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Solar PV Module
Test Chamber



4634 Orkney Drive, Missouri City 77459, Texas

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PRESENCE

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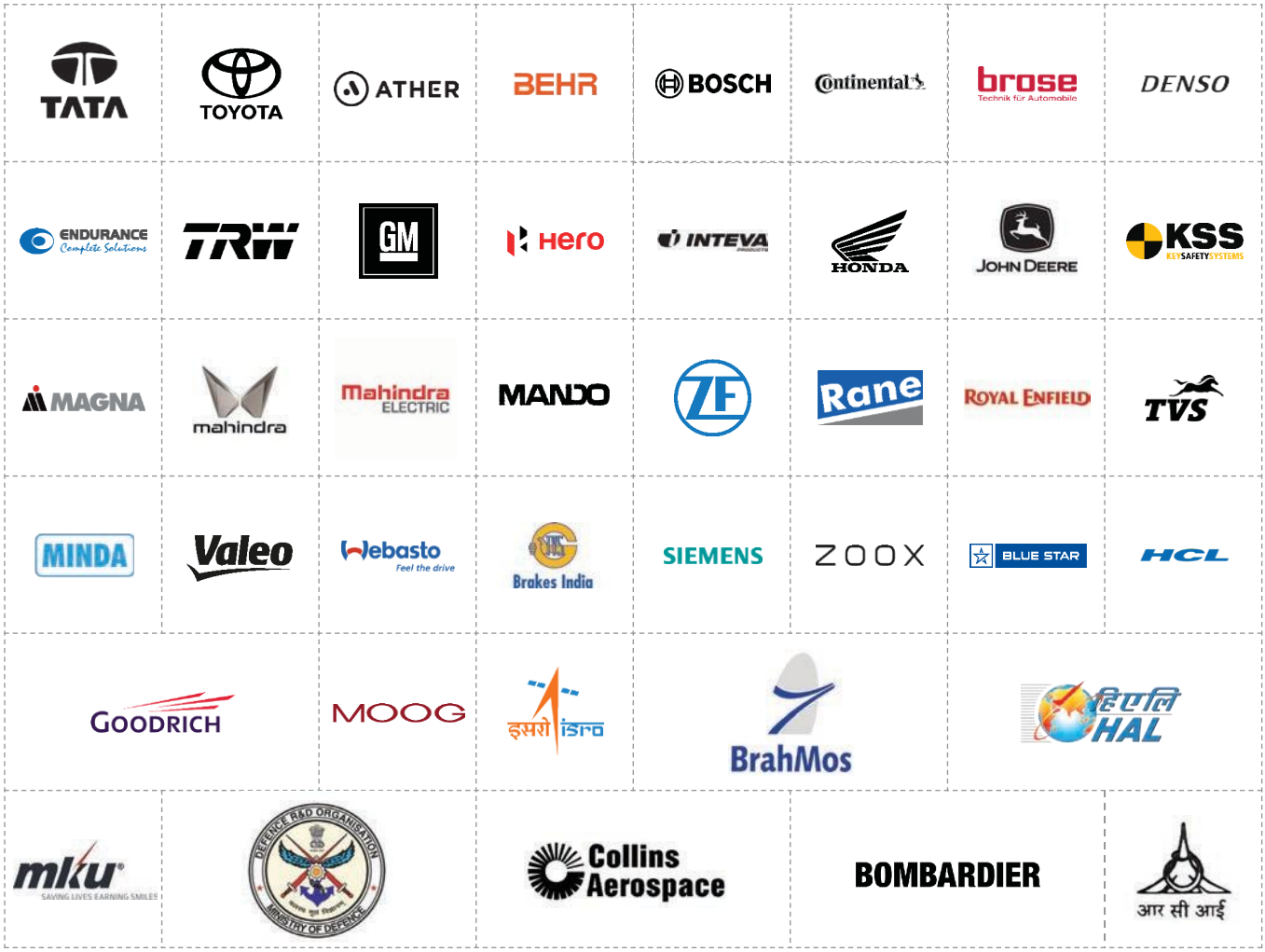
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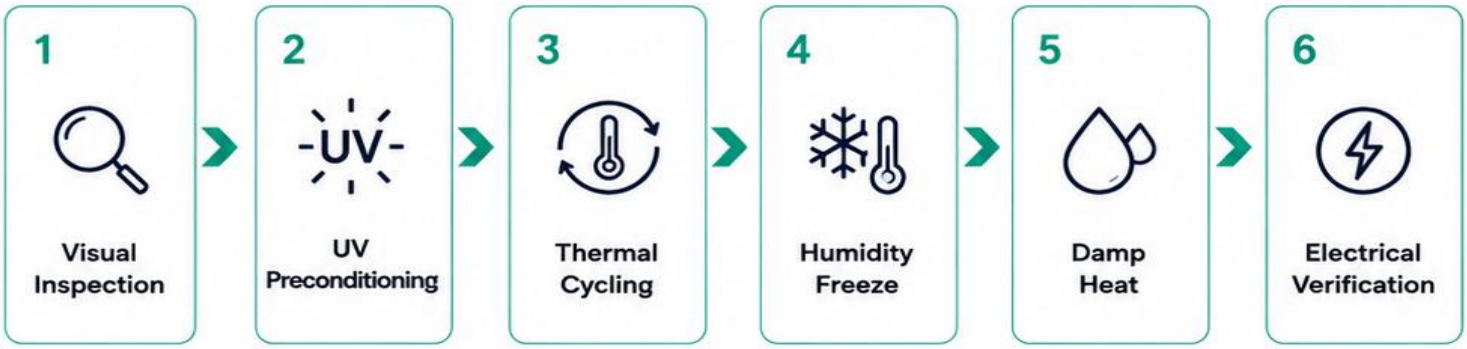
THEY TRUST US

