

“This Is Going to Be Rough”



3D SURFACE PROFILER

VK-X3000 Series

NANOMETER, MICROMETER, AND MILLIMETER MEASUREMENTS IN ONE SYSTEM



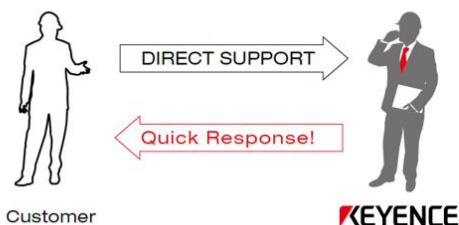
Who is Keyence?

Global Network

Over
200 Offices
in more than
45 Countries



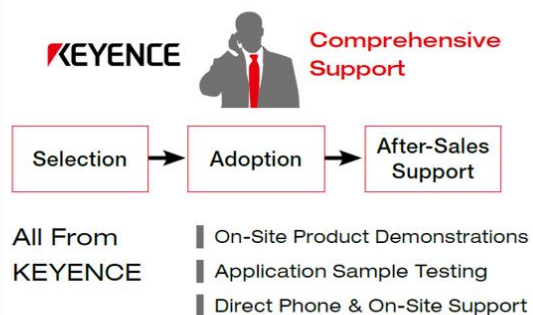
Direct Sales Network



Your Sales Engineer

- Local
- Specialized Product Expert
- KEYENCE Direct

Direct Support



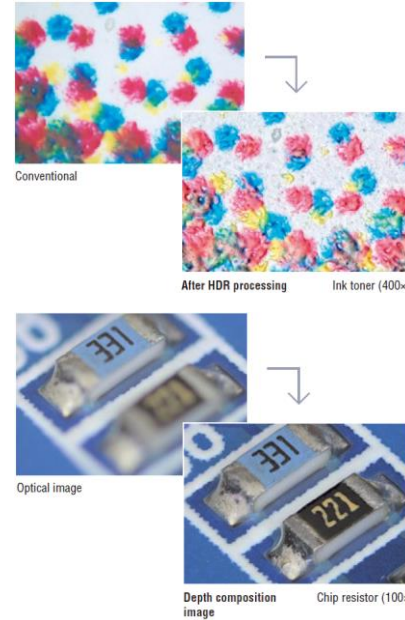
70%
NEW
WORLD'S FIRST OR
INDUSTRY'S FIRST PRODUCTS

RANKED #38
"THE WORLD'S MOST
INNOVATIVE COMPANIES"
-2018, FORBES
TOP 100 SINCE 2011

WHAT DOES THE VK-X3000 DO?



Scans in as little as 5 seconds!



16-bit laser color image

1



QUICK

Measures an entire area in as little as 5 seconds with **.1 nm vertical resolution**

2



COMPLETE

Analyzes form, contour & roughness with **+780,000 data points** in a single image

