High-Accuracy Surface Scanning Method

High resolution of 0.01 μm
The high-accuracy, surface scanning method allows measurements of all types of targets

A tuning fork and oscillator unit are combined to create a surface scanning laser. This results in precise displacement and profile measurements that are unaffected by target color or angle.

Surface Scanning Laser
Confocal Displacement Meter

LT-9000 Series

Vertical Z-axis scanning
A tuning fork is combined with the confocal principle to obtain high-accuracy measurement.

Horizontal X-axis scanning
An oscillator unit creates a wide scan area. This allows increased measurement stability.
Excellent resolution of 0.01 µm for high-accuracy applications

Vertical

The coaxial optical system improves measurement performance

High angular characteristics
Measurement of film thickness

Z-axis scanning

High-accuracy measurement method uses the confocal principle and tuning fork

The laser beam is focused on the target surface through an objective lens that vibrates up and down at high speed by means of a tuning fork. The beam reflected off the target surface is converged on a pinhole and then enters the light-receiving element. By measuring the exact position of the objective lens when the light enters the light-receiving element, the target height can be determined. The sensor measures the distance to the target surface accurately without being affected by the material, color, or angle of the target.

When focus is not obtained on the target surface

When focus is obtained on the target surface

A small amount of reflected light passes through the pinhole.

All of the reflected light passes through the pinhole.

New wide scanning feature increases measurement stability and versatility

X-axis scanning

High-accuracy scanning using an oscillator unit

The 0.000079” 2 µm laser beam spot can be scanned horizontally for up to 0.043307” 1100 µm by using the high-accuracy oscillating mechanism. This new scanning method enables measurements of profile, angle, and area.

Adjustable scanning width according to the application

The scanning width of the laser beam can be changed freely according to the application and the surface condition of the target. In addition, highly stable displacement measurements are ensured by calculating the scanning data.
A variety of high accuracy measurements are possible.

Typical applications for the LT-9000 Series

<table>
<thead>
<tr>
<th>Microscopic targets</th>
<th>A small spot size enables the measurement of microscopic features.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring the height of bonding wire</td>
<td>Measuring the score depth of a pull-tab</td>
</tr>
<tr>
<td>The height of narrow pitch bonding wire can be measured reliably.</td>
<td>The depth and profile of the groove can be measured stably.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rough-surfaced targets</th>
<th>The light intensity integration function and laser scanning method offer high stability.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring warpage of a wafer</td>
<td>When the laser scanning method is disabled:</td>
</tr>
<tr>
<td>The warpage of a wafer with a pattern can be measured stably.</td>
<td>The measurement is affected by the pattern on the surface.</td>
</tr>
<tr>
<td>When the laser scanning method is enabled:</td>
<td>The measurement value is unstable due to the influence of the surface conditions.</td>
</tr>
<tr>
<td>Accurate measurement is obtained by eliminating the influence of the pattern.</td>
<td>The measurement value is stable, enabling the measurement of the warpage profile.</td>
</tr>
</tbody>
</table>

The light intensity integration function —— Provides high stability

1. The 0.000079” 2 μm beam spot is shifted in the X-axis direction with the movement of the oscillator unit.
2. The data of each spot in the X-axis direction is divided into two categories: the displacement position data (Z-axis) and the light intensity data.
3. Data is obtained from the rough surface of the target, in which stable data with high received light intensity and unstable data with low received light intensity are mixed. The light intensity integration function further enhances the difference of the light intensity by integrating the light intensity of the Z-axis direction, and it outputs stable displacement position data unaffected by the unstable data with low received light intensity.
Multiple measurement modes for a wide range of applications

**Profile measurement**  The surface profile can be traced accurately using the oscillating unit.

Measuring the profile of solder paste on a PWB

The surface profile can be traced using the double-scanning method. The height difference between the two points can be measured.

**Transparent object thickness measurement**  The surface condition, film thickness, and thickness of transparent objects can be measured. In addition, the slant correction function enables more reliable measurements.

Measuring the thickness of an optical disc

The surface condition, film thickness, and thickness of transparent objects can be measured stably by utilizing the confocal principle.

**Angle measurement**  An angle can be measured in increments of 0.01 degrees based on the measurement values of two or more points obtained by scanning the laser beam spot.

Measuring the parallelism of a CCD and cover glass

The inclination of a CCD surface against the rear surface of the glass can be measured accurately using the newly developed relative angle measurement.

