



Beam Profiler & Laser Autocollimator

Smart ProCo H651 Series

The User's Manual

Thank you for choosing our products.

Before using the Products, read this manual, thoroughly.

After reading this manual, please keep it close for your immediate future reference.



Index

Introduction	4
0. Definitions (Terms and Abbreviations)	6
1. For Your Safety – Precautions of Use	7
1.1 Warning Labels Addressed in this Manual	7
1.2 Managing the Products	7
1.3 Precautions.....	8
1.3.1 Ambient Temperature and Illuminance.....	8
1.3.2 Power Supply	8
1.3.3 Disassembly / Modification.....	8
1.3.4 Effects of Dust and Dirt.....	8
1.3.5 Influence of Vibration	9
1.3.6 Disturbance by the Air Fluctuation	9
1.3.7 Waterproof and Explosion-proof.....	9
1.3.8 Actions in Case of Abnormality.....	9
1.3.9 Repair	9
1.3.10 Disposal of the Products.....	10
1.3.11 Residual Risks.....	10
1.3.12 CE Marking	10
1.4 Use of Laser Products for Your Safety.....	11
1.4.1 Corresponding Laser Classes for the Products.....	11
1.4.2 Laser Class Identification Labels on the Products	12
2. Preparing	14
2.1 Functions and Features.....	14
2.2 Package Items	17
2.3 Overview Specifications of the Products.....	17
2.4 External Dimensions of the Products	18
2.5 Names and Functions of the Products.....	19
2.6 System Configuration Example	20
2.7 Components Required for the Configuration	20
2.8 Installation Method (Example)	21
2.9 Connecting Power to the Internal Light Source	22
2.10 Connecting to a Computer	22
2.11 The Software - Installation of the Suruga OptGauge	23
2.11.1 Software License Agreement.....	23
2.11.2 Installation PC System Requirements	25
2.11.3 Installation of the Software	26

2.12	Turning the Power On	33
3.	Measuring	34
3.1	Sensor Head Usage Precautions and Setting (Installation)	34
3.1.1	Interlock Control Specifications.....	34
3.1.2	For Reflection Angle Measurement	35
3.1.3	For External Light Angle Measurement.....	37
3.2	Measurement Overview	38
3.2.1	Angle View	38
3.2.2	Profile View	65
4.	Specifications of the Products and Accessories	75
4.1	The Specifications of the Products	75
4.2	AC/DC Converter Electrical Specifications.....	77
4.3	The Products and Cable Electrical Specifications	77
4.4	The specifications of the Applicable Wire Range for the Interlock and Trigger Inputs.....	77
4.5	Equivalent Circuit Diagram	78
5.	Failures? Frequently Asked Questions	79
5.1	Symptoms and Countermeasure	79
6.	Warranty - After-Sales Service	81
6.1	Warranty Terms, Conditions and Coverage.....	81
6.2	After-Sales Service	81

Introduction

This document is the "User's Manual" for the H651 series – Beam Profiler and Laser Autocollimator (hereafter, referred to as "the Products" or "the sensor head").

This "User's Manual" (hereafter referred to as "this Manual") provides information and basic operating instructions for the Products, which prefixed with H651.

To use the Products effectively and safely, please read this Manual carefully and fully understand its contents before using the Products.

[COPYRIGHT]

Copyright © SURUGA SEIKI Co. Ltd. All rights reserved.

H651 Series User's Manual

Issue Date	2025 September
Manual Version	V.1.0.0

Revision History

Date	Revision	Details
2025 September	V.1.0.0	1 st version

NOTICE

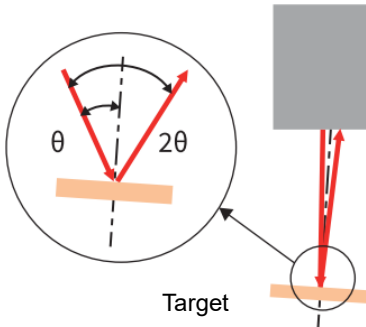
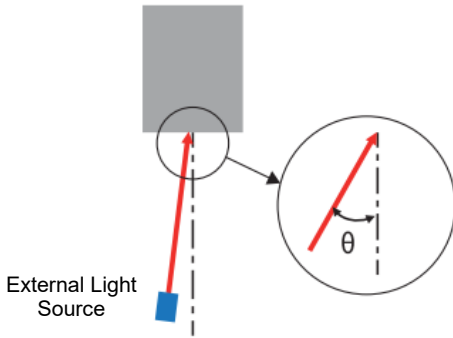
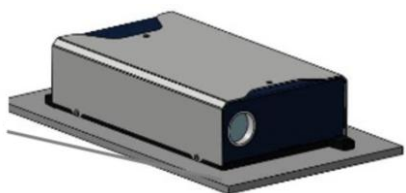
All information contained in this Manual is deemed correct at the time of publication.

The SURUGA SEIKI Co. Ltd. (thereafter, “the SURUGA”) reserves the right to change specifications without notice to the users of the Products.

You can download the latest version of this Manual and the Software from our WEB site



(<http://jpn.surugaseiki.com/>) or (<https://eng.surugaseiki.com/>).

0. Definitions (Terms and Abbreviations)

Terms and Abbreviations	Definitions
Reflection Angle Measurement	 <p>The diagram shows a light source (grey rectangle) emitting a red beam towards a 'Target' (orange rectangle). A circular inset provides a magnified view of the reflection. In this inset, a dashed vertical line represents the normal. The angle between the incident beam and the normal is labeled θ. The angle between the reflected beam and the normal is labeled 2θ.</p> <p>Fig. 1 A measurement method that uses an internal light source to measure the angle of reflected light from an object. The 2θ is measured, and the θ is calculated from the measurement results as shown in Fig. 1.</p>
External Light Angle Measurement	 <p>The diagram shows an 'External Light Source' (blue square) emitting a red beam towards a grey rectangular object. A circular inset shows a magnified view of the incident beam. In this inset, a dashed vertical line represents the normal, and the angle between the incident beam and the normal is labeled θ.</p> <p>Fig. 2 A measurement method that directly utilizes laser or LED light beams to determine angles. The angle θ of the external incident light is taken as the measurement result as shown in the Fig.2.</p>
Reference Plane	 <p>The image shows a black, rectangular electronic device mounted on a grey base. A white line points to the bottom surface of the device, which is labeled 'Reference plane'.</p>
The Products	The Smart ProCo H651 Serie
The Software	The Suruga OptGauge software
This manual	The user's manual for Smart LAC H651 serie
Sensor Camera	Internal sensor camera embedded in the Product.
Def.	Default

1. For Your Safety – Precautions of Use

1.1 Warning Labels Addressed in this Manual

 Warning	May result in serious injury, damage to equipment, or other serious damages.
 Careful	May result in minor physical injury or equipment damage.
Attention	Instructions for safe handling are provided for the product.

1.2 Managing the Products

The Product uses a laser diode for its internal light source. We recommend that the Product is in an environment where appropriate safety measures are taken for the laser before any use.

- The SURUGA shall not guarantee the functions and performance of the Products if used in a manner other than that specified in this manual, or if modified.
- When other equipment combines the Products, the functions and the SURUGA shall not guarantee the performance of the Products, depending on your design, operating conditions, and environment.
- Do not subject each device, including peripherals, to sudden temperature changes, which may cause condensation and equipment failure.
- Do not wipe the Products with a wet rag, benzene, thinner, or the alike, which may cause discoloration or deformation of the Products. If they are heavily soiled, wring out a cloth with diluted pH-neutral detergent and wipe off the stain, then dry the Products with a soft cloth.
- If you suspect the Products being malfunctioning, please contact our local sales office.

1.3 Precautions

1.3.1 Ambient Temperature and Illuminance

- Changes in ambient temperature can cause measurement errors. Please be advised to keep the ambient temperature, always, at a constant level.
- Avoid using the Products near lighting equipment that repeatedly turns on and off at high frequencies. If this is not possible, use a light shield or similar device to avoid being affected.

1.3.2 Power Supply



- Use the correct power supply voltage. Otherwise, fire, electric shock, or malfunction may occur.
- Be sure to turn off the power to and devices connected to the Product when connecting or disconnecting various connecting wires. Otherwise, the Products may be damaged.
- Do not turn off the power while setting items. Sudden power cut-off while setting data, part or all configuration data may be lost.

1.3.3 Disassembly / Modification



Do not disassemble or modify any unit of the Products. Disassembly or modification may cause fire or electric shock. The warranty is void if the Products are disassembled or modified by anyone other than our employees or our certified third party.

1.3.4 Effects of Dust and Dirt

The following cases may cause measurement errors due to the influence of dust, dirt, water, oil, etc.

- Dust and dirt on the cover glass: Use dry-clean air to blow off any dirt on the cover glass. If the cover glass is heavily soiled, wipe it off with a soft cloth soaked in thin alcohol.
- Adhesion on the surface of the object to be measured: Blow it off with clean air or wipe off the dirt.
- Intrusion into the optical axis area by floating or by splashing: Please take measures such as installing a protective cover or air purging.

1.3.5 Influence of Vibration

Vibration transmitted either to the Products or to a measurement target (or both) may cause measured values unstable. In such cases, please be advised that, in order to obtain stable results, you may take extra efforts such as suppressing the vibration or averaging out result values upon increasing the number of measurements.

1.3.6 Disturbance by the Air Fluctuation

The influence of slow shimmering of the air may cause the measured value to vary. In such cases, covering the measuring section with an airproof cover is advised.

1.3.7 Waterproof and Explosion-proof



- The Products are not intended for use in areas where explosion protection is required. Do not use the Products in locations where flammable gases or other explosive atmospheres exist.
- The Products are not waterproof. Do not use the Products in locations where liquids may splash or flow into the Products.

1.3.8 Actions in Case of Abnormality



In the following cases, immediately turn off the power and disconnect the USB cable. Continuing to use the Products in an abnormal state may cause damage:

- When abnormal sounds, strange smells, or smoke is detected.
- If the power cord is damaged.
- If water or other liquid is spilled on the Product.

1.3.9 Repair

For repair, please contact our local sales office,

- When water or foreign matter gets inside the Products.
- When the Product is damaged due to being dropped or external impact.
- When you smell a strange odor due to smoke emission from the Product.

1.3.10 Disposal of the Products

When disposing the Products, they are treated as industrial wastes. Please follow in accordance with local laws and regulations or by any other appropriate methods. The SURUGA shall not collect the Products for disposing them.

1.3.11 Residual Risks

Attention

This Manual does not disclose all risks associated with the Products. For residual or unexpected risks, or any other risks involved, please implement the safety design of machinery in accordance with ISO 12100 or your appropriate industrial safety standards that you follow.

1.3.12 CE Marking

The Products comply with the CE marking for the following complying standards and conditions. When the Products are applied in EU countries, the following conditions must be met:

- EN IEC 61326-1:2021
- EMI: EN IEC 61000-6-4:2019
- EMS: EN IEC 61000-6-1:2019

Note: The length of all input and output cables, including the power cable connected to the Product, must be less than 30 meters.

1.4 Use of Laser Products for Your Safety

1.4.1 Corresponding Laser Classes for the Products



The following describes the hazards of the laser class in the Products. For specific safety precautions for the laser classes, please follow your occupational safety regulations.



Laser Class	Precautions
Class 1	Safe under reasonably foreseeable conditions A Laser product which is safe for use with observation optics such as a loupe and binoculars Applicable products: All models with a built-in laser at the wavelength of 980 nm
Class 2	Normally, your eyes are protected and safe due to aversion reactions such as blinking. Laser products that may cause temporary visual impairment or risk of secondary injury due to aversive reactions if the user intentionally stares at the laser beam. Applicable products: All models with a built-in laser at the wavelength of 660 nm

Ref : IEC 60825:2014 / JIS C 6802 : 2014 : *Safety of Laser Products*



1.4.2 Laser Class Identification Labels on the Products

The description contents of the laser class identification labels and the warning labels, and their posting positions are illustrated below.

The label contents differ depending on the product model. Please confirm the model of the Product before any use.



Table 1 : Laser Labels and Descriptions

Laser Class Identification Label	
Class1	Class2
	
Background color: Yellow Text color: Black	Background color: Yellow Text color: Black

Warning Label

Background color: Yellow Text color: Black

The notation method and description of the label conform to JIS C 6802:2014

SURUGA SEIKI CO.,LTD.

505, Nanatsushinya, Shimizu-ku,
Shizuoka-shi, Shizuoka, 424-8566, JAPAN

No.

MFD

Model



MADE
IN
JAPAN



About KC correspondence: Class A

사용자 안내문

이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

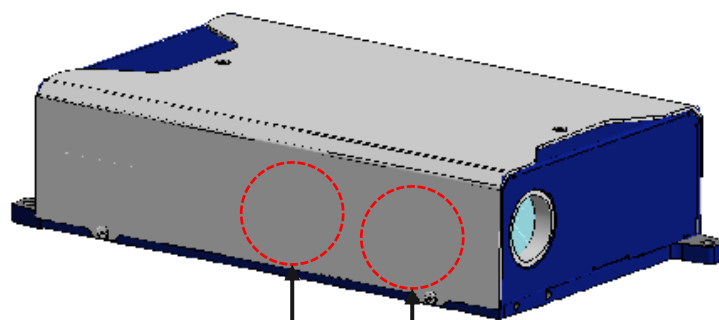
Reference English translation:

User guide This equipment has been conformity-assessed for use in a professional environment and Interference may occur.



Common locations for the laser labels to all models

The warning label for the laser emission port and the identification label for the laser class are attached to the left side of the product when viewed from the front.



Laser Warning Label

Laser Class ID Label

2. Preparing

2.1 Functions and Features

The Products are multifunctional measuring instrument that determines the angle, divergence, position, and beam diameter of an object from the beam incident upon the sensor camera.

The following features are mainly available.

- Angle measurement
(Φ 3 mm diameter by determining the angle of incident light from an external source)
 - Measurement range: $\pm 1.5^\circ$ (circular Area)
 - Linearity: $\pm 0.45\%$ of F.S.
(F.S. = 3.0° : measuring by the internal light source wavelength ± 10 nm)
 - Repeatability: 1 sec.
(within the 6σ of the averaging times = 256 measurements)

*See "[Specifications of the Products and Accessories](#)" for more details

- Divergence measurement
 - Measurement range: 20 mrad or less
 - Linearity: 5% of F.S. (F.S. = 20 mrad)
- *See "[Divergence](#)" in the Angle View section for details.

- Position measurement (when using $\Phi 3$ mm beam)
 - Viewing range: Φ 6 mm.
 - Linearity: $\pm 0.5\%$ of F.S.
(F.S.=2.8 mm: measuring by the internal light source wavelength ± 10 nm).
 - Repeatability: 1 μ m (6σ , when measured with averaging = 256 times).

*See "[Specifications of the Products and Accessories](#)" for more details.

- Beam diameter measurement

- Measurement range: Φ 60 μ m to Φ 6 mm
(we recommend that the Spot diameter should be less than 1/2 of viewing range if you apply the Auto Aperture).

*See "[Specifications of the Products and Accessories](#)" for more details.

- The PC Software is available for connecting the Product for various measurements.

*See "[Installation Method \(Example\)](#)" for more details.

- Measurement of multiple light points is available.

* See "[Multi Spot](#)" in the Measurement Overview for more details.

- The reflection angle measurement and the external light angle measurement are available.

- For reflection angle measurement, use the internal light source to measure the angle of its reflected light.
- For external light angle measurement, the angle of the beam of laser or LED can be measured directly.

*See "[Angle Measurement](#)" in the Angle View for more details.

Table 2 Function List

Functions		Details
Measurement	Angle	See the Angle Measurement in the Angle View
	Divergence	See the Divergence in the Angle View
	Position	See the Beam Centroid in the Angle View
	Diameter	See the Beam Centroid in the Profile View
	Angle Rotation	See the Rotation Angle in the Angle View. See the Rotation Angle in the Profile View.
	Line Position	See the Line Position in the Profile View.
Convenient Functions	ROI	See the Aperture in the Angle View. See the Aperture in the Profile View.
	Auto Aperture	See the Aperture in the Angle View. See the Aperture in the Profile View.


	Automatic Brightness	See the Automatic Brightness control in the Angle View. See the Automatic Brightness control in the Profile View.
	Adaptive Cal	See the Adaptive Cal in the Angle View. See the Adaptive Cal in the Profile View.
	Maximum Luminance Value Measurement	*1
	Total Count Measurement	
	Binning	
	Denoising	
	Measurement Results Storage	
Display	Zero Offset	See the Origin Offset in the Angle View. See the Origin Offset in the Profile View.
	Screen Image Zoom	See the Zoom In in the Angle View. See the Zoom In in the Angle View.
	Unit Conversion	*1
	Rotation	
	Mirroring	
Judgement	Angle Judgement	See the Judgement in the Angle View. See the Judgement in the Profile View.
	Beam Divergence Judgement	
	Position Judgement	
	Beam Diameter Judgement	
	Maximum Luminance Judgement Value	
Communication	RS232C	*1
	TCP/IP	

*1 see the software manual, the "Suruga OptGauge User's Manual", for more details.

2.2 Package Items

In addition to the Product, the package delivered to the user contains an adjusting screwdriver for the internal light source and a USB memory stick.

1.  The Product

2.  A USB memory stick contents:

Suruga OptGauge (the sensor application), camera driver, device authentication file and this Manual).

*The latest version can be downloaded from the SURUGA website (<http://jpn.surugaseiki.com/>).

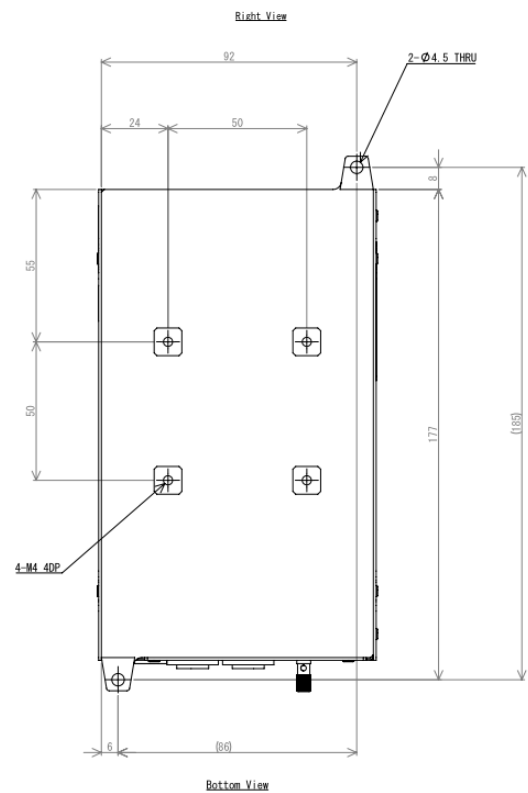
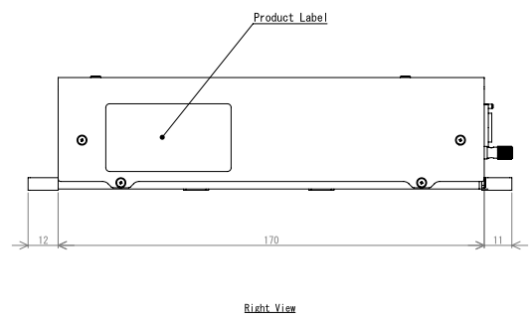
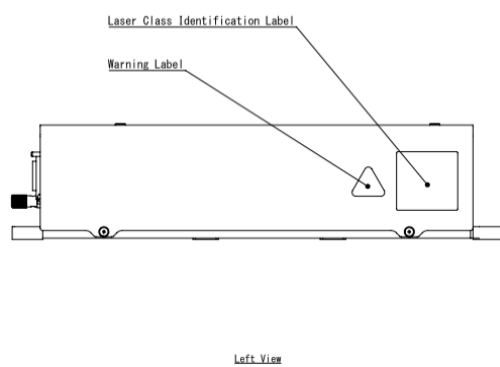
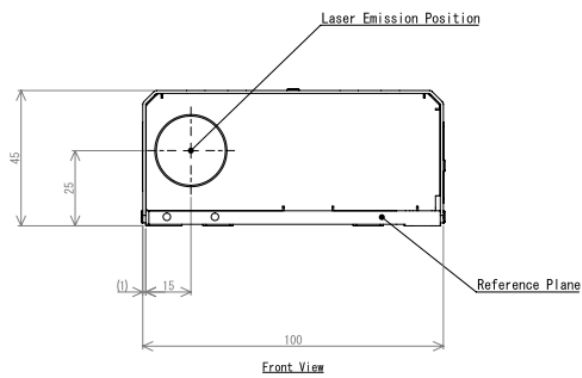
3. The AC/DC power supply for the Internal light source

2.3 Overview Specifications of the Products

Specifications Table of the Products

External Dimensions	170 mm x 100 mm x 45 mm (excluding protruding parts)
Body Weight	Approximately 0.9 kg
Power Supply	12 VDC
Power Consumption	5 W or below
Laser Class	Class1 (H651NL) / Class2 (H651VL)
Protective Functions	Short-circuit protection and reverse polarity protection
Communication Functions	USB3.0 standard
Operating Temperature and Humidity	0°C to + 40°C, 35% to 85% RH (no condensation)
Storage Temperature and Humidity	- 10°C to + 60°C, 35% to 85% RH (no condensation)
Atmosphere	Avoid direct sunlight, corrosive or inflammable gases, liquids, powders & dust, and other toxic substances
Housing Material	Aluminum

2.4 External Dimensions of the Products



2.5 Names and Functions of the Products

- ① Internal light source switch
Turns the power supply for the internal light source ON and OFF.