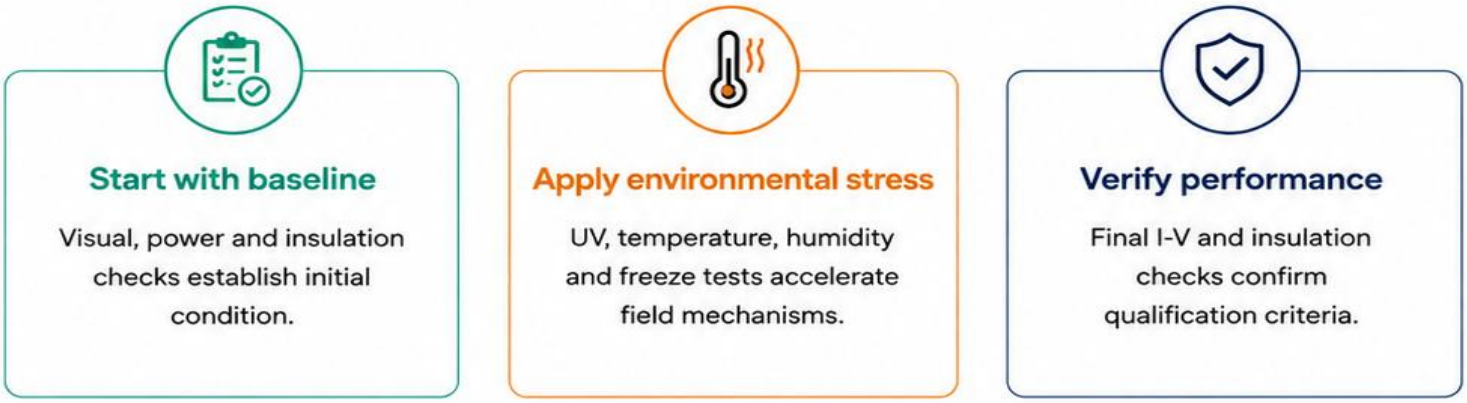



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SAVING LIVES EARNING SMILES
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IEC Qualification Flow

