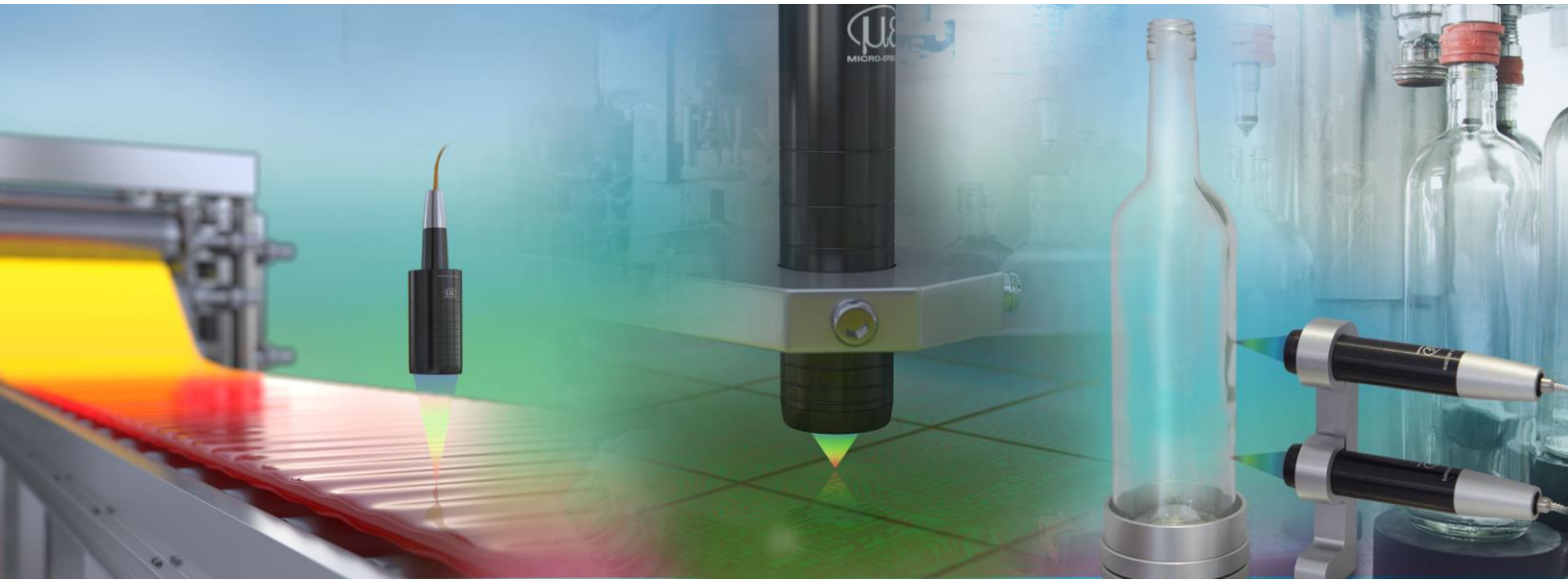


How to Reach Unrivaled Precision in Distance and Thickness Measurements with Confocal Sensors

The unique optical confocalDT measurement system from Micro-Epsilon is based on the optical measuring principle, which specifically takes advantage of the so-called chromatic aberration of light. This refers to the different refraction of light in relation to its wavelengths. It measures distances by means of wavelength (spectrometry).

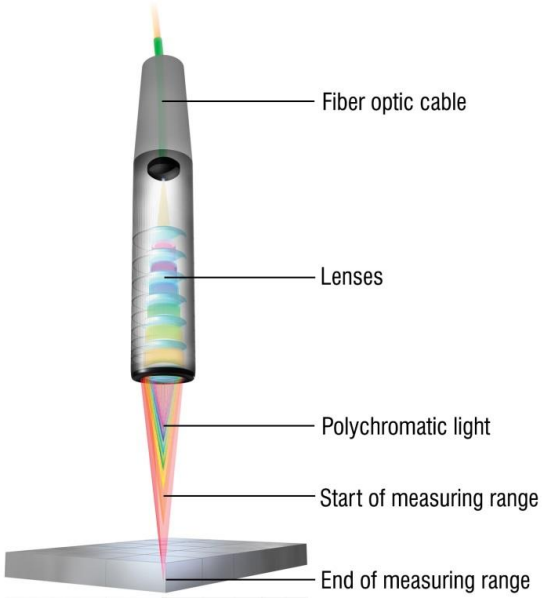
Confocal chromatic measuring systems are increasingly used for fast distance and thickness measurements. Different sensor and controller models open versatile fields of application, e.g. in the semiconductor industry, glass industry, medical engineering and plastics production.

Decisive Advantages

Compared with laser triangulation sensors, confocal chromatic sensors offer numerous advantages. The advantages become evident where conventional laser sensors come up against their limits. Especially when measuring on reflecting and shiny targets, confocal chromatic sensors provide high accuracy whereas laser sensors are overdriven due to the high light intensity.

