

Michael Grütz

## Success with the small and fine: Micro Packaging Solutions from HARTING are strengthened by Cooperation with LPKF



Decreasing size and increasing performance – HARTING Electro-Optics is meeting these market demands by way of micro packaging solutions. The solutions are offered as project services.

The LPKF LDS (Laser Direct Structuring) process plays a key role here by enabling the cost-efficient mass production of 3D circuit carriers that are tailored to individual customer requirements.

### COOPERATION AGREEMENT

In the course of the productronica 2003 trade fair, a cooperation agreement between HARTING Electro-Optics and the LPKF Company in Garbsen was signed on November 10, 2003, that focuses on the joint development and qualification of the LDS process. LPKF is an established equipment manufacturer and service provider in the field of laser microprocessing. Some of the operations covered are micro-drilling, structuring, cutting and surface treatments in the micrometer range, based on laser equipment and serving the widest range of application fields. Thanks to the new cooperation agreement and associated equipment base, HARTING now has access to patented, leading-edge technologies offering high application flexibility.

### WORKING WITH THE LPKF LDS PROCESS

The LPKF LDS process is an additive procedure for creating 3D circuit structures on a plastic carrier. The principle of the procedure is based on laser activation of a metal complex. To this end, the metal complex, in a finely distributed form, is added to the plastic material (LCP, PBT and PP are currently available).

The blanks for the circuit carrier are injection molded from these special plastic materials by way of a conventional injection molding procedure. The blanks may typically measure in the range from 2 x 2 x 1 mm to 100 x 100 x 30 mm.

In the subsequent structuring process in the laser structuring system, the circuit structures are “written” onto the blank with a laser beam, in a 3D structuring process. This process destroys, i.e.

opens the metal complex, and the metal seeds for the subsequent metal-plating process are exposed.

### STRUCTURING PROCESS

The structuring process allows processing times in the seconds range; thanks to batch processing (or also production run processing) it is possible to reduce the average processing time per piece even further. The data for the structuring is generated directly from the CAD data and processed immediately in the laser system, which allows structuring without the need to produce any masks. After a cleaning step to remove the ablation products (ablation: removal of material using a high temperature process and creation of a clean surface), the metal layers that form the later circuit structures are applied in a multiple-step wet-chemical process.

### LAYER BY LAYER

The starting layer plays a crucial role here; it essentially determines the adhesion properties for the entire metal setup. This starting layer is always generated using purely chemical deposition. In an adequate process the starting layer only grows in those areas at which the metal seeds were previously already exposed, so that the deposited metal represents an exact image of the previous structuring. The layers applied subsequently ensure the appropriate surface properties, which allows further processing with typical electronic assembly technologies, such as SMD soldering, conducting adhesives, chip and wire bonding or flip chip technologies. A typical layer combination used in this context is copper-nickel-gold, with a total layer thickness of approximately 8 – 11 µm. The chemical deposited structures can be reinforced by electroplating. This presupposes the existence of contacting possibilities for the electroplating process. Such contacting possibilities must already be taken into consideration during the development of the



Figure 1 shows a part manufactured with the LDS method.



parts. Furthermore, it must be noted that while a layer applied with electroplating is considerably thicker and less rough, when the electroplate layer grows, the track conductor image is also considerably changed horizontally. The comparison with the match in Figure 1 impressively demonstrates the achievable structure sizes that are currently in the range of 200  $\mu\text{m}$ . Further work is directed at advancing down to the region of structure sizes around 100  $\mu\text{m}$ . The procedure also enables the creation of vias, i.e. the connection between 2 sides of the carrier.

#### SUMMARY

In summary, it can be stated that the procedure outlined above is opening up new potentials for the HARTING Company in the field

of micro packaging. The advantages of the procedure are primarily based on its flexibility, permitting subsequent adjustment of the circuit structure design without any tool changes at all. Just as important is the possibility of interlacing mechanical and electrical functionalities, as a mechanical carrier simultaneously serves as the carrier of a three-dimensional conductor image, and therefore allows a further step in component miniaturization. The cooperation project with the LPKF Company merges the strengths of the two companies to deliver maximum customer benefits, combining LPKF's equipment knowledge and first procedure results with HARTING's technology experience and qualification procedure knowledge.

The products created with this new method are finding use in the fields of medical technology and sensor technology, among others.



Figure 2 shows a cross-section through a 300  $\mu\text{m}$  through-plating (via), magnified 100 times, before and after the metal coating.



Michael Grätz  
[www.HARTING-Mitronics.com](http://www.HARTING-Mitronics.com)  
[mit@HARTING.com](mailto:mit@HARTING.com)