**Measurement of a cross-sectional area**  The cross-sectional area can be determined based on the cross sectional profile obtained by scanning the laser beam spot.

Measuring the cross-sectional area of liquid sealing material

The profile and cross-sectional area of sealing material applied for bonding glass substrates.

Multiple measurement modes for a wide range of applications

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Quick and easy setup functions

Microscope function ——— Employing a high-speed auto-focus lens for clear images

An ultra-compact CCD camera is incorporated in the sensor head. The target image can be enlarged approximately 85 times* on the monitor screen. The special optical design provides sharp images, allowing easy positioning of microscopic targets.
* When using special monitor CA-MN81

Monitor for measured value and waveform display ——— For real-time display of measured values and waveform

Observations of displacement and profile data can be performed with ease.

Soldered area of leads

Engraved mark

Simplified setup menu ——— Simple operation using special remote console

The special remote console and user-friendly setup menu greatly simplify the setup process. Measurement can begin just minutes after unpacking the box.

Multiple I/O options come standard ——— For enhanced operational flexibility

All of the necessary interfaces including 2 channels of analog outputs, RS-232C output, 2 channels of decision outputs, and binary outputs are incorporated as standard into the compact housing.

(Only half the size of conventional models.)

<table>
<thead>
<tr>
<th>Analog output</th>
<th>RS-232C output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binary output</td>
<td>Limits output</td>
</tr>
</tbody>
</table>

2-channel decision output and binary output

RS-232C 2-channel analog output
### System configuration

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controller</td>
<td>LT-9501/9001, LT-9501SO(5652)/9001SO(5653)</td>
</tr>
<tr>
<td>Remote control console</td>
<td>(Included with the LT-9501)</td>
</tr>
<tr>
<td>Measuring unit</td>
<td>LT-9010M</td>
</tr>
<tr>
<td>Measuring unit</td>
<td>LT-9030M</td>
</tr>
<tr>
<td>I/O cable</td>
<td>9.84' 3 m</td>
</tr>
<tr>
<td>Measuring unit mounting</td>
<td>OP-96368</td>
</tr>
<tr>
<td>Stand</td>
<td>OP-42278</td>
</tr>
<tr>
<td>RS-232 cable</td>
<td>OP-96369</td>
</tr>
<tr>
<td>6.56' 2 m extension cable</td>
<td>LT-C2</td>
</tr>
<tr>
<td>32.81' 10 m extension cable</td>
<td>LT-C10</td>
</tr>
<tr>
<td>* The X-Y stage is not included.</td>
<td></td>
</tr>
</tbody>
</table>

### Dimensions

**Unit: mm inch**

<table>
<thead>
<tr>
<th>Controller</th>
<th>LT-9501/9001, LT-9501SO(5652)/9001SO(5653)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (Effective display area)</td>
<td>191.2 7.52</td>
</tr>
<tr>
<td>(Dimensions of mounting bracket)</td>
<td>191.2 7.52</td>
</tr>
</tbody>
</table>

| Remote control console      | 2.30 0.09 |
| Cable between the measuring unit and the controller LT-C2/LT-C10 | 6.07 0.24 |

| Measuring unit              | LT-9010M  |
| Measuring unit mounting     | OP-96368  |
| I/O cable                   | 3 x ø4.5  |
| RS-232 cable                | OP-96369  |
| 6.56' 2 m extension cable   | LT-C2    |
| 32.81' 10 m extension cable | LT-C10   |

| LCD monitor                 | CA-MN81  |
| Panel cutout                |          |
| Panel thickness: 1.5 mm or 6.0 mm | 0.24' 0.95 |
| Mounting bracket            |          |
| Mounting screw              |          |

| Stand                       | OP-42278 |
| RS-232 cable                | OP-96369 |
| 6.56' 2 m extension cable   | LT-C2    |
| 32.81' 10 m extension cable | LT-C10   |

* The X-Y stage is not included.
New features of the LT-9000 Series

Interchangeable sensor head and controller
A CPU is built into the sensor head so that the sensor head and controller become interchangeable. The calibration data and other information of the sensor head is digitally transferred to the controller. Complicated adjustments are no longer required upon replacement.

Calibration function
The measured values can be calibrated by using a reference target. Since logical calibration can be performed using numerical values, optimal adjustment can be made according to the details of the actual target measurements.

