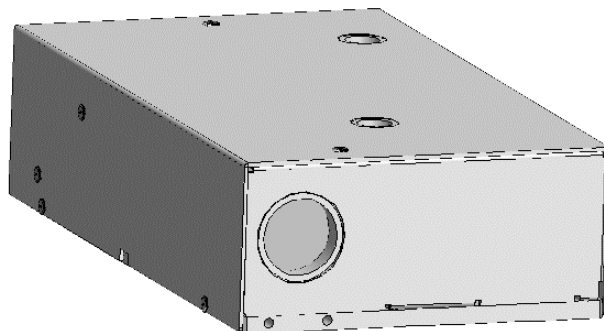Laser Autocollimator Beam Profiler

Smart ProCo H650 Series

User's Manual

Thank you for purchasing our product.

Before using the product, read this manual thoroughly.

After reading this manual, store it for your future immediate referencing.

Index

Preface

This document is the "User's Manual" for the H650 series (Laser Autocollimator and Beam Profiler) (hereafter, referred to as "the Product(s)").

This "User's Manual" (hereafter referred to as "this Manual") provides information and basic operating instructions for the Products. The term, "the Products" is, in general, for all models of laser measuring instruments starting with the H650 model number presented by Suruga Seiki Co., Ltd., and in this Manual, specifications, functions, parts names, etc., are all common to all products in the series, unless we explicitly mention exceptions.

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

H650 Series User's Manual

Issue Date	2025 February
Manual Version	V.1.3.0

Revision History

Date	Revision	Details
2024 February	V.1.0.0	1st version
2024 March	V.1.1.0	Revised for Suruga OptGauge Ver.1.1.0
2024 December	V.1.2.0	CE/KC Compliance Added
2025 January	V.1.2.1	Repair Notice Added
2025 February	V.1.3.0	Suruga OptGauge Ver. 1.1.3 Support ・Measurement Option Setting Details 　Log File -> Image 　　Added: Full Color/Gray Scale, PNG/BMP/TIFF ・Controlling from External Devices Read/Write Commands 　Added: MLT/ASC/PSC/RFP/IOE/RAE/IOC/IOF Execute Commands 　Added: AR, MSN/PR,MSN/RO
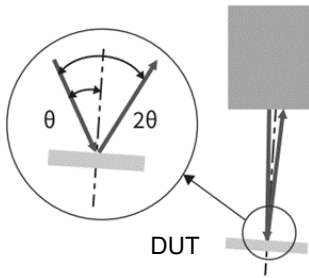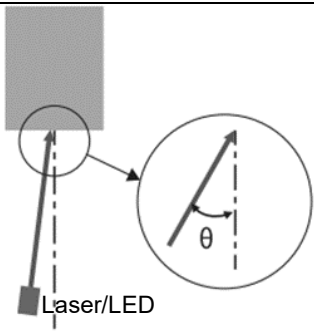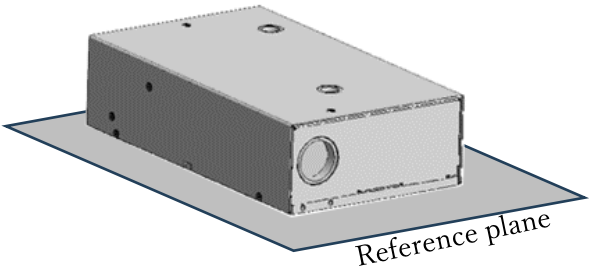
NOTICE

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

SURUGA SEIKI CORPORATION reserves the right to change specifications without notice to the user of the Product offered.

The latest version of this manual can be downloaded from our WEB site (http://jpn.surugaseiki.com/).

Definitions (terms and abbreviations)

Terms and Abbreviations	Definitions
Reflection Angle Measurement	 DUT A method to measure the angle of a beam from internal light source reflected up on a device under test (DUT). The angle 2θ is measured to calculate the θ as result.
External Light Angle Measurement	 Laser/LED A method to measure the angle θ of a beam from external light source such as laser or LED.
Reference Plane	 Reference plane It is the plane at the base plate of the H650
OptGauge	Measurement software "Suruga OptGauge"
The Software	Suruga OptGauge
This Manual	H650 User's Manual
The Sensor Camera	The built-in sensor camera with the Products
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 damage.
⚠ **Careful**	May result in minor physical injury or equipment damage.
Attention	Instructions for safe handling are provided for the product.

1.2 Handling this Product

➢ The Products emit laser beam. It is recommended that the Products are in an environment where appropriate safety measures are taken for the laser class before any use.

➢ 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 being modified.

➢ When other equipment combines the Products, the functions and 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 product with a wet rag, benzene, thinner, or the alike. which may cause discoloration or deformation of the Product. If the Product is heavily soiled, wring out a cloth with diluted PH-neutral detergent and wipe off the stain, then dry the Product with a soft cloth.

➢ If you suspect the Products are in malfunction, 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 Product 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

⚠ Warning

- Use the correct power supply voltage. Failure to do so may result in fire, electric shock, or malfunction.
- Be sure to turn off the power to the Product and devices connected to the Product when connecting or disconnecting various connecting wires. Failure to do so may result in damage to the Product.
- 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

⚠ Warning

Do not disassemble or modify the unit. Doing so may cause fire or electric shock. The warranty is void if the Product is 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: Take measures such as installing a protective cover or air purging.

1.3.5　Influence of Vibration

- Vibration to a DUT may cause the measured value to vary. In such a case, a more accurate measurement can be obtained by increasing the number of times the measured values are averaged.

1.3.6　Disturbance by the air fluctuation

The influence of slow air fluctuation 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 Explosionproof

⚠ Warning

- 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 Product.

1.3.8　Actions in case of abnormality

⚠ Warning

In the following cases, turn the power OFF, immediately. Use of the Product under abnormal conditions may result in malfunction.
- 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 main unit
- When the product is damaged due to being dropped or external impact.
- When there is a strange odor due to smoke emission

1.3.10　Disposal of this Product

When disposing of the Products, treat it as industrial waste. Please follow in accordance with laws and regulations or by other appropriate methods. Suruga shall not collect the Product for purpose.

Please dispose of all materials used to package the Product in accordance with the law or by other appropriate methods. Suruga shall not collect these materials for the purpose.

1.3.11 Residual Risks

This document 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.

1.3.12　CE Marking

This product complies with CE marking for the following complying standards and conditions. When this product is used in EU countries, keep the following conditions.
- 　EMI：EN 55011:2016/A1:2017/A2:2021 Group 1 Class A
- 　EMS：EN IEC 61000-6-1:2019

※ The length of all input and output cables, including the power cable connected to this product, must be less than 30 meters."

1.4　Use of Laser Products for Your Safety

1.4.1　Corresponding laser classes for Autocollimator H650 series

The following describes the hazards of the laser class in the H650 series.
For specific safety precautions for the laser class, please follow your occupational safety regulations.

⚠ **Careful**

Laser Class	Precautions
Class 2	**Normally, blinking, or other aversive reactions protect the eyes and make the laser beam safe.** Intentional staring at the laser beam may cause temporary visual impairment and risk of secondary injury due to aversion reactions.

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

1.4.2 Laser Class Identification Labels on the Products

The contents of the laser class identification label and of the warning label, and the pasting positions where you find them are shown below.

⚠ Careful

Table 1 : Laser Labels and Descriptions

Laser Class Identification Label	Warning Label
Class2	
クラス2レーザ製品 Class 2 Laser Product (IEC60825-1 : 2014) *Output : 1mW *Wavelength : 660nm *Duration : CW	
Background color: Yellow	Background color: Yellow
Text color: Black	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.

