

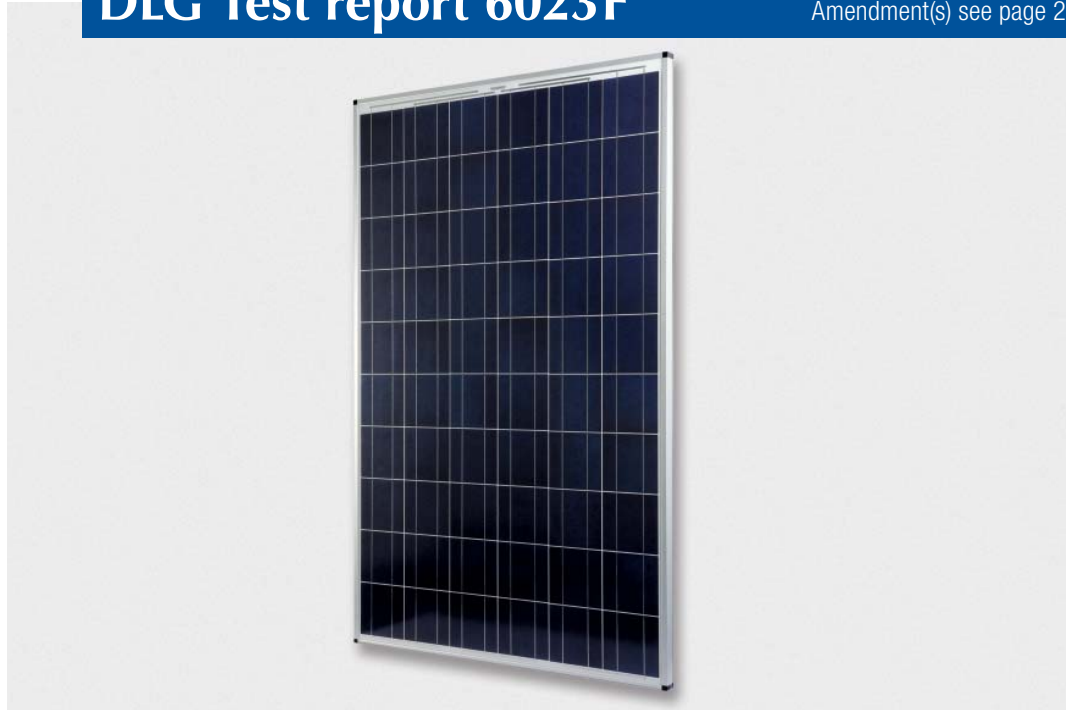
Win Win Precision Technology Co., Ltd.

Ammonia resistance

Solar module WINAICO WSP-2xxP6 (220 – 240 Wp)

DLG Test report 6023F

Amendment(s) see page 2



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Evaluation – short version

Test result (Comparison before/after ammonia climate exposure)	Evaluation*
Power conservation	
very small decrease in power, $\leq 0,4\%$	++
Visual inspection	
no damage, slight yellowing of the cells, corrosion of the glass surface and the frame	+
Insulation test and insulation resistance under wet conditions	
Requirements are fulfilled, no reduction of the insulation resistance under wet conditions. Insulation resistance remains at a high or very high level (under wet conditions)	n.e.

Evaluation range

The following evaluation range is applied in the DLG-FokusTest "Ammonia resistance":

Evaluation	Test result power conservation	Test result visual inspection
++	$\leq -2\%$	no alterations
+	$> -2,0\%$ to $\leq -3,5\%$	very slight alterations
○	$> -3,5\%$ to $\leq -5,0\%$	slight alterations

The DLG-FokusTest "Ammonia resistance" is considered passed if the insulation requirements are fulfilled and the test criteria "power conservation" and "visual inspection" are evaluated at least "standard".

