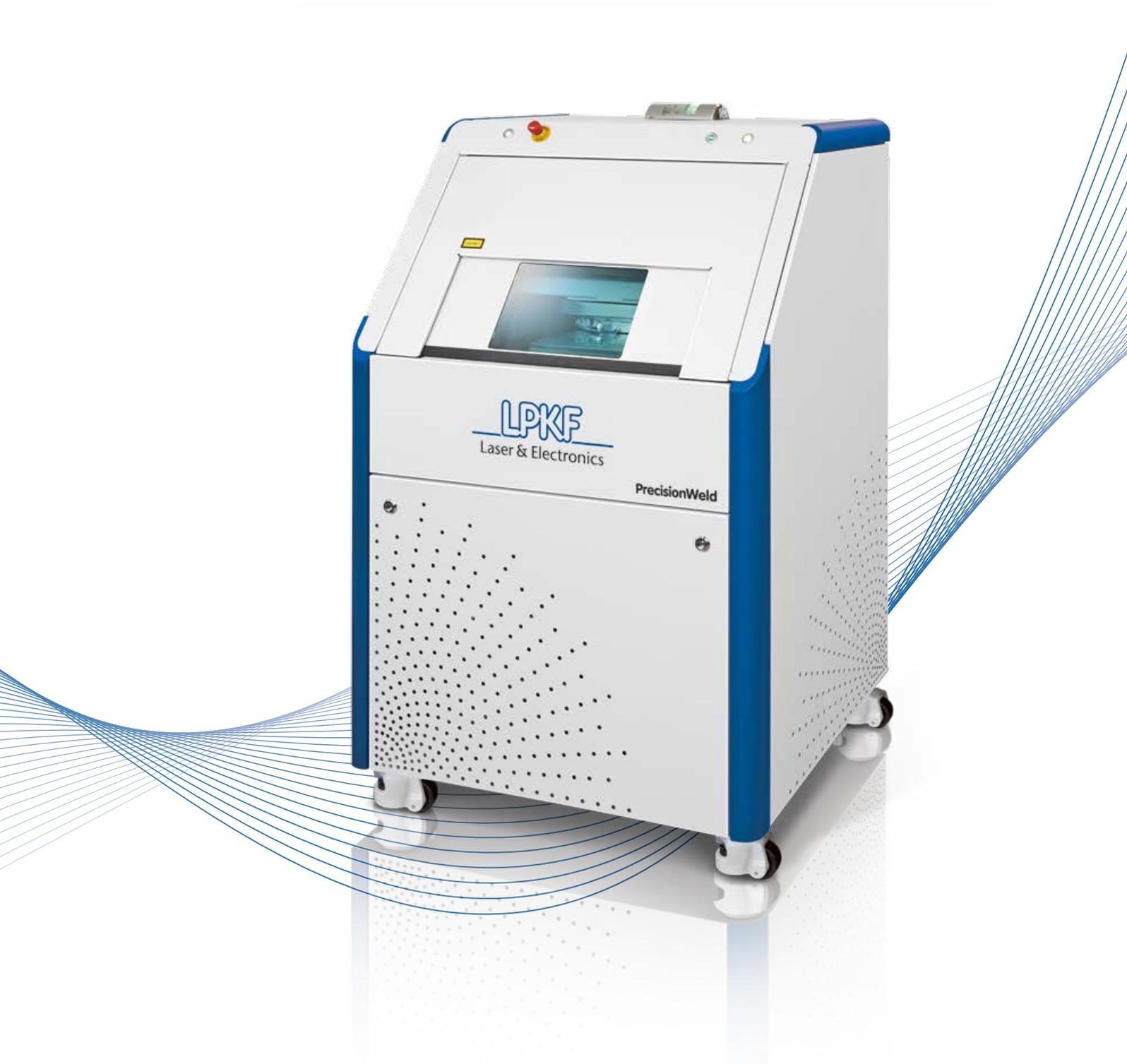
