



IN-LINE 2D MEASUREMENT SYSTEM

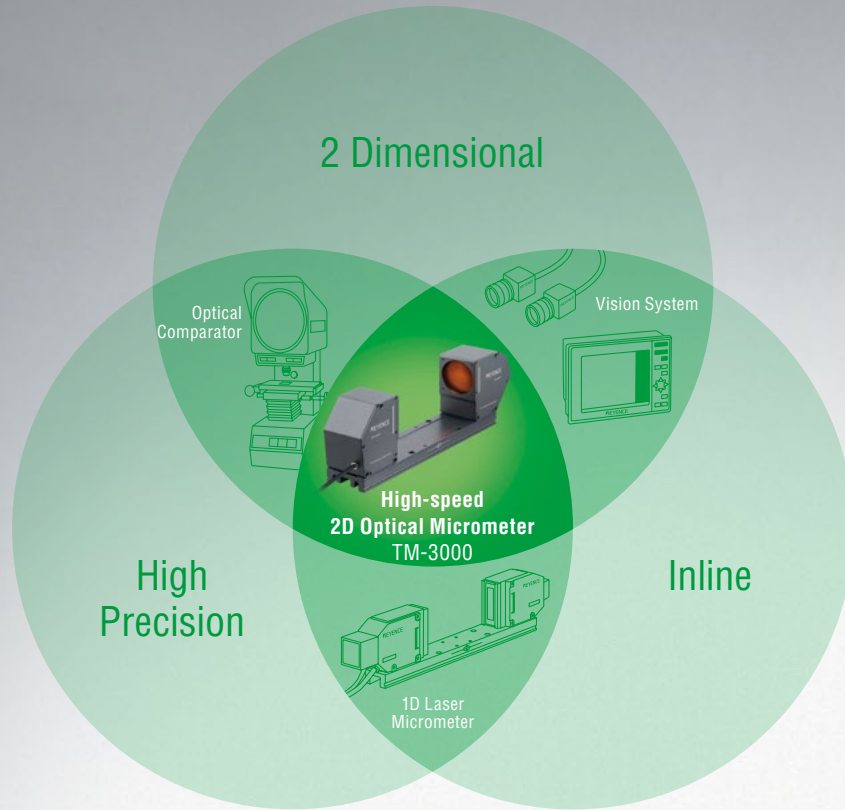
MEASURES 2 DIMENSIONS WITH MICRON PRECISION



| | | | | |
|----------------------------|--------|-------|----|--------|
| Outer diameter A | 24.000 | 60 | HI | 24.020 |
| Two-dimensional Micrometer | | [mm] | LO | 23.980 |
| Outer diameter B | 28.001 | 60 | HI | 28.020 |
| | | [mm] | LO | 27.980 |
| Outer diameter C | 31.998 | 60 | HI | 32.020 |
| | | [mm] | LO | 31.980 |
| Outer diameter D | 30.002 | 60 | HI | 30.020 |
| | | [mm] | LO | 29.980 |
| Step a | 2.000 | 60 | HI | 2.020 |
| | | [mm] | LO | 1.980 |
| Step b | 0.499 | 60 | HI | 0.520 |
| | | [mm] | LO | 0.480 |
| Angle c | 0.12 | 60 | HI | 0.30 |
| | | [deg] | LO | -0.30 |
| Width d | 3.500 | 60 | HI | 3.550 |
| | | [mm] | LO | 3.450 |

Commitment to In-line Measurement

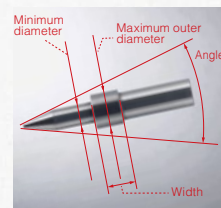
Performs in line 2D dimensional measurements with high speed and precision.
The TM-3000 Series, the industry's first inline 2D measurement system.



Because the TM-3000 is 2D it can...

Measure single point and edge dimensions

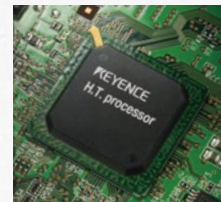
No need to position an object, outer diameter and angles can be measured instantaneously. In addition, since the object position is recognised, accurate measurement is performed with position correction. Furthermore, variations due to surface roughness of an object are suppressed with edge averaging, improving the reliability of measurement.



High speed production support

Newly developed HT processor

Newly developed high speed 2D dedicated includes a high-speed computing CPU and two dedicated image processing DSPs. Using a total of four processors for parallel processing, TM-3000 Series allows for fast processing of 1800(images)/minute.



*HT Processor...High Speed Two Dimensional Processor

*1800 images/min... calculated with approx. 33 ms trigger interval (default setting)

High precision inspection

A high brightness LED and a double telecentric optical system ensure high precision performance

A advantage of the thrubeam type which is not affected by external lighting, $\pm 0.15 \mu\text{m}$ repeatability.



Traceable two dimensional inspections in line

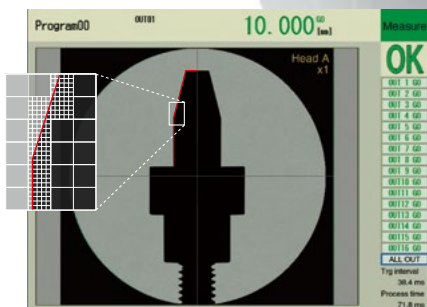
Measurement principle

Uniform collimated lighting with a green LED. Two-dimensional CMOS array detects the light-dark edges in the received light, and measures the dimensions.

Dual telecentric optical system

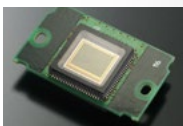
Dual telecentric lenses ensure only collimated light is used for imaging. Even though the distance from the object to the lenses changes, the size of the image on the CMOS does not change. High precision measurement is possible.

Even with slight deviations of the object within the measurement area, the size of the image does not change.



Pinpoint sub-pixel processing

High speed and high precision are achieved by performing pinpoint extraction and sub-pixel processing on just the contour within the specified measurement area, from the silhouette imaged on the CMOS.



HUD unit + collimator lens

Collimated light is produced without any unevenness by spreading LED light uniformly across the complete range.

*HUD unit = High Uniform Diffusion unit

High brightness InGaN green LED

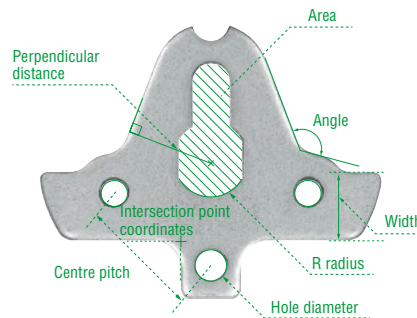
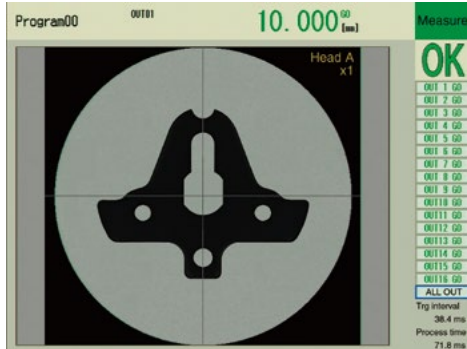
A high brightness LED is used, combining three features,

- Even Brightness Distribution
- Resistant to EMF
- Eye Safe

A variety of measurement modes greatly expand the inspection possibilities

Because the system works in two dimensions it can...

