



LAB N° 0001



TEST REPORT

Number:
L0001089/A rev.00

Issue date:
2016-11-17

Final address:
Solarteg Srl
Via Ettore Ximenes, 1
20125 Milano - Italy

Testing sample:
(Photovoltaic Modules)
Tegola fotovoltaica GTFV90

Test type:
Visual Inspection
Maximum power determination
Dielectric withstand test
Wet leakage current test
Thermal cycling test (200)
Damp-heat test (1000h)

Test result:
Pass

Reference Standard:
IEC 61215:2005
IEC 61730-2:2012

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Test Report
IEC 61215:2005
Thin-film terrestrial photovoltaic (PV) modules – Design qualification and type approval
IEC 61730-2:2012
Photovoltaic (PV) module safety qualification – Requirements for testing.

Test Report

Tested by Stefano Brambillasca / Jessica Cattaneo
Written by Marco Pirozzo
Approved by Luca Votta - *Head of the Lab*

Firmato da: VOTTA LUCA
Motivo: Approvazione
Luogo: Legnano
Data: 17/11/2016 11:44:33

Issue date 2016-11-17

Test Laboratory

Name **Kiwa Cermet Italia S.p.A**
Address Via Cremona 1, 20025 Legnano (MI)

Final Addressee

Name **Solarteg Srl**
Address Via Ettore Ximenes, 1 - 20125 Milano, Italy
Contact person Luca Morganti

Test details

Reference standard IEC 61215:2005 - IEC 61730-2:2012
Requested test **IEC 61215**
10.1 Visual inspection
10.2 Maximum power determination
10.3 Insulation test → N/A⁴
10.4 Measurement of temperature coefficients → N/A⁴
10.5 Measurement of nominal operating cell temperature (NOCT) → N/A⁴
10.6 Performance at STC and NOCT → N/A⁴ → N/A⁴
10.7 Performance at low irradiance → N/A⁴
10.8 Outdoor exposure test → N/A⁴
10.9 Hot-spot endurance test



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- 10.10 UV preconditioning test → N/A ⁴
- 10.11 Thermal cycling test (50) → N/A ⁴
- 10.11 Thermal cycling test (200)
- 10.12 Humidity freeze test → N/A ⁴
- 10.13 Damp-heat test (1000 h)
- 10.14 Robustness of termination test → N/A ⁴
- 10.15 Wet leakage current test
- 10.16 Mechanical load test → N/A ⁴
- 10.17 Hail test → N/A ⁴
- 10.18 Bypass diode thermal test → N/A ⁴

IEC 61730-2

- 10.2 Accessibility test MST 11 → N/A ⁴
- 10.3 Cut susceptibility test MST 12 → N/A ⁴
- 10.4 Ground continuity test MST 13 → N/A ³
- 10.5 Impulse voltage test MST 14 → N/A ⁴
- 10.6 Dielectric withstand test MST16 → N/A ⁴
- 10.7 Temperature test MST 21 → N/A ⁴
- 10.8 Fire Test → N/A ¹
- 10.9 Reverse current overload Test MST 26 → N/A ⁴
- 10.10 Module breakage test MST 32 → N/A ⁴

COMPONENT TESTS

- 11.2 Conduit bending test MST 33 (S) → N/A ²
- 11.3 Terminal box knockout tests MST 44 (S) → N/A ²

(*) Test is not accredited

N/A

Sample details

Brand

Photovoltaic Modules (PV)



