



WORLD'S FIRST

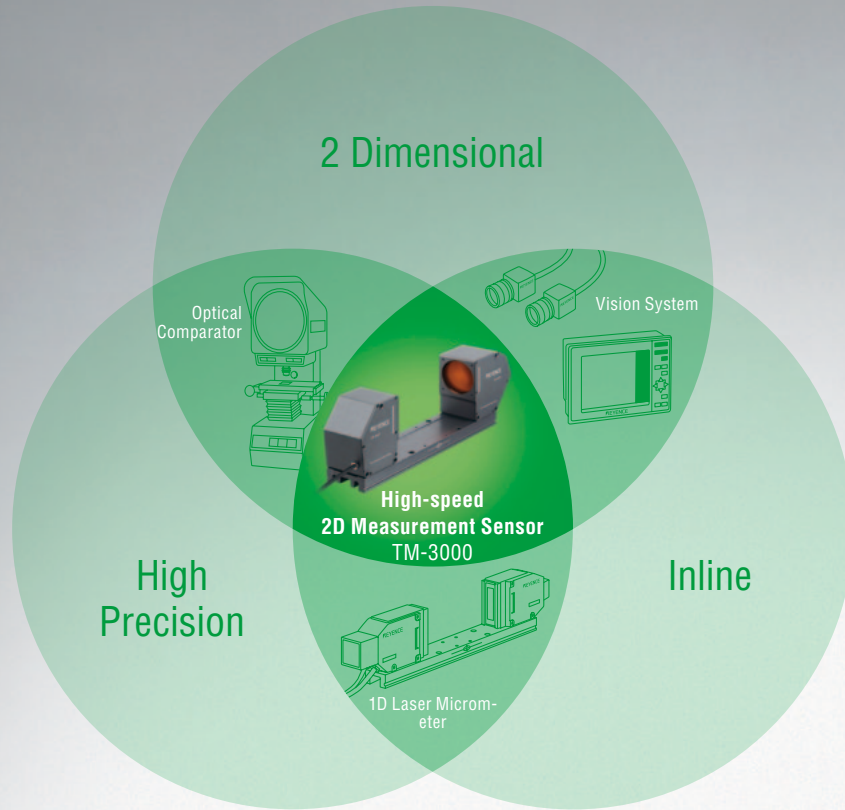
# IN-LINE 2D MEASUREMENT SYSTEM

MEASURES 2 DIMENSIONS WITH MICRON PRECISION



# Commitment to In-line Measurement

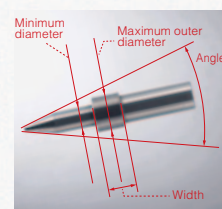
Performs in line 2D dimensional measurements with high speed and precision.  
The new TM-3000 Series, the industry's first inline 2D measurement system.



## 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.



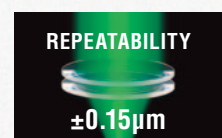
\*HT Processor...High Speed Two Dimensional Processor

\*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

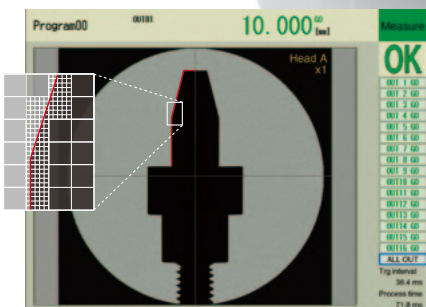
### Measurement principle

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

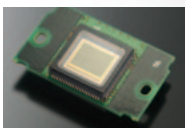
Dual telecentric lenses ensure only collimated light is used for imaging. Even though the distance from the object to the lenses change, the size of the image on the CMOS does not change. High precision measurement is possible.

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

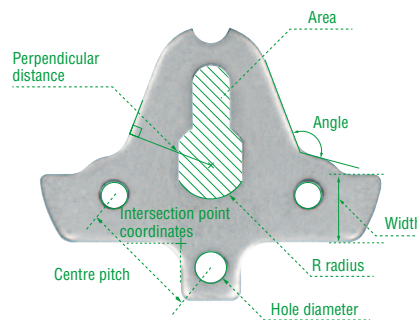
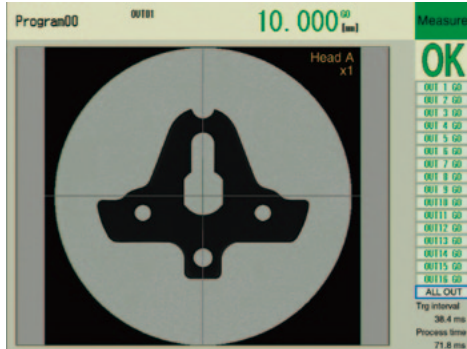
A high brightness LED is used, combining three features,

