NEW **3D Laser Scanning Confocal Microscope**

VK-X250/X150/X120

ACCURACY & SIMPLICITY

AUTOMATICALLY ANALYZES AND DIFFERENTIATES 3D SURFACES

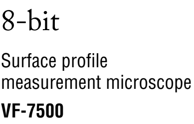
16 BIT

ADVANCED LASER MICROSCOPE

16-bit 3D LASER SCANNING CONFOCAL MICROSCOPE: **VK-X250/X150/X120 Series**

HISTORY OF LASER SCANNING MICROSCOPES

1995



8-bit

Surface profile
measurement microscope
VF-7500

1999

8-bit

3D profile
measurement microscope
VK-8500

2003

14-bit

Color 3D profile
measurement microscope
VK-9500

2008

14-bit

3D
laser microscope
VK-8700

2008

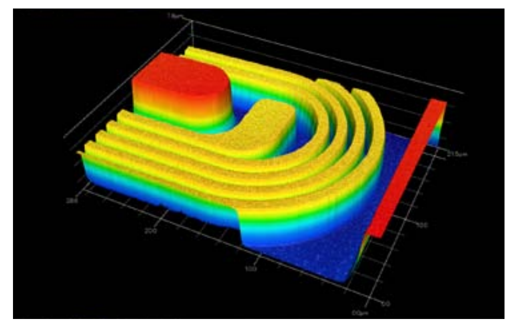
14-bit

High-resolution
3D laser microscope
VK-9700

HIGHEST ACCURACY IN THE INDUSTRY

HIGH-SENSITIVITY 16-BIT PHOTOMULTIPLIER (PMT)

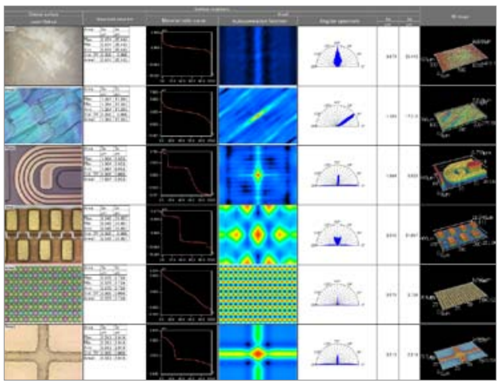
Our state-of-the-art sensor technologies are more than 16 times more sensitive than conventional systems. Whether at low or high magnification, an exact 3D measurement can be made, even on objects with complex geometries, with high-resolution and low noise.



FULLY-AUTOMATIC MEASUREMENT AND ANALYSIS

AI-SCAN - COLLECTS ACCURATE DATA WITH JUST ONE CLICK
AI-ANALYZER - SHOWS DIFFERENCES BETWEEN SURFACES

Different shapes and materials reflect light in various ways and require their own settings in order to properly measure and collect data on them. The VK-X250/X150/X120 Series can not only determine the appropriate settings to use for optimal results, but can also automatically compare data from multiple surfaces and tell you the differences.



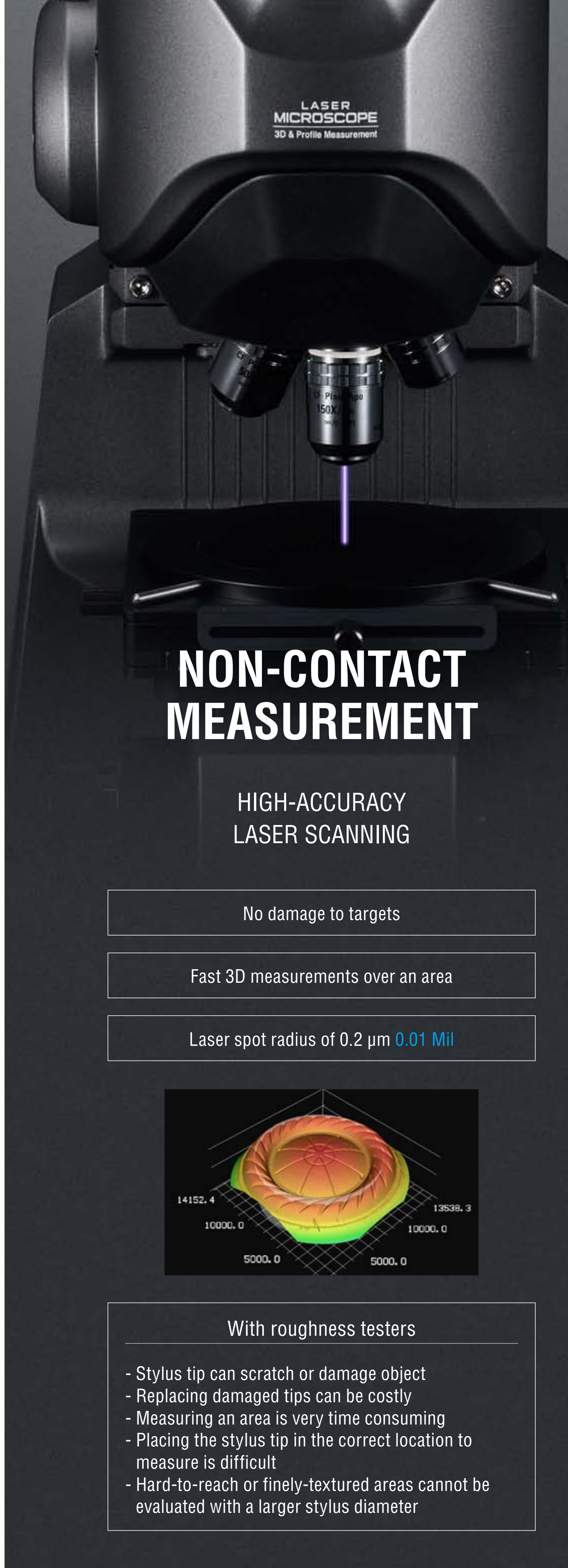
HIGH-RESOLUTION/ HIGH-MAGNIFICATION IMAGING

FULLY-FOCUSED COLOR OBSERVATION

Besides measurement, the system also functions like an optical microscope and an SEM by capturing high-resolution, fully-focused images with traceable XY measurements.

16-BIT LASER MICROSCOPE OFFERS MANY ADVANTAGES NOT POSSIBLE WITH CONVENTIONAL EQUIPMENT

There are a wide variety of measurement systems and microscopes for characterizing surfaces. Compared to other equipment, the VK-X can solve many challenges that cannot be addressed by these systems. The VK-X is based on KEYENCE's proven experience in laser application, optical design, and image analysis technologies, creating a new standard for analysis in research and development, as well as production and quality control.



NON-CONTACT MEASUREMENT

HIGH-ACCURACY
LASER SCANNING

No damage to targets

Fast 3D measurements over an area

Laser spot radius of 0.2 µm 0.01 Mil

With roughness testers

- Stylus tip can scratch or damage object
- Replacing damaged tips can be costly
- Measuring an area is very time consuming
- Placing the stylus tip in the correct location to measure is difficult
- Hard-to-reach or finely-textured areas cannot be evaluated with a larger stylus diameter

EASY & FAST

HIGH-RESOLUTION COLOR OBSERVATION WITHOUT PRE-PROCESSING

16-bit color imaging

No pre-processing or vacuum required

Works on any material

With SEMs

- Samples must be coated
- Vacuum is required
- Large objects cannot fit in the chamber
- Only provides monochrome images
- Difficult and time-consuming to operate

NO RESTRICTIONS ON OBJECTS

HIGH-ACCURACY MEASUREMENT WITH PINHOLE CONFOCAL SYSTEM

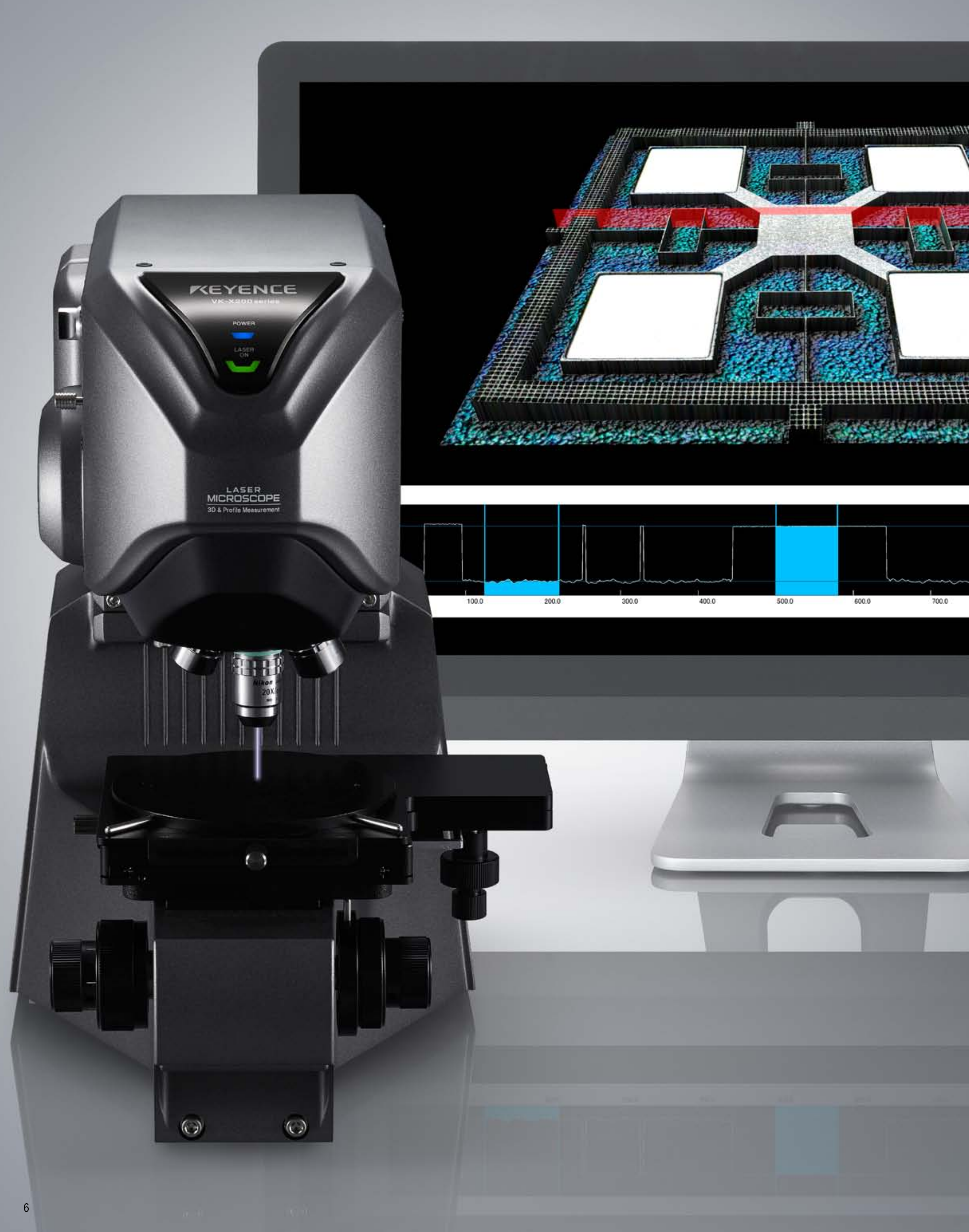
Measures steep slopes with low noise

Tilted objects do not affect measurement

High lateral resolution

With optical interferometers

- Poorly-reflective and transparent surfaces cannot be measured adequately
- Cannot collect data on steep angles
- Tilt correction is required
- Lateral resolution is limited by white light

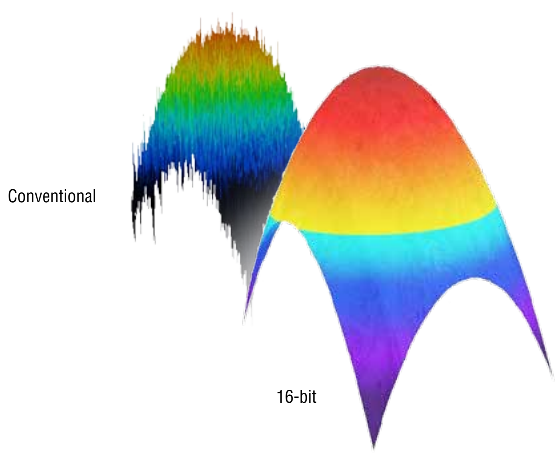

KEYENCE
VK-X200 series
POWER
LASER ON
LASER
MICROSCOPE
3D & Profile Measurement
100.0
200.0
300.0
400.0
500.0
600.0
700.0

Rapid laser scanning of surfaces

Laser × 16 bits =

HIGH-ACCURACY 3D MEASUREMENT

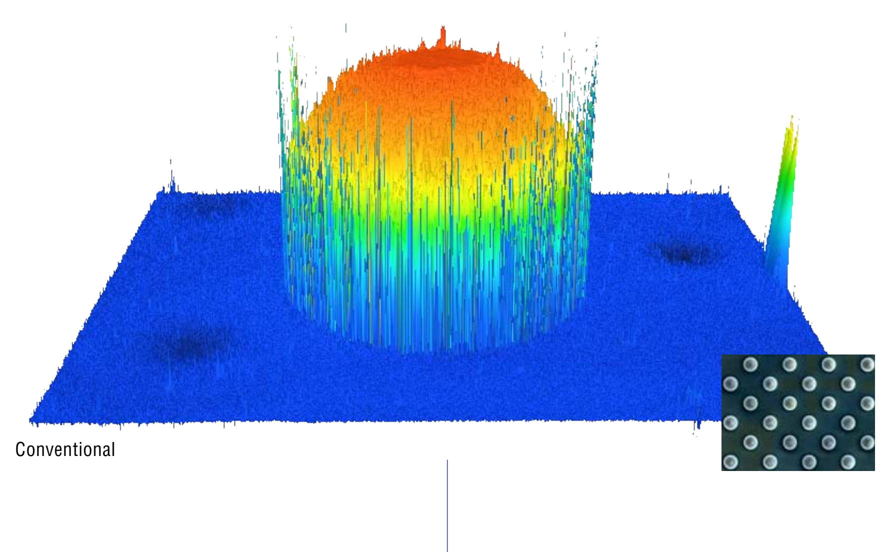
The VK-X laser microscope gathers information by scanning a laser across the surface of an object. By using a high-sensitivity 16-bit photomultiplier to receive the reflected laser light, the system can capture highly-accurate 3D measurement data over any shape or material.



Highest Accuracy in the Industry

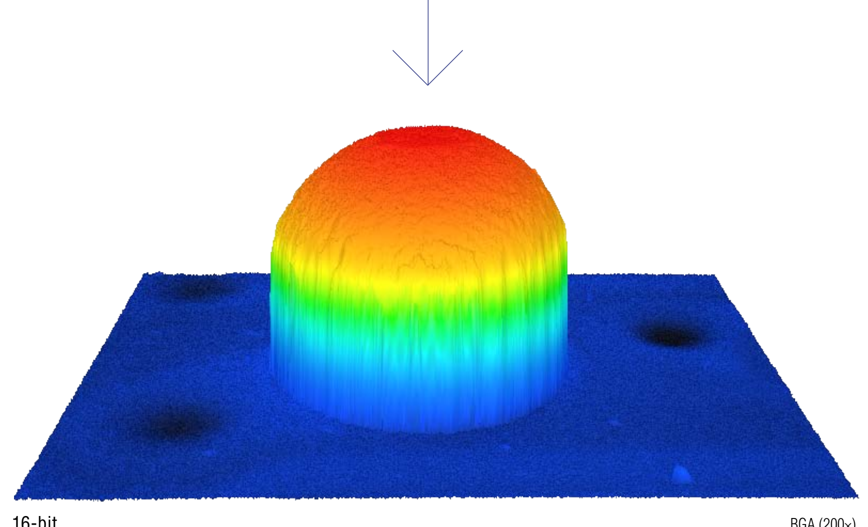
16-BIT SENSING

One of the most important components when collecting measurement data is the sensor used to receive the reflected light. Our original sensor technologies take a new approach to measuring objects that not only allow them to gather data on curved or steep surfaces, but also minimize the amount of noise, a common issue with most conventional, non-contact measurement systems.



Conventional

MEASURE ANY
SHAPE AND MATERIAL



16-bit

BGA (200×)

Measure any object from millimeters to nanometers

HIGH-SENSITIVITY 16-BIT PHOTOMULTIPLIER

For laser microscopes, which measure a target by capturing reflected laser light, how the light is captured and interpreted as height information is important. The VK-X achieves high-resolution sensing by using a 16-bit photomultiplier as its laser receiving element.

Conventional

Conventional waveform data

16-bit

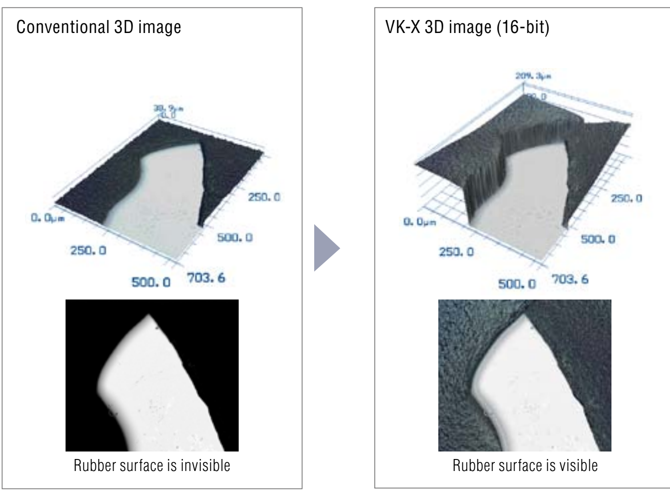
16-bit waveform data

Metal pin tip (200×)

16-bit (65,536-shade) processing

MEASURES SAMPLES WITH REFLECTANCE OR COLOR VARIATIONS IN A SINGLE OPERATION

A photomultiplier, an optical sensor with extremely high-sensitivity and high-speed response, receives reflected laser light and processes it in 16 bits (65,536 shades). Surface profile data can be captured even for samples with different reflectances and surface colors within the same field-of-view.



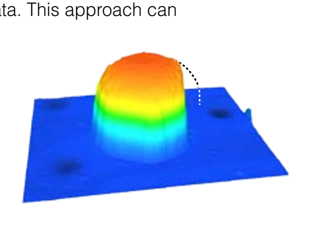
Glass + rubber: Sample with an extreme reflectance difference (400×)

MEASURE FROM A DISTANCE

Accurate nano-scale measurements can be made, even from a distance, because the high-sensitivity, 16-bit PMT can capture weakly reflected laser light.