Simplified sequence for environmental qualification and electrical verification





Test Standards

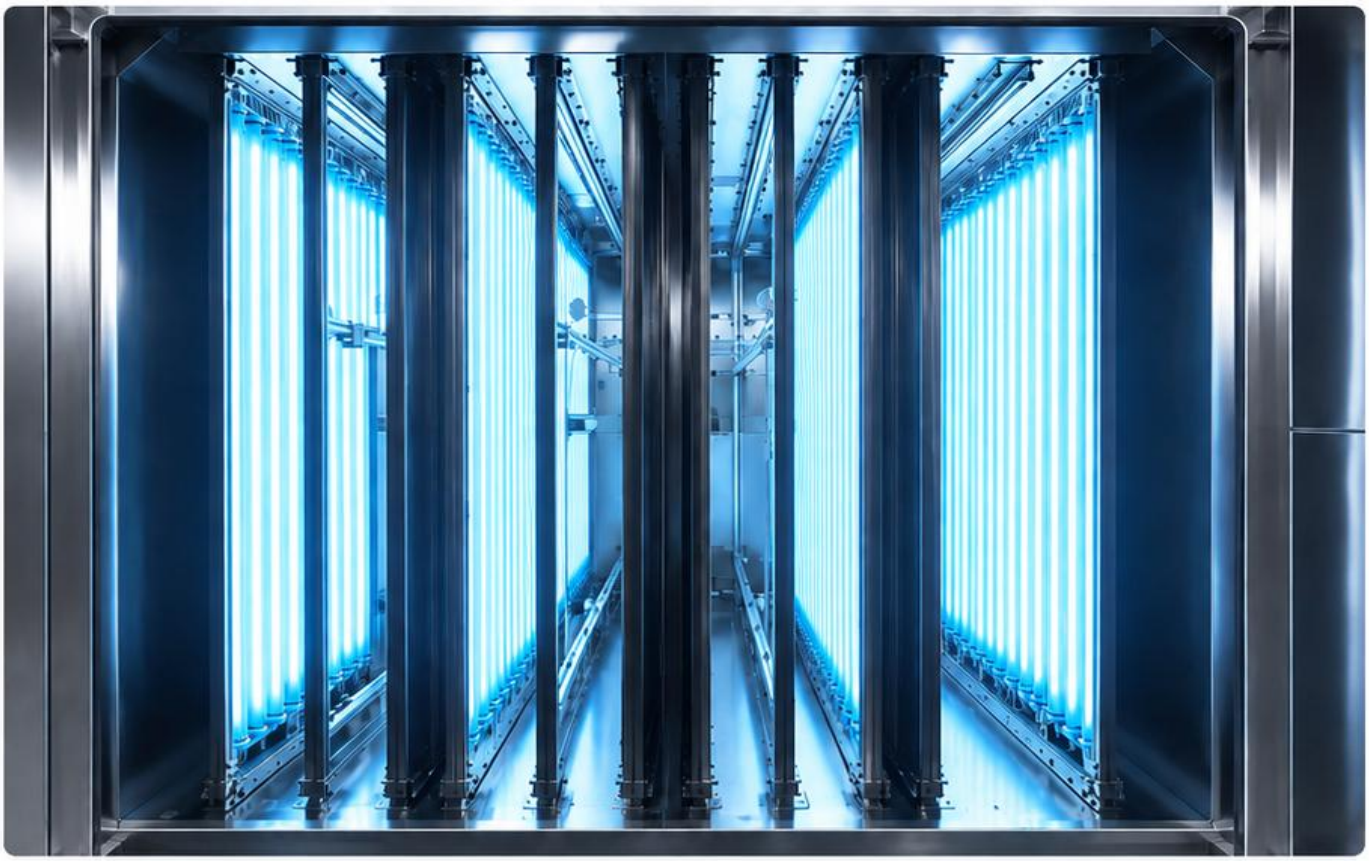
Test Standard	Test Standard Description
IEC 61215	Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification Temperature Cycling: -40°C to +85°C for 50 and/or 200 cycles Humidity Freeze: -40°C to +85°C & 85% RH for 10 cycles Damp Heat: +85°C & 85% RH for 1,000 hours
IEC 61646	Thin-film terrestrial photovoltaic (PV) modules - Design qualification Temperature Cycling: -40°C to +85°C for 50 and/or 200 cycles Humidity Freeze: -40°C to +85°C & 85% RH for 10 cycles Damp Heat: +85°C & 85% RH for 1,000 hours
IEC 61730	Photovoltaic module safety qualification Part 2: Requirements for testing
IEC 62108	Concentrator photovoltaic (CPV) modules and assemblies - Design qualification
UL 1703	Flat Plate Photovoltaic Modules and Panels
ASTM E1171	Test methods for photovoltaic modules in cyclic temperature and humidity environments

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UV PRE-CONDITIONING CHAMBER

Standards Compliant Testing

IEC 61215 – UV Pre-Conditioning Test for PV Modules | Full-size PV modules | UV Tubes | Metal Halide



Model		MWC9500UV	MWC15KUV
Test Space Dimension	in mm (WxDxH)	1400 x 2900 x 2350	2250 x 2900 x 2350
	in inches (WxDxH)	55 x 114 x 93	89 x 114 x 93
Test Space Volume	in Ltrs	9500.	15000.
	in Cu.ft	336.	530.
Temperature Range	°C	60.	
	°F	140.	
No. of Panels	No.	2.	
Type of Panels		Monofacial	Bifacial

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IEC UV Chamber Requirements

A controlled dose of UV energy is applied at elevated module temperature

15 kWh/m²
UV Dose

280–400 nm
Wavelength

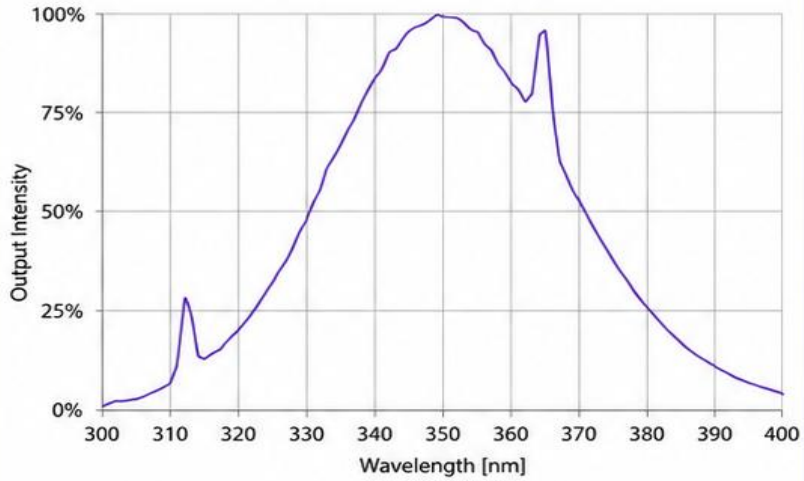
60°C ±5°C
Module Temperature

MPP Load
Near maximum power

Key aspect of this test

IEC UV testing requires not only the specified total UV intensity but also compliance with the defined UVA and UVB spectral distribution.

