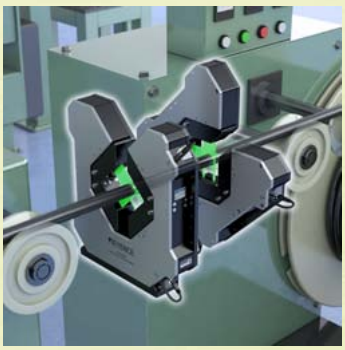
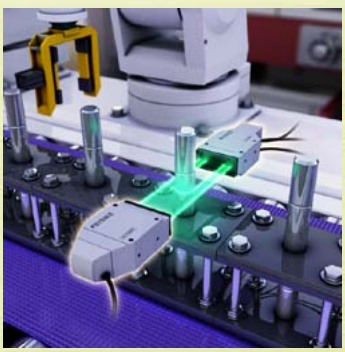
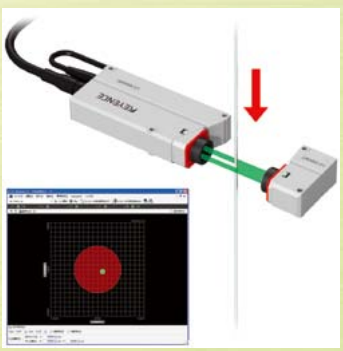
KEYENCE

MEASUREMENT APPLICATION GUIDE

OUTER/INNER DIAMETER Measurement



INDEX

Outer Diameter Measurement

OUTER DIAMETER MEASUREMENT METHOD

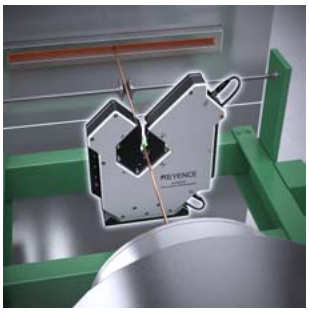
Selection Guide

Measuring the outer diameter of copy rollers

Measuring the outer diameter of ultra-thin wires

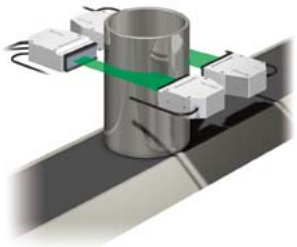
Outer diameter measurement → P.4

Measuring the outer diameter of extruded products

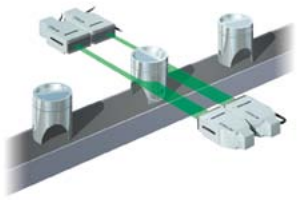


Measuring the outer diameter of drawn wires

X/Y-axis synchronous outer diameter measurement → P.5

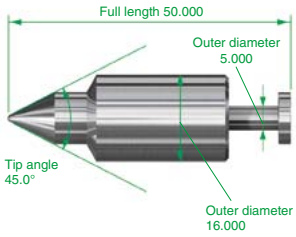


Measuring the outer diameter of steel pipes

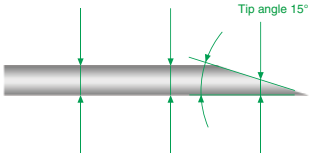


Measuring the outer diameter of pistons

Outer diameter measurement of large diameter objects → P.5

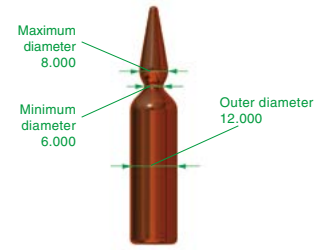


Measuring the outer diameter of needle valves

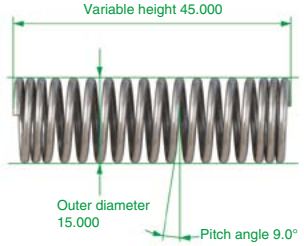


Measuring the outer diameter of injection needles

Outer diameter, angle, radius & other measurements simultaneously → P.6



Measuring the outer diameter of ampoules



Measuring the outer diameter of springs

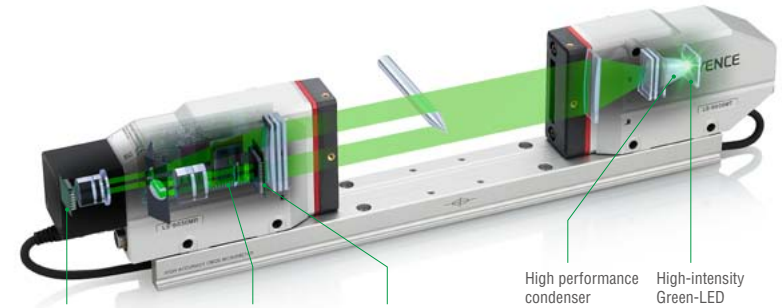
Outer diameter measurement of characteristic shapes (Minimum/maximum outer diameter, etc.) → P.6