ACCURATE MEASUREMENT DATA CANNOT BE ACHIEVED WITH FILTERING

Conventional systems reduce noise in an image by applying smoothing and noise cut filters to the data. This approach can sometimes impair judgment because it does not accurately reflect the actual surface conditions. If the raw data that is collected is insufficient, no amount of filtering will improve the measurement result.

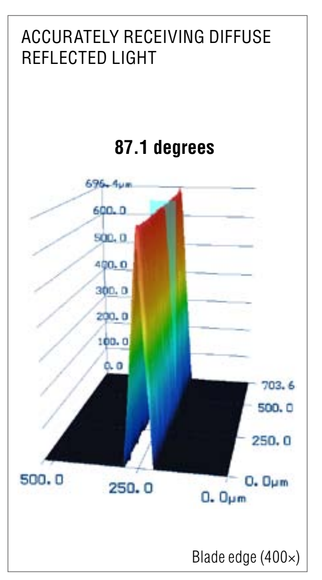


16 times the dynamic range of conventional models

MEASURE STEEP ANGLES

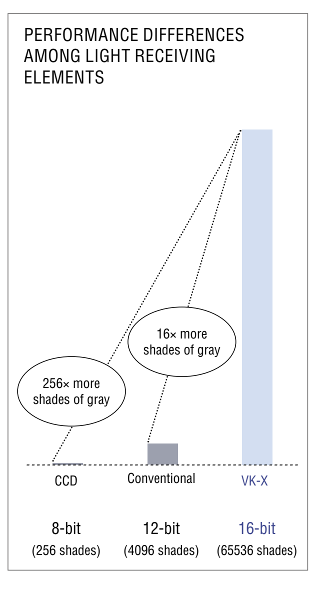
The VK-X receives all reflected laser light, from weak to strong, at one time and processes it with a sensitivity 16 times higher than conventional laser microscopes. This enables accurate measurement for samples with steep angles or complicated shapes, as well as wide areas at a low magnification.

ACCURATELY RECEIVING DIFFUSE REFLECTED LIGHT



Blade edge (400×)

PERFORMANCE DIFFERENCES AMONG LIGHT RECEIVING ELEMENTS



TECHNOLOGIES THAT SUPPORT THE HIGHEST ACCURACY IN THE INDUSTRY

High-resolution objective lenses

EXTENSIVE LENS LINEUP

For more accurate measurement, a wide lineup of optical lenses is available for the VK-X, from 2.5× to 150× magnification, with reduced distortion. All lenses undergo special tuning and inspection before being shipped with each system. The lineup includes lenses with long working distances and those for samples with a high aspect ratio.

Fluorite, which has low refraction and color aberration, is used as the lens material

Comprehensive lineup including lenses with long working distances

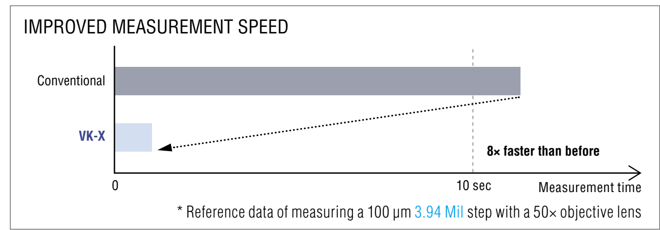
Examples of lenses with long working distances	Monitor magnification	Working distance
Standard 5× lens	100×	22.5 mm 0.89"
Ultra-long range 20× lens	400×	20.5 mm 0.81"
Ultra-long range 50× lens	1000×	13.8 mm 0.54"
Ultra-long range 100× lens	2000×	4.7 mm 0.19"

Measures 8 times faster than conventional models

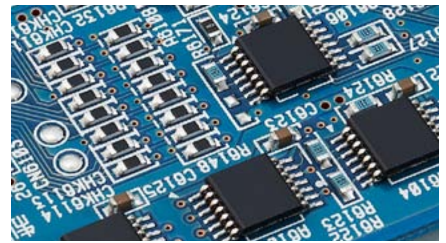
HIGH-SPEED AREA SCAN UP TO 120 HZ

While the PMT has an incredibly fast response time, the speed of data acquisition also depends upon the X/Y-axis scanners.
Plane measurement is now possible at 120 Hz with unchanged accuracy. When only numerical values and waveform are required, line measurement can be done at rates up to 7900 Hz.

IMPROVED MEASUREMENT SPEED



* Reference data of measuring a 100 μm 3.94 Mil step with a 50× objective lens



HIGH-SPEED PROCESSOR 7900

A built-in custom IC enables high-speed processing in parallel with high-sensitivity light receiving processing. Entire surfaces can be measured quickly, while a line measurement can usually be done in less than one second.

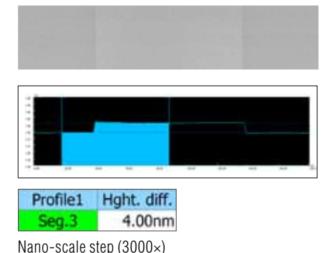
Increased accuracy

0.5-NM LINEAR SCALE

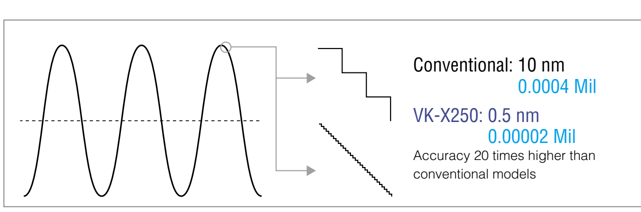
A newly-developed, high-accuracy 0.5 nm linear scale module is built in to improve the Z-resolution of an objective lens by more than 20 times when compared to a conventional system. This enables better detection of surface features, with each measurement being traceable to national standards.

Linear scale module

Sensor that measures dimensions using two scales to convert movement and displacement into electrical signals



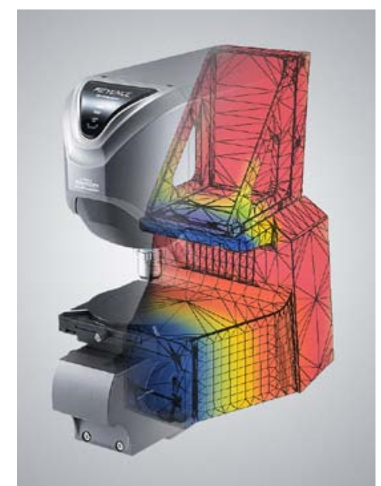
Nano-scale step (3000×)

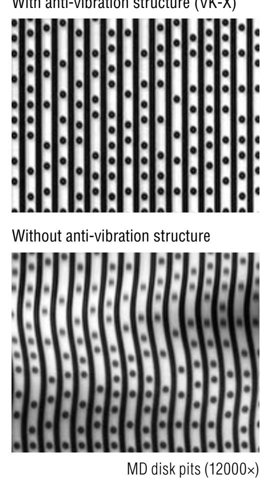


Install in any location

ANTI-VIBRATION/SPACE-SAVING DESIGN

Stable measurement is achieved with no influence from vibration or noise thanks to the compact, high-rigidity, and low-center-of-gravity design of the microscope body, as well as a dedicated anti-vibration system. The VK-X requires minimal space to set up and has been designed to withstand vibration found in an office environment.





MD disk pits (12000×)

Easy and accurate measurement over a wide area

WIDE-SCAN

While maintaining the current magnification, you can stitch images together for a wider field-of-view. More reliable data can be obtained by measuring a larger field-of-view at one time. Stitched data will contain no distortion because images are stitched through our original pattern matching calculations based on XY and Z information.

BEFORE STITCHING

AFTER STITCHING

LED pad (1000×)

AI-SCAN & WIDE-SCAN

Each field-of-view and upper/lower limits for laser scanning

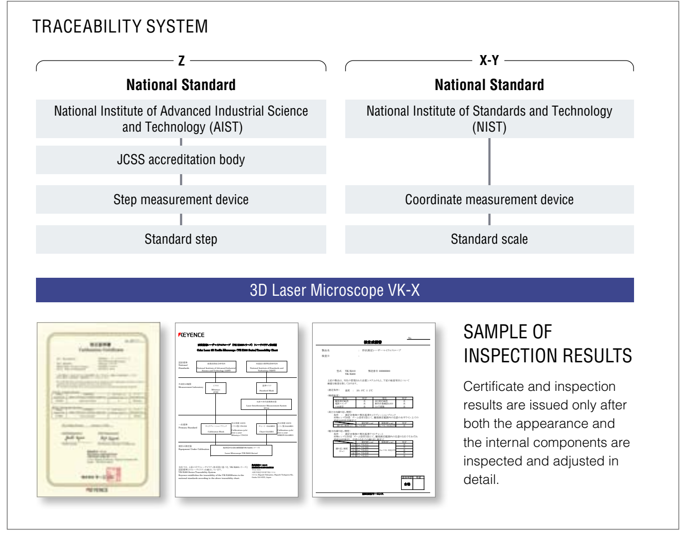
Light intensity adjustment in each field-of-view

Range to be stitched

Measurement results can be traced according to national standards

TRACEABILITY SUPPORT

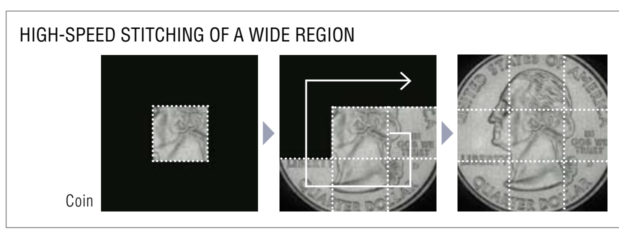
The VK-X can be used as a reliable measurement device because its measurement results are based on a traceability system in compliance with a national standard. On-site inspection service is also available free of charge to support a long service life.



Easily find your location on an object

NAVIGATION SYSTEM

When imaging at a high magnification, you may sometimes lose track of where you are observing. The navigation system, newly-equipped on the VK-X, enables you to check where you are viewing within the entire range. It is also possible to move to a specific position at high magnification by clicking on that location within the navigation image.

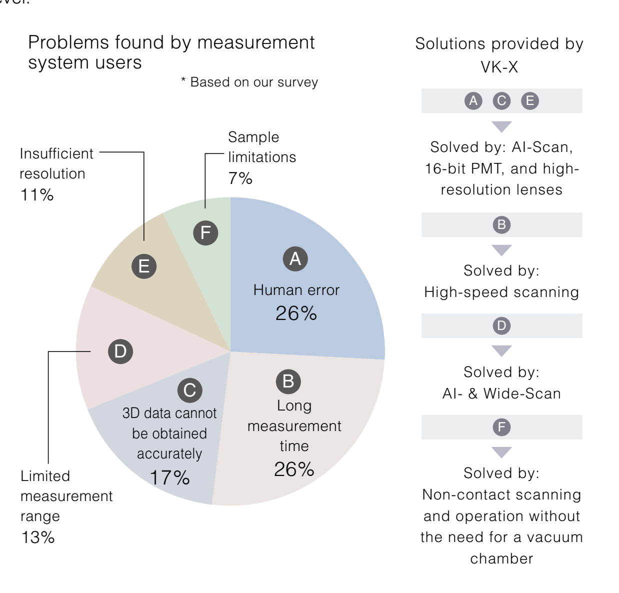


Move position with a click

Stitch only required areas

SOLVES PROBLEMS WITH CONVENTIONAL MEASUREMENT SYSTEMS

Many issues associated with conventional equipment, such as limited measurement capability and operation difficulty, can be easily solved with the VK-X. This microscope can provide users with a variety of surface measurements while being simple enough to be operated by users of any level.



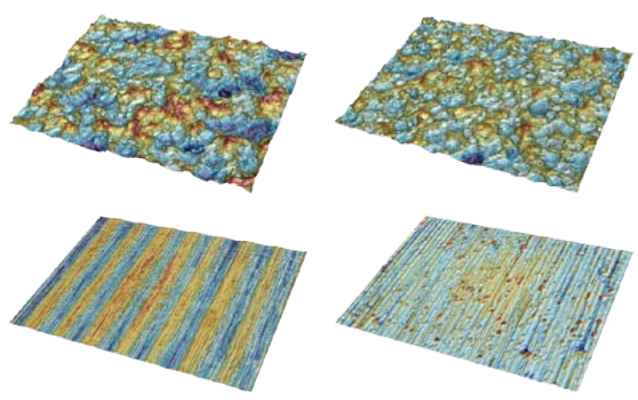
LOCK
RELEASE

Simplified data acquisition and analysis

AI-SCAN & AI-ANALYZER

FULLY-AUTOMATIC MEASUREMENT & ANALYSIS

There are two main processes with any measurement system - acquiring the data and then analyzing it. The VK-X is not only able to automatically scan and collect surface data with just the click of a button, but it can also automatically analyze the information and display the differences between the surfaces.



World's first

FULLY-AUTOMATIC MEASUREMENT

AI-SCAN

With just a click of the mouse, all of the settings and parameters required for obtaining accurate 3D data of a surface can be automatically calculated. AI-Scan enables you to complete measurements in a single procedure while maintaining accurate results.

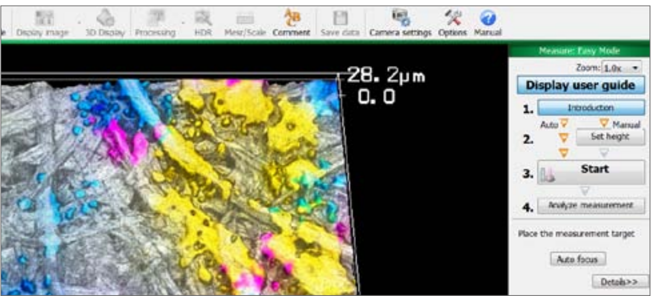
A single click achieves the same measurement as experienced operators

Start measurement

Reliable and repeatable measurements

AI-SCAN ENSURES CONSISTENT RESULTS

Measurement results can often vary depending on the skill of the operator. With the AI-Scan function, these inconsistencies can be eliminated by simplifying and automating the data acquisition process. Users just need to place the target to be measured on the stage and click the mouse to activate the scan. All settings required to capture the best data, including the setting of the upper and lower limits and proper laser intensity, are automatically done. Anyone, regardless of their experience, can perform the same measurement with consistent results.



AI-Scan = Artificial Intelligence-Laser Scan

CONVENTIONAL MEASUREMENT STEPS

1. Set the upper and lower limits of the measurement range.
2. Adjust the lens height and visually check for areas that are over-saturated by the laser light. Reduce the intensity of the laser.
3. Increase the intensity of the laser until you reach the maximum point that does not cause over-saturation.
4. Measure the sample.
5. Check the measurement results for improper data (over/under-saturation).
6. If any problems are detected, adjust the laser intensity again before resuming measurement.

↳ **Repeat steps 4 to 6 until you obtain accurate results.**

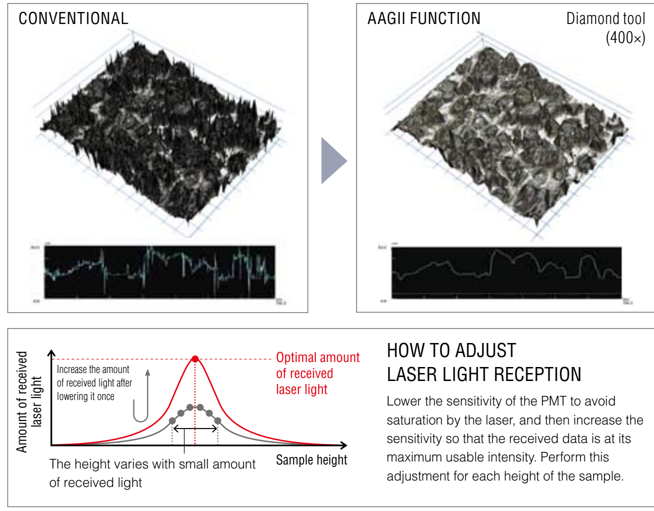
AI-Scan Algorithm & Custom LSI

Our original algorithm and custom LSI will reproduce a series of operations designed to be carried out by an experienced measurement operator. In addition, it is now possible to set an optimal amount of received laser light due to a new protective circuit that prevents damage to the PMT even under maximum light intensity.

Optimally adjusts laser intensity

AAGII FUNCTION (AAG = ADVANCED AUTO GAIN)

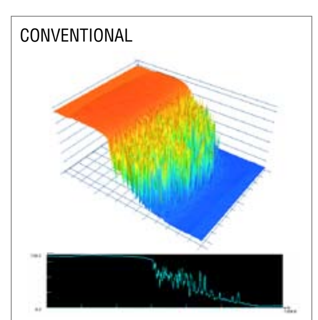
To measure an object accurately with a laser, it is necessary to adjust the amount of received laser light according to the shape and material of the target. Improper adjustment will produce varied measurement results. Once the amount of received light has been optimized, you can accurately measure samples with complex surfaces or those with large differences in reflectance.

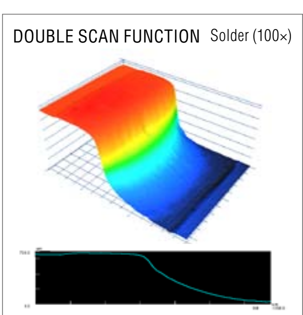


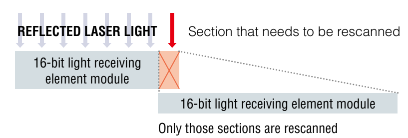
Automatic re-scanning of surfaces

DOUBLE SCAN FUNCTION

The amount of received laser light is physically limited with a single scan. Some surfaces may not be measured properly even after the amount of received light is increased to the upper limit with the AAG function. If a surface cannot be measured accurately with a single scan, the object is scanned again to collect missing data and generate accurate results.







