3D SURFACE MEASUREMENTS IN AS LITTLE AS 4 SECONDS
ONE-SHOT 3D MEASUREMENT

JUST PLACE AND CLICK TO COLLECT 3D DATA

NEW
Wide-Area 3D Measurement System
VR-3000 Series
Measure an entire area in as little as four seconds with 0.1 μm vertical resolution

1 **Quick, accurate 3D measurements**

Analyze form, contour, and roughness with 780,000 data points in a single image

2 **Complete 3D surface analysis**

XYZ traceable measurements compliant with international standards

3 **Unmatched measurement precision**
Conventional Measuring Instruments

When measuring only points and lines

- Typical measurement systems only provide measurement data on the areas that they are able to contact with a probe tip.
- Measuring specific locations by simply eyeing where to put the probe makes the results unreliable.

- Measurement of specific areas is difficult
- Measurements take a long time
- Measurement results vary from person to person
Non-contact surface scanning

The VR-3000 Wide-Area 3D Measurement System quickly scans the entire topography of a surface so that reliable measurements can be made at any point on an object.

- Max and min heights can be reliably measured
- Scans in as little as 4 seconds
- Repeatable and reproducible measurement results
Quick, accurate 3D measurements

Just click!

Measurements in as little as 4 seconds
Anyone Can Measure Quickly and Accurately
Highly-reproducible measurements with 0.1 μm z-resolution in as little as 4 seconds

Fast measurement with no need to worry about probe placement

With conventional profile measurement systems, a user may spend a lot of time positioning the probe tip to touch the correct area of the target. The VR-3000 Series makes it simple by only requiring that the user place the sample on the stage, and then click the Measure button to collect data in as little as four seconds.

Scans the entire surface to ensure that no data is missed

With the VR-3000 Series, 3D information for the entire surface is obtained with a single scan. Users can see the overall shape of the target, including the highest and lowest points, without having to re-scan the surface or guess-and-check as to whether the correct location has been measured.

With conventional profile measurement systems, set up and measurement is time-consuming.

Various adjustments are required, such as selection of the sample type, stylus tip, and measurement parameters. In addition, it’s nearly impossible to tell whether measurement of the designated point has been performed.

Dent measurements
Precise positioning is difficult.

User-caused errors are frequent. Extensive training is required. Difficult to reproduce results.
Complete 3D surface analysis

Measure the entire surface, not just points or lines

With a CMM or contact profiler, it’s necessary to measure several places in order to try to understand the shape of the surface.

With a coordinate-measuring machine... measurement is performed at a **point**

With a profile measuring instrument... measurement is performed in a **line**
Visualize Your Surface Like Never Before
Measure the entire surface and analyze the overall shape

When measuring with points and lines...
With point and line measurements, it’s hard to know where to measure when trying to find the difference between the highest point and the lowest point.
- No way to see the highest or lowest points
- Difficult to measure exact locations

With one-shot 3D measurement
One-shot measurement of the entire surface is performed, making it possible to see a target’s overall shape and waviness.
- See highest and lowest points at a glance
- Quickly obtain the overall shape

Measure any location after just one scan
Because the VR-3000 Series shows the overall shape of a target, including the highest and lowest points, measurement can be done for any targeted area. The surface data obtained can also be reanalyzed and measured at any point in the future.
Patterned light is emitted from the transmitter lens and projected onto the surface of the object. When the reflected light is viewed from a different angle using the receiver lens, the light appears banded and bent due to the height changes on the object’s surface. A CMOS camera is used to capture the reflected light, and based on triangulation, the height and position can be calculated.

**Measurement principle**

**Light-section method**

Triangulation measurement of height differences using structured illumination

Patterned light is emitted from the transmitter lens and projected onto the surface of the object. When the reflected light is viewed from a different angle using the receiver lens, the light appears banded and bent due to the height changes on the object’s surface. A CMOS camera is used to capture the reflected light, and based on triangulation, the height and position can be calculated.
Calculating height

Changes in height will cause the patterned light to appear bent at each height change. The amount of the bend, or \( d \) in the image to the left, is used to calculate the height.

