
Test Date [YYYY-MM-DD]……..:	2018-05-10		—
Maximum system voltage [V_{DC}]……...:	1500		—
Test voltage applied V_{TEST} [V_{DC}]……..:	8000/1500		—
Module area A [m²]……..:	1.94		—
Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
GDP180175-12	☐	>5000	>9700	P
Supplementary information: the maximum resistance measurement range is 5000MΩ				
10.29 B1	**TABLE: Humidity freeze 10 test- MST52**		P
Test Date [YYYY-MM-DD] start/end..... :	2018-05-11/2018-05-21		—
Total cycles (10) ..... :	10		—
Applied current (A) ..... :	0.05		—
Sample #	Open circuits (yes/no)		—
GDP180175-12	No		P
Supplementary information: N/A			
(10.2 Visual inspection after MST 52)			P
Test Date [YYYY-MM-DD]..... :	2018-05-21		—
Sample #	Nature and position of initial findings – comments or attach photos		—
GDP180175-12	No major visual defects found		P
Supplementary information: N/A			
(10.13 Insulation Test after MST52)			**P**
Test Date [YYYY-MM-DD]……..:	2018-05-21		—
Maximum system voltage [V_{DC}]……...:	1500		—
Test voltage applied V_{TEST} [V_{DC}]……..:	8000/1500		—

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Module area A [m²]……..:			1.94	—
Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
GDP180175-12	☐	>5000	>9700	P
Supplementary information: the maximum resistance measurement range is 5000MΩ				

(10.14 Wet leakage current test after MST52)			P
Test Date [YYYY-MM-DD]……..……..:	2018-05-21		—
Test Voltage applied [V] ..... ……..:	1500		—
Solution resistivity [Ω cm)……:	< 3500Ω cm at 22 ± 2°C	2708	P
Solution temperature [°C]……....:	22.4		P

Sample #	Measured [MΩ]	Insulation resistance x A [MΩ·m²]	Result
GDP180175-12	219.4	425.64	P
Supplementary information: Size of module area 1.94 [m²]			

10.15 F	**TABLE: Temperature Test - MST 21**			P
	Test Date [YYYY-MM-DD]…….:	2018-06-11		—
	Sample No. .....:	GDP180175-4		—
	Reference solar irradiance [W/m²] .....:	1000		—
	Reference ambient temperature [°C] .....:	50.2		—
	Test method	☐ Outdoor method ☒ Solar simulator method		—
Measuring location	Component temperature T_{OBS} [°C]	Normalised temperature T_{CON} [°C]	Component temperature limit [°C]	—
Module superstrate above the centre cell	—	—	—	—
Module substrate below the centre cell	71.4	61.2	113	P
Terminal enclosure interior surface	78.4	68.2	90	P
Field wiring terminals	60.7	50.5	90	P
Insulation of the field wiring leads	59.6	49.4	90	P
External connector bodies	64.3	54.1	90	P
Diode bodies	74.5	64.3	200	P
Frame	—	—	—	—
Supplementary information: $T_{CON} = T_{OBS} + (40\ °C - T_{AMB})$, Thermal material requirements are given in 5.5 of IEC 61730-1:2016.				

10.1	**TABLE: Visual Inspection - MST 01 (after MST 21)**		**P**
Test Date [YYYY-MM-DD]…….:		2018-06-11	—

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Sample No.	Nature and position of findings	—
GDP180175-4	No major visual defects found	P
Supplementary information: N/A		

10.6	**TABLE: Insulation Test- MST 16 (after MST 21)**		P
Test Date [YYYY-MM-DD]……:		2018-06-11	—
	Maximum system voltage [V_{DC}]……:	1500	—
	Test voltage applied V_{TEST} [V_{DC}]……:	8000/1500	—
	Module area A [m²] ……:	1.94	—

Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
GDP180175-4	☐	>5000	>9700	P
Supplementary information: the maximum resistance measurement range is 5000MΩ				

10.14	**TABLE: Wet Leakage Current Test - MST 17 (after MST 21)**		**P**
	Test Date [YYYY-MM-DD]……:	2018-06-11	—
	Maximum system voltage [V_{DC}] ……:	1500	—
	Test voltage applied V_{TEST} [V_{DC}] ……:	1500	—
	Module area A [m²]……:	1.94	—
	Resistivity of wetting agent [Ω·cm]……:	2704	P
	Average wetting agent temperature [°C] ……:	22.3	P

Sample No.	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
GDP180175-4	309.3	600.04	P
Supplementary information: N/A			

10.2F	**TABLE: Reverse Current Overload Test - MST 26**		**P**
	Test Date [YYYY-MM-DD]……:	2018-07-12	—
	Module over-current protection rating [A] ……:	20	—
	Test current [A] ……:	27	—
	Range of applied voltage [V]……:	56.7~50.4	—
	Test duration[h]……:	2	—

Sample No.		—
GDP180175-4	☒ No flaming of the module ☒ No flaming or charring of the tissue paper	P
Supplementary information: N/A		

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10.1	**TABLE: Visual Inspection - MST 01 (after MST 26)**			**P**
Test Date [YYYY-MM-DD]……:			2018-07-12	—
Sample No.	Nature and position of findings			—
GDP180175-4	No major visual defects found			P
Supplementary information: N/A				
10.6	**TABLE: Insulation Test- MST 16 (after MST 26)**			**P**
	Maximum system voltage [V_{DC}]…….:		1500	—
	Test voltage applied V_{TEST} [V_{DC}] …….:		8000/1500	—
	Module area A [m²] …….:		1.94	—
Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
GDP180175-4	☐	>5000	>9700	P
Supplementary information: the maximum resistance measurement range is 5000MΩ				
10.14	**TABLE: Wet Leakage Current Test - MST 17 (after MST 26)**			**P**
	Test Date [YYYY-MM-DD]……:		2018-07-12	—
	Maximum system voltage [V_{DC}] ……:		1500	—
	Test voltage applied V_{TEST} [V_{DC}] ……:		1500	—
	Module area A [m²]……:		1.94	—
	Resistivity of wetting agent [Ω·cm]……:		2714	—
	Average wetting agent temperature [°C] ……:		22.6	—
Sample No.	Insulation resistance at V_{TEST} [MΩ]		Insulation resistance x A [MΩ·m²]	—
GDP180175-4	330.2		640.59	P
Supplementary information:N/A				

10.12G	**TABLE: Impulse Voltage Test - MST 14**		**P**
	Test Date [YYYY-MM-DD]……:	2018-05-31	—
	Maximum system voltage [V_{DC}]……:	1500	—
	Impulse voltage [V] ……:	20000	—
	Conductivity of conducting glue [Ω/625 mm²] ……:	0.065	P
Sample No.			
GDP180175-14	☒ No evidence of dielectric breakdown or surface tracking observed		P
Supplementary information: N/A			
10.1	**TABLE: Visual Inspection - MST 01 (after Impulse Voltage Test)**		**P**
	Test Date [YYYY-MM-DD]……:	2018-05-31	—

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Sample No.	Nature and position of findings	—
GDP180175-14	No major visual defects found	P
Supplementary information: N/A		