3

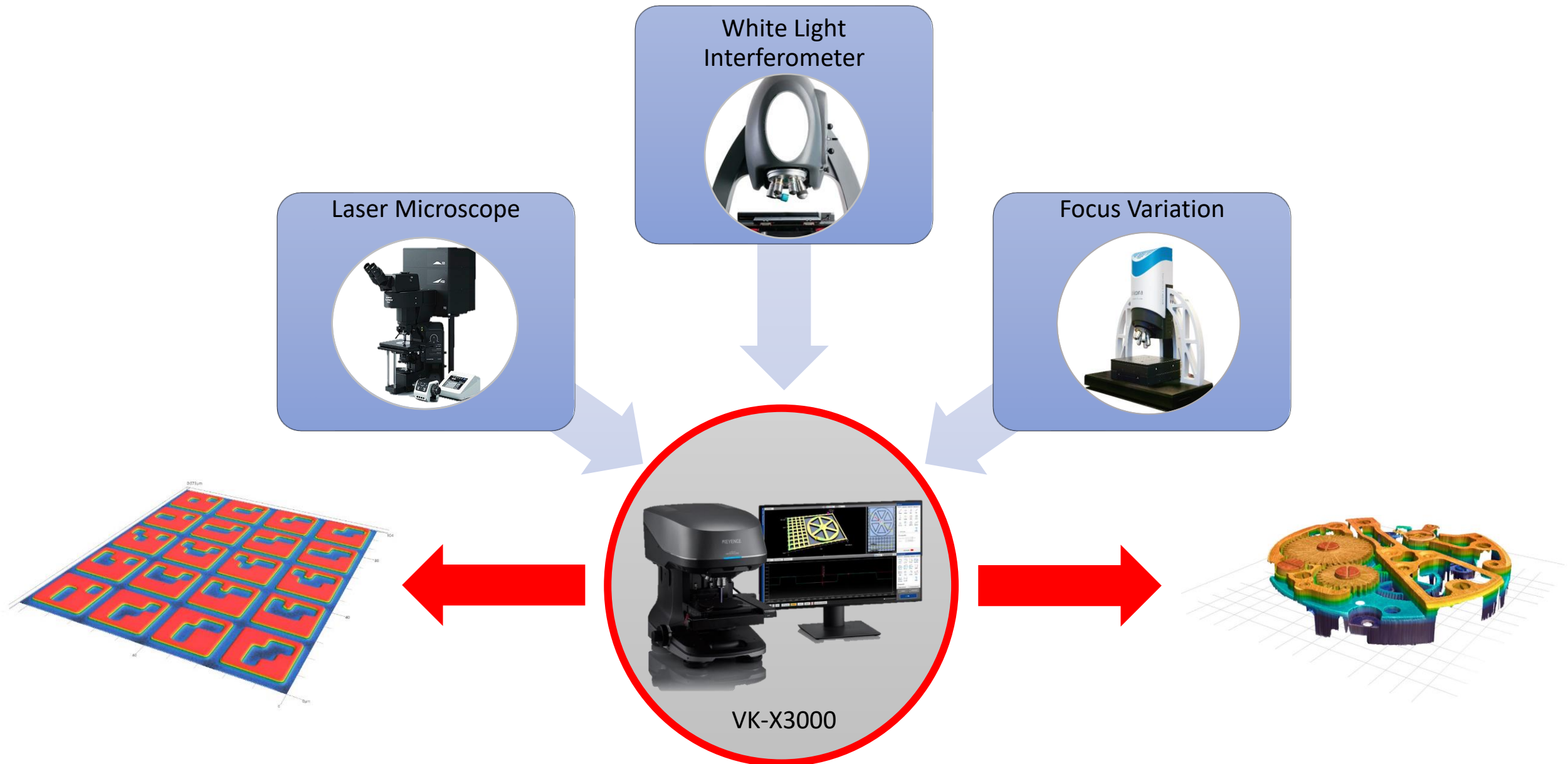
PRECISE

XYZ **traceable** measurements compliant with international standards

| Laser + Optical | 3D | Multi-line Roughness | | | |
|-----------------|----|----------------------|-----------------------|-----------------------|-----------------------|
| | | Profiles | Horizon 1 | | |
| | | | Rz Ave. μm | Rz Ave. μm | Rz Ave. μm |
| Sample A | | | 0.623 | 3.935 | 8.499 |
| Sample B | | | 0.419 | 2.402 | 8.005 |
| Sample C | | | 0.351 | 2.093 | 6.997 |
| Sample D | | | 0.260 | 1.557 | 6.876 |

Roughness measurement of blasted surface (1000x)

WORLD'S FIRST 3 IN 1 TECHNOLOGY



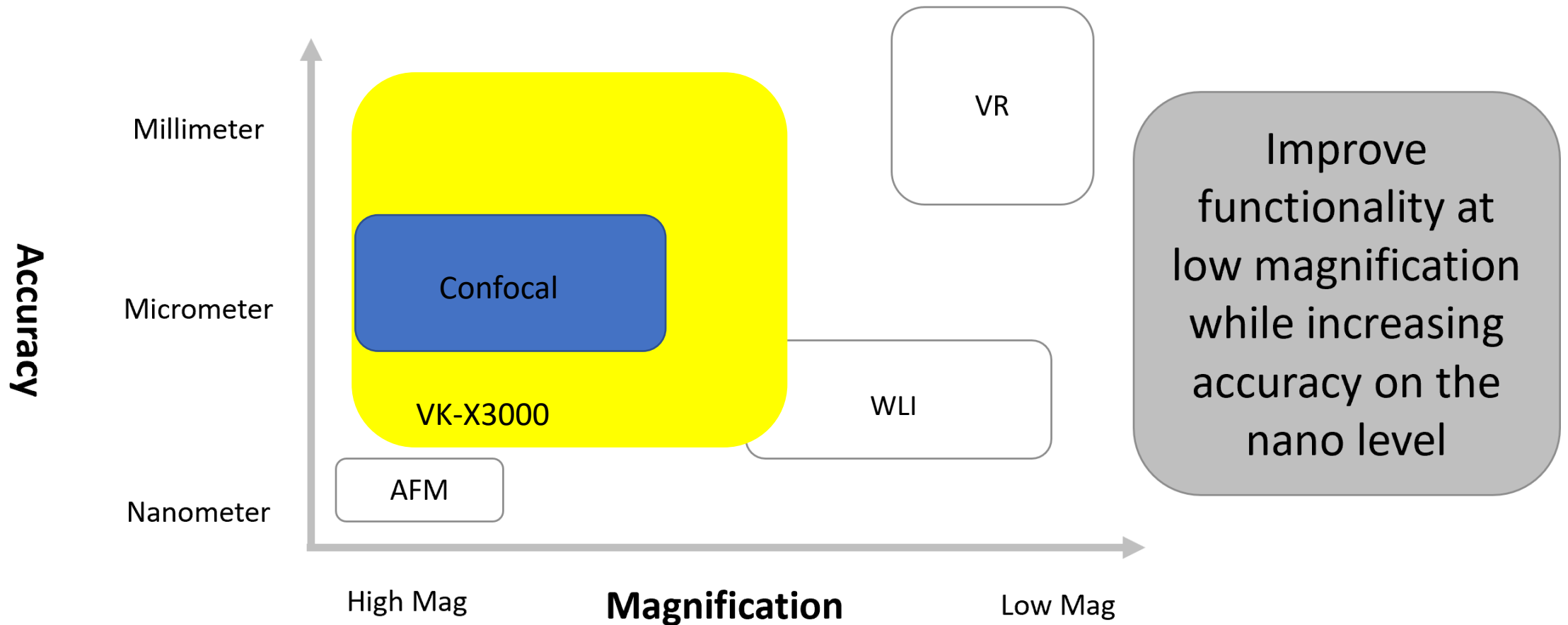
For the first time ever, users can take nanometer, micrometer, and millimeter measurements with a single system

