SD-100 Optical Probe Station

The SD-100 consists of a probe station hardware, rack-mount control modules, and software that automates fiber alignments and integrated photonic device testing. The hardware includes a thermally-tuned chip stage, a fiber aligner, and imaging systems that aid in visual alignment. The software's features and algorithms automate fiber alignments and multi-device testing, reducing tasks that used to take days when done manually to a few hours. Optional upgrades, such as additional fiber aligners or electrical probes, further expand its capabilities. As designs mature and enter pre-production, upgrade options exist, which add multi-die capabilities similar to the MD-100 system.

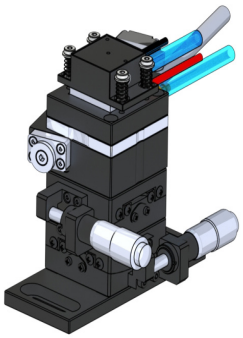
FEATURES

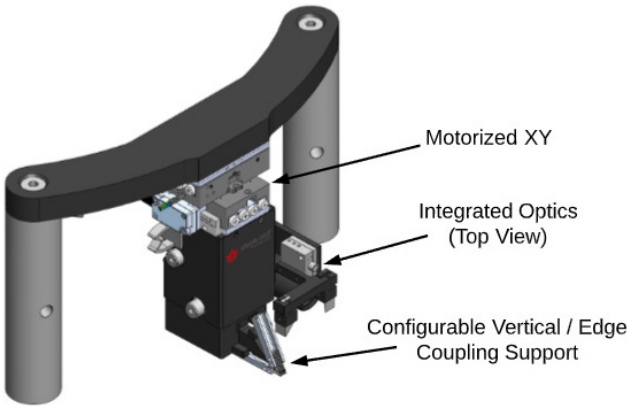
- **Automates optical alignment**
  2D scanning gets first-light fast and specialized 2D and 3D fiber align algorithms maximize coupling
- **Intuitive software**
  A process-driven UI guides the testing process and provides motion control, external test equipment integration, and multi-device test automation
- **Long-travel fiber aligners**
  Piezo-stage assembly with integrated optics supports both vertical and edge-coupled fiber arrays
- **Compatibility with existing test instrumentation**
  Built-in support for popular bench-top lasers, detectors, OSAs, and source-meters

OPTIONS

Adding a second fiber aligner enables complex fiber ↔ chip ↔ fiber testing applications. The platen supports up to three DC or RF probe positioners. The probe positioners can be motorized for convenience and automation. An enclosure to block stray light and protect the test environment is available. Finally, the fotonica API allows integration into existing frameworks and custom test environments.

HARDWARE





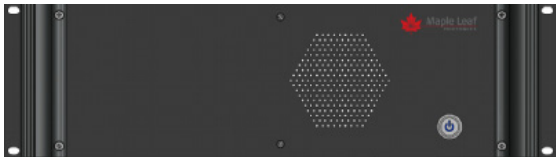
Chip Stage

- 3 DOF (XYZ rotations) with motorized Z-rotation to align chip to fiber aligner
- Dual goniometers adjust the tip-tilt of the chip relative to the fiber (XY rotations)
- 25 x 25 mm die mount with selectable vacuum ports
- Integrated TEC with a thermal sensor
- Active heat sink with optional water cooling

Fiber Aligner

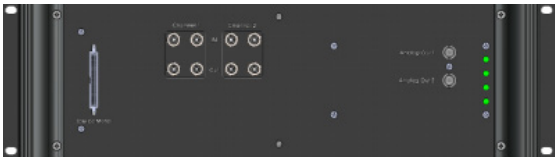
- 6 DOF (XYZ and their rotations) with four motorized axes
- Long-travel piezo stages (26 mm in XY, 12 mm in Z) with nanometer step resolution support whole die testing
- Motorized fiber rotation optimizes coupling and alignment
  - Vertically-coupled (X rotation): 0° to 40°
  - Edge-coupled (Y rotation): +/- 1°
- Integrated optics move in XY with the fiber and provide a magnified top-view of the fiber/array tip and on-chip devices