- ② Indicator
Displays the internal light source status with 3 colors.

Green: the internal light source is OFF (initial status)

Orange: the internal light source is ON

Red: Detecting interlock (*Internal light source can not be turned ON while being interlocked)

- ③ USB connectors x 2

It connects the Product to a computer of a customer.

- ④ Power inlet for internal light source

A terminal for the AC/DC adapter for the internal light source.

- ⑤ The Interlock and trigger input connector

You may connect the interlock and the trigger inputs as following;

1: INTERLOCK+

2: INTERLOCK-

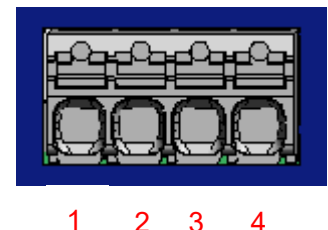
3: TRIG 5V+

4: TRIG 5V-

*For the applicable wires, please see "The Specifications of The Applicable

Wire Range for The Interlock and Trigger Inputs" for more details.

See "The Specifications of The Applicable Wire Range for The Interlock and Trigger Inputs"

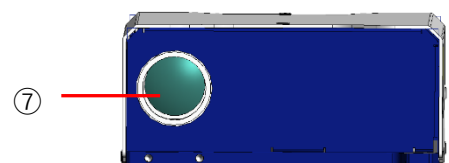


- ⑥ FG Terminal

A frame ground to reduce electrical noise and to prevent malfunction.

- ⑦ Laser emission port

Irradiates the laser when the internal light source is ON.

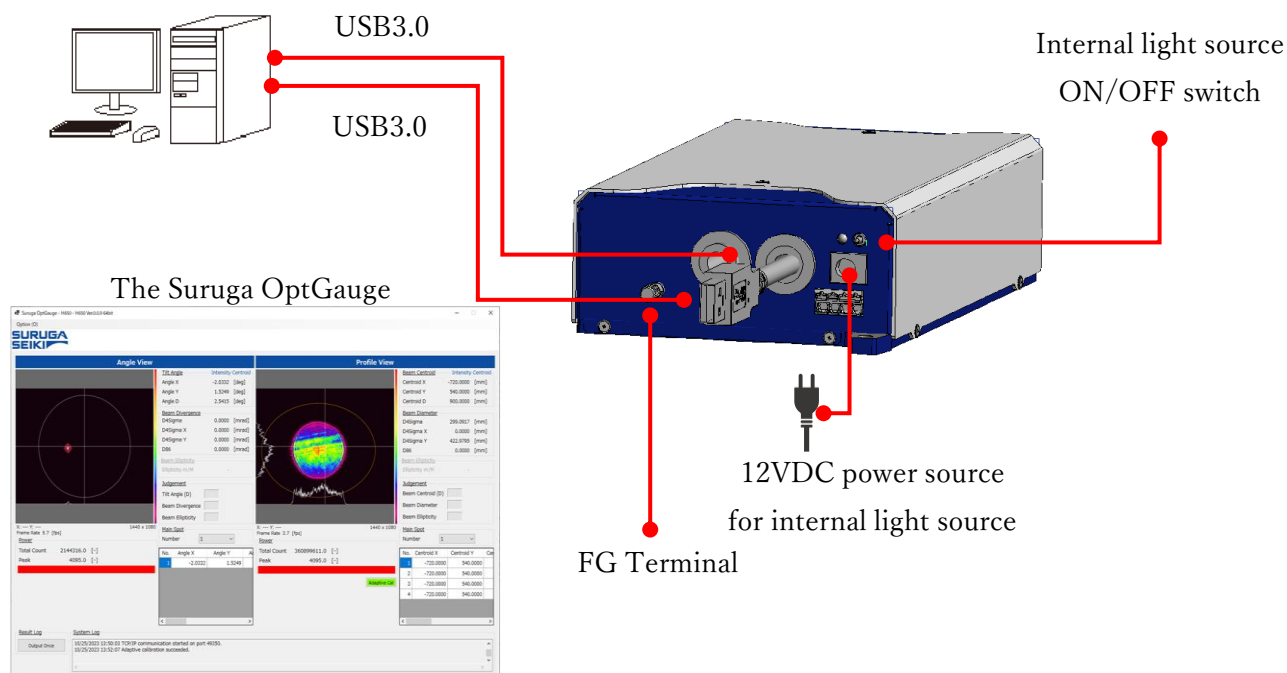


Laser emission
surface (front)



DO NOT irradiate the human body; eyes, skin, or any other parts before all safety precautions are taken.

2.6 System Configuration Example



2.7 Components Required for the Configuration

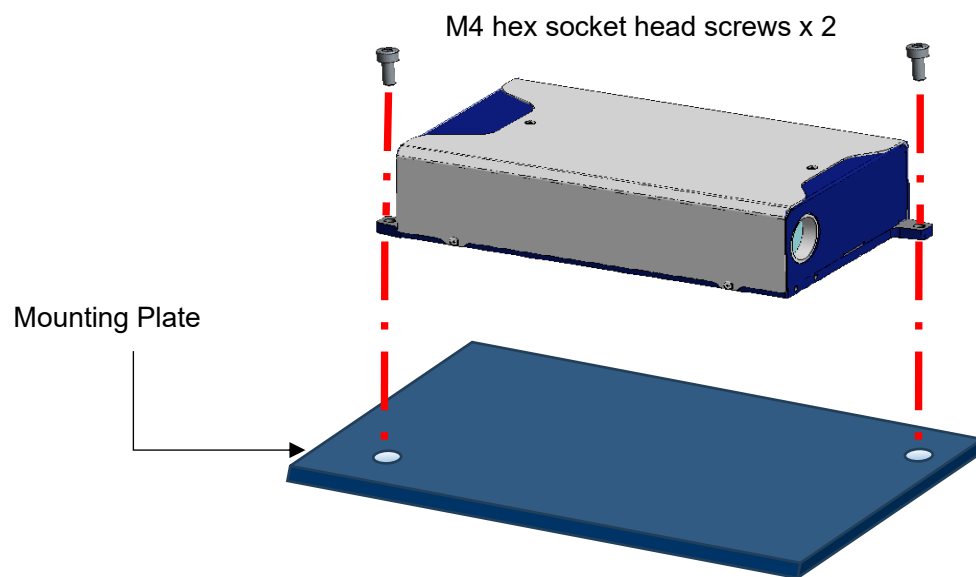
- The sensor head
- The 12VDC power source for internal light source (the AC/DC adapter included).
- A computer, a monitor, and a keyboard for the Products.
- The Suruga OptGauge: measurement software for the Products.

2.8 Installation Method (Example)

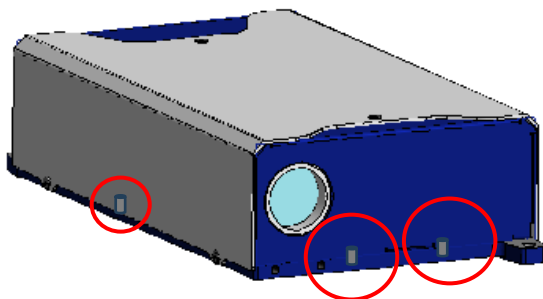
This section provides an example of mounting the Product.

1. Place the Product on a mounting plate that you prepared.
Use M4 hex socket head cap screws (length: 8 mm to 10 mm).

*See [External Dimensions of the Products](#)"



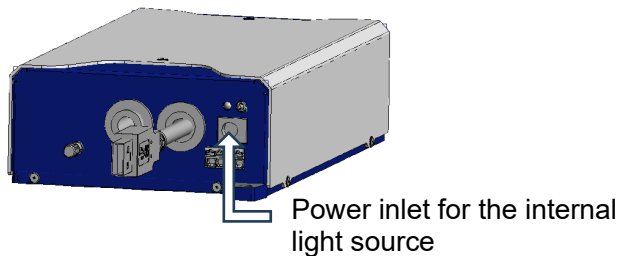
2. The reference position is the base plate on the front, left side of the Product.
Fasten the bolt with a parallel pin or other means pressed against it.



2.9 Connecting Power to the Internal Light Source

Please use only the proper AC/DC adapter.

Insert the DC plug of the AC/DC adapter into the designated socket before inserting the AC side into an outlet. Note: you should ground the FG terminal.



Attention

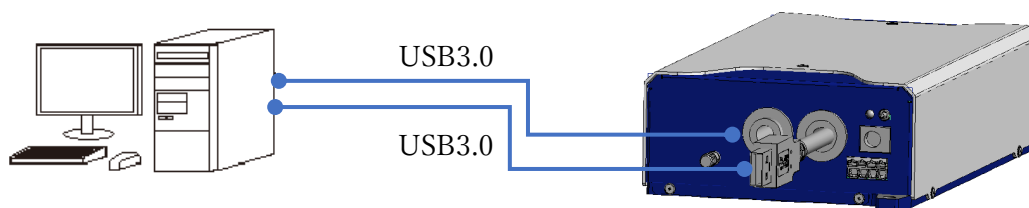
Do not turn on the AC adapter until the Software installation is complete.

Please ground the FG terminal to prevent malfunctions caused by electrical noise.

2.10 Connecting to a Computer

Connect the USB3.0 cable to a USB port compatible with USB3.0.

Be sure to use a computer with a USB3.0-compatible port.



Attention

Do not disconnect the USB cable while the Software is running. Normal operation will be disrupted.

If the cable disconnects, close the application, reinsert the USB cable, and restart the application.

2.11 The Software - Installation of the Suruga OptGauge



If downgrading of the Software, setting information added to a newer version may not be correctly loaded. If downgrading to an earlier version of the Software, it would not read correctly the settings only available to the newer versions so that the software would not even start up.

Therefore, please be advised to back up the folder with your option files being stored, to delete the original option file folder and then to re-installing an earlier version.

[Folder Path]

C:/Users/[UserName]/Documents/Suruga/OptGauge/[Product Serial No.]

2.11.1 Software License Agreement

To use the Suruga OptGauge (hereafter as "the Software"), the customer must consent to the following software license agreement (hereafter as "this agreement").

When installing or copying all or part of the Software on a computer, or using the Software after installation, it is considered that the customer has consented to all terms of this agreement, and the agreement is bilaterally concluded.

Article 1 (Permissions)

The Software is free of charge.

The copyright for the Software, its manual, and other documents concerning the Software belong to SURUGA SEIKI Co., Ltd. (hereafter as "the SURUGA").

The SURUGA grants all users for non-proprietary rights to the use of the Software.

Article 2 (Usage Restrictions)

The SURUGA permits the use of the Software only for the purposes of operating the Products and collecting data.

The SURUGA prohibits the use of the Software for any other purposes than that the SURUGA's intended.

Article 3 (Reproduction and Modification)

The Software can be copied only to the computers using the Products. The SURUGA prohibits modification, redistribution, and reverse engineering.

Article 4 (Disclaimers)

Users make the use of the Software on their own responsibility.

The SURUGA bears no responsibility and is not liable for any direct, indirect, incidental, special, supervenient, or punitive damage including but not limited to; data loss, business interruptions, and loss of profit, incurred arising out of or failure to use the Software.

In addition, The SURUGA bears no responsibility and is not liable for any damage incurred arising out of software bugs, errors, viruses, malfunctions due to illicit third-party access, or security issues with the Software.

The SURUGA holds no responsibility and is not liable to damages incurred upon modification of the Software.

Article 5 (Support)

The SURUGA provides technical support for the Software. However, there is no guarantee that our technical support will achieve the customer's purpose.

Article 6 (Termination of Agreement)

The right to use the Software will be, immediately, terminated upon violation of the conditions of this agreement.

2.11.2 Installation PC System Requirements

[Recommended System Requirements]*¹

Hardware requirements	Supported OS	Windows 11 64-bit, Version 24H2 or later* ⁴
	CPU	Intel Core i5 - 1345U CPU 1.6 GHz or higher 10-core 12-thread
	RAM	16GB or higher
	Storage capacity	1GB or higher
	Display resolution	1920 x 1080
	USB	USB3.0 (type A) port: 2 or more
Software requirements	Framework	.NET8.0* ³

[Minimum System Requirements]*²

Hardware requirements	Supported OS	Windows 10 Pro 64bit, Windows 11 64-bit, Version 24H2 or later* ⁴
	CPU	Intel Core i5 - 8265U CPU 1.6GHz 4-core 8-thread
	RAM	8GB or higher
	Storage capacity	1GB or higher
	Display resolution	1920 x 1080
	USB	USB3.0 (type A) port: 2 or more
Software requirements	Framework	.NET8.0* ³

*1 “Recommended System Requirements” refers to a level where waiting times are minimal and operation is comfortable.

*2 “Minimum System Requirements” refers to a level where the Software can start and perform basic functions.

*3 If .NET8.0 is not installed on your computer, install “.NET Desktop Runtime 8.x.x.” from the Microsoft website

*4 It has been confirmed that the Software may not operate properly on Windows 11 Version 23H2 due to differences in certain system components and operating specifications. Please update to the latest Windows version (24H2 or later).

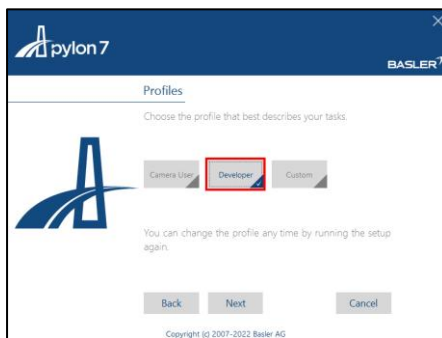
2.11.3 Installation of the Software

2.11.3.1 Installation from the USB Driver

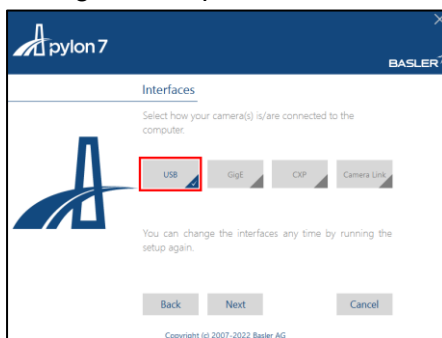
1. Double-click the "... ¥Driver" "Basler_pylon_7.0.0.24651.exe" to begin installation.



2. Consent to your installation on the confirmation screen.
3. Set the installation method (Profiles) to "Developer".



4. Set the sensor camera connection method (Interfaces) to "USB." Thereafter, use the default settings to complete the installation .



2.11.3.2 Installation from the Download File

Where to download: the Suruga website (<http://jpn.surugaseiki.com/>).

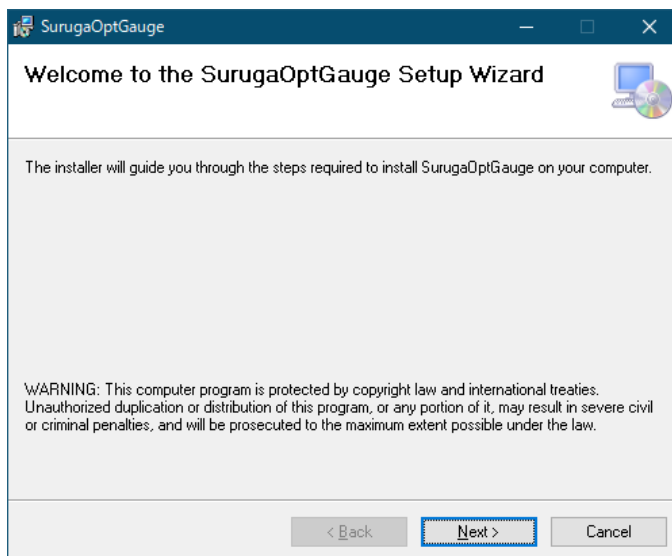
2.11.3.3 Installation of the Software

Install the Software.

1. Double-click "SurugaOptGaugeSetup_x.x.xx.msi" in the directory "... ¥Application".

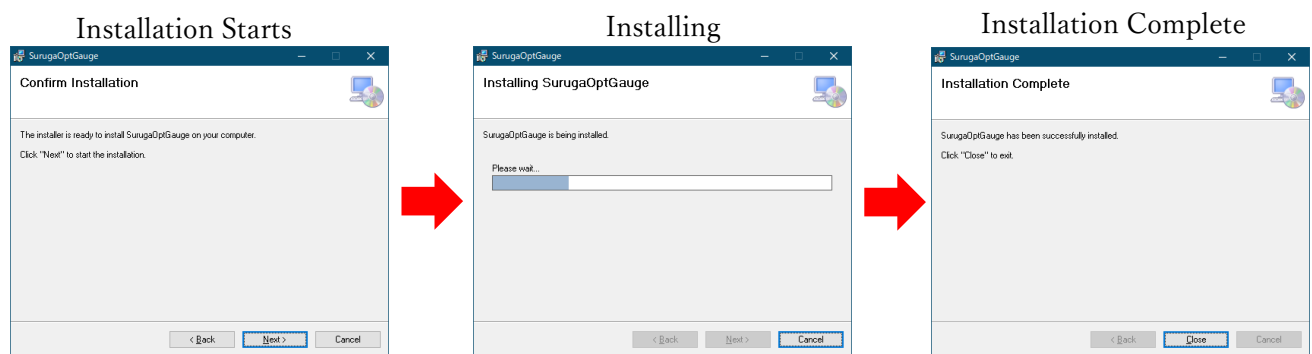
名前	更新日時	種類	サイズ
 SurugaOptGaugeSetup_x.x.x.msi	2023/11/28 19:12	Windows インストー...	61,590 KB

2. Click 「Next>」



3. Click "Next>" to begin installation .

When installation is complete, click "Close".



4. The Suruga OptGauge will be created on the desktop.



This concludes the installation procedures.

2.11.3.4 Copying the Device Authentication File

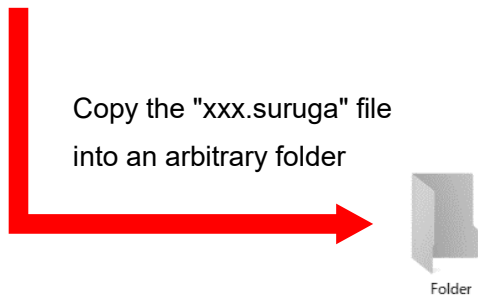
Attention

Authentication file

For the Products, calibration values are set for each device. Therefore, the Software requires reading of a "device authentication file (.suruga)" in which the unique individual device information is stored.

To load the device authentication file into the Software, copy the file "xxx.suruga" in the ".../Authentication File" to an arbitrary file location .

名前	更新日時	種類	サイズ
xxx.suruga	2023/09/28 10:55	SURUGA ファイル	6 KB



Note:

If your security settings prevent you from copying the device authentication file to your PC, you can read it directly from the USB memory stick supplied with the Product, so this procedure is not necessary.

2.11.3.5 Starting up / Shutting Down of the Software

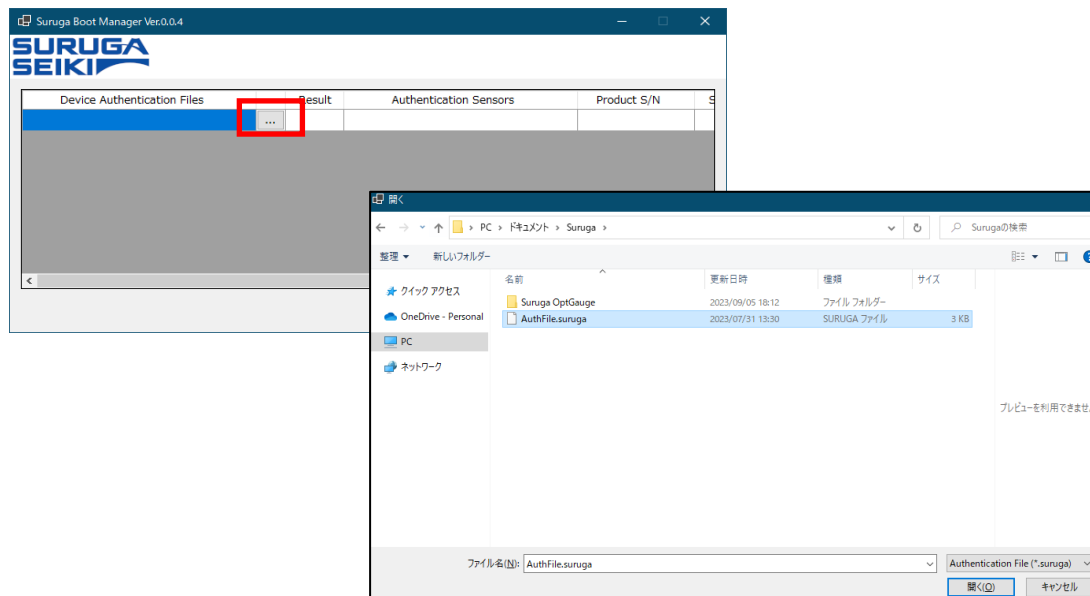
How to start-up

1. Double-click "Suruga OptGauge" icon in the "...¥Desktop".

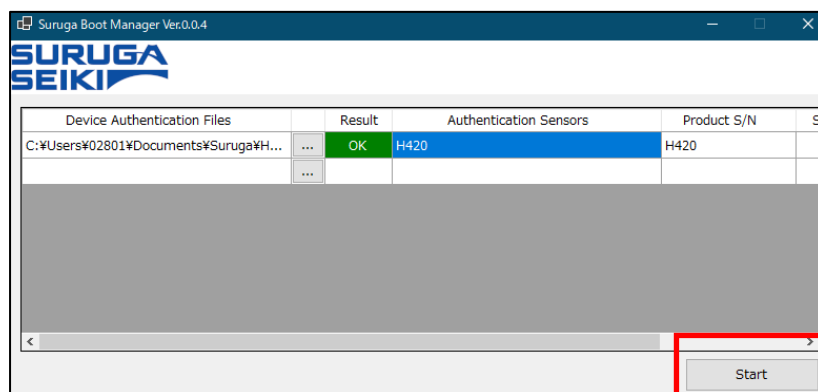


2. Click on " ..." in the item "Device Authentication File" and select the extension ".suruga" in the folder in which the unique "Device Authentication File" was copied.