10.6	**TABLE: Insulation Test- MST 16 (after Impulse Voltage Test)**			**P**
	Maximum system voltage [V_{DC}] ..... :	1500		—
	Test voltage applied V_{TEST} [V_{DC}]..... :	8000/1500		—
	Module area A [m²]..... :	1.94		—
Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
GDP180175-14	☐	>5000	>9700	P
Supplementary information: the maximum resistance measurement range is 5000MΩ				

10.10	**TABLE: Cut Susceptibility Test - MST 12**		**P**
	Test Date [YYYY-MM-DD].....:	2018-06-21	—
	Applied force [N] ..... :	8.9	—
Sample No.			—
GDP180175-5	☒ No exposure of active circuitry of the module		P
GDP180175-7	☒ No exposure of active circuitry of the module		P
GDP180175-9	☒ No exposure of active circuitry of the module		P
GDP180175-11	☒ No exposure of active circuitry of the module		P
GDP180175-12	☒ No exposure of active circuitry of the module		P
Supplementary information:N/A			

10.6	**TABLE: Insulation Test- MST 16 (after Cut Susceptibility Test)**			**P**
	Maximum system voltage [V_{DC}]..... :	1500		—
	Test voltage applied V_{TEST} [V_{DC}] ..... :	8000/1500		—
	Module area A [m²]..... :	1.94		—
Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
GDP180175-5	☐	>5000	>9700	P
GDP180175-7	☐	>5000	>9700	P
GDP180175-9	☐	>5000	>9700	P
GDP180175-11	☐	>5000	>9700	P
GDP180175-12	☐	>5000	>9700	P
Supplementary information: the maximum resistance measurement range is 5000MΩ				
MST 17	**TABLE: Wet Leakage Current Test - MST 17 (after Cut Susceptibility Test)**			P

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Clause	Requirement + Test	Result - Remark	Verdict

	Maximum system voltage [V_{DC}]..... :	1500	—
	Test voltage applied V_{TEST} [V_{DC}] ..... :	1500	—
	Module area A [m²]..... :	1.94	—
	Resistivity of wetting agent [Ω·cm]..... :	2704	—
	Average wetting agent temperature [°C]..... :	22.4	—
Sample No.	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
GDP180175-5	403.6	782.98	P
GDP180175-7	274.2	531.95	P
GDP180175-9	286.3	555.42	P
GDP180175-11	295.1	572.49	P
GDP180175-12	383.6	744.18	P
Supplementary information: N/A			

10.13 Final	**TABLE: Continuity Test of Equipotential Bonding - MST 13**		**P**
	Test Date [YYYY-MM-DD]……:	2018-06-21	—
	Maximum system voltage [V_{DC}] ..... :	1500	—
	Current applied [A] ..... :	50	—
	Location of designated grounding point ..... :	On the middle of the longest frame	—
	Location of second contacting point ..... :	On the other middle of the longest frame	—
Sample No.	Voltage [V_{DC}]	Resistance [Ω]	—
GDP180175-5	0.30	0.006	P
GDP180175-7	0.30	0.006	P
GDP180175-9	0.25	0.005	P
GDP180175-11	0.35	0.007	P
GDP180175-12	0.25	0.005	P
Supplementary information: N/A			

10.2 Final	**TABLE: Accessibility Test - MST 11**		**P**
	Test Date [YYYY-MM-DD]……:	2018-06-21	—
	Maximum system voltage [V_{DC}]..... :	1500	—
Sample No.	Result [MΩ]		—
GDP180175-5	>5000		P
GDP180175-7	>5000		P

IEC 61730-2: Part 2: Requirements for testing			
Clause	Requirement + Test	Result - Remark	Verdict

GDP180175-9	>5000	P
GDP180175-11	>5000	P
GDP180175-12	>5000	P
Supplementary information: The maximum resistance measurement range is 5000MΩ		

10.3 Final	**TABLE: Max. power determination– MST 02 (Final)**						P
Test Date [YYYY-MM-DD]..... :			2018-07-16				—
Irradiance (W/m^2)			1000				—
Module temperature (°C)			25				—
Test method .....:			☒ Simulator ☐ Natural sunlight				—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Result
GDP180175-1	47.957	39.110	9.595	9.315	364.307	79.17	P
GDP180175-4	47.725	38.721	9.575	9.240	357.781	76.83	P
GDP180175-5	47.789	38.766	9.691	9.247	358.485	77.41	P
GDP180175-7	47.935	38.852	9.785	9.396	365.072	77.83	P
GDP180175-9	47.483	38.103	9.668	9.125	347.692	75.74	P
GDP180175-11	47.891	38.580	9.798	9.435	364.001	77.57	P
GDP180175-12	47.910	38.685	9.769	9.366	362.334	77.41	P
Supplementary information: The IV curves (didn't not) show any additional kinks or other unusual characteristics as compared to the initial IV curve.							

10.2 Final	**TABLE: Visual Inspection - MST 01 (Final)**	**P**
Test Date [YYYY-MM-DD]..... :	2018-07-16	—
Sample No.	Nature and position of findings	—
GDP180175-1	No major visual defects found	P
GDP180175-4	No major visual defects found	P
GDP180175-5	No major visual defects found	P
GDP180175-7	No major visual defects found	P
GDP180175-9	No major visual defects found	P
GDP180175-11	No major visual defects found	P
GDP180175-12	No major visual defects found	P
Supplementary information: N/A		

10.6 Final	**TABLE: Durability of markings- MST 05**	P
Test Date [YYYY-MM-DD]..... :	2018-07-16	—

IEC 61730-2: Part 2: Requirements for testing			
Clause	Requirement + Test	Result - Remark	Verdict
	Aromatics content in petroleum spirits by volume [%] (≤0.1%)..... :	≤0.1%	P
	Kauri-butenol value in petroleum spirits by volume [%](≤29%)) ..... :	≤29%	P
	Initial boiling point [°C] (about 65) ..... :	About 65	P
	Dry point [°C] (about 69) ..... :	About 69	P
	Mass per unit volume [kg/l] (about 0.7)..... :	0.659	P
	Rubbing time..... :	15s with water 15s with petroleum spirits	P
Sample No.	Nature and position of findings		—
GDP180175-1	Marking is legible, not be removed easily, no curling		P
GDP180175-4	Marking is legible, not be removed easily, no curling		P
GDP180175-5	Marking is legible, not be removed easily, no curling		P
GDP180175-7	Marking is legible, not be removed easily, no curling		P
GDP180175-9	Marking is legible, not be removed easily, no curling		P
GDP180175-11	Marking is legible, not be removed easily, no curling		P
GDP180175-12	Marking is legible, not be removed easily, no curling		P
Supplementary information: N/A			

10.7 Final	**TABLE: Sharp edge test-MST 06**		**P**
Test Date [YYYY-MM-DD]..... :		2018-07-16	—
Sample No.	Nature and position of findings		—
GDP180175-1	No sharp edge		P
GDP180175-4	No sharp edge		P
GDP180175-5	No sharp edge		P
GDP180175-7	No sharp edge		P
GDP180175-9	No sharp edge		P
GDP180175-11	No sharp edge		P
GDP180175-12	No sharp edge		P
Supplementary information: N/A			

