Measurements with SIOS interferometers, highly precise, fast and effective

The main focus is the development of laser-interferometric fiber-coupled sensors for length, angular and vibration measurement.

Development and production to 100% in Germany at one location.

SIOS offers standard and customer-specific solutions of the highest precision and dynamics in 4 business areas.
STANDARD and CUSTOMIZED OEM UNITS

He-Ne laser

Custom-tailored units for coupling laser beams into single-mode or multimode (polarization-insensitive/polarization-preserving) optical fibers

Available with either factory-fitted fiberoptic connectors (DIN, E2000, etc.) on their loose ends or with fiber pigtails
MINIATURE RETROREFLECTOR INTERFEROMETER  MI Series

Compact version of MI 5000 for service and on site use MI 5000 K

Optionally with transportation system case
INDUSTRIAL CUSTOMER APPLICATIONS / CALIBRATIONS

MINIATURE RETROREFLECTOR INTERFEROMETER MI Series

Branch - Calibration services of length - accreditation offices

- first tests with standard MI5000 on the Zeiss ULM 600 comparator
- SIOS designed and manufactured adapter angle
- retro reflector fixed by magnetic holder

- permanent installation of special MI5000
- plane plate mount for lateral beam adjustment
- retro reflector fix mounted in flight to the scale
SP-NG Series Interferometer for industrial applications

- Easy to use
- Quick and easy beam direction alignment
- Small ball reflector with screw and magnetic fastening
- Robust sensor construction
- Splash-water protected housing
- Fiber cable with protection cable conduit
- Options to minimize alignment errors

90°-Beam deflection
Accessory for measurements up to 80 m
Beam direction alignment for OEM version
## INTERFEROMETERS FOR LONG RANGES

### LONG-RANGE INTERFEROMETER

Version with telescope in combination with hollow reflector

<table>
<thead>
<tr>
<th>Measurement range</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• beam magnification</td>
<td>2x ≤ 40 m</td>
</tr>
<tr>
<td></td>
<td>3x ≤ 60 m</td>
</tr>
<tr>
<td></td>
<td>5x ≤ 80 m...≤ 100 m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lateral displacement</th>
<th>± 15 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>• by 5x beam magnification</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max. tilt of hollow reflector</th>
<th>± 22.5°</th>
</tr>
</thead>
</table>

- Beam magnification varies from 2x to 5x, allowing measurement ranges from 2x ≤ 40 m to 5x ≤ 80 m...≤ 100 m.
- Lateral displacement is ± 15 mm with a 5x beam magnification.
- Max. tilt of hollow reflector is ± 22.5°.
**Example 1**

- Abbe-offset, $d$  
  1 mm  
- Dynamic mirror tilt, $\varphi$  
  ±8 arcsec (±39 µrad)  

**Abbe error**  
±39 nm

**Example 2**

- Abbe-offset, $d$  
  100 mm  
- Dynamic mirror tilt, $\varphi$  
  ±0.8 arcsec (±3.9 µrad)  

**Abbe error**  
±387 nm

\[ \Delta l_{Abbe} = d \cdot \tan(\phi) \]

- $d$ - Abbe-offset  
- $\varphi$ - Angle
## STANDARD PRODUCTS

### TRIPLE-BEAM PLANE-MIRROR INTERFEROMETER  SP-TR Series

**TECHNICAL DATA**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length measuring ranges, each channel</td>
<td>2 m</td>
</tr>
<tr>
<td>Length resolution</td>
<td>0.1 nm</td>
</tr>
<tr>
<td>Pitch and yaw measuring ranges</td>
<td>± 1.5 arcmin</td>
</tr>
<tr>
<td>Angular resolution at 0.1 nm length resolution</td>
<td>0.002 arcsec</td>
</tr>
<tr>
<td>Max. translation range</td>
<td>800 mm/s</td>
</tr>
</tbody>
</table>
Interferometer with tilt invariant reflectors

Interferometer SP-Series with ball reflector

Interferometer SP-Series with hollow reflector

Triple-cat's eye reflector

Increase of angular and length measuring range up to ± 12.5°
Correction of Abbe-error in the application

Correction of Abbe-errors by simultaneous length and angle measurements

- Simultaneous measurement of displacement and angle
- Measuring points are defined by every measuring beam
- Rotation point of the surface can be defined
- Correction of Abbe-errors is possible

![Diagram of interferometer and target](image)

- Position deviations
  - Pitch angle
  - Yaw angle

- Corrected position deviations

*Graphs showing position and corrected position deviations with distance.*
5 DOF Calibration Interferometer SP15000C5