Some metal halide lamp systems can achieve the required total irradiance while failing to meet the required UVA/UVB balance. True IEC compliance is achieved through precise spectral control using a carefully selected combination of UV lamp technologies.



UV Spectrum

Major Performance Criteria

- UV Irradiation : At least 15 kWh/m2
- Wave Length : Between 280 nm and 400 nm
- UVA Range : 320–400 nm
- UVB Range : 280–320 nm
- UVB ratio (between 280 nm and 320 nm) : From 3–10%
- Wavelengths between 280 nm and 400 nm does not exceed 250 W/m2
- UV irradiance uncertainty : within ±15% across the solar panel
- Temperature Range : Module temperature maintained at 60 ± 5°C
- Temperature Monitoring : Using thermocouples attached to the module surface

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Thermal Cycling Test Chamber

A repeated temperature cycle from freeze to high temperature

Temperature Range
Typically cycled between **-40°C and +85°C** as specified in industry standards.

Number of Cycles
Usually **200 cycles** for qualification testing (depending on the applicable standard and test sequence).

Temperature Transition Rate
Controlled heating and cooling rates to prevent unrealistic thermal shock while meeting the standard requirements.

Dwell Time
Adequate holding time at both the high and low temperature extremes to ensure the entire module reaches the specified temperature.



Specifications

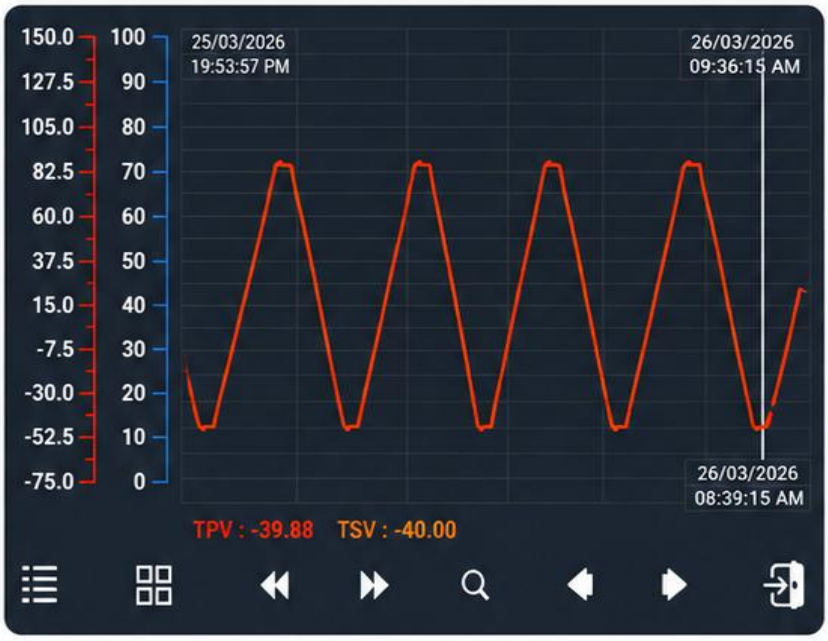
Model		MWC5600TC	MWC16KTC
Test Space Dimension	in mm (WxDxH)	1200 x 2600 x 1800	3000 x 2800 x 1900
	in inches (WxDxH)	47 x 102 x 71	118 x 110 x 75
Test Space Volume	in Ltrs	5600	15960
	in Cu.ft	198	564
Temperature Range	°C	-40 to +85	
	°F	-40 to +185	
Ramp Rates	100 deg C/Hour		
Panel Size	in mm (WxDxH)	50 x 2300 x 1400	50 x 2500 x 1500
No of panels	Nos	10	25

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IEC THERMAL CYCLING PROFILE

A repeated temperature cycle from freeze to high temperature

Actual Test cycle time not exceeding 6 hours



-40°C → +85°C
Temperature Range

200 cycles
Qualification Cycle Count

100°C/hr
Maximum Ramp

10 min
Minimum Dwell

Critical parameters

- At any transition of temperature the ramp rate should be a maximum of 100oC/Hour

CHAMBER DESIGN CONSIDERATIONS

The chamber must reproduce stress profiles consistently across loaded modules

FAST TRANSITION

High-capacity refrigeration and heating support controlled ramps.

AIRFLOW UNIFORMITY

Uniform temperature prevents over- or under-testing modules.

LARGE PANEL LOADING

Fixture and airflow design must support full PV panels.

