Test Report issued under the responsibility of:

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

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

Report Number. ..... :	704061707705-10 part 2 of 2
Date of issue ..... :	2020-07-04
Total number of pages ..... :	55
TÜV SÜD Branch ……..:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
Applicant's name ..... :	Hengdian Group DMEGC Magnetics Co., LTD (76043)
Address ..... :	Hengdian Industrial Zone, 322118 Dongyang City, Zhejiang Province P.R.China.
Test specification:	
Standard ..... :	IEC 61730-1:2016 IEC 61730-2:2016
Test procedure ..... :	TÜV SÜD Mark
Non-standard test method ..... :	N/A
Test Report Form No. ..... :	IEC61730a
Test Report Form(s) Originator .... :	**TÜV SÜD Product Service GmbH**
Master TRF ..... :	Dated 2016-12

Test item description .....:	Photovoltaic (PV) Module(s)
Trade Mark .....:	DMEGC
Manufacturer.....:	**DMEGC SOLAR Module Factory. (Production Facility Code: 76053)**
Address .....:	Hengdian Industrial Zone, 322118 Dongyang City, Zhejiang Province P.R.China.
Model/Type reference.....:	a)DMxxxM6-72HSW,(xxx=415-445, in step of 5W) b)DMxxxM6-60HSW,(xxx=345-370, in step of 5W) test model type DM440M6-72HSW.
Ratings.....:	1500V system voltage, safety calss II, The rated output power at STC: a)415W,420W,425W,430W,435W,440W,445W; b)345W,350W,355W,360W,365W,370W.

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

Testing location/address ..... :		
Tested by (name + signature)..... :		
Witnessed by (name + signature) ..... :		
Approved by (name + signature) ..... :		
Supervised by (name + signature)..... :		

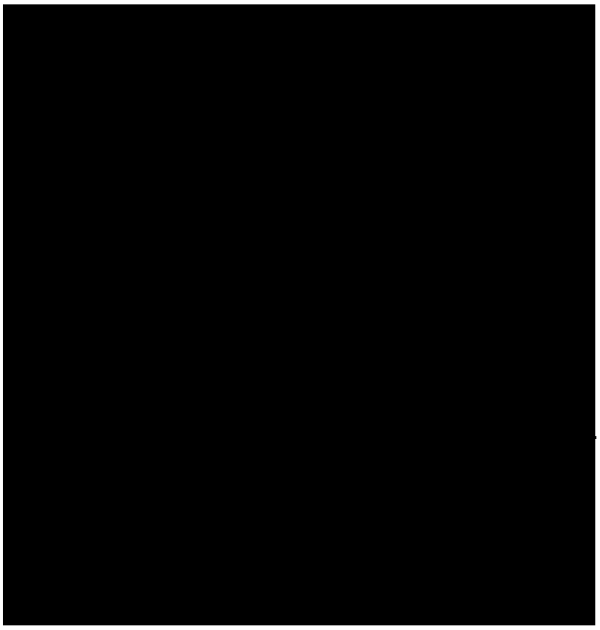
List of Attachments (including a total number of pages in each attachment):

N/A

Summary of testing:

Tests performed (name of test and test clause):

Comparing with previous project 704061707705-08, some components listed below are added:



5.According to IEC TS 62915 edition 1, some test cluases listed below were conducted on representative model DM440M6-72HSW.
Which can cover other models of family a, and b.

a)DMxxxM6-72HSW,(xxx=415-445, in step of 5W)

b)DMxxxM6-60HSW,(xxx=345-370, in step of 5W)

All models in family bin are identical in structure, except for different output power.

Visual inspection (MST01)

Accessibility test (MST 11)

Testing location:

Changzhou HuaYang Inspection and Testing Technology Co., Ltd.

No.8 Lanxiang Road, Wujin Economic Development Zone, Changzhou, Jiangsu, P.R.China

Continuity test of equipment bonding (MST13) Material creep test (MST 37) Impulse voltage test (MST 14) Temperature test (MST 21) Reverse current overload test (MST 26) Module breakage test (MST 32) Insulation test (MST16) Sequence B1 Sequence B, Fire test according to UL790 (MST23) 6.DM450M-72HSW was selected as the representative model for qualification of higher end power class.	
Summary of compliance with National Differences: N/A **List of countries addressed** ☐ **The product fulfils the requirements of _____ (insert standard number and edition and delete the text in parenthesis, leave it blank or delete the whole sentence, if not applicable)**	

Copy of marking plate:

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

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

Abbreviations used in the report:

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

Testing:	
Date of receipt of test item .....:	2020-03-23
Date (s) of performance of tests.....:	2020-03-24 to 2020-06-28

General remarks:	
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report. **Throughout this report a ☐ comma / ☒ point is used as the decimal separator.**	
Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:	
The application for obtaining a TÜV SÜD Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided ..... :	☐ **Yes** ☒ **Not applicable**
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (ies) ..... :	DMEGC SOLAR Module Factory. (Production Facility Code: 76053) Hengdian Industrial Zone, 322118 Dongyang City, Zhejiang Province P.R.China.

General product information:

PV module type reference ..... : See page 6 in part 1 of 2

Product Electrical Ratings at STC

Nominal maximum power (Pmax, tolerance) .....: See page 6 in part 1 of 2

Nominal open circuit voltage at (Voc, tolerance) .....: See page 6 in part 1 of 2

Nominal short circuit current at (Isc, tolerance) .....: See page 6 in part 1 of 2

Nominal maximum power voltage (Vmp) .....: See page 6 in part 1 of 2

Nominal maximum power current (Imp) .....: See page 6 in part 1 of 2

Product Safety Ratings

Maximum systems operating voltage .....: 1500VDC

Maximum over-current protection rating .....: 20A

Safety class in accordance with IEC 61140.....: Class II

Fire safety class .....: Class C according to UL790

Recommended maximum series/parallel module configurations .....: Refer to manual document

Scope of Module Safety Qualification Testing:

☐ Initial module safety qualification

☒ Extension of module safety qualification 704061707705-09

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

Model differences and modification:

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

Module group assignment:

Sample #	Type/model	Sample S/N	Remark
HA2020TL-140-001X	DM440M6-72HSW	DMHSWS7232031600011	Control module
HA2020TL-140-004X	DM440M6-72HSW	DMHSWS7232031600099	Temperature Test
HA2020TL-140-005X	DM440M6-72HSW	DMHSWS7232031600038	Reverse current test
HA2020TL-140-006X	DM440M6-72HSW	DMHSWS7232031600093	UV Sequence

HA2020TL-140-008X	DM440M6-72HSW	DMHSWS7232031600040	TC200 Sequence
HA2020TL-140-010X	DM440M6-72HSW	DMHSWS7232031600041	DH1000 Sequence
HA2020TL-111-001X	DM440M6-72HSW	DMHSWS7232031600001	Sequence B
HA2020TL-111-002X	DM440M6-72HSW	DMHSWS7232031600003	Sequence B1
HA2020TL-140-012X	DM440M6-72HSW	DMHSWS7232031600064	Materials creep test
HA2020TL-140-013X	DM440M6-72HSW	DMHSWS7232031600111	Impulse voltage test
HA2020TL-140-014X	DM440M6-72HSW	DMHSWS7232031600059	Module breakage test
HA2020TL-140-015X	DM440M6-72HSW	DMHSWS7232031600096	Ignitability
HA2020TL-140-016X	DM440M6-72HSW	DMHSWS7232031600107	Fire test class C
HA2020TL-140-017X	DM440M6-72HSW	DMHSWS7232031600054	Fire test class C
Supplementary information: N/A			

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

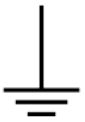
Note (2) Use the “General product information” field to describe the range of electrical and safety ratings, if the TRF covers a type family of modules.

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

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
4	**Classification, applications and intended use**		P
	The PV modules shall be classified according to IEC 61140 (Class 0, II, III) ..... :	Class II	—
	The PV modules are marked in accordance with 5.2.2.		P
5	**Requirements for design and construction**		P
5.1	**General**		P
	All PV modules are suitable for operation in outdoor non-weather protected locations, exposed to direct and indirect (albedo) solar radiation, in an environmental temperature range of at least –40 ° C to +40 ° C and up to 100 % relative humidity as well as rain.		P
	Compliance is verified by evaluation of materials, components and PV module construction as well as tests specified in IEC 61730-2.		P
	The provided assemblies of the product don't involve any action that is likely to affect compliance with the requirements of the IEC 61730 series.		P
	Incorporation of a PV module into the final assembly doesn't require any alteration of the PV module from its originally evaluated form.		N/A
	All PV module mounting and wiring methods specified in the installation instructions are evaluated for compliance with the IEC 61730 series.		P
	Compliance with the IEC 61730 series assesses the impact of the mounting and wiring methods on the safety of the PV modules, but does not assess the safety or suitability of the mounting or wiring methods for their intended use, see IEC 61215. These are subject to additional requirements or local code requirements.		P
	The construction of a PV module is such that equipotential bonding continuity, if applicable, is not interrupted by installation.		P
	Any adjustable or movable structural part is provided with a locking device to reduce the likelihood of unintentional movement, if any such movement may result in a risk of fire, electric shock, or injury to persons.		N/A
	PV modules don't have accessible burrs, sharp edges or sharp points that can cause injury to users or service persons. Edges and points that appear to be sharp by inspection, comply with the sharp edge test (MST 06).		P

