Prüfbericht-Nr.: *Test Report No.*:	**21223851.001**	**Auftrags-Nr.:** *Order No.*:	21226121	Seite 1 von 9 *Page 1 of 9*
Kunden-Referenz-Nr.: *Client Reference No.*:	204889	**Auftragsdatum:** *Order date*:	17 July 2014	
Auftraggeber: *Client*:	SolarPark Korea Co., Ltd. 292,300 Wanju-Sandan 6 ro, Bongdong-wup, 565-902 WANJU-GUN, Jeollabuk-do, South Korea			
Prüfgegenstand: *Test item*:	Photovoltaic (PV) modules			
Bezeichnung / Typ-Nr.: *Identification / Type No.*:	SPP xxx smart (xxx = 210 to 260, in steps of 5) SPP xxx SR (xxx = 230 to 270, in steps of 5)			
Auftrags-Inhalt: *Order content*:	Salt mist corrosion testing of photovoltaic (PV) modules			
Prüfgrundlage: *Test specification*:	IEC 61701:2011, EN 61701:2012 severity 6 Salt mist corrosion testing of photovoltaic (PV) modules			

Wareneingangsdatum: *Date of receipt*:	31 July 2014
Prüfmuster-Nr.: *Test sample No.*:	HV2014002755 - HV2014002760
Prüfzeitraum: *Testing period*:	01 August 2014 – xx October 2014
Ort der Prüfung: *Place of testing*:	Cologne
Prüflaboratorium: *Testing laboratory*:	Solar Energy Assessment Center
Prüfergebnis*: *Test result**:	Pass

Detaillierte Fotodokumentation
siehe Anlage zu diesem Bericht

Detailed photo documentation see appendix to this report

geprüft von / *tested by*:			**kontrolliert von /** *reviewed by*:		
15.10.2014	S. Menzler, project engineer		15.10.2014	L. Jakisch, business field manager	
Datum *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*

Sonstiges / *Other*:

Zustand des Prüfgegenstandes bei Anlieferung: *Condition of the test item at delivery*:	Prüfmuster vollständig und unbeschädigt *Test item complete and undamaged*

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
Legend:	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.
This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.

V04

Liste der verwendeten Prüfmittel
List of used test equipment

Prüfmittel *Test equipment*	**Prüfmittel-Nr. / ID-Nr.** *Equipment No. / ID-No.*	**Nächste Kalibrierung** *Next calibration*
Software	**Version No.**	**--**
KaliBritt	1.0.0.161	
TUV Rheinland SUSI	1.3.0.0	
PSLoad	2.6.11.3	
S!MPATI.exe, 22623	4	
Weather-DAQ_V_1.2.tst	1.2	
ODTS_7.tst	2.4.2	
ShowSpectrum	2.3	
TUV Rheinland LightSoaking	1.2.0.2	
Temptc_dioden_7	7	
ISO_WL	1.0.2.1	
Corro Master	1.0	

Produktbeschreibung
Product description

1	**Produktdetails** *Product details* SPP xxx smart (xxx = 210 to 260, in steps of 5) SPP xxx SR (xxx = 230 to 270, in steps of 5)
2	**Verwendete Materialien** *Used materials* see Constructional Data Form (CDF) in the annex of this test report
3	**Adresse(n) der Fertigungsstätte(n)** *Address(es) of the manufacturing site(s)* SolarPark Korea Co., Ltd. 292,300 Wanju-Sandan 6 ro, Bongdong-wup, 565-902 WANJU-GUN, Jeollabuk-do, South Korea
4	**Zusammenfassung der Prüfergebnisse** *Summary of test results* According to the inquiry the resistance to salt mist of photovoltaic (PV) modules should be assessed in accordance with IEC 61701:2011. For the qualification of the modules to this test initial and final control measurements were performed before and after the salt mist corrosion testing. The measurements included relative power measurements, insulation testing and visual inspections. The maximum permissible power degradation of 5 % must not be exceeded. Furthermore the minimum requirements for the insulation test and wet leakage test as defined in IEC 61215:2005-10.3 and -10.15 have to be met. No major visual defects as defined in IEC 61215:2005 shall occur. The tests of the requirements of IEC 61701:2011 were all fulfilled according to its regulations of the pass criteria. The above listed module types have passed all tests of the IEC 61215:2005 standard before salt mist resistance test was applied (see history of certification). Test failures: - This test report includes a **history of certification** in appendix “Zusatzdokumentation/Additional Documentation” and appendix “Foto-Dokumentation/Photo Documentation”.