⚠ Careful

The Laser Label Attaching Positions Common 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
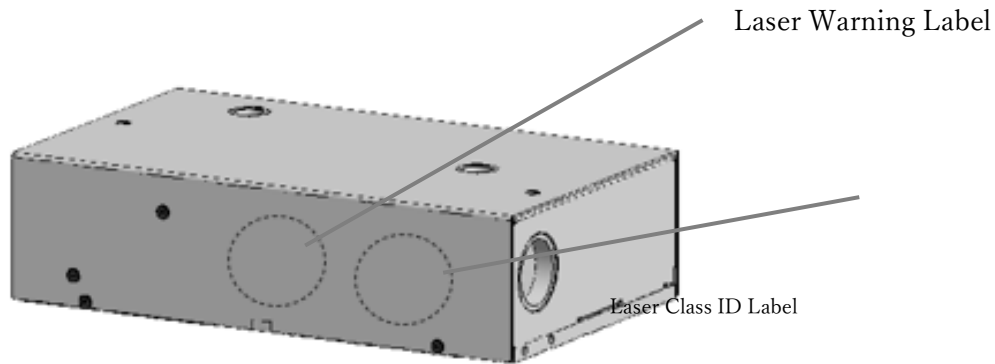
2. Preparing

2.1 Functions and Features

The Products are multifunctional instrument that measuring the angle of an object, divergence, position, and beam diameter from the laser beam incident on sensors. They have the following main features:

- Angle measurement (Φ3 mm diameter if an external light beam)
  - Measurement range: +/- 1.5°
  - Repeatability: 1s (determined at 6σ, averaging = 256 times)
  - Linearity: +/- 0.45% of F.S. (F.S.=3.0°)
    *Refer to "H650 Series Sensor Head and Accessories Specification Details" section.

- Divergence measurement
  - Measurement range: ≤ 20 mrad
  - Linearity: 5% of F.S. (F.S.=20 mrad)
    *Refer to "Divergence" in the Function Details section.

- Position measurement (when using Φ3mm beam)
  - Viewing range: Φ6 mm
  - Repeatability: 1 um (6σ, when measured with averaging = 256 times)
  - Linearity: +/- 0.5% of F.S. (F.S.=3 mm)
    *Refer to "H650 Series Sensor Head and Accessories Specification Details" section.

- Beam Diameter Measurement
  - Measurement range: Φ0.06 mm to Φ6 mm (we recommend that the Spot diameter should be less than 1/2 of viewing range when Auto Aperture is applied).
    *Refer to "H650 Series Sensor Head and Accessories Specification Details" section.

- The sensor head cable can be connected to PC for measurement with the software.
    *Refer to "Preparing: System Configuration Example

- Multiple light spots measurement
    *Refer to "Multi Spot" in the Function Details section.

- Reflection angle measurement and external incident light angle measurement
  For reflection angle measurements, the internal light source is available to measure the angle of reflected light.

For external incident light angle measurements, the angle is calculated by directly measuring the light flux of a laser or a LED.

 *Refer to "Tilt Angle / Beam Angel" in the Function Details section.

Table 2 Function List

Functions		Details
Measurement	Angle	See "Tilt Angle/Beam Angle" in the Function Details.
	Divergence	See "Divergence" in the Function Details.
	Position	See "Beam Centroid" in the Function Details.
	Beam Diameter	See "Beam Diameter" in the Function Details.
Useful Functions	Maximum brightness	See "Power" in the OptGauge Main Screen Details.
	Total counts	
	Binning	See "Binning"in the Measurement Option Settings.
	ROI	See "Aperture" in the Function Details.
	Auto Aperture	
	Adaptive Calibration	See "Adaptive Cal"」in the Function Details.
	Denoising	See "Denoising" in the Measurement Option Settings.
	Storing results	See "LogFile" in the Measurement Option Settings.
Displays	Offset from Zero point	See "Origin Offset" in the Function Details.
	Unit conversion	See "AngleUnit" in the Measurement Option Settings.
	Image rotation	See"CameraSettings" in the Measurement Option Settings.
	Image mirroring	
	Image zooming	See "Zooming" in the Function Details.
Judgement	Angle	See "Judgement" in the Function Details.
	Beam Divergence	
	Position	
	Beam diameter	
	Maximum brightness	
Communication	RS232C	See "RS232C" in the Control from External Devices.
	TCP/IP	See "TCP/IP" in the Control from External Devices.

2.2　Checking the Package

Please keep in mind that the shipping box contains, in addition to the main unit, a screwdriver for adjusting the internal light source, a USB memory stick and an AC/DC converter as the accessories.

1. 　　An H650 body

2. 　　A screwdriver for light intensity adjustment

3. 　　A USB memory stick

   （Contents： OptGauge(Measuring Software)、 camera driver、 device authentication file、 and this Manual）．
   Please download the latest version from out WEB site（http://jpn.surugaseiki.com/）．

4. An AC/DC power supply for the Internal light source

2.3　H650 Series Specifications

Table 3 H650 Series Common Specifications

External dimensions	170 mm x 100 mm x 45 mm
Body Weight	1.0 kg
Power Supply	DC12 V
Power Consumption	5　W or less
Laser Class	Class2
Protective Functions	Short-circuit protection and reverse polarity protection
Communications	USB3.0 industrial standard
Operating temperature/humidity	0℃ to +40℃、 35% to 85% RH (no condensation)
Storage temperature/humidity	-10℃ to +60℃、 35% to 85% RH (no condensation)
Operating Environment	No direct sunlight, no corrosive or flammable gases, liquids, dust, or other harmful substances
Body	Aluminum