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

5.2	**Marking and documentation**		P
5.2.1	**General**		
	Instructions related to safety are in an official language of the country where the equipment is to be installed.	In English	P
5.2.2	**Marking**		P
5.2.2.1	**General**		P
	Each PV module shall include the following clear and indelible markings		—
	a) Name, registered trade name, or registered trade mark of manufacturer	**DMEGC** (logo)	P
	b) Type or model number designation;	DM370-M156-72 DMH385M6-144SW	P
	c) Serial number	Provided under superstrate near the top rail of frame	P
	d) Date and place of manufacture; alternatively serial number assuring traceability of date and place of manufacture	Serial number allowing to trace the date and place of manufacture	P
	e) Polarity of terminals or leads	Provided on cable and connectors.	P
	f) “Maximum system voltage” or ”V_{sys}”	1500V DC	P
	g) Class of protection against electrical shock, in accordance with Clause 4 of IEC 61730-1:2016	Class II	P
	h) “voltage at open-circuit” or “V_{oc}” including manufacturing tolerances;	48.04V ± 3% for example	P
	i) “Current at short-circuit;” or “I_{sc}” including manufacturing tolerances;	9.83A ± 3% for example	P
	j) “PV module maximum power” or “P_{max}’’ including manufacturing tolerances;	370W ± 3% for example	P
	k) Compliance “Maximum overcurrent protection rating”, is verified by reverse current overload test (MST 26).	20A	P
	All electrical data is shown as relative to standard test conditions (STC) (1 000 W/m^2, (25 ± 2) °C, AM 1.5 according to IEC 60904-3).		P
	International symbols is used where applicable		P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	Compliance is verified according to visual inspection (MST 01) and durability of markings (MST 05).		P
	PV connectors or wiring is marked in accordance to IEC 62852 with a symbol “Do not disconnect under load”, as given in Annex A in standards IEC 61730-1:2016. Symbol or warning notice is imprinted or labelled close to connector. PV connectors is clearly marked indicating the terminal polarity.		P
	For Class II and Class 0 PV modules, the  (IEC 60417-6042: Caution, risk of electric shock) symbol shall be applied near the PV module electrical connection means.		P
	PV modules shall be marked to indicate the classes as follows: Class II:  Class 0: No symbol Class III: 	Marking according to IEC 60417-5172: Class II equipment	P
	PV modules provided with a functional earth connection are provided with a symbol according to 5.2.2.2.2, Figure 3: 		N/A
	PV modules provided with terminals for field wiring rated only for use with copper wire are marked, at or adjacent to the terminals, with the statement "Use copper wire only", "Cu only", or the equivalent.		N/A
	PV modules provided with terminals for field wiring rated only for use with a different specific wiring material is marked with a similar statement referring to the rated material.		N/A
	PV modules provided with terminals for field wiring rated for use with all types of wiring material do not need to be marked.		N/A
5.2.2.2	**Symbols**		
5.2.2.2.1	**Equipotential bonding**		
	A wiring terminal or bonding location of a PV module intended to accommodate a field installed bonding conductor for equipotential bonding is identified with the appropriate symbol IEC 60417-5021 (DB:2002-10) (IEC 61730-1:2016 Figure 2)). Alternatively IEC 60417-5017 (IEC 61730-1:2016, Figure 1) can be used. No other terminal or location is identified in this manner.		P
5.2.2.2.2	**Functional earthing**		

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	A wiring terminal or bonding location of a PV module intended to accommodate a field installed functional earthing conductor is identified with the appropriate symbol (IEC 60417-5018 (DB: 2002-10) (IEC 61730-1:2016 Figure 3).		N/A
5.2.3	**Documentation**		P
	PV modules are supplied with documentation describing the methods of electrical and mechanical installation as well as the electrical ratings of the PV module.		P
	The documentation states the Class under which the PV module was qualified and any specific limitations required for that Class.		P
	The documentation states the environmental conditions to which the module has been qualified, which by default includes a temperature range of –40 °C to +40 °C and wind/snow load including safety factor.	Designed load: Positive: 3600 Pa Negative: 2400 Pa Safety factor for both side: 1.5	P
	It is ensured that appropriate documentation for safe installation, use, and maintenance is available to installers and operators.		P
	Environmental conditions to which a PV module has been qualified may include IEC 61701 or IEC 62716		N/A
	The documentation shall contain the following information:		—
	all information required by 5.2.2.1 with exception of c), d) and e);		P
	recommended maximum series/parallel PV module configurations;	Refer to manual document	P
	the current rating of overcurrent protection, as determined in MST 26.	20 A	P
	manufacturer's stated tolerance for V_{oc}, I_{sc} and maximum power output P_{max} under standard test conditions;	Pmax: ±3% Voc, ±4% Isc: ±3%	P
	temperature coefficient for voltage at open-circuit	Refer to IEC61215 report	P
	temperature coefficient for maximum power;	Refer to IEC61215 report	P
	temperature coefficient for short-circuit current.	Refer to IEC61215 report	P
	All electrical data is shown as relative to standard test conditions (1 000 W/m², (25 ± 2) °C, AM 1,5 according to IEC 60904-3).	—	P
	International symbols are used where applicable	—	P
	The electrical documentation includes a detailed description of the electrical installation wiring method to be used. This description includes:		—
	the minimum cable diameters for PV modules intended for field wiring		N/A

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

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

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

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	Compliance is checked by inspection and by reverse current overload test (MST 26).		P
5.3.3	**External wiring and cables**		P
	External wires and cables shall fulfil the requirements of EN 50618	Certificate according to EN50618 is provided	P
5.3.4	**Connectors**		P
	External DC connectors fulfil the requirements of IEC 62852.	Certificate according to IEC 62852 is provided	P
	Connectors are marked in accordance with 5.2.2.		P
5.3.5	**Junction boxes for PV modules**		P
	Junction boxes for PV modules fulfil the requirements of IEC 62790	Certificate according to IEC 62790 is provided	P
5.3.6	**Frontsheets and backsheets**		P
	Front- and backsheets are typically compositions of layered materials, such as films, adhesives or coatings, in which at least one material layer delivers the relied upon electrical insulation and other layers may provide extended protection of the relied upon insulation against the environmental factors.		P
	Layers of frontsheets and backsheets which are relied upon for insulation withstand all relevant mechanical, electrical, thermal, and environmental stresses, with compliance demonstrated at the material or component level.		P
	Layers which represent a part of a tracking path (creepage) are classified into a material group (see 5.6.3.3).		P
	In general polymeric frontsheets and backsheets meet the relevant requirements of section 5.5.2, with compliance demonstrated by the tests in IEC 61730-2.		P
	If these sheets are used as relied upon insulation they at a minimum fulfil the requirements of 5.6.4.3 for insulation in thin layers.		P
	In addition, polymeric front- and backsheets used as relied upon insulation meet the requirements of 5.5.2.3.		P
	The values for TI or RTE (RTI) according to 5.5.2.3.3 are evaluated under consideration of particular requirements for flexible multilayer sheets given in IEC 60216-2. Relevant RTI values evaluated in accordance to UL 746B are accepted as an alternative to RTE.	120°C	P
	Adhesion of the front- and backsheet, e.g. to the encapsulant or glass, are appropriate.Compliance is checked by passing the IEC 61730-2 test sequence.		P

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

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

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

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

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

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

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

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	Materials used as electrical insulation withstand electrical stresses which occur in the application both in the unconditioned and preconditioned cases.		P
	If relevant for clearance and creepage distance evaluation insulating materials are assigned a materials group designation based on a CTI rating.		P
	Insulating materials between conductive parts of different polarity or between conductive parts and accessible surfaces are assessed according to their material group designation based on their CTI rating (see B.2.2.4.2), if those materials are a part of a creepage distance.		P
	CTI rating is required from each surface, on which tracking could occur, e.g. at inner front and/ or backsheet layer surface to encapsulant, if applicable. See Clause B.9. Figures B.2, B.3 and B.4.		P
	Whenever electrical stress is present through a material layer (not along an interface or surface) the concept of distance through insulation is applicable and CTI is not required.	Pollution degree 1	P
	Additionally, the following PV module tests apply: – Insulation test (MST 16) before and after preconditioning, and – Impulse voltage test (MST 14).		P
5.5.2.3.3	**Endurance to thermal stress – RTE (RTI) or TI (mechanical/electrical)**		P
	Materials used as relied upon insulation have a minimum relative thermal endurance, relative thermal index or temperature index (RTE/RTI or TI) in accordance with IEC 60216-5 or IEC 60216-1 equal to or greater than the maximum normalized operating temperature of the material as measured in the particular mounting situation (e.g. roof mounted) during the temperature test (MST 21), or 90 °C, whichever is higher. For open rack mounted PV modules, the normalized measured maximum PV module operating temperature can be assumed to be 90 °C, so the insulation RTE/RTI or TI rating shall be at least 90 °C. To ensure that the electrical and mechanical properties are provided through the expected lifetime the TI and RTE (RTI) values have to be evaluated as mechanical and electrical ones according to IEC 60216-2. Relevant RTI values evaluated in accordance to UL 746B are accepted as an alternative to RTE.	Refer to temperature test (MST 21)	P
5.5.2.3.4	**Polymeric insulating materials used as external parts**		P
	External polymeric parts of the PV module whose deterioration could impair the safety meet the following additional requirements:		—