DOUBLE SCAN

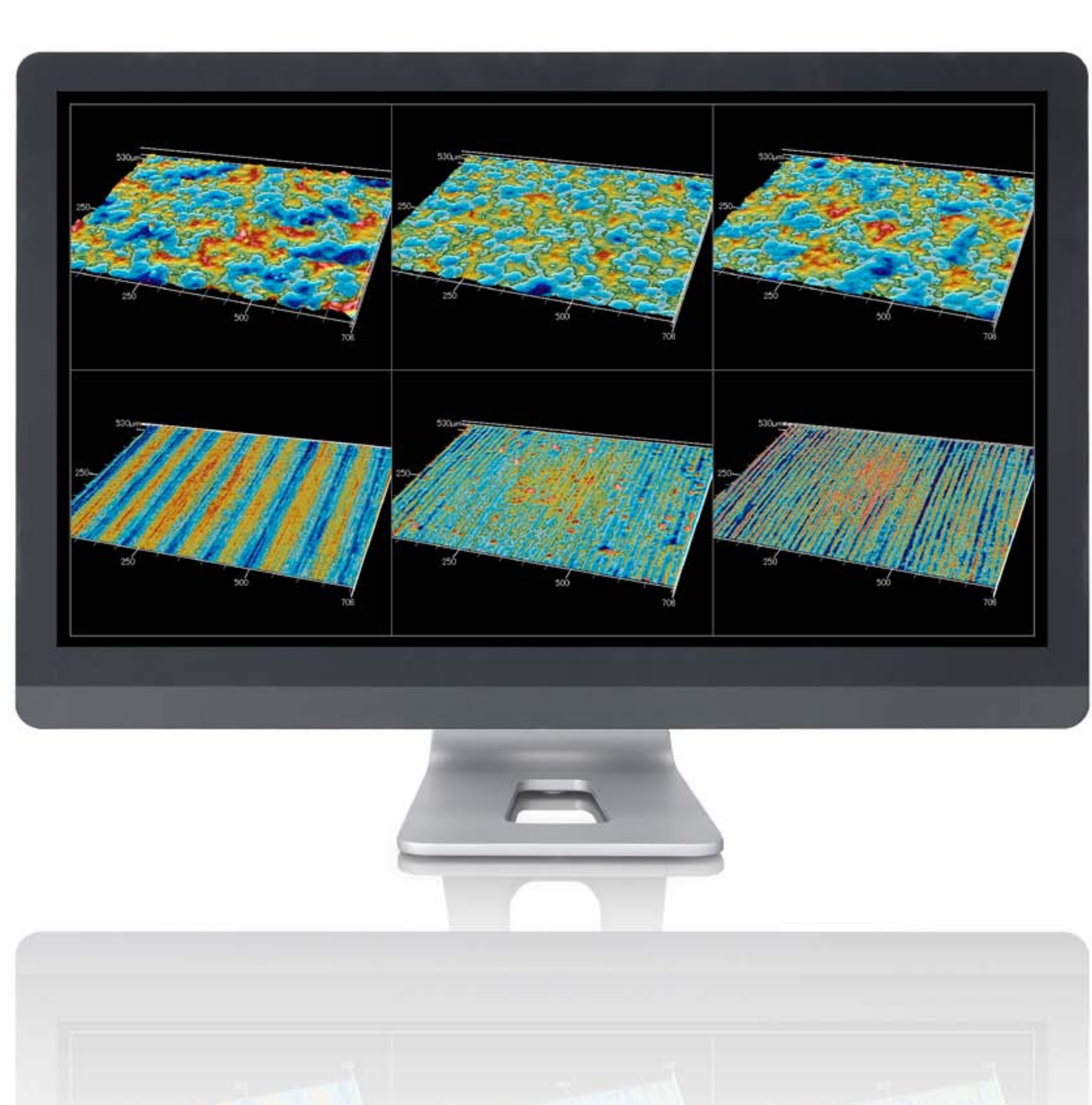
Any section with unstable reflected laser light is scanned again in 16 bits (65,536 shades) to achieve reliable measurement.

AUTOMATED ANALYSIS TOOL

AI-ANALYZER

Once accurate measurement data are obtained, how do you analyze them? The VK-X provides new tools to automate analysis operations and improve analysis accuracy and efficiency. You can view the differences between multiple surfaces and objectively analyze the results.

SHOWS THE DIFFERENCES YOU NEED TO KNOW



Measurement position detection & quantification function

AUTOMATIC EDGE DETECTION

Our cutting-edge image processing technologies enable you to specify exactly where to measure.
Edge detection tools ensure that any measurement point or line is placed exactly along the profile of the object. This helps to eliminate any variation between different individuals and guarantees accurate results.

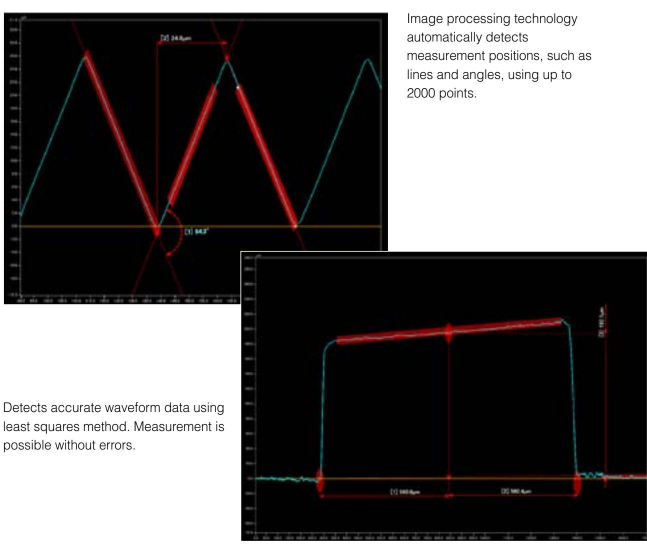


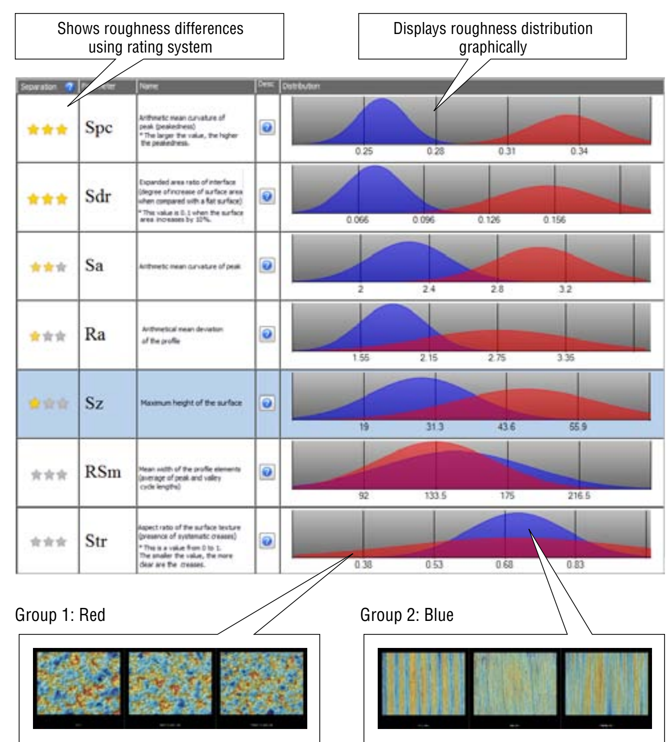
Image processing technology automatically detects measurement positions, such as lines and angles, using up to 2000 points.

Detects accurate waveform data using least squares method. Measurement is possible without errors.

Surface roughness visualization tool

DISPLAYS KEY DATA FOR EVALUATION

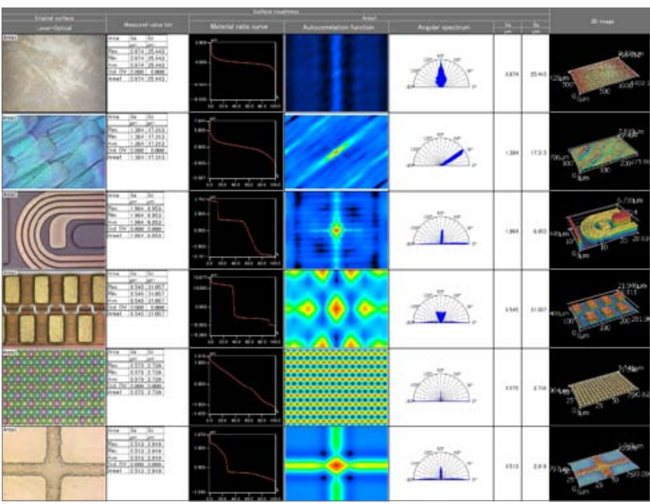
42 roughness parameters are used to automatically compare surface conditions across multiple samples. This function quantifies differences in the surface values and prioritizes them based on their degree of separation, making it incredibly easy to evaluate discrepancies between samples.



Multiple file display tool

VIEW DIFFERENCES BETWEEN MULTIPLE SURFACES

Shows multiple results simultaneously so that you can compare them. Every setting can be applied collectively, including the measurement position, height/width range, and the reference plane for measurement. Different samples can be measured under the same conditions so that you can understand where and what differences exist at a glance.



Shows and prioritizes values for 42 parameters

Analysis result

Parameters are ordered by degree of separation.
Select parameters to be added to a report.

Separation	Parameter	Name	Desc
★★★	Sal	Autocorrelation length	
★★★	RΔq	Root mean square slope of the profile	
★★★	RSm	Mean width of the profile elements (average of peak and valley cycle lengths)	
★★★	Str	Aspect ratio of the surface texture (presence of systematic creases) * This is a value from 0 to 1. The smaller the value, the more clear are the creases.	
★★★	Sdq	Root mean square gradient	
★★★	Smr2	lower material ratio	
★★★	Sk	Core height of the surface	

Separation	Parameter
★★★	Ra
★★★	Sq
★★★	SMr1
★★★	Rq
★★★	Sxp
★★★	Rt
★★★	Rz

Separation	Parameter
★★★	Rpk
★★★	Spc
★★★	Ssk
★★★	Rsk
★★★	Mr1
★★★	Rku
★★★	RzJIS

MEASUREMENT POSITION DETECTION FUNCTIONS

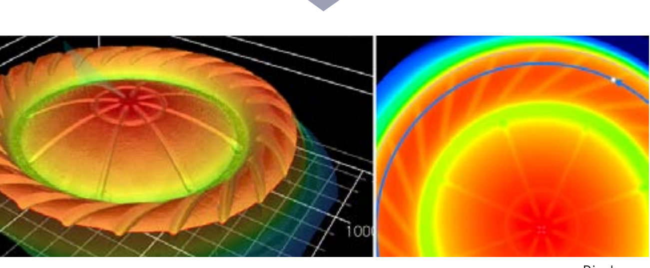
MEASURES ANY LOCATION ON SCREEN

SECTIONAL MEASUREMENT FUNCTION

The VK-X enables you to set a sectional measurement line (profile line) anywhere you want on a captured 3D image. Unlike contact profilers that measure a line by physically dragging a stylus tip across the surface, the line position can easily be adjusted with the VK-X, and there are multiple line-types that can be used. In addition, measurement results can be saved so that you can perform the same measurement again at a later time.

CONVENTIONAL
Contact measurement system

Difficult to measure an exact desired point



Diaphragm

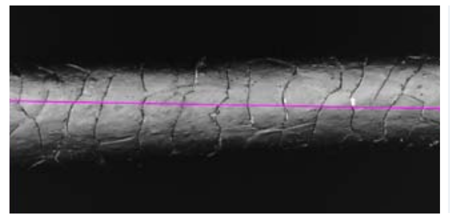
You can specify where you want to measure on the 2D/3D images.

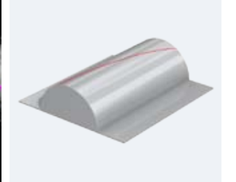
SPECIFY EXACT MEASUREMENT POINTS

SECTIONAL MEASUREMENT AUXILIARY TOOLS

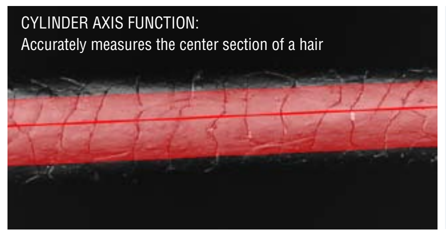
Auxiliary tools are designed to make it easy to choose the appropriate measurement position (e.g. sphere or cylinder center, max/min height, etc.). These functions help to improve measurement accuracy by ensuring that the correct area is measured, even when being done by different users.

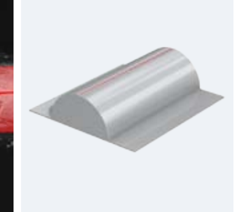
CONVENTIONAL
Hair surface measurement: measurement points vary each time.





Nearly impossible to repeatably measure the same location

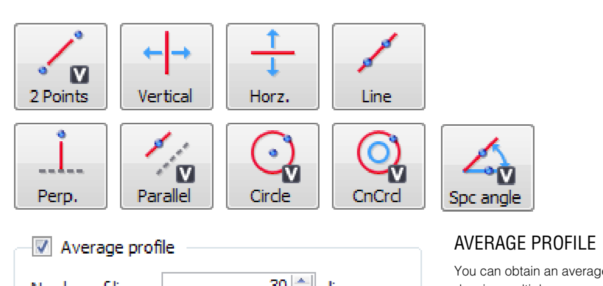




Hair (3000×)

By using a wide variety of auxiliary tools, you can specify the target measurement position precisely.

AVAILABLE MEASUREMENT TOOLS

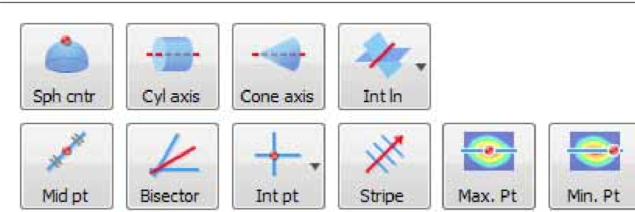


AVERAGE PROFILE

You can obtain an average by drawing multiple measurement lines (profile lines).

AUXILIARY PROFILE TOOLS

AUXILIARY ASSISTANCE TOOLS



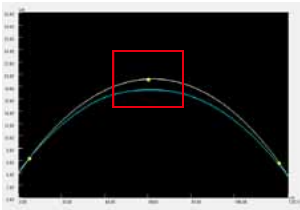
RELIABLY MEASURES ALONG THE OUTPUT PROFILE LINE

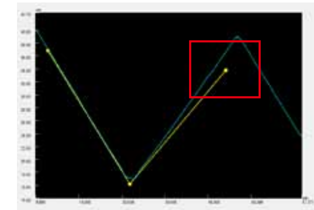
MEASUREMENT POSITION DETECTION FUNCTIONS

No matter how carefully you try, it is nearly impossible to repeatably click the exact same point on a profile line. Conventionally, this has generated varied results for each measurement. To achieve consistent measurement with greater accuracy, the VK-X Series can automatically detect and correct a position as long as the waveform results exist within a certain range.

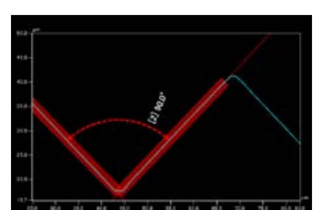
CONVENTIONAL

Error occurs depending on the selected position.





Because the measurement position is determined based on a single point, data cannot be measured accurately if that point is specified incorrectly.



Edge-detection tools automatically snap to the line that you want to measure.

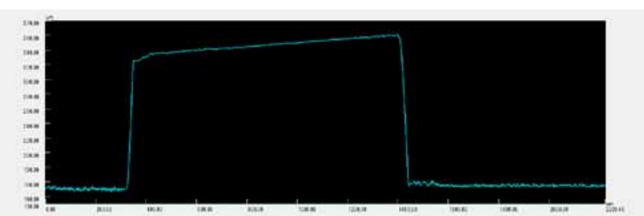
MEASURES ADDITIONAL TARGET PROFILES

MEASUREMENT AUXILIARY TOOLS

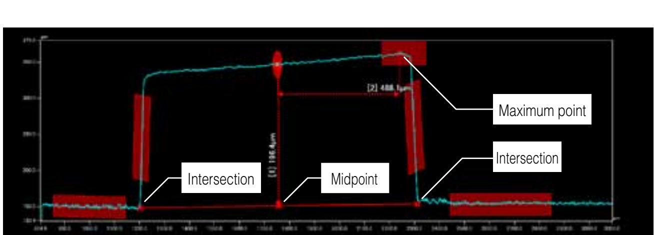
As with setting of measurement lines (profile lines), a wide variety of auxiliary tools are also available.

For example, it is possible to automatically detect the maximum and minimum points on a waveform as well as to set an intersection or midpoint location.

CONVENTIONAL

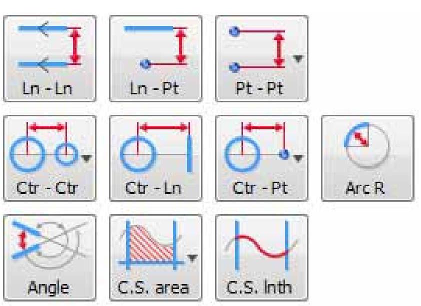


Points such as maximum, minimum, intersection, and midpoint cannot be set.

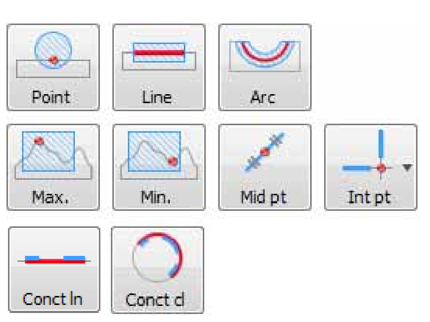


By using a wide variety of auxiliary tools, you can measure exactly where and how you want.

PROFILE MEASUREMENT TOOLS

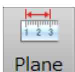


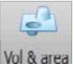
AUXILIARY PROFILE TOOLS



AI-Analyzer

QUANTIFICATION FUNCTIONS

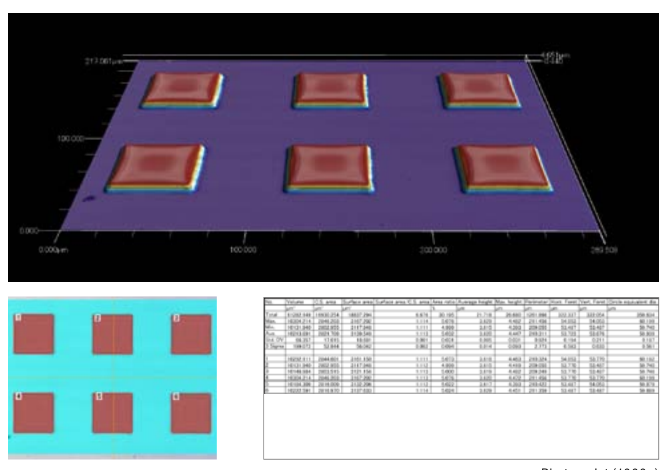




ACCURATE 3D QUANTIFICATION

PLANE/VOLUME/AREA MEASUREMENT

3D data can be used not only in point-to-point, parallel line, and radius measurements but also in volume and area measurements. Up to 3000 points can be measured, including volume, surface area, sectional area, area ratio, average height, maximum height, circumference, and equivalent circle diameters.