Simultaneously measure a maximum of 16 measurement points within the measurement area. The time for measurement has been greatly reduced.



Example of measurement

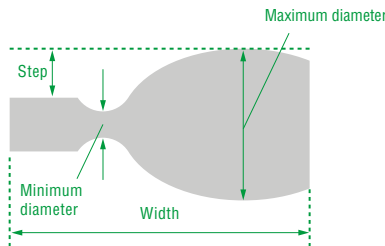
- : Hole diameter
- : Centre pitch
- : Intersection point coordinates
- : R radius
- : Width
- : Angle
- : Perpendicular distance
- : Area

Diverse measurement modes

A flexible combination of 15 types of basic measurement modes, and 8 types of auxiliary measurement modes, can support a variety of inspections.

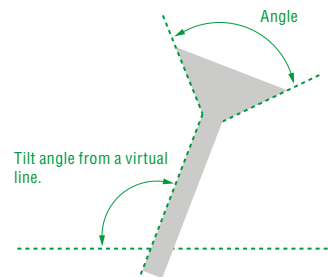
Outer diameter/Step/Width

Measures a maximum diameter/minimum diameter within the specified area, and a step/width between the detected edges.



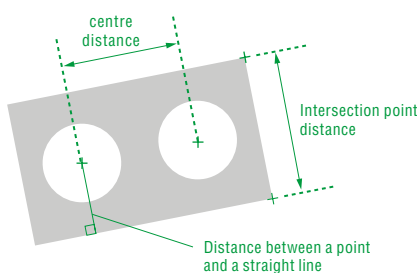
Angle

Measures an angle between two detected straight lines, and a tilt angle from a virtual line.



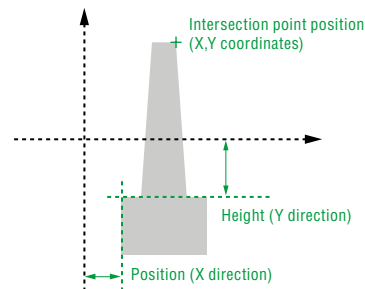
Distance/Intersection Point Distance

Measures a centre of the circles and intersection point, distance between 2 specified points, distance from a point to a straight line.



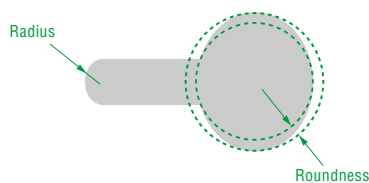
Height / Position/Coordinates

Measures height/ position of detected edges and coordinates of specified points.



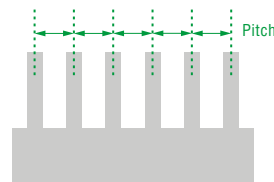
Radius/Roundness

Measures radius and roundness of specified arc.



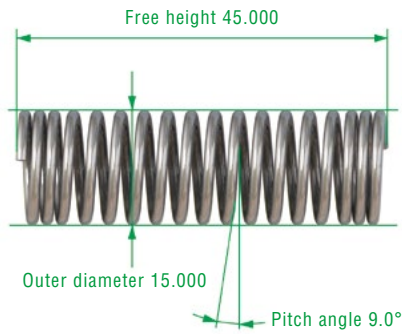
Pitch

Measures a maximum/minimum/average pitch within the specified area.

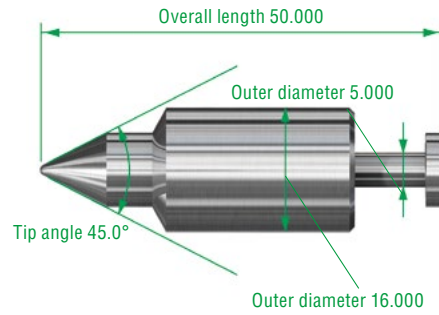


APPLICATIONS

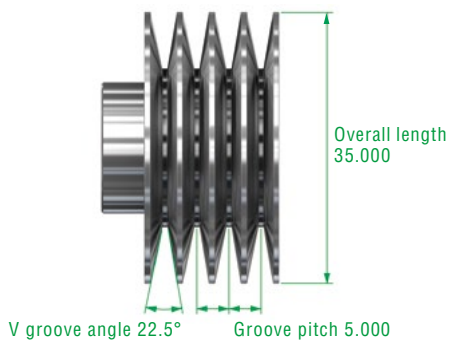
Unit: mm



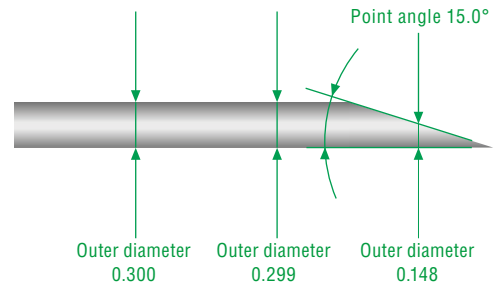
Measures outer diameter /pitch angel of springs



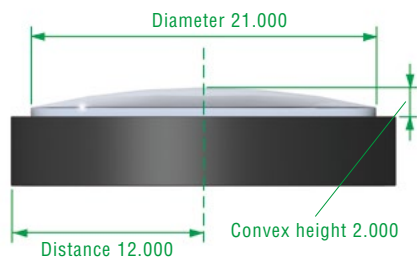
Measures outer diameter/tip angle of needle valves



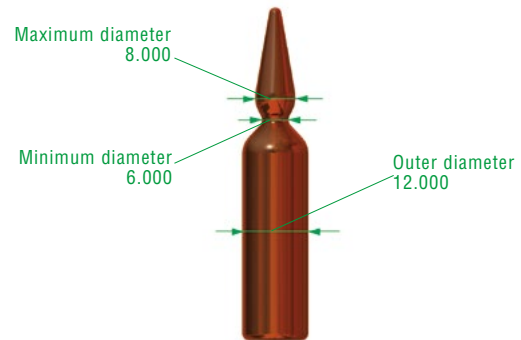
Measures pulley groove pitches/V groove angles