Range and Resolution of SP 15000 C5

**Displacement**
- Range: 0 ... 15/50 m
- Resolution: 20 pm

**Straightness**
- Range: ± 4 mm
- Resolution: 10 nm
- Axial Range: 6.5 m

**Pitch / Yaw Angle**
- Range: ± 5°
- Resolution: 0.0004 arcsec
5 DOF Calibration Interferometer SP15000C5

Accessories
Cosine - Error in the Application

Direction alignment error

Example 1
- Visible beam shift at target: 0.5 mm
- Movement distance: 500 mm
- Angle: 3.4 arcmin (1 mrad)
- Error: 500 nm/m

Example 2
- Visible beam shift at target: 1 mm
- Movement distance: 50 mm
- Angle: 68 arcmin (20 mrad)
- Error: 200 µm/m

$$\Delta l_{\cos} = l_m \cdot [1 - \cos(\phi)]$$

$l_m$ - Measuring displacement

$\phi$ - Angle
5 DOF Calibration Interferometer SP15000C5

Alignment of measurement beams reflector unit and straightness mirror

- Hungary
- Peter Grundschok/Sales director

- 5 DOF Calibration Interferometer SP15000C5

- Integrated position sensor for alignment signal

- Signal monitor

- y,z -positioning platform

- pitch/yaw adjuster
Calibration Software for SIOS Interferometers InfasAXIS

Current measurement information:
Calibration Software for SIOS Interferometers InfasAXIS

- Supports **all** SIOS calibration interferometers
- All data are stored in the database
- Evaluation can be recalculated at any time
- PDF Protocol
- Available standards for data evaluation:
  - VDI/DGQ 3441
  - DIN ISO 230
  - Straightness according to VDI 2617
- Environmental data included
OEM APPLICATIONS / CUSTOMIZED SYSTEMS

- From single solution to OEM supplier
- Multi-beam arrangements
- UHV Applications
**RETROFIT AND COMPLETE SYSTEMS**

<table>
<thead>
<tr>
<th>GAUGE BLOCK CALIBRATION SYSTEM</th>
<th>THICKNESS MEASURING SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Upper gauging probe: LM 20</td>
<td>Two probes for both-side operation</td>
</tr>
<tr>
<td>• Replacement of standard gauging probes</td>
<td>High precision thickness measurement of lenses, wafers, foils, plane parts, spheres etc.</td>
</tr>
</tbody>
</table>

Adaptable to specific customer requirements
<table>
<thead>
<tr>
<th>COMPLETE SYSTEMS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>WAFER THICKNESS MEASURING STATION</td>
<td>THICKNESS MEASUREMENT OF OPTICAL LENSES</td>
</tr>
<tr>
<td>High-precision station for measuring semiconductor wafers or other objects with plane-parallel geometries and diameters ranging up to 300 mm</td>
<td></td>
</tr>
</tbody>
</table>

- **Uncertainty** ≤ 50 nm
- **Uncertainty** ≤ 10 nm
Test-measurements on copper lenses

Task: Radius and topography measurements

Test bench based on SP2000DI
RETROFIT AND COMPLETE SYSTEMS

Multi-purpose-calibration-stand

- Replacement of an old Nano-Mach interferometer
- Development of a new control-unit of the measuring station
STANDARD PRODUCTS

High-precision temperature, air pressure and air humidity measurements

Temperature measurement:
- Resolution: 0.1 mK / 1 mK
- Measurement uncertainty: ± 50 mK
  typical, depending on the kind of calibration
- Measuring intervall: >4 s

Sensor are calibrated digitally together with the measuring electronic

PT100 air and material temperature sensor, customized design possible

- 4 (up to 15) wired temperature sensor
- 15 wireless temperature sensors
- 2 air pressure sensors
- 2 air humidity sensors
LASERINTERFEROMETRIC VIBROMETERS

LSV-NG Series

<table>
<thead>
<tr>
<th>Working distance</th>
<th>30...70 mm, 240 mm, 480 mm</th>
<th>Working distance (continuously selectable)</th>
<th>240 mm - 2500 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amplitude resolution</td>
<td>5 pm</td>
<td>Amplitude resolution</td>
<td>5 pm</td>
</tr>
</tbody>
</table>

LSV 120 NG

with a fixed focal length or with exchangeable lenses

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>0 – 5 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface roughness</td>
<td>arbitrary</td>
</tr>
<tr>
<td>Object velocity</td>
<td>3 m/s</td>
</tr>
</tbody>
</table>
LASERINTERFEROMETRIC VIBROMETERS

NANO VIBRATION ANALYZER

High resolution frequency analysis of vibrating micro objects

Vibrometer application for measurements of:

- Resonance frequency
- Actuator efficiency
- Detector sensitivity
- Mechanical crosstalk

NA Series

Laser spot

Microscope

Vibrometer

Cantilever array

20 pm
Minute-gear-wheel Alpha

- Measuring object: Mechanical watch (NOMOS Glashütte)
- Material: gold plated brass
- Measuring of flatness
- NMM-1 with laser-focus-sensor

Quelle: http://www.nomos-glashuette.com
THANK YOU VERY MUCH FOR YOUR ATTENTION!

Please visit us on booth no. 95

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