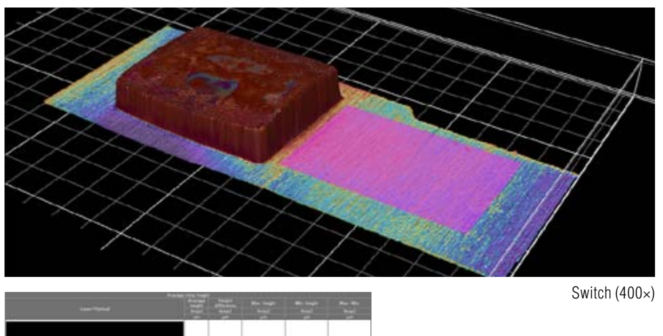


Photoresist (1000×)

MEASURE DEGREE OF FLATNESS

AVERAGE STEP MEASUREMENT

Within a specified region, users can measure average height, the step height from a reference plane, and difference in max/min heights. The degree of flatness can also be calculated using max/min data. Up to 10 regions can be selected for evaluation.



Switch (400×)

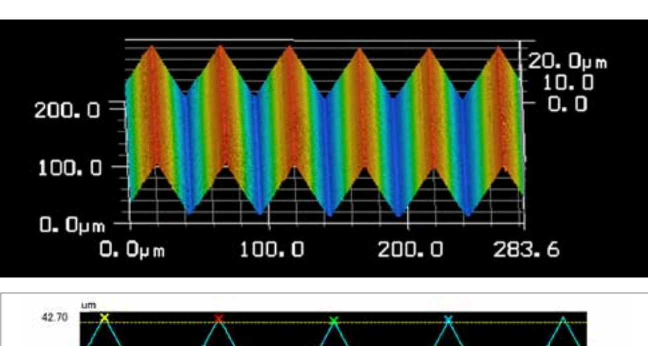
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	1.1	(Ref.)	10.9	−5.1	16.0

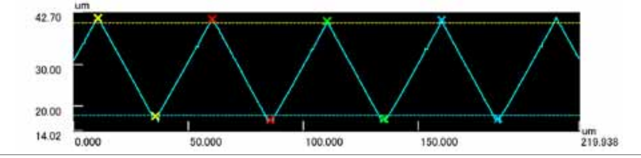
Measure the degree of flatness of the specified section

AUTOMATICALLY MEASURES WIDTH AND HEIGHT

AUTOMATIC MEASUREMENT

For samples with highly-regular or repeating structures, the width and height can be measured automatically based on the light intensity data (light intensity value, differentiation, and secondary differentiation) and height data included in measurement results. Using the template function, samples can be measured simply by clicking the mouse, improving your inspection productivity.



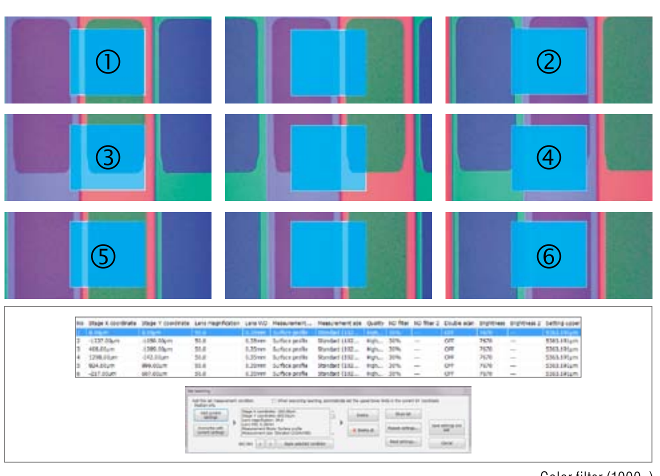


Substrate (100×, stitching of 7 × 6 images)

AUTOMATIC MEASUREMENT OF UP TO 500 POINTS

TEACHING MEASUREMENT

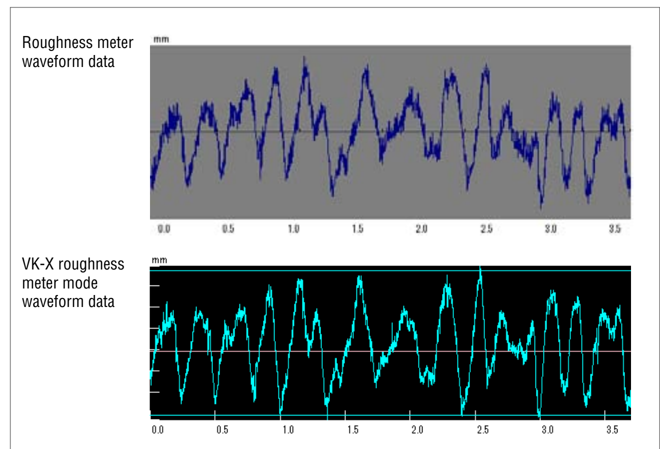
With the motorized XY stage, up to 500 points can be measured automatically simply by providing XY coordinates to the controller. This is effective for measuring multiple points on a single sample or evaluating a large number of specific samples. Coordinates can be edited on the main unit or in Excel.



Color filter (1000×)

INDIVIDUAL AND MULTIPLE LINE ROUGHNESS MEASUREMENT

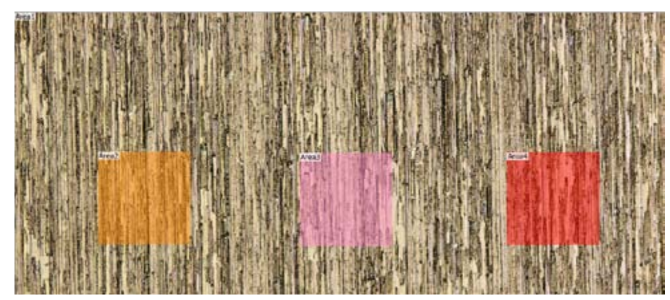
Roughness measurement is important not only for finish and appearance quality but also to control product service life and mechanical efficiency. The VK-X's "Roughness meter mode" enables measurements that are correlated with a contact roughness meter. In this mode, you can measure data precisely, while still benefiting from the non-contact, small beam-spot scan method. Line roughness can be measured easily even for a large number of samples.



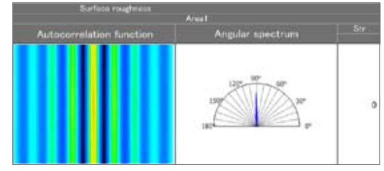
ISO 25178 COMPLIANT

SURFACE ROUGHNESS MEASUREMENT

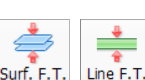
Surface roughness can be measured using the non-contact, plane measurement function. Unlike line roughness measurement, this approach will not be affected by scan direction or measurement point inconsistencies. This measurement is in compliance with ISO 25178 (International Organization for Standardization). Sa (average surface roughness) and other surface parameters can be measured with extremely-high resolution.



Processed metal surface (400×)



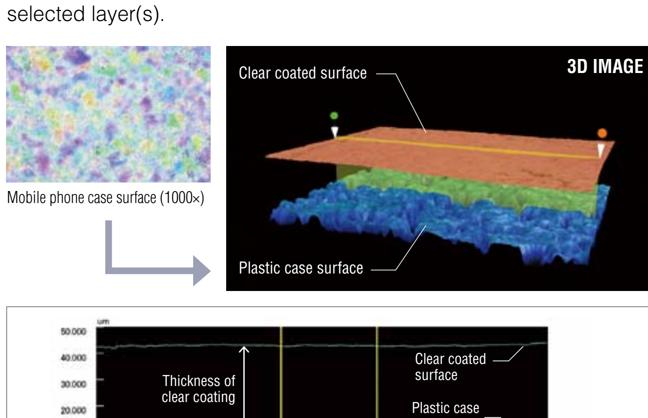
Non-contact surface roughness measurement



NON-DESTRUCTIVE APPROACH TO MEASURE THICKNESS

FILM THICKNESS MEASUREMENT

For transparent targets, transmitted light goes beyond the focal position of the top surface to detect the focal position of the bottom surface. As a result, the thickness can be obtained by calculating the difference between the two layers. It is possible to measure the film thickness at multiple layers in the entire field-of-view, and you can check the 3D display and sectional profile display of each or multiple selected layer(s).



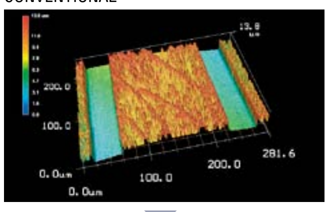
Mobile phone case surface (1000×)

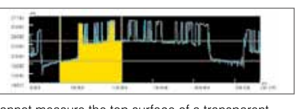
ACHIEVED BY HIGH-SENSITIVITY PROCESSING

TRANSPARENT AND THIN-FILM SURFACE MEASUREMENT

The VK-X is equipped with a function that allows it to obtain detailed surface data from the topmost layer of a transparent film. Using Transparent Top mode, light reflected from the closest surface to the lens (topmost layer) is captured, while other signals are ignored.

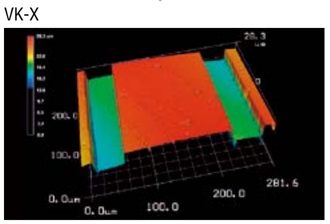
CONVENTIONAL

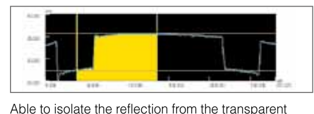




Cannot measure the top surface of a transparent layer due to strong reflection from the bottom layer

VK-X



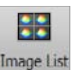


Able to isolate the reflection from the transparent surface layer

Resist (1000×)

AI-Analyzer

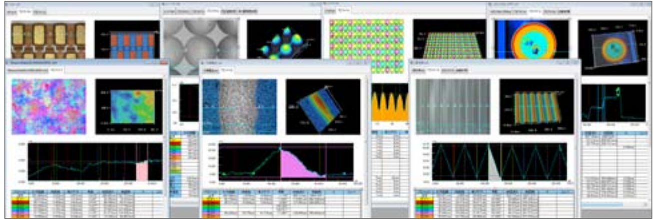
COMPARATIVE ANALYSIS FUNCTION



ARRANGE AND DISPLAY MULTIPLE FILES

MULTI-FILE VIEW

No matter how deep you analyze one piece of data, there is a limitation on what you can identify. For further analysis, it is more effective to compare multiple samples. With the VK-X, it is possible to open multiple files simultaneously to measure data such as the cross section, roughness, volume, and area. You can immediately find changes in samples and differences between good and bad samples.



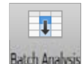
Separate result files require longer analysis time and hinder understanding.
Combining the data in Excel can be time consuming.

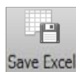
You can arrange samples you want to analyze and specify the item to compare for analysis.

- More than 100 files can be evaluated
- Fast operation despite extremely large amount of data processing.
- Reference plane can be set.

REAL DATUM SET

When the heights of two points located 1 mm 0.04" away from each other are measured, an inclination of 0.1 degrees generates an error on the order of several microns. While line-based or 3-point correction methods cannot ensure an accurate inclination adjustment, the VK-X can detect a correct reference plane using up to 1.5 million points of height data.

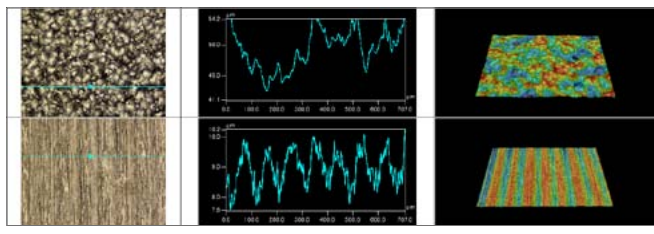




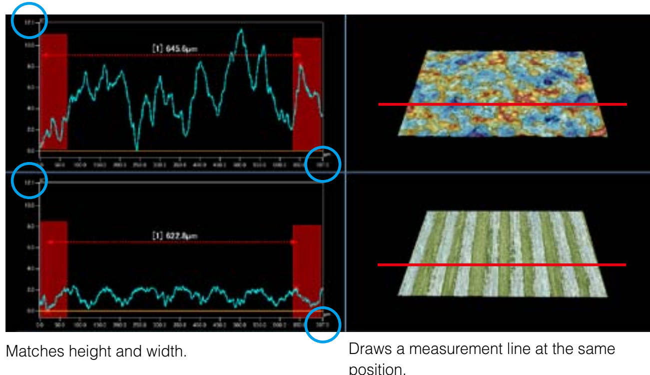
COLLECTIVE ANALYSIS OF MULTIPLE FILES

AUTO ARRANGE

Multiple samples, once arranged and displayed, can be analyzed collectively. It is possible to apply the same conditions, including reference plane (height = 0), height/width, and 3D orientation. You can also establish the same analysis process, such as where to draw a profile line and measurement position.



Due to an unaligned height range, users cannot tell visually which projections and depressions are greater. Measurement positions differ between the two files.



Matches height and width.

Draws a measurement line at the same position.

Height and width ranges are aligned so that different surfaces can be compared. The measurement location can also be linked to enable accurate analysis.

- X-, Y-, and Z-axis ranges can be aligned or adjusted based on a specified file.
- Height display setting (3D color display) can be applied collectively.
- Image processing settings can be applied to multiple pieces of measurement data.
- Analysis settings (such as maximum/minimum point registration and sectional measurement) can be applied to other measurement data.

EASY TO UNDERSTAND ROUGHNESS DIFFERENCES

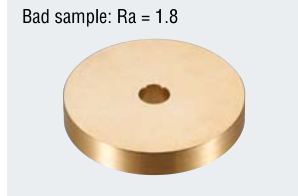
ROUGHNESS PARAMETER SUGGESTIONS

Instant visualization of optimal roughness parameters

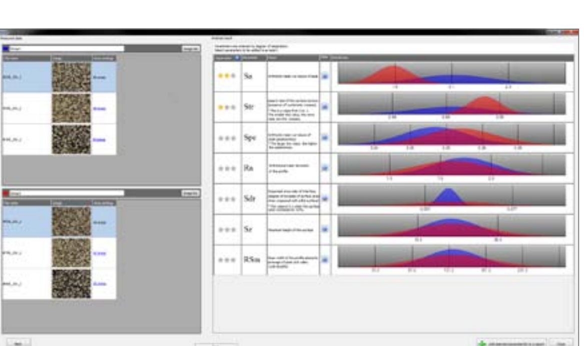
Surface conditions of multiple samples can be visualized instantaneously using roughness parameters. You can check visually, with graphical data, how surfaces differ between samples.

Good sample: Ra = 1.8

Bad sample: Ra = 1.8



Even though these parts feel and appear different, the Ra and Rz values are the same.



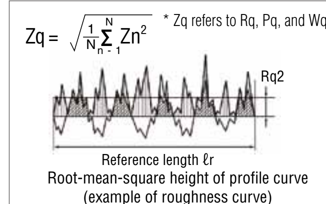
Seven optimally selected parameters are always displayed by default

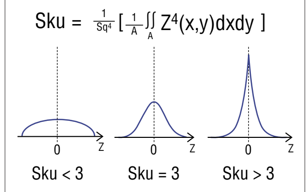
Roughness parameter variations can be checked visually.

- 42 roughness parameters are automatically checked for their numerical variances. A graphical rating system is used to prioritize the parameters.
- Differences in the seven most commonly used roughness parameters are extracted and displayed by default (can also be set manually).
- Suggested numeric data is expanded to the Multi-File View.
- You can view the results you want to check on the 3D image list.

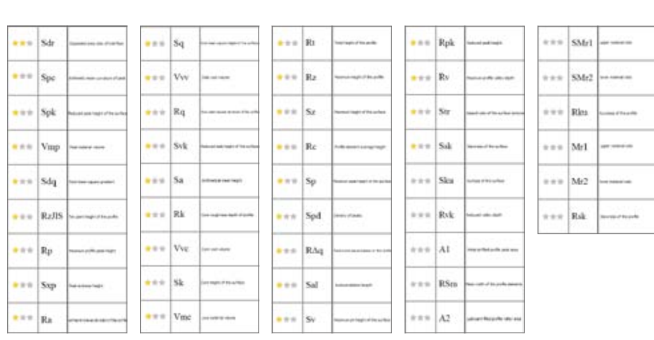
Easy control using new parameters

Although Ra and Rz are often used to evaluate roughness, there are many other roughness parameters as well. The Parameter Suggestion function displays key roughness factors about the measured surface. Even without an in-depth knowledge of roughness, anyone can carry out effective evaluation of a surface.





Numeric outputs are not only difficult to understand but also require time for comparison.



Control and evaluation are now possible using an easy-to-understand rating system.

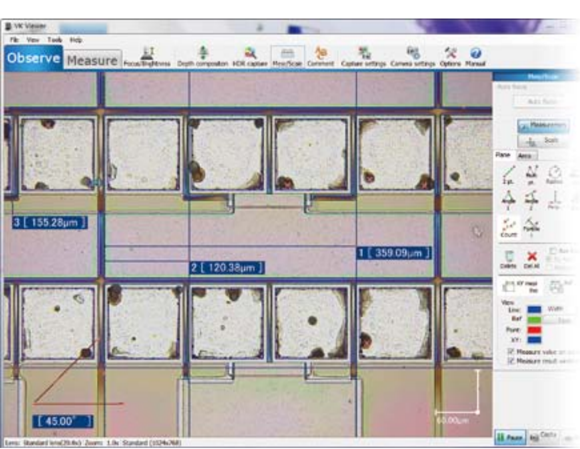
- You can check variance indexes, which could not be recognized before.
- Evaluate characteristics across multiple samples.
- Pressing the description button displays the details of the roughness parameter.
- Various filters specific to surface and line roughness measurement are available.

KEYENCE
LASER
MICROSCOPE

SEM-LIKE IMAGES WITH THE EASE-OF-USE OF AN OPTICAL MICROSCOPE

HIGH-RESOLUTION/ HIGH-MAGNIFICATION IMAGING

High-resolution, full-focus, color observation is possible, from low to high magnifications, without the need for a vacuum. Traceable XY measurements can be performed in real-time on an image, increasing the versatility of the VK-X.