If not able to copy the device authentication file to your computer, select it directly from the USB memory stick.



3. Confirm the "Result" is "OK", and press "Start" .

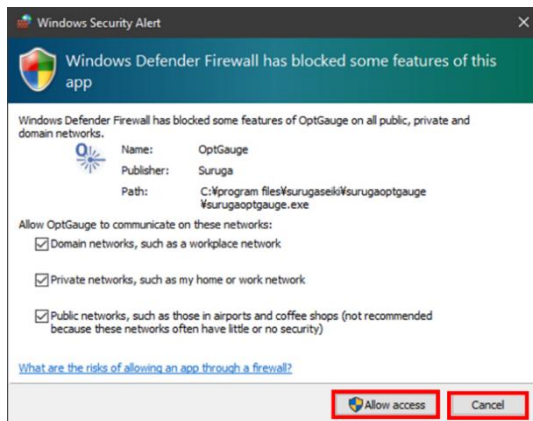


Attention

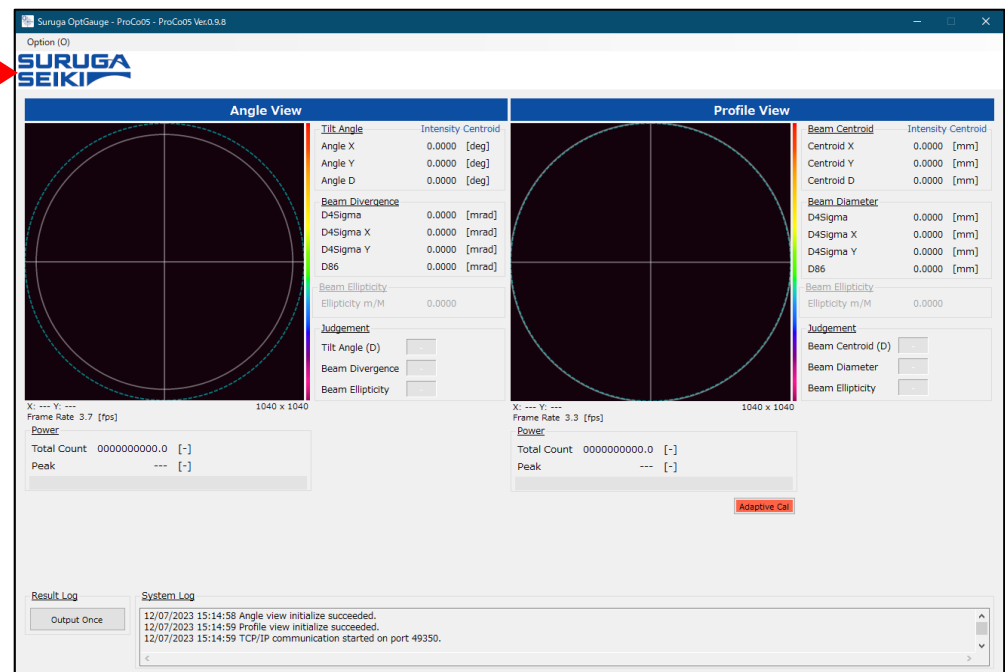
The Software incorporates TCP/IP communication controls. Consequently, upon initial launch, the following warning may appear depending on your PC's security settings.

If your PC or network environment permits TCP/IP communication, please tick all boxes and click 'Allow access'. If you cannot permit it, click 'Cancel'.

If not, click "Cancel".



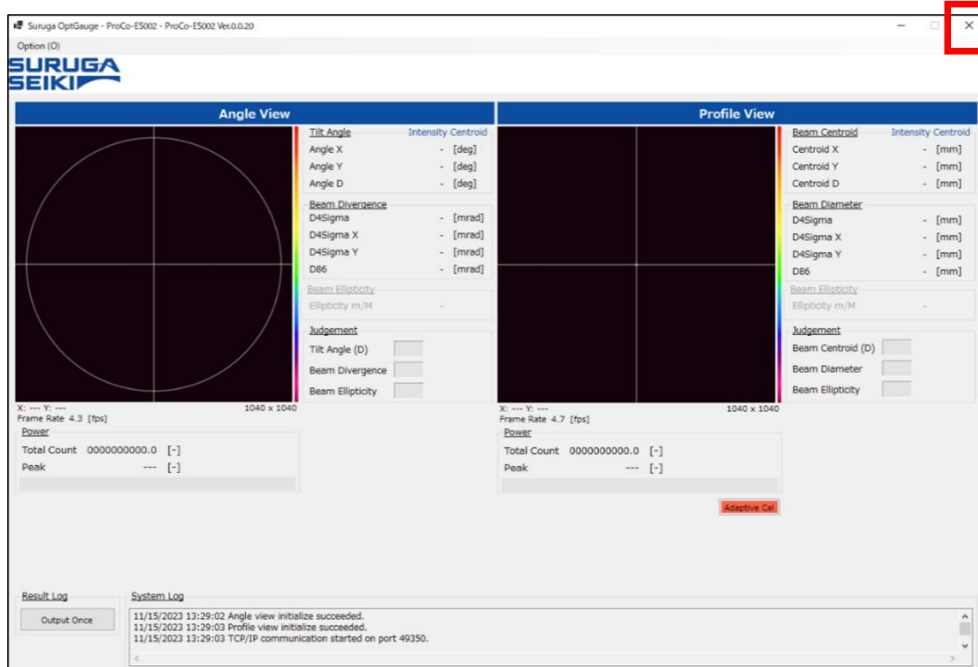
4. The application will start up.



(Changes can be made after the fact in "Control Panel / All Control Panel Items / Windows Defender Firewall / Allowed Apps").

Shutting Down the Suruga OptGauge

1. Click the "x" button to shut down the Software

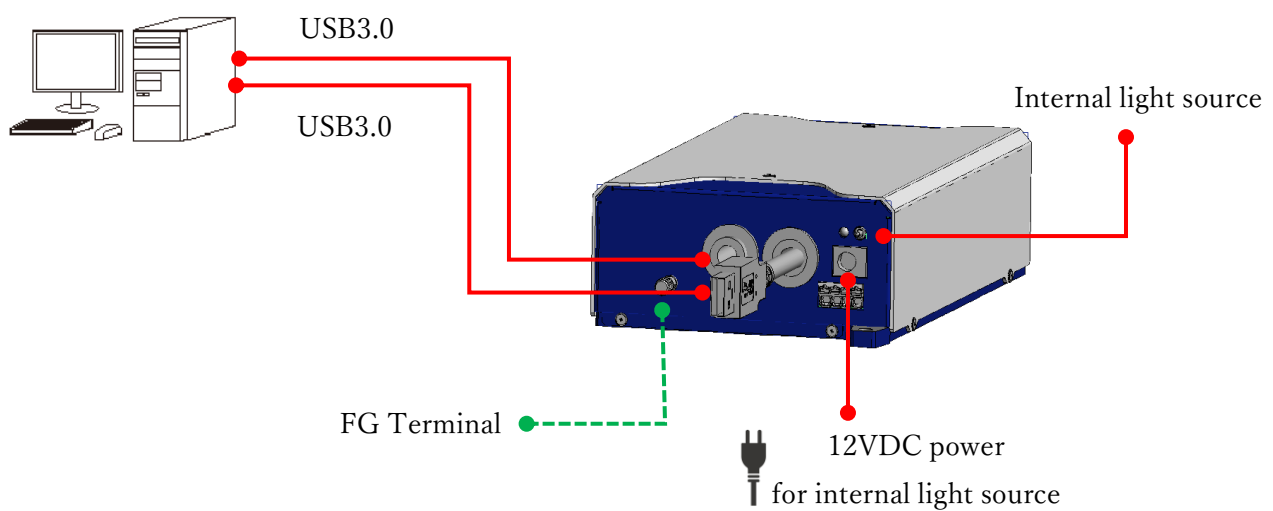


2.12 Turning the Power On



DO NOT turn on the power to the Product until the Software installation on your PC are completed and your supervisor confirms work safety.

To turn on the internal light source, connect the DC12V power adapter for internal light source to an outlet and set the internal light source ON/OFF switch to ON.



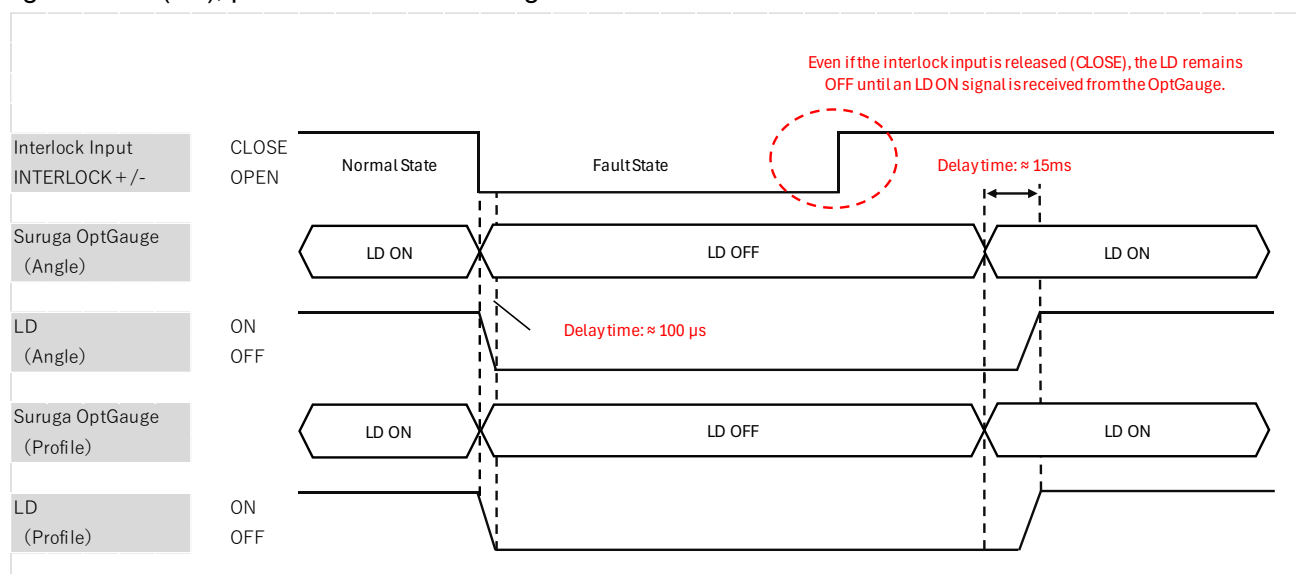
3. Measuring

3.1 Sensor Head Usage Precautions and Setting (Installation)

This section describes the setting method for the Products, using the Software.

3.1.1 Interlock Control Specifications

To ensure safe operation, the Products use the interlock control to manage the switching on and off of the internal light source (LD). For details on the timing of interlock control, the Software, and the internal light source (LD), please refer to the timing chart below.



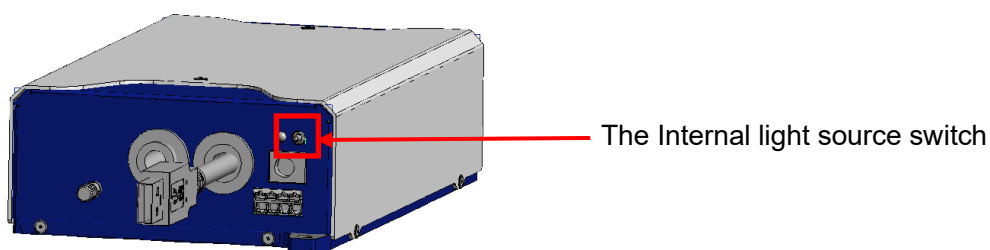
3.1.2 For Reflection Angle Measurement

1. Switch off the internal light source and position the measuring target 200 mm away from the reference surface.

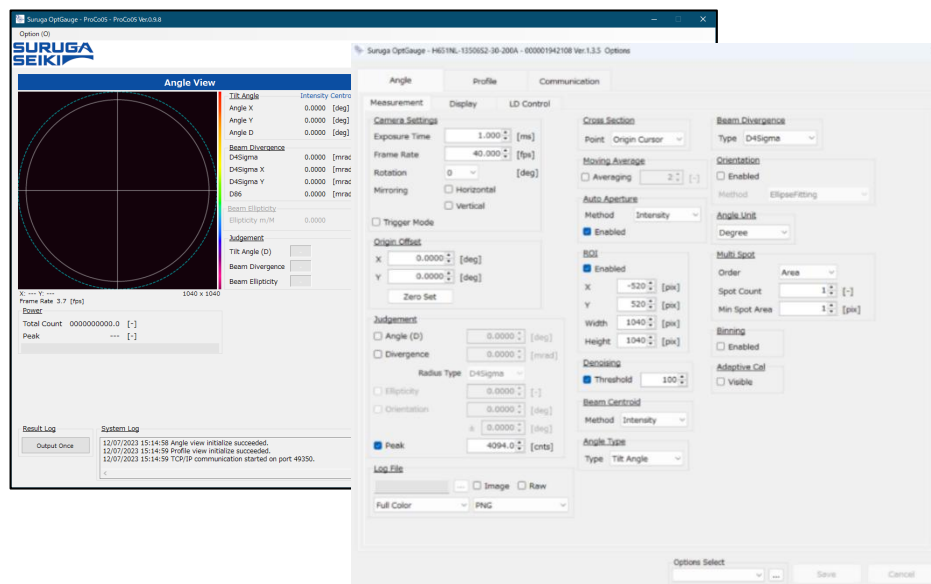
If the measuring target has a low reflectance, measurement may not be possible. (Reflectance of 10% or higher is recommended.)



2. When installation is complete, turn the internal light source switch ON.



3. Launch the Software and open the Option screen.

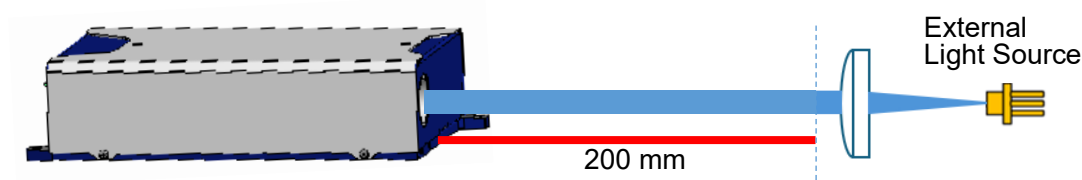


4. Set the Angle Type to "Tilt Angle" on the Angle tab in the Option screen.
(See "the Angle Measurement" in the Angle View).
5. Select the LD Control sub-tab at the Angle tab in the Option screen.
6. Click the LD button*1 within the Internal Light Source group box to turn on the internal light source.
7. Click the Tune button*1 within the LD Adjustment group box.
8. Select the LD Control sub-tab in the Profile tab of the Option screen.
9. Click the Tune button*1 within the LD Adjustment group box.
10. 90 minutes warm-up time to ensure stable measurements (no operation necessary)

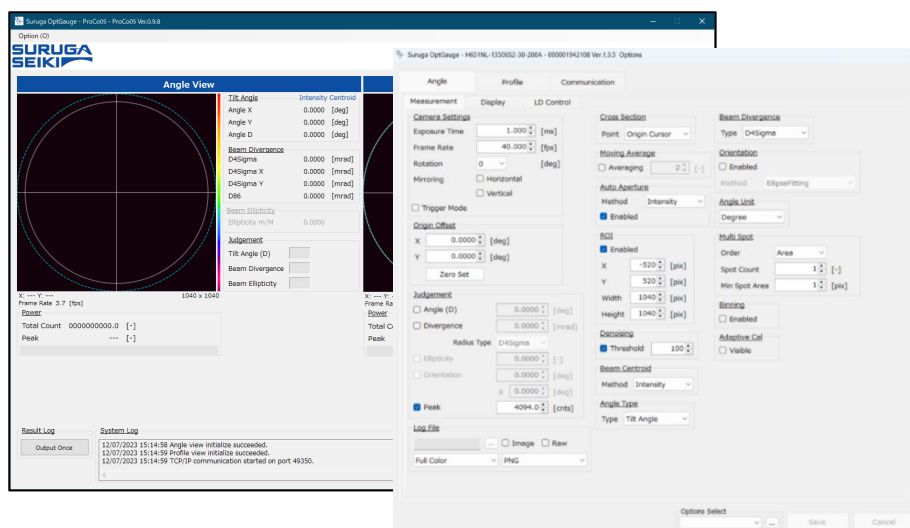
*1 see the separate software manual, the *"Suruga OptGauge User's Manual"* for details.

3.1.3 For External Light Angle Measurement

1. Turn off the internal light source and set the distance between the front edge of the sensor head reference plane and the beam position you wish to measure to be 200 mm away



2. Launch the Suruga OptGauge and open the Option screen.



3. Set the Angle Type to "Beam Angle*2" on the Angle tab in the Option screen.
4. Select the LD Control sub-tab in the Angle tab of the Option screen.
5. Adjust the light intensity of the external light source, click the Tune button*¹ in the LD Adjustment group box, and set it to "3500 to 3800" (optimal value) while observing the Peak*¹ on the measurement screen.
6. Select the LD Control sub-tab in the Angle tab of the Option screen.
7. Adjust the light intensity of the external light source, click the Tune button*¹ in the LD Adjustment group box, and set it to "3500–3800" (optimal value) while observing the Peak*¹ on the measurement screen.

*¹ See the separate software manual, *the "Suruga OptGauge User's Manual"* for details.

3.2 Measurement Overview

3.2.1 Angle View

3.2.1.1 Angle Measurement

You need to change the measurement mode according to your measuring purpose.

For the reflection angle measurement, select "Tilt Angle".

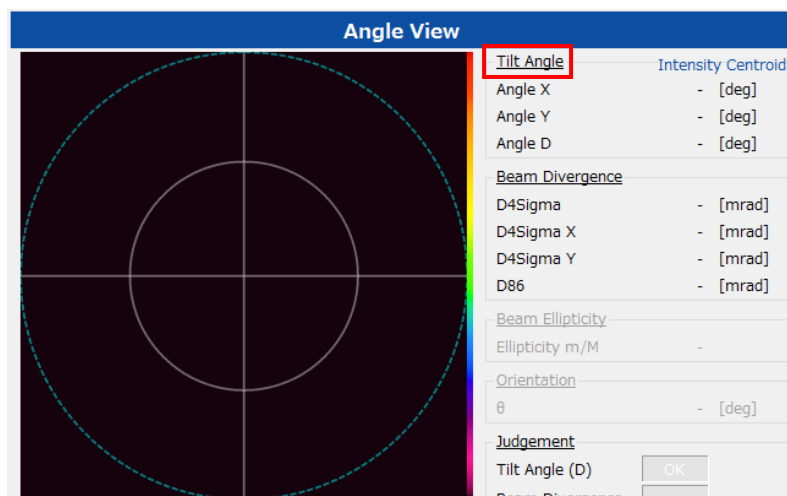
For the external light angle measurement, select "Beam Angle".

Measuring a reflection angle

You may select [Tilt Angle] in the "Angle Type" in the Option setting.

Angle Type
Type Tilt Angle ▼

Starting reflection angle measurement.

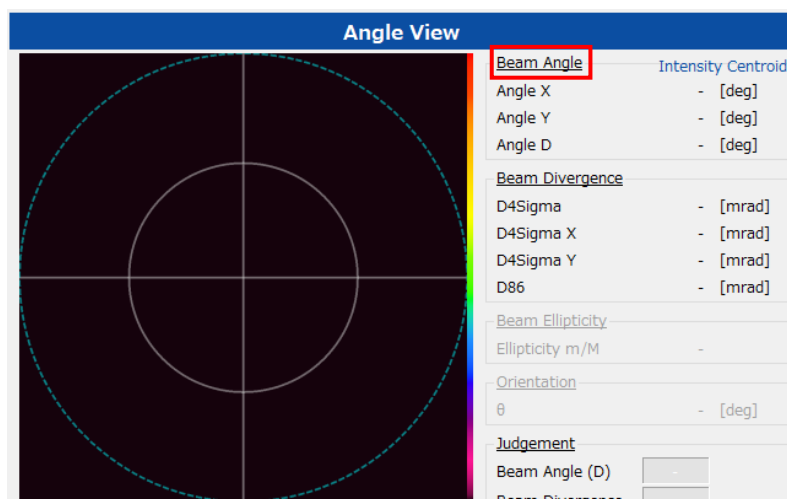


Measuring an external light angle

You may select [Beam Angle] in the "Angle Type" in the Option setting.

Angle Type
Type Beam Angle ▼

Starting external light angle measurement.



3.2.1.2 Divergence

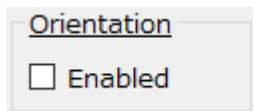
Divergence indicates how much the light beam expands at an angle as it propagates.

A light beam with small divergence means that there is little expansion during propagation over long distance, while a beam with a large divergence expands rapidly over short distance.

