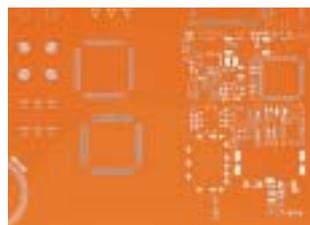
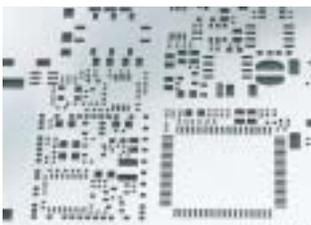




Stencil Manufacturing in Perfection

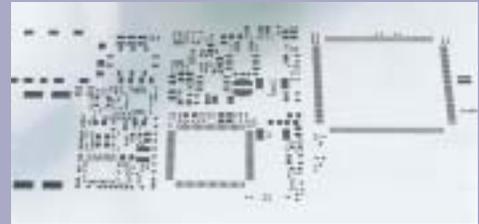
- Productivity
- Reliability
- Precision
- Innovation



Applications

Metal Stencils

Laser cut SMT stencils have raised the bar on precision and quality throughout the electronic manufacturing service industry. First pass yield, consistent aperture size and location, superior side wall quality and instant turnaround are probably the most compelling reasons to choose laser over any other production technology for SMT solder paste stencils.



BGA Stencils

SMT stencils with ball grid array footprints are a lot more demanding. Most stencil laser system are available with **LPKF's proprietary TurboCut technology** for maximum aperture roundness and top-notch productivity.

TurboCut III is optionally available for LPKF stencil laser systems SL 600 HS, SL 800 HS and SL 600 HS Polymer and comes standard on SL 600 MicroCut



Wafer Bump Stencils

Stencils for flip-chip production can feature hundreds of thousand of very small apertures and require excellent precision. LPKF has specifically designed laser systems to address these demands. The SL 600 MicroCut for instance, combines the speed of TurboCut with LPKF's new **PulseShape technology** to avoid coining on extremely dense stencils.

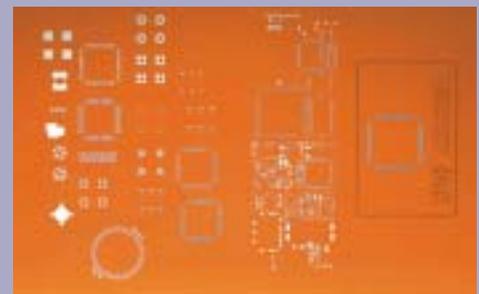
Figure on the right: wafer bump stencil, cut with SL 600 MicroCut



Polymer Stencils

Polymer stencils have superb paste release allowing up to three times faster printing speed and are better for ultra fine pitch or wafer bump applications. They also have better board contact than steel stencils due to the flexibility of polymer material. Quick and easy positioning of the transparent material will save setup time and polymer has a longer useful life and better resistance to coining. Since polymer stencils do not use a mesh border, there is a larger print area in a smaller frame.

Figure on the right: polymer stencil, cut with SL 600 HS Polymer



Precision Cut Metal Parts

LPKF stencil lasers are also used to produce metal parts for various applications including micro-mechanical and medical parts, vapor deposition templates for OLED's among others requiring superb precision and reproducibility.

Astronomy

LPKF stencil lasers are also used in astronomy to cut very precise slit masks for telescopes in various materials such as stainless-steel, Invar or carbon fiber.

These parts can be produced using the metal stretching frame or the honeycomb, vacuum table.



European Southern Observatory, Chili



LPKF StencilLaser systems

There is an LPKF Stencil Laser for every situation. These systems range from the SL 800 with its unique separate X and Y axis, air bearing supports and optional auto loader to the low cost SL 740 wide track support rail system. In every case, the system uses the same LPKF designed and manufactured laser system because regardless of the speed or size of the system, the cut quality must be and is maintained. These systems can cut sheets using the sheet clamping frame or can cut preframed sheets.

