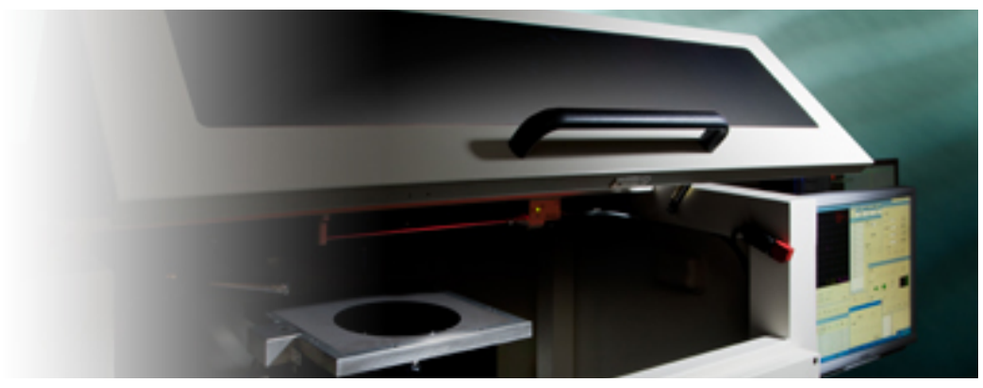
OptoSigma® Photonics Assembly System

TOSA/ROSA/BOSA Assembling System



▶ The System Built for Active Optical Device Assembly

TOSA, ROSA, and BOSA are key optical sub-assemblies used in communication modules. This system supports their assembly by combining precision motion control, active alignment, and YAG laser welding in a single workflow. It helps improve consistency, simplify setup, and support repeatable production of active optical devices.

▶ Why This Process Matters

In active optical device assembly, small positional variations can directly affect coupling performance and production stability. A controlled workflow is therefore essential to maintain repeatability during alignment and fixation. That is exactly how OptoSigma presents this platform on its official alignment-system guide.

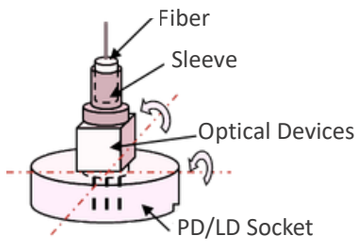


*Illustration of a typical assembly structure showing fiber positioning and alignment relative to the optical device and PD/LD socket.

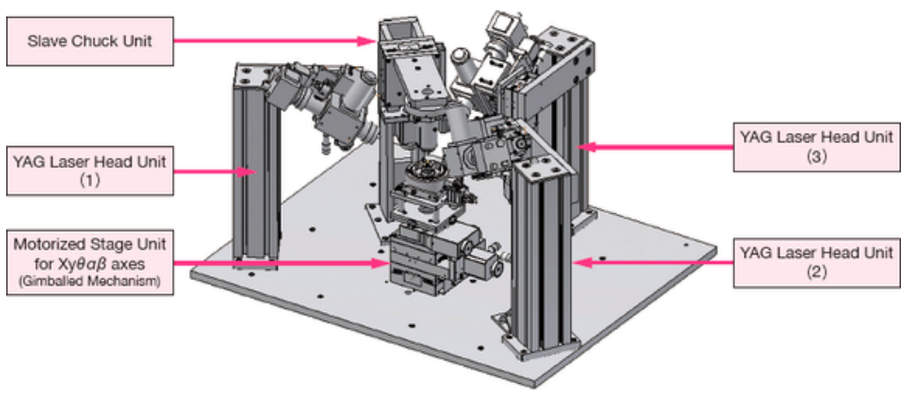
TOSA
Transmitter-side optical device assembly for laser-based output coupling.

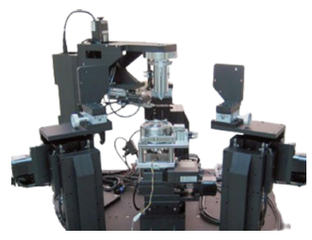
ROSA
Receiver-side optical device assembly for photodetector-side alignment.

BOSA
Integrated bidirectional optical device assembly combining transmit and receive paths in a compact structure.

▶ System Configuration Example

YAG Laser Welding Automatic Alignment System (Active Device)





Main Units

1. Motorized Stage Unit - Multi Controller
2. YAG Laser Head Unit (1) - Driver Box
3. YAG Laser Head Unit (2) - Base + Frame
4. YAG Laser Head Unit (3) - Cable Set
5. Slave Chuck Unit

