

# In-House Rapid PCB Prototyping Product Catalog

Circuit Board Plotters

Laser Structuring

Through-Hole Plating

Multilayers

SMT/Finishing

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Laser & Electronics

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For more information, please visit our website at [www.lpkf.com](http://www.lpkf.com).





# LPKF Laser & Electronics

## Welcome to LPKF Rapid PCB Prototyping

In this catalog, you will find everything you need for rapid prototyping of printed circuit boards: machines, tools, consumables, accessories, and software. With this, you can manufacture single-sided, double-sided, or even multilayer PCBs in-house.

### **Why In-House Prototyping?**

With today's rapid pace of technological advancement, staying ahead of the competition is key. Instead of waiting for external suppliers, you can do your own prototyping in-house and save a huge amount of time. This allows for multiple iteration cycles between planning and optimized layout. Security is also an important factor. With in-house prototyping, all designs remain safely within the company.

Producing high-quality PCBs in your company's development department or in-house lab gives you a decisive advantage. With LPKF products, single-sided and double-sided PCBs, multilayers, high-capacity circuits, RF and microwave PCBs, and rigid and flex PCBs can be manufactured – offering exciting options for electronic products.

Ask for our “TechGuide PCB-Prototyping” brochure, in which we explain the individual process steps and provide tips and tricks for using the LPKF systems. For tasks that go beyond electronics development, take a look at our “Scientific Prototyping” brochure: in it, you will find laser systems and processes, e. g., for laser plastic welding, for manufacturing 3D MIDs using the LDS process, or for ceramics, LTCC, or TCO processing.

### **About LPKF**

With over 40 years of experience and numerous customer-specific solutions to its name, LPKF is a global leader in rapid PCB prototyping. Approximately 600 employees around the world provide professional sales and service support.

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# Rapid PCB Prototyping – The Faster Way to Create Circuit Boards

Speeding up development means getting to market more quickly. With the rapid PCB prototyping solutions from LPKF, this is easy to accomplish. From mechanical or laser structuring of the base material to production of the complex multilayer prototype: all the necessary tasks can be performed in less than a day. The entire prototyping cycle – from design to production and optimization – can be run through in a single day using LPKF products.

## PCB Structuring

LPKF ProtoMats are setting global standards in precision, flexibility, and user-friendliness. LPKF circuit board plotters are indispensable for fast in-house production of PCBs – for quantities ranging from one-offs for development projects to small batches. They are ideal for high-capacity, analog, digital, RF, and microwave applications. Made in Europe: for over three decades now, LPKF circuit board plotters have served as a benchmark in the milling, drilling, and contour milling of PCBs.

More demanding production methods can be handled with twin products. PCB structuring and micro material processing with LPKF's ProtoLaser S4 and ProtoLaser U4 compact laser systems are setting new standards in quality, speed, and materials capabilities. The innovative LPKF ProtoMat D104 unites two worlds. It works as a mechanical circuit board plotter and is equipped with a UV laser for handling fine structures.

## Multilayers, Through-Hole Plating, and Assembly

LPKF circuit board plotters are ideal for rapid prototyping of multilayer PCBs. Combined with a multilayer press such as the MultiPress S and a through-hole plating system, they can create high-grade multilayer PCBs for subsequent assembly with the LPKF ProtoPlace. The advantages are especially evident in the development phase for complex designs.

## Versatile Software

Each LPKF structuring system is delivered with a comprehensive software package that has been optimized for ease of use, maximum quality, and rapid generation of results. LPKF CircuitPro supports all standard CAD data file formats for import and transmits the production data to the structuring system.

## Other Applications

Along with being able to produce PCBs in record time, LPKF systems have proven their versatility in a wide variety of applications: from housings, front panels, aluminum and plastics processing, depaneling of assembled boards, and cutting and engraving of plastic films to geometrically precise structuring of ceramic RF boards.





# LPKF Circuit Board Plotters

Fast, precise, and easy – LPKF’s circuit board plotters have been meeting these user demands for over 40 years.

## **In-House Production of PCB Prototypes and Small Batches**

LPKF’s ProtoMat systems are available in three different series. The E series ProtoMats supply LPKF quality at an entry-level price – they do without extra options and automation, but still offer the highest quality basic functionality.

The ProtoMat S systems are largely automated. They come in an attractive protective housing,

feature automatic tool changing, and can be used for other applications through a vacuum table and a vision system.

The LPKF ProtoMat D104 is a powerful circuit board plotter with a special feature: when especially high precision is required, the system switches over to an integrated laser tool. This enables the production of conductors with a fineness that cannot be achieved with any other process.



## High-Quality Equipment for New Applications

Even the simplest system, the ProtoMat E34, can structure, drill, and mill single- and double-sided PCBs with high quality.

The key features of all LPKF ProtoMats include:

**Protective housing:** The ProtoMat housing makes processing especially comfortable. It seals the working chamber off from the environment and reduces noise emissions.

**Circuit board plotter spindles:** The LPKF ProtoMats come with different milling spindles that rotate at speeds of 30 000 RPM to 100 000 RPM (controlled). A high spindle speed enables faster processing, increases resolution, and improves side wall quality.

**Tool change:** The E series ProtoMats have collet chucks for manual tool changing, whereas the other ProtoMats independently select the tools. This allows for highly automated, unsupervised operation and slashes processing times. Another feature of the automatic tool changer is the integrated automatic milling depth adjustment device.

**Camera system:** With the integrated registration camera system, the LPKF ProtoMats achieve a precision of  $\pm 20 \mu\text{m}$  for processing of double-sided PCBs with fiducial marks. A camera increases this precision even more: it detects registration marks or geometric features of the board and automatically adjusts the milling width – for fully automated processing.

**Vacuum table:** The integrated vacuum table facilitates processing of flexible materials and securely holds small workpieces down on the working surface.

# Overview of Application Areas

## **Milling/Drilling of Single- and Double-Sided PCBs**

The main application for LPKF ProtoMats is production of PCB prototypes with FR4 substrates by milling of insulation channels, drilling of mounting and contact holes, and routing of the board out of the base material.

## **Milling/Drilling of RF and Microwave Substrates**

RF and microwave prototypes require extremely precise structuring of special base materials. High-speed spindles produce these fine structures with 90° edges and minimal penetration into the substrate.

## **Milling/Drilling of Multilayers with up to Eight Layers**

LPKF processes can be used to manufacture multilayer prototypes with up to eight layers. For this, a fiducial camera is recommended for precise positioning.

## **Milling of Flexible and Rigid-flex PCBs**

A vacuum table holds flexible printed circuit board materials securely against the working surface. A high spindle rotational speed aids in gentle structuring and depaneling of these delicate boards.

## **Contour Milling of PCBs**

When there are multiple PCBs arranged on a base material, routing contours with break-out tabs allow for depaneling without causing damage.

## **Engraving of Front Panels and Labels**

LPKF circuit board plotters can engrave flat front panels and labels made of plastic, Plexiglas, aluminum, brass, and other materials with high precision.

## **Routing of Cutouts in Front Panels**

Unlike engraving, this involves penetration of the material.

## **Processing of Housings**

LPKF circuit board plotters with adjustable Z-axes (maximum travel: 35 mm) can be used to manufacture planar and nonplanar housing parts.

## **Milling of Plastics**

Thanks to the 2.5-dimensional capabilities, parts or mounting brackets can be produced from suitable plastic block materials.

## **Milling of SMT Solder Paste Stencils**

With the circuit board plotter, polyimide stencils for solder paste printing can be manufactured directly from CAD data.

## **Milling of Solder Frames**

Solder frames hold the boards in place during the soldering process. LPKF circuit board plotters with stepper motor-controlled Z-axes are ideal for milling of the fixtures in relatively thick temperature-resistant material.

## **Reworking of PCBs**

LPKF ProtoMats can be used for the efficient depaneling of assembled (populated) and bare (unpopulated) boards as well as for PCB reworking.

## **Drilling of Test Adapters**

With an LPKF ProtoMat with high-speed spindle and stepper motor-controlled Z-axis, adapter plates for a bed of nails tester can be drilled perfectly.

## **Inspection Templates**

LPKF circuit board plotters are ideally suited to precise structuring of inspection templates.

## **Depaneling of Assembled Boards**

Cutting of tabs or full-section cuts can be performed as long as the cutting channel can be accessed by the ProtoMat's tool.

## **Ultrafine Conductor Structuring**

For high-resolution, highly integrated electronic components, a large number of densely packed connector terminals must be contacted. The very fine (<200 µm) conductor structures require high spindle speeds or laser tools.

## **Metal Layers on Ceramics**

Metal layers on fired ceramics are sensitive to mechanical loads, but they also place high demands on the tools. This is where the laser shines because it works without exerting any mechanical forces.

## **Reworking of RF Structures**

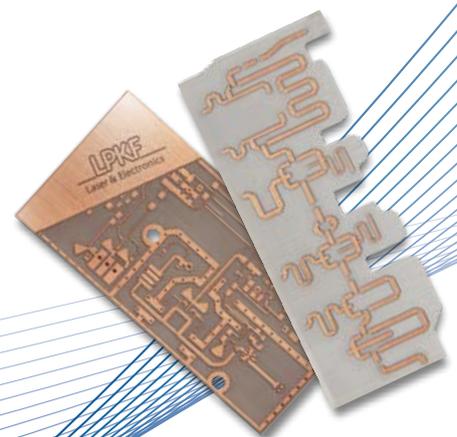
The LPKF ProtoMat D104 can rapidly produce rough structures and add the finishing touches with the laser tool, e. g., for complex RF structures.

## **Dispensing**

The compressed air-assisted dispenser applies the solder paste to the board with high positioning accuracy.

Application	ProtoMat					Application Tips
	E34	E44	S64	S104	D104	
Milling/drilling of single- and double-sided PCBs	•	•	•	•	•	
Milling/drilling of RF and microwave substrates	–	–	•	•	•	LPKF recommends the S104 or the D104 for RF/microwave layouts as the main applications
Milling/drilling of multilayers with up to eight layers	–	–	•	•	•	LPKF recommends optical fiducial recognition for improved accuracy and ease of handling*
Milling of flexible and rigid-flex PCBs	–	–	–/•	•	•	Flexible substrates necessitate a vacuum table, standard feature for the D104, S64, and the S104
Contour routing of PCBs	•	•	•	•	•	
Engraving of front panels and labels	•	•	•	•	•	
Routing of cutouts in front panels	–	–	•	•	•	LPKF recommends the S104, or the S64 for milling of aluminum front panels
Processing of housings	–	–	•	•	–	LPKF recommends the S64 and the S104 for the Z-axis control required for plastic and aluminum housings
Milling of plastics	•	•	•	•	•	
Milling of SMT solder paste stencils	–	–	–/•	•	•	Flexible substrates necessitate a vacuum table, standard feature for the D104, S64, and the S104
Milling of solder frames	–	–	•	•	–	LPKF recommends the S64 and the S104 due to the stepper motor-controlled milling width adjustment
Reworking of PCBs	–	–	•	•	•	LPKF recommends the D104, the S64, and the S104 due to the optical position detection feature
Drilling of test adapters	–	–	•	•	•	LPKF recommends the S64 or the S104 due to the stepper motor-controlled Z-axis.
Inspection templates	–	–	•	•	•	
Depaneling of assembled boards	–	–	•	•	–	LPKF recommends the S64 or the S104 due to the Z-axis control.
Ultrafine conductor structuring	–	–	–	–	•	
Metal layers on ceramics	–	–	–	–	•	
Reworking of RF structures	–	–	–	–	•	
Dispensing	–	–	•	•	–	

\* The camera system is a standard feature for the ProtoMat models E44, S64, S104, and D104



# LPKF ProtoMat E34/E44 – Compact, Easy to Use, Precise

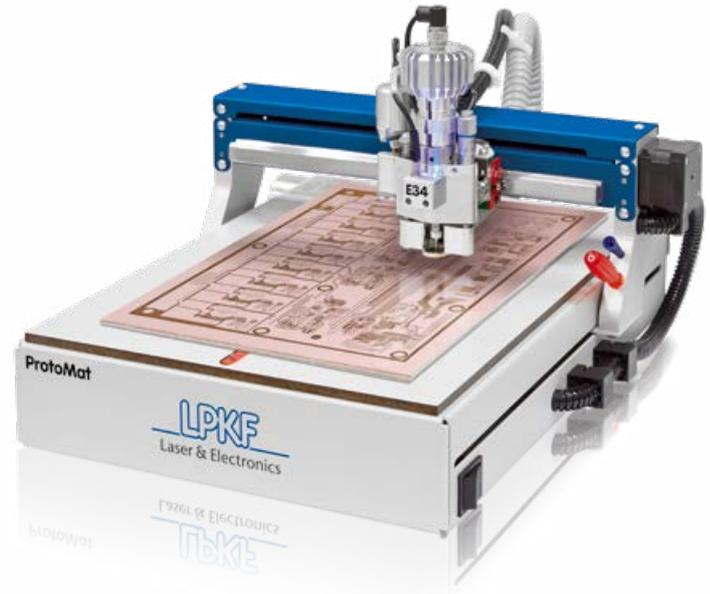
With the ProtoMat E34 and the ProtoMat E44, LPKF offers low-cost, compact circuit board plotters designed exclusively for circuit board processing. The systems are ruggedly constructed. With their manual tool change, they are designed for training purposes or irregular use. Nonetheless, the ProtoMats are just as good as their big brothers when it comes to circuit board structuring.

Both systems can structure single- or double-sided circuit boards, drill holes, perform contour milling, and even engrave front panels. The LPKF CircuitPro CAM software supports the user during processing. A collet chuck facilitates manual tool changing.