2.4 The Products Dimensions

Laser emission position

45
25
0.5
16
100

Front View

170

Right View

96

40

50 32

2-⌀4.5Through hole,
φ9Spot facing depth43

Top View

18 32 32
25 50
55
50
40
96

4-M4x0.7Depth4

Bottom View

19
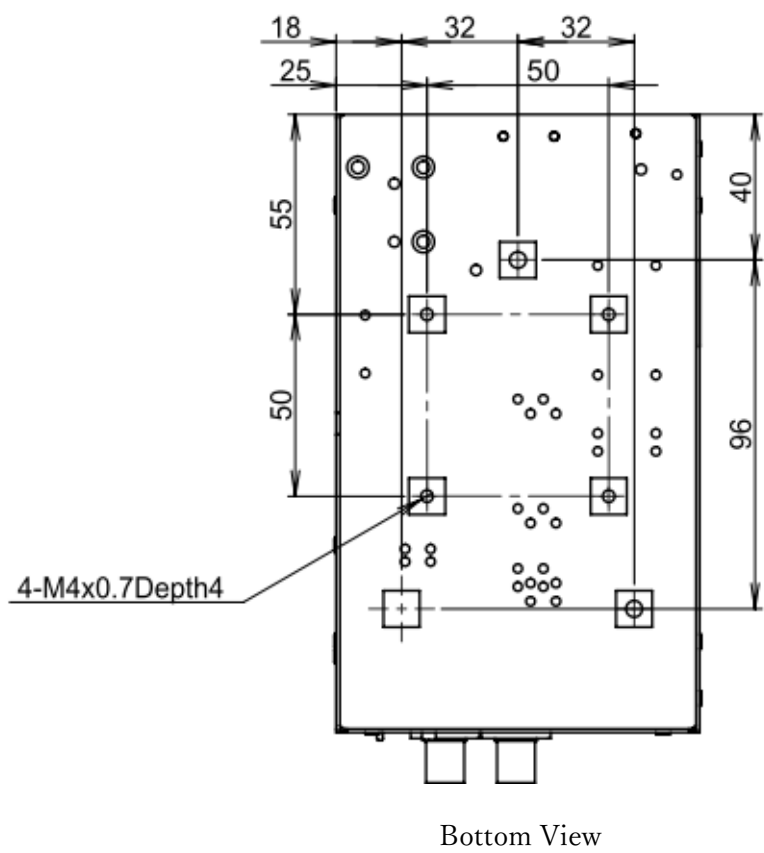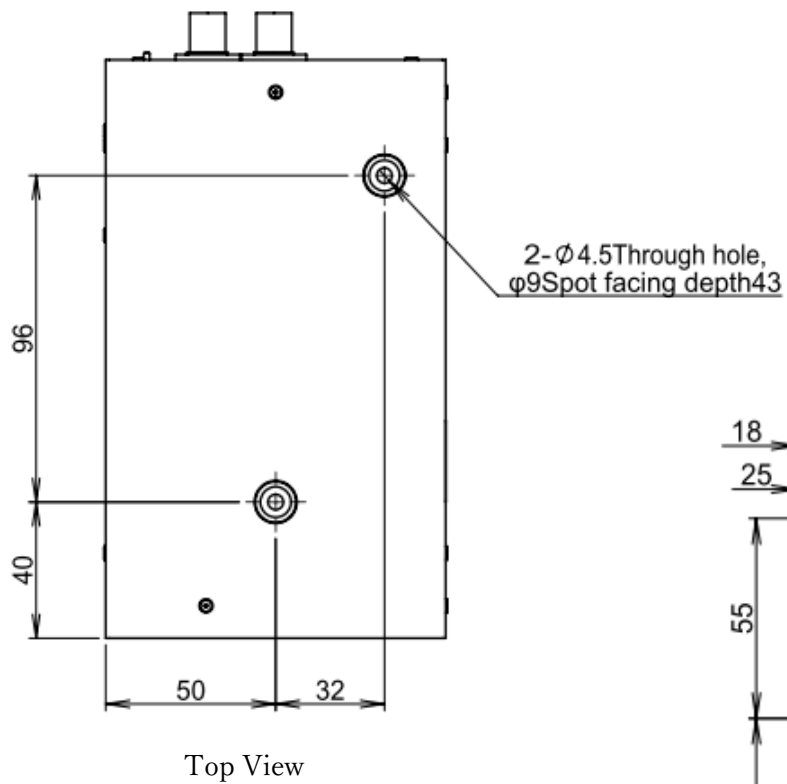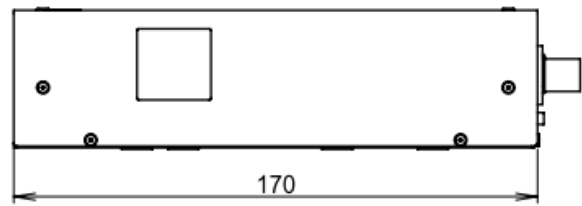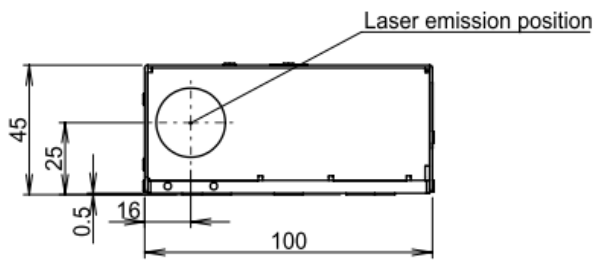
2.5　Names and Functions: Parts of the Products

① Internal light source ON/OFF switch
When the switch lights up orange, it is
indicating the internal light source is turned on.

② USB connectors x 2
USB connectors x2 connect H650 to a computer
of a customer.

③ A knob for controlling internal light source intensity.
Adjusts the light intensity of the internal light source. The intensity increases at clockwise and
decreases at counterclockwise.
*Note: Please use the supplied screwdriver for light intensity adjustment

④ Power supply port for the internal light source
An AC/DC adapter connection port for the supplied power converter.

⑤ FG terminal
It prevents malfunctions due to the electrical noise. Grounding is required.

⑥ Laser output port
When the internal light source is ON, a laser beam
irradiates.
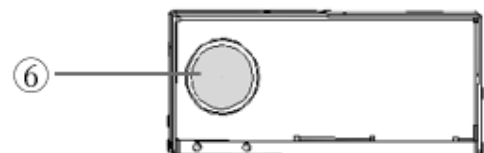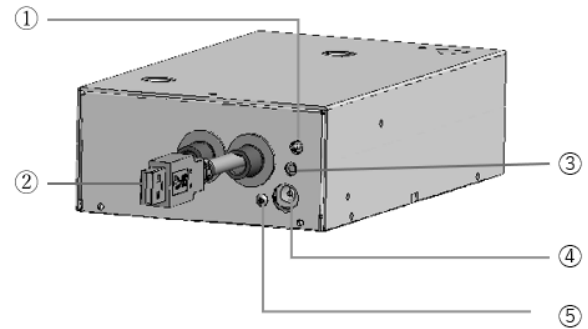
Laser Emission Side
（Front）

⚠ Careful

<u>Do not irradiate the human body, eyes, skin, or any other objects</u>
<u>without safety conformity.</u>

2.6　System Configuration Example

Figure 1 : System Connections
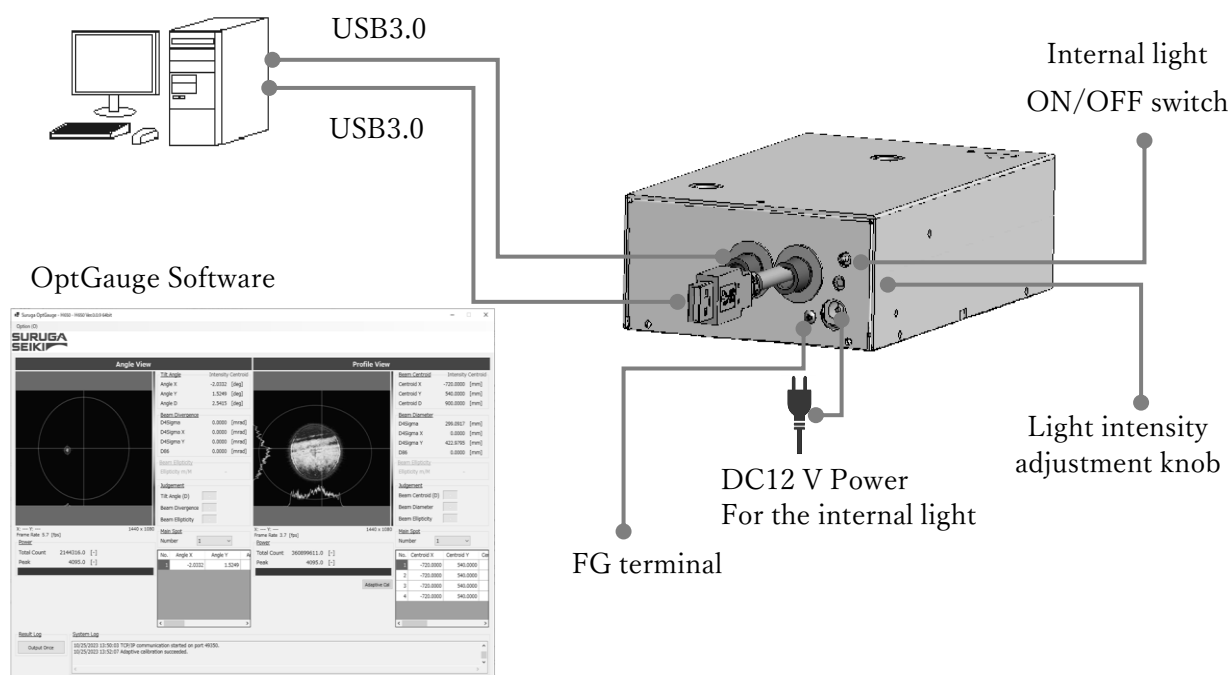
2.7　Components Required for the Configuration

- ・ H650 Sensor body
- ・ Power supply to the internal light source（AC/DC converter accessary）
- ・ Your PC, PC monitor and keyboard
- ・ Suruga OptGauge; measurement software for the Products

2.8 The Products Installation (example)

This section provides an example of mounting H650 series.

1. Place the Product on a mounting plate prepared by the customer.
   Use M4 hex socket head cap screws (length: 8-10 mm).
   (See the "H650 Series Outline Drawing" for details.)

