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. ..... :	704062011501-00 part 1 of 2
Date of issue ..... :	2020-12-24
Total number of pages ..... :	123
TÜV SÜD Branch ..... :	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
Applicant's name ..... :	YUHUAN SUNPRO POWER CO.,LTD
Address ..... :	Qinggang Technological Ind.Zon, 317606 Yuhuan, Zhejiang Province PEOPLE'S REPUBLIC OF CHINA
Test specification:	
Standard ..... :	☒ IEC 61215-1:2016 ☒ IEC 61215-2:2016 ☒ IEC 61215-1-1:2016 ☐ IEC 61215-1-2:2016 ☐ IEC 61215-1-3:2016 ☐ IEC 61215-1-4:2016
Test procedure ..... :	TÜV SÜD Mark
Non-standard test method ..... :	N/A
Test Report Form No. ..... :	IEC61215D_SE
Test Report Form(s) Originator .... :	TÜV SÜD Product Service GmbH
Master TRF ..... :	2017-11-30

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

General disclaimer:

The test results presented in this report relate only to the object tested.
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Test item description ..... :	Photovoltaic (PV) Module(s)
Trade Mark ..... :	SUNPRO POWER
Manufacturer ..... :	YUHUAN SUNPRO POWER CO., LTD Qinggang Technological Ind.Zon, 317606 Yuhuan, Zhejiang Province PEOPLE'S REPUBLIC OF CHINA
Model/Type reference ..... :	See page 9~14 of this report
Ratings ..... :	See page 9~14 of this report

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):			
☒	**TÜV SÜD Branch:**	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch	
Testing location/address ..... :		No. 151 Heng Tong Road, Shanghai 200070, P. R. China	
☒	**Associated Testing Laboratory:**	Changzhou HuaYang Inspection and Testing Technology Co., Ltd.	
Testing location/address ..... :		No.8 Lanxiang Road, Wujin Economic Development Zone	
Tested by (name + signature) ..... :		Gang Huang	Huang Gang
Approved by (name + signature) ..... :		Rongwei Jing	Jing Rongwei
☐	**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	Version: SP202001
Drawings mechanical	Refer to Annex 2: 704062011501-00 part 2 of 2
Circuit diagram	Refer to Annex 2: 704062011501-00 part 2 of 2
Photographs	Attachment No.1: 11_ pages
Component datasheets / certificates	Attachment No.2: 47 page
Others:	
Product Description Sheet (Manufacturers and type references)	Annex 1, 3_ pages
Test table for verifying other stabilization procedure	Annex 2, N/A_ pages
Lower and higher output power modules	Annex 3, 7_ pages
List of test equipment used	Annex 4, 2_ pages

Summary of testing:	
Tests performed (name of test and test clause): **Test Item 1:** Basic testing performed on sample HA2020TL-509-xxxA, see module group assignment. Below models are added: SPxxx-72M, xxx=370 to 410 in step of 5 SPxxx-60M, xxx=305 to 340 in step of 5 SPxxx-54M, xxx=280 to 310 in step of 5 SPxxx-48M, xxx=245 to 270 in step of 5 SPxxx-36M, xxx=185 to 205 in step of 5 xxx is standing for rated output power at STC Full tests according to IEC 61215-1:2016, IEC 61215-1-1:2016, IEC 61215-2:2016 were conducted on model SP390-72M For qualification of power class above, MQT 19.1 Initial Stabilization & Performance at STC (MQT 06.1) are performed on higher end model SP410-72M &lower end model SP370-72M. **Test Item 2:** Based on test item 1, testing performed on sample HA2020TL-509-xxxC, see module group assignment. Following modification were included: 1. Add new cell: Mono-Si, M1669BPERC,9BB, ½ cut Cell, manufactured by Tongwei Solar (HEFEI) CO., LTD. 2. Add new juction box: PV02, manufactured by Taizhou Chuangda Electronic Co., Ltd. 3. Add new cell connector Base Cu, Purity	Testing location: Changzhou HuaYang Inspection and Testing Technology Co., Ltd. No.8 Lanxiang Road, Wujin Economic Development Zone

≥99.97%, Cross section: Φ0.35mm, Coating: Sn60Pb40 4. Add new models: SPxxx-144M, xxx=410 to 460 in step of 5 SPxxx-120M, xxx=340 to 385 in step of 5 xxx is standing for rated output power at STC Following tests according to IEC 61215-1:2016, IEC 61215-1-1:2016, IEC 61215-2:2016 were conducted on model SP430-144M MQT 01 Visual inspection MQT 03 Insulation test MQT 06.1 Performance at STC MQT 15 Wet leakage current MQT 18.1 Bypass diode thermal test MQT 18.2 Bypass diode functionality test MQT 09 Hot spot endurance test MQT 10 UV precondition test MQT 11 Thermal cycling test 50 cycles MQT 12 Humidity freeze test 10 cycles MQT 14 Robustness of terminations MQT 19.1Initial Stabilization MQT 11 Thermal cycling test 200 cycles MQT 13 Damp heat 1000 test MQT 16 Static mechanical load test For qualification of power class above, MQT 19.1 Initial Stabilization & Performance at STC (MQT 06.1) are performed on higher end model SP460-144M &lower end model SP410-144M. **Test Item 3:** Based on test item 2, testing performed on sample HA2020TL-509-xxxD, see module group assignment. Following modification were included: 1. Add new cell: Mono-Si, M1589BPERC,9BB, ½ cut Cell, manufactured by Tongwei Solar (HEFEI) CO., LTD. 2. Add new models: SPxxx-144MG, xxx=380 to 415 in step of 5 SPxxx-120MG, xxx=315 to 345 in step of 5 xxx is standing for rated output power at STC Following tests according to IEC 61215-1:2016, IEC 61215-1-1:2016, IEC 61215-2:2016 were conducted on model SP400-144MG MQT 01 Visual inspection MQT 03 Insulation test MQT 06.1 Performance at STC MQT 15 Wet leakage current MQT 18.2 Bypass diode functionality test MQT 09 Hot spot endurance test MQT 19.1Initial Stabilization MQT 11 Thermal cycling test 200 cycles For qualification of power class above, MQT 19.1 Initial Stabilization & Performance at STC (MQT	

06.1) are performed on higher end model SP380-144MG &lower end model SP415-144MG.	

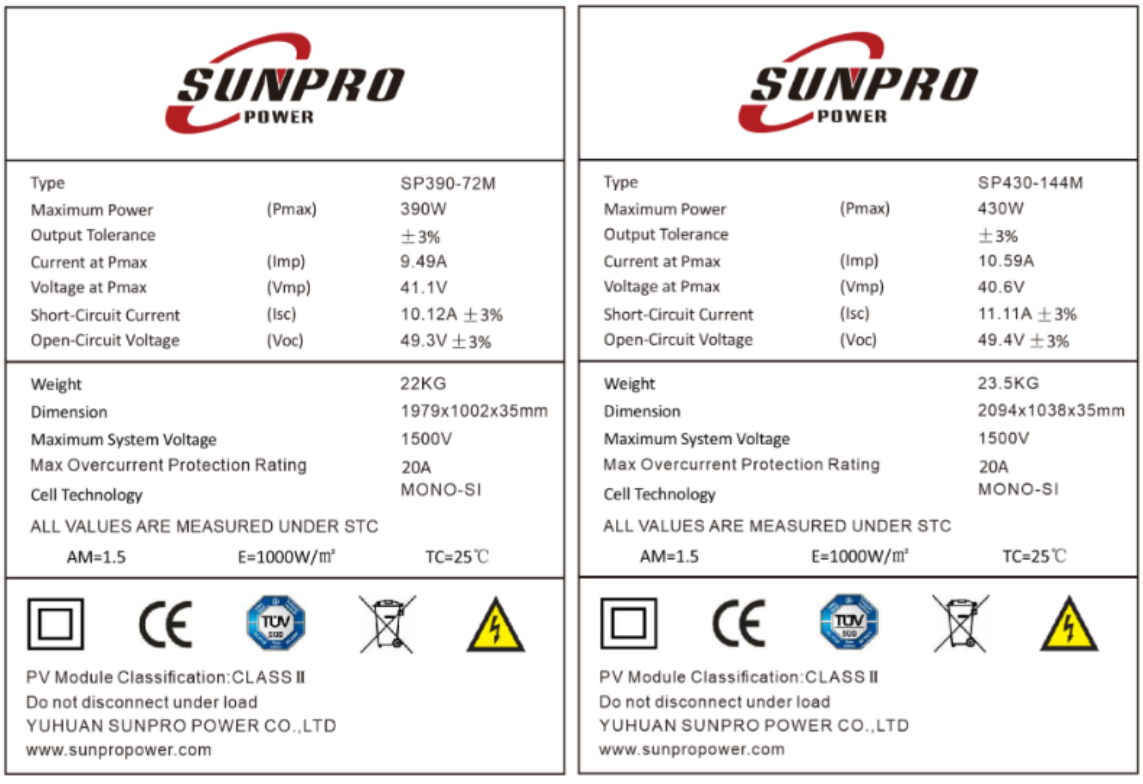
Summary of compliance with National Differences (List of countries addressed):

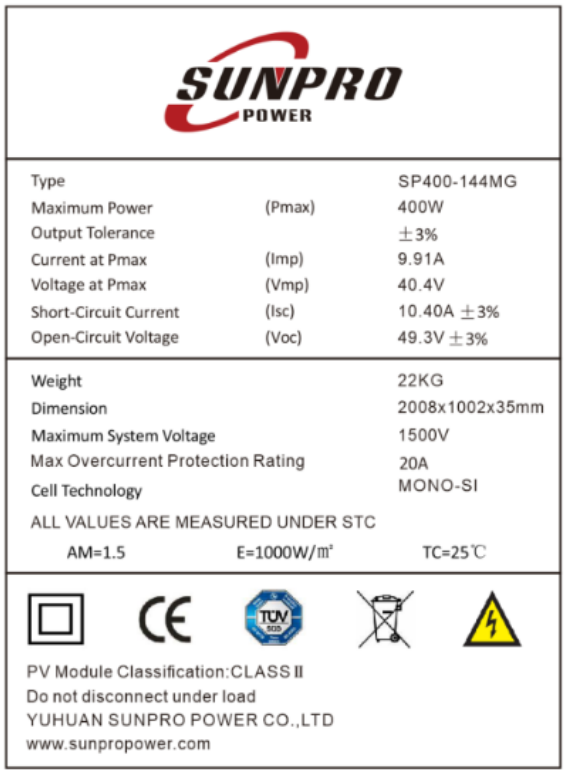
The text of IEC 61215-1: 2016 was approved by CENELEC as EN 61215-1: 2016 without any modification.
The text of IEC 61215-1-1: 2016 was approved by CENELEC as EN 61215-1-1: 2016 without any modification.
The text of IEC 61215-2: 2016 was approved by CENELEC as EN 61215-2: 2017 without any modification.

☒ The product fulfils the requirements of ___ EN 61215-1: 2016/ EN 61215-1-1: 2016/ EN 61215-2: 2017 _____ (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..... :	2020-08-28
Dates of tests (beginning/end)..... :	2020-09-01/2020-11-27

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) ..... :	YUHUAN SUNPRO POWER CO.,LTD Qinggang Technological Ind.Zon, 317606 Yuhuan, Zhejiang Province

PRODUCT ELECTRICAL RATINGS:				
Module type	SP370-72M	SP375-72M	SP380-72M	SP385-72M
Voc [V] /Tolerance± 3%	48.2	48.4	48.5	49.1
Isc [Adc] /Tolerance± 3%	9.72	9.76	9.82	9.92
Vmp [V]	40.4	40.5	40.6	40.8
Imax [Adc]	9.16	9.26	9.36	9.44
Pmp [W] /Tolerance± 3%	370	375	380	385
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Product Electrical Ratings:				
Module type	SP390-72M	SP395-72M	SP400-72M	SP405-72M
Voc [V] /Tolerance± 3%	49.3	49.5	49.8	50.1
Isc [Adc] /Tolerance± 3%	10.12	10.23	10.36	10.39
Vmp [V]	41.1	41.4	41.7	42.0
Imax [Adc]	9.49	9.55	9.60	9.65
Pmp [W] /Tolerance± 3%	390	395	400	405
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP410-72M	SP305-60M	SP310-60M	SP315-60M
Voc [V] /Tolerance± 3%	50.2	39.9	40.5	40.7
Isc [Adc] /Tolerance± 3%	10.5	9.64	9.92	10.04
Vmp [V]	42.3	32.6	33.0	33.2
Imax [Adc]	9.70	9.19	9.40	9.49
Pmp [W] /Tolerance± 3%	410	305	310	315
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP320-60M	SP325-60M	SP330-60M	SP335-60M
Voc [V] /Tolerance± 3%	40.9	41.5	41.8	42.2

Isc [Adc] /Tolerance± 3%	10.15	10.17	10.25	10.32
Vmp [V]	33.4	33.6	33.8	34.0
Imax [Adc]	9.59	9.67	9.76	9.85
Pmp [W] /Tolerance± 3%	320	325	330	335
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP340-60M	SP280-54M	SP285-54M	SP290-54M
Voc [V] /Tolerance± 3%	42.6	36.4	36.6	36.8
Isc [Adc] /Tolerance± 3%	10.38	9.98	10.10	10.23
Vmp [V]	34.2	29.7	29.8	30.0
Imax [Adc]	9.94	9.43	9.56	9.67
Pmp [W] /Tolerance± 3%	340	280	285	290
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP295-54M	SP300-54M	SP305-54M	SP310-54M
Voc [V] /Tolerance± 3%	37.3	37.6	37.9	38.3
Isc [Adc] /Tolerance± 3%	10.27	10.36	10.45	10.50
Vmp [V]	30.2	30.4	30.5	30.7
Imax [Adc]	9.77	9.87	10.00	10.10
Pmp [W] /Tolerance± 3%	295	300	305	310
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP245-48M	SP250-48M	SP255-48M	SP260-48M
Voc [V] /Tolerance± 3%	31.9	32.4	32.7	33.1
Isc [Adc] /Tolerance± 3%	9.73	10.00	10.13	10.20
Vmp [V]	26.0	26.4	26.7	26.9
Imax [Adc]	9.43	9.47	9.56	9.67
Pmp [W] /Tolerance± 3%	245	250	255	260

Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP265-48M	SP270-48M	SP185-36M	SP190-36M
Voc [V] /Tolerance± 3%	33.4	33.7	24.3	24.4
Isc [Adc] /Tolerance± 3%	10.30	10.41	9.89	10.12
Vmp [V]	27.0	27.1	19.8	19.9
Imax [Adc]	9.82	9.97	9.35	9.55
Pmp [W] /Tolerance± 3%	265	270	185	190
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP195-36M	SP200-36M	SP205-36M	SP410-144M
Voc [V] /Tolerance± 3%	24.8	25.0	25.5	49.0
Isc [Adc] /Tolerance± 3%	10.22	10.39	10.45	10.76
Vmp [V]	20.16	20.27	20.52	40.2
Imax [Adc]	9.68	9.87	10.00	10.2
Pmp [W] /Tolerance± 3%	195	200	205	410
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP415-144M	SP420-144M	SP425-144M	SP430-144M
Voc [V] /Tolerance± 3%	49.1	49.2	49.3	49.4
Isc [Adc] /Tolerance± 3%	10.85	10.95	11.01	11.11
Vmp [V]	40.3	40.4	40.5	40.6
Imax [Adc]	10.3	10.4	10.5	10.59
Pmp [W] /Tolerance± 3%	415	420	425	430
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP435-144M	SP440-144M	SP445-144M	SP450-144M
Voc [V] /Tolerance± 3%	49.5	49.6	49.7	49.8

Isc [Adc] /Tolerance± 3%	11.23	11.34	11.45	11.56
Vmp [V]	40.7	40.8	40.9	41.0
Imax [Adc]	10.69	10.79	10.89	10.98
Pmp [W] /Tolerance± 3%	435	440	445	450
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP455-144M	SP460-144M	SP340-120M	SP345-120M
Voc [V] /Tolerance± 3%	49.9	50.0	40.8	40.9
Isc [Adc] /Tolerance± 3%	11.65	11.69	10.72	10.85
Vmp [V]	41.1	41.2	33.5	33.6
Imax [Adc]	11.08	11.17	10.15	10.27
Pmp [W] /Tolerance± 3%	455	460	340	345
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP350-120M	SP355-120M	SP360-120M	SP365-120M
Voc [V] /Tolerance± 3%	41.0	41.1	41.2	41.3
Isc [Adc] /Tolerance± 3%	11.03	11.07	11.18	11.30
Vmp [V]	33.7	33.8	33.9	34.0
Imax [Adc]	10.39	10.51	10.62	10.74
Pmp [W] /Tolerance± 3%	350	355	360	365
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP370-120M	SP375-120M	SP380-120M	SP385-120M
Voc [V] /Tolerance± 3%	41.4	41.5	41.6	41.7
Isc [Adc] /Tolerance± 3%	11.41	11.53	11.65	11.71
Vmp [V]	34.1	34.2	34.3	34.4
Imax [Adc]	10.85	10.97	11.08	11.20
Pmp [W] /Tolerance± 3%	370	375	380	385

Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP380-144MG	SP385-144MG	SP390-144MG	SP395-144MG
Voc [V] /Tolerance± 3%	48.5	48.7	48.9	49.1
Isc [Adc] /Tolerance± 3%	10.09	10.17	10.24	10.32
Vmp [V]	39.6	39.8	40.0	40.2
Imax [Adc]	9.6	9.68	9.75	9.84
Pmp [W] /Tolerance± 3%	380	385	390	395
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP400-144MG	SP405-144MG	SP410-144MG	SP415-144MG
Voc [V] /Tolerance± 3%	49.3	49.5	49.7	49.9
Isc [Adc] /Tolerance± 3%	10.40	10.48	10.55	10.64
Vmp [V]	40.4	40.6	40.8	41.0
Imax [Adc]	9.91	9.98	10.05	10.13
Pmp [W] /Tolerance± 3%	400	405	410	415
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP315-120MG	SP320-120MG	SP325-120MG	SP330-120MG
Voc [V] /Tolerance± 3%	40.0	40.2	40.4	40.6
Isc [Adc] /Tolerance± 3%	10.20	10.27	10.3	10.40
Vmp [V]	33.2	33.4	33.6	33.8
Imax [Adc]	9.51	9.60	9.69	9.76
Pmp [W] /Tolerance± 3%	315	320	325	330
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	20	20	20	20
Module type	SP335-120MG	SP340-120MG	SP345-120MG	−
Voc [V] /Tolerance± 3%	40.7	41.1	41.2	−