10.8 Final	**TABLE Bypass diode functionality test - MST 07**	**P**
Test Date [YYYY-MM-DD].....:	2018-07-16	—
☐ Method A		N/A
Ambient temperature [°C] .....:	—	—
Current flow applied [A] .....:	—	—

IEC 61730-2: Part 2: Requirements for testing			
Clause	Requirement + Test	Result - Remark	Verdict

Sample #	VFM	$V_{FMrated}$	VFM = (N × $V_{FMrated}$) ± 10 %	Result
—	—	—	☐ Yes ☐ No	—
Supplementary information:				
☒ Method B				—
Sample #	IV curve bend after shading			Result
GDP180175-1	☒			P
GDP180175-4	☒			P
GDP180175-5	☒			P
GDP180175-7	☒			P
GDP180175-9	☒			P
GDP180175-11	☒			P
GDP180175-12	☒			P
Supplementary information: N/A				

10.22 Final	**TABLE: Screw Connections Test- MST 33**		**N/A**
10.22.1	**TABLE: Test for general screw connections - MST 33a**		—
	Test Date [YYYY-MM-DD]……:	—	—
	Nominal outer thread diameter of screw [mm] . :	—	—
	Torque type ..... :	☐ Type1 ☐ Type2 ☐ Type3	—
Sample No.			—
—	☐ During the test, no damage impairing the further use of the fixing or screwed connection occur		—
	☐ After the test, it is still possible to introduce the screw or nut made of insulation material in the intended manner.		—
Supplementary information:			
10.22.2	**TABLE: Test for Locking Screws- MST 33b**		N/A
	Test Date [YYYY-MM-DD]……:		—
	Thread size ..... :		—
	Torque ..... :	☐ 2.5 Nm ☐ 5.0 Nm	—
Sample No.			—
	☐ No loosening shall occur.		
Supplementary information:			

10.5 Final	**TABLE: Insulation thickness test– MST 04**	P
Test Date [YYYY-MM-DD] ..... :	2018-07-30	—

IEC 61730-2: Part 2: Requirements for testing			
Clause	Requirement + Test	Result - Remark	Verdict

Sample No. ..... :	GDP180175-11		—
	a) Single-layer sheet providing relied upon insulation		N/A
	Thickness of single layer		—
	b) Multi-layer sheets providing relied upon insulation if single layers are characterized individually :		N/A
	Thickness of each layer, and sum thickness		—
	c) Multi-layer sheets providing relied upon insulation if single layers are not characterized individually:		P
	Thickness of combined thickness of all layers	390.5 to 411.3µm	P
Supplementary information: 12 positions are measured. Measurement uncertainty is 2%			

ANNEX 1: CONSTRUCTIONAL DETAILS

A1.1	MODULE TYPE/S
	UL-360M-72HV

A1.2	MODULE DESIGN	
	Module dimensions (L x W x H) [mm] ..... :	1956*992*46
	Weights..... :	23 kg
	Front/Rear cover bonding classification ..... :	☒ rigid/flexible ☐ rigid/rigid ☐ flexible/flexible

A1.3	SOLAR CELL	
	Cell type reference ..... :	**Ningbo Ulica Solar Science&Technology Co.,Ltd** Cell type: 156M-5BB, P type mono crystalline silicon
	Cell dimensions L x W x T (± %) [mm] .....:	156.75 x 156.75
	Cell thickness [µm].....:	200±20
	Cell area [cm²] .....:	244.32

A1.4	IDENTIFICATION OF MATERIALS	
	Front cover ..... :	**Henan Ancai Hi-tech Co., Ltd.** Type: tempered glass with AR coating Thickness: 3.2 mm
	Rear cover ..... :	**Crown Advanced Materials Co.,Ltd** Type: Crown BE-xn, White, Material: PVDF /PET/PO Thickness: 22um/250um/50um, total: 350 (-10%,+20%)um
	Encapsulation material ..... :	**Shanghai HIUV New Materials Co., Ltd** Type: S201MT1, (front side) thickness:0.5mm±0.1mm Type: S201W, (back side) thickness:0.5mm±0.1mm
	Frame parts ..... :	**Wuxi Zhongde Aluminum Product Co,.Ltd** Anodized aluminum alloy, 6063-T5, silver colour, Cross-section graph: 46mm*35mm
	Mounting parts ..... :	N/A
	Adhesive for frame ..... :	**Hangzhou Zhijiang Silicone Chemicals Co., LTD** Type: JS-606
	Edge sealing ..... :	N/A
	Internal wiring ..... :	N/A
	Cell connector ..... :	**Suzhou Sanysolar Materials Technology Corporation** Cross section: 0.25 ×0.9 mm, Material: Base Cu ≥ 99.97%, Coating Sn60%Pb40%, 0.025±0.005 mm at each side.

	String connector..... :	**Suzhou Sanysolar Materials Technology Corporation** Cross section: 0.25 × 7 mm, Material: Base Cu ≥ 99.97%, Coating Sn60%Pb40%, 0.025±0.005 mm at each side.
	Soldering material..... :	N/A
	Fluxing agent..... :	**ASAHI Solder Technology CO,LTD** Type: SF56
	Junction box..... :	**Zhejiang Zhonghuan Sunter PV Technology Co.,Ltd** Type: PV-ZH011-6B, DC 1500 V, 15A, IP 67, -40 °C to 85 °C TÜV Rheinland certified, No. R 50345461
	Cable..... :	**Zhejiang Zhonghuan Sunter PV Technology Co.,Ltd.** Type: H1Z2Z2-K 1×4mm^2, 1500V DC, -40 °C to 90 °C, TÜV Rheinland certified, No. R 50330654
	Connector..... :	**Zhejiang Zhonghuan Sunter PV Technology Co.,Ltd.** Type: PV-ZH202B, DC 1500V, 30A, IP 67, -40 °C to 85 °C TUV SUD Certified, No. R 50350557
	Bypass diode..... :	**Zhejiang Zhonghuan Sunter PV Technology Co.,Ltd.** Type: 20SQ045, Schottky, Max. peak reverse voltage 45 V, Max. average forward current 20 A, Max. junction temperature 200 °C.
	Potting material..... :	**Hangzhou Zhijiang Silicone Chemicals Co., LTD** Type: JS-1184, Rated V-0 at min. 3.0 mm thick, RTI=105, CTI=0, UL certified, No. E335227
	Adhesive for junction box ..... :	**Hangzhou Zhijiang Silicone Chemicals Co., LTD** Type: JS-606, Rated V-0, at min. 3.0 mm thick, RTI=105, UL certified, No. E335227
	Additional material (e. g. fixing tape, insulation tape ,Label)..... :	Fixing tape: **TERAOKA SEISAKOSHO Co., Ltd.** Type: 631S#38 Insulation sheet: **Crown Advanced Materials Co.,Ltd** Type: Crown BE-xn, White, Material: PVDF /PET/PO Thickness: 22um/250um/50um, total: 350 (-10%,+20%)um