MEASUREMENT PRINCIPLE

1D Thru-beam Measurement Principle (LS-9000 Series)

NEW METHOD | LONG LIFE | HIGH-ACCURACY | HIGH-SPEED

[Principle] Green-LED light is emitted as a uniform collimated beam. The CMOS detects the position of the edge between light and dark edges of the received light and calculates measured values.



Monitor CMOS
The Monitor CMOS tracks workpiece inclination to automatically correct for tilt errors.

Target Position CMOS
The CMOS measures the position between the transmitter and receiver

High-speed exposure CMOS
Proprietary designed measurement CMOS features an integrated amplifier to maximise performance and speed.

High performance condenser
Lens unit efficiently focuses LED light

High-intensity Green-LED
High-intensity Green LED lasts longer than traditional LED light sources while providing high intensity and evenly-distributed lighting.

Fastest in its class

12.3 times faster than conventional systems

16,000 Hz
sampling rate

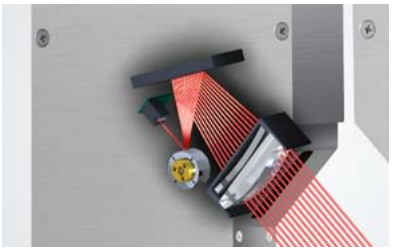
Fitted with a high-speed exposure CMOS and high-intensity Green-LED to produce a 16,000 Hz sampling rate, surpassing previous systems. Improves production line cycle times and ensures more stable measurement.

POINT **LS-9000 Series promises long life due to its motor-less structure.**

Advantage over conventional systems

By eliminating the polygon mirror and motor, both of which are subject to severe wear during normal operation, a structure without any moving parts is achieved. This significantly reduces the maintenance cost.

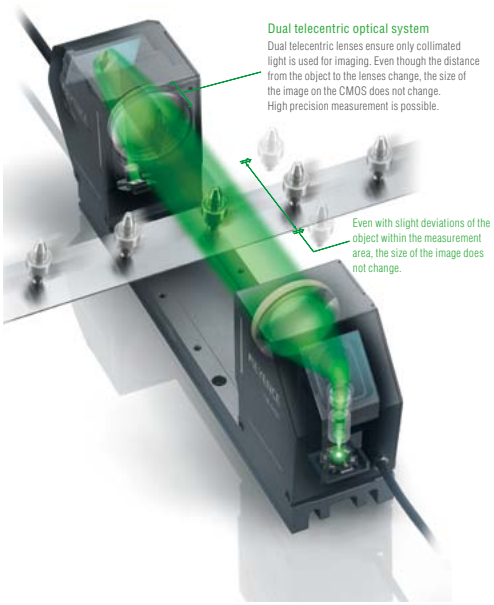
Conventional system



LS-9000

2D Thru-Beam Measurement Principle (TM Series)

2D | HIGH-ACCURACY | MULTI POINT

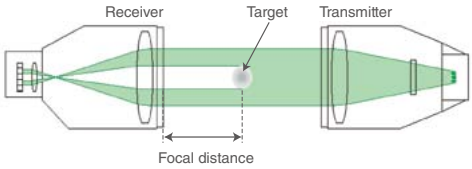


Uniform collimated lighting with a green LED. Two-dimensional CMOS array detects the light-dark edges in the received light, and measures the dimensions.

