



# Desert-Gobi-Wasteland PV Solution White Paper

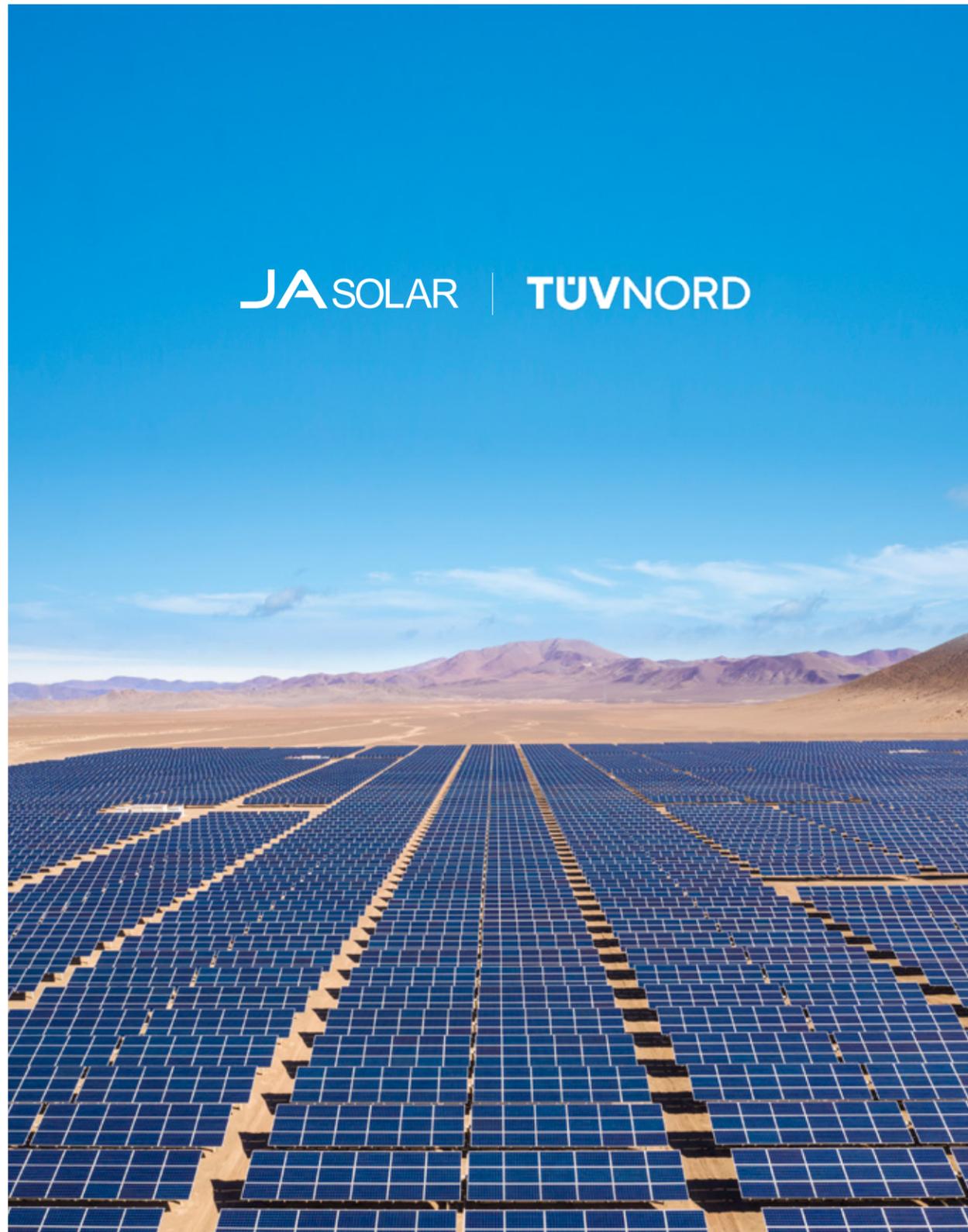


# CONTENTS

<b>01</b>	<b>Foreword</b>	02
<b>02</b>	<b>Desert-Gobi-Wasteland Environments and Research Background</b>	03
	2.1 Development advantages	04
	2.2 Development challenges	04
<b>03</b>	<b>Reliability Risks of Desert-Gobi-Wasteland Modules</b>	05
	3.1 High-intensity UV radiation	05
	3.2 Sandstorms	06
	3.3 High temperature environment	07
<b>04</b>	<b>Desert-Gobi-Wasteland Solutions - Characteristics of DesertBlue Modules</b>	09
<b>05</b>	<b>Reliability Evaluation Sequence for Desert-Gobi-Wasteland Solutions</b>	11

<b>06</b>	<b>Desert-Gobi-Wasteland Solutions - DesertBlue Modules Testing</b>	15
	6.1 Sand-dust abrasion resistance performance test	15
	6.2 High-UV aging test	17
	6.3 Combined thermal shock and UV aging test	18
	6.4 High temperature thermal resistance performance evaluation	19
	6.5 Load-bearing capacity under high temperature stress	20
	6.6 Outdoor empirical test	21
	6.6.1 JA Solar's Shanghai Fengxian Base simulation empirical test	21
	6.6.2 Empirical test in Ulan Buh Desert, Inner Mongolia	22
	6.6.3 Empirical tests at Tengger desert post office, Inner Mongolia	23
	6.6.4 Xinjiang demonstration project	24
<b>07</b>	<b>Economic Analysis of Desert-Gobi-Wasteland Solutions</b>	25
<b>08</b>	<b>Summary and Industry Significance</b>	26





## 01 | Foreword

Against the backdrop of global energy structure transformation and the pursuit of carbon peaking and carbon neutrality goals, the photovoltaic industry, as a key player in green energy, is experiencing unprecedented development opportunities. With the continuous expansion of application scenarios for photovoltaic (PV) power plants, arid and high temperature environments such as deserts, Gobi areas, and wastelands have emerged as key choices for deploying large-scale ground-mounted PV installations due to their abundant land and solar irradiation resources. However, extreme climate conditions in these environments—such as large temperature variations, high-intensity UV radiation, and frequent sandstorms—impose higher requirements on the long-term reliability, power generation performance, and service life of PV modules.