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

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	In accordance with IEC 60950-1 metal parts designed for applications in climates with wet or humid ambient conditions are not in contact to metal parts that have a difference of their electrochemical potentials of more than 600 mV.		P
	Larger electrochemical potential differences are permissible if the contact points of these materials are designed to remain dry.		N/A
	Electrochemical potentials for specific material combinations are taken into consideration.	Junction box meet the IEC 62790 requirements	P
	Iron or mild steel as a part of the product are plated, painted, or enamelled for protection against corrosion.	Junction box meet the IEC 62790 requirements	N/A
	The corrosion protection at a minimum shall be at least equivalent to a zinc coating of 0,015 mm thickness.		N/A
	Simple sheared or cut edges and punched holes are not required to be additionally protected, provided these features do not affect the mechanical bonding, mounting or structural performance of the PV module.		P
	Compliance is checked by inspection.		P
5.5.3.2	**Current carrying parts**		P
	Under normal operation current-carrying parts have a sufficient mechanical strength and electrical conductivity.		P
	If environmental conditions may cause corrosion current-carrying materials (metal, polymeric based, etc.) are protected against corrosion, e.g. by coating.		P
	In case of current-carrying parts consisting of corrosion protective coated metal the coating are capable of preventing corrosion according to either one of ISO 1456, ISO 1461, ISO 2081 or ISO 2093.		N/A
	If the current-carrying parts may be stressed by abrasion, coated metal parts are not allowed.		N/A
	Other materials are protected accordingly.		N/A
5.5.4	**Adhesives**		P
	Adhesives are appropriate for the application. Compliance is checked by relevant tests of IEC 61730-2, including lap shear strength test (MST 36), peel test (MST 35), robustness of terminations test (MST 42), mechanical load test (MST 34), and visual inspection (MST 01), accessibility test (MST 11), wet leakage current test (MST 17) pre- and post- test sequences, where applicable.		P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	If an adhesive is part of the relied upon electrical insulation it has to meet the requirements of 5.5.2.3.3.		N/A
Supplementary information: Specific requirements for adhesives are under consideration.			

5.6	**Protection against electric shock**		P
5.6.2	**Protection against accessibility to hazardous live parts**		
5.6.2.1	**General**		
	PV modules are constructed to provide adequate protection against accessibility to hazardous live parts (〉 35 V DC).		P
	For Class 0 PV modules, accessible parts shall be separated from hazardous live parts by at least basic insulation.		N/A
	Class II PV modules shall be so constructed and enclosed that only parts separated from hazardous live parts by double or reinforced insulation are accessible.		P
	In Class III PV modules live parts are not considered as hazardous, so a separation from accessible parts is not needed.		N/A
	To ensure sufficient functionality and protection against hazardous lighting arc, live parts of different polarity are separated by at least functional insulation.		N/A
	Compliance is checked by visual inspection (MST 01) and by accessibility test (MST 11).		P
	Materials used for realizing protection against accessibility of hazardous live parts by means of enclosure, insulation barrier or relied upon insulation comply with the requirements of 5.5.2 due to their application.		P
5.6.2.2	**Protection by means of enclosures and insulation barriers**		P
	Enclosures or insulation barriers are so designed that, after mounting, the live parts are not accessible. This requirement is fulfilled even if there is any deformation of the housing and/or cover as a result of mechanical and thermal stress, which can occur during normal use. Furthermore, the degree of protection of the housing is not be impaired by this possible deformation.		P
	Parts of enclosures and insulation barriers that provide protection in accordance with these requirements are not removable without the use of a tool. Lids which are attached without screws have one or several detectable features, e.g. recesses, which enable tools to be deployed in order to remove them. If the lid is removed correctly the tool may not come into contact with the live parts.		P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	An insulation barrier is held in place and is not adversely affected by influences expected during normal operation to the extent that its necessary electrical and mechanical properties fall below the minimum acceptable values for the application.		N/A
	Parts shall be prevented from loosening or turning if such loosening or turning may result in a risk of fire, electric shock, or injury to persons.		P
5.6.2.3	**Protection by means of insulation of live parts**		P
	An insulation material providing the sole insulation between a live part and an accessible metal part, or between uninsulated live parts not of the same potential, is of adequate thickness and of a material appropriate for the application. If the maximum power dissipation between two neighbouring cells is less than 15 W (based on solar cell rating), neighbouring solar cells connected in series have no special insulation requirements		P
	Required type of insulation as defined in IEC 61140 is as below:		—
	For class 0, Protection required against direct contact is required. Besides, basic insulation between live parts and accessible metal parts, basic insulation between live parts and accessible surfaces, and basic insulation between live parts of different potential of the same circuit are required		N/A
	For class II, Protection required against direct contact is required. Besides, reinforc insulation between live parts and accessible metal parts, reinforce insulation between live parts and accessible surfaces, and basic insulation between live parts of different potential of the same circuit are required		P
	For class III, Protection required against direct contact is not required. Besides, function insulation between live parts and accessible metal parts, function insulation between live parts and accessible surfaces, and function insulation between live parts of different potential of the same circuit are required		N/A
Supplementary information:			
5.6.3	**Insulation coordination**		P
5.6.3.2	**Pollution degree**	Pollution degree 1	—
5.6.3.3	**Material groups**		—
5.6.3.4	**Clearances (cl) and creepage distances (cr)**		P
	Minimum clearances (cl) and creepage distances (cr) between internal live parts and outer accessible surfaces	a), c)15.0 mm b), d)16.75 mm	P

IEC 61730-1: Part 1: Requirements for construction			
Clause	Requirement + Test	Result - Remark	Verdict
	Minimum clearances (cl) and creepage distances (cr) between live parts of different potential inside a PV module	a), c)15.0 mm b), d)16.75 mm	P
	Minimum clearances (cl) and creepage distances (cr) between terminals of different polarity of rewireable junction boxes		N/A
Supplementary information:			
5.6.4	**Distance through insulation (dti)**		P
5.6.4.2	**Cemented joints**		—
	Distance through cemented joints		—
	Dry volume resistivity as measured according to IEC 62788-1-2, method A.		—
	Wet volume resistivity as measured according to IEC 62788-1-2, method A.		—
5.6.4.3	**Insulation in thin layers**		P
	a) Single-layer sheet providing relied upon insulation		—
	Thickness of single layer		—
	RTI / RTE / TI as defined in 5.5.2.3.3		—
	Dielectric strength for reinforced insulation		—
	b) Multi-layer sheets providing relied upon insulation if single layers are characterized individually:		—
	Thickness of each layer, and sum thickness		—
	RTI / RTE / TI for each layer as defined in 5.5.2.3.3		—
	Dielectric strength for basic insulation for each layer		—
	c) Multi-layer sheets providing relied upon insulation if single layers are not characterized individually:		
	Thickness of combined thickness of all layers	refer to MST 04	P
	RTI / RTE / TI for combined layers as defined in 5.5.2.3.3	120°C	P
	Dielectric strength of entire multi-layer sheet providing relied upon insulation fulfill requirements for reinforced insulation.	8000V	P
Supplementary information: N/A			

IEC 61730-2: Part 2: Requirements for testing			
Clause	Requirement + Test	Result - Remark	Verdict
10	**Test Procedures**		
	Safety qualification testing includes the following Module Safety Tests (MST) of IEC 61730-2:		
10.2	MST 01 – Visual inspection .....:	see table 10.2	P
10.3	MST 02 – Performance at STC .....:	see table 10.3	P
10.4	MST 03 – Maximum power determination .....:	see table 10.4	P
10.5	MST 04 – Insulation thickness test .....:	see table 10.5	P
10.6	MST 05– Durability of markings.....:	see table 10.6	P
10.7	MST 06– Sharp edge test.....:	see table 10.7	P
10.8	MST 07– Bypass diode functionality test.....:	see table 10.8	P
10.9	MST 11 – Accessibility test.....:	see table 10.9	P
10.10	MST 12 – Cut susceptibility test .....:	see table 10.10	P
10.11	MST 13 – Continuity test of equipotential bonding:	see table 10.11	P
10.12	MST 14 – Impulse voltage test .....:	see table 10.12	P
10.13	MST 16 – insulation test .....:	see table 10.13	P
10.14	MST 17 – Wet leakage current test .....:	see table 10.14	P
10.15	MST 21 – Temperature test.....:	see table 10.15	P
10.16	MST 22 – Hot-spot test.....:	see report no.: 704061707705-09 part 1 of 2	P
10.17	MST 23 – Fire test .....:	see table 10.17	P
10.18	MST 24 – Ignitability test .....:	see table 10.18	P
10.19	MST 24 5– Bypass diode thermal test.....:	see report no.: 704061707705-09 part 1 of 2	P
10.20	MST 26 – Reverse current overload Test.....:	see table 10.20	P
10.21	MST 32 – Module breakage test.....:	see table 10.21	P
10.22	MST 33 – Screw connections test .....:	see table 10.22	P
10.23	MST 34 – Static mechanical load test .....:	see report no.	P
10.24	MST 35 – Peel test .....:	~~see table 10.24~~	N/A
10.25	MST 36 – Lap shear strength test .....:	~~see table 10.25~~	N/A
10.26	MST 37 – Materials creep test.....:	see table 10.26	P
10.27	MST 42 – Robustness of terminations test.....:	see report no.: 704061707705-09 part 1 of 2	P
10.28	MST 51 – Thermal cycling test .....:	see report no.: 704061707705-09 part 1 of 2	P
10.29	MST 52 – Humidity freeze test .....:	see report no.: 704061707705-09 part 1 of 2	P

