Enhanced Reliability – 670W Vertex Module
Extreme weather conditions such as strong winds, heavy snow, and hail present serious challenges for all PV module manufacturers, in mechanical performance terms.
Trina Solar Vertex Family
Trina Solar – Pioneering Ultra-high Power Modules

- Vertex modules are available from 410 to 670W+ in power, covering all applications.
- In various applications, Vertex output is 35W to 90W higher than the industry average, BOS savings in range of 0.5~1.6 c USD/W.
Enhanced Tests
670W - Proven Mechanical Performance

- High reliability ensures extended power generation
- All tests conducted by independent 3rd parties
- All test samples are randomly picked from mass production (DEG21C.20)
- Mechanical load and warranty should comply with latest official Trina Solar User Manual and Trina Solar Warranty
Static Load
Equivalent Level to Traditional Modules

670W Module reliability simulations evaluating wind and snow resistance.

Fixed tilt
- Static load: +5400Pa/-2400Pa

Tracker
- Static load: +3600Pa/-2400Pa
- Static load: +2400Pa/-2400Pa

Vertex non-destructive cutting cell

Conventional cutting cell

Conventional module structure

670W Vertex module structure
Non-uniform Snow Load Tests

2.8M Snow Load Endurance

The modules are installed at an incline - the test stress is applied at the bottom and gradually increased.

7000Pa, 2.8 m of snow

Post testing, power degradation is only 0.56%.

*Test modules: 210-670 bifacial and dual-glass modules, clamping installation
Static Load Test Under -40°C

Enhanced Mechanical Load Characteristics

Mechanical load test under (-40°C): Working in extreme low-temperature environments is one of the critical situations, which can result in reduced mechanical performance/damage.

*Vertex 670 single and dual glass modules with cross-beam screw installation: static load criteria +5400Pa/-2400Pa

Dependable in extreme low-temperatures
Hail Impact
35mm Hail Impact Resistance

Simulated impact of different sized hail on module output.

<table>
<thead>
<tr>
<th>Hail size</th>
<th>Power degradation</th>
<th>Trina test results</th>
<th>Tests passed</th>
</tr>
</thead>
<tbody>
<tr>
<td>25mm</td>
<td>&lt; 3%</td>
<td>35mm</td>
<td>0.17%</td>
</tr>
<tr>
<td>35mm</td>
<td>0.53%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Single glass —— hail test

<table>
<thead>
<tr>
<th>IEC standard</th>
<th>Trina test results</th>
<th>Tests passed</th>
</tr>
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<td>Hail size</td>
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Dual glass —— hail test

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Trina test size

IEC test size
Enhanced Dynamic Load Test

±1000PA @20000 Cycles Passed

During their lifecycle, modules endure long-term dynamic stresses on their upper and back sides. The frame, cells and BoS are subjected to fatigue stress which can be simulated by dynamic load testing.

"IEC62782: DML±1000Pa: positive and negative cycles 3~7 time/min, 5.6h/1000times"

Test results: after 1000Pa dynamic load in 20,000 cycles, - power degradation was only 0.1%.

7.5 times IEC standard
Single glass module

4 times standard
Dual glass module

20 times (clamping) strength than standard

Note: National Key Laboratory for PV Science and Technology
Wind Tunnel Test
62m/s Extreme Wind Performance

Wind tunnel test: One of the best methods to verify mechanical stability. Wind loads applied from 30m/s to 62m/s, each lasting 30 second. Once target wind speed is achieved and stabilized, test is maintained for 900 seconds.

<table>
<thead>
<tr>
<th>Wind speed (m/s)</th>
<th>Reference module (530W)</th>
<th>Trina Vertex module (670W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.53</td>
<td>Slight vibration.</td>
<td>Slight vibration.</td>
</tr>
<tr>
<td>45.80</td>
<td></td>
<td>The surface of the module distorts in the middle; severe vibration</td>
</tr>
<tr>
<td>59.54</td>
<td>Mounting failed with module under test blown away</td>
<td></td>
</tr>
<tr>
<td>62.60</td>
<td>/</td>
<td>Under highest wind speed the module experiences damage</td>
</tr>
</tbody>
</table>

Vertex 53m/s wind test:

<table>
<thead>
<tr>
<th></th>
<th>30° tilt</th>
<th>45° tilt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screw</td>
<td>Pass</td>
<td>Pass</td>
</tr>
<tr>
<td>Hybrid</td>
<td>Pass</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Robustness of Vertex module outperforms reference module
Installation Tips
The Installation Method Strongly Impacts System Stability.

Enhanced Installations >
To optimize for extreme weather such as heavy snow or strong winds Trina Solar recommends hybrid installation methods to ensure better system stability.

Hybrid Fixation
Clamp + Bolt
210 Vertex modules: over 18GW of signed orders

- **Spain**: 176MW & 202MW
- **Hebei LingShou**, China: 50MW
- **Hebei NanGong**, China: 400MW
- **Hubei LuoTian**, China: 100MW
- **QingHai DaChaiDan**, China: 112MW
- **Bison Energy**, Vietnam: 2.85MW
- **Vietnam**: 40MW, HoChiMinh & Hanoi
- **NA 4,000MW**: Building
- **Brazil**: 715MW & 850MW
- **Yulin**, China: 100MW
- **Singapore**: 60MW
- **Vietnam Vinh Long**: 49.3MW
- **Vietnam**: 50.6MW
- **Vietnam HoChiMinh & Hanoi**: 40MW
- **Building**
- **Done**
SUMMARY

1. The Vertex 670W module achieves outstanding mechanical load performance.

2. Verified in enhanced tests for extreme weather conditions such as strong wind, heavy snow, extreme cold and hail.

3. The installation method strongly impacts system stability. Hybrid fixation is recommended for extreme weather conditions.
THANKS!