**Highly-efficient measurement algorithms**

Accurate, repeatable, and traceable results

---

**One-shot 3D Algorithm**

We combined our TMT one-shot algorithm for high-accuracy, true color measurements with our high resolution 3D technology to create the world’s first algorithm for instant 3D measurement.

**TMT (Telecentric Multi-Triangulation) Algorithm**

By using three, double-telecentric lenses with the multi-triangulation technology of our displacement gauges, we have created a unique algorithm for quick and accurate 3D measurement.

**Real color 3D Technology**

Red, green, and blue light from a dedicated lighting unit are captured by a new high-accuracy CMOS sensor. Images captured separately with each light color are compiled to create a full color image. This process produces vivid and detailed images that cannot be obtained with a standard color camera and white-light illumination.

---

**XYZ Traceability**

The measurement results, obtained using the world’s first algorithm of its type, are traceable according to international standards, so users can obtain highly-reliable measurements.

**Calibration**

An inspection report and calibration gauge with calibration certificate are standard items included with each system. The gauge uses the same reference scale used by JCSS certified operators. Instead of hiring a technician to perform calibration, users can easily do it themselves on-site.
**Technology designed for high-precision**

Sophisticated optics and hardware

---

**Minimal distortion over the entire measurement area.**

Three, Double-telecentric Lenses

To achieve high-accuracy 3D measurement, it is crucial that the transmitter and receiver lenses are made in such a way to minimize distortion, and that changes in the distance between the object and lens do not alter the size of the image. The VR-3000 contains a total of three wide telecentric lenses, used in combination with the industry’s largest CMOS. The advanced optical design allows high-accuracy one-shot 3D measurement of areas up to 3 cm 1.18”.

---

**Telecentric Lenses Improve Accuracy**

---

**Feature size is unchanged as the lens moves through focus**

When measuring objects with height differences, it is important that the field-of-view remains constant as the lens moves in the Z direction. By using a telecentric lens, the VR-3000 can accurately measure height differences up to ±5 mm ±0.20” at one time.

---

**Minimizes distortion at the periphery**

When measuring a wide area, stretching 30 mm 1.18” diagonally, in one shot, telecentric lenses will result in minimal distortion throughout the entire field-of-view. Telecentric lenses also provide clearer, sharper, and more accurate image details.

---

**Transmitter lens provide uniform illumination**

With a telecentric lens, the target is illuminated evenly throughout the entire measurement range. This allows for high-accuracy measurement of the target no matter where it is placed.
High-accuracy CMOS sensor
The industry’s largest high-accuracy CMOS is used, allowing data to be obtained with minimal noise for high-resolution image capture.

Specially designed vibration-proof rubber
The VR-3000 is equipped with vibration-proof rubber with over four times the vibration prevention of conventional materials. The material absorbs a wide range of vibration, from low to high frequencies, allowing for stable imaging and measurement even at high magnifications.

Real color light unit
The VR-3000 has a light source that emits red, green, and blue light for true color reproduction. The combination of an optical system and optical fibers minimizes inaccuracies when composing the color.

Accurate Imaging
No Vibration Isolation Required
Designed to withstand large amounts of vibration
Strength analysis was used to create a highly-rigid frame and remove the need for vibration isolation equipment, such as an air table. The image below is a diagram of the strength analysis on the structure of the system.

Specially designed vibration-proof rubber
The VR-3000 is equipped with vibration-proof rubber with over four times the vibration prevention of conventional materials. The material absorbs a wide range of vibration, from low to high frequencies, allowing for stable imaging and measurement even at high magnifications.
Numerous measurement and analysis functions
From shape and roughness to volume and 2D measurements

Height/width/angle/radius measurement

Profile measurement

Measurements such as height, width, cross-sectional area, angle, and radius can be made by simply pointing and clicking across the desired area. Up to 12 different types of measurements can be performed.

Height difference/planarity measurement

Measure average height difference

Height differences between two surfaces can be measured using 780,000 data points. The surface data can also be used for performing planarity measurements.

Volume/area/counting

Measure volume and surface area

Using height data, a target's volume, area, and the XY dimensions of a specified height can be measured. Counting can also be performed simultaneously.
Support for a wide range of measurements, from 2D to 3D

Curvature, line roughness (ISO 4287: 1997), surface roughness (ISO 25178)

### Line roughness

Calculate typical roughness parameters, such as Ra, Rz, etc. With several measurement options available, even measurements that are difficult to perform with contact profilers, like those on circularly-shaped parts, can be done.

