Optical Sensor

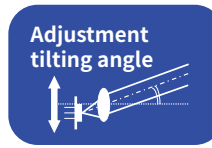## Select from Optical Sensor Model

Angle and Tilt Laser Autocollimator: Smart LAC

Tilt

Adjustment tilting angle
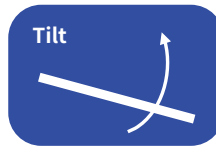
Non-contact angle and tilt measurement by using laser.

■Easy setup and measurement by Non-contact and Wide working distance.
■Various application as Optical alignment, Audio & Visual equipment alignment, Machine alignment and material check.
■Image Processing Unit can analyze various condition and process various output.

Wide, High Speed, High Resolution Laser Autocollimator: Smart W-LAC

Tilt

Runout measurement

Sampling 200/250/500KHz
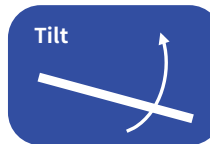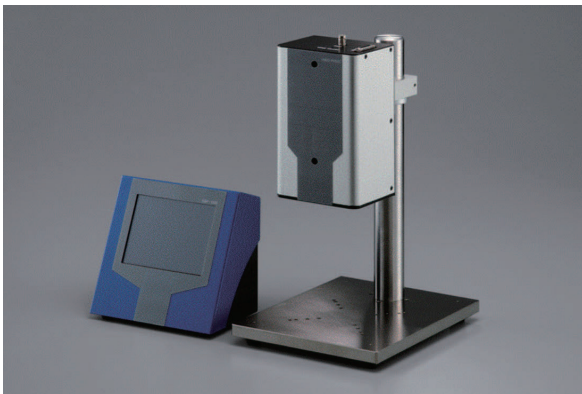
Dynamic Measurement for
High Speed moving Objects.

■Non-contact Measurement by Laser.
■High Speed sampling: 500,000Hz(0.2μSec).High Resolution: 0.0001deg(0.36μSec).
■Enhanced dynamic defect analysis can be done by high speed measurement and analog output.

Guidance

## Angle and Height Multi-AXIS Laser Autocollimator: MAX-LAC-3D
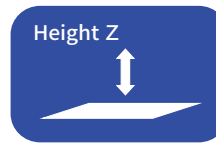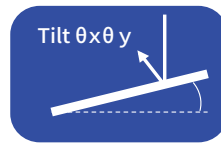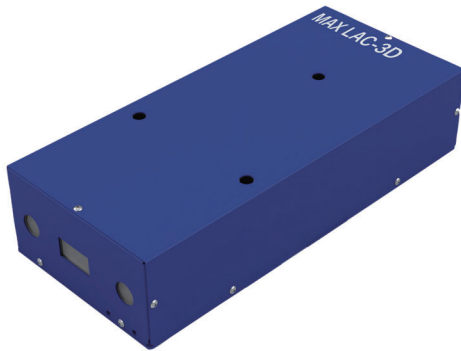
Tilt θx θy

Height Z

3-dimension(θx,θy, Z) Parameter can be measured at once.

■Co-axial Measurement：One sensor can measure 3-dimension parameter.

■Non-contact: Specular reflection measurement by laser.

■Excellent Repeatability and Linearity.

■High speed sampling (Less latency by transmission delay).

※Please contact us for details.

Angle, Height and Position Multi-AXIS Laser Autocollimator: MAX-LAC-5D

Tilt θx θy

XY Position

Height Z
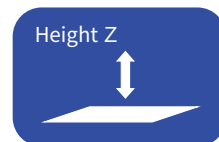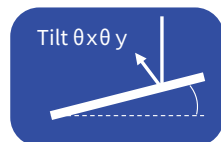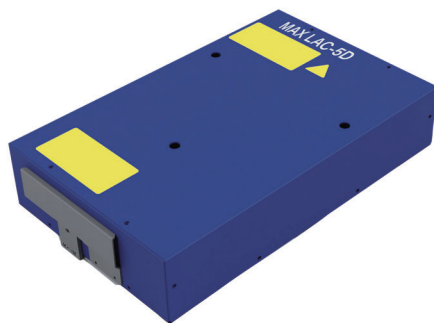
5-dimension(θx,θy, X,Y,Z) Parameter can be measured at once.