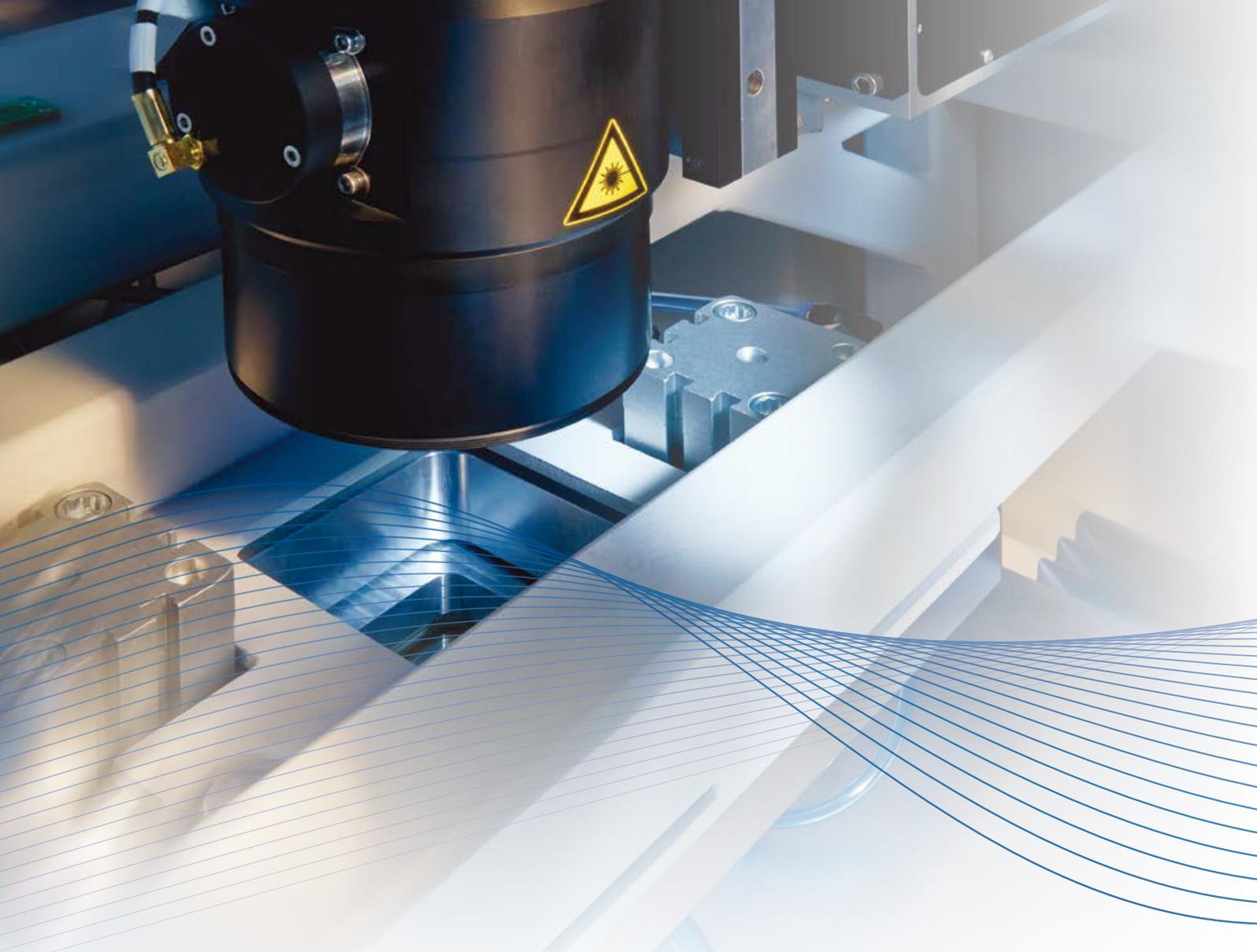


