

SCHOTT Solar AG

Resistance to ammonia

SCHOTT Poly™ 3xx (280-320 Wp) double glass module

DLG Test Report 5895 F



Manufacturer/applicant

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Test conditions and performance of the test

The DLG focus test "ammonia resistance" was carried out as a laboratory test in accordance with the patented "DLG test standard for solar modules in agricultural use". This laboratory test is intended to determine the PV module's ability to resist the effects of air on buildings for livestock during the operating life of at least 20 years.

The test took place in a gasification test chamber with the following climatic conditions:

| | |
|------------------------|----------|
| Test period: | 1500 hrs |
| Air temperature: | 70 °C |
| relative air humidity: | 70 % |
| ammonia concentration: | 750 ppm |

In order to assess the resistance to ammonia, each module was subject to a visual examination (10.1¹), an insulation test (10.3¹), and a wet insulation resistance test (10.15¹), and

a performance measurement (10.2¹) before and after the environmental test.

In order to determine its performance under weaker irradiation conditions, in addition to the STC setting (1000 W/m², irradiation intensity comparable to bright sunlight), measurements were taken at irradiation intensities of 800 and 200 W/m² (irradiation intensities comparable to cloudy conditions).

Two modules were tested, with the following serial numbers:
140500090635 (no. 1)
140500090669 (no. 2)

¹ Test step in accordance with DIN EN 61215:2005 „Crystalline Silicon Terrestrial Photovoltaic (PV) Modules – System Suitability and System Approval“

Principal technical data (Manufacturer's information)

Design

- Solar module (PV module) made of multicrystalline silicon solar cells
- Double glass module constructed with a cavity-free anodized aluminium frame
- 80 solar cells connected in series (□ 15.6 cm)
- Type of solar cell: MAIN-Iso
- IP 65 junction box with four bypass diodes, with Tyco Solarlok interconnection (length: (-) 0.9 m, (+) 2.1 m)

Module electrical data¹

| | |
|--|--------|
| Nominal power, P _{MPP} | 280 Wp |
| Current at nominal power, I _{MPP} | 7.16 A |
| Voltage at nominal power, U _{MPP} | 39.1 V |
| Short-circuit current, I _{SC} | 7.95 A |
| Open-circuit voltage, U _{OC} | 48.1 V |
| System voltage, U | 1000 V |
| Module efficiency | 12.7 % |

Dimensions and weight

| | |
|-------------------------|---------------------------|
| length / width / height | 1685 mm / 1313 mm / 50 mm |
| Weight | 41.5 kg |

¹ Rating tolerance for power output is ± 4%, and rating tolerance for all other parameters ± 10%

Notes on the abbreviations:

- Depending on the load, the current (I) and voltage (U) assume various values between zero and a maximum value (the short-circuit current when U=0, and the off-load voltage when I=0). For example, a higher flow of current leads to a decrease in voltage, and vice versa. Only at one operating point, the "Maximum Power Point", or MPP, maximum output is produced.
- For the purposes of comparability, pv module characteristic values, (P_{MPP}, U_{MPP} and I_{MPP}), are determined under the following Standard Test Conditions (STC) in accordance with IEC standard 60904: cell temperature: 25 °C, irradiation intensity: 1000 W/m² with a defined light spectrum (class A solar simulator) with an air mass of AM=1.5.

Evaluation in summary form

| Test criterion | Test result (comparison before/ after climate chamber test with ammonia) | Rating |
|---|--|--------|
| Performance stability | very low degradation, ≤ 1 % | ++ |
| Visual examination | no damages; formation of a light coating on the front | + |
| Insulation test, and wet insulation resistance | The requirements are met, no alterations were observed | N.R. |

Evaluation range: ++ / + / ○ / - / -- (○ = standard) / N.R. = not rated

Evaluation table

The following evaluation table is used for the DLG focus test „Resistance to ammonia“:

| Evaluation | Test result: performance stability | Test result: visual examination |
|------------|------------------------------------|---------------------------------|
| ++ | ≤ -2 %; | no abnormalities |
| + | > -2 % to ≤ -3.5 % | very low abnormalities |
| ○ | > -3.5 % to ≤ -5 % | slight abnormalities |

The DLG focus test "resistance to ammonia" is considered to have been approved if the insulation requirements are met and the "performance stability" and "visual examination" test criteria are rated as at least "standard".

Test results

The "SCHOTT Poly™ 280" PV module has passed the DLG focus test "resistance to ammonia". Based on this result, it can be assumed that this type of PV module is resistant to ammonia-bearing atmospheres on buildings for livestock, and that no additional degradation beyond what is normally to be expected occurs.