OUTER DIAMETER

Outer Diameter Measurement

Measurement method

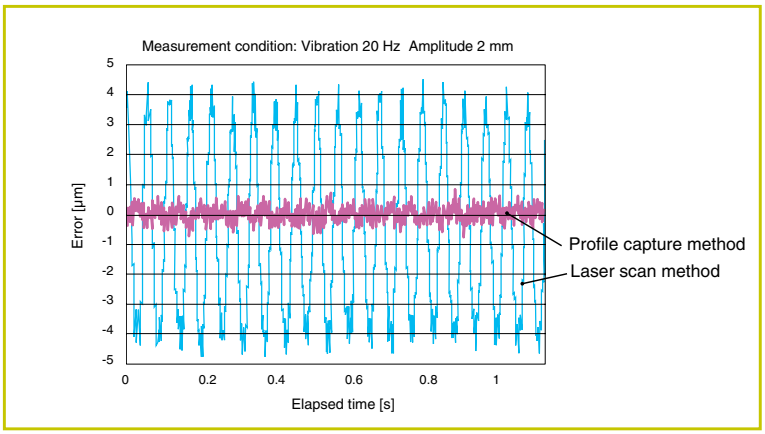


The shadow size of a target is measured.
Rotating the target allows the measurement of the outer diameter in all directions.

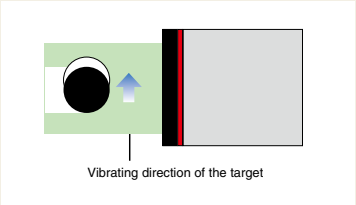
POINT **Technology achieving "stable measurement of vibrating targets"**

It is the measuring principle that determines the accuracy which can be achieved in-line.
Compare the results when the outer diameter of a vibrating target is measured.

Measuring the outer diameter of long targets in-line

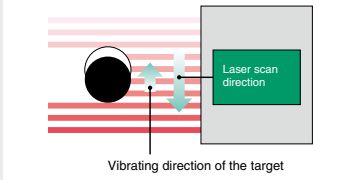


Profile capture method (LS-9000)



The LS-9000 Series recognizes the condition of the target within the exposure time of 20 µs, obtains the light intensity data, and measures the outer diameter based on the data.
Since the exposure time is extremely short, the influence of the vibration on the measurement can be minimized.

Laser scan method



The laser scans the target from the top to the bottom.
If the target vibrates in the opposite direction to the laser scan direction, the exposure time becomes shorter, resulting in the smaller outer diameter being measured.

Applications


Measuring the outer diameter of connector housings


Measuring the outer diameter of copy rollers

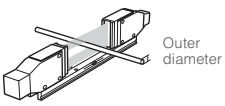

Measuring the outer diameter of ultra-thin wires

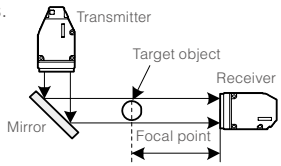

Measuring the outer diameter of optical fibres

→ P.6

ADVANCED INSTALLATION TECHNIQUE

If your application does not allow space for installation of the transmitter and/or receiver, you may try using mirrors.

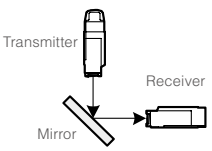




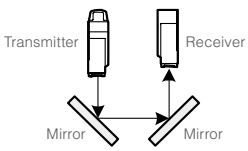
Using mirrors as shown in the figure on the left enables measurement in confined areas.

[Application examples]

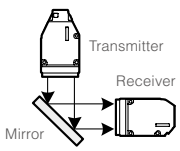
90° reflection



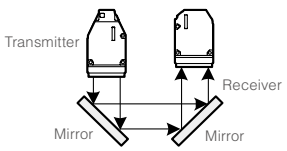
180° reflection



90° reflection



180° reflection



Outer Diameter Measurement

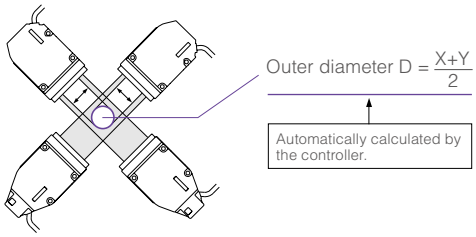
OUTER DIAMETER

X and Y Axes Synchronous Outer Diameter Measurement

Debut of a new 2-axis outer diameter measuring instrument

Conceptual image of the measurement

Two optical measuring units are incorporated into a single housing to measure the outer diameters in the X- and Y-axis directions simultaneously. This integrated unit reduced installation time and eliminates optical axis adjustment, enabling wide range of applications including accurate X/Y-axis measurement or unevenness detection.