## LPKF ProtoMat E44 Extensions

A camera helps the ProtoMat E44 achieve better positioning accuracy with double-sided boards. In addition, the measuring camera enables easy adjustment of the milling depth. A spindle speed of 40 000 RPM provides for a higher working speed. Optimized tool parameters saved in the software accelerate the work process.

- Table system barely larger than a DIN A3 sheet
- Speed of 30 000 or 40 000 RPM
- Manual tool exchange
- With LPKF CircuitPro software
- LPKF quality at an entry-level price
- Protective housing available



### LPKF ProtoMat E34/E44 (Part no.: 10052741 / 10052739)

<b>Max. material size and layout area (X/Y/Z)</b>	229 mm x 305 mm x 10 mm (9" x 12" x 0.4")
<b>Mechanical resolution (X/Y)</b>	0.8 µm (0.04 mil)
<b>Repeatability</b>	± 0.005 mm (± 0.2 mil)
<b>Precision of front-to-back alignment</b>	± 0.02 mm (± 0.8 mil)
<b>Milling spindle</b>	30 000 RPM or 40 000 RPM, software-controlled
<b>Tool change</b>	Manual
<b>Milling width adjustment</b>	Manual
<b>Tool holder</b>	3.175 mm (1/8")
<b>Drilling speed</b>	100 holes/min
<b>Travel speed (X/Y)</b>	Max. 100 mm/s (4"/s)
<b>X/Y-drive</b>	2-phase stepper motor
<b>Z-drive</b>	2-phase stepper motor
<b>Dimensions (W x H x D)</b>	370 mm x 300 mm x 450 mm (14.6" x 11.8" x 17.7")
<b>Weight</b>	15 kg (33 lbs)
<b>Operating conditions</b>	
<b>Power supply</b>	90 – 240 V, 50 – 60 Hz, 120 W
<b>Options and accessories (starting on p. 17)</b>	Dust extraction unit

Technical specifications subject to change.



# LPKF ProtoMat S64 – Allrounder for Rapid PCB Prototyping

LPKF ProtoMat S64: The fast and reliable basic system for almost all in-house PCB prototyping applications – also for multilayer production. The low-maintenance milling spindle produces fine structures up to 100 µm at high speed. Housing parts can be machined up to 2.5-dimensional. The extensive equipment, including dispenser and vacuum table, makes the ProtoMat S64 the perfect addition to any development environment.

## Fast and Automatic

The 60 000 rpm rotating milling spindle guarantees short machining times with geometric precision. The spindle and milling depth sensor require little maintenance thanks to the self-cleaning function.

Short set-up times and unattended operation enable automatic tool change and automatic milling width adjustment. Sensors ensure the exact milling depth and monitor the tool change process. Without additional data calculation, the integrated dispenser automatically applies solder paste to solder pads.

## Integrated, Intuitive Operating Software

The ProtoMat system software is highly flexible, easy to use and includes a parameter library for different materials. If required, the integrated Process Guide leads the user step-by-step through the machining process.

- Fully automatic operation incl. automatic tool change
- Low-maintenance milling spindle with high speed
- Intuitive, integrated system software
- Camera controlled fiducial mark recognition and milling width control
- Granite base for highest result accuracy



LPKF ProtoMat S64 (Part no.: 127411)	
Max. material size and layout area (X/Y/Z)	229 mm x 305 mm x 8 mm (9" x 12" x 0.3")
Mechanical resolution (X/Y)	0.5 µm (0.02 mil)
Repeatability	±0.001 mm (±0.04 mil)
Milling spindle	Max. 60 000 RPM, software-controlled
Tool change	Automatic, 15 positions
Milling width adjustment	Automatic, micro switch ± 1 µm (0.04 mil)
Tool holder	3.175 mm (1/8")
Drilling speed	100 strokes/min
Travel speed (X/Y)	150 mm/s (6"/s)
X/Y-drive, Z-drive, tool feed	3-phase stepper motor, 2-phase stepper motor, 2-phase stepper motor
Solder paste dispense rate	≥0.3 mm (≥0.011") (solder point), ≥0.4 mm (≥0.015") (pad)
Dimensions (W x H x D), weight	680 mm x 560 mm x 800 mm (26.8" x 22.0" x 31.5"), 95 kg (210 lbs)
Operating conditions	
Power supply	90 – 240 V, 50 – 60 Hz, 450 W
Compressed air supply	6 bar; 200 Liter @ atmospheric pressure
Options and accessories (starting on p. 17)	Dust extraction unit, compressor, StatusLight

Technical specifications subject to change.



# LPKF ProtoMat S104 – Specialist for HF and Microwave Applications

The LPKF ProtoMat S104 is fully equipped for electronics laboratories. Thanks to its high-performance spindle and vacuum table, it is suitable for HF applications, thin laminates and substrates with sensitive surfaces (trace widths up to 100 µm on FR4 18/18 Cu).

## Fast and Precise

Drilling and milling even very fine structures: The ProtoMat S104 works quickly and with particular precision at a speed of 100 000 RPM, high travel speeds and high mechanical resolution. The high-frequency spindle and milling depth sensor require little maintenance as they are self-cleaning.

## Fully Automatic for Short Process Times

Easy-to-use = everything is automatic: material and copper thickness measurement, milling width adjustment, tool change. The solder paste is also applied automatically without additional data calculation. Short set-up times and operator-free processing guarantee short process times.

## 2,5 Dimensional

The ProtoMat S104 is ideal for processing front panels and housings as well as assembled PCBs. It also performs depth milling in printed circuit boards.

## Intuitive: the ProtoMat System Software

The software is highly flexible and easy to use, e. g. due to the parameter library for materials. The calculations meet the particularly high requirements of HF applications.

- Top-class model with fully automatic operation
- Available rotation speed up to 100 000 rpm
- 20 tool change positions
- Optical register mark recognition
- Integrated vacuum table
- Easy-to-use package
- Granite machine base for optimum accuracy



### LPKF ProtoMat S104 (Part no.: 127410)

<b>Max. material size and layout area (X/Y/Z)</b>	229 mm x 305 mm x 8 mm (9" x 12" x 0.3")
<b>Mechanical resolution (X/Y)</b>	0.5 µm (0.02 mil)
<b>Repeatability</b>	± 0.001 mm (± 0.04 mil)
<b>Milling spindle</b>	Max. 100 000 RPM, software-controlled
<b>Tool change</b>	Automatic, 20 positions
<b>Milling width adjustment</b>	Automatic, micro switch ± 1 µm
<b>Tool holder</b>	3.175 mm (1/8")
<b>Drilling speed</b>	100 strokes/min
<b>Travel speed (X/Y)</b>	150 mm/s (6"/s)
<b>X/Y-drive, Z-drive, tool feed</b>	3-phase stepper motor, 2-phase stepper motor, 2-phase stepper motor
<b>Solder paste dispense rate</b>	≥ 0.3 mm (≥ 0.011") (solder point), ≥ 0.4 mm (≥ 0.015") (pad)
<b>Dimensions (W x H x D), weight</b>	680 mm x 560 mm x 800 mm (26.8" x 22.0" x 31.5"), 95 kg (210 lbs)
<b>Operating conditions</b>	
<b>Power supply</b>	90 – 240 V, 50 – 60 Hz, 450 W
<b>Compressed air supply</b>	6 bar; 200 Liter @ atmospheric pressure
<b>Options and accessories (starting on p. 17)</b>	Dust extraction unit, compressor, StatusLight, measuring microscope

Technical specifications subject to change.



## LPKF ProtoMat D104 – Fine Pitch and Maximum Precision

The LPKF ProtoMat D104 combines high precision milling with a laser tool. With a laser and mechanical milling tool, it can easily achieve a pitch of 150 µm on FR4 materials (18 µm Cu) – for particularly fine layout structures such as in the routing of a BGA or complex RF circuits. The ProtoMat D104 works with a maximum spindle speed of 100 000 RPM, 15-position automatic tool change, and a repeatability of ± 1 µm.

The intuitive CircuitPro system software can even guide the user through complex circuit board stackups. The software decides when the faster tools or the precise laser (focus of just 15 µm) should be used. Thanks to the processing by laser, structures with a 50-µm trace and a 35-µm space can be produced on ceramic materials; the finest achievable cutting channel size is 15 µm.

The ProtoMat D104 includes a non-contact sensor for automated tool depth adjustment allowing for unattended operations. An integrated vacuum table holds the substrate firmly in place. A vision system can read in material positions and measure the structuring results.

- UV laser tool for high-precision structuring
- Integrated measuring camera/vision system
- 100 000-RPM spindle, automatic tool change, vacuum table
- Mechanical milling/drilling and laser structuring



### LPKF ProtoMat D104 (Part no.: 10030011)

<b>Max. material size and layout area (X/Y/Z)</b>	305 mm x 229 mm x 10 mm (12" x 9" x 0.4")
<b>Mechanical resolution (X/Y)</b>	0.3 µm (0.01 mil)
<b>Repeatability</b>	± 1 µm (± 0.04 mil)
<b>Milling spindle</b>	Max. 100 000 RPM, software-controlled
<b>Tool change</b>	Automatic, 15 positions
<b>Milling width adjustment</b>	Automatic
<b>Tool holder</b>	3.175 mm (1/8")
<b>Drilling speed</b>	120 strokes/min
<b>Travel speed (X/Y)</b>	Max. 100 mm/s (3.7"/s)
<b>X/Y-drive</b>	3-phase stepper motor
<b>Z-drive</b>	2-phase stepper motor
<b>Dimensions (W x H x D)</b>	660 mm x 700 mm x 870 mm (26" x 27.6" x 34.3")
<b>Weight</b>	99 kg (218.3 lbs)
<b>Operating conditions</b>	
<b>Power supply</b>	90 – 240 V, 50 – 60 Hz, 440 W
<b>Compressed air supply</b>	6 bar (87 psi), 100 L/min (3.5 cfm)
<b>Options and accessories (starting on p. 17)</b>	Dust extraction unit, compressor, StatusLight, measuring microscope

Technical specifications subject to change.



# Comparison of LPKF Circuit Board Plotters

## Performance and Features

Property	ProtoMat E34	E44	S64	S104	D104
Working area (X/Y)	229 mm x 305 mm (9" x 12")	229 mm x 305 mm (9" x 12")	229 mm x 305 mm (9" x 12")	229 mm x 305 mm (9" x 12")	229 mm x 305 mm (9" x 12")
Mechanical resolution (X/Y)	0.8 µm (0.04 mil)	0.8 µm (0.04 mil)	0.5 µm (0.02 mil)	0.5 µm (0.02 mil)	0.3 µm (0.01 mil)
Travel speed (X/Y)	100 mm/s	100 mm/s	150 mm/s	150 mm/s	100 mm/s
Repeatability	± 0.005 mm (± 0.2 mil)	± 0.005 mm (± 0.2 mil)	± 0.001 mm (± 0.04 mil)	± 0.001 mm (± 0.04 mil)	± 0.001 mm (± 0.04 mil)
Working area (Z)	10 mm (0.4")	10 mm (0.4")	8 mm (0.3")	8 mm (0.3")	10 mm (0.4")
Mechanical resolution (Z)	0.85 µm (0.033 mil)	0.85 µm (0.033 mil)	0.2 µm (0.008 mil)	0.2 µm (0.008 mil)	0.2 µm (0.008 mil)
Travel speed (Z)	20 mm/s	20 mm/s	25 mm/s	25 mm/s	25 mm/s
Spindle speed	30 000 RPM	40 000 RPM	60 000 RPM	100 000 RPM	100 000 RPM
Drilling speed	100 strokes/min	100 strokes/min	100 strokes/min	100 strokes/min	120 strokes/min
Temperature sensor	-	-	•	•	•
Dispenser	-	-	•	•	-
Software LPKF CircuitPro	•	•	•	•	•
Automatic tool change	-	-	15	20	15
Vacuum table	-	-	•	•	•
Optical fiducial recognition	-	•	•	•	•
Acoustic cabinet	Optional	Optional	•	•	•
Automatic milling width adjustment	-	-	•	•	•
Working depth limiter	Mechanical	Mechanical	Mechanical	Mechanical	Pneumatic
StatusLight	-	-	Optional	Optional	•
Ports	1 x USB	2 x USB	2 x USB	2 x USB	2 x USB
Footprint (W x D)	370 mm x 450 mm (14.6" x 17.7")	370 mm x 450 mm (14.6" x 17.7")	670 mm x 840 mm (26.4" x 33")	670 mm x 840 mm (26.4" x 33")	660 mm x 870 mm (26" x 34.3")
Weight	15 kg (33 lbs)	15 kg (33 lbs)	95 kg (210 lbs)	95 kg (210 lbs)	99 kg (218.3 lbs)
Compressed air supply required?	Not required	Not required	6 bar; 200 Liter @ atmospheric pressure	6 bar; 200 Liter @ atmospheric pressure	For operation 6 bar (87 psi) 100 L/min (3.5 cfm)

• = Standard      - = Not available      Optional = Optionally available as upgrade or accessory

Technical specifications subject to change.





# Innovative Laser Technology for Rapid PCB Prototyping

LPKF's micro material processing options for PCB prototyping now include non-contact laser processes – from structuring and processing of printed circuit boards to processing of special materials.