HOW THESE CAPABILITIES DIFFERENTIATE THE VK FROM COMPETITION



Confidential Document
Do not remove from KEYENCE office

Market position: Accuracy and Magnification



How It Works

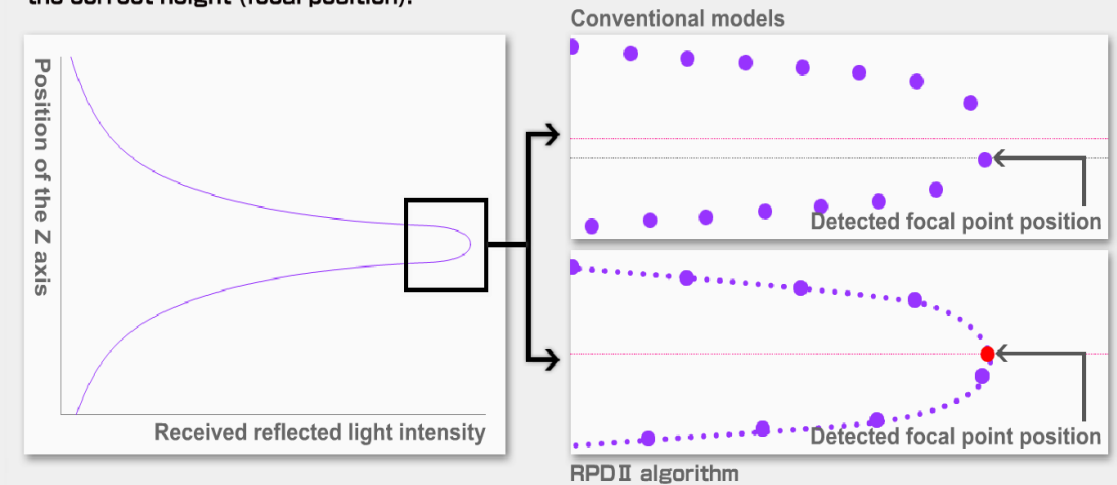


For a laser scanning microscope that obtains data based on laser reflection, this is the most important element. The VK-X utilizes a 16-bit photomultiplier with the best dynamic range in the industry.

The PMT is able to receive a wide range of reflected laser intensities, spanning from weak to strong.

RPDII algorithm

The amount of reflected light that has been obtained is compensated for to detect the correct height (focal position).



LASER CONFOCAL CONCEPT

KEYENCE

Top of the line performance

3D Laser Scanning Microscope

VK-X1000

Measurement principle



1. Scan the laser along the XY axes.

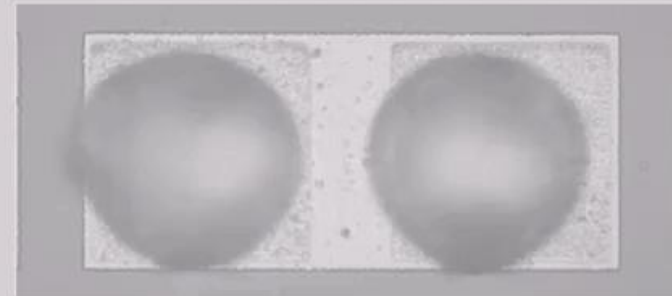
2 WAY LIGHT SOURCE FOR OPTICAL AND LASER IMAGING

KEYENCE

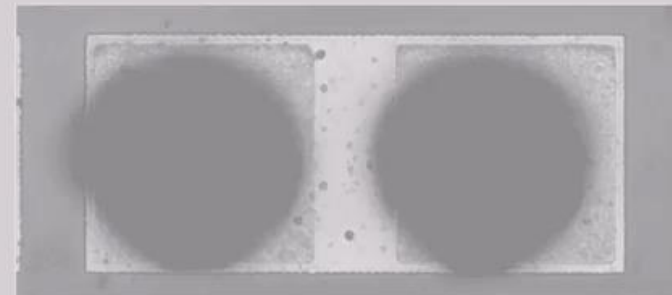
Top of the line performance

2-way light source

3D Laser Scanning Microscope
VK-X1000



Optical microscope image



Light intensity ultra-depth image

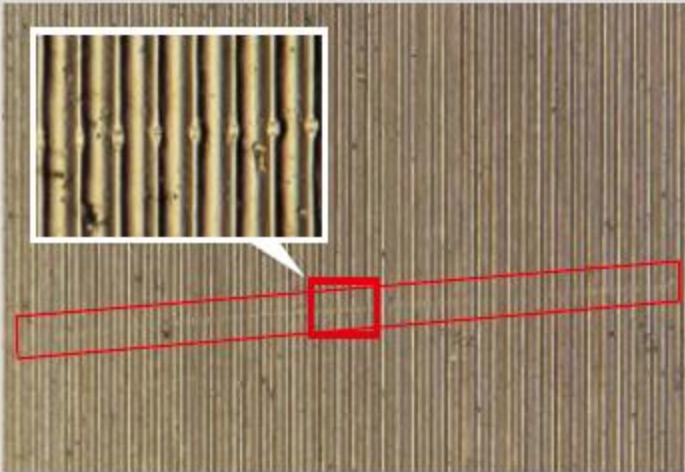
VK-X3000 As A Surface Roughness Tool

LIMITATIONS OF CONTACT MEASUREMENT METHODS

Profilometers

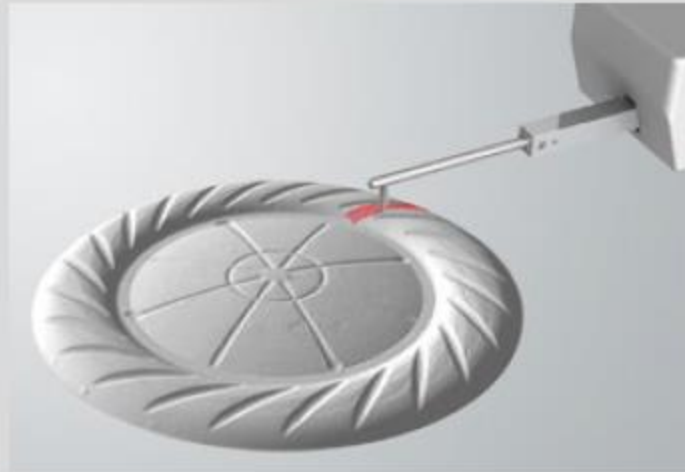


Damage to surface

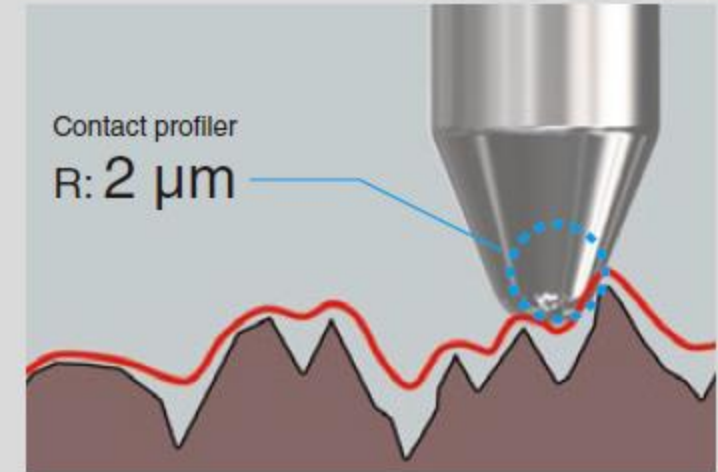


Aluminum surface (200x)

