

MSA-100-3D Micro System Analyzer



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3D vibration measurement
for MEMS & microsystems
Product brochure



Because real life
happens in 3D



3D deflection shape measurement of microstructures with pm resolution for both out-of-plane and in-plane motion mark the state-of-the art microscope based vibration measurement.

3D vibration measurements for microsystems

The MSA-100-3D Micro System Analyzer is designed for 3D vibration analysis with high lateral resolution. It is especially suited for microsystems, precision mechanics parts and for studies on the dynamics of HGAs and secondary actuators in the data storage industry.

The instrument is based on a novel 3D vibrometer setup enabling pm-resolution for both out-of-plane and in-plane motion. It has a frequency bandwidth of 25 MHz. An integrated XY-traverse stage with full software support for high-precision sample movement enables scanned measurements for obtaining 3D deflection shapes.

Technology

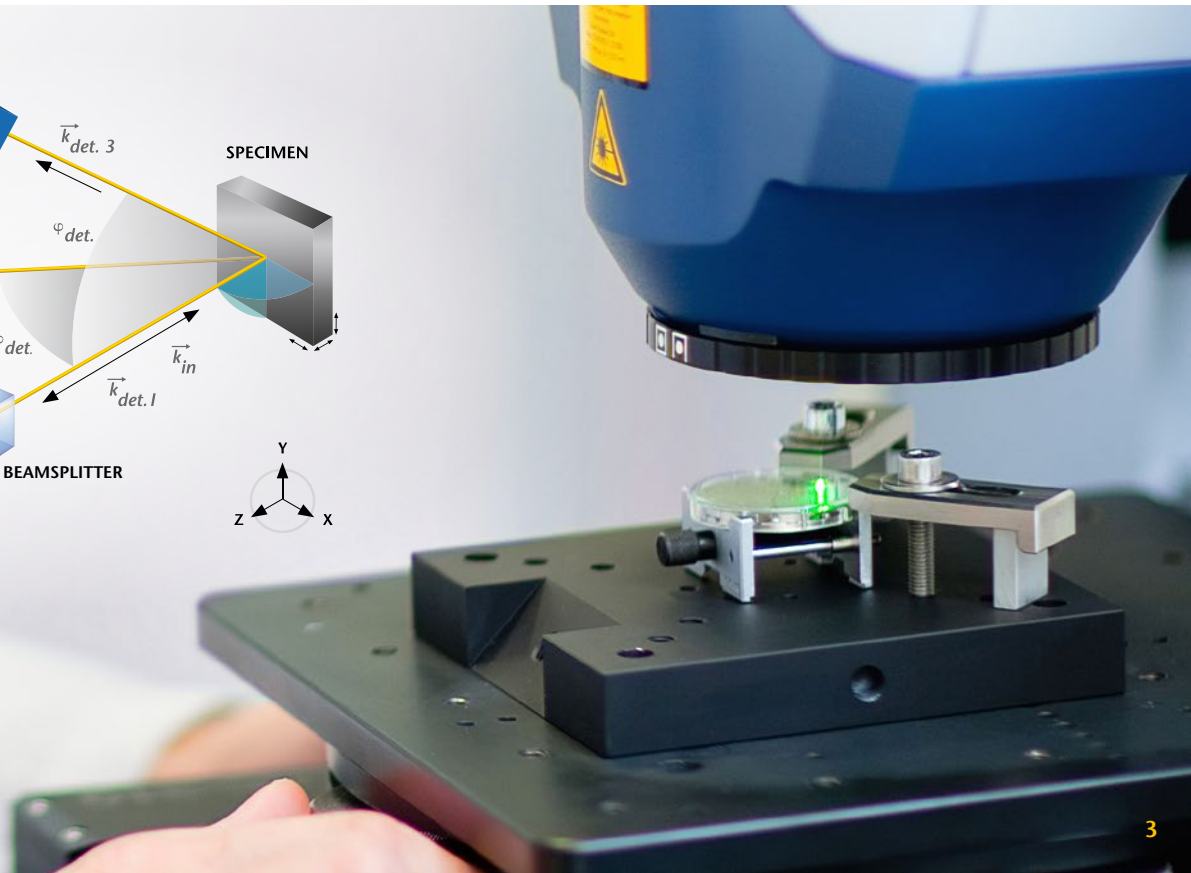
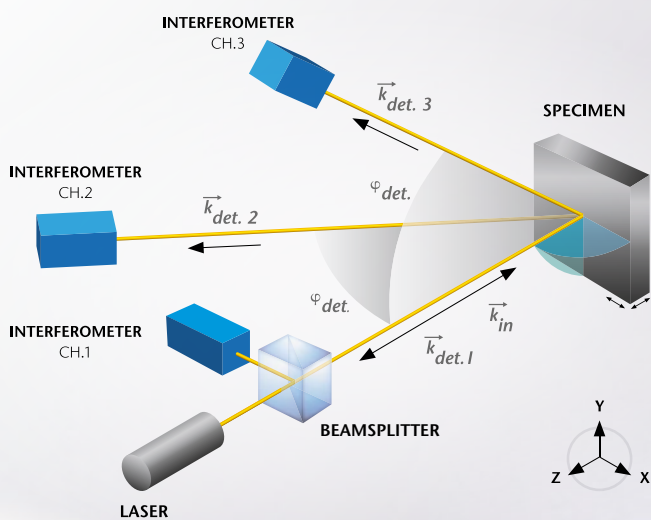
This novel measurement instrument is based on heterodyne Mach-Zehnder interferometry with 3 linearly independent interferometer paths. The laser beam directed on-axis through the main interferometer is frequency-shifted acousto-optically with respect to the 3 reference beams by a Bragg-cell. The scattered light is then collected on-axis and in two off-axis directions. The 3 detector signals contain the complete broadband 3D vibration spectra at the measurement spot. A coordinate transformation is employed to derive the vibration data in Cartesian coordinates. Operating deflection shapes of all resonances are measured by scanning the laser beam over the surface of the sample.