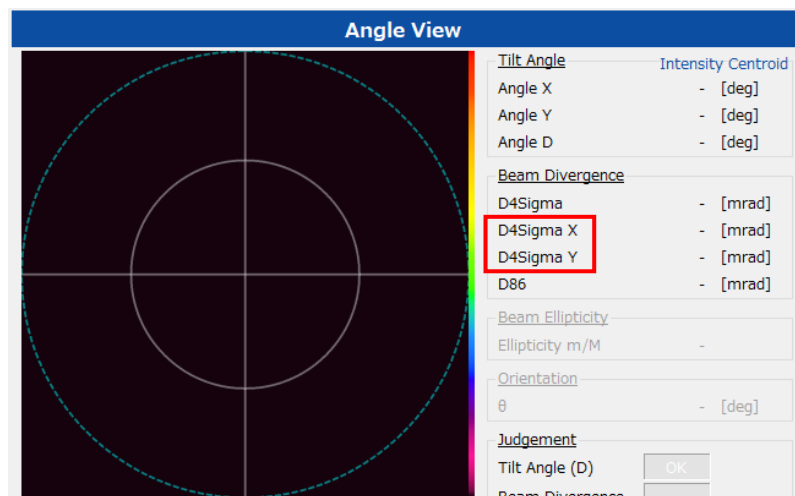
The Products display divergence in a half-angle with mrad (milli radian). It has two modes of measurement.

Measuring a $D4\sigma$ beam diameter^{*1} (elliptical beam) of divergence along with X-axis and Y-axis directions.

Set "Orientation Enabled" in the option settings to "Disabled".

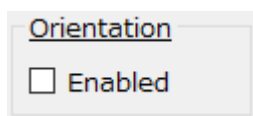


Measures beam divergence by "D4Sigma X" and "D4Sigma Y" ^{*1}

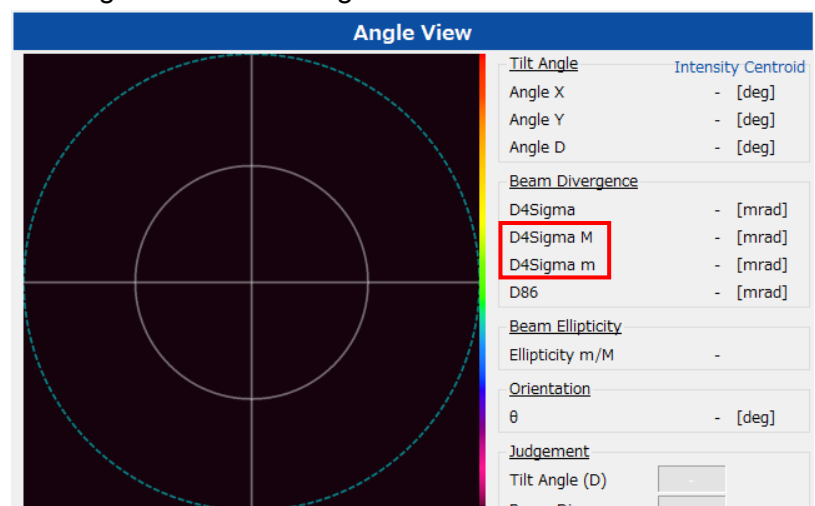


Measuring a $D4\sigma$ beam diameter^{*1} (elliptical beam) of divergence along with M (major: long axis) and m (minor: short axis).

Set "Orientation Enabled" in the option settings to "Enabled".



Measures beam divergence by "D4Sigma M" and "D4Sigma m" ^{*1}



^{*1} The beam diameter can be selected as $D4\sigma$ or $1/e^2$.

See the separate software manual, the "Suruga OptGauge User's Manual" for details.

3.2.1.3 Beam Centroid

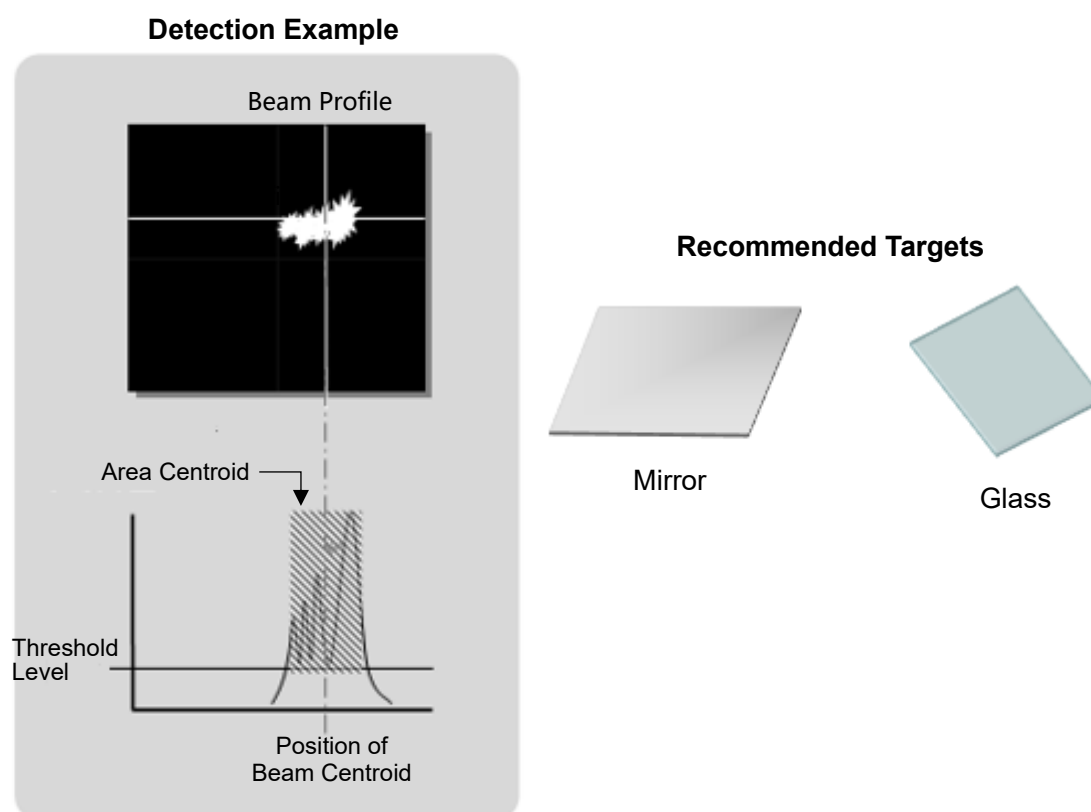
The method for determining the center position of a light spot can be selected by the type either beam area (area centroid) and beam intensity (luminance centroid) at the "Beam Centroid" in the Option setting. We recommend selecting the type of "Beam Centroid" according to a target to be measured.

Area Centroid (Area)

For the area centroid of a light beam, its centroid position is calculated from an irradiated area higher luminance than the denoising threshold value and results as an angle. Therefore, by raising the threshold value, the effects of the edges of the peak profile can be minimized.

We recommend selecting this type of measurement for targets such mirror with uniform surface and to reflect a light beam without blur or smudge*.

- ※ Optically, blur or smudge is defined as, for instance, luminous point with elongating edge profile in normal distribution, half-width deviating largely from normal distribution, or objects with irregular profiles which are not smooth.



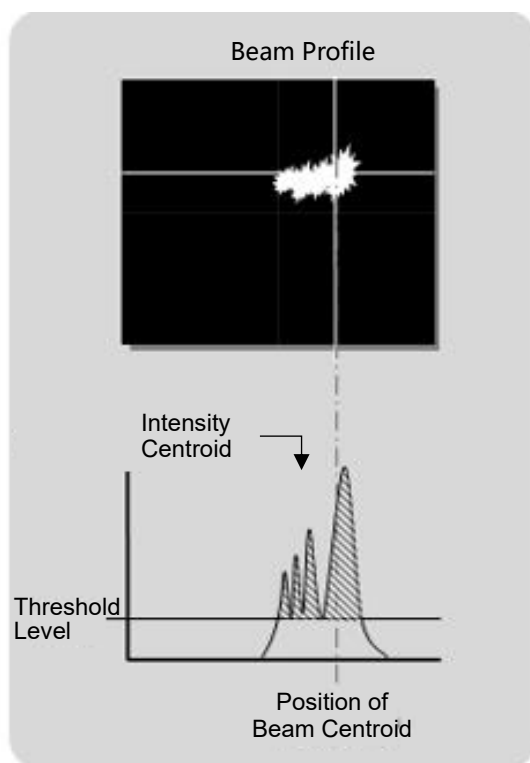
Intensity Centroid

For the center position of the intensity is calculated from pixels with intensity higher than the noise reduction threshold and displayed as an angle.

Lowering the threshold allows obtaining the center surrounding area of blurred or smeared light spots.

We recommend measuring targets which exhibit blurring or smearing in the light spot due to reflections from surfaces that are not uniform, such as resin surfaces.

Detection Example



Recommended Target



Concave Lens

3.2.1.4 Beam Ellipticity

Beam Ellipticity determines how far the light beam shape is deformed from circular to elliptical.

Beam Ellipticity Equation:

$$\text{Beam Ellipticity} = m \text{ (minor) beam diameter} / M \text{ (major) beam diameter}^{*1}$$

The following describes its use.

**1 The beam diameter can be selected as $D4\sigma$ or $1/e^2$.*

See the separate software manual, *the "Suruga OptGauge User's Manual"* for details.

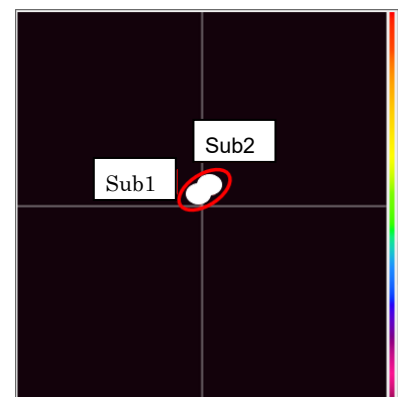
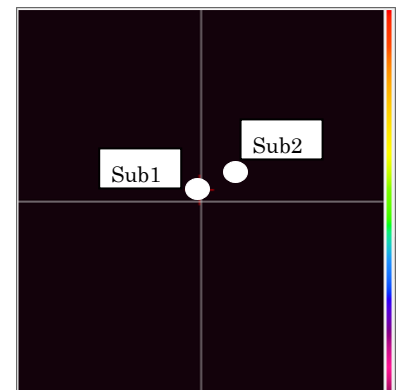
Beam Ellipticity Usage

You may select it to measure the parallelism of two or more measured targets.

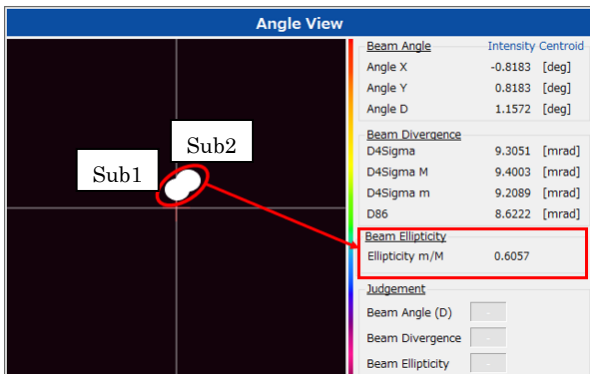
1. The beam spots of "Sub 1" and "Sub 2" shown in the right are incident lights on the sensor head, and the angles of each can be measured.

We move the two beam spots close to each other so that the Sub1 and Sub2 are nearly parallel.

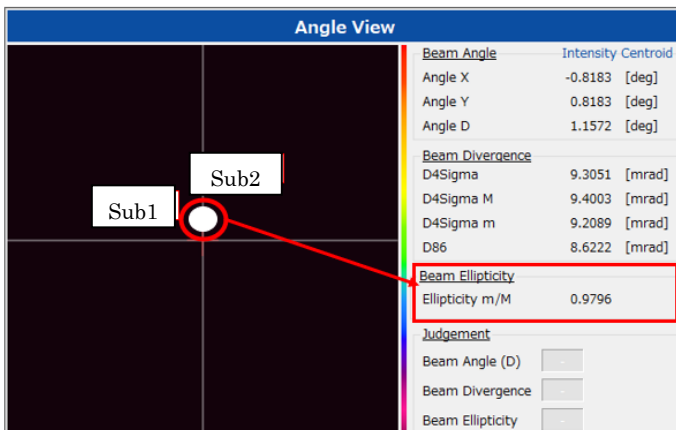
2. As the two light spots are getting closer like in the illustrated frame, the sensor recognizes them as a single elliptical light spot.



3. When No.2 above occurs, conduct No. 4 while confirming the beam ellipticity figures.



4. Move the two beams even closer together. Closer the ellipticity to "1.000" and the two targets are nearer to parallel.

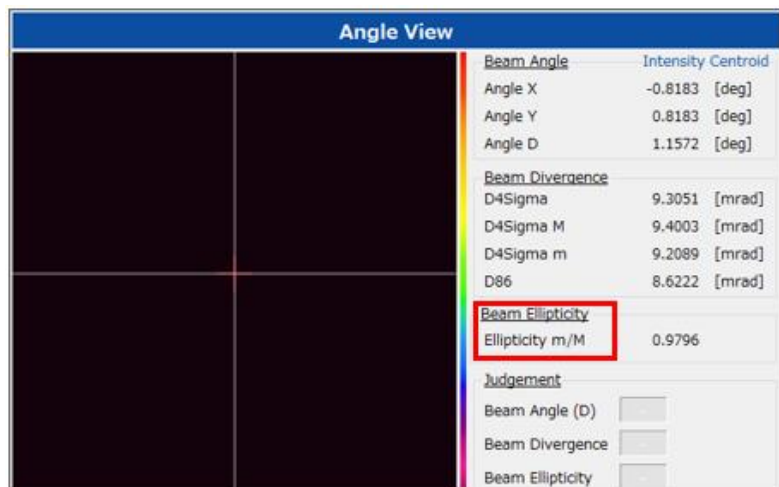


For Ellipticity Measurement

Check the box, " Enabled" in Orientation option setting.

Orientation

☒ Enabled



3.2.1.5 Rotation Angle

This feature measures the rotation angle of the elliptical beam based on images captured by the camera and displays it on the screen.

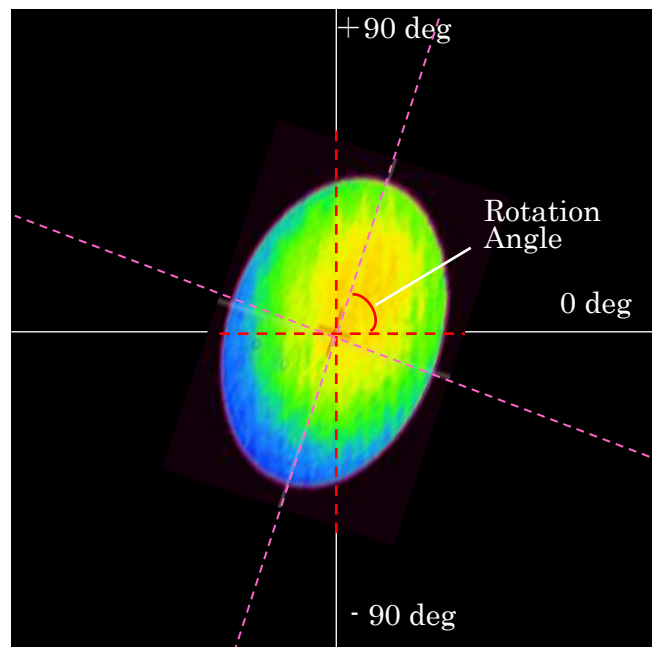
Rotation angle measurement is only available when the “Orientation” option setting is enabled.

Definition of Rotation Angle

It is defined as the angle between the beam's principal axis in the rightward direction and the horizontal rightward direction.

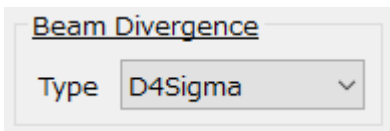
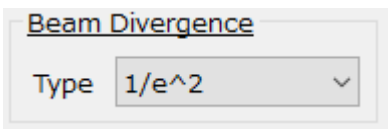
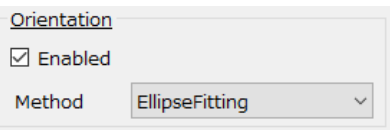
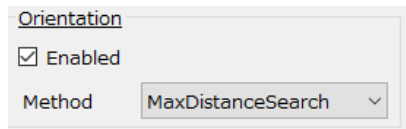
A positive (+) value is assigned when the principal axis points upward relative to the horizontal direction, and a negative (-) value when it points downward.

The beam's major axis and minor axis are considered mutually perpendicular, and the rotation angle is expressed within the range of $\pm 90^\circ$.



Measurement Methods

There are two types of measurement methods for the rotational angle.

Rotational Angle Measurement Compliant with ISO standards	
<p>Select [D4 Signal] for the “Beam Divergence” in the Option settings as below.</p> 	<p>Only if [D4 Sigma] is selected, Will the rotation angle be measured in accordance with ISO 11146-2.</p>
Rotational Angle Measurement NOT Compliant with ISO standards	
<p>Select [1/e^2] for the “Beam Divergence” in the Option setting as below.</p> 	<p>Only if [1/e^2] is selected, will the following two non-ISO-compliant rotation angles be measured.*1</p>
	<p>[Ellipse Fitting]</p>  <p>This method performs elliptical fitting on the beam region exceeding 13.5% of its peak value and calculates a rotational angle as the inclination of the major axis of the resulting ellipse.</p> <p>Advantage</p> <p>It obtains a high-precision rotational angle if a shape is close to an ideal ellipse, as it considers an overall beam shape.</p>
	<p>[Maximum Distance of Two Points Search Method]</p>  <p>For beam regions exceeding 13.5% of its peak value, the main axis is defined as the straight line passing through the centroid that maximizes the distance between two points where it intersects the beam boundary. The rotation angle is calculated based on the slope of the main axis.</p> <p>Advantage</p> <p>Although the beam shape contains distortion or noise, it easily obtains a stable rotation angle with minimal variation in the direction of the main axis.</p>

*1 When the beam spot is small (about 3x3 pixels or less), the error increases due to reduced pixel resolution.

3.2.1.6 Judgement

The judgement function is available in intuitively understandable expression of whether the measurement value is within the target range.

Here, as examples, we have the procedures for Angle (D) and Peak.

Angle View	
	Beam Angle Intensity Centroid
	Angle X -0.8183 [deg] Angle Y 0.8183 [deg] Angle D 1.1572 [deg]
	Beam Divergence
	D4Sigma 9.2701 [mrad] D4Sigma M 9.3874 [mrad] D4Sigma m 9.1513 [mrad] D86 8.5790 [mrad]
	Beam Ellipticity
	Ellipticity m/M 0.9748
Judgement	
Beam Angle (D) OK	
Beam Divergence 	
Beam Ellipticity 	

Angle View	
	Beam Angle Intensity Centroid
	Angle X -0.8183 [deg] Angle Y 0.8183 [deg] Angle D 1.1572 [deg]
	Beam Divergence
	D4Sigma 9.2417 [mrad] D4Sigma M 9.2906 [mrad] D4Sigma m 9.1925 [mrad] D86 8.5695 [mrad]
	Beam Ellipticity
	Ellipticity m/M 0.9894
Judgement	
Beam Angle (D) NG	
Beam Divergence 	
Beam Ellipticity 	

Selecting the Angle (D)

1. Adjusting the angle and aim to set the "Angle(D)" of the measurement result to less than 0.5000. Enabling the "Angle(D)" in the "Judgement Settings" in the Option setting and enter the value to be "0.5000 deg".

Suruga OptGauge - H651VL-1350R2-30-200A - H651-TEST Ver.1.3.3 64bit Options - Debug

Angle Profile Communication

Measurement Display LD Control

Camera Settings

Exposure Time 1.000 [ms]

Frame Rate 40.000 [fps]

Rotation 0 [deg]

Mirroring ☐ Horizontal ☐ Vertical

☐ Trigger Mode

Origin Offset

X 0.0000 [deg]

Y 0.0000 [deg]

Zero Set

Judgement

☒ Angle (D) 0.0000 [deg]

☐ Divergence 0.0000 [mrad]

Radius Type D4Sigma

☐ Ellipticity 0.0000 [-]

☒ Peak 4094.0 [cnts]

Log File

Full Color PNG

Cross Section

Point Origin Cursor

Moving Average

☐ Averaging 2 [-]

Auto Aperture

Method Intensity

☒ Enabled

ROI

☒ Enabled

X -520 [pix]

Y 520 [pix]

Width 1040 [pix]

Height 1040 [pix]

Angle Type

Type Tilt Angle

Denoising

☒ Threshold 100

Beam Centroid

Method Intensity

Orientation

☐ Enabled

Angle Unit

Degree

Multi Spot

Order Area

Spot Count 1 [-]

Min Spot Area 1 [pix]

Binning

☐ Enabled

Adaptive Cal

☐ Visible

Beam Divergence

Type D4Sigma

Options Select

Save Cancel

2. As a result of adjusting the angle, the result of Angle D on the measurement screen is not less than 0.5000 deg (1), so the judgment result is "NG" (2) at the "Tilt Angle(D)" of the "Judgement".



3. As a result of adjusting the angle one more time, the result of Angle D on the measurement screen is less than 0.5000 deg (1), so the judgment result of "Tilt Angle(D)" in "Judgement" is displayed as OK (2).