Difficult to position stylus

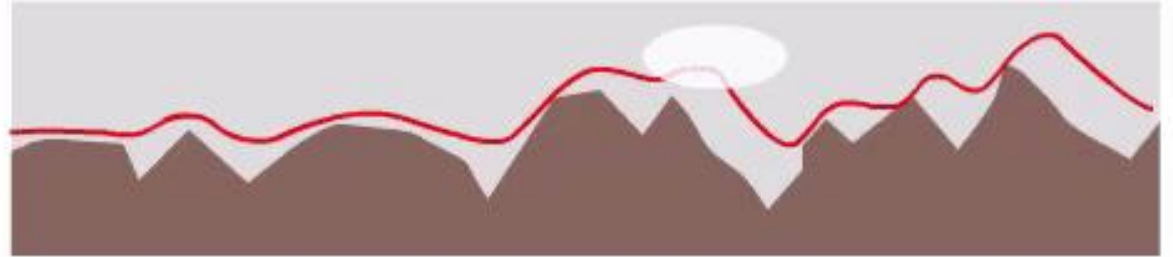
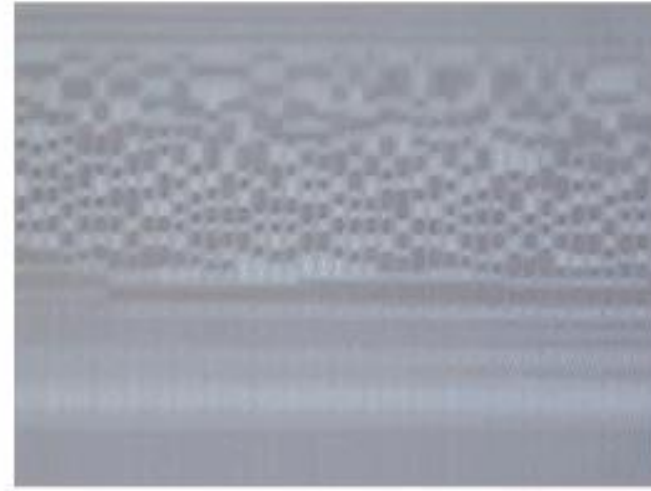
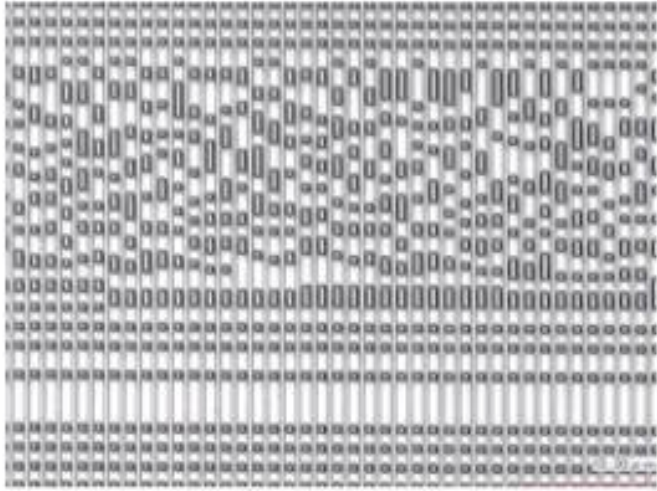