Manufacturer

Solarteg Srl

Model/reference type

Tegola fotovoltaica GTFV90

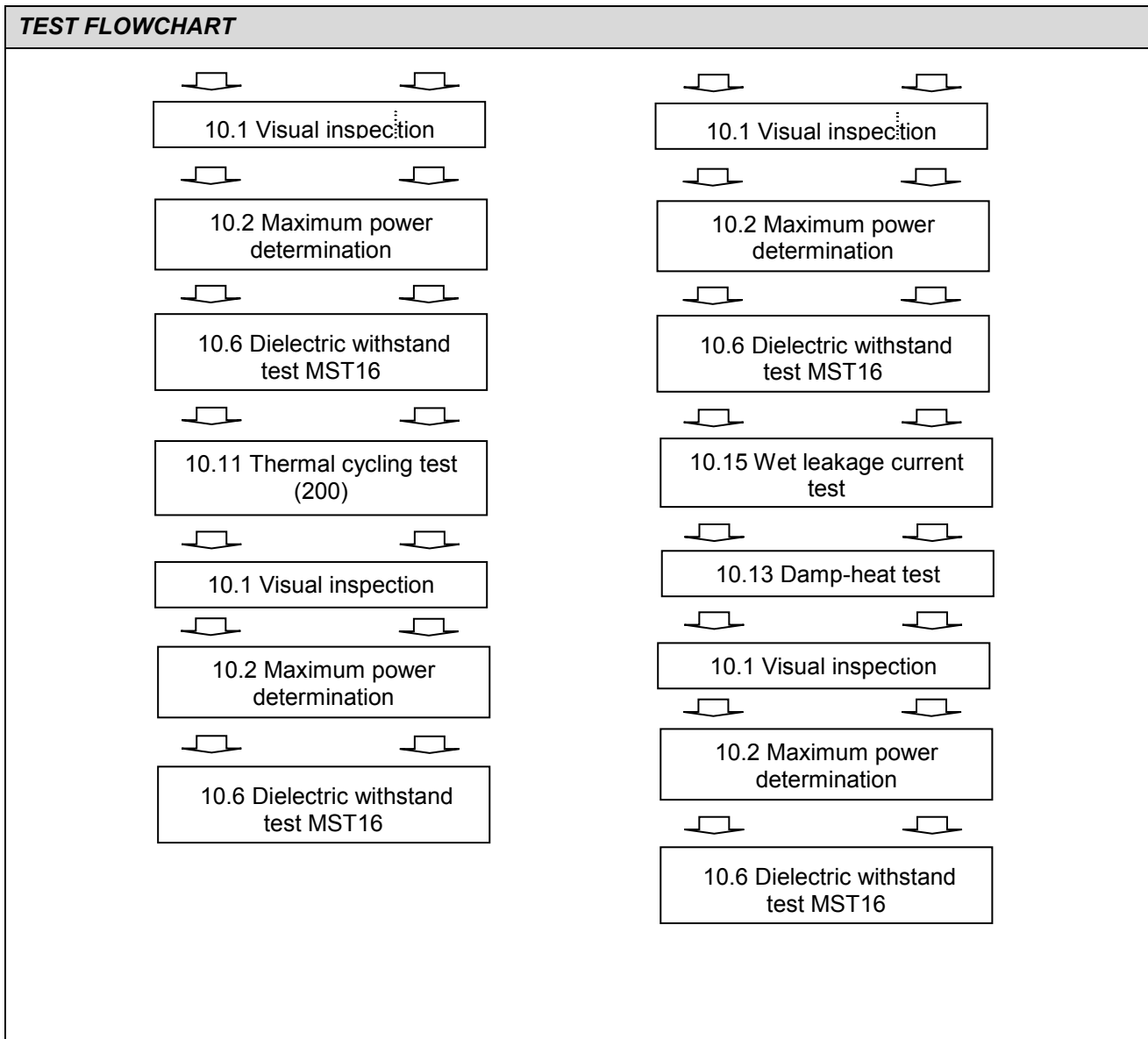
Remarks

- N/A ¹ → European Fire Test is under consideration
- N/A ² → The junction has not conduits or knockouts
- N/A ³ → Polymeric flexible module without frame
- N/A ⁴ → Not required by the client



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TESTS	
<p>List of Performed Test (Test name)</p> <p>IEC 61215 10.1 Visual inspection 10.2 Maximum power determination 10.11 Thermal cycling test (200) 10.13 Damp-heat test (1000h) 10.15 Wet leakage current test</p> <p>IEC 61730-2 10.6 Dielectric withstand test MST16</p>	<p>Test site</p> <p>Kiwa Cermet Italia S.p.A Via Cremona 1, 20025 Legnano (MI)</p>

