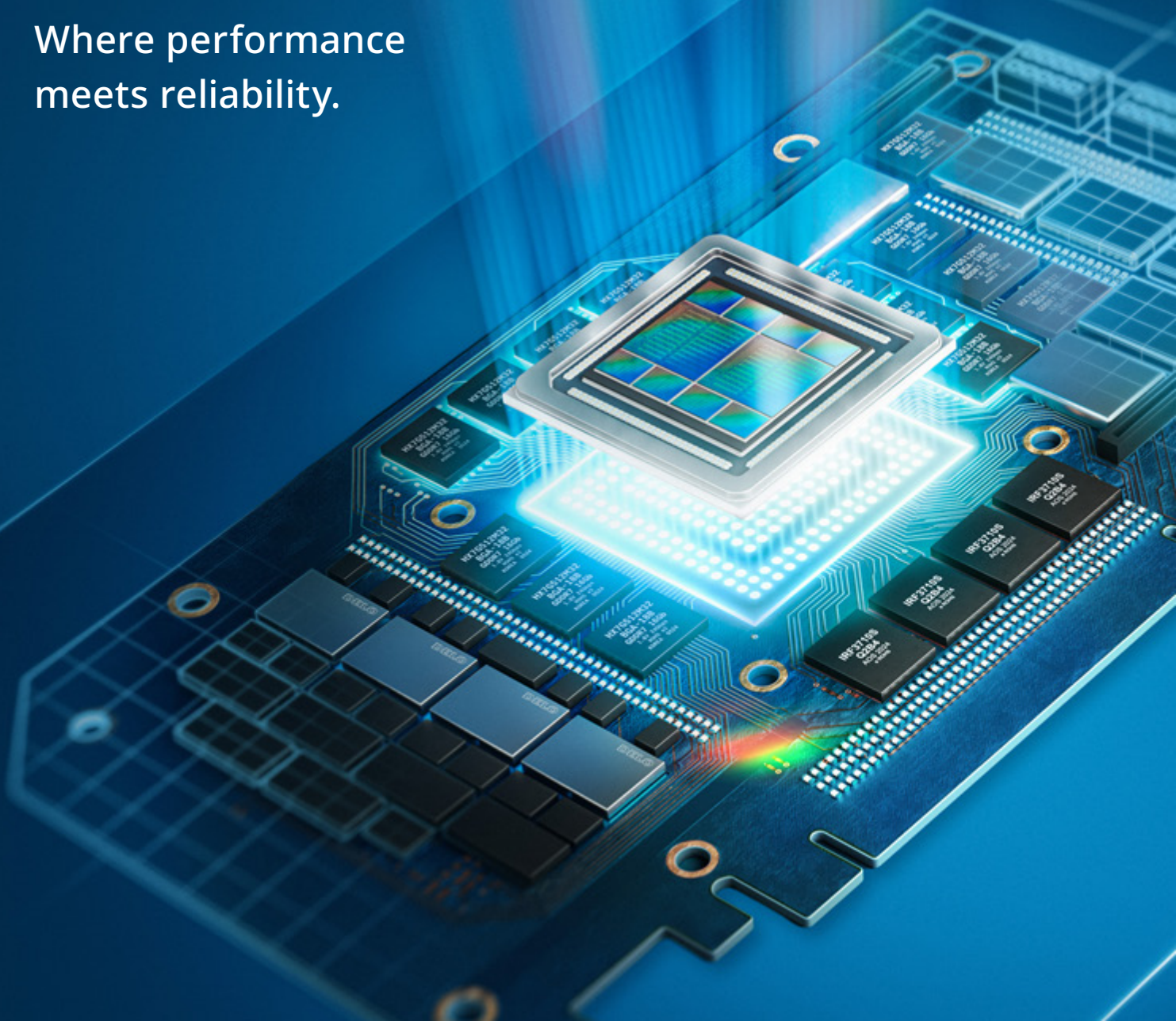


Advanced packaging

Adhesives for the Chiplet Era

Where performance
meets reliability.



Enabling heterogeneous integration

Adhesives for advanced packaging

Reliable materials for high-density, high-performance packaging.

Artificial intelligence is revolutionizing our world at breathtaking speed with advanced packaging playing a crucial role.

The engineering challenges are formidable: maximum packaging density to deliver unprecedented computing power, ultra-fine I/O connections demanding micrometer precision, and sophisticated thermal management for extreme heat loads.