IEC 61730-2: Part 2: Requirements for testing			
Clause	Requirement + Test	Result - Remark	Verdict
10.30	MST 53 – Damp heat test.....:	see report no.: 704061707705-09 part 1 of 2	P
10.31	MST 54 – UV preconditioning test.....:	see report no.: 704061707705-09 part 1 of 2	P
10.32	MST 55 – Cold conditioning.....:	see table 10.32	P
10.33	MST 56 – Dry heat conditioning .....:	see table 10.33	P
Supplementary information: N/A			

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

10.2	**TABLE: Visual Inspection - MST 01 (Initial)**	P
Test Date [YYYY-MM-DD] .....:	2020-03-16 For Sample HA2020TL-111-001X ~ HA2020TL-111-002X; 2020-03-24 For Other Samples	—

Sample No.	Nature and position of findings	—
HA2020TL-140-001X	No major visual defects found	P
HA2020TL-140-004X	No major visual defects found	P
HA2020TL-140-005X	No major visual defects found	P
HA2020TL-140-006X	No major visual defects found	P
HA2020TL-140-008X	No major visual defects found	P
HA2020TL-140-010X	No major visual defects found	P
HA2020TL-111-001X	No major visual defects found	P
HA2020TL-111-002X	No major visual defects found	P
HA2020TL-140-012X	No major visual defects found	P
HA2020TL-140-013X	No major visual defects found	P
HA2020TL-140-014X	No major visual defects found	P
HA2020TL-140-015X	No major visual defects found	P
HA2020TL-140-016X	No major visual defects found	P
HA2020TL-140-017X	No major visual defects found	P
Supplementary information: N/A		

10.3	**TABLE: Performance at STC – MST 02**					P
Test Date [YYYY-MM-DD]..... :			2020-03-27			—
Irradiance (W/m^2)			1000			—
Module temperature (°C)			25			—
Test method..... :			☒ Simulator ☐ Natural sunlight			—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]
HA2020TL-140-001X	49.369	40.966	11.379	10.843	444.208	79.07
Supplementary information: N/A						

Table 8: MST 03 - Maximum power determination		
Test Date [YYYY-MM-DD]	2020-03-16 For Sample HA2020TL-111-001X ~ HA2020TL-111-002X; 2020-03-27 For Other Samples	—
Irradiance (W/m2)	1000	—

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

Module temperature (°C)	25						—
Test method	☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmp [W]	FF [%]	Result
HA2020TL-140-004X	11.383	49.341	10.812	40.902	442.226	78.73	—
HA2020TL-140-005X	11.430	49.365	10.864	40.885	444.159	78.72	—
HA2020TL-140-006X	11.398	49.269	10.855	40.727	442.091	78.73	—
HA2020TL-140-008X	11.431	49.374	10.866	40.926	444.715	78.80	—
HA2020TL-140-010X	11.439	49.227	10.887	40.712	443.226	78.71	—
HA2020TL-111-001X	11.478	49.381	10.891	40.904	445.484	78.60	—
HA2020TL-111-002X	11.467	49.453	10.887	40.980	446.130	78.68	—
HA2020TL-140-012X	11.434	49.338	10.903	40.865	445.543	78.98	—
HA2020TL-140-013X	11.439	49.358	10.915	40.891	446.330	79.05	—
Supplementary information:N/A							

10.9	**TABLE: Accessibility Test - MST 11 (Initial)**		N/A
	Test Date [YYYY-MM-DD]……:	2020-03-16 For Sample HA2020TL-111-001X ~ HA2020TL-111-002X; 2020-03-27 For Other Samples	—
	Maximum system voltage [V_{DC}] .....:	1500	—

Sample No.	Result [MΩ]	—
HA2020TL-140-006X	>500	P
HA2020TL-140-008X	>500	P
HA2020TL-140-010X	>500	P
HA2020TL-111-001X	>500	P
HA2020TL-111-002X	>500	P
HA2020TL-140-012X	>500	P
Supplementary information: N/A		

10.11	**TABLE: Continuity Test of Equipotential Bonding - MST 13 (Initial)**	N/A

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

	Test Date [YYYY-MM-DD] .....:	2020-03-16 For Sample HA2020TL-111-001X ~ HA2020TL-111-002X; 2020-03-27 For Other Samples	—
	Maximum system voltage [V_{DC}].....:	20	—
	Current applied [A].....:	50	—
	Location of designated grounding point.....:	on the middle of longer frame	—
	Location of second contacting point.....:	on the middle of longer frame	—

Sample No.	Voltage [V_{DC}]	Resistance [Ω]	—
HA2020TL-140-006X	0.059	0.001	—
HA2020TL-140-008X	0.062	0.001	—
HA2020TL-140-010X	0.073	0.001	—
HA2020TL-111-001X	0.069	0.001	—
HA2020TL-111-002X	0.069	0.001	
HA2020TL-140-012X	0.070	0.001	
HA2020TL-140-014X	0.072	0.001	

Supplementary information: N/A

10.13	**TABLE: Insulation Test - MST 16 (Initial)**			P
	Test Date [YYYY-MM-DD]…….:		2020-03-16 For Sample HA2020TL-111-001X ~ HA2020TL-111-002X; 2020-03-27 For Other Samples	—
	Maximum system voltage [V_{DC}].....:		1500	—
	Test voltage applied V_{TEST} [V_{DC}].....:		8000/1500	—
	Module area A [m²].....:		2.22	—

Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
HA2020TL-140-001X	☐	＞2000	>4440	P
HA2020TL-140-004X	☐	＞2000	>4440	P
HA2020TL-140-005X	☐	＞2000	>4440	P
HA2020TL-140-006X	☐	＞2000	>4440	P
HA2020TL-140-008X	☐	＞2000	>4440	P
HA2020TL-140-010X	☐	＞2000	>4440	P
HA2020TL-111-001X	☐	＞2000	>4440	P
HA2020TL-111-002X	☐	＞2000	>4440	P

IEC 61730-2: Part 2: Requirements for testing				
Clause	Requirement + Test		Result - Remark	Verdict
HA2020TL-140-012X	☐	＞2000	>4440	P
HA2020TL-140-013X	☐	＞2000	>4440	
Supplementary information: Size of module 2.22[m²]				

10.14	**TABLE: Wet Leakage Current Test - MST 17 (Initial)**		P
	Test Date [YYYY-MM-DD]……:	2020-03-16 For Sample HA2020TL-111-001X ~ HA2020TL-111-002X; 2020-03-27 For Other Samples	—
	Maximum system voltage [V_{DC}].....:	1500	—
	Test voltage applied V_{TEST} [V_{DC}].....:	1500	—
	Module area A [m²].....:	2.22	—
	Resistivity of wetting agent [Ω·cm].....:	2372	—
	Average wetting agent temperature [°C].....:	23.0	—
Sample No.	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
HA2020TL-140-001X	＞2000	>4440	P
HA2020TL-140-004X	＞2000	>4440	P
HA2020TL-140-005X	＞2000	>4440	P
HA2020TL-140-006X	＞2000	>4440	P
HA2020TL-140-008X	＞2000	>4440	P
HA2020TL-140-010X	＞2000	>4440	P
HA2020TL-111-001X	＞2000	>4440	P
HA2020TL-111-002X	＞2000	>4440	P
HA2020TL-140-012X	＞2000	>4440	P
Supplementary information: N/A			

10.17	**TABLE: Fire Test - MST 23**		N/A
	Test Date [YYYY-MM-DD]……:	2020-04-15	—
	Module fire resistance class .....:	C	—
	No. of modules provided to create the test assembly.....:	2	—
	Testing method .....:	According to UL790	
Sample No.	Observations		—
HA2020TL-140-016X HA2020TL-140-017X	☐ Modules comply with the requirements for the fire resistance class		N/A

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

Supplementary information: Sample HA2020TL-140-016X used for spread of flame test. Sample HA2020TL-140-017X used for ignition of brands

10.18	**TABLE: Ignitability Test- MST 24**		N/A
	Test Date [YYYY-MM-DD]……:	2020-04-09	
	Testing operation.....:	☒ Surface exposure ☐ Edge exposure	—
Sample No.	Observations		—
HA2020TL-140-015X	☐ Ignition occurs; ☐ the flame tip reaches a height of 150 mm above the flame application point with 20s		N/A
Supplementary information: No Ignition occurs.			