In addition, LPKF can supply a system with different LPKF designed and built laser for producing polymer stencils. This system is supplied with a vacuum fixture for cutting sheets or a frame clamp fixture for cutting preframed sheets.

Two features unique to LPKF systems are the TurboCut, which cuts small circles with unmatched roundness up to 25,000 apertures per

hour and the focus positioning, which requires no auto-focus. Besides needing no auto focus, the beam can be adjusted with the programmable beam expander to achieve the desired taper of the aperture sidewall (including zero taper).

The LPKF Stencil Laser Systems are designed to cut with high pressure air to save production costs or oxygen to allow for a wider range of operating parameters or cut thicker material.

The software supplied with the systems is designed, implemented and maintained by LPKF. It provides more features specific to stencil manufacturing than can be listed here but three major areas are automatic laser parameter settings based on aperture characteristics, automatic adjustment of beam parameters to maintain cutting performance and generation of test data for stencil testing with ScanCheck.

LPKF SL 800 HS

This is the absolute standard for speed, accuracy, size, reliability, in other words profit, in the stencil laser world. Since the X and Y axes are separate, the system can be driven to a higher acceleration than any other system available and still maintains superior accuracy because the motion of one axis does not impact the other axis. Higher acceleration is important because when cutting a standard aperture, most systems will not even approach their maximum rated speed. With the superior acceleration of the SL 800 HS, reaching its maximum rated cutting speed is not a problem. Of course, this system uses linear drives with a digital controller that utilizes an auto-optimize function which sets various functions such as acceleration, damping factor, jerk factor, etc to optimum values for the system and glass scales for positional accuracy. Special features such as a loading function that supports the sheet during loading and an optional auto loader help make the SL 800 the most productive system on the market.

The SL 800 HS also features the standard LPKF focus system which eliminates the unreliable and unstable auto-focus system and comes with a programmable beam expander which allows for programmable taper (including zero taper). It can also be equipped with TurboCut - an option to cut round apertures extremely fast.



LPKF SL 600 HS

The LPKF SL 600 HS is the logical upgrade to the world class SL 600. The SL 600 HS features a real granite table and a wide track air bearing system needed to maintain the accuracy and stability required to make the stencils demanded by today's users. The drive system is a linear motor drive system with a digital controller that utilizes an auto-optimize function to set various functions such as acceleration, damping factor, jerk factor, etc. to optimum values for the system. In addition, the table uses the glass scale for position feedback and therefore the position accuracy is maintained without the requirement for periodic calibration.

The SL 600 HS also features the standard LPKF focus system and comes with a programmable beam expander which allows for programmable taper (including zero taper). It can also be equipped with TurboCut - an option to cut round apertures extremely fast.



LPKF SL 740

The LPKF SL 740 is the newest system in the LPKF Stencil Laser family. It is designed for start-ups, limited use in-house stencil users and those who need a slightly larger format but do not need the speed of an LPKF SL 800 or Turbo Cut. The compromise with the SL740 is speed but not cut quality; the reward for this compromise is lower price. The LPKF laser source is the same as other LPKF metal cutting system (except MicroCut) but the system uses a steel bearing support system instead of the air bearing systems used on other, faster LPKF systems. This bearing system is bolted to a granite table and has a span of approximately one meter; thereby avoiding the errors inherent in other systems which use a narrow support system. The drive is provided by the same proven lead screw and servo motor system used in the original LPKF SL 600.

The SL 740 also features the standard LPKF focus system and is equipped with a programmable beam expander which allows for programmable taper (including zero taper). TurboCut is not available on the SL740.



LPKF SL 600 MicroCut

The LPKF SL 600 MicroCut is the most recent addition to the line of LPKF precision laser stencil systems. The SL 600 MicroCut uses LPKF's new, proprietary **PulseShape technology** which results in a particularly high quality beam and the ability to cut apertures as small as 30 μm . The result is that the warping or coining common in very dense stencils is all but eliminated. This warping is caused by the HAZ relieving stress in the stencil material and is more severe as the percentage of the material affected by the HAZ becomes large with respect to the total material between apertures.

