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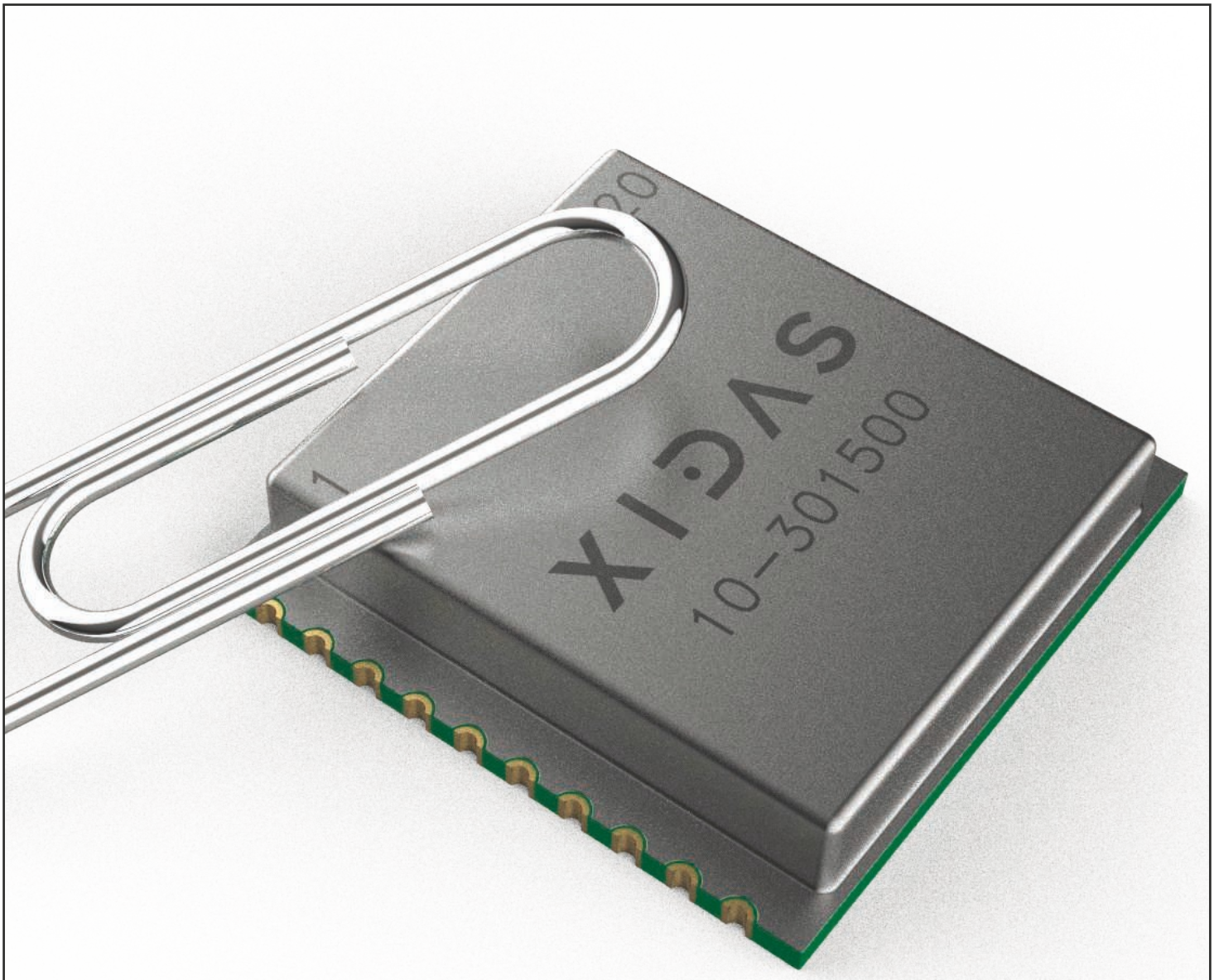
COMMERCIAL MICRO MANUFACTURING



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The advantages of line confocal imaging over coaxial confocal imaging

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Line confocal imaging (LCI) is an optical technology for metrology applications requiring resolutions down to 50 nm. Conventional confocal imaging uses a coaxial design that is limited to single- or multiple-point sensors. LCI, on the other hand, uses an off-axis design that offers a line scan capability, meaning it can afford numerous advantages over coaxial confocal imaging.