Highlights



- Real-time measurement with high bandwidth
- Sub-pm displacement resolution for both out-of-plane and in-plane motion
- Single-point and full-field scanning measurements
- Frequency range up to 25 MHz
- Small spot size of $<4\ \mu\text{m}$ for high lateral resolution
- Large stand-off distance of 38 mm
- Probe station compatible

The MSA-100-3D Micro System Analyzer solves many challenging development tasks. It is based on the directionally resolved analysis of the Doppler frequency shift of light backscattered from just a single laser beam impinging on a vibrating or moving object. Subpicometer amplitude resolution is achieved for both Out-Of-Plane (OOP) and In-Plane (IP) motion with a small laser spot resulting in high spatial resolution data. This combined with up to 25 MHz bandwidth real time data will open a realm of entirely new applications for the characterization of MEMS and other micro mechanical structures.



Application areas

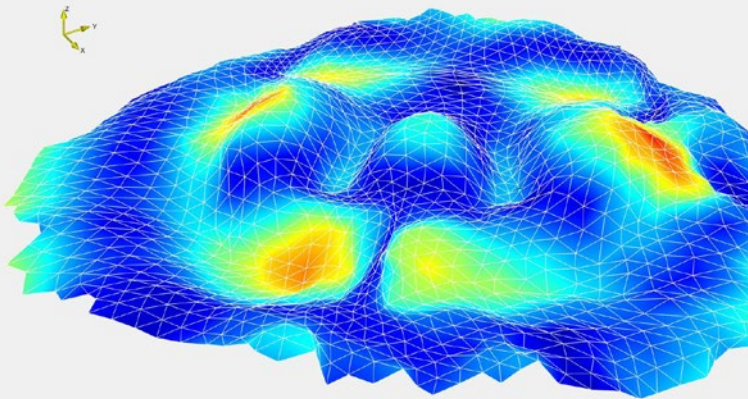
MEMS sensors and actuators

The primary direction of motion for many MEMS devices is defined by the principal plane of the device (in-plane, IP). Typical examples include inertial sensors such as accelerometers or gyroscopes. In another class of devices the principal direction of motion is perpendicular to the plane of the device (out-of-plane, OOP), typical examples are micro mirrors and mirror arrays, inkjet printing heads, microphones and pressure sensor membranes.