Microfluidics and Clear-Clear Joints
Precision Welding with the LPKF PrecisionWeld





A Major Breakthrough in Technology

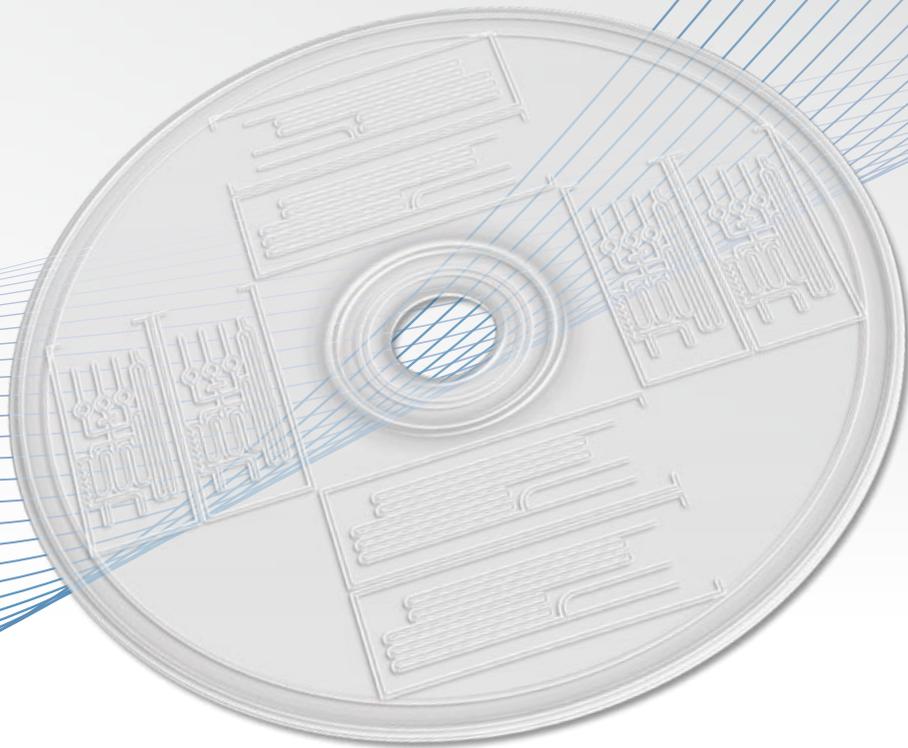
Plastics are being trusted to handle more and more complex functions in many products. This requires detailed specifications for the joining process to accommodate the new materials and applications. The ground-breaking, innovative laser welding system incorporated within the LPKF PrecisionWeld tool allows new areas of application, with increased precision and width of the weld seam, as well as new layout options.

Extremely Flexible

Laser plastic welding allows superior flexibility and performance. Advantages include inexpensive component holders, easily programmable welding contours and sophisticated quality assurance technologies that operate during or after the welding process. This ensures high variability, rapid development times, significant financial benefits associated with the component holders, and an exceptionally low rejection rate during production.

LPKF has a wealth of experience in laser welding. The Laser Welding Application Center provides interested parties with advice on an array of topics such as product design and process parameters, while also handling job-shop orders for series production and peak production relief.

- Main application: microfluidics
- Compact – sits on rollers to easily fit through any laboratory door
- Tried-and-tested machine concept



Benefits for Microfluidics Applications

Microfluidics applications, involving the analysis or precise dosing of liquids, have become increasingly significant in recent years. The channels used for the transportation of liquids in microfluidics devices are so fine that capillary forces override the effects of gravity. Channel widths of 100 μm are no longer uncommon. When these components are created using conventional methods, particles, additives or deviations from the planned welding geometry, they often produce rejects.

Rejects are less likely to occur when using transmission laser welding technology because it requires no additives and does not expose the components to mechanical or high thermal stress. Due to the small laser focus the thermal conduction is spatial limited and the weld flash is restricted. There are no unwanted particles.

The new LPKF PrecisionWeld adds another application to laser plastic welding: it is specially designed for particularly fine microfluidic weld seams. These fine weld seams have a width of only 100 μm . The positioning repeatability of 30 μm is highlighted by the name of the system – this level of precision is unprecedented and unmatched by any other technology.

In addition, highly informative quality inspections can be integrated directly into the welding process: better safe than sorry – especially when producing sophisticated end products.

LPKF PrecisionWeld

- For prototypes and series production
- With a laser scanner and positioning table
- Automatic focus adjustment
- Integrated vision system





Exceptionally efficient: easy to use component holders

Rugged Machine Concept

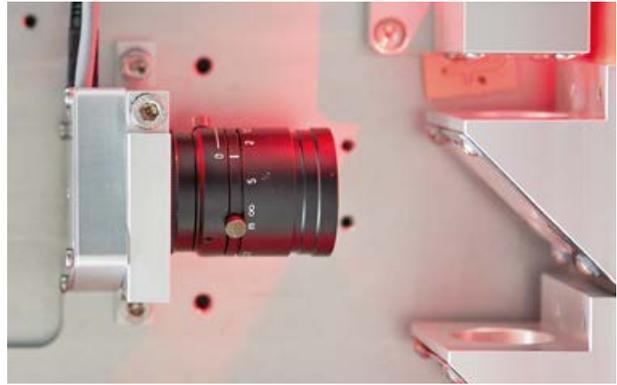
The LPKF PrecisionWeld is based on a tried-and-tested machine concept used for 24/7 production. The laser system is initially laid out for manual operation to support prototype development and small-batch production. If manual feeding does not provide the required performance, the LPKF PrecisionWeld can also be equipped with suitable handling devices for highly efficient industrial mass production.