Isc [Adc] /Tolerance± 3%	10.50	10.60	10.62	−
Vmp [V]	34.0	34.2	34.5	−
Imax [Adc]	9.85	9.94	10.00	−
Pmp [W] /Tolerance± 3%	335	340	345	−
Maximum system voltage [V]	1500	1500	1500	−
Maximum Over-Current Protection Rating [A]	20	20	20	−
Note: Further qualification for higher and/or lower output power see annex 3				

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

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

☐ Test programs for thin-film PV modules

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

Note: The clause references modifications extracted from IEC 62915

MODULE GROUP ASSIGNMENT:				
Below samples are for test item 1				
Sample #	Sample Group ID	Type/model	Sample S/N	Remark
HA2020TL-509-001A	A1	SP390-72M	4082008221440059	Control module
HA2020TL-509-002A	A2	SP390-72M	4082008221440054	LIR+Temp.coe
HA2020TL-509-003A	A3	SP390-72M	4082008221440062	LIR+Temp.coe
HA2020TL-509-004A	B	SP390-72M	4082008221440052	HS+BD
HA2020TL-509-005A	C1	SP390-72M	4082008221440063	UV15+TC50+HF
HA2020TL-509-006A	C2	SP390-72M	4082008221440057	UV15+TC50+HF
HA2020TL-509-007A	D1	SP390-72M	4082008221440060	TC200
HA2020TL-509-008A	D2	SP390-72M	4082008221440055	TC200
HA2020TL-509-009A	E1	SP390-72M	4082008221440050	DH1000+ML
HA2020TL-509-010A	E2	SP390-72M	4082008221440056	DH1000+Hail
HA2020TL-509-016A	—	SP370-72M	4082008221440001	Lower
HA2020TL-509-017A	—	SP370-72M	4082008221440002	Lower
HA2020TL-509-018A	—	SP410-72M	4082008231440001	Higher
HA2020TL-509-019A	—	SP410-72M	4082008231440002	Higher
Below samples are for test item 2				
Sample #	Sample Group ID	Type/model	Sample S/N	Remark
HA2020TL-509-001C	A1	SP430-144M	3082008180720008	Control module
HA2020TL-509-002C	B	SP430-144M	3082008180720010	HS+BD
HA2020TL-509-003C	C1	SP430-144M	3082008180720004	UV15+TC50+HF
HA2020TL-509-004C	C2	SP430-144M	3082008180720002	UV15+TC50+HF

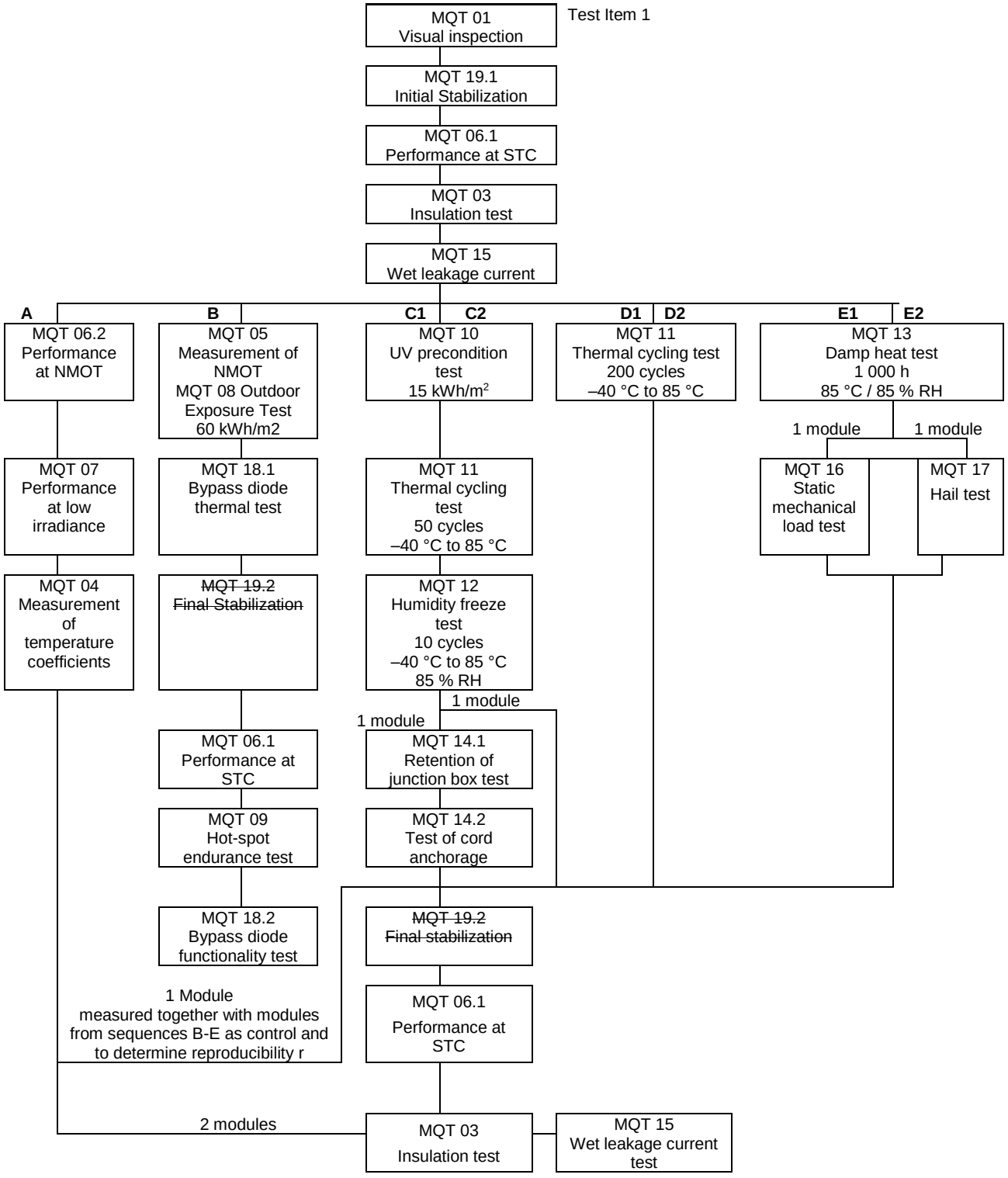
HA2020TL-509-005C	D1	SP430-144M	3082008180720003	TC200
HA2020TL-509-006C	D2	SP430-144M	3082008180720007	TC200
HA2020TL-509-007C	E1	SP430-144M	3082008180720009	DH1000+ML
HA2020TL-509-008C	E2	SP430-144M	3082008180720001	DH1000
HA2020TL-509-011C	—	SP410-144M	3082008150720001	Lower
HA2020TL-509-012C	—	SP410-144M	3082008150720002	Lower
HA2020TL-509-013C	—	SP460-144M	3082008190720001	Higher
HA2020TL-509-014C	—	SP460-144M	3082008190720002	Higher
Below samples are for test item 3				
Sample #	Sample Group ID	Type/model	Sample S/N	Remark
HA2020TL-509-001D	A	SP400-144MG	3082008281440002	Control module
HA2020TL-509-002D	B	SP400-144MG	3082008281440004	HS
HA2020TL-509-003D	D1	SP400-144MG	3082008281440001	TC200
HA2020TL-509-004D	D2	SP400-144MG	3082008281440003	TC200
HA2020TL-509-005D	—	SP380-144MG	3082008271440001	Lower
HA2020TL-509-006D	—	SP380-144MG	3082008271440002	Lower
HA2020TL-509-007D	—	SP415-144MG	3082008291440001	Higher
HA2020TL-509-008D	—	SP415-144MG	3082008291440002	Higher
Supplementary information: Further qualification for higher and/or lower output power see annex 3				

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.

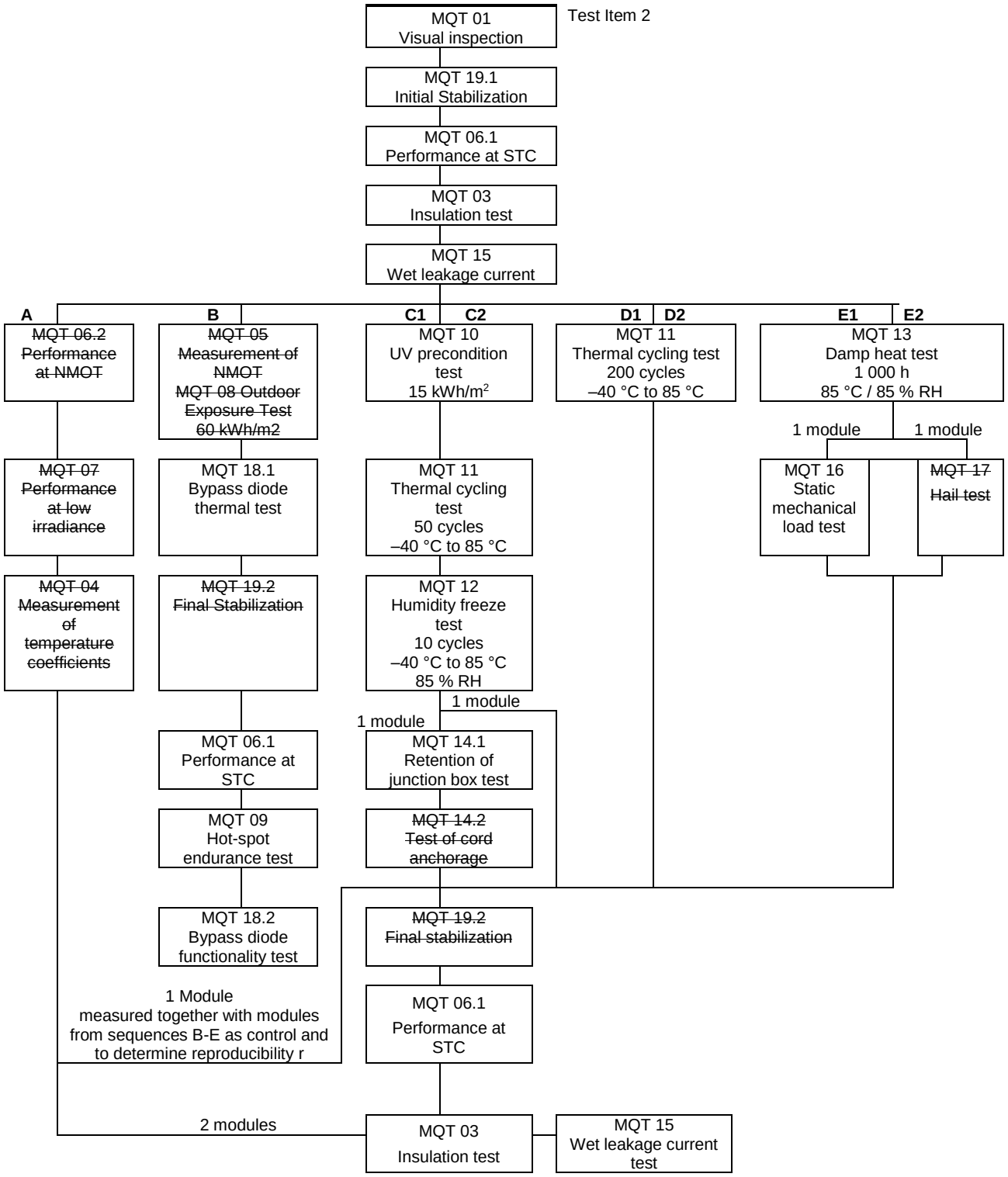
Note (3) Use Annex 1 to list the used materials and components of the module (manufacturer/supplier and type reference).

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

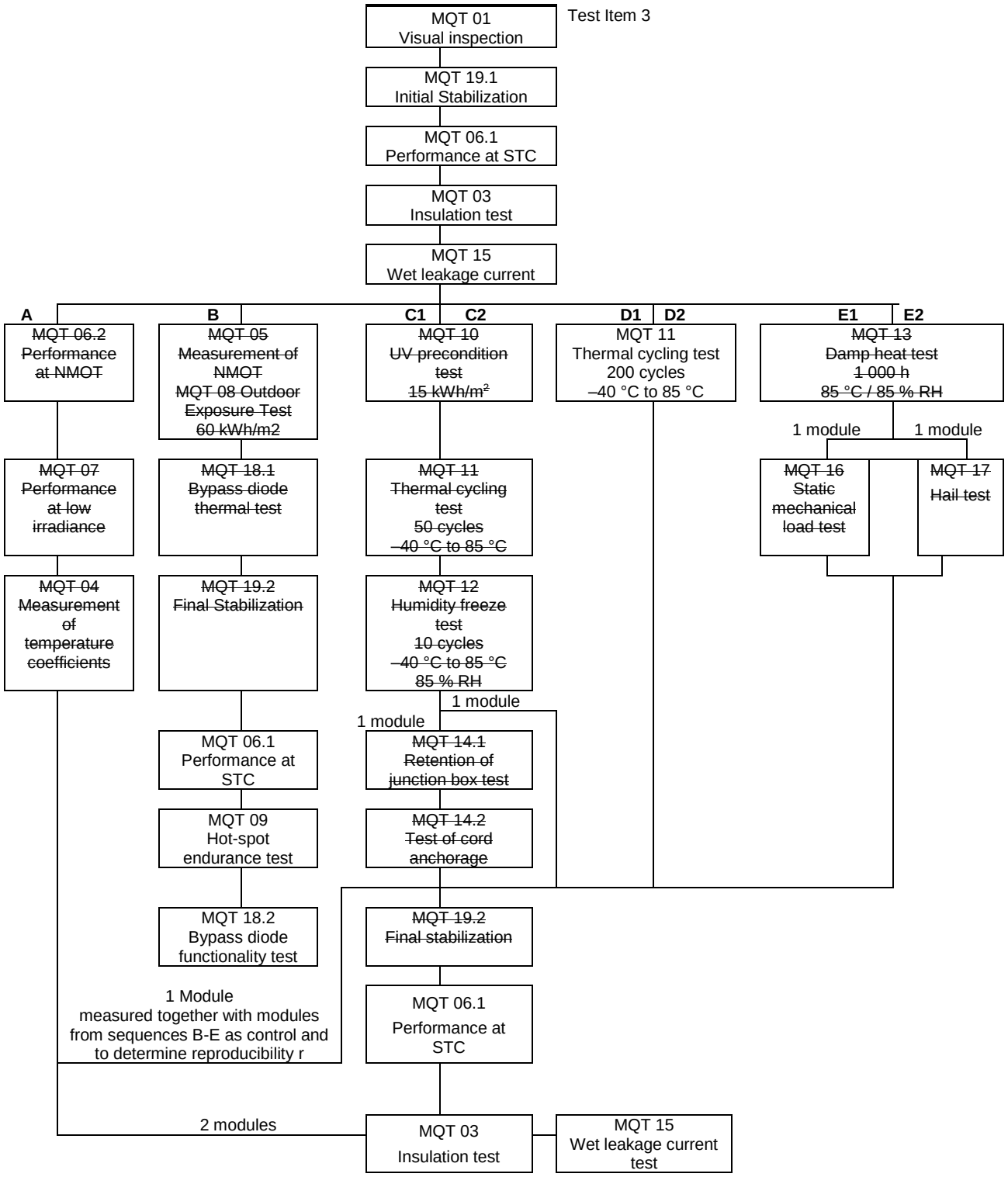
IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
11	**TEST FLOW (if it is not a full test, strikethrough non-performed test)** Note: Deviations from test sequence are possible but must be documented.		



IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict



IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict



IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
5. MARKING AND DOCUMENTATION			P
5.1	**Name Plate**		
	All electrical data is shown as relative to standard test conditions (1 000 W/m², 25 °C, AM 1,5 according to IEC TS 61836).	Marked on label	P
	International symbols are used where applicable.	Marked on label	P
	The module includes clear and indelible markings:		—
	a. Name, registered trade name or registered trade mark of manufacturer	YUHUAN SUNPRO POWER CO., LTD	P
	b. Type or model number designation	SP390-72M	P
	c. Serial number (unless marked on other part of product)	4082008221440059 for example	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.	49.3 ± 3% for example	P
	h. Current at short-circuit or Isc including tolerances	10.12 ± 3% for example	P
	i. Module maximum power or Pmax including tolerances	390 ± 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 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Maximum series/parallel module configuration is recommended	Refer to manual document	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		N/A
	h. Performance at NMOT (MQT 06.2) is specified		N/A
	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	Refer to manual document	P
	k. Any limitations on wiring methods and wire management that apply to the wiring compartment or box;		P
	l. The size, type, material and temperature rating of the conductors to be used		P
	m. Type of terminals for field wiring		N/A
	n. Specific PV connector model/types and manufacturer to which the module connectors are mated		P
	o. The bonding method(s) to be used (if applicable); all provided or specified hardware is identified in the documentation	Refer to manual document	P
	p. The type and ratings of bypass diode to be used (if applicable)	Refer to manual document	P
	q. limitations to the mounting situation (e.g., slope, orientation, mounting means, cooling)	Refer to manual document	P

IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
	r. A statement indicating the fire rating(s) and the applied standard and the limitations to that rating (e.g., installation slope, sub-structure or other applicable installation information)	Refer to manual document	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	Designed load: Positive: 3600Pa Negative: 1600Pa Safety factor for both sides: 1.5	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	±3	±3	
		m_1	m_2	m_3	
	measurement uncertainty in % of laboratory	2.12	0.98	2.26	
	Laboratory reproducibility r .....:	HA2020TL-509-xxxA: +0.09 HA2020TL-509-xxxC: +0.06 HA2020TL-509-xxxD: +0.08			
	After stabilization, each individual module meets the requirements				P
	P_{max}	See Table 03			P
	V_{oc}	See Table 03			P

IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
	I_{sc}:.....	See Table 03	P
	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		N/A
Supplementary information: N/A			

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict
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 A1, A2, A3	P
4.6	Performance at NMOT (MQT 06.2) .....:	See Table 06	P
4.7	Performance at low irradiance (MQT 07).....:	See Table 07	P
4.4	Measurement of temperature coefficients (MQT 04) .....:	See Table 08	P
Sequence B	**1 Module**	Sample B	P
4.5	Measurement of nominal module operating temperature (NMOT, °C) (MQT 05) .....:	See Table 09	P
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	P
	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	P
4.9	Hot spot endurance test (MQT 09) .....:	See Table 13.1 - 13.5	P
Sequence C	**2 Modules**	Samples C1 C2	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 C1	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

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict
4.14.3	Test of cord anchorage (MQT 14.2)		P
4.14.3.1	This test omitted if junction box is qualified to IEC 62790 .....:	Refer to junction box certificate	—
4.14.3.2.1	Junction boxes intended to be used with cables specified by the manufacturer……:	—	—
4.14.3.2.2	Junction boxes intended to be used with generic cables……:	—	—
Sequence D	**2 Modules**	Sample D1, D2	P
4.11	Thermal cycling test 200 cycles (MQT 11) .....:	See Table 18.1 - 18.2	P
Sequence E	**2 Modules**	Samples E1, E2	P
4.13	Damp heat test (MQT 13) .....:	See Table 19.1 - 19.4	P
Sequence E1	**1 Module**	Sample E1	P
4.16	Static mechanical load test (MQT 16).....:	See Table 19.5 - 19.7	P
Sequence E2	**1 Module**	Sample E2	P
4.17	Hail test (MQT 17)	See Table 19.8 - 19.10	P
	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

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

TABLE 01: MQT 01 ini: Initial Visual inspection		P
Test Date [YYYY-MM-DD]..... :	2020-09-01	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-001A	No major visual defects found	P
HA2020TL-509-002A	No major visual defects found	P
HA2020TL-509-003A	No major visual defects found	P
HA2020TL-509-004A	No major visual defects found	P
HA2020TL-509-005A	No major visual defects found	P
HA2020TL-509-006A	No major visual defects found	P
HA2020TL-509-007A	No major visual defects found	P
HA2020TL-509-008A	No major visual defects found	P
HA2020TL-509-009A	No major visual defects found	P
HA2020TL-509-010A	No major visual defects found	P
Supplementary information: N/A		

TABLE 02: MQT 19.1 ini: Initial stabilization							P
TABLE 02.1: MQT 06.1 ini: Performance at STC before initial stabilization							
Test Date [YYYY-MM-DD]..... :	2020-09-01						—
Test method..... :	☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
HA2020TL-509-001A	10.142	49.381	9.552	41.222	393.753	78.62	P
HA2020TL-509-002A	10.182	49.201	9.586	40.936	392.412	78.33	P
HA2020TL-509-003A	10.189	49.426	9.545	41.298	394.189	78.27	P
HA2020TL-509-004A	10.144	49.523	9.589	41.303	396.054	78.84	P

IEC 61215-2							
Clause	Requirement + Test				Result - Remark		Verdict
HA2020TL-509-005A	10.162	49.558	9.557	41.334	395.029	78.44	P
HA2020TL-509-006A	10.120	49.538	9.535	41.391	394.663	78.72	P
HA2020TL-509-007A	10.194	49.410	9.616	41.044	394.679	78.36	P
HA2020TL-509-008A	10.137	49.646	9.531	41.402	394.602	78.41	P
HA2020TL-509-009A	10.213	49.386	9.651	41.054	396.212	78.55	P
HA2020TL-509-010A	10.180	49.573	9.540	41.534	396.234	78.52	P
Supplementary information: N/A							

TABLE 02.2: MQT 19.1 ini: Initial Stabilization procedure

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 #	HA2020TL-509-001A	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	393.753	—	—
1	5	800~1000	50	4.3	392.001	—	—
2	5	800~1000	50	4.3	390.465	0.84	Yes
3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-002A	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	392.412	—	—
1	5	800~1000	50	4.3	390.672	—	—
2	5	800~1000	50	4.3	389.962	0.63	Yes
3	—	—	—	—	—	—	—

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

Sample #	HA2020TL-509-003A	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	394.189	—	—
1	5	800~1000	50	4.3	392.164	—	—
2	5	800~1000	50	4.3	391.632	0.65	Yes
3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-004A	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	396.054	—	—
1	5	800~1000	50	4.3	394.091	—	—
2	5	800~1000	50	4.3	393.276	0.70	Yes
3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-005A	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	395.029	—	—
1	5	800~1000	50	4.3	393.891	—	—
2	5	800~1000	50	4.4	391.739	0.84	Yes
3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-006A	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	394.663	—	—

IEC 61215-2							
Clause	Requirement + Test				Result - Remark		Verdict
1	5	800~1000	50	4.3	393.154	—	—
2	5	800~1000	50	4.4	391.261	0.87	Yes
3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-007A	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	394.679	—	—
1	5	800~1000	50	4.3	393.889	—	—
2	5	800~1000	50	4.3	392.348	0.59	Yes
3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-008A	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	394.602	—	—
1	5	800~1000	50	4.3	393.519	—	—
2	5	800~1000	50	4.3	391.368	0.82	Yes
3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-009A	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	396.212	—	—
1	5	800~1000	50	4.3	393.702	—	—
2	5	800~1000	50	4.3	392.450	0.95	Yes
3	—	—	—	—	—	—	—

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

Sample #	HA2020TL-509-010A	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	396.234	—	—
1	5	800~1000	50	4.3	394.982	—	—
2	5	800~1000	50	4.3	392.835	0.86	Yes
3	—	—	—	—	—	—	—

Supplementary information: N/A	
☐ Other stabilization procedures	
Sample #	Test Date (YYYY-MM-DD) start/end
—	—
—	—
—	—
—	—
Test method description:	
Supplementary information:	

TABLE 03: MQT 06.1 ini: Performance at STC after initial stabilization										P
Test Date [YYYY-MM-DD]..... :	2020-09-09									—
Pmax(lab) lower limit (W) ..... :	370.45									—
$\bar{P}_{max}(Lab)$ lower limit (W) ..... :	381.90									P
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 #	Voc [V]		Isc [A]		Vmp [V]	Imp [A]	Pmax [W]		FF [%]	Result
	Meas.	Max. calc.	Meas.	Max. calc.			Meas.	Min. calc.		
HA2020TL-509-001A	49.138	50.29	10.162	10.19	40.925	9.541	390.465	370.45	78.20	P
HA2020TL-509-002A	49.140	50.29	10.141	10.19	40.838	9.549	389.962	370.45	78.25	P
HA2020TL-509-003A	49.230	50.29	10.134	10.19	41.099	9.529	391.632	370.45	78.50	P

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Clause	Requirement + Test	Result - Remark	Verdict

HA2020TL-509-004A	49.341	50.29	10.153	10.19	41.185	9.549	393.276	370.45	78.50	P
HA2020TL-509-005A	49.467	50.29	10.165	10.19	41.327	9.479	391.739	370.45	77.91	P
HA2020TL-509-006A	49.401	50.29	10.077	10.19	41.294	9.475	391.261	370.45	78.60	P
HA2020TL-509-007A	49.239	50.29	10.101	10.19	41.002	9.569	392.348	370.45	78.89	P
HA2020TL-509-008A	49.625	50.29	10.131	10.19	41.257	9.486	391.368	370.45	77.85	P
HA2020TL-509-009A	49.269	50.29	10.164	10.19	41.077	9.554	392.450	370.45	78.37	P
HA2020TL-509-010A	49.381	50.29	10.108	10.19	41.338	9.503	392.835	370.45	78.70	P
Average	—						391.734	381.90	—	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].....:		2020-09-09		—
Test Voltage applied [V] .....:		8000/1500		—
Size of module [m²].....:		1.98		—
Required Resistance [MΩ].....:		20.2		—
Sample #	Measured	Dielectric breakdown		Result
	MΩ	Yes (description)	No	
HA2020TL-509-001A	>2000	No dielectrical breakdown	X	P
HA2020TL-509-002A	>2000	No dielectrical breakdown	X	P
HA2020TL-509-003A	>2000	No dielectrical breakdown	X	P
HA2020TL-509-004A	>2000	No dielectrical breakdown	X	P
HA2020TL-509-005A	>2000	No dielectrical breakdown	X	P
HA2020TL-509-006A	>2000	No dielectrical breakdown	X	P
HA2020TL-509-007A	>2000	No dielectrical breakdown	X	P

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HA2020TL-509-008A	>2000	No dielectrical breakdown	X	P
HA2020TL-509-009A	>2000	No dielectrical breakdown	X	P
HA2020TL-509-010A	>2000	No dielectrical breakdown	X	P
Supplementary information: The maximum resistance measurement range is 2000MΩ				

TABLE 05: MQT 15 ini: Initial Wet leakage current test			P
Test Date [YYYY-MM-DD] .....:	2020-09-09		—
Test Voltage applied [V] .....:	1500		—
Solution resistivity [Ω/ cm) .....:	< 3,500 Ω/ cm at 22 ± 2°C	2461	—
Solution temperature [°C].....:	23.4		—
Size of module [m²] .....:	1.98		—

Sample #	Required Resistance [MΩ]	Measured [MΩ]	Result
HA2020TL-509-001A	20.2	>2000	P
HA2020TL-509-002A	20.2	>2000	P
HA2020TL-509-003A	20.2	>2000	P
HA2020TL-509-004A	20.2	>2000	P
HA2020TL-509-005A	20.2	>2000	P
HA2020TL-509-006A	20.2	>2000	P
HA2020TL-509-007A	20.2	>2000	P
HA2020TL-509-008A	20.2	>2000	P
HA2020TL-509-009A	20.2	>2000	P
HA2020TL-509-010A	20.2	>2000	P
Supplementary information: The maximum resistance measurement range is 2000MΩ			

TABLE 06: MQT 06.2 - Performance at NMOT		—
Test Date [YYYY-MM-DD]..... :	2020-10-13	—

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Clause	Requirement + Test	Result - Remark	Verdict

Module temperature (°C) ..... :	42.8	—
Test method ..... :	☒ Simulator ☐ Natural sunlight	—

Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
HA2020TL-509-001A	7.943	46.590	7.742	38.270	296.283	80.06	—
HA2020TL-509-002A	7.962	46.323	7.739	38.242	295.955	80.25	—
HA2020TL-509-003A	7.960	46.588	7.754	38.268	296.732	80.02	—

Supplementary information:

TABLE 07: MQT 07 - Performance at low irradiance		P
Test Date [YYYY-MM-DD] ..... :	2020-10-13	—
Test method ..:	☐ Outdoor measurement	—
	Ambient air temperature [°C]: 25	
	Irradiance [W/m²]: 200	
	Module temperature [°C]: 25	
	☒ Data corrected to a 25°C cell temperature and 200 W/m² irradiance	
	☐ Directly measured	—

Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]
HA2020TL-509-001A	45.969	2.019	39.339	1.921	75.563	81.43
HA2020TL-509-002A	45.901	2.008	39.311	1.918	75.416	81.83
HA2020TL-509-003A	45.929	2.017	39.335	1.927	75.807	81.83

Supplementary information: N/A

TABLE 08: MQT 04 - Measurement of temperature coefficients		P
Test Date [YYYY-MM-DD] ..... :	HA2020TL-509-001A: 2020-10-13 HA2020TL-509-002A: 2020-10-13 HA2020TL-509-003A: 2020-10-14	—
Ambient air temperature [°C] high/low ..... :	—	—
Irradiance [W/m²] high/low ..... :	1000	—

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Module temperature [°C] high/low.....:		HA2020TL-509-001A:55.1/25.0 HA2020TL-509-002A:54.9/25.0 HA2020TL-509-003A:55.0/25.1		—
Sample #	α [%/°C]	β [%/°C]	δ [%/°C]	—
HA2020TL-509-001A	0.056	-0.255	-0.345	P
HA2020TL-509-002A	0.053	-0.246	-0.338	P
HA2020TL-509-003A	0.059	-0.250	-0.341	P
Supplementary information: N/A				

TABLE 09: MQT 05 - Measurement of Nominal Module Operating Temperature (NMOT, °C)		—
Test Date [YYYY-MM-DD].....:	2020-09-11/2020-10-13	
Electrical load:	☐ Restive load ☒ MPPT	
All details for the measurements are kept on file and are available on request.		
Sample #	HA2020TL-509-004A	
Calculated u_0 [W/(m^2.°C)]	27.34	
Calculated u_1 [W.s/(m^3.°C)]	7.75	
Calculated NMOT	42.8	
Supplementary information: N/A		

TABLE 10: MQT 08 - Outdoor exposure test		P
Test Date [YYYY-MM-DD] start/end .....:	2020-09-11/2020-10-13	—
Sample #	HA2020TL-509-004A	—
Total irradiation dosage [kWh/m^2].....:	60.0	—
Angle of tilt the test module .....:	37°±5°	—
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].....:	2020-10-13	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-004A	No major visual defects found	P
Supplementary information: N/A		

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Clause	Requirement + Test	Result - Remark	Verdict

Table 10.2: MQT 15: Wet leakage current test after outdoor exposure test				P
Test Date [YYYY-MM-DD] ..... :	2020-10-13			—
Test Voltage applied [V] ..... :	1500			—
Solution temperature [°C] ..... :	22.7			—
Size of module [m²] ..... :	1.98			—
Solution resistivity [Ω/ cm) ..... :	< 3,500 Ω/ cm at 22 ± 2°C	2366		—
Sample #	Measured [MΩ]	Limit [MΩ]		Result
HA2020TL-509-004A	>2000	20.2		P
Supplementary information: The maximum resistance measurement range is 2000MΩ				

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

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: Size of module [m²]					

TABLE 11: MQT 18: Bypass diode thermal test		P
Test Date [YYYY-MM-DD] start/end ..... :	2020-10-16	—
Sample #	HA2020TL-509-004A	—
Module temperature [°C] ..... :	75±5	—
Number of diodes in junction box ..... :	3	—
Diode manufacturer ..... :	Taizhou Chuangda Electronic Co., Ltd.	—

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Diode type designation ..... :	Schottky, PV3045				—
Max. permissible junction temperature T_{jmax} [°C] (according to diode datasheet) ..... :	200				—
Detailed description of sample preparation procedure ..... :	Standard production module				—
Step 1, Determination of *V*D versus *T*J characteristic					—
	30 ± 2 °C	50 ± 2 °C	70 ± 2 °C	90 ± 2 °C	
Ambient temperature of the junction box ..... :	30.2	49.9	70.0	90.1	
Pulsed current ..... :	10.067	10.067	10.067	10.067	
Voltage drop [V] ..... :	0.4572 0.4483 0.4548	0.4367 0.4326 0.4329	0.4116 0.4092 0.4103	0.3865 0.3832 0.3858	
VD versus TJ characteristic ..... :	Diode 1: V_D = -0.0012 T_J + 0.4943 Diode 2: V_D = -0.0011 T_J + 0.4841 Diode 3: V_D = -0.0011 T_J + 0.4900				—
Max. permissible junction temperature T_{jmax} [°C] (according to diode datasheet) ..... :	200				—
Step 2, Bypass diode thermal test					
	Diode 1	Diode 2	Diode 3	Result	
Current flow applied [A] ..... :	10.067	10.067	10.067	—	
Max. diode surface temperature allowed T_{jmax} [°C] :	200	200	200	—	
Voltage drop [V] after 1h ..... :	0.3558	0.3501	0.3532	—	
Calculated max. junction temperature T_{jcalc} [°C] .... :	116.540	121.694	118.973	—	
T_{jcalc} < T_{jmax} (test passed)? yes/no ..... :	yes	yes	yes	P	
Current flow (1.25 * Isc) [A] ..... :	12.584	12.584	12.584	—	
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] ..... :	2020-10-16	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-004A	No major visual defects found	P
Supplementary information: N/A		

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TABLE 11.2: MQT 15 - Wet leakage current test after bypass diode thermal test				P
Test Date [YYYY-MM-DD] ..... :		2020-10-16		—
Test Voltage applied [V] ..... :		1500		—
Solution temperature [°C] ..... :		21.3		—
Size of module [m²] ..... :		1.98		—
Solution resistivity [Ω/ cm) ..... :		< 3,500 Ω/ cm at 22 ± 2°C	2325	—
Sample #	Measured [MΩ]	Limit [MΩ]		Result
HA2020TL-509-004A	>2000	20.2		P
Supplementary information: The maximum resistance measurement range is 2000MΩ.				

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 #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]	—
—	—	—	—	—	—	—	—
Supplementary information: —							

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

TABLE 12: MQT 18.2 - Bypass diode functionality test after bypass diode thermal test				P
Test Date [YYYY-MM-DD]..... :		2020-10-16		—
☐ Method A				—
Ambient temperature [°C] ……:				—
Current flow applied [A] ……..……:				—
Sample #	VFM	$V_{FMrated}$	VFM = (N × $V_{FMrated}$) ± 10 %	Result

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Clause	Requirement + Test	Result - Remark	Verdict

—	—	—	☐ Yes ☐ No	—
Supplementary information:				
☒ Method B				—
Sample #	Diode	IV curve after shading		Result
HA2020TL-509-004A	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 #		Test Date (YYYY-MM-DD) start/end .....:		—			
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Supplementary information: —							
☐ Other stabilization procedures							
Sample #	—	Test Date (YYYY-MM-DD) start/end ..... :		—			
Test method description: —							
Supplementary information: See Annex 3 for verification of this alternative stabilization procedure							

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 13: MQT 09 - Hot-spot endurance test					P
Test Date [YYYY-MM-DD] start/end .....:	2020-10-24/2020-10-25				—
Sample #	HA2020TL-509-004A				—
Procedure of technology.....:	☒ wafer-based technologies (WBT) MQT 09.1 ☐ monolithically integrated (MLI) thin film technologies MQT 09.2				—
Cell interconnection circuit.....:	☒ S ☐ SP ☐ SPS				—
Type of light source .....:	☐ Pulse Simulator ☒ Steady state Simulator ☐ Natural sunlight				—
Module temperature at thermal equilibrium [°C] .:	50.3				—
TABLE 13.1: MQT 09 - Hot-spot endurance test for WBT					—
Selected hot-spot cells.....:	LOW shunt resistance	LOW shunt resistance	LOW shunt resistance	HIGH shunt resistance	—
	202	215	230	1874	
Shading rate [%].....:	10	10	10	10	—
Max. measured cell temperature in each cell [°C]:	153.3	150.9	148.6	145.0	—
Test duration of each shading [h] .....:	1	1	1	1	—
Irradiance during shading [W/m²] ……. .....:	1000	1000	1000	1000	—
Supplementray information: N/A					

TABLE 13.2: MQT 09 - Hot-spot endurance test for MLI		N/A
Selected hot-spot cells.....:	—	—
Number of cells shaded .....:	—	—
Max. measured cell temperature [°C] .....:	—	—
Test duration during shading [h] .....:	—	—
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].....:	2020-10-25	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-004A	No major visual defects found	P
Supplementary information: N/A		

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 13.4: MQT 02 - Maximum power determination after hot-spot endurance test							P
Test Date [YYYY-MM-DD]:			2020-10-25				—
Module temperature [°C]:			25				—
Irradiance [W/m²):			1000				—
Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]	—
HA2020TL-509-004A	49.158	10.036	41.030	9.429	386.872	78.42	P
Supplementary information: N/A							

TABLE 13.5: MQT 03 - Insulation test after hot-spot endurance test					P
Test Date [YYYY-MM-DD]:			2020-10-25		—
Test Voltage applied [V]:			8000/1500		—
Size of module [m²]:			1.98		—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
HA2020TL-509-004A	>2000	20.2	No dielectric breakdown	X	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.					