The key advantage of line confocal sensors is their ability to generate 3D tomography, 3D topography and 2D intensity data simultaneously over a 2 k line scan at fast scan rates (namely up to 3 kHz at full measurement range). Line confocal scanning avoids unwanted reflections from shiny metal surfaces and the off-axis arrangement permits multi-layer (tomography) scanning.

In addition, line confocal sensors are much easier to mount, enabling them to achieve angular performance of +/-20 degrees on mirror and glass surfaces, and +/-80 degrees on opaque, matte surfaces for high-quality scan data acquisition. Excellent angular performance makes line confocal sensors less sensitive to surface orientation during scan data acquisition, and line confocal scanning can handle just about any surface, from transparent, mirror-like to opaque and shiny.

Before the introduction of line confocal systems, single- or multiple-point coaxial confocal systems had been the industry standard. These required long scan data acquisition times to generate a profile or area and could only measure the top surface.

Further advantages of line confocal sensors include: no additional filtering is required for analysis; ability to scan and measure materials in any colour combination; ability to measure all surface types, including glossy, transparent, translucent, curved, convex, concave, soft, fragile and porous; metrology-grade resolution and accuracy are provided at high speed (up to 3 kHz at full measurement range); easy to acquire high-quality scan data on any surface feature with excellent angular performance.

