Through-Glass Vias with Laser Precision

LPKF Vitrion 5000
Glass Interposers with High-Speed Laser Processing

In the interconnection of highly integrated chips with conventional circuit boards, interposers are used to compensate for different geometrical dimensions. The contacts in the tiny semiconductor chips are converted to assembly-compatible dimensions by interposers. The new LPKF TGV process generates highly precise holes for subsequent through-hole plating.

5000 Holes per Second
Glass is an ideal substrate for integrated circuits. It is stable, has good electrical properties, possesses a compatible coefficient of thermal expansion, and is cheap. However, machining – especially on a micron scale – is tricky. Previous processes have fallen short of targets for process speed, quality, or structural resolution.

The LPKF TGV process combines the advantages of a glass substrate with the precision of a laser process. Holes could previously only be produced with insufficient quality at a maximum rate of 1000 holes per second. But with the TGV process perfect holes can be made at five times the speed – and it’s getting faster all the time.
An ultrashort pulse laser modifies the glass structure in a single pulse.

The modified holes are opened in a standard wet etching process. The modified structures respond significantly faster to the etching process than the unmodified glass.

Each interposer has a large number of vias.

In a single production step, numerous interposers are produced on a standard glass wafer.

**Overview of LPKF TGV Process**

Base material is an industrial standard glass for interposers.

**Additional Process Steps for Interposer Production**

Metallization and structuring of the interposer

Example: Circuitry on glass interposer

The interposer connects very fine contacts from integrated circuits to the tracks on the PCB.

One single chip combines different electronic modules.
The LPKF Vitrion 5000 laser system is designed solely for machining delicate glass wafers. It can process panels up to 510 mm x 510 mm in size as well as max. 18” glass wafers. LPKF supplies systems for manual and automated assembly.

The LPKF Vitrion 5000 utilizes a laser that was developed specifically for these applications. System control is accomplished with user-friendly system software that enables differentiation between programming and production mode as well as integration into an MES.
• Clean-room compatible
• Easy maintenance
• Laser safety class 1 under normal operating conditions

The LPKF Vitrion 5000 is clean-room compatible and can be easily integrated into a wall without extra requirements. All maintenance work can be performed from the back, enabling the unit to be integrated into typical semiconductor production lines. The standard version of the Vitrion 5000 is supplied with a workbench for manual handling.

The camera system for precise part position detection and an integrated SMEMA interface facilitate automation of the overall interposer production process.

Complete Solution for Interposer Production
LPKF supplies not only the laser system for glass modification but also consulting services to ensure an optimum etching process.

This comprehensive package reduces integration time and effort for the customer and optimizes process quality, if necessary, in collaboration with external service providers.
Process Parameters

Variable Prozessführung

Glass interposers are mainly manufactured using two processes, both of which can be implemented with the LPKF TGV technology. Thus, the TGV process can be smoothly integrated into existing production chains.

In the wafer-based process, blind holes are first produced in the glass. Then the wafer is polished down to the desired glass thickness. This creates conical through-glass vias with constant taper angles and aspect ratios (hole diameter to glass thickness) of up to 1:10.

The panel-based process generates classic vias, usually in thin substrates. The laser activates the glass over the entire thickness. Subsequent etching is performed uniformly on both sides to produce the desired hourglass shape. Here, too, aspect ratios of up to 1:10 can be achieved.

In the wafer process, the laser and etching steps generate conical blind vias in the glass. Subsequent polishing opens the holes.

The vias exhibit pinched waists. The top diameter x 1 adjusts itself in relation to the extent of material reduction.
Variable Hole Geometries
Both processes can be used for glass with a thickness of up to 300 μm. Hole diameter is primarily a function of the etching time. Currently holes with diameters down to 5 μm can be made in 50-micron-thick glass in mass production operations.

Through control of the etching duration, the hole diameter can be adjusted precisely. The etching process reduces the overall thickness of the glass wafer by approximately 20%.

- Glass as interposer
- Efficient ultrafast laser process
- Up to 5000 holes per second
- Standard production wafers
Worldwide Support for Through-Glass Via Formation
Wherever they are in the world, users of LPKF systems can be supported from our application centers in Germany, the USA, Japan, Korea and China. At these centers, users have access to LPKF’s extensive experience in laser material processing.

Technical Data: LPKF Vitrion 5000

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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<tbody>
<tr>
<td>Laser class</td>
<td>1</td>
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<tr>
<td>Max. working area (X x Y)</td>
<td>510 mm x 510 mm (20” x 20”)</td>
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<tr>
<td>Max. material size (X x Y)</td>
<td>Panel: 510 mm x 510 mm (20” x 20”)</td>
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<tr>
<td></td>
<td>Wafer: up to 18”</td>
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<tr>
<td>Data input formats</td>
<td>DXF</td>
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<tr>
<td>Max. structuring speed</td>
<td>&gt; 5000 vias/s</td>
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<tr>
<td>Pattern accuracy</td>
<td>0.8 + L (100&quot;)</td>
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<tr>
<td>System dimensions (W x H x D)</td>
<td>1 700 mm x 1 700 mm* x 1 620 mm (67” x 67” x 63.7”)</td>
</tr>
<tr>
<td>Weight</td>
<td>~1 600 kg (3 527 lbs)</td>
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<tr>
<td>Operating conditions</td>
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<tr>
<td>Power supply</td>
<td>400 V / 16 A; 3~ + N + PE</td>
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<tr>
<td>Power Consumption</td>
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<td>Cooling</td>
<td>Water supply and return, &lt;22 °C (71.6 °F)</td>
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<tr>
<td>Ambient temperature</td>
<td>21 °C ± 0.5 °C (69.8 °F ± 1 °F)</td>
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<tr>
<td>Humidity</td>
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<td>Compressed air</td>
<td>0.6 MPa</td>
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<tr>
<td>Required accessories</td>
<td>Exhaust unit</td>
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* Height incl. StatusLight = 2 100 mm (82.7")