Maintenance of performance

The performance measurements results before and after the climate chamber test are summarised in table 1 and figure 1.

In overall terms, the degradation of no more than $\leq 1\%$ is to be considered very low.

Visual examination

Upon visual examination, no damages or significant abnormalities were observed either before or after the environmental test. However, a light laminar coating had formed on the front of both modules. This coating was mainly visible in the lower area of the long face of the module. This side was towards the bottom of the test chamber.

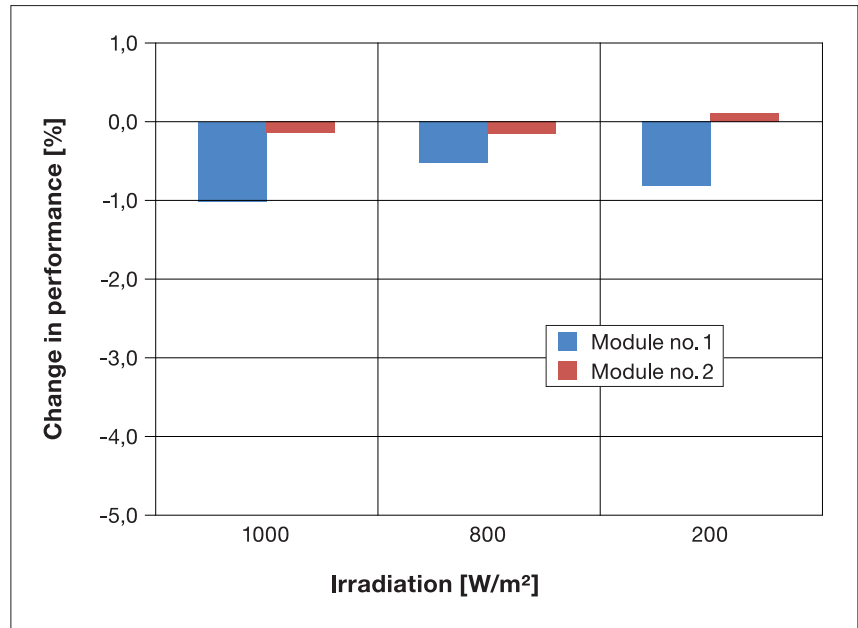


Figure 1: Change in performance after the environmental test in an ammonium atmosphere

Insulation test

In the insulation test, the requirements were met (no breakdown, no surface cracks, and insulation resistance of at least $40 \text{ M}\Omega\text{m}^2$).

An insulation resistance of $> 2200 \text{ M}\Omega\text{m}^2$ was measured.

The result was unchanged after the climate chamber test.

Wet Insulation resistance

The requirements were met.

An insulation resistance of $> 1300 \text{ M}\Omega\text{m}^2$ was measured (requirement: $> 40 \text{ M}\Omega\text{m}^2$).

The result was unchanged after the climate chamber test.

Table 1: Performance stability

| Module no. | Criterion | Intensity of irradiation | | | | | |
|------------|------------------------|--------------------------|----------|----------|----------|----------|---------|
| | | 1000 W/m² | | 800 W/m² | | 200 W/m² | |
| | | before | after | before | after | before | after |
| 1 | Performance at the MPP | 286.8 Wp | 283.9 Wp | 222.9 Wp | 221.7 Wp | 55.0 Wp | 54.6 Wp |
| | Change in performance | -1,0 % | | -0,5 % | | -0,8 % | |
| 2 | Performance at the MPP | 287.5 Wp | 287.1 Wp | 223.0 Wp | 222.7 Wp | 54.9 Wp | 54.9 Wp |
| | Change in performance | -0,1 % | | -0,2 % | | 0,1 % | |

Comments

The performance values measured represent relative, not absolute, values. The reason for this is that the flashers used for the measurements (model: cetisPV-XF2M AM 1.5 Class A solar simulator) had not been calibrated for the same cell material as the material the specimens were made from.

For prototype certification in accordance with DIN EN 61215, the reduction in performance must not exceed 5% (only applies in respect of STC conditions).

The focus test included a climate chamber test under laboratory conditions.

Based on the available results, the "SCHOTT Poly™ 280" PV module meets the requirements in respect of the test criterion "resistance to ammonia", (rating "o" or better), and receives the DLG focus test mark.

Other criteria were not tested.

Performance of the test

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ENTAM – European Network for Testing of Agricultural Machines, is the network of European testing stations. ENTAM's aim is the Europe-wide distribution of test results for farmers, agricultural equipment merchants and manufacturers.

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