* Evaluation range: ++ / + / ○ / - / -- (○ = standard) / n.e. = no evaluation

Main technical data (according to the manufacturer)

Design

Solar module (PV-module) made of polycrystalline silicon solar cells (mc-Si) consisting of:

- solar cells made of mc-Si, 60 cells (□ 156 mm, 6x10)
- front glass made of solar glass (3.2 mm)
- profile frame made of anodized aluminium

Connection

Connection box: Tyco (IP65)

Plug-and-socket connector: Tyco (IP65)

Cable: 4 mm², length 1,000 mm per terminal

Electrical module data (type: WSP-230P6)

Rated power, P_{MPP} 230 Wp

Rated current, I_{MPP} 7.72 A

Rated voltage, U_{MPP} 29.81 V

Short-circuit current, I_{SC} 8.30 A

No-load voltage, U_{OC} 38.86 V

System voltage, U 1000 V

Module efficiency 14.13%

Power tolerance under STC 0 to +5 Wp

Temperature coefficients

– TK P_{MPP} -0.40 %/K

– TK I_{SC} 0.06 %/K

– TK U_{OC} -0.34 %/K

Measurements and weight

Length / width / height 1665 / 999 / 40 mm

Weight 22,7 kg

Limits

max. permissible voltage 1000 V DC

permissible module temperature -40 to 90 °C

max. load (pressure or suction) 5400 N/m² [1]

max. back current 15 A

Explanation of abbreviations

- Current (I) and voltage (U) assume different values between zero and a maximum depending on the load (short-circuit current at $U=0$ and no-load voltage at $I=0$). Thus, a strong current, for example, causes voltage to drop and vice versa. The greatest output is produced only at one operating point, the maximum power point (MPP).
- For comparability, PV-module parameters (P_{MPP} , U_{MPP} and I_{MPP}) are determined under the following standard test conditions (STC) according to IEC 60904: cell temperature: 25 °C, irradiation intensity: 1000 W/m² and a defined light spectrum (class A sun simulator) with an AirMass of AM=1.5.

Amendment for: [1] "N/mm²"

Test results

The PV module of the type "WINAICO WSP-230P6" passed the DLG FokusTest "Ammonia resistance". Based on this result, one can assume that this module type is resistant to animal house air containing ammonia and that the aging process to be expected under normal circumstances is not accelerated.

Power conservation

The results of power measurement before and after the climate test are listed in Table 1 and Figure 1. The overall decrease in power must be considered very small (DLG evaluation: ++). The maximum decrease in power was -0.4%.

Annotations

The measured power values are relative values and no absolute values. This is due to the fact that the flasher used for the measurement (type: cetisPV-XF2M AM 1.5 Class A sun simulator) had not been calibrated with the same cell material as the tested units.

For type approval according to DIN EN 61215, power decrease may not exceed 5%. (This only applies under standard test conditions).

Visual inspection

During visual inspection, no damage or highly noticeable alterations were found before or after the climate test.

After the climate test in the ammonia gassing chamber, slight yellowing was found in the entire edge area and the spaces between the cells. Corrosion was visible on the glass surface and on the frame. On the glass, this corrosion ap-

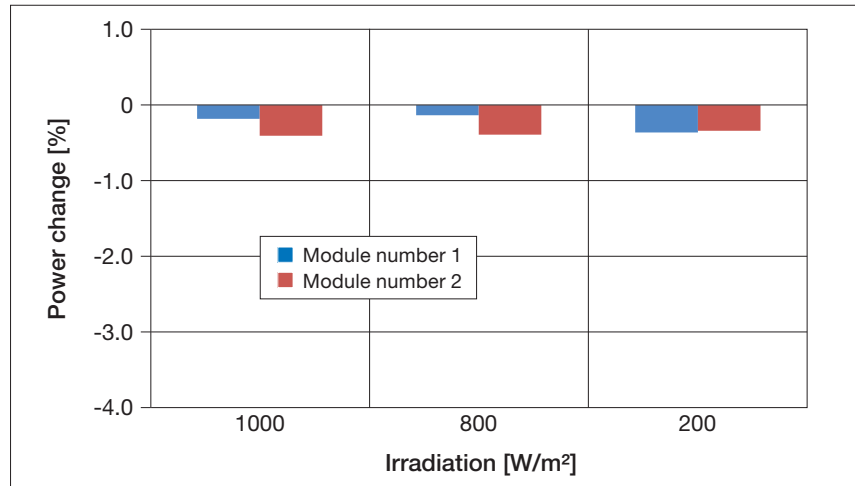


Figure 2: Power change after the climate test under an ammonia atmosphere

peared in the form of stain formation and dull spots with deposits, whose size reached up to one longitudinal cell row. The gloss on the surface of the solar pipe was duller than in new units.