- 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

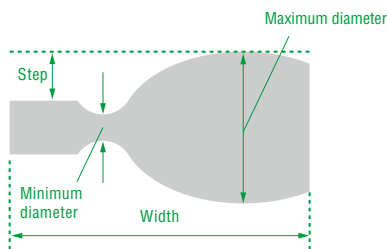
- : Hole diameter
- : Centre pitch
- : Intersection point coordinates
- : R radius
- : Width
- : Angle
- : Perpendicular distance
- : Area

## 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.

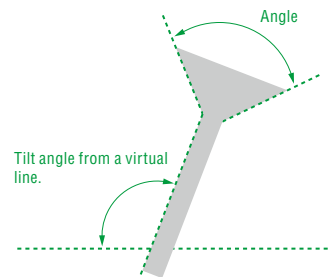
### Outer diameter/Step/Width

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



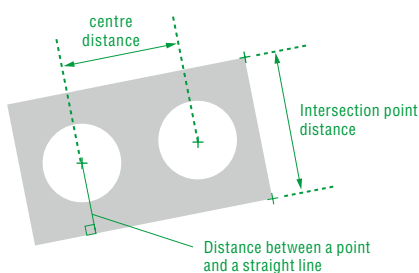
### Angle

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



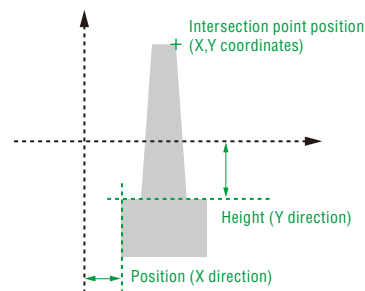
### Distance/Intersection Point Distance

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



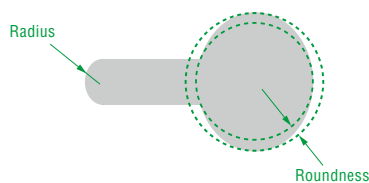
### Height / Position/Coordinates

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



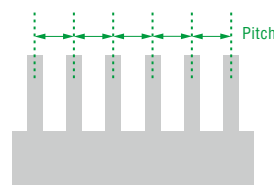
### Radius/Roundness

Measures radius and roundness of specified arc.



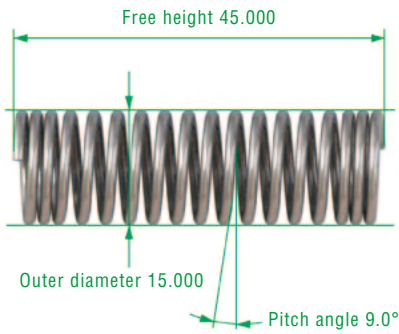
### Pitch

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

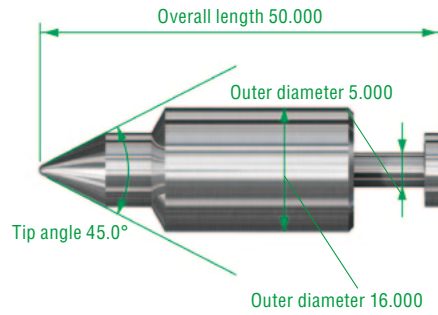


# APPLICATIONS

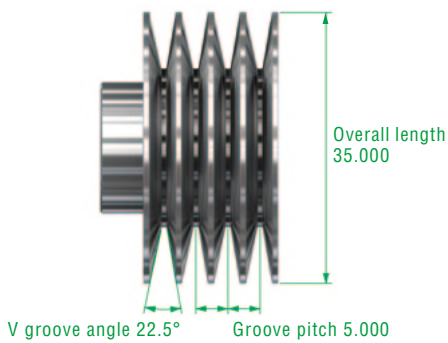
Unit: mm



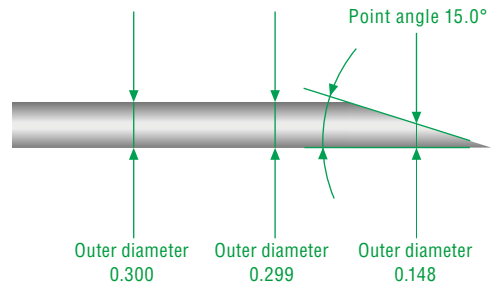
Measures outer diameter /pitch angel of springs



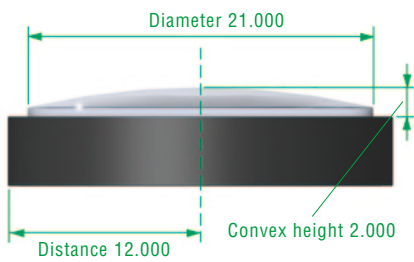
Measures outer diameter/tip angle of needle valves



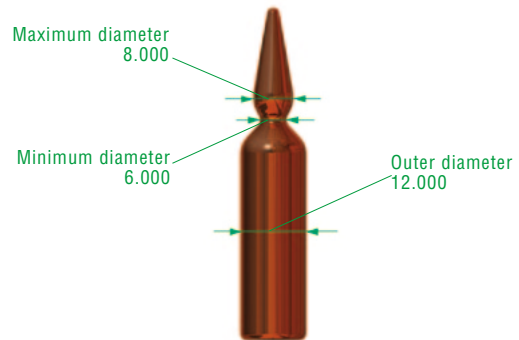
Measures pulley groove pitches/V groove angles