Against this backdrop, precise performance evaluation and authoritative certification of PV modules in specific scenarios such as deserts, Gobi areas, and wastelands are of paramount importance. JA Solar has collaborated with **TÜV NORD**, an internationally recognized testing, inspection and certification institution, to jointly initiate a specialized research project targeting extreme environments such as deserts, Gobi areas, and wastelands. This initiative aims to conduct comprehensive scenario-based validation and performance evaluation of JA Solar's self-developed solution for these harsh conditions — the DesertBlue modules.

This white paper represents a key achievement of JA Solar's in-depth collaboration with **TÜV NORD**. It systematically demonstrates the power generation capability, weather resistance, and comprehensive performance of DesertBlue modules in deserts, Gobi areas, and wastelands through simulations exceeding extreme stress conditions. The testing encompasses not only typical desert environmental factors such as extreme temperature cycling, ultra-high-dose UV aging, and severe wind-sand abrasion, but also incorporates multi-stress coupled accelerated testing methodologies. This approach aims to scientifically evaluate the reliability performance of PV modules over extended operational lifespans of 25 years or longer within a significantly shortened testing duration.

It is expected that the comprehensive data and rigorous conclusions presented in this white paper will provide valuable references for power plant investors, design institutes, and industry partners, establishing new benchmarks for equipment selection, system design, and risk management in PV power plants under complex scenarios such as global deserts, Gobi areas, and wastelands.



## 02 | Desert-Gobi-Wasteland Environments and Research Background

Desert-Gobi-Wasteland environments cover nearly 27% of China's territory and approximately 25% of global land area, featuring vast but underutilized land resources that are now prioritized for development. The PV systems PV systems have become increasingly prominent in ecological restoration within desert, Gobi, and wasteland environments. Taking Phase I project of the Tengger Desert Base in Ningxia as an example, PV modules were installed with checkerboard straw barriers and drought-resistant grass seeds (such as *Artemisia sphaerocephala* and *Astragalus adsurgens*) sown underneath. Vertical sand barriers were constructed along the periphery to reduce wind-blown sand flow. This approach has achieved sand control across an area of 26,000 mu, significantly improving the regional ecological environment.

In environmental improvement, PV modules reduce sunlight exposure and lower surface evaporation rates. Additionally, the cleaning wastewater of PV modules can be used for irrigation, creating favorable conditions for vegetation restoration. The practice in Zhongwei PV Industrial Park, Ningxia demonstrates that this operating mode mentioned above significantly increases vegetation coverage, achieving synergistic effects between ecological restoration and clean energy development.



### 2.1 Development advantages

**Abundant solar irradiation resources:** Desert-Gobi-Wasteland environments feature long sunshine duration and high-intensity solar radiation, with annual average sunshine hours generally exceeding 2,000 hours, and even surpassing 3,000 hours in some areas, providing superior conditions for solar energy development.

**Abundant land resources:** Vast territory with sparse population and minimal shading obstacles, ideal for deployment of large-scale PV power plant.

### 2.2 Development challenges

**Dust impact:** Dust accumulation causes glass surface abrasion and coating aging, reducing light transmittance and affecting power generation efficiency while increasing hotspot risks. Coupled with the fact that deserts, Gobi area, and wastelands are predominantly located in remote uninhabited areas, transportation is inconvenient, and operational maintenance (O&M) cleaning faces significant challenges with high costs.

**Gusty threat:** Frequent strong winds may trigger issues such as micro-cracks in solar cells, deformation or tearing of module frames, and glass breakage, severely compromising both module safety and power generation performance.

**High-intensity UV radiation:** Prolonged exposure to high-intensity ultraviolet rays accelerates the aging of encapsulation materials, resulting in reduced module sealing performance and light transmittance.

**Large temperature variations:** The actual operating temperature frequently deviates significantly from standard test conditions (25°C), leading to power output degradation, accelerated material aging, and compromised module reliability and lifespan.