### Surface roughness

Measure surface roughness in accordance with ISO 25178. These measurements evaluate data over an area, giving more reliable roughness results by taking into account more data points.

### 2D measurement

Various 2D measurements are available including distances between points, lines, and circles, diameter, and angle. Users can also measure the height at specific points on the image by just clicking the location on-screen.
Measurements including cross-section, volume, area, planarity, and roughness can be performed on several files simultaneously and under the same measurement conditions. For example, users are able to see changes in topography or shape between prototypes that were made under different manufacturing conditions or to visualize and measure surface wear over time. This greatly reduces the number of operations and process time required for measurement and prevents mistakes from occurring due to changes in measurement conditions.

**NEW FEATURE**

**Compare and differentiate between multiple samples simultaneously**

**NEW** Multi-file analysis function

**Auto Arrange function**

Auto Arrange makes it possible to batch process all the data through a single operation, reducing analysis time and preventing measurement errors.

**Quickly compare topography: 3D List Display function**

Visually compare 3D images from multiple samples side-by-side for easier understanding and explanation of surface changes or differences.
Advanced support functions for improved analysis

Efficient data collection: Continuous Measurement Mode

The VR-3000 Series incorporates a continuous measurement mode that captures data in a more streamlined process. Measurement can be done without moving between software, allowing work to be performed with greater efficiency.

High reproducibility: Position Adjustment & Pattern Matching

A semi-transparent master image is displayed on-screen to be used as a reference for position alignment. Simply place the object near the reference image and click a button to perform automatic positioning. Additionally, small changes in alignment can be corrected through the use of highly-accurate pattern matching.

Output and analyze data post-process: Excel Data Output/CAD Output

Data collected by the VR can be output directly to Excel exactly as it appears on the screen. In addition, all measurement results can be exported to CAD, including STL, STEP, and ASCII file types, giving you a wide variety of options in how the data can be utilized.
Profile comparisons between defective and non-defective parts, as well as for CAD data, prototypes, and other targets, is easy. The overall surface shapes obtained can be used for measuring the differences between the same locations in two different data sets.

No complex settings: Auto Position Adjustment function

3D position adjustment for tilting and height misalignment is done automatically by taking into account various elements, including reference planes.

Visualization of shape differences: [Subtraction] Color Display function

Two objects can be overlaid, and areas higher than the reference are displayed in red while lower areas are displayed in blue. This makes it possible to check differences visually.

* VR-H2P software module is required for the data comparison function, and VR-H2CA software module is required for CAD comparisons.
Quick and easy 3D shape inspection

Based on registered tolerances, pass/fail (OK/NG) judgment can be made as soon as measurements are taken. This saves inspection time in various quality and analysis applications such as setting prototype conditions or performing acceptance inspections.

**Easy configuration of program settings:**
Program Settings function

Configuring program settings is simple. No special training is required. Registered inspection setting files can also be used in other systems.

**Efficient management of measurement results:**
Statistical Analysis function

Measurement results are automatically stored in the database, and trend graphs and histograms are automatically created. Reports to be submitted to relevant parties can also be created automatically, minimizing the time required for various operations following inspection.
Measure form and contour over a wide area
Image stitching function

Incline correction
Stage inclination caused by the weight of an object can be accurately corrected using a built-in stage sensor.

Auto Focus mode
The VR-3000 implements an Auto Focus function that is able to automatically adjust for changes in an object’s height when stitching in the XY directions.

Data recapture
If any area is not originally captured when stitching, it is possible to re-scan only those specific locations, without having to re-scan the entire part again.

Measure over a large area with a high-speed, motorized XY stage

High-speed image stitching process

Precision measurement is ensured even on a stitched image.
**Functions as both a 3D measurement system and microscope**

**High-definition imaging**

**9 megapixel 3 CMOS camera**

Red, green, and blue data are obtained for each pixel, allowing for clear observation with excellent color reproduction.

Samples can be imaged under magnifications ranging from 12x to 160x. High resolution images of up to 9 megapixels can be captured and saved by simply pushing the Capture button.