DELO engineers **high-tech adhesives** that consistently exceed these demanding requirements. Our precision-formulated materials meet stringent industry standards like **JEDEC MSL** or **AEC Q100** while delivering the **highest performance** and **reliability**. They are extensively tested on test vehicles using Besi equipment, PVA Tepla, and a standard reflow oven.

With DELO you benefit from **advanced packaging solutions made in Germany**.

Die-side capacitor (DSC) encapsulation

Stiffener attach

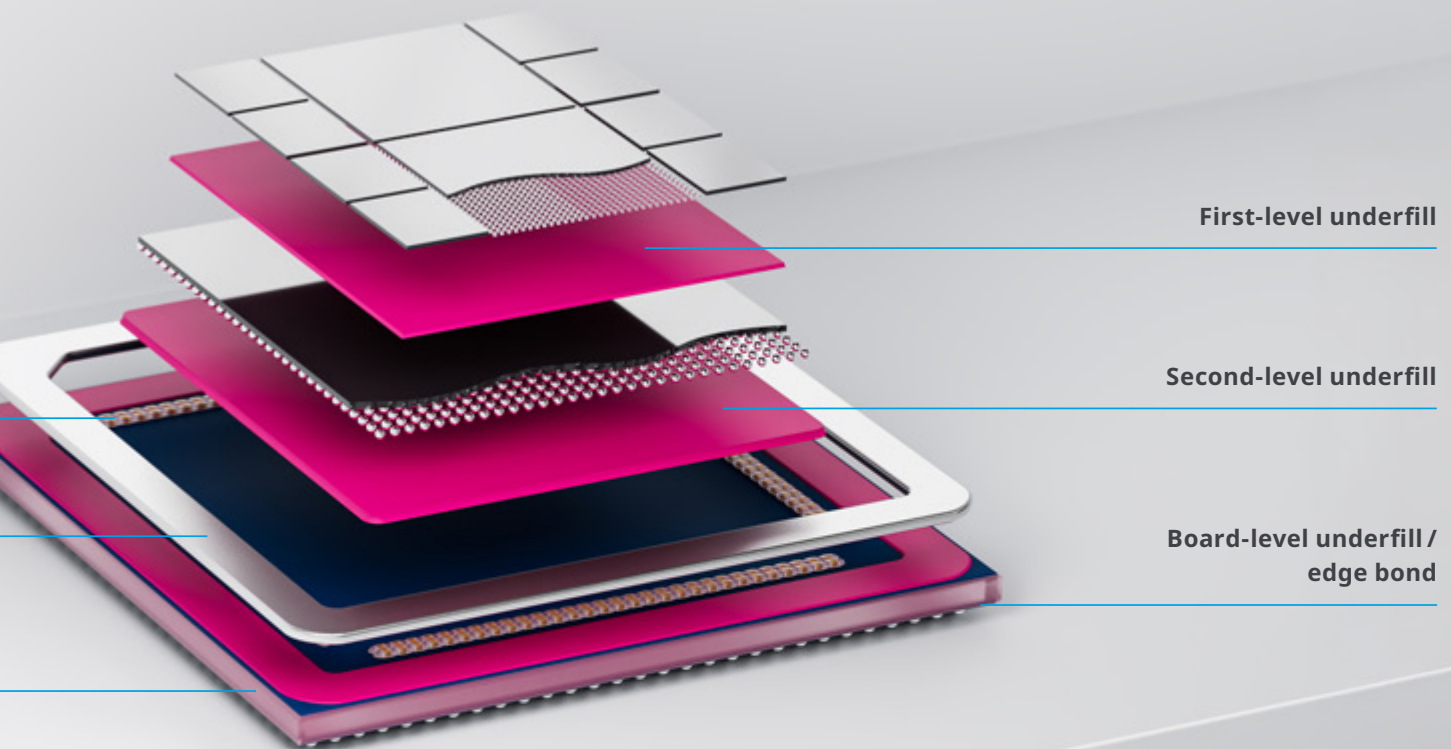
Edge coating for glass core substrates



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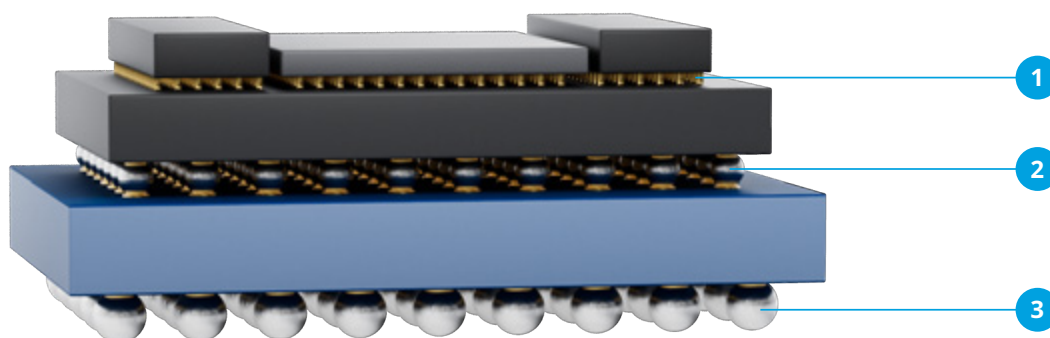
or ackaging



Applications

Capillary underfill

Mechanical stability during temperature cycling demands reinforced solder joints. DELO's capillary underfill solutions provide **optimal viscosity** for complete gap filling, low dielectric loss factors (Dk / Df), and improved thermal conductivity for effective heat management. **Excellent adhesion**, and **thermo-mechanical properties** keep tensions and warpage low. Long processing times and reduced curing temperatures deliver the performance your electronic assemblies demand.



Application directions

	1 First-level	2 Second-level	3 Board-level
Gap / Stand-off	< 25 μm	< 100 μm	< 150 – 200 μm
Pitch	~40 μm	~160 μm	> 800 μm
Flow challenges	+++	++	+
Dk / Df	2.5 / < 0.005	3.0 / 0.005	Lower priority
Thermal conductivity	> 1.5 W / m $\times$ K	1.5 W / m $\times$ K	Lower priority
Purity	Highest requirements	High requirements	IPC standard



— Adhesive

Adhesive requirements

First-level

- › Extremely low viscosity and perfect capillary flow for ultra-fine gaps
