CONNECTOR PIN INSPECTION
USING 3D PROFILOMETRY

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INTRO:

Electronic applications typically have challenging surfaces, angles, steps and structures to be measured during development. Whether it is circuit board flatness or microstructures on the board itself, precise measurement is crucial. As components continue to shrink in size, and surfaces become problematic, the measurement needs to be precise

IMPORTANCE OF 3D NON CONTACT PROFILOMETER FOR ELECTRONICS MEASUREMENT
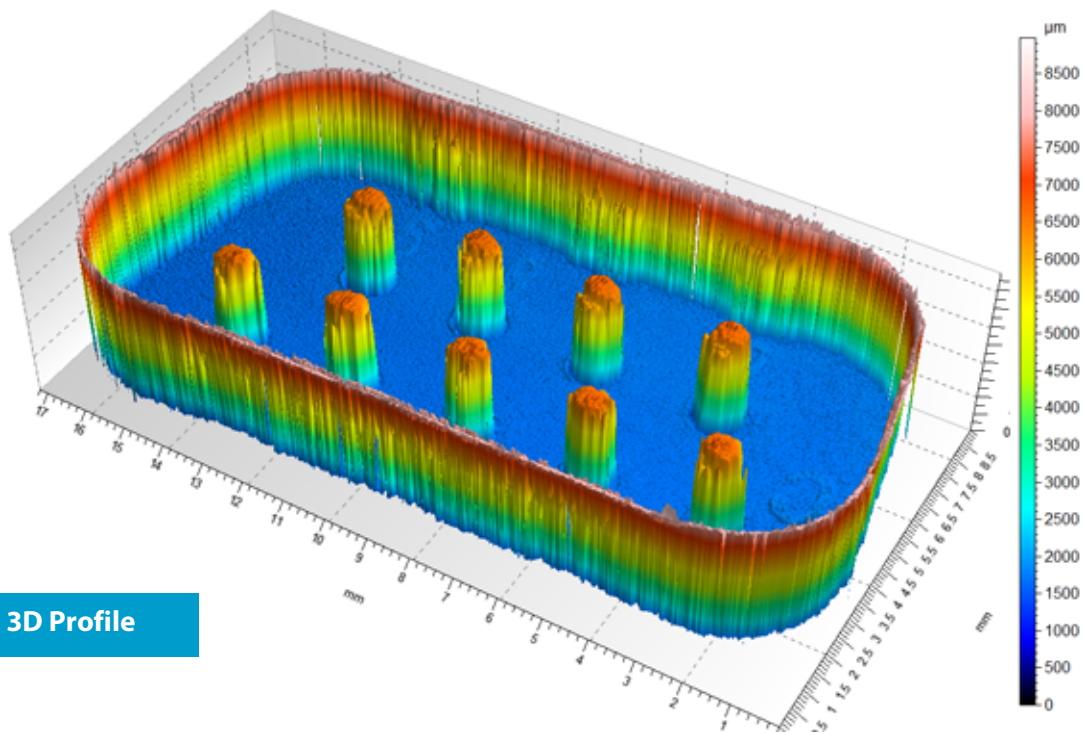
Because the precise measurement is vital to the end use, it will be crucial to monitor and control the end result. Understanding surface roughness, planarity, flatness and others can lead to the best selection of processing and control measures. Insuring the quality control of such parameters will heavily rely upon quantifiable, reproducible and reliable inspection of the electronic applications. The Nanovea 3D Non-Contact Profilometers utilize chromatic confocal technology with unique capability to measure applications found within microelectronics. Where other techniques fail to provide reliable data, due to probe contact, surface variation, angle, absorption or reflectivity, Nanovea Profilometers succeed.