A1.5	**MODULE DESIGN - MINIMUM DISTANCES**	
	Between cells..... :	1.5mm
	Between cell and edge of laminate ..... :	16.25 mm

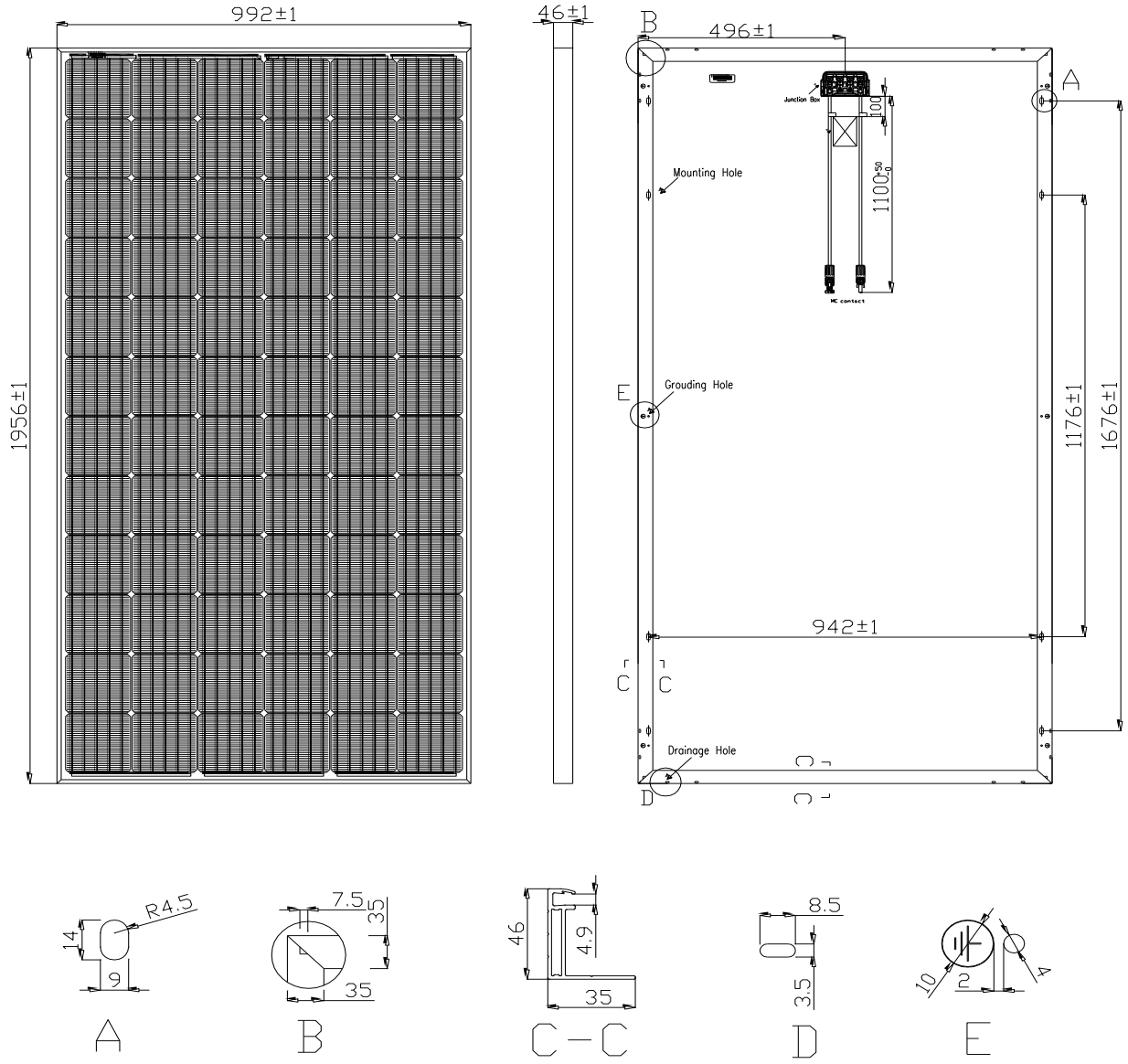
	Between any current carrying part and edge of laminate ..... :	15.75 mm

A1.6	**MODULE DESIGN - ELECTRICAL CONFIGURATION**	
	Total number of cells..... :	72
	Serial-parallel connection of cells ..... :	24
	Cells per bypass diode ..... :	24
	No. of bypass diodes..... :	3

