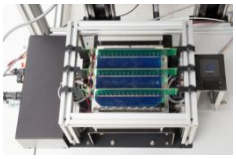
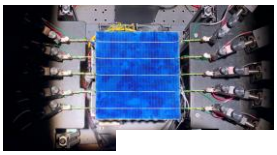
High Performance Test Fixtures
For Reliable IV Testing of all types of Solar Cells

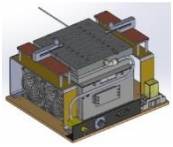
Standalone, Multi-busbar, Bifacial, Busbar free & Cut-cell Test Fixtures & more

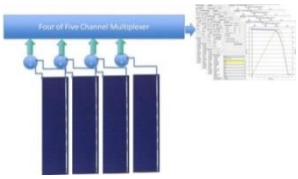
KEY FEATURES

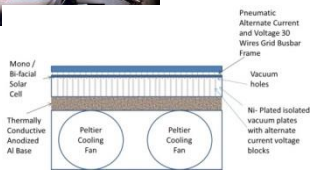
- Testing of solar cells (small to 300mm x 300mm)
- Fast reliable measurements with minimum contact resistance
- Measures up to 12 Busbar Si solar cells
- No shadowing from busbars
- Integration option with 10°C – 150°C Peltier temperature control fixture
- Two system configurations for measuring Bi-facial solar cells
- Special test fixture for measuring Busbar-free Si solar cells
- Unique design for measuring Si Cut-cells
- Intergrates with OAI IV Optimized Software and solar simulators











OAI provides various types of vacuum test fixtures to accurately measure solar cell IV curves. These test fixtures come in the following key configurations:

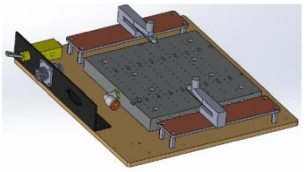
1. **Standard Test Fixture with Micro-manipulators**
2. **Multi-busbar Test Fixture: 2 to 12 Busbars**
3. **Bi-facial Test Fixture – Two approaches**
4. **Busbar-Less Test Fixture**
5. **Si Cut-cell Test Fixture with Multiplexing Function**

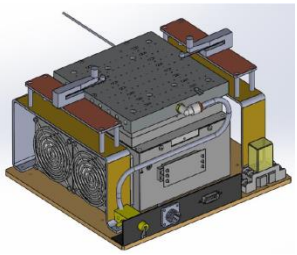
Solar Cells ranging from 2”x@” up to 12”x12” casn be tested in the high performance test fixture. The Cut-cell fixture provides the measurement of 156mm x 31.2mm or 156mm x 39mm and other sizes Si solar cells. OAI’s test fixtures also come with upgrade option to Peltier / Air Cooling system to control chuck temperature from 10°C to 70°C, with additional option up to 150°C. These custom fixtures can be further optimized and used to measure **Mono, Multi and Multi-busbar Si, Bifacial, Busbar-free, Si Cut-Cell, GaAs, CdTe, a-Si:H, Organic, Perovskite**, and various other thin film solar cells.

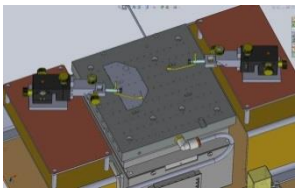
The unique test fixture design, including the busbar, probe and station provide good contact with minimum contact resistance. Combine OAI’s IV Rider Software, Test Fixture and Solar Simulator, for a system system providing the most accurate IV Measurements.

- www.oainet.com
- sales@oainet.com

1. Standard Test Fixture with Micro-manipulators





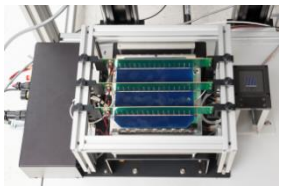


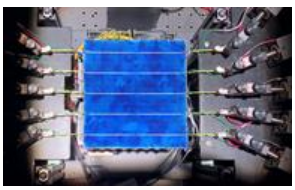
The standard vacuum test fixture comes in various custom sizes from 2”sq to 12”sq along with two or more micro-manipulators and probe stations. The vacuum chuck is manufactured from Al or Cu plate which can also be black anodized to isolate it from the active layers and back contacts on the solar cell. The test fixture comes with standard or custom design isolated voltage and current pins positioned per the required cell structure. This provides an ability to perform IV measurement with solar cells having either all contacts facing towards the chuck or having contacts on both top and bottom faces of the solar cell. The test fixture allows 4 – probe I-V measurements to yield high accuracy when connected to a source meter. These test fixtures also come mounted with an irradiance monitoring solar cell.