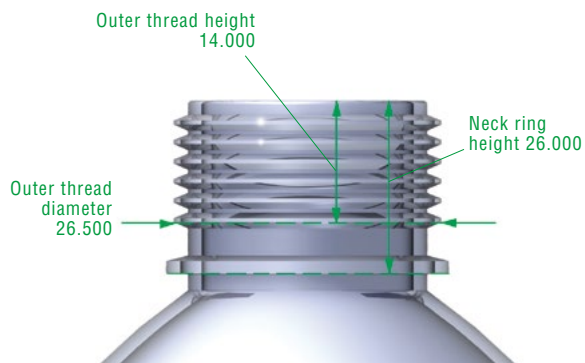
Measures multi-point outer diameter/point angle of injection needles



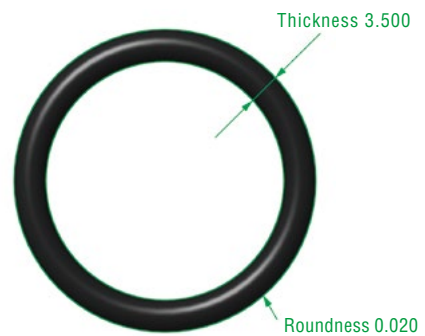
Measures diameter/height of lenses



Measures maximum diameter/minimum diameter of ampules



Measures outer diameter and threading a PET bottle

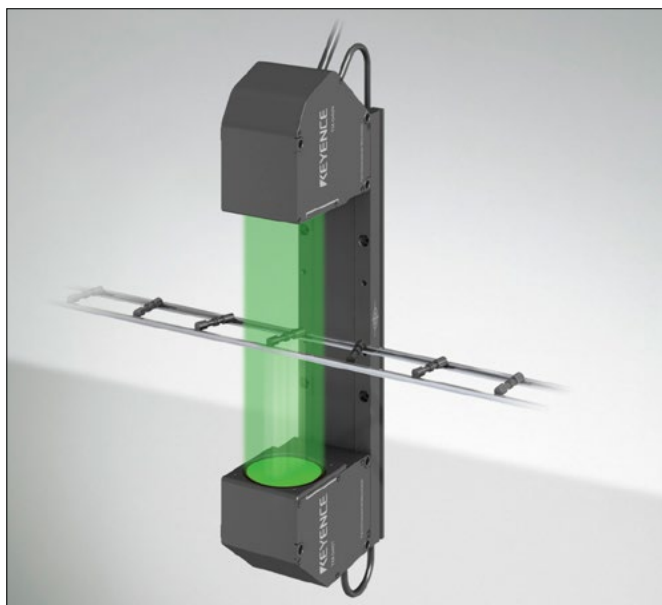


Measures roundness/thickness of O-rings

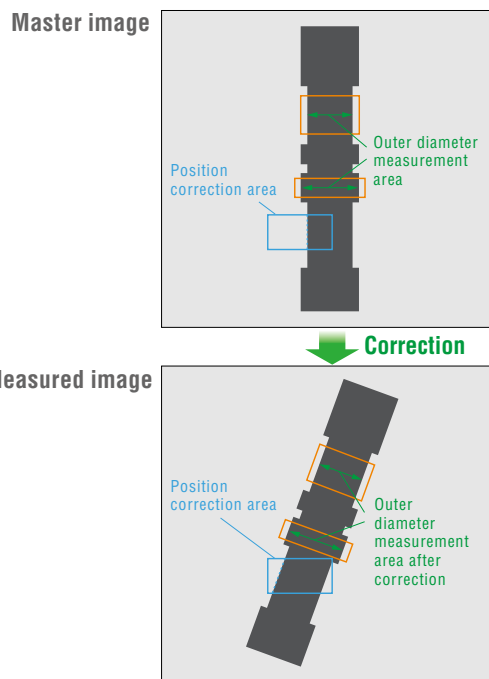
Correction function with on-the-spot power

Position correction function [edge correction/pattern correction]

Automatically corrects misalignments and tilt of the target which is directly linked to measurement errors. Can measure accurately even when positioning is difficult or objects are conveyed in random orientations.

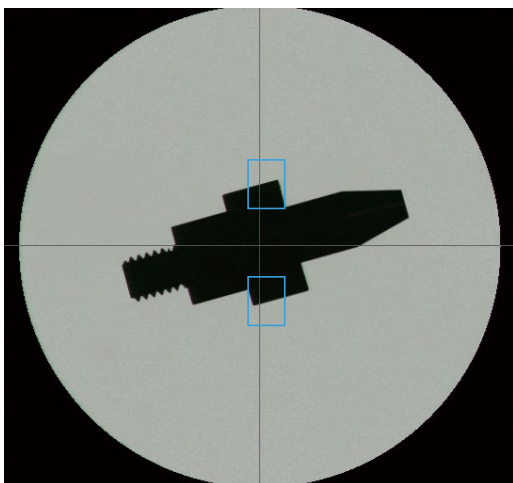


Because the measurement area autotracks according to the position and tilt of objects within the compensation area, it can be measured accurately.