- › Nano-scale fillers to prevent blockage
- › Zero voids to avoid micro-bump fatigue and cracking
- › Ultra-high purity to preserve signal integrity

Second-level

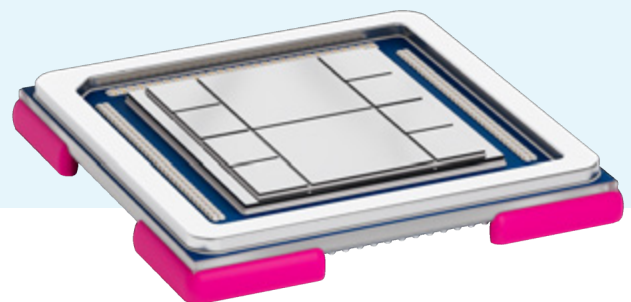
- › CTE-matched formulation to compensate mismatch and reduce warpage risk
- › Low viscosity with excellent capillary flow for complete, void-free fill across large interposer areas
- › High modulus to mechanically constrain interposer bow
- › Stiff yet tough to resist deformation and cracking

Board-level

- › Low viscosity to fill various gap sizes
- › Small filler size to meet current and future design requirements
- › Low curing temperature for board and component compatibility
- › High thermal cycling resistance to pass automotive tests

Reworkable and sustainable

Reducing waste and adopting repair-over-replacement approaches are becoming increasingly important. Our technology roadmap focuses on reworkable solutions like fast curing edge bond adhesives that provide a potential alternative to underfill. Reworking can be done at elevated temperatures without chemicals.



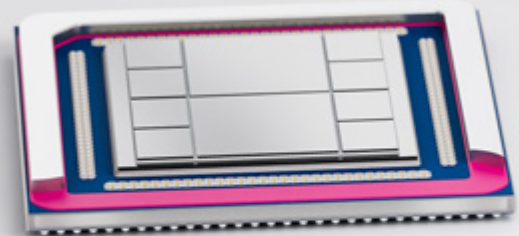
Adhesive solutions

- › DELO MONOPOX CU series, heat-curing

Applications

Stiffener attach

As advanced packages scale in size and complexity, the mechanical demands on stiffener attach adhesives become increasingly critical for maintaining package integrity. DELO's high-tech solutions control warpage and prevent delamination by ensuring **stable bondline thickness, withstanding multiple high-temperature reflow steps**, and **maintaining reliable mechanical characteristics** throughout the entire assembly process.