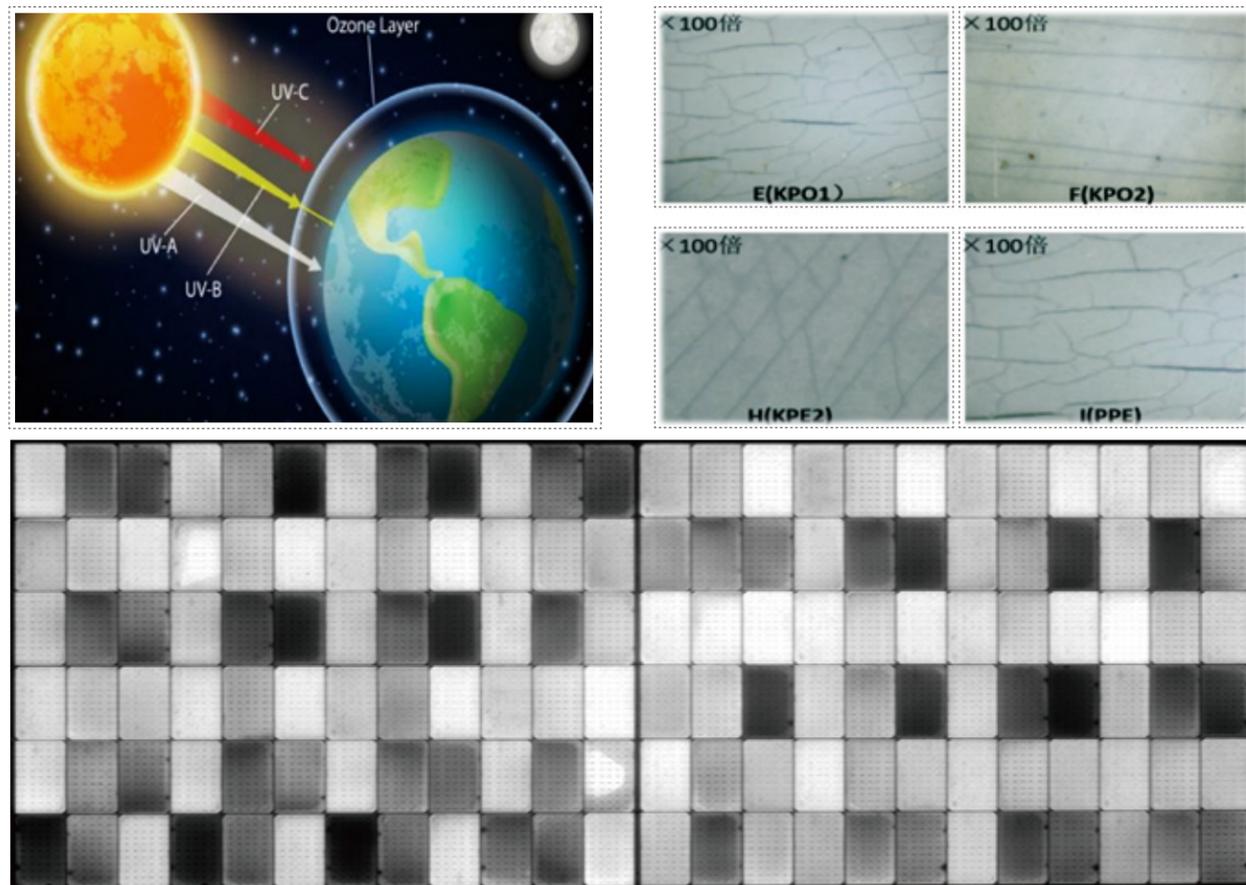


## 03 | Reliability Risks of Desert-Gobi-Wasteland Modules

### 3.1 High-intensity UV radiation

Although Desert-Gobi-Wasteland regions possess abundant solar irradiation resources, excessive UV radiation can cause severe damage to PV modules. High-intensity UV radiation accelerates the aging process of encapsulation materials (such as EVA encapsulant), triggering photochemical reactions that lead to material failure, reduced light transmittance, and compromised sealing performance. Once the encapsulation materials degrade and fail, moisture and oxygen can infiltrate into the interior of PV modules, triggering oxidation and corrosion of solar cells, which ultimately accelerates the performance degradation of PV modules.

Additionally, high-intensity UV irradiation can induce the rupture of Si-H bonds in solar cells, generating excessive H atomic clusters that promote carrier recombination and degrade cell performance. Meanwhile, the generation of hot carriers may damage the passivation layer, increase interfacial state density, and further degrade module efficiency.



### 3.2 Sandstorms

PV modules operating in Desert-Gobi-Wasteland environments face unique operational challenges, with frequent sandstorms being particularly prominent. These sandstorms typically feature prolonged duration and extensive impact areas, with an annual occurrence frequency reaching dozens of times. During the active sandstorm season, visibility frequently drops below 100 meters, with suspended particulate matter (PM) concentrations in the air exceeding 10mg/m<sup>3</sup>. Such extreme weather not only triggers sharp fluctuations in instantaneous power generation but also imposes sustained adverse effects:

Strong winds accompanied by sandstorms may overturn PV mounting structures or modules, causing physical damage. A PV project in Xinjiang once suffered severe losses due to widespread module bending and mounting structure collapses caused by a Level 13 gale.

Driven by strong winds, sand and dust particles collide with PV module surfaces at high velocities, potentially scratching the glass protective layers or coatings, which reduces light transmittance and accelerates material degradation. The wind-sand environment in desert Environments further exacerbates surface abrasion of PV modules, potentially compromising the sealing performance of encapsulant materials (e.g., EVA encapsulant) and increasing the risk of moisture ingress.

Uneven dust accumulation causes localized temperature rise in modules, leading to hotspot. Hotspots not only accelerate cell aging but may also cause module burnout or even fire hazards.



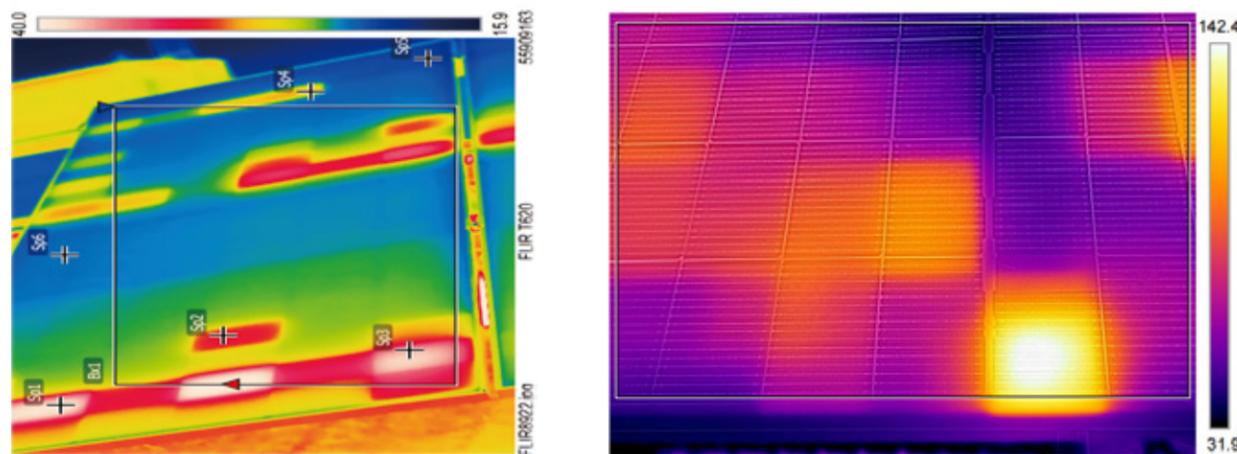
### 3.3 High temperature environment

PV modules face severe thermal challenges under the extreme climate conditions of deserts, Gobi areas, and wastelands. The drastic diurnal temperature fluctuations significantly impact module performance.

Ambient temperatures in Desert-Gobi-Wasteland environments can reach 0–50°C. The output power of PV modules exhibits a negative correlation with temperature, with a typical peak power temperature coefficient of approximately -0.29%/°C. For instance, when the module temperature rises from 25°C to 85°C, the power generation loss can reach approximately 17%.

When module surfaces are obstructed by dust, shading, or other occlusions, the shaded areas are prone to developing hotspots, thus resulting in localized high temperatures (exceeding 180°C) that cause performance degradation of PV modules. High temperature environments further exacerbate the hotspot effect. This will accelerate material aging, compromising module structural integrity and electrical safety.