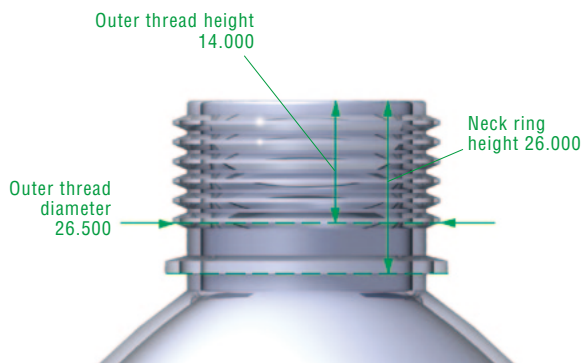
Measures multi-point outer diameter/point angle of injection needles



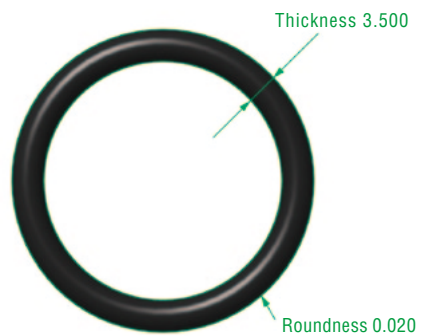
Measures diameter/height of lenses



Measures maximum diameter/minimum diameter of ampules



Measures outer diameter and threading a PET bottle

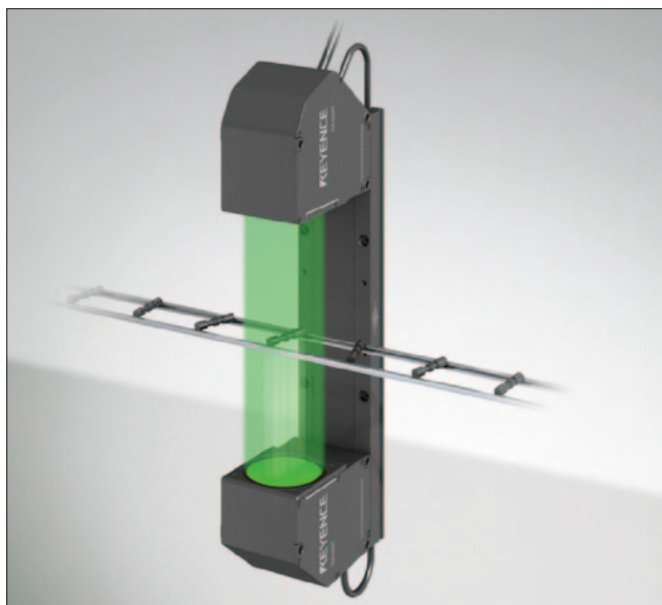


Measures roundness/thickness of O-rings

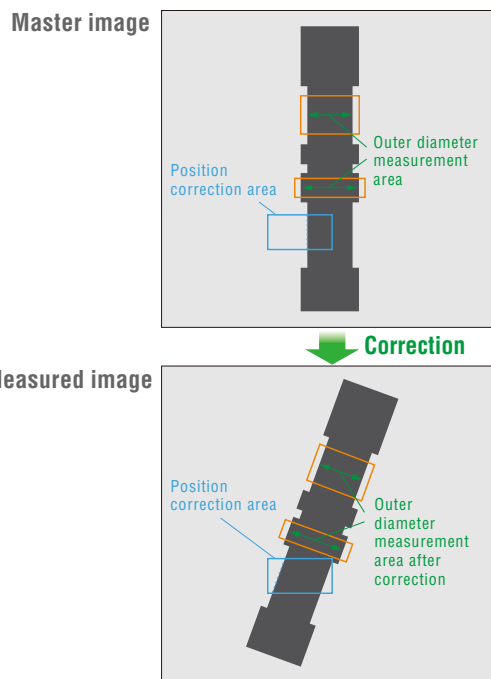
# Correction function with on-the-spot power

## 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.

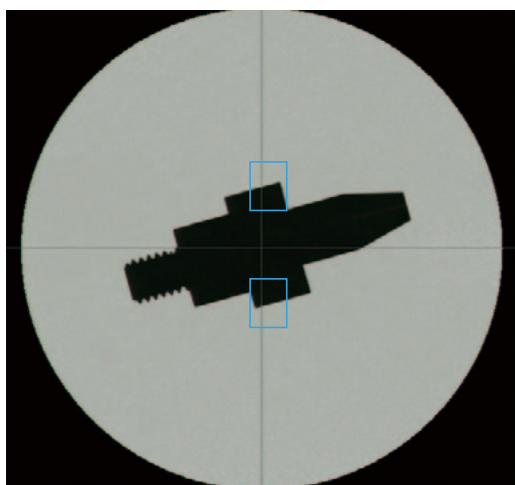


Because the measurement area autotracks according to the position and tilt of objects within the compensation area, it can be measured accurately.