Absatz	**IEC 61701:2011, EN 61701:2012 severity 6**	Messergebnisse - Bemerkungen	Bewertung
Clause	Anforderungen - Prüfungen / *Requirements - Tests*	*Measuring results - Remarks*	*Evaluation*

-	**List of test samples**		
Sample No.	Sample S/N	Remarks / constructional characteristics (e.g. cell, backsheet, frame type)	—
HV2014002755	917211428000683	A-Reference	
HV2014002756	917211428000690	Salt mist corrosion test	
HV2014002757	917211428000706	Salt mist corrosion test	
HV2014002758	911031428000188	A-Reference	
HV2014002759	911031428000171	Salt mist corrosion test	
HV2014002760	911031428000157	Salt mist corrosion test	

6.2 c)	**Visual inspection (Initial)**	
Sample No.	Nature and position of initial findings	—
HV2014002755	No visual defects	P
HV2014002756	No visual defects	P
HV2014002757	No visual defects	P
HV2014002758	No visual defects	P
HV2014002759	No visual defects	P
HV2014002760	No visual defects	P
Supplementary information: -		

Absatz	**IEC 61701:2011, EN 61701:2012 severity 6**	Messergebnisse - Bemerkungen	Bewertung
Clause	Anforderungen - Prüfungen / *Requirements - Tests*	*Measuring results - Remarks*	*Evaluation*

6.2 a) Maximum power determination (Initial)

Module temperature [°C]			Corrected to 25				—
Irradiance [W/m²]			1000				
Sample No.	P_{max} [W]	V_{mpp} [V]	I_{mpp} [A]	V_{oc} [V]	I_{sc} [A]	FF [%]	
HV2014002755	255.8	30.37	8.42	37.68	8.92	76.1	P
HV2014002756	255.4	30.37	8.41	37.67	8.86	76.5	P
HV2014002757	255.5	30.34	8.42	37.65	8.90	76.3	P
HV2014002758	251.6	30.15	8.35	37.61	8.79	76.1	P
HV2014002759	252.2	30.55	8.26	37.60	8.80	76.3	P
HV2014002760	252.0	30.60	8.24	37.57	8.82	76.1	P

Supplementary information: -

6.2 e) Insulation test (Initial)

Maximum system voltage [V_{DC}]				1000		—
High voltage applied [V_{DC}]				3000		
Insulation resistance measured at [V_{DC}]				1000		
Sample No.	Measured	Area	Result*	Dielectric breakdown		
	[GΩ]	[m²]	[GΩ × m²]	Yes (description)	No	
HV2014002755	13.33	1.64	21.86		X	P
HV2014002756	13.33	1.64	21.86		X	P
HV2014002757	2.03	1.64	3.33		X	P
HV2014002758	13.33	1.64	21.86		X	P
HV2014002759	13.33	1.64	21.86		X	P
HV2014002760	13.33	1.64	21.86		X	P

* Minimum requirement acc. to the standard is 0.04 GΩ × m²]

Supplementary information: -

Absatz	**IEC 61701:2011, EN 61701:2012 severity 6**	Messergebnisse - Bemerkungen	Bewertung
Clause	Anforderungen - Prüfungen / *Requirements - Tests*	*Measuring results - Remarks*	*Evaluation*

6.2 b) Wet leakage current test (Initial)

Insulation resistance measured at [V_{DC}]		1000		—
Solution resistivity [Ω cm]		< 3,500		P
Solution temperature [°C]		22 ± 3		P
Sample No.	Measured [MΩ]	Area [m²]	Result* [MΩ × m²]	—
HV2014002755	1362.0	1.64	2233.7	P
HV2014002756	1440.0	1.64	2361.6	P
HV2014002757	1362.0	1.64	2233.7	P
HV2014002758	337.0	1.64	552.7	P
HV2014002759	353.0	1.64	578.9	P
HV2014002760	338.0	1.64	554.3	P
* Minimum requirement acc. to the standard is 40 MΩ × m²[22].				
Supplementary information: -				

6.2 d) Ground continuity test (Initial)

Maximum over-current protection rating [A]		15		—
Current applied [A]		37.5		
Location of designated grounding point		E		
Location of second contacting point		A		
Sample No.	Position in test sequence	Voltage [mV]	Resistance [mΩ]	
HV2014002755	A-Reference	18.0	0.5	P
HV2014002756	Salt mist corrosion test	15.0	0.4	P
HV2014002757	Salt mist corrosion test	16.0	0.4	P
HV2014002758	A-Reference	16.0	0.4	P
HV2014002759	Salt mist corrosion test	16.0	0.4	P
HV2014002760	Salt mist corrosion test	15.0	0.4	P
Supplementary information: -				

Absatz	**IEC 61701:2011, EN 61701:2012 severity 6**	Messergebnisse - Bemerkungen	Bewertung
Clause	Anforderungen - Prüfungen / *Requirements - Tests*	*Measuring results - Remarks*	*Evaluation*

7	**Salt mist corrosion test**	
Sample No. 1	HV2014002756	—
Sample No. 2	HV2014002757	
Sample No. 3	HV2014002759	
Sample No. 4	HV2014002760	
NaCl - concentration [%]	5	
Temperature [°C]	35	
Rel. humidity [%]	approx. 93	
Course of cycle (7 days)	- 2 h / 35°C / reaction of NaCl / ca. 93 % relative humidity (condensation of test items) - 22 h / 40°C / 93 % relative humidity (phase of drying) - after four periods of spraying and storage one storage period under standard atmosphere at 23°C and 45 % - 55 % relative humidity follows for 3 days	
Duration	8 cycles = 56 days	
Supplementary information: -		

9.2 c)	**Visual inspection after salt mist corrosion test**	
Sample No.	Nature and position of findings	—
HV2014002756	No visual defects	P
HV2014002757	No visual defects	P
HV2014002759	No visual defects	P
HV2014002760	No visual defects	P
Supplementary information: -		