■Co-axial Measurement：One sensor can measure 5-dimension parameter.

■Non-contact: Specular reflection measurement by laser.

■Excellent Repeatability and Linearity.

■High speed sampling (Less latency by transmission delay).
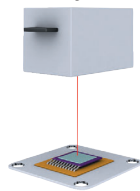
※Please contact us for details.
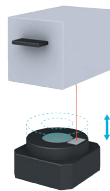
Select from Applications

Smart LAC

Lens tilting Angle	CMOS device tilting angle	VCM actuator drift	External Laser tilting angle
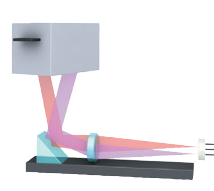
Smart LAC / Smart W-LAC / Smart LAC

Prism Angle	Digital Camera Mirror angle	Galvano mirror Angle	Optical Device Mounting angle
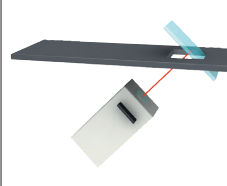
Smart LAC

Mirror Parallelism	Mechanical parts Parallelism by High precision press	Parallelism for Motor and shaft	Embedded system
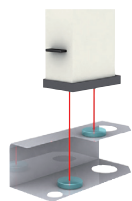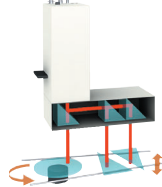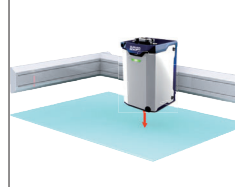
Smart W-LAC
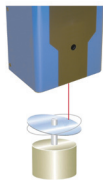
Motor Center run-out	Actuator Pitch and Yawing
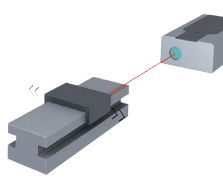
MAX LAC-3D/-5D

VCM inspection	Auto Focus inspection

Select from Industry area

Smart LAC

Prism Mounting Angle alignment
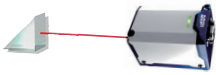
Mechanical parts Parallelism by High precision press
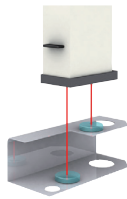
Press angle measurement
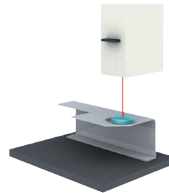
Embedded system

Smart LAC

Optical Device tilt angle
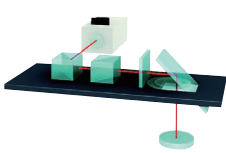
Parallelism for Motor and shaft
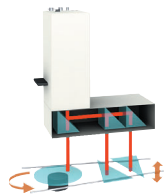
Actuator Skew measurement

Lens tilting angle

Smart LAC

Actuator Pitch and Yawing
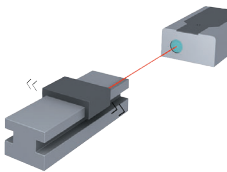
Gimbal angle measurement
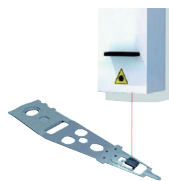
Digital Camera Mirror angle
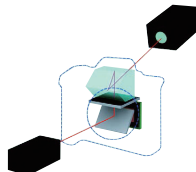
Smart W-LAC

Galvano mirror wobble measurement
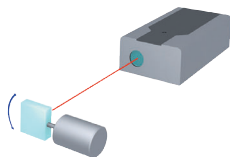
Motor Center run-out
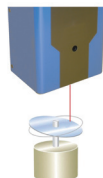
MAX LAC-3D/-5D

VCM Actuator tilt Measurement
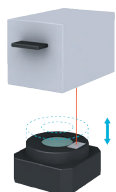
VCM Inspection Auto Focus inspection

Auto Focus

Laser Autocollimator Technical Guide

■What is a Laser autocollimator?