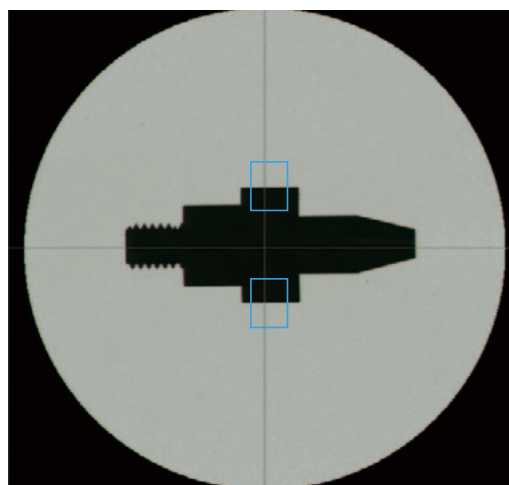


## Tilt correction function

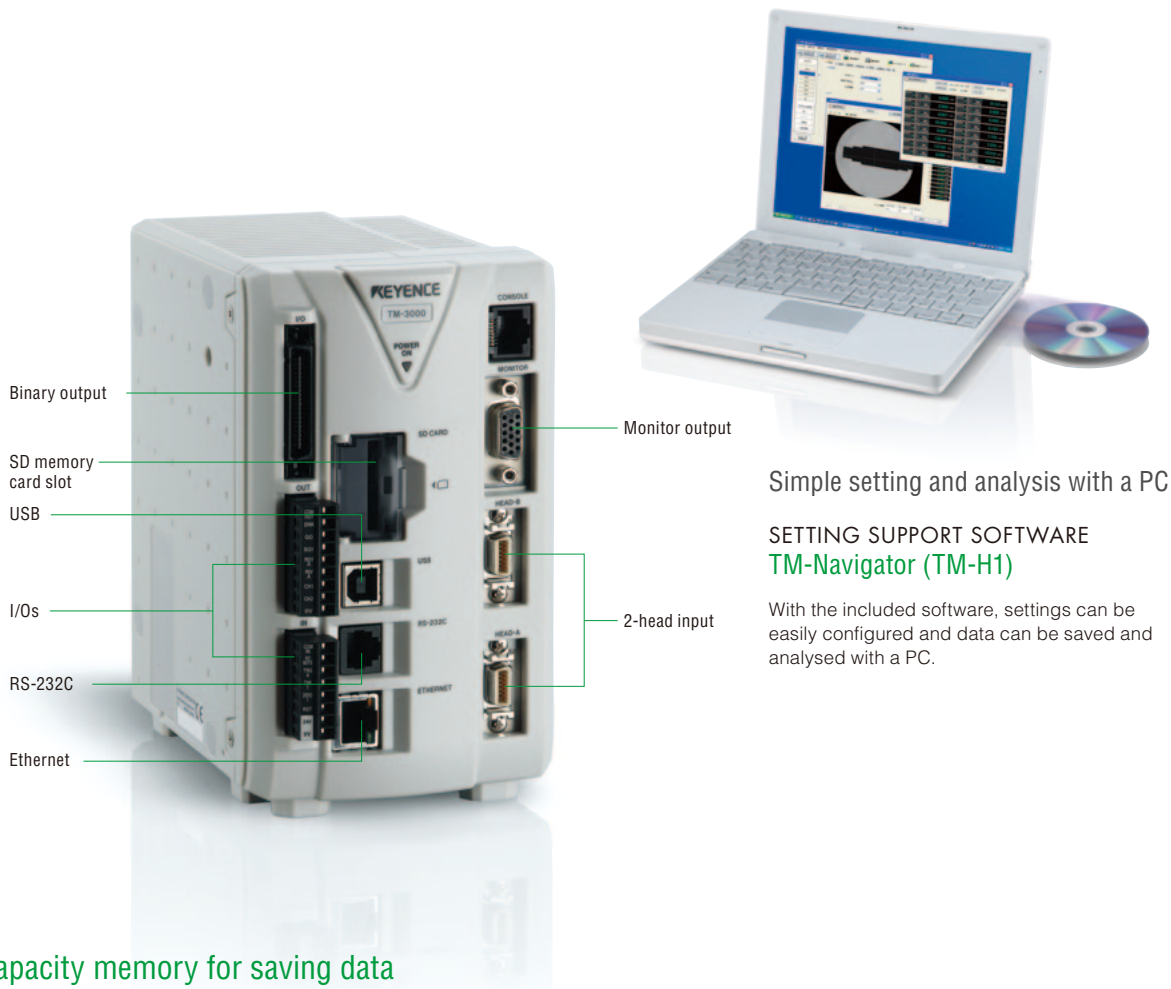
When installing the sensor head, a tilt of the master workpiece is horizontally/vertically corrected, which significantly reduces adjustment times.