Stylus tip size limits resolution

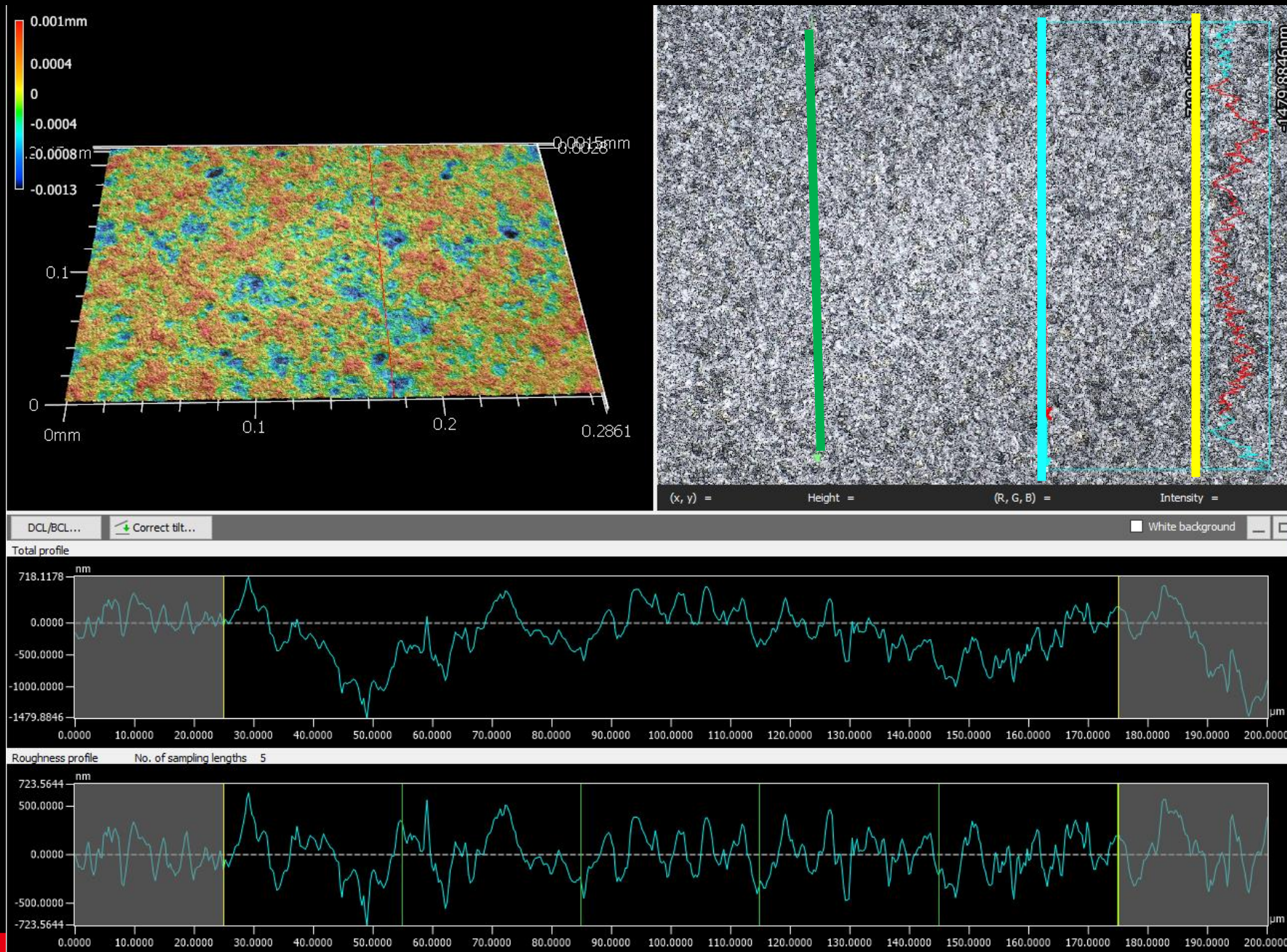


Contact profilometer struggles to capture accurate data – especially on curved surface or parts with complex geometry.

VK's LASER SOURCE VS WHITE LIGHT CONFOCAL/INTERFEROMETERS



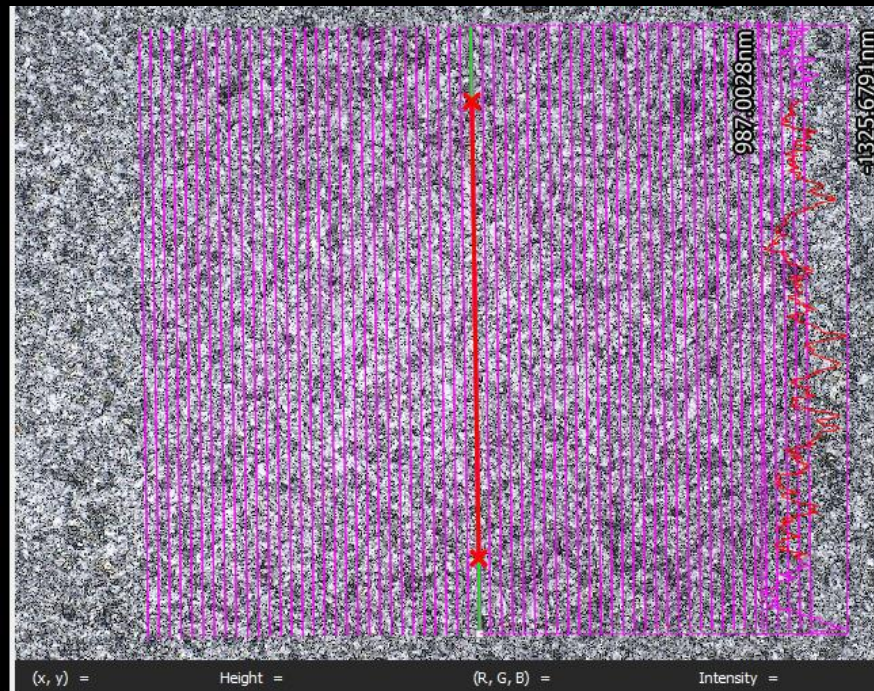
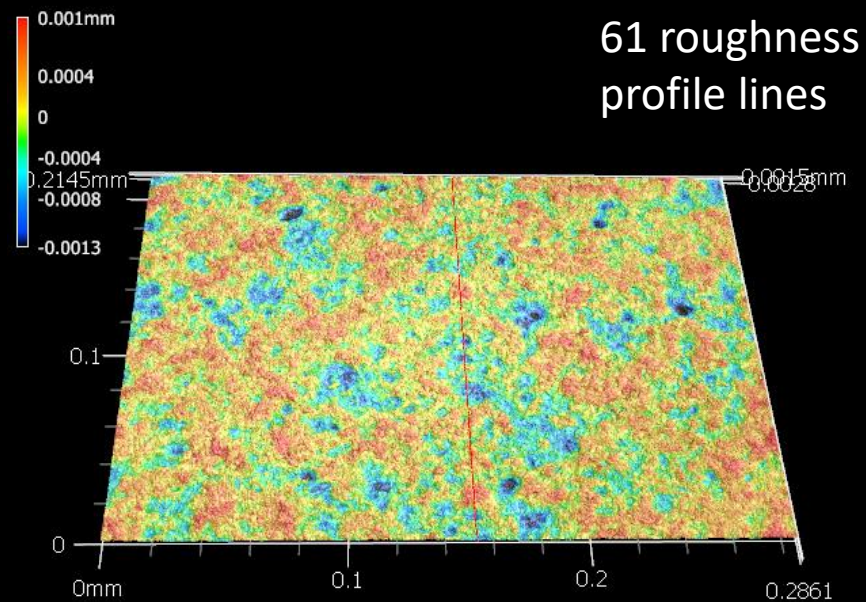
CONVENTIONAL ROUGHNESS MEASUREMENTS