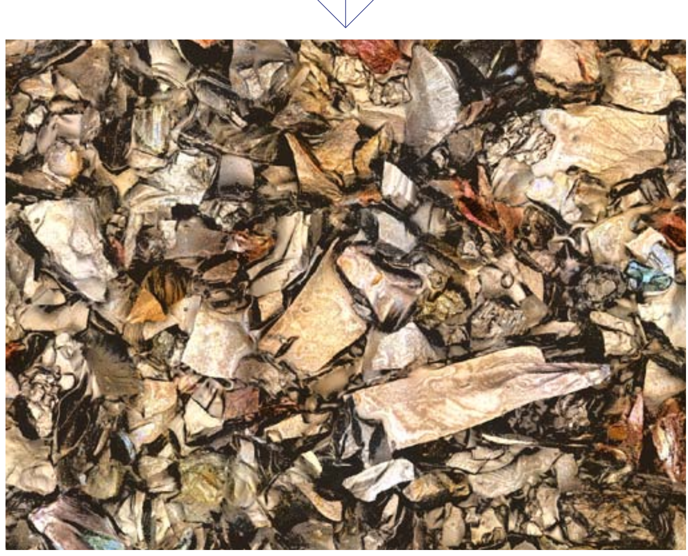


HIGH-RESOLUTION/ HIGH-MAGNIFICATION IMAGING

Adding to the flexibility of our laser microscope, KEYENCE has incorporated many of the observation, image capture, and measurement functions of our award-winning digital microscopes. When combined with the technology of our laser microscopes, these functions allow for a wide variety of uses, which were not previously possible with conventional 3D measurement equipment.

FULLY-FOCUSED OPTICAL IMAGE

SHOWS WHAT YOU COULD NOT SEE BEFORE



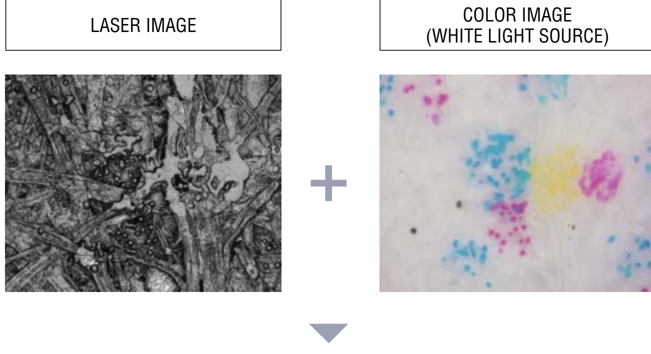
16-BIT LASER COLOR IMAGE

Abrasive (400×)

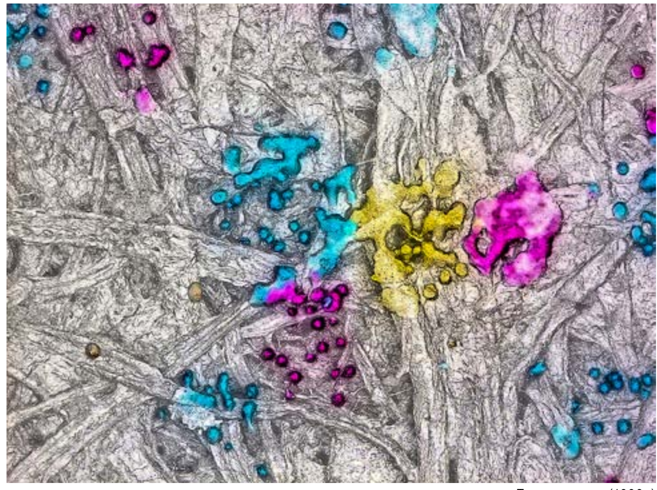
Capture high-resolution, SEM-like images with color

16-BIT LASER COLOR OBSERVATION

By scanning the entire surface of a target with short-wavelength laser, SEM-equivalent, high-resolution observation is achieved, which is not possible with optical microscopes. Full-focus color imaging is enabled by extracting and overlaying color information with laser data for each pixel.

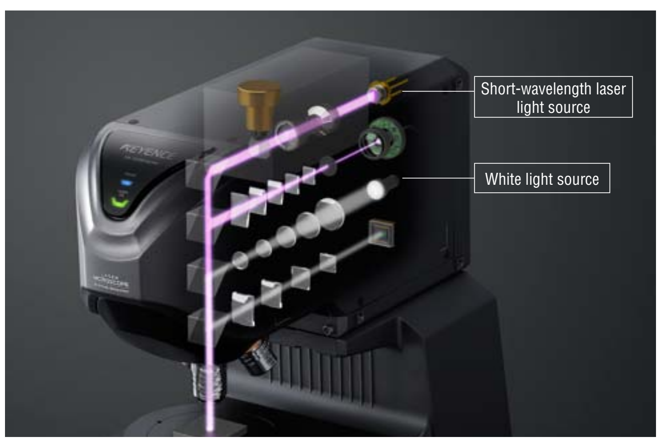


16-BIT LASER COLOR IMAGE



Toner on paper (1000×)

Combination of short-wavelength laser and white light sources enables color observation at high resolution.



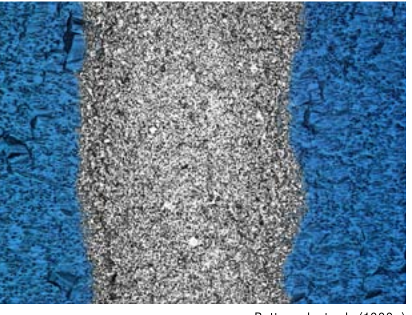
Observe at low to high magnification with no sample preparation

MAGNIFICATION OF UP TO 28000×

The VK-X supports magnified observation from millimeters to nanometers. Depending on the lens combination used, observation can be performed at a magnification from 50× to 28000×. Since a vacuum chamber is not required, each sample can be imaged in high-resolution immediately.

Switch (400×)

High-quality lenses minimize distortion and color aberration to give the most accurate color representation of the object.

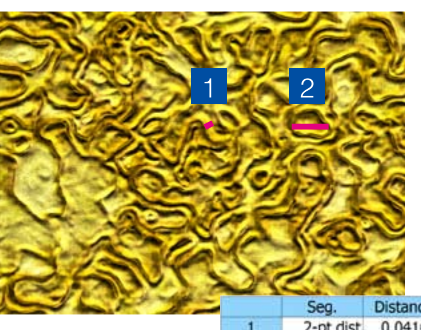


Battery electrode (1000×)

Combining color and high-resolution laser data allows construction of images of objects with previously impossible levels of detail.

Bump (3000×)

Overlaying the optical image with the laser image produces an SEM-like photo with true-color.



	Seg.	Distance
1	2-pt dist	0.041um
2	2-pt dist	0.111um

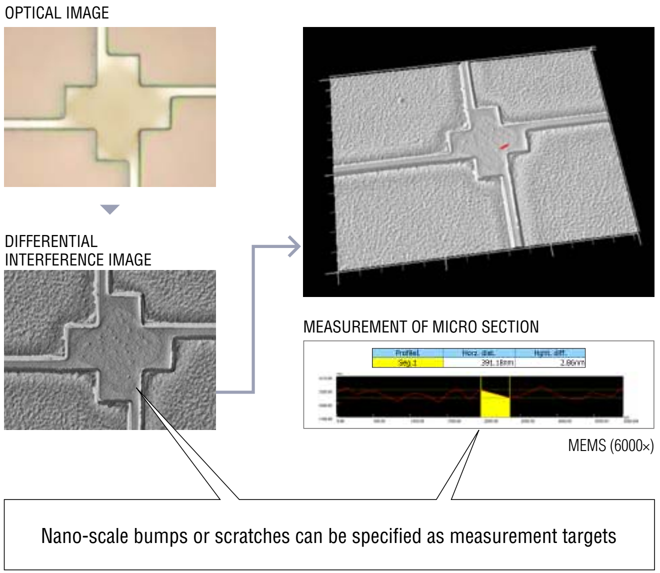
Bump (24000×)

The short-wavelength laser is able to capture images with nano-level features without the need for a vacuum, well beyond the capabilities of a conventional optical microscope.

Visualize nano-scale texture and scratches

C-LASER DIFFERENTIAL INTERFERENCE

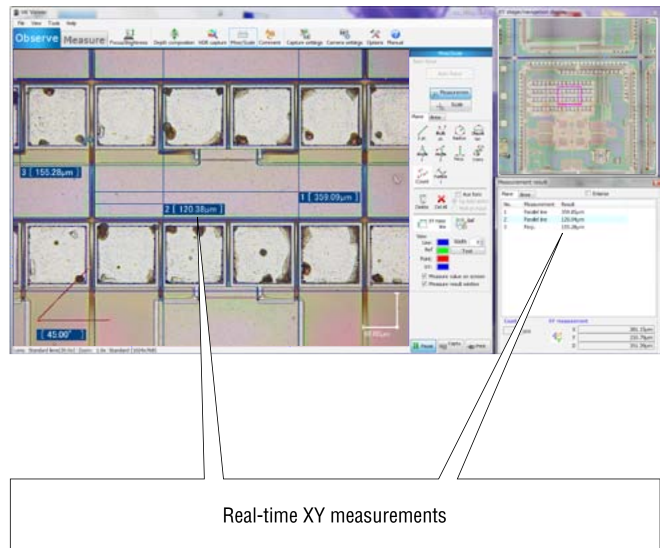
Our differential interference imaging method enhances surface details and makes nano-level features visible. 3D images more clearly display changes in surface texture, making it easier to accurately measure differences in height.



Real-time on-screen measurements

X/Y DIMENSION MEASUREMENT (TRACEABILITY SUPPORT)

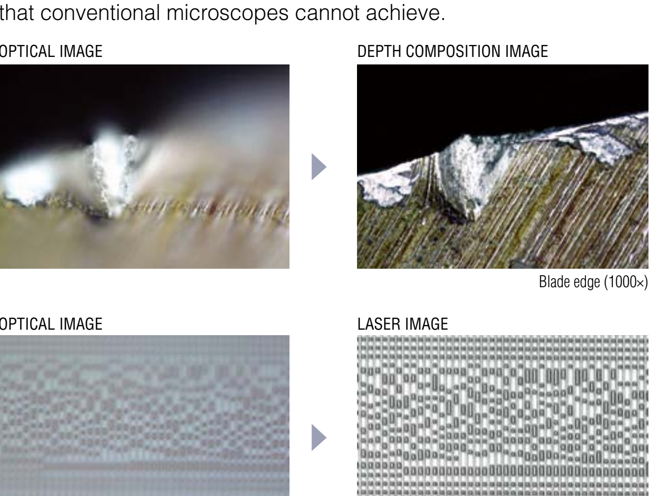
Besides 3D measurement, the VK-X is able to apply up to 19 different types of 2D measurements on an image, including length, radius, angle, etc. Detailed analysis is possible without errors by using functions such as automatic edge extraction and multi-point input.



Fully focused images even at high magnification

HIGH-SPEED DEPTH COMPOSITION FUNCTION/ AUTO FOCUS

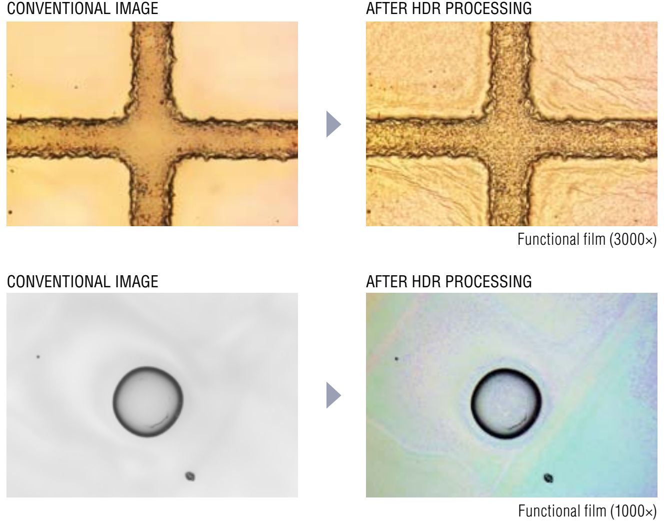
Even for samples with irregular surfaces or changes in height, only a part of which can be focused on by optical microscopes, the VK-X can create fully-focused images instantaneously.
Observation, measurement, and recording can be performed with the entire image fully-focused, enabling accurate and quick analysis that conventional microscopes cannot achieve.



Increase contrast and texture with 16-bit image data

HIGH DYNAMIC RANGE (HDR) FUNCTION

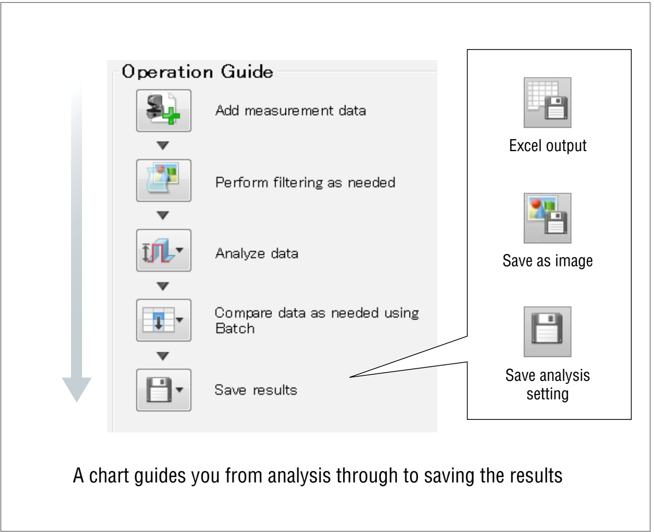
A single image with high-level gradation is generated by capturing several images with different brightness levels. This function can reproduce details of samples with poor texture, low contrast, or those that have glare, enabling incredibly clear observation.



Advanced analysis regardless of experience

EASY MODE

Easy mode is available so that even a first-time operator can easily combine advanced analysis automation tools. By simply following a flow chart, you can output data to Excel or save images. Analysis settings can also be saved so that they can be applied to other files.

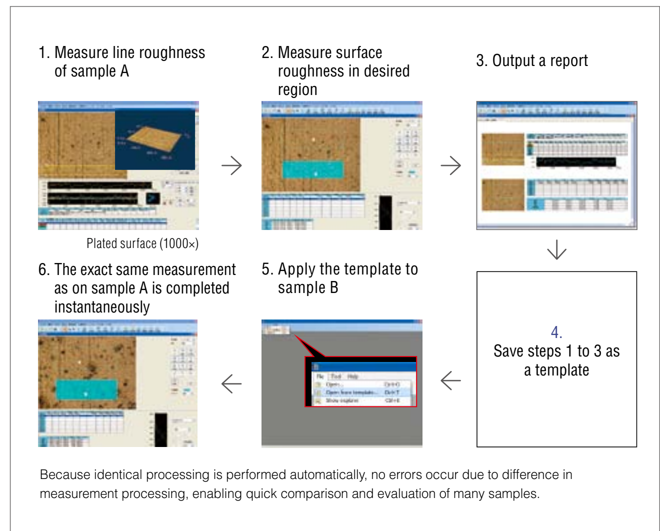


A chart guides you from analysis through to saving the results

Reproducible analysis reports

TEMPLATE FUNCTION

All operations and measurements can be recorded as a template. This function enables the exact same operations to be performed automatically for a different image. Analysis results can be obtained quickly and without variation between users, even when measuring a large number of samples.



Because identical processing is performed automatically, no errors occur due to difference in measurement processing, enabling quick comparison and evaluation of many samples.

Optimal for fully-experienced operators

EXPERT MODE

To unlock the full potential of the system, Expert Mode allows users to manually control all measurement settings, including brightness, measurement range, and scan speed. Scan method can also be adjusted depending on the required measurement data (surface profile, transparent surface measurement, and film thickness).

Unlimited site license

INDEPENDENT APPLICATION

Each software package for the VK-X has an unlimited site license. Share the software between multiple computers or departments to increase efficiency.

Compare with design drawings

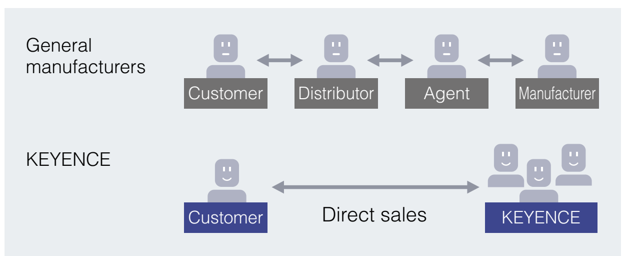
OUTPUT CAD DATA

3D data measured by the VK-X can be output to STP and ASC files so that it can be used in various CAD software.

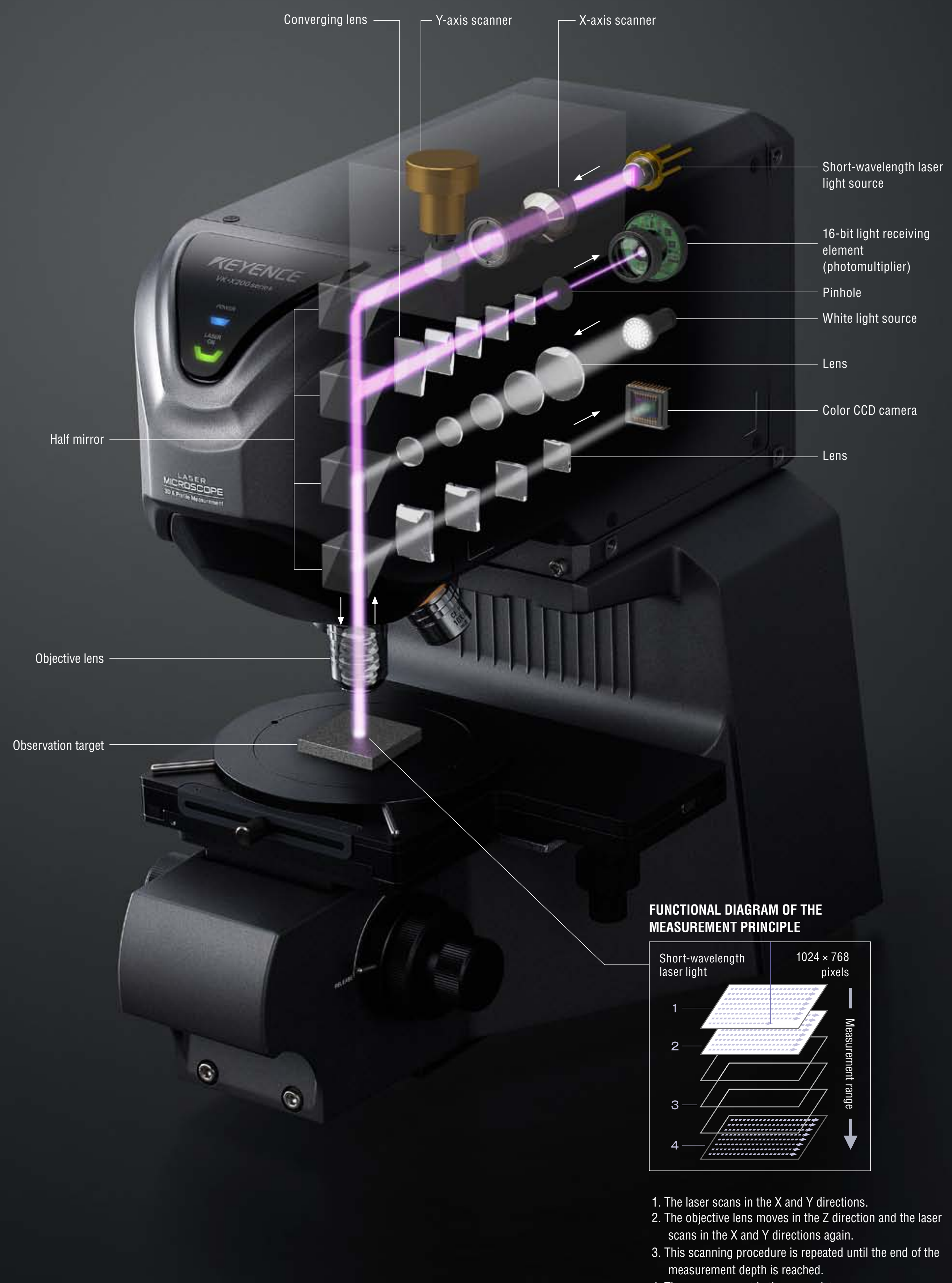
Fast and reliable service

DIRECT SALES MODEL PROVIDES UNMATCHED CUSTOMER SUPPORT

We provide our products directly from the manufacturer without using agents or distributors. Technically-knowledgeable sales engineers offer quick and thorough post-sales service and support. In addition to free on-site evaluation, replacement equipment are also available to use free of charge in the event that your system needs to be repaired. Our customers can confidently rely on our after-purchase support.