Selecting the Peak

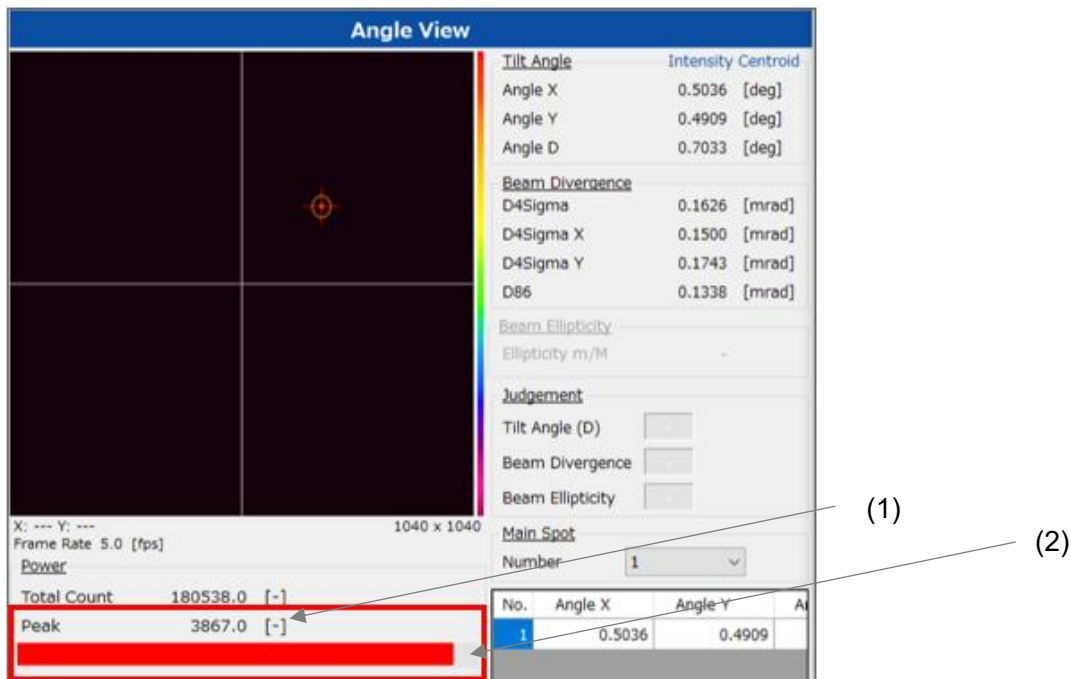
1. Adjusting the light intensity and set the “Peak” of the measurement result to be less than 3500. Set “Peak” to “Enable” in the “Judgement Settings” option and set it to “3500.0”.

The screenshot shows the Sunuga OptGauge software interface with the 'Judgement' tab selected. The 'Peak' checkbox is checked and highlighted with a red box, with a value of 4094.0 [cnts] next to it. Other settings visible include:

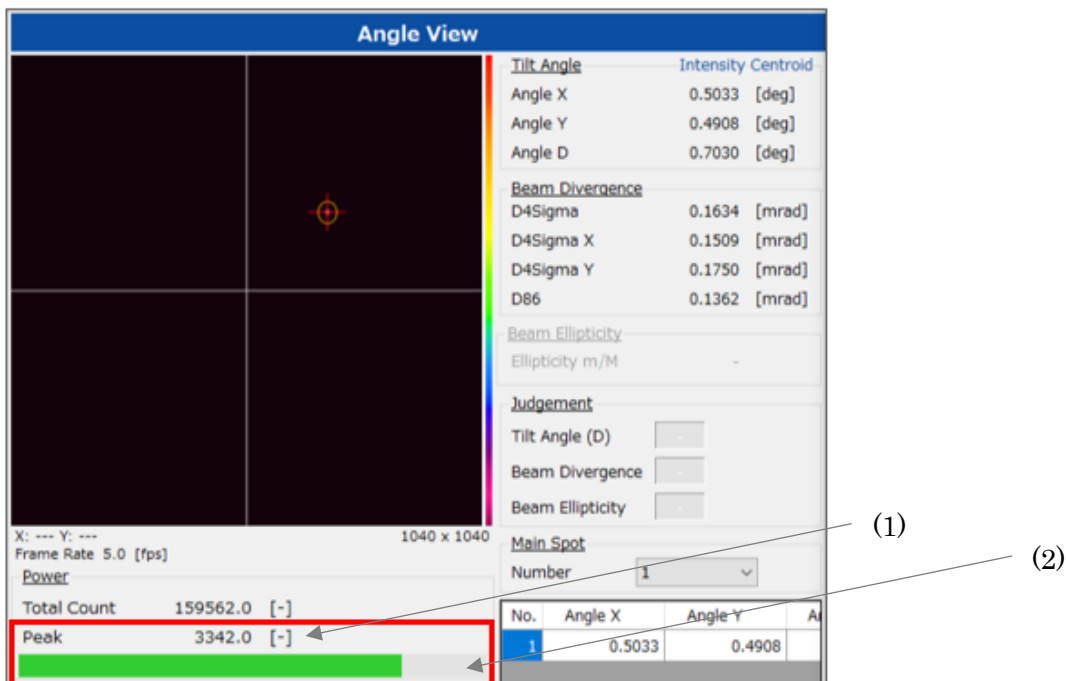
- Camera Settings:** Exposure Time 1.000 [ms], Frame Rate 40.000 [fps], Rotation 0 [deg], Mirroring (Horizontal/Vertical), Trigger Mode.
- Origin Offset:** X 0.0000 [deg], Y 0.0000 [deg], Zero Set button.
- Judgement:** Angle (D) 0.0000 [deg], Divergence 0.0000 [mrad], Radius Type D4Sigma, Ellipticity 0.0000 [-], **Peak** 4094.0 [cnts] (checked and highlighted).
- Log File:** Image/Raw checkboxes, Full Color/PNG dropdown.
- Cross Section:** Point Origin Cursor, Moving Average Averaging 2 [-].
- Auto Aperture:** Method Intensity, Enabled checkbox, ROI X -520 [pix], Y 520 [pix], Width 1040 [pix], Height 1040 [pix].
- Angle Type:** Type Tilt Angle.
- Denosing:** Threshold 100.
- Beam Centroid:** Method Intensity.
- Orientation:** Enabled checkbox, Angle Unit Degree.
- Multi Spot:** Order Area, Spot Count 1 [-], Min Spot Area 1 [pix].
- Binning:** Enabled checkbox.
- Adaptive Cal:** Visible checkbox.
- Beam Divergence:** Type D4Sigma.

Buttons at the bottom include Options Select, Save, and Cancel.

2. As result of adjusting the light intensity, the Peak value on the measurement goes below 3500.0 (shown as 1), so the judgement takes N.G., and the Peak display bar turns red (shown as 2)



3. As result of re-adjusting the light intensity, the Peak value on the measurement exceeds 3500.0 (shown as 1), so the judgement takes O.K., and the Peak display bar turns green (shown as 2)

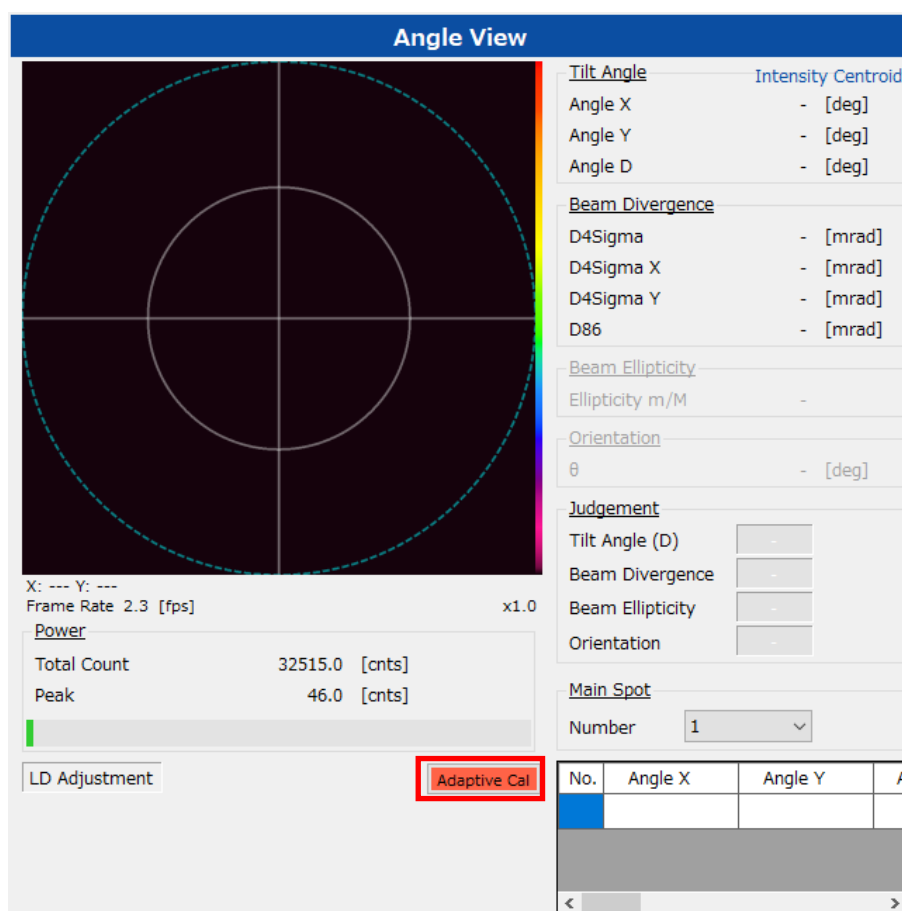


3.2.1.7 Adaptive Cal

The "Adaptive Cal" is a function that improves beam calculation accuracy by removing noise from the entire sensor. This function is an automatic denoising function that calculates the baseline correction value from the entire sensor and offsets it from the pixel data of each pixel.

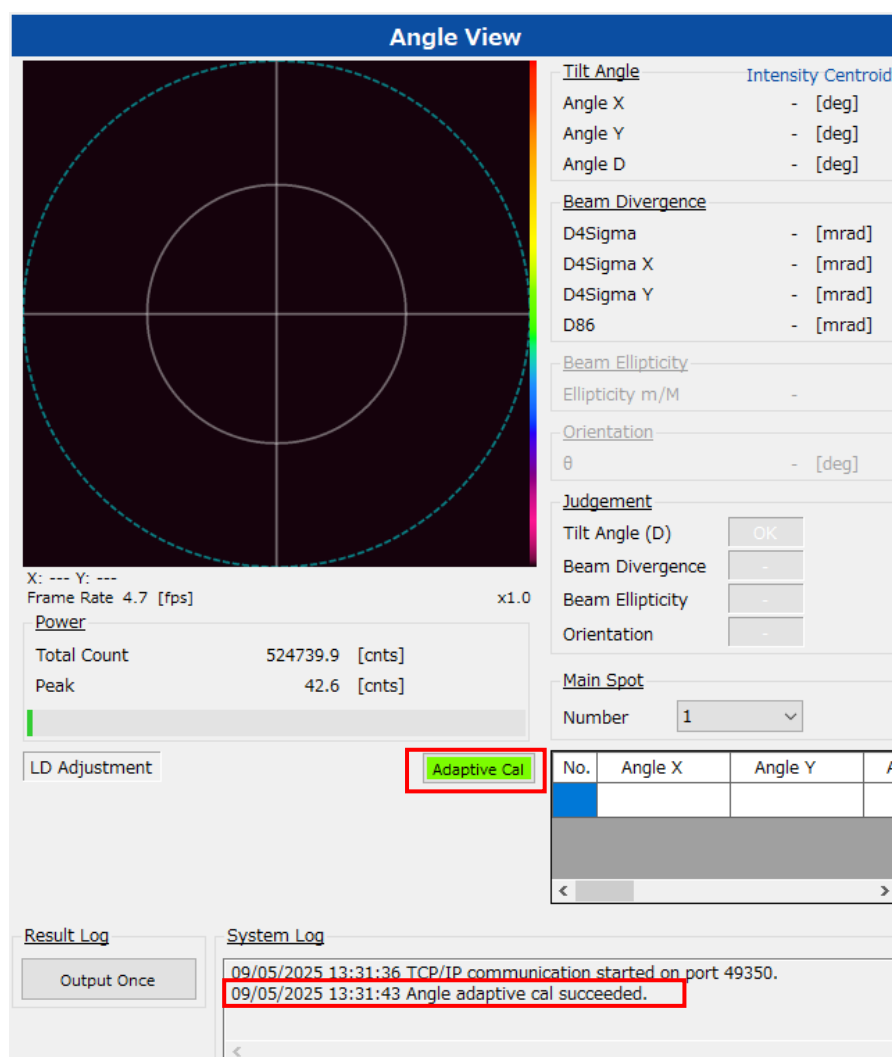
This function must be executed when starting up the software and every time the exposure time in the camera settings is changed

1. Prevent the beam to enter into the Sensor Head.
2. Enable the Adaptive Cal by clicking [Adaptive Cal] in the option settings.



3. When Adaptive Cal is executed, the button color will change.
4. Completion is indicated when 'Angle adaptive cal succeeded.' appears in the System Log.
5. Thereafter, direct the beam into the Product and commence measurement.

*1 For details of optional features, refer to the separate software manual, *the "Suruga OptGauge User's Manual"*.



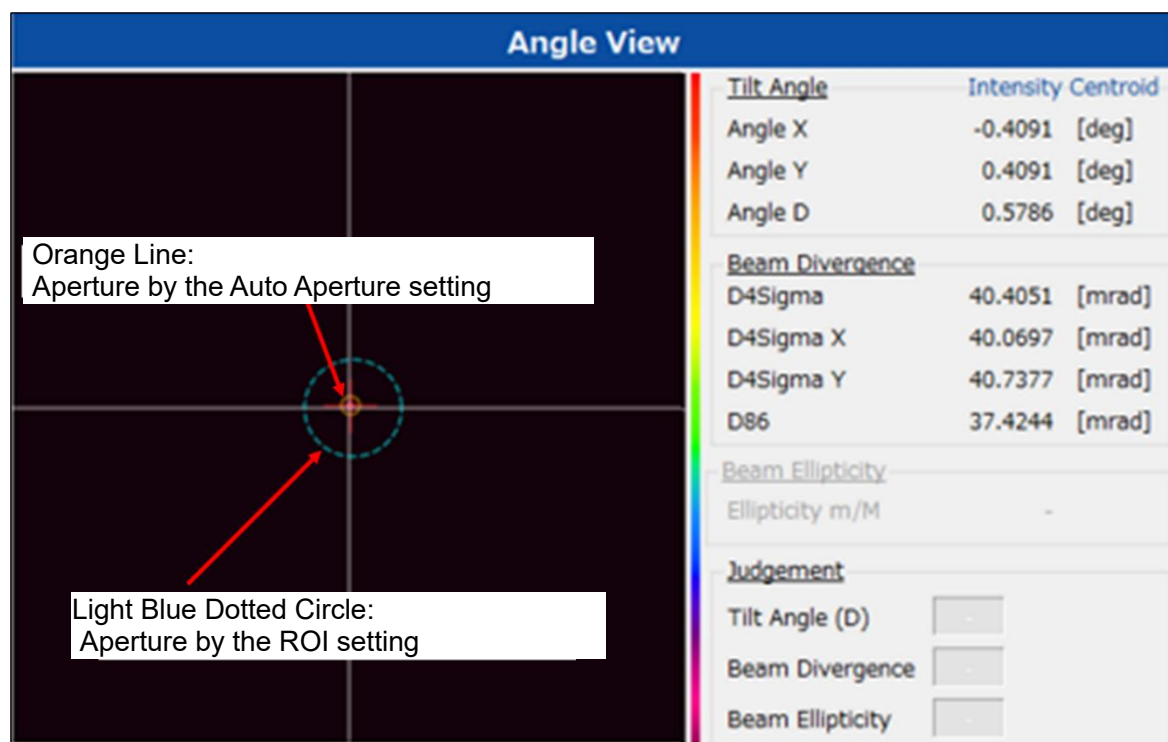
Attention

If the beam light enters into the Product or ambient light is causing serious noise, the adaptive calibration will not be succeeded. Please conduct it in an environment where lights interfere with the sensor camera. It is also notable to disable the denoising function for this purpose.

3.2.1.8 Aperture

The “Auto Aperture” and “ROI” settings are available for measuring a light beam divergence to eliminate the effects of noise such as ambient lights.

By using these two functions, measurement reducing ambient lights can be achieved.



Aperture Explains

Auto Aperture	This function is suitable for measuring a dynamic beam light in which the position, size, shape or intensity of the beam may changes over time. It automatically adjusts the Aperture.
ROI	This function is suitable for measuring a beam in which position, size, shape or intensity rarely changes over time. The Aperture must be adjusted manually.

Info

Using Auto Aperture and ROI simultaneously allows you to emphasize only the critical aspects of beam intensity, shape, and position, thereby minimizing the impact of noise and interference.

As results, the measurement improves the accuracy.

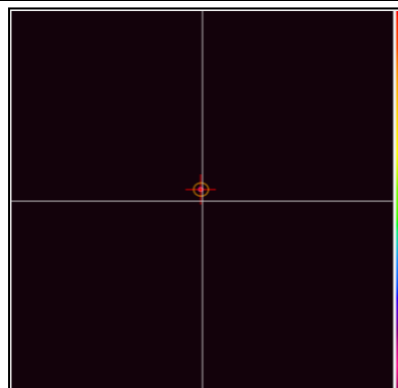
If the beam position remains unchanged, we recommend using both simultaneously.

Setting Methods

Setting Auto Aperture

Check the "Enabled" in the Auto Aperture option setting.

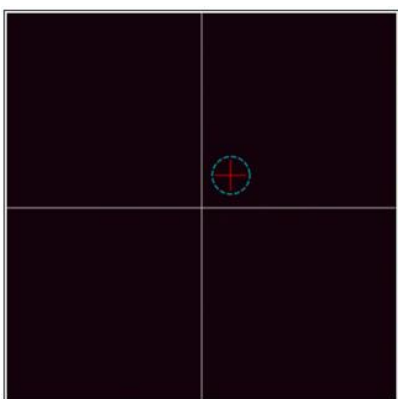
Auto Aperture
<input checked="" type="checkbox"/> Enabled



Setting ROI

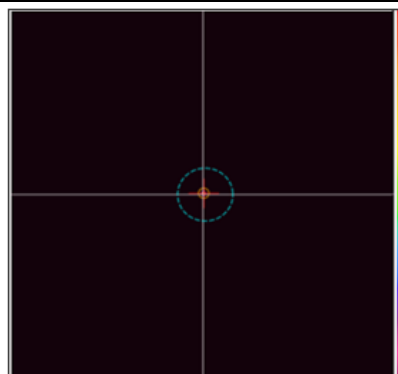
Enable "ROI" in the "ROI" option settings and set the X, position, width, Height (size) to enclose the beam.

ROI	
<input checked="" type="checkbox"/> Enabled	
X	<input type="text" value="28"/> [pix]
Y	<input type="text" value="137"/> [pix]
Width	<input type="text" value="100"/> [pix]
Height	<input type="text" value="100"/> [pix]



Setting Auto Aperture and ROI

To enclose the light beam, set "Auto Aperture" and "ROI" to enable in the option settings, and set the X and Y (location), Width and Height (size) of the "ROI".



3.2.1.9 Origin Offset

The Origin Offset function shifts the center position of the sensor camera center from the default position to any position as desired.

By using the offset function, an arbitrary position can be aligned as a reference position.

There are three offset methods as below.

Setting Methods

Setting from the Option Screen

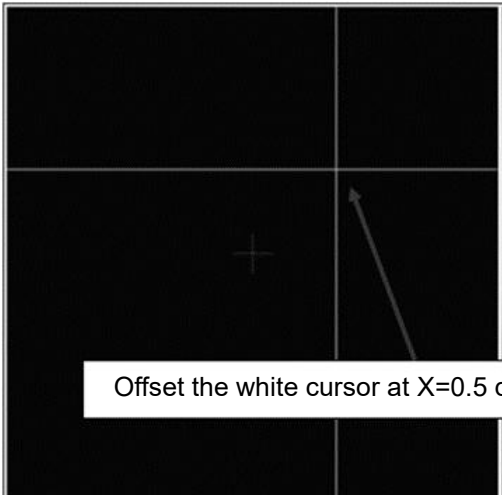
Set "Origin Offset" option settings to the desired values.

Origin Offset

X [deg]

Y [deg]

Ex.: Set at X = 0.5deg, Y = 0.5deg



Tilt Angle		Intensity Centroid
Angle X	-0.5008	[deg]
Angle Y	-0.5004	[deg]
Angle D	0.7080	[deg]

Beam Divergence	
D4Sigma	13.8399 [mrad]
D4Sigma X	13.7931 [mrad]
D4Sigma Y	13.8865 [mrad]
D86	12.8666 [mrad]

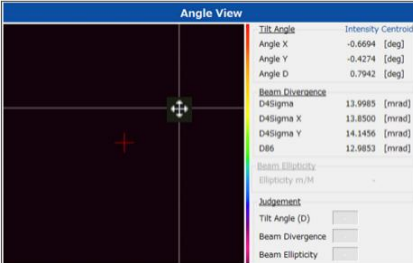
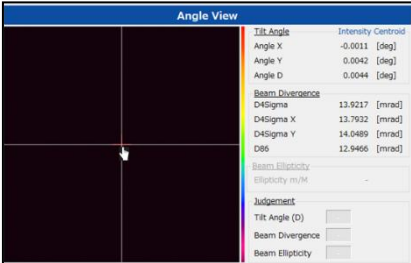
Beam Ellipticity	
Ellipticity m/M	-

Beam Divergence

Beam Ellipticity

Setting from the View Screen

1. Open the option setting screen.
2. Target the view screen cross (white) with cursor.
3. When the mouse icon changes, perform "drag and drop."