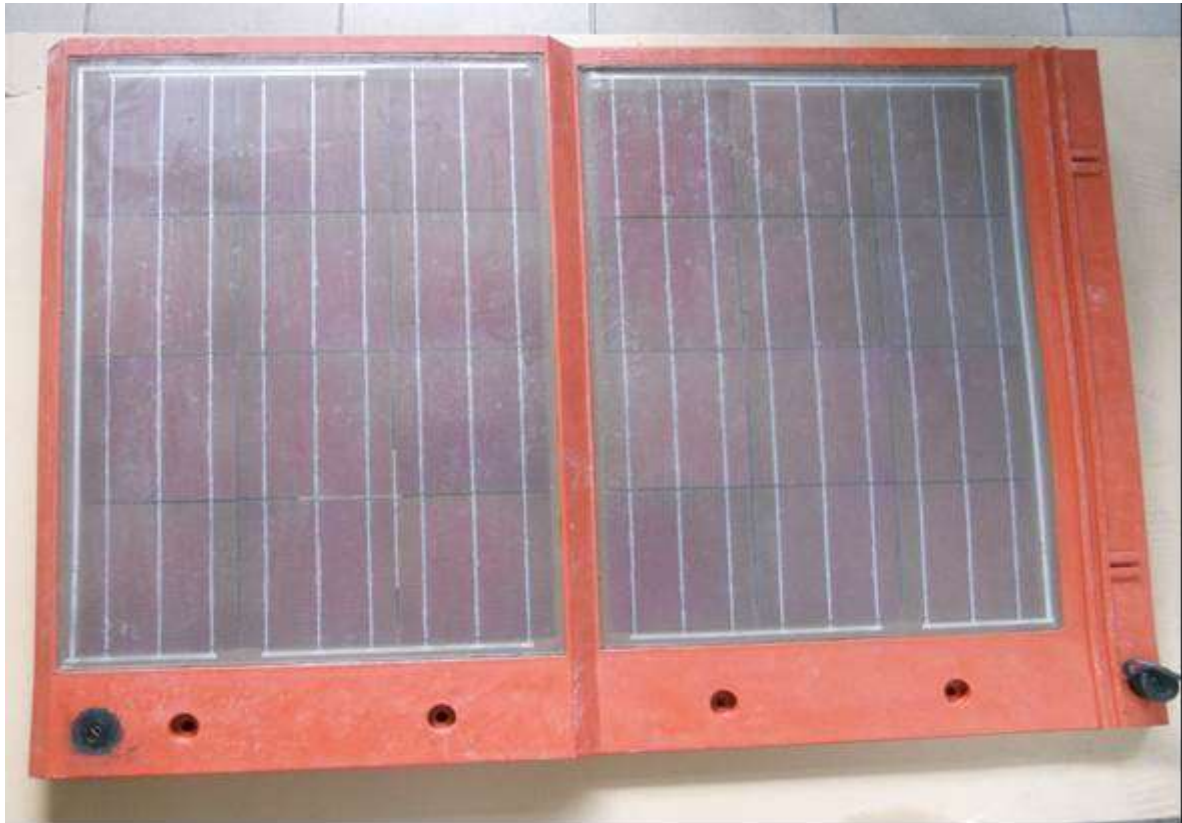




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TECHNICAL SPECIFICATIONS OF THE SAMPLE UNDER TEST	
General features	
Model designation	Tegola fotovoltaica GTFV90
Module total length x width	1195 x 820 mm (placement: only horizontal)
Module weight	15,8 kg
Cell	
Single cell area	24336 mm ² (156 x 156 mm)
Cell technology	Polycrystalline, maple red color
Cell manufacturer and part #	LOFSOLAR - unknown
Cell manufacturing location	TAIWAN
Total number of cells	24
Number of cells in series	24
Number of series strings	1
Diode	
Number of bypass diodes	2
Diode manufacturer and part #	Diode Inc. - SBR12U45LH
Bypass diode rating	12A SBR
Bypass diode max junction temperature	See attached specification
thermal resistance from junction to case	See attached specification
Interconnection	
Cell Interconnect material and supplier model no.	Cu+Sn62Pb36Ag2 -- Schlenk
Cell Interconnect dimensions	5x0,3mm
String Interconnect material and supplier model no.	ONLY 1 string
String Interconnect dimensions	ONLY 1 string
Solder bonding technique and material	Soldering by contact and hot air flow
Fluxing agent	Kester 952S
Superstrate and substrate	
Superstrate type	Tempered Glass
Superstrate manufacturer and part #	ILVAGLASS – Mistlite C, 3,2 mm
Substrate type	Backsheet
Substrate manufacturer and part #	Coveme DyMat CLRPYE
Frame	
Frame type/material	SMC (Sheet Molding Compound) – vedasi allegato
Frame adhesive	SODASEAL 215 LM – vedasi allegato
Encapsulant	
Encapsulant type	EVA
Encapsulant manufacturer and part #	SKC
Junction box	
Junction box manufacturer and part #	No JB is present
Junction box fixing adhesive	No JB is present
Is junction box intended for use with conduit?	No JB is present
Cable type	No cables are present
Connector type	Proprietary patented connector (MI2012A002087)
Electrical specifications	
Maximum system voltage	1000 V
Open-circuit voltage, VOC	15,0
Short-circuit current, ISC	8,4
Maximum power voltage, VMP	11,4
Maximum power current, IMP	7,9
Maximum power, PMP	90
Maximum series fuse rating (A)	12 A