A Proven Foundation

Compact LPKF laser systems have been used successfully in industry and development for many years. The LPKF PrecisionWeld is the first unit to use a tried-and-tested machine concept from UV laser cutting for plastic welding applications.

The LPKF PrecisionWeld is most notable for its compactness and mobility: all it needs is a power cable and a compressed air line for operation. The system can be placed on rollers and moved to a new position at any time. The dimensions of the machine are only 875 x 1,430 x 750 mm (width x height x depth) (34.5" x 56.3" x 29.5"). Merging scan fields extend the processing field to a maximum of 320 x 320 mm (12.6" x 12.6").

The special design mechanically decouples the processing area and the machine housing. The laser scanner and the processing table are suspended to dampen vibrations.



Vision system for fiducial identification

Automatic Adjustment of the Focus Position

The LPKF PrecisionWeld system is the first to automatically align the focus position of the laser beam with the welding level. So an even more precise control of the welding process can be achieved.

Integrated Vision System

The LPKF PrecisionWeld comes equipped with a vision system that identifies contrastless topographic fiducial marks. These fiducials do not need to be printed because they can be created in a one-step process when the channels are integrated. This streamlines the process and boosts the overall processing accuracy.

When the fiducials are read in, the system references the pre-set component geometries to an accuracy of 2 µm and compensates for virtually any tolerances in the component holder as well as in the component itself – increasing the number of good parts.

Optimized Laser Source

At the core of the LPKF PrecisionWeld is a fiber laser with a wavelength of 1,940 nm. Lasers with this wavelength can be used to join parts using the standard transmission laser welding method, combining a transparent component with an absorbent component, along with the newly developed LPKF ClearJoining technology (clear-clear joints).

Different Methods with the New Laser Source

Transmission laser welding has demonstrated superior handling of sophisticated and complex weld specifications. The LPKF PrecisionWeld surpasses existing technologies with the addition of the new clear-clear method.

Transmission Laser Welding for Optimum Joins

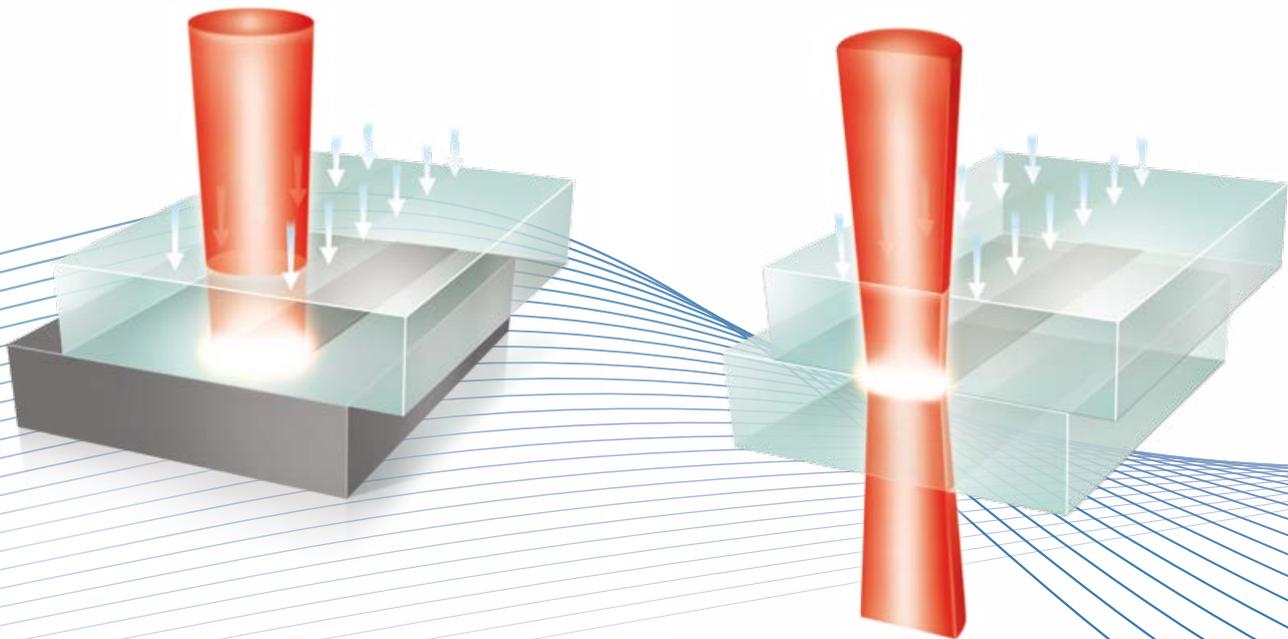
Transmission laser welding involves securely joining two components with different absorption properties together with respect to the wavelength of the welding laser. Both parts are often created from the same polymer, the difference being that the laser-absorbing joining partner has been pigmented with an additive – usually soot.

