

Canadian Solar Inc.

Ammonia resistance

Solar module CS6P-xxxP (220-250 Wp)

DLG Test Report 6003F



Manufacturer / registering company

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Evaluation – short version

Test criterion	Test result (Comparison before/after ammonia climate exposure)	Evaluation*
Power conservation		
	very small decrease in power, $\leq 1,3\%$	++
Visual inspection		
	no damage, slight yellowing of the cells and slight frame corrosion at a few places	+
Insulation test and insulation resistance under wet conditions		
	Requirements are fulfilled, no or slight reduction, insulation resistance remains at a very high level	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, front glass made of tempered glass (3.2 mm), profile frame made of anodized aluminium,
60 high-capacity cells (□ 156 mm)

Connection

Connection box: CM0804-01A, with 3 bypass diodes
Plug-and-socket connector: QC4
Cable length per terminal: 950 mm

Electrical module data (type: CS6P-240P)

Rated power, P_{MPP}	240 Wp
Rated current, I_{MPP}	8.03 A
Rated voltage, U_{MPP}	29.9 V
Short-circuit current, I_{SC}	8.59 A
No-load voltage, U_{OC}	37.0 V
System voltage, U	1000 V
Module efficiency	13.7 %
Power tolerance under S_{TC}	+5 W
Power coefficient, P_{MPP}	-0.430 %/K
Temperature coefficient, I_{SC}	0.065 %/K
Temperature coefficient, U_{OC}	-0.340 %/K

Measurements and weight

Length / width / height	1638 / 982 / 40 mm
Weight	20 kg

Limits

max. permissible voltage	1000 V DC
max. back current, I_R	15 A
permissible module temperature	-40 to 85 °C
max. load (pressure or suction)	5400 N/mm ²
Application class (acc. to IEC 61730)	A
Protection class	IP 65

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.

Test results

The PV module of the type "CS6P-240P" 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 -1.3%.

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) was not 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 noticeable alterations were found before or after the climate test.

After the climate test in the ammonia gassing chamber, a small number of stain-like, slightly corroded spots was visible on the frame. In addition, slight yellowing was found in the entire edge area

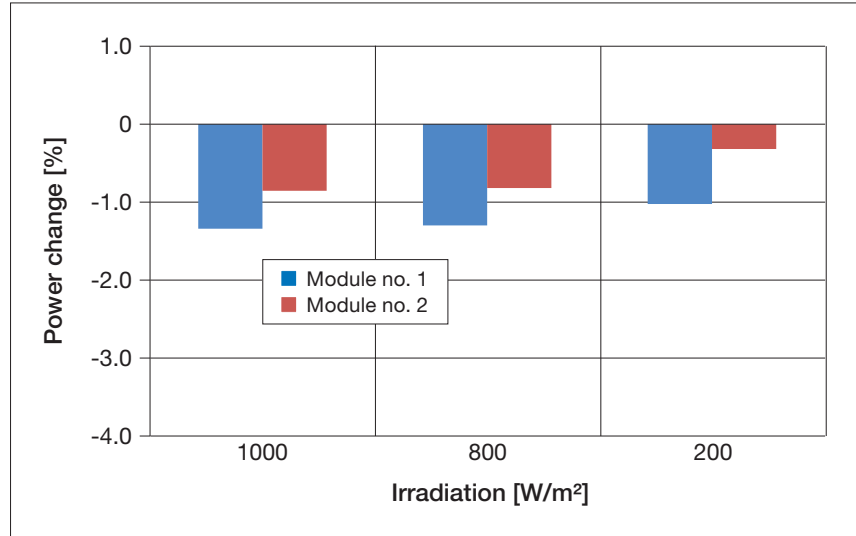


Figure 2: Power change after the climate test under an ammonia atmosphere

and the space between the cells. No alterations were visible on the glass surface, the film on the back side and the connection box including the cable.

Altogether, these alterations were considered very small.

Insulation test

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

Insulation resistance showed no change over new condition (measured value: > 1650 MΩm²) as a result of the climate test.

According to the DLG evaluation standard*, this meant that the insulation resistance values were at a very high level (range of values: > 1500 MΩm²).

Insulation resistance under wet conditions

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

When new, resistance values of 795 MΩm² (module number 1) and 710 MΩm² (module number 2) were measured. Only in module number 1 did insulation resistance decrease by ca. 5% after the climate test as compared with the initial value. In module number 2, insulation resistance grew by ca. 18%.

Thus, insulation resistance under wet conditions is at a very high level given the glass-film design of the module (value range: > 250 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]	234.6	231.4	188.3	185.8	44.6	44.2
	Power change [%]		-1.3		-1.3		-1.0
2	Power at MPP [Wp]	233.9	231.9	187.8	186.3	44.5	44.4
	Power change [%]		-0.9		-0.8		-0.3

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 "CS6P-240P" from the

module type series "CS6P-xxxP" with the power classifications (xxx) 220/225/230/235/240/245 and 250 was registered for the test.

The two modules used for the test had the following serial numbers: Y110326290039 (number 1), Y110326290040 (number 2).

A reference module with an identical design (serial number: Y110326290041) 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 "CS6P-240P" 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

"CS6P-xxxP" with the power classifications (xxx) 220/225/230/235/240/245 and 250.

Other criteria were not tested.

Realization of the tests

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