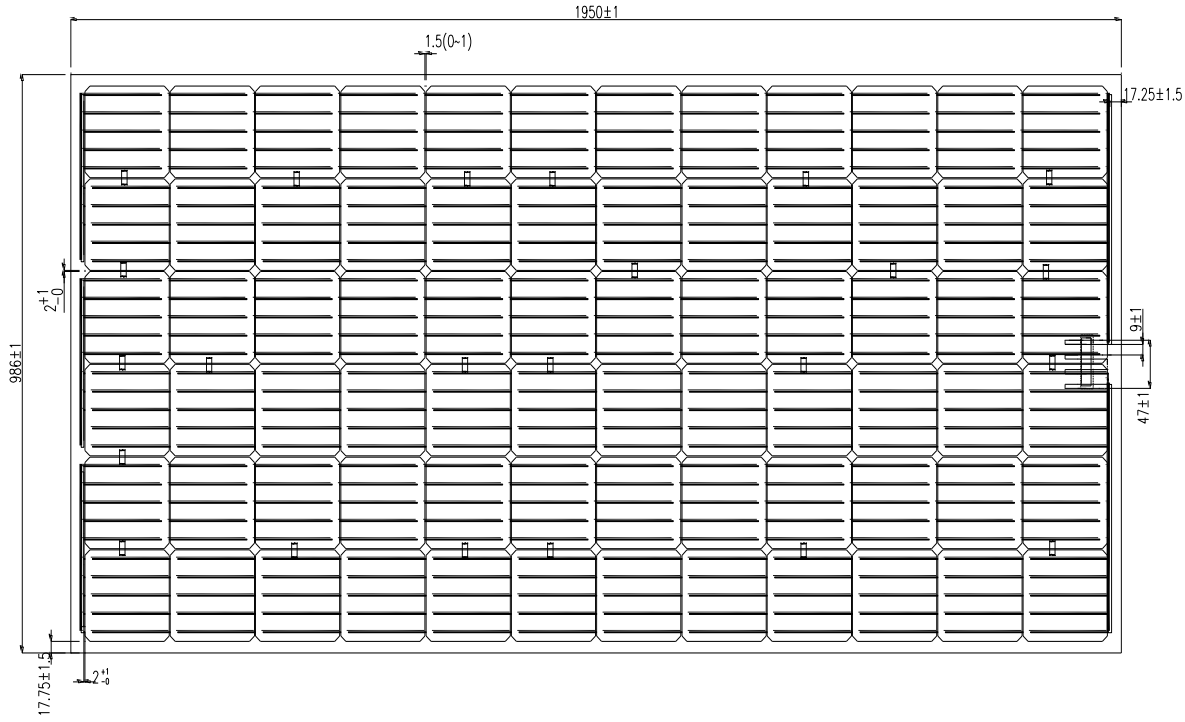
ANNEX 2: CONSTRUCTURE DETAILS

72 CELLS MODULE (1500V OR 1000V)

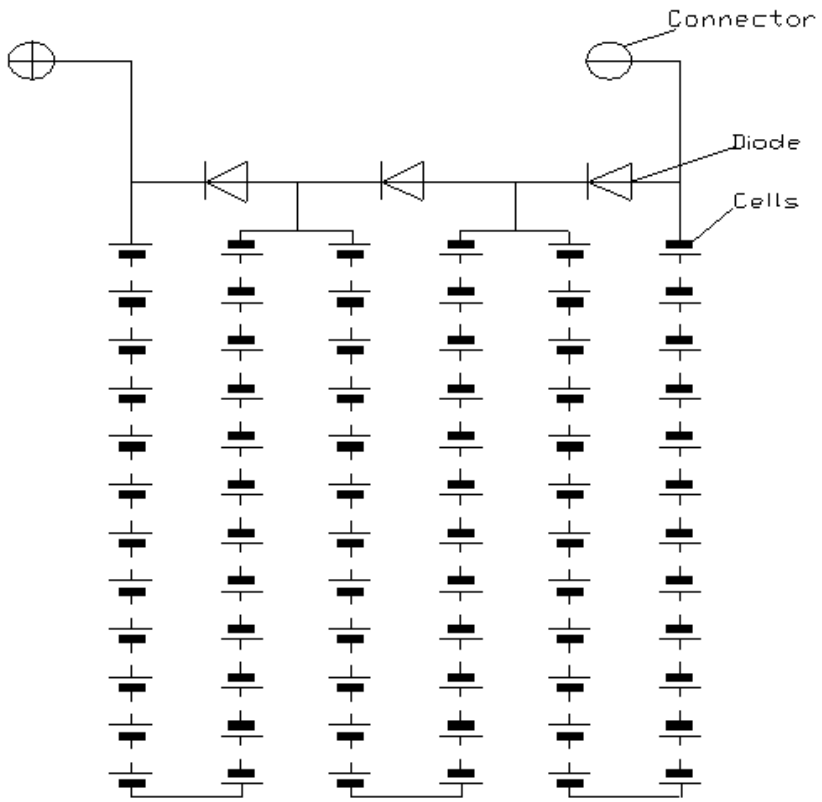
FRAME DIMENSION



Cell and conductor layout on the laminate

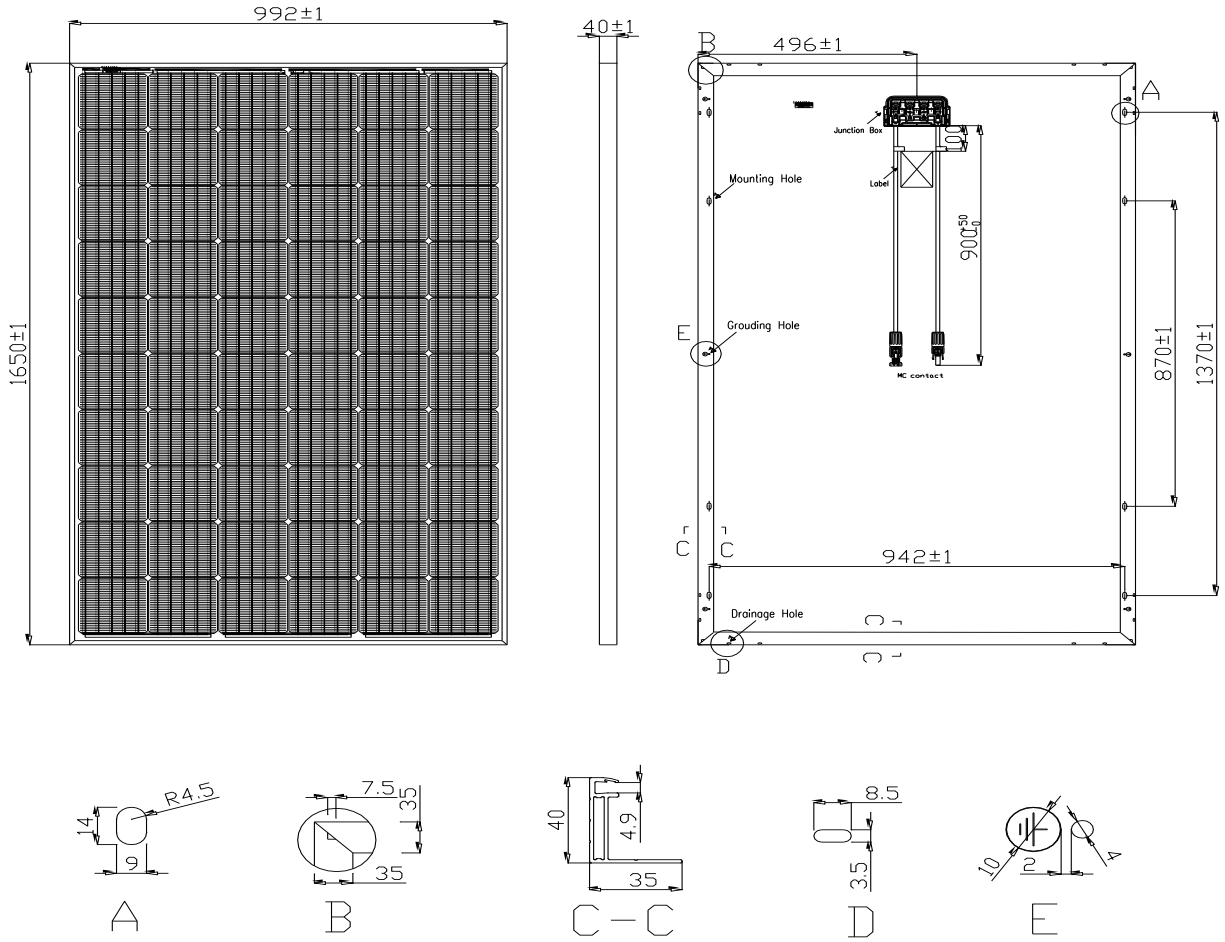


