INSTANT HIGH-ACCURACY
3D MEASUREMENT

WI-5000 Series
Measure height with exceptional accuracy — 80,000 points in just 0.13 seconds
1 CAPTURE SHAPES EXACTLY AS THEY ARE

The WI-5000 Series captures 80,000 points of height data instantaneously across a maximum measurement area of 10 × 10 mm 0.39" × 0.39". The principles of white light interferometry result in accurate measurement of the target shape even if its colors or materials vary in reflectivity.

2 100% INSPECTION IN PROCESS

KEYENCE has developed a proprietary system capable of high-speed measurement of 80,000 points in as little as 0.13 seconds. The high-speed performance makes high-accuracy, in-line inspection a reality.

3 EFFICIENT OFFLINE INSPECTION

Using the dedicated mounting stand, the sensor is easily configured for offline inspection. Additionally, many functions, such as simplified measurement and data capture were specifically designed for efficient and effective offline use.
Highly-Accurate Measurements are acquired with white light interferometry

The light emitted from the light source is split in two by the beam splitter. One beam reflects off the target and the other reflects off the reference mirror. Both beams then strike the light-receiving element as interfering light waves. These interfering light waves provide the highest level of interference when the lengths of their optical paths coincide. The optical unit, which incorporates all the optical components, moves up and down to obtain contrasting images. For each measurement point in these images, the device reads the position of the optical unit at the highest level of interference. This information is then used to determine the distance to the target.

Select the sensor head that best suits your application

KEYENCE offers three types of sensor heads, each of which is designed for a specific application — from the high-resolution model to the wide-field model the WI-5000 has the flexibility to solve your application.

<table>
<thead>
<tr>
<th></th>
<th>High-resolution model WI-001</th>
<th>Standard model WI-004</th>
<th>Wide-field model WI-010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement range</td>
<td>$1 \times 1 \text{ mm } 0.04&quot; \times 0.04&quot;$</td>
<td>$4 \times 4 \text{ mm } 0.16&quot; \times 0.16&quot;$</td>
<td>$10 \times 10 \text{ mm } 0.39&quot; \times 0.39&quot;$</td>
</tr>
<tr>
<td>Minimum detection area</td>
<td>$4 \times 4 \mu m \ 0.000157&quot; \times 0.000157&quot;$</td>
<td>$15 \times 15 \mu m \ 0.000591&quot; \times 0.000591&quot;$</td>
<td>$40 \times 40 \mu m \ 0.001575&quot; \times 0.001575&quot;$</td>
</tr>
<tr>
<td>Height measurement range</td>
<td>$1.4 \text{ mm } 0.06&quot;$ (Standard Mode), $0.7 \text{ mm } 0.03&quot;$ (High-Speed Mode)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeatability (height difference)</td>
<td></td>
<td>$0.1 \mu m \ 0.000004&quot;$</td>
<td></td>
</tr>
</tbody>
</table>
The WI-5000 Series emits light with a wide dynamic range. This allows the sensor to simultaneously measure targets with different reflectivity (such as shiny metal and dull rubbers) from a single captured image. Accurate shapes can be captured even for measurement targets made of resin or other translucent material, because the process is not affected by internal reflections.

When a conventional triangulation method is used to measure an object, the light returning to the sensor can be blocked causing "dead zones" which cannot be measured. This effect is avoided with the WI-5000 Series.

The WI-5000 Series features a wide range of measurement modes that can overcome a variety measurement challenges. From those requiring height data (such as height difference/volume measurement) to those requiring plane data (such as width/area measurement) the WI-5000 has the tools to solve the application.

The principles of white light interferometry overcome the issues that impede the accuracy of profile measurement, such as differences in target materials and colors as well as areas with dead zones that cannot be measured.
100% INLINE MEASUREMENT AT HIGH SPEEDS

Instead of measuring points, the WI-5000 Series measures over a surface, ensuring 100% inspection instead of mere sample inspection.

**CONVENTIONAL METHOD**  
1D DISPLACEMENT SENSOR + MOVING STAGE

In order to measure multiple points, the sensor must scan the target quickly and accurately. Doing so requires the stage to be moved, which makes inspection extremely time-consuming. Additional instrumentation that can be costly or complex is also required.

**CONVENTIONAL METHOD**
- Requires a high-precision moving stage
- Requires a highly accurate positioning control mechanism
- Requires programming of processing software

**Complex instrumentation**

Processing flow of multi-point measurement

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**WI-5000 Series**

**ELIMINATES THE NEED FOR A Moving STAGE**

With the surface measurement method, multiple points are captured simultaneously without the need for a high-precision moving stage. This simplifies instrumentation, significantly reduces measurement time, and enables 100% inspection.

**With the WI-5000 Series**
- Does not require a high-precision moving stage
  - Accommodates batch area measurement
- Does not require precise positioning
  - Incorporates a position-correction function measurement
- Does not require programming prior to measurement
  - Integrates a variety of measurement functions.

