

DELO High-Tech Adhesives

Adhesive-enabled optics alignment

Christoph Appel | 05/02/2026 | DVN Munich Lighting Workshop

The Precision Challenge in Modern Automotive Lighting



Mechanical stress & thermal drift

Tolerance stack-ups

Increasing optical complexity

<10 μm positional tolerances

<0.1° tilt requirements

MTF stability critical for pixel clarity

→ Mechanical fixation reaches its limits
→ Active Alignment crucial for μm -level placement

Why Traditional Methods Fall Short

Criteria	Screwing	Clipping	Laser Welding	Adhesives
Precision*	✗ ± 100-500 µm	✗ ± 200-1000 µm	✓ ± 10-50 µm	✓ ± 5-40 µm
Complex Geometries	✗ Limited	✗ Very limited	⚠ Material dependent	✓ Any shape
Process Time*	⚠ 30-60 sec.	✓ <10 sec.	✓ 5-15 sec.	✓ 10-30 sec.
Investment Costs	✓ Low	✓ Very low	✗ High	⚠ Medium
Material Selection	✓ Universal	⚠ Limited	✗ Restricted	✓ Very wide
Reversibility	✓ Yes	⚠ Limited	✗ No	⚠ Very limited

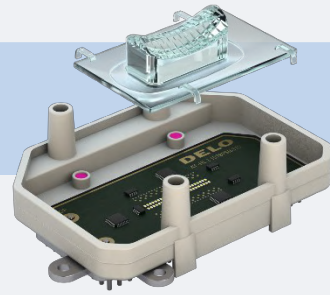
*Average values based on our experience and the feedback of our customers

- ➔ **Mechanical fixation: No precise alignment**
- ➔ **Laser welding: Material constraints, equipment costs**
- ➔ **Adhesive bonding: freedom in design & miniaturization**

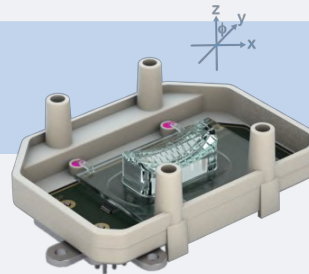
Adhesive-enabled Alignment: An Energy-efficient Process



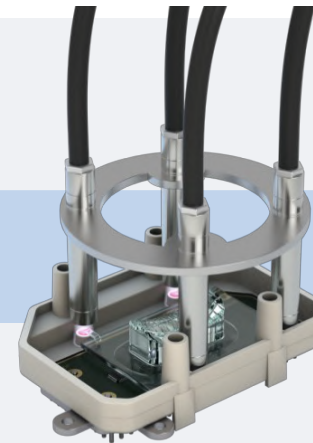
DISPENSING



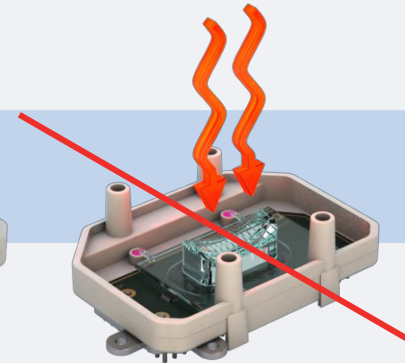
JOINING



ACTIVE ALIGNMENT



LIGHT FIXATION



HEAT CURING

CO₂ footprint calculation



2,000,000
Parts per year



16 s
Cycle time



Production side
Germany



5 years
Project lifetime

Dual curing



5s @ 1000 mW/cm²
50 min @ +100 °C



430 MWh/year
134 t CO₂ equivalent

Light curing only



5s @ 1000 mW/cm²



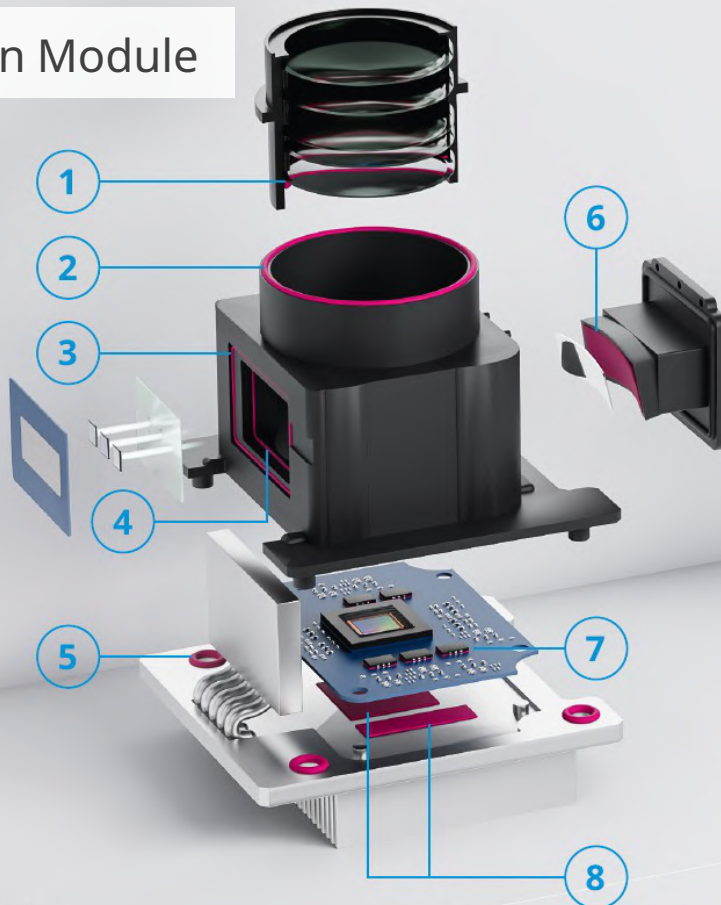
890 kWh/year
0.3 t CO₂ equivalent



311 g CO₂/kWh | 0,212 €/kWh

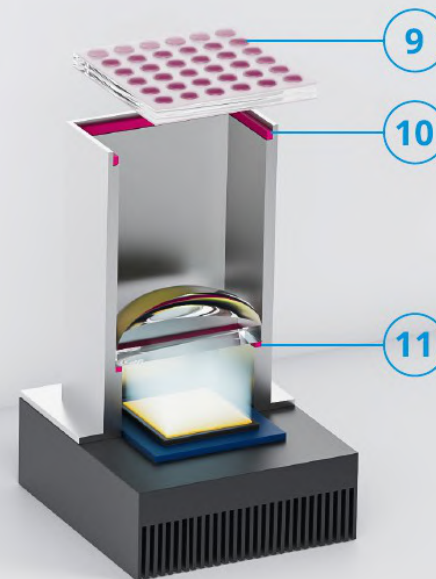
How Adhesives Enable Modern Projection Modules

DLP Projection Module



Adhesive

MLA Projection Module



- 1 Lens to barrel
- 2 Barrel to housing (AA*)
- 3 PCB to housing
- 4 Lens to housing
- 5 Housing to heat sink (AA*)
- 6 Mirror to housing

- 7 Die attach
- 8 PCB to heat sink
- 9 MLA optical material
- 10 MLA to housing
- 11 Lens to housing

AA* = active alignment

→ **Bonding = key enabler for next-generation high-resolution projection**



We are
where you are

DELO Locations DELO Partner

DELO