LINEX

Inline Wet Process Equipment for Cleaning of New Cell Formats Like PERC – HJT – TOPCon – Tandem & more
PV Technology Powers the World

SINGULUS TECHNOLOGIES provides technology solutions for both crystalline and thin-film high-performance solar cell platforms.

SINGULUS TECHNOLOGIES is an established equipment supplier with customers producing crystalline and CIGS/CdTe solar cells. SINGULUS TECHNOLOGIES cooperates with cell manufacturers worldwide and develops processes, which improve the efficiency of solar cells and at the same time reduce production costs. Evolutionary improvement in cell concepts like PERC - HJT - TOPCon – Tandem will drive the future of crystalline solar. SINGULUS TECHNOLOGIES’ expertise includes vacuum thin-film coating (PECVD, physical vapor deposition (PVD), evaporation), surface engineering, wet chemical processes and thermal processing.

Future Cell Concepts: TOPCon Solar Cells

Tunnel oxide passivated contacts (TOPCon Solar Cells) are based on an ultrathin tunnel oxide capped by a doped Si film exhibiting excellent passivation and contact properties. This cell design has so far resulted in efficiencies of up to 25.7%.

SINGULUS TECHNOLOGIES provides for the production of TOPCon high performance solar cells the important manufacturing steps: inline wet processing and vacuum deposition (PVD & PECVD).
LINEX
Inline Wet Process Equipment

SINGULUS TECHNOLOGIES provides complete automated dry-in/dry-out solutions for wet-chemical treatment of Si-wafers in standard high-efficiency cell lines.

The ongoing evolution of proven concepts in process management and the integration of innovative approaches are the basis for the development of a new generation of horizontal wet processing systems.

LINEX is an inline wet processing platform with horizontal substrate transport for Si wafers. The SINGULUS TECHNOLOGIES LINEX system combines an advanced transportation system and sustainable/innovative processing modules with proven and efficient chemical treatment.

In addition to proven processes, the focus is on new applications such as single side treatment, polish etching, emitter etching and ozone applications. The highly integrated design, high throughput, high availability and low breakage rates make LINEX very attractive for solar cell manufacturers worldwide.

Typical Performance Characteristics
→ Inline from R & D tool to the fully integrated 10 lane system
→ Alkaline process up to 90 °C possible in 5 or 10 lane systems
→ Polish etch up to 10 µm
→ Integration of ozone
→ Uniform media flow on wafer surface
→ Consistent flow conditions from lane to lane
→ Easy integration of new or additional process options
→ High uptime up to 98 %
→ High throughput and best performance
→ Low cost of ownership
→ Low breakage rate down to 0.01 %
→ Best footprint
→ SSE application up to 5 µm

Controlled – Precise – Intelligent
→ Fully automated inline wet process equipment with integrated process control
→ Compact process modules with innovative media and process management
→ Simple and robust wafer transport system
→ Shadow-free contact of the wafer top surface with the process media
→ Wafer tracking and wafer thickness measurement

Safe – Clean – User Friendly
→ Safe for operators, environment and for reliable processing
→ Cleanroom compatible design according to ISO and SEMI standards
→ Gentle wafer transport through the process media
→ Excellent accessibility of the process modules from all sides
LINEX Process Applications

**Final Clean** (Mono & Multi):
Wafer cleaning after separation, with ultrasonic & additives

**Alkaline Texture** (Mono):
Ultra short process time, superior aesthetics

**Single Side Etching**:
Single side etching of a-Si for TOPCon applications

**Single Side Polish** (Mono & Multi):
Acidic or alkaline rear side polishing up to 5 µm

**Ozone**:
Advanced cleaning technology

Advanced Production Methods for Crystalline Solar Cells

### LINEX Final Clean

- **Load**
- Alkaline/ Additive
- Ultrasonic
- Rinse
- Postclean
- Rinse
- Dry
- Unload

### LINEX ALTEX

- **Load**
- Preclean
- Rinse
- Alkaline Tex
- Rinse
- SINGOZON
- Rinse
- Dry
- Unload

### LINEX ALKALINE SSE

- **Load**
- Single Side Etching
- Rinse
- SINGOZON
- Rinse
- Dry
- Unload
## LINEX Technical Data

### LINEX FINAL CLEAN

<table>
<thead>
<tr>
<th></th>
<th>5 Lane (Mono)</th>
<th>5 Lane (Multi)</th>
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</thead>
<tbody>
<tr>
<td>Throughput</td>
<td>5000 wph</td>
<td>5000 wph</td>
</tr>
<tr>
<td>Velocity</td>
<td>3 m/min</td>
<td>3 m/min</td>
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<tr>
<td>Footprint</td>
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<td>6400 mm</td>
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### LINEX ALTEX Mono

<table>
<thead>
<tr>
<th></th>
<th>5 Lane*</th>
<th>10 Lane*</th>
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<tbody>
<tr>
<td>Throughput</td>
<td>5000 wph</td>
<td>10000 wph</td>
</tr>
<tr>
<td>Footprint</td>
<td>15000 mm</td>
<td>17000 mm</td>
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</table>

### LINEX SSE/Polish/PSG

<table>
<thead>
<tr>
<th></th>
<th>5 Lane*</th>
<th>10 Lane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throughput</td>
<td>5000 wph</td>
<td>10000 wph</td>
</tr>
<tr>
<td>Footprint</td>
<td>9800 mm</td>
<td>9800 mm</td>
</tr>
</tbody>
</table>

*linex ozone option available*
SINGULUS TECHNOLOGIES develops and assembles innovative machines and systems for efficient and resource-saving production processes, which are used worldwide in the solar, semiconductor, medical technology, consumer goods and data storage.

The company’s core competencies include various processes of coating technology, surface treatment and wet-chemical and thermal production processes.