Circuit diagram

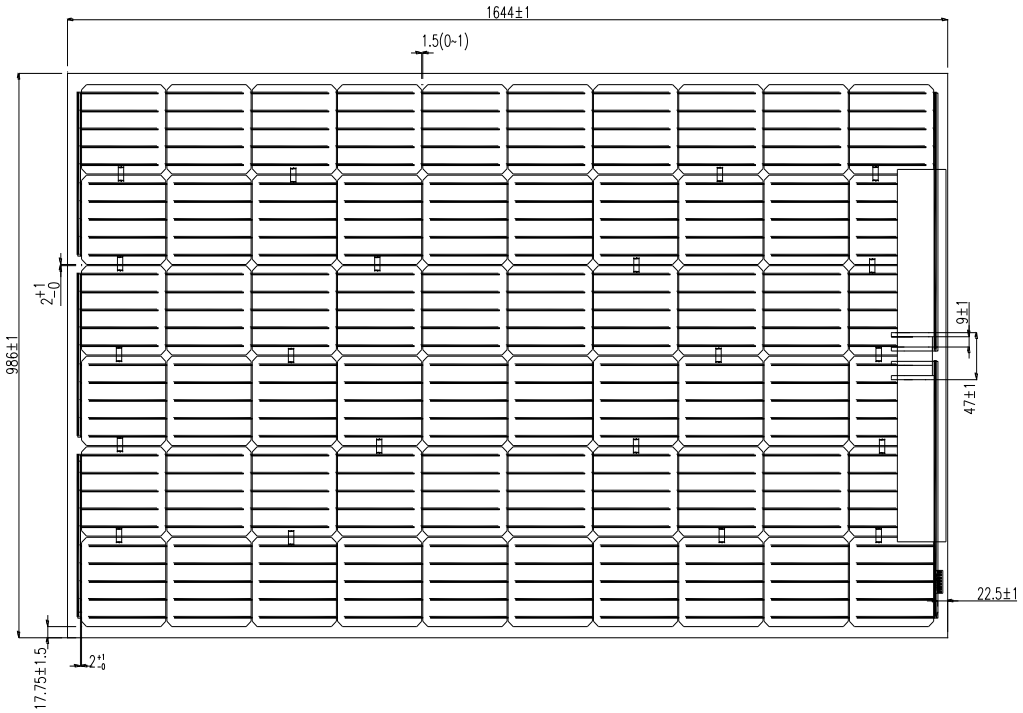


60 CELLS MODULE (1500V OR 1000V)

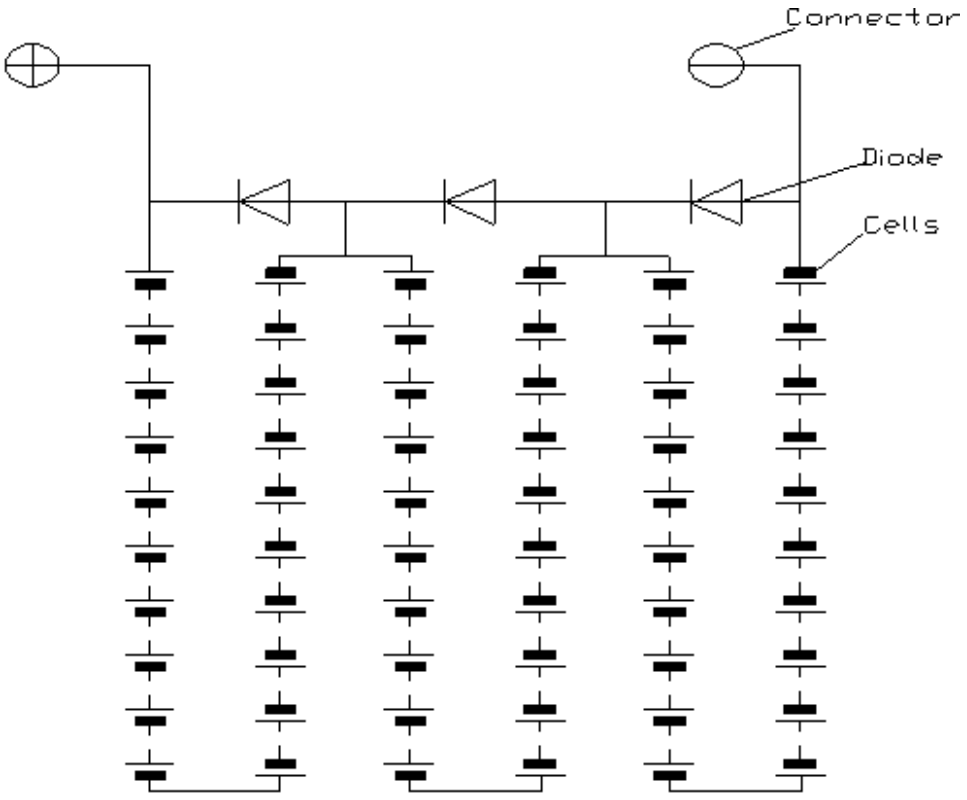
FRAME DIMENSION



Cell and conductor layout on the laminate

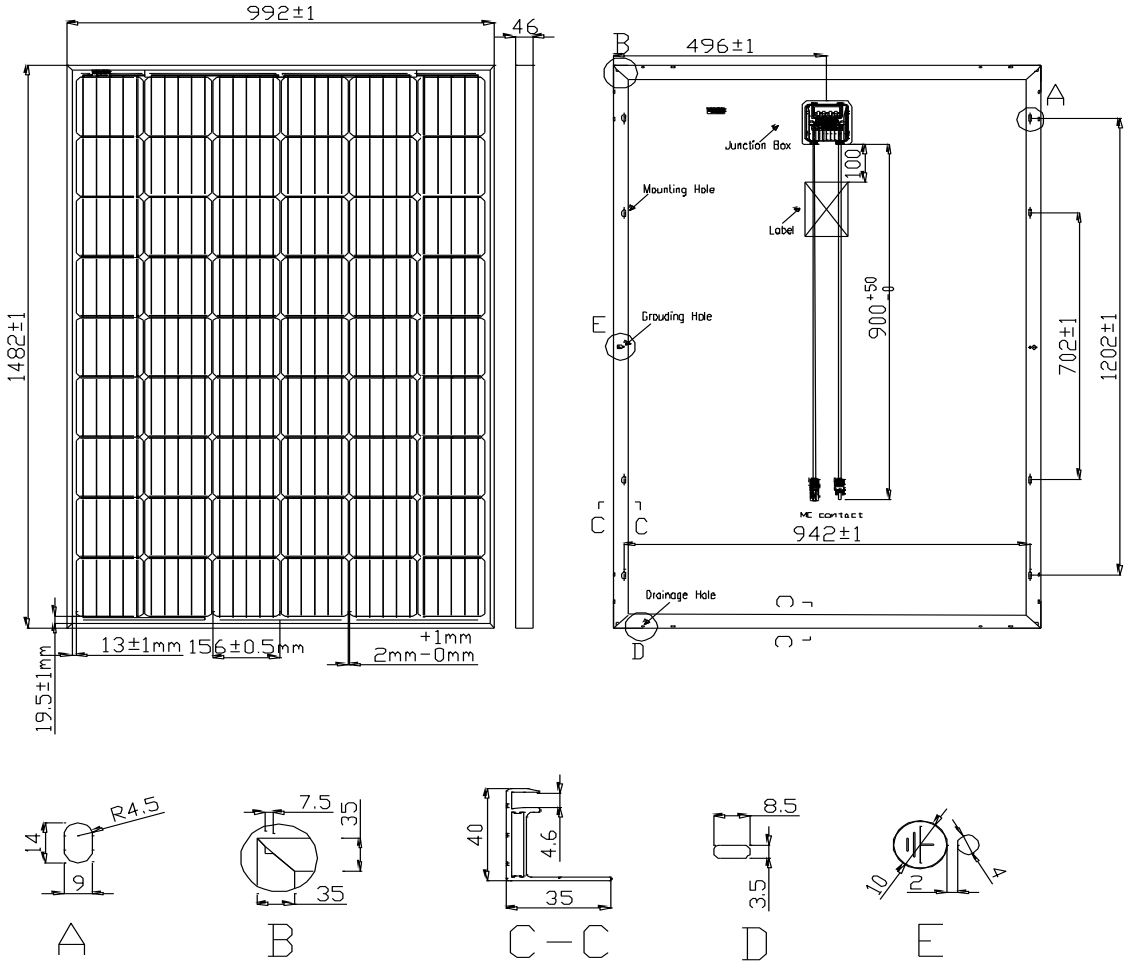


Circuit diagram