Up to 65.6’ 20 m cable extension
Wiring can be extended up to 65.6’ 20 m by adopting the digital method for communications between the controller and sensor head. This greatly enhances the installation flexibility.

Various measurement modes
The LT-9000 Series features 9 types of measurement hold modes, including Peak hold, Bottom hold, and Peak-to-peak hold mode. The mode can be set up as desired according to the application without using an analog controller or PLC.

2-channel simultaneous measurement
The measurement of two different points can be performed simultaneously. The surface position and thickness of glass can be measured and displayed at the same time.

Applications by industry

<table>
<thead>
<tr>
<th>Automotive industry</th>
<th>LCD industry</th>
<th>Print industry</th>
<th>Medical industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring the surface profile of a brake disc</td>
<td>Measuring the cross-sectional area of liquid sealing material on LCD glass</td>
<td>Measuring the cell depth of a print roll</td>
<td>Measuring the thickness of a contact lens</td>
</tr>
</tbody>
</table>
Specifications

Controller

<table>
<thead>
<tr>
<th>Model</th>
<th>Measuring unit compatibility</th>
<th>Display</th>
<th>Terminal block</th>
<th>Control I/O</th>
<th>Main function</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT-9501/LT-9001</td>
<td>LT-9010M/LT-9010</td>
<td>LT-9030M/LT-9030</td>
<td>Measuring unit</td>
<td>Analog output</td>
<td>Limits mode</td>
<td>Power supply voltage</td>
</tr>
<tr>
<td>LT-9501SO(5652)/LT-9001SO(5653)</td>
<td>LT-9030M/LT-9030</td>
<td>LT-9030</td>
<td>LT-9010M/LT-9010</td>
<td>Non-voltage input</td>
<td>For OUT1 and OUT2, and NPN open collector output</td>
<td>100 to 240 VAC±10% 50/60 Hz</td>
</tr>
<tr>
<td>LT-9010M/LT-9010</td>
<td>LT-9030M/LT-9030</td>
<td>LT-9030</td>
<td>LT-9010</td>
<td>Measured data output (21 bits), OUT1/OUT2/PROFILE selectable</td>
<td>NPN open collector output</td>
<td>110 VA or lower</td>
</tr>
<tr>
<td>LT-9010</td>
<td>LT-9030</td>
<td>LT-9030</td>
<td>LT-9010</td>
<td>NPN open collector output</td>
<td>Non-voltage input</td>
<td>Overvoltage category II</td>
</tr>
<tr>
<td>LT-9010M</td>
<td>LT-9010</td>
<td>LT-9030M</td>
<td>LT-9030</td>
<td>NPN open collector output</td>
<td>Non-voltage input</td>
<td>Pollution degree 2</td>
</tr>
</tbody>
</table>

Microscope function

<table>
<thead>
<tr>
<th>Microscope function</th>
<th>LT-9501 only</th>
<th>LT-9001SO only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available</td>
<td>Available (LT-9501SO(5652) only)</td>
<td></td>
</tr>
</tbody>
</table>

Measuring unit compatibility

Measuring units are interchangeable without factory recalibration.

Display

- Minimum display unit: 0.01 µm, 1 µm/0.01 µm
- Display range: ±9999.99 µm, ±999999 µm
- Display cycle: 10 times/sec.
- Timing input/Reset input/Auto-zero input: Non-voltage input

Terminal block

- Analog output: ±10 V × 2 outputs, output impedance: 100 Ω
- Timing input/Reset input/Auto-zero input: Non-voltage input
- Monitor dedicated power supply: 24 VDC, 1 A

Control I/O

- Binary mode: Measured data output, OUT1/OUT2/PROFILE selectable
- Strobe output: NPN open collector output
- Binary selection output: NPN open collector output
- Binary selection input: Non-voltage input
- Stability output: NPN open collector output
- Laser remote input: Non-voltage input
- Program change input: Non-voltage input × 3 inputs

Main function

- Distance mode: Distance measurement, Transparent object thickness measurement, Relative angle measurement, Surface selection, Dark-out, Mask, Trend graph display, and Scan width/interval change
- Profile mode: Area selection (Average, Maximum, Minimum, Maximum-to-minimum, Area) Area calculation, Scan width/interval change, Dark-out, Smoothing, Averaging, and Profile data output
- Common: Light intensity accumulation, Microscope (LT-9501, LT-9501SO(5652) only), Tolerance judgment, 8-program registration, Calibration, Averaging, Hold modes, Auto-zero, and interface language selection