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)**

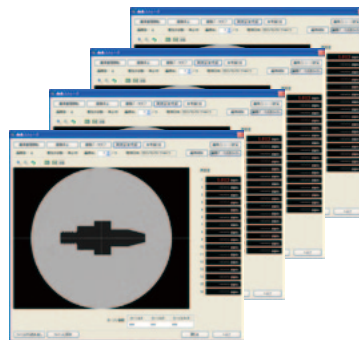
With the included software, settings can be easily configured and data can be saved and analysed with a PC.

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	2008/9/7 21:44:59	0476	093	0352	0114	058	0340	0352	0901	0125	0402	0527
2	2008/9/7 21:44:59	0471	0539	0551	0112	0521	0340	0352	0901	0125	0402	0527
3	2008/9/7 21:44:59	0466	0418	0482	0112	0418	0340	0352	0901	0125	0402	0527
4	2008/9/7 21:44:59	0460	0418	0482	0112	0418	0340	0352	0901	0125	0402	0527
5	2008/9/7 21:44:59	0457	0461	0481	0112	0468	0340	0352	0901	0124	0402	0526
6	2008/9/7 21:44:59	0471	0488	0502	0112	0488	0340	0352	0901	0124	0402	0526
7	2008/9/7 21:44:59	0472	0457	0484	0111	0459	0352	0402	0401	0121	0402	0526
8	2008/9/7 21:44:59	0471	0482	0508	0108	0488	0352	0402	0401	0121	0402	0526
9	2008/9/7 21:44:59	0476	0482	0502	0107	0488	0352	0402	0401	0121	0402	0526
10	2008/9/7 21:44:59	0476	0482	0502	0107	0488	0352	0402	0401	0121	0402	0526
11	2008/9/7 21:44:59	0476	0482	0502	0107	0488	0352	0402	0401	0121	0402	0526
12	2008/9/7 21:44:59	0488	0424	0493	0108	0488	0352	0402	0401	0121	0402	0526
13	2008/9/7 21:44:59	0488	0424	0493	0108	0488	0352	0402	0401	0121	0402	0526
14	2008/9/7 21:44:59	0487	0422	0492	0108	0488	0352	0402	0401	0121	0402	0526
15	2008/9/7 21:44:59	0488	0425	0493	0108	0488	0352	0402	0401	0121	0402	0526
16	2008/9/7 21:44:59	0488	0425	0493	0108	0488	0352	0402	0401	0121	0402	0526
17	2008/9/7 21:44:59	0488	0425	0493	0108	0488	0352	0402	0401	0121	0402	0526
18	2008/9/7 21:44:59	0488	0425	0493	0108	0488	0352	0402	0401	0121	0402	0526
19	2008/9/7 21:44:59	0488	0425	0493	0108	0488	0352	0402	0401	0121	0402	0526
20	2008/9/7 21:44:59	0488	0425	0493	0108	0488	0352	0402	0401	0121	0402	0526
21	2008/9/7 21:44:59	0501	0388	0388	0108	047	0388	0402	0401	0121	0402	0526
22	2008/9/7 21:44:59	0508	0387	0388	0108	0412	0392	0402	0401	0121	0402	0526

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 HEAD)



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* <sup>1</sup>	±2 μm* <sup>3</sup>	±3 μm* <sup>5</sup>	
Repeatability	±0.06 μm* <sup>2</sup>	±0.15 μm* <sup>4</sup>	±0.2 μm* <sup>6</sup>	
Sampling cycle (trigger interval) * <sup>7</sup>	5.5ms (33ms at the initial setting)			
Environmental resistance	Enclosure rating * <sup>8</sup>	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 * <sup>1</sup>	2 units max.		
Display	Minimum display unit	0.01 μm, 0.001 mm <sup>2</sup> , 0.01°	
	Maximum display range	±9999.99 mm, ±99999.9 mm <sup>2</sup> , ±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* <sup>2</sup>	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		

\*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

<b>CPU</b>	Pentium III 1GHz min. (recommended 1.7GHz min.)
<b>Support OS</b>	Windows 7 <sup>*1</sup> Windows Vista <sup>*2</sup>
	Windows XP Professional Edition/Home Edition
	Windows 2000 Professional
<b>Memory capacity</b>	512MB min. (1GB min. recommended)
<b>Resolution of display</b>	XGA (1024 x 768 pixels) min, 256 colours min.
<b>Free disk space</b>	1GB min.
<b>Interface <sup>*3</sup></b>	As described above, all those mounted, USB2.0/1.1 <sup>*4</sup> , Ethernet <sup>*5</sup>

\*For your OS, use environments above that recommended.  
 \*1 Supports all editions Home Premium, Professional, Ultimate.  
 \*2 Supports all editions Ultimate, Business, Home Premium, Home Basic. 64 bit versions are not supported.  
 \*3 Communicate selecting any of them. Simultaneous communication is not possible.  
 \*4 Connection through a USB hub is not included in the guarantee.  
 \*5 Connection to LAN and connection via a router is not included in the guarantee.  
 •Windows Vista, Windows XP, Windows 2000 Professional are registered trademarks of US Microsoft Corporation.  
 •Pentium is a registered trademark of intel Corporation.

