LPKF LDS Prototyping

3D MID Manufacturing Made Easy

LPKF
Laser & Electronics

The Market for 3D Parts is Growing ...

Molded interconnect devices (MIDs) create new possibilities in product characteristics and production methods. The LDS method and the laser structuring devices in the LPKF Fusion3D platform play a big part in the success of this technology by providing outstanding flexibility and slashing time to market. The ease of prototyping facilitates development and optimization of LDS components.

Investment in a Growth Market

Smaller size, higher density, greater precision – electronics developers have been facing these challenges for years now. Especially for products with limited space and weight, new solutions are needed.

One convincing response to this need is provided by molded interconnect devices (MIDs), injection-molded plastic parts integrating conductive traces and electronic components and thus combining both mechanical and electronic functions.

Laser direct structuring has now become the preferred method for making MIDs. The conductive structures that subsequently form the conducting layers are printed on the part by the laser.

Huge Demand

Every second smartphone already contains LDS components; tablet PCs and ultrabooks are also increasingly using them. LDS has also arrived on the automotive scene: Antenna substrates for radar antennas, barometric pressure sensors and mass air flow (MAF) sensors, handles for motorbikes, and steering wheel controls are already being mass-produced. Medical technology and general electronics applications – antennas, packaging, and chip stacks – also utilize the advantages of this technology.

However, the advancements don't stop there: With a new LDS powder paint, metal substrates can be used, e. g., for LED applications, and new laser sources can generate even finer-pitch conductive structures.

Contents

- Leading in MIDs
- Saves space, weight and money
- High precision and flexibility
- Economical prototyping method

All major smartphone manufacturers use LDS in their products

Prototyping with LPKF Laser Direct Structuring (LDS)

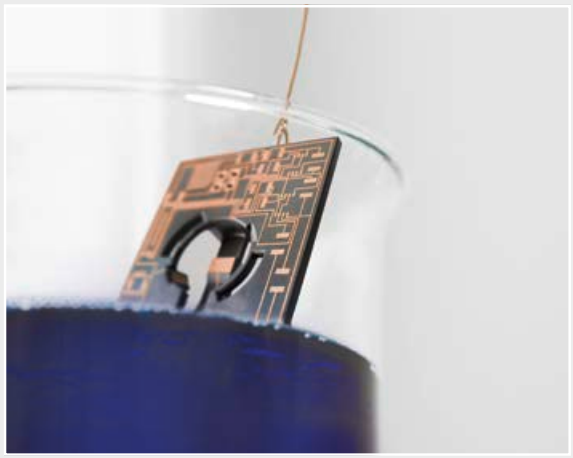
With laser direct structuring, a laser beam applies conductive structures to a three-dimensional plastic part. Copper and other metal layers are then built up on these structures in an electroless process.

Overview of LDS Prototyping Process

1. Creating the three-dimensional part

2. Painting the part with LPKF ProtoPaint LDS

3. Structuring the circuit tracks with the LPKF ProtoLaser 3D



4. Selective metallization with LPKF ProtoPlate

- Makes plastic parts LDS-capable
- Easy application – one coat is usually enough
- Good coverage and adhesion

LDS Coating from a Spray Can

For mass production, the LDS process requires a plastic material containing an LDS additive. The laser beam exposes and activates this additive. During prototyping the LPKF ProtoPaint LDS paint generates an activatable surface.

The basis for an LDS prototype is a 3D part produced, for example, using an additive process (3D printing).

For activation of the paint with a curing component, the lower lid of the spray can is removed. Then a key ring is mounted and rotated a few times. After a few minutes of shaking the paint is ready for use and remains processable for about four hours.

After being thoroughly cleaned the part is painted in crosswise strokes from a distance of 15 – 20 cm. For three-dimensional parts with steep faces, painting should be done in stages to prevent the paint from bleeding.

The part is then dried in a convection oven at a maximum temperature of 70 °C (160 °F) for at least 180 minutes. Good wetting of the surface by the paint and good curing are prerequisites for good metallization.

Facts and figures

- Paint color: black
- Can be stored unopened for up to a year
- Processing temperature: 20 °C – 24 °C (68 °F – 75 °F), room temperature
- Dried to dust-repellent condition after approx. 30 minutes
- Completely dried after three hours at 70 °C (160 °F)

LPKF ProtoPaint LDS is shipped as a set containing six spray cans, test plates, and an application video

Laboratory-Scale 3D Laser

The specially developed LPKF ProtoLaser 3D is designed to perform the second step in LDS prototyping.

The work platform has dimensions of 500 x 500 mm (19.7” x 19.7”) and a z-axis travel of 200 mm (7.8”). A pilot laser and a powerful vision system aid in setup and alignment of multiple structuring steps.