CONTROL MODULES



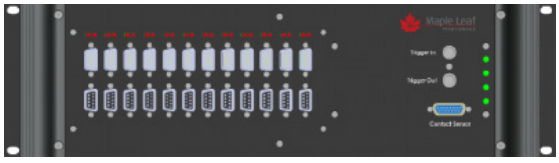
System Control Module

Industrial grade PC with expandable memory, additional PCIe slots, 8 USB ports, and dual monitor connectors hosting the fotonica software suite



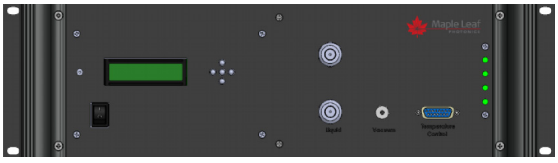
Photonics Control Module (Optional)

Laser, detector, polarization control, and optical switches dedicated to fiber alignment, 8-64 SMU channels to bias on-chip circuitry



Motor Control Module

Motion and contact sensor circuitry to control chip stage and fiber aligner movement; integrated trigger logic for scans and sweeps when using external lasers and detectors

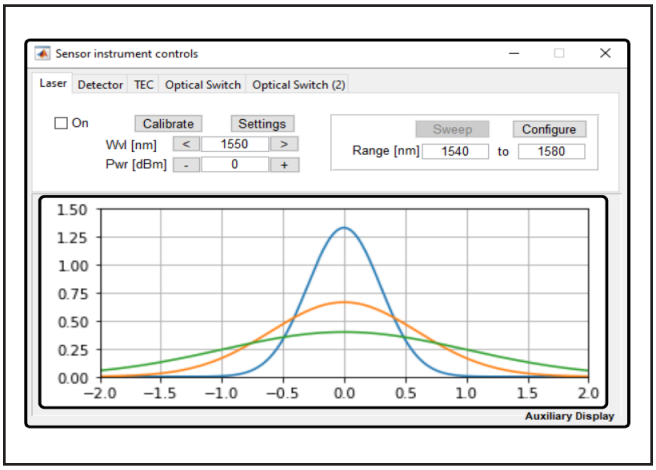


Environmental Control Module

Sensors and controls to manage the testing environment; the optional water pump/reservoir/radiator to thermally tune the chip-stage heat sink; TEC controller

SOFTWARE

The fotonica software suite helps users execute complex, parametric tests involving multiple instruments and on-chip devices. Test sequences, instrument settings, temperature and electrical bias can be defined through the script interface to create custom test procedures. Alternatively, the API allows Fotonica's core functionality to be integrated into existing environments or custom software applications.

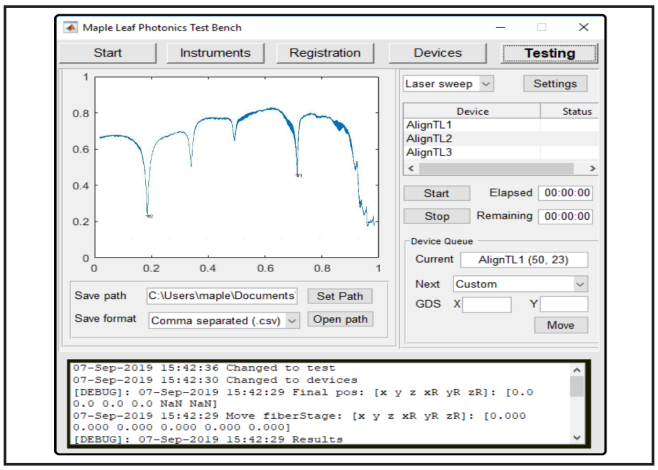


Instrument and Motion Control

fotonica provides the necessary instrument settings, motion control, and routines (such as wavelength sweeps and fiber alignments) required for automated testing.