Absatz	**IEC 61701:2011, EN 61701:2012 severity 6**	Messergebnisse - Bemerkungen	Bewertung
Clause	Anforderungen - Prüfungen / *Requirements - Tests*	*Measuring results - Remarks*	*Evaluation*

9.2 a) Maximum power determination after salt mist corrosion test

Module temperature [°C]			Corrected to 25					—
Irradiance [W/m²]			1000					
Sample No.	P_{max} [W]	V_{mpp} [V]	I_{mpp} [A]	V_{oc} [V]	I_{sc} [A]	FF [%]	Degradation [%]	
HV2014002756	251.6	30.23	8.32	37.62	8.82	75.8	-1.5	P
HV2014002757	250.9	30.19	8.31	37.58	8.80	75.9	-1.8	P
HV2014002759	248.3	30.02	8.27	37.53	8.73	75.8	-1.6	P
HV2014002760	248.8	30.03	8.28	37.51	8.78	75.6	-1.3	P
Supplementary information: Maximum allowable P_{max} degradation after this test is 5 %.								

9.2 e) Insulation test after salt mist corrosion test

Test voltage applied [V]				1000		—
Sample No.	Measured	Area	Result*	Dielectric breakdown		
	[GΩ]	[m²]	[GΩ × m²]	Yes (description)	No	
HV2014002756	1.20	1.64	1.97		X	P
HV2014002757	0.94	1.64	1.54		X	P
HV2014002759	13.33	1.64	21.86		X	P
HV2014002760	13.33	1.64	21.86		X	P
* Minimum requirement acc. to the standard is 0.04 GΩ × m²]						
Supplementary information: -						

Absatz	**IEC 61701:2011, EN 61701:2012 severity 6**	Messergebnisse - Bemerkungen	Bewertung
Clause	Anforderungen - Prüfungen / *Requirements - Tests*	*Measuring results - Remarks*	*Evaluation*

9.2 b) Wet leakage current test after salt mist corrosion test

Insulation resistance measured at [V_{DC}]		1000		—
Solution resistivity [Ω cm]		< 3,500		P
Solution temperature [°C]		22 ± 3		P
Sample No.	Measured [MΩ]	Area [m²]	Result* [MΩ × m²]	—
HV2014002756	745.0	1.64	1221.8	P
HV2014002757	729.0	1.64	1195.6	P
HV2014002759	298.0	1.64	488.7	P
HV2014002760	322.0	1.64	528.1	P
* Minimum requirement acc. to the standard is 40 MΩ × m²]				
Supplementary information: -				

9.2 d) Ground continuity test after salt mist corrosion test

Maximum over-current protection rating [A]		15	—
Current applied [A]		37.5	
Location of designated grounding point		E	
Location of second contacting point		A	
Sample No.	Voltage [mV]	Resistance [mΩ]	
HV2014002756	9.0	0.2	P
HV2014002757	9.0	0.2	P
HV2014002759	14.0	0.4	P
HV2014002760	9.0	0.2	P
Supplementary information: -			

ANLAGE zum Prüfbericht-Nr.: 21223851.001
APPENDIX to Test Report No.:

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

Statement of the estimated uncertainty of the test verdicts

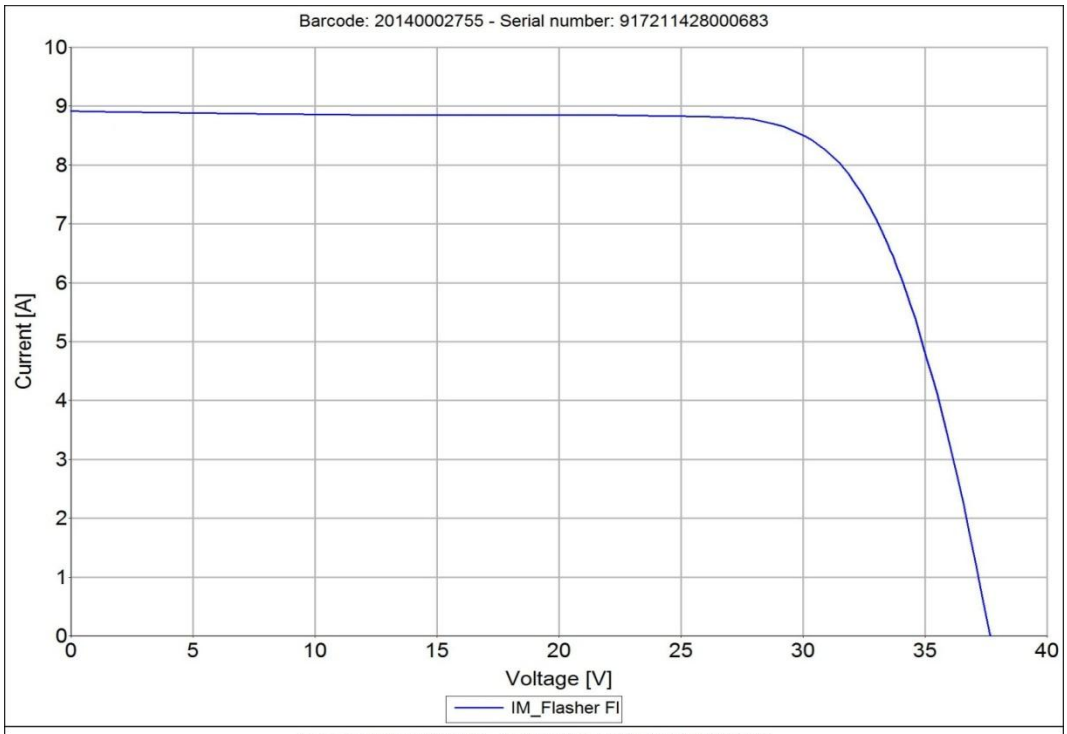
- Electrical performance rating is outside the scope of IEC 61215:2005 qualification testing. The verdicts of performance rating are only related to the test samples that were subjected to the tests. They cannot be generalised to the modules from the series production.
- The calibration to STC was performed with a class AAA solar simulator. The extended measurement uncertainty is:
  - 2σ (P_{mpp}) ≤ ± 2.5 %
  - 2σ (I_{SC}) ≤ ± 2.3 %
  - 2σ (V_{OC}) ≤ ± 1.0 %
- Relative measurements were performed with a flash type solar simulator.
- The accuracy of measurement reproduction with the solar simulator is less than ±1%.