Scanning head lineup

STANDARD MODEL

Model	LS-9030D
Measurable target	ø0.3 mm to ø30 mm
Smallest detectable object	0.3 mm
Measurement accuracy	±2 µm
Repeatability	±0.1 µm
Sampling cycle	16000 samples/sec.

SMALL DIAMETER MODEL

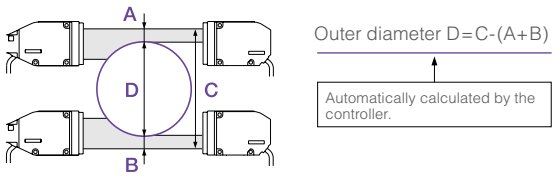
Model	LS-9006D
Measurable target	ø0.04 mm to ø6 mm
Smallest detectable object	0.04 mm
Measurement accuracy	±0.5 µm
Repeatability	±0.03 µm
Sampling cycle	16000 samples/sec.

OUTER DIAMETER

Outer Diameter Measurement of a Large Diameter Object

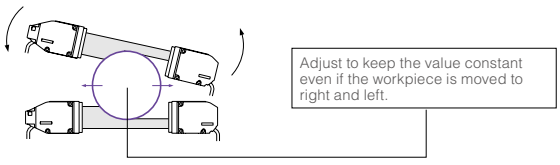
Measurement method

Install the measurement instruments as shown in the figure on the right, and measure a workpiece with a known outer diameter. By inputting the obtained value “D” of the master workpiece to the controller, “C” is determined in the controller. The controller then automatically makes a calculation based on the “A” and “B” obtained by each of the measuring instruments. Thus, the outer diameter “D” is obtained.

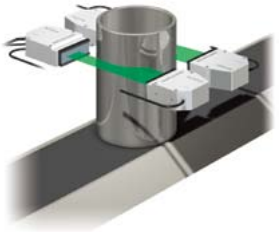


Tips for installation

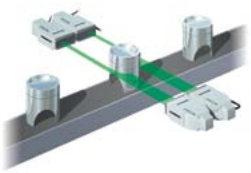
To ensure the sensors are aligned, set the master workpiece in the beams and move it right and left. If the resulting measurement is not constant, adjust the sensor heads to be more parallel.



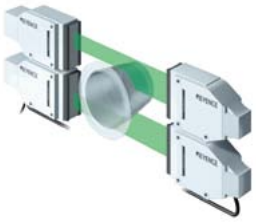
Applications



Measuring the outer diameter of a steel pipe



Measuring the outer diameter of a piston



Measuring the outer diameter of a resin container

Inner Diameter Measurement

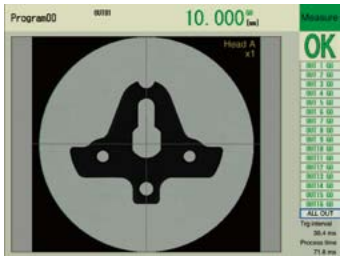
INNER DIAMETER

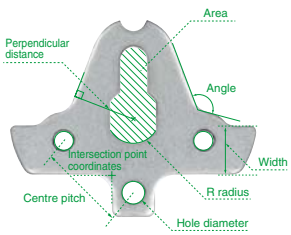
Multi-point Simultaneous Measurement of Shapes with Difficult Geometrie

Measurement method

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

Measurement screen of TM-3000 Series





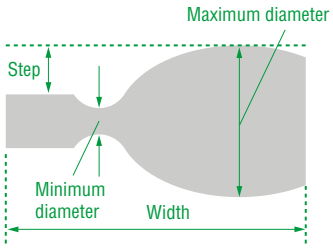
Example of measurement

1to 3 : Hole diameter
4, 5 : Centre pitch
6, 7: Intersection point coordinates
8 : R radius
9 to 11: Width
12, 13 : Angle
14, 15: Perpendicular distance
16 : Area

Measurement example

Outer diameter/Step/Width

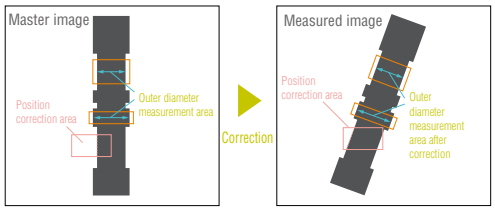
Measures a maximum diameter/minimum diameter within the specified area, and a step/width between the detected edges.