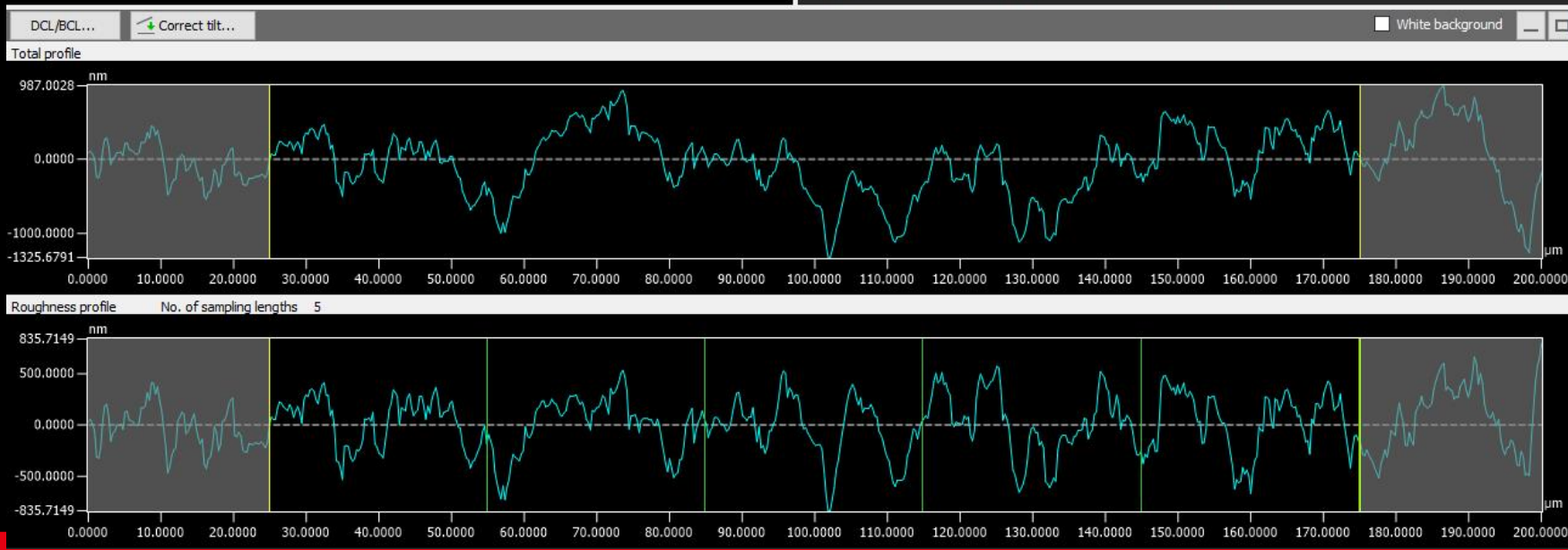
Line roughness

| | Ra/Pa/Wa | Rz/Pz/Wz |
|---------|----------|----------|
| Unit | nm | nm |
| Ave. | 188.8 | 1037.8 |
| Max. | 199.6 | 1085.0 |
| Min. | 178.1 | 1010.1 |
| Std. DV | 8.8 | 33.5 |
| Green | 199.6 | 1085.0 |
| Blue | 178.1 | 1010.1 |
| Yellow | 188.8 | 1018.4 |

USING ALL DATA PRESENT FOR DEEPER UNDERSTANDING



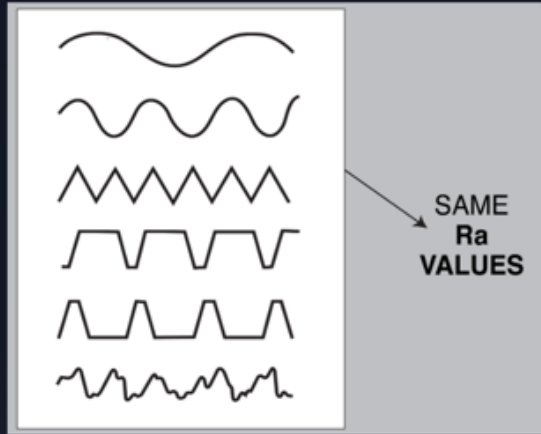
| Measured values(Purple) | | |
|-------------------------|----------|----------|
| | Ra/Pa/Wa | Rz/Pz/Wz |
| Unit | nm | nm |
| Ave. | 197.8 | 1088.4 |
| Max. | 246.9 | 1403.8 |
| Min. | 150.0 | 886.2 |
| Std. DV | 21.3 | 104.5 |
| Line 1 | 185.3 | 1028.6 |
| Line 2 | 195.8 | 994.9 |
| Line 3 | 182.6 | 1007.1 |
| Line 4 | 150.0 | 914.0 |
| Line 5 | 166.7 | 1008.1 |
| Line 6 | 207.3 | 1101.6 |
| Line 7 | 216.5 | 1045.3 |
| Line 8 | 223.9 | 1230.1 |
| Line 9 | 182.6 | 1037.9 |
| Line 10 | 223.4 | 1238.9 |
| Line 11 | 175.2 | 1030.2 |
| Line 12 | 194.8 | 1180.8 |
| Line 13 | 187.5 | 1048.6 |
| Line 14 | 190.8 | 898.7 |
| Line 15 | 235.9 | 1297.3 |
| Line 16 | 216.5 | 1246.1 |
| Line 17 | 199.7 | 1097.6 |
| Line 18 | 183.1 | 1051.4 |
| Line 19 | 158.6 | 976.5 |
| Line 20 | 195.1 | 1014.4 |
| Line 21 | 177.8 | 1020.9 |
| Line 22 | 214.6 | 1113.6 |
| Line 23 | 175.4 | 1016.7 |
| Line 24 | 186.9 | 1061.7 |
| Line 25 | 171.7 | 886.2 |
| Line 26 | 202.4 | 1105.2 |
| Line 27 | 229.1 | 1247.6 |
| Line 28 | 233.6 | 1145.9 |
| Line 29 | 219.3 | 1200.7 |
| Line 30 | 181.5 | 944.8 |
| Line 31 | 229.2 | 1187.7 |
| Line 32 | 246.9 | 1206.4 |
| Line 33 | 203.6 | 1141.2 |
| Line 34 | 168.1 | 1066.3 |
| Line 35 | 188.4 | 1154.7 |
| Line 36 | 187.3 | 1037.4 |
| Line 37 | 173.1 | 1007.3 |
| Line 38 | 222.7 | 1175.4 |
| Line 39 | 189.9 | 999.6 |
| Line 40 | 183.2 | 934.9 |
| Line 41 | 195.4 | 1116.3 |
| Line 42 | 179.2 | 1091.8 |
| Line 43 | 195.3 | 1084.4 |
| Line 44 | 194.2 | 979.1 |
| Line 45 | 176.7 | 1004.7 |
| Line 46 | 207.8 | 1050.3 |