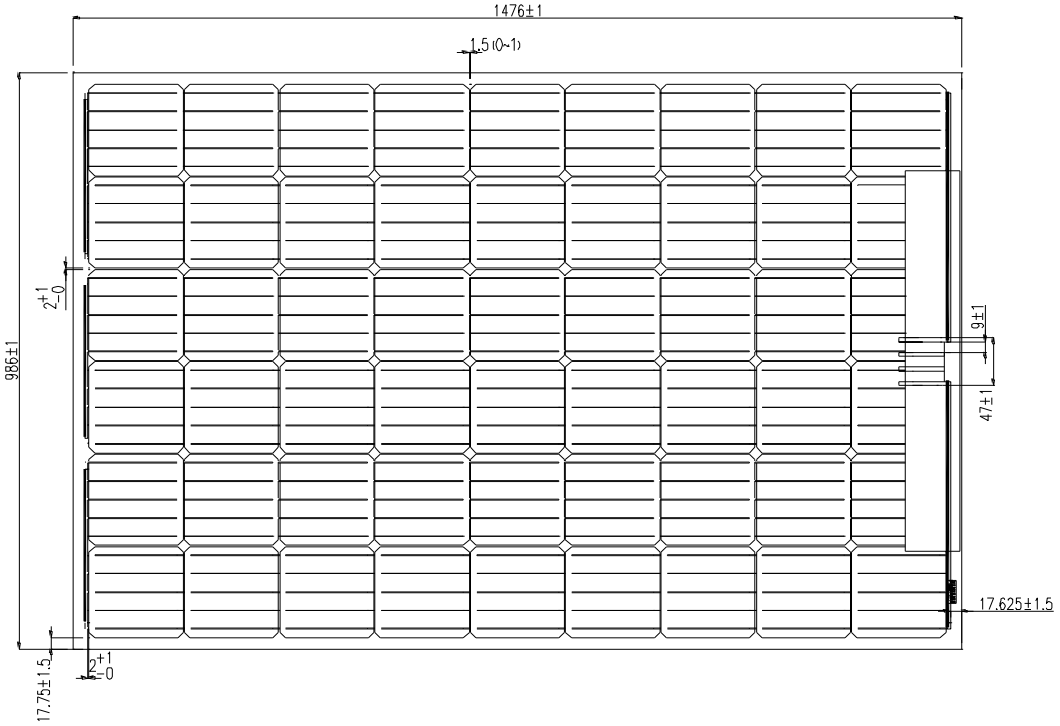


54 CELLS MODULE (1500V OR 1000V)

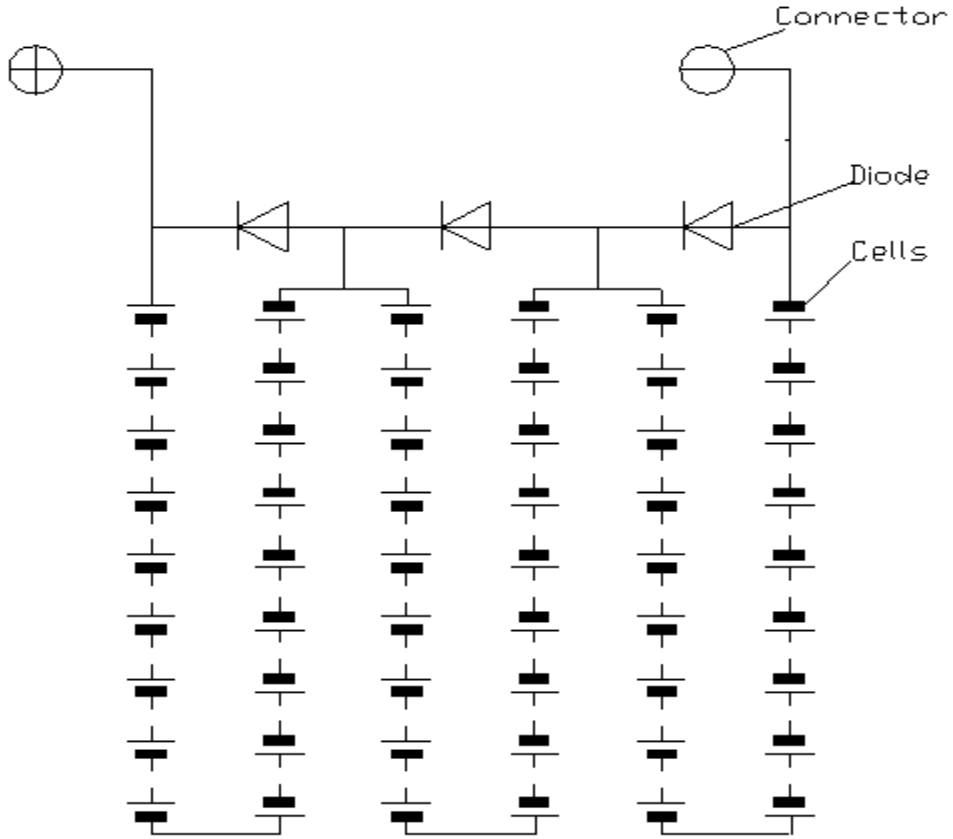
FRAME DIMENSION



Cell and conductor layout on the laminate

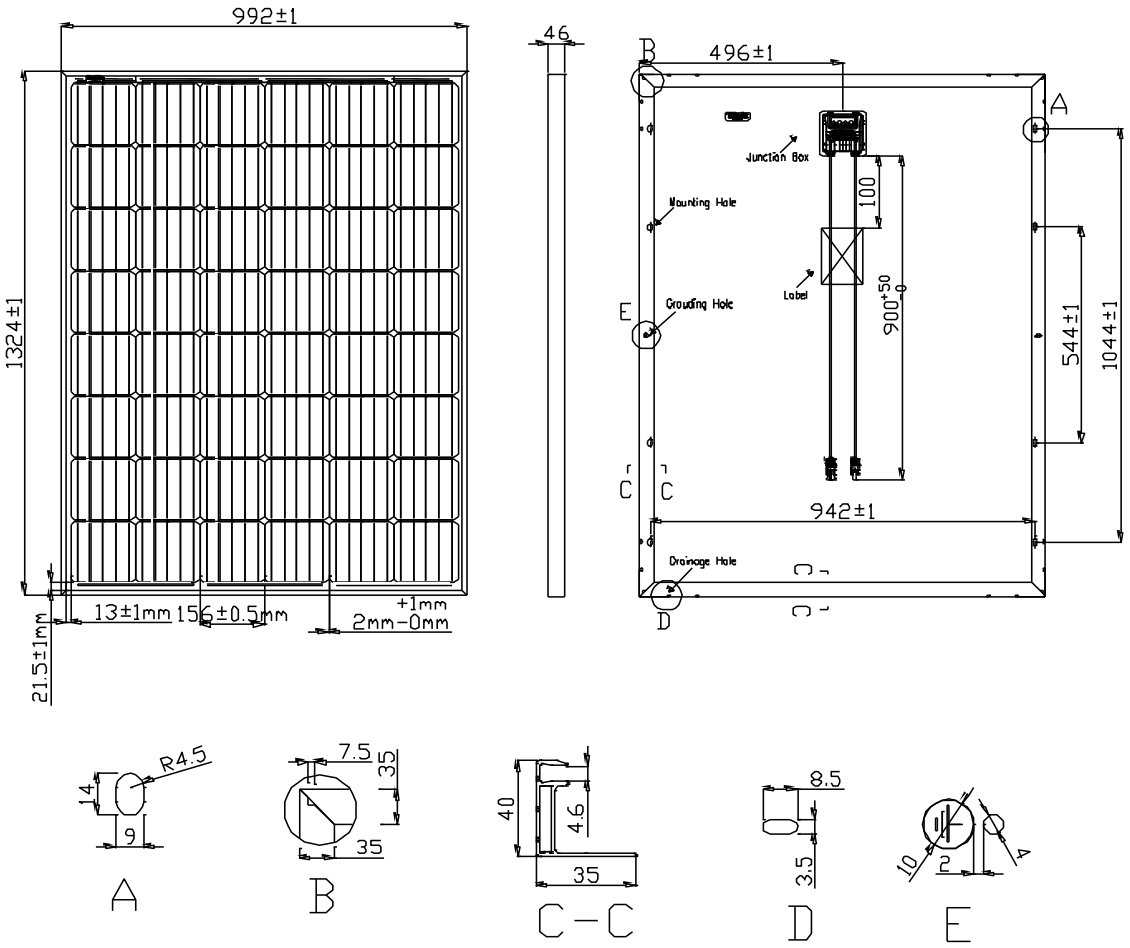


Circuit diagram