However, in most cases the real performance cannot be characterized as either pure OOP or IP vibration. Instead, it is a superposition of both motion components. Therefore high-resolution measurement data from all motion directions are needed for a complete description. In addition, the vibration measurement has to be very sensitive, in the picometer range, to catch the smallest parasitic contributions.



Enabling deflection shape analysis for MEMS and microstructures with excellent resolution for both out-of-plane and in-plane motion components, here a Piezo transducer



Data storage

A sophisticated non-contact 3D measurement technology like LDV helps to accomplish the engineering task to increase R/W head-positioning accuracy in hard disk drive (HDD) development to achieve higher storage density and better reliability. Precise time-domain data and various operational deflection shape measurements help to quickly verify new designs thus accelerating the development process.

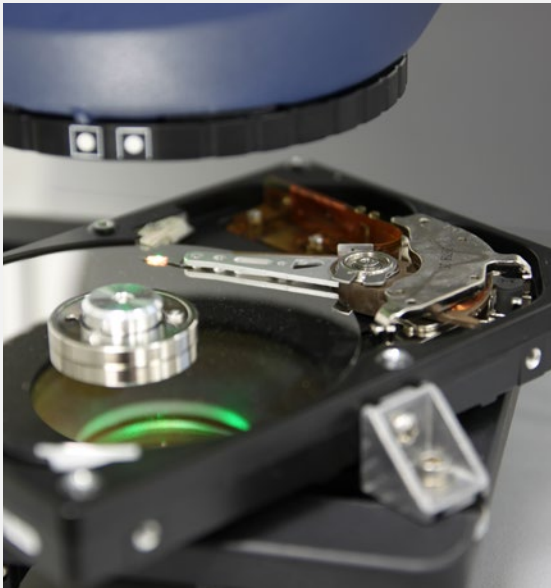
Bio-medical applications

Biological systems like insect hearing organs which display complex 3D vibrations on the nm-scale when exposed to sound can be studied in real-time with the MSA-100-3D Micro System Analyzer.

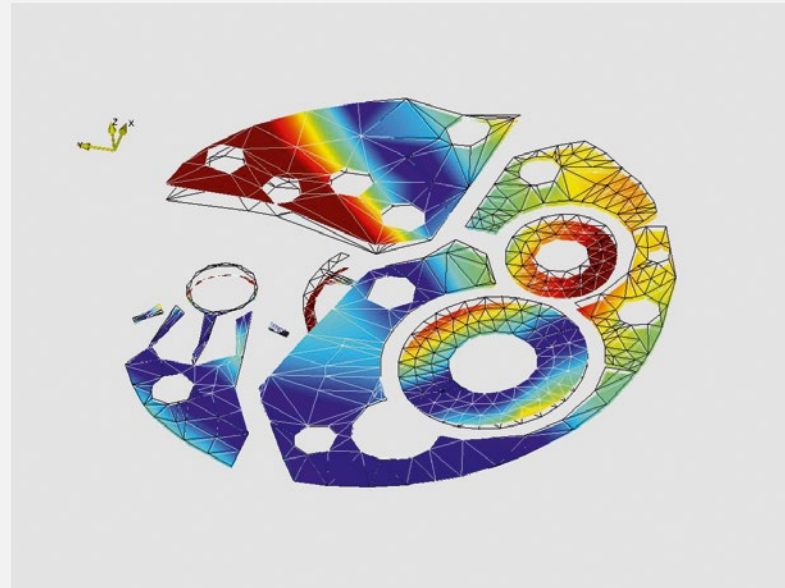
Precision micro mechanics

High precision micro mechanic components, assemblies and tools are essential elements in many industries ranging from semiconductor, medical, dental, watch-making to aerospace and other high technology industries. An easy, non-contact precision measurement leads to a significant characterization of the 3D dynamic properties of micro mechanic parts and assemblies thus helping to develop better products in a shorter time.