In environments with extreme diurnal temperature variations, PV modules can reach surface temperatures exceeding 85°C during the day due to intense solar irradiation, then plummet to below -20°C at night through radiative cooling, resulting in daily temperature differentials of approximately 100°C. Such drastic temperature variations can induce fatigue fractures in the solder ribbons and exacerbate the propagation of micro-crack in the solar cells. Meanwhile, repeated thermal expansion and contraction further compromises the reliability of electrical connections, thereby increasing system failure risks. This poses a severe challenge to the structural integrity and long-term reliability of PV modules.



## 04 | Desert-Gobi-Wasteland Solutions - Characteristics of DesertBlue Modules

### Excellent self-cleaning performance

The product incorporates a nano-scale self-cleaning coating, whose dense microstructure and antistatic properties significantly reduce dust adhesion, enabling effortless self-cleaning via wind force, resulting in a >32% reduction in light transmittance degradation compared to conventional PV module glass.

### Enhanced weather resistance and abrasion resistance

The reliability of each aspect has been improved by at least 32%, with the service life extended by 3 to 5 years. Meanwhile, the hardness of encapsulation material has been enhanced, resulting in a 14% reduction in power loss under severe dusty conditions.

### High-load design

Equipped with high-strength steel frames, DesertBlue modules withstand 6000 Pa front loading and 4000 Pa back loading, representing over 60% improvement in load capacity compared to conventional PV modules. The steel frame material combines thermal expansion adaptability with excellent conductivity, reducing grounding material requirements and carbon emissions.

### Excellent high temperature performance

The temperature coefficient is optimized to  $-0.28\%/^{\circ}\text{C}$ . Combined with JA Solar's TOPCon cells featuring high open-circuit voltage, the power output is increased by 0.5–0.6% under desert conditions at  $50^{\circ}\text{C}$  ambient temperature and module operating temperature of  $75\text{--}85^{\circ}\text{C}$ . Compared with conventional PV modules, DesertBlue modules operate at a temperature nearly  $5^{\circ}\text{C}$  lower in dusty environments, which equates to an additional power generation capacity increase of approximately 1.5%.

### Excellent UV resistance

DesertBlue modules incorporate JA Solar's proprietary n-type Bycium+ high-efficiency cells, further enhancing module performance. This cell employs technologies such as millisecond-level low-oxygen n-type silicon wafers, excellent surface passivation and passivated contact techniques, laser-enhanced contact optimization, ultra-fine grid metallization, and bifacial anti-reflective coatings. It delivers high conversion efficiency while maintaining potential for further UV resistance optimization through high-performance encapsulation technologies.

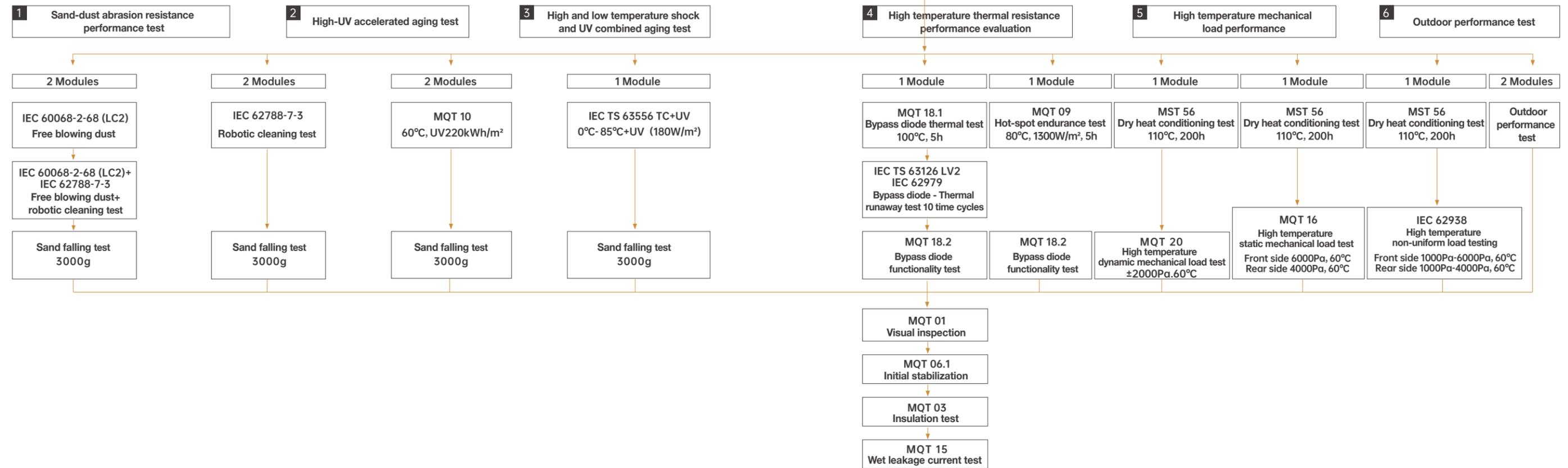


# 05 | Reliability Evaluation Sequence for Desert-Gobi-Wasteland Solutions

After developing solutions tailored to the complex environmental characteristics of deserts, Gobi areas, and wastelands, JA Solar collaborated with TÜV NORD to establish a systematic and hierarchical reliability verification system.

Based on IEC international standards, while also integrating typical climatic conditions and stringent requirements specific to deserts, Gobi areas, and wastelands, this evaluation system features customized test sequences targeting severe sandstorms, high temperatures, high-intensity UV radiation, and mechanical loads as key failure factors. It enables accelerated simulation of module operating conditions over a 25-year or even longer timeframe under laboratory conditions, thereby scientifically assessing the long-term reliability and performance stability of solutions tailored for Desert-Gobi-Wasteland environments under extreme conditions.

The evaluation sequences and test data presented in the following sections were independently supervised and verified by TÜV NORD, fully demonstrating JA Solar's rigorous approach and technical capabilities in high-reliability product development.