Pictures of samples: front and back side





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Test result Abbreviation:	
Not applicable	N/A
The sample is conformed to the requirements	P (Pass)
The sample is not conformed to the requirements	F (Fail)
Dates	
Receipt date of testing samples	2016/02/01
Test date	From 2016/02/02 to 2016/11/15
Abbreviations	
Pmp – Maximum power	Eff – Cell efficiency
Isc – Short circuit current	VI - 10.1 Visual inspection
Voc – Open circuit voltage	PS - 10.2 Maximum power determination
I _{mp} – Current at maximum power	IN* - 10.6 Dielectric withstand test MST16 (S)
V _{mp} – Voltage at maximum power	WIN - 10.15 Wet leakage current test
FF – Fill Factor	(S) - SAFETY tests according to IEC 61730-2
Remarks	
The test results shown in this test report are exclusively referred to the tested samples. This test report cannot be reproduced in part without a written permission of KIWA S.p.a. "(Cf. annex #)" it refers to other information annexed to the report. "(see annexed table)" it refers to a table annexed to the report.	

TESTING PROCEDURE
<input type="checkbox"/> New module type <ul style="list-style-type: none"> <input type="checkbox"/> Modifications (if yes, please choose the applicable modification according to the IEC 61730-2 Retesting Guideline): <ul style="list-style-type: none"> <input type="checkbox"/> Change in cell technology <input type="checkbox"/> Modification to encapsulation system <input type="checkbox"/> Modification to superstrate <input type="checkbox"/> Increase in module size <input type="checkbox"/> Modification to backsheet / substrate <input type="checkbox"/> Modification to frame and/ or mounting structure <input type="checkbox"/> Modification to junction box/ electrical termination <input type="checkbox"/> Change in cell interconnect materials or technique <input type="checkbox"/> Change in electrical circuit of an identical package <input type="checkbox"/> Higher or lower power output (by 10%) in the identical package including size and using the identical cell process <input type="checkbox"/> Qualification of a frameless module after the design has received certification as a framed module <input type="checkbox"/> Change in bypass diode or number of diodes
<input checked="" type="checkbox"/> Tests ad hoc as required by the client.



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TABLE 1	SAMPLING	
	Sampling is made under the responsibility of the customer	
	The customer has selected 4 samples	
	The tested PV modules/samples has been sent by the customer	


TABLE 2	MARKING	
	Name, monogram or symbol of manufacturer:	
	Type or model number:	Tegola fotovoltaica GTFV90
	Serial number of the tested samples	"S762020224-38806001 S762020139-38806000" "S762020222-38806001 S762020119-38806000" "VE048000157-16 VE048000122-16" "VE048000158-16 VE048000128-16"
	Maximum system voltage:	1000 V
	Production date* and site:	Solarteg Srl Via Ettore Ximenes, 1 20125 Milano - Italy
(*) : Production date is not available		

TABLE 3	TEST PROCEDURES	
IEC 61215		
10.1	Visual inspection	Table 10.1
10.2	Maximum power determination	Table 10.2
10.11	Thermal cycling test (200)	Table 10.11
10.13	Damp-heat test (1000h)	Table 10.13
10.15	Wet leakage current test	Table 10.15
IEC 61730-2		
10.6	Dielectric withstand test MST16	Table 10.6 (S)