M4 hex socket head screws x 2

H650

Mounting Plate
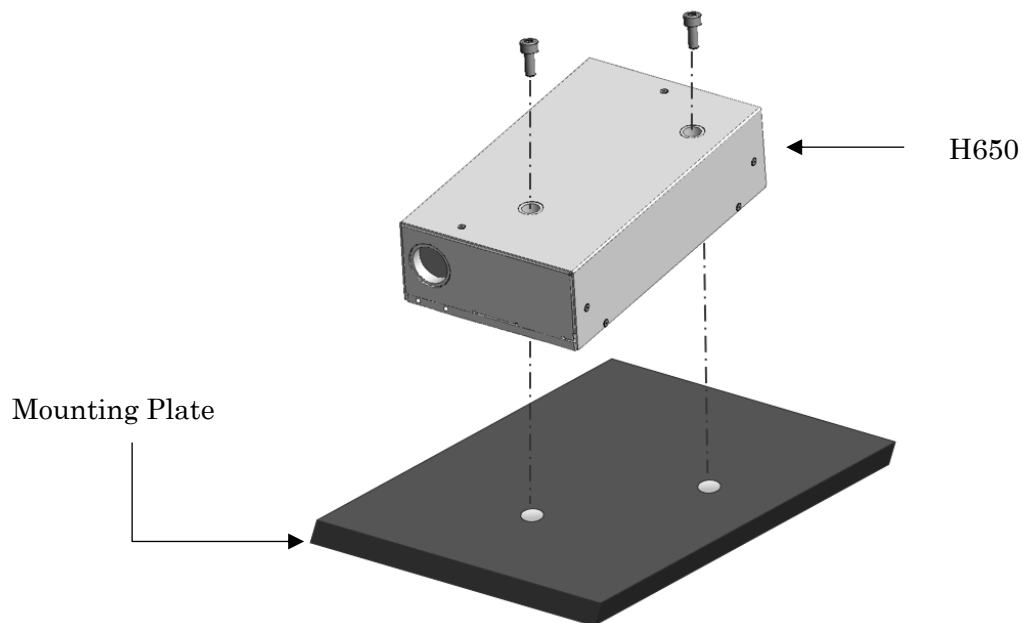
2. The reference position is the base plate on the front, left side of the H650. Fasten the bolt with a parallel pin or other means pressed against it.
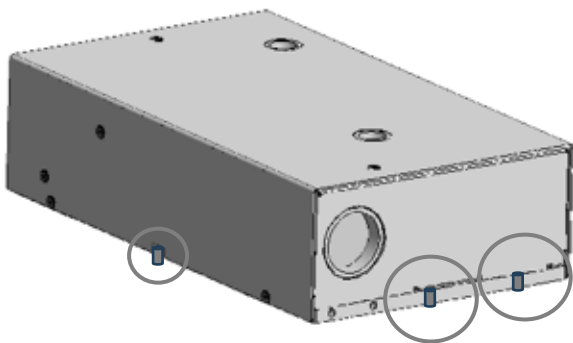
2.9   How to Connect the Power Supply for the Internal Light Source

Please use the supplied AC/DC power converter.

Before plugging the AC side of the AC/DC converter into an outlet, insert the plug of the DC side of the converter into the specified socket.

The FG terminal must be grounded.
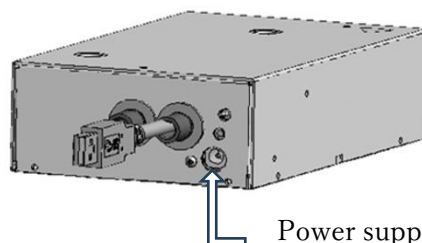
Power supply socket
for light source

Attention

Do not turn on the converter power until software installation is completed. The FG terminal should be grounded to prevent malfunction due to the electrical noise.

2.10   Connecting to PC

Connect the USB3.0 cable of the main unit to a USB port that supports USB3.0. Be sure to use a USB 3.0 compatible port on the PC side.

USB3.0 Cable

USB3.0 Cable
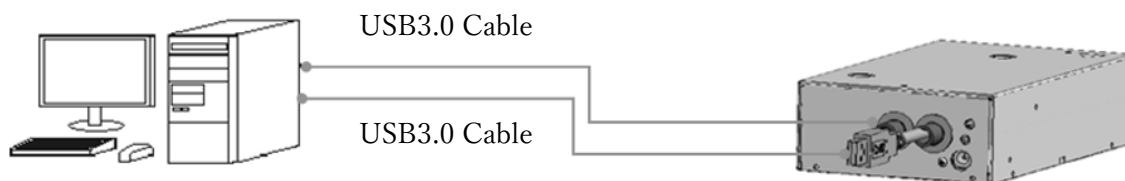
Attention

Do not disconnect the USB cable while the software is running. It prevents normal operation.

If the cable is disconnected, please exit the software, reconnect the USB cable, and then restart the software.

2.11 Software - Suruga OptGauge Installation

2.11.1 Software License Agreement

Use of the Suruga OptGauge (hereafter as "the software") is conditioned upon your acceptance of the following software license agreement (hereafter as "this Agreement").
Your installation or duplication of all or any part of the Software on a computer, or use of the software installed on a computer, constitutes your agreement to all the terms and conditions of this Agreement.

Article 1 (License)

The Software may be used free of charge.

The copyright of the software, the manual of the software and other materials related to the software belongs to SURUGA SEIKI (hereinafter referred to as "SURUGA SEIKI"). You are granted a non-exclusive right to use the Software.

Article 2 (Restriction of Use)

Use of this software is permitted only for the purpose of operating this product and collecting data. Any other use is prohibited.

Article 3 (Reproduction and Tampering)

Reproduction of the software is permitted only on the PC on which this product is used.

However, modification, redistribution, and reverse engineering are prohibited.

Article 4 (Disclaimer)

1. the user shall use this software at his/her own risk.

2. the company shall not be liable for any direct, indirect, incidental, special, consequential, or punitive damages (including but not limited to loss of data, business interruption, or loss of profits) arising out of the use or inability to use this software.

3. we shall not be liable for damages arising from bugs, errors, viruses, unauthorized access by third parties, or other defects or security problems in the software.

4. shall not be liable for any damages arising from tampering with the Software.

Article 5 (Support)

The Company shall provide technical support regarding the Software. However, we guarantee that by our technical support, however, the Company does not guarantee that the customer's purpose will be achieved by the Company's technical support.

Article 6 (Termination)

Your right to use the software shall terminate immediately if you breach any of the terms of this Agreement.

2.11.2 Recommended Installing PC Environment

Hardware specifications	Supported OS	Windows 10 Pro 64 bit
	CPU	Intel Core i5 – 10400 CPU 2.90 GHz or higher 6 core 12 threads
	RAM	8GB or more
	Storage Space	1GB or more
	Display resolution	1920x1080
	USB	USB3.0 with Type A port：3 ports or more
Software specifications	Framework	.NET6.0※

NET6.0" is not installed on your PC, please install ".NET RunTime6.0.x.x" from the Microsoft website. NET RunTime6.0.x.x" from the Microsoft website.

2.11.3 Installing the Software

2.11.3.1 Installing the USB Driver

1. Start the installation by double-clicking "Basler_pylon_7.0.0.24651.exe" in "¥CameraDriver".

2. Please agree to the installation confirmation screen
3. Select "Developer" for the installation method (Profiles).
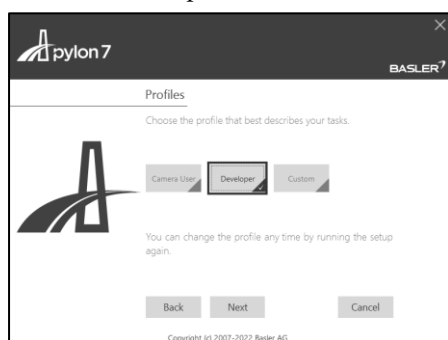
4. Select "USB" as the sensor camera connection method (Interfaces) for the sensor camera. Leave the default setting as it is and complete the installation.
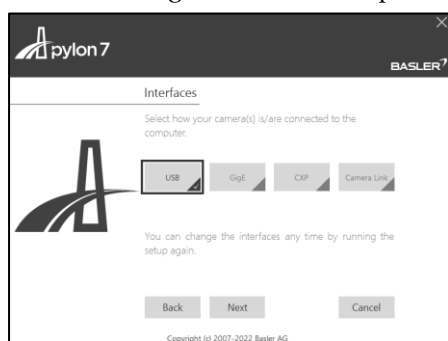
2.11.3.2 By Download

Where to download:
Please download from our WEB site (http://jpn.surugaseiki.com/).

