

# CSIR PHOTOVOLTAIC MODULE QUALITY AND RELIABILITY TESTING LABORATORY

Advancing solar excellence through  
science, innovation and reliability



science, technology  
& innovation

Department:  
Science, Technology and Innovation  
REPUBLIC OF SOUTH AFRICA



**CSIR**  
Touching lives through innovation

# INTRODUCTION

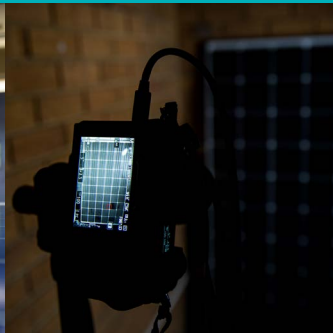
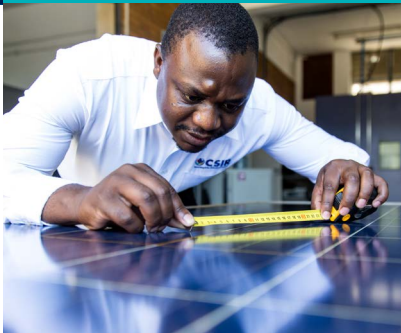
The CSIR Photovoltaic (PV) Module Quality and Reliability Testing Laboratory is Africa's first dedicated facility for independent PV module testing. Equipped with world-class infrastructure, the laboratory evaluates performance, safety and long-term durability under simulated environmental conditions.

Through rigorous pre-construction testing, we ensure that only high-quality PV modules suited to South Africa's unique and demanding climate are deployed in solar energy projects.

## OUR VALUE PROPOSITION

### World-class testing infrastructure

Our laboratory features advanced systems that replicate real-world environmental stresses, enabling precise and independent validation of PV module performance.

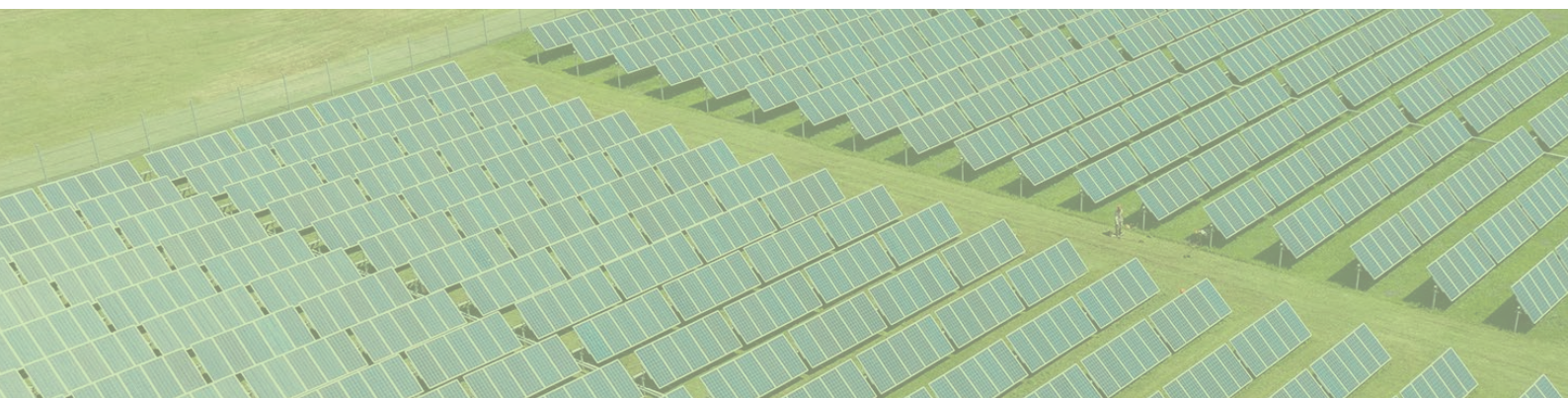


## ISO/IEC 17025 ACCREDITED

Testing is conducted under ISO/IEC 17025 accreditation and complies with IEC 61215:2021, the international benchmark for PV module design qualification and warranty validation. We are accredited for 15 test methods.