The laser beam passes through the laser-transparent joining partner to melt the underlying laser-absorbent part along the line of the weld seam. Thermal conduction assisted by a moderate clamping pressure causes the upper part to melt as well. When the seam has cooled down, both parts are permanently welded together. The strength of this laser weld seam is similar to solid plastic and very close to a welding factor of 1.

LPKF ClearJoining: Clear-Clear Welding

This new welding technology joins two laser-transparent partners without additives. Additives can not only block the approval process for certain products, they are also undesirable when the optical properties of the unadulterated material are stipulated by specific applications. The LPKF ClearJoining technology welds two identical polymer components together through the precision focus of the laser beam on the joining zone – the line of the weld seam between the two parts.

This welding technology uses a laser with a wavelength of 1,940 nm. Welding is based on the principle of partial absorption, meaning that the laser beam can penetrate and warm up the entire thickness of the material. The maximum temperature occurs at the point of the highest energy density: in the focus.



Examples of Applications



Lab-on-a chip: microfluidic cartridge in the dimension of a mobile phone



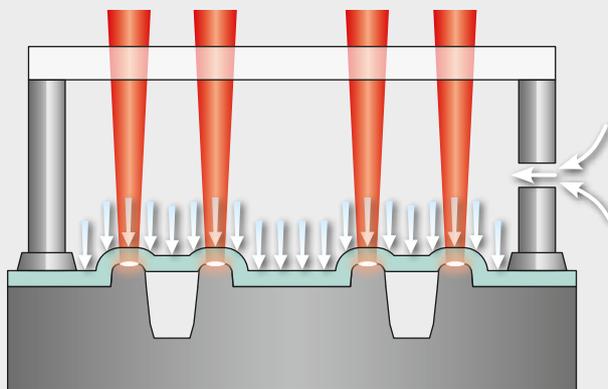
This atomizer dispenses an exactly predefined amount of active ingredients



The transparent microfluidic wafer was welded with the new ClearJoining technology



Perfect focussing on the weld seam – laser welded clear-clear joints without any additives



Differential Pressure Clamping Technology

Differential pressure clamping technology facilitates the creation of high-quality microfluidic components. The clamping tool holds the upper joining partner in an air-tight grip. Applying internal pressure creates a homogenous pressure ratio, and therefore virtually 100 % contact between the lower and upper joining partners. The differential pressure clamping technology allows burrs – created when the channels in the lower component are produced using hot stamping – to be reliably bridged over and positively locked.

Worldwide Service & Support

24/7 in an industrial environment – no problem for LPKF's successfully tried and tested laser welding systems. For your support we have: highly trained service staff around the world available for machine setup and servicing; an Application Center to help with feasibility studies and machine concepts; job-shop production to tackle production peaks and volume production start-ups. More than just laser welding: LPKF creates solutions – together with its clients.

Technical Data: LPKF PrecisionWeld 3000	
Laser class	1
Laser beam source	Thulium fiber laser
Laser wavelength	1 940 nm
Processing field	320 mm x 320 mm (12.6" x 12.6")
Power supply	110 V / 220 V (50 – 60 Hz), (single phase), approx. 1.2 kW
Air supply	6 bar, 160 l/min (unoiled)
Diameter of the focussed laser beam	65 µm
Positioning repeatability	30 µm
Cooling system	Integrated air cooling unit
Ambient temperature	22 °C ± 2 °C (71.6 °F ± 3.6 °F)
Humidity	< 60 % (non-condensing)
Options	<ul style="list-style-type: none"> • Tablet PC for easy machine operation • SMEMA interface for automatic operation in a production line • HEPA fine filter to create a particle-free environment in the interior compartment
Required accessories	<ul style="list-style-type: none"> • Vacuum pump • PC with the following system specifications: Microsoft® Windows® XP or 7, 1 GHz processor or better, minimum 1 GB RAM, screen resolution minimum 1 024 x 768 pixels, USB 2.0
Dimensions (W x H x D)	875 mm x 1 430 mm x 750 mm (34.5" x 56.3" x 29.5")
Weight	360 kg (794 lbs)



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