

# SINGULAR

Static Inline Tool for High Uptime ICP-PECVD  
Anti Reflection Coatings



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# Static Inline AR Coating Tool for c-Si Solar Cells

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## SINGULAR – Innovative and Modular AR Coating Tool

Solar cell production is making the transition from the pioneering stage towards mass production. Innovative and flexible cell concepts demand a mass production solution which is equally innovative and flexible, as the leap there from the laboratory is the most expensive step in the development process.

SINGULAR is an ICP-PECVD coating tool for anti reflection coatings (ARC) for crystalline silicon solar cells. The tool offers an innovative static inline production (SIP) concept, which combines the advantages of static processing and inline substrate transport. During static processing, the substrates are not moved, facilitating layer stacks and gradient layers. The innovative ICP-PECVD process allows

perfect control over film composition and film density at high deposition rates (ICP – Inductively Coupled Plasma).

SINGULAR is a fully automated inline coating tool consisting of independent modules. The essential benefit of the static inline technology is the transport and process of small substrate production lots, which guarantees stable processes, continuous output, flexibility and a small footprint.

The first SINGULAR was delivered at the end of 2009 with the corresponding fully-automated wafer handling and buffering systems developed by SINGULUS. Since the beginning of 2010, the SINGULAR has been used in production lines for the manufacturing of silicon solar cells, delivering excellent efficiencies.

## Solar - Transition from Machine Supplier to System Provider

SINGULUS and STANGL are cooperating with leading cell manufacturers and institutes for the development of new technologies and plant concepts for improved cell concepts with higher efficiency and production technologies with decreasing production costs. The company's target is to position itself at the forefront for the introduction of new technologies with respect to silicon as well as thin film solar technology. In the coming years, SINGULUS will offer a broad range of new machines for the photovoltaics industry, providing manufacturers of both silicon and thin film cells new production technologies with cost advantages. This is of particular interest during periods of economic pressure in the photovoltaics market.

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### Main Features

- \_ For cells mono and multi cell, sizes 125 x 125 mm and 156 x 156 mm
- \_ Output up to 1,500 wafers/h for one SINGULAR
- \_ Up to three SINGULAR for a production line (up to 4,500 wafers/h)
- \_ High uptime due to inline chamber cleaning
- \_ Efficient raw material consumption
- \_ Optimized for lowest cost of ownership
- \_ Integrated automatic carrier loading/unloading system
- \_ Modular, highly integrated design
- \_ Short installation and ramp-up time
- \_ Small footprint

# Concept



## Fast, Economical, Flexible

SINGULAR is a redundant modular system, consisting of one, two or three self-sufficient SINGULAR linked to a production line. Each SINGULAR has an output of up to 1,500 wafers/h and is able to maintain its productivity during maintenance of other SINGULAR.

Additionally, uptime is high due to automatic inline chamber cleaning that does not interrupt the throughput during production.

The SINGULAR has its own proprietary automated handling for loading and unloading the wafers gently into the production carriers to minimize wafer breakage.

## Controlled, Precise, Intelligent

The proven SINGULUS servo concept provides cycle time optimized motion paired with a high level of reliability (> 8,500 installed SINGULUS systems worldwide).

The SINGULAR is prepared for “Manufacturing Execution System” (MES).

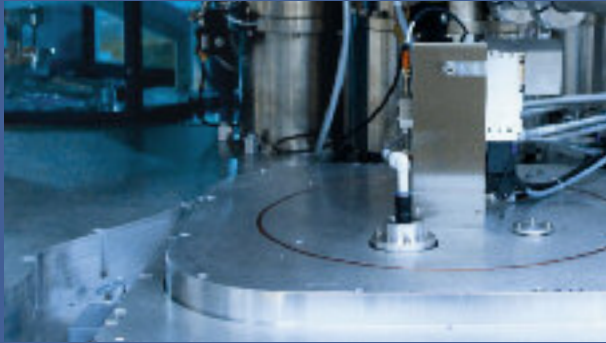
## Compact, Clean, User-Friendly

All vacuum pumps, electrical cabinets and power supplies are integrated into the machine frame, resulting in a small footprint with excellent accessibility.

The loading area includes a clean room to prevent contamination of the transported and processed wafers.

The SINGULAR conforms to CE, UL regulations and Semi S2 compliant. Operation is easy, with a touch screen and intuitive user interface.

