



SILEX II

Batch Wet Processing
System for Solar Cells

SINGULUS 

SILEX II

Modular, Automated Wet Processing System for Batch Cleaning and Etching for Solar Cells

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

The modular SILEX II batch system offers a wide range of process options. With respect to highest flexibility in configuration, the SILEX II machine is characterized by a clear modular design and a compact footprint. The SILEX II machine concept fulfills current and future requirements of capacity, flexibility and reliability for mass production.

The SILEX II 12000 was specially designed for larger production volumes. With this mass production system about 550 MW annual capacity are possible for Heterojunction cell manufacturing.

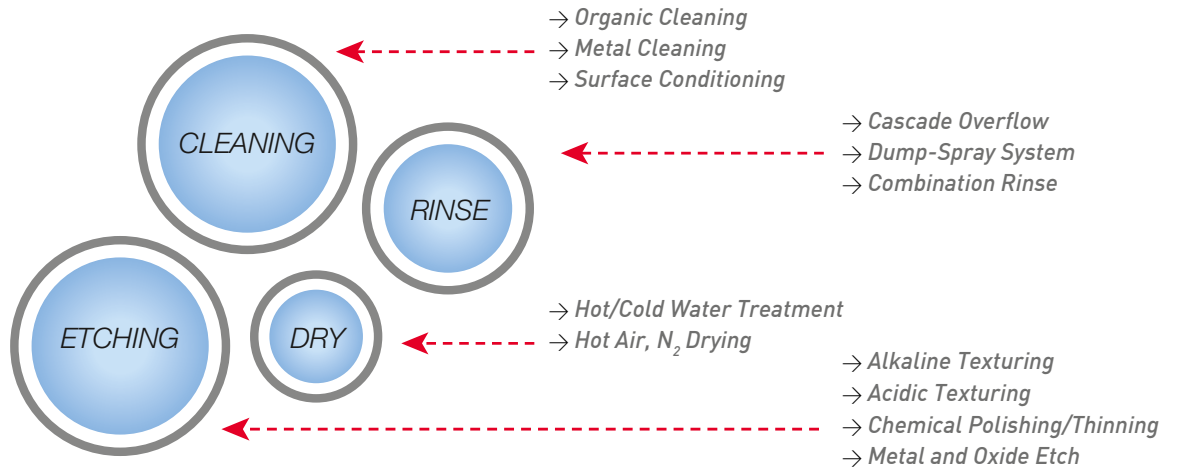
The SILEX II 8000 system achieves an output of up to 8,000 wph. The SILEX II 4000 system with a reduced batch size will cover a tool capacity of up to 4,000 wph for smaller volume production. All SILEX II systems are running with very low scrap rates down to 0.01 % and a high process yield.



SILEX II

Batch Wet
Processing Equipment

Common and Advanced Process Applications



SILEX II Batch Wet Processing Equipment

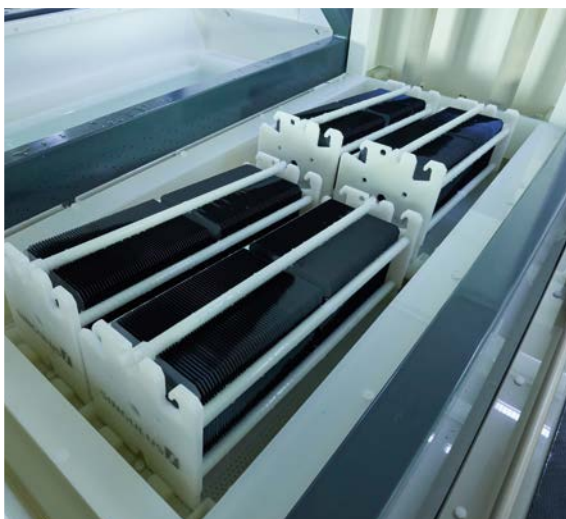
The **SILEX II ALTEX** machine is designed to apply IPA-free texturing processes, offering substantial cost advantages compared to traditional etching systems. This texturing process can be adjusted to the individual requirements of standard and advanced cell technologies.

The **SILEX II CLEANTEX** combines common etching and cleaning steps of monocrystalline Si with advanced cleaning and conditioning processes. Efficient cleaning steps are an indispensable requirement to improve cell efficiencies and reduce operation costs. Ozone-based cleaning operations, applied on SILEX II wet bench, combine efficient organic and metal removal with an appropriate surface conditioning. Due to low chemical costs and consumption, simple process control and high metal removal efficiency, ozonized cleaning baths are the perfect substitute for traditional, expensive multi-step RCA cleanings, known from the solar and semiconductor industry.

The **SILEX II CLEAN** is provided to run dedicated cleaning sequences for pre- or post-deposition processes. Depending on cell process flow and requirement the configuration can be designed individually, involving RCA or Ozone based cleanings as well as slight etching steps.