In addition to a Quick Start guide provided with the unit, an additional in-depth manual is also included.

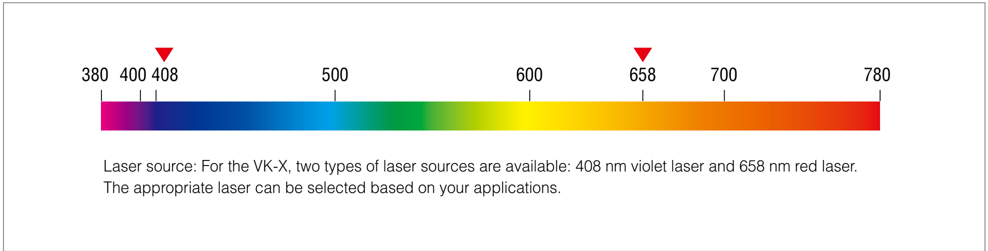


FUNCTIONAL DIAGRAM OF THE MEASUREMENT PRINCIPLE

1. The laser scans in the X and Y directions.
2. The objective lens moves in the Z direction and the laser scans in the X and Y directions again.
3. This scanning procedure is repeated until the end of the measurement depth is reached.
4. The measurement is then complete.

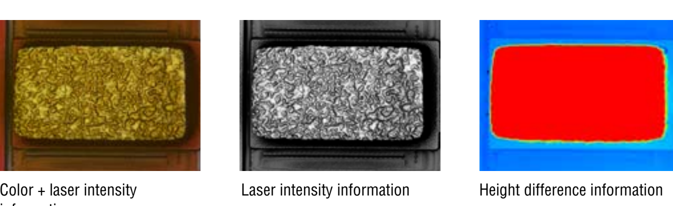
DUAL LIGHT SOURCES

The VK-X uses two light sources: a laser light source and white light source.
Image and height data are captured by using a high-speed scanner to raster the laser across the surface of the object. The white light source enables the capture of color information, similar to an optical microscope, while the laser information provides much higher lateral resolution.



THREE TYPES OF IMAGES

Laser light, transmitted through an X-Y scanning optical system, scans within the field-of-view by dividing the region into up to 2048 × 1536 pixels. This scanning is repeated for each Z-position within the measurement range to obtain matching reflected laser light data and color information for each pixel. Then, only the color and height data at each focal position is used to generate the high-resolution color and height-difference images.

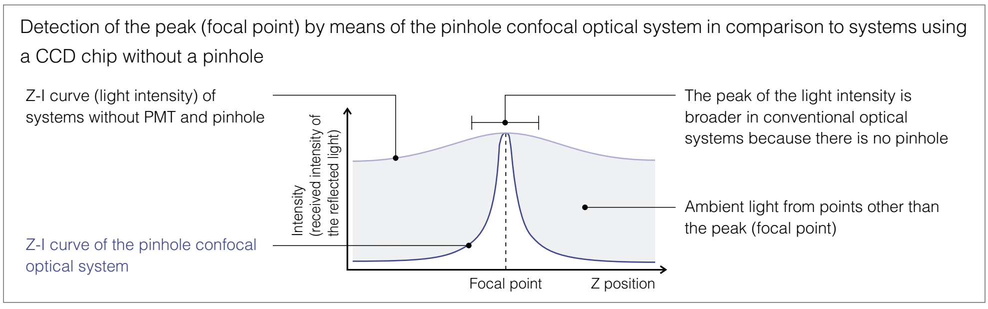


Color + laser intensity information | Laser intensity information | Height difference information

PINHOLE CONFOCAL OPTICAL SYSTEM

The VK-X incorporates a pinhole confocal optical system. Because an ultra-small pinhole completely eliminates ambient and out-of-focus light, the position that has reflected the most intense light can be recognized as the actual height. In addition to high-accuracy measurement, high-magnification, fully-focused imaging is also possible.

Detection of the peak (focal point) by means of the pinhole confocal optical system in comparison to systems using a CCD chip without a pinhole



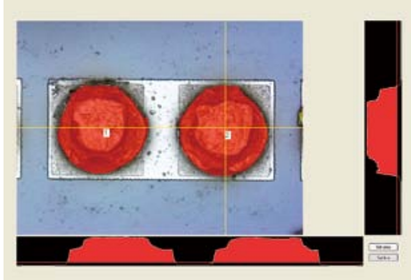
ANALYSIS EXPANSION MODULE VK-H1XP

The Analysis Expansion Module is available for samples that require position compensation and for measuring angles of spheres and planes. This module provides additional 3D measurement tools for improving analysis efficiency and flexibility.

MEASUREMENT OF BUMPS/VOIDS

Capture regions which lie above (bumps) or below (voids) defined limit values and measure area ratios and volume.

BUMP MEASUREMENT



	Average height	Max. height	C.S. area	Surface area	Volume	Area ratio
1	27.767um	40.005um	8113.581um2	15602.002um2	169761.452um3	10.205%
2	28.330um	43.170um	8136.815um2	15795.484um2	173880.683um3	10.244%
3	2.756um	5.959um	77.386um2	190.974um2	210.954um3	0.129%
Total	58.815um	86.135um	12327.886um2	31588.460um2	343833.089um3	20.578%
Max.	28.330um	43.170um	8136.815um2	15795.484um2	173880.683um3	10.244%
Min.	2.756um	5.959um	77.386um2	190.974um2	210.954um3	0.129%
Ave.	19.611um	28.713um	4109.162um2	10529.487um2	114611.030um3	6.859%
Std. DV	11.935um	16.086um	2851.121um2	7310.899um2	80910.378um3	4.759%
3sigma	35.804um	48.266um	8553.363um2	21932.578um2	242731.134um3	14.278%

Wire bond (2000×)

SPHERE MEASUREMENT AND SURFACE ANGLE MEASUREMENT

Extracts and measures the radii of a spherical structure based on 3D surface data. Eliminates user error by automatically extracting information instead of relying on a user's judgment.

SPHERE MEASUREMENT

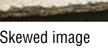
	Measurement m...	Setting method	Radius	Comment
1	Sphere	Rectangle	146.532um	
2	Sphere	Rectangle	142.829um	
3	Sphere	Rectangle	144.667um	
4				
5				
Total			434.027um	
Max.			146.532um	
Min.			142.829um	
Ave.			144.676um	
Std. DV			1.512um	
3sigma			4.535um	

Microlenses (1000×)

POSITION CORRECTION

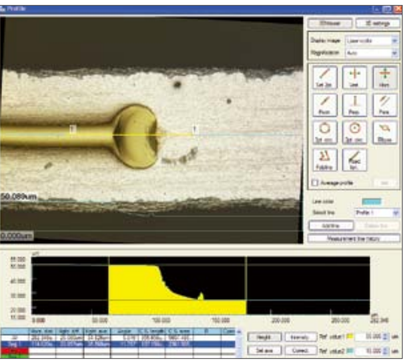
Automatically adjusts the image so that the image opens at the same position as another saved image. When applied within a template, this software can automatically align, process, and measure a large number of samples.

AUTOMATIC POSITION CORRECTION



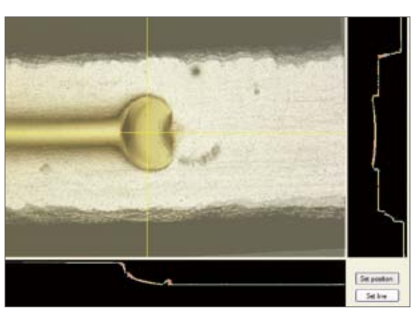
Skewed image

After automatic position correction



Wire bonding (1000×)

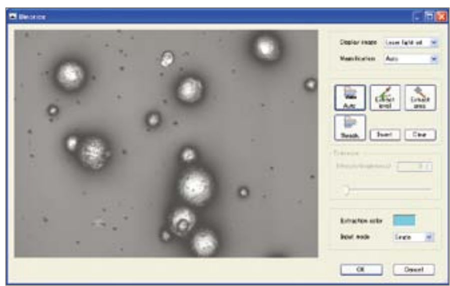
HEIGHT DIFFERENCE ANALYSIS FUNCTION

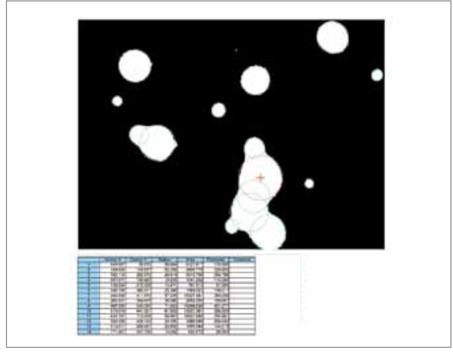


Analyzes the difference between two surfaces based on 3D image data. Enables surface-based image analysis that can capture even the smallest of changes.

PARTICLE ANALYSIS MODULE VK-H1XG

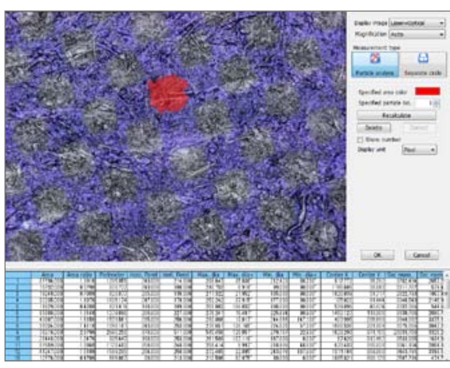
Automatically counts the number of particles and measures the diameters, major and minor axes, area, area ratio, etc. on a surface. Processing, such as circular shape separation, expansion, and erosion can also be performed automatically.

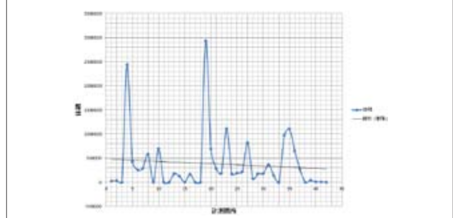




Metal surface with particles (1000×)

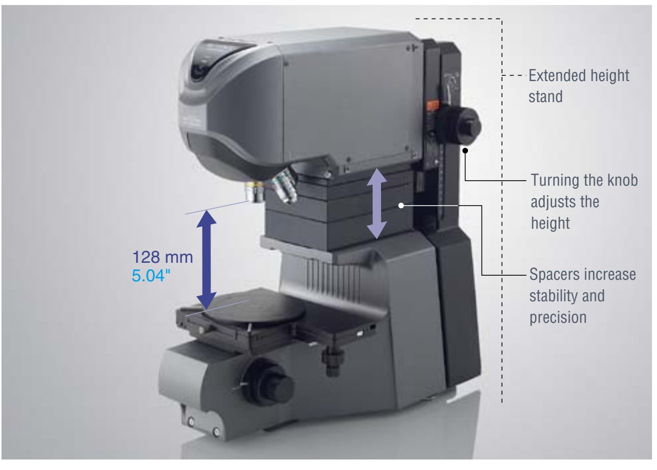
Particles can be counted and analyzed based on accurate 3D surface data instead of color or brightness changes like typical microscope systems. The results can be output to Excel or other software for further analysis or statistical processing.





EXTENDED HEIGHT STAND

This expandable stand attaches to the back of the microscope unit, giving the system the ability to adjust up to 100 mm 3.94" more than the standard setup. Spacers can be added in between the measurement head and base to increase the stability and improve measurement results at high-magnification.



MOTORIZED STAGE

The high-accuracy, motorized XY stage enables faster and more precise movement, teaching measurement, and image stitching capabilities. It is also possible to adjust the speed and acceleration of X/Y movement.

300 mm 11.81" WAFER STAGE

This easy-to-mount stage can examine and analyze the entire surface of a 300 mm 11.81" wafer. Please contact KEYENCE for other sizes.

300 × 300 mm 11.81" × 11.81" STAGE

A wide region can be measured by mounting the measurement head onto an optional, large motorized XY stage.

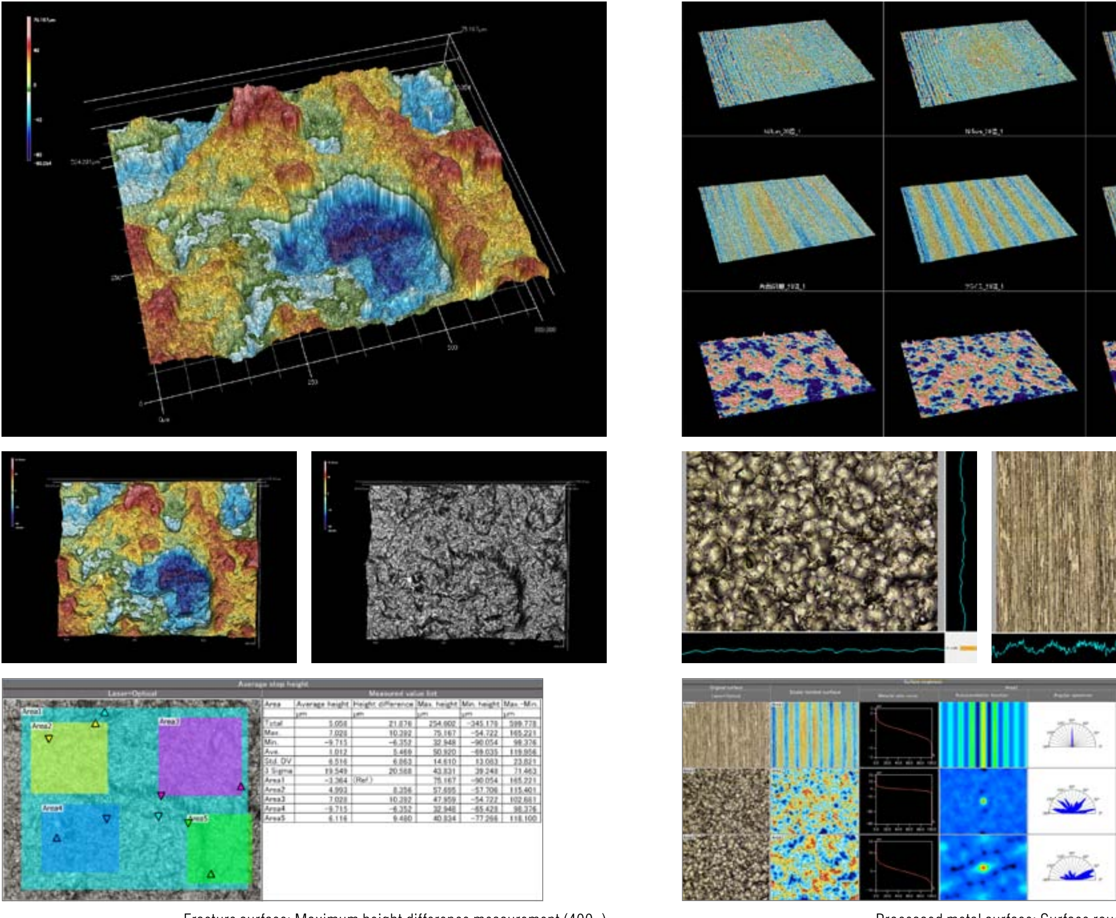
500 × 500 mm 19.69" × 19.69" STAGE

A 500 mm 19.69" stage is also available for customers who want to move the motorized XY stage over a wider range. Please contact KEYENCE for more information.

SUPER-LARGE SAMPLE STAGE

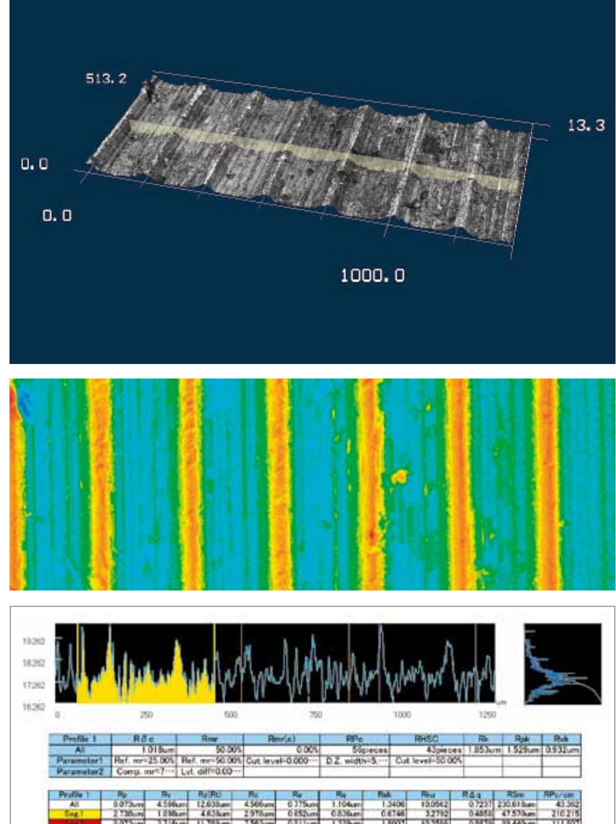
If requested, we can propose customized stages that can measure larger samples (e.g. solar panel substrates, etc.).