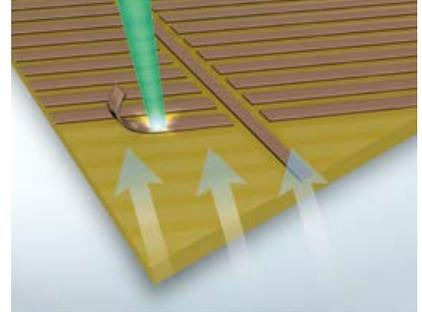
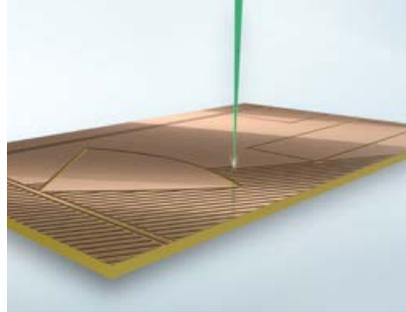
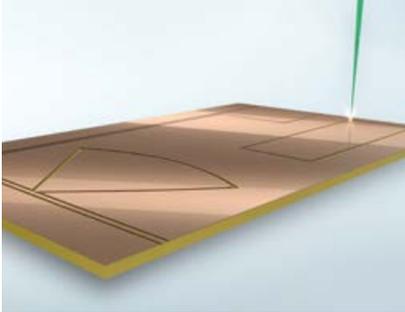
Two laser systems are available for use in development environments. The ProtoLaser S4 is the ideal system for laser structuring of circuit boards with laminated PCB materials.

The ProtoLaser U4 offers even finer laser focus for structuring laminated substrates.

With its UV laser, it can be used nearly universally on a wide range of materials, allowing for drilling, cutting, and engraving. Both systems come with the powerful LPKF CircuitPro CAM software.

# Laser Micro Material Processing

Laser processes offer numerous advantages over mechanical processes. The laser beam works in a non-contact manner without exerting any mechanical forces on the material being processed.



Depending on the process control and the laser wavelength used, the laser can heat, melt, evaporate, or even be transmitted through the material. Because different materials possess different absorption rates for the laser wavelengths employed, material combinations common in electronics can also be processed and substrate damage can be reduced.

The small spot size of the laser beam is a major advantage. It enables cutting channels down to a mere 15  $\mu\text{m}$  in width to be produced. This precision can also be achieved, e. g., for corner radii and sharp cutting edges – making the laser particularly useful for RF applications.

Structuring within the framework of PCB prototyping is similar to mechanical milling: The laser beam ablates the copper next to the future traces without leaving any residues and generates the conductive pattern based on these insulation channels. The structure exhibits sharply cut edges.

For large copper rubout areas, an extended patented process is used: The laser cuts the area into thin strips and detaches these strips from the organic substrate by heating. This drastically reduces the processing time.

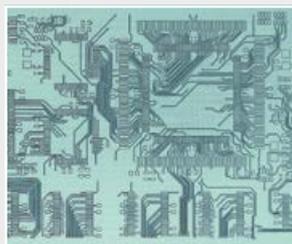
LPKF ProtoLasers are also capable of cutting common PCB materials. Full-section cuts through thin materials are no problem; tab cuts can be made in thicker materials. The laser also performs impressively in the depaneling of rigid-flex components and drilling of holes.

LPKF ProtoLasers are compact and economical. They only need a power outlet and compressed air and can fit through any lab door. The LPKF ProtoLaser S4 and the LPKF ProtoLaser U4 each feature a vacuum table and a vision system and correspond to Class 1 lasers in operation (no additional protective measures required).

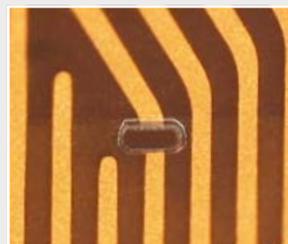
## Other Laser Applications



Creation of solder mask openings



Direct exposure of resists  
(ultrafine conductor production)



PCB reworking



Cutting of mounting holes

# LPKF ProtoLaser S4 – Laser Structuring of PCBs

With the LPKF ProtoLaser S4, you can get from layout to structured PCB in just a few minutes – with precise geometries on a wide variety of substrates. The ProtoLaser S4 uses a green (532-nm) laser source that, despite its high cutting performance for copper, barely damages the substrate. Hence, this laboratory laser can also reliably process copper surfaces with inhomogeneities up to 6 µm in thickness variance and is also suitable for manufacturing of multilayer components. This ensures fast processing, compatibility with a wide range of materials, and reliable process results in the lab!

The ProtoLaser S4 is the solution for efficient prototyping of complex digital and analog circuits as well as RF and microwave PCBs up to a size of 229 mm x 305 mm (9" x 12"). It achieves exact geometries on nearly any material and is ideal for production of single- and double-sided PCBs, antennas, filters, and numerous other applications in which precise, vertical side walls are essential.

- Maximum mechanical precision, precise geometries, optimal repeatability
- Compact and reliable: suitable for laboratory use
- Compatible with nearly all commonly used printed circuit board materials
- Prototyping and on-demand manufacturing of customer-specific small batches



## LPKF ProtoLaser S4 (Part no.: 10055359)

<b>Max. material size and layout area (X/Y/Z)</b>	229 mm x 305 mm x 7 mm (9" x 12" x 0.28")
<b>Structuring speed</b>	Ø 9 cm <sup>2</sup> /min (Ø 1.4 in <sup>2</sup> /min) <sup>a</sup> , on laminated substrate
<b>Diameter of focused laser beam</b>	23 µm (0.9 mil)
<b>Minimum line/space</b>	75 µm/25 µm (2.9 mil/1 mil), on laminated substrate (18 µm Cu) <sup>a</sup>
<b>Accuracy*</b>	± 1.98 µm (± 0.08 mil)
<b>Repeatability</b>	± 2 µm (± 0.08 mil) <sup>b</sup>
<b>Laser power</b>	Max. 12 W
<b>Laser pulse frequency</b>	25 – 300 kHz
<b>Z-axis</b>	Stepper motor, software-controlled
<b>Dimensions (W x H x D)</b>	910 mm x 1650 mm x 795 mm (35.8" x 64.9" x 31.3") <sup>c</sup>
<b>Weight</b>	340 kg (750 lbs)
<b>Operating conditions</b>	
<b>Power supply</b>	90 – 240 V, 50 – 60 Hz, 1.4 kW
<b>Compressed air supply</b>	Min. 6 bar (87 psi), 230 L/min (8.12 cfm)
<b>Cooling</b>	Air-cooled (internal cooling cycle)
<b>Ambient temperature</b>	22 °C ± 2 °C (71.6 °F ± 4 °F)
<b>Options and accessories (starting on p. 17)</b>	Dust extraction unit, compressor, StatusLight, standard PC

<sup>a</sup> Depending on material and laser beam parameters

<sup>b</sup> Direct repeat of laser beam movement

<sup>c</sup> Height with open hood: 1765 mm (69.5")

\* Mechanical resolution scanfield



# LPKF ProtoLaser U4 – Multipurpose Tool for the Electronics Lab

## One System, Multiple Applications

The LPKF ProtoLaser U4 with integrated UV laser is capable of processing a wide variety of materials. It is easy to install and even easier to use. The high pulse energy of the UV laser leads to a residue-free ablation process, resulting in geometrically precise contours.

The LPKF ProtoLaser U4 can structure or cut diverse materials quickly and cleanly. The laser wavelength used makes the UV laser a truly multifunctional tool. A UV laser beam can cut individual boards out of large boards with high precision and no stress, drill holes and microvias, and create openings in solder masks. It can cut and structure LTCCs, fired ceramics, ITO/TCO substrates, delicate prepregs, and laminated materials.

An extensive materials library supplies the laser parameters for key materials. Because the ProtoLaser U4 works without material contact, tooling costs are a thing of the past. Micro material processing thus benefits from the fine laser beam diameter, the extremely precise focusing along the Z-axis, and the exact control of the processing positions.

- Noncontact depaneling of rigid, rigid-flex, and flexible boards
- Stability in low-energy range
- Power measurement on the substrate plane
- Focused laser spot size of 20 µm



### LPKF ProtoLaser U4 (Part no.: 10055358)

<b>Max. material size and layout area (X/Y/Z)</b>	229 mm x 305 mm x 7 mm (9" x 12" x 0.28")
<b>Structuring speed</b>	∅ 3 cm <sup>2</sup> /min (∅ 0.46 in <sup>2</sup> /min) <sup>a</sup> , on laminated substrate
<b>Diameter of focused laser beam</b>	20 µm (0.8 mil)
<b>Minimum line/space</b>	50 µm/20 µm (2 mil/0.8 mil), on laminated substrate (18 µm Cu) <sup>a</sup>
<b>Accuracy*</b>	± 1.98 µm (± 0.08 mil)
<b>Repeatability</b>	± 2 µm <sup>b</sup> (± 0.08 mil)
<b>Laser power</b>	5.7 W
<b>Laser pulse frequency</b>	25 – 300 kHz
<b>Z-axis</b>	Stepper motor, software-controlled
<b>Dimensions (W x H x D)</b>	910 mm x 1650 mm x 795 mm (35.8" x 64.9" x 31.3") <sup>c</sup>
<b>Weight</b>	340 kg (750 lbs)
<b>Operating conditions</b>	
<b>Power supply</b>	90 – 240 V, 50 – 60 Hz, 1.4 kW
<b>Compressed air supply</b>	Min. 6 bar (87 psi), 230 L/min (8.12 cfm)
<b>Cooling</b>	Air-cooled (internal cooling cycle)
<b>Ambient temperature</b>	22 °C ± 2 °C (71.6 °F ± 4 °F)
<b>Options and accessories (starting on p. 17)</b>	Dust extraction unit, compressor, StatusLight, standard PC

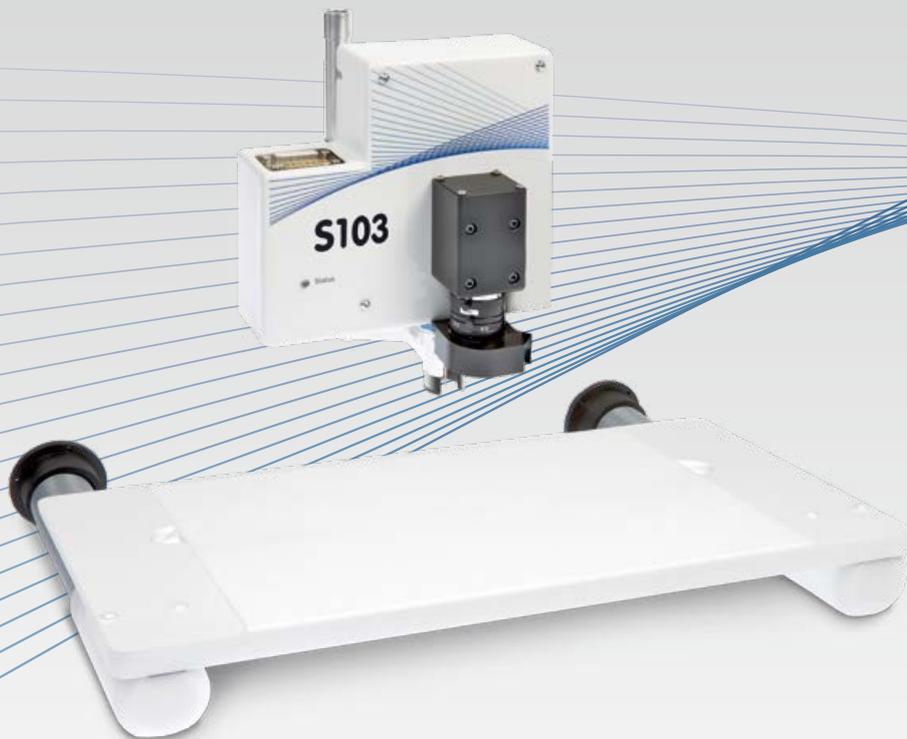
<sup>a</sup> Depending on material and laser beam parameters

<sup>b</sup> Direct repeat of laser beam movement

<sup>c</sup> Height with open hood: 1765 mm (69.5")

\* Mechanical resolution scanfield





## Options and Accessories for LPKF Circuit Board Plotters and ProtoLasers

The performance capabilities of the LPKF circuit board plotters and ProtoLasers can be extended through the addition of accessories and options. High-grade materials and precision workmanship ensure the high reliability and longevity of all add-ons. The accessories can easily be installed in existing systems without the help of specialists.

### Dust Extraction Unit

The LPKF dust extraction unit with absolute filter eliminates fibers, chips, and fine dust. The integrated AutoSwitch function switches the dust extraction unit on and off automatically.

Dust Extraction Unit	ProtoMat S + E	ProtoLaser + ProtoMat D104
<b>Part no.</b>	10033243	124391
<b>Vacuum pressure</b>	Max. 22 500 Pa	Max. 21 000 Pa
<b>Air flow rate</b>	241 m <sup>3</sup> /h (142 cfm)	320 m <sup>3</sup> /h (188 cfm)
<b>Power consumption</b>	800 W (230 V) or 960 W (120 V)	1.6 kW (230 V, 50/60 Hz)
<b>Dimensions (W x H x D)</b>	250 mm x 300 mm x 350 mm (10" x 12" x 14")	365 mm x 1245 mm x 501 mm (14.4" x 49" x 19.7")
<b>Acoustic pressure</b>	50 dB(A)	Ca. 65 dB(A)
<b>Absolute filter</b>	HEPA filter	HEPA filter
<b>Remote control</b>	Software-controlled	Software-controlled



## Protective Housing (for ProtoMat E34/E44)

The protective housing for the E series ProtoMats lowers noise emissions and keeps the work environment free of fibers and chips.

<b>Protective Housing</b>	<b>ProtoMat E34/E44</b>
<b>Part no.</b>	10060031



## Compressor

The LPKF compressors ensure a constant, reliable supply of compressed air to LPKF systems that use it.