POINT **No errors caused by position deviation**

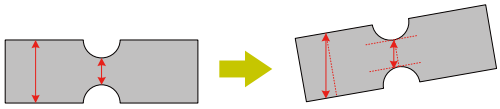
Position correction function [edge correction/pattern correction]

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.

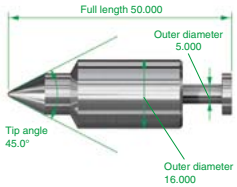


If the position correction function is not used…

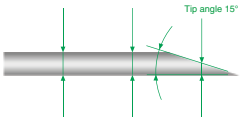
When the target inclines, a dimension that is different from the originally targeted section is measured as shown in the figure below. This may cause wrong judgement where an OK product is judged as NG, and vice versa.



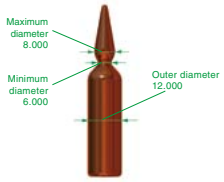
Applications



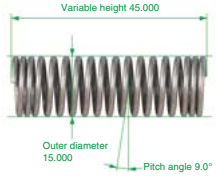
Outer diameter/tip angle measurement of needle valves



Measuring the outer diameter of injection needles



Measuring the outer diameter of ampoules



Measuring the outer diameter of springs

INNER DIAMETER

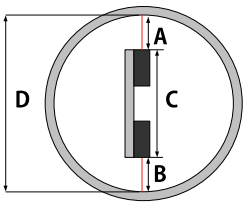
Inner Diameter Measurement

Measurement method

If the sensor heads can pass through the inside of the target object, the inner diameter is obtained by measuring the distances to the inner surface as shown in the figure on the right.

Inner diameter D=A+B+C

* Measure a master workpiece with a known inner diameter “D”. By inputting the value “D” to the controller, and measuring "A" and "B", “C” is determined in the controller.

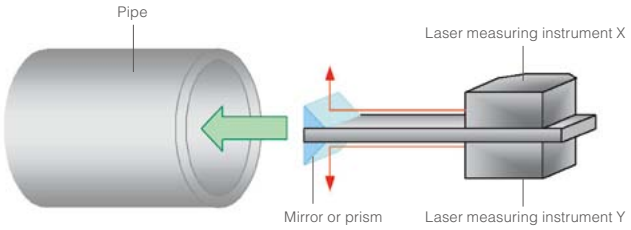


Recommended Products

- LK-G5000 Series → The large number of available sensor heads provides a wide range of application options.

Inner diameter measurement

If the sensor heads cannot pass through the inside of the target object, use mirrors or prisms to bend the laser beams as shown in the image on the right.

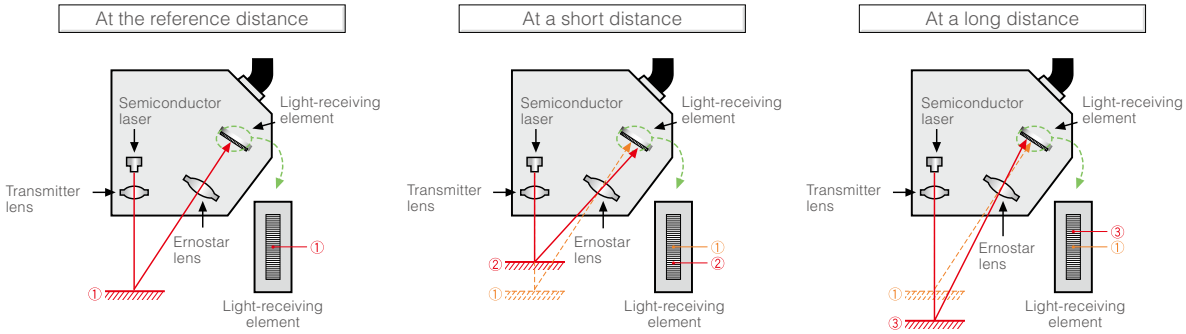


INNER DIAMETER

Measurement Principle

1D Triangulation Measurement Principle (LK-G Series)

HIGH-SPEED | WIDE RANGE | 12 SENSOR HEADS CONNECTION

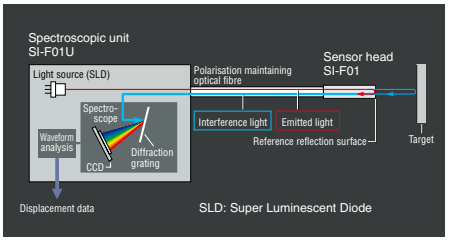


The semiconductor laser emits the laser beam to the target as shown above. The light reflected off the target is focused by the ernostar lens and forms an image on the light-receiving element. The position of the beam spot on the receiving element varies with the distance to the target. This variation is evaluated and converted into a measurement of target position.