Laser autocollimator

- Measure instantaneously the angle in a single location.
- θxθy 2 demension coodinates display
- Long width
- High resolution 1 sec.

↑Y
→x

Display 2D angle coordinates
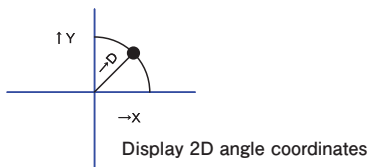
Length measurement system

Calculates the differences in height between any 2 points with a length measurement sensor.

5μm

例:30mm
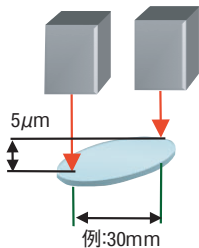
5Resolution is =Atan(0.005/30)=34sec in 5μm change.θ＝Atan (0.005／30) ＝34second

■Angle measurement principle

When the parallel light incidents to the collecting lens, it will be converted to the position information on the focal plane depending on the incidence angle.Irradiation of parallel laser beam to the measurement object using this principle, the tilt value of the object will be measured by collecting reflection light on the CMOS.

CMOS

Position

Cposition

Angle

Collimating lens

Collimating lens

Measurement objects
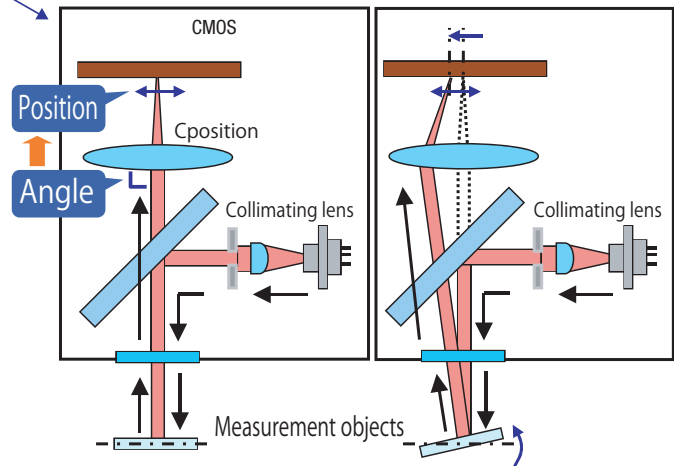
Left drawing:If the object is perpendicular to the irradiation beam, the reflection light returns to vertical, and light will be collected in the center.

Right drawing:In case of the object is tilted, the reflection light will tilt to the left, and also collecting area will move to the left.

Can be known the tilt by measuring the different between the reflection light and collecting area.

■Unchanged the measurement result, even the measurement distance is changed.

The measurement result that is gotten by using an autocollimator as an angle is measured directly even if the distance between the object is changed.Available for pitching and yawing measurement of the up and down.

Imaging in the same point

Refrected optics angle is always same

Measurement distance （Z direction）
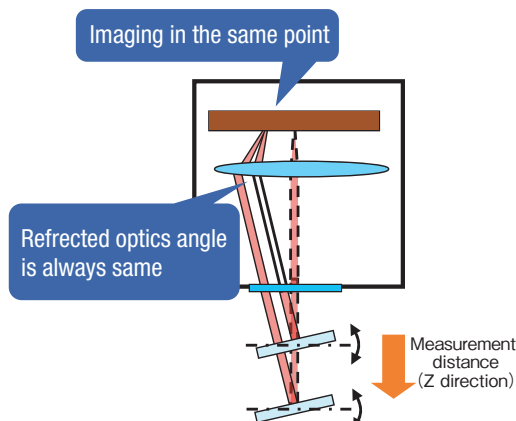
■Specialized usage: External light source incidence measurement

Normal (The reflection measurement)

Normally an autocollimator is used in the reflection measurement. (Left drawing)When the object tilt is θ degree, the reflection light returns 2θ degree angle.Autocollimator shows tilt angle θ degree of the object.

