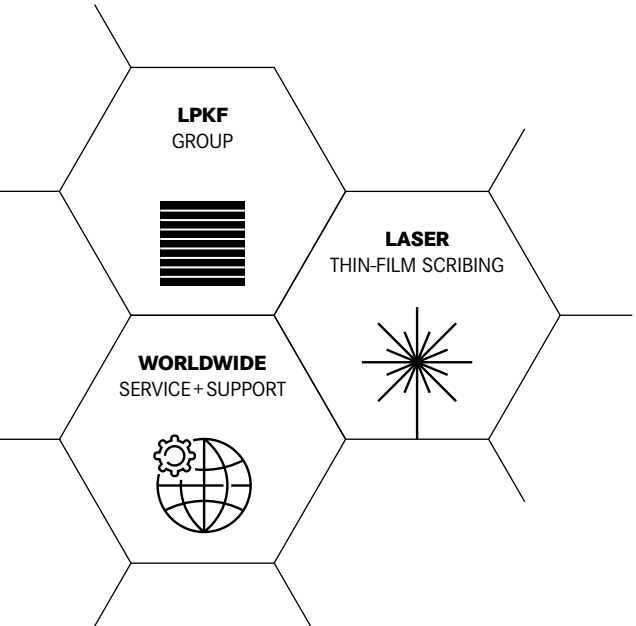
HIGH-END THIN-FILM PV PRODUCTION SYSTEM

LPKF ALLEGRO

LPKF
Laser & Electronics

COMMITMENT TO RESULTS

LPKF ALLEGRO LASER SCRIBER



In musical terminology, Allegro means fast. LPKF Allegro systems perform at high speed with absolute precision. Imagine a solar fab to be a great orchestra. LPKF Allegro laser scribing systems would be world class players perfectly contributing to the overall goal, the 'grid parity.' LPKF strives to provide the most productive and reliable equipment to the solar industry – all while keeping on the cutting edge of development. LPKF's engineers and technicians are committed to reaching this goal.

THE MASTER OF EFFICIENCY

Profitability Counts

Producing ultra-precise structures on large, damageable substrates is a challenging task. Thermal deformations arising between laser scribing steps only increase the level of difficulty. Ultra-precise structuring with the Allegro laser scriber allows module efficiencies to be increased as much as physically possible.

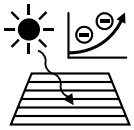
LPKF Allegro laser scribers are exceptionally economical in terms of investment and operation and offer the highest possible throughput. Innovative, field-tested concepts compensate for virtually any deviations from the optimal cell geometry across the entire process chain and establish the basis for solar modules with maximum efficiency.

LPKF SolarQuipment has acknowledged expertise in laser, drive and control technology as well as extensive experience in laser micromachining. As part of the LPKF Group, SolarQuipment benefits from a wide range of laser applications, an internal community of qualified laser experts and a worldwide service and sales network.

The Allegro series laser scribers are already successfully being used in 24/7 manufacturing for more than 15 years.

Highest Throughput

A compact, multi-beam head enables maximum acceleration and speed, reducing the laser scriber cycle time. One scribing head move produces multiple structures at the same time. Substrate handling processes are parallelized to the greatest possible extent, which increases the machine's throughput and reduces production costs.



Maximum Module Efficiency

The weakest cell greatly impacts the overall performance of the module. Producing an ultra-precise layout with uniform cell size distribution in the P1 step is critical. The subsequent P2 and P3 lines are accurately aligned and positioned based on this master. Two unique features – the Dynamic Path Tracking and Dynamic Focus Tracking – coordinate to create the smallest possible dead zones, whereby the active module area is increased. This leads to maximum module efficiency.

Optimum Availability

LPKF Allegro laser scribers are designed to be robust, low-maintenance and easy to service. The systems feature maintenance-free air bearings for feeding glass and the movement of the machining head, long-life laser sources and pre-aligned optical and mechanical components. This effectively minimizes both scheduled and unscheduled downtimes, increasing system availability.