Compressor	Compressor 24 L	Compressor 50 L	Compressor 60 L*
<b>Part no.</b>	10032687	104863	122805
<b>Tank size</b>	24 L	50 L	60 L
<b>Max. pressure</b>	8 bar (116 psi)	10 bar (145 psi)	10 bar (145 psi)
<b>Output</b>	50 L/min (1.8 cfm)	165 L/min (5.8 cfm)	240 L/min (8.5 cfm)
<b>Outside dims. (W x H x D)</b>	400 x 540 x 400 mm (15.7" x 21.3" x 15.7")	1000 x 770 x 390 mm (39.4" x 30.3" x 15.4")	970 x 770 x 480 mm (38" x 30" x 19")
<b>Weight</b>	29 kg (64 lbs)	56 kg (123.2 lbs)	90 kg (198.4 lbs)
<b>Acoustic noise</b>	40 dB(A)	68 dB(A)	83 dB(A)
<b>Recommended for</b>	LPKF ProtoPlace S		LPKF ProtoLaser S4/U4 LPKF ProtoMat D 104

\* incl. refrigerant-type dryer



## Precision Ring Setter

The LPKF precision ring setter consists of an adjustment unit with a measuring microscope. It can precisely position distance rings on the tool for placement into the collet chuck without any further adjustment.

<b>Precision Ring Setter</b>	<b>ProtoMat</b>
<b>Part no.</b>	116698



## Measuring Microscope

The LPKF measuring microscope has a magnification of 100x and a metric scale to facilitate adjustment of insulation milling widths and quality control.

<b>Measuring Microscope</b>	
<b>Part no.</b>	10035579



## Adjustment Tool (for ProtoLasers)

This set of precision tools can be used to adjust the workbench and the laser.

<b>Adjustment Tool</b>	<b>ProtoLaser</b>
<b>Part no.</b>	118005





## Operating Materials for LPKF Circuit Board Plotters and ProtoLasers

LPKF supplies high-quality consumables – from copper-clad base materials to cleaning pads and special adhesive tape, LPKF guarantees first-class product quality.

### Copper-Clad FR4 Base Materials (thickness of 1.5 mm, 10 per package)

Unless otherwise specified, the base materials are shipped with dimensions 229 mm x 305 mm (9" x 12").

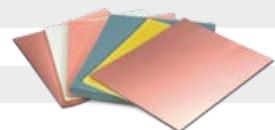
Part no.	Description
SET-10-1053	Base material FR4, 5/5 µm with protective film, predrilled 3-mm registration holes
115968	Base material FR4, 0/18 µm, predrilled 3-mm registration holes
115967	Base material FR4, 18/18 µm, predrilled 3-mm registration holes
SET-10-1001	Base material FR4, 0/35 µm, predrilled 3-mm registration holes
SET-10-1000	Base material FR4, 35/35 µm, predrilled 3-mm registration holes
112059	Base material FR4, DIN A3, 5/5 µm with protective film
106398	Base material FR4, DIN A3, 18/18 µm
106400	Base material FR4, DIN A3, 0/35 µm
106401	Base material FR4, DIN A3, 35/35 µm



### Multilayer Materials

The LPKF multilayer starter sets include all the materials necessary for producing high-quality multilayers (LPKF MultiPress required). Base size: 229 mm x 305 mm (9" x 12").

Part no.	Description
121103	4-layer multilayer set/galvanic through-hole plating
121102	4-layer multilayer set/chemical-free through-hole plating
121093	6-layer multilayer set/galvanic through-hole plating
124481	8-layer multilayer set/galvanic through-hole plating



## Drill Underlay Sheets

Drill underlay sheets are used as backing for the base materials to prevent damage to the machine table.

Part no.	Description	Sheets per Package
SET-10-1086	Drill underlay sheet, DIN A4, d = 2 mm	10
106389	Drill underlay sheet, DIN A3, d = 2 mm	10
SET-10-1052	Drill underlay sheet (predrilled), 229 mm x 305 mm (9" x 12"), d = 2 mm	10



## Block Materials

More than just PCBs. With specially tested block materials, LPKF circuit board plotters with controllable Z-axes can quickly generate precise 2.5-dimensional bodies such as mounting brackets.

Part no.	Description
10044715	Block material for sheet metal forming & drawing tools, foundry patterns, and master patterns & copies, 250 x 250 x 8 mm, red
106389	Block material for master patterns & copies, cubing & working models, and general model construction, 300 x 250 x 8 mm, brown

## Honeycomb and Sintered Plates for the Vacuum Table

Honeycomb and sintered plates reliably secure base materials to the vacuum table and can be exchanged separately.

Part no.	Description	Plates per Package
116148	Honeycomb plates for vacuum tables ProConduct and ProtoMat S series, 5 mm thick, Ø 3.5 mm	4
116099	Sinter plate for LPKF vacuum table for ProtoMat S63/S103, 5 mm in thickness	4
10055362	High precision sinter plate 315 x 239 x 1,5 mm, for LPKF vacuum table for ProtoLaser S4/U4, ProtoMat S64/S104	1

## Starter Sets for ProtoMats

LPKF starter sets include an extensive selection of operating materials, tools, and other accessories for rapid startup. We offer customized starter sets for each circuit board plotter. Please check the LPKF website or contact us for information on the exact contents.

Part no.	Description
127696	Starter set for ProtoMat E34/E44
10082407	Starter set for ProtoMat S64
10086886	Starter set for ProtoMat S104
10086885	Starter set 2.5D for ProtoMat S series
10035172	Starter set for ProtoMat D104



## Cleaning Pads

Part no.	Description	Pads per Package
106403	The metal-free, ultrafine board cleaning pads remove the oxidation residues from the copper layer on the base material.	10

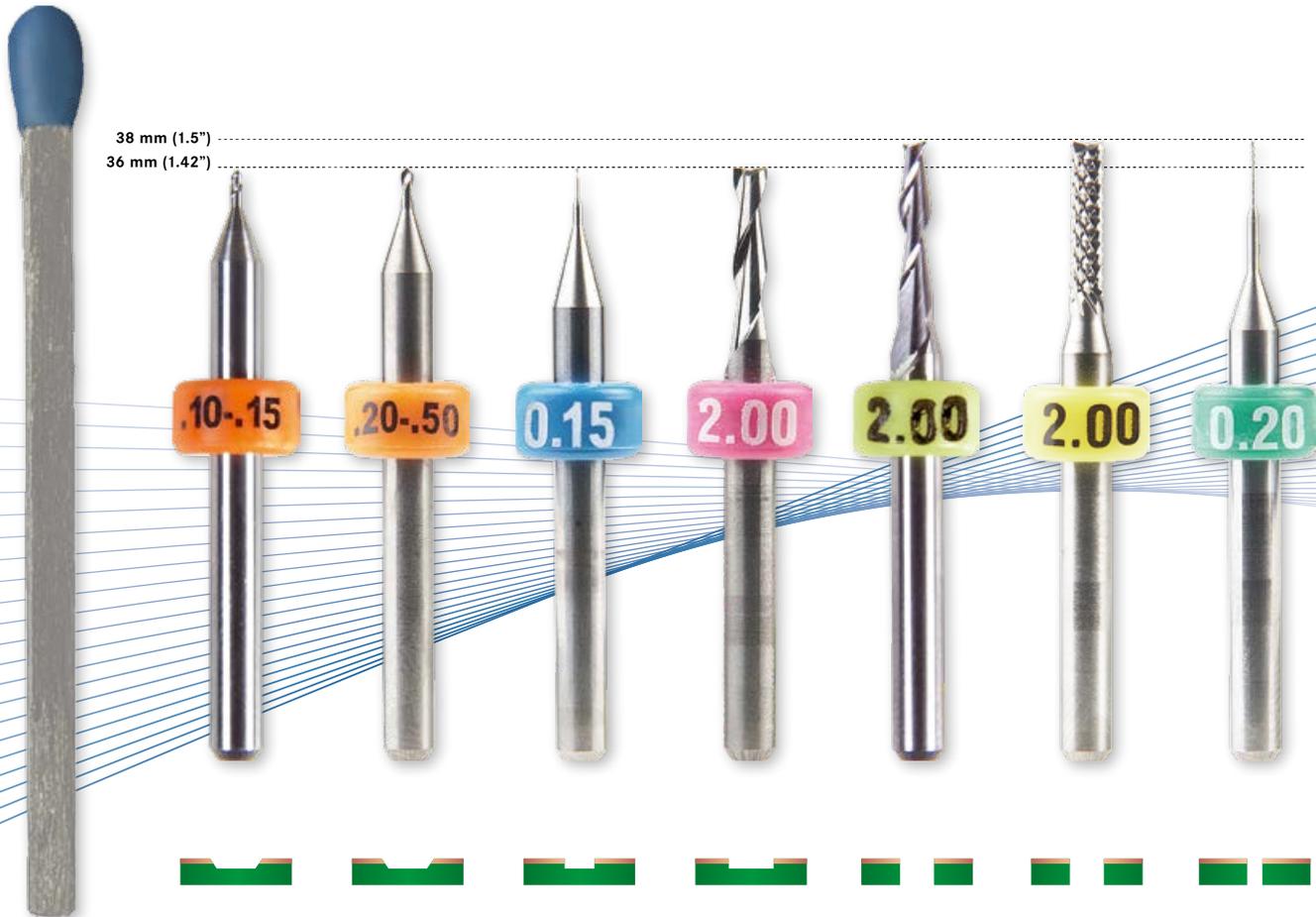


## Special Adhesive Tape

Part no.	Description
106373	The special adhesive tape holds the base material flat against the workbench and can be removed without leaving any residues.

# LPKF Drilling and Milling Tools for LPKF ProtoMats

LPKF places high demands on every single tool. The drilling and milling tools developed especially for LPKF are high-quality hard metal tools. They guarantee a long service life, precise structures, and cleanly milled edges.



The tools are divided into two main categories: surface tools with a total length of 36 mm (1.42") for surface machining (cutters and end mills) and through-thickness tools with a total length of 38 mm (1.5") for penetrating the base material (spiral drills, contour routers, and end mills).

## **Starter Toolbox 1/8" Shaft with Distance Rings (Part no. 129103)**

For all LPKF ProtoMat models. Includes tools with pressed-on distance rings: various universal cutters, microcutters, end mills, contour routers, and spiral drills in a handy toolbox.

## **RF and Microwave Starter Toolbox with Distance Rings (Part no. 116394)**

Supplements the toolkit with 20 special RF end mill tools.

Part no.	Length/Milling Width	Description
<b>Microcutter/fine-line milling tool 1/8", conical, orange distance ring, 36 mm</b>		
115836	0.10–0.15 mm (4–6 mil)	For fine insulation spacings with a Cu thickness of 18 µm
<b>Universal cutter 1/8", conical, orange distance ring, 36 mm</b>		
115835	0.2–0.5 mm (8–20 mil)	For milling of different insulation spacings in copper-coated base material
<b>End mill (RF) 1/8", cylindrical, blue distance ring, 36 mm</b>		
115832	d=0.15 mm (6 mil)	For minimal insulation spacings in RF applications
115833	d=0.25 mm (10 mil)	
115834	d=0.40 mm (16 mil)	
<b>End mill 1/8", cylindrical, violet distance ring, 36 mm</b>		
115839	d=0.80 mm (31 mil)	For wide insulation spacings and engraving of aluminum front panels and cutouts
115840	d=1.00 mm (39 mil)	
129100*	d=2.00 mm (79 mil)	
129101*	d=3.00 mm (118 mil)	
<b>End mill long 1/8", cylindrical, light green distance ring, 38 mm</b>		
115837	d=1.00 mm (39 mil)	For milling of Al and contour milling of soft base materials for RF and microwave applications
129102*	d=2.00 mm (79 mil)	
<b>Contour router 1/8", cylindrical, yellow distance ring, 38 mm</b>		
115844	d=1.00 mm (39 mil)	For milling of internal and external contours and drilled holes >2.4 mm (>94 mil)
129099*	d=2.00 mm (79 mil)	
<b>Spiral drill 1/8", cylindrical, green distance ring, 38 mm</b>		
115846	d=0.20 mm (8 mil)	For drilled holes <2.4 mm (<94 mil)
115847	d=0.30 mm (12 mil)	
115848	d=0.40 mm (16 mil)	
115849	d=0.50 mm (20 mil)	
115850	d=0.60 mm (24 mil)	
115851	d=0.70 mm (28 mil)	
115852	d=0.80 mm (31 mil)	
115853	d=0.85 mm (33 mil)	
115854	d=0.90 mm (35 mil)	
115855	d=1.00 mm (39 mil)	
115856	d=1.10 mm (43 mil)	
115857	d=1.20 mm (47 mil)	
115858	d=1.30 mm (51 mil)	
115859	d=1.40 mm (55 mil)	
115860	d=1.50 mm (59 mil)	
115861	d=1.60 mm (63 mil)	
115862	d=1.70 mm (67 mil)	
115863	d=1.80 mm (71 mil)	
115864	d=1.90 mm (75 mil)	
115865	d=2.00 mm (79 mil)	
115866	d=2.10 mm (83 mil)	
115867	d=2.20 mm (87 mil)	
115868	d=2.30 mm (91 mil)	
115869	d=2.40 mm (94 mil)	
115870	d=2.95 mm (116 mil)	
115871	d=3.00 mm (118 mil)	

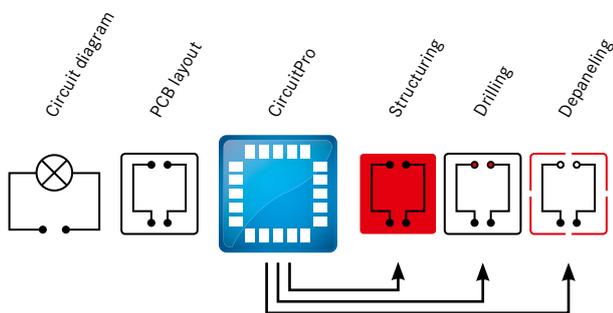


\* Shaft 25 mm (984 mil)



# LPKF CircuitPro – Smart Software with Intuitive Operation

The LPKF circuit board plotters and ProtoLasers come with powerful system software. It imports the data from the design software, uses it to generate the individual processing steps, prepares it for production, and guides the user step by step through the manufacturing process.