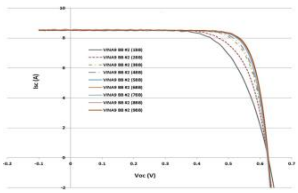
The Test Fixtures can also be upgraded with a Peltier / Air Cooling system to provide temperature control from 5°C – 150°C with accuracy of ±0.5°C. The system operates at 110VAC-220VAC, 50 – 60Hz

Note: The test fixture comes with 2 micro-manipulator (x-y-z joysticks) probe kits and a vacuum pump.

2. Multi-Busbar Test Fixture: 2 to 12 Busbars





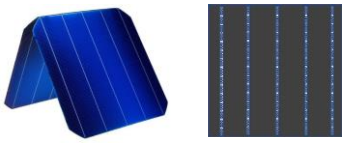


The Muilti busbar Test Fixture is pneumatically controlled and manual loading 156mm x 156mm Si Solar Cell Test Fixture with Peltier temperature upgrade. It comes in standard three busbars configuration. The vacuum chuck is made with Al or Cu back plate that comes with a vacuum pump to hold samples down. The back plate provides a number of isolated voltage pin contacts . The back plate itself provides sensing of the current. The contact pins are spring loaded and comes with either flat or flower tips.

The busbars are fabricated using a 0.787mm to 1.2mm thick PCB board designed with 15 pairs of isolated voltage and current probe pins pairs. The distance between the two pin pairs is kept at a distance to minimize the voltage drop. In addition, for multiple busbars (≥5), a combination of micro-manipulators can also be used to collect accurate Isc. The system can be integrated with 0.787mm thin bus bars and can includeup to 12 busbars. These busbars provide a minimum shadowing of the Si Solar Cells. The shadowing can be resolved by adding a correction factor in IV Rider oftware and first measuring Isc using micro-manipulators, as shown in the picture on right.

The test fixture can also be upgraded with a Peltier / Air Cooling system to provide a temperature control from 5°C – 150°C with accuracy of ±0.5°C. The system operates at 110VAC-220VAC, 50 – 60Hz

3. Bi-facial Test Fixture – Two Approaches

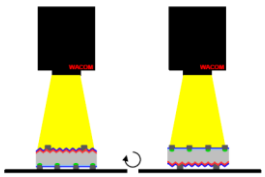


Approach 1:

OAI offers an advanced approach and system configurations to measure bifacial solar cells, as shown

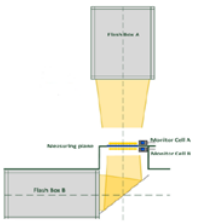
***Approach 1*:** This allows for the use of a special test fixture with a hard black anodized 156mm x 156mm vacuum plate. The top surface is a non-conductive plate. The test fixture contains the slots for up to 12 busbars having 15 sets of 3 source -sense pins. The isolated source sense pins are spring loaded. The probe pins can be either flat or flower tips.

To make the top contact on the bifacial solar cell busbars, the test fixture also comes integrated with a pneumatically controlled and manual loaded multi busbar frame.



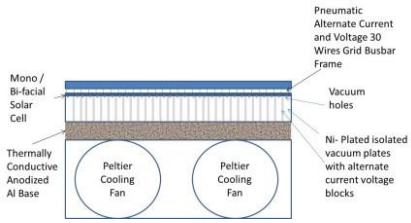
Approach 2:

Approach 2: This This fixture test are from both the top and bottom side using a Station which has two solar simulators installed with beams facing vertically downward and upward. The test procedure follows the IEC 60904-1-2 guidelines. This system comes with a unique non-reflective test fixture with special wire contacts which touch the bifacial cell busbars and provides the contact. The top simulator can be used to provide intensity up to 1.2 Suns and the bottom simulator intensity can be adjusted up to 0.25 Suns.