CONTROLLER



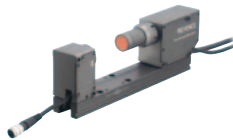
Controller  
TM-3001(P)

CONTROLLER LINEUP

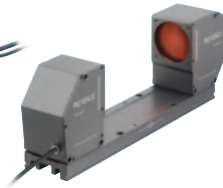
NPN Output type	TM-3001
PNP Output type	TM-3001P

SENSOR HEADS

Sensor head  
ø6 mm type  
TM-006



Sensor head  
ø40mm type  
TM-040



Sensor head  
ø65mm type  
TM-065



MONITOR

Console (Optional)  
OP-82125



Setting and support software  
TM-H1



USB cable (Optional)  
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, 30m)



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



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



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



Ethernet cable  
OP-66843 (3 m)



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



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)



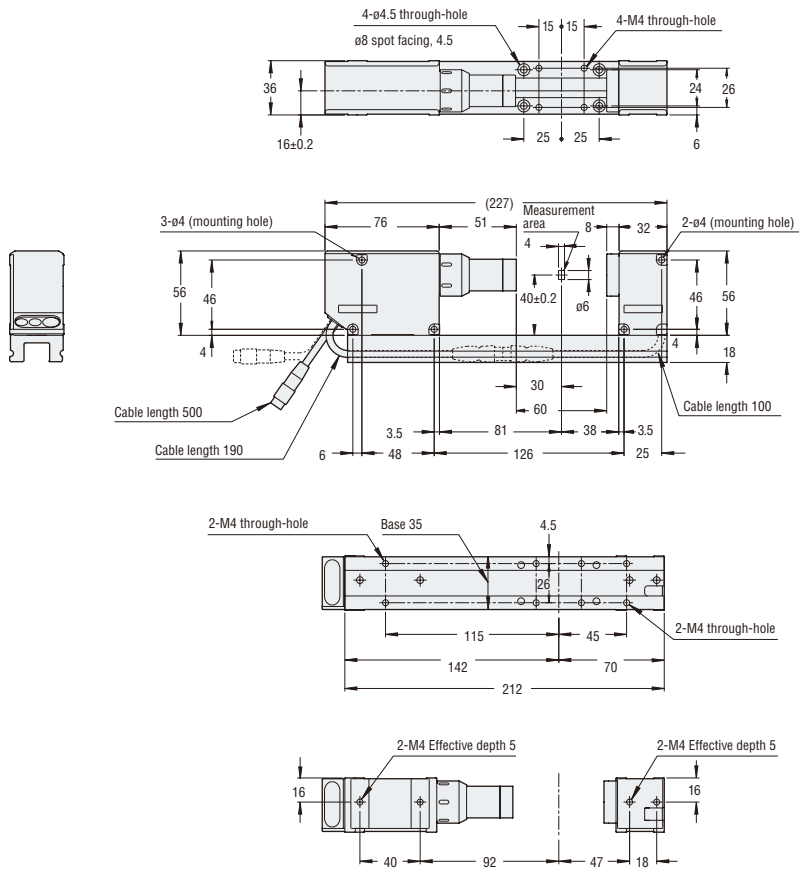
Memory card  
CA-SD4G (4GB)  
CA-SD1G (1GB)



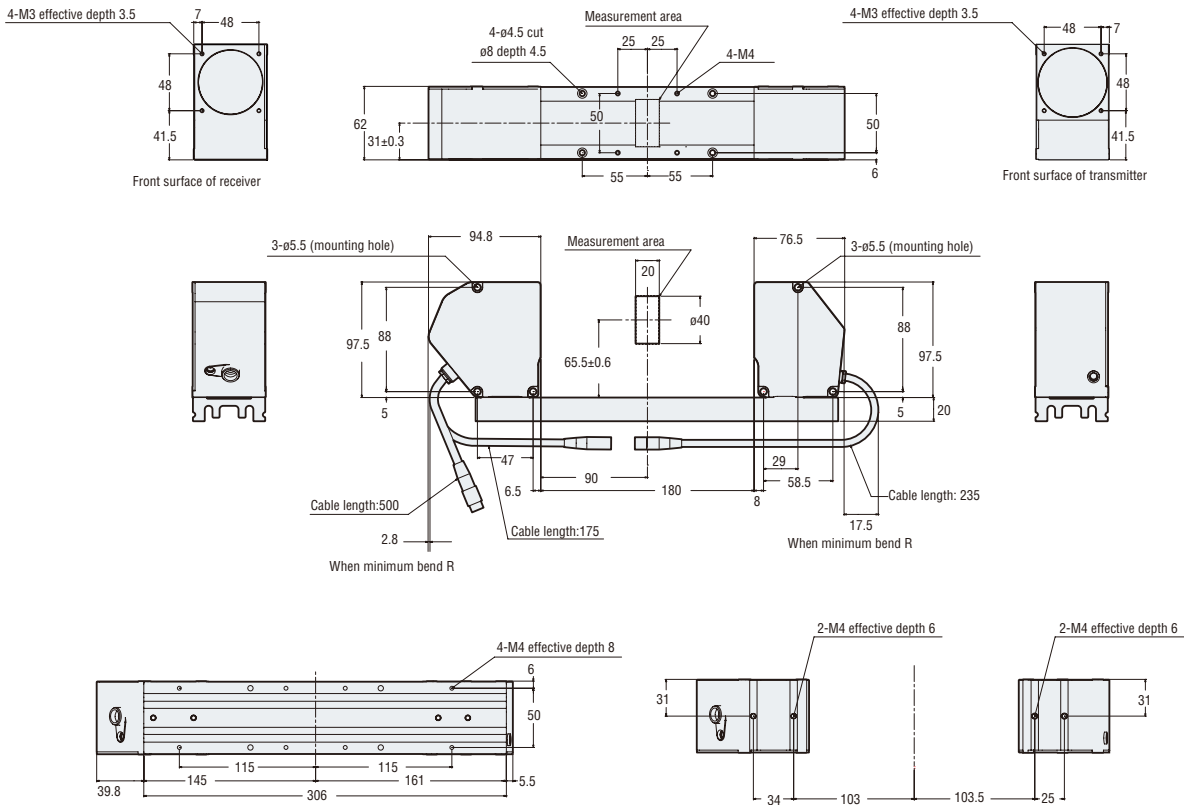
# DIMENSIONS (SENSOR HEADS)