10.21	**TABLE: Module Breakage Test - MST 32**		N/A
	Test Date [YYYY-MM-DD]……:	2020-05-19	—
	Weight of impactor [kg] .....:	45.5	—
	Thickness of sample [mm].....:	40	—
	Mounting technique used.....:	Bolting on long frame side using four outer mounting holes	—
Sample No.			—
HA2020TL-140-014X	☒ No break occurred		
	☐ The PV module separate from the mounting structure or from the framing		
	☐ Breakage occurred, but no shear or opening large enough for a 76 mm diameter sphere to pass freely has developed.		
	☐ Breakage occurred, but no particles larger than 65 cm² have been ejected from the sample.		
Supplementary information: N/A			
10.13	**TABLE: Continuity Test of Equipotential Bonding - MST 13**		—
	Test Date [YYYY-MM-DD]……:	2020-05-19	—
	Maximum system voltage [V_{DC}].....:	1500	—
	Current applied [A].....:	50	—
	Location of designated equipotential bonding point:	on the middle of longer frame	—
	Location of second contacting point.....:	on the middle of longer frame	—
Sample No.	Voltage [V_{DC}]	Resistance [Ω]	—
HA2020TL-140-014X	0.077	0.002	—
Supplementary information: N/A			

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

10.24	**TABLE: Peel test - MST 35**		N/A
Sample #	(unconditioned / after sequence B)		—
Width of cemented joint	≤ 10 mm / > 10 mm		—
Location of test strip	Top left / Top right / Left Top / Right Top / Left middle / Right middle / Left bottom / Right bottom / Bottom left / Bottom right		—
Interface of test strip	☐ Interface between flexible backsheet and cemented joint material ☐ Interface between rigid backsheet and cemented joint material		—
Force-deflexion graph	Test strip [Top left] ---Force-deflexion graph----		
	Test strip [Top right] ---Force-deflexion graph----		
Arithmetic mean M1 of adhesion force of unconditioned samples [N]			
Arithmetic mean M2 of adhesion force of samples conditioned with sequence B [N]			
Pass criteria: Loss of adhesion force: $0.5 < \frac{\sum_1^n M2}{\sum_1^n M1}$			
Supplementary information:			

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

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

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

10.26A	**TABLE: Materials Creep Test- MST 37**		P
	Test Date [YYYY-MM-DD] start/end ..... :	2020-03-24/2020-04-02	—
	Module temperature [°C] ..... :	105±5	—
	Mounting technique used ..... :	Be mounted vertically in the test chamber.	—

Sample No.	HA2020TL-140-012X	—
Minimum cl and cr	Meet the cr and cl distances as specified in either Table 3 or Table 4 of IEC 61730-1:2016	
Between internal live parts and outer accessible surfaces after MST 37	☒**Yes** ☐ **No**	P
Between live parts of different potential inside a PV module after MST 37	☒**Yes** ☐ **No**	P
Between terminals of different polarity of rewireable junction boxes after MST 37	☐**Yes** ☐ **No**	P

(10.2 Visual inspection after Materials Creep Test MST37)		P
Test Date [YYYY-MM-DD]..... :	2020-04-02	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2020TL-140-012X	No major defects	P
Supplementary information: N/A		

(10.13 Insulation Test after Materials Creep Test MST37)		P
Test Date [YYYY-MM-DD]…….:	2020-04-02	
Maximum system voltage [V_{DC}]…….:	1500	—
Test voltage applied V_{TEST} [V_{DC}]…….:	8000/1500	—
Module area A [m²]……..:	2.22	—

Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
HA2020TL-140-012X	☐	>2000	>4440	P
Supplementary information: N/A				

(10.14 Wet leakage current test after Materials Creep Test MST37)			P
Test Date [YYYY-MM-DD].....……..:	2020-04-02		—
Test Voltage applied [V] .....……..:	1500		—
Solution resistivity [Ω cm)……..:	< 3500Ω cm at 22 ± 2°C	2370	P
Solution temperature [°C]…….....:	23.3		P

Sample #	Measured [MΩ]	Insulation resistance x A [MΩ·m²]	Result
HA2020TL-140-012X	>2000	>4440	P

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

Supplementary information: N/A			
(10.9 Accessibility Test after Materials Creep Test MST37)			P
Test Date [YYYY-MM-DD]……:		2020-04-02	P
Maximum system voltage [V_{DC}]……:		1500	—
Sample No.	Result [MΩ]		—
HA2020TL-140-012X	>500		P
Supplementary information: N/A			
(10.11 Continuity Test of Equipotential Bonding after Materials Creep Test)			P
Test Date[YYYY-MM-DD]……..……:		2020-04-02	—
Maximum system voltage [V_{DC}]……		1500	—
Current applied [A]……		50	—
Location of designated equipotential bonding point……...:		at the middle of the long frame	—
Location of second contacting point……		at the middle of the long frame	—
Sample No.	Voltage [V_{DC}]	Resistance [Ω]	—
HA2020TL-140-012X	0.078	0.002	P
Supplementary information: N/A			

10.30 B	**TABLE: Damp heat 200 test- MST53**		P
Test Date [YYYY-MM-DD] start/end .....:		2020-03-18/2020-03-27	—
Total hours (200)..... :		200h	—
(10.2 Visual inspection after MST53)			
Test Date [YYYY-MM-DD].....:		2020-03-27	
Sample #	Nature and position of initial findings – comments or attach photos		—
HA2020TL-111-001X	No major defects		P
Supplementary information: N/A			
10.31 B	**TABLE: UV preconditioning test- MST54**		P
Test Date (YYYY-MM-DD) start/end.....:		2020-04-02/2020-04-23	—
Module temperature [°C] ..... :		60±5	
UV irradiance (280-400nm) [w/m²] ..... :		120.5	—
Ratio of UV irradiance (280-320nm) (%) ..... :		3.8	P
UV irradiation (280-400nm) [kWh/ m²] ..... :		60	
Module operation condition .....:		☒ Short circuited ☐ Pmax	

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

Supplementary information: Front was exposed			
(10.2 Visual inspection after MST 54)			P
Test Date [YYYY-MM-DD].....:		2020-04-23	—
Sample #	Nature and position of initial findings – comments or attach photos		—
HA2020TL-111-001X	No major defects		P
Supplementary information: N/A			
10.29 B	**TABLE: Humidity freeze 10 test- MST52**		P
Test Date [YYYY-MM-DD] start/end .....:		2020-04-29/2020-05-09	—
Total cycles (10) ..... :		10	—
Applied current (A) ..... :		0.03	—
Sample #	Open circuits (yes/no)		—
HA2020TL-111-001X	no		P
Supplementary information: N/A			
(10.2 Visual inspection after MST 52)			P
Test Date [YYYY-MM-DD].....:		2020-05-09	—
Sample #	Nature and position of initial findings – comments or attach photos		—
HA2020TL-111-001X	No major defects		P
Supplementary information: N/A			
10.31 B	**TABLE: UV preconditioning test- MST54**		P
Test Date (YYYY-MM-DD) start/end.....:		2020-05-15/2020-05-30	—
Module temperature [°C] ..... :		60±5	P
UV irradiance (280-400nm) [w/m²] ..... :		182.3	—
Ratio of UV irradiance (280-320nm) (%) ..... :		6.9	P
UV irradiation (280-400nm) [kWh/ m²] ..... :		60	P
Module operation condition .....:		☒ Short circuited ☐ Pmax	P
Supplementary information: back was exposed			
(10.2 Visual inspection after MST 54)			P
Test Date [YYYY-MM-DD].....:		2020-05-30	—
Sample #	Nature and position of initial findings – comments or attach photos		—
HA2020TL-111-001X	No major defects		P
Supplementary information: N/A			

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

10.29 B	**TABLE: Humidity freeze 10 test- MST52**		P
Test Date [YYYY-MM-DD] start/end .....:	2020-06-01/2020-06-11		—
Total cycles (10) ..... :	10		—
Applied current (A) ..... :	0.03		—
Sample #	Open circuits (yes/no)		—
HA2020TL-111-001X	no		P
Supplementary information:N/A			
(10.2 Visual inspection after MST 52)			P
Test Date [YYYY-MM-DD].....:	2020-06-11		—
Sample #	Nature and position of initial findings – comments or attach photos		—
HA2020TL-111-001X	No major defects		P
Supplementary information: N/A			
(10.13 Insulation Test after MST52)			P
Test Date [YYYY-MM-DD]…….:	2020-06-11		—
Maximum system voltage [V_{DC}]……...:	1500		—
Test voltage applied V_{TEST} [V_{DC}]……..:	8000/1500		—
Module area A [m²]…….:	2.22		—
Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
HA2020TL-111-001X	☐	>2000	>4440	P
Supplementary information: N/A				
(10.14 Wet leakage current test after MST52)				P
Test Date [YYYY-MM-DD]……..……...:	2020-06-11			—
Test Voltage applied [V] ..... ……..:	1500			—
Solution resistivity [Ω cm)……:	2260			P
Solution temperature [°C]……....:	21.8			P
Sample #	Measured [MΩ]	Insulation resistance x A [MΩ·m²]		Result
HA2020TL-111-001X	>2000	>4440		P
Supplementary information: N/A				

10.32 B1	**TABLE: Cold Conditioning - MST55**		P
Test Date [YYYY-MM-DD] start/end .....:	2020-03-19/2020-03-21		—
Total hours	48h		—