The ProtoLaser 3D uses data from conventional layout programs and is supplied with the powerful LPKF CircuitPro 3D CAM software. The vision system detects fiducials and component contours and facilitates structuring in diverse positions.

The laser optical components in the ProtoLaser 3D correspond to those in the LDS production systems. The LDS design rules also apply to the prototyping process.

The compact ProtoLaser 3D can be rolled through any laboratory door

- Compact – fits through any laboratory door
- Flexible and economical
- With vision system and pilot laser

True three-dimensionality: The ProtoLaser 3D can structure parts from all sides

Simple part fixtures can be used for laser structuring because they do not need to absorb any mechanical forces. The part fixture shown can easily be made from POM plastic using an LPKF ProtoMat or with a 3D printer using negative layout data of the part. It ensures part feed-in at the required angle.

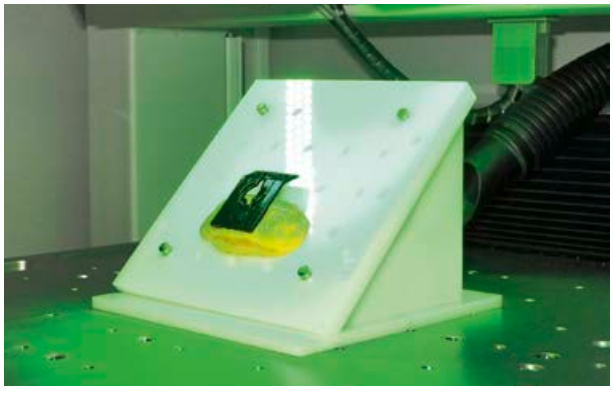
In many cases, a dimensionally stable dental impression paste is sufficient for placement of the part on the fixture. In more demanding situations and for some part fixtures, compressed air and vacuum connections may need to be routed into the workroom.

The painted part is mounted on the fabricated fixture. Depending on the layout, multiple structuring passes may be necessary. The vision system helps in aligning the conductive structures.

Facts and figures

- Scanfield: 100 x 100 x 40 mm (3.9” x 3.9” x 1.6”)
- System dimensions (W x H x D): 880 x 1 820 x 720 mm (34.6” x 71.7” x 28.3”); height with opened hood
- Weight: (661.4 lbs)
- Software included

Compact solution: Very little space is needed for LDS prototyping

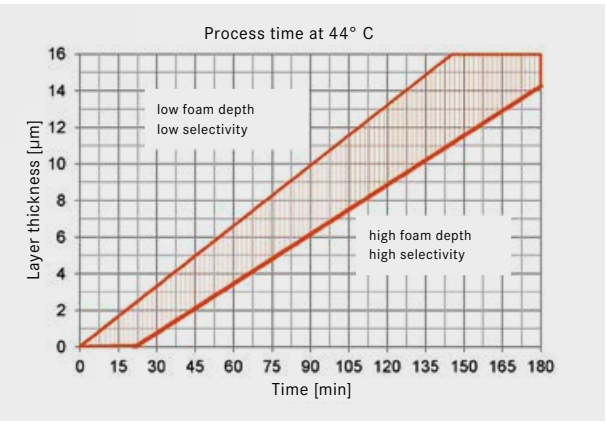


The parts can be secured flexibly using a paste

Metallizing Circuit Tracks with LPKF ProtoPlate

After structuring the parts are rinsed off thoroughly for the last step. In an electroless metallization bath, a copper layer is built up on the structured regions.

The LPKF ProtoPlate basic package comprises an integrated machining cell with glass beaker, magnetic stirrer, temperature monitor, and internal air filter. The chemicals consumed in the copper layer buildup process are included in the LPKF ProtoPlate CU set.



Layer thickness depends on exposure time

- Metallization following a simple recipe
- No knowledge of chemistry required
- Easily determinable layer thickness
- Near-production layer thicknesses

1. Pour the copper solution into the beaker

2. Pour in the activator to start the metallization bath

3. Immerse the part in the bath

4. Rinse the part – and the part is ready

As Easy as Making Coffee

The metallization process is extremely simple. The consumables are numbered. First the copper solution (1) is poured into the glass beaker and heated to about 44 °C (110 °F).

The premixed activator (2) is then added to activate the metallization bath. The metallization bath can be used for one to two hours after activation.

Cleaned structured parts are suspended in the bath (3). The metallization process starts after a few minutes. Depending on the duration of metallization, uniform copper layers with thicknesses ranging from 0.12 mil to 0.39 mil are built up on the plastic part. The times required to achieve specific layer thicknesses are supplied in a table.

The LDS components are then removed and rinsed off (4). The used metallization solution can be poured into the original canister and disposed of. A label for disposal is supplied with the consumables package.