ACCURATE CONTROL

Repeatable sensors, calibration and logging are critical.

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HUMIDITY FREEZE TEST CHAMBER

MAJOR PARAMETERS

- **Temperature Range** : Typically cycled between -40°C and +85°C as specified in industry standards.
- One complete humidity freeze test cycle shall be completed within **24 hours**.
- The module shall be maintained at **85°C and 85% RH** for a minimum of **20 hours** during each cycle.
- The total time for **cooling from 85°C to -40°C and heating back from -40°C to 85°C**, including a minimum **30-minute dwell at -40°C, shall not exceed 4 hours**.
- The chamber shall achieve the specified **temperature transition rates** while maintaining the overall **24-hour cycle duration** and complying with the applicable test standard.



TEMPERATURE RANGE
-40°C to +85°C

CYCLE DURATION
One complete cycle within 24 hours

HUMIDITY CONDITION
85°C and 85% RH for minimum 20 hours per cycle

MINIMUM DWELL
30-minute dwell at -40°C

TRANSITION RATE
Temperature transition rates as per applicable test standard

Model		**MWC5600HF**	**MWC16KHF**
Test Space Dimension	in mm (WxDxH)	1200 x 2600 x 1800	3000 x 2800 x 1900
	in inches (WxDxH)	47 x 102 x 71	118 x 110 x 75
Test Space Volume	in Ltrs	5600	15960
	in Cu.ft	198	564
Temperature Range	°C	-50 to +120	
	°F	-58 to +248	
Ramp Rates		Options: 100 deg C/Hour or 200 deg C/Hour	
Climatic Range	in °C	+10 to +85	
	in °F	+50 to +185	
Humidity Range		10 to 98% RH	
Panel Size	in mm (WxDxH)	50 x 2300 x 1400	50 x 2500 x 1500
No. of Panels		10	25

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IEC HUMIDITY FREEZE PROFILE

A combined humidity and freeze cycle stresses moisture-prone interfaces

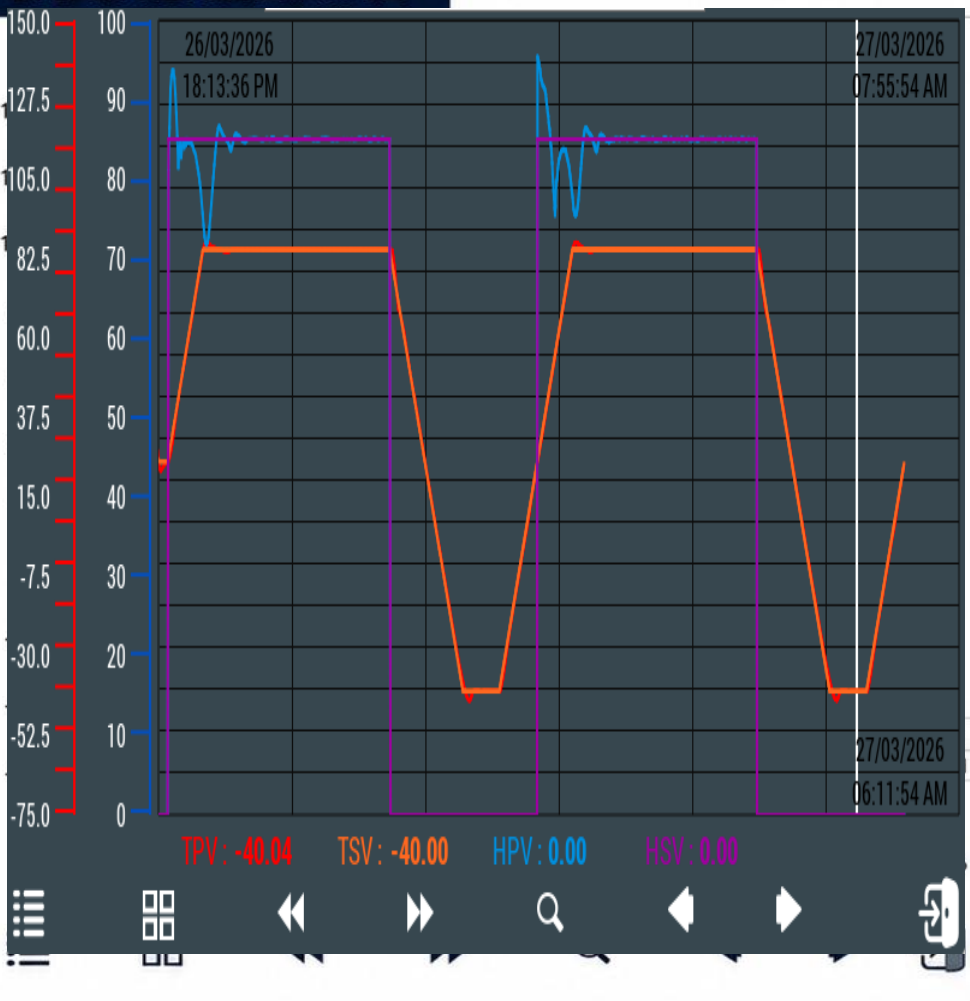
85°C
High Temperature

85% RH
Humidity Dwell

-40°C
Freeze Point

10 cycles
Cycle Count

CYCLE PROFILE EXAMPLE



EVALUATES

Hot humid daytime exposure

Simulates prolonged exposure to high temperature and humidity conditions.