This laser source, in combination with the LPKF 600 HS table, TurboCut III and the programmable beam expander result in a system that is outstanding for stencils used for CSP, flip-chip and wafer bumping and with a throughput of up to 25,000 apertures per hour.



LPKF SL 600 HS Polymer

The LPKF SL 600 HS Polymer laser system is another example of the leadership of LPKF in new technology. The system is similar to the SL 600 HS except the IR laser source is replaced with an LPKF designed and manufactured UV source and the stretching frame is replaced with a vacuum table. The source is designed to ablate polymer instead of melting metal and the fixture is designed to hold thin material such as polymer for stencils or flex circuit for routing. Polymer stencils have release characteristics equal to the best electro-formed stencils and can be produced on the SL 600 HS polymer system much faster and cheaper. The SL 600 HS Polymer is also suitable for cutting unfired ceramics, polymer films and flexible circuits.

The SL600HS Polymer is equipped with LPKF's focus system and motorized beam expander for programmable taper. It can also be upgraded with TurboCut for up to 15,000 round apertures per hour.



Details

Proprietary Laser Sources

LPKF has designed special laser sources for its stencil laser systems. These laser sources are optimized for performance, power, stability, uptime at minimal operation cost. **Genuine LPKF laser sources** provide a much broader range of control parameters than standard off-shelf third party products. The output power is continuously monitored and maintained to guarantee consistency, optimum quality and the smallest possible beam size.



Cutting heads

LPKF stencil laser systems are able to use both compressed air and oxygen as a cutting gas. Oxygen is usually recommended for thick materials or thin and very dense stencils. Compressed air is considerably less expensive and performs just as good on standard SMT stencils. The cutting head design is compliant with laser safety class I without any additional machine enclosures.

Our systems feature the standard **LPKF focus system** which eliminates unreliable and unstable auto-focus systems and come standard with a programmable beam expander which allows for programmable taper (including zero taper).



Air Bearing Tables

Most LPKF Systems use frictionless, air bearing tables. These tables provide the support and stability required to produce precision stencils. They are also very reliable and therefore help deliver outstanding up time for the systems. The combination of frictionless bearings riding on a granite surface driven by high speed linear motors provides the right combination needed for the SL 600 and SL 800 systems to meet their superior throughput and accuracy specifications.



Versatile Clamping Frame

This frame is used to hold sheets of metal. This frame provides for the manufacture of stencils or precision part from unmounted sheets. The mounting clamps can be removed quickly so that pre-mounted sheets can be processed.



Professional support

Stencil lasers have to operate around the clock.

LPKF provides superior technical support and customer service around the world. Our highly skilled personnel is **locally based in North America** and covers all aspects of a stencil laser from the software to laser source itself. LPKF laser service engineers are also available to audit stencil productions and to consult with customers on process optimization in areas of speed and quality.



LPKF TurboCut III

This LPKF exclusive feature designed to cut round holes with diameters of 40 μm (30 μm SL 600 MicroCut) to 800 μm . TurboCut uses rotating optics to move the cutting beam in a circle around a fixed point. This solves several problems. Since the large mass of the table does not have to move during the cutting process, the apertures can be cut up to **25,000 apertures per hour**. Since the cutting process is based on a circular movement, the "roundness" of small circles is better and takes significantly less time to cut than with X/Y movements of a normal table.

LPKF TurboCut LF III also performs a cleaning process for the cutting nozzle. This cleaning procedure is programmable and fully automatic, to minimize the necessary user interaction for maintenance.



The 3rd Shift - LPKF AutoLoader for SL 800 HS

The Autoloader is available on the SL 800 HS and is used where essentially unattended operation is desired. The system will accept 15 sheets of metal mounted in frames supplied with the Autoloader and will load and unload frames automatically.



