DAP-PL-4314.00

Test-Report

PI-Report-Number: 201213150a_V1
Module SN: ET-P660E090912012473

2012/09/24

Client:

ET Solar Group
Attn. Mr. Pavel Zheng
27F, Galaxy International Plaza
7 Shanxi Road, Nanjing 210009, China
Nanjing, China

Consultants:

PI Photovoltaik-Institut Berlin AG
Wrangelstraße 100
10997 Berlin, Germany

Report-Number: 201213150a_V1
Module SN: ET-P660E090912012473

Client:	ET Solar Group Attn. Mr. Pavel Zheng 27F, Galaxy International Plaza 7 Shanxi Road, Nanjing 210009, China Nanjing, China
Address of laboratory:	PI Photovoltaik-Institut Berlin AG Wrangelstraße 100 Gebäude 43 - Labor 10997 Berlin, Germany
Proposal number:	20125260
Order number:	201213150
Order date:	2012/09/17
Delivery date:	2012/09/17
Test start:	2012/09/17
Test end:	2012/09/24
Responsible project engineer:	Dipl.-Ing. (FH) Carsten Kühler

i.A.

Person in charge
Dipl.-Ing. (FH) Carsten Kühler

i.A.

Checked by André Prorok, M.Sc.

The test results in this report relate just to the test objects. The sampling was done by the client.

Table of Contents

1 General Information about the Test Objects and Label Pictures

Serial number	Producer	Type	Cell material	Number of cells	Module area [m²]
ET-P660E090912012473	ET Solar	ET-P660240	multi-c-Si	60	1.94

Figure 1: Label and Serial number picture of module type ET-P660240.

Figure 2: Picture of the original delivery packaging.

2 Test description

2.1 Polarisation analysis

To analyse the potential induced degradation problem the following test sequence was implemented:

- I-V measurement in accordance with IEC60904-1 before PID test.
- Initial electroluminescence analysis according to the PI standard.
- Grounding of the module as described in the manual (via frame).
- Temperature of 85°C.
- Relative humidity of 85%.
- The voltage applied between the cells and the frame corresponds to the maximum system voltage given by the label.
- Period of testing 96 hours.
- Final I-V measurement in accordance with IEC 60904-1 within four hours after finishing the test.
- Final electroluminescence analysis.

For assessing the tested objects the modules will be classified in three PID quality categories A, B and C. A classifies modules with power drops below 5%, B between 5 and 30% and C all modules with a higher power deviation above.

2.2 I-V Curve Determination at Standard Test Conditions (STC)

General information about the measuring system:

The I-V curve has been determined at Standard Test Conditions (STC) in accordance with IEC 60904-3. Thereby a solar simulator Class A type Pasan SS3b has been used. The calibration of the solar simulator has been performed with a stabilized cell with WPVS (World Photovoltaic Standard) cell format. The calibration of the cell is traceable to PTB and calibrated by ISE Freiburg on the 2012/04/23, calibration sign 100446PIB-DKD-K-47101.
The spectrum of the simulator is always verified with an internal spectrometer calibrated by PTB.
The measuring system error referring to the maximum power is < ±3%. The mismatch correction value for multi-c-Si and the solar simulator mentioned above is 1.007.
Corrected with STC-Tool-Version: 2.0.6

Temperature coefficients (PI standard values):

T_{coeff} (V_{oc}): -0.326 %/K

T_{coeff} (I_{sc}): 0.052 %/K

Statement of the estimated uncertainty of the 'Maximum Power Determination' (IEC 10.2) test results:
Updated: 2011/03/23

IEC Test	Measurand	Measurement uncertainty	Repeatability
10.2	P_{MPP}	2.9%	0.33%
	V_{OC}	1.3%	0.12%
	I_{SC}	2.2%	0.13%

3 Test Results

3.1.1 STC Result Compilation

Serial number	Status	P_{MPP} [W]	V_{MPP} [V]	I_{MPP} [A]	V_{OC} [V]	I_{SC} [A]	FF [%]	Power deviation to label* / initial [%]
ET-P660E090912012473	initial	247.1	30.34	8.146	37.62	8.709	75.42	3.0*
	after PID	246.3	30.23	8.149	37.48	8.738	75.22	-0.3

3.1.2 Detailed Results of I-V Curve Determination at STC and Electroluminescence analyses

3.1.2.1 Modul SN:ET-P660E090912012473

I-V Curve Determination at STC initial – SN: ET-P660E090912012473

The measurements are accomplished at an irradiance of 1000 W/m² and a sweep time of 8 ms (1-flash). The results are then corrected to 25 °C.