Sand-dust abrasion resistance performance test			
To verify the abrasion resistance of PV glass of Desert-Gobi-Wasteland Modules in Desert-Gobi-Wasteland environments			
IEC 60068-2-68 (LC2) Free blowing dust		IEC 62788-7-3 Robotic cleaning test	
Sand falling test		Sand falling test	
MQT 01	MQT 02	MQT 01	MQT 02
MQT 03	MQT 15	MQT 03	MQT 15

High-UV accelerated aging test	
To verify the resistance of Desert-Gobi-Wasteland modules to high UV aging at elevated temperatures and to sand falling test after aging.	
MQT 10 High-UV test	
Sand falling test	
MQT 01	MQT 02
MQT 03	MQT 15

High and low temperature shock and UV combined aging test	
To verify the UV aging resistance of the Desert-Gobi-Wasteland modules under high and low temperature shock and the resistance to sand falling test after aging.	
IEC TS 63556 Thermal cycling including UV	
Sand falling test	
MQT 01	MQT 02
MQT 03	MQT 15

Outdoor performance test
To evaluate the actual power generation performance of Desert-Gobi-Wasteland modules under outdoor installation conditions.
IEC TS 61724-2 Outdoor performance test

High temperature mechanical load performance					
To verify mechanical stress on PV modules caused by sandstorms in Desert-Gobi-Wasteland environments					
MQT 20 High temperature dynamic mechanical load test		MQT 16 High temperature static mechanical load test		IEC 62938 High temperature non-uniform load testing	
MQT 01	MQT 02	MQT 01	MQT 02	MQT 01	MQT 02
MQT 03	MQT 15	MQT 03	MQT 15	MQT 03	MQT 15

High temperature thermal resistance performance evaluation			
To verify the hot-spot endurance test and diode performance of Desert-Gobi-Wasteland modules in high desert temperature environments			
MQT 18.1 Bypass diode thermal test		MQT 09 Hot-spot endurance test	
IEC 62979 Bypass diode - Thermal runaway test		-	
MQT 18.2 Bypass diode functionality test		-	
MQT 01	MQT 02	MQT 01	MQT 02
MQT 03	MQT 15	MQT 03	MQT 15



## 06 | Desert-Gobi-Wasteland Solutions - DesertBlue Modules Testing

After establishing a systematic reliability evaluation framework, JA Solar conducted comprehensive validation of DesertBlue modules' key performance in Desert-Gobi-Wasteland environments, fully demonstrating their long-term operational stability and superior performance under extreme conditions.

### 6.1 Sand-dust abrasion resistance performance test

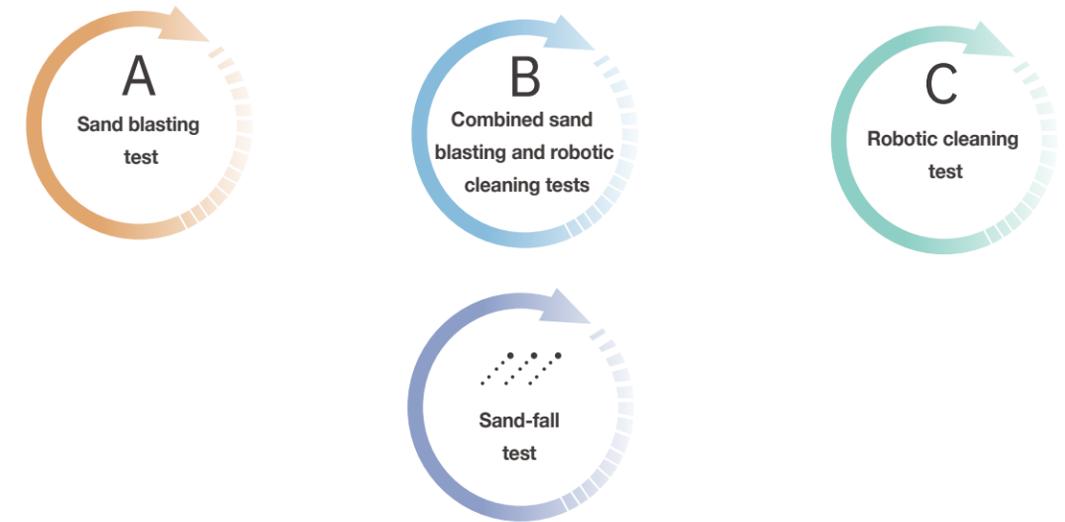
The abrasion resistance of module glass was validated through robotic cleaning and sand blasting tests. The abrasion resistance was evaluated by observing glass surface abrasion and module power degradation.

**A Sand blasting test:** The 4-hour test was conducted with a sand density of 5 g/m<sup>3</sup>/h, wind speed of 15-20 m/s, using a mixture of 50 μm (70%) and 150 μm (30%) particles. The LC2 sand-blowing test simulates a harsher wind-driven sand environment, in the test chamber.

**B Combined sand blasting and robotic cleaning tests:** Robotic cleaning was simultaneously performed under the aforementioned sand blasting conditions to comprehensively evaluate abrasion resistance.

**C Robotic cleaning test:** The robot operated at 0.3 m/s with 188 g of mixed sand spread every 30 minutes. A total of 11,000 cleaning cycles were performed to simulate 30 years of outdoor cleaning impact on the modules.

**Sand-fall test:** An additional sand-fall test was conducted following each sequence test. The modules were mounted on rotatable brackets, and a certain amount of sand particles was added into a funnel to allow it to undergo free-fall and scour the glass surface, so as to verify the abrasion resistance of the glass coating. The test utilized sand particles ranging from 140 μm to 2 mm in size, with a total weight of 3000g.

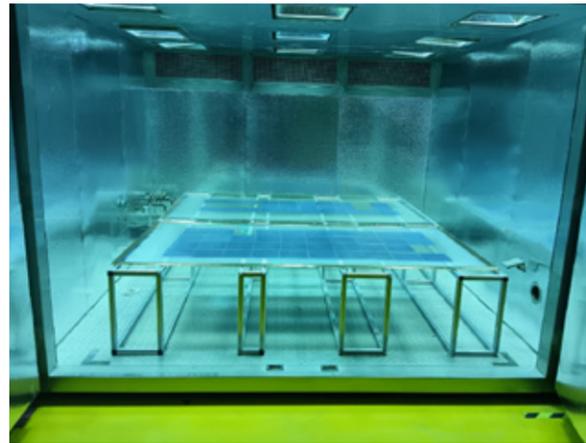


The test results are shown in the following table:

Test Item	Power Degradation	Visual Inspection	Insulation Wet Leakage Current Test
A. Sand blasting test (LC2)	0.51%	Passed	Passed
B. Combined sand blasting (LC2) + robotic cleaning tests	0.56%	Passed	Passed
C. Robotic cleaning test	0.63%	Passed	Passed
Sand-fall test	A: 0.10% B: 0.11% C: 0.07%	A: Passed B: Passed C: Passed	A: Passed B: Passed C: Passed

## 6.2 High-UV aging test

Given the high level of UV irradiation in Desert-Gobi-Wasteland regions, to simulate the environment where intense UV irradiation coexists with high temperatures in desert regions, this test sets the total UV radiation exposure at 220 kWh and maintains the test environment temperature at 60°C, with the objective of evaluating the UV aging resistance performance of DesertBlue modules under high temperature conditions. Performance changes were evaluated by comparing power degradation values before and after testing. After completing the comprehensive UV aging test, the samples were immediately subjected to sand-fall test to evaluate their post-aging resistance to sand abrasion.