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

(48h)……..:				
Module temperature (-40±3°C)……...:		-40°C		
(10.2 Visual inspection after MST55)				P
Test Date [YYYY-MM-DD].....:		2020-03-21		—
Sample #	Nature and position of initial findings – comments or attach photos			—
HA2020TL-111-002X	No major defects			P
Supplementary information: N/A				
(10.13 Insulation Test after MST55)				P
Test Date [YYYY-MM-DD]…….:			2020-03-21	—
Maximum system voltage [V_{DC}]……...:			1500	—
Test voltage applied V_{TEST} [V_{DC}]……..:			8000/1500	—
Module area A [m²]…….:			2.22	—
Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
HA2020TL-111-002X	☐	>2000	>4440	P
Supplementary information: N/A				
10.33 B1	**TABLE: Dry Heat Conditioning- MST56**			P
Test Date [YYYY-MM-DD] start/end .....:		2020-03-24/2020-04-02		—
Total hours (200)…….:		200h		—
Module temperature (°C)……...:		105		
(10.2 Visual inspection after MST56)				P
Test Date [YYYY-MM-DD].....:		2020-04-02		—
Sample #	Nature and position of initial findings – comments or attach photos			—
HA2020TL-111-002X	No major defects			P
Supplementary information: N/A				
(10.13 Insulation Test after MST56)				P
Test Date [YYYY-MM-DD]…….:			2020-04-02	—
Maximum system voltage [V_{DC}]……...:			1500	—
Test voltage applied V_{TEST} [V_{DC}]……..:			8000/1500	—
Module area A [m²]…….:			2.22	—
Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
HA2020TL-111-002X	☐	>2000	>4440	P

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

Supplementary information: N/A			
10.29 B1	**TABLE: Humidity freeze 10 test- MST52**		P
Test Date [YYYY-MM-DD] start/end .....:		2020-04-13/2020-04-23	—
Total cycles (10) ..... :		10	—
Applied current (A) ..... :		0.03	—
Sample #	Open circuits (yes/no)		—
HA2020TL-111-002X	no		P
Supplementary information: N/A			
(10.2 Visual inspection after MST 52)			P
Test Date [YYYY-MM-DD].....:		2020-04-23	—
Sample #	Nature and position of initial findings – comments or attach photos		—
HA2020TL-111-002X	No major defects		P
Supplementary information: N/A			
10.32 B1	**TABLE: Cold Conditioning - MST55**		P
Test Date [YYYY-MM-DD] start/end .....:		2020-04-24/2020-04-26	—
Total hours (48)……..:		48h	—
Module temperature (-40±3°C)……..:		-40°C	
(10.2 Visual inspection after MST55)			P
Test Date [YYYY-MM-DD].....:		2020-04-26	—
Sample #	Nature and position of initial findings – comments or attach photos		—
HA2020TL-111-002X	No major defects		P
Supplementary information: N/A			
(10.13 Insulation Test after MST55)			P
Test Date [YYYY-MM-DD]…….:		2020-04-26	—
Maximum system voltage [V_{DC}]……...:		1500	—
Test voltage applied V_{TEST} [V_{DC}]……..:		8000/1500	—
Module area A [m²]…….:		2.22	—

Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
HA2020TL-111-002X	☐	>2000	>4440	P
Supplementary information: N/A				

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

10.29 B1	**TABLE: Humidity freeze 10 test- MST52**			P
Test Date [YYYY-MM-DD] start/end .....:	2020-04-29/2020-05-09			—
Total cycles (10) ..... :	10			—
Applied current (A) ..... :	0.03			—
Sample #	Open circuits (yes/no)			—
HA2020TL-111-002X	no			P
Supplementary information: N/A				
(10.2 Visual inspection after MST 52)				P
Test Date [YYYY-MM-DD].....:	2020-05-09			—
Sample #	Nature and position of initial findings – comments or attach photos			—
HA2020TL-111-002X	No major defects			P
Supplementary information: N/A				
(10.13 Insulation Test after MST52)				P
Test Date [YYYY-MM-DD]…….:	2020-05-09			—
Maximum system voltage [V_{DC}]……...:	1500			—
Test voltage applied V_{TEST} [V_{DC}]……..:	8000/1500			—
Module area A [m²]…….:	2.22			—
Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
HA2020TL-111-002X	☐	>2000	>4440	P
Supplementary information:N/A				
(10.14 Wet leakage current test after MST52)				P
Test Date [YYYY-MM-DD]……..……..:	2020-05-09			—
Test Voltage applied [V] ..... ……..:	1500			—
Solution resistivity [Ω cm)…….:	< 3500Ω cm at 22 ± 2°C	2290		P
Solution temperature [°C]…….....:	21.8			P
Sample #	Measured [MΩ]	Insulation resistance x A [MΩ·m²]		Result
HA2020TL-111-002X	>2000	>4440		P
Supplementary information: N/A				

10.15 F	**TABLE: Temperature Test - MST 21**		P
	Test Date [YYYY-MM-DD]…….:	2020-03-30	—
	Sample No. ..... :	HA2020TL-140-004X	—

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

	Reference solar irradiance [W/m²]..... :	1000	—
	Reference ambient temperature [°C]..... :	42.3	—
	Test method	☐ Outdoor method ☒ Solar simulator method	—

Measuring location	Component temperature T_{OBS} [°C]	Normalised temperature T_{CON} [°C]	Component temperature limit [°C]	—
Module superstrate above the centre cell	70.8	68.5	90	P
Module substrate below the centre cell	73.1	70.8	126	P
Terminal enclosure interior surface	55.8	53.5	90	P
~~Field~~ wiring terminals	60.6	58.3	85	P
Insulation of the ~~field~~ wiring leads	53.4	51.1	90	P
External connector bodies	62.9	60.6	85	P
Diode bodies	51.9	49.6	200	P
Frame	70.8	68.5	90	P

Supplementary information: $T_{CON} = T_{OBS} + (40\ °C - T_{AMB})$,
Thermal material requirements are given in 5.5 of IEC 61730-1:2016.

10.1	**TABLE: Visual Inspection - MST 01 (after MST 21)**	—
Test Date [YYYY-MM-DD]……:	2020-03-30	

Sample No.	Nature and position of findings	—
HA2020TL-140-004X	No major defects.	P

Supplementary information: N/A

10.6	**TABLE: Insulation Test- MST 16 (after MST 21)**	P
Test Date [YYYY-MM-DD]……:	2020-03-30	

	Maximum system voltage [V_{DC}]..... :	1500	—
	Test voltage applied V_{TEST} [V_{DC}] ..... :	8000/1500	—
	Module area A [m²]..... :	2.22	—

Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
HA2020TL-140-004X	☐	>2000	>4440	P

Supplementary information: N/A

10.14	**TABLE: Wet Leakage Current Test - MST 17 (after MST 21)**	P
	Test Date [YYYY-MM-DD]……:	2020-03-30	—
	Maximum system voltage [V_{DC}] ..... :	1500	—
	Test voltage applied V_{TEST} [V_{DC}] ..... :	1500	—
	Module area A [m²]..... :	2.22	—

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

	Resistivity of wetting agent [Ω·cm]..... :	2263	—
	Average wetting agent temperature [°C] ..... :	23.1	—
Sample No.	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
HA2020TL-140-004X	>2000	>4440	P
Supplementary information: N/A			

10.2F	**TABLE: Reverse Current Overload Test - MST 26**		P
	Test Date [YYYY-MM-DD]……:	2020-05-14	—
	Module over-current protection rating [A]..... :	20	—
	Test current [A]..... :	27	—
	Range of applied voltage [V] ..... :	50-55	—
	Test duration[h] ..... :	2	—
Sample No.			—
HA2020TL-140-005X	☒ No flaming of the module ☒ No flaming or charring of the tissue paper		P
Supplementary information: N/A			
10.1	**TABLE: Visual Inspection - MST 01 (after MST 26)**		P
Test Date [YYYY-MM-DD]……:		2020-05-14	—
Sample No.	Nature and position of findings		—
HA2020TL-140-005X	No major visual defects found		P
Supplementary information: N/A			

10.6	**TABLE: Insulation Test- MST 16 (after MST 26)**			P
	Maximum system voltage [V_{DC}]..... :		1500	—
	Test voltage applied V_{TEST} [V_{DC}] ..... :		8000/1500	—
	Module area A [m²]..... :		2.22	—
Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
HA2020TL-140-005X	☐	>2000	>4440	P
Supplementary information: N/A				

10.14	**TABLE: Wet Leakage Current Test - MST 17 (after MST 26)**		P
	Test Date [YYYY-MM-DD]……:	2020-05-14	—
	Maximum system voltage [V_{DC}] ..... :	1500	—
	Test voltage applied V_{TEST} [V_{DC}] ..... :	1500	—

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

	Module area A [m²]..... :	2.22	—
	Resistivity of wetting agent [Ω·cm]..... :	18.0	—
	Average wetting agent temperature [°C] ..... :	22.9	—
Sample No.	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
HA2020TL-140-005X	>2000	>4440	P
Supplementary information: Solution resistivity 2182 [Ω·cm] .			