TABLE 13.6: MQT 15 - Wet leakage current test after hot-spot endurance test				P
Test Date [YYYY-MM-DD]:		2020-10-25		—
Test Voltage applied [V]:		1500		—
Solution temperature [°C]:		21.6		—
Size of module [m²]		1.98		—
Solution resistivity [Ω/ cm):		< 3,500 Ω/ cm at 22 ± 2°C	2547	—
Sample #	Measured [MΩ]	Limit [MΩ]		Result
HA2020TL-509-004A	>2000	20.2		P
Supplementary information: The maximum resistance measurement range is 2000MΩ.				

TABLE 13.7: MQT 18.2 - Bypass diode functionality test after Hot-spot endurance test				P
Test Date [YYYY-MM-DD]:		2020-10-25		—
☐ Method A				—
Ambient temperature [°C]:		—		—
Current flow applied [A]:		—		—
Sample #	VFM	$V_{FMrated}$	VFM = (N × $V_{FMrated}$) ± 10 %	Result

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Clause	Requirement + Test	Result - Remark	Verdict

—	—	—	☐ Yes ☐ No	—
Supplementary information: —				
☒ Method B				—
Sample #	Diode	IV curve after shading		Result
HA2020TL-509-004A	Diode 1	Turn on		P
	Diode 2	Turn on		P
	Diode 3	Turn on		P
Supplementary information: N/A				

TABLE 14: MQT 10 - UV preconditioning test		P
Test Date (YYYY-MM-DD) start/end .....:	2020-09-14 / 2020-09-18	—
Module temperature [°C] ..... :	60±5	—
UV irradiance (280-400nm) [W/m²] ..... :	157.3	—
Ratio of UV irradiance (280-320nm) (%) .....:	4.8	—
UV dose (280-400nm) [kWh/ m²] ..... :	15	—
Module operation condition ..... .:	☒ Short circuited ☐ Pmax	—
Supplementary information: N/A		

TABLE 14.1: MQT 01 - Visual inspection after UV preconditioning test		P
Test Date [YYYY-MM-DD].....:	2020-09-18	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-005A	No major visual defects found	P
HA2020TL-509-006A	No major visual defects found	P
Supplementary information: N/A		

TABLE 14.2: MQT 15 - Wet leakage current test after UV preconditioning test			P
Test Date [YYYY-MM-DD]..... :	2020-09-18		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C].....:	22.5		—
Size of module [m²] ..... :	1.98		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	2456	—
Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
HA2020TL-509-005A	>2000	20.2	P

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HA2020TL-509-006A	>2000	20.2	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

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 #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]	Result
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
Supplementary information: N/A							

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 :	2020-09-19/2020-09-28		—
Total cycles (50):	50		—
Applied current (A) :	During the heat up cycle from -40 °C to 80 °C	9.479 for HA2020TL-509-005A 9.475for HA2020TL-509-006A	—
	Other stages	0.03	—
Sample #	Open circuits (yes/no)		—
HA2020TL-509-005A	No		P
HA2020TL-509-006A	No		P

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Clause	Requirement + Test	Result - Remark	Verdict

Supplementary information: N/A

TABLE 15.1: MQT 01 - Visual inspection after thermal cycling 50 test		P
Test Date [YYYY-MM-DD]..... :	2020-09-28	—

Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-005A	No major visual defects found	P
HA2020TL-509-006A	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]..... :	2020-09-28		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C] ……..:	23.3		—
Size of module [m²]	1.98		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	2285	—

Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
HA2020TL-509-005A	>2000	20.2	P
HA2020TL-509-006A	>2000	20.2	P

Supplementary information: The maximum resistance measurement range is 2000MΩ.

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

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] ..... :	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

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

TABLE 16: MQT 12 - Humidity freeze 10 test		P
Test Date [YYYY-MM-DD] start/end ..... :	2020-09-29/2020-10-09	—
Total cycles (10) ..... :	10	—
Applied current (A) ..... :	0.03	—
Sample #	Open circuits (yes/no)	—
HA2020TL-509-005A	No	P
HA2020TL-509-006A	No	P
Supplementary information: N/A		

TABLE 16.1: MQT 01 - Visual inspection after humidity freeze 10 test		P
Test Date [YYYY-MM-DD]..... :	2020-10-09	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-005A	No major visual defects found	P
HA2020TL-509-006A	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]..... :	2020-10-09		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C]……..:	22.5		—
Size of module [m²] ..... :	1.98		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	2481	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2020TL-509-005A	>2000	20.2	P

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Clause	Requirement + Test	Result - Remark	Verdict
HA2020TL-509-006A	>2000	20.2	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

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 #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	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: —					

TABLE 17: MQT 14 - Robustness of terminations test		P
Test Date [YYYY-MM-DD] start/end .....:	2020-10-12	—

TABLE 17.1: MQT 14.1 Retention of junction box on mounting surface		P
Sample #	HA2020TL-509-005A	—
Supplementary information: The applied force is 40N		

TABLE 17.2: MQT 01 - Visual inspection after retention of junction box on mounting surface		P
Test Date [YYYY-MM-DD].....:	2020-10-12	—

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-005A	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] ..... :	2020-10-12		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C] ..... :	23.2		—
Size of module [m²]	1.98		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	2476	—

Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2020TL-509-005A	>2000	20.2	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

TABLE 17.4: MQT 14.2 - Test of cord anchorage						P
Sample #	HA2020TL-509-005A					—
☒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	4	30	2	0.07		P
	Cable diameter, [mm]	Torque Force, [Nm]	Permissible angle [°]	Measured angle [°]		Result
Torque test	4	0.1	45	3.6		P
☐ Junction boxes intended to be used with generic cables						—
	Anchorage diameter range [mm]	Test mandrel [mm]	Tension Force, [N]	Permissible displacement [mm]	Measured displacement [mm]	Result
Pull test	Min —	—	—	—	—	—
	Anchorage diameter range [mm]	Test mandrel [mm]	Torque Force [Nm]	Permissible angle [°]	Measured angle [°]	Result
Torque test	Max —	—	—	—	—	—
Supplementary information:N/A						

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 17.5: MQT 01 - Visual inspection after retention of test of cord anchorage		P
Test Date [YYYY-MM-DD].....:	2020-10-12	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-005A	No major visual defects found	P
Supplementary information: N/A		

TABLE 17.6: MQT 15 - Wet leakage current test after retention of test of cord anchorage			P
Test Date [YYYY-MM-DD]..... :	2020-10-12		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C].....:	23.1		—
Size of module [m²]	1.98		—
Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
HA2020TL-509-005A	>2000	20.2	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

TABLE 17.7: MQT 03 - Insulation test after test of cord anchorage					P
Test Date [YYYY-MM-DD]..... :	2020-10-12				—
Test Voltage applied [V] ..... :	1500				—
Size of module [m²] ..... :	1.98				—
Required Resistance [MΩ]..... :	20.2				—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
HA2020TL-509-005A	>2000	20.2	No dielectric breakdown	X	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.					

TABLE 18: MQT 11 - Thermal cycling 200 test			P
Test Date [YYYY-MM-DD] start/end .....:	2020-09-19/2020-10-23		—
Total cycles (200).....:	200		—
Applied current (A) .....:	During the heat up cycle from –40 °C to 80 °C	9.569A for HA2020TL-509-007A. 9.486A for HA2020TL-509-008A.	—
	Other stages	0.03	—
Sample #	Open circuits (yes/no)		—

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Clause	Requirement + Test	Result - Remark	Verdict

HA2020TL-509-007A	No	P
HA2020TL-509-008A	No	P
Supplementary information: N/A		

TABLE 18.1: MQT 01 - Visual inspection after thermal cycling 200 test		P
Test Date [YYYY-MM-DD].....:	2020-10-23	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-007A	No major visual defects found	P
HA2020TL-509-008A	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].....:	2020-10-23		—
Test Voltage applied [V] .....:	1500		—
Solution temperature [°C].....:	21.2		—
Size of module [m²].....:	1.98		—
Solution resistivity [Ω/ cm) .....:	< 3,500 Ω/ cm at 22 ± 2°C	2417	—

Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2020TL-509-007A	>2000	20.2	P
HA2020TL-509-008A	>2000	20.2	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

TABLE 19: MQT 13 - Damp heat 1000 test		P
Test Date [YYYY-MM-DD] start/end .....:	2020-09-10/2020-10-22	—
Total hours (1000h) .....:	1000	—
Sample #	Open circuits (yes/no)	—
HA2020TL-509-009A	No	P
HA2020TL-509-010A	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]..... :	2020-10-22		—
Sample #	Nature and position of initial findings – comments or attach photos		—
HA2020TL-509-009A	No major visual defects found		P
HA2020TL-509-010A	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]..... :	2020-10-22			—
Test Voltage applied [V]..... :	1500			—
Solution temperature [°C]..... :	21.4			—
Size of module [m²]..... :	1.98			—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	2388		—
Sample #	Measured [MΩ]	Limit [MΩ]		Result
HA2020TL-509-009A	＞2000	20.2		P
HA2020TL-509-010A	＞2000	20.2		P
Supplementary information: The maximum resistance measurement range is 2000MΩ.				

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

TABLE 19.4: MQT 03 - Insulation test after damp heat 1000 test - Optional					—
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	

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Clause	Requirement + Test	Result - Remark	Verdict

—	—	—	—	—	—
—	—	—	—	—	—

Supplementary information:

TABLE 19.5: MQT 16 Static mechanical load test			P
Sample #:	HA2020TL-509-009A		—
Design load (front side/ back side) .....:	3600/ 1600		—
Safety factors .....:	1.5		—
Test Date [YYYY-MM-DD].....	2020-10-23/2020-10-24		—
Mounting method ..... :	Installed by 4 mounting holes		—
Load applied to..... :	front side	back side	—
Mechanical load [Pa].....:	5400	2400	—
First cycle time (start/end).....:	09:15/10:15	10:40/11:40	—
Intermittent open-circuit (yes/no) .....:	no	no	P
Second cycle time (start/end) .....:	13:20/14:20	14:45/15:45	—
Intermittent open-circuit (yes/no) .....:	no	no	P
Third cycle time (start/end) .....:	16:00/17:00	08:15/09:15	—
Intermittent open-circuit (yes/no) .....:	no	no	P
Supplementary information: clamp mounting method was used.			

TABLE 19.6: MQT 01 - Visual inspection after static mechanical load test		P
Test Date [YYYY-MM-DD].....:	2020-10-24	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-009A	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].....:	2020-10-24			—
Test Voltage applied [V] ..... :	1500			—
Solution temperature [°C]..... :	21.0			—
Size of module [m²] .....:	1.98			—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	2528		—
Sample #	Measured [MΩ]	Limit [MΩ]		Result
HA2020TL-509-009A	>2000	20.2		P

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Clause	Requirement + Test	Result - Remark	Verdict

Supplementary information: The maximum resistance measurement range is 2000MΩ.

TABLE 19.8: MQT 17 - Hail impact test							P
Test Date [YYYY-MM-DD]..... :	2020-10-24						—
Sample #	HA2020TL-509-010A						—
Ice ball size [mm] ..... :	1	2	3	4	5	6	—
	24.9	24.5	25.2	25.7	24.3	25.8	
	7	8	9	10	11	/	
	25.5	24.9	25.6	25.7	24.5	/	
Ice ball weight [g] ..... :	1	2	3	4	5	6	—
	7.48	7.44	7.56	7.58	7.41	7.61	
	7	8	9	10	11	/	
	7.55	7.52	7.55	7.60	7.43	/	
Ice ball velocity [m/s]..... :	1	2	3	4	5	6	—
	23.2	23.4	23.5	22.8	23.8	22.5	
	7	8	9	10	11	/	
	22.1	23.8	23.1	22.6	22.9	/	
Number of impact locations ..... :	—						—

Supplementary information: (impact location descriptions)

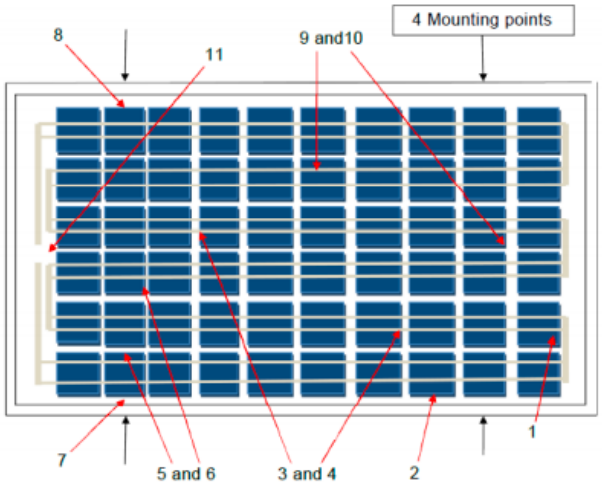

TABLE 19.9: MQT 01 - Visual inspection after hail impact test		P
Test Date [YYYY-MM-DD]..... :	2020-10-24	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-	No major visual defects found	P

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Clause	Requirement + Test	Result - Remark	Verdict
010A			
Supplementary information: N/A			

TABLE 19.10: MQT 15 - Wet leakage current test after hail impact test			P
Test Date [YYYY-MM-DD] ..... :	2020-10-24		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C] ..... :	21.0		—
Size of module [m²] ..... :	1.98		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	2528	

Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
HA2020TL-509-010A	>2000	20.2	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

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 #		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)

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Clause	Requirement + Test	Result - Remark	Verdict

Initial	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—

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]..... : 2020-10-24 —

Test method..... ☒ Simulator ☐ Natural sunlight —

Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation [%]	Result
HA2020TL-509-001A	49.142	10.151	40.919	9.534	390.122	78.21	390.465	+0.09	P
HA2020TL-509-005A	49.004	10.032	40.853	9.372	382.874	77.88	391.386	+2.17	P
HA2020TL-509-006A	49.024	9.962	40.856	9.386	383.474	78.52	390.909	+1.90	P
HA2020TL-509-007A	49.091	10.147	40.841	9.527	389.092	78.11	391.995	+0.74	P
HA2020TL-509-008A	49.514	10.098	41.170	9.416	387.657	77.53	391.016	+0.86	P
HA2020TL-509-009A	48.934	10.024	40.659	9.427	383.292	78.14	392.097	+2.25	P
HA2020TL-509-010A	49.163	9.985	41.081	9.378	385.258	78.48	392.481	+1.84	P

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Clause	Requirement + Test	Result - Remark	Verdict

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] ..... :			2020-10-24		—
Test Voltage applied [V] ..... :			8000/1500		—
Size of module [m²] ..... :			1.98		—
Sample #	Required	Measured	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
HA2020TL-509-001A	20.2	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-002A	20.2	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-003A	20.2	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-005A	20.2	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-006A	20.2	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-007A	20.2	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-008A	20.2	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-009A	20.2	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-010A	20.2	>2000	No Dielectrical breakdown	X	P
Supplementary information: the maximum resistance measurement range is 2000MΩ.					

TABLE 22: MQT 15 fin: Final Wet leakage current test			P
Test Date [YYYY-MM-DD] ..... :		2020-10-24	—
Test Voltage applied [V] ..... :		1500	—
Solution temperature [°C] ..... :		22 ± 2	—
Size of module [m²] ..... :		1.98	—
Required Resistance [MΩ] ..... :		20.2	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2020TL-509-001A	>2000	20.2	P

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Clause	Requirement + Test	Result - Remark	Verdict

HA2020TL-509-002A	>2000	20.2	P
HA2020TL-509-003A	>2000	20.2	P
HA2020TL-509-005A	>2000	20.2	P
HA2020TL-509-006A	>2000	20.2	P
HA2020TL-509-007A	>2000	20.2	P
HA2020TL-509-008A	>2000	20.2	P
HA2020TL-509-009A	>2000	20.2	P
HA2020TL-509-010A	>2000	20.2	P
Supplementary information: Solution resistivity <3500 [Ω·cm]. The maximum resistance measurement range is 2000MΩ.			