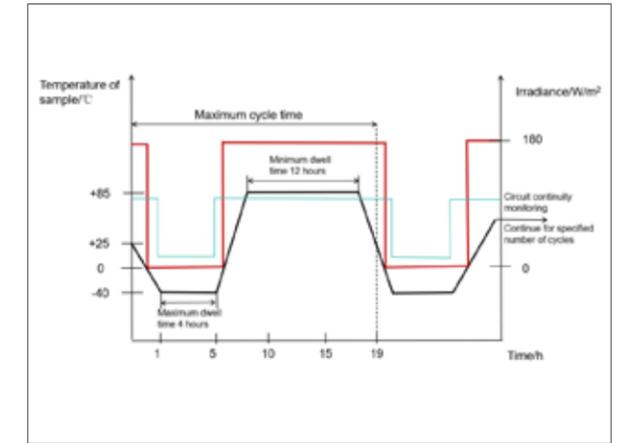


The test results are shown in the following table:

Test Item	Power Degradation	Visual Inspection	Insulation Wet Leakage Current Test
Combined high-UV accelerated aging tests	2.49%	Passed	Passed
Sand-fall test	0.09%	Passed	Passed

## 6.3 Combined thermal shock and UV aging test

Given the significant diurnal temperature variations and prolonged exposure to extreme temperatures in Desert-Gobi-Wasteland environments, DesertBlue modules were subjected to rigorous combined aging tests. The test extended the duration of temperature cycling to 12 hours and 4 hours respectively (-40°C to 85°C range) to precisely simulate desert conditions. Simultaneously, a UV irradiation condition of 180W/m<sup>2</sup> was introduced during the temperature rise period, with cumulative UV exposure reaching 60kWh/m<sup>2</sup> to comprehensively validate the weather resistance of DesertBlue modules. After completing the combined aging test, a sand-fall test was conducted again to further verify the sand abrasion resistance of DesertBlue modules.



The test results are shown in the following table:

Test Item	Power Degradation	Visual Inspection	Insulation Wet Leakage Current Test
Combined thermal shock and UV aging tests	1.15%	Passed	Passed
Sand-fall test	0.11%	Passed	Passed

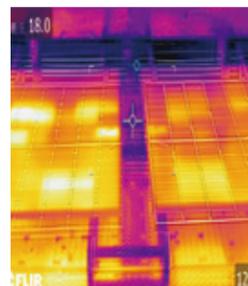
## 6.4 High temperature thermal resistance performance evaluation

In desert scenarios, the operating temperature of PV modules can reach as high as 85°C during the daytime, and in some areas, it may even exceed this threshold. Such extreme high temperature environments impose stringent requirements on the thermal resistance of PV modules. Furthermore, shading caused by dust and other contaminants can trigger the hotspot effect, leading to a sharp localized temperature rise in modules that severely compromises operational safety and lifespan. The module's resistance to hotspot and diode's high temperature endurance were evaluated through enhanced hotspot test, diode junction temperature, and diode thermal runaway tests.

**High temperature hot-spot endurance test:** The highest-temperature cell was identified using infrared screening. Hotspot test was conducted under enhanced irradiance (1300 W/m<sup>2</sup>±50 W/m<sup>2</sup>) and elevated ambient temperature (80°C ±5°C) to evaluate and verify the thermal endurance of DesertBlue modules under extreme conditions.

**Bypass diode thermal test:** The test conditions comply with IEC TS 63126. After obtaining the linear curve, the ambient temperature of the constant current test was increased to 100°C to evaluate the thermal performance of the diode components used in DesertBlue modules under high temperature conditions.

**Bypass diode - Thermal runaway test:** Diode thermal runaway test was conducted in accordance with IEC 62979. To better simulate actual operating conditions in desert environments, the test cycle count was increased by 10 to verify the reliability of DesertBlue modules' diode components under high temperature conditions.



The test results are summarized in the following table:

Test Item	Power Degradation	Visual Inspection	Insulation Wet Leakage Current Test	Diode Functional Test
Hot-spot endurance test	1.00%	Passed	Passed	Functional retention
Bypass diode thermal test bypass diode - Thermal runaway test	0.56% 0.59%	Passed	Passed	Functional retention

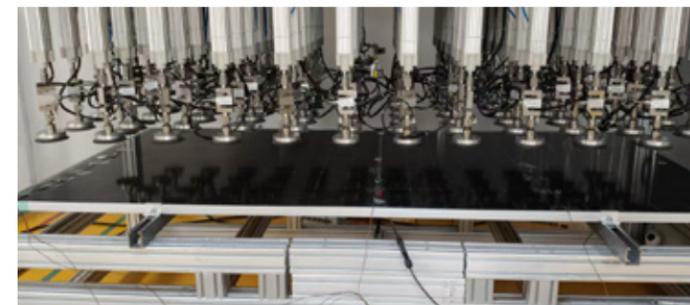
## 6.5 Load-bearing capacity under high temperature stress

To simulate the mechanical stress on PV modules caused by sandstorms in Desert-Gobi-Wasteland environments, a series of test schemes combining conventional load testing with high temperature environments was designed. Considering actual operating conditions, all test samples were evaluated according to IEC 61730-2 MST 56, with an ambient temperature of 110°C during the 200-hour initial test phase.

**High temperature dynamic mechanical load test:** At 60°C ambient temperature, 2000 Pa dynamic mechanical loads were applied to both front and back sides of PV modules for 1000 cycles to simulate frequent wind-sand impacts on DesertBlue modules.