LPKF CircuitPro can import data in all commonly used data exchange formats, offers extensive editing options, and controls the connected circuit board plotters and ProtoLasers. The CAM software can even prepare data for combined process workflows for the ProtoLasers and ProtoMats. The software independently suggests the optimal tool parameters based on the material and the LPKF processing system.

The software also generates templates for solder masks, dispensing positions, and legend printing. LPKF CircuitPro is included with the LPKF systems. A free demo version is available on the LPKF website.

- Powerful CAM software supplied with every ProtoMat and ProtoLaser – for optimized manufacturing processes
- Interactive process editor
- Intuitive operation – minimal training requirements
- Extensive data interfaces
- Reliable process control and monitoring

### PCB Prototyping with Software Support

Powerful and user-friendly: these two attributes were at the top of the list of requirements during development of the LPKF CircuitPro system software. Even less experienced users can produce complex PCB prototypes thanks to the well-thought-out user navigation.

LPKF CircuitPro is the result of 40 years of experience in the manufacturing of PCB prototypes. The software recognizes the necessary work steps and guides the user comfortably through the production process by means of wizards. Empirically proven process parameters for the main PCB materials are already available in libraries. LPKF CircuitPro precisely processes precisely the data required by PCB manufacturers.

CircuitPro automatically imports aperture tables and tool lists as well as Gerber and NC data, combines multiple PCBs on a panel, and employs methods for checking the layout. Refined software routines determine the most effective process sequence for the respective processing system and optimally use the available tools.

The user can load finished projects or easily optimize newly created production steps in the integrated editor.

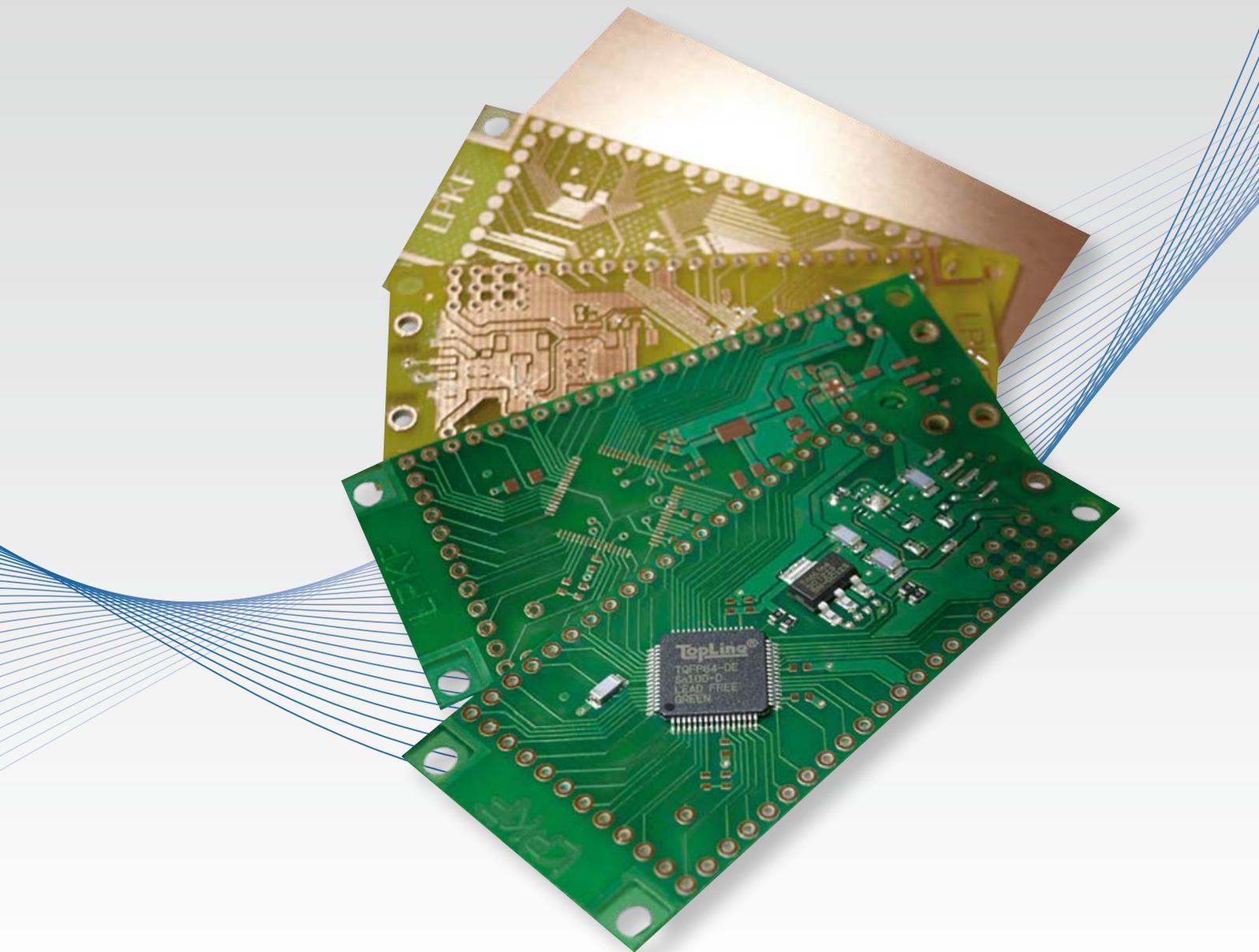
### Intelligent Helpers

The LPKF CircuitPro wizards can even guide occasional users quickly and reliably through the entire process – with no training required. Wizards help in data preparation and indicate the necessary user interventions. This reduces training times and yields quick results.



The PCB production wizard helps the user by providing clear instructions on the next work step

	<b>LPKF CircuitPro</b>
<b>Import formats for PCB processing</b>	Gerber Standard (RS-274-D), Extended Gerber (RS-274-X), Excellon NC Drill (Versions 1 and 2), Sieb & Meier NC Drill, HP-GL™, DPF, Auto-CAD™ DXF, IGES, LMD, STEP



# Systems and Processes for Manufacturing Component Population

The prototyping process isn't finished when the PCB has been manufactured. Only after through-hole plating, solder mask application, assembly, and reflow soldering have been completed is an electronic component assembly created from a printed circuit board.

## LPKF EasyContac – Manual Through-Hole Plating of Double-Sided PCBs



- Easy and inexpensive
- Comes complete with tool
- Ideal for a small number of through holes

LPKF EasyContac is a manual system for through-hole plating of double-sided PCBs with copper alloy rivets. The set includes 1000 rivets each of outside diameter 0.8 mm (32 mil), 1.0 mm (40 mil), 1.2 mm (48 mil), and 1.4 mm (56 mil), press tools, an anvil, and tweezers.

The contact resistance is 10 mΩ; the rivet system can be used for material thicknesses of up to about 1.5 mm (59 mil).

**Part no.: 110914**



[www.lpkf.com/easycontac](http://www.lpkf.com/easycontac)

## LPKF ProConduct – Through-Hole Plating of PCBs without Chemicals

Reliable through-hole plating without using a galvanic process! The paste-based through-hole plating method is also suitable for a large number of through holes with a minimum diameter of 0.4 mm (15 mil) and a maximum aspect ratio of 1:4.

The contact resistance is about 20 mΩ with a standard deviation of 8 mΩ. FR4, RF, and microwave materials (including PTFE-based materials) are suitable for contacting.

The procedure is simple:

- First a protective film is adhered to each side of the structured board
- Then a ProtoMat drills the required holes through the films and the board
- With the help of a squeegee and a vacuum – the vacuum tables on the ProtoMats are used for this purpose – the ProConduct paste is pulled through the holes on both sides
- The protective films are removed and the board is cured in the convection oven

LPKF ProConduct comes as a complete set with all tools, disposable gloves, protective films, and paste in portions with the required amounts.

- No galvanic baths or chemicals
- Low-resistance, thermally stable plated through holes
- Quick and easy operation
- Also suitable for PTFE and other challenging substrates



**Options and accessories (p. 34)**

Vacuum table, convection oven

**Part no. 115790**



[www.lpkf.com/proconduct](http://www.lpkf.com/proconduct)

# LPKF Contac S4 – Table-Top Through-Hole Electroplating

In galvanic through-hole plating, a very homogeneous copper layer is deposited over the entire surface of the base material and the inner walls of the through holes down to a minimum hole diameter of 0.2 mm (8 mil). The compact LPKF Contac S4 has six baths for reliably performing this task: all work steps from surface activation to the tin finish are integrated in a compact, low-maintenance unit.

The LPKF Contac S4 utilizes newly designed anode plates and reverse pulse plating for especially uniform copper layer buildup. PCBs with through-hole plating accomplished in this way are also suitable, e. g., for structuring with the LPKF ProtoLaser S4.

The integrated computer with touch display assumes the operation and guides the user through each step of the metallization process.

The Contac S4 can also process multilayers with up to eight layers with a maximum aspect ratio of 1:10 (hole diameter to PCB thickness). A final tin bath step protects the surface and improves solderability. The long-lasting chemicals require little maintenance and have been developed and optimized specifically for the system.

- Uniform copper layer buildup
- Reverse pulse plating (RPP), black hole process, and microvia cleaning
- Chemical (electroless) tin plating
- Through-hole plating even for small diameters of >0.2 mm (> 8 mil)
- No knowledge of chemistry required



## LPKF Contac S4 (Part no.: 10055361)

<b>Max. material size (X x Y)</b>	230 mm x 330 mm (9.1" x 13")
<b>Max. layout area (X x Y)</b>	200 mm x 300 mm (7.9" x 11.8")
<b>Reverse pulse plating</b>	Adjustable
<b>Tolerance</b>	± 2 µm (0.08 mil), copper coating
<b>Minimum hole diameter</b>	≥ 0.2 mm (0.8 mil)
<b>ViaCleaner</b>	Integrated
<b>Chemical tin plating</b>	Integrated
<b>Process time</b>	Approx. 90 – 120 min
<b>Power supply</b>	90 – 240 V, 50 – 60 Hz, 0.6 kW
<b>Dimensions (W x H x D)</b>	856 mm x 446 mm x 542 mm (33.7" x 17.7" x 21.3")
<b>Options and accessories (p. 34)</b>	ViaCleaner chemical set, powder for electroless tin plating

Technical specifications subject to change.



## LPKF MultiPress S – Multilayer Press

The LPKF MultiPress S is a tabletop system for laminating multilayers in your own lab. The short process time of only about 90 minutes and the ease of use make the system an ideal tool for reliable manufacturing of multilayer prototypes and small batches.

The LPKF MultiPress S can bond complex printed circuit boards with up to eight layers in a single operation. Various pressure, temperature, and time profiles offer maximum flexibility in selection of materials and number of layers. The MultiPress S is supplied with a manual pump or automatic hydraulic system.

- In-house production of multilayer prototypes with rigid and flexible materials as well as RF materials
- Very short process times
- Easy menu navigation via LCD display
- Default and customizable process profiles
- Automatic hydraulic system



<b>LPKF MultiPress S (Part no.: 120734<sup>1</sup> / 120736<sup>2</sup>)</b>	
<b>Max. layout size</b>	200 mm x 275 mm (7.8" x 10.8")
<b>Max. laminating area</b>	229 mm x 305 mm (9" x 12")
<b>Max. laminating pressure</b>	286 N/cm <sup>2</sup> at 229 x 305 mm (9" x 12")
<b>Max. temperature</b>	250 °C (480 °F)
<b>Max. number of layers</b>	8 (depending on material and layout)
<b>Pressing time</b>	Approx. 90 min <sup>a</sup>
<b>Dimensions (W x H x D)</b>	600 mm x 620 mm x 530 mm (23.6" x 24.4" x 20.9")
<b>Weight</b>	170 kg (375 lbs) <sup>b</sup>
<b>Power supply</b>	90 – 240 V, 50/60 Hz, 2.3 kW <sup>1</sup> /2.8 kW <sup>2</sup>
<b>Microprocessor controlled</b>	9 pressure/temperature/time profiles
<b>Hydraulic unit dimensions (W x H x D)</b>	260 mm x 410 mm x 280 mm (10.4" x 16.2" x 11") 100 mm x 150 mm x 700 mm (3.9" x 5.9" x 27.6") <sup>2</sup>
<b>Hydraulic unit weight</b>	15 kg (33 lbs) <sup>1</sup> , 5 kg (11 lbs) <sup>2</sup>
<b>Base materials</b>	FR4, others on request, see page 19 for multilayer sets
<b>Options and accessories (p. 34)</b>	Upgrades: automatic hydraulics upgrade, rolling table

<sup>1</sup> With manual pump

<sup>a</sup> Depending on material compound

<sup>2</sup> With automatic hydraulics

<sup>b</sup> Plus weight of hand pump or automatic hydraulics

Technical specifications subject to change.



# LPKF ProMask and ProLegend – Solder Masks and Legend Printing

The structured PCB prototypes receive a professional surface finish through a photosensitive process. First the entire surface of the structured board is coated with a light-sensitive paint (photoresist). A printed transparency film serves as a mask, with which the coating is then exposed in a UV exposure unit. After development the coating regions (solder pads) to be removed are rinsed off.