4. Busbar-Less Test Fixture

This pneumatically controlled 156mm x 156mm vacuum test fixture with manual substrate loading provides a unique configuration for most accurate I-V measurements for both mono ,bi-facial and n/p type busbar-less solar cells having grid patterns. As shown in the picture on right, the top pneumatic frame contains about 30 wires of ~250um diameter and is placed at an optimal distance of ~5mm to minimize resistive losses. These wires provide alternate current and voltage connections on the top of the cell. The busbar-less solar cell is placed on the vacuum fixture plate which is Al, Ni or Cu plated and contains vacuum holes to hold the solar cell down. The test fixture has ~30 blocks of isolated vacuum plates with a polished convex surface that run perpendicular to the top grid wires. These electrically isolated vacuum plates are also placed at ~5mm gap and provide an alternate current and voltage connection to the bottom of the solar cell. The illumination of the solar cell takes place from the top grid side of the test fixture. The convex surface of the vacuum test fixture provides a good and firm contact of the top grid wires with proper tensile force to the solar cell.



The Test Fixtures can also be upgraded with a Peltier / Air Cooling System to provide a temperature control from 5°C – 150°C with accuracy of ±0.5°C. The system operates at 110VAC-220VAC, 50 – 60Hz.

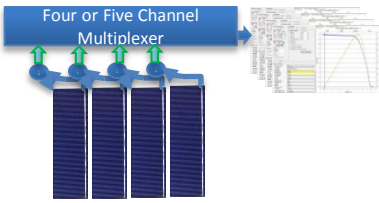
5. Si Cut-cell Test Fixture with Multiplexing Function

This 156mm x 156mm text fixture provides a unique capability to measure 4 to 5 Si Cut-cells simultaneously **(each size: 156mm x 31.2m or 156mm x 39mm or any custom size).**

The System comes with unique vacuum chuck which is fabricated with an Al or Cu vacuum plate and holds from 4 to 5 Si Cut-cells down. The back plate provides a number of isolated voltage pin contacts under each cut cell. The vacuum plate itself provides sensing of current. The contact pins are spring loaded and come with either flat or flower tips.

The system also comes with pneumatically controlled and manual ly loaded 4 – 5 buss-bars to provide contact with the solar cells from the top on each of the cut cells. Note that each bus bar is isolated with respect to each other.

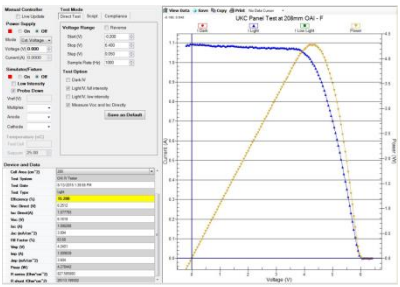
The system will also come with required 4 – 5 SMUs of each size 3A and a 5 channel multiplexer to connect and IV Software to measure all 4 -5 Si Cut-cells simultaneously with a single exposure in <150msec.



The Test Fixtures can also be upgraded with a Peltier / Air Cooling system to provide a temperature control from 5°C – 150°C with accuracy of ±0.5°C. The system operates at 110VAC-220VAC, 50 – 60Hz
Note: The unit comes with a separate temperature controller to adjust the cell temperature using the OAI OPTIMZED IV Software.

OAI OPTIMIZED IV SOFTWARE

- Optimizes the numerical calculations and parameters as recommended by NREL for IV test data
- Allows IV testing at the optimized voltage sweep rate to minimize solar cell's capacitance response.
- Runs sweeps in both forward Isc to Voc bias and reverse Voc to Isc bias directions to arrive at optimized testing conditions.
- Provides the measurement values of contact resistance and gives Isc,, Voc, FF, Rs, Rsh, Imax, Vmax, Pmax and Efficiency from an IV curve.
- Comes with multiplexing sequential I-V Measurements of several cells at a single exposure
- With I-V curve normalization and software upgrades, the software collects the reference ratio with respect to deviation from STC conditions for Intensity and temperature and provides an accurate normalized I-V curve.
- **The OAI** Optimized IV Software Package includes the software, computer, moniter, irrandiance monitoring kit, cables and connectors..



- **OAI 464 S. HillviewDrive, Milpitas, CA 95035 408-233-0600**
- **www.oainet.com sales@oainet.com**