(e.g.) When the object tilts 0.1-degree, 0.2-degree tilted reflection light returns to an autocollimator, but measurement value is displayed 0.1-degree.

θ θ

θ
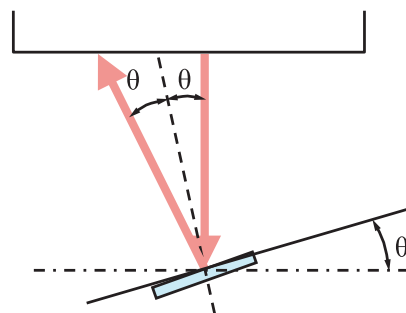
Measure the external light source

Can be measured laser beam tilt that is emitted from the object light source by turning off the semiconductor laser (LD) in the autocollimator.

■Angle value

The spot position on the sensor is displayed as 2-dimensional angular coordinates.

As shown in the figure below, the X-direction angle component, Y-direction angle component, and spot-direction angle are displayed. The unit of angle can be selected from deg, rad, sec.

$$D=\sqrt{(X^2+Y^2)}$$

2-dimensional angular coordinates

↑Y

→X

D
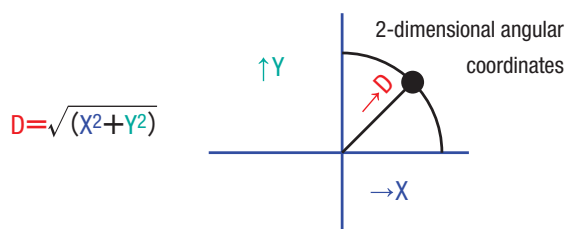
■Field of view angle

The measurement range (field of view) of the laser autocollimator is determined by the design value of the optical system of the sensor head.

Basically, the measurable range is limited by WD (working distance). Generally, the shorter the distance can measure the wide angle,

and the longer the distance can only measure the smaller angle.

For details, refer to the specifications of each model.

Laser Autocollimator Technical Guide [Notice]

■Working Distance

If the distance between Laser Autocollimator to the Object is longer than a specification, the reflected beam may go out from sensor area , then a specification angular range may not cover. Please use within a specification W.D.

Goes out sensor area

Possible to measure

Impossible to measure

Working Distance (Z-AXIS Direction)

■Laser Class

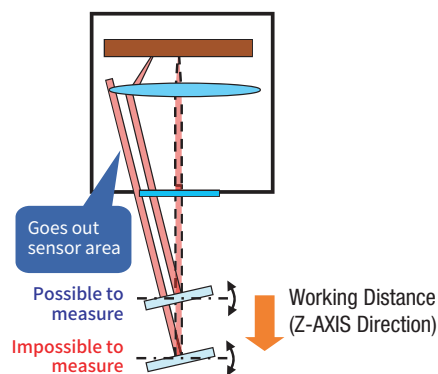| Class 1	A laser that is safe under reasonably foreseeable driving conditions.
Class 1M	Lasers with a wavelength range of 02.5 to 4000 nm that are safe under reasonably foreseeable operating conditions. However, it is considered dangerous when observing using optical equipment.
Class 2	A laser with a wavelength range of 400 to 700 nm (visible light) whose eyes are protected by avoidance behavior including blinking.
Class 2M	A laser with a wavelength range of 400 to 700 nm (visible light) whose eyes are protected by avoidance behavior including blinking. However, it is considered dangerous when observing using optical equipment.
Class 3R	Lasers with a wavelength range of 302.5 nm to 106 nm where direct beam observation is potentially dangerous. Within 5 times that of Class 2 in visible light (400 to 700 nm). Wavelengths other than visible are within 5 times that of class 1.
Class 3B	Lasers that are dangerous to observe the beam directly. However, diffuse reflected light is usually considered safe.
Class 4	A laser that can cause dangerous diffuse reflection. Not only do they cause skin damage, but they can also pose a risk of fire.