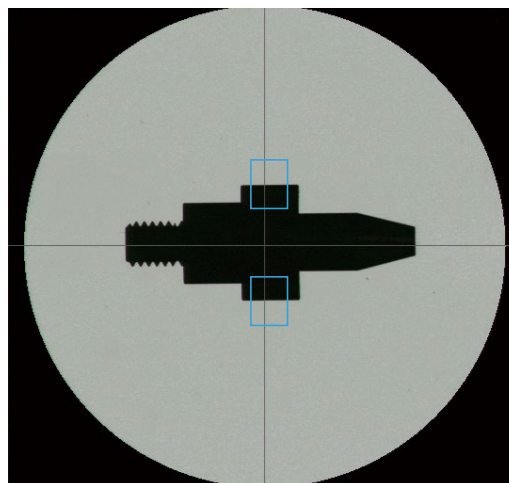


Tilt correction function

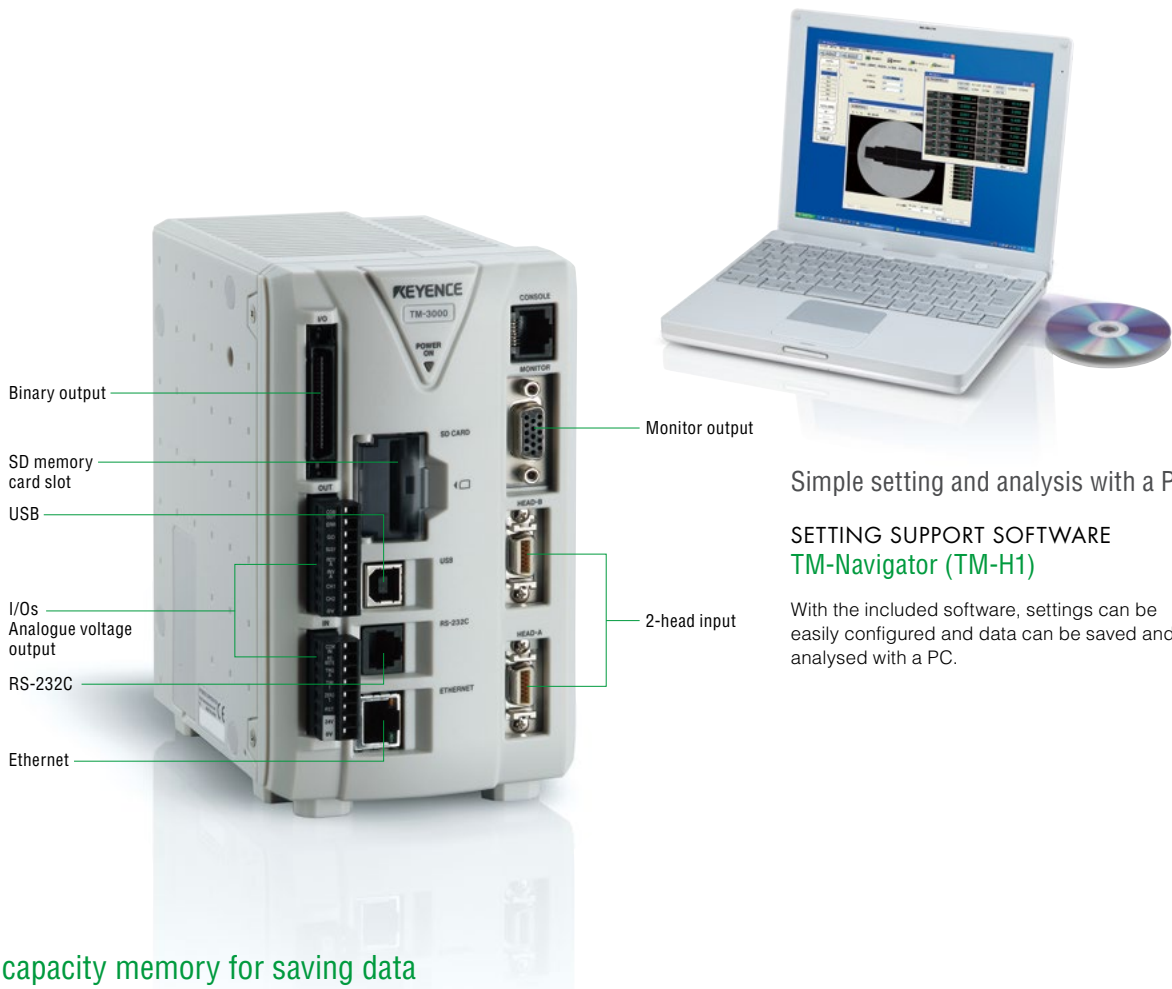
When installing the sensor head, a tilt of the master workpiece is horizontally/vertically corrected, which significantly reduces adjustment times.



The image of the workpiece is tilted due to the sensor head which has not been installed at an appropriate angle.



By means of the tilt correction function, the workpiece image is horizontally/vertically captured and accurately measured.



Simple setting and analysis with a PC

SETTING SUPPORT SOFTWARE
TM-Navigator (TM-H1)

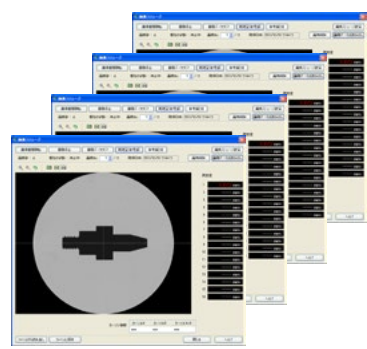
With the included software, settings can be easily configured and data can be saved and analysed with a PC.

Large capacity memory for saving data

The controller has built in high capacity memory. A memory card slot is included for recording histories of multiproduct/mass production.

Profile saving
For analysing NG records or production history.

Maximum 100 images



| | A | B | C | D | E | F | G | H | I | J | K | L |
|----|-------------------|------|------|------|------|------|------|------|------|------|------|------|
| 1 | 2008/9/9 20:44:59 | 0476 | 0193 | 0392 | 0514 | 0584 | 0140 | 0359 | 0903 | 0125 | 0402 | 0637 |
| 2 | 2008/9/9 20:44:59 | 0471 | 0539 | 0501 | 0310 | 0503 | 0340 | 0302 | 0903 | 0329 | 0406 | 0304 |
| 3 | 2008/9/9 20:44:59 | 0466 | 0418 | 0547 | 0332 | 0519 | 0346 | 0329 | 0465 | 0327 | 0406 | 0302 |
| 4 | 2008/9/9 20:44:59 | 0469 | 0418 | 0548 | 0310 | 0343 | 0340 | 0307 | 0903 | 0325 | 0402 | 0302 |
| 5 | 2008/9/9 20:44:59 | 0471 | 0461 | 0543 | 0302 | 0368 | 0346 | 0307 | 0406 | 0324 | 0402 | 0304 |
| 6 | 2008/9/9 20:44:59 | 0470 | 0468 | 0502 | 0312 | 0484 | 0388 | 0319 | 0406 | 0326 | 0408 | 0406 |
| 7 | 2008/9/9 20:44:59 | 0470 | 0437 | 0504 | 0311 | 0409 | 0302 | 0303 | 0401 | 0321 | 0402 | 0304 |
| 8 | 2008/9/9 20:44:59 | 0471 | 0462 | 0506 | 0308 | 0308 | 0306 | 0329 | 0312 | 0329 | 0401 | 0308 |
| 9 | 2008/9/9 20:44:59 | 0476 | 0462 | 0506 | 0311 | 0306 | 0306 | 0319 | 0319 | 0322 | 0401 | 0308 |
| 10 | 2008/9/9 20:44:59 | 0476 | 0431 | 0501 | 0311 | 0302 | 0302 | 0319 | 0303 | 0321 | 0401 | 0305 |
| 11 | 2008/9/9 20:44:59 | 0476 | 0462 | 0506 | 0311 | 0306 | 0306 | 0319 | 0319 | 0322 | 0401 | 0308 |
| 12 | 2008/9/9 20:44:59 | 0488 | 0424 | 0503 | 0308 | 0305 | 0308 | 0304 | 0401 | 0321 | 0301 | 0301 |
| 13 | 2008/9/9 20:44:59 | 0488 | 0429 | 0506 | 0307 | 0308 | 0306 | 0306 | 0401 | 0302 | 0401 | 0301 |
| 14 | 2008/9/9 20:44:59 | 0467 | 0472 | 0502 | 0306 | 0308 | 0306 | 0304 | 0401 | 0313 | 0302 | 0301 |
| 15 | 2008/9/9 20:44:59 | 0486 | 0425 | 0508 | 0308 | 0308 | 0306 | 0306 | 0401 | 0302 | 0401 | 0301 |
| 16 | 2008/9/9 20:44:59 | 0485 | 0419 | 0506 | 0306 | 0308 | 0306 | 0306 | 0401 | 0302 | 0401 | 0301 |
| 17 | 2008/9/9 20:44:59 | 0485 | 0417 | 0509 | 0304 | 0307 | 0307 | 0319 | 0306 | 0321 | 0306 | 0302 |
| 18 | 2008/9/9 20:44:59 | 0485 | 0407 | 0506 | 0302 | 0301 | 0301 | 0319 | 0311 | 0319 | 0306 | 0301 |
| 19 | 2008/9/9 20:44:59 | 048 | 0430 | 0508 | 0306 | 0305 | 0301 | 0319 | 0401 | 0316 | 0306 | 0301 |
| 20 | 2008/9/9 20:44:59 | 048 | 04 | 0407 | 0306 | 0406 | 0305 | 0319 | 0406 | 0316 | 0306 | 0301 |
| 21 | 2008/9/9 20:44:59 | 0501 | 0306 | 0506 | 0306 | 041 | 0308 | 0407 | 0401 | 0312 | 0306 | 0301 |
| 22 | 2008/9/9 20:44:59 | 0906 | 0307 | 0304 | 0306 | 0312 | 0302 | 0409 | 0401 | 0309 | 0309 | 0308 |