▶ Key Manufacturing Use Cases

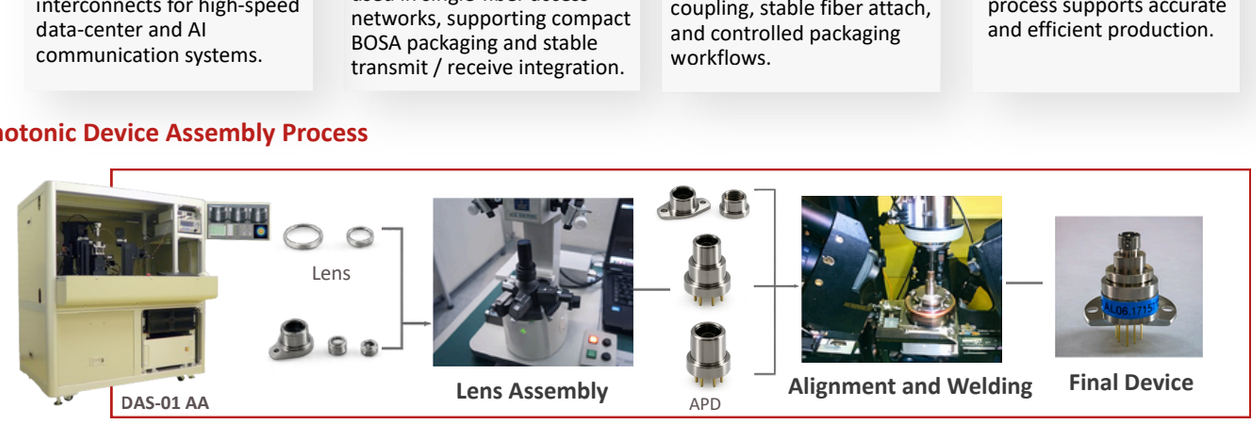
Datacom & AI Infrastructure
Assembly solutions for TOSA and ROSA devices used in next-generation optical interconnects for high-speed data-center and AI communication systems.

Optical Access Networks / PON
Precision assembly for bidirectional optical devices used in single-fiber access networks, supporting compact BOSA packaging and stable transmit / receive integration.

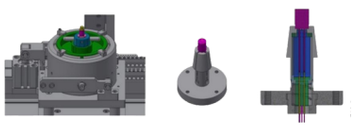
Silicon Photonics Packaging
Assembly and alignment for photonic integrated devices requiring compact optical coupling, stable fiber attach, and controlled packaging workflows.

Active Alignment and Bonding (OSA)
A high-speed, high-precision active alignment process supports accurate and efficient production.

▶ Photonic Device Assembly Process



- A typical assembly workflow includes component preparation, lens assembly, active alignment, and YAG laser welding, leading to the final device configuration.
- After optical alignment, the aligned condition must be maintained during final fixation. The integrated YAG laser head supports a single workflow from alignment to welding, helping preserve positional stability.



▶ How OptoSigma Supports Optical Sub-assembly Manufacturing?

— Reducing Alignment Time in Photonic Device Assembly 210 s → 60 s

- Alignment time is dominated by signal search. Conventional alignment methods rely on scanning patterns, which introduce unnecessary movement and extend the time required to locate the optical signal.
- OptoSigma system using Vectorized Gradient Search to predict the waveguide core location, we lock on First Light in < 2 seconds over a 100µm area.

Conventional Alignment Algorithm

SPIRAL
Measurements will be taken in a spiral pattern from the current position.

Raster
By line across the search area.

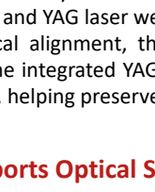
SPIRAL + 3LINE Search

Home position	= 15sec
Alignment position	
SPIRAL Alignment	≤ 120sec
3LINE Alignment	≤ 60sec
Home position	= 15sec

Total 210 s

OptoSigma's Alignment Algorithm

NelderMead



Specified 3-axis simultaneous alignment (helical)

- Tracking max power in 3D space
- There is no unnecessary movement

Nelder-Mead Search

Home position	= 15sec
Alignment position	
Nelder-Mead Alignment	≤ 30sec
Home position	= 15sec

Total 60 s

▶ Productivity Impact

— Comparisation between Manual and Automated Alignment

Manual vs Automated

Task	Manual	Automated
Loading	Required	Required
Search	100% Monitoring	0% Monitoring
UV Bonding	Critical Monitoring	0% Monitoring
Operator	Busy	Available

Result: Remove monitoring. Free up operators.

The system provides high repeatability and easy device loading and unloading. It supports different devices through interchangeable device holders, with alignment algorithms configurable for each device. A gimballed fitting mechanism helps reduce assembly time. Remote control is supported, and an ultra high speed alignment version is also available.

Operator Shift

Manual → continuous adjustment

Automated → no monitoring

Operator can now
- Prepare substrates
- Inspect devices
- Run multiple stations

ROI FOCUS

The main loss is **not labor**, it's device scrap during packaging.

Automation removes:
- Continuous monitoring
- Cure-related alignment drift

RESULT: +12% post-cure yield
−30% scrap reduction

Payback: < 4 months

Bottom Line

- **0% Monitoring** during search & bonding
- **−30% Scrap** from packaging yield loss
- **Operators Available** for parallel tasks

Annual Capital Recovery
€ 800k
Based on 2% yield improvement on 100k PIC chips @ €400 cost.

▶ OptoSigma offers a complete product lineup for photonic assembly

For applications such as PIC packaging, fiber coupling, TOSA/ROSA/BOSA assembly, and waveguide alignment, OptoSigma also offers matching positioning stages, observation units, peripheral devices, optical fiber products, and fiber optics holders.

Laser Processing

Measurement & Evaluation

UV Cure Waveguide Automatic Alignment System (Passive devices)

OptoSigma®