# Main Components



## Substrate Carrier Loading/Unloading Module

- \_ One five-position turntable receiving substrate carriers, each transporting four wafers
- \_ One H-Handling unit to transfer the uncoated wafers from the incoming conveyor into the carriers and unload the coated wafers from the carriers to the outgoing conveyor
- \_ One camera system to position the incoming wafers very precisely into the substrate carriers

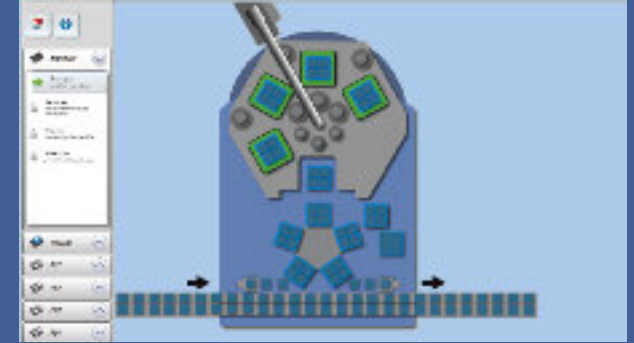


## Heating Station

The heating station is installed in the position next to the load lock. The maximum heating power density is up to 150 kW/m<sup>2</sup> for the whole array. This allows temperatures of up to 600 °C and heating ramps of up to 70 °C/s for the wafers (depending on the wafer type).

## ICP – PECVD Deposition Station

Standard are three independently controlled ICP-PECVD deposition stations. An additional fourth one can be integrated into main vacuum chamber for higher throughput or for additional



process steps like back side coating. The ICP-PECVD process allows perfect control on film composition and density at a high deposition rate (ICP – Inductively Coupled Plasma).

## Control Concept

The complete machine, including carrier loading and unloading module, is controlled via one central industrial PC. All safety interlocks are carried out by an additional integrated safety PLC. 19" touch screen displays allow convenient operation of the SINGULAR.

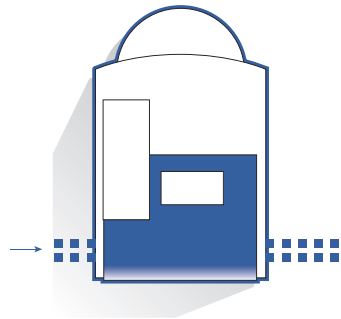
## Technical Data SINGULAR

<b>Wafer Materials</b>	Mono crystalline silicon, Multi crystalline silicon, UMG silicon
<b>Wafer Dimensions</b>	125 x 125 mm and 156 x 156 mm
<b>Wafer Thickness</b>	150 µm up to 270 µm

<b>Output</b>	up to 1,500 wafers/h (single SINGULAR) up to 3,000 wafers/h (two SINGULAR in a line) up to 4,500 wafers/h (three SINGULAR in a line)
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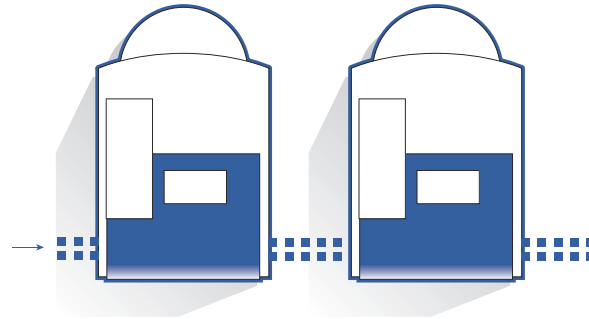
<b>Footprint</b>	3 x 5 m for each SINGULAR
<b>Main Voltage</b>	3/PE AC 400 V, 50 or 60 Hz
<b>Other Required Utilities</b>	cooling water, compressed air, process gases

### 1 SINGULAR – Single System



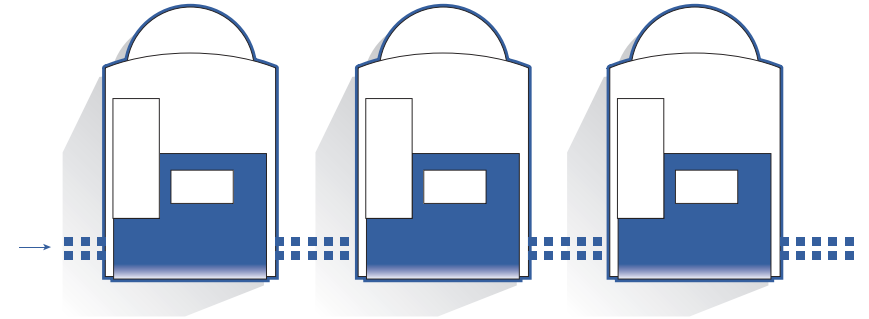
Capacity up to 1,500 wafers/h depending on configuration and process demands

### 2 SINGULAR – Dual System



Up to 3,000 wafers/h depending on configuration and process demands

### 3 SINGULAR – Triple System



Up to 4,500 wafers/h depending on configuration and process demands

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