10.12G	**TABLE: Impulse Voltage Test - MST 14**		P
	Test Date [YYYY-MM-DD]……:	2020-04-15	—
	Maximum system voltage [V_{DC}].....:	1500	—
	Impulse voltage [V] .....:	20000	—
	Conductivity of conducting glue [Ω/625 mm²].....:	0.02	P
Sample No.			
HA2020TL-140-013X	☐ No evidence of dielectric breakdown or surface tracking observed		P
Supplementary information: N/A			

10.1	**TABLE: Visual Inspection - MST 01 (after Impulse Voltage Test)**		P
Sample No.	Nature and position of findings		—
HA2020TL-140-013X	no major defects		P
Supplementary information: N/A			

10.6	**TABLE: Insulation Test- MST 16 (after Impulse Voltage Test)**			P
	Maximum system voltage [V_{DC}] .....:		1500	—
	Test voltage applied V_{TEST} [V_{DC}].....:		8000/1500	—
	Module area A [m²] .....:		2.22	—
Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
HA2020TL-140-013X	☐	>2000	>4440	P
Supplementary information: N/A				

10.10	**TABLE: Cut Susceptibility Test - MST 12**		P
	Test Date [YYYY-MM-DD]……:	2020-06-15	
	Applied force [N] .....:	8.9	—
Sample No.			—
HA2020TL-140-006X	☒ No exposure of active circuitry of the module		P
HA2020TL-140-008X	☒ No exposure of active circuitry of the module		P
HA2020TL-140-010X	☒ No exposure of active circuitry of the module		P

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

HA2020TL-111-001X	☒ No exposure of active circuitry of the module			P
HA2020TL-111-002X	☒ No exposure of active circuitry of the module			P
Supplementary information: N/A				
10.6	**TABLE: Insulation Test- MST 16 (after Cut Susceptibility Test)**			P
	Maximum system voltage [V_{DC}] .....:	1500		—
	Test voltage applied V_{TEST} [V_{DC}].....:	8000/1500		—
	Module area A [m²] .....:	2.22		—
Sample No.	Dielectric breakdown	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]	—
HA2020TL-140-006X	☐	>2000	>4440	P
HA2020TL-140-008X	☐	>2000	>4440	P
HA2020TL-140-010X	☐	>2000	>4440	P
HA2020TL-111-001X	☐	>2000	>4440	P
HA2020TL-111-002X	☐	>2000	>4440	P
Supplementary information: N/A				
MST 17	**TABLE: Wet Leakage Current Test - MST 17 (after Cut Susceptibility Test)**			P
	Maximum system voltage [V_{DC}] .....:	1500		—
	Test voltage applied V_{TEST} [V_{DC}].....:	1500		—
	Module area A [m²] .....:	2.22		—
	Resistivity of wetting agent [Ω·cm].....:	2169		—
	Average wetting agent temperature [°C].....:	22.7		—
Sample No.	Insulation resistance at V_{TEST} [MΩ]	Insulation resistance x A [MΩ·m²]		—
HA2020TL-140-006X	>2000	>4440		P
HA2020TL-140-008X	>2000	>4440		P
HA2020TL-140-010X	>2000	>4440		P
HA2020TL-111-001X	>2000	>4440		P
HA2020TL-111-002X	>2000	>4440		P
Supplementary information: N/A				

10.13 Final	**TABLE: Continuity Test of Equipotential Bonding - MST 13**		P
	Test Date [YYYY-MM-DD…….:	2020-06-15	—
	Maximum system voltage [V_{DC}] .....:	1500	—
	Current applied [A] .....:	50	—
	Location of designated grounding point .....:	on the middle of longer frame	—

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

	Location of second contacting point.....:	on the middle of longer frame	—
Sample No.	Voltage [V_{DC}]	Resistance [Ω]	—
HA2020TL-140-006X	0.071	0.001	P
HA2020TL-140-008X	0.068	0.001	P
HA2020TL-140-010X	0.075	0.002	P
HA2020TL-111-001X	0.073	0.001	P
HA2020TL-111-002X	0.074	0.001	P
Supplementary information: N/A			

10.2 Final	**TABLE: Accessibility Test - MST 11**		P
	Test Date [YYYY-MM-DD]……:	2020-06-15	—
	Maximum system voltage [V_{DC}]..... :	1500	—
Sample No.	Result [MΩ]		—
HA2020TL-140-006X	>500		P
HA2020TL-140-008X	>500		P
HA2020TL-140-010X	>500		P
HA2020TL-111-001X	>500		P
HA2020TL-111-002X	>500		P
Supplementary information: N/A			

10.3 Final	**TABLE: Max. power determination– MST 02 (Final)**						P
Test Date [YYYY-MM-DD]..... :			2020-06-17				—
Irradiance (W/m²)			1000				—
Module temperature (°C)			25				—
Test method..... :			☒ Simulator		☐ Natural sunlight		—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	Result
HA2020TL-140-001X	49.371	11.373	40.955	10.805	442.514	78.81	P
HA2020TL-140-005X	49.361	11.384	40.807	10.774	439.674	78.24	P
HA2020TL-140-006X	49.052	11.300	40.592	10.708	434.658	78.42	P
HA2020TL-140-008X	49.494	11.373	41.072	10.659	437.787	77.77	P
HA2020TL-140-010X	48.795	11.224	40.132	10.592	425.090	77.62	P
HA2020TL-111-	48.684	11.223	39.870	10.633	423.924	77.59	P

IEC 61730-2: Part 2: Requirements for testing							
Clause	Requirement + Test			Result - Remark			Verdict
001X							
HA2020TL-111-002X	48.407	11.334	39.584	10.727	424.634	77.40	P
Supplementary information: The IV curves (didn't not) show any additional kinks or other unusual characteristics as compared to the initial IV curve.							

10.2 Final	**TABLE: Visual Inspection - MST 01 (Final)**	P
Test Date [YYYYMM-DD] ..... :	2020-06-17	—
Sample No.	Nature and position of findings	—
HA2020TL-140-001X	No major visual defects found	P
HA2020TL-140-005X	No major visual defects found	P
HA2020TL-140-006X	No major visual defects found	P
HA2020TL-140-008X	No major visual defects found	P
HA2020TL-140-010X	No major visual defects found	P
HA2020TL-111-001X	No major visual defects found	P
HA2020TL-111-002X	No major visual defects found	P
Supplementary information: N/A		

10.6 Final	**TABLE: Durability of markings- MST 05**		P
Test Date [YYYY-MM-DD]…… :	2020-06-17		—
	Aromatics content in petroleum spirits by volume [%] (≤0.1%) ..... :	≤0.1%	—
	Kauri-butenol value in petroleum spirits by volume [%](≤29%)) ..... :	≤29%	—
	Initial boiling point [°C] (about 65)..... :	about 65	—
	Dry point [°C**] (about 69) ..... :**	about 69	—
	Mass per unit volume [kg/l] (about 0.7) ..... :	about 0.7	—
	Rubbing time ..... :	15s with water 15s with petroleum spirits	—
Sample No.	Nature and position of findings		—
HA2020TL-140-001X	Marking is legible, not be removed easily, no curling		P
HA2020TL-140-005X	Marking is legible, not be removed easily, no curling		P
HA2020TL-140-006X	Marking is legible, not be removed easily, no curling		P
HA2020TL-140-008X	Marking is legible, not be removed easily, no curling		P
HA2020TL-140-010X	Marking is legible, not be removed easily, no curling		P
HA2020TL-111-001X	Marking is legible, not be removed easily, no curling		P
HA2020TL-111-002X	Marking is legible, not be removed easily, no curling		P

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

Supplementary information: N/A

10.7 Final	TABLE: Sharp edge test-MST 06	P
Test Date [YYYY-MM-DD]…… :	2020-06-17	—

Sample No.	Nature and position of findings	—
HA2020TL-140-001X	No sharp edges	P
HA2020TL-140-005X	No sharp edges	P
HA2020TL-140-006X	No sharp edges	P
HA2020TL-140-008X	No sharp edges	P
HA2020TL-140-010X	No sharp edges	P
HA2020TL-111-001X	No sharp edges	P
HA2020TL-111-002X	No sharp edges	P

Supplementary information: N/A

10.8 Final	TABLE Bypass diode functionality test - MST 07	P
Test Date [YYYY-MM-DD]…….:	2020-06-17	
☐ Method A		
Ambient temperature [°C] ……..:		
Current flow applied [A] ……...……:		

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

Supplementary information: N/A

☒ Method B		—
Sample #	IV curve bend after shading	Result
HA2020TL-140-001X	☒	P
HA2020TL-140-005X	☒	P
HA2020TL-140-006X	☒	P
HA2020TL-140-008X	☒	P
HA2020TL-140-010X	☒	P
HA2020TL-111-001X	☒	P
HA2020TL-111-	☒	P

IEC 61730-2: Part 2: Requirements for testing			
Clause	Requirement + Test	Result - Remark	Verdict
002X			
Supplementary information: N/A			

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

10.5 Final	**TABLE: Insulation thickness test– MST 04**		P
Test Date [YYYY-MM-DD] ..... :	2020-06-18		—
Sample No. ..... :	HA2020TL-111-001X		—
	a) Single-layer sheet providing relied upon insulation		—
	Thickness of single layer		—
	b) Multi-layer sheets providing relied upon insulation if single layers are characterized individually:		—
	Thickness of each layer, and sum thickness		—
	c) Multi-layer sheets providing relied upon insulation if single layers are not characterized individually:		—
	Thickness of combined thickness of all layers	330.35 to 346.76um	—
Supplementary information: 12 positions are measured. Measurement uncertainty is 1.92%. The measured insulation thickness is greater than the requirements listed in either Table 3 or Table 4 of IEC 61730-1:2016 depending on the PV module's Class according to IEC 61140 and considering the measurement uncertainty of the test and the set-up.			