LPKF ProMask is an easy-to-apply green solder mask for reliable soldering of SMD or conventional components. It prevents short circuits during soldering and protects the surface. It is ideal for SMT prototypes with closely spaced conductive traces.

LPKF ProLegend performs the professional task of legend printing and can add logos and labels to PCB prototypes.

- Compact, quick, and easy to use
- Protective surface finish and professional labeling
- Four simple steps
- Environmentally friendly



<b>LPKF ProMask / LPKF ProLegend (Part no.: 117072 / 117584)</b>	
<b>Max. material size</b>	229 mm x 305 mm (9" x 12")
<b>Max. layout area of image exposer</b>	240 mm x 340 mm (9.5" x 13")
<b>Processing time</b>	Approx. 60 min/cycle
<b>Pad separation</b>	≥ 0.5 mm (≥ 20 mil) fine pitch
<b>Adhesive strength</b>	Class H and T, test method: IPC-SM-840 C, item 3.5.2.1
<b>Solder bath resistance</b>	20 s at 265 °C (509 °F), test method: IPC-SM-840 C, item 3.7.2 10 s at 288 °C (550 °F), test method: MIL-P 55 110 D 20 s at 288 °C (550 °F), test method: UL 94 (lead-free)
<b>Surface resistance</b>	2 x 10 exp 14 Ω, test method: VDE 0303, Part 30, DIN IEC 93
<b>Moisture resistance and isolation resistance</b>	Class H and T, test method: IPC-SM-840 C, item 3.9.1
<b>Solving/cleaning agent resistance</b>	IPC-SM-840 C, item 3.9.1 (10 percent alkaline cleaner, isopropanol, monoethanolamine)
<b>Minimum capital height</b>	2 mm (with 1200 dpi laser printer)
<b>Minimum capital strength</b>	0.1 mm (with 1200 dpi laser printer)
<b>Hardware requirements</b>	Min. 600 dpi laser printer
<b>Software requirements</b>	LPKF CircuitPro
<b>Options and accessories (p. 34)</b>	UV exposer, convection oven

Technical specifications subject to change.



# LPKF ProtoPrint S and ProtoPrint S RP – SMT Stencil Printers

## Reliable Solder Paste Printing

When mounting tiny SMD components on boards, the developer needs to be able to rely on precisely applied solder paste. A large number of solder deposits can be achieved reliably and rapidly with stencil printing.

With the ProtoPrint S, LPKF offers a precise manual stencil printer for SMT prototypes and small batches. The ProtoPrint S uses stainless steel stencils, whereas the ProtoPrint S RP has an integrated Zelflex clamping frame to allow the additional use of polyimide film. Polyimide film stencils can be manufactured easily with any LPKF ProtoMat.

The LPKF stencil printers offer high positioning accuracy, SMD fine-pitch printing, adjustable printing height, speed-controlled parallel separation of stencil and board, and easy tensioning of the stencil frames.

Before PCB production a print can be made on a test film – for easily checking the print result and fine-tuning with micrometer screw gauges.

- SMD fine-pitch printing down to 0.3 mm
- Screen printing, gluing, test film printing
- Printing of populated double-sided boards
- Parallel separation of stencil and board



	LPKF ProtoPrint S (Part no.: 127067)	ProtoPrint S RP (Part no.: 127066)
<b>Frame dimensions</b>	<ul style="list-style-type: none"> <li>• Width to 430 mm (16.9")</li> <li>• Length adjustable from 420 mm to 520 mm (16.5" to 20.5")</li> <li>• Height adjustable from 20 mm to 40 mm (0.8" to 1.6")</li> </ul>	
<b>Max. print area</b>	260 mm x 330 mm (10.2" x 13")	164 mm x 230 mm (6.5" x 9.1")
<b>Print type</b>	Manual	
<b>Print table adjustment</b>	X and Y ± 10 mm (0.4"/400 mil), $\theta$ ± 5°	
<b>Max. PCB thickness</b>	5 mm (0.2"), optionally thicker	
<b>Frame type</b>	Zelflex QR 362 mm x 480 mm (14.3" x 18.9")	Zelflex QR 266 mm x 380 mm with adapter (10.5" x 15")
<b>Squeegee type</b>	Hand squeegee, rubber, 260 mm (10.2")	Hand squeegee, metal, 180 mm (7")
<b>Accuracy (machine)</b>	± 20 µm (± 1 mil)	
<b>Double-sided print</b>	Max. component height 15 mm (0.59")	
<b>Dimensions (W x H x D)</b>	850 mm x 180 mm x 530 mm (33.4" x 7.1" x 20.9")	
<b>Weight</b>	30 kg (66 lbs)	
<b>Operating conditions</b>	Temperature: 15 – 35 °C (59 – 95 °F); humidity: 30 – 80 %	
<b>Options and accessories (p. 35)</b>	Stretching frame, squeegees	

Technical specifications subject to change.



# LPKF ProtoPlace S – Easy SMT Assembly

The LPKF ProtoPlace S manual pick & place system picks up SMD components via a vacuum from the component tray or from a feeder. Following initial manual positioning fine adjustment is performed using micrometer screw gauges. The component is then safely and accurately lowered by a pneumatic mechanism. In addition to assembly, the ProtoPlace S also works as a dispenser for solder paste, glue, and auxiliary materials.

An LCD display and menu-based navigation make operation easy. The optional camera system with color monitor supports the user in precise positioning of high-pin-count components.

## Accessories

The ProtoPlace S can be upgraded with a vacuum table, a component turntable with up to 90 component trays, and a feeder carrier with stick and roller feeders. The microcamera and an LCD monitor are a great help in fine-pitch component assembly, and a compressor and an air pressure controller provide for the necessary pressure for the dispensing function.

- Precise mounting of fine-pitch components
- Optional feeders and component turntable
- Pneumatic component placement
- Dispensing function
- Microprocessor controlled
- Optional camera system and vacuum table



### LPKF ProtoPlace S (Part no.: 126979)

<b>Max. PCB size</b>	297 mm x 420 mm (11.8" x 16.5")
<b>Min. component size</b>	0201 chip components
<b>Pulse/pause duration</b>	0.1 – 9 s / 0.1 – 2 s
<b>Dosing quantity (Dispenser)</b>	Min. 0.2 µl
<b>Component turntable position</b>	Rear
<b>Feeder position</b>	Left
<b>Adjustable air pressure</b>	0.1 – 4 bar (1.4 – 58 psi)
<b>Vacuum</b>	Max. 0.8 bar (11.6 psi)
<b>Weight</b>	29 kg (64 lbs) depending on accessories
<b>Dimensions (W x H x D)</b> (with all feeders and turntable)	1000 mm x 500 mm x 900 mm (40" x 20" x 35")
<b>Dimensions (W x H x D)</b> (machine only)	760 mm x 250 mm x 760 mm (30" x 10" x 30")
<b>Operating conditions</b>	Temperature: 15 – 35 °C, (59 – 95 °F); humidity: 30 – 80 %
<b>Compressed air supply</b>	8 bar (116 psi), min. 50 L/min (1.76 cfm), unlubricated, waterless
<b>Power supply</b>	90 – 240 V, 50 – 60 Hz, 10 W
<b>Options and accessories (p. 35)</b>	Vacuum table, component turntable, feeder carrier (stick/roller feeders), microcamera, LCD monitor, compressor, and air pressure regulator

Technical specifications subject to change.



# LPKF ProtoFlow S/N2 – Reflow Ovens for Lead-Free Soldering

## Hot Air Soldering with Profile

The compact LPKF ProtoFlow S/N2 oven is ideal for RoHS-compliant lead-free reflow soldering. The large motorized drawer holds the assembled board and automatically opens to cool the board. The “MultiZone” function divides the soldering process into up to five phases, each with a separate temperature profile. Three internal temperature sensors help ensure that the temperature distribution is uniform over the entire board.

The LPKF ProtoFlow is perfect for SMD reflow soldering or curing of through-hole plating pastes. The controlled protective gas (nitrogen) function greatly reduces oxidation during the soldering process, thereby optimizing the solder joints.

The LPKF FlowShow software displays the temperature profile on a connected PC and controls individual temperature profiles.

- RoHS-compliant lead-free reflow soldering
- Simple menu navigation via LCD display and arrow keys
- Preprogrammed and customized reflow profiles, process logs
- Motorized drawer with fans for automatic cooling
- Optional additional temperature sensors
- Able to use protective nitrogen gas and regular air



	<b>LPKF ProtoFlow S/N2 (Part no.: 126977)</b>
<b>Max. PCB size</b>	230 mm x 305 mm (9" x 12")
<b>Max. preheat temperature/time</b>	220 °C (428 °F), 999 s
<b>Max. reflow temperature/time</b>	320 °C (608 °F), 600 s
<b>Long thermal treatment: temperature/time</b>	220 °C (428 °F), 64 h
<b>Temperature stabilizing time</b>	<5 min
<b>PCB cooling</b>	Two fans, adjustable speed, mounted on base
<b>Power supply</b>	90–240 V, 50–60 Hz, single-phase, 3.2 kW
<b>Dimensions (W x H x D)</b>	647 mm x 315 mm x 450 mm (25.5" x 12.4" x 17.7")
<b>Weight</b>	22 kg (48.5 lbs)
<b>Operating conditions</b>	Temperature: 15–30 °C (59–95 °F) Relative humidity: 30–80 %
<b>Nitrogen pressure</b>	2–8 bar (29–116 psi)
<b>Nitrogen flow rate</b>	0–730 l/h (0–26 cfm)
<b>Software requirements</b>	Windows 7 or higher, USB 2.0
<b>Options and accessories (p. 36)</b>	Temperature indicating device

Technical specifications subject to change.



## LPKF ProtoFlow E – Reflow Oven for Compact PCBs

The LPKF ProtoFlow E is a compact and easy-to-use convection oven for lead-free reflow soldering of PCBs with sizes up to 160 mm x 200 mm. With the straightforward four-key menu navigation and an LCD display, setting the process parameters is a snap. Optional PC-based control is possible via a USB interface. The soldering operation can be viewed through an inspection window, allowing process adaptations to be made during the soldering process.

The precisely controlled air temperature ensures homogeneous heat distribution over the entire board. Thus, the oven is also suitable for drying and curing processes in CB prototyping.

The LPKF ProtoFlow E is designed for occasional use, especially for training purposes.

- Lead-free reflow soldering up to 320 °C
- Temperature zones and time profiles
- Compact and extremely economical
- Ideal for prototypes and small batches
- Recommended for training purposes or occasional use



	<b>LPKF ProtoFlow E (Part no.: 10023178)</b>
<b>Max. PCB size</b>	160 mm x 200 mm (6.3" x 8")
<b>Max. preheat temperature/time</b>	220 °C (428 °F), 999 s
<b>Max. reflow temperature/time</b>	320 °C (608 °F), 600 s
<b>Long thermal treatment: temperature/time</b>	220 °C (428 °F), 64 h
<b>Temperature stabilizing time</b>	<5 min
<b>Dimensions (W x H x D)</b>	400 mm x 280 mm x 380 mm (15.7" x 11" x 14.7")
<b>Power supply</b>	90 – 240 V, single-phase, 50 – 60 Hz, 1650 W (max.)
<b>Weight</b>	18 kg (40 lbs)

Technical specifications subject to change.



# Accessories for SMT Systems and Processes

## Accessories for Through-Hole Plating with LPKF ProConduct

### Convection Oven (Part no. 115877)

The convection oven is used for curing the ProConduct paste, predries the board for the solder mask, and cures the solder mask or label in approximately 30 minutes. With timer and precise temperature control.



### Vacuum Table (Part no. 115878)

Vacuum table developed especially for the ProConduct system for suctioning off excess paste prior to curing.



### Dust Extraction Unit (Part no. 10033243)

The dust extraction unit maintains a constant vacuum level across the entire vacuum table.

## Accessories for Pressing of Multilayers with the LPKF MultiPress S

### Rolling Table (Part no. 107050)

A mobile table on sturdy rollers especially for the MultiPress S.

### Automatic Hydraulics Upgrade (Part no. 120744)

The automatic hydraulic unit is an extension of the LPKF MultiPress S.

## Accessories for LPKF ProMask and LPKF ProLegend

### UV Exposer

Transfers the film template to a photosensitive layer in approximately 30 seconds.

230/240 V: Part no. 117050

110/120 V: Part no. 117192



### LPKF ProMask Consumable Set (Part no. 117108)

Contains ProMask solder resist, developer, conditioner, and laser printer film.

### LPKF ProLegend Consumable Set (Part no. 117564)

Contains ProLegend labeling paint, developer, conditioner, and laser printer film.



**Convection Oven** (Part no. 115877), see above.

## Accessories for LPKF Contac S4

### Chemical Set (Part no. SET-10-1124) for Galvanic Through-Hole Plating Comprising:

ViaCleaner chemical set (Part no. SET-10-1123), 5 L cleaner 110, 5 L cleaner 210, 5 L activator 310, 15 L copper plater 400, and 0.5 L shine 400.

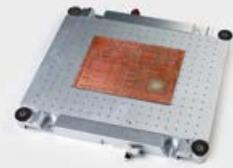
### Powder for Electroless Tin Plating (Part no. SET-10-1090)

For mixing of 10 L of tin plating solution for a sealed, solderable surface finish.

## Accessories for LPKF ProtoPrint S / ProtoPrint S RP

### Vacuum Table (Part no. 10032764)

The vacuum table secures all board types – from rigid to flexible – independently of board thickness. It can be transferred from one system to another without disruption of the vacuum. The vacuum table can also be equipped with an optional ceramic plate (Part no. 125021) for use for the subsequent reflow process.