Tilt Angle		Intensity Centroid
Angle X	-0.6694	[deg]
Angle Y	-0.4274	[deg]
Angle D	0.7942	[deg]

Beam Divergence	
D4Sigma	13.9985 [mrad]
D4Sigma X	13.8500 [mrad]
D4Sigma Y	14.1456 [mrad]
D86	12.9853 [mrad]

Beam Ellipticity	
Ellipticity m/M	-

Judgement

Tilt Angle (D)

Beam Divergence

Beam Ellipticity

4. Once changing "Origin Offset", save the Option settings.

Origin Offset

X [deg]

Y [deg]

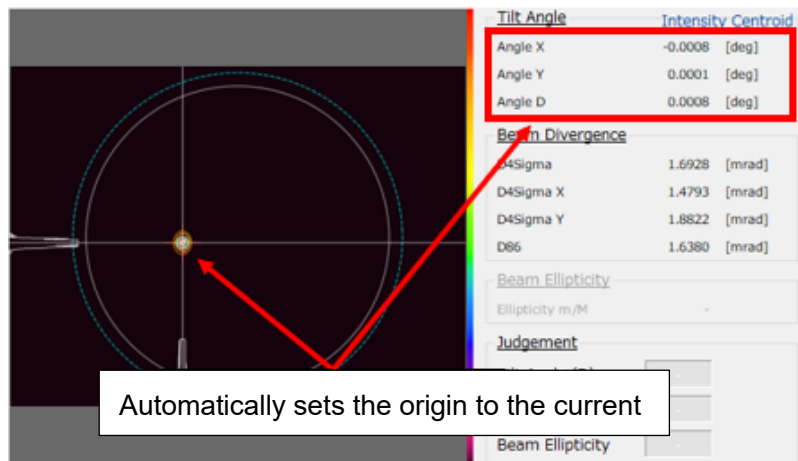
Setting from the Zero Set Button

Click the “Zero Set” in the Origin Offset option settings.

Origin Offset

X	0.0000	[deg]
Y	0.0000	[deg]
Zero Set		

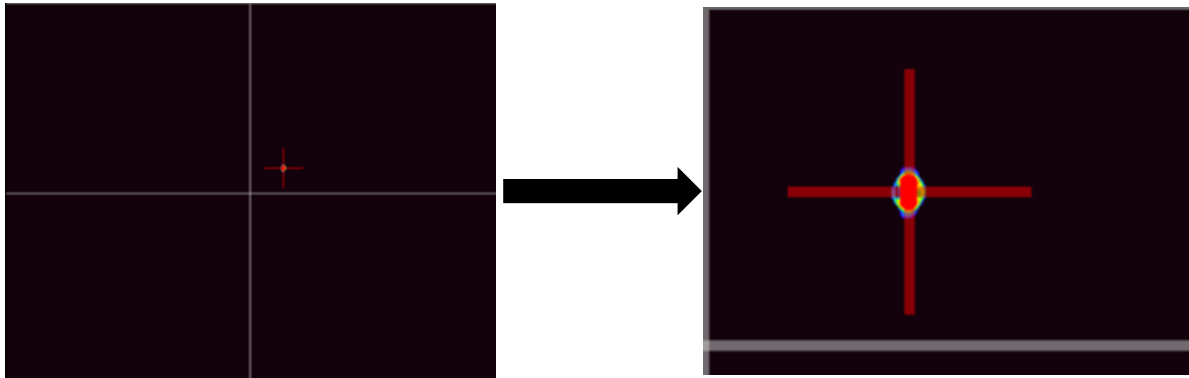
*The values of the Origin Offset X and the Origin Offset Y will be automatically set to the current measurement coordinates.



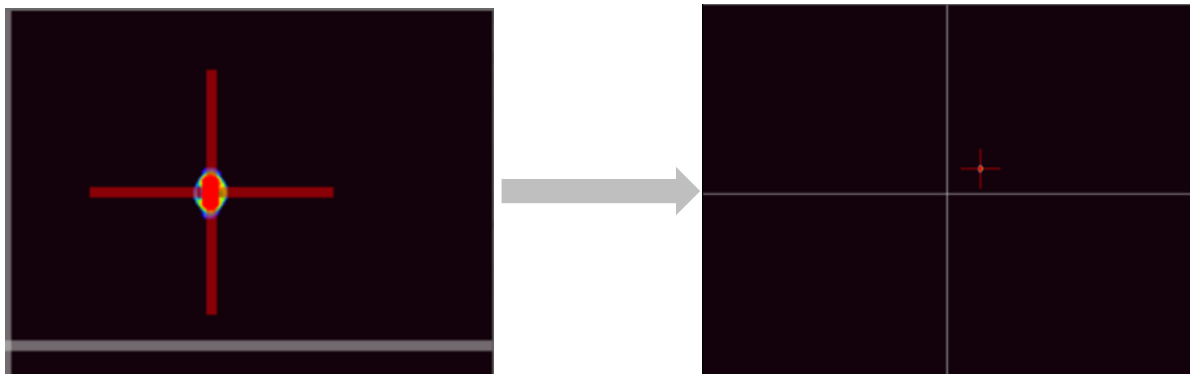
3.2.1.10 Zoom In

The Zoom function is available for observation of the light beam status on the View screen.

1. To zoom in, hold down the Ctrl key and scroll the mouse wheel forward (upward) on the View screen.
2. You can adjust the display position by dragging the mouse.



3. To zoom out, hold down the Ctrl key and scroll the mouse wheel backward (downward) on the View screen. You can continue the Zooming Out until the display to its original size.



4. To exit the zoom mode, right-click on the mouse in the View screen.

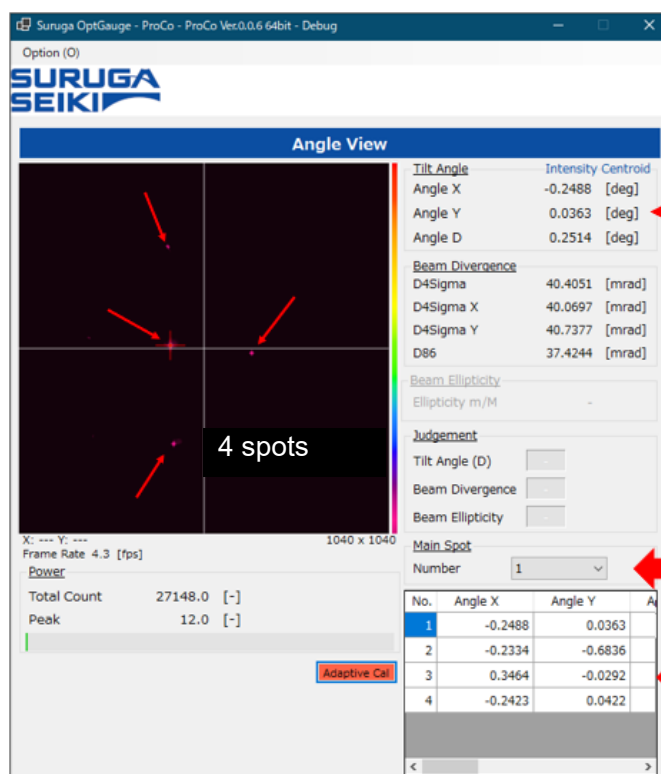
3.2.1.11 Multi Spot

The Products support multi-spot measurement of up to 100 spots simultaneously.

The use of the Multi Spot setting enables the measurement results screen display order and number to be set.

Detection conditions can also be set to filter measurement targets.

Ex. Explaining the screen for detection of multiple beams (4 spots)



By changing "Number", the corresponding Number (No.) in the list below can be displayed in the Title Angle at the top.

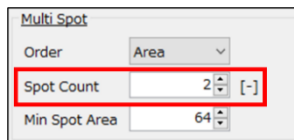
Displays the measurement results of 4 spots on the measurement results screen.

The list is automatically updated with the number of detected beams.

Setting Method

To Enter the Number of Measuring Spots to Display

Changing the "Spot Count"
in the Multi Spot option
settings.



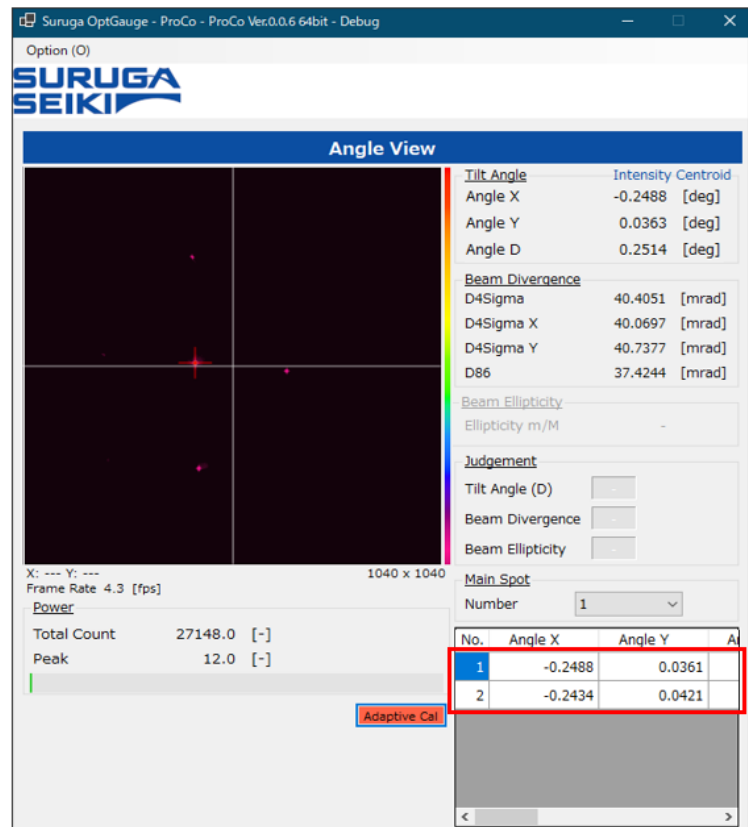
Multi Spot

Order: Area

Spot Count: 2 [-]

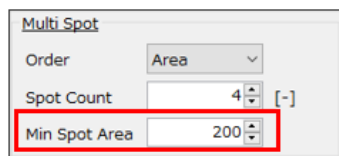
Min Spot Area: 64

By changing the "Spot Count", you can specify the number of spots displayed on the measurement results screen.



To Enter the Conditions (size) of the Beams to Detect for the Measurement Targets

Changing the "Min Spot Area" in option settings.



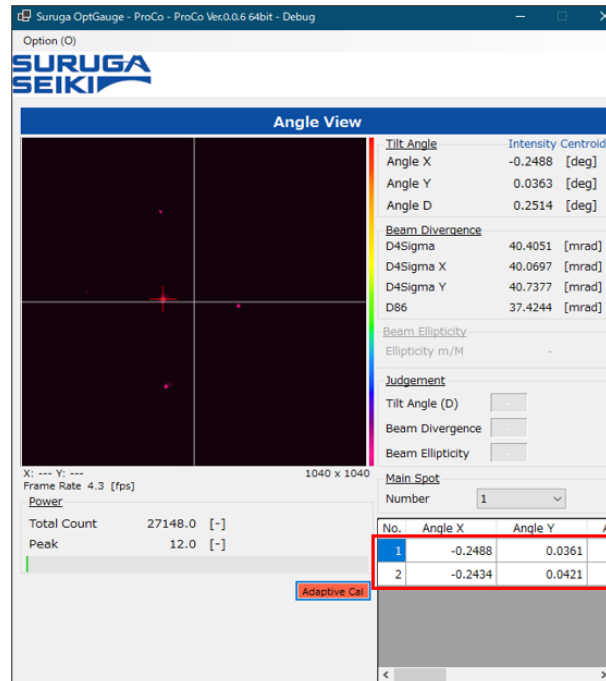
Multi Spot

Order: Area

Spot Count: 4 [-]

Min Spot Area: 200

By changing the 'Min Spot Area', you can specify the conditions for the beam to be detected as the measurement target.



Info

The beam condition (size) should be considered as the set value in terms of area (pixels).

In the example setting, the sensor camera will detect the spots as measuring targets if the area of spot is over 200 pixels.

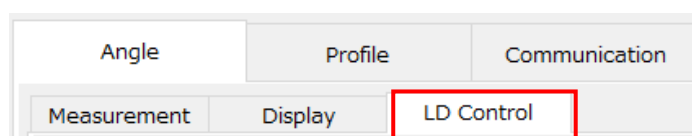
3.2.1.12 Automatic Brightness Control

The “Automatic Brightness” function is available for the Products to adjust the peak brightness of the light beam to a specified value by automatically regulating the exposure time and the LD output power. Note that if the reflectance of the target is unknown, be advised to enter 100 as the default value for the ‘Reflectivity’ in the ‘LD Adjustment’ group.

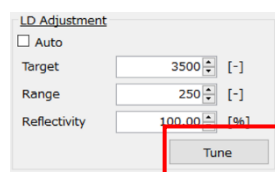
● One-time execution of the Automatic Brightness control

The following procedure describes how to manually execute the Automatic Brightness control at your desired moment.

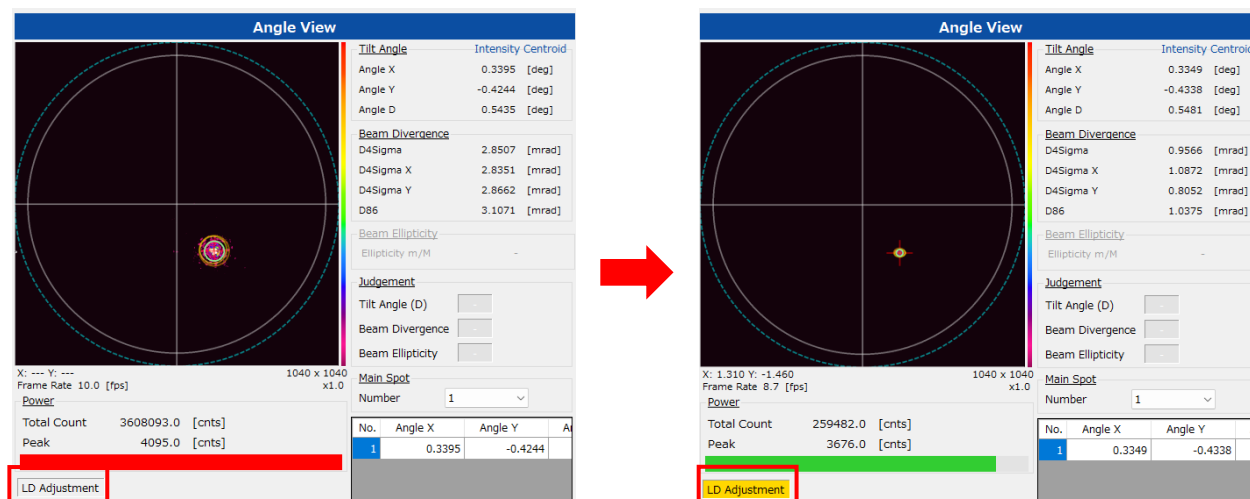
1. Open the Options window and select the LD Control tab.



2. Click the Tune button in the LD Adjustment group.



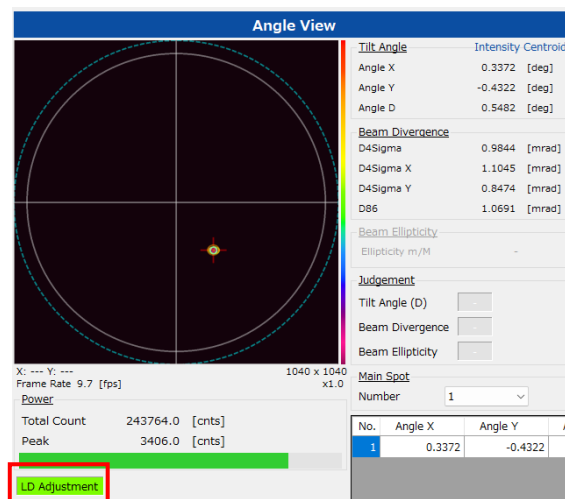
3. The Automatic Brightness control starts.



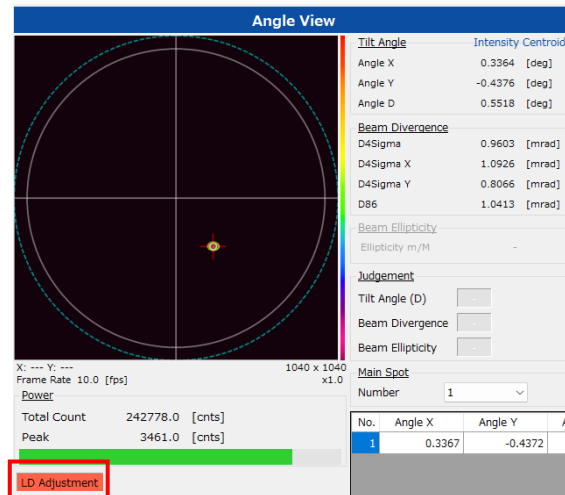
* The LD Adjustment section on the main screen will be grayed out if Automatic Brightness control has not yet been executed.

* When Automatic Brightness control starts, the LD Adjustment section will be displayed in yellow, indicating that the adjustment is in progress.

4. Automatic Brightness control completes.



After the adjustment successfully completes, the LD Adjustment section turns to green indicating the successful completion.



*If the adjustment fails, the LD Adjustment section turns red indicating the failure.

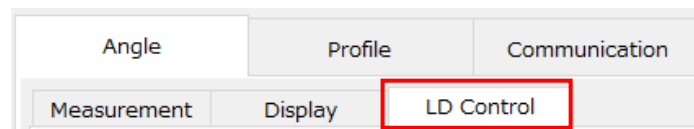
● Continuous Automatic Brightness Control

When the beam spot moves due to angle or displacement, the brightness may increase or decrease.

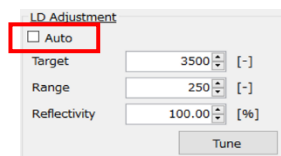
To retain the brightness at a specified value even when the beam spot moves, perform the Continuous Automatic Brightness to keep it at the desired level.

To perform the method of the constant automatic brightness is shown below.

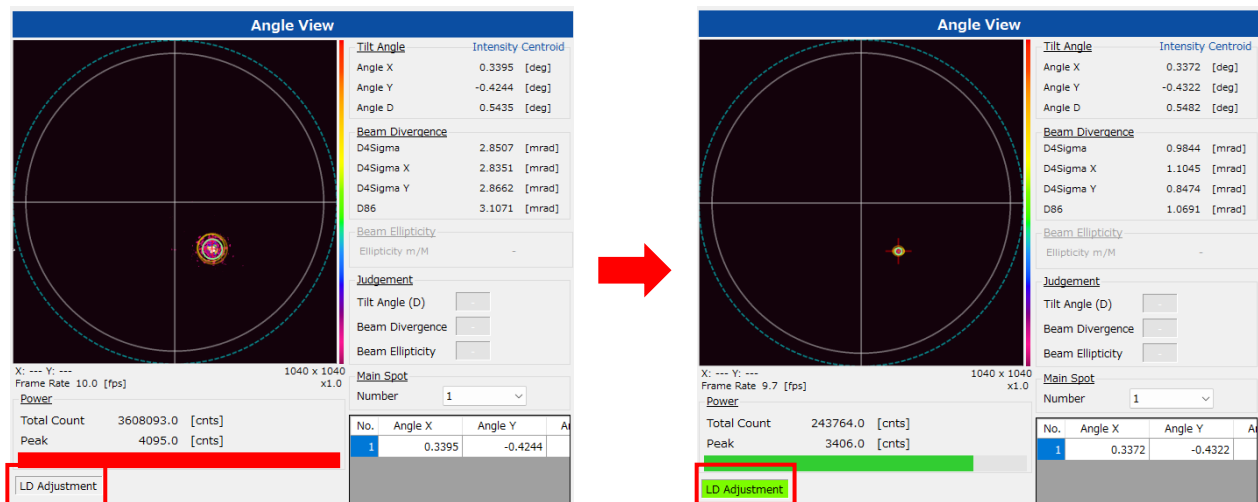
1. Open the Options window and display the LD Control tab.



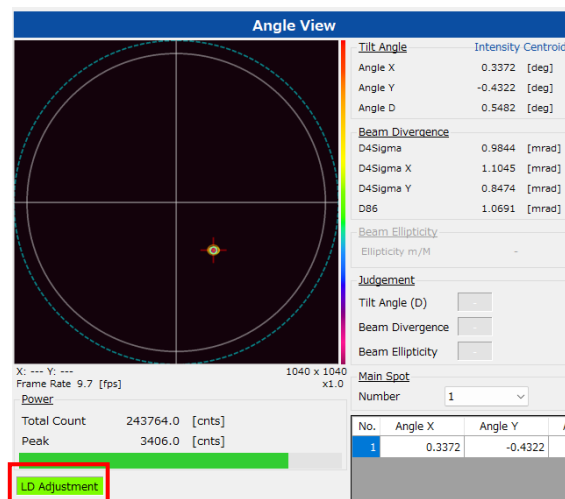
2. Click the Auto checkbox in the LD Adjustment group.