Transition into cold night freezing

Represents rapid cooling and transition to sub-zero temperatures.

Interface stress from moisture expansion

Evaluates stress on module interfaces caused by moisture ingress and freezing.

PURPOSE

- Evaluates the durability of PV modules against the combined effects of high humidity followed by freezing temperatures, which can induce moisture ingress, delamination, and mechanical stress.

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DAMP HEAT TEST CHAMBERS

Long-Term Humidity Reliability Testing for PV Modules and Electronic Systems. Damp heat testing exposes products to prolonged high temperature and high humidity conditions to accelerate aging mechanisms such as corrosion, insulation degradation, delamination, and moisture induced electrical failures.



STANDARDS COMPLIANT TESTING

IEC 61215 – Damp Heat (DH) Test for PV Modules | Full-size PV modules | Product Temperature Control

1000 Hours Uninterrupted Exposure

85°C Temperature

85% RH Humidity

Steady State Profile

High Reliability Long-Term Stability

Precise Control Accurate & Consistent

SPECIFICATIONS

Model		MWC16KDH
Test Space Dimension	in mm (WxDxH)	3000 x 2800 x 1900
	in inches (WxDxH)	118 x 110 x 75
Test Space Volume	in Ltrs	15960
	in Cu.ft	564
Temperature Range	°C	+80 to +85
	°F	+176 to +185
Ramp Rates		NA
Humidity Range		85% RH
Panel Size		50 x 2500 x 1500
No of panels		25

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IEC DAMP HEAT CONDITIONS

A long-duration steady-state test at high humidity and high temperature

1000

hours uninterrupted exposure

Tropical climates
High ambient humidity and heat

Coastal installations
Salt, moisture and corrosion pressure

High humidity environments
Long wet dwell times

25+ years moisture exposure
Accelerated ageing signal

85°C	85% RH	Steady state
Temperature	Humidity	Profile



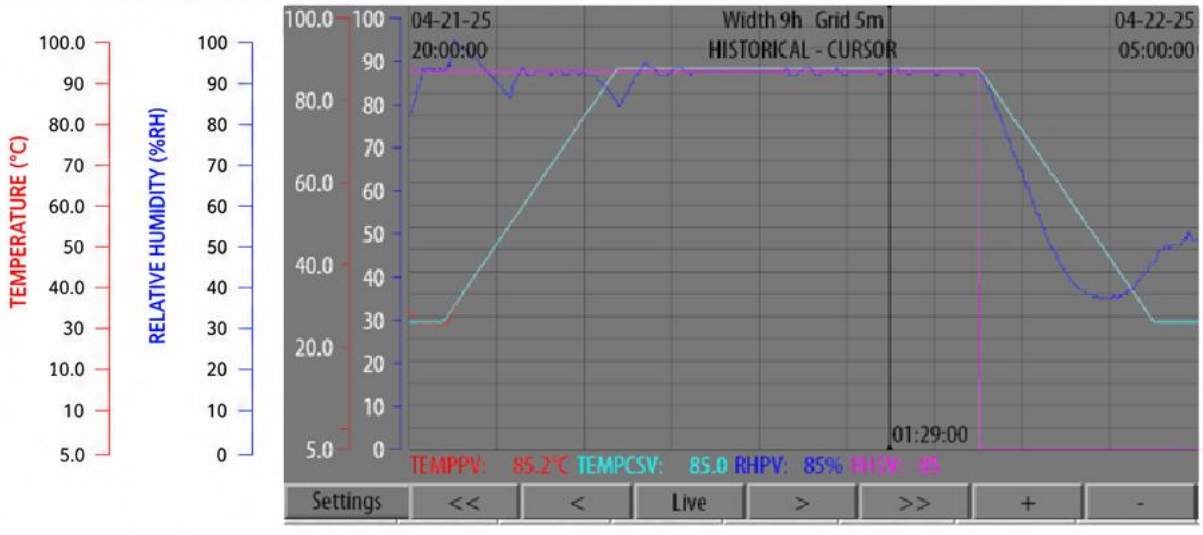
Purpose

- Evaluates the long-term durability and reliability of PV modules under prolonged exposure to high temperature and high humidity

Major Parameters

- Maintains the chamber at **85°C** and **85% RH** continuously for the duration specified

DAMP HEAT PROFILE (TYPICAL EXAMPLE)



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CME UV TECHNOLOGY

FLUORESCENT UV LAMP

UV-FL/VHO-180W-2M-38D LAMP

180W UV Fluorescent Lamp (280–400nm)

PRODUCT OVERVIEW

The UV-FL/VHO-180W-2M-38D is a high-intensity Broad band Fluorescent UV lamp engineered for applications requiring strong UV output in the 280–400 nm wavelength range. The lamp delivers stable performance, high irradiance and long useful life.