Max. base material size: 229 mm x 279 mm (9" x 11")  
Max. compressed air: 7 bar (102 psi)  
Compressed air supply: 1.7 – 6 bar (24.7 – 87 psi), 0.3 – 0.79 l/s

### Mechanical Stretching Frame

ZelFlex QR 362x480, double-sided (included with the ProtoPrint S).  
ZelFlex QR 266x380, double-sided (included with the ProtoPrint S RP).



### Pneumatic Stretching Frame (Part no. 127094)

ZelFlex Z4P 406 mm x 508 mm x 25 mm slim, four-sided (16" x 20" x 1")  
(print area 306 mm x 408 mm (12" x 16.1")).

### Magnetic Edge Support

Magnetic edge support (set of 4) Part no. 126507  
Magnetic support pin (set of 4) Part no. 128946  
Positioning pin (set of 4) Part no. 128947

### Squeegee

Various squeegees for applying solder paste.

Hand-held squeegee, rubber, 180 mm (7"):	Part no. 10023549
Hand-held squeegee, rubber, 260 mm (10.2"):	Part no. 108140
Hand-held squeegee, metal, 180 mm (7"):	Part no. 10023958
Hand-held squeegee, metal, 260 mm (10.2"):	Part no. 124870
Hand-held squeegee, Permalex, 180 mm (7"):	Part no. 10023550
Hand-held squeegee, Permalex, 260 mm (10.2"):	Part no. 122257

### Test Print Film (Part no. 115632)

The test print film simplifies and speeds up setup for new print jobs.



### Polyimide Film (Part no. 108321)

Set (10 sheets, 210 mm x 297 mm (8.3" x 11.7"), 0.125 mm (5 mil) thick).

## Accessories for SMT Assembly with LPKF ProtoPlace S

### Micro-Camera (Part no. 115040)

The micro-camera is mounted right on the manipulator. Component placement is shown in enlarged form on the optional color monitor. The vision system greatly aids users in positioning of fine-pitch components.

### LCD Color Monitor (Part no. 119777)

The LCD monitor accurately displays details of the image transferred from the optional camera and enables precise positioning of extremely small components.

### Compressor (Part no. 10032687)

The compressor with 24-L tank is ultra-quiet (40 dB) and delivers 50 L/min (1.8 cfm) at a pressure of 8 bar (116 psi).

### **Air Pressure Regulator** (Part no. 124919)

Air pressure regulator with water separator and 5- $\mu$ m particle filter for side installation on the ProtoPlace S.

### **Feeder Carrier** (Part no. 115590)

The feeder carrier can hold up to 12 feeders simultaneously.

It is required for the additional roller or stick feeders.

### **Roller Feeder**

Roller feeders for components with various widths are available for use with the LPKF ProtoPlace.

Roller feeder 8 mm: Part no. 116004

Roller feeder 12 mm: Part no. 116008

Roller feeder 16 mm: Part no. 116009



### **Stick Feeder**

The LPKF ProtoPlace can accommodate stick feeders for various components.

S08–S028: Part no. 101356

S08L–S028L: Part no. 101356

PLCC28–PLCC44: Part no. 101357

PLCC52–PLCC84: Part no. 103897



### **Motorized Components Turntable**

The motorized components turntable considerably accelerates component pick-up.

The components are stored in trays that can be labeled.

45 component trays: Part no. 114460

75 component trays: Part no. 114461

90 component trays: Part no. 114462

**Vacuum Table** (Part no. 119684), see page 34.

## **Accessories for ProtoPlace E / ProtoPrint E**

### **Magnetic Fixing Pins**

Set of magnetic fixing pins (Part no. 10015381). For double-sided printing: magnetic edge supports (4 pieces), magnetic support pins (4 pieces), magnetic positioning pins (2 pieces).

Magnetic edge supports with corner brackets (4 pieces), Part no. 126507

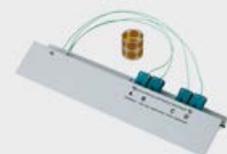
Magnetic support pins (4 pieces), Part no. 10015383

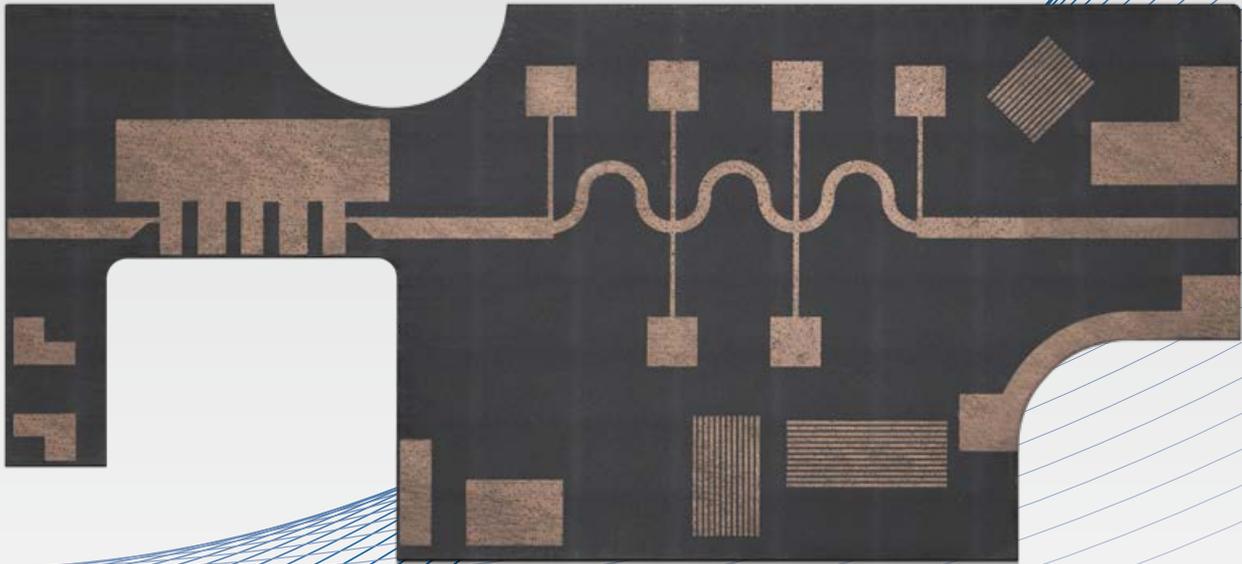
Magnetic positioning pins (2 pieces), Part no. 10015385

## **Accessories for Reflow Soldering with the LPKF ProtoFlow S/N2**

### **Temperature Indicating Device** (Part no. 117850)

An add-on module with four freely positionable temperature sensors supplements the LPKF ProtoFlow S/N2. The temperature sensors transmit the exact temperatures of critical components or the board in real time. The temperature profiles of all four sensors are displayed in a temperature-time graph on a monitor and saved for later analysis. The profile writer requires a PC with USB interface as well as standard (spreadsheet) software.





## Scientific Prototyping – Laser Systems for Development and Science

LPKF offers a comprehensive range of coordinated machines and processes for PCB prototyping. New laser systems for special tasks have continually been developed and are now combined under “Scientific Prototyping.” However, the prototyping systems can also process more than just PCBs.

# LPKF ProtoLaser R – Cold Laser Processing

## Laser Ablation With Practically No Heat Input

The shorter the laser pulse, the lower the heat input into the surrounding material. With a picosecond laser, there is practically no heat transfer; the targeted material evaporates immediately.

## Proven Housing

The LPKF ProtoLaser R is packaged in the familiar third-generation ProtoLaser system housing. It is decoupled from the effects of the environment and can be rolled through any lab door.

## Micro Material Processing Specialist

Lasers for micro material processing do not require high powers, but rather they need to exhibit stable laser parameters in the lower output range. The LPKF ProtoLaser R features a laser source with a laser power of up to 4 W. This allows even complex thin film systems, temperature-sensitive substrates, and OLED coatings on glass to be ablated or structured. The laser system requires no masks or films to accomplish these tasks.

## Established System Software

The LPKF ProtoLaser R comes with tried and true system software. Support of all common CAD formats is enabled through the combination of LPKF CircuitPro and LPKF CircuitMaster.

- Picosecond lasers for research labs
- Cold ablation of various thin films
- Intuitive CAM software
- Housing design proven in practice



<b>LPKF ProtoLaser R (Part no.: 10065053)</b>	
<b>Max. material size and layout area (X x Y x Z)</b>	229 mm x 305 mm x 10 mm ( 9" x 12 " x 0.4" )
<b>Laser wavelength</b>	1030 nm
<b>Laser pulse frequency</b>	Max. 200 kHz
<b>Laser pulse duration</b>	1 ps
<b>Laser power</b>	Max. 4 W
<b>Laser spot diameter in focus position</b>	15 µm (0.6 mil)
<b>Table move speed (X x Y x Z)</b>	100 mm/s x 100 mm/s x 10 mm/s (4"/s x 4"/s x 0.4"/s)
<b>Dimensions (W x H x D)</b>	875 mm x 1430 mm x 820 mm (34.5" x 56.3" x 32.3")
<b>Weight</b>	300 kg (661.4 lbs)
<b>Electrical consumption</b>	90 – 240 V; 1.5 kW
<b>Options and accessories (starting on p. 17)</b>	Exhaust unit, compressor, PC

Technical specifications subject to change.

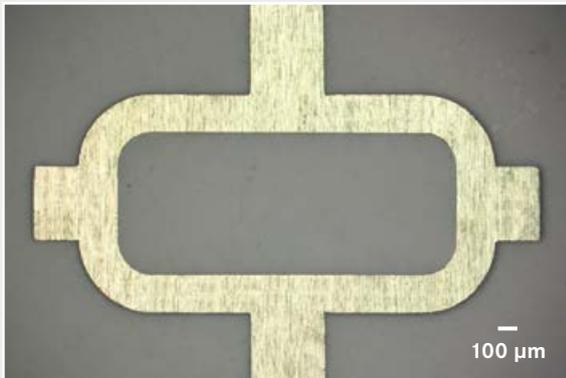


## Ultrashort-Pulse Laser for Processing Thin Films

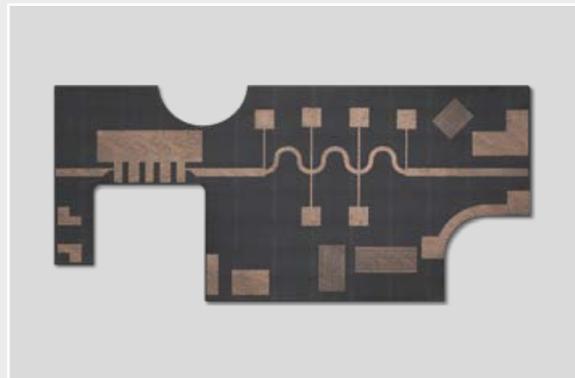
With the ProtoLaser R, LPKF offers an especially economical laser system with a pulse width of around 1 ps. It is designed for processing thin films. With a laser spot size of just 15  $\mu\text{m}$ , this laser system can convert geometrical representations in the layout to real geometries on the target material with especially high precision.

The LPKF ProtoLaser R can gently ablate or structure complex thin film systems, temperature-sensitive substrates, and OLED coatings on glass. The laser system requires no masks or films to accomplish these tasks.

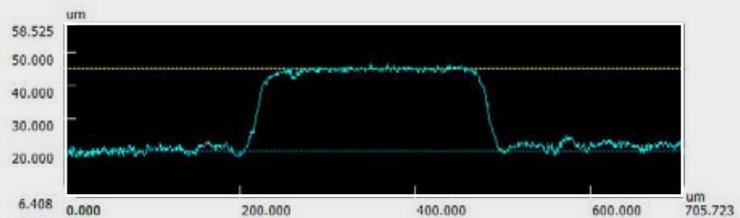
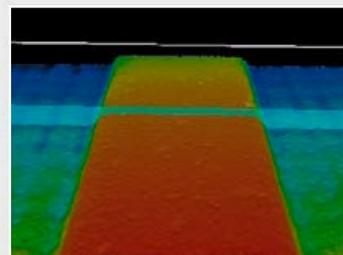
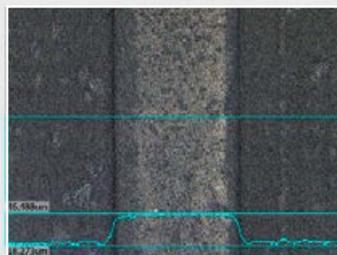
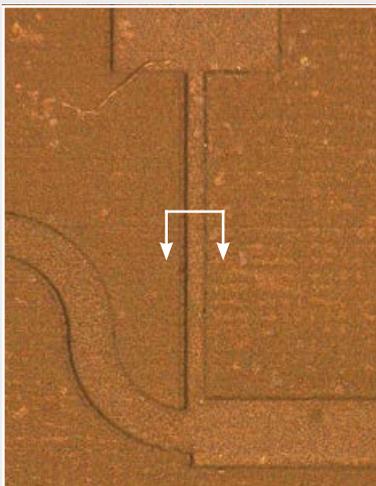
### Applications



The USP laser can flexibly and precisely cut geometries out of thin metal foils. Thanks to the powerful CAM software, multiple trials can be made within a short period of time.



Processing of a delicate component made of LTCC carbon tape. The carbon tape applies fine geometrical structures to the LTCC multilayer stacks during firing. The LPKF ProtoLaser R can cut, drill, or engrave this material without changing the target geometry through the effects of heat.