TABLE 4	MAJOR VISUAL DEFECTS: For the purposes of design qualification and type approval, the following are considered to be major visual defects.	
	Broken, cracked, or torn external surfaces, including superstrates, substrates, frames and junction boxes.	Table 10.1
	Bent or misaligned external surfaces, including superstrates, substrates, frames and junction boxes to the extent that the installation and/or operation of the module would be impaired.	Table 10.1
	A crack in a cell the propagation of which could remove more than 10 % of that cell's area from the electrical circuit of the module.	Table 10.1
	Bubbles or delaminations forming a continuous path between any part of the electrical circuit and the edge of the module.	Table 10.1
	Loss of mechanical integrity, to the extent that the installation and/or operation of the module would be impaired.	Table 10.1



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TABLE 5		UNCERTAINTY						
Measured parameter	Range	Probability distribution	level of Confidence (%)	k	Degree of freedom	Expanded uncertainty	Unit	
IEC 61215								
Test 10.2 / 10.6 (STC)								
V _{oc}	15.03÷15.11	Normal	95.45	2	∞	± 0.03	V	
I _{sc} measured	8.48÷8.65	Normal	95.45	2	∞	± 0.015	A	
I _{sc} evaluated	8.48÷8.65	Normal	95.45	2	∞	± 0.27	A	
V _{mp}	11.56÷12.21	Normal	95.45	2	∞	± 0.11	V	
I _{mp}	7.78÷8.07	Normal	95.45	2	∞	± 0.27	A	
P _{mp}	92.1÷98.5	Normal	95.45	2	∞	± 3.5	W	
FF	-	Normal	95.45	2	∞	± 2.7	%	
eff	-	Normal	95.45	2	∞	± 0.8	%	
Irradiance	@1000	Normal	95.45	2	∞	± 30	Wm ⁻²	
Temperature	0.0÷50.0	Normal	95.45	2	∞	± 0.6	°C	
Test 10.11								
Temperature (rate of climb)	-40÷+85	Normal	95.45	2	∞	± 2.3	°C/h	
Temperature (rate of descent)	-40÷+85	Normal	95.45	2	∞	± 2.8	°C/h	
Module Temperature	@-40	Normal	95.45	2	∞	± 2.0	°C	
Module Temperature	@+85	Normal	95.45	2	∞	± 1.7	°C	
Current	7.97 ÷ 7.99	Normal	95.45	2	∞	± 0.01	A	
Test 10.13								
Module Temperature	@+85.0	Normal	95.45	2	∞	± 1.1	°C	
Humidity	@85.0	Normal	95.45	2	∞	± 4	%	
Test 10.15								
Electrical Insulation (surface > 0,1m ²)	-	Normal	95.45	2	∞	± 3	% ¹	
Voltage	@1000	Normal	95.45	2	∞	± 6	V	
Humidity	20÷90	Normal	95.45	2	∞	± 5	%RH	
Resistivity	1894÷2342	Normal	95.45	2	∞	100	Ωcm	
Temperature	0.0÷50.0	Normal	95.45	2	∞	0.6	°C	
¹ Percentage on the reading value given in MΩm ²								
IEC 61730-2								
Test 10.6 MST16								
Electrical Insulation (surface > 0,1m ²)	-	Normal	95.45	2	∞	± 4	% ²	
Voltage	@1000	Normal	95.45	2	∞	± 6	V	
Voltage	@6000	Normal	95.45	2	∞	± 41	V	
Humidity	20÷90	Normal	95.45	2	∞	± 5	% RH	
² Percentage on the reading value given in MΩm ²								



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IEC 61215

Test 10.1		TABLE 10.1: Visual Inspection	
Initial Examination			
Sample serial number	Test Date	Nature and position of initial finding - description	P/F
"S762020224-38806001 S762020139-38806000"	2016/02/02	No major visual defects	P
"S762020222-38806001 S762020119-38806000"	2016/02/02	No major visual defects	P
"VE048000157-16 VE048000122-16"	2016/09/13	No major visual defects	P
"VE048000158-16 VE048000128-16"	2016/09/13	No major visual defects	P
Intermediate and final examinations			
IEC 61			
Final Visual Inspection			
"S762020224-38806001 S762020139-38806000"	2016/04/06	No major visual defects	P
"S762020222-38806001 S762020119-38806000"	2016/04/04	No major visual defects	P
"VE048000157-16 VE048000122-16"	2016/11/14	No major visual defects	P
"VE048000158-16 VE048000128-16"	2016/11/14	No major visual defects	P
<i>Remarks: /</i>			