Source: JIS C 6802 excerpt
Publisher: Japanese Standards Association

Angle measurement

Laser autocollimator

High speed・High resolution

Standard

Accessories

Sample preparation

①Check Object Status

Laser

Not Mirror Surface

Laser

Mirror Surface

Surface Condition

No

Yes

Put Mirror on

Several Reflections=>NG

few Reflections=>OK

②Measurement Range

②Measurement Range
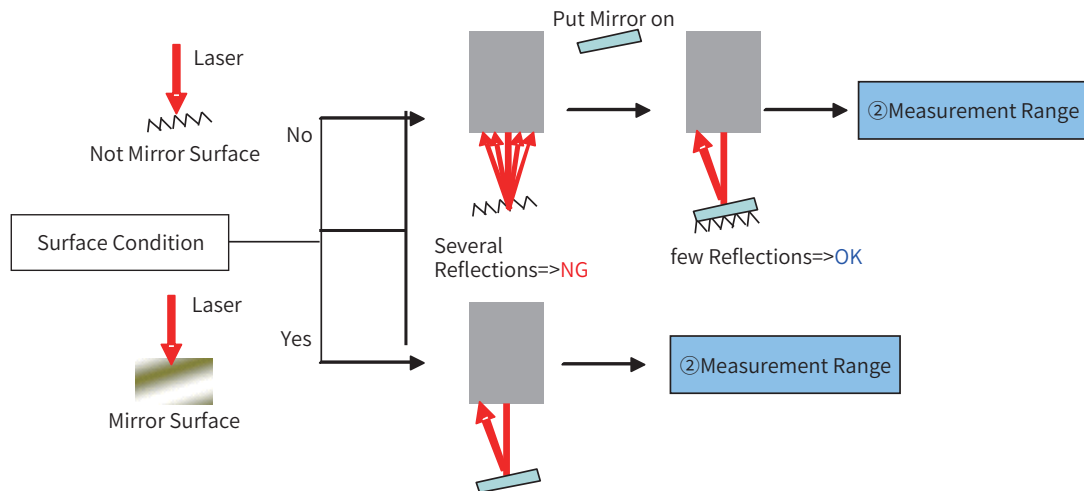
②Check Measurement Range

Laser Autocollimator

Within Measurement Angle

Measurement OK
↓

③Select Model

Goes to Out of Range

Out of Measurement Angle
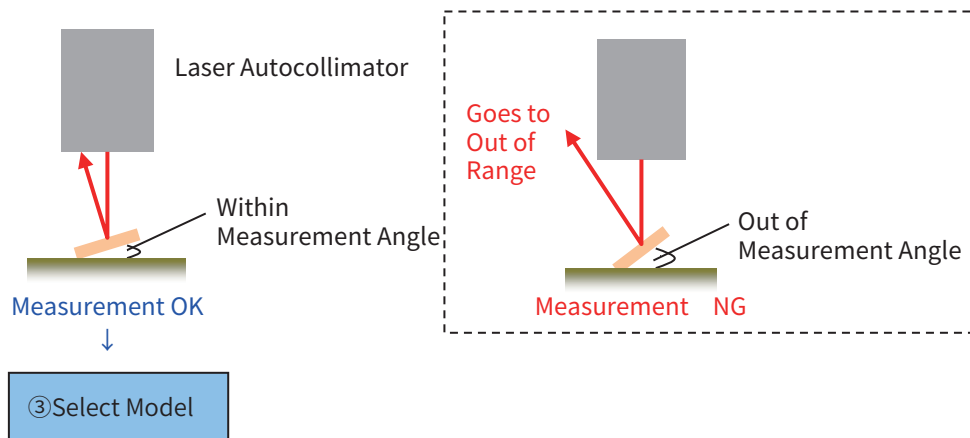
Measurement　NG

③　Select Model

	Smart LAC H410	Smart W-LAC H900	Smart W-LAC H920
Measurement Range	±1.75°	±0.17〜0.9°	±5.0°
Working Distance	0〜300mm	150mm or 230mm	70mm
Sampling Speed	40Hz	250/500 kHz	200kHz