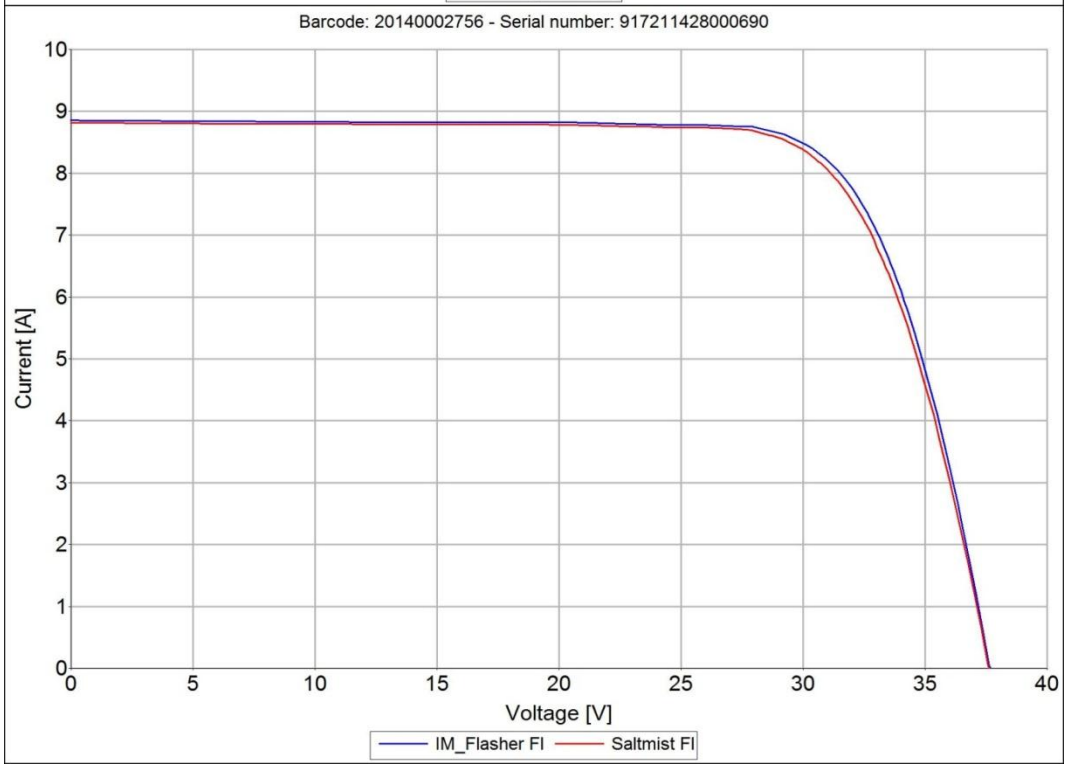
History of certification

Subject	Module type	Project no.	Certificate no.	Date of issue
Basic qualification	See certificate	-	40031207	22 October 2010