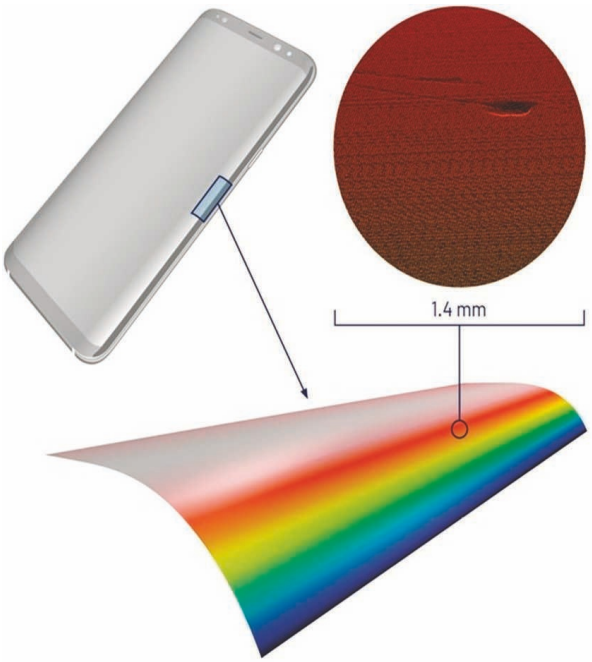
Applications

Curved edge display inspection

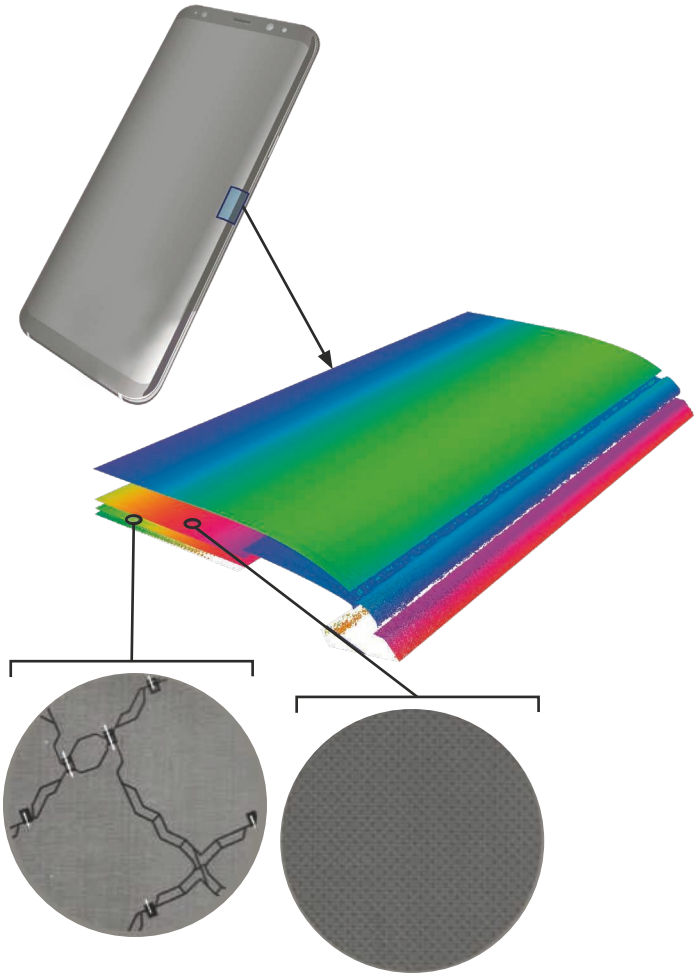
Line confocal sensors deliver excellent performance on large surface angles. They are used to scan, measure and inspect the profile of curved 2.5D and 3D screen glass used in cell phone and tablet designs at a surface angle of up to +/-20 degrees. Conventional vision solutions can only capture quality data on surface angles of +/-7 degrees or less.

Multi-layered material inspection

Line confocal sensors are ideal for transparent material inspection and quality control, one of the key applications in capturing the surface of mobile device displays and detecting layers inside and under the screen. The combination of 3D tomography (multi-layer) and 2D intensity imaging can be used to identify defects such as delamination, scratches or dust on the surface or inside of laminated glass, mobile phone displays, or any other type of transparent multilayered material material such as sealed medical packages.



▶ A curved edge display concept for a smartphone screen. ▶



▶ *A transparent materials concept for a smartphone screen.* ▶

Moreover, unlike other types of imaging sensors, line confocal sensors not only detect the location of the defect, but they also identify the layer of material it is in. They even measure the dimensions of the defect down to the sub-micron level.

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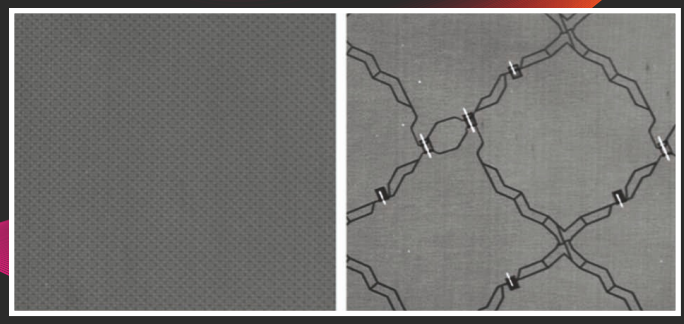
Component and assembly inspection

Line confocal sensors are relied on for fast and accurate component and final assembly inspection, both in inline and offline applications. They can exceed standard inspection methods, particularly in the case of measuring complex materials and surfaces.