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 01: MQT 01 ini: Initial Visual inspection		P
Test Date [YYYY-MM-DD]..... :	2020-09-01	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-001C	No major visual defects found	P
HA2020TL-509-002C	No major visual defects found	P
HA2020TL-509-003C	No major visual defects found	P
HA2020TL-509-004C	No major visual defects found	P
HA2020TL-509-005C	No major visual defects found	P
HA2020TL-509-006C	No major visual defects found	P
HA2020TL-509-007C	No major visual defects found	P
HA2020TL-509-008C	No major visual defects found	P
Supplementary information: N/A		

TABLE 02: MQT 19.1 ini: Initial stabilization							P
TABLE 02.1: MQT 06.1 ini: Performance at STC before initial stabilization							
Test Date [YYYY-MM-DD]..... :	2020-09-01						—
Test method..... :	☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
HA2020TL-509-001C	11.113	49.486	10.635	40.727	433.132	78.76	P
HA2020TL-509-002C	11.115	49.628	10.672	40.808	435.503	78.95	P
HA2020TL-509-003C	11.133	49.663	10.630	40.839	434.119	78.52	P
HA2020TL-509-004C	11.091	49.643	10.608	40.896	433.825	78.79	P
HA2020TL-509-005C	11.165	49.515	10.686	40.549	433.290	78.38	P
HA2020TL-509-006C	11.108	49.751	10.614	40.907	434.187	78.57	P
HA2020TL-509-007C	11.184	49.491	10.694	40.559	433.738	78.36	P

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Clause	Requirement + Test	Result - Remark	Verdict

HA2020TL-509-008C	11.151	49.578	10.623	40.871	434.177	78.53	P

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 #	HA2020TL-509-001C	Test Date (YYYY-MM-DD) start/end .....:	2020-09-01/2020-09-09

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	—	—	—	—	433.132	—	—
1	5	800~1000	50	3.8	431.099	—	—
2	5	800~1000	50	3.8	429.826	0.77	Yes
3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-002C	Test Date (YYYY-MM-DD) start/end .....:	2020-09-01/2020-09-09

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	—	—	—	—	435.503	—	—
1	5	800~1000	50	3.8	433.597	—	—
2	5	800~1000	50	3.8	431.819	0.85	Yes
3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-003C	Test Date (YYYY-MM-DD) start/end .....:	2020-09-01/2020-09-09

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	—	—	—	—	434.119	—	—
1	5	800~1000	50	3.8	433.358	—	—
2	5	800~1000	50	3.9	431.570	0.59	Yes
3	—	—	—	—	—	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	HA2020TL-509-004C	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	433.825	—	—
1	5	800~1000	50	3.8	432.636	—	—
2	5	800~1000	50	3.9	431.798	0.47	Yes
3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-005C	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	433.290	—	—
1	5	800~1000	50	3.8	432.611	—	—
2	5	800~1000	50	3.8	431.418	0.43	Yes
3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-006C	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	434.187	—	—
1	5	800~1000	50	3.8	432.975	—	—
2	5	800~1000	50	3.9	431.374	0.65	Yes
3	—	—	—	—	—	—	—
Sample #	HA2020TL-509-007C	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	433.738	—	—
1	5	800~1000	50	3.8	432.854	—	—
2	5	800~1000	50	3.8	431.671	0.48	Yes

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Clause	Requirement + Test	Result - Remark	Verdict

3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-008C	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	434.177	—	—
1	5	800~1000	50	3.8	433.790	—	—
2	5	800~1000	50	3.9	432.364	0.42	Yes
3	—	—	—	—	—	—	—

Supplementary information: N/A	
☐ Other stabilization procedures	
Sample #	Test Date (YYYY-MM-DD) start/end
—	—
—	—
—	—
—	—
Test method description:	
Supplementary information:	

TABLE 03: MQT 06.1 ini: Performance at STC after initial stabilization		P
Test Date [YYYY-MM-DD]..... :	2020-09-09	—
Pmax(lab) lower limit (W) ..... :	408.44	—
$\bar{P}_{max}(Lab)$ lower limit (W) ..... :	421.07	P
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 #	Voc [V]		Isc [A]		Vmp [V]	Imp [A]	Pmax [W]		FF [%]	Result
	Meas.	Max. calc.	Meas.	Max. calc.			Meas.	Min. calc.		
HA2020TL-509-001C	49.243	50.39	11.133	11.19	40.420	10.634	429.826	408.44	78.40	P
HA2020TL-509-002C	49.446	50.39	11.084	11.19	40.730	10.602	431.819	408.44	78.79	P

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Clause	Requirement + Test	Result - Remark	Verdict

HA2020TL-509-003C	49.547	50.39	11.118	11.19	40.822	10.572	431.570	408.44	78.34	P
HA2020TL-509-004C	49.506	50.39	11.048	11.19	40.859	10.568	431.798	408.44	78.95	P
HA2020TL-509-005C	49.344	50.39	11.172	11.19	40.501	10.652	431.418	408.44	78.26	P
HA2020TL-509-006C	49.730	50.39	11.102	11.19	40.776	10.579	431.374	408.44	78.13	P
HA2020TL-509-007C	49.374	50.39	11.135	11.19	40.582	10.637	431.671	408.44	78.52	P
HA2020TL-509-008C	49.486	50.39	11.079	11.19	40.843	10.586	432.364	408.44	78.86	P
Average	—						431.48	421.07	—	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].....:	2020-09-09			—
Test Voltage applied [V] .....:	8000/1500			—
Size of module [m²].....:	2.17			—
Required Resistance [MΩ].....:	18.4			—
Sample #	Measured	Dielectric breakdown		Result
	MΩ	Yes (description)	No	
HA2020TL-509-001C	>2000	No dielectrical breakdown	X	P
HA2020TL-509-002C	>2000	No dielectrical breakdown	X	P
HA2020TL-509-003C	>2000	No dielectrical breakdown	X	P
HA2020TL-509-004C	>2000	No dielectrical breakdown	X	P
HA2020TL-509-005C	>2000	No dielectrical breakdown	X	P
HA2020TL-509-006C	>2000	No dielectrical breakdown	X	P
HA2020TL-509-007C	>2000	No dielectrical breakdown	X	P
HA2020TL-509-008C	>2000	No dielectrical breakdown	X	P
Supplementary information: The maximum resistance measurement range is 2000MΩ				

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 05: MQT 15 ini: Initial Wet leakage current test			P
Test Date [YYYY-MM-DD] .....:	2020-09-09		—
Test Voltage applied [V] .....:	1500		—
Solution resistivity [Ω/ cm) .....:	< 3,500 Ω/ cm at 22 ± 2°C	2461	—
Solution temperature [°C].....:	23.4		—
Size of module [m²] .....:	2.17		—

Sample #	Required Resistance [MΩ]	Measured [MΩ]	Result
HA2020TL-509-001C	18.4	>2000	P
HA2020TL-509-002C	18.4	>2000	P
HA2020TL-509-003C	18.4	>2000	P
HA2020TL-509-004C	18.4	>2000	P
HA2020TL-509-005C	18.4	>2000	P
HA2020TL-509-006C	18.4	>2000	P
HA2020TL-509-007C	18.4	>2000	P
HA2020TL-509-008C	18.4	>2000	P

Supplementary information: The maximum resistance measurement range is 2000MΩ

TABLE 06: MQT 06.2 - Performance at NMOT			—
Test Date [YYYY-MM-DD]..... :	—		—
Module temperature (°C) ..... :	—		—
Test method..... :	☐ Simulator	☐ Natural sunlight	—

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

Supplementary information: —

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 07: MQT 07 - Performance at low irradiance							—
Test Date [YYYY-MM-DD] ..... :	—						—
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 #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—

Supplementary information: N/A

TABLE 08: MQT 04 - Measurement of temperature coefficients				—
Test Date [YYYY-MM-DD] .....:	—			—
Ambient air temperature [°C] high/low .....:	—			—
Irradiance [W/m^2] high/low.....:	—			—
Module temperature [°C] high/low.....:	—			—
Sample #	α [%/°C]	β [%/°C]	δ [%/°C]	—
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—

Supplementary information: N/A

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

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Clause	Requirement + Test	Result - Remark	Verdict

Supplementary information: —

TABLE 10: MQT 08 - Outdoor exposure test		—
Test Date [YYYY-MM-DD] start/end .....:	—	—
Sample #	—	—
Total irradiation dosage [kWh/m²] .....:	—	—
Angle of tilt the test module .....:	—	—
Electrical load:	☐Restive load ☐ MPPT	—
Supplementary information: N/A		

Table 10.1: MQT 01: Visual inspection after outdoor exposure test		—
Test Date [YYYY-MM-DD].....:	—	—
Sample #	Nature and position of initial findings – comments or attach photos	—
—	—	—
Supplementary information: N/A		

Table 10.2: MQT 15: Wet leakage current test after outdoor exposure test			—
Test Date [YYYY-MM-DD] .....:	—		—
Test Voltage applied [V] .....:	—		—
Solution temperature [°C] .....:	—		—
Size of module [m²] .....:	—		—
Solution resistivity [Ω/ cm) .....:	< 3,500 Ω/ cm at 22 ± 2°C	—	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
—	—	—	—
Supplementary information: —			

Table 10.3: MQT 02 - Maximum power determination after outdoor exposure test - Optional						N/A
Test Date [YYYY-MM-DD].....:	—					—
Module temperature [°C].....:	—					—
Irradiance [W/m²) .....:	—					—
Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]
—	—	—	—	—	—	—
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 ..... :	2020-10-16				—
Sample #	HA2020TL-509-002C				—
Module temperature [°C] ..... :	75±5				—
Number of diodes in junction box ..... :	3				—
Diode manufacturer ..... :	Taizhou Chuangda Electronic Co., Ltd.				—
Diode type designation ..... :	Schottky, PV3045				—
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 ..... :	30.3	50.0	70.1	89.9	
Pulsed current ..... :	11.084	11.084	11.084	11.084	
Voltage drop [V] ..... :	0.4313 0.4413 0.4277	0.4186 0.4256 0.4147	0.4021 0.4101 0.3981	0.3886 0.3962 0.3845	
VD versus TJ characteristic ..... :	Diode 1: V_D = -0.0007 T_J + 0.4538 Diode 2: V_D = -0.0008 T_J + 0.4638 Diode 3: V_D = -0.0007 T_J + 0.4504				—
Max. permissible junction temperature Tj_{max} [°C] (according to diode datasheet) ..... :	200				—
Step 2, Bypass diode thermal test					
	Diode 1	Diode 2	Diode 3		Result
Current flow applied [A] ..... :	11.084	11.084	11.084		—

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Max. diode surface temperature allowed Tj_{max} [°C] :	200	200	200	—
Voltage drop [V] after 1h ..... :	0.3650	0.3742	0.3647	—
Calculated max. junction temperature Tj_{calc} [°C] .... :	122.044	118.195	116.492	—
Tj_{calc} < Tj_{max} (test passed)? yes/no ..... :	yes	yes	yes	P
Current flow (1.25 * Isc) [A] ..... :	13.855	13.855	13.855	—
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] ..... :	2020-10-16	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-002C	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] ..... :	2020-10-16			—
Test Voltage applied [V] ..... :	1500			—
Solution temperature [°C] ..... :	21.3			—
Size of module [m²] ..... :	2.17			—
Solution resistivity [Ω/ cm) ..... :	< 3,500 Ω/ cm at 22 ± 2°C	2325		—
Sample #	Measured [MΩ]	Limit [MΩ]		Result
HA2020TL-509-002C	>2000	18.4		P
Supplementary information: The maximum resistance measurement range is 2000MΩ.				

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 #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]	—
—	—	—	—	—	—	—	—
Supplementary information: —							

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Clause	Requirement + Test	Result - Remark	Verdict

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

TABLE 12: MQT 18.2 - Bypass diode functionality test after bypass diode thermal test				P
Test Date [YYYY-MM-DD] ..... :		2020-10-16		—
☐ Method A				—
Ambient temperature [°C] ……:				—
Current flow applied [A] ……..……:				—
Sample #	VFM	$V_{FMrated}$	VFM = (N × $V_{FMrated}$) ± 10 %	Result
—	—	—	☐ Yes ☐ No	—
Supplementary information:				
☒ Method B				—
Sample #	Diode	IV curve after shading		Result
HA2020TL-509-002C	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: —							

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Clause	Requirement + Test	Result - Remark	Verdict

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 #		Test Date (YYYY-MM-DD) start/end .....:			—		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Supplementary information: —							
☐ Other stabilization procedures							
Sample #	—	Test Date (YYYY-MM-DD) start/end ..... :			—		
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 .....:	2020-10-24/2020-10-25				—
Sample #	HA2020TL-509-002C				—
Procedure of technology.....:	☒ wafer-based technologies (WBT) MQT 09.1 ☐ monolithically integrated (MLI) thin film technologies MQT 09.2				—
Cell interconnection circuit.....:	☐ S ☐ SP ☒ SPS				—
Type of light source .....:	☐ Pulse Simulator ☒ Steady state Simulator ☐ Natural sunlight				—
Module temperature at thermal equilibrium [°C] .:	51.6				—
TABLE 13.1: MQT 09 - Hot-spot endurance test for WBT					—
Selected hot-spot cells.....:	LOW shunt resistance	LOW shunt resistance	LOW shunt resistance	HIGH shunt resistance	—
	195	219	226	1847	
Shading rate [%].....:	30	30	30	30	—
Max. measured cell temperature in each cell [°C]:	155.1	152.9	148.3	144.6	—

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Clause	Requirement + Test	Result - Remark	Verdict

Test duration of each shading [h] .....:	1	1	1	1	—
Irradiance during shading [W/m²] ……..... :	1000	1000	1000	1000	—
Supplementray information: N/A					

TABLE 13.2: MQT 09 - Hot-spot endurance test for MLI		N/A
Selected hot-spot cells.....:	—	—
Number of cells shaded .....:	—	—
Max. measured cell temperature [°C] .....:	—	—
Test duration during shading [h] .....:	—	—
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].....:	2020-10-25	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-002C	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].....:	2020-10-25						—
Module temperature [°C].....:	25						—
Irradiance [W/m^2) .....:	1000						—
Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]	—
HA2020TL-509-002C	49.277	11.030	40.607	10.545	428.201	78.78	P
Supplementary information: N/A							

TABLE 13.5: MQT 03 - Insulation test after hot-spot endurance test					P
Test Date [YYYY-MM-DD].....:	2020-10-25				—
Test Voltage applied [V] .....:	8000/1500				—
Size of module [m²].....:	2.17				—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	

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Clause	Requirement + Test	Result - Remark	Verdict

HA2020TL-509-002C	>2000	18.4	No dielectric breakdown	X	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.					

TABLE 13.6: MQT 15 - Wet leakage current test after hot-spot endurance test			P
Test Date [YYYY-MM-DD].....:	2020-10-25		—
Test Voltage applied [V] .....:	1500		—
Solution temperature [°C].....:	21.6		—
Size of module [m²]	2.17		—
Solution resistivity [Ω/ cm) .....:	< 3,500 Ω/ cm at 22 ± 2°C	2547	—

Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2020TL-509-002C	>2000	18.4	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

TABLE 13.7: MQT 18.2 - Bypass diode functionality test after Hot-spot endurance test				P
Test Date [YYYY-MM-DD].....:	2020-10-25			—
☐ Method A				—
Ambient temperature [°C] .....:	—			—
Current flow applied [A] .....:	—			—

Sample #	VFM	$V_{FMrated}$	VFM = (N × $V_{FMrated}$) ± 10 %	Result
—	—	—	☐ Yes ☐ No	—
Supplementary information: —				

☒ Method B			—
Sample #	Diode	IV curve after shading	Result
HA2020TL-509-002C	Diode 1	Turn on	P
	Diode 2	Turn on	P
	Diode 3	Turn on	P
Supplementary information: N/A			

TABLE 14: MQT 10 - UV preconditioning test		P
Test Date (YYYY-MM-DD) start/end.....:	2020-09-14 / 2020-09-18	—
Module temperature [°C] .....:	60±5	—
UV irradiance (280-400nm) [W/m²] .....:	156.4	—
Ratio of UV irradiance (280-320nm) (%) .....:	4.9	—
UV dose (280-400nm) [kWh/ m²] .....:	15	—
Module operation condition .....:	☒ Short circuited ☐ Pmax	—

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Clause	Requirement + Test	Result - Remark	Verdict

Supplementary information: —

TABLE 14.1: MQT 01 - Visual inspection after UV preconditioning test		P
Test Date [YYYY-MM-DD]..... :	2020-09-18	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-003C	No major visual defects found	P
HA2020TL-509-004C	No major visual defects found	P
Supplementary information: N/A		

TABLE 14.2: MQT 15 - Wet leakage current test after UV preconditioning test			P
Test Date [YYYY-MM-DD]..... :	2020-09-18		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C]..... :	22.5		—
Size of module [m²] ..... :	2.17		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	2456	—
Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
HA2020TL-509-003C	>2000	18.4	P
HA2020TL-509-004C	>2000	18.4	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

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 #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]	Result
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
Supplementary information: N/A							

TABLE 14.4: MQT 03 - Insulation test after UV preconditioning test - Optional		N/A
Test Date [YYYY-MM-DD]..... :	—	—
Test Voltage applied [V] ..... :	—	—

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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 .....:	2020-09-19/2020-09-28			—
Total cycles (50).....:	50			—
Applied current (A) .....:	During the heat up cycle from -40 °C to 80 °C	10.572 for HA2020TL-509-003C 10.568for HA2020TL-509-004C		—
	Other stages	0.03		—
Sample #	Open circuits (yes/no)			—
HA2020TL-509-003C	No			P
HA2020TL-509-004C	No			P
Supplementary information: N/A				

TABLE 15.1: MQT 01 - Visual inspection after thermal cycling 50 test				P
Test Date [YYYY-MM-DD].....:	2020-09-28			—
Sample #	Nature and position of initial findings – comments or attach photos			—
HA2020TL-509-003C	No major visual defects found			P
HA2020TL-509-004C	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]..... :	2020-09-28			—
Test Voltage applied [V] ..... :	1500			—
Solution temperature [°C] ……..:	23.3			—
Size of module [m²]	2.17			—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	2285		—

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
HA2020TL-509-003C	>2000	18.4	P
HA2020TL-509-004C	>2000	18.4	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

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 #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]
—	—	—	—	—	—	—
—	—	—	—	—	—	—
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	
—	—	—	—	—
—	—	—	—	—
Supplementary information: —				

TABLE 16: MQT 12 - Humidity freeze 10 test		P
Test Date [YYYY-MM-DD] start/end ..... :	2020-09-29/2020-10-09	—
Total cycles (10) ..... :	10	—
Applied current (A) ..... :	0.03	—
Sample #	Open circuits (yes/no)	—
HA2020TL-509-003C	No	P
HA2020TL-509-004C	No	P
Supplementary information: N/A		

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 16.1: MQT 01 - Visual inspection after humidity freeze 10 test		P
Test Date [YYYY-MM-DD].....:	2020-10-09	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-003C	No major visual defects found	P
HA2020TL-509-004C	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].....:	2020-10-09		—
Test Voltage applied [V] .....:	1500		—
Solution temperature [°C]…….:	22.5		—
Size of module [m²].....:	2.17		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	2317	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2020TL-509-003C	>2000	18.4	P
HA2020TL-509-004C	>2000	18.4	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