Zoom-in with very high resolution allow a close look on fine-mechanics like gears in watches. Detecting unwanted vibrations and displacements in pm-range is crucial to comply with the highest quality standards in this sector.



Microscopic 3D analysis ensure highest quality and accuracy in product development processes



3D deflection shape of watch components

Models and accessories



Either as single point or as full-field 3D scanning, the MSA-100-3D stands for flexibility with different bandwidth configurations for vibration measurement:

- H-Version up to 100 kHz
- M-Version up to 2.5 MHz
- V-Version up to 25 MHz

Intelligent software

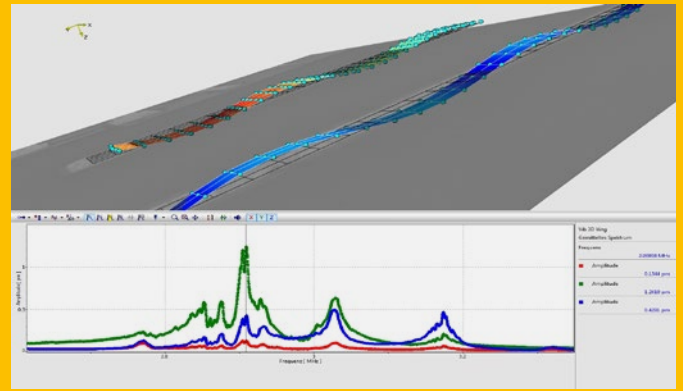
Simple operation: The proven Polytec PSV scanning vibrometer software is the base and has been extended with powerful features for fast and highly productive 3D vibration measurement on micro structures. The automated video stitching function allows an easy extension of the scan area on larger structures. The support for the motorized z-axis allows the easy assignment of optimum focus values to individual measurement points or a group of points.

Intuitive data analysis and evaluation: Frequency data over the instrument's whole bandwidth is available, without the need to know discrete frequencies in advance. The intuitive software package has a fully featured analyzer for time domain, FFT, Zoom FFT, averaging and peak hold measurements using a wide range of excitation wave forms. Data visualization includes full frequency response function (FRF) and operational deflection shape (ODS) capabilities with impressive 3D animations. Post processing and further data evaluation is enhanced by an open programming interface, versatile data export to modal analysis packages (UFF, ASCII, binary) and a powerful built-in signal processor.



Configuration with portal stand, automated z-axis, xy-positioning table and actively-controlled vibration isolated workstation

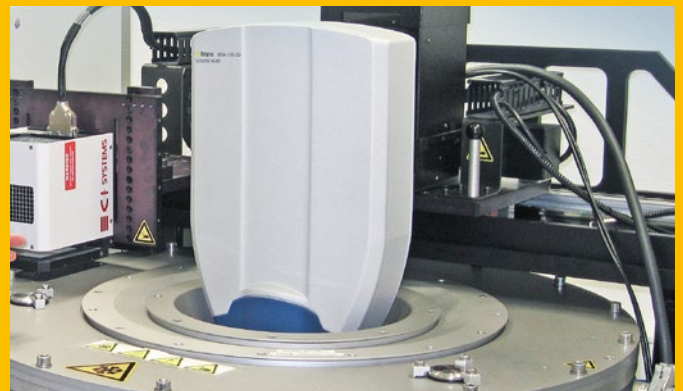
Intuitive visualization of
3D deflection shapes in
PSV software



The XY-positioning table
with tip-tilt compensation,
vibration isolated workstation
and more extras enable
comfortable work