For daily production control and traceability

65536 data can be stored

Handling many product types

The memory in the controller stores up to 16 programmes. By using a function to search from the memory card, up to 256 programmes can be switched to handle various product types.

Handles 256 types

| | Programme setting | Image saving | Data storage |
|-----------------|-------------------|---------------|------------------------|
| Internal memory | 16 | 100 | 65,536 × 16 |
| SD card (4GB) | 256 | Approx. 3,800 | 65,536 × Approx. 8,000 |

SPECIFICATIONS (SENSOR HEADS)



| Model | TM-006 | TM-040 | TM-065 | |
|--|-------------------------------------|-----------------------------|-----------------------|---------------|
| Measuring range | ø6 mm | ø40 mm | ø65 mm | |
| Smallest detectable object | 0.04 mm | 0.3 mm | 0.5 mm | |
| Transmitter/receiver distance | 60 mm | 180 mm | 270 mm | |
| Light source | GaN Green LED | InGaN Green LED | | |
| Measurement accuracy | ±0.5 μm* ¹ | ±2 μm* ³ | ±3 μm* ⁵ | |
| Repeatability | ±0.06 μm* ² | ±0.15 μm* ⁴ | ±0.2 μm* ⁶ | |
| Sampling cycle (trigger interval) * ⁷ | 5.5ms (33ms at the initial setting) | | | |
| Environmental resistance | Enclosure rating * ⁸ | IP64 | | |
| | Ambient temperature | 0 to 50°C | | |
| | Relative humidity | 35 to 85% (No condensation) | | |
| Material | Aluminium | | | |
| Weight | Transmitter | Approx. 140g | Approx. 560g | Approx. 1280g |
| | Receiver | Approx. 340g | Approx. 720g | Approx. 1460g |
| | Base | Approx. 220g | Approx. 630g | Approx. 1500g |

*1 In a measurement area of 2 mm×ø4 mm error when measuring width of KEYENCE standard object (glass calibration scale).

*2 Value of ±2σ measuring the width of KEYENCE standard object (glass calibration scale) in the centre of the measurement area, an average 16 times, average 1.3 mm line.

*3 In a measurement area of 10 mm×ø26 mm error when measuring width of KEYENCE standard object (glass calibration scale).

*4 Value of ±2σ measuring the width of KEYENCE standard object (glass calibration scale) in the centre of the measurement area, an average 16 times, average 8 mm line.

*5 Error when measuring width of KEYENCE standard object (glass calibration scale) in a measurement area of 20 mm×ø40 mm.

*6 Value of ±2σ measuring the width of KEYENCE standard object (glass calibration scale) in the centre of the measurement area, an average 16 times, average 14 mm line.

*7 When measurement area is minimum, others are initial settings

*8 Apart from connector component

SPECIFICATIONS (CONTROLLER)

| Model | TM-3001 | TM-3001P | |
|--|--|---|---|
| Sensor head compatibility | Compatible | | |
| Number of connectable sensors * ¹ | 2 units max. | | |
| Display | Minimum display unit | 0.01 μm, 0.001 mm ² , 0.01° | |
| | Maximum display range | ±9999.99 mm, ±99999.9 mm ² , ±99999.9° | |
| Input terminal block | Laser remote interlock input | Non-voltage input | |
| | Trigger input (for Head A) | Voltage input | |
| | Timing 1 input | | |
| | Auto-zero 1 input | | |
| | Reset input | | |
| Output terminal block | Analogue voltage output | ±10 V x 2 outputs, out put impedance: 100 Ω | |
| | Total judgment output | NPN open-collector output | PNP open-collector output |
| | Error output | NPN open-collector output (N.C.) | PNP open-collector output (N.C.) |
| | Process output | NPN open-collector output | PNP open-collector output |
| | Trigger input enable output | | |
| | Adjusted error output | | |
| Expansion connector | Trigger input (for Head A) | Non-voltage input | Voltage input |
| | Timing 2 input | | |
| | Auto-zero 2 input | | |
| | Programme switching input | Non-voltage input, 4 inputs | Voltage input, 4 inputs |
| | Memory card save input | Non-voltage input | Voltage input |
| | Judgment/Binary output* ² | 3-level judgment output: OUT1 to OUT16, total judgment output Binary output: OUT1 to OUT16 measured data output (21 bits) NPN open-collector output | 3-level judgment output: OUT1 to OUT16, total judgment output Binary output: OUT1 to OUT16 measured data output (21 bits) PNP open-collector output |
| | Strobe output | NPN open-collector output | PNP open-collector output |
| Trigger input enable output | | | |
| Analogue RGB monitor output | SVGA (800 x 600 pixels) | | |
| RS-232C interface | Measured data output and control input/output (Maximum baud rate: 115200 bps, selectable) | | |
| USB interface | In conformity with USB Revision 2.0 HI-SPEED (USB 1.1 Full-SPEED compatible) | | |
| Ethernet interface | 1000BASE-T/1000 BASE-TX/10 BASE-T | | |
| Memory card | SD card CA-SD4G (4GB), CA-SD1G (1GB) support | | |
| Major functions | Position correction function, OUT name change function, select measurement mode (outer diameter, height, step height, position, width, distance, intersection distance, angle, radius, roundness, coordinates, area, search, ring test, pitch) functions, OUT function between operators, auxiliary measurements (straight edge, circular edge, the edge bounding line, centre line, intersection, straight line between two points, any line, any point), functions, scaling function, average function, measurement function, measurement value alarm setting function, tolerance setting function, auto-zero function, storage (data/image) function, memory card storage function, programme memory function, trigger mode change function, mutual interference prevention function, adjustable measuring range function, detection threshold value change function, mask function, attitude correction function, display language switching function, support software setting function, trigger interval-measurement time display function, others | | |
| Ratings | Power supply voltage | 24 VDC ±10%, Ripple: 10% (P to P) or less | |
| | Current consumption | 1 head connected 480mA max./ 2 heads connected 550mA max. | |
| Environmental resistance | Ambient temperature | 0 to 50°C | |
| | Relative humidity | 35 to 85% (No condensation) | |
| Material | Polycarbonate | | |
| Weight | Approx. 1120g | | |