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 #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	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].....:	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
—	—	—	—	—	—
—	—	—	—	—	—
Supplementary information: —					

TABLE 17: MQT 14 - Robustness of terminations test		P
Test Date [YYYY-MM-DD] start/end .....:	2020-10-12	—

TABLE 17.1: MQT 14.1 Retention of junction box on mounting surface		P
Sample #	HA2020TL-509-003C	—
Supplementary information: The applied force is 40N		

TABLE 17.2: MQT 01 - Visual inspection after retention of junction box on mounting surface		P
Test Date [YYYY-MM-DD]..... :	2020-10-12	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-003C	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]..... :	2020-10-12		—
Test Voltage applied [V] ..... :	1500		—
Solution temperature [°C].....:	23.2		—
Size of module [m²]	2.17		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	2419	—

Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2020TL-509-003C	>2000	18.4	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

TABLE 17.4: MQT 14.2 - Test of cord anchorage		—
Sample #	—	—
☐Junction boxes intended to be used with cables specified by the manufacturer		—

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Clause	Requirement + Test	Result - Remark	Verdict

	Cable diameter, [mm]	Tension Force, [N]	Permissible displacement, [mm]	Measured displacement, [mm]	Result
Pull test	—	—	—	—	—
	Cable diameter, [mm]	Torque Force, [Nm]	Permissible angle [°]	Measured angle [°]	Result
Torque test	—	—	—	—	—
☐ Junction boxes intended to be used with generic cables					—

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

TABLE 17.5: MQT 01 - Visual inspection after retention of test of cord anchorage		—
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			—
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		—
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 18: MQT 11 - Thermal cycling 200 test			P
Test Date [YYYY-MM-DD] start/end .....:	2020-09-19/2020-10-23		—
Total cycles (200).....:	200		—
Applied current (A) .....:	During the heat up cycle from –40 °C to 80 °C	10.637A for HA2020TL-509-005C. 10.586A for HA2020TL-509-006C.	—
	Other stages	0.03	—

Sample #	Open circuits (yes/no)	—
HA2020TL-509-005C	No	P
HA2020TL-509-006C	No	P
Supplementary information: N/A		

TABLE 18.1: MQT 01 - Visual inspection after thermal cycling 200 test		P
Test Date [YYYY-MM-DD].....:	2020-10-23	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-005C	No major visual defects found	P
HA2020TL-509-006C	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].....:	2020-10-23		—
Test Voltage applied [V] .....:	1500		—
Solution temperature [°C].....:	21.2		—
Size of module [m²].....:	2.17		—
Solution resistivity [Ω/ cm) .....:	< 3,500 Ω/ cm at 22 ± 2°C	2417	—

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	Measured [MΩ]	—	Result
HA2020TL-509-005C	>2000	18.4	P
HA2020TL-509-006C	>2000	18.4	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

TABLE 19: MQT 13 - Damp heat 1000 test		P
Test Date [YYYY-MM-DD] start/end .....:	2020-09-10/2020-10-22	—
Total hours (1000h) .....:	1000	—
Sample #	Open circuits (yes/no)	—
HA2020TL-509-007C	No	P
HA2020TL-509-008C	No	P
Supplementary information: N/A		

TABLE 19.1: MQT 01 - Visual inspection after damp heat 1000 test		P
Test Date [YYYY-MM-DD].....:	2020-10-22	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-007C	No major visual defects found	P
HA2020TL-509-008C	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].....:	2020-10-22		—
Test Voltage applied [V] .....:	1500		—
Solution temperature [°C].....:	21.4		—
Size of module [m²] .....:	2.17		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	2388	—

Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2020TL-509-007C	>2000	18.4	P
HA2020TL-509-008C	>2000	18.4	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

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Clause	Requirement + Test	Result - Remark	Verdict

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

TABLE 19.4: MQT 03 - Insulation test after damp heat 1000 test - Optional					—
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	
—	—	—	—	—	—
—	—	—	—	—	—
Supplementary information:					

TABLE 19.5: MQT 16 Static mechanical load test			P
Sample #:	HA2020TL-509-007C		—
Design load (front side/ back side) ..... :	3600/ 1600		—
Safety factors ..... :	1.5		—
Test Date [YYYY-MM-DD].....	2020-10-22/2020-10-23		—
Mounting method ..... :	Installed by 4 mounting holes		—
Load applied to..... :	front side	back side	—
Mechanical load [Pa]..... :	5400	2400	—
First cycle time (start/end)..... :	13:05/14:05	14:30/15:30	—
Intermittent open-circuit (yes/no) ..... :	no	no	P
Second cycle time (start/end) ..... :	16:10/17:10	17:35/18:35	—
Intermittent open-circuit (yes/no) ..... :	no	no	P
Third cycle time (start/end) ..... :	18:50/19:50	08:15/09:15	—
Intermittent open-circuit (yes/no) ..... :	no	no	P
Supplementary information: clamp mounting method was used			

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 19.6: MQT 01 - Visual inspection after static mechanical load test		
Test Date [YYYY-MM-DD]..... :	2020-10-23	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-007C	No major visual defects found	P
Supplementary information: N/A		

TABLE 19.7: MQT 15 - Wet leakage current test after static mechanical load test			
Test Date [YYYY-MM-DD]..... :	2020-10-23		—
Test Voltage applied [V]..... :	1500		—
Solution temperature [°C]..... :	21.0		—
Size of module [m²]..... :	2.17		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	2417	—

Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2020TL-509-007C	>2000	18.4	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

TABLE 19.8: MQT 17 - Hail impact test							—
Test Date [YYYY-MM-DD]..... :	—						—
Sample #	—						—
Ice ball size [mm] ..... :	1	2	3	4	5	6	—
	—	—	—	—	—	—	
	7	8	9	10	11	/	
	—	—	—	—	—	/	
Ice ball weight [g] ..... :	1	2	3	4	5	6	—
	—	—	—	—	—	—	
	7	8	9	10	11	/	
	—	—	—	—	—	/	
Ice ball velocity [m/s]..... :	1	2	3	4	5	6	—
	—	—	—	—	—	—	
	7	8	9	10	11	/	
	—	—	—	—	—	/	
Number of impact locations ..... :	—						—
Supplementary information: —							

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 19.9: MQT 01 - Visual inspection after hail impact test		
Test Date [YYYY-MM-DD]..... :	—	—
Sample #	Nature and position of initial findings – comments or attach photos	—
—	—	—
Supplementary information: —		

TABLE 19.10: MQT 15 - Wet leakage current test after hail impact test			
Test Date [YYYY-MM-DD]..... :	—		—
Test Voltage applied [V]..... :	—		—
Solution temperature [°C]..... :	—		—
Size of module [m²] ..... :	—		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	—	
Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
—	—	—	—
Supplementary information: —			

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 :		

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Clause	Requirement + Test	Result - Remark	Verdict

Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Sample #		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	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
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]..... :	2020-10-24								—
Test method.....	☒ Simulator ☐ Natural sunlight								—
Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation [%]	Result
HA2020TL-509-001C	49.247	11.122	40.424	10.627	429.586	78.43	429.826	+0.06	P
HA2020TL-509-003C	49.139	11.043	40.358	10.495	423.557	78.05	431.311	+1.80	P
HA2020TL-509-004C	49.229	10.977	40.461	10.499	424.800	78.61	431.539	+1.56	P
HA2020TL-509-005C	49.196	11.118	40.356	10.614	428.339	78.31	431.159	+0.65	P

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Clause	Requirement + Test						Result - Remark		Verdict
HA2020TL-509-006C	49.619	11.069	40.745	10.506	428.051	77.94	431.115	+0.71	P
HA2020TL-509-007C	49.039	11.095	40.064	10.590	424.278	77.98	431.412	+1.65	P
HA2020TL-509-008C	49.368	11.056	40.676	10.529	428.269	78.46	432.105	+0.89	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] ..... :			2020-10-24		—
Test Voltage applied [V] ..... :			8000/1500		—
Size of module [m²] ..... :			2.17		—
Sample #	Required	Measured	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
HA2020TL-509-001C	18.4	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-003C	18.4	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-004C	18.4	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-005C	18.4	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-006C	18.4	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-007C	18.4	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-008C	18.4	>2000	No Dielectrical breakdown	X	P
Supplementary information: the maximum resistance measurement range is 2000MΩ.					

TABLE 22: MQT 15 fin: Final Wet leakage current test		P
Test Date [YYYY-MM-DD] ..... :	2020-10-24	—
Test Voltage applied [V] ..... :	1500	—
Solution temperature [°C] ..... :	22 ± 2	—
Size of module [m²] ..... :	2.17	—
Required Resistance [MΩ] ..... :	18.4	—

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2020TL-509-001C	>2000	18.4	P
HA2020TL-509-003C	>2000	18.4	P
HA2020TL-509-004C	>2000	18.4	P
HA2020TL-509-005C	>2000	18.4	P
HA2020TL-509-006C	>2000	18.4	P
HA2020TL-509-007C	>2000	18.4	P
HA2020TL-509-008C	>2000	18.4	P
Supplementary information: Solution resistivity <3500 [Ω·cm]. The maximum resistance measurement range is 2000MΩ.			

TABLE 01: MQT 01 ini: Initial Visual inspection		P
Test Date [YYYY-MM-DD]..... :	2020-09-01	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-001D	No major visual defects found	P
HA2020TL-509-002D	No major visual defects found	P
HA2020TL-509-003D	No major visual defects found	P
HA2020TL-509-004D	No major visual defects found	P
Supplementary information: N/A		

TABLE 02: MQT 19.1 ini: Initial stabilization							P
TABLE 02.1: MQT 06.1 ini: Performance at STC before initial stabilization							
Test Date [YYYY-MM-DD]..... :	2020-09-01						—
Test method..... :	☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
HA2020TL-509-001D	10.437	49.321	9.952	40.458	402.638	78.22	P
HA2020TL-509-002D	10.422	49.333	9.966	40.484	403.464	78.47	P

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Clause	Requirement + Test				Result - Remark		Verdict
HA2020TL-509-003D	10.429	49.330	9.962	40.345	401.917	78.12	P
HA2020TL-509-004D	10.396	49.373	9.945	40.448	402.255	78.37	P
Supplementary information: N/A							

TABLE 02.2: MQT 19.1 ini: Initial Stabilization procedure

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 #	HA2020TL-509-001D	Test Date (YYYY-MM-DD) start/end .....:	2020-09-01/2020-09-09

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	—	—	—	—	402.638	—	—
1	5	800~1000	50	4.1	401.370	—	—
2	5	800~1000	50	4.1	400.847	0.45	Yes
3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-002D	Test Date (YYYY-MM-DD) start/end .....:	2020-09-01/2020-09-09

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	—	—	—	—	403.464	—	—
1	5	800~1000	50	4.1	401.844	—	—
2	5	800~1000	50	4.1	401.159	0.57	Yes
3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-003D	Test Date (YYYY-MM-DD) start/end .....:	2020-09-01/2020-09-09

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	—	—	—	—	401.917	—	—
1	5	800~1000	50	4.1	401.265	—	—
2	5	800~1000	50	4.1	400.306	0.40	Yes

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Clause	Requirement + Test	Result - Remark	Verdict

3	—	—	—	—	—	—	—

Sample #	HA2020TL-509-004D	Test Date (YYYY-MM-DD) start/end .....:			2020-09-01/2020-09-09		
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	—	—	—	—	402.255	—	—
1	5	800~1000	50	4.1	401.351	—	—
2	5	800~1000	50	4.1	399.162	0.77	Yes
3	—	—	—	—	—	—	—

Supplementary information: N/A	
☐ Other stabilization procedures	
Sample #	Test Date (YYYY-MM-DD) start/end
—	—
—	—
—	—
—	—
Test method description:	
Supplementary information:	

TABLE 03: MQT 06.1 ini: Performance at STC after initial stabilization		P
Test Date [YYYY-MM-DD] ..... :	2020-09-09	—
Pmax(lab) lower limit (W) ..... :	379.95	—
$\bar{P}_{max}(Lab)$ lower limit (W) ..... :	391.70	P
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 #	Voc [V]		Isc [A]		Vmp [V]	Imp [A]	Pmax [W]		FF [%]	Result
	Meas.	Max. calc.	Meas.	Max. calc.			Meas.	Min. calc.		
HA2020TL-509-001D	49.304	50.29	10.378	10.48	40.351	9.934	400.847	379.95	78.34	P
HA2020TL-509-002D	49.319	50.29	10.399	10.48	40.419	9.925	401.159	379.95	78.22	P

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Clause	Requirement + Test	Result - Remark	Verdict

HA2020TL-509-003D	49.317	50.29	10.389	10.48	40.325	9.927	400.306	379.95	78.13	P
HA2020TL-509-004D	49.182	50.29	10.379	10.48	40.356	9.891	399.162	379.95	78.20	P
Average	—						400.771	391.70	—	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].....:	2020-09-09			—
Test Voltage applied [V] .....:	8000/1500			—
Size of module [m²].....:	2.01			—
Required Resistance [MΩ].....:	19.9			—
Sample #	Measured	Dielectric breakdown		Result
	MΩ	Yes (description)	No	
HA2020TL-509-001D	>2000	No dielectrical breakdown	X	P
HA2020TL-509-002D	>2000	No dielectrical breakdown	X	P
HA2020TL-509-003D	>2000	No dielectrical breakdown	X	P
HA2020TL-509-004D	>2000	No dielectrical breakdown	X	P
Supplementary information: The maximum resistance measurement range is 2000MΩ				

TABLE 05: MQT 15 ini: Initial Wet leakage current test			P
Test Date [YYYY-MM-DD].....:	2020-09-09		—
Test Voltage applied [V].....:	1500		—
Solution resistivity [Ω/ cm) .....:	< 3,500 Ω/ cm at 22 ± 2°C	2461	—
Solution temperature [°C].....:	23.4		—
Size of module [m²].....:	2.01		—

Sample #	Required Resistance [MΩ]	Measured [MΩ]	Result
HA2020TL-509-001D	19.9	>2000	P
HA2020TL-509-002D	19.9	>2000	P
HA2020TL-509-003D	19.9	>2000	P

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Clause	Requirement + Test	Result - Remark	Verdict

HA2020TL-509-004D	19.9	>2000	P
Supplementary information: The maximum resistance measurement range is 2000MΩ			

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

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

Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
Supplementary information: N/A						

TABLE 08: MQT 04 - Measurement of temperature coefficients		—
Test Date [YYYY-MM-DD] ..... :	—	—
Ambient air temperature [°C] high/low ..... :	—	—
Irradiance [W/m²] high/low ..... :	—	—
Module temperature [°C] high/low ..... :	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	α [%/°C]	β [%/°C]	δ [%/°C]	—
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—

Supplementary information: N/A

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

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

Table 10.1: MQT 01: Visual inspection after outdoor exposure test		—
Test Date [YYYY-MM-DD].....:	—	—
Sample #	Nature and position of initial findings – comments or attach photos	—
—	—	—
Supplementary information—		

Table 10.2: MQT 15: Wet leakage current test after outdoor exposure test		—
Test Date [YYYY-MM-DD] .....:	—	—
Test Voltage applied [V] .....:	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

Solution temperature [°C] .....:	—		—
Size of module [m²] .....:	—		—
Solution resistivity [Ω/ cm) .....:	< 3,500 Ω/ cm at 22 ± 2°C	—	—

Sample #	Measured [MΩ]	Limit [MΩ]	Result
—	—	—	—

Supplementary information: —

Table 10.3: MQT 02 - Maximum power determination after outdoor exposure test - Optional						N/A
Test Date [YYYY-MM-DD].....:	—					—
Module temperature [°C].....:	—					—
Irradiance [W/m²) .....:	—					—

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

Supplementary information: N/A

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		
Test Date [YYYY-MM-DD] start/end .....:	—	—
Sample #	—	—
Module temperature [°C].....:	—	—
Number of diodes in junction box .....:	—	—
Diode manufacturer .....:	—	—
Diode type designation .....:	—	—
Max. permissible junction temperature Tj_{max} [°C] (according to diode datasheet) .....:	—	—
Detailed description of sample preparation	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

procedure .....:					
Step 1, Determination of *V*D versus *T*J characteristic					—
	30 ± 2 °C	50 ± 2 °C	70 ± 2 °C	90 ± 2 °C	
Ambient temperature of the junction box .....:	—	—	—	—	
Pulsed current .....:	—	—	—	—	
Voltage drop [V] .....:	—	—	—	—	
VD versus TJ characteristic.....:	—				—
Max. permissible junction temperature Tj_{max} [°C] (according to diode datasheet) ..... :	—				—
Step 2, Bypass diode thermal test					
	Diode 1	Diode 2	Diode 3		Result
Current flow applied [A] .....:	—	—	—		—
Max. diode surface temperature allowed Tj_{max} [°C] :	—	—	—		—
Voltage drop [V] after 1h.....:	—	—	—		—
Calculated max. junction temperature Tj_{calc} [°C] ....:	—	—	—		—
Tj_{calc} < Tj_{max} (test passed)? yes/no .....:	—	—	—		—
Current flow (1.25 * Isc) [A] .....:	—	—	—		—
Bypass diode remain(s) functional (yes/no) .....:	—	—	—		—

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		—
Test Date [YYYY-MM-DD].....:	—	—
Sample #	Nature and position of initial findings – comments or attach photos	—
—	—	—
Supplementary information: N/A		

TABLE 11.2: MQT 15 - Wet leakage current test after bypass diode thermal test				—
Test Date [YYYY-MM-DD] .....:		—		—
Test Voltage applied [V].....:		—		—
Solution temperature [°C] .....:		—		—
Size of module [m²].....:		—		—
Solution resistivity [Ω/ cm) .....:		< 3,500 Ω/ cm at 22 ± 2°C	—	—
Sample #	Measured [MΩ]	Limit [MΩ]		Result

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Clause	Requirement + Test	Result - Remark	Verdict
—	—	—	—
Supplementary information: —			

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 #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]	—
—	—	—	—	—	—	—	—
Supplementary information: —							

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

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

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Clause	Requirement + Test	Result - Remark	Verdict

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 #		Test Date (YYYY-MM-DD) start/end .....:		—			
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Resistive load	P_{max} (W) at the end of cycle	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
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 13: MQT 09 - Hot-spot endurance test		P
Test Date [YYYY-MM-DD] start/end .....:	2020-10-18/2020-10-19	—
Sample #	HA2020TL-509-002D	—
Procedure of technology.....:	☒ wafer-based technologies (WBT) MQT 09.1 ☐ monolithically integrated (MLI) thin film technologies MQT 09.2	—
Cell interconnection circuit.....:	☐ S ☐ SP ☒ SPS	—
Type of light source .....:	☐ Pulse Simulator	—

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Clause	Requirement + Test	Result - Remark	Verdict

	☒ Steady state Simulator ☐ Natural sunlight	
Module temperature at thermal equilibrium [°C] .:	51.3	—

TABLE 13.1: MQT 09 - Hot-spot endurance test for WBT					—
Selected hot-spot cells.....:	LOW shunt resistance	LOW shunt resistance	LOW shunt resistance	HIGH shunt resistance	—
	192	203	229	1856	
Shading rate [%].....:	30	30	30	30	—
Max. measured cell temperature in each cell [°C]:	151.2	149.8	144.0	136.3	—
Test duration of each shading [h] .....:	1	1	1	1	—
Irradiance during shading [W/m²] ……. .....:	1000	1000	1000	1000	—
Supplementray information: N/A					

TABLE 13.2: MQT 09 - Hot-spot endurance test for MLI		N/A
Selected hot-spot cells.....:	—	—
Number of cells shaded .....:	—	—
Max. measured cell temperature [°C] .....:	—	—
Test duration during shading [h] .....:	—	—
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].....:	2020-10-19	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-002D	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].....:	2020-10-19						—
Module temperature [°C].....:	25						—
Irradiance [W/m^2) .....:	1000						—
Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]	—
HA2020TL-509-002D	49.291	10.379	40.414	9.891	399.735	78.13	P

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Clause	Requirement + Test	Result - Remark	Verdict

Supplementary information: N/A

TABLE 13.5: MQT 03 - Insulation test after hot-spot endurance test					P
Test Date [YYYY-MM-DD]:			2020-10-19		—
Test Voltage applied [V]:			8000/1500		—
Size of module [m²]:			2.01		—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
HA2020TL-509-002D	>2000	19.9	No dielectric breakdown	X	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.					