Adhesive requirements

- › Stable bondline thickness (BLT)
- › Strong adhesion on substrate and stiffener frame
- › Resistance to delamination (especially under thermal cycling)
- › Reflow and moisture resistance according to JEDEC MSL
- › Controlled flow behaviour
- › Good wettability

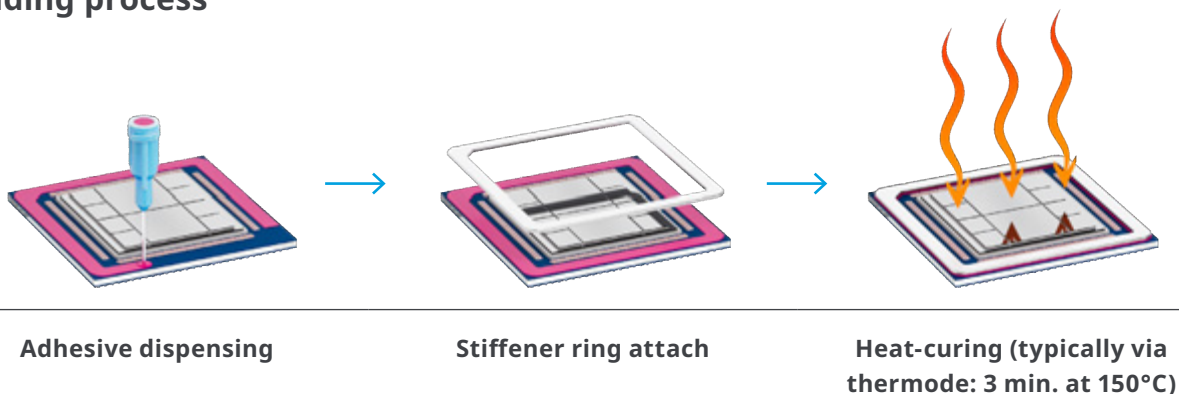
Packaging under pressure

The explosive demand for AI, data centers, and automotive HPC is pushing semiconductor packages to their limits—larger, denser, more powerful. As chipmakers race to deliver performance, package reliability becomes a competitive differentiator. Stiffener frames are now a market requirement, not an engineering detail.

Adhesive solutions

- › DELO MONOPOX EG series, heat-curing

Bonding process



Applications

Die-side capacitor encapsulation

Growing package complexity exposes substrate capacitors to mechanical stress, moisture, and electrical interference. DELO's precise encapsulation solutions ensure **reliable insulation**, **long-term stability**, and **strong adhesion** to capacitor and substrate for **stable power delivery**.



— Adhesive

Adhesive requirements

- › Full coverage in minimal layer thickness
- › Delamination free at T0, post TCT and uHAST
- › Stable material properties even after reflow
- › Gap filling viscosity to avoid bridging

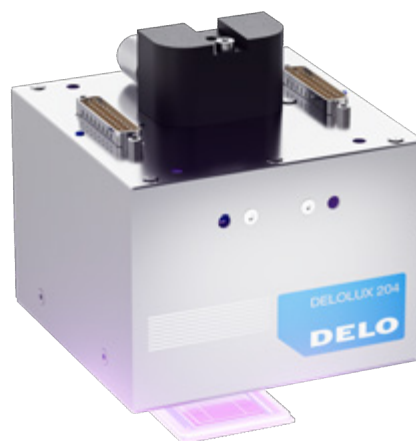
Adhesive solutions

- › DELO PHOTOBOND GE-series, UV-curing
- › DELO DUALBOND EG-series, UV + heat-curing
- › DELO MONOPOX EG series, heat-curing

Built for high volumes

Surging demand for high-performance AI hardware has made die-side capacitor encapsulation a high-volume production challenge. Where conventional processes struggle to keep pace, DELO's complete process solution—adhesive, jetting valve and UV-curing lamps from one source—delivers a decisive throughput advantage: significantly higher UPH, resilience through multiple reflow steps, and long-term stability under thermal cycling.

Bonding process



Adhesive application
via precise jetting

Fast UV-curing

Applications

Micro dam

Achieving higher component density and more compact designs in modern 2.5D packages requires precise control of underfill flow during capillary underfilling. DELO micro dam adhesives enable sub-100 μm line flow barriers that **reduce keep-out zones**—keeping packages clean and **contamination-free**, even as miniaturization continues.