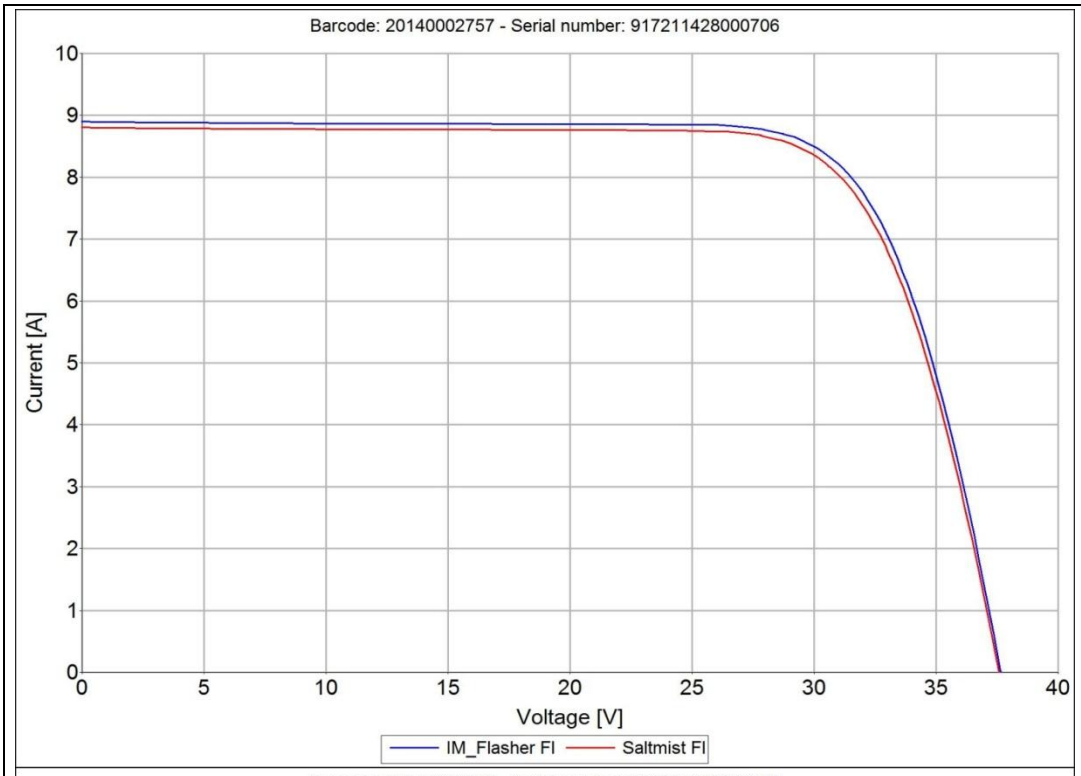
ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