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Test 10.2										
TABLE 10.2: Maximum power determination										
Initial measurements										
Temperature (°C)							25			
Irradiance (W/m ²)							1000			
Light Source Spectrum							AM1.5			
Sample serial number	Test date	Temp (°C)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	Pmp (W)	Eff (%)	FF (%)	
"S762020224-38806001 S762020139-38806000"	2016/02/02	25.0	15.11	11.56	8.59	7.97	92.1	15.8	71.0	
"S762020222-38806001 S762020119-38806000"	2016/02/02	25.0	15.03	11.85	8.48	7.78	92.2	15.8	72.3	
"VE048000157-16 VE048000122-16"	2016/09/13	25.0	15.10	11.56	8.57	7.99	92.4	15.8	71.4	
"VE048000158-16 VE048000128-16"	2016/09/13	25.0	15.04	11.72	8.50	7.88	92.4	15.8	72.3	
Intermediate and final measurements										
Sample serial number	Test date	Temp (°C)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	Pmp (W)	Eff (%)	FF (%)	
IEC 61215										
Final Maximum power determination										
"S762020224-38806001 S762020139-38806000"	2016/04/06	25.0	15.03	11.85	8.48	7.78	92.2	15.8	72.3	
"S762020222-38806001 S762020119-38806000"	2016/04/04	25.0	15.10	11.56	8.57	7.99	92.4	15.8	71.4	
"VE048000157-16 VE048000122-16"	2016/11/14	25.0	15.04	11.72	8.50	7.88	92.4	15.8	72.3	
"VE048000158-16 VE048000128-16"	2016/11/14	25.0	15.10	12.21	8.65	8.07	98.5	16.9	75.4	
Total output power loss respect to the minimum power declared by manufacturer										
"S762020224-38806001 S762020139-38806000"	0.11% ¹									
"S762020222-38806001 S762020119-38806000"	0.00%									
"VE048000157-16 VE048000122-16"	-3.15%									
"VE048000158-16 VE048000128-16"	-0.72%									
Supplementary information:										
¹ Positive values are due to the measurement uncertainty										
Remarks: Tests have been performed indoor.										



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Test 10.11		TABLE 10.11: Thermal cycling test		
200 cycles				
Test date		From 2016/02/05 to 2016/04/04		
Range of temperature (°C)		- 40 ÷ + 85	Δ=125 °C	
Current applied to modules during the test (A)				
Sample serial number "S762020224-38806001 S762020139-38806000"		7.97 A		
Sample serial number "S762020222-38806001 S762020119-38806000"		7.99 A		
Control tests				
Sample serial number	Ground-faults	10.1 Visual Inspection (P/F)	10.2 Maximum power determination <i>Variation after this test (%)</i>	10.6 Dielectric withstand test MST16 (S) - (P/F)
"S762020224-38806001 S762020139-38806000"	NO	P	0.11% ¹	P
"S762020222-38806001 S762020119-38806000"	NO	P	0.00%	P
Supplementary information:				
¹ Positive values are due to the measurement uncertainty				
Remarks: The module passes (P) the test if:				
<ul style="list-style-type: none"> - no interruption of current flow during the test; - no evidence of major visual defects, as defined in table 4 (Table 10.1); - the degradation of maximum output power shall not exceed 5 % of the value measured before the test (Table 10.2); - insulation resistance shall meet the same requirements as for the initial measurements (Table 10.6 S). 				

Test 10.13		TABLE 10.13: Damp-heat test			
Test date		From 2016/09/13 to 2016/11/10			
Average temperature (°C)		85			
Average relative humidity (%)		85			
Test duration (h)		1000			
Control tests					
Sample serial number	Ground-faults	10.1 Visual Inspection (P/F)	10.2 Maximum power determination <i>Variation after this test (%)</i>	10.6 Dielectric withstand test MST16 (S) - (P/F)	10.15 Wet leakage current test (P/F)
"VE048000157-16 VE048000122-16"	NO	P	-3.15%	P	P
"VE048000158-16 VE048000128-16"	NO	P	-0.72%	P	P
Supplementary information: /					
Remarks: The module passes (P) the test if:					
<ul style="list-style-type: none"> - no evidence of major visual defects, as defined in table 4 (Table 10.1); - the degradation of maximum output power shall not exceed 5 % of the value measured before the test (Table 10.2); - the insulation test and the wet leakage current test shall meet the same requirements as for the initial measurements (Table 10.6 (S) and Table 10.15). 					