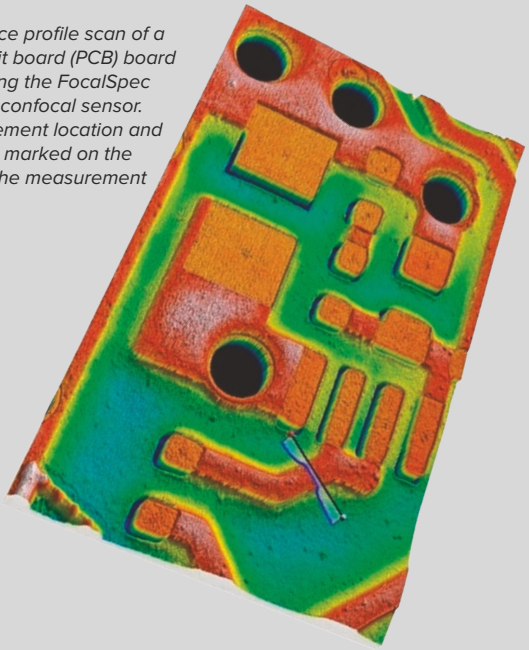
Engineers can use these sensors for measuring component dimensions, orientation, step height, gap and offset, material thickness, and surface properties such as roughness and flatness. They can also use them to inspect soldering and gluing quality on small parts such as printed circuit boards (PCBs).

▶ *2D grayscale intensity images of the smartphone screen layers obtained using a line confocal sensor. The separate display layers can be clearly visualised due to the line confocal sensor's large measurement range.* ▶

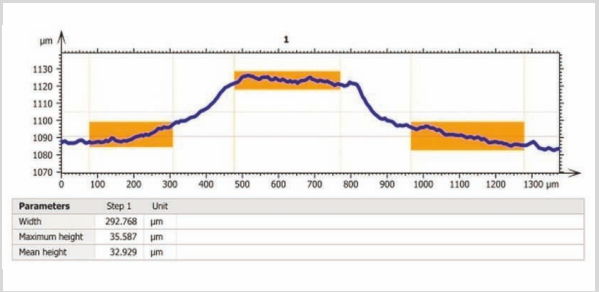


▶ *A scan of a smartphone camera structure obtained using the FocalSpec LCI1201 line confocal sensor. In addition to dimensional measurements, particles and delaminated camera optics can be identified.* ▶

Line confocal sensors generate scan data that is equal in quality to traditional microscope data; however, unlike a microscope, line confocal sensors generate millions of data points simultaneously and can acquire the object in motion. This facilitates full inspection of electronic components and their assembly for inline production environments.



▶ A 3D surface profile scan of a printed circuit board (PCB) board obtained using the FocalSpec LCI1600 line confocal sensor. The measurement location and direction are marked on the image. See the measurement below. ▶



▶ A detailed contour analysis of a PCB conductive track. ▶

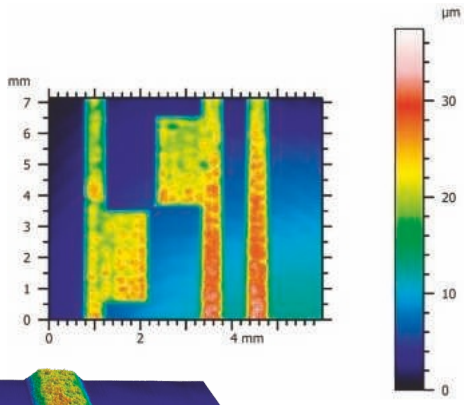
Printed, hybrid and flexible electronics inspection

Line confocal sensors can be used at various stages of the printed electronics manufacturing process, starting with substrate material development and manufacturing, where surface roughness is a key measurement.