## TECHNICAL EXPERTISE

Our multidisciplinary team brings extensive experience across PV technologies, delivering accurate testing, trusted analysis and strategic technical guidance.



# OUR UNIQUE CAPABILITIES

## 1. ACCELERATED STRESS TESTING

We simulate years of environmental wear within weeks of identifying failure mechanisms early. This testing applies to both new and in-service modules to assess degradation and validate long-term reliability.

### Key tests include:

- **Thermal cycling**  
Simulates temperature fluctuations to stress interconnects and detect failures from expansion and contraction. This test is conducted between  $-40\text{ }^{\circ}\text{C}$  and  $85\text{ }^{\circ}\text{C}$  to simulate these operating conditions.
- **Humidity freeze testing**  
Evaluates the durability of lamination, junction box adhesion, and edge sealing under extreme conditions. This test is conducted between 85% humidity and  $85\text{ }^{\circ}\text{C}$ , followed by sub-zero temperatures ( $-40\text{ }^{\circ}\text{C}$ ).
- **Damp heat testing**  
Assesses resistance to prolonged heat and humidity, stressing encapsulation materials and backsheets, at 85 % humidity and  $85\text{ }^{\circ}\text{C}$  for 42 days.
- **Mechanical load testing**  
Simulates wind and structural loads to evaluate module strength and integrity.

## 2. ADVANCED CHARACTERISATION EQUIPMENT

- **Sun simulator**  
Measures current–voltage characteristics and power output across varying irradiance and temperature conditions, verifying performance and quantifying degradation. High-Potential Electrical Tester (Hypot).  
Detects insulation failures under wet and dry conditions, ensuring long-term electrical safety.
- **Electroluminescence imaging**  
Reveals internal defects such as microcracks, inactive regions, corrosion, and diode failures. This inspection method detects approximately 90% of the module defects that affect energy generation.

Our proprietary AI-driven deep learning models automatically identify and quantify 12 electroluminescence (EL) image defect types, enhancing diagnostic accuracy and predictive reliability.

- Speed and agility
- Rapid turnaround
- Efficient workflows ensure fast delivery of results, accelerating project timelines.
- Flexible testing protocols
- Customised testing programmes tailored to specific client requirements and environmental conditions.
- Accessibility and collaboration
- Strategic location, conveniently located at the CSIR campus, accessible to both local and international clients.

## COLLABORATIVE APPROACH

We partner with manufacturers, developers and investors to deliver tailored, project-specific testing solutions.

## OUR COMPETITIVE ADVANTAGE

- **Competitive pricing**

Premium testing services delivered at cost-effective rates.

- Cost risk reduction
- Early defect detection prevents costly failures, replacements and performance losses post-installation.
- Thought leadership in solar PV research

**The CSIR PV laboratory is a leader in Africa, combining:**

- Accelerated stress testing
- Artificial intelligence and machine learning
- Automated performance monitoring
- Advanced fault detection systems

Our integrated approach enhances the accuracy, diagnostic capability and predictive power of PV module reliability testing.

## OUR EXPERTISE

- Solar cell and PV module research and development
- PV module reliability and quality testing
- Machine learning and data science in PV systems
- Semiconductor engineering and technology management



## WHY ENGAGE WITH US?

- Unmatched expertise
- Industry-leading knowledge and experience in PV technologies
- Rigorous testing
- Assurance that your modules meet the highest global standards.
- Innovative solutions
- Access to cutting-edge technology and AI-driven analytics.
- Trusted partner
- Proven track record and collaborative engagement model.

## CONTACT US

### **CSIR Photovoltaic (PV) Module Quality and Reliability Testing Laboratory**

**Contact:** Manjunath Basappa Ayanna

**Email:** pvlab@csir.co.za

**EXPLORE THE FUTURE OF RELIABLE, HIGH-PERFORMANCE SOLAR PV SOLUTIONS.**