**16-bit HDR function**

The VR-3000 is able to capture up to 16 bits of red, green, and blue color data to perform significantly more accurate imaging of a sample than what can be captured with traditional 8-bit devices.

**Built-in depth composition function**

When analyzing samples with a large change in height, or when increasing the magnification, the depth-of-field can become limited. The VR-3000’s telecentric lenses and depth composition function make it possible to adjust the image so that the entire surface is in focus.
Automotive/Metal/Tooling

Trapezoidal screw (screw threading and angle)

Metal retaining material (compared with 3D-CAD data)
Electrical/Electronics

- Handy terminal (frame warpage)
- Handy terminal charging stand (shape)
- 7-inch tablet (case waviness)
- Wave washer (height difference)
PCB (appearance, overall curvature, plating waviness)

Connector pins (pin height)

IC (lead float)

BGA (fluctuations in height)

Metal components (waviness, 2D measurements)
Chemical/Plastic

- Rubber handle (Defect analysis)
- Optical component (resin mold sink marks)
- Plastic case (average groove depth)
- Diaphragm (shape, distortion)
- Fan (height from reference)
Other

Weather-stripping (line roughness, surface roughness)

Handheld controller (button height)

Dents formed between fibers
(Measured while fibers are being pressed with a glass plate.)

Grain (overall grain depth)

SOFC (solid oxide fuel cell) (volume)
High-end model with motorized XY stage
VR-3200
- XY-axis motorized control
- Z-axis motorized control
- Color imaging
- Wide-field/high-magnification camera

Standard model with color/high-magnification imaging capabilities
VR-3100
- XY-axis manual control
- Z-axis motorized control
- Color imaging
- Wide-field/high-magnification camera

Basic model
VR-3050
- Z-axis manual control
- Wide-field camera
OP-87709 Tilt stage
This stage allows users to observe and measure objects from an angle without having to manipulate the object by hand. The stage is designed so that the sample securely adheres to the stage when positioned at an angle.

OP-87708 100 mm 3.94" Spacer
Inserting this 100 mm 3.94" high spacer between the measurement unit and the base allows you to measure objects up to 188 mm 7.40" * in height. This extra space can be also used for setting a heated stage or custom fixture.

OP-87717 Manual slider for image stitching
The manual slider allows measurement of a wider field, up to 270 mm 10.63", when used together with the Stitching Module (optional).

VR-S200 Motorized XY stage
Fully-motorized XY control using the mouse. Combined with the Stitching Module (optional), this stage enables the system to perform image stitching with higher speed and accuracy.

Custom stages
KEYENCE offers a variety of large-sized or special stages to meet your needs. Contact us for more details.
<table>
<thead>
<tr>
<th>Model</th>
<th>Controller</th>
<th>VR-3000K</th>
<th>VR-3100</th>
<th>VR-3050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>VR-3200</td>
<td>Standard</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>XY stage</td>
<td>VR-S200</td>
<td>Standard</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>Manual slider for stitching</td>
<td>OP-87717</td>
<td>--</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>100 mm 3.94&quot; spacer</td>
<td>OP-87708</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>Tilt stage</td>
<td>OP-87709</td>
<td>Standard</td>
<td>Standard</td>
<td>Standard</td>
</tr>
<tr>
<td>Calibration standard</td>
<td>OP-87710</td>
<td>Standard</td>
<td>Standard</td>
<td>Standard</td>
</tr>
<tr>
<td>Viewer software</td>
<td>VR-H2VE</td>
<td>Required</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>Analyzer software</td>
<td>VR-H2AE</td>
<td>Required</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>Stitching module</td>
<td>VR-H2J</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>Comparative measurement module</td>
<td>VR-H2P</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>3D-CAD comparative module</td>
<td>VR-H2CA</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
</tr>
</tbody>
</table>
### First-class customer support that only a direct service system can provide

KEYENCE employs a direct sales system that eliminates intermediaries, such as distributors and dealers, from our sales channel. Our experienced, highly-skilled sales engineers respond quickly to customers’ inquiries, providing them with exceptional after-sales service and support.

KEYENCE also offers free on-site inspection services and provides equipment loans free of charge in the event of a failure. With this level of service, KEYENCE provides post-sales support you can rely on.