**High temperature static mechanical load test:** At 60°C ambient temperature, DesertBlue modules were subjected to 6000 Pa front side and 4000 Pa rear side static loads to evaluate the limits of material resistance under high temperature and extremely strong wind conditions.

**High temperature non-uniform load testing:** When the module temperature reached 60°C, progressively increasing mechanical loads were applied—1000 Pa to 6000 Pa on the front side and 1000 Pa to 4000 Pa on the rear side—to evaluate the flexural resistance performance of DesertBlue modules under conditions of high temperature and uneven strong winds.



The test results are summarized in the following table:

Test Item	Power Degradation	Visual Inspection	Insulation Wet Leakage Current Test
High temperature dynamic mechanical	2.74%	Passed	Passed
High temperature static mechanical load test	0.42%	Passed	Passed
High temperature non-uniform load testing	0.22%	Passed	Passed

## 6.6 Outdoor empirical test

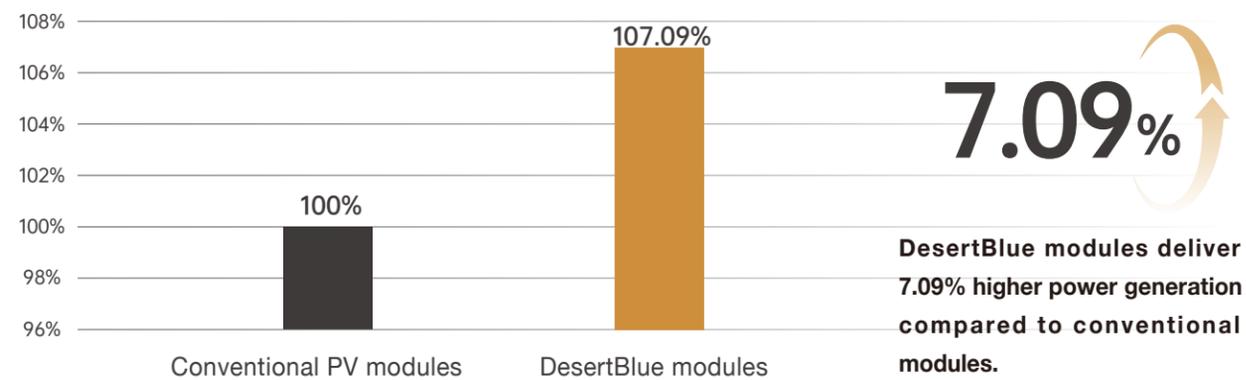
### 6.6.1 JA Solar's Shanghai Fengxian Base simulation empirical test

The core innovation of this test lies in adopting artificial sand spreading simulation. By precisely controlling the sand particle size, the weight and spreading duration, a highly accurate replication of wind-blown sand erosion on the surface of PV modules in Desert-Gobi-Wasteland environments has been achieved. The test focused on observing and analyzing the multiple impacts of sand dust on modules, particularly the power generation enhancement resulting from the anti-dust adhesion capability of module surfaces.

This rigorous scenario-based testing enabled JA Solar to not only accumulate valuable data on module power generation performance in dusty environments, but also validate the exceptional weather resistance of Desert-Gobi-Wasteland modules. This provides robust data support and reliability validation for the widespread application of products in harsh environments such as deserts, Gobi area, and wastelands, ensuring that customers' PV power plants can maintain high efficiency and stable operation even under severe sand and dust conditions.

At JA Solar's Fengxian Base, DesertBlue modules achieved a 7.09% power generation gain compared to conventional modules during the statistical period.

Outdoor performance test (Simulated Heavy Dusty Conditions)



📍 JA Solar Fengxian test site | 🕒 Data period: July 1 - July 10

🏗️ Installation angle: 38 degrees  
 🧼 No artificial cleaning or maintenance was performed during the test period.

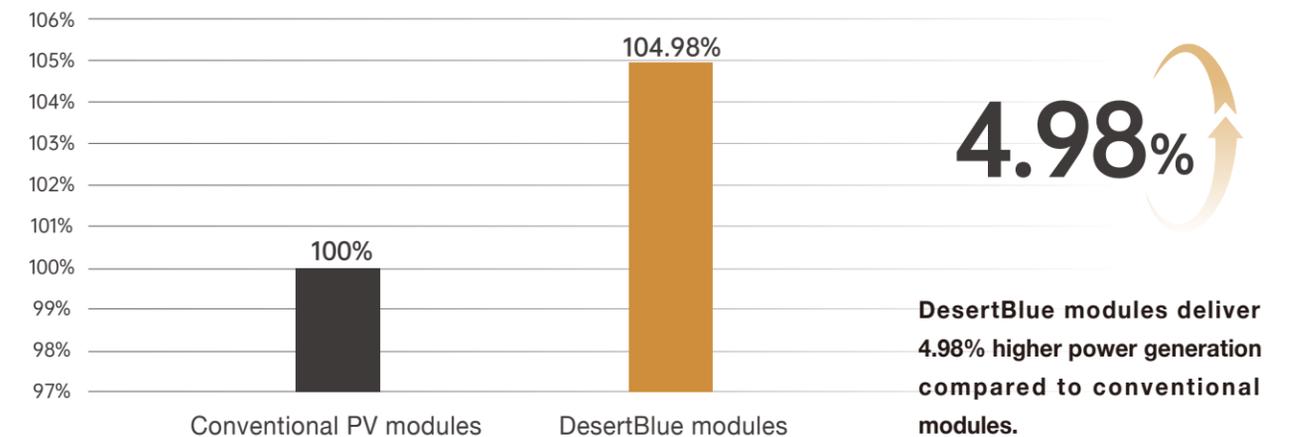
### 6.6.2 Empirical test in Ulan Buh Desert, Inner Mongolia

JA Solar established an empirical test base for Desert-Gobi-Wasteland modules in Ulan Buh Desert, adopting a 2P mounting. The power generation data of Desert-Gobi-Wasteland modules and conventional modules were monitored to compare their performance differences.

After nearly four months of empirical test data collection, DesertBlue modules demonstrated a 4.98% power generation increase compared to conventional modules. Further validation was obtained for the power generation advantages of Desert-Gobi-Wasteland modules in specialized application scenarios.



