

CISARIS

Selenisation Furnace for an Optimized
CIGS Absorber Formation



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Introduction

SINGULUS TECHNOLOGIES is the world market leader in manufacturing mass production equipment for Optical Discs CD/DVD/Blu-ray. With the acquisition of the solar company STANGL, the foundation was laid to establish SINGULUS in the photovoltaics market.

Numerous new products were developed and made marketable at SINGULUS and SINGULUS STANGL SOLAR.

The company's target is to position itself at the forefront for the introduction of new technologies with respect to silicon and thin film solar

technology. SINGULUS will offer a broad product range of new machines for the photovoltaics industry. This selection will provide manufacturers of silicon cells new production technologies and therefore particular cost advantages. Especially during times of cost pressures in the photovoltaics market the interest regarding new cost efficient concepts increases.

Thin Film Solar Technology

Thin film solar panels offer specific advantages over to silicon solar technology. Amongst these are the retention of efficiency during periods of weak sun intensity and an easy integration into architectural design elements. SINGULUS is the

market leader for wet-chemical cleaning for CIS and CdTe processes. New production concepts such as the spray ion layer gas reaction (ILGAR®) process, expand the value-added chain in the area of thin film solar technology. 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 addition, SINGULUS will progress on the way to a system supplier in this solar segment, as well.





Main Characteristics CISARIS:

- _ Second generation inline selenisation furnace with optimized cycle time
- _ Rapid heating (up to ~ 4 °C/s) of large substrates with metal precursor coating (CIG)
- _ Homogeneous gas distribution and low gas consumption through optimized inlet system
- _ Introduction of H₂S (H₂Se) gas at various stages of the process possible
- _ Uniform heating of large substrates up to 550 °C by using optimized IR radiators for achieving the required crystal quality
- _ Uniform cooling of the substrate to avoid glass warpage
- _ Excellent temperature control (mean variation < 5 °C) at all process stages
- _ Process at atmospheric pressure
- _ Oxygen and water vapor free process atmosphere guaranteed through pump/purge cycles
- _ Excellent maintenance concept with maximum accessibility of all machine components
- _ Proven safety system based on a solid risk management and safety engineering

Concept



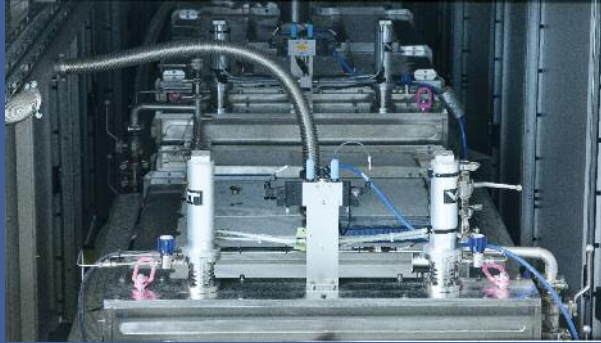
CISARIS – Selenisation furnace for an optimized CIGS absorber formation

The CISARIS oven is an inline rapid thermal processing equipment, designed for the CIGS_{Se} absorber formation on large area glass substrates. CISARIS consists of a handling station, a vacuum tight process section and a return conveyor and is optimized for the mass production of CIS solar

modules. The main features of the CISARIS include a high uptime and mechanical yield, as well as a fast cycle time, which, in combination with the robust selenisation process, lead to a production capacity of over 25 MWp per year. CISARIS is a proven innovative and reliable equipment, which has been newly developed at SINGULUS based on the previous generation selenisation ovens. CISARIS can safely handle the thermal processing

of large glass substrates of over 1 sqm at temperatures up to 550 °C under a toxic and corrosive gas atmosphere. High heating and cooling rates, combined with an excellent temperature homogeneity during all process stages are the key factors, which allow the formation of an optimal CIGS_{Se} absorber, required for the production of high efficiency solar modules.

Key Components



The CISARIS machine consists of the following key components:

_ Handling section:

Transport of the substrates between the FAB automation and the CISARIS

_ Process section

_ Load chamber #1 (LC1):

Pump- and purge cycles to remove atmospheric residuals

_ Load chamber #2 (LC2):

Process gas inlet
Pump- and purge cycles to remove toxic gases from the process chamber

_ Heating section: (HC1/HC2/HC3/HC4/HC5)

Five successive heating chambers for the formation of the CIGSSe absorber material

_ Cooling section: CC1/CC2

Two successive cooling chambers for the cooling of the substrate down to the specified temperature

_ Exit chamber (EC):

Pump- and purge cycles to remove toxic gases from the process chamber

_ Return conveyor section:

Returning the substrate to the handling system and additional cooling process in a N₂ atmosphere via forced N₂ cooling stations

_ Periphery:

_ Housing

_ Cold traps (selenium absorber)

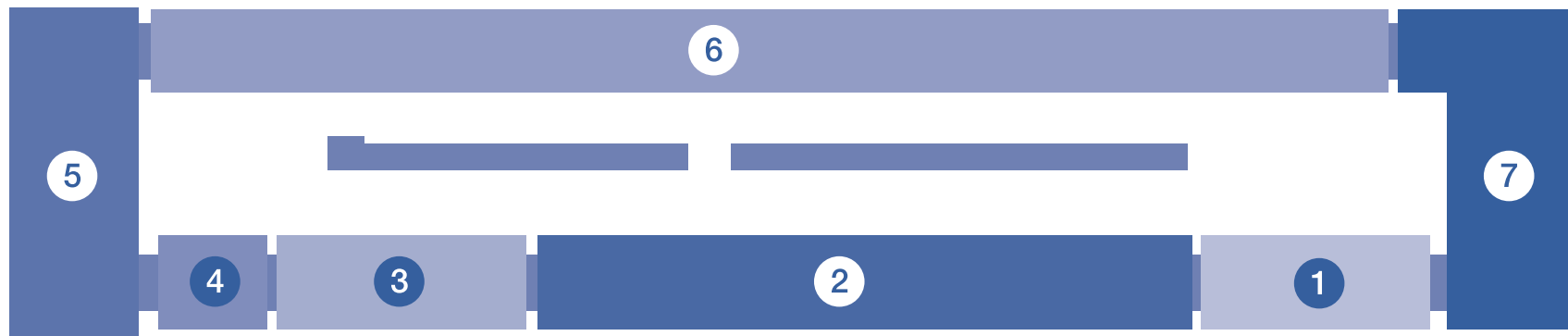
_ Oil heating system

_ Pumping system

_ Gas detection system

_ Metrology

Schematic Layout



- | | |
|-----------------------|---|
| 1. Entrance load lock | 5. Cross transport |
| 2. Heating section | 6. Return conveyor with convective cooling stations |
| 3. Cooling section | 7. Handling station |
| 4. Exit load lock | |

Technical Data

Material	CIG and CIGSe precursors on glass substrates
Material Dimensions	1583 x 660 mm ² (other substrate sizes on request)
Material Thickness	2 - 3 mm

Output	approx. 190.000 substrates/year
Footprint	36 x 10 m ²
Cycle Time	< 135 s
Uptime	> 85%

Mechanical Target Yield	> 99,5 %
Main Voltage	400 V 3AC/PE 50/60 Hz
Other Required Utilities	cooling water, compressed air, process gases

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