— Adhesive

Adhesive requirements

- › Tuned rheology to ensure fine dispensing but stable bondline
- › Wet-in-wet line stacking for highest UPH
- › Flexible curing options, e.g., UV, UV + heat-curing or heat-curing
- › Halogen- and solvent-free formulations
- › Tested under JEDEC MSL conditions

Adhesive solutions

- › DELO DUALBOND EG series, dual-curing

Developed in close cooperation

Precise control of underfill flow boundaries is critical in today's compact advanced packages. Developed in close collaboration with NSW Automation, DELO's micro dam solution combines NSW's inline dispensing platform with DELO's UV-curing adhesives and lamps—a precisely tuned process that protects keep-out zones and enables the next level of miniaturization.

Bonding process



Adhesive application
via precise dispensing

Fast UV-curing

Expertise

Adhesive development and testing

15+

Test vehicles to check our adhesives in your application

Expertise that matches your needs

Developing the **right adhesive** for your advanced packaging application requires more than standard testing; it requires a **development partner** with the depth and expertise to match your exact needs.

Our laboratories cover nearly every relevant assembly process and testing requirement at highest technical level, evaluating adhesive performance under real-world conditions. Representative test vehicles replicate your actual application scenarios, validating solutions under authentic process flows and thermal profiles.

Machine learning algorithms accelerate formulation development, while **advanced simulations** predict adhesive behavior across varying process windows and environmental conditions, so you get **optimized solutions** at the **speed you demand**.

We provide product quality you can rely on: all our materials for advanced packaging are successfully tested under relevant conditions such as **JEDEC MSL and AEC Q100**.

And because we believe in advancing the industry as a whole, we actively share our research at premier IEEE and iMAPS conferences. As a member of iMAPS, IEEE, and SEMI, DELO is deeply embedded in the **global packaging community**, bringing you solutions that reflect the latest industry developments.



Check out our technical white papers.
go.delo.de/white-papers



Contact our experts.
advanced-packaging@delo.de

Coming next

Co-packaged optics (CPO)

As data volumes continue to surge, optical transceivers and photonic integrated circuits (PICs) have become significant components in modern data processing infrastructure. DELO develops high-tech adhesives that meet the demanding optical and mechanical requirements of these advanced systems, **enabling the future of light-based data processing** in data centers.

Our adhesives deliver **improved signal integrity** that minimizes signal loss while ensuring **optimal data speed**, exceptional **thermal stability** that maintains bonding strength under temperature fluctuations, and **precision alignment** capabilities for critical components like single-mode fibers and photonic circuits. These advanced properties provide the foundation for next-generation AI-enabled packaging solutions.

V-groove bonding and lid attach

For passive alignment of fiber to PIC

Strain relief

Tension equalizing

Dust sealing

Protection of sensitive optical elements

Coupling

Highly precise alignment of optical elements



Want to learn more?

go.delo.de/optical-communication

Die-side capacitor (DSC) encapsulation
Protection from short circuits

Underfill
Reinforcement of interconnects

Stiffener attach
Managing package coplanarity

Edge coating for glass core substrates
Protection of brittle glass edges against cracks

Adhesive

DELO Industrial Adhesives

**China | Czechia | France | Germany HQ | Italy | Japan
Korea | Malaysia | Singapore | Thailand | USA**

The data and information provided are based on tests performed under laboratory conditions. Reliable information about the behavior of the product under practical conditions and its suitability for a specific purpose cannot be concluded from this. It is the customer's responsibility to test the suitability of a product for the intended purpose by considering all specific requirements and by applying standards the customer deems suitable (e. g. DIN 2304-1). Type, physical and chemical properties of the materials to be processed with the product, as well as all actual influences occurring during transport, storage, processing and use, may cause deviations in the behavior of the product compared to its behavior under laboratory conditions. All data provided are typical average values or uniquely determined parameters measured under laboratory conditions. The data and information provided are therefore no guarantee for specific product properties or the suitability of the product for a specific purpose. Nothing contained herein shall be construed to indicate the non-existence of any relevant patents or to constitute a permission, encouragement or recommendation to practice any development covered by any patents, without permission of the owner of this patent. All products provided by DELO are subject to DELO's General Terms of Business. Verbal ancillary agreements are deemed not to exist.

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