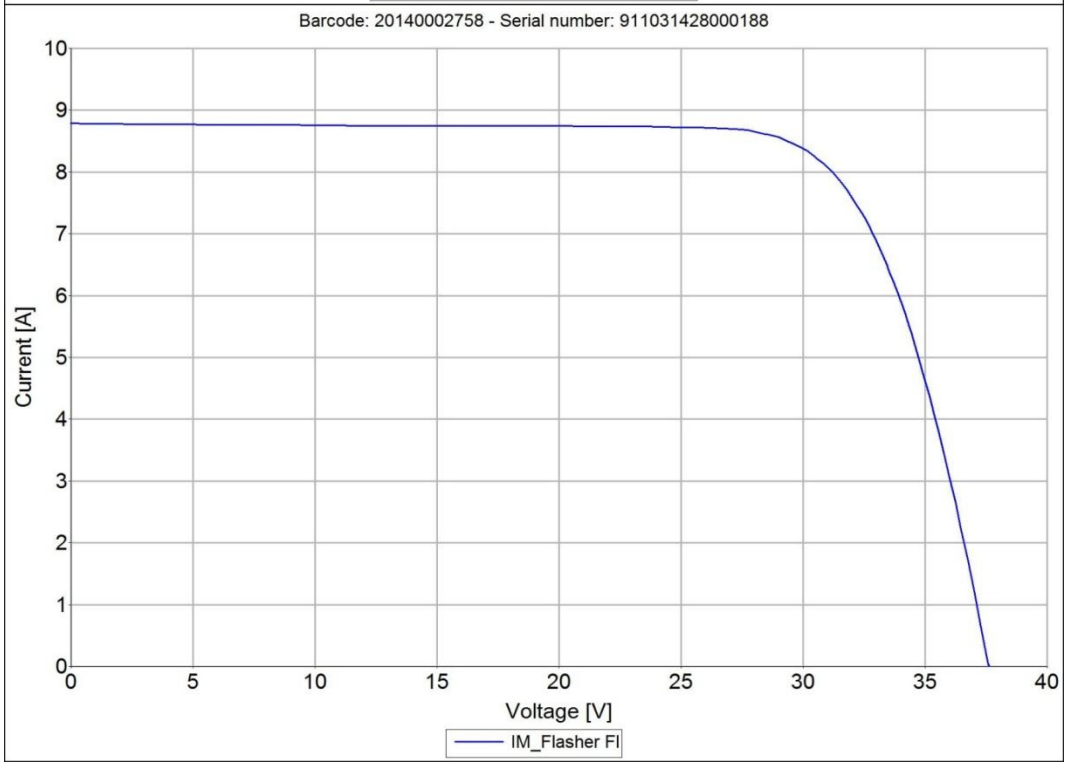
Measurement reports



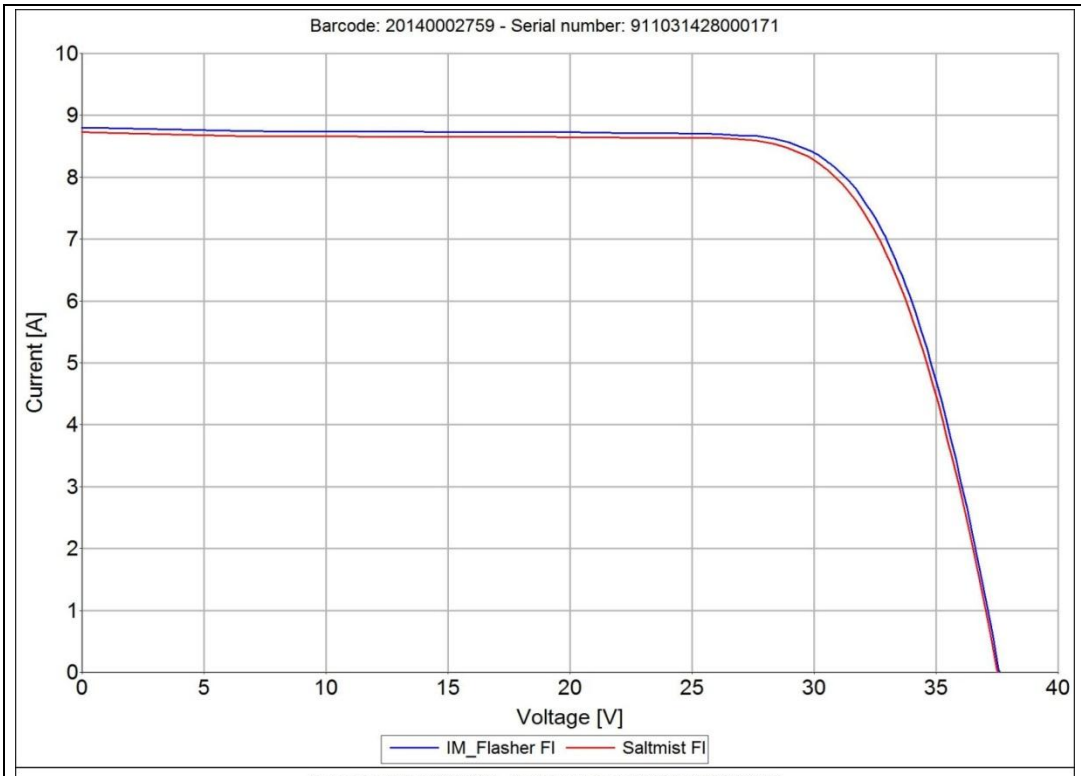


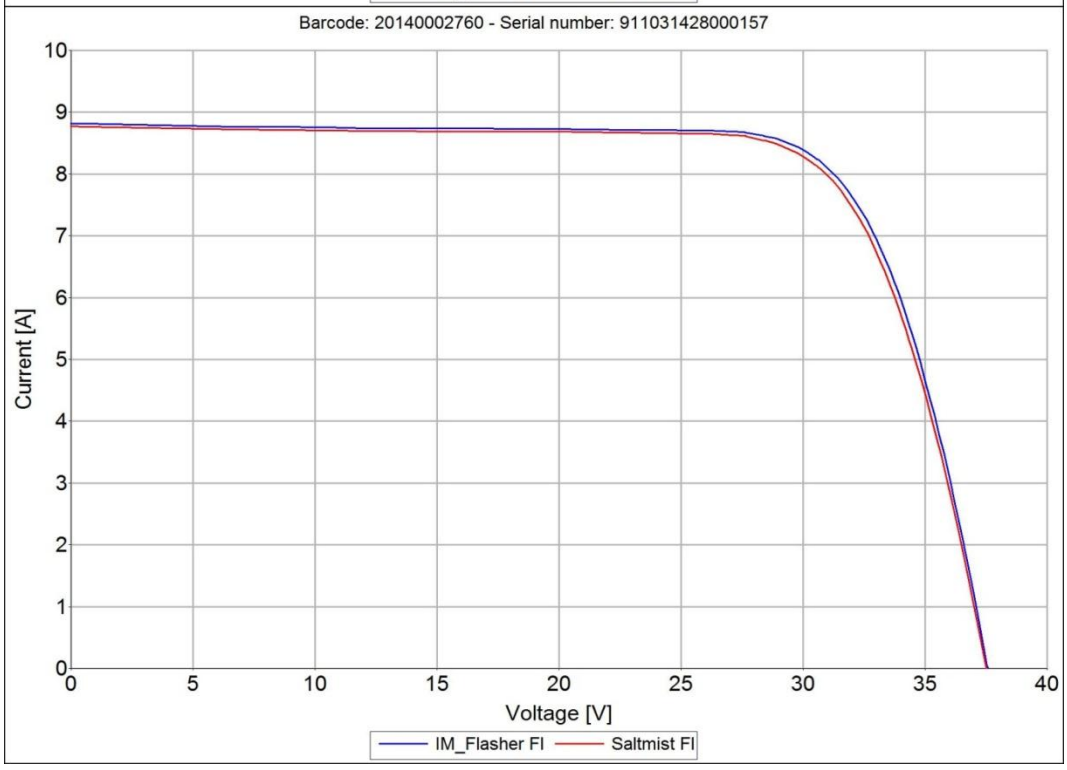
ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION





ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION





ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

Electroluminescence images

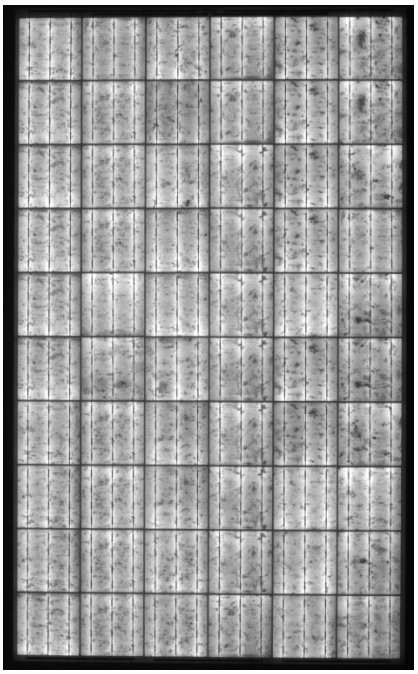


Fig. 1: HV2014002756

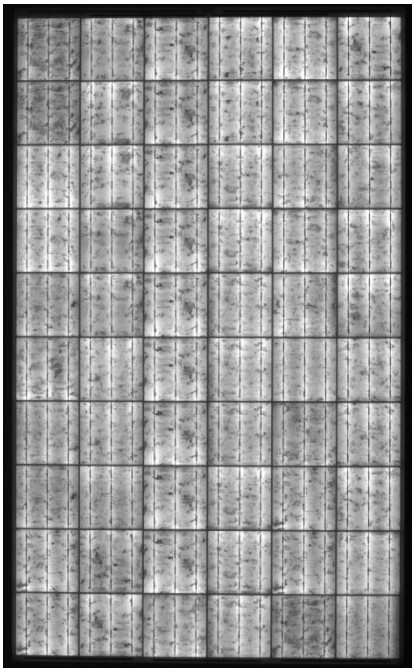


Fig. 2: HV2014002757

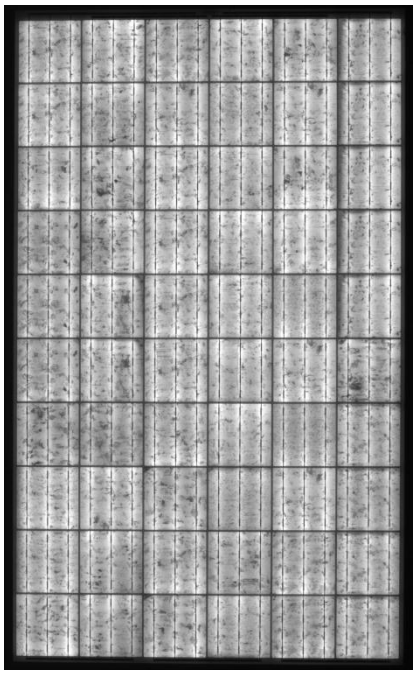


Fig. 3: HV2014002759

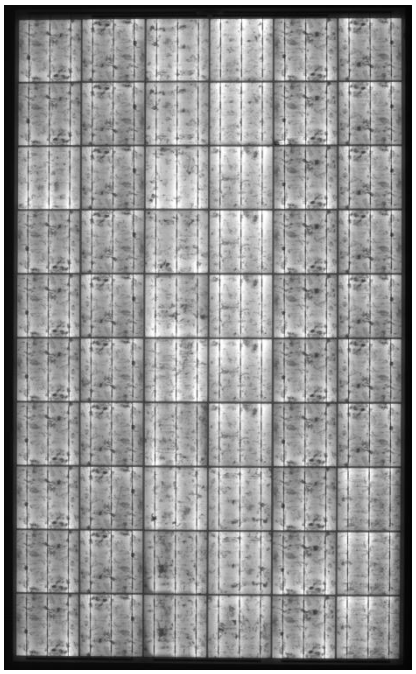


Fig. 4: HV2014002760

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

Electroluminescence images after ammonia corrosion test

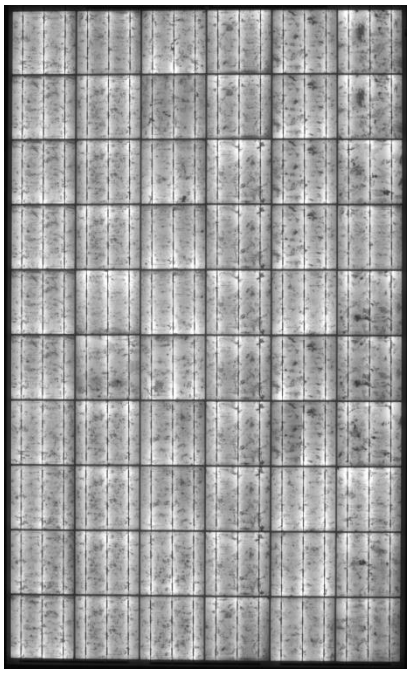


Fig. 5: HV2014002756

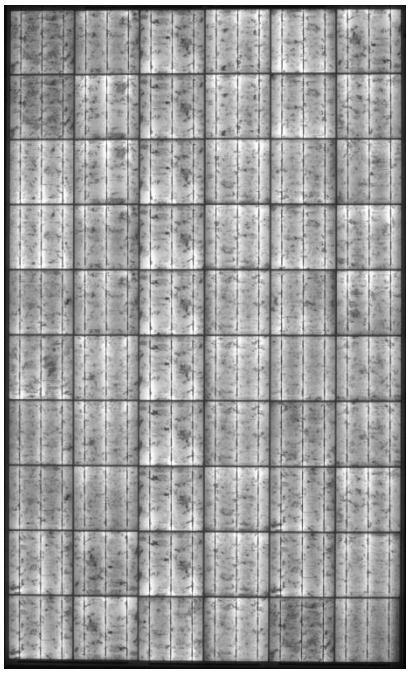


Fig. 6: HV2014002757

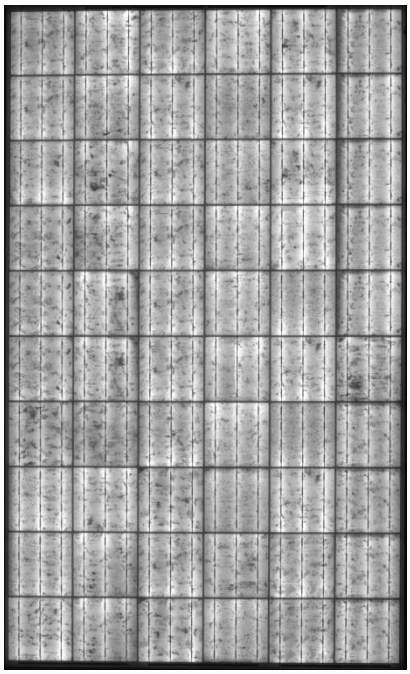


Fig. 7: HV2014002759

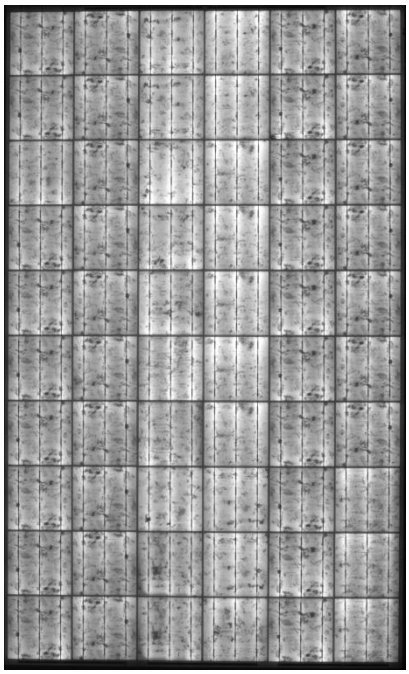


Fig. 8: HV2014002760

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

Photos of modules

Fig. 9: front view of test sample

Fig. 10: rear view of test sample

Fig. 11: detail view of junction box

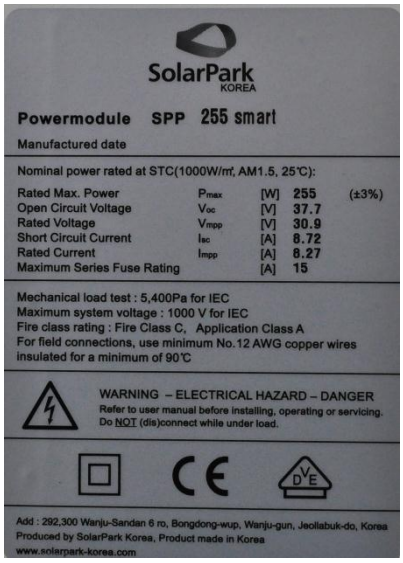


Fig. 12: detail view of type label

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

Fig. 13: detail view of connectors

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

Photos of modules after ammonia corrosion test

Fig. 14: front view of test sample

Fig. 15: rear view of test sample

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

Constructional Data Form for Photovoltaic Modules

	SPP xxx smart	
Object	Manufacturer / trademark	Type / model