Rating

- Power supply voltage: 100 to 240 VAC±10% 50/60 Hz
- Current consumption: 110 VA or lower
- Overvoltage category: II
- Pollution degree: 2
- Ambient temperature: 0 to 35°C 32 to 95°F, No condensation
- Relative humidity: 35 to 85%, No condensation
- Weight: Approx. 2.4 kg

Distance mode

- Distance measurement, Transparent object thickness measurement, Angle measurement, Angle mode, Angle measurement, Relative angle measurement, Surface selection, Dark-out, Mask, Trend graph display, and Scan width/interval change

Profile mode

- Area selection (Average, Maximum, Minimum, Maximum-to-minimum, Area) Area calculation, Scan width/interval change, Dark-out, Smoothing, Averaging, and Profile data output

Cable between the sensor head and controller (Extension cable)

<table>
<thead>
<tr>
<th>Model</th>
<th>Cable length</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT-C2</td>
<td>1.5 to 10 m</td>
<td>Approx. 200 g</td>
</tr>
<tr>
<td>LT-C10</td>
<td>1.5 to 10 m</td>
<td>Approx. 700 g</td>
</tr>
</tbody>
</table>

Measuring Unit

<table>
<thead>
<tr>
<th>Type</th>
<th>High-accuracy</th>
<th>Long-range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>LT-9010M</td>
<td>LT-9010</td>
</tr>
<tr>
<td>Measurement range</td>
<td>±0.01 µm ±0.3 mm</td>
<td>±0.04 µm ±1.0 mm</td>
</tr>
<tr>
<td>Reference distance</td>
<td>0.25' 6 mm</td>
<td>1.18' 30 mm</td>
</tr>
<tr>
<td>Wavelength</td>
<td>655 nm</td>
<td>Visible red semiconductor laser</td>
</tr>
<tr>
<td>Output</td>
<td>170 µW (IEC)/3.0 µW (FDA)</td>
<td></td>
</tr>
<tr>
<td>Laser Class</td>
<td>Class IIa (FDA CDRH 21CFR Part 1040.10), Class 1 (IEC60825-1)</td>
<td></td>
</tr>
<tr>
<td>Spot diameter</td>
<td>Approx. 0.000079' ø2 µm</td>
<td>Approx. 0.000079' ø2 µm</td>
</tr>
<tr>
<td>Scan width/interval</td>
<td>0 to 0.004724' 120 µm/0.000079' 2 µm</td>
<td>0 to 0.004724' 120 µm/0.000079' 2 µm</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.01 µm</td>
<td>0.000003' 0.1 µm</td>
</tr>
<tr>
<td>Linearity</td>
<td>±0.5% of F.S.</td>
<td>±0.3% of F.S.</td>
</tr>
<tr>
<td>Sampling cycle</td>
<td>640 µs to 356 ms (14 steps)</td>
<td>640 µs to 356 ms (14 steps)</td>
</tr>
<tr>
<td>Temperature characteristics</td>
<td>±0.5% of F.S.</td>
<td>±0.25% of F.S.</td>
</tr>
<tr>
<td>Microscope function</td>
<td>Available</td>
<td>Available</td>
</tr>
<tr>
<td>Field of view</td>
<td>0.05' x 0.04' 1.3 mm x 1.95 mm</td>
<td>2.5 mm x 2.0 mm</td>
</tr>
<tr>
<td>Illumination light source</td>
<td>Infrared LED (wavelength: 870 nm)</td>
<td>Infrared LED (wavelength: 870 nm)</td>
</tr>
<tr>
<td>Ambient light</td>
<td>Incandescent lamp/fluorescent lamp: 10000 lux max.</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>0 to 35°C 32 to 95°F, No condensation</td>
<td></td>
</tr>
<tr>
<td>Relative humidity</td>
<td>35 to 85%, No condensation</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 400 g</td>
<td></td>
</tr>
</tbody>
</table>

1. The value when the measurement target is an mirrored surface object that is measured in displacement mode, scan width/interval 0.004724' 120 µm/0.000079' 2 µm, and 8-times average
2. The value when the FINE mode is set to OFF.
3. Sampling rates differs according to the manufacturing variation of individual measuring units.
www.keyence.com/measure/