	Label data		
Producer:	ET Solar		
Serial number:	ET-P660E090912012473		
Module type:	ET-P660240	**Test results**	**Deviation to label [%]**
P_{MPP} [W]:	240	247.1	3.0
V_{MPP} [V]:	29.96	30.34	1.3
I_{MPP} [A]:	8.02	8.146	1.6
V_{OC} [V]:	37.17	37.62	1.2
I_{SC} [A]:	8.58	8.709	1.5
FF [%]:	75.34 (PI calculated)	75.42	0.1

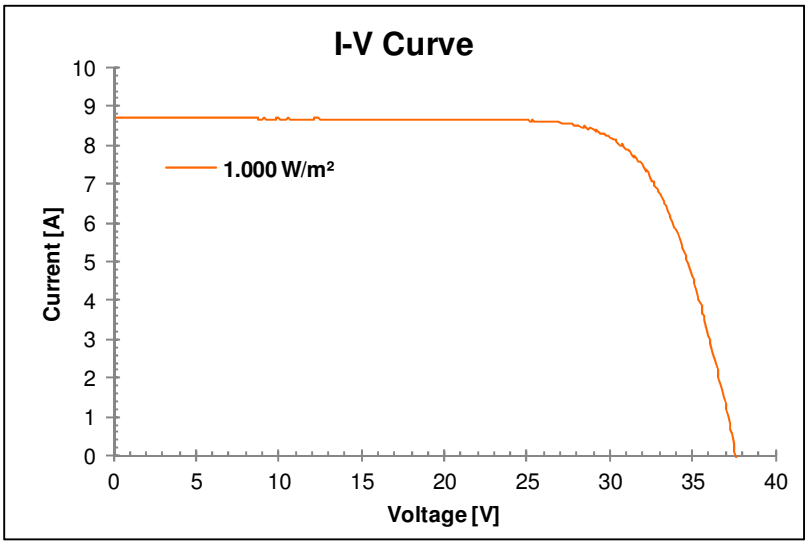

Figure 3: Temperature corrected I-V curve of module ET-P660E090912012473.

I-V Curve Determination at STC after PID – SN: ET-P660E090912012473

The measurements are accomplished at an irradiance of 1000 W/m² and a sweep time of 8 ms (1-flash). The results are then corrected to 25 °C.

	Initial data		
Producer:	ET Solar		
Serial number:	ET-P660E090912012473		
Module type:	ET-P660240WW	**Test results**	**Deviation to inital [%]**
P_{MPP} [W]:	247.1	246.3	-0.3
V_{MPP} [V]:	30.34	30.23	-0.4
I_{MPP} [A]:	8.146	8.149	0.0
V_{OC} [V]:	37.62	37.48	-0.4
I_{SC} [A]:	8.709	8.738	0.3
FF [%]:	75.42	75.22	-0.3
PID quality categorization	**- A -**		

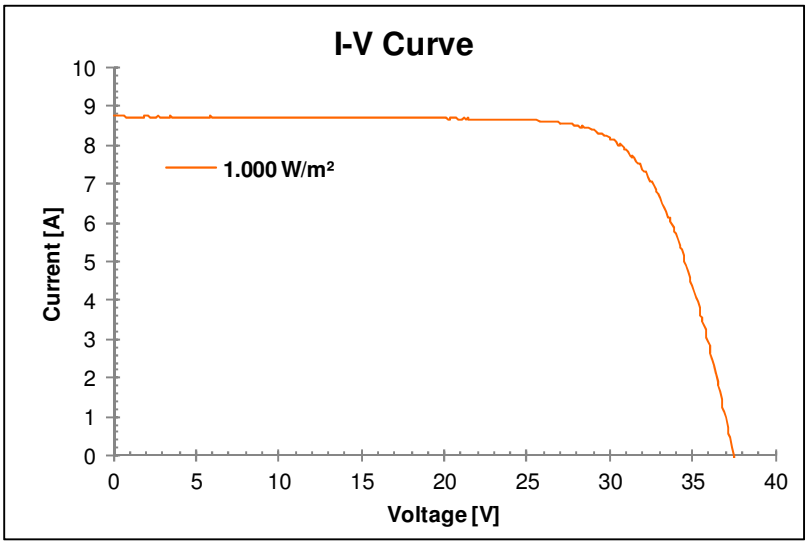

Figure 4: Temperature corrected I-V curve of module ET-P660E090912012473.

Electroluminescence analysis before and after PID (DH 48h) – SN: ET-P660E090912012473

Initial image	After PID