Applications and Trends

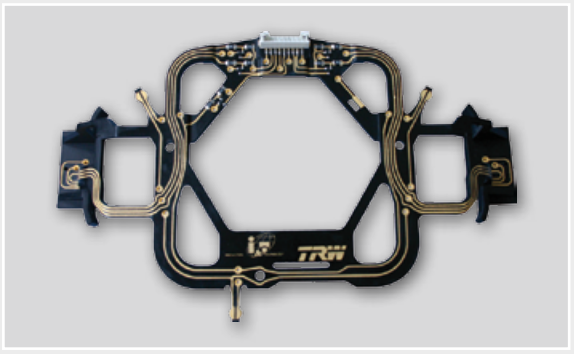
LPKF's LDS prototyping solution offers completely new possibilities in electronics by closing the gap between three-dimensional design and mass production of a part. Now different variations and iteration steps can be implemented cheaply and rapidly to achieve a sizable reduction in time to market.

LDS parts have proven performance in numerous fields:

Smartphone antenna produced by LDS

LDS as an Antenna Solution

Clips or housing parts are turned into 3D antennas.



One part for all functions: LDS yields a reduction in weight and assembly time

Connection and Contacting

Connection and contacting of complex components. LDS can also be used for producing vias, for example.

Part for hearing aid (Manufacturers: Siemens Audiologische Technik GmbH, Harting AG)

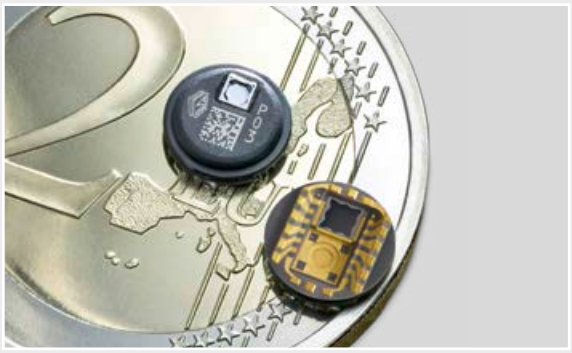
Miniaturization

When it has to be small and compact. One of the first applications was a hearing aid, in which every gram lost contributes to greater wearing comfort.

After a short chemical metallization step, classic galvanization produces a smooth copper layer up to 1.38 mil in thickness

Innovations for New Markets

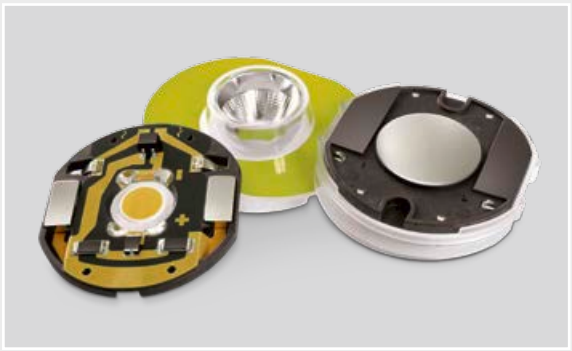
Galvanic reinforcement generates components that can also withstand high mechanical and thermal loads or are suitable for bonding due to their smooth metal surfaces.



The LDS housing combines sensor and analysis electronics

Chip Stacks

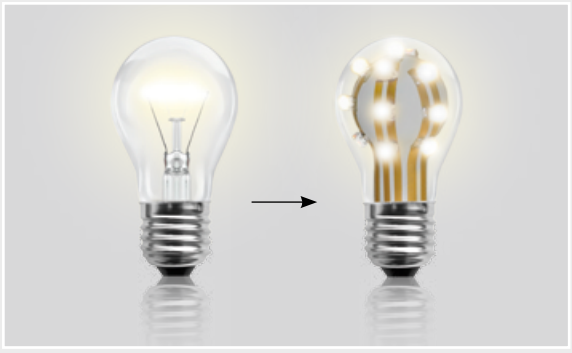
In chip stacks, an LDS housing can provide the necessary contacts between the components. A high density is achieved through the fine pitch and the possibility of placing traces on the housing exterior.



New design: With Clip'n Slide LED disks, elaborate lighting concepts can be realized in a snap

LED Solutions

LED as retrofit lights or variable spotlights. The wide range of plastic materials that can be used with the LDS process widens the possibilities for layouts and complex lighting designs.



LEDs on metal bases: A convincing solution to thermal problems in LED lighting

Metal Substrates

With the LDS PowderCoating powder paint, metal substrates can be coated and processed using the LDS method. LEDs can be mounted right on the substrates – thereby eliminating the problem of heat dissipation.

Global Support

LPKF-LDS users have service centers close by in Europe, the USA and Asia. Experts in the application center in Germany use their expertise to provide practical and knowledgeable advice including the production of samples.

The global LPKF network for service and distribution:

- Headquarters
- LPKF Group
- LPKF Distributors

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