2.11.3.3 Installing the Software

1. Double-click the "SurugaOptGaugeSetup_x.x.xx.msi" in the "… ¥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>」

SurugaOptGauge

Welcome to the SurugaOptGauge Setup Wizard

The installer will guide you through the steps required to install SurugaOptGauge on your computer.

WARNING: This computer program is protected by copyright law and international treaties.
Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil
or criminal penalties, and will be prosecuted to the maximum extent possible under the law.

< Back   Next >   Cancel

3. After "Next>, the installation starts.

   Click "Close" to finish.

Installation Starts	Installing	Installation Complete
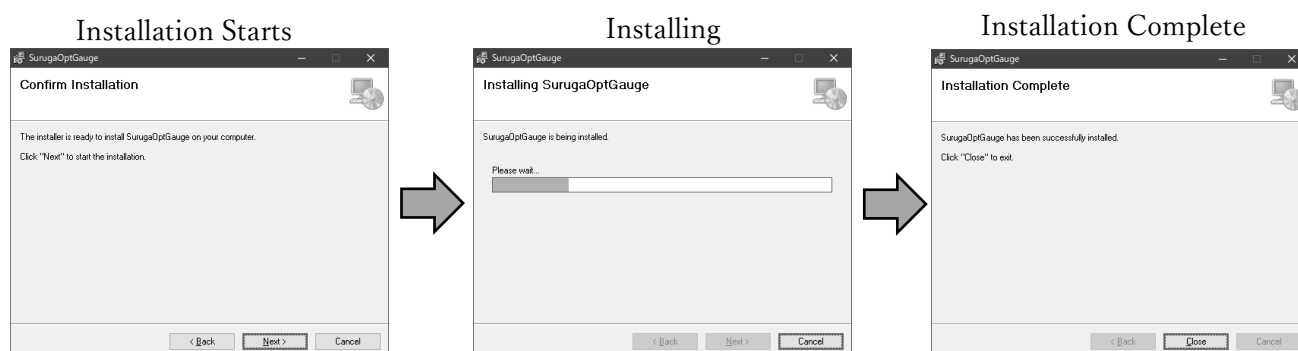
4. "OptGauge" icon will be appears in the desktop。
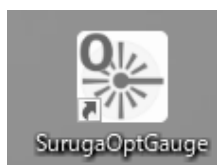
This concludes the installation procedures.

2.11.3.4 Copy of Device Authentication File

Note 1: What the authentication file is.
Because calibration values are determined for each device for the product, "OptGauge" requires reading the device authentication file (extension .suruga)" in which individual unique information is stored.

To load the device authentication file into the installed Suruga OptGauge, copy the file "xxx.suruga" in the "... /AuthenticationFile" 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

Copy the "xxx.suruga" file to the arbitrary location.

Folder
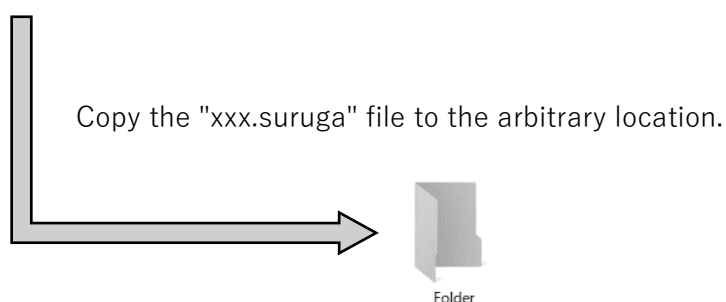
Note 2:
If your security does not allow you to copy the device authentication file to your PC, this procedure is not necessary because the file can be read directly from the USB memory stick provided with the device.

2.11.3.5 OptGauge Startup / Shutdown

OptGauge startup

1. Double-click "SurugaOptGauge" 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.
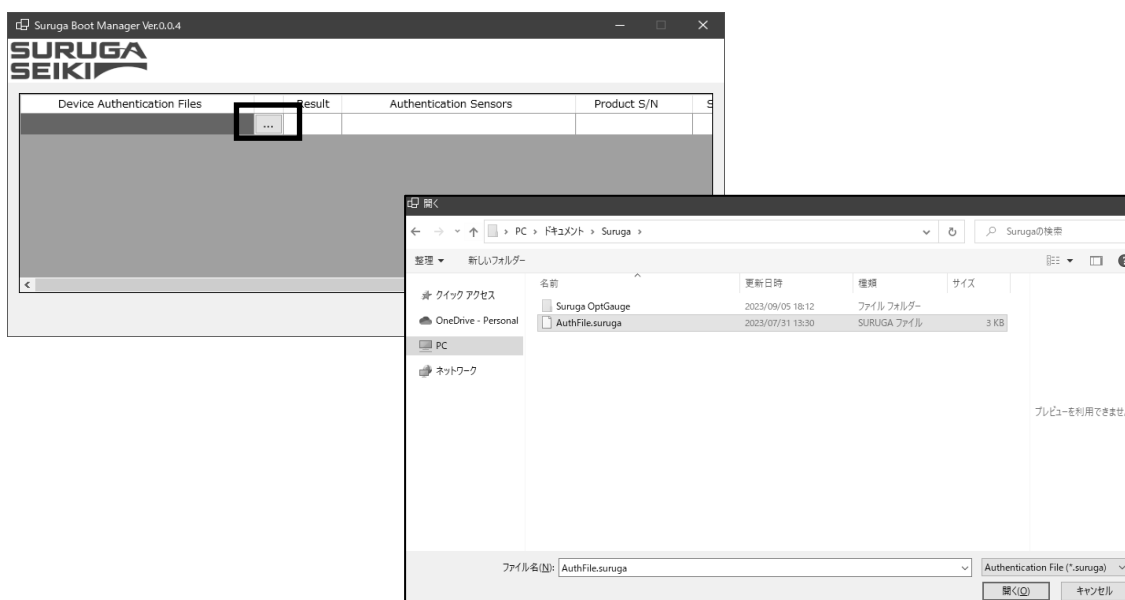
3. Confirm the "Result" is "OK", and press "Start".
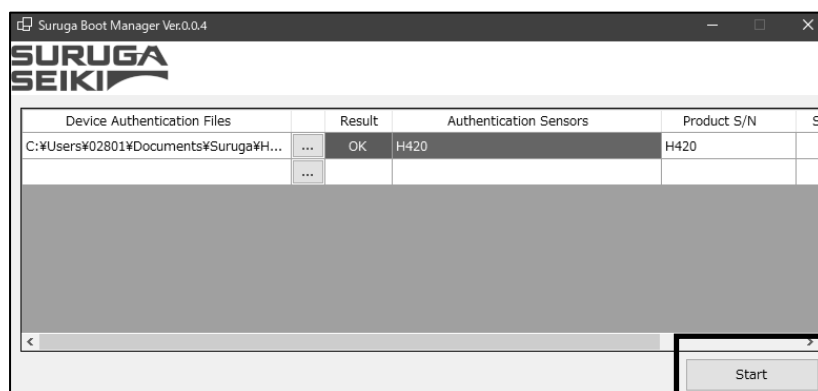
Attention

*Because this software controls TCP/IP communication, the following warning may appear depending on the security settings of your PC for first time launching.