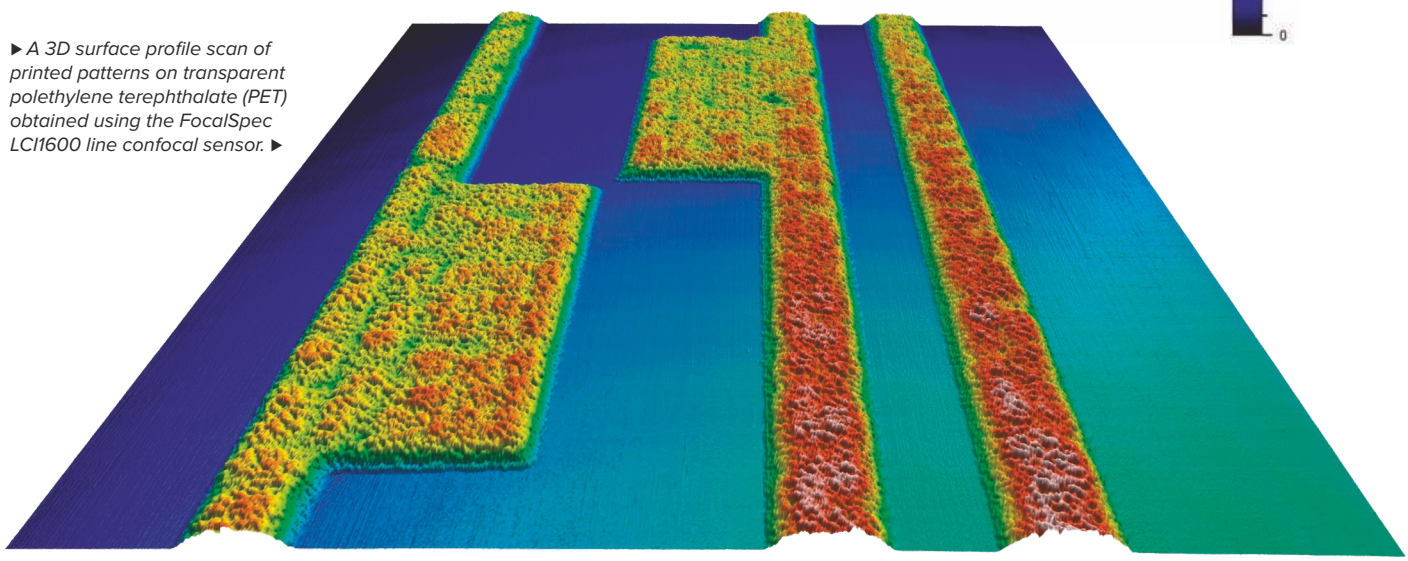
All substrate materials can be detected using these sensors, whether they are shiny, glossy or transparent (for example, polyethylene terephthalate (PET) foil or glass). Furthermore, defects can be identified, such as delamination, scratches or impurities in coatings and transparent substrates.

Line confocal sensors provide quick and accurate 3D topographic imaging, be it for screen-printing, inkjet printing or dispensing materials. They also provide step height and width measurement of printed structures.

In addition, line confocal sensors easily capture cemented or glued components on transparent substrates. They can not only be used for obtaining traditional 3D dimensional measurements, but also for inspecting air gaps, bubbles and other types of delamination on or through the transparent substrate.



▶ A 3D surface profile scan of printed patterns on transparent polethylene terephthalate (PET) obtained using the FocalSpec LCI1600 line confocal sensor. ▶



▶ *The FocalSpec range of line confocal sensors from LMI Technologies.* ▶

Medical parts and packaging inspection

Line confocal sensors are able to scan the depth and shape of embossed and etched 3D features of medical parts, the parting line flash of moulded medical parts, surface roughness and texture of extruded medical parts and web products, and burr height in precision-stamped and micromachined medical parts.

One of the most common applications leveraging the large measurement range of line confocal sensors is non-destructive 3D tomographic imaging for completeness and integrity of heat seals in sterile medical packages.

Conclusion

Line confocal sensors provide a highly specialised vision solution for the most challenging, complex measurement applications. Their ability to simultaneously generate 3D tomography, 3D topography and 2D intensity data allows them to perform high accuracy measurement tasks that conventional solutions cannot, such as scanning and quality inspection of curved, transparent, multi-layered and highly reflective materials. In addition, these sensors offer exceptionally fast scan rates, making them suitable for inline production environments. ●

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