Typical Features

- High throughput performance up to 550 MW annual production
- High uptime up to 95 %
- Low breakage rate down to 0.01 %
- Wafer thickness down to 120 µm (wafer size M6) (<120 µm on request)
- Individual, flexible process sequencing
- Onboard scheduler software for throughput tuning
- Onboard performance analyzer software
- Ozone-enhanced cleaning and etching processes
- Short and stable IPA-free texturing process
- Appropriate and effective rinsing and drying



SILEX II

Technical Data

Application	Etching and cleaning of solar/IC wafers	
Throughput	Up to 12,000/8,000/4,000 wph	
Processes	Pre-clean SDE/texture Cleaning Rinse Drying	Alkaline, acidic Alkaline (CellTex®) Alkaline, acidic DIW overflow rinse Hot Air, Hot N ₂
Wafer	Size Thickness	M1-M6 <120 µm post process
Facilities	Liquid media Gases Exhaust Electrical power	DI water, chemicals Compressed air, N ₂ , O ₂ 400 VAC
Options	DI water heater Chiller Extended load/unload buffer Chemical supply systems Waste water pump stations SINGULUS process carrier (100 wafers) Ozone system	

¹ Standard configuration for CellTex® Process (BKM SINGULUS)

² 200/400 wafer batch

³ Standard configuration 2-steps clean

SILEX II

Advanced Wet Processing



Alkaline Texturing

The core of the current and future batch process applications is the alkaline texturing process of mono-crystalline silicon, generating pyramidal-etched surfaces with optimal light trapping, passivation and contacting properties.

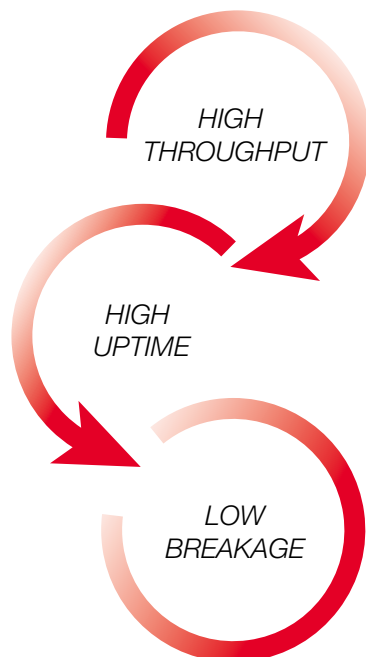
State-of-the-Art Texturing Additive

- Commercially available, worldwide supported
- Multiple pyramid size tuning options
- Short and robust etching process with large process window and close uniformity range
- Stable composition with long bath lifetime
- Non-hazardous, non-flammable, non-dangerous
- Readily biodegradable

Ozone Cleaning

Ozone is one of the most powerful oxidizing agents. Effective Ozone-gas injection, low chemical concentrations and ambient process temperatures guarantee stable and highly effective process sequences for oxidation, cleaning and etching.

- Reduced CoO cost saving effect vs. RCA cleaning (high chemical cost)
- Higher minority carrier lifetime (combined Si etch-back and advanced cleaning)
- Smaller machine footprint (reduced number of process tanks)
- Improved surface passivation
- Environmentally friendly process using





Headquarters

SINGULUS TECHNOLOGIES AG
Hanauer Landstrasse 103
63796 Kahl, Germany
Tel. +49 6188 440-0
Fax +49 6188 440-1130
sales@singulus.de
www.singulus.de

Production Site for Wet Processing Systems

SINGULUS TECHNOLOGIES AG
Branch Office Fuerstenfeldbruck
Fraunhoferstr. 9
82256 Fuerstenfeldbruck, Germany
Tel. +49 8141 3600-0
Fax +49 8141 3600-2100
sales@singulus.de

Subsidiaries

China
SINGULUS TECHNOLOGIES CHINA
Room B412-413,
No. 1400 Jiangchang Road,
Jingan District, Shanghai, China
Zip Code: 200072
Tel. +86 21 61073997

Contact: Greens Pan
Tel. +86 13822138376
greens.pan@singulus.com.cn

France
**SINGULUS TECHNOLOGIES
FRANCE S.A.R.L.**
Tel. +33 3 893111-29
singulus@club-internet.fr

Latin America
**SINGULUS TECHNOLOGIES
LATIN AMERICA LTDA.**
Tel. +55 1121 6524-10
sales@singulus.com.br

Singapore/South East Asia
**SINGULUS TECHNOLOGIES
ASIA PACIFIC PTE LTD.**
Tel. +65 674 119-12
sales@singulus.com.sg

Taiwan, China
**SINGULUS TECHNOLOGIES
TAIWAN LTD.**
Tel. +886 2 8692-6996
sales@singulus.com.tw

United States, Mexico and Canada
SINGULUS TECHNOLOGIES INC.
Tel. +1 860 68380-00
sales@singulus.com



THIN FILM
DEPOSITION

SURFACE
ENGINEERING

THERMAL
PROCESSING

WET
CHEMICAL

SINGULUS TECHNOLOGIES – Technologies for a Sustainable World

Responsible and sustainable corporate governance is very important to SINGULUS TECHNOLOGIES. SINGULUS TECHNOLOGIES develops and assembles innovative machines and systems for efficient and resource-saving production processes, which are used worldwide in the solar/hydrogen, semiconductor, medical technology, consumer goods and data storage sectors. SINGULUS TECHNOLOGIES regards sustainability as an opportunity to position itself with innovative products that follow this spirit. In the focus are:

- environmental awareness
- efficient use of resources
- avoidance of unnecessary CO₂ pollution

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