Cost Efficiency

Optimized machine dynamics, precision laser scribing and the minimum-cost machine concept make Allegro laser scribers an exceedingly cost-effective solution for producing thin-film solar modules.

THE HEART OF THE SYSTEM

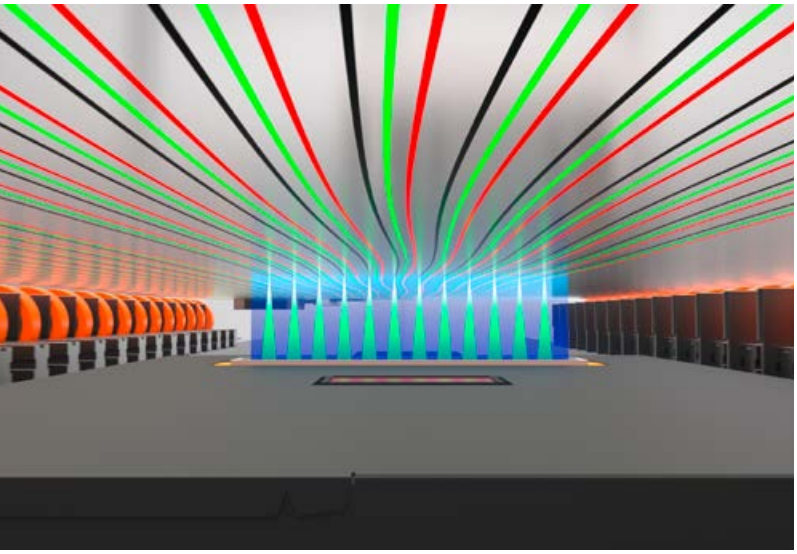
THE SCRIBING HEAD

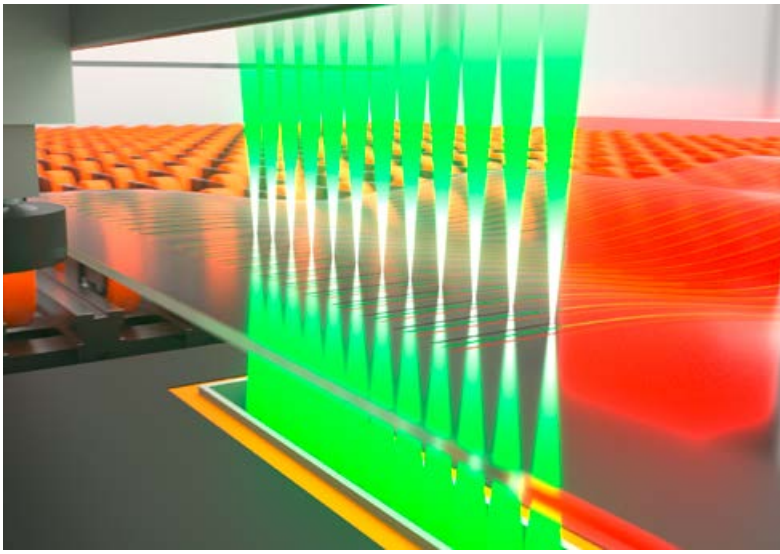
A solid machine base provides precision, dynamics and reliability. The actual laser scribing is done by the moving laser scribing head, the heart of the Allegro system.

The Allegro implements the concept of moving and an optimal coordinating of all integrated laser components, thus combining key functions in a compact design. It arranges several parallel laser beams and dynamically focuses them on the film to be scribed.

This approach allows an array of intelligent and cost-effective solutions to maximize the module's efficiency, minimize the so-called dead zone and stabilize the scribing process.

LPKF Allegro laser scribers tolerate changes in the shape of the glass within the manufacturing chain. They compensate for distortion and warping due to thermal factors. This eliminates time-consuming and costly substrate conditioning steps prior to laser scribing.