In case of Smart W-LAC H900,H920

EX: Target Angle 5deg
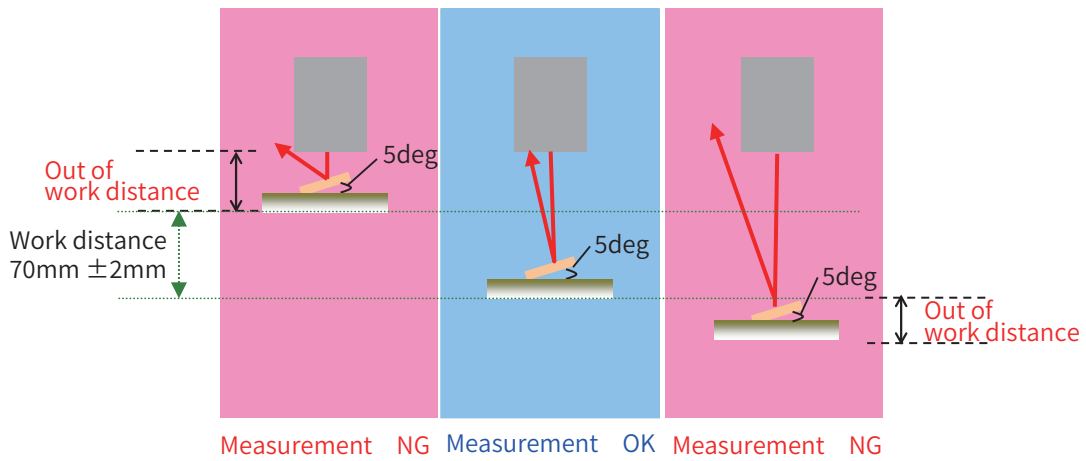
Out of work distance

Work distance 70mm ±2mm

5deg

5deg

5deg

Out of work distance

Measurement   NG   Measurement   OK   Measurement   NG

Optical Sensor

Laser Autocollimator Technical Guide(Measurement Technique)

■Right angle Prism measurement

Right angle(90deg) is measured by using jig to hold the prism as blow image.

By Laser Autocollimator setting as horizontal way, Vertical Prism plane can be measured.

■Scattered reflection Measurement (Resin/Metal)

Laser Autocollimator can not handle scattered light, divergent light and condensed light.
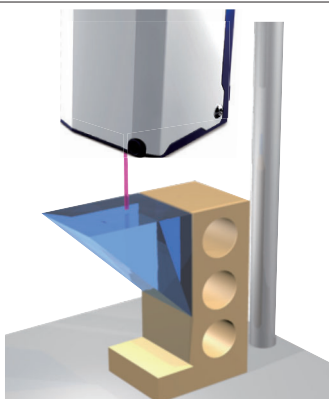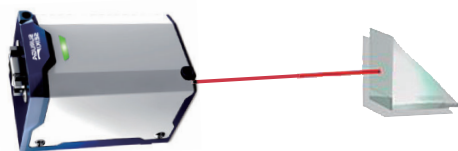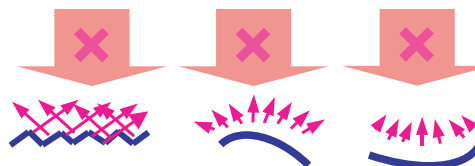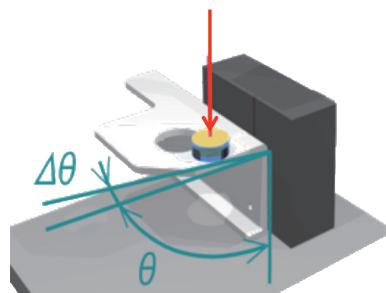
By putting parallel mirror on to the object, Laser Autocollimator can measure object tilting angle.

■Simultaneous measurement for two surface parallelism

Laser Autocollimator can measure two different height or two different position tilt angle simultaneously.