**TM-006**

Unit: mm



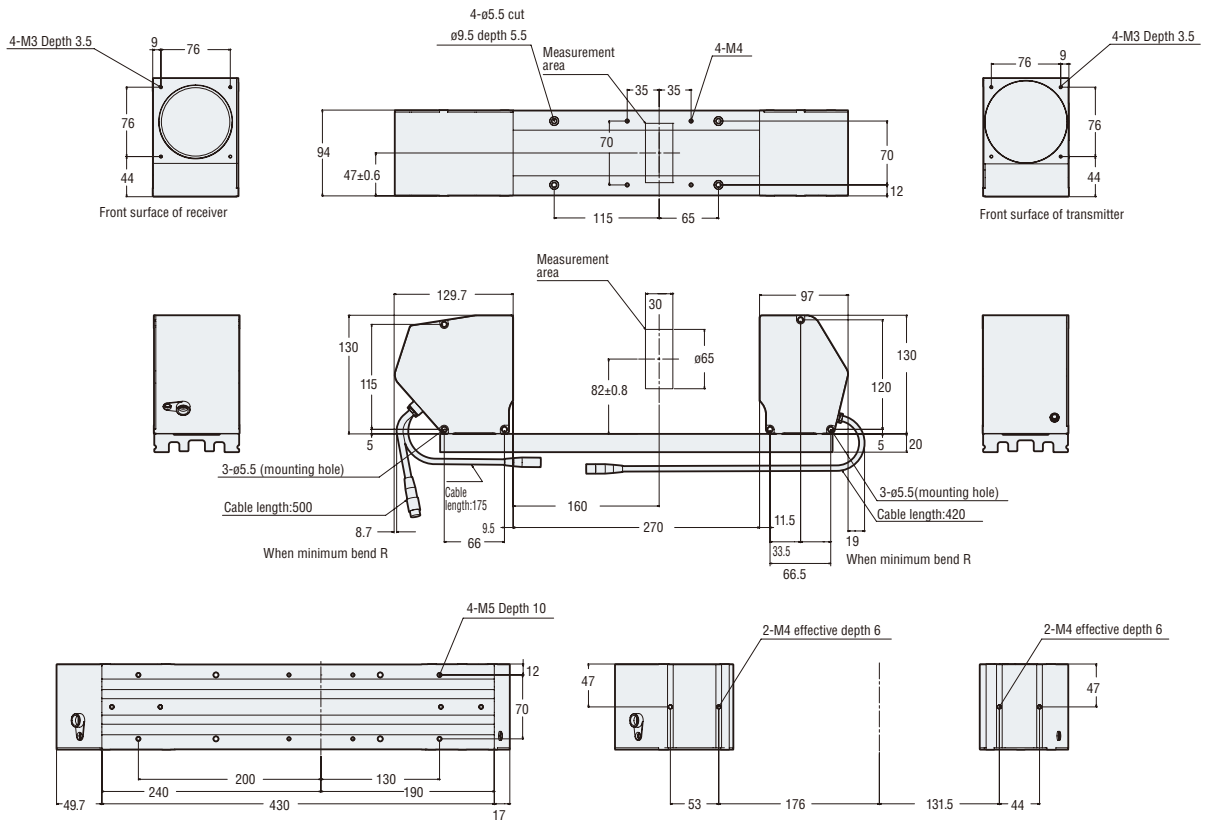
**TM-040**



DIMENSIONS (SENSOR HEADS)