Front cover	Xinyi PV products (Anhui) Holdings Ltd.	Tempered Low Iron Patterned glass / 3.2 mm thickness with AR Coating (optional) on the air side
Rear cover	SKC	BF3GE
Encapsulation material	SKC	EF 2N
Frame parts	Shin Yang Metal Industrial Co., Ltd.	Solar Frame
Adhesive (frame)	BEIZING TONSAN ADHESIVE Co., LTD.	1527
Junction box	Jiangsu Tonglin Electric Co. Ltd.	TL-BOX026
Potting material (junction box)	Otto Chemie	S650
Bypass diode	Panjit Semi Conductor	SB1540LS
Cable	Suzhou Baohing Electric Wire&Cable Co., Ltd.	PV1-F, 1x4mm², PV Cable
Connector	Jiangsu Tonglin Electric Co. Ltd.	TL-CABLE01 Connector
Adhesive (junction box)	BEIZING TONSAN ADHESIVE Co., LTD.	1527

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

	SPP xxx SR	
Object	Manufacturer / trademark	Type / model
Front cover	Xinyi PV products (Anhui) Holdings Ltd.	Tempered Low Iron Patterned glass / 3.2 mm thickness with AR Coating (optional) on the air side
Rear cover	COVEME	PYE SPV
Encapsulation material	HANGZHOU FIRST PV Material Co., LTD	F806
Frame parts	Shin Yang Metal Industrial Co., Ltd.	Solar Frame
Adhesive (frame)	BEIZING TONSAN ADHESIVE Co., LTD.	1527
Junction box	Jiangsu Tonglin Electric Co. Ltd.	TL-BOX026
Potting material (junction box)	-	-
Bypass diode	Panjit Semi Conductor	SB1540LS
Cable	Suzhou Baohing Electric Wire&Cable Co., Ltd.	PV1-F, 1x4mm², PV Cable
Connector	Jiangsu Tonglin Electric Co. Ltd.	TL-CABLE01 Connector
Adhesive (junction box)	BEIZING TONSAN ADHESIVE Co., LTD.	1527