【Two Parallel planes on the same axis】 【Parallelism of two different planes】
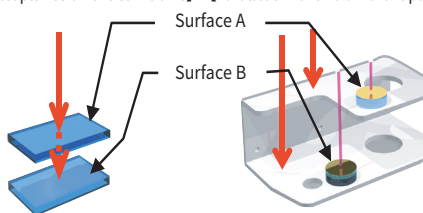
Surface A

Surface B

<Left figure> One laser beam is transmitted and the parallelism coaxial surface is measured.
<Right figure> Using 2-Beam adaptor(Optional), different height and position planes parallelism can be measured simultaneously.
At these case, when two plans become parallel, observed spot overlap at one point.

L1-2=0.150deg
Surface A
L1
Surface B
L2

L1-2=0.0deg
L1 L2

Parallel

Overlap
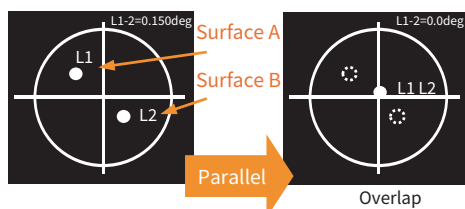
■Lens tilt angle measurement
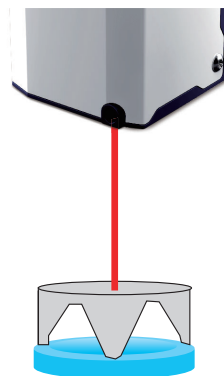
The lens tilt angle is measured by pointing the laser on the Lens Flange(Flat surface point).
<Problem>
Rough surface of Lens Flange.

<Solutions>
Use mirror surface jig which is mounted on to Lens flange.

■Tips for center of gravity evaluation

When measuring the tilt of a surface with low flatness such as the edge surface of a lens, Luminance center of gravity mode is suitable.
Luminance center of Gravity mode has better Linearity and repeatability than Area Center of Gravity mode.

Camera Output
12 bit(4096 Step)

Intensity

Insufficient   Appropriate   Insufficient
Brightness   Brightness   Brightness

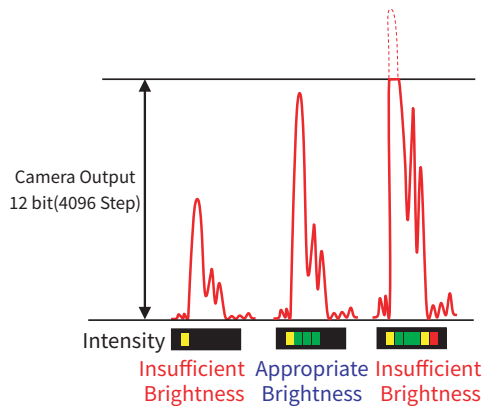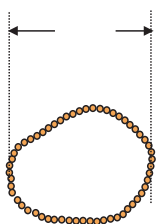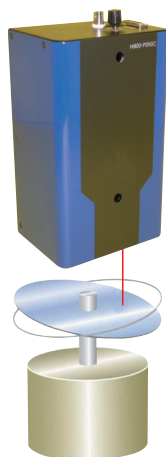When using the Brightness Center of Gravity Mode, in order to improve the measurement accuracy, Check the Intensity and use it within an Appropriate Brightness range.

■Fluctuation measurement for Precision motor/Optical disk drive.
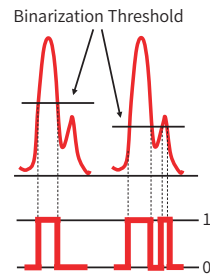
H900 series can perform the Blur analysis such as Precision motor or Optical Drive surface blur/axial shake analysis.

Fluctuation analysis:
H900 series motor mode

Feature
High speed sampling can allow to measure precis surface blur/axial shake value.

■Glossary: Binarization Threshold

Binarization Threshold

1

0

The Binarization threshold is the criterion for converting Gray image to Binary image.
Binarization processing is an image processing method that sets to One which is excess than criteria and other set to Zero.

Remarks: This criteria is set in the Area Center of Gravity Mode.