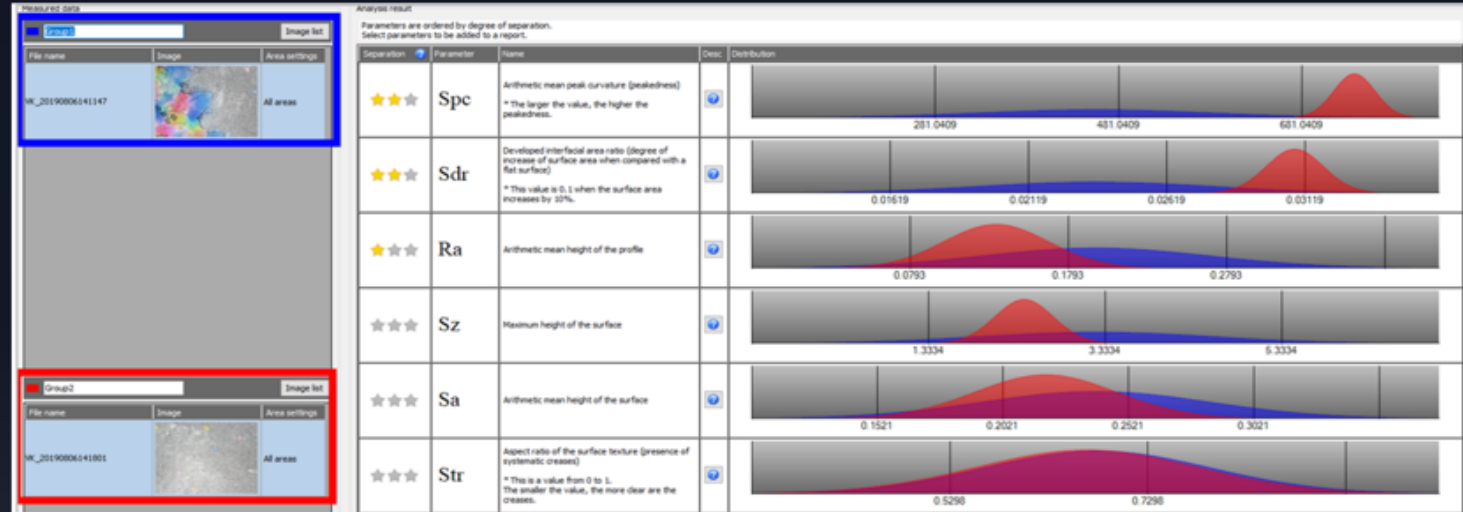
ROUGHNESS BEYOND RA AND RZ



Why is it important to understand roughness beyond Ra?



Ra does not always correlate with a surface's ability to perform a function.



Analyzes 42 different roughness parameters and ranks largest degree of separation between two groups of data.

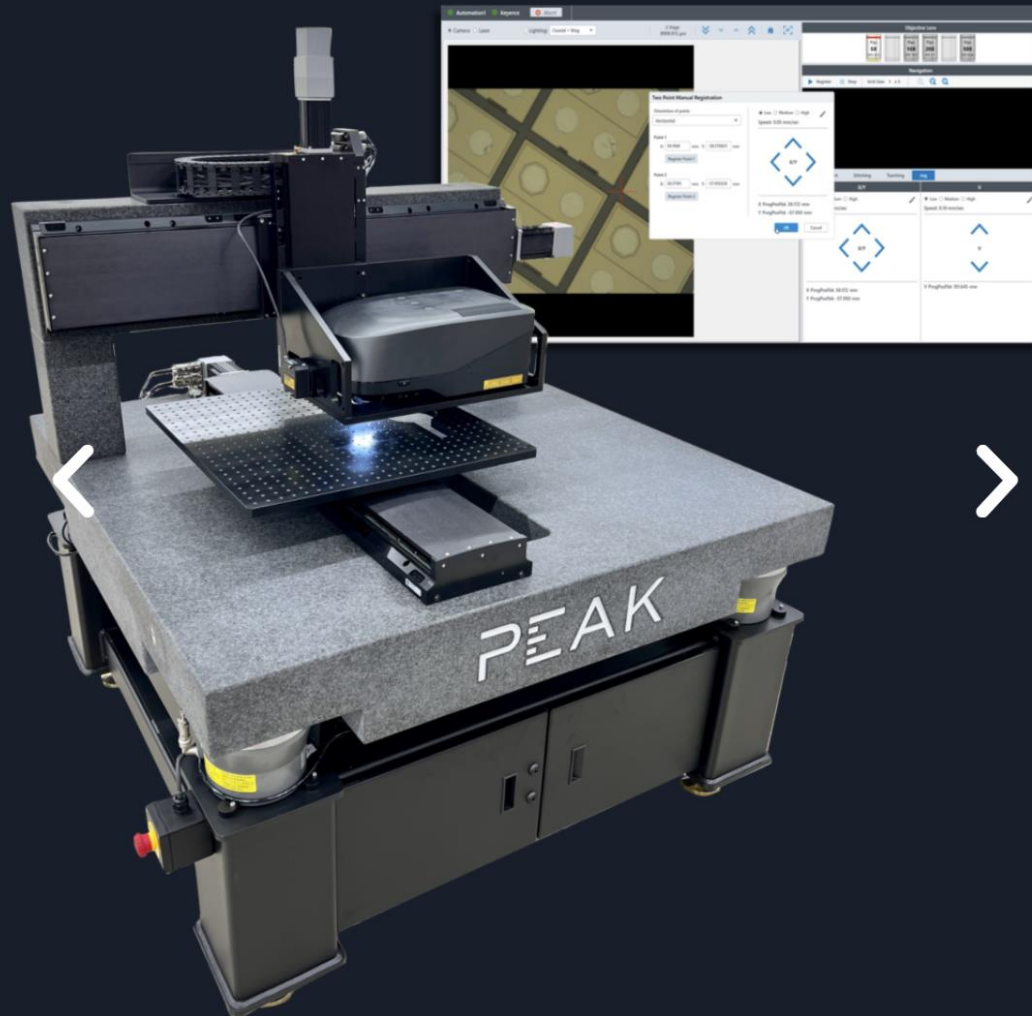
The recommendation tool will tell you which parameter of roughness has the highest degree of separation. **This feature is unique to Keyence software** and not possible with other tools on the market! Allows for better confidence and understanding of a sample's surface roughness beyond Ra and Rz.