KEY FEATURES

- Broad band wavelength
- UV output in 280–400 nm range
- Energy distribution across wavelengths
- High Irradiance Stability
- Electronic or magnetic ballast compatibility
- High reliability for continuous operation

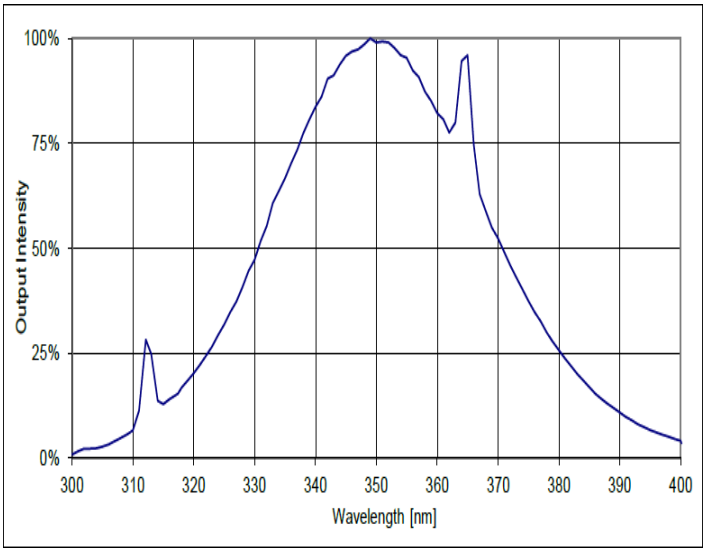
APPLICATIONS

- IEC 61215 UV Preconditioning
- Photovoltaic (PV) Module Testing
- Automotive Industry
- Electronics Industry
- Environmental simulation chambers
- UV exposure and aging tests
- Material degradation

TECHNICAL SPECIFICATIONS

Note: A spectral power distribution chart (280–400 nm) is shown in the original datasheet illustrating prominent emission peaks in the 340–360 nm range.

PARAMETER	SPECIFICATION
Lamp Type	UV Fluorescent Lamp
Rated Power	180W
Spectral Range	280 – 400 nm
Lamp Length	2000 mm
UVA	9%
UVB	4%
UVC	0%
Starter	EN 60155
Ignition	External Ballast Required

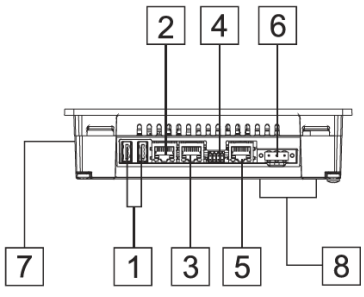


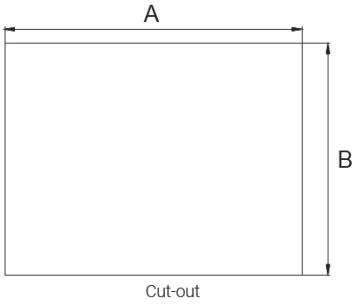
enviCoM™ 4.0

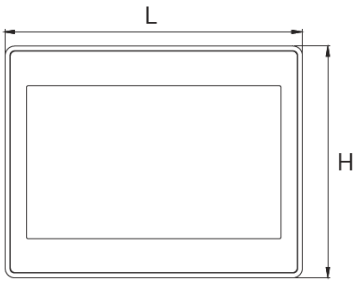
Open architecture control platform for connected environmental testing

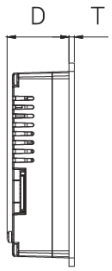


- Industry 4.0 Product Concept
- HW and FW Optimised for Extremely Fast Operation
- System and Project Rapid Boot-Up
- OS Linux RT
- JMobile – the software that powers the X Platform
- CODESYS V3 with Ethernet I/O Stacks
- Multitouch and Gesturing
- Brilliant Display
- Wide Angle Visibility
- Beautiful 16,000,000 Colors
- Resistant to Scratches, UV and Chemicals
- Total Glass Design
- Network Separation possibile via Up to 3 Ethernet
- Networks with different IP addresses
- Plug in Modules for System Expansion
- IECEx, ATEX, DNV-GL, UL certification: Ordinary and Class 1 Div 2