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Test 10.15		TABLE 10.15: Wet leakage current test ¹							
Admissible resistivity of the water solution ($\Omega \cdot \text{cm}$)		< 3500							
Admissible temperature of the water solution ($^{\circ}\text{C}$)		$22^{\circ}\text{C} \pm 3^{\circ}\text{C}$							
DC Voltage (V)		1000							
Module Area (m^2)		0.968							
Sample serial number	Test date	Resistivity of the water solution ($\Omega \cdot \text{cm}$)	Water solution temperature ($^{\circ}\text{C}$)	Environment		Applied Voltage (V)	$\text{M}\Omega \cdot \text{m}^2$ @ Applied Voltage	P/F	
				Temp. ($^{\circ}\text{C}$)	Humidity (%R.H.)				
Initial values									
"VE048000157-16 VE048000122-16"	2016/09/13	2342	23.7	29.7	39	1031	5653	P	
"VE048000158-16 VE048000128-16"	2016/09/13	2342	23.7	29.7	39	1031	1607	P	
Intermediate and final values									
IEC 61215									
After the 10.13 Damp-heat test (1000h)									
"VE048000157-16 VE048000122-16"	2016/11/14	1894	19.7	19.5	34	1030	6786	P	
"VE048000158-16 VE048000128-16"	2016/11/15	1894	19.7	19.5	34	1030	662	P	
<p><u>Supplementary information:</u> ¹ IEC 61215 requires surface tension of the water to be 0.03 N/m or less. This requirement has been harmonized with IEC 61646 by a CTL Decision Sheet n. 757/2010 within IECCE CB Scheme. Instead of IEC 61215:2005 Ed.2 Clause 10.15.2.a) was used IEC 61646:2008 Ed.2 Clause 10.15.2.a).</p> <p><u>Remarks:</u> the sample pass (P) the test if the measured insulation resistance shall be not less than $400\text{M}\Omega$ (for modules with an area of less than $0,1\text{m}^2$) and the measured insulation resistance times the area of the module shall be not less than $40\text{M}\Omega \cdot \text{m}^2$ (For modules with an area larger than $0,1\text{m}^2$).</p>									



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IEC 61730-2

Test 10.6		TABLE 10.6 (S): Dielectric withstand test MST16					
Maximum voltage system (V, DC)		1000					
Nominal value of the maximum applied voltage (V, DC)		6000					
Module Area (m ²)		0.968					
Initial values							
Sample serial number	Test date	Environmental		Applied Voltage 1 (V)	Applied Voltage 2 (V)	MΩ*m ² @ Applied Voltage 2	P/F
		Temp. (°C)	Humidity (%R.H.)				
"S762020224-38806001 S762020139-38806000"	2016/02/02	25.6	37	6124	1031	17327	P
"S762020222-38806001 S762020119-38806000"	2016/02/02	24.9	38	6124	1031	75601	P
"VE048000157-16 VE048000122-16"	2016/09/13	29.7	37	6097	1031	76666	P
"VE048000158-16 VE048000128-16"	2016/09/13	29.7	37	6098	1031	78698	P
Intermediate and final values							
IEC 61215							
After the 10.11 Thermal cycling test (200)							
"S762020224-38806001 S762020139-38806000"	2016/04/06	25.6	34	6107	1031	111320	P
"S762020222-38806001 S762020119-38806000"	2016/04/06	25.6	34	6108	1031	98736	P
After the 10.13 Damp-heat test (1000h)							
"VE048000157-16 VE048000122-16"	2016/11/14	21.2	31	6125	1030	20231	P
"VE048000158-16 VE048000128-16"	2016/11/14	21.2	31	6125	1030	92154	P

----- End of the Test Report n. L0001089/A rev.0 -----