Dynamic Path Tracking

Dynamic tracking in steps P2 and P3 minimizes the spaces between individual scribing tracks. During scribing a sensor determines the position of the previous track and corrects all beams in the scribing head. The close spacing of the laser beams in the scribing head allows exact scribing using only one sensor to determine the previous track position. Dynamic Path Tracking reduces the safety clearance required and maximizes module efficiency.

Dynamic Focus Tracking

Wavy substrates from thermal processing or small process windows impair laser scribing results by reducing module efficiency and process stability. Dynamic Focus Tracking keeps every laser beam in its focal plane on the module during scribing. This leads to optimal scribing results on wavy substrates or small process windows without increasing system complexity.

THE SOLARMASTER GUI

In addition to the Allegro's hardware, the system's graphical user interface (GUI) is a key factor impacting ease of use. The SolarMaster features an intuitive GUI developed based on multiple ergonomic aspects. This facilitates operation and setting of production recipes while helping avoid operating errors.

Furthermore, the tool setter is equipped with special supporting functions to quickly determine optimal process parameters. The SolarMaster offers different user levels to help manage access.

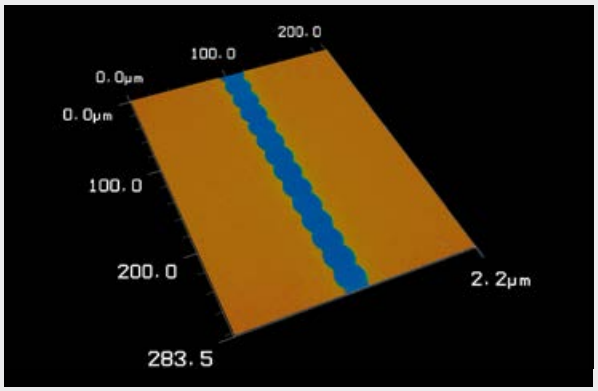
LPKF APPLICATION CENTER

YOUR SUCCESS BEGINS HERE

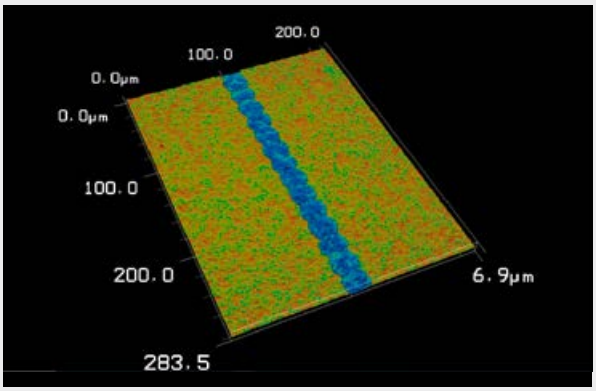
LPKF SolarQuipment has an in-house application center in which a special team of experts develops the best possible process solutions for individual customer requirements in consideration of technological and cost aspects.

High-tech equipment and a multitude of modern analysis systems are used in the lab.

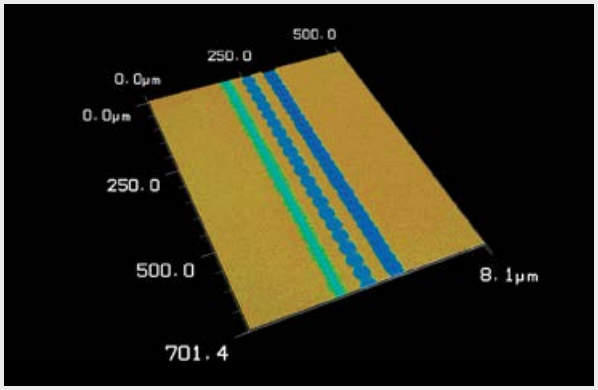
Services include process studies, first article inspections, feasibility studies on different materials, solution-finding, and implementation of measures for process optimization.