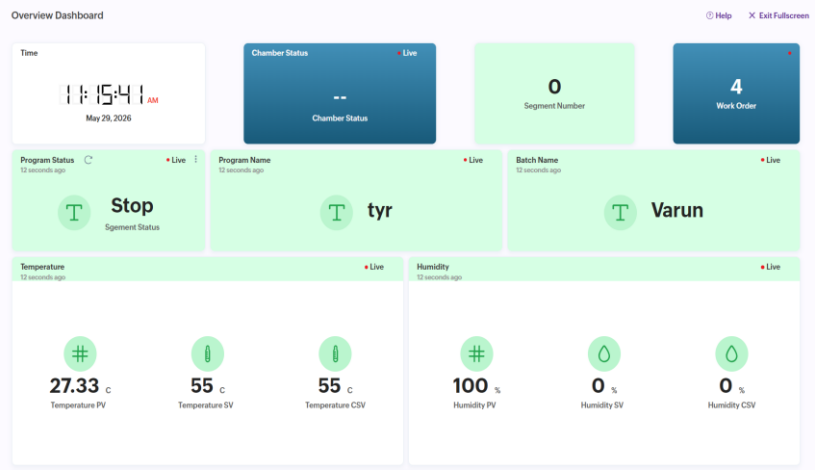


1 USB ports 1 and 2
2 Ethernet port 2 (10/100 Mb)
3 Ethernet port 1 (10/100 Mb)
4 Serial port
5 Ethernet port 0 (10/100/1000 Mb)
6 Power supply
7 SD Card slot
8 2 Expansion slots for plugin modules

Ethernet port	3 (port 0 - 10/100/1000, port 1 - 10/100, port 2 - 10/100)
USB port	2 (Host V2.0, max. 500 mA)
Serial port	1 (RS-232, RS-485, RS-422, software configurable). Max 3 serial ports using plug-in modules.
SD card	Yes
Expansion	2 slot for plug in modules

Levito IOT:

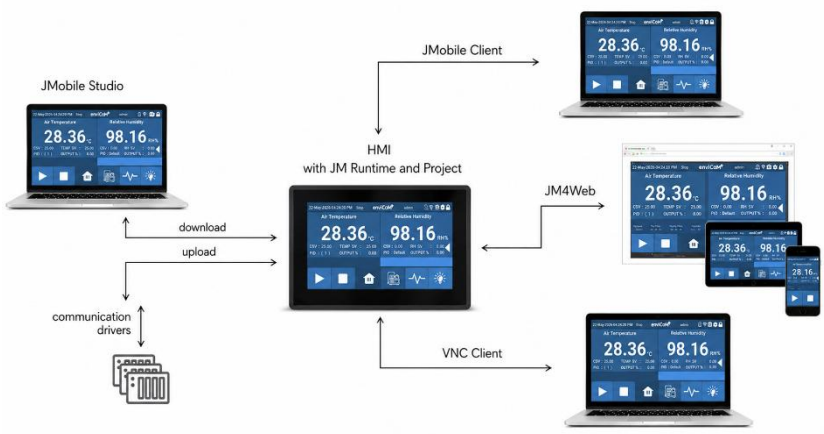
MQTT and IoT cloud layer for dashboards, alerts, and analytics



- MQTT broker enables IoT communication for industrial sensors and machines
- Levito IoT cloud provides real-time monitoring and remote visibility
- Dashboards track temperature, humidity, compressor status, and energy
- Alarm notifications, maintenance reminders, and cycle-end reports
- Cloud backup supports historical analysis and reporting

J-Mobile Remote Diagnostics & Support:

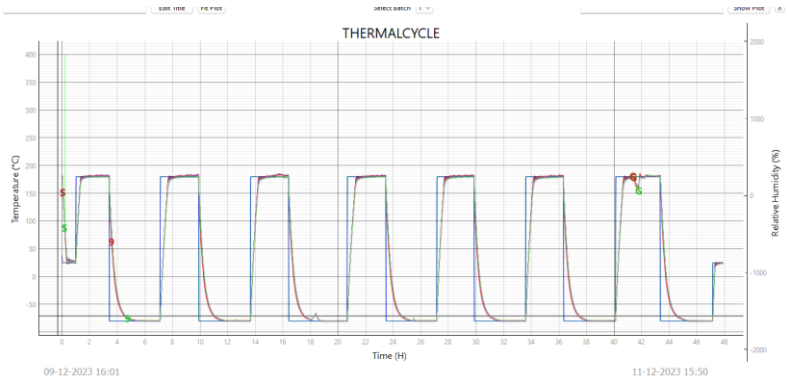
Mobile remote monitoring, notification, and troubleshooting support



- Monitor temperature, humidity, setpoints, and chamber status in real time
- Remote start/stop and basic operational control
- Alarm and event notifications for quick response
- Secure authentication with access-level management
- Remote diagnostics help reduce downtime and speed support

enviCoM™ 4.0 Reports

CSV-to-report workflow with graphs, alarms, events, and PDF output



- Convert CSV batch files into formatted reports
- Generate graphical test data representation with alarm codes
- Create PDF reports with test results and custom report fields
- Produce alarm, event, and historical data reports