Vacuum Honeycomb Table

The LPKF vacuum table is designed to hold flex material for polymer stencil cutting, microvia drilling, HDI structuring, flex circuit routing or processing and for holding metals that are too thin to be held in the standard sheet frames. The polycarbonate honeycomb table is supplied with an integrated vacuum system designed for the purpose of holding the material and exhausting the cutting residue.



LPKF ZelFlex Reusable Stencil Frames

Fixed frames have many disadvantages. The mesh relaxes and the tension changes; each stencil is mounted at a different angle to the frame; the frame takes significantly more space for storage and the old style frames use epoxy and must be recycled.

ZelFlex frames provide constant tension in both X and Y dimensions, they can be re-tensioned by simply applying air pressure and they do not require a license for the clamping pattern. The stencils can be stored as sheets instead of mounted stencils and therefore require less storage space.



Software

LPKF CircuitCAM

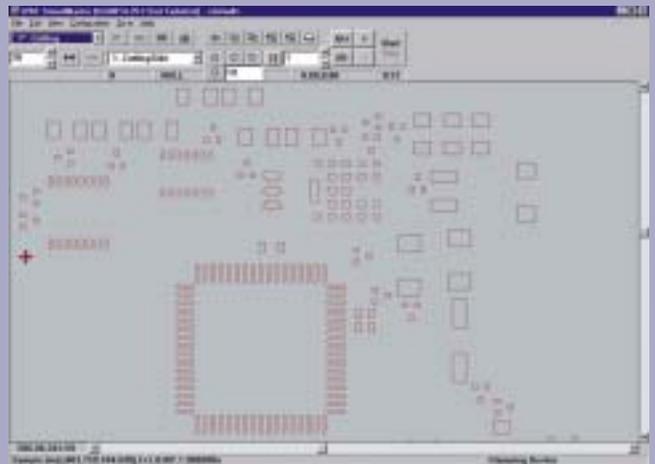
CircuitCAM is a full featured CAM station software that has two main functions. One is to import, display and edit data generated by the customers CAD system. All standard formats including Gerber®, DXF®, Barco® DPF, ODB++®, Excellon and HP-GL® are supported. Some of the advanced features of CircuitCAM include, draw to flash conversion, global manipulation of data and **the most powerful aperture modification tool in the industry**. Some of the most important features includes the ability to have a custom aperture libraries and to specify classes of apertures such as fine pitch and normal so the cutting data can be optimized for these unique groups of apertures.

The second function of CircuitCAM is to generate output data that is used to drive the system or to inspect the resulting stencil.

LPKF StencilMaster

StencilMaster is the machine control software and takes the data from CircuitCAM and provides the tools needed to cut the stencil. Since a facility may have more than one type of LPKF Laser System, it makes sense to add system specific parameters at the system instead of requiring different cutting data for different systems. In addition, manufacturing specific information such as placement, rotation, step and repeat functions are done here.

StencilMaster operates independently from CircuitCAM, which means one set of data can be in data perpetration while another one is in production at the same time. System parameters such as lamp usage, tool setting, etc. are maintained in StencilMaster. There is a graphics display of the operation of the system and access to the control functions of the system so the operator can see at a glance how the job is progressing and has command of the system functions



Quality Management - LPKF ScanCheck

As the requirement for more precise stencils increases, the need for verification of the stencil becomes more important. The problems with existing system are either lack of resolution or lack of speed.

The LPKF ScanCheck has **12,000 dpi resolution** (better than 3 µm), generates a full scan (450 X 670 mm) in 12 minutes and will provide analysis and generate a report in less than 1 minute. The measurements include position, area, dimensions of regular shapes and absence or presence of apertures. The ScanCheck system is compatible with all types of SMT stencils, including laser cut, chem-etched or e-formed.

This combination of speed, resolution and accuracy is available only with the LPKF ScanCheck AOI system.