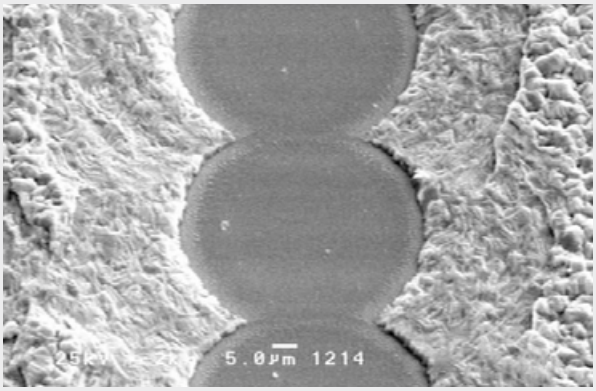
Perovskite P1 ablation with optimized pulse duration:
No material flaking or burr at the track edges, no glass damage, no cracks in the glass.



Selective font contact removal during the P3 scribing step in CIGS: no flaking, no thermal influence on absorber.



Minimal dead zone: All scribing steps are perfectly alined to each other for the maximum active area and therefore the highest module efficiency.



SEM image of laser material ablation for precise process inspection. An EDX analysis gives the opportunity to determine chemical elements and their composition in the process zone.

STATE-OF-THE-ART EQUIPMENT FOR THE BEST RESULTS

- LPKF Presto laser system for processing thin-film solar cells
- Galvo scanner and polygon scanner for complex 2D structuring
- Various laser sources (ns – fs, IR – UV) for optimal material removal
- Special optical components for laser beam shaping and manipulation
- Laser beam analysis with special cameras for laser beam characterization and optimization
- Absorption/transmission measurements for selection of optimal laser
- 3D laser scanning microscope for ablation investigations such as measurement of ablation depth
- Scanning electron microscope with EDX function for high-resolution analysis and determination of chemical material composition

What's your application? Contact us!

LPKF Laser & Electronics – Pioneer in Laser Technology

LPKF Laser & Electronics AG is a leading provider of laser-based solutions for the technology industry. Founded in 1976, the technology company is globally active, with four production locations in Europe, subsidiaries in the USA, China, Japan, and Korea, and capable sales partners in numerous countries and various industries. Laser systems from LPKF are key elements in the manufacturing of printed circuit boards, microchips, automotive parts, solar modules, and many other components.

LPKF SolarQuipment GmbH is a segment of LPKF. At the Suhl (Thuringia) location, the company has been developing, building, and selling sophisticated laser systems for the photovoltaics market for 15 years now. As a leading provider of highly specialized laser systems for structuring thin-film solar modules, SolarQuipment combines expertise in laser, control, and drive technology with extensive experience in laser micromachining of various materials. In this way, the company can offer innovative, high-quality, state-of-the-art systems to demanding customers around the world.

SolarQuipment supports manufacturers of thin-film modules on their paths to successful and efficiency-optimized end products. The company attaches great importance to joint technology and application development as well as analysis and configuration of optimal manufacturing processes. SolarQuipment also provides support in installation and commissioning.

LPKF engineers are at customers' disposal as contact persons during the production process and carry out the necessary service and maintenance work on site. Every day, more than a hundred laser scribers in 24/7 operations around the world ensure successful thin-film module production and hence satisfied customers.

LPKF ALLEGRO SERIES	
Thin-film technologies	CdTe, CIS, CIGS, Perovskite
Laser wavelength	1064 nm, 532 nm or 355 nm
Laser pulse lengths	Femtoseconds to Nanoseconds
Scribing line width	Depending on wavelength and optical configuration
Line to line distance	Motor-driven and self-calibrating
Processing	From film and glass side
Processing beams	Multiple according to customer requirements
Substrate dimensions	Customer specific
Substrate thickness	2 mm – 6 mm (0.08" – 0.24")
Substrate material	Float glass
Particle extraction	LPKF HighVacuum 500*
MES interface	OPC server or SECSGem
Software	LPKF SolarMaster
Additional features	Process integrated quality inspection Dynamic Path Tracking Dynamic Focus Tracking

* High-vacuum extraction and filtration system with filter cleaning, dust collection in a barrel, filter and barrel exchange optimized for harmful dusts, HEPA filter optional.

Photos may also show optional accessories.

LPKF Laser & Electronics

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