3. The Automatic Brightness control starts.



4. The Automatic Brightness control completes.

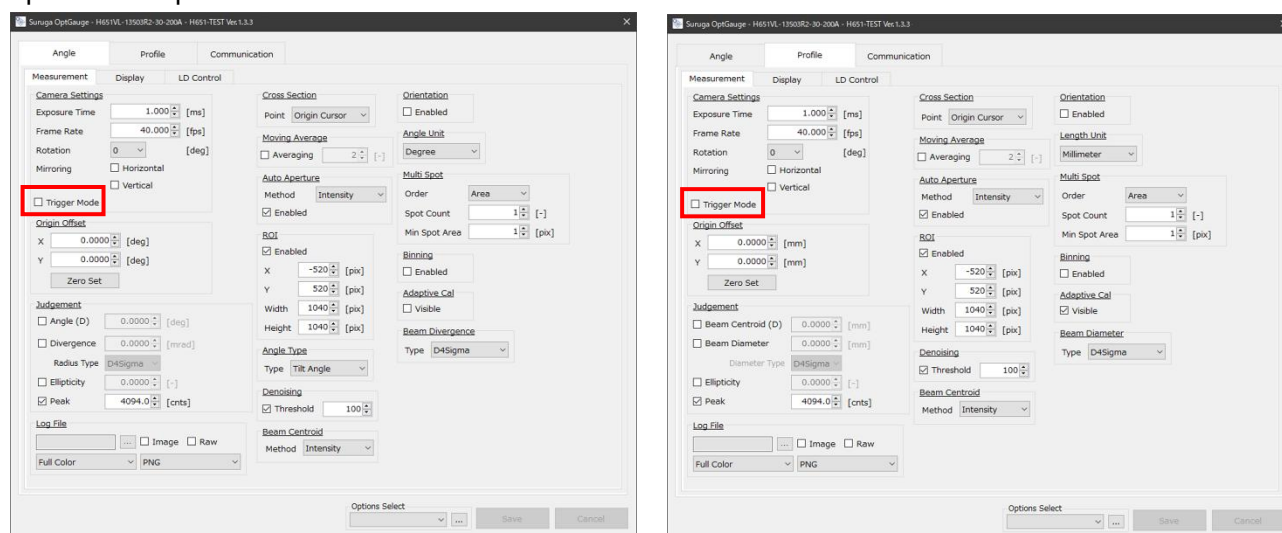


Thereafter, the Automatic Brightness adjustment will be executed when the measured brightness value falls outside the range specified in the "Range" option, using the brightness value of the "Target" option within the LD Adjustment group as the reference.

3.2.1.13 External Trigger Mode

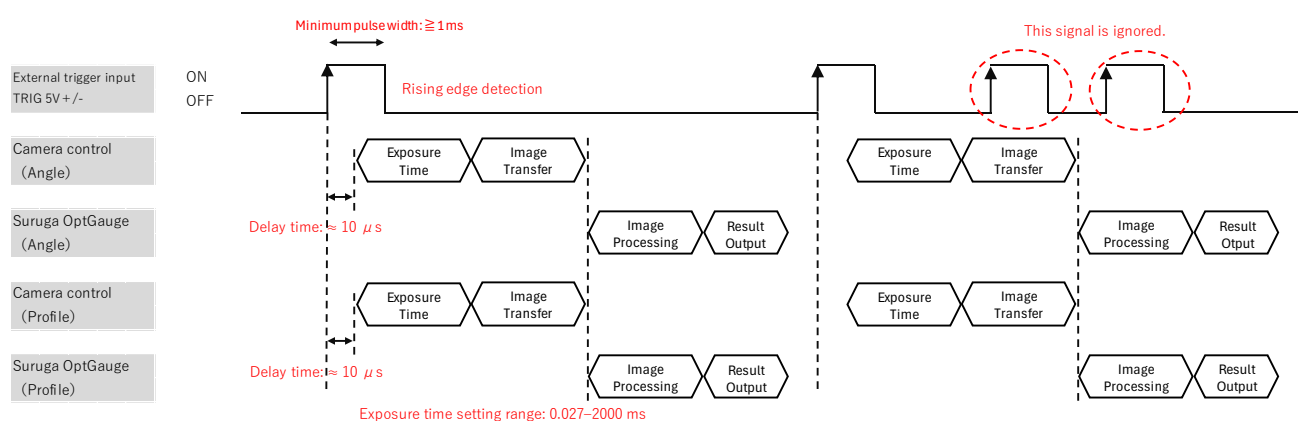
The external trigger function is available for the Products, allowing measurements to be performed in response to trigger signals (pulse input) from external devices. By using this function, measurement timing can be controlled on the user's system side.

To enable the external trigger, please activate the Trigger Mode option for Angle and the Trigger Mode option for Displacement.



It detects the rising edge (OFF→ON) of an external trigger input, acquires an image, and outputs the measurement results.

When triggering consecutively, ensure an interval of at least one frame is maintained to prevent measurement timing from overlapping.



3.2.2 Profile View

3.2.2.1 Beam Centroid

It determines the beam centroid.

It indicates the distance between the center of an incident beam and the coordinate origin.

The method for determining the center of the light spot can be selected from the Area Centroid or the Intensity Centroid via the Beam Centroid option settings. We recommend configuring the 'Beam Centroid' settings depending on the target.

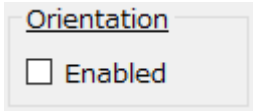
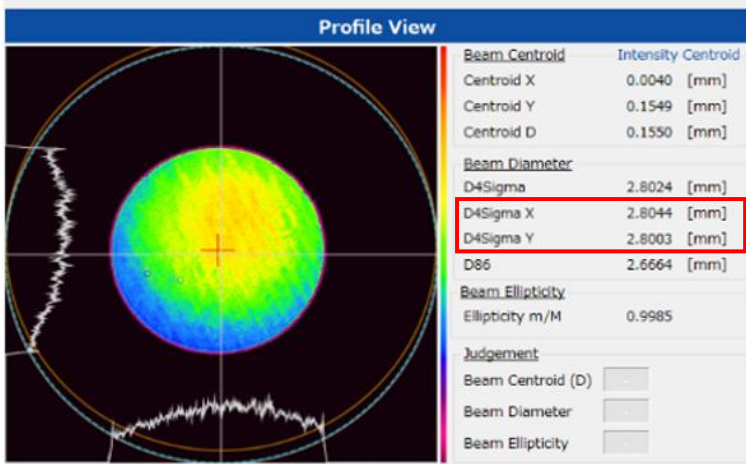
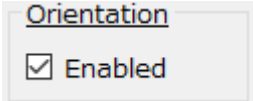
For details on Area Centroid and Intensity Centroid, refer to the "[Beam Centroid](#)" in the Angle View.

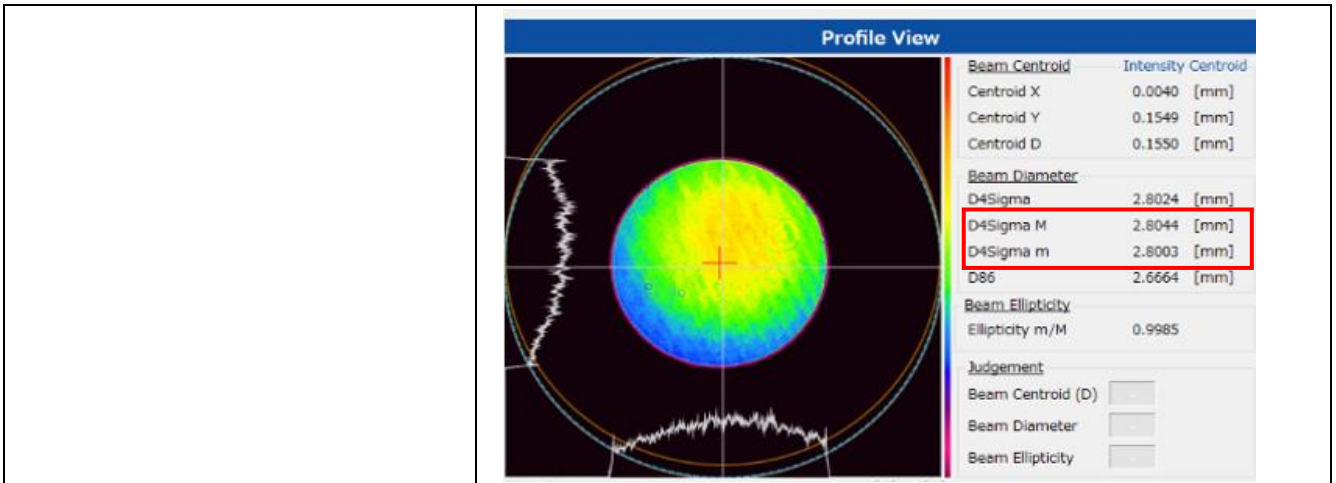
3.2.2.2 Beam Diameter

It is available for measuring the beam diameter.

It is the size measurement of an incident beam to the Profile sensor in the unit of "mm" or " μm ".

The measurement consists of two modes.

To Measure the Beam Widths in X-axis and Y-axis Directions at D4 σ Beam Diameter* ¹ (elliptical beam)	
Uncheck the "Enabled" in the "Orientation" option setting. 	To measure the beam diameter by "D4Sigma X" and "D4Sigma Y" 
To Measure the Beam Widths in the M (major axis) and m (minor axis) at the D4 σ Beam Diameter (elliptical beam)* ¹	
Check the "Enabled" in "Orientation" option setting. 	To measure the beam diameter By "D4Sigma M" and "D4Sigma m"



*1 the methods measuring the beam diameter can be selected either the $D4\sigma$ or the $1/e^2$.

See the separate software manual, the "Suruga OptGauge User's Manual" for details.

3.2.2.3 Beam Ellipticity

The Beam Ellipticity (hereafter referred to as "Ellipticity") indicates how much the beam shape is biased from circular to elliptical.

To Measure Ellipticity

Check "Enabled" in the "Orientation" option setting.

Orientation

☒ Enabled

Beam Centroid		Intensity Centroid	
Centroid X	0.0040	[mm]	
Centroid Y	0.1549	[mm]	
Centroid D	0.1550	[mm]	

Beam Diameter	
D4Sigma	2.8024 [mm]
D4Sigma M	2.8044 [mm]
D4Sigma m	2.8003 [mm]
D86	2.6664 [mm]

Beam Ellipticity	
Ellipticity m/M	0.9985

Judgement	
Beam Centroid (D)	<input type="checkbox"/>
Beam Diameter	<input type="checkbox"/>
Beam Ellipticity	<input type="checkbox"/>

3.2.2.4 Rotation Angle Measurement

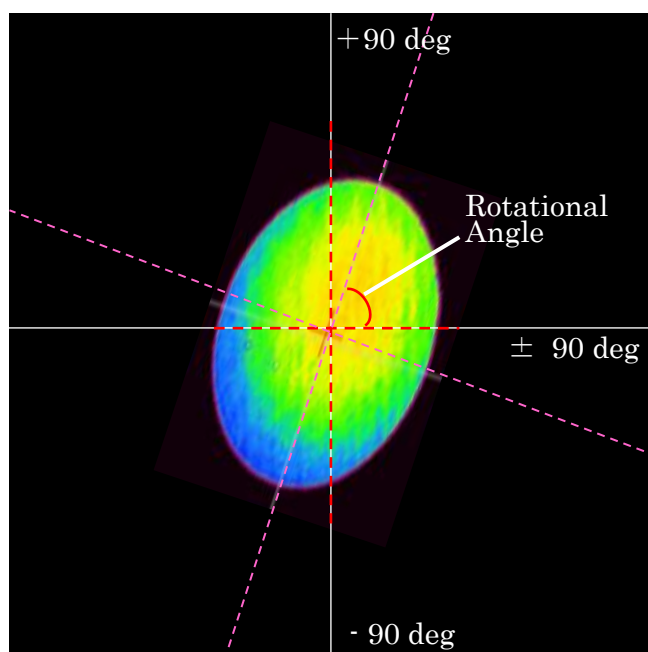
This function measures the rotation angle of an elliptical beam based on an image captured by the camera and displays it on the screen.

The Rotation angle measurement is only available if the "Orientation" option setting is enabled.

The Definition of Rotation Angle

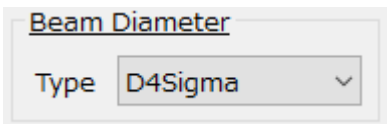
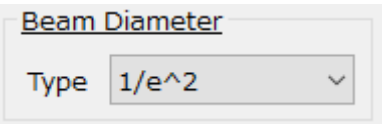
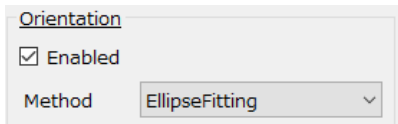
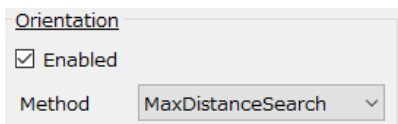
It is defined as the angle between the beam's principal axis in the rightward direction and the horizontal rightward direction. A positive (+) value is assigned when the principal axis lies above the horizontal plane, and a negative (-) value when it lies below.

The beam's major and minor axes are assumed to be mutually perpendicular, and the rotation angle is expressed within the range of $\pm 90^\circ$. downward. The beam's major axis and minor axis are considered mutually perpendicular, and the rotation angle is expressed within the range of $\pm 90^\circ$.



Measurement Methods

There are two types of measurement methods for a rotational angle.

Rotational Angle Measurement Compliant with ISO standards	
<p>Select [D4 Sigma] for the “Beam Diameter” in the Option Settings as below.</p> 	<p>Only If the “D4 Sigma” is selected, Will the rotation angle be measured in accordance with ISO 11146-2.</p>
Rotational Angle Measurement NOT Compliant with ISO standards	
<p>Select [1/e²] for the “Beam Diameter” in the Option Settings as below.</p> 	<p>Only if the “1/e²” is selected, will the following two non-ISO-compliant rotation angles be measured.*¹</p>
	<p>[Ellipse Fitting]</p> <p>This method performs elliptical fitting on a beam region exceeding 13.5% of the peak value and calculates a rotational angle as the inclination of the major axis of the resulting ellipse.</p>  <p>Advantage</p> <p>It obtains a high-precision rotational angle when a shape is close to an ideal ellipse, as this method considers an overall beam shape.</p>
	<p>[Maximum Distance of Two Points Search Method]</p> <p>For beam regions exceeding 13.5% of the peak value, the method calculates the rotation angle by taking as the principal axis the straight line passing through the centroid that maximizes the distance between two points where it intersects the beam boundary and uses this as the rotation angle.</p>  <p>Advantage</p> <p>Although the beam shape contains distortion or noise, it easily obtains a stable rotation angle with minimal variation in the direction of the main axis.</p>

*¹ When the beam spot is small (about 3x3 pixels or less), the error increases due to reduced pixel resolution.

3.2.2.5 Line Position Measurement

This function measures the linear position on the beam's cross-section.

The Line position measurement is only available when 'Image Processing Mode' in the optional setting is enabled. A measurement result display area for 'Beam Diameter' is switched to display the results from this function.

Displaying Result: Beam Diameter

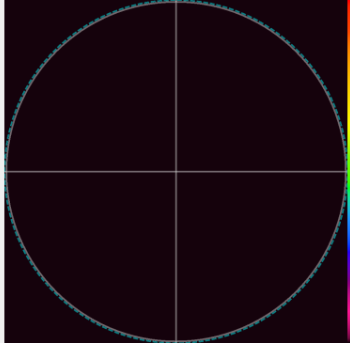
Uncheck the "Enabled" in the option setting.

Image Processing Mode

☐ Enabled

Threshold

Profile View



X: --- Y: ---

Beam Centroid	Intensity Centroid
Centroid X	- [mm]
Centroid Y	- [mm]
Centroid D	- [mm]

Beam Diameter

D4Sigma - [mm]

D4Sigma X - [mm]

D4Sigma Y - [mm]

D86 - [mm]

Beam Ellipticity

Ellipticity m/M -

Orientation

θ - [deg]

Judgement

Beam Centroid (D)

Beam Diameter

Displaying Result: Line Position

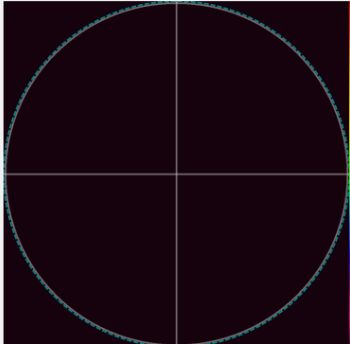
Check the "Enabled" in the option setting.

Image Processing Mode

☒ Enabled

Threshold

Profile View



X: --- Y: ---

Beam Centroid	Intensity Centroid
Centroid X	- [mm]
Centroid Y	- [mm]
Centroid D	- [mm]

Line Position

Line X - [mm]

Line Y - [mm]

Judgement

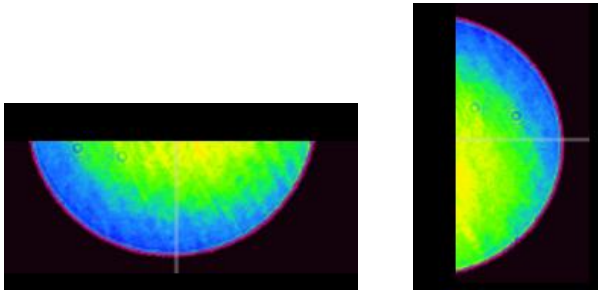
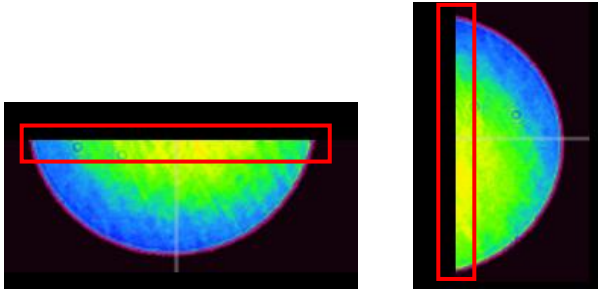
Beam Centroid (D)

Line Position

Main Spot

Measurement Targets

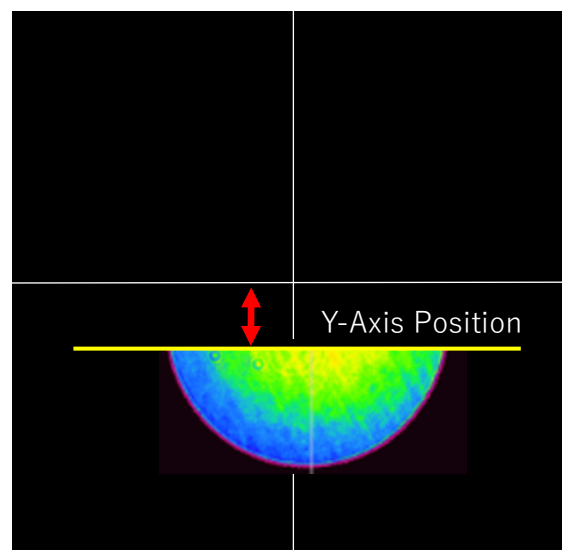
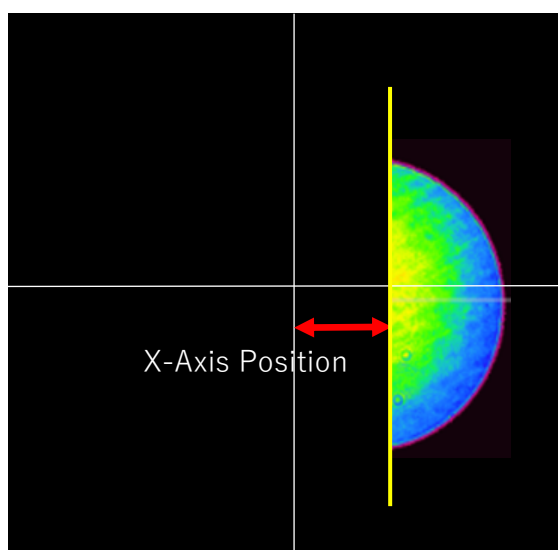
The shapes and measurement locations of a target that this function detects are as follows.

Target Shape	
A shape with a partially circular or elliptical outline, where part of the circle or ellipse is cut off at the top and bottom or left and right.	
Measurement Site	
Straight edges that are not arcs *The slope of straight lines shall be limited to within $\pm 10^\circ$ of horizontal or vertical; any deviation beyond this range shall be excluded from measurement.	

The Definition of the Line Position Measurement

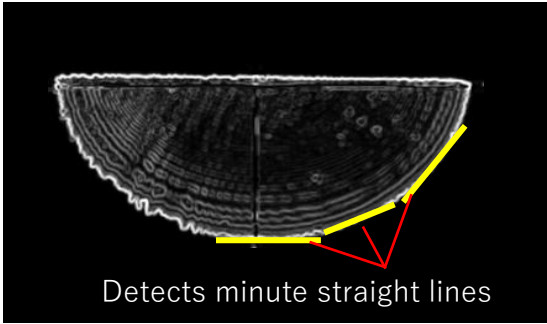
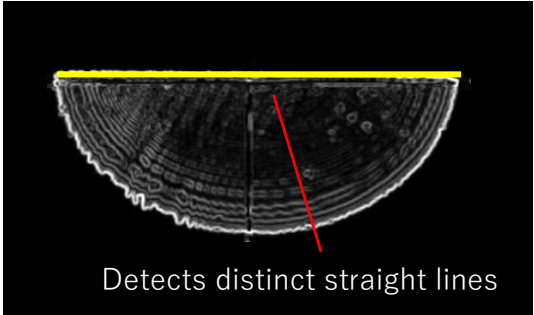
The position of the 'measurement area' is displayed on the screen as coordinates.

If horizontal cut, the X-axis direction is used as the reference; if vertical cut, the Y-axis direction is used as the reference. The representative position of the detected straight line is displayed as the line position.