Outdoor performance test



📍 Ulan Buh Desert - Bayan Gol Town, Dengkou County, Bayannur | 🕒 Data period: May 27 - Sept 24

🏗️ Installation angle: 38 degrees  
 🧼 No artificial cleaning or maintenance was performed during the test period.

### 6.6.3 Empirical tests at Tengger desert post office, Inner Mongolia

JA Solar, in collaboration with TÜV NORD has established an empirical test platform in the Tengger Desert, a region characterized by a typical temperate continental desert climate with notably pronounced annual and diurnal temperature variations. In summer, the maximum temperature can soar above 40°C, while in winter, the minimum temperature can plummet to below -25°C. Additionally, this location is situated in a wind-prone corridor, experiencing relatively high average annual wind speeds and frequent sand and dust activities. During non-sandstorm conditions, due to aerosol suspension and slight wind-induced dust lifting, the daily natural sedimentation of sand and dust can reach tens to hundreds of grams per square meter. This not only results in sustained abrasive effects on the glass surface of PV modules caused by strong winds carrying fine sand particles, but also significantly impairs the modules' light absorption capability due to dust adhering to their surfaces, ultimately leading to a reduction in power generation.

The project evaluated the actual power generation performance of dust-resistant PV modules through outdoor energy generation monitoring. The performance was comprehensively evaluated by calculating the Watt-hour power generation capacity and PR value of the modules, combined with temperature data statistics.

The project achieved grid connection on October 2025, with power generation data under continuous monitoring.



### 6.6.4 Xinjiang demonstration project

The Xinjiang region enjoys abundant sunshine, with an annual sunshine duration of approximately 3,000 to 3,200 hours, making it one of the regions richest in solar thermal energy resources. The Turpan region features abundant solar resources and extreme aridity. The annual average temperature is 13.9°C, with over 100 days exceeding 35°C. The extreme high temperature in summer reaches 49.6°C, with ground surface temperatures typically exceeding 70°C and a recorded peak of 82.3°C. The average annual precipitation is 16.4 mm, while the annual evaporation exceeds 3000 mm.

Xinjiang is a pivotal region for construction of China's "Desert-Gobi-Wasteland" large-scale wind and solar power bases. The empirical test data collected here can directly support large-scale PV projects in Xinjiang and across the entire Northwest region, providing precise first-hand data for site selection, design, equipment selection, and O&M. This enables power plants to achieve lower levelized cost of electricity (LCOE) and higher return on investment (ROI) throughout their entire lifecycle.

The project was completed in October 2025, with power generation data currently under monitoring.



## 07 | Economic Analysis of Desert-Gobi-Wasteland Solutions

**Desert-Gobi-Wasteland Solution – DesertBlue modules deliver comprehensive value to customers across construction, operation, and power generation systems.**

DesertBlue modules significantly reduce initial investment costs of projects in deserts, Gobi areas, and wastelands, achieving 0.003 CNY/W savings in grounding costs, along with 0.04 CNY/W and 0.025 CNY/W savings in cleaning robot costs for China and the Middle East markets respectively.

During the operational phase, taking a 100 MW desert power plant as an example, manual cleaning (dry brushing) frequency can be reduced by half, saving 240,000 CNY annually and 6 million CNY cumulatively over 25 years. In Northwest China and the Middle East, robotic cleaning (dry brushing) operating costs over 25 years can also achieve savings of 7 million CNY and 5.4 million CNY respectively.

In terms of power generation, the Ulan Buh Demonstration Project (Inner Mongolia Energy, IME) utilizes DesertBlue modules, which demonstrate a 4.98% increase in energy yield compared to conventional modules.

The immense customer value generated can be largely attributed to JA Solar's profound insights into the harsh environmental conditions of deserts, Gobi area and wastelands, as well as its meticulous understanding of customer-specific requirements. As a trusted green energy solutions partner for global customers, JA Solar has been deeply involved in numerous Desert-Gobi-Wasteland PV projects, identifying four major challenges: fine particulates in dust, large-particle abrasion, high load under strong wind, and extreme temperature and UV. Through technological innovation, these challenges have been systematically addressed, delivering highly reliable and high-return module solutions to customers.



## 08 | Summary and Industry Significance

**JA Solar's Desert-Gobi-Wasteland Solution—the launch of DesertBlue modules epitomizes the company's deep commitment to PV technology R&D and its precise alignment with market demands in the solar energy sector.**

In reliability testing, DesertBlue modules not only strictly comply with IEC requirements but also implement significantly more rigorous test conditions to validate their exceptional durability and stability in extreme environments. Specifically:

**Hotspot test:** The operating temperature range of PV modules has been elevated from the  $55 \pm 15^\circ\text{C}$  specified in IEC 61215-2 to  $80 \pm 5^\circ\text{C}$ , significantly enhancing the evaluation rigor of module resistance to hotspot under high-temperature conditions.

**UV aging test:** The cumulative irradiance has been significantly increased from  $15\text{kWh/m}^2$  as required by the IEC 61215-2 standard to  $220\text{kWh/m}^2$ , verifying the material's outstanding weather resistance and UV degradation resistance under more stringent conditions..

**Mechanical stress test:** In addition to conventional dynamic and static load tests, ultra-high limit loads of 6000/4000 Pa have been introduced, with coupled high-temperature conditions to simulate structural reliability under combined thermal-mechanical stresses in real operating environments.

**Sand and dust test:** By simulating the sand and dust friction caused by wind and sand, cleaning and installation, etc., the wear resistance of the front panel glass of the component is verified to ensure that it can effectively resist the loss of power generation efficiency caused by surface wear throughout its entire life cycle.

JA Solar's DesertBlue modules transcend industry benchmarks, setting a new performance standard. Their exceptional temperature coefficient and bifacial energy generation capability ensure stable and efficient power output under harsh conditions, including extreme heat, desert environments, and high-albedo surfaces. The product has successfully passed more stringent testing per IEC standards, guaranteeing over 25 years of reliable performance for solar power plants. This solution delivers an optimized LCOE and superior long-term returns, making it an outstanding choice for sustainable energy investments.

This white paper is **TÜV NORD**-certified, fully demonstrating JA Solar's global leadership in extreme-environment PV technologies. In the future, JA Solar will continue to collaborate with partners to drive innovation and application of high-reliability PV products, providing sustained momentum for the global clean energy transition.

JA SOLAR

**DUST OFF. POWER ON.**