TRANSPORTATION AND METAL

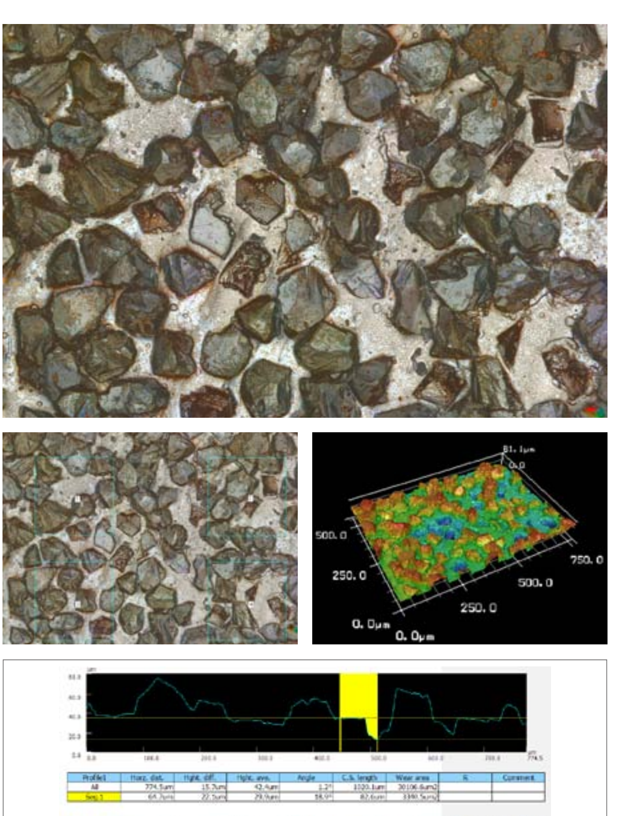


Fracture surface: Maximum height difference measurement (400×)

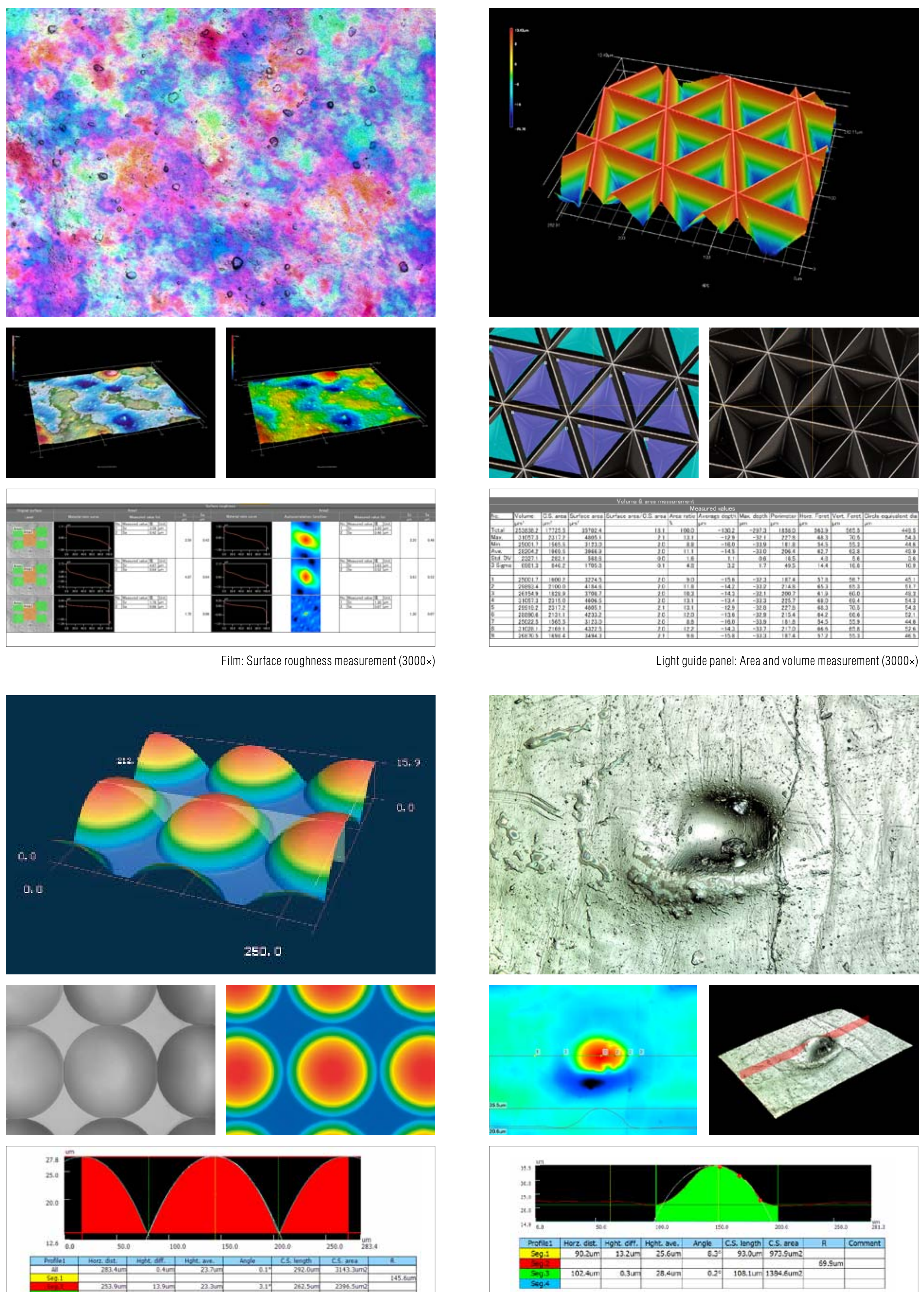
Processed metal surface: Surface roughness comparison (400×)



Steering component: Roughness measurement (400×, two images stitched)



Metal grindstone: Surface shape and roughness measurement (400×)



Film: Surface roughness measurement (3000×)

Volume & area measurement

Measured values

No.	Volume	C.S. area	Surface area	Surface area/C.S. area	Area ratio	Average depth	Max. depth	Perimeter	Horz. Feret	Vert. Feret	Circle equivalent dia
	μm³	μm²	μm²		%	μm	μm	μm	μm	μm	μm
Total	253838.2	17725.5	35702.4	13.1	100.0	-130.2	-297.3	1858.0	562.9	565.5	449.5
Max.	31057.3	2317.2	4805.1	2.1	13.1	-12.9	-32.1	227.8	68.3	70.5	54.3
Min.	25001.7	1565.5	3123.0	2.0	8.8	-16.0	-33.9	181.8	54.5	55.3	44.6
Ave.	28204.2	1960.5	3966.3	2.0	11.1	-14.5	-33.0	206.4	62.7	62.8	49.9
Std. DV	2327.1	282.1	568.5	0.0	1.6	1.1	0.6	16.5	4.8	5.6	3.6
3 Sigma	6981.3	846.2	1705.3	0.1	4.8	3.2	1.7	49.5	14.4	16.8	10.9
1	25001.7	1600.2	3274.5	2.0	9.0	-15.6	-32.3	187.4	57.8	58.7	45.1
2	29893.4	2100.0	4184.6	2.0	11.8	-14.2	-33.2	214.8	65.3	65.3	51.7
3	26154.9	1829.9	3798.7	2.0	10.3	-14.3	-32.1	200.7	61.9	60.0	49.3
4	31057.3	2315.0	4606.5	2.0	13.1	-13.4	-33.3	225.7	68.0	69.4	54.3
5	29910.2	2317.2	4805.1	2.1	13.1	-12.9	-32.8	227.8	68.3	70.5	54.3
6	28090.6	2131.1	4233.2	2.0	12.0	-13.6	-32.9	215.4	64.2	66.6	52.1
7	25022.5	1565.5	3123.0	2.0	8.8	-16.0	-33.9	181.8	54.5	55.9	44.6
8	31028.1	2169.1	4322.5	2.0	12.2	-14.3	-33.7	217.0	66.6	65.8	52.6
9	26870.5	1498.4	3494.3	2.1	9.6	-15.8	-33.3	187.4	57.2	55.3	46.5

Light guide panel: Area and volume measurement (3000×)

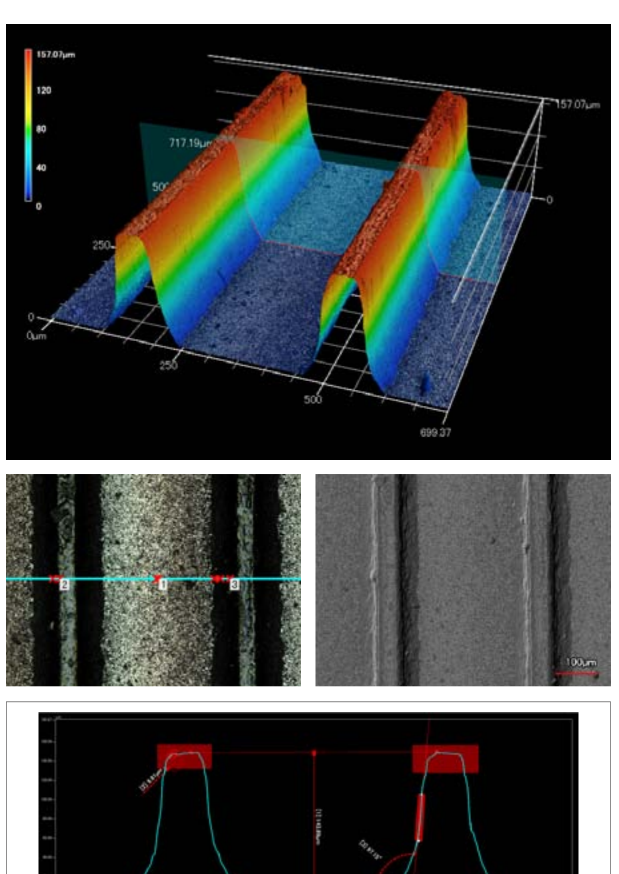
Profile1	Horz. dist.	Hght. diff.	Hght. ave.	Angle	C.S. length	C.S. area	R
All	283.4um	0.4um	23.7um	0.1°	292.0um	3143.3um2	
Seg.1							145.6um
Seg.2	253.9um	13.9um	23.3um	3.1°	262.5um	2396.5um2	
Seg.3	123.8um	0.3um	23.3um	0.1°	128.2um	1326.9um2	

Microlens: Radius measurement (1000×)

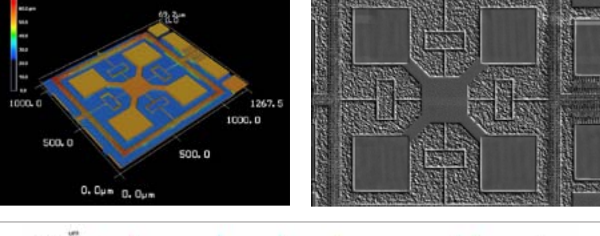
Profile1	Horz. dist.	Hght. diff.	Hght. ave.	Angle	C.S. length	C.S. area	R	Comment
Seg.1	90.2um	13.2um	25.6um	8.3°	93.0um	973.9um2		
Seg.2							69.9um	
Seg.3	102.4um	0.3um	28.4um	0.2°	108.1um	1394.6um2		
Seg.4								

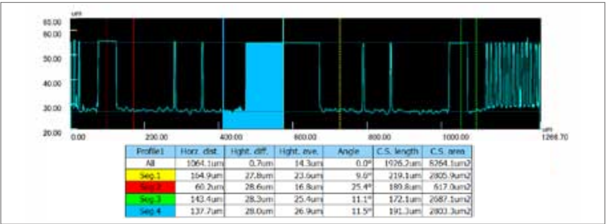
Film: Fish eye measurement (1000×)

SEMICONDUCTOR AND ELECTRONIC COMPONENTS



PDP: Sectional measurement (1000×)

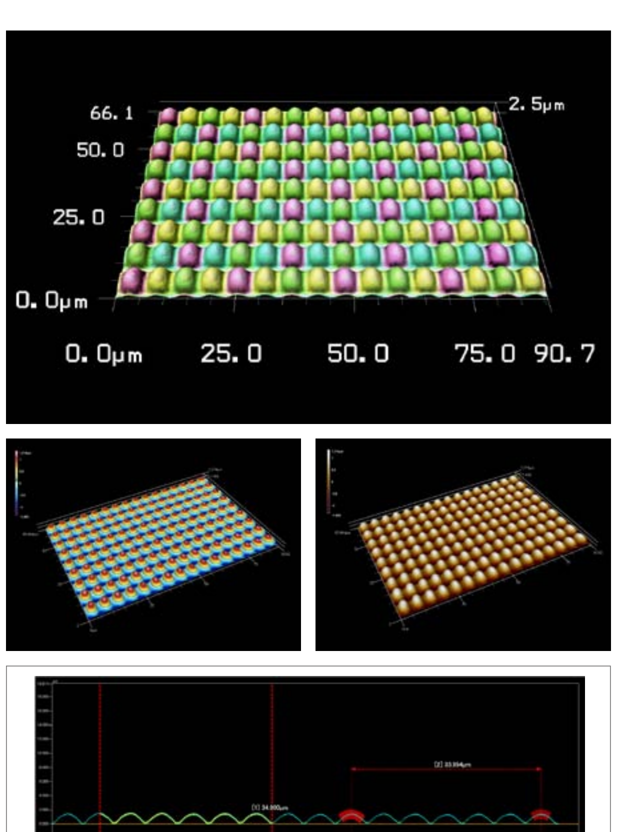




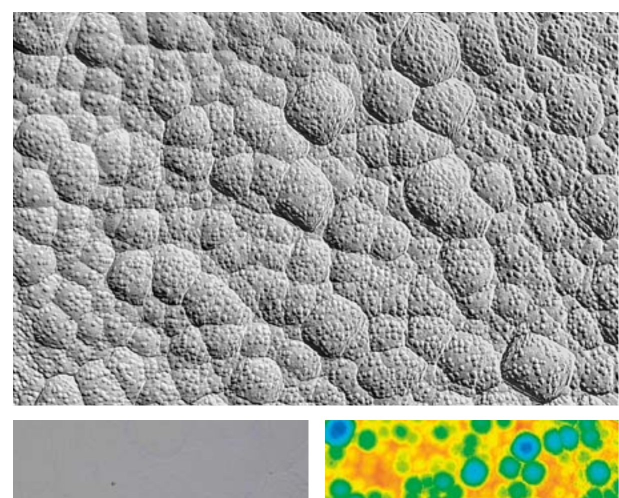
Profile1	Horz. dist.	Hght. diff.	Hght. ave.	Angle	C.S. length	C.S. area
All	1064.1um	0.7um	14.3um	0.0°	1926.2um	8264.1um2
Seg.1	164.9um	27.8um	23.6um	9.6°	219.1um	2805.9um2
[illegible]	60.2um	28.6um	16.8um	25.4°	180.8um	617.0um2
Seg.3	143.4um	28.3um	25.4um	11.1°	172.1um	2687.1um2
Seg.4	137.7um	28.0um	26.9um	11.5°	191.3um	2803.3um2

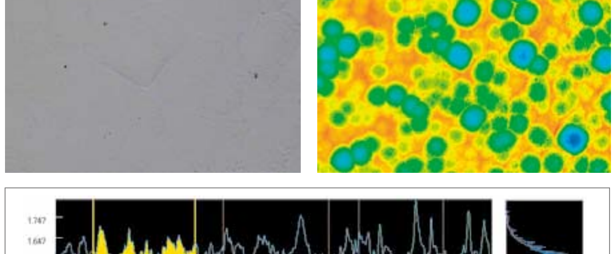
MEMS: Height and width measurement (200×)

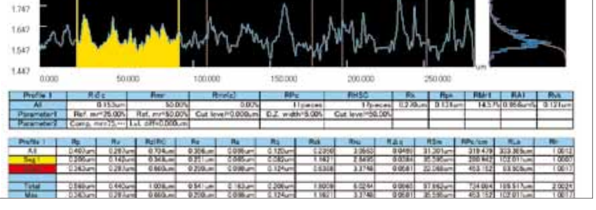
Provided by Mita Laboratory Department of Electrical Engineering and Information Systems, Graduate School of Engineering, University of Tokyo Generated at the VLSI Design and Education Center (VDEC) at the University of Tokyo



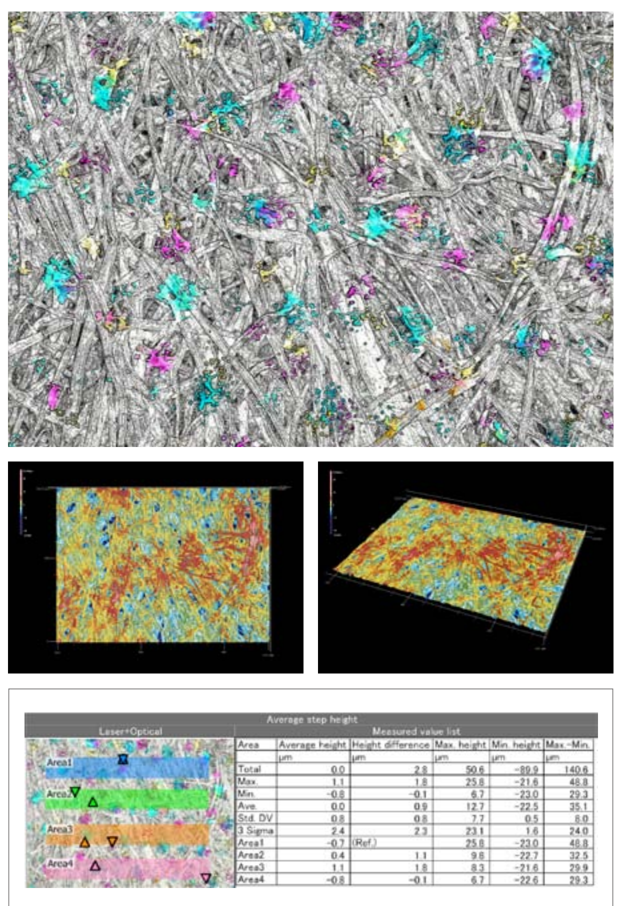
CCD: Sectional length measurement (3000×)