If your PC or network environment allows TCP/IP communication, check all the boxes, and click "Allow Access. If not, please click "Cancel".

（If you want to change the settings later, you can do so in "Control Panel ➤ All Control Panel Items ➤ Windows Defender Firewall ➤ Allowed Apps").
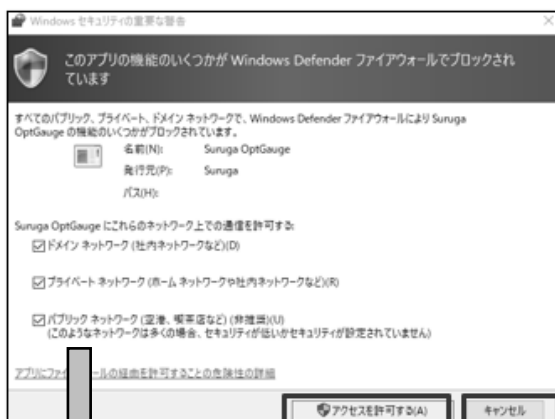
4. The software starts
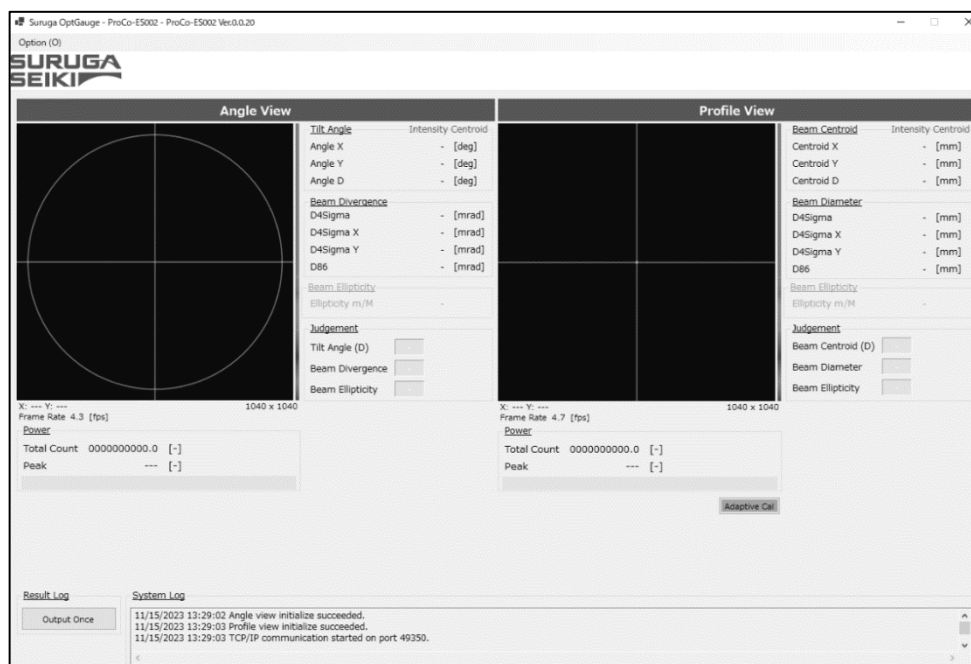
OptGauge shutdown

1. Click the "X" in the OptGauge.
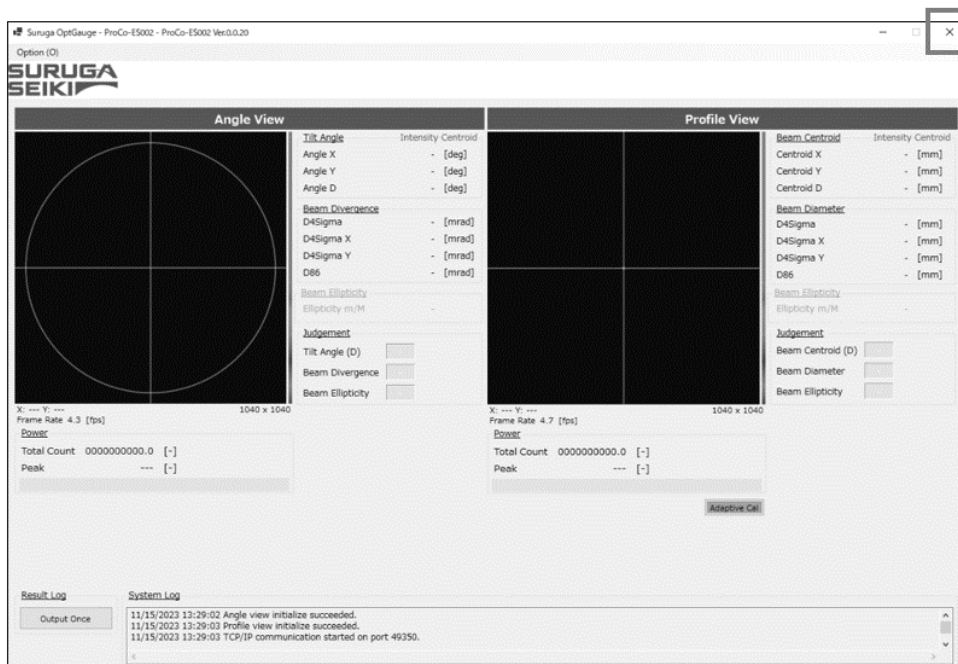
2.12 Power UP

Do not turn on the sensor head until the installation of the Products and the software installation are complete and the person in charge has confirmed that the operation is all safe.

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

USB3.0

USB3.0

Internal light
ON/OFF switch

FG terminal

DC12 V Power
For the internal light

Light intensity
adjustment knob
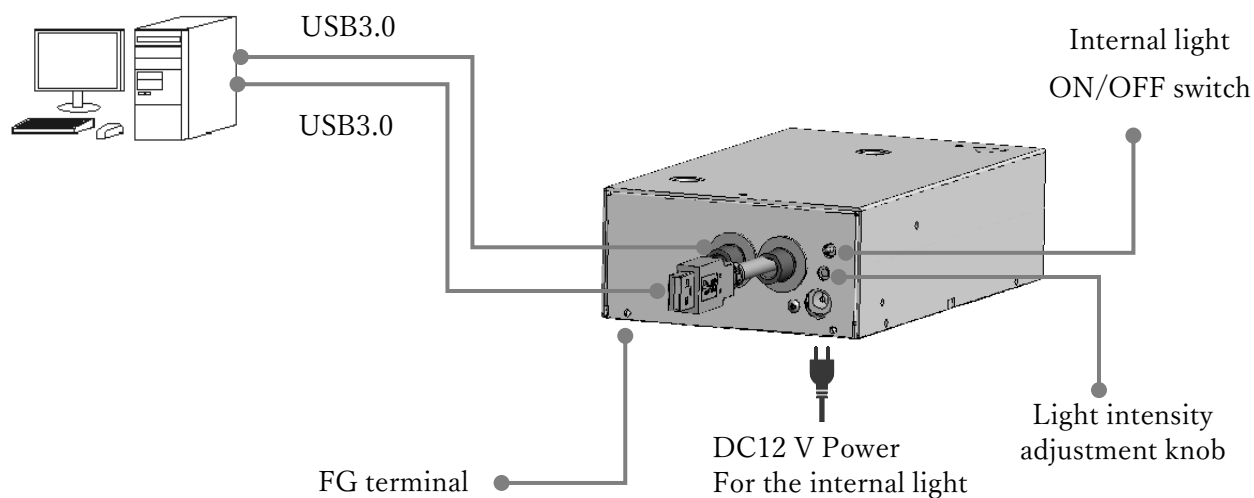
3. Settings

3.1 This section describes how to set the sensor head using the software - Suruga OptGauge

- for the Products. Precautions for Handling the Sensor Head and Setting (installation)

Method

3.1.1   The Reflection Angle Measurement

1.   Turn off the H650's internal light source and set a device under test to be in 200 mm away from the reference plane.
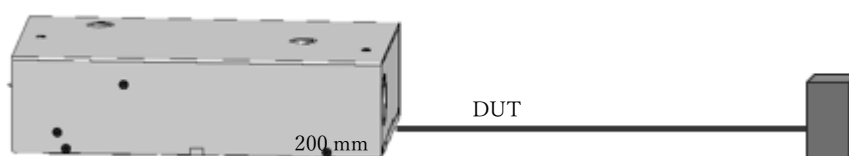
2.   Turn on the internal light source switch after installation is complete.
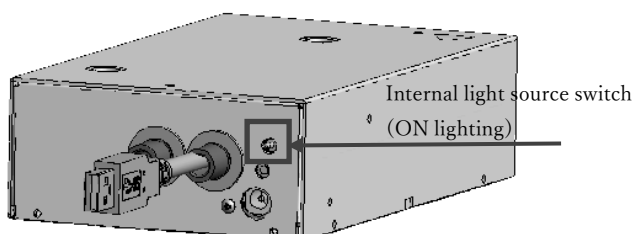
3.   Start the OptGauge and open the Option screen.