MSA-100-3D integrated in a
vacuum probe station

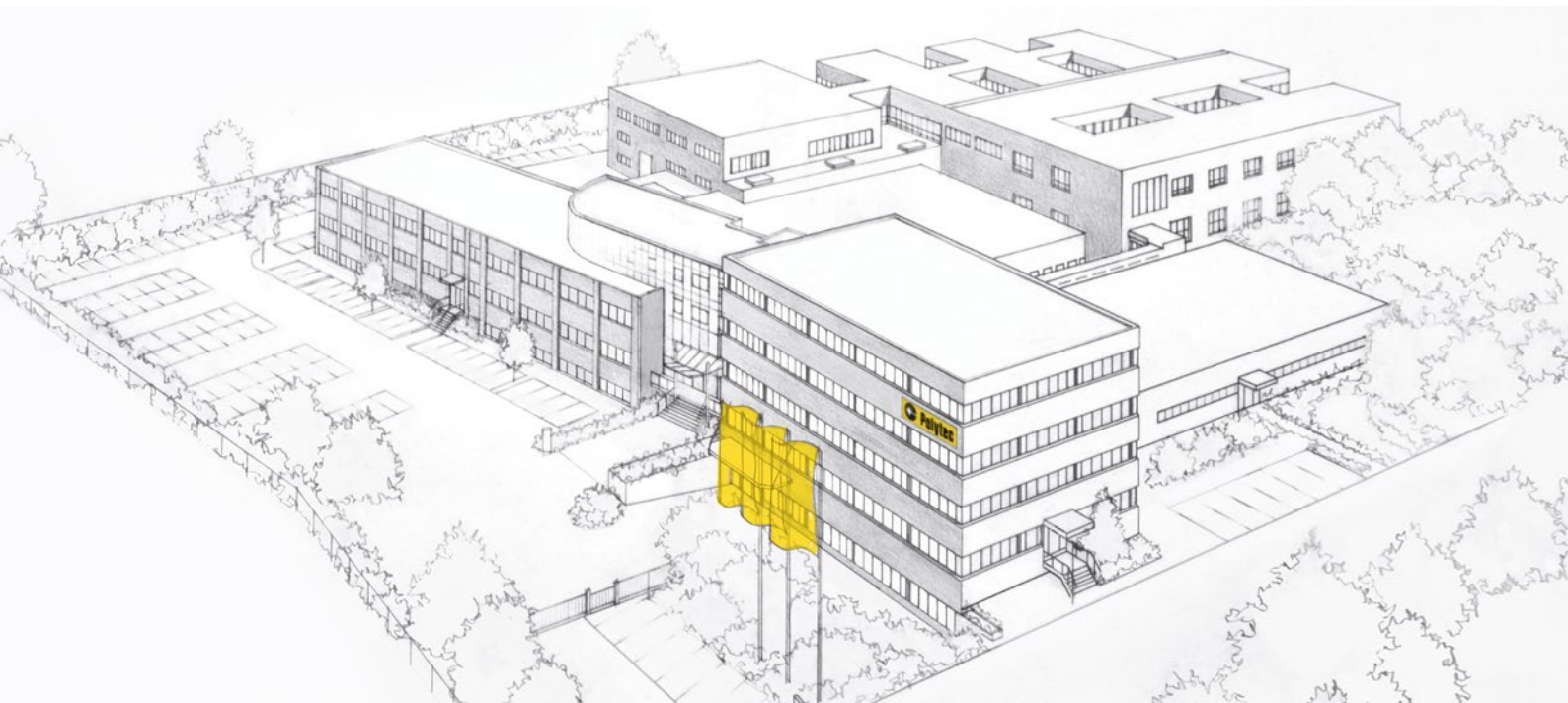


Stands and sample positioning

A flexible mounting concept allows to install the MSA-100 Sensor Head specifically to the application requirements, with either standard or portal stand mounting or installed on probe stations. Polytec stands are available on air-damped or actively-controlled vibration isolated tables and can also be installed on table top vibration isolation breadboards or on user supplied optical tables. XY-stages with tip-tilt compensation allow precise sample positioning and full field scanning. For more information, please see the accessory data sheet.

Probe station compatibility

The MSA-100-3D can easily be adapted to probe stations for automated or semi-automated measurements on wafer-level, even under vacuum conditions. Mounting holes equivalent to a Mitutoyo FS70-L-S (short base) back plate enable an easy integration on commercially available probe stations. Its long working distance and sensor head form allows also the installation at vacuum, pressure or temperature chambers.



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