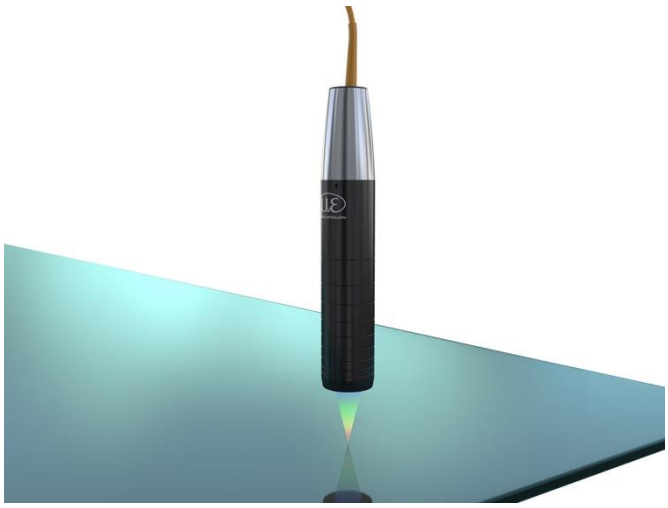
Measuring principle

The confocal chromatic measuring principle is based on polychromatic light (white light) which is divided into separate spectral colors by being focused through a multi-lens optical system in the sensor at different distances from the sensor. Short-wave, blue light (400nm) is refracted more than long-wave, red light (700nm). The start of the measuring range is with blue light and the end is with red light. A specific distance to the target is assigned to each wavelength by a factory calibration of the controller. Only the wavelength which is exactly focused on the target is used for the measurement in the sensor system. The light reflected from this point is imaged by an optical arrangement onto a light sensitive sensor element, on which the associated spectral color is detected and evaluated. In the case of thickness measurements, several distance points are evaluated accordingly.



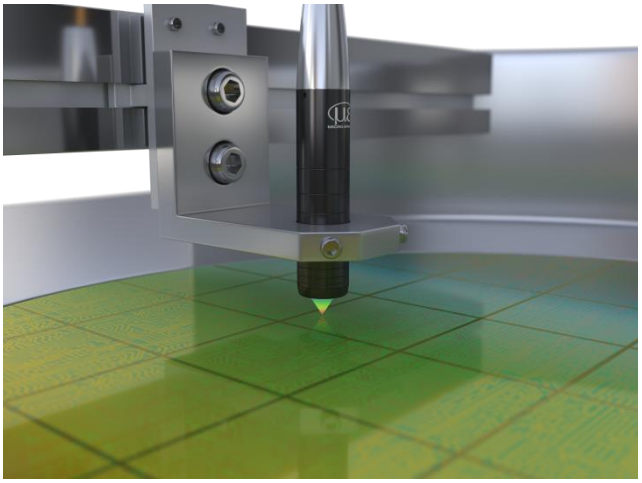
Distance measurement on any surface

In contrast to laser-optical sensors, confocal chromatic sensors are almost independent of the light reflected by the surface. Therefore, the distance can be measured from dark and mat surfaces as well as from shiny and reflecting surfaces.



Micro-Epsilon Technology advantages

Due to the factory calibration of Micro-Epsilon confocal systems, a certain distance to the measurement object is assigned to each light wavelength or color. The surface properties do not influence the measurement accuracy. This unique measuring principle enables high precision distance and displacement measurement for diffuse and reflecting surfaces even on mirror and liquid. The measurement spot is not larger than few microns and stays constant even with changing measurement distances. During a scan, extremely high lateral resolution in all directions can be achieved providing microscopic topography results.



Extreme resolution: surface scan of a wafer

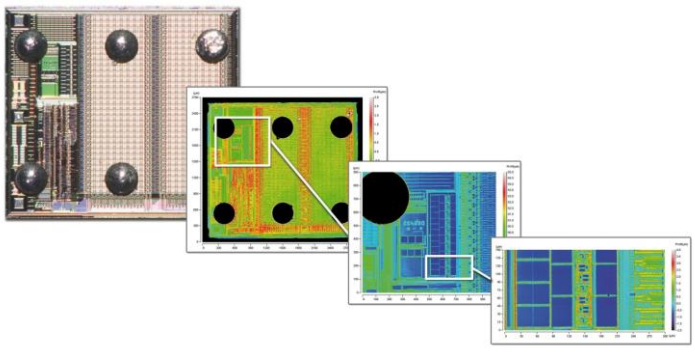
Using a high-powered light source and a high-speed spectrometer, measurement rates up to 70,000 Hz can be reached. The system is inherently immune to EMI and even suitable for EX-proof environments.