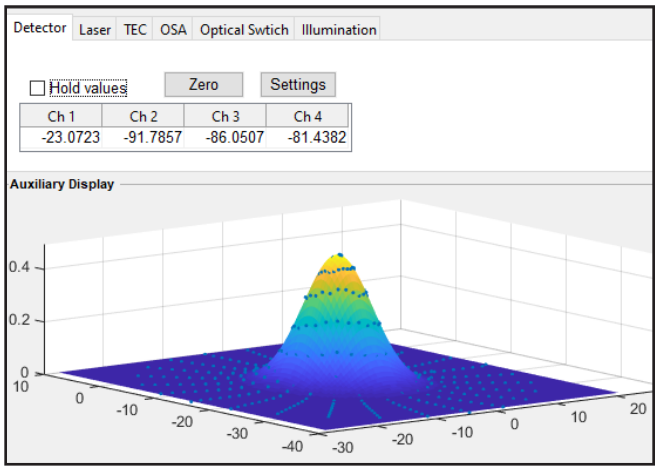
First Light and Fiber Alignment Algorithms

The raster scan gets first light quickly and allows users to set up a coordinate system to address every device on the chip.



Automated Testing

The automated test control allows users to test hundreds of devices in a single run or parametrically test over temperature, current, or voltage.



fotonica GUI and API

The GUI controls automated tests and displays 2D and 3D (shown) alignments. The API allows further customization and integration into other environments.

SD-100 PROBE STATION SPECS

Chip Stage Details (3 DOF)	Specifications
Die mount[1]	25 x 25 mm with mechanical edge alignment
Z rotation	± 2°, stepper
X and Y rotations[2]	± 2°, manual
Thermal tuning	25° to 50° C
Vacuum ports to secure chips	3 ports, 2 mm diameter

Fiber Stage Details (6 DOF)	
XY linear motion	26 mm of travel, piezo, 1 nm resolution
Z motion	12 mm of travel, piezo, 1 nm resolution
Edge coupled rotation (Y axis)	±1° travel, 10 µ° resolution
Vertically coupled rotation (X axis)	0-40° travel, 10 µ° resolution
Z axis rotation (chip and fiber orthogonality)	±2°, manual
Y axis rotation (chip and fiber co-planarity)	±2°, manual

Alignment Optics Details	
Fiber Stage (top-view, moves with fiber)[3]	Fixed 2x magnification, 3.6 mm FOV[6], manual focus, 5MP sensor
Overhead (top-view, stationary)[4]	0.6-7x magnification, 1-12 mm FOV[6]: manual fine focus, 5MP sensor, coaxial illumination
Side Align (side-view, stationary)[5]	0.6-7x magnification, 1-12 mm FOV[6]: manual fine focus, 5MP sensor

Control Modules	
System Control Module (SCM)[7]	Industrial grade PC with Intel i5 CPU, 16 GB RAM, 500 GB SSD, and Windows 10 Pro
Motion Control Module(MCM)[8]	Motor controllers and trigger logic
Environment Control Module (ECM)[9]	TEC controller; 20° to 50° C
Photonics Control Module (PCM)[10]	Alignment laser, dual channel detector, and polarization switch

Instrument Drivers (as of 6/30/19)

Swept Lasers: Agilent 8164A/81682A; Keysight 8164B/81606A, N7711A, N7714; EXFO (Yenista) T100S-HP; Santec TSL 510, 550

Optical Spectrum Analyzers: Anritsu MS9740A; Yokogawa AQ6370B

Optical Power Meters: Agilent 8163A; EXFO CTP 10; Keysight N7744A, N7748A, N7745, N7447; Thorlabs PM100, PM100D

Thermoelectric Coolers (TEC): Mapleleaf TEC; Arroyo 53305, 5240; Newport (ILX) LDT-5910B; Stanford Research PTC10

Source Measurement Units (SMU): Mapleleaf SMUs; Nicslab XPOW; Keysight U2722A, U2723A; Tektronix (Keithley) 2400

Contact factory for recent additions or quotation for specific instruments. Specifications are subject to change without notice.

Notes

1. Option: custom chip mount
2. Option: motorized axes
3. Zoomed in view of the fiber tip
4. View entire chip, probe needles, and fiber; 84mm working distance
5. View the fiber distance to the chip's surface; 150mm working distance
6. Field of view (FOV) diagonal measure for 1/2.5" sensor
7. Option: Upgrade CPU, video capability, RAM, or SSD
8. Option: needle-based contact sensor
9. Option: water pump, radiator and reservoir to thermally tune sink
10. Options: 0-4π polarization control and 8 to 96 source measurement unit (voltage or current controlled)

Maple Leaf Photonics is located in Seattle, Washington
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