MEASUREMENT OBJECTIVE

In this application, the Nanovea ST400 is used to measure the full area of a connector surface and its pins. The application was chosen for its challenging features while highlighting the measurement options with Nanovea's technique. There is an endless list surface parameters that can be automatically calculated after the surface scan. Here we will review a full 3D profile, flatness of the connector base, coplanarity of the pins and the roughness of a pin tip.
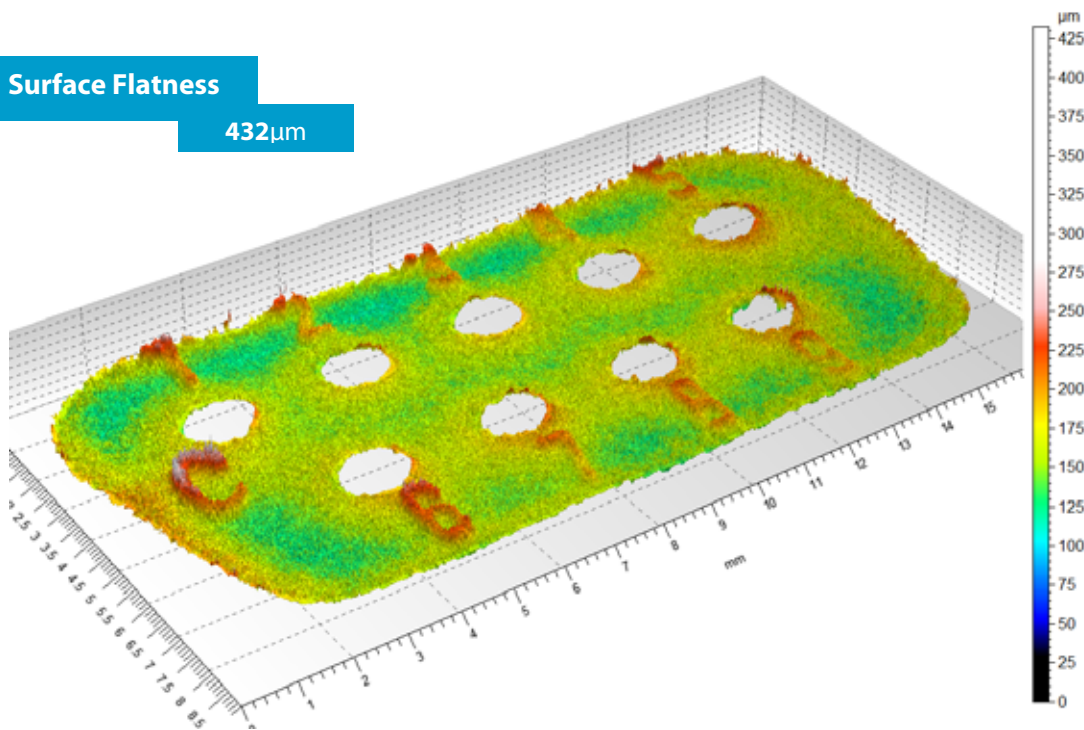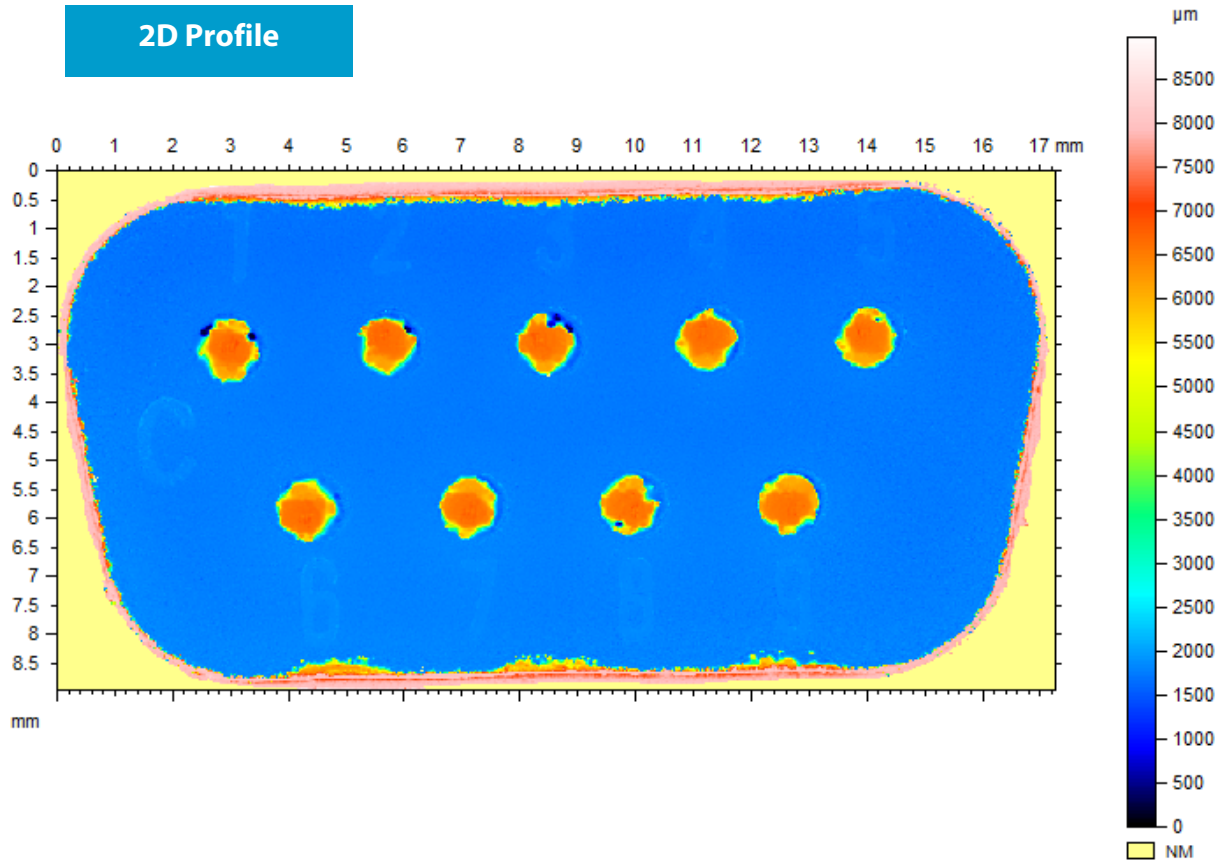
RESULTS:

3D Profile

Surface Flatness

432μm

2D Profile

Planarity of Pins

	1	2	3	4	5	6
Maximum depth	5031.259 µm	5039.055 µm	5023.463 µm	5069.264 µm	5017.616 µm	5051.236 µm
Mean depth	4985.369 µm	4984.381 µm	4985.567 µm	4987.931 µm	4976.670 µm	4991.364 µm

Roughness of Pin Tip

ISO 25178

| Height Parameters		
Sq	3.125	µm
Ssk	-2.149	
Sku	18.585	
Sp	11.498	µm
Sv	59.893	µm
Sz	71.392	µm
Sa	2.076	µm
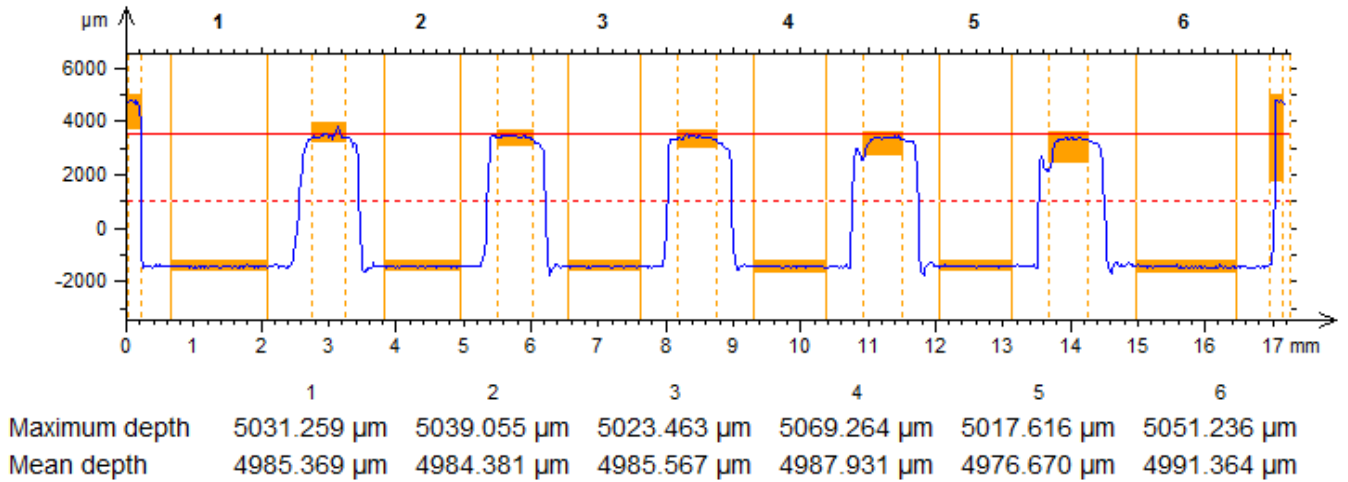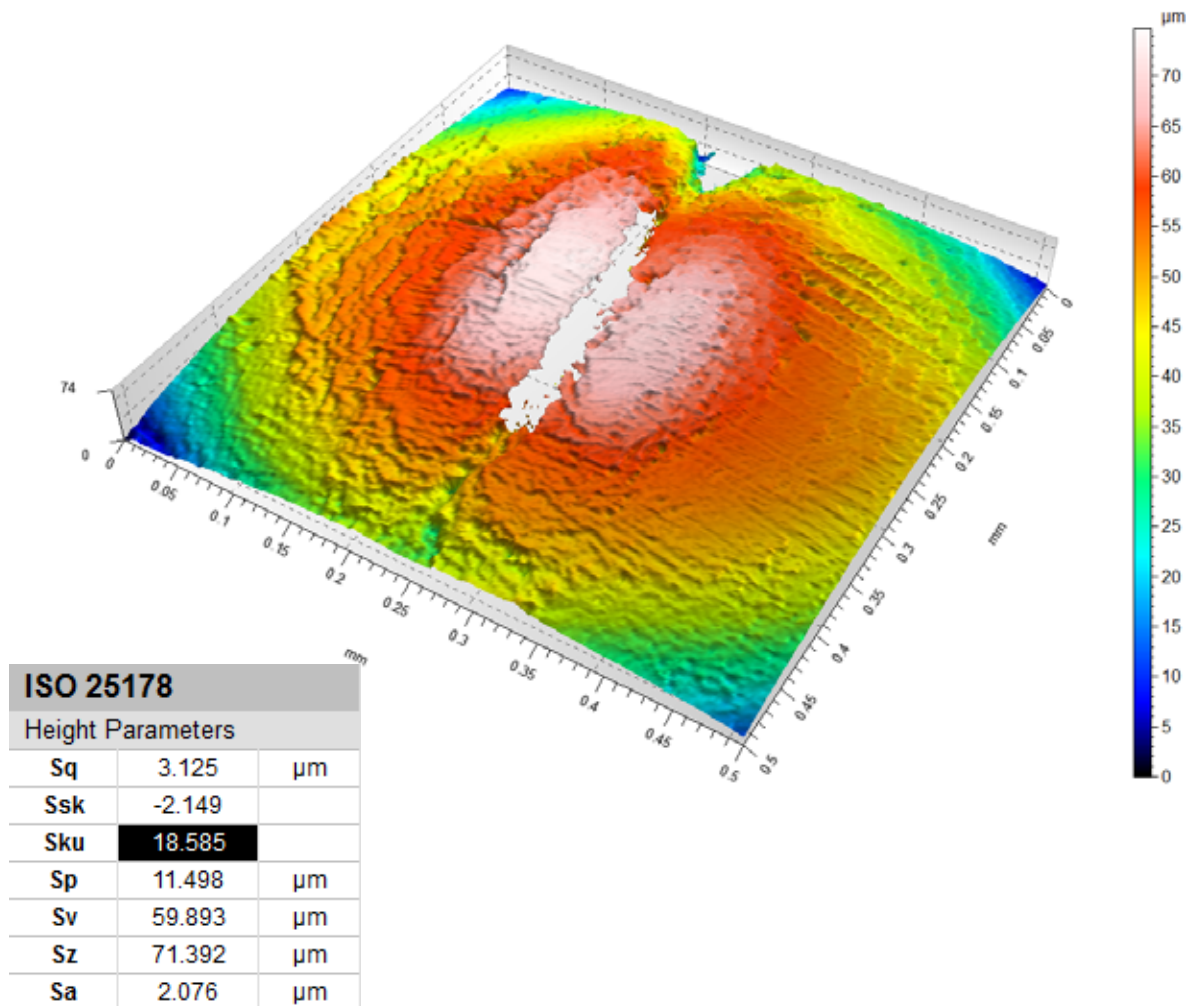
CONCLUSION:

In this application, we have shown how the Nanovea ST400 3D Non Contact Profilometer can precisely characterize both the topography and the nanometer details of an electronic connector and its pins. From the 3D surface measurements, areas of interest can quickly be identified and then analyzed with a list of endless measurements (Dimension, Roughness Finish Texture, Shape Form Topography, Flatness Warpage Planarity, Volume Area, Step-Height Depth Thickness and others). To further view in detail, a 2D cross section can quickly be chosen to analyze at nanometer range. With this information electronic surface areas can be broadly investigated with a complete set of surface measurement resources. Special areas of interest could have been further analyzed with integrated AFM module. Nanovea 3D Profilometers speeds range from 20mm/s to 1m/s for laboratory or research to the needs of hi-speed inspection; can be built with custom size, speeds, scanning capabilities, Class 1 Clean Room compliance, with Indexing Conveyor and for Inline or online Integration.

MEASUREMENT PRINCIPLE:

The Chromatic Confocal technique uses a white light source, where light passes through an objective lens with a high degree of chromatic aberration. The refractive index of the objective lens will vary in relation to the wavelength of the light. In effect, each separate wavelength of the incident white light will re-focus at a different distance from the lens (different height). When the measured sample is within the range of possible heights, a single monochromatic point will be focalized to form the image. Due to the confocal configuration of the system, only the focused wavelength will pass through the spatial filter with high efficiency, thus causing all other wavelengths to be out of focus. The spectral analysis is done using a diffraction grating. This technique deviates each wavelength at a different position, intercepting a line of CCD, which in turn indicates the position of the maximum intensity and allows direct correspondence to the Z height position.
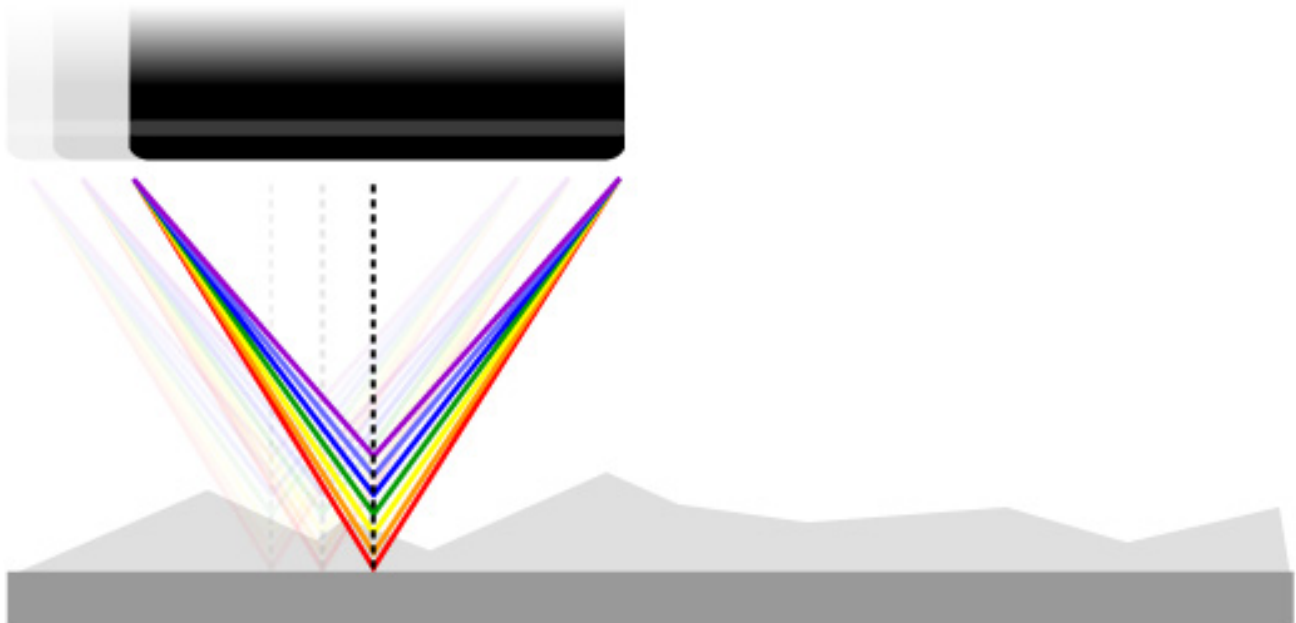
Unlike the errors caused by probe contact or the manipulative Interferometry technique, Chromatic Confocal technology measures height directly from the detection of the wavelength that hits the surface of the sample in focus. It is a direct measurement with no mathematical software manipulation. This provides unmatched accuracy on the surface measured because a data point is either measured accurately without software interpretation or not at all. The software completes the unmeasured point but the user is fully aware of it and can have confidence that there are no hidden artifacts created by software guessing.