High Performance

- Distance and thickness measurement with high resolution and measuring rate
- Extremely small and constant spot size
- Nanometre resolution
- Almost surface-independent, also valid for mirrored and glass surfaces

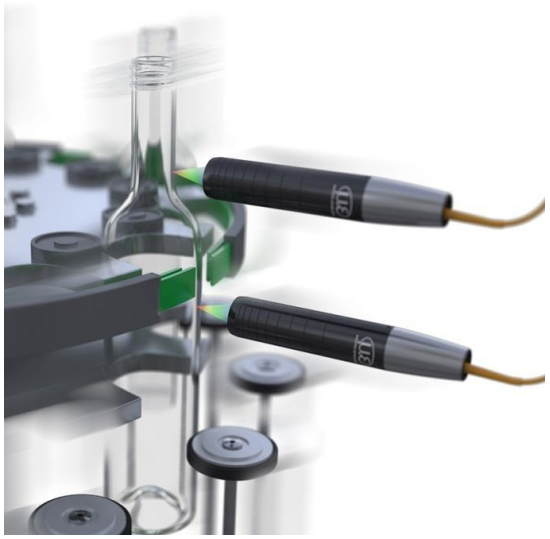
Submicron resolution

Confocal chromatic sensors provide an extremely high resolution. As individual spectral colors are used for the measurement, resolutions in the submicron range are possible. Confocal controllers from Micro-Epsilon provide a resolution of 1nm. However, the resolution is reduced by optical effects of the lens arrangement in such a way that a max. resolution of 10nm can be achieved.



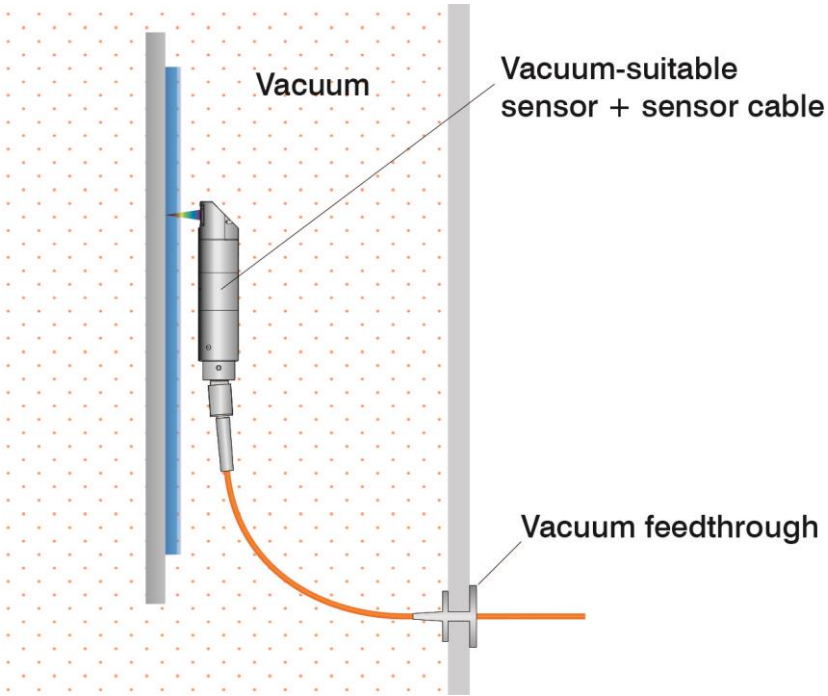
High measuring rates for dynamic measurement tasks

The confocal measuring principle enables high speed measurements. Depending on the models and components used, the controllers of different manufacturers provide different measuring rates. Controllers from Micro-Epsilon offer with up to 70kHz the highest measuring rate in the world. However, it is important to adapt the exposure to the respective surface. Therefore, controllers from Micro-Epsilon operate based on a exposure control feature which uses the previous measuring cycle offering the fastest surface adaptation available.