*1 1 or 2 units can be connected only with the same head model

*2 OUT 1 to OUT 8 decision result, OUT 9 to OUT 16 decision result, time share output of binary measurement data.

• The rating of the NPN/PNP open collector output (output terminal block): 50 mA (30 V or less) max., residual voltage: 1.4 V or less (50 mA) 1.0 V (20 mA)

• The rating of the NPN/PNP open collector output (expansion connector): 50 mA (30 V or less) max., residual voltage: 1.0 V or less

• Rating for non-voltage input, ON voltage 1V max., OFF current 0.3mA max. (trigger input terminal, ON voltage 5V max., OFF current 1mA max.)

• Voltage rating, maximum rating 26.4V, ON voltage 10.8V, OFF current 0.3mA (trigger input terminal maximum rating 26.4V, ON voltage 10.8V, OFF current 1mA)

OPERATING SYSTEM ENVIRONMENT

| | |
|------------------------------|--|
| CPU | Pentium III 1GHz min. (recommended 1.7GHz min.) |
| Support OS | Windows 10 ^{*1} Windows 7 (SP1 or later) ^{*2} |
| | Windows Vista (SP2 or later) ^{*3} |
| | Windows XP (SP3 or later) ^{*4} |
| Memory capacity | 512MB min. (1GB min. recommended) |
| Resolution of display | XGA (1024 x 768 pixels) min, 256 colours min. |
| Free disk space | 1GB min. |
| Interface | As described above, all those mounted, USB2.0/1.1 ^{*5} , Ethernet ^{*6} |

*For your OS, use environments above that recommended.

*1 Home, Pro, and Enterprise editions are supported.

*2 Home Premium, Professional, and Ultimate editions are supported.

*3 Ultimate, Business, Home Premium, and Home Basic editions are supported.

*4 Professional and Home editions are supported.

*5 Connection through a USB hub is not included in the guarantee.

*6 Connection to LAN and connection via a router is not included in the guarantee.

CONTROLLER



Controller
TM-3001(P)

CONTROLLER LINEUP

| | |
|-----------------|----------|
| NPN Output type | TM-3001 |
| PNP Output type | TM-3001P |

SENSOR HEADS

Sensor head
ø6 mm type
TM-006



Sensor head
ø40 mm type
TM-040



Sensor head
ø65 mm type
TM-065



MONITOR

Console (Optional)
OP-87504



Setting and support software
TM-H1



USB cable
OP-66844



High-resolution monitor
CA-MP81



Monitor stand
OP-42278



CABLE - CONNECTOR

Cable between
head and controller
CB-Axx
(0.7, 2, 5, 10, 20, 30 m)



Transmitter to receiver
expansion cable
OP-87033 (1 m)
OP-87034 (3 m)



Cable between
controller - monitor
OP-66842 (3 m)



I/O connector cable
OP-51657 (3 m)



Ethernet cable
OP-66843 (3 m)



RS-232C
communication cable
OP-96368 (2.5 m)



D-sub9 pin conversion
connector
OP-26401



D-sub25 pin conversion
connector
OP-96369



OPTION

Protective cover
OP-87035 (2 per pack)
(for TM-040)
OP-87036 (2 per pack)
(for TM-065)



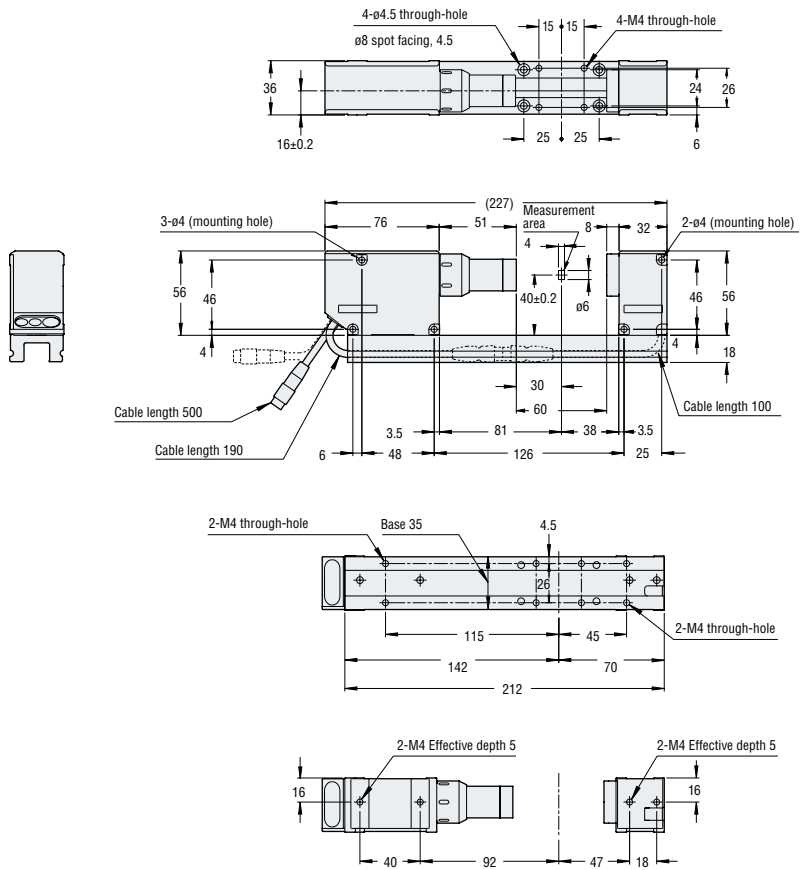
Memory card
CA-SD4G (4 GB)
CA-SD1G (1 GB)