ANNEX 1: CONSTRUCTIONAL DETAILS

A1.1	MODULE TYPE/S
	a)DMxxxM6-72HSW,(xxx=415-445, in step of 5W) b)DMxxxM6-60HSW,(xxx=345-370, in step of 5W)

A1.2	MODULE DESIGN	
	Module dimensions (L x W x H) [mm] .....:	a) 2000x992x40 [mm] or b) 1675x992x40 [mm]
	Weights.....:	a) 22.7 kg b) 19.3 kg
	Front/Rear cover bonding classification .....:	☒ rigid/flexible ☐ rigid/rigid ☐ flexible/flexible

A1.3	SOLAR CELL	
	Cell type reference .....:	Hengdian Group DMEGC Magnetics Co.,Ltd Cell type: DMBD9B166 PERC cell , Mono-Si
	Cell dimensions L x W x T (± %) [mm] .....:	Mono-Si, Cell type: DMBD9B166 PERC cell Cell dimensions L x W: 166±0.25x 166±0.25 (mm) Half cut Cell dimensions L x W:166(±0.25)x83 (±0.25) (mm) Diameter: 223±0.25mm Cell thickness: 180±18 (μm) or 200±20 (μm) Cell area:275.56(cm²) Half cut Cell area:137.78(cm²) Front surface :0.7mm busbar silver, blue anti-reflecting coating(silicon nitride), 9 busbars.
	Cell thickness [μm] .....:	180 ± 18
	Cell area [cm²] .....:	137.78 for half cut cells

A1.4	IDENTIFICATION OF MATERIALS	
	Front cover.....:	Type Coating Tempered glass , 2.8mm thickness.Thickness: 2.8mm. HENAN ANCAI HI-TECH CO.,LTD
	Rear cover .....:	TFB30(plus),0.320mm, PVF 25 μ m/Adhesive10 μ m /PET 275 μ m/FFC:10 μ m, partial discharge voltage 1500VDC, white. Jolywood (Suzhou) Sunwatt Co.,Ltd.
	Encapsulation material front side .....:	Type: F806W (near substrate) / F406PS

		(near front surface) Thickness: 0.45/0.5mm or 0.5/0.5mm or 0.55/0.55mm. Hangzhou First Applied Material Co.,Ltd
	Frame parts ..... :	Type:6063-T5, Anodized aluminum alloy, Thickness=40mm for 72cells PV modules **Jiangyin Haihong New Energy Technology Co., Ltd.**
	Mounting parts ..... :	N/A
	Adhesive for frame ..... :	Type: HT906Z, White Silicone adhesive or black. **SHANGHAI HUITIAN NEW MATERIAL CO LTD**
	Edge sealing ..... :	N/A
	Internal wiring ..... :	N/A
	Cell connector ..... :	Round Wire Ribbon, RWR 0.32, Sn60Pb40. Copper Wt%> Min 99.95%. Suzhou YourBest New-type Materials Co.,Ltd.
	String connector ..... :	Dimension: 0.3x5(mm) or 0.4x5(mm) Coating composition: Sn60Pb40 Base material:Cu,TU1 Cu99.97%-99.99%, Suzhou YourBest New-type Materials Co.,Ltd.
	Soldering material ..... :	N/A
	Fluxing agent ..... :	Type: SF56, no clean halogen free liquid flux. **Singapore Asahi Chemical and Solder Industries Pte Ltd**
	Junction box ..... :	PV-JB12N1, 20A/1500VDC, IP68. Suzhou UKT New Energy Technology CO.,LTD.
	Cable ..... :	H1Z2Z2-K 1x4.0mm^2 , 1500VDC, -40 to +90°C. Wuxi Xinhongye Wire&Cable Co.,Ltd.
	Connector ..... :	PV-CO02-xy, Rated voltage 1500V DC, Rated Current 30A. SUZHOU UKT NEW ENERGY TECHNOLOGY CO.,LTD.
	Bypass diode ..... :	Type: UKTH3045-12, rated current 20A, If=30A, Vrrm=45V, (Tj=200°C).Schottky Max. peak reverse voltage 45V Forward Rectified current 30A Max junction temperature 200°C SUZHOU UKT NEW ENERGY TECHNOLOGY CO.,LTD

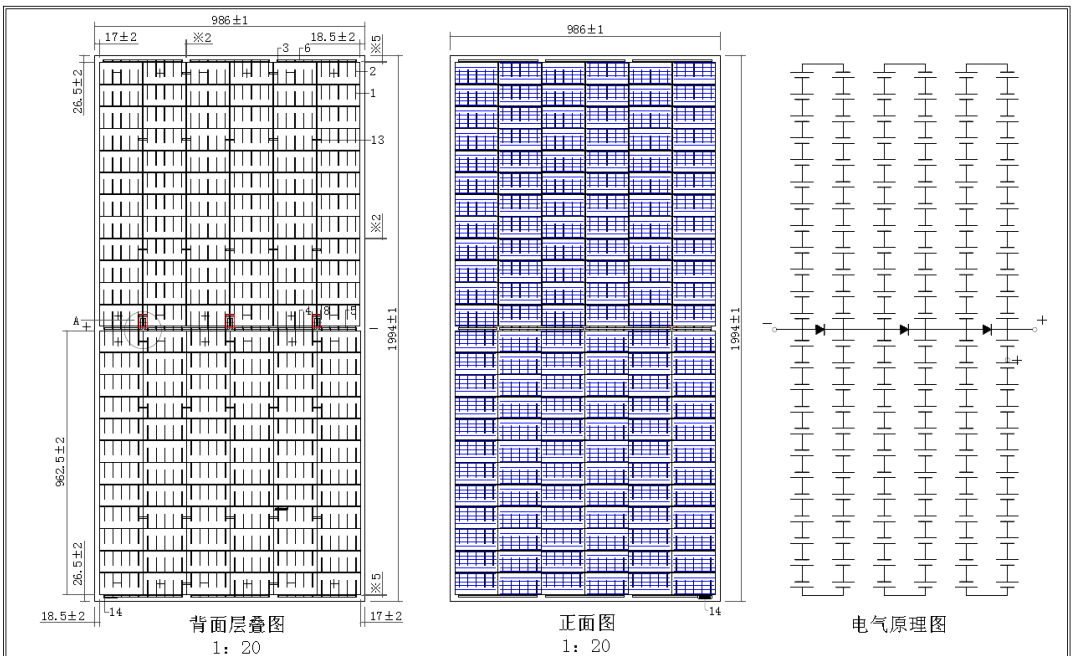
	Potting material.....:	**SHANGHAI HUITIAN NEW MATERIAL CO LTD** Type: 5299W-S, Rated V-0, RTI=105, CTI=0, UL certified, No. E248611
	Adhesive for junction box .....:	**SHANGHAI HUITIAN NEW MATERIAL CO LTD** Type: HT906Z, Rated V-0, RTI=105, CTI=0, UL certified, No. E248611
	Additional material (e. g. fixing tape, insulation tape).....:	Fixing tape: **3M COMPANY** Type: UV-1, Anti-UV PET Tape, 0.06 mm thick. Insulation sheet: Same with Rear cover

A1.5	**MODULE DESIGN - MINIMUM DISTANCES**	
	Between cells.....:	1.7±0.5
	Between cell and accessible surfaces.....:	15 mm
	Between any current carrying part and accessible surfaces .....:	a)15.0 mm b)15.0 mm

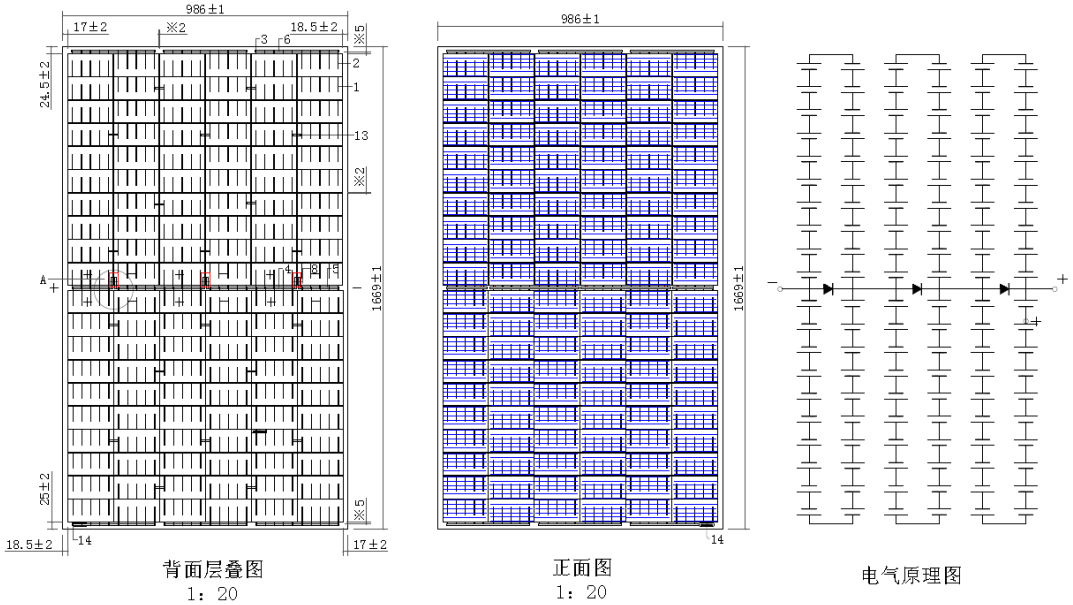
A1.6	**MODULE DESIGN - ELECTRICAL CONFIGURATION**	
	Total number of cells .....:	a)144 b)120
	Serial-parallel connection of cells.....:	All Serial
	Cells per bypass diode .....:	a)48 b)40
	No. of bypass diodes .....:	3

ANNEX 2: CONSTRUCTURE DETAILS

144 cells mdoule



120 cells mdoule



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