■Glossary: 4096 Gradations

Camera sensitivity
12-bit division
(4096 gradations)

Maximum
brightness
2880
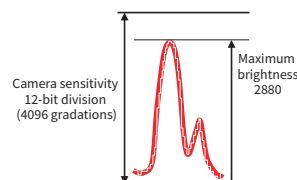
An intensity of Laser Autocollimator is 12bit (4096 Steps)
At the Brightness Center of gravity case, 12bit data is used to get Brightness Center of Gravity,
At the Area Center of Gravity, Binary data is used to get Aera Center of Gravity.
Then the Brightness Center of Gravity value is accurate the Area Center of Gravity value.

Remarks: Noise reduction criteria must be set for the Brightness Center of Gravity mode.

Optical Sensor

The difference between Smart LAC to Smart W-LAC

■ The detector is different

Detector

Position

Tilt Angle

Condenser lens

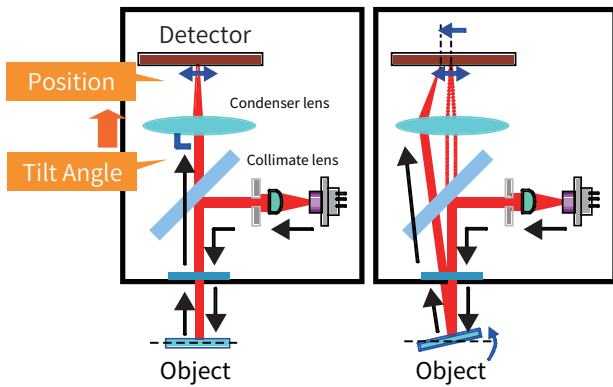Collimate lens

Object

Object

Detector	
Detector	**Model**
CMOS	SSmart LAC H410
PSD	Smart W-LAC Series H900, H920

CMOS   Complementary Metal Oxide Semiconductor

2D position sensor
Vertical 480Pixel x Horizontal 640pixel

Monitor View

X= − 0.3deg
Y=   0.0deg
D=   0.3deg

Based on X and Y position data, CCD/CMOS type sensor can handle several spot at once.
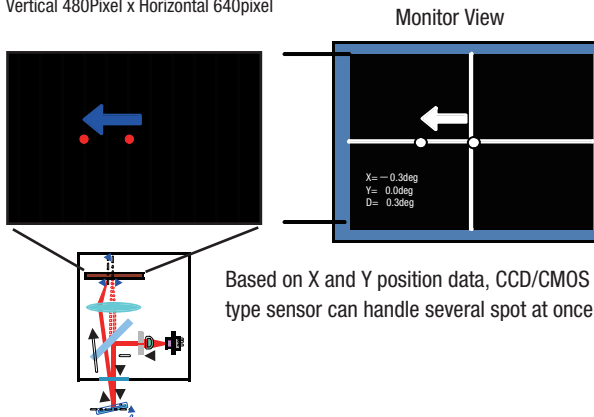
PSD   Position Sensitive Detector

1D detector using surface resistance characteristics.

Advantage

Due to continuous electrical signal. Detector can provide High resolution and Fast response time.

Disadvantage

Due to 1D sensor, it could not identify several spot position.(Not support Multi Spot measurement).

Requests/Inquiries

For requests and inquiries regarding our products and support, please contact us.

• Need a drawing of an optical sensor product

• Need a price of the product

• Need an instruction manual for optical sensor products

• Need a sample program of IPU

e-ost@suruga-g.co.jp

Please Contact.

- -

• Demo request

①Company Name

②Contact Person

③Model name

④Desirable Date

⑤Use case

Please note ① to ⑤, then please contact us.

e-ost@suruga-g.co.jp

Please Contact.

Standard Demo period is two weeks.

- -

• Products Calibration Service

• Issue Inspection Certification

Please contact with a request for [Inspection Certification」

e-ost@suruga-g.co.jp

Please Contact.

※Calibration fee is requird separately.
※If you need to ship the inspection certificate and the product
together,Please contact us before ordering.

Angle
measurement

Laser
autocollimator

High speed・
High resolution

Standard

Accessories