Line Detection Sensitivity

The sensitivity of the line detection can be adjusted by modifying the Threshold in the Image Processing Mode option setting.

The Threshold of the Image Processing Mode	
<p>Reducing the value makes it easier to detect fine straight lines.</p> <div><p><u>Image Processing Mode</u></p><p><input checked="" type="checkbox"/> Enabled</p><p>Threshold <input type="text" value="30"/></p></div>	 <p>Detects minute straight lines</p>
<p>Increasing the value will result in detecting more distinct straight lines.</p> <div><p><u>Image Processing Mode</u></p><p><input checked="" type="checkbox"/> Enabled</p><p>Threshold <input type="text" value="80"/></p></div>	 <p>Detects distinct straight lines</p>

If the value is too large, the target line may not be detected as the system seeks a line with minimal noise.

3.2.2.6 Judgement

The judgment function is applied to provide an intuitively understandable expression of whether the measurement value is within the target range.

See "[Judgement](#) in the Angle View" for a setting example.

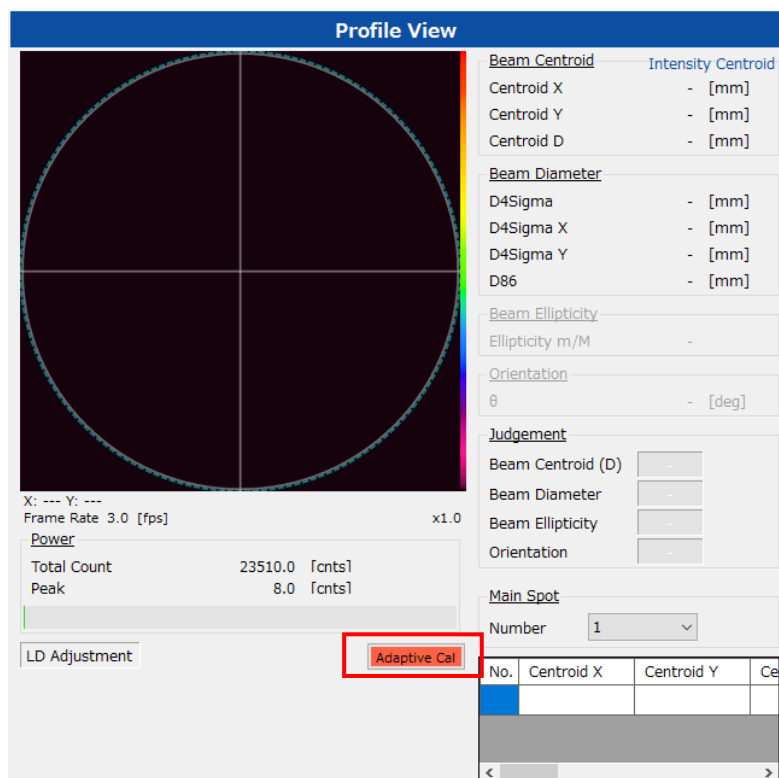
3.2.2.7 Adaptive Cal

The Adaptive Cal is a function that reduces measurement errors caused by noise by removing a certain amount of noise from the entire image data acquired by the sensor camera.

It has an automatic noise reduction feature that calculates a baseline correction value and offsets each pixel data by that amount.

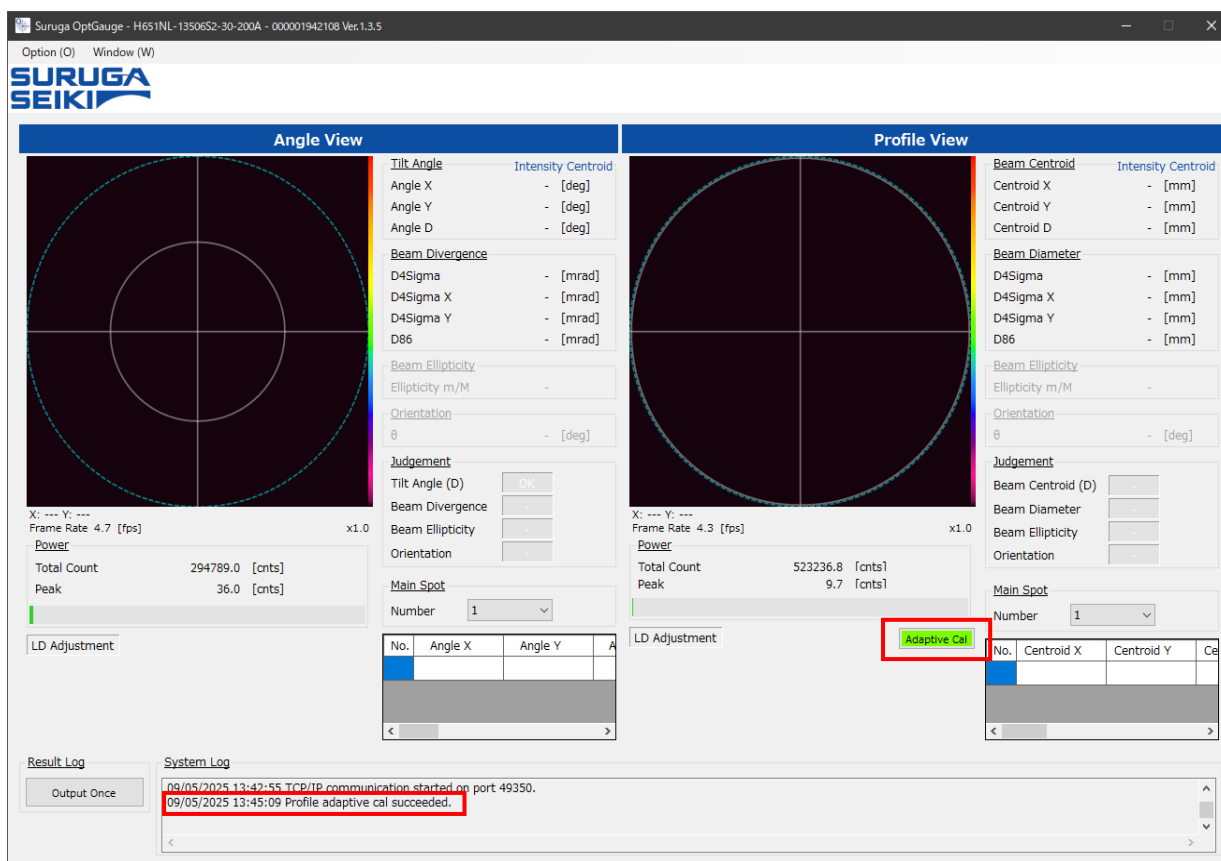
It must be executed each time the exposure time in the camera settings is changed when launching the Software.

1. Prevent the beam to enter into the Product.
2. Enable the Adaptive Cal by clicking [Adaptive Cal] in the option settings.



3. When the Adaptive Cal is enabled, the icon color changes.
4. When "Adaptive Cal succeeded" is displayed in the System Log, the process is complete.

5. Thereafter, set the beam incoming to the sensor head and begin measurement.



*1 For details of the optional features, please refer to the separate software manual *the 'Suruga Opt Gauge User's Manual'*.

Attention

If the beam light enters into the sensor or ambient light is causing serious noise, the adaptive calibration will not be succeeded. Please conduct it in an environment where lights interfere with the sensor camera. It is also notable to disable the denoising function for this purpose.

3.2.2.8 Aperture

The settings for the Auto Aperture and the ROI are provided to exclude the influence of extraneous light and other noise from the measurement results for the beam diameter.

By using these two functions, measurements can be performed while eliminating noise caused by ambient light, etc.

See "[Aperture](#)" at the Angle View section for details.

3.2.2.9 Origin Offset

The Origin Offset function allows the center position of the sensor camera to be offset from its factory default position to any desired location.

By utilizing the offset function, alignment can be performed using any chosen point as the reference point.

There are three methods for performing the offset.

See "[Origin Offset](#)" in the Angle View section for details.

3.2.2.10 Zoom In

The View screen has a Zoom function to observe the condition of a light beam.

See "[Zoom In](#)" in the Angle View section for details.

3.2.2.11 Multi Spot

The Products support Multi Spot measurement, enabling simultaneous measurements of up to 100 points.

Using the Multi Spot settings, you can configure the "display order" and "number of points displayed" on the measurement results screen.

Furthermore, you can set "detection conditions" to narrow down the measurement targets.

See "[Multi Spot](#)" in the Angle View for details.

3.2.2.12 Automatic Brightness Control

The Products feature that automatically adjusts the exposure time and dims the peak brightness of the light to a specified level.

See "Angle View --> [Automatic Brightness control](#)" for details.

3.2.2.13 External Trigger Model

The Products support an external trigger function, allowing measurements to be performed in response to trigger signals (pulse input) from external devices. By using this function, measurement timing can be controlled on the user's system side.

See "Angle View --> [External Trigger Model](#)" for details.

4. Specifications of the Products and Accessories

4.1 The Specifications of the Products

Item		Specifications	
Model Series		H651VL-13506R2-30-200A	H651NL-13506S2-30-200A
External Light Source	Wavelength	VIS: 400 nm to 700 nm	NIR: 700 nm to 1000 nm
	Mix. Diameter	6 mm	
	Light Intensity	0.05 mW to 1.0 mW	
Internal Light Source	Wavelength	660 nm	980 nm
	Diameter	Φ 3 mm	
	Emission Intensity	1 mW or less (Class2)	0.2 mW or less(Class1)
	Emission Position	15 mm × 25 mm (Distance from the reference plane) (see the External Dimensions of the Products)	
Angle Measurement	Range ^{*1}	+/- 1.5°(circular range)	
	Linearity ^{*2}	+/- 0.45% of F.S.(F.S.=3.0°)	
	Repeatability ^{*3}	1 s (6σ)	
Divergence Measurement	Range	20 mrad or less	
	Linearity	5% of F.S.(F.S. = 20 mrad)	
Location Measurement	Viewing Range	Φ 6 mm	
	Linearity	+/- 0.5% of F.S.(F.S. = 2.8 mm)	
	Repeatability	1 μm (6σ)	
Beam Diameter Measurement	Actual Spot Size ^{*4}	Φ 60 μm to Φ 6 mm	
Working Distance		200 mm +/- 4 mm	
Frame Rate		8 to 10 Hz (with the recommended computer specifications)	
Interlock input terminal INTERLOCK+ INTERLOCK—		Interlock inputs: (none-voltage contact, the laser emission starts with the short circuit of +/-) Internal voltage: 3.3 V. Short circuit current: 2 mA. Open input conditions: 10 kΩ or more or 2.6 V or above. Short-circuit input conditions: 0.5 kΩ or less or "1.0 V or	

		below.
Trigger input terminal TRIG 5V+ TRIG 5V—		The trigger input for a measurement starts: (rising edge detection to start a measurement in the 5V signal system) Input voltage: 0 V to 6 V. Input current: 4 mA (at 5 V input). ON voltage: 3.0 V or above. OFF voltage: 1.0 V or below.
Environmental Conditions	Operating Condition ^{*5}	0 to + 40°C、 35 to 85% RH
	Storage Condition	- 10 to + 60 °C
	Vibration Resistance	Frequency range: 10 Hz to 500 Hz Max. acceleration: 2 G in X,Y,Z 3 directions (10 sweeps)
Weight		Approximately 0.9 kg

*1 When measuring with Φ 3 mm external laser beam

*2 When measuring with the internal light source (wavelength ± 10 nm)

*3 Averaging counts of 256 measurements

*4 When using Auto Aperture settings, it is recommended to measure spot diameters of less than half the field of view.

*5 Shipping inspection environment: 22–24 °C, 35–85% RH

4.2 AC/DC Converter Electrical Specifications

AC / DC Converter Specifications Overview	
Rated Input (AC)	AC100~240 V
Rated Output (DC)	12 V/3.0 A
Acquired Industrial Standards	PSE, BSMI, cUL, FCC, KC, CE, GS, RCM, CCC
Protective Functions	short-circuit protection, overcurrent protection, overvoltage protection
RoHS	RoHS10
AC Side Plug Shape	Type-A
Product Dimensions (mm)	99 x 50 x 33
DC Cable Length	1.5 m +/- 30 mm
DC Plug Polarity	Center Positive

4.3 The Products and Cable Electrical Specifications

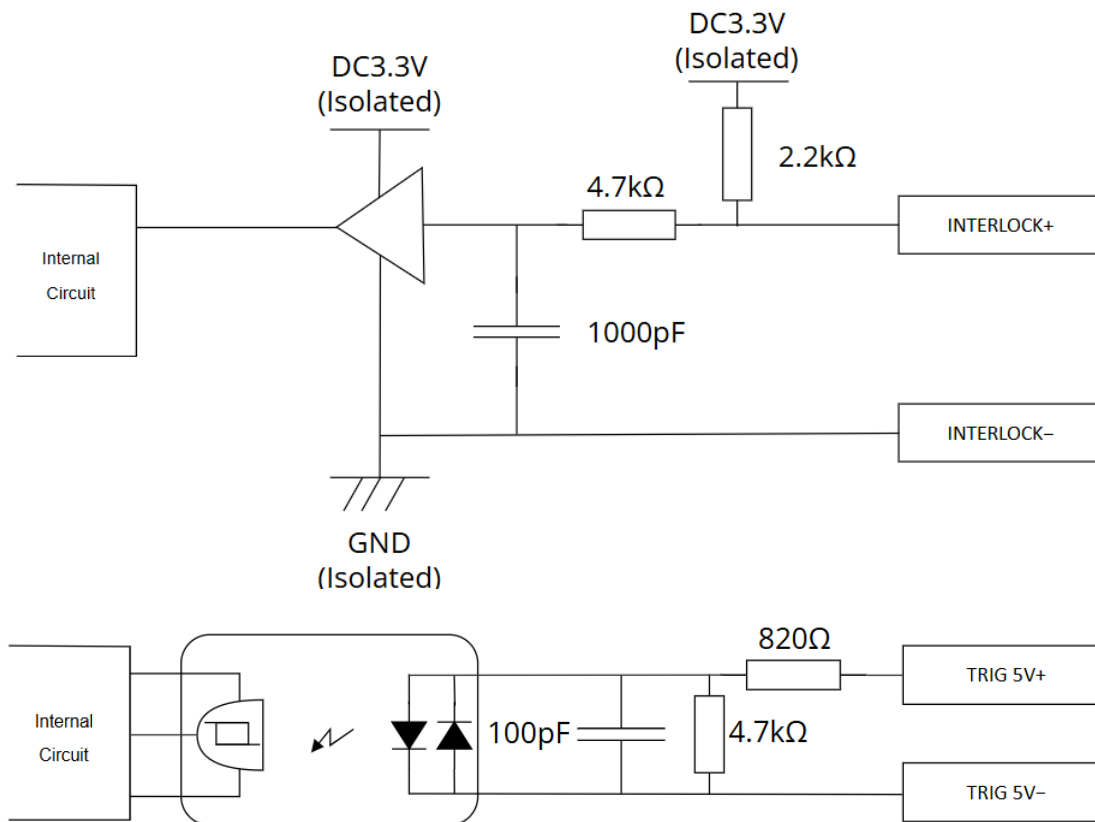
The Products and Cable Specifications Overview	
Rated Input (power consumption)	DC12 V / 3 A (5 W or below)
Cable Type	USB cable compliant with USB3.0 (5Gbps) standard
Connector	USB3.0 Type A
Cable Length	3.0 m

4.4 The specifications of the Applicable Wire Range for the Interlock and Trigger Inputs

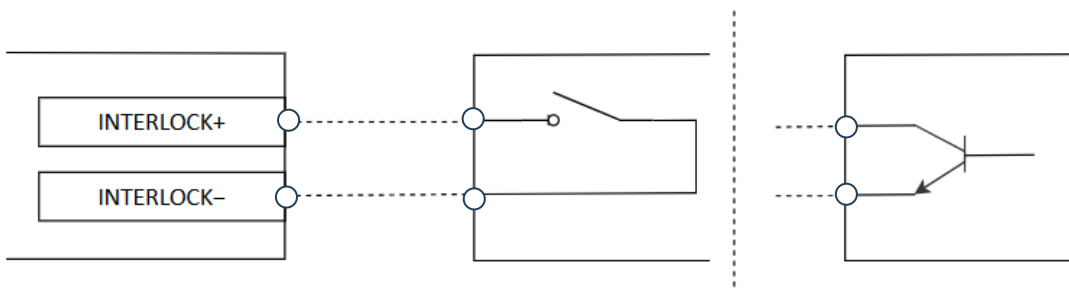
Stranded wire	0.2 mm ² to 1.5 mm ² (AWG24 to 16)
Solid wire	0.2 mm ² to 1.5 mm ² (AWG24 to 16)
Stranded wire with a ferrule terminal without insulation sleeve	0.2 mm ² to 1.5 mm ² (AWG24 to 16)
Stranded wire with a ferrule terminal with insulation sleeve	0.2 mm ² to 0.75 mm ² (AWG24 to 18)
Stripping length of outer sheath	8 mm

4.5 Equivalent Circuit Diagram

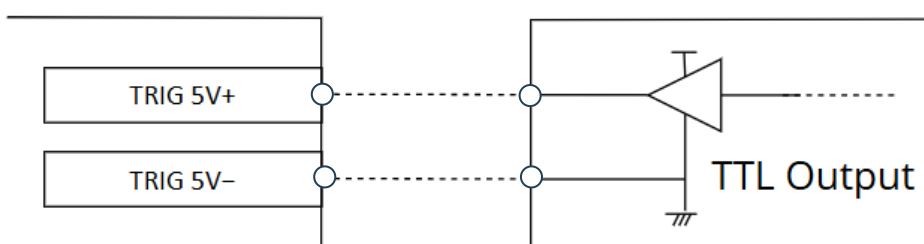
This section provides interlock input and trigger input terminal circuit diagrams and connection examples.



● INTERLOCK+/- connection example



● TRIG 5V+/- connection example



5. Failures? Frequently Asked Questions

5.1 Symptoms and Countermeasure

Useful information for troubleshooting is listed below.

Check if the table below shows your trouble.

Symptom	Cause	Countermeasure
Internal light source power is not turned on.	AC adapter or power cable is not correctly connected.	12VDC is not supplied.
	12VDC is not supplied.	Correctly connect the 12VDC power source.
Application does not start up.	USB cable is not correctly connected.	Connect the USB cable to the USB3.0 port.
	Device authentication file is not being read.	Read the device authentication file (.suruga) corresponding to the purchased sensor head.
Application stops during startup.	USB cable disconnected.	Close the application, connect the USB cable correctly, and restart the application.
The Software does not start correctly	The sensor camera may be malfunctioning (check the all cable connections)	Please contact our sales representative from the optical equipment division for further assistance.
Application stops during startup	With Windows 11 Version 23H2, due to differences in some system components and specifications, the Software may not function properly.	Please update to the latest Windows version (24H2 or later).
	USB cable disconnected.	Close the application, connect the USB cable correctly, and restart the application.
Beam is not displayed on screen.	Exposure Time* ¹ is too short.	Adjust exposure time to the optimal speed.
	Large tilt on the target.	Adjust the measurement target tilt so that the reflectance light enters within +/- 1.5° of the visual angle.
Measurement target	Noise is causing serious effects	Enable the Threshold in the

centroid is unstable.		Denoising settings and adjust the threshold.
RS232C communication is not working.	RS232C cable is not correctly connected	Correctly connect RS232C cable.
	Computer communication conditions are not set correctly.	Set the communication settings correctly on the PC.
TCP/IP communication is not working.	Ethernet cable is not correctly connected.	Correctly connect Ethernet cable.
	Computer communication conditions are not set correctly.	Set the computer communication settings correctly.

*1 see the separate software manual, the "Suruga Opt Gauge User's Manual" for details.

6. Warranty - After-Sales Service

6.1 Warranty Terms, Conditions and Coverage

- Before contacting us, please confirm the serial number of the individual product.
- The warranty period is one year after delivery.
- However, the following cases are not covered by the warranty and will be repaired for a fee.
 - Failure or damage caused by misuse, modification or repair by someone other than the company's designated persons from us.
 - Failure or damage caused by improper handling, such as dropping the Products during transportation or moving.
 - Failure or damage caused by fire, salt damage, gas damage, abnormal voltage, earthquake, lightning, wind, flood, or other natural disasters
 - In the event of a malfunction or damage caused by improper handling contrary to the methods and precautions described in the instruction manual.

We reserve the right to revise, modify, or amend these Warranty Terms and Conditions (hereinafter referred to as "Revisions, etc."), and in the event of such revisions, etc., we shall promptly post the revised Warranty Terms and Conditions in this catalog or on our website (<http://jpn.surugaseiki.com/>). If you place an order for the Products after such revision, you shall be deemed to have accepted the revision.

6.2 After-Sales Service

Before requesting repair, please check the items in "[Failures? Frequently Asked Questions](#)". If you have any questions, please contact our Optical Instruments Division Sales Department.

< During the Warranty Period >

When damage occurs under a normal use state following the cautions/warnings/notes written in this manual, Suruga conducts a repair service for free. For any damages out of warranty period mentioned above, Suruga charges a fee for any repair service.

< After the Warranty Period >

A repair service is available with a fee to maintain the functionalities of the Products up on your requests.

< If repair is required >

For repair and calibration inquiries, please contact to the following address.

info@suruga-g.co.jp

Misumi Group

SURUGA SEIKI CO., LTD.

HEAD OFFICE

505, Nanatsushinya, Shimizu-ku,
Shizuoka City, Shizuoka 424-8566, Japan
Tel : +81-54-344-0332 Fax : +81-54-346-1196
<https://eng.surugaseki.com/>