33
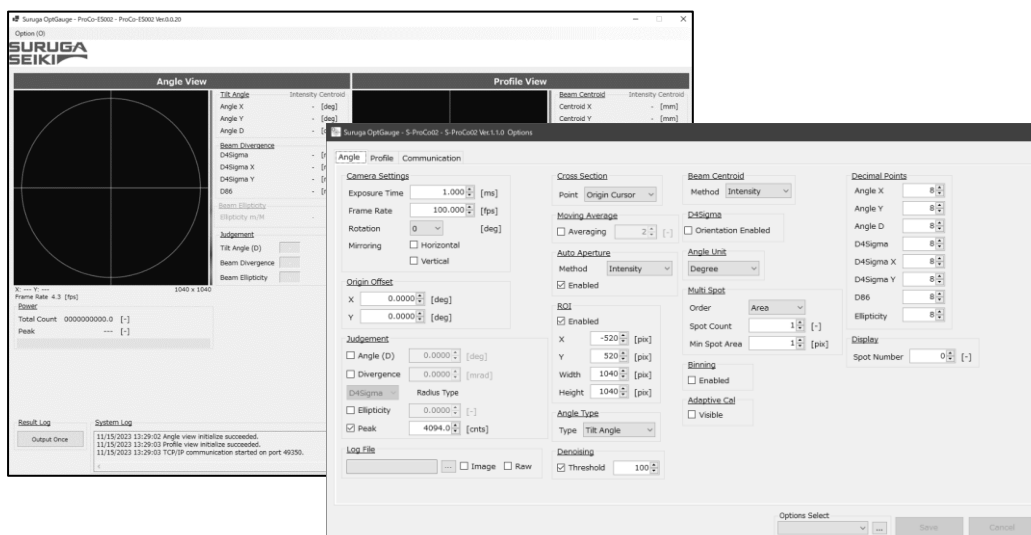
4. Set Angle Type[1] to "Tilt Angle" on the Angle tab in the option screen.

5. Set the Peak[2] in the measurement screen to be between 3500 and 3800 (optimum value) by adjusting "Exposure Time"[1] in the Options screen and the light intensity with the screwdriver on the light intensity adjustment knob.

    [1] refer to the "Angle Type" in the Measurement Option Settings.
    [2] refer to the "CameraSettings" in the Measurement Option Settings.
    [3] refer to the "Power" on the OptGauge Main Screen.

3.1.2　Measuring an External Incident Light Beam

1. Turn off the H650's 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.

External Ligh Source

2. Start the OptGauge and open the Option screen.
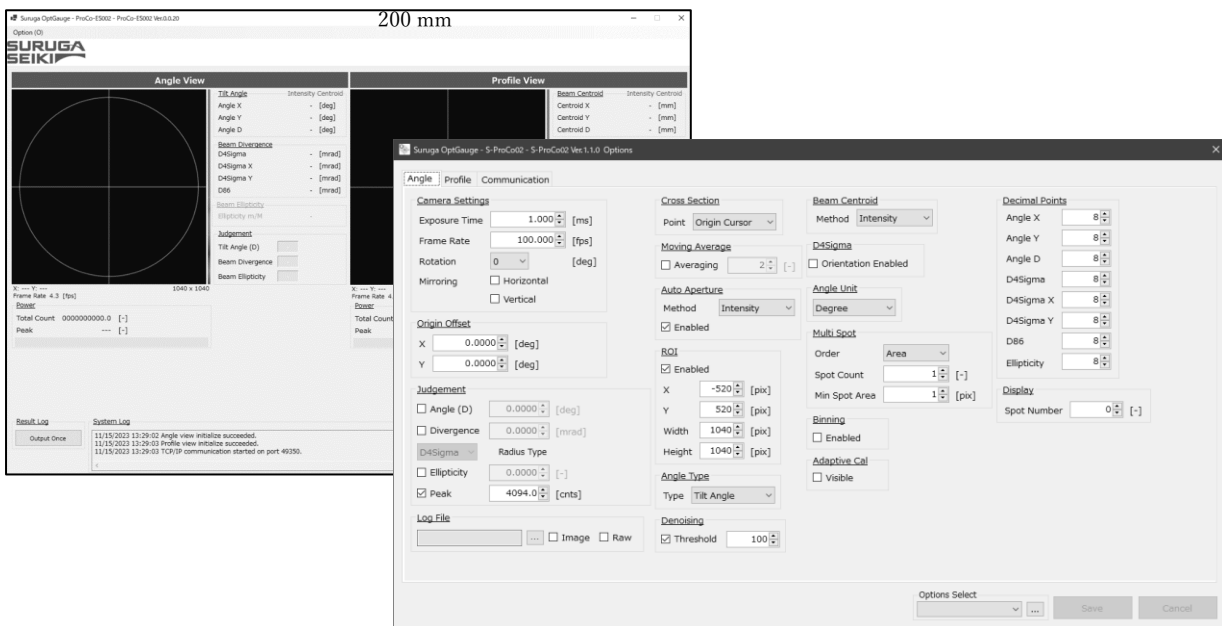
3. Set Angle Type[*1] to "Beam Angle" on the Angle tab in the Option screen.

   Set the Peak[*2] in the Measurement screen to be between 3500 and 3800 (optimum value) by adjusting "Exposure Time"[*3] in the Options screen and the light intensity with the screwdriver on the light intensity adjustment knob.

*1 refer to the "Angle Type" in the Measurement Option Settings.

*2 refer to the "Camera Settings" in the Measurement Option Settings.

*3 refer to the "Power" on the OptGauge Main Screen.