Specifications

	SL 800 HS	SL 600 HS
Cutting performance (with TurboCut III)	up to 8,000* (25,000)** apertures per hour	up to 6,000* (25,000)** apertures per hour
Cutting area	31.5" x 31.5" (800mm x 800mm)	23.6" x 23.6" (600mm x 600mm)
Smallest aperture	40µm (1.5 mil)	40µm (1.5 mil)
Maximum sheet size	37.7" x 35.5" (950mm x 900mm)	33.5" x 31.5" (850mm x 800mm)
Maximum cutting thickness	23mil (600µm)	23mil (600µm)
Positioning speed	max. 10" per second (250mm/s)	max. 6" per second (150mm/s)
Laser pulse frequency / wavelength	up to 5 kHz @1064 nm (IR)	up to 5 kHz @1064 nm (IR)
Overall positioning accuracy	+/- 3µm @ 68°F +/- 1°F	+/- 4µm @ 68°F +/- 1°F
Angular precision	< 2 arc seconds	< 2 arc seconds
Repeatability	+/- 1 µm	+/- 1 µm
X/Y table dimensions (L x W x H)	87"/69"/55" (2,200mm/1,750mm/1,400mm)	91"/69"/53" (2,300mm/1,750mm/1,350mm)
Controller cabinet dimensions (L x W x H)	38"/24"/75" (950mm/600mm/1,900mm)	38"/24"/75" (950mm/600mm/1,900mm)
Overall weight	9,910 lb. (4,500 kg)	7,710 lb. (3,500 kg)

	SL 740	
Cutting performance	up to 3,000* (n/a)** apertures per hour	
Cutting area	29.1" x 29.1" (740mm x 740mm)	
Smallest aperture	40µm (1.5 mil)	
Maximum sheet size	35.5" x 34.3" (900mm x 870mm)	
Maximum cutting thickness	23mil (600µm)	
Positioning speed	max. 3.15" per second (80 mm/s)	
Laser pulse frequency / wavelength	up to 5 kHz @1064 nm (IR)	
Overall positioning accuracy	+/- 8 µm @ 68°F +/- 1°F	
Angular precision	< 6 arc seconds	
Repeatability	+/- 2.5 µm	
X/Y table dimensions (L x W x H)	99"/79"/59" (2,500mm/2,000mm/1,500mm)	
Controller cabinet dimensions (L x W x H)	38"/24"/75" (950mm/600mm/1,900mm)	
Overall weight	7,710 lb. (3,500 kg)	

	SL 600 MicroCut	SL 600 HS Polymer
Cutting performance (with TurboCut III)	up to 6,000* (25,000)** apertures per hour	up to 4,000* (15,000)** apertures per hour
Cutting area	23.6" x 23.6" (600mm x 600mm)	23.6" x 23.6" (600mm x 600mm)
Smallest aperture	25µm (1.5 mil)	25µm (1.5 mil)
Maximum sheet size	33.5" x 31.5" (850mm x 800mm)	32.3" x 31.5" (820mm x 800mm)
Maximum cutting thickness	10mil (250µm)	10 mil (250µm)
Positioning speed	max. 6" per second (150mm/s)	max. 6" per second (150mm/s)
Laser pulse frequency / wavelength	up to 5 kHz @1064 nm (IR)	up to 5 kHz @1064 nm (IR)
Overall positioning accuracy	+/- 4µm @ 68°F +/- 1°F	+/- 4µm @ 68°F +/- 1°F
Angular precision	< 2 arc seconds	< 2 arc seconds
Repeatability	+/- 1 µm	+/- 1 µm
X/Y table dimensions (L x W x H)	91"/69"/53" (2,300mm/1,750mm/1,350mm)	91"/69"/53" (2,300mm/1,750mm/1,350mm)
Controller cabinet dimensions (L x W x H)	38"/24"/75" (950mm/600mm/1,900mm)	38"/24"/75" (950mm/600mm/1,900mm)
Overall weight	7,710 lb. (3,500 kg)	7,710 lb. (3,500 kg)

* LPKF test pattern
 **with LPKF TurboCut III



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This machine is designed as a **Class I Laser Product** during normal operation. In maintenance mode this system becomes a **Class IV Laser Product**.