SI Series Measurement Principle (Spectral-interference method)

COMPACT | ULTRA HIGH-ACCURACY

Development of a new principle can meet incompatible needs for small size with high accuracy that was previously impossible.



SLD

Part of the broad wavelength light emitted from the SLD is reflected by the head’s reference surface, while the part that passes the reference surface is mirror-reflected on the target and returns into the head.

Interference light

The two reflected light beams interfere with each other. The intensity of the interference light with a specific wavelength is determined according to the distance between the reference surface and the target. The relative maximum interference is reached when the determined distance is an integral multiple of the wavelength.

Spectroscopic analysis

Splitting the interference light into different wavelengths with the spectroscope produces an optical intensity distribution for a specific wavelength. The distance to the target is obtained by carrying out waveform analysis on the distribution.

DISPLACEMENT METER/DIMENSION MEASUREMENT SYSTEM LINEUP

Reflective-Type Measurement Instrument

High-Speed, High-Accuracy CMOS Laser Displacement Sensor

LK-G5000 Series

HIGH-SPEED
WIDE RANGE
12 SENSOR HEADS CONNECTION

High-speed 2D/3D Laser Scanner

LJ-V7000 Series

2D/3D
MULTI POINT
HIGH-SPEED
PROFILES

Surface Scanning Laser Confocal Displacement Meter

LT-9000 Series

HIGH-ACCURACY
DOUBLE-SCANNING
CLEAR TARGET THICKNESS

Thrubeam-Type Measurement Instrument

High-speed Optical Micrometer

LS-9000 Series

GREEN LED
LONG LIFE
HIGH-ACCURACY
HIGH-SPEED

High-speed 2D Measurement Sensor

TM Series

2D
MULTI POINT

KEYENCE

Please visit: www.keyence.com

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

KEYENCE CORPORATION

AUSTRIA
Phone: +43 22 36-3782 66-0

BELGIUM
Phone: +32 1 528 1222

BRAZIL
Phone: +55-11-3045-4011

CANADA
Phone: +1-905-366-7655

CHINA
Phone: +86-21-5058-6228

CZECH REPUBLIC
Phone: +420 222 191 483

FRANCE
Phone: +33 1 56 37 78 00

GERMANY
Phone: +49 61 02 36 89-0

HONG KONG
Phone: +852-3104-1010

HUNGARY
Phone: +36 1 802 73 60

INDIA
Phone: +91-44-4963-0900

INDONESIA
Phone: +62-21-2966-0120

ITALY
Phone: +39-02-6688220

JAPAN
Phone: +81-6-6379-2211

KOREA
Phone: +82-31-789-4300

MALAYSIA
Phone: +60-3-2092-2211

MEXICO
Phone: +52-55-8850-0100

NETHERLANDS
Phone: +31 40 20 66 100

POLAND
Phone: +48 71 36861 60

ROMANIA
Phone: +40 269-232-808

SINGAPORE
Phone: +65-6392-1011

SLOVAKIA
Phone: +421 2 5939 6461

SLOVENIA
Phone: +386 1-4701-666

SWITZERLAND
Phone: +41 43-45577 30

TAIWAN
Phone: +886-2-2718-8700

THAILAND
Phone: +66-2-369-2777

UK & IRELAND
Phone: +44-1908-696900

USA
Phone: +1-201-930-0100

VIETNAM
Phone: +84-4-3760-6214

WW1-1115

The information in this publication is based on KEYENCE's internal research/evaluation at the time of release and is subject to change without notice.
Company and product names mentioned in this catalogue are trademarks or registered trademarks of their respective companies.
Copyright (c) 2010 KEYENCE CORPORATION. All rights reserved.

MeasureODID-WW-EN0907-E 1084-2 E600848 Printed in Japan