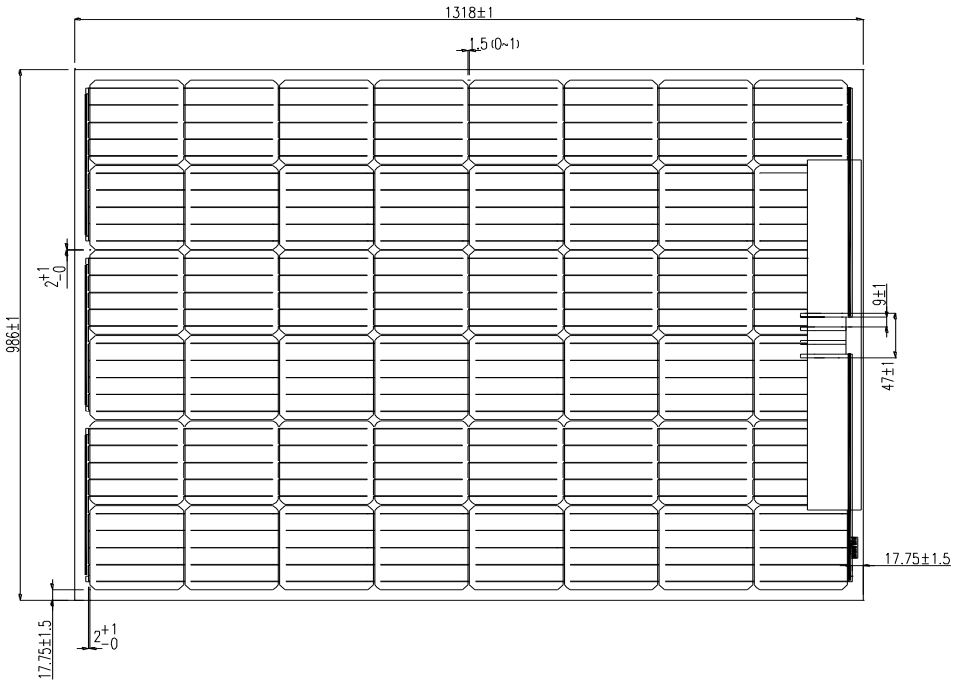


48 CELLS MODULE (1500V OR 1000V)

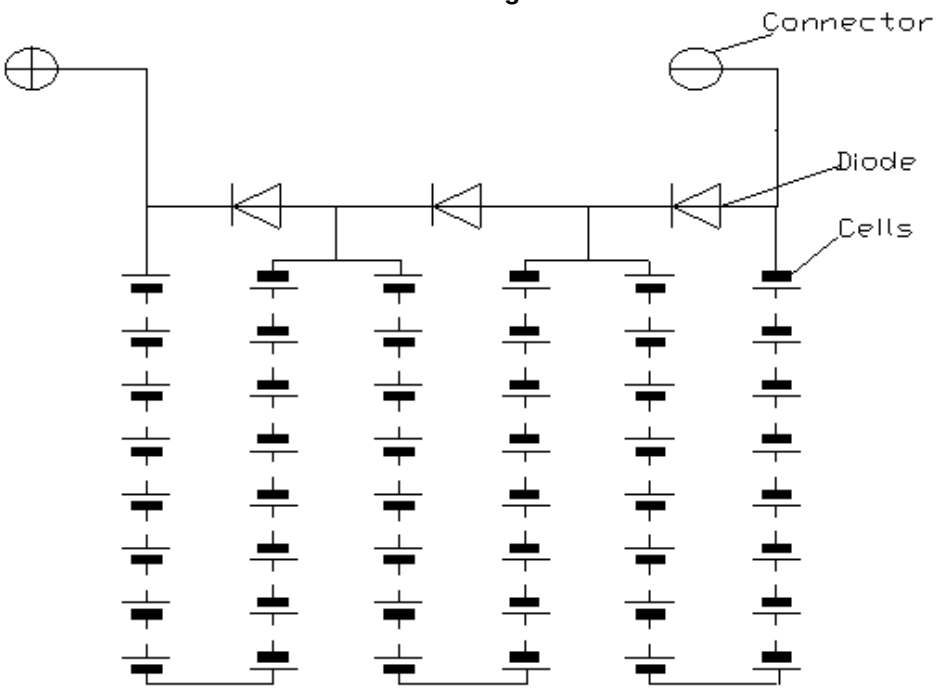
FRAME DIMENSION



Cell and conductor layout on the laminate



Circuit diagram



---------- End of TRF No. IEC61703a series----------