#### VR Head/Controller

<table>
<thead>
<tr>
<th>Model</th>
<th>Controller Head</th>
<th>VR-3200</th>
<th>VR-3000K</th>
<th>VR-3100</th>
<th>VR-3050</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Magnification on a 15&quot; monitor</td>
<td>12x</td>
<td>25x</td>
<td>38x</td>
<td>50x</td>
</tr>
<tr>
<td>Field-of-view</td>
<td>Horizontal (H): mm inch</td>
<td>0.9x</td>
<td>1.2x</td>
<td>1.5x</td>
<td>2.0x</td>
</tr>
<tr>
<td></td>
<td>Vertical (V): mm inch</td>
<td>0.71</td>
<td>0.97</td>
<td>0.57</td>
<td>0.73</td>
</tr>
<tr>
<td>Zoom</td>
<td>1x to 4x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurable height</td>
<td>10 mm ±0.05  (±5 mm ±0.02°)</td>
<td>10 mm ±0.05  (±5 mm ±0.02°)</td>
<td>10 mm ±0.04  (±0.5 mm ±0.02°)</td>
<td>10 mm ±0.04  (±0.5 mm ±0.02°)</td>
<td>10 mm ±0.04  (±5 mm ±0.02°)</td>
</tr>
<tr>
<td>Standard scale</td>
<td>±0.1 µm</td>
<td>±0.5 µm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeatability (µm)</td>
<td>0.1 µm</td>
<td>0.5 µm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width measurement</td>
<td>1 µm</td>
<td>0.5 µm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement accuracy</td>
<td>±5 µm</td>
<td>±2 µm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width measurement</td>
<td>±5 µm</td>
<td>±2 µm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stitching function</td>
<td>Full automatic (XY stage automatic control + auto focus) measurement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motorized XY stage VR-S200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XY stroke</td>
<td>184 x 88 mm 7.24&quot; x 3.46&quot; (motorized)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z stroke</td>
<td>90 mm 3.54&quot; (motorized)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotation</td>
<td>±180° (sample rotating stage)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working distance</td>
<td>70 mm 2.76&quot; (200 mm *) (manual)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Image receiving element</td>
<td>4 megapixel monochrome CMOS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmitter lens</td>
<td>Two, double-telecentric lenses</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receiver lens</td>
<td>Double-telecentric lens</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light sources</td>
<td>Observation light source</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement light source</td>
<td>LED ring light (red, green, blue)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data processing</td>
<td>1024 x 768 pixels, 2048 x 1536 pixels</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power source</td>
<td>100 to 240 VAC ±10%, 50/60 Hz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>150 VA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental resistance</td>
<td>Ambient temperature for use</td>
<td>15 to 30°C 59 to 86°F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative humidity for use</td>
<td>35 to 80% (no condensation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>Controller</td>
<td>28.0 kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td>22.5 kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width</td>
<td>96M13652</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First-class customer support that only a direct service system can provide

KEYENCE employs a direct sales system that eliminates intermediaries, such as distributors and dealers, from our sales channel. Our experienced, highly-skilled sales engineers respond quickly to customers’ inquiries, providing them with exceptional after-sales service and support.

KEYENCE also offers free on-site inspection services and provides equipment loans free of charge in the event of a failure. With this level of service, KEYENCE provides post-sales support you can rely on.

In addition to the “Getting Started Guide” provided with the product, a full color manual is also available.
Automatically Analyze and Differentiate 3D Surfaces

3D LASER SCANNING CONFOCAL MICROSCOPE
VK-X250/X150/X120

- Non-contact, ultra high-accuracy 3D measurement
- 60x - 28800x magnification range
- Fully-automated measurements with just one click
- Works on any surface shape regardless of material
- Process multiple files at once for faster results
- Easily evaluate up to 42 different roughness parameters

The New Standard for Microscopes

DIGITAL MICROSCOPE
VHX-5000

- All-in-one microscope that incorporates observation, image capture and measurement capabilities
- Depth-of-field 20 times greater than optical microscopes
- Motorized XYZ controls for simplified operation
- Instantly view any area entirely in focus
- Intuitive user interface allows everyone to perform analysis easily
- Advanced 2D and automated area measurement functions