Processing flow of multi-point measurement

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** Eliminates the Need for a Moving Stage**

Instead of measuring points, the WI-5000 Series measures over a surface, ensuring 100% inspection instead of mere sample inspection.
Our proprietary system performs area measurement at high speed

Achieves high-speed measurement across the surface

**Dedicated image pickup device + IPO*-Engine**

*Interference Parallel Operation*

KEYENCE has mounted a dedicated image capture device inside the system. Following high-speed image capture, it processes the data at ultra-high speed. This is made possible with a new parallel processing engine that reads the captured data, calculates the interference peak, and transmits the height images at ultra-high speed. This configuration significantly accelerates the high-accuracy inference calculation, a time-consuming process with conventional configurations. This innovation enables batch measurement of 80,000 points of height data.

**Innovative design that suppresses vibration**

**CB* Scan System**

*Counter-balanced*

KEYENCE has developed a mechanical structure that minimizes vibration generated during Z-axis scanning. As the optical unit moves during the scan sequence, the center of gravity inside the sensor head shifts. This system offsets this shift by moving a counterweight in the opposite direction. This innovation contributes to stable measurement during high-speed scanning and allows the compact sensor head to be embedded into various manufacturing devices.

**Comparison of conventional and CB scan systems**

- **Conventional System**
  - Shifting center of gravity
  - Measurement error due to vibration
  - Heavy load on moving section

- **CB Scan System**
  - No shift in center of gravity
  - Stable measurement
  - Long service life
STREAMLINED OFFLINE INSPECTION FOR SIGNIFICANTLY REDUCED LABOR TIMES

Simply place the target on the stage for complete, error-free, and instantaneous 3D measurement, even with an inexperienced operator.

**CONVENTIONAL METHOD**

**INSPECTION WITH A MEASURING MICROSCOPE**

A conventional measuring microscope requires manual movement of the stage along the X/Y axes and sliding up or down for focus adjustment, resulting in inspections with excessive labor requirements. Additionally, different operators can often measure the same part differently, introducing another source of error into your measurements.

**CONVENTIONAL METHOD**

- Manually move stage along X/Y axes
- Slide stage up or down to adjust focus
- Requires hours of labor while introducing measurement errors

Processing flow of height difference measurement

<table>
<thead>
<tr>
<th>Set target</th>
<th>Adjust focus</th>
<th>Set zero-point</th>
<th>Slide stage</th>
<th>Adjust focus</th>
<th>Read measured value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**WI-5000 Series WITH DEDICATED STAND**

A dedicated stand to secure the sensor head is available for offline inspections. The position correction function allows inspection to be performed simply by placing the target onto the stage. This significantly reduces the labor required for inspection while eliminating errors introduced by the different techniques of individual operators.

**With the WI-5000 Series**

- Does not require precise positioning
- Significantly reduces labor required for inspections
- No errors introduced by individual operators

Processing flow of multi-point measurement

<table>
<thead>
<tr>
<th>Set target</th>
<th>Measurement is completed instantly</th>
<th>Inspection time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection time</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
FOR EASY EVALUATION OF PROTOTYPES:

QUICK MEASUREMENT

A 3D measurement can be captured and then measured, without any pre-programming. A cross-section of a captured 3D image can also be measured. Various measurement functions are available, including height difference, width, angle, and cross-sectional area.

WHEN DATA RECORDING IS TIME-CONSUMING:

LOGGING FUNCTION

The measurement result can be saved in the controller with a single click. What’s more, the measurement results of a complete lot can be saved to a CSV file so that documentation can easily be generated on a PC.

WHEN WORKING WITH MULTIPLE SYSTEMS:

REMOTE OPERATION FUNCTION

With the included software, you can collect the measurement results from the controllers at a remote site or change their settings from your desktop PC.
Measuring the height of terminals on surface-mounted components

The wide dynamic range ensures stable measurements even when terminals (highly reflected light) and ceramic packages (low reflected light) are present in an image.

Measuring the height/volume of precision adhesive

The height and volume of the adhesive can be measured immediately after application. The principles of white light interferometry provide micron-level measurements with high-accuracy.

Measuring the dimensions/flatness of precision parts

Various dimensions of precision pressed parts — such as height, flatness, and pitch — can be measured simultaneously. High-speed sampling has made it possible to incorporate 100% inspection in a production facility.
Measuring the height of balls on BGA

The Multi-Point Height Measurement tool allows for easy measurement of multiple balls on a BGA. The peak value of each ball as well as the area and volume can be measured instantaneously.