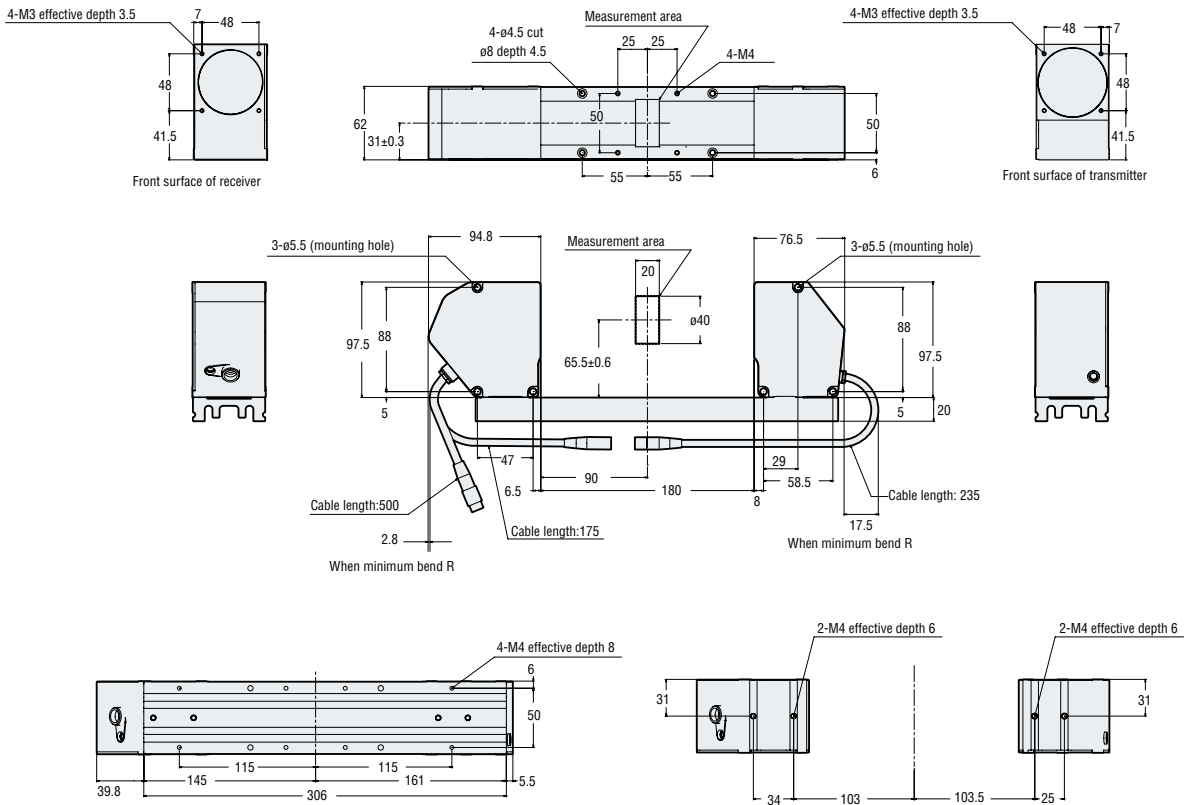
DIMENSIONS (SENSOR HEADS)

TM-006

Unit: mm



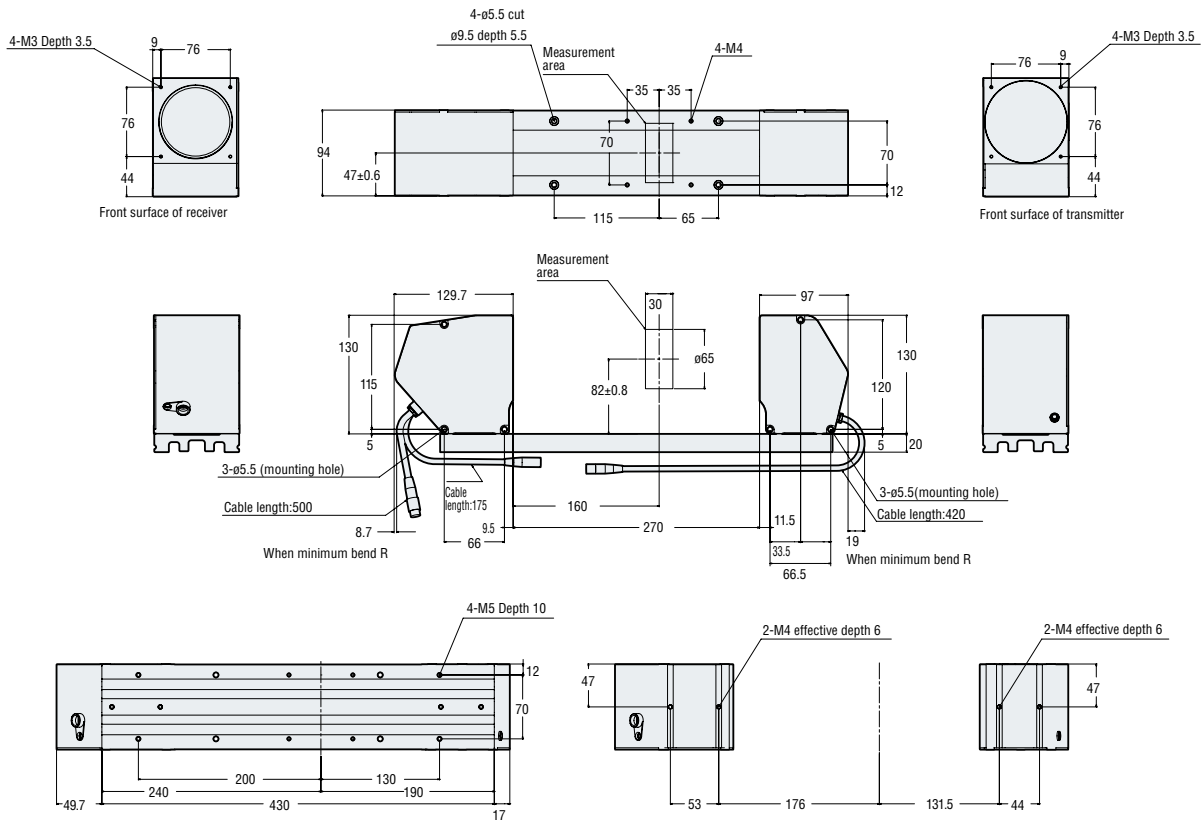
TM-040



DIMENSIONS (SENSOR HEADS)