Nanovea optical pens have zero influence from sample reflectivity or absorption. Variations require no sample preparation and have advanced ability to measure high surface angles. Capable of large Z measurement ranges. Measure any material: transparent or opaque, specular or diffusive, polished or rough. Measurement includes: Profile Dimension, Roughness Finish Texture, Shape Form Topography, Flatness Warpage Planarity, Volume Area, Step-Height Depth Thickness and many others.

DEFINITION OF HEIGHT PARAMETERS

Height Parameter		Definition
Sa	Arithmetical Mean Height	Mean surface roughness. $$Sa = \frac{1}{A} \iint_A |z(x,y)| dxdy$$
Sq	Root Mean Square Height	Standard deviation of the height distribution, or RMS surface roughness. $$Sq = \sqrt{\frac{1}{A} \iint_A z^2(x,y) dxdy}$$ Computes the standard deviation for the amplitudes of the surface (RMS).
Sp	Maximum Peak Height	Height between the highest peak and the mean plane.
Sv	Maximum Pit Height	Depth between the mean plane and the deepest valley.
Sz	Maximum Height	Height between the highest peak and the deepest valley.
Ssk	Skewness	Skewness of the height distribution. $$Ssk = \frac{1}{Sq^3} \left[\frac{1}{A} \iint_A z^3(x,y) dxdy \right]$$ Skewness qualifies the symmetry of the height distribution. A negative Ssk indicates that the surface is composed of mainly one plateau and deep and fine valleys. In this case, the distribution is sloping to the top. A positive Ssk indicates a surface with a lot of peaks on a plane. Therefore, the distribution is sloping to the bottom. Due to the large exponent used, this parameter is very sensitive to the sampling and noise of the measurement.
Sku	Kurtosis	Kurtosis of the height distribution. $$Sku = \frac{1}{Sq^4} \left[\frac{1}{A} \iint_A z^4(x,y) dxdy \right]$$ Kurtosis qualifies the flatness of the height distribution. Due to the large exponent used, this parameter is very sensitive to the sampling and noise of the measurement.
Spar	Projected Area	Projected surface area.
Sdar	Developed Area	Developed surface area.