Measuring the thickness of printing on PCBs

Multi-Capture is effective for targets exceeding the measurement area of 10 × 10 mm 0.39” × 0.39”. Multiple sections can be measured under different conditions without the need to switch programs.
### System Configuration

- **Controller:** WI-5000
- **Color LCD monitor:** 8-inch: CA-MP81/12-inch: CA-MP120
- **Dedicated monitor stand:** OP-87262

#### Sensor Head Connecting Cables

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Connector Type</th>
<th>Cable Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard cable</td>
<td>Straight</td>
<td>3 m (9.8')</td>
</tr>
<tr>
<td></td>
<td>L-shaped</td>
<td>WI-C3L</td>
</tr>
<tr>
<td>Hi-flex robotic cable</td>
<td>Straight</td>
<td>WI-C3R</td>
</tr>
</tbody>
</table>

#### Options

- **SD card (industrial-grade):**
  - CA-SD16G (16 GB)
  - CA-SD4G (4 GB)
  - CA-SD1G (1 GB)
- **Adapters for communication cables:**
  - 9-pin OP-26486
  - 25-pin OP-26485
  - 9-pin SYSMAC OP-84384
  - 9-pin MELSEC OP-86930
- **USB cable:** OP-66844
- **RS-232C communication cable:** OP-26487 (2.5 m (8.2'))
- **Ethernet cable:** OP-66843 (3 m (9.8'))
- **Extension I/O cable:** OP-51657 (3 m (9.8'))
- **Step calibration block:** OP-88165
- **RGB monitor cable:**
  - OP-66842 (3 m (9.8'))
  - OP-87055 (10 m (32.8'))
- **Dedicated stand:** WI-S1
- **Sensor head:** WI-001/004/010
- **Sensor head connecting cable:**
  - WI-C3
  - WI-C5
  - WI-C10
  - WI-C3L
  - WI-C5L
  - WI-C10L
  - WI-C3R
  - WI-C5R
  - WI-C10R
The workpiece stopping time at capturing is 120 ms (High Speed Mode) or 240 ms (Standard Mode).

Dedicated stand

Controller

No. of connectorable sensor heads
1

No. of registration settings
Up to 1000 settings on SD Card 1 and SD Card 2 individually (depending on the capacity and configuration of the SD Card), external switching possible

No. of measurement tools
100 tools (slitting 20 are intended for position adjustment)

Measurement mode
Height Height Measurement, Height Difference Measurement, Arranged Multi-Point Height Measurement, Free Multi-Point Height Measurement, Profile Measurement, and Continuous Height Measurement

Dimension measurement
Center wavelength 830 nm
Laser class (IEC60825-1) Class 3R
Output 3.6 mW

Guide light source
Wavelength 660 nm
Laser class (IEC60825-1) Class 1
Output 0.15 mW

Light source for measurement
Internal Trigger 133 ms (High Speed Mode), 266 ms (Standard Mode)
External Trigger 266 ms max. (High Speed Mode), 532 ms max. (Standard Mode)

Environmental resistance
Ambient light Incandescent lamp/fluorescent lamp: 5000 lux max.
Ambient temperature 0 to +35°C 32 to +95°F
Relative humidity 20 to 85% (No condensation)

Weight
Approx. 2000 g

Sensor head

Model
WI-001 WI-004 WI-010

Reference distance
16 mm 0.63"

Measurement range
Z 1.4 mm 0.056" (Standard Mode), 0.7 mm 0.03" (High Speed Mode)
XY 1 × 1 mm 0.04" × 0.04", 4 × 4 mm 0.16" × 0.16", 10 × 10 mm 0.39" × 0.39"

Minimum detection area
4 × 4 μm 0.000157" × 0.000157", 15 × 15 μm 0.0006" × 0.0006", 40 × 40 μm 0.001575" × 0.001575"

Repeatability (height difference)
0.1 μm 0.0000394"

Linearity (height difference)
±2.8 μm 0.000110" (±0.2% of F.S., ± 1.4 mm 0.056", ±20 to +30°C, ±68 to +86°F)

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Output 3.6 mW

Guide light source
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Laser class (IEC60825-1) Class 1
Output 0.15 mW

Ambient light
Incandescent lamp/fluorescent lamp: 5000 lux max.

Ambient temperature
0 to +35°C 32 to +95°F
Relative humidity
20 to 85% (No condensation)

Weight
Approx. 2000 g

The laser classification for FDA(CDRH) is implemented based on IEC60825-1 in accordance with the requirements of Laser Notice No. 50.
The resolution of the height (distance from head reference plane to measurement workpiece) is 1 μm(*4).

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1D DISPLACEMENT SENSOR

**LK-G5000 Series**

Today’s laser displacement sensors must be able to measure a variety of targets with exceptional speed, accuracy, and versatility. KEYENCE is meeting these needs by adopting advanced technologies that demonstrate industry-leading performance in all areas.

2D DISPLACEMENT SENSOR

**LJ-V7000 Series**

This product was designed with inline profile measurement in mind and is capable of capturing 64,000 images per second. Using the industry first double-blue polarized laser, this system is able to provide extremely stable and highly accurate profile measurements on even the most challenging of targets.