No alterations were visible on the film on the back side and the connection box.

Altogether, these alterations were considered small to very small.

Insulation test

During the insulation test, the requirements (no breakdown, no surface rupture, insulation resistance at least 40 MΩm²) were fulfilled.

As a result of the climate test, insulation resistance decreased significantly from the very high level of the new unit (measured value: >1660 MΩm²) by ca. 40% to values of approximately 1,000 MΩ.

According to the DLG evaluation standard*, this meant that the insulation resistance values were at a high level (range of values: >500 to 1,000 MΩm²).

Insulation resistance under wet conditions

The required insulation resistance of at least 40 MΩm² was reached.

In the new unit, resistance values of 730 MΩm² (module number 1) and 683 MΩm² (module number 2) were measured. After the climate test, the high insulation resistance values changed only insignificantly as compared with the initial values.

For a module with a glass-film design, insulation resistance under wet conditions is therefore at an extremely high level (value range: >300 MΩm²)*.

* DLG evaluation standard "Insulation resistance" for the DLG test "Ammonia resistance of PV modules"

Table 1: Power conservation

Module number	Parameter	Irradiation intensity					
		1000 W/m²		800 W/m²		200 W/m²	
		before	after	before	after	before	after
1	Power at MPP [Wp]	232.0	231.6	186.5	186.3	45.2	45.0
	Power change [%]		-0.18		-0.13		-0.36
2	Power at MPP [Wp]	232.0	231.1	186.5	185.8	45.0	44.9
	Power change [%]		-0.40		-0.39		-0.34

Test conditions and realization of the test

The DLG FokusTest "Ammonia resistance" was carried out as a laboratory test according to the patented "DLG test standard for solar modules in agricultural use". This laboratory test is intended to determine the ability of the PV module to withstand the effects of animal house air over a period of use of at least 20 years.

The test was carried out in a gassing chamber under the following climate conditions:

Test duration	1500 h
Air temperature	70 °C
Relative humidity	70 %
Ammonia concentration	750 ppm

For the evaluation of ammonia resistance, every module was subject to visual inspection (10.1*), an insulation test (10.3*), a test of insulation resistance under wet conditions (10.15*), as well as an output measurement (10.2*) before and after the climate test.

In order to determine capacity under weaker irradiation conditions, measurements at irradiation intensities of 800 and 200 W/m² (irradiation intensity comparable to cloudy weather) were carried out in addition to the STC setting (1,000 W/m², irradiation intensity comparable to sunshine).

The type "WSP-230P6" from the

module type series "WINAICO WSP-2xxP6" with the power classifications (2xx) 220/225/230/235 and 240 was registered for the test.

The two modules used for the test had the following serial numbers: WSP1101W16UM00341 (No. 1), WSP1101W16UM00342 (No. 2).

A reference module with an identical design (serial number: WSP1101W16UM00805) was available for visual inspection after the climate test.

* Test step according to DIN EN 61215:2005 "Crystalline silicon terrestrial photovoltaic (PV) modules: design qualification and type approval"

Test

The FokusTest included a climate exposure test under laboratory conditions.

Based on the available results, the PV-module of the type "WINAICO WSP-230P6" fulfills the requirements for the awarding of the test sign DLG FokusTest with regard to the test criterion "ammonia resistance" (evaluation „O" or better).

The DLG test sign applies to all types of the module type series "WINAICO WSP-2xxP6" with the power classifications (xxx) 220/225/230/235 and 240.

Other criteria were not tested.

Realization of the tests

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