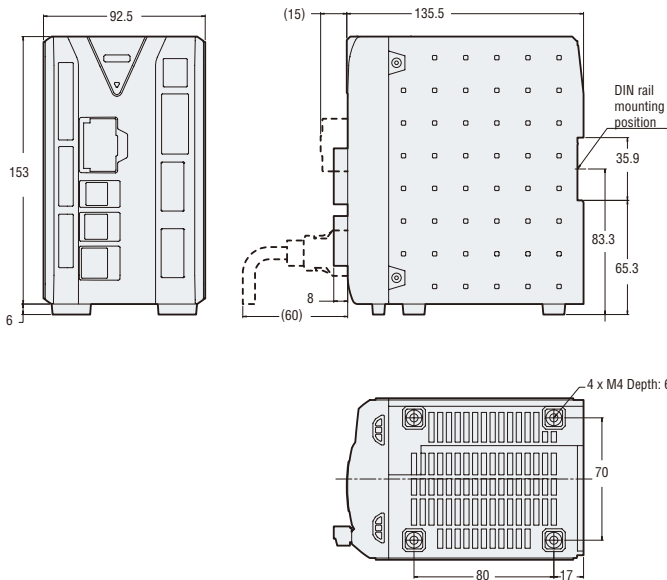
TM-065

Unit: mm



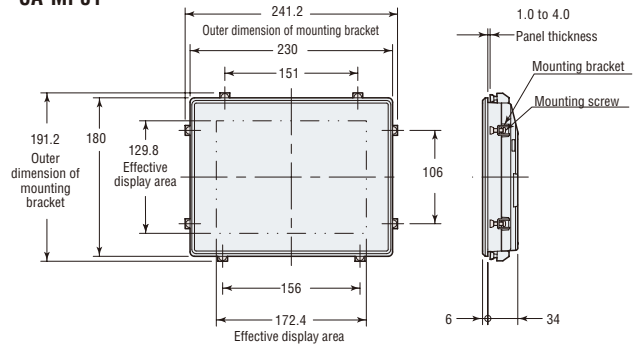
DIMENSIONS (CONTROLLER)

TM-3001(P)

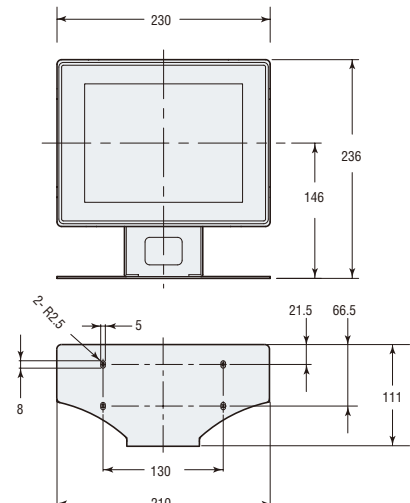


DIMENSIONS (MONITOR)

LCD monitor  
CA-MP81



Stand  
OP-42278



## LASER DISPLACEMENT (2D)

LJ-G Series



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



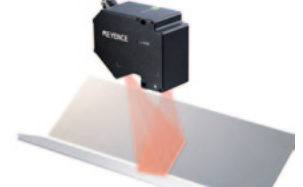
Confirmation of PCB mounting height



Confirmation of door/hood mounting accuracy



Confirmation of sealant coating profile



Confirmation of welding groove position

## OPTICAL MICROMETER

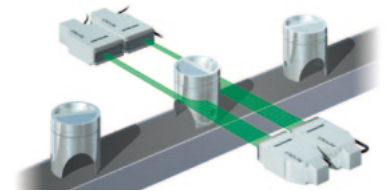
LS Series



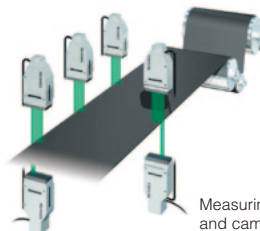
- High repeatability  $\pm 0.06 \mu\text{m}$
- High speed 2,400 samples/second
- Maintenance-free design
- Easy set-up, target viewer



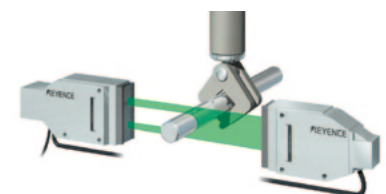
Measuring the outer diameter of a fibre



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

## LASER DISPLACEMENT

LK-G5000 Series

## CONFOCAL DISPLACEMENT

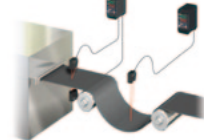
LT Series



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



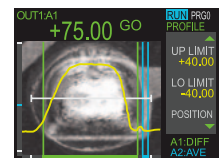
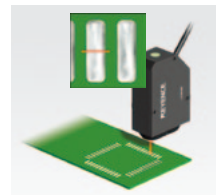
Vibration test of high-temperature-muffler



Thickness measurement/loop control of a rubber sheet



- 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](http://www.keyence.com)



### SAFETY INFORMATION

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

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