# LPKF ProtoLaser U4 – Universal Laser Processing in the Development Lab

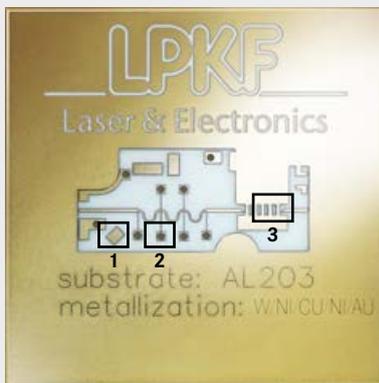
The LPKF ProtoLaser U4 is a laser system with wide-ranging processing capabilities thanks to its UV laser source. The ProtoLaser U4 can structure and cut PCBs, process ceramics and LTCCs, structure thin films, or ablate invisible TCO layers on transparent substrates.

The ProtoLaser U4 features stability in the lower output range and power measurement on the substrate plane for challenging material processing tasks in R&D laboratories as well as for small batches.

**Technical Data for the LPKF ProtoLaser U4: page 16**

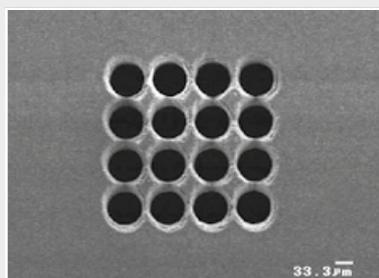
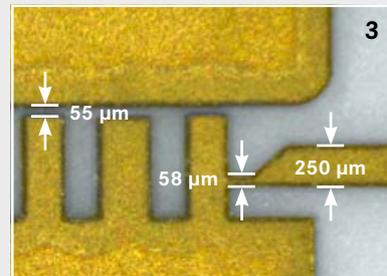
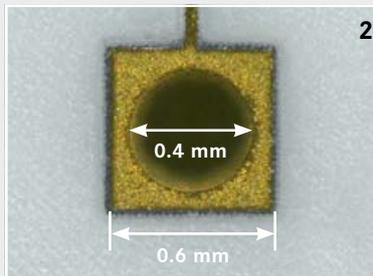
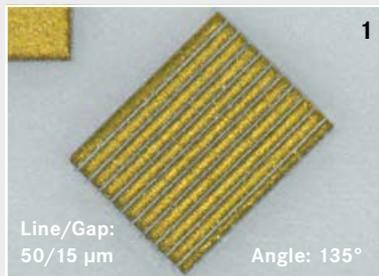
## Applications

The main unique selling point of the LPKF ProtoLaser U4 is its multifunctionality. The laser beam with a UV wavelength is suitable for processing an extremely wide range of materials.

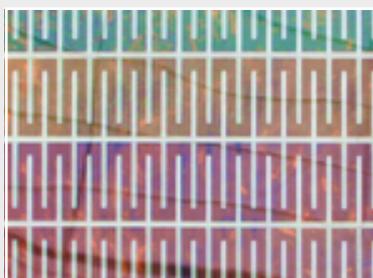


### Ceramics and Metal Layer Processing

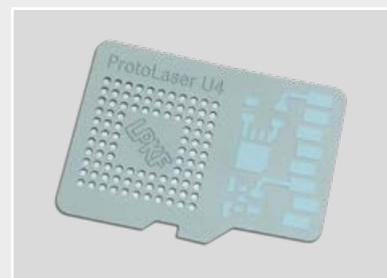
Metal layers on ceramics ( $Al_2O_3$ ): The LPKF ProtoLaser U4 can score, precisely structure, engrave, and even drill ceramics – these are just some examples from the wide range of applications presented in a separate LPKF brochure.



Scoring, cutting, drilling, or structuring fired ceramics: holes with a diameter of 50 μm in fired ceramics with minimal tab width can only be produced with a laser.



Organic solar cells require precise energy input during processing. The LPKF ProtoLaser U4 with a stable output power in the lower range can meet this requirement.



Delicate LTCC components: The UV laser can cut, engrave, and drill mechanically sensitive substrates.



# Conductive Traces on 3D Plastic Parts – LPKF ProtoLaser 3D

The LDS process generates traces on three-dimensional plastic parts using a laser and a subsequent metallization process. A 3D MID combines both mechanical and electronic functions in a single device: a Mechatronic Integrated Devices (MID).



Laser Direct Structuring (LDS) is assuming a leading role for MIDs. A laser writes the conductive pattern on LDS-doped injection-molded parts. The traces are built up in a subsequent metallization bath.

In LDS prototyping, for example, plastic parts made by 3D printers are used. The base part is coated with LPKF ProtoPaint LDS, which contains the LDS additives.

The ProtoLaser 3D performs the laser structuring. The system features a height-adjustable working stage for structuring of parts of various dimensions.

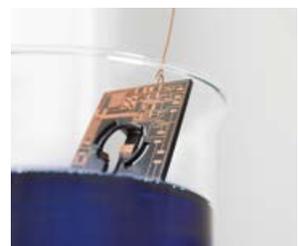
The work envelope has dimensions of 300 mm x 300 mm x 50 mm (11.8" x 11.8" x 2"); the scanning field is 100 mm x 100 mm x 25 mm (3.9" x 3.9" x 1") large.

LPKF offers the ready-to-use LPKF ProtoPlate solution for electroless metallization. The process takes place in a protective housing and uses premixed bath chemicals as consumables. The components are simply suspended in the bath; the resultant copper layer thickness is a function of dwell time.

More information on the LDS process and possible application areas can be found in LPKF's free LDS brochure.

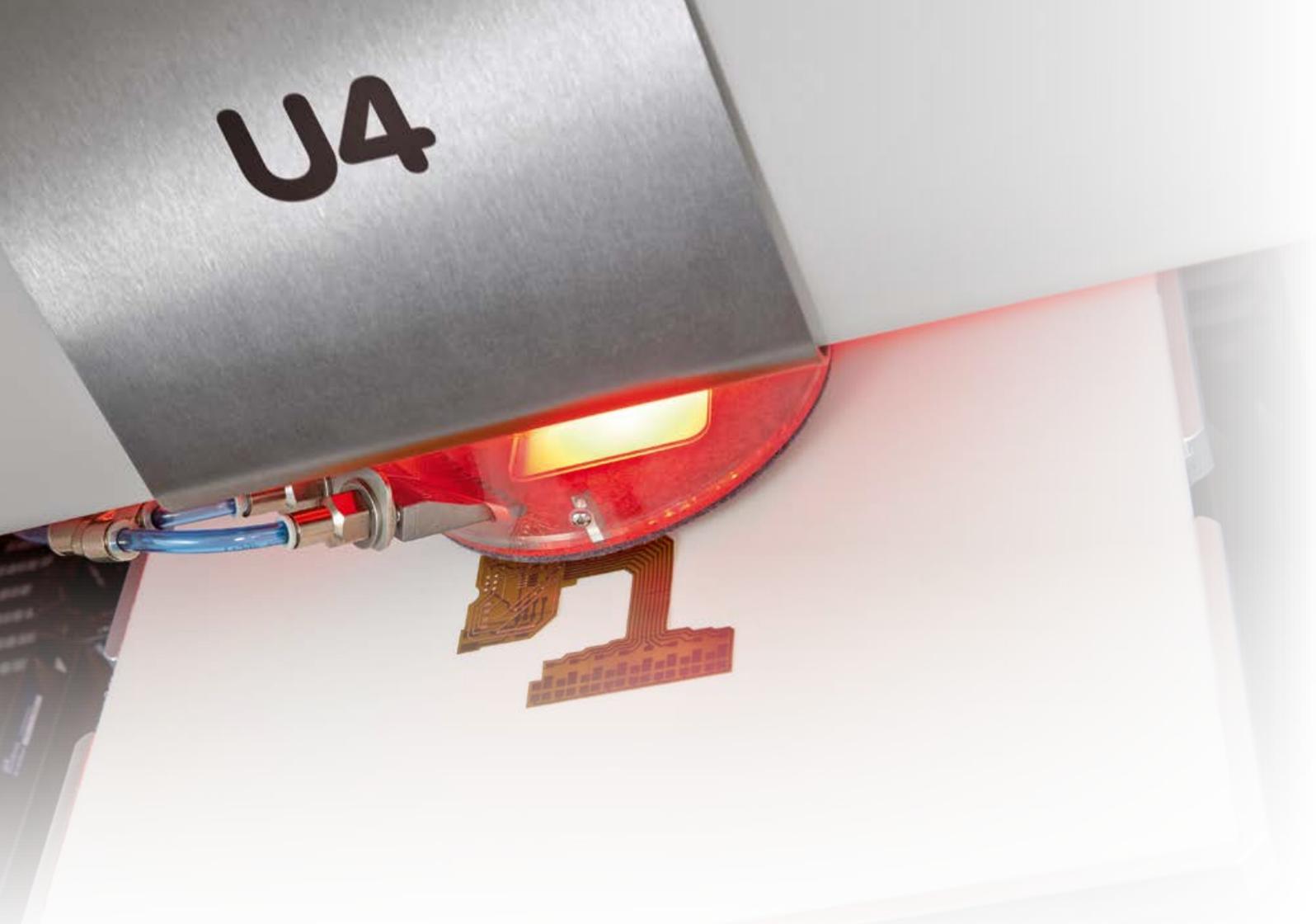


Three components for LDS prototyping: LPKF ProtoPaint LDS (spray can); ProtoLaser 3D, and ProtoPlate for metallization in a beaker.



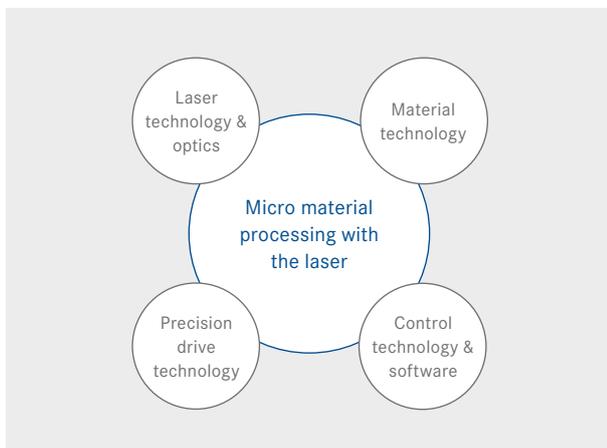
LDS prototyping stages (left to right): 3D print, coating of the base part, laser structuring, and finished 3D MID.





# Micro Material Processing Specialist

LPKF has made a name for itself with systems for easy PCB prototyping. However, that's not all the Germany-based mechanical engineering specialist has to offer: the company sees itself as a specialist in micro material processing, almost always using a laser.



Successful micro material processing requires several core competencies – which LPKF has developed over the course of many years. For example, specialized laser sources are developed and manufactured in-house: laser micro material processing poses different challenges than welding of thick sheet steel does.

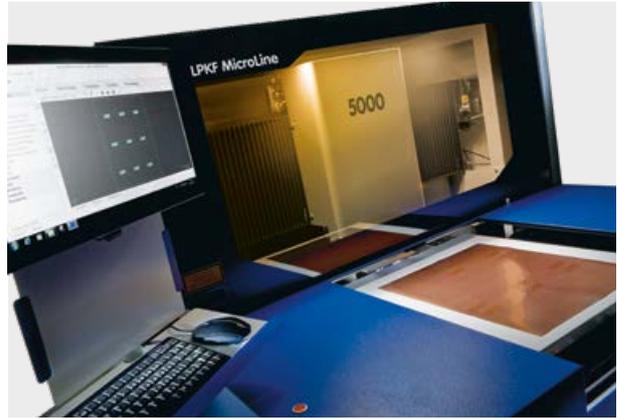
Devices manufactured using LPKF systems and processes can be found in the electronics, medical technology, and automotive industries as well as in sophisticated consumer products.



### Laboratory Solutions for Research & Development

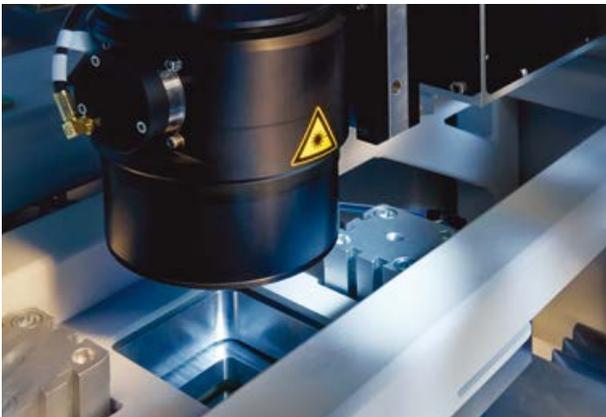
This business unit houses systems and processes for research and development. It includes PCB prototyping and scientific prototyping.

The “Scientific” division comprises laser systems for microfluidics and components, 3D MID prototyping, laser processes for the lab, and a novel ultrashort-pulse laser. The range is expanding continuously.



### Production Systems for Electronics Manufacturing

Laser technology for the electronics industry: this is where systems from the StencilLaser and MicroLine series can be found. StencilLasers can precisely cut holes in large metal foils, which then serve as masks for solder paste printing. MicroLine lasers perform the processing of printed circuit board materials: drilling holes, depaneling assembled boards from larger panels, or cutting delicate foil materials for layer buildup. With the Laser Direct Structuring (LDS) technology patented by LPKF, conductive traces are applied to three-dimensional plastic parts.



### Laser Plastic Welding

Thanks to laser technology, delicate microfluidics can be welded rapidly, reliably, and cleanly. The laser beam penetrates the upper laser-transparent joining partner and outputs its energy to the lower, laser-absorbent part. This results in welded joints of high quality in terms of both mechanical properties and appearance – for the medical technology, automotive, and consumer products industries.



### Thin-Film Solar Module Scribing

This business unit is focused on the manufacturing of high-performance thin-film solar modules. For conduction of electricity through the extremely thin layers, series connection is necessary. LPKF laser scribers break up the active layers on the large solar modules into fine strips – with never-before-seen precision and speed.

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