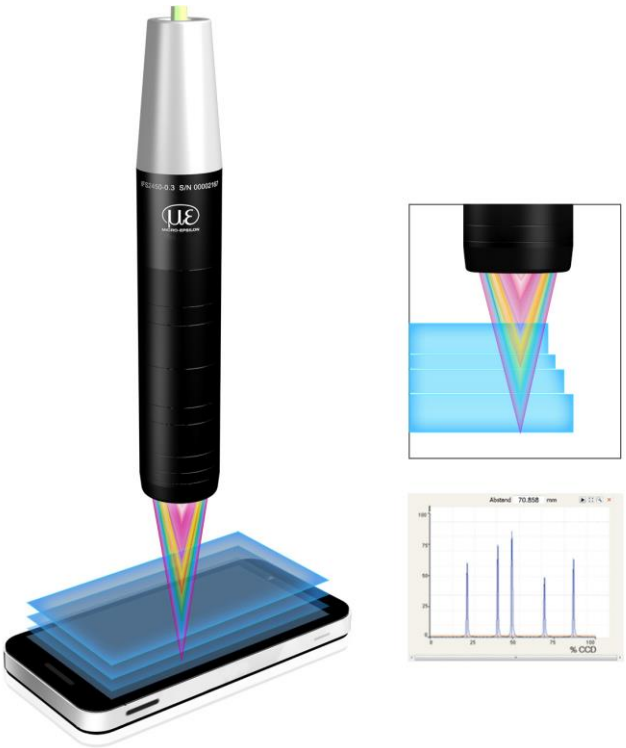
Ready for vacuum

Unlike other measuring systems, confocal chromatic sensors are basically suitable for use in vacuum, as the sensor consists of passive components. Therefore, the sensor does not emanate any heat. However, all components must be suitable for use in vacuum. In a vacuum, especially in a high vacuum (HV) and an ultra-high vacuum (UHV), no conventional materials must be used which might contaminate the environment by outgassing. Particularly for use in vacuum applications, Micro-Epsilon offers confocal chromatic sensors, cables and accessories which can be used according to their respective specification.



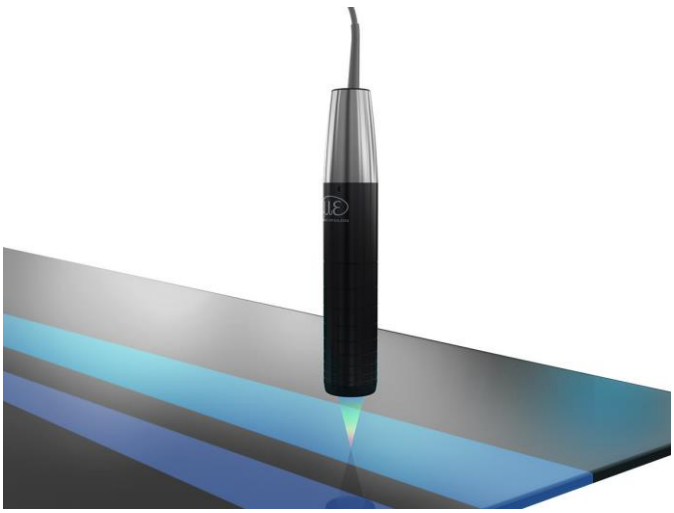
One-sided thickness measurement of transparent materials

The confocal chromatic measuring principle enables thickness measurements of transparent materials such as glass. The thickness is detected to micrometer accuracy using just one single sensor which uses the reflections of the front and rear side of the material. These reflections generate peaks on the CCD array based on which the corresponding distance and thickness are calculated. Therefore, you should know the refraction index of the transparent material.



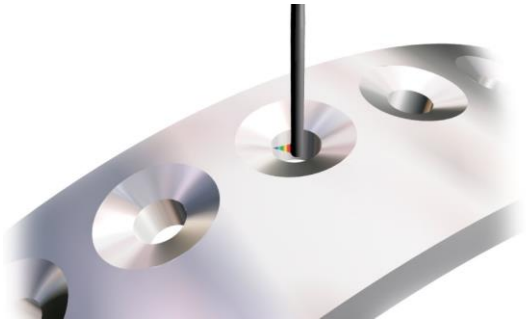
Surface adaption based on control and exposure

The intensity of the reflected light depends on the degree of reflection of the target. If the reflectivity changes during a measurement, e.g. with transitions from bright to dark materials or from reflecting to mat surfaces, the intensity on the receiver element in the controller changes. However, stable measurements require a sufficiently high level of intensity. For this reason, confocalDT controllers from Micro-Epsilon are equipped with high-speed exposure control which readjusts the current exposure cycle of the CCD line. Each previously detected value serves as basis regardless of the set measuring rate. The exposure control feature ensures instantaneous adaption to different reflection characteristics, e.g. of metal and glass. Decisive advantages of this CCD line regulation includes high dynamics and fast adaption.Particularly when compared to other methods such as the regulation of the light source depending on the surface reflection, the surface adaption from Micro-Epsilon offers the worldwide fastest control feature and ensures reliable measurement results.



Cavity inspection

The laser beam path of confocal chromatic sensors is compact and concentric. In contrast to laser triangulation sensors, the axial beam path of confocal chromatic sensors avoids shadowing effects, enabling measurements even in sleeves and recesses. In addition, Micro-Epsilon offers confocal chromatic sensors with a 90° beam path that allow for geometric characters to be measured inside holes and recesses.



Ease of use via web interface

Due to a user-friendly web interface, the entire configuration process of controller and sensors is carried out without using any additional software. The web interface can be accessed via Ethernet and provides set up and configuration options. Materials are stored in an expandable materials database.
Data output is via Ethernet, EtherCAT, RS422 or analog output.

Click here to watch video

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