TABLE 13.6: MQT 15 - Wet leakage current test after hot-spot endurance test				P
Test Date [YYYY-MM-DD]:		2020-10-19		—
Test Voltage applied [V]:		1500		—
Solution temperature [°C]:		22.5		—
Size of module [m²]		2.01		—
Solution resistivity [Ω/ cm):		< 3,500 Ω/ cm at 22 ± 2°C	2349	—
Sample #	Measured [MΩ]	Limit [MΩ]		Result
HA2020TL-509-002D	>2000	19.9		P
Supplementary information: The maximum resistance measurement range is 2000MΩ.				

TABLE 13.7: MQT 18.2 - Bypass diode functionality test after Hot-spot endurance test				P
Test Date [YYYY-MM-DD]:		2020-10-19		—
☐ Method A				—
Ambient temperature [°C]:		—		—
Current flow applied [A]:		—		—
Sample #	VFM	$V_{FMrated}$	VFM = (N × $V_{FMrated}$) ± 10 %	Result
—	—	—	☐ Yes ☐ No	—
Supplementary information: —				
☒ Method B				—
Sample #	Diode	IV curve after shading		Result
HA2020TL-509-002D	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		
Test Date (YYYY-MM-DD) start/end.....:	—	—
Module temperature [°C] .....:	—	—
UV irradiance (280-400nm) [W/m²] .....:	—	—
Ratio of UV irradiance (280-320nm) (%) .....:	—	—
UV dose (280-400nm) [kWh/ m²] .....:	—	—
Module operation condition .....:	☐ Short circuited ☐ Pmax	—
Supplementary information: —		

TABLE 14.1: MQT 01 - Visual inspection after UV preconditioning test		
Test Date [YYYY-MM-DD].....:	—	—
Sample #	Nature and position of initial findings – comments or attach photos	—
—	—	—
—	—	—
Supplementary information: N/A		

TABLE 14.2: MQT 15 - Wet leakage current test after UV preconditioning test			
Test Date [YYYY-MM-DD].....:	—		—
Test Voltage applied [V] .....:	—		—
Solution temperature [°C].....:	—		—
Size of module [m²].....:	—		—
Solution resistivity [Ω/ cm) .....:	< 3,500 Ω/ cm at 22 ± 2°C	—	—

Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
—	—	—	—
—	—	—	—
Supplementary information: —			

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

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Clause	Requirement + Test	Result - Remark	Verdict

—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—

Supplementary information: N/A

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			—
Test Date [YYYY-MM-DD] start/end ..... :	—		—
Total cycles (50)..... :	—		—
Applied current (A) ..... :	During the heat up cycle from -40 °C to 80 °C	—	—
	Other stages	—	—
Sample #	Open circuits (yes/no)		—
—	—		—
—	—		—

Supplementary information: N/A

TABLE 15.1: MQT 01 - Visual inspection after thermal cycling 50 test		—
Test Date [YYYY-MM-DD]..... :	—	—
Sample #	Nature and position of initial findings – comments or attach photos	—
—	—	—
—	—	—

Supplementary information: N/A

TABLE 15.2: MQT 15 - Wet leakage current test after thermal cycling 50 test		—
Test Date [YYYY-MM-DD]..... :	—	—
Test Voltage applied [V] ..... :	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

Solution temperature [°C] ……..:	—		—
Size of module [m²]	—		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	—	—

Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
—	—	—	—
—	—	—	—

Supplementary information: —

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

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	
—	—	—	—	—
—	—	—	—	—

Supplementary information: —

TABLE 16: MQT 12 - Humidity freeze 10 test		—
Test Date [YYYY-MM-DD] start/end .....:	—	—
Total cycles (10) .....:	10	—
Applied current (A) .....:	—	—

Sample #	Open circuits (yes/no)	—
—	—	—

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Clause	Requirement + Test	Result - Remark	Verdict
—	—		—
Supplementary information: N/A			

TABLE 16.1: MQT 01 - Visual inspection after humidity freeze 10 test			—
Test Date [YYYY-MM-DD].....:	—		—
Sample #	Nature and position of initial findings – comments or attach photos		—
—	—		—
—	—		—
Supplementary information: N/A			

TABLE 16.2: MQT 15 - Wet leakage current test after humidity freeze 10 test			—
Test Date [YYYY-MM-DD].....:	—		—
Test Voltage applied [V] .....:	—		—
Solution temperature [°C]…….:	—		—
Size of module [m²].....:	—		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	—	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
—	—	—	—
—	—	—	—
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

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 #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	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].....:	—	—

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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: Size of module [m²]					

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

TABLE 17.1: MQT 14.1 Retention of junction box on mounting surface		—
Sample #	—	—
Supplementary information:		

TABLE 17.2: MQT 01 - Visual inspection after retention of junction box on mounting surface		—
Test Date [YYYY-MM-DD]..... :	—	—
Sample #	Nature and position of initial findings – comments or attach photos	—
—	—	—
Supplementary information: N/A		

TABLE 17.3: MQT 15 - Wet leakage current test after retention of junction box on mounting surface			—
Test Date [YYYY-MM-DD]..... :	—		—
Test Voltage applied [V] ..... :	—		—
Solution temperature [°C].....:	—		—
Size of module [m²]	—		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	—	—

Sample #	Measured [MΩ]	Limit [MΩ]	Result
—	—	—	—
Supplementary information: —			

TABLE 17.4: MQT 14.2 - Test of cord anchorage		—
Sample #	—	—
☐Junction boxes intended to be used with cables specified by the manufacturer		—

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Clause	Requirement + Test	Result - Remark	Verdict

	Cable diameter, [mm]	Tension Force, [N]	Permissible displacement, [mm]	Measured displacement, [mm]	Result
Pull test	—	—	—	—	—
	Cable diameter, [mm]	Torque Force, [Nm]	Permissible angle [°]	Measured angle [°]	Result
Torque test	—	—	—	—	—
☐ Junction boxes intended to be used with generic cables					—

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

TABLE 17.5: MQT 01 - Visual inspection after retention of test of cord anchorage		—
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			—
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		—
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 18: MQT 11 - Thermal cycling 200 test			P
Test Date [YYYY-MM-DD] start/end .....:	2020-09-19/2020-10-23		—
Total cycles (200).....:	200		—
Applied current (A) .....:	During the heat up cycle from –40 °C to 80 °C	9.927A for HA2020TL-509-003D. 9.891A for HA2020TL-509-004D.	—
	Other stages	0.03	—

Sample #	Open circuits (yes/no)	—
HA2020TL-509-003D	No	P
HA2020TL-509-004D	No	P
Supplementary information: N/A		

TABLE 18.1: MQT 01 - Visual inspection after thermal cycling 200 test		P
Test Date [YYYY-MM-DD].....:	2020-10-23	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-509-003D	No major visual defects found	P
HA2020TL-509-004D	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].....:	2020-10-23		—
Test Voltage applied [V] .....:	1500		—
Solution temperature [°C].....:	21.2		—
Size of module [m²].....:	2.01		—
Solution resistivity [Ω/ cm) .....:	< 3,500 Ω/ cm at 22 ± 2°C	2417	—

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Clause	Requirement + Test	Result - Remark	Verdict

Sample #	Measured [MΩ]	—	Result
HA2020TL-509-003D	>2000	19.9	P
HA2020TL-509-004D	>2000	19.9	P
Supplementary information: The maximum resistance measurement range is 2000MΩ.			

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

TABLE 19.1: MQT 01 - Visual inspection after damp heat 1000 test			—
Test Date [YYYY-MM-DD].....:	—		—
Sample #	Nature and position of initial findings – comments or attach photos		—
—	—		—
—	—		—
Supplementary information: N/A			

TABLE 19.2: MQT 15 - Wet leakage current test after damp heat 1000 test			—
Test Date [YYYY-MM-DD].....:	—		—
Test Voltage applied [V] .....:	—		—
Solution temperature [°C].....:	—		—
Size of module [m²] .....:	—		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	—	—

Sample #	Measured [MΩ]	Limit [MΩ]	Result
—	—	—	—
—	—	—	—
Supplementary information: —			

TABLE 19.3: MQT 02 - Maximum power determination after damp heat 1000 test - Optional		—
Test Date [YYYY-MM-DD].....:	—	—
Module temperature [°C].....:	—	—
Irradiance [W/m²) .....:	—	—

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

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Clause	Requirement + Test	Result - Remark	Verdict

—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—

Supplementary information:

TABLE 19.4: MQT 03 - Insulation test after damp heat 1000 test - Optional		—
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	
—	—	—	—	—	—
—	—	—	—	—	—

Supplementary information: —

TABLE 19.5: MQT 16 Static mechanical load test			—
Sample #:	—		—
Design load (front side/ back side) .....:	—		—
Safety factors .....:	—		—
Test Date [YYYY-MM-DD]	—		—
Mounting method ..... :	—		—
Load applied to..... :	front side	back side	—
Mechanical load [Pa].....:	—	—	—
First cycle time (start/end).....:	—	—	—
Intermittent open-circuit (yes/no) .....:	—	—	—
Second cycle time (start/end) .....:	—	—	—
Intermittent open-circuit (yes/no) .....:	—	—	—
Third cycle time (start/end) .....:	—	—	—
Intermittent open-circuit (yes/no) .....:	—	—	—

Supplementary information: N/A

TABLE 19.6: MQT 01 - Visual inspection after static mechanical load test		—
Test Date [YYYY-MM-DD].....:	—	—
Sample #	Nature and position of initial findings – comments or attach photos	—
—	—	—

Supplementary information: N/A

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 19.7: MQT 15 - Wet leakage current test after static mechanical load test				—
Test Date [YYYY-MM-DD]..... :		—		—
Test Voltage applied [V]..... :		—		—
Solution temperature [°C]..... :		—		—
Size of module [m²] ..... :		—		—
Solution resistivity [Ω/ cm)		< 3,500 Ω/ cm at 22 ± 2°C	—	—
Sample #	Measured [MΩ]	Limit [MΩ]		Result
—	—	—		—
Supplementary information: —				

TABLE 19.8: MQT 17 - Hail impact test							—
Test Date [YYYY-MM-DD]..... :	—						—
Sample #	—						—
Ice ball size [mm] ..... :	1	2	3	4	5	6	—
	—	—	—	—	—	—	
	7	8	9	10	11	/	
	—	—	—	—	—	/	
Ice ball weight [g] ..... :	1	2	3	4	5	6	—
	—	—	—	—	—	—	
	7	8	9	10	11	/	
	—	—	—	—	—	/	
Ice ball velocity [m/s]..... :	1	2	3	4	5	6	—
	—	—	—	—	—	—	
	7	8	9	10	11	/	
	—	—	—	—	—	/	
Number of impact locations ..... :	—						—
Supplementary information: —							

TABLE 19.9: MQT 01 - Visual inspection after hail impact test		
Test Date [YYYY-MM-DD]..... :	—	—
Sample #	Nature and position of initial findings – comments or attach photos	—
—	—	—
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			—
Test Date [YYYY-MM-DD] ..... :	—		—
Test Voltage applied [V] ..... :	—		—
Solution temperature [°C] ..... :	—		—
Size of module [m²] ..... :	—		—
Solution resistivity [Ω/ cm)	< 3,500 Ω/ cm at 22 ± 2°C	—	

Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
—	—	—	—

Supplementary information: —

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

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Clause	Requirement + Test	Result - Remark	Verdict

—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—

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] ..... : 2020-10-23 —

Test method ..... ☒ Simulator ☐ Natural sunlight —

Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation [%]	Result
HA2020TL-509-001D	49.297	10.418	40.355	9.925	400.523	77.99	400.847	+0.08	P
HA2020TL-509-003D	49.272	10.332	40.400	9.812	396.405	77.87	399.986	+0.90	P
HA2020TL-509-004D	49.225	10.335	40.327	9.817	395.890	77.82	398.843	+0.74	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] ..... : 2020-10-23 —

Test Voltage applied [V] ..... : 8000/1500 —

Size of module [m²] ..... : 2.01 —

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

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Clause	Requirement + Test	Result - Remark	Verdict

HA2020TL-509-001D	19.9	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-003D	19.9	>2000	No Dielectrical breakdown	X	P
HA2020TL-509-004D	19.9	>2000	No Dielectrical breakdown	X	P
Supplementary information: the maximum resistance measurement range is 2000MΩ.					

TABLE 22: MQT 15 fin: Final Wet leakage current test			P
Test Date [YYYY-MM-DD] ..... :		2020-10-23	—
Test Voltage applied [V] ..... :		1500	—
Solution temperature [°C]..... :		22 ± 2	—
Size of module [m²] ..... :		2.01	—
Required Resistance [MΩ]..... :		19.9	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2020TL-509-001D	>2000	19.9	P
HA2020TL-509-003D	>2000	19.9	P
HA2020TL-509-004D	>2000	19.9	P
Supplementary information: Solution resistivity <3500 [Ω·cm]. The maximum resistance measurement range is 2000MΩ.			

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ANNEX 1: PRODUCT DESCRIPTION SHEET (MANUFACTURERS AND TYPE REFERENCES)

A1.1	**MODULE TYPE/S**
	a)SPxxx-72M, xxx=370 to 410 in step of 5, b)SPxxx-60M, xxx=305 to 340 in step of 5, c)SPxxx-54M, xxx=280 to 310 in step of 5, d)SPxxx-48M, xxx=245 to 270 in step of 5, e)SPxxx-36M, xxx=185 to 205 in step of 5, f)SPxxx-144M, xxx=410 to 460 in step of 5, g)SPxxx-120M, xxx=340 to 385 in step of 5, h)SPxxx-144MG, xxx=380 to 415 in step of 5, i)SPxxx-120MG, xxx=315 to 345 in step of 5, xxx is standing for rated output power at STC

A1.2	**MODULE DESIGN**	
	Module dimensions (L x W x H) [mm] .....:	a) 1979 x 1002 x 35 [mm] b) 1665 x 1002 x 35 [mm] c) 1500 x 1002 x 35 [mm] d) 1348 x 1002 x 35 [mm] e) 1500 x 675 x 35 [mm] f) 2094 x1038 x 35 [mm] g) 1755 x1038 x 35 [mm] h) 2008 x1002 x 35 [mm] i) 1685 x 1002 x 35 [mm]
	Weights.....:	a) 22.0kg (approx) b) 19.0kg (approx) c) 16.1kg (approx) d) 14.6kg (approx) e) 11.7kg (approx) f) 23.5kg (approx) g)19.5kg (approx) h)22.0 kg (approx) i)18.0 kg (approx)
	Front/Rear cover bonding classification .....:	☒ rigid/flexible ☐ rigid/rigid ☐ flexible/flexible

A1.3-1	**SOLAR CELL**	
	Cell type reference .....:	Tongwei Solar (HEFEI) CO., LTD Model: M1585BPERC SE,5BB Cell technology: Mono-Si
	Cell dimensions L x W x T (± %) [mm] .....:	158.75x 158.75±0.25
	Cell thickness [µm] .....:	190 ± 19
	Cell area [cm²] .....:	252.02
A1.3-2	**SOLAR CELL**	
	Cell type reference .....:	Tongwei Solar (HEFEI) CO., LTD Model: M1669BPERC,9BB, ½ cut Cell Cell technology: Mono-Si
	Cell dimensions L x W x T (± %) [mm] .....:	166x83±0.25

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	Cell thickness [µm] ..... :	190 ± 19
	Cell area [cm²] ..... :	137.09
A1.3-3	**SOLAR CELL**	
	Cell type reference ..... :	Tongwei Solar (HEFEI) CO., LTD Model: M1589BPERC,9BB, ½ cut Cell Cell technology: Mono-Si
	Cell dimensions L x W x T (± %) [mm] ..... :	158.75x79.38±0.25
	Cell thickness [µm] ..... :	190 ± 19
	Cell area [cm²] ..... :	126.01