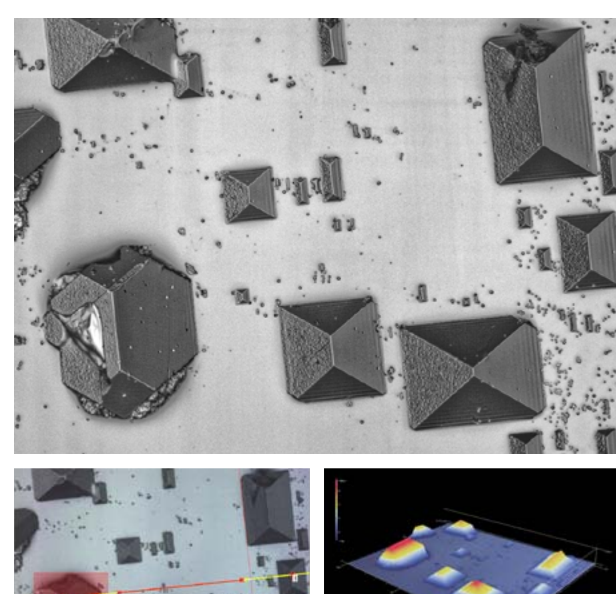


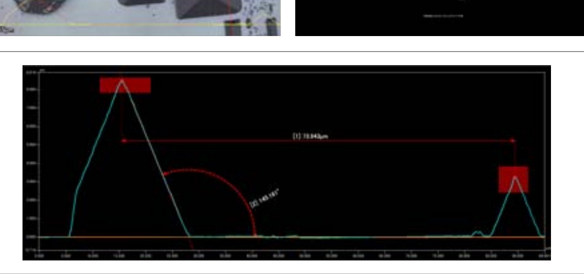
Wafer backside: Roughness measurement (1000×)



Area	Average height	Height difference	Max. height	Min. height	Max.-Min.
	µm	µm	µm	µm	µm
Total	0.0	2.8	50.6	-89.9	140.6
Max.	1.1	1.8	25.8	-21.6	48.8
Min.	-0.8	-0.1	6.7	-23.0	29.3
Ave.	0.0	0.9	12.7	-22.5	35.1
Std. DV	0.8	0.8	7.7	0.5	8.0
3 Sigma	2.4	2.3	23.1	1.6	24.0
Area1	-0.7	(Ref.)	25.8	-23.0	48.8
Area2	0.4	1.1	9.6	-22.7	32.5
Area3	1.1	1.8	8.3	-21.6	29.9
Area4	-0.8	-0.1	6.7	-22.6	29.3

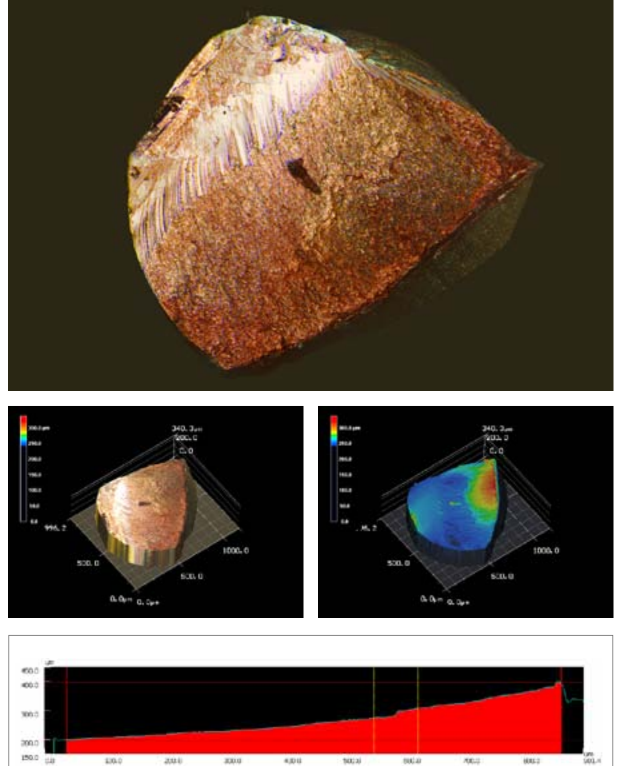
Paper surface: Degree of flatness measurement (100×)





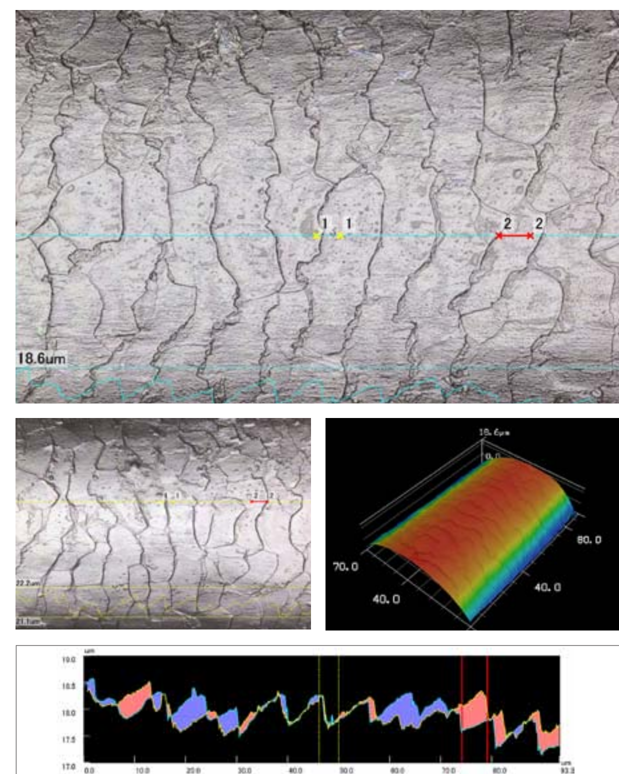
Assets on GaAs due to liquid phase growth (3000×):

Provided by Prof. Tadaaki Kaneko, Department of Chemistry, School of Science and Technology, Kansei Gakuin University



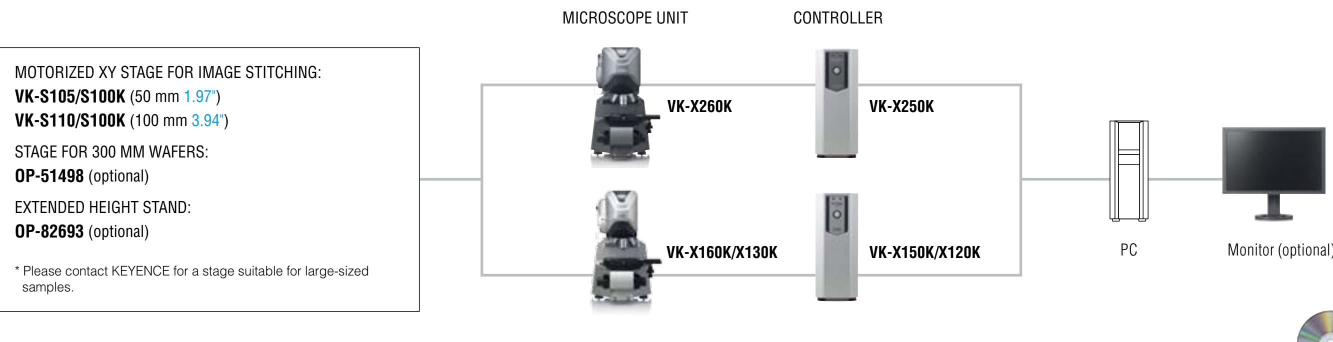
Profile1	Horz. dist.	Hght. diff.	Hght. ave.	Angle	C.S. length	C.S. area	R	Comment
All	901.4um	329.5um	265.7um	20.1°	1488.3um	151032.6um2		
Seg.1	74.1um	33.2um	288.4um	24.1°	95.4um	14111.0um2		
Seg.2	827.3um	197.2um	268.8um	13.4°	1129.1um	139761.3um2		
Seg.3								

Metal fracture surface: Striation (200×)



Hair: Cuticle comparison (3000×)

SYSTEM CONFIGURATION



MOTORIZED XY STAGE FOR IMAGE STITCHING:
VK-S105/S100K (50 mm 1.97")
VK-S110/S100K (100 mm 3.94")

STAGE FOR 300 MM WAFERS:
OP-51498 (optional)

EXTENDED HEIGHT STAND:
OP-82693 (optional)

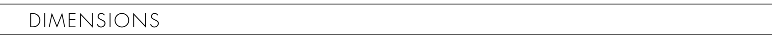
* Please contact KEYENCE for a stage suitable for large-sized samples.

OBSERVATION APPLICATION: **VK-H1XV2E**
IMAGE STITCHING APPLICATION: **VK-H1XJE** (optional)

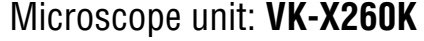
MULTI-FILE ANALYSIS APPLICATION: **VK-H1XME**
PARTICLE ANALYSIS MODULE: **VK-H1XG** (optional)

ANALYSIS EXPANSION MODULE: **VK-H1XP** (optional)
ISO 25178 SURFACE TEXTURE MEASUREMENT MODULE: **VK-H1XR** (optional)

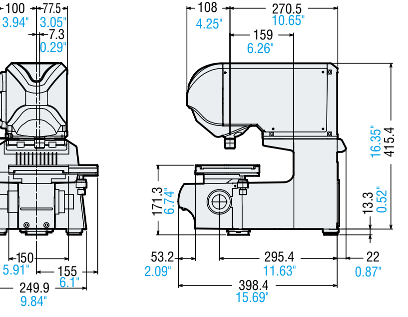
DIMENSIONS



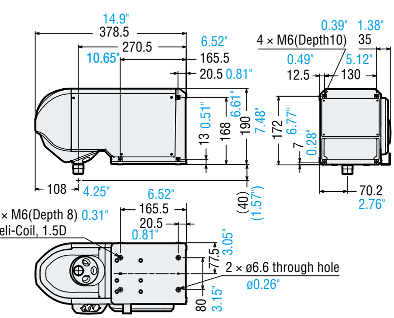
Unit: mm inch



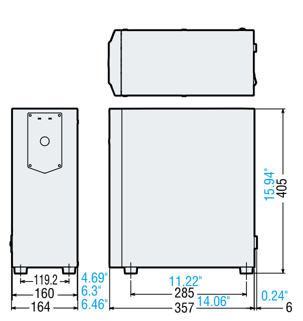
Microscope unit: **VK-X260K**



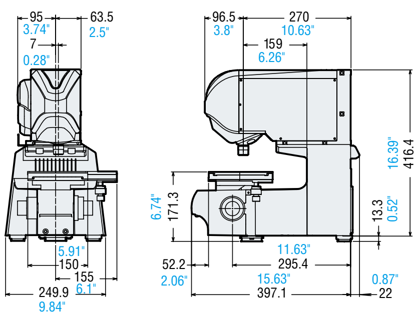
Measurement head



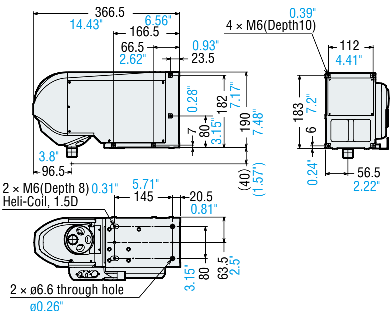
Controller: **VK-X250K**



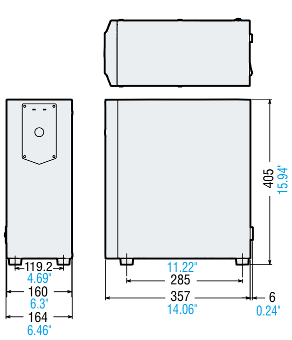
Microscope unit: **VK-X160K/X130K**

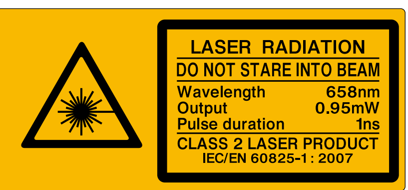


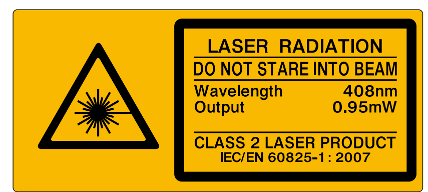
Measurement head



Controller: **VK-X150K/X120K**







BASIC FUNCTIONS

Model (controller/microscope unit)		VK-X250K/X260K	VK-X150K/X160K	VK-X120K/X130K
Total magnification*1		Up to 28000×	Up to 19200×	
Field of view (minimum range)		11 µm to 5400 µm 0.43 Mil to 212.6 Mil	16 µm to 5400 µm 0.63 Mil to 212.6 Mil	
Frame rate*2 (laser measurement speed)		4 to 120 Hz, 7900 Hz		
Measurement principle	Optical system	Pinhole confocal optical system		
	Light receiving element	16-bit photomultiplier		
	Scanning method (during general measurement and image stitching)	Automatic upper/lower limit setting, high-speed light intensity optimization (AAGII), poor reflected light intensity supplement (Double Scan)		
Height measurement	Display resolution	0.5 nm 0.00002 Mil	5 nm 0.0002 Mil	
	Linear scale	0.5 nm 0.00002 Mil	5 nm 0.0002 Mil	
	Dynamic range	16 bits		
	Repeatability σ*3	20× 40 nm 0.0016 Mil, 50× 12 nm 0.0005 Mil, 150× 12 nm 0.0005 Mil	20× 40 nm 0.0016 Mil, 50× 20 nm 0.0008 Mil, 100× 20 nm 0.0008 Mil	
	Memory for Z-axis measurement	14 million steps	1.4 million steps	
	Accuracy*3	0.2+L/100 µm 0.008+L/0.004 Mil or less (L=Measuring Length)		
Z stage configuration	Structure	Base with separate measuring head		
	Maximum sample height	28 mm, 128 mm 1.1", 5.04" (optional)		
Width measurement	Display resolution	1 nm 0.00004 Mil	10 nm 0.0004 Mil	
	Repeatability 3σ*3	20× 100 nm 0.004 Mil, 50× 40 nm 0.0016 Mil, 150× 20 nm 0.0008 Mil	20× 100 nm 0.004 Mil, 50× 50 nm 0.002 Mil, 100× 30 nm 0.001 Mil	
	Accuracy*3	±2%		
XY stage configuration	Manual: Operating range	70 mm × 70 mm 2.76" × 2.76"		
	Motorized: Operating range*4	50 mm × 50 mm 1.97" × 1.97" 100 mm × 100 mm 3.94" × 3.94"		
Observation	Observation image	Super-high-resolution color CCD image 16-bit laser color confocal image Confocal + ND filter optical system C-laser differential interference image		
	Maximum capture resolution	3072 × 2304		
Measurement laser light source	Wavelength	Violet laser, 408 nm	Red semiconductor laser, 658 nm	
	Maximum output	0.95 mW		
	Laser Class	Class 2 laser product (IEC60825-1)		
Weight	Microscope unit	Approx. 26 kg (sensor head detached: approx. 10 kg)	Approx. 25 kg (sensor head detached: approx. 8.5 kg)	
	Controller	Approx. 11 kg		

*1: For 23-inch monitors. *2: At top speed when using a combination of measurement mode/measurement quality/lens magnification. When the line scan has a measurement pitch that is within 0.1 µm 0.004 Mil.
*3: When measuring a standard sample (standard scale) with a 20× or greater lens at an ambient temperature of 20 ± 2°C 68 ± 3.6°F. However, does not apply to the VK-X120/130 with a 50× lens. *4: When a motorized stage is mounted.

MEASURING LENSES

Objective lens	W/D (mm inch)	Field of view	VK-X260K	VK-X160K	VK-X130K
×2.5	8.8 0.35"	675 × 506 µm to 5400 × 4048 µm 26.57 × 19.92 Mil to 212.6 × 159.37 Mil	Optional	Optional	Optional
×5	22.5 0.89"	337 × 253 µm to 2700 × 2025 µm 13.27 × 9.96 Mil to 106.3 × 79.72 Mil	Optional	Optional	○
×10	16.5 0.65"	168 × 126 µm to 1350 × 1012 µm 6.61 × 4.96 Mil to 53.15 × 39.84 Mil	○	○	○
×20	3.1 0.12"	84 × 63 µm to 675 × 506 µm 3.31 × 2.48 Mil to 26.57 × 19.92 Mil	○	○	○
×50	0.35 0.01"	33.7 × 25.2 µm to 270 × 202 µm 1.33 × 0.99 Mil to 10.63 × 7.95 Mil	○	○	○
×100	0.54 0.02"	16.8 × 12.6 µm to 135 × 101 µm 0.66 × 0.5 Mil to 5.31 × 3.98 Mil	Optional	○	Optional
×150	0.3 0.01"	11 × 8.3 µm to 90 × 67 µm 0.43 × 0.33 Mil to 3.54 × 2.64 Mil	○	Optional	Optional
Long range, 20×	11.0 0.43"	84 × 63 µm to 675 × 506 µm 3.31 × 2.48 Mil to 26.57 × 19.92 Mi	Optional	Optional	Optional
Long range, 50×	8.7 0.34"	33.7 × 25.2 µm to 270 × 202 µm 1.33 × 0.99 Mil to 10.63 × 7.95 Mil	Optional	Optional	Optional
Long range, 100×	2 0.08"	16.8 × 12.6 µm to 135 × 101 µm 0.66 × 0.5 Mil to 5.31 × 3.98 Mil	Optional	Optional	Optional
Ultra-long range, 20×	20.5 0.81"	84 × 63 µm to 675 × 506 µm 3.31 × 2.48 Mil to 26.57 × 19.92 Mil	Optional	Optional	Optional
Ultra-long range, 50×	13.8 0.54"	33.7 × 25.2 µm to 270 × 202 µm 1.33 × 0.99 Mil to 10.63 × 7.95 Mil	Optional	Optional	Optional
Ultra-long range, 100×	4.7 0.19"	16.8 × 12.6 µm to 135 × 101 µm 0.66 × 0.5 Mil to 5.31 × 3.98 Mil	Optional	Optional	Optional
Lens replacement			Can be replaced by the user		

VARIOUS FUNCTIONS

Function	Description
Microscope functions	Auto focus, depth composition, dimension measurement, automatic edge detection, HDR
Analysis functions	Shape analysis, profile/step/angle/volume/surface area/radius/roughness (ISO)/film thickness (line and surface), teaching, automatic measurement, comparative analysis, template, automatic template positioning (optional),particle analysis (optional)
Multiple file analysis functions	Multiple file display (Multi-File View) Reference plane setting (Real Datum Set) Multiple file condition unification (Auto Arrange) Collective height display setting: Collectively changes the height display for multiple pieces of measurement data. For example, the height range can be unified for all measurement data based on the reference plane (height = 0). Collective graph display setting: X-axis and Z-axis setting unification, zero display for the minimum profile point, line fitting for each profile data, adjustment based on specified data. Image processing unification: Applies image processing executed for particular measurement data to other measurement data Analysis setting unification: Applies analysis processing executed for particular measurement data to other measurement data Multiple file analysis setting saving Roughness parameter suggestion (Ra, Sz, Sdr, Sa, RSm, Str, Spc, etc.) 3D list display

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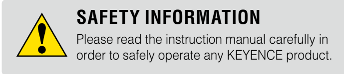

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