| Function | Details | Applicable products | Example parameters |
|-------------------------------|---|--|---|
| Appearance and gloss | Scattering of reflected light, glare, quality, and sharpness (thinness of coated surfaces) | Plated surfaces, indurated surface finishing, grain finishing, various steel plates with mirror surfaces | R _{AQ} , R _q , R _a , R _{ku} |
| Tightness | Roughness between surfaces in contact with each other (leakage from gaps) | Packages, valves, cocks, cylinders | R _a , R _p , R _{Sm} , R _{pk} |
| Texture | Feel of the surface | Sheets, lacquered surfaces, grain evaluation, knurling | R _z , R _{Ma} , R _{Ma} , R _{pc} |
| Friction force | Friction force between surfaces in contact | Shafts and bearings, clutches, film, valves | R _{Ma} , R _{Ma} , R _{zjs} , R _p |
| Adhesion | Optimal coating shape for a package and its adhesive, peeling difficulty for plating | Block gauges, PCBs, undercoating for adhesive surfaces, undercoating for plating | R _{zjs} , R _z , R _{Ma} , R _{Ma} , R _{ir} |
| Sealing lubricant | Storing lubricating oil in valleys | Gears, fixtures, holes | R _v , load curve, R _{mr} , R _{vk} , R _{Mc} , Mr2, RA2 |
| Print quality | Paper texture and ink spreading | Printing paper | R _a , R _v , R _{vk} , R _{pc} |
| Noise and vibrations | Vibrations in surfaces being transferred at high speed | Bearings, gears | R _z |
| Ease of peeling | Ease of peeling molded products from molds | Molds | R _{zjs} , R _z , R _{Ma} , R _{Ma} , R _{ir} |
| Optical performance | Disturbance and scattering of the refraction of luminous flux | Mirrors, lenses, prisms | R _{Ma} , R _q , R _a |
| Wear | Ease of wear caused by load concentration during sliding | Shafts, bearings, piston rings, guides | R _p , load curve, R _{mr} , R _{pk} , R _{sk} |
| Fatigue failure and strength | Fatigue failure due to stress concentration caused by notched shapes | Steel rods, crankshafts, bolts | R _z , R _v , R _{vk} |
| Stiffness at joining surfaces | Increased deflection due to stress concentration occurring at peaks caused by only portions of joining surfaces coming into contact with each other | Bolt tightening parts | R _{mr} , R _{zjs} , R _p , R _{pk} |

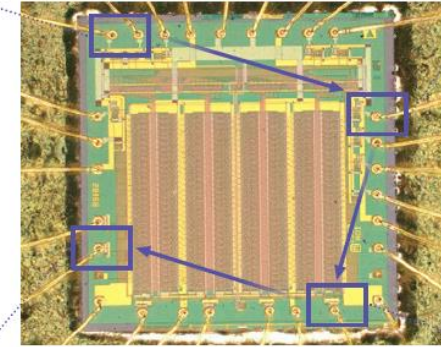
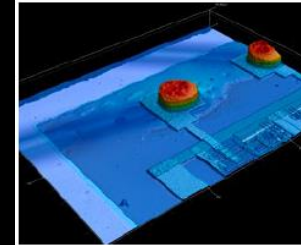
ADDITIONAL FUNCTION FOR BETTER DATA ACQUISITION

Expanded Integration

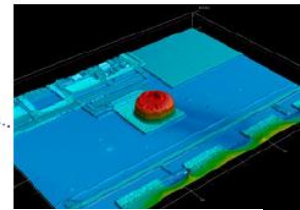
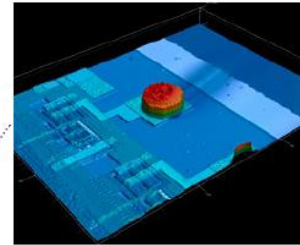
Additional software is used to extend the VK's capabilities



Using an advanced motorized stage, images and measurements can be taken at programmed locations, increasing the number of test samples that can be evaluated and completely automating the inspection process.



Wire bonding (400x; stitched image)



New measurement principle for thin films

Spectral interference film thickness measurement **NEW**

Analyzing the interference between light reflected on the surface of a film and the light reflected from the substrate allows measurement of the thickness of film as thin as 0.1 μm . A refractive index database for some 70 typical materials is also included, enabling analysis of various types of films.