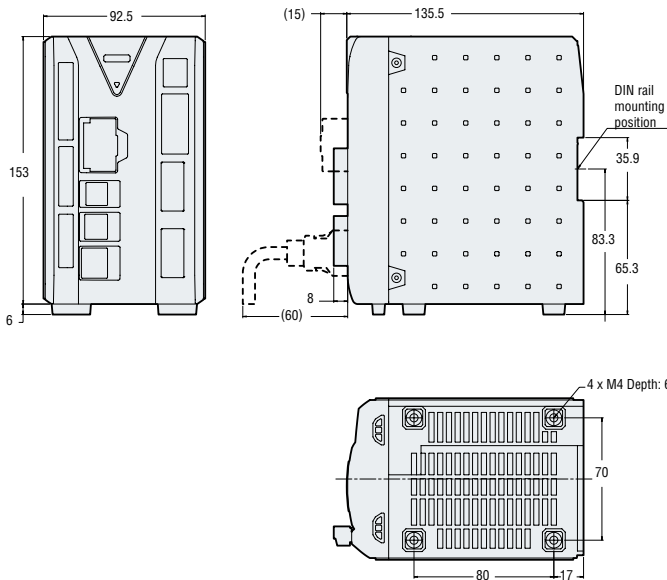
TM-065

Unit: mm



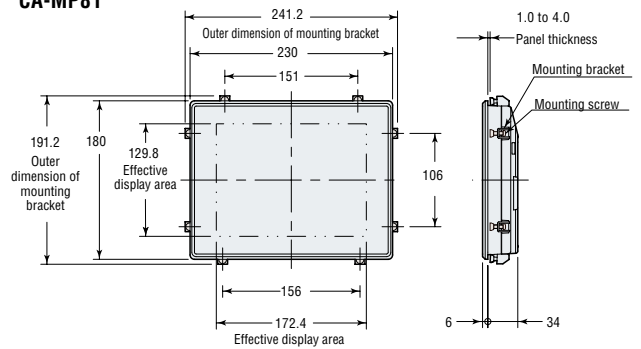
DIMENSIONS (CONTROLLER)

TM-3001(P)

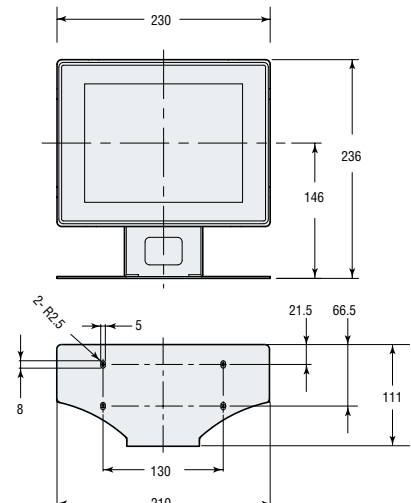


DIMENSIONS (MONITOR)

**LCD monitor
CA-MP81**



**Stand
OP-42278**



LASER DISPLACEMENT (2D)

LJ-G Series



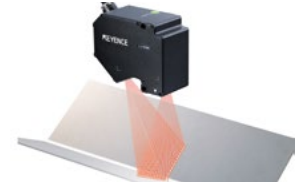
Confirmation of PCB mounting height



Confirmation of door/hood mounting accuracy



Confirmation of sealant coating profile



Confirmation of welding groove position

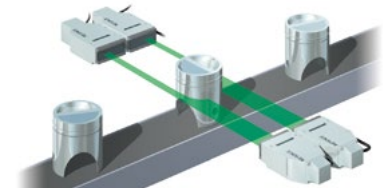
- High-accuracy of $\pm 0.1\%$ of F.S.
- High-speed sampling
- Simultaneous measurement/judgment at 8 points
- Stable measurement of all targets

OPTICAL MICROMETER

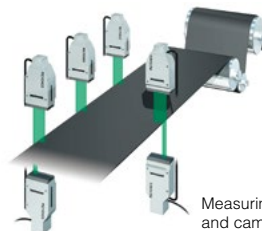
LS Series



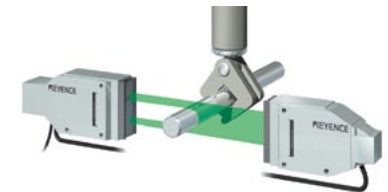
Measuring the outer diameter of a fibre



Measuring the outer diameter of a piston



Measuring the width and camber angle of a rubber sheet



Measuring the outer diameter of a processed shaft

- High-repeatability $\pm 0.06 \mu\text{m}$
- High-speed 2,400 samples/second
- Maintenance-free design
- Easy set-up, target viewer

LASER DISPLACEMENT

LK-G5000 Series



- Sampling rate of 392 kHz
- Linearity of $\pm 0.02\%$ of F.S.
- Repeatability down to $0.01 \mu\text{m}$



Vibration test of high-temperature-muffler



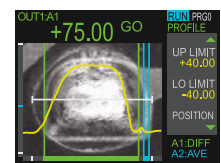
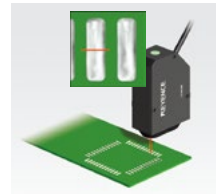
Thickness measurement/loop control of a rubber sheet

CONFOCAL DISPLACEMENT

LT Series



- Surface scanning method for a variety of high-accuracy measurements
- Multiple measurement modes
- $0.3 \mu\text{m}$ resolution



Measuring the profile of solder paste on a PWB

KEYENCE

Please visit: www.keyence.com



SAFETY INFORMATION

Please read the instruction manual carefully in order to safely operate any KEYENCE product.

GLOBAL NETWORK

CONTACT YOUR NEAREST OFFICE FOR RELEASE STATUS

AUSTRIA
Phone: +43 2236 378266 0

CZECH REPUBLIC
Phone: +420 220 184 700

INDIA
Phone: +91-44-4963-0900

MALAYSIA
Phone: +60-3-7883-2211

ROMANIA
Phone: +40 269 232 808

TAIWAN
Phone: +886-2-2721-8080

BELGIUM
Phone: +32 15 281 222

FRANCE
Phone: +33-1-56-37-78-00

INDONESIA
Phone: +62-21-2966-0120

MEXICO
Phone: +52-55-8850-0100

SINGAPORE
Phone: +65-6392-1011

THAILAND
Phone: +66-2-369-2777

BRAZIL
Phone: +55-11-3045-4011

GERMANY
Phone: +49-6102-3689-0

ITALY
Phone: +39-02-6688220

NETHERLANDS
Phone: +31 40 20 66 100

SLOVAKIA
Phone: +421 2 5939 6461

UK & IRELAND
Phone: +44 1908-696-900

CANADA
Phone: +1-905-366-7655

HONG KONG
Phone: +852-3104-1010

JAPAN
Phone: +81-6-6379-2211

PHILIPPINES
Phone: +63-2-8981-5000

SLOVENIA
Phone: +386 1 4701 666

USA
Phone: +1-201-930-0100

CHINA
Phone: +86-21-5058-6228

HUNGARY
Phone: +36 1 802 73 60

KOREA
Phone: +82-31-789-4300

POLAND
Phone: +48 71 36861 60

SWITZERLAND
Phone: +41 43 455 77 30

VIETNAM
Phone: +84-24-3772-5555