A1.4	**IDENTIFICATION OF MATERIALS**	
	Front cover..... :	Changzhou Hongshida Energy technology Co., Ltd. Type:AR coating tempered glass, Thickness: 3.2 mm
	Rear cover ..... :	Jolywood (Suzhou) Sunwatt Co., Ltd. Type:FFC-JW3010(plus) Material: FFC (air side)/PET/FFC (cell side),Thickness:13um(white)/285um/12um(white), total 310um, Color: White
	Encapsulation material ..... :	Changzhou Sveck PV New Material Co., Ltd. Material: EVA, type:SV-15296P (front), Thickness: 0.50mm Material: EVA, type:SV-15297P(back) Thickness: 0.50mm
	Frame parts ..... :	Yangzhou Yuxin metal products Co., Ltd. Anodized aluminum alloy, type 6063-T5, assembled by key corners Thickness:35mm
	Mounting parts..... :	N/A
	Adhesive for frame ..... :	Suzhou Tonsan Adhesive Ltd. Type: TS1527
	Edge sealing..... :	N/A
	Internal wiring ..... :	N/A
	Cell connector..... :	Wuxi Changliang Photoelectric Technology Co., Ltd. Base Cu, Purity ≥99.97%, Cross section: 0.25×1.0mm, Coating: Sn60Pb40
		Wuxi Changliang Photoelectric Technology Co., Ltd. Base Cu, Purity ≥99.97%, Cross section: Φ0.35mm, Coating: Sn60Pb40

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	String connector .....:	Wuxi Changliang Photoelectric Technology Co., Ltd. Base Cu (TU1). Purity ≥99.97%. Coating: Sn60Pb40.Cross section: 6 x 0.35 mm
	Soldering material.....:	N/A
	Fluxing agent .....:	LANTRONIC Type: SE/A603-2
	Junction box.....:	Taizhou Chuangda Electronic Co., Ltd. Type: PV-JB08-A, DC1500V,15A, -40 to85°C, IP68(1m,1h)
		Taizhou Chuangda Electronic Co., Ltd. Type: PV02, DC1500V,18A, -40 to 85°C, IP68(1m,1h)
	Cable .....:	Taizhou Chuangda Electronic Co., Ltd. Type: H1Z2Z2-K 1×4mm2, DC 1500V, -40 °C to 90 °C
	Connector .....:	Taizhou Chuangda Electronic Co., Ltd. Type: PV-TT02,1500V DC,43A, -40 to 85°C, IP68(1m,1h),
	Bypass diode .....:	for PV-JB08-A:Taizhou Chuangda Electronic Co., Ltd. Schottky, Type: 30PV045 Max. peak reverse voltage 45V, Forward Rectified current 30A. Max junction temperature 200°C
		for PV02:Taizhou Chuangda Electronic Co., Ltd. Schottky, Type: PV3045 Max. peak reverse voltage 45V, Forward Rectified current 30A. Max junction temperature 200°C
	Potting material.....:	Suzhou Tonsan Adhesive Ltd. Type TS1521
	Adhesive for junction box .....:	Suzhou Tonsan Adhesive Ltd. Type TS1527
	Additional material (e. g. fixing tape, insulation tape).....:	Insulation material between string connectors: same as backsheet Fixing tape: 3M Anti-UV PET Tape, type: UV-1 Label: Hangzhou TOKA INK CO, LTD Type: UV 161 S series

A1.5	**MODULE DESIGN - MINIMUM DISTANCES**	
	Between cells.....:	a)b)c)d)e)f)g)2±1mm, h)i)1.8±0.5mm
	Between cell and accessible surfaces.....:	a)13.0mm b)14.25mm c)13.75mm d)14.25mm e)14.0mm f)12.25mm g)12.75mm h)15.25mm i)15.25mm
	Between any current carrying part and accessible surfaces .....:	a)12.0mm b)13.75mm c)13.75mm d)14.0mm e)14.0mm f)12.25mm g)12.75mm h)13.7mm i)14.05mm

A1.6	MODULE DESIGN - ELECTRICAL CONFIGURATION	
	Total number of cells ..... :	a)72, b)60, c)54, d)48, e)36, f)144,g)120,h)144,i)120
	Serial-parallel connection of cells ..... :	a)72-1, b)60-1, c)54-1, d)48-1, e)36-1, f)24-2-3,g)20-2-3,h)24-2-3,i)20-2-3
	Cells per bypass diode ..... :	a)724, b)20, c)18, d)16, e)18, f)24x2,g)20x2,h)24x2,i)20x2
	No. of bypass diodes ..... :	3

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Annex 2: Test table for verifying other alternative stabilization procedure

Step 1: Alternative stabilization								
Test Date (YYYY-MM-DD) start/end:								—
Test method description:								—
	Sample M10		Sample M11		Sample M12			—
Power before alternative stabilization (W)	—		—		—			—
Power after alternative stabilization (W)	—		—		—			—
Supplementary information:								
Step 2: Light exposure								
☐ Simulator ☐ Natural sunlight								
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight								
Sample	Test Date (YYYY-MM-DD) start/end.....:							

Test cycle	Light source	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	—	—	—	—	—	—	—	—

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

Test cycle	Light source	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	—	—	—	—	—	—	—	—

Supplementary information:

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Step 3: Stabilization determination				
	Sample	Sample	Sample M	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:				

Annex 3-1: Lower and higher output power modules

Test item 1

TABLE A.4.1 Performance at STC before initial stabilization							P
Test Date [YYYY-MM-DD]..... :	2020-09-01						—
Test method..... :	☒ Simulator ☐ Natural sunlight						—
Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]	Result
HA2020TL-509-016A	47.854	9.900	39.924	9.310	371.689	78.46	—
HA2020TL-509-017A	47.804	9.921	39.945	9.296	371.325	78.30	—
HA2020TL-509-018A	50.841	10.320	42.484	9.709	412.477	78.62	—
HA2020TL-509-019A	50.887	10.325	42.503	9.686	411.684	78.36	—
Supplementary information: N/A							

TABLE A.4.2: MQT 19.1 ini: Initial Stabilization procedure							P
Light exposure method ..... :	☒ Simulator ☐ Natural sunlight						—
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Stabilization criterion x per IEC 61215-1-x..... :	1						—
Sample #	HA2020TL-509-016A	Test Date (YYYY-MM-DD) start/end ..... :			2020-09-01/2020-09-09		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Test cycle	Integrated irradiation (kWh/m2)	$P_{max} – P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	371.689	—	—
1	5	800~1000	50	4.3	371.147	—	—
2	5	800~1000	50	4.3	369.228	0.66	Yes

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3	—	—	—	—	—	—	—
Sample #	HA2020TL-509-017A	Test Date (YYYY-MM-DD) start/end ..... :			2020-09-01/2020-09-09		
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	—	—	—	—	371.325	—	—
1	5	Above 800	50	4.3	370.418	—	—
2	5	Above 800	50	4.3	368.962	0.64	Yes
3	—	—	—	—	—	—	—
Sample #	HA2020TL-509-018A	Test Date (YYYY-MM-DD) start/end ..... :			2020-09-01/2020-09-09		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Test cycle	Integrated irradiation (kWh/m2)	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	412.477	—	—
1	5	800~1000	50	4.3	411.031	—	—
2	5	800~1000	50	4.4	408.694	0.92	Yes
3	—	—	—	—	—	—	—
Sample #	HA2020TL-509-019A	Test Date (YYYY-MM-DD) start/end ..... :			2020-09-01/2020-09-09		
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	—	—	—	—	411.684	—	—
1	5	Above 800	50	4.4	410.304	—	—
2	5	Above 800	50	4.3	409.486	0.54	Yes
3	—	—	—	—	—	—	—

Supplementary information:		
☐ Other stabilization procedures		
Sample #	Test Date (YYYY-MM-DD) start/end .....:	

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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] ..... :	2020-09-09						—
	Lower end power class		Higher end power class				—
Pmax(lab) (W) ..... :	≥351.45		≥389.44				—
$\bar{P}_{max}(Lab)$ (W)	≥362.32		≥401.49				—
Voc(lab) (V) ..... :	≤49.16		≤51.20				—
Isc (lab) (A) ..... :	≤9.79		≤10.58				—
Test method ..... :	☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
HA2020TL-509-016A	9.774	47.706	9.266	39.848	369.228	79.19	P
HA2020TL-509-017A	9.770	47.750	9.267	39.815	368.962	79.09	P
HA2020TL-509-018A	10.311	50.651	9.665	42.286	408.694	78.26	P
HA2020TL-509-019A	10.335	50.579	9.706	42.189	409.486	78.34	P
Supplementary information: N/A							

Annex 3-2: Lower and higher output power modules

Test item 2

TABLE A.4.1 Performance at STC before initial stabilization							P
Test Date [YYYY-MM-DD] ..... :	2020-09-01						—
Test method ..... :	☒ Simulator ☐ Natural sunlight						—
Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]	Result
HA2020TL-509-011C	48.632	10.824	40.086	10.288	412.400	78.34	—
HA2020TL-509-012C	48.682	10.809	40.065	10.302	412.745	78.44	—
HA2020TL-509-013C	50.578	11.496	41.651	10.965	456.703	78.55	—

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HA2020TL-509-014C	50.532	11.491	41.632	10.988	457.452	78.78	—

Supplementary information: N/A

TABLE A.4.2: MQT 19.1 ini: Initial Stabilization procedure							P
Light exposure method ..... :	☒ Simulator ☐ Natural sunlight						—
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Stabilization criterion x per IEC 61215-1-x..... :	1						—
Sample #	HA2020TL-509-011C	Test Date (YYYY-MM-DD) start/end ..... :			2020-09-09/2020-09-14		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Test cycle	Integrated irradiation (kWh/m2)	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	412.400	—	—
1	5	800~1000	50	3.9	411.447	—	—
2	5	800~1000	50	3.9	409.904	0.61	Yes
3	—	—	—	—	—	—	—
Sample #	HA2020TL-509-012C	Test Date (YYYY-MM-DD) start/end ..... :			2020-09-09/2020-09-14		
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	—	—	—	—	412.745	—	—
1	5	Above 800	50	3.9	412.134	—	—
2	5	Above 800	50	3.9	409.507	0.79	Yes
3	—	—	—	—	—	—	—
Sample #	HA2020TL-509-013C	Test Date (YYYY-MM-DD) start/end ..... :			2020-09-09/2020-09-14		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Test cycle	Integrated irradiation (kWh/m2)	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	456.703	—	—
1	5	800~1000	50	3.8	455.044	—	—
2	5	800~1000	50	3.8	453.674	0.79	Yes
3	—	—	—	—	—	—	—
Sample #	HA2020TL-509-014C	Test Date (YYYY-MM-DD) start/end ..... :			2020-09-09/2020-09-14		

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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	—	—	—	—	457.452	—	—
1	5	Above 800	50	3.8	455.649	—	—
2	5	Above 800	50	3.8	454.013	0.75	Yes
3	—	—	—	—	—	—	—

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 A.4.3: MQT 6.1 Performance at STC after initial stabilization							P
Test Date [YYYY-MM-DD]..... :			2020-09-14				—
			Lower end power class	Higher end power class			—
Pmax(lab) (W) ..... :			≥389.44	≥436.94			—
$\bar{P}_{max}(Lab)$ (W)			≥401.49	≥450.45			—
Voc(lab) (V) ..... :			≤49.98	≤51.0			—
Isc (lab) (A) ..... :			≤10.84	≤11.77			—
Test method.....:			☒ Simulator	☐ Natural sunlight			—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
HA2020TL-509-011C	10.803	48.578	10.259	39.956	409.904	78.11	P
HA2020TL-509-012C	10.777	48.534	10.241	39.989	409.507	78.29	P
HA2020TL-509-013C	11.486	50.270	10.975	41.337	453.674	78.57	P
HA2020TL-509-014C	11.482	50.342	10.958	41.434	454.013	78.55	P
Supplementary information: N/A							

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Annex 3-3: Lower and higher output power modules

Test item 3

TABLE A.4.1 Performance at STC before initial stabilization							P
Test Date [YYYY-MM-DD]..... :	2020-09-01						—
Test method..... :	☒ Simulator ☐ Natural sunlight						—
Sample #	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmax [W]	FF [%]	Result
HA2020TL-509-005D	47.934	10.205	39.252	9.721	381.569	78.00	—
HA2020TL-509-006D	47.938	10.202	39.282	9.734	382.371	78.18	—
HA2020TL-509-007D	50.505	10.547	41.492	10.069	417.783	78.43	—
HA2020TL-509-008D	50.393	10.542	41.298	10.089	416.656	78.43	—
Supplementary information: N/A							

TABLE A.4.2: MQT 19.1 ini: Initial Stabilization procedure							P
Light exposure method ..... :	☒ Simulator ☐ Natural sunlight						—
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Stabilization criterion x per IEC 61215-1-x..... :	1						—
Sample #	HA2020TL-509-005D	Test Date (YYYY-MM-DD) start/end ..... :			2020-09-09/2020-09-14		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Test cycle	Integrated irradiation (kWh/m2)	$P_{max} – P_{min}) / P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	381.569	—	—
1	5	800~1000	50	4.0	379.544	—	—
2	5	800~1000	50	4.0	378.147	0.90	Yes
3	—	—	—	—	—	—	—
Sample #	HA2020TL-509-006D	Test Date (YYYY-MM-DD) start/end ..... :			2020-09-09/2020-09-14		
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	—	—	—	—	382.371	—	—
1	5	Above 800	50	4.0	380.536	—	—
2	5	Above 800	50	4.0	379.215	0.83	Yes
3	—	—	—	—	—	—	—

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Sample #	HA2020TL-509-007D	Test Date (YYYY-MM-DD) start/end ..... :			2020-09-09/2020-09-14		
Test cycle	Integrated irradiation (kWh/m2)	Irradiance (W/m2)	Module temperature (°C)	Test cycle	Integrated irradiation (kWh/m2)	$P_{max} – P_{min}$) / $P_{average}$ (%)	Stable (Yes/No)
Initial	—	—	—	—	417.783	—	—
1	5	800~1000	50	4.1	414.654	—	—
2	5	800~1000	50	4.1	414.357	0.82	Yes
3	—	—	—	—	—	—	—
Sample #	HA2020TL-509-008D	Test Date (YYYY-MM-DD) start/end ..... :			2020-09-09/2020-09-14		
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	—	—	—	—	416.656	—	—
1	5	Above 800	50	4.1	415.308	—	—
2	5	Above 800	50	4.1	413.613	0.73	Yes
3	—	—	—	—	—	—	—

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 A.4.3: MQT 6.1 Performance at STC after initial stabilization			P
Test Date [YYYY-MM-DD]..... :	2020-09-14		—
	Lower end power class	Higher end power class	—
Pmax(lab) (W) ..... :	≥360.95	≥394.19	—
$\bar{P}_{max}(Lab)$ (W)	≥372.11	≥406.38	—
Voc(lab) (V) ..... :	≤49.47	≤50.90	—
Isc (lab) (A) ..... :	≤10.16	≤10.72	—
Test method.....:	☒ Simulator ☐ Natural sunlight		—

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Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
HA2020TL-509-005D	10.104	47.904	9.673	39.093	378.147	78.13	P
HA2020TL-509-006D	10.100	47.873	9.714	39.038	379.215	78.43	P
HA2020TL-509-007D	10.524	50.384	10.040	41.271	414.357	78.14	P
HA2020TL-509-008D	10.525	50.354	10.026	41.254	413.613	78.04	P
Supplementary information: N/A							

Annex 4: List of measurement equipment

Clause	Measurement / testing	Testing / measuring equipment / material used, (Equipment ID)	Range used	Last Calibration date	Calibration due date
MQT 01	Visual inspection	Visual inspection table HYJC-YS-033	/	2020.09.10	2021.09.11
		Illumination photometer HYJC-YS-070	/	2020.06.12	2021.06.11
MQT 02	Maximum power determination	Module pulse simulator HYJC-YS-021	AAA	2019.12.20	2020.12.19
MQT 03	Insulation test	Programmable control voltage insulation meter HYJC-YS-155	/	2020.09.10	2021.09.11
MQT 04	Measurement of temperature coefficients	Module pulse simulator HYJC-YS-021	AAA	2019.12.20	2020.12.19
MQT 06	Performance at STC and NMOT	Module pulse simulator HYJC-YS-021	AAA	2019.12.20	2020.12.19
MQT 07	Performance at low irradiance	Module pulse simulator HYJC-YS-021	AAA	2019.12.20	2020.12.19
MQT 08	Outdoor Exposure Test	Meteorological collector HYJC-YS-034	/	2020.09.10	2021.09.11
MQT 09	Hot-spot endurance test	Steady state simulator HYJC-YS-014	/	2019.12.20	2020.12.19
		Multichannel temperature recorder HYJC-YS-073	/	2020.09.10	2021.09.11
MQT 10	UV preconditioning test	UV test chamber HYJC-YS-024	/	2020.01.17	2021.01.16
MQT 11	Thermal cycling test	Thermal cycling test chamber HYJC-YS-054	/	2020.09.10	2021.09.11
		Current continuity monitoring system HYJC-YS-139	/	2020.09.10	2021.09.11
MQT 12	Humidity-freeze test	Humidity-freeze test chamber HYJC-YS-141	/	2020.09.10	2021.09.11
		Current continuity monitoring system HYJC-YS-151	/	2020.09.10	2021.09.11
MQT 13	Damp-heat test	Damp-heat test chamber HYJC-YS-135	/	2020.09.10	2021.09.11
		Damp-heat test chamber HYJC-YS-001	/	2020.09.10	2021.09.11
MQT 14	Robustness of terminations	Terminations tester HYJC-YS-035	/	2020.05.25	2021.05.24
MQT 15	Wet leakage current test	Programmable control voltage insulation meter HYJC-YS-155	/	2020.09.10	2021.09.11

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		Conductance meter HYJC-YS-171	/	2020.09.10	2021.09.11
MQT 16	Static mechanical load test	Mechanical load test machine HYJC-YS-030	/	2020.09.10	2021.09.11
MQT 17	Hail test	Hail tester HYJC-YS-036	/	2019.12.17	2020.12.16
MQT 18.1	Bypass diode thermal test	Diode electrostatic discharge tester HYJC-YS-156	/	2020.09.10	2021.09.11
MQT 18.2	Bypass diode functionality test	Module pulse simulator HYJC-YS-021	AAA	2019.12.20	2020.12.19
MQT 19.1	Stabilization	Steady state simulator HYJC-YS-006	/	2019.12.17	2020.12.16

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