3.2 The Software – Items and Functions on the Main Screen of the Software

OptGauge Main Screen
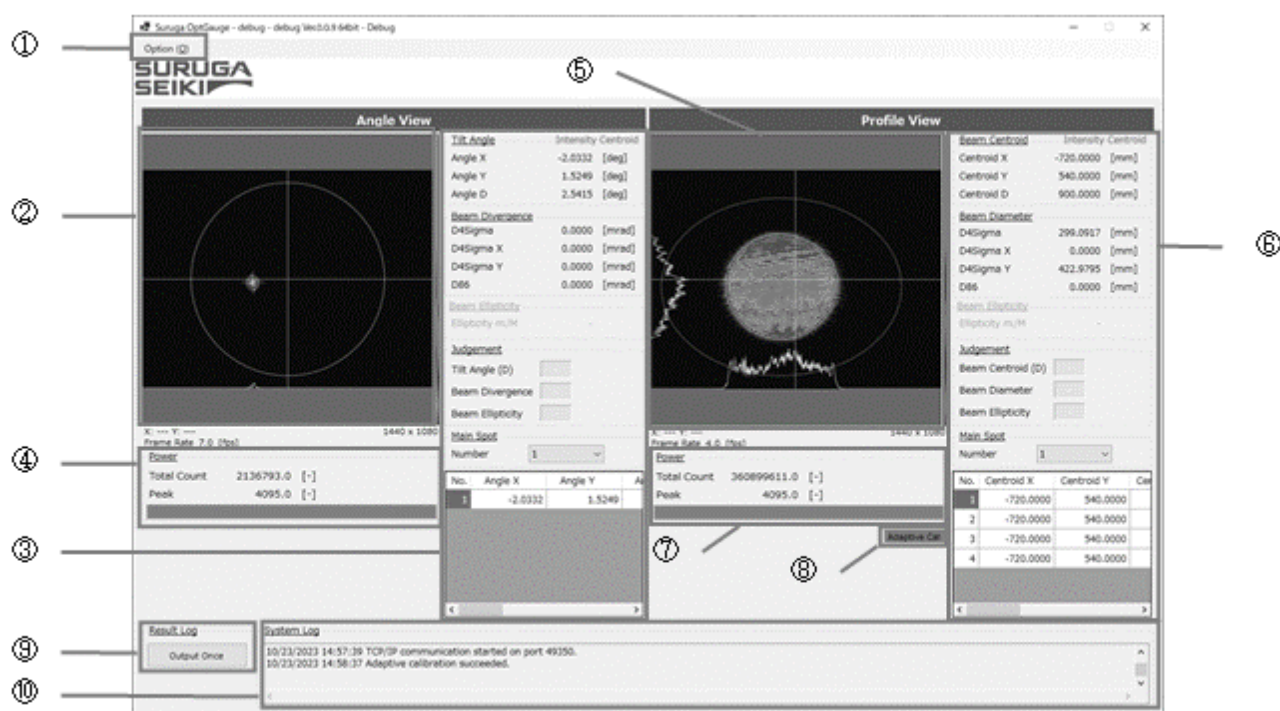
①	Option	Opens the Options dialog box
②	Angle View	Area for an image taken by the angle sensor
③	Angle measurement results	Area for angle measurement results
④	Angle Power	Area for beam intensity taken by the angle sensor
⑤	Profile View	Area for an image taken by the profile sensor
⑥	Profile measurement results	Area for the Profile measurement results
⑦	Profile Power	Beam intensity measured by the Profile sensor
⑧	Adaptive Cal	Execute the Adaptive Calibration (denoising)
⑨	Result Log	Output measurement results and measurement images to a designated file folder on PC.
⑩	System Log	Area for software operation logs

3.2.1 OptGauge Main Display Details

3.2.1.1 Angle View

① Cross（Red）		The centroid position of a light beam
② Aperture（Blue、Orange）		Limit the area for computation with respect to observation. See "Aperture" in the Function Details
③ Cross（white）		The center position of the coordinates
④ Aperture（white）		The range of angle measurement
⑤ Profile		The intensity distribution of a beam

⑥ Tilt(Beam)Angle	Selecting the measurement mode at "Angle Type" in the Option settings	
	See "Tilt(Beam)Angle" in the Function Details	
	Angle X	Angle of the X-axis component of the center cross(white)
	Angle Y	Angle of the Y-axis component of the center cross(white)
	Angle D	Angle from the center cross (white)
⑦ Beam Divergence	Selecting the measurement mode at "D4Sigma" in the Option settings	
	See "divergence" in the Function Details	
	D4Sigma	Displays Divergence of D4σ beam in half angle
	D4Sigma X(M)	Displays D4σ X(M) divergence in half angle
	D4Sigma Y(m)	Displays Divergence of D4σ Y(m) in half angle
	D86	Displays Divergence of D86 beam in half angle
⑧ Beam Ellipticity	Available when "Orientation Enabled" in the Option Settings is in active.	
	See "Beam Ellipticity" in the Function Details	
	Ellipticity m/M	Displays the ellipticity of the D4σ beam width
⑨ Judgement	In the "Judgement Settings", enter ☑ for the measurement data you wish to judge、 and set the judgement criteria in [0.0000 ⇅]	
	See "Judgement" in the Function Details	
	Tilt Angle (D)	"OK" is displayed if the set criteria are met, "NG" if not
	Beam Divergence	
	Beam Ellipticity	
⑩ Main Spot	Number	Specifies beam spots to be displayed in "⑥ Tilt(Beam)Angle", "⑦ Beam Divergence", and "⑧ Beam Ellipticity" during multi-point beam measurement.
⑪ Multi Spot Meas. Display Area	When multiple beam spots are detected, the measurement results for the beam spots are automatically listed and displayed.	
⑫ X-Y Coordinates	Coordinates are displayed when the mouse cursor is hovered over	
Frame Rate	The image update rate per second from image data capture to completion of measurement data calculations	
⑬ Power	Total Count	Total count value of a light beam (0～4,429,152,000)
	Peak	Maximum beam intensity (0～4095)
⑭ Adaptive Cal	Improve calculation accuracy by removing overall noise from an image captured by the sensor.	
	See "Adaptive Cal" in the Function Details	

3.2.1.2 Profile View

① Cross（Red）		The centroid position of a light beam
② Aperture（Blue、Orange）		Limit the area for computation with respect to observation*. *See "Aperture" in the Function Details
③ Cross（white）		The center position of the coordinates
④ Aperture（white）		The range of angle measurement
⑤ Profile		Display the intensity distribution of a beam

|		Centroid X	The centroid X centered at the X-axis component of the cross (white)
⑥	Beam Centroid	Centroid Y	The centroid Y centered at the Y-axis component of the cross (white)
		Centroid D	The centroid centered at the cross (white)
⑦	Beam Diameter	Change measurement mode by the "D4Sigma" in the Option settings See "Beam diameter" in the Function Details	
		D4Sigma	Displays D4σ beam diameter
		D4Sigma X(M)	Displays D4σ X(M) beam width
		D4Sigma Y(m)	Displays D4σ Y(m) beam width
		D86	Displays D86.5 beam diameter
⑧	Beam Ellipticity	Available when "Orientation Enabled" in the Option settings is in active. See "Beam Ellipticity" in the Function Details	
		Ellipticity m/M	Displays ellipticity of D4σ beam width
⑨	Judgement	In the "Judgement Settings", enter ☑ for the measurement data you wish to judge、and set the judgement criteria in ⌷ 0.0000 ⌄ See "Judgement" in the Function Details	
		Beam Centroid (D)	"OK" is displayed if the set criteria are met, and "NG" if not
		Beam Diameter	
		Beam Ellipticity	
⑩	Main Spot	Number	Specifies beam spots to be displayed in "⑥ Beam Centroid ", "⑦Beam Diameter ", and "⑧ Beam Ellipticity " during multi-point beam measurement.
⑪	Multi Spot Measurement Display Area	When multiple beam spots are detected, the measurement results for the beam spots are automatically listed and displayed.	
⑫	X-Y coordinates	Coordinates are displayed when the mouse cursor is hovered over	
	Frame Rate	The image update rate per second from image data capture to completion of measurement data calculations	
⑬	Power	Total Count	Total count value of a beam (0～4,429,152,000)
		Peak	Maximum intensity of a beam (0～4095)
⑭	Adaptive Cal	Improve calculation accuracy by removing overall noise from an image captured by the sensor. See "Adaptive Cal" in the Function Details	

3.3 Function Details (and Parameters Detail Setting Details)
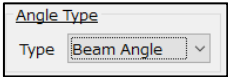
3.3.1   Angle View

3.3.1.1   Tilt Angle/Beam Angle

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".

For the reflectance angle measurement	
Set "Angle Type" in option settings to [Tilt Angle] Angle Type Type Tilt Angle	It starts reflectance angle measurement. **Angle View** Tilt Angle — Intensity Centroid Angle X -0.4091 [deg] Angle Y 0.4091 [deg] Angle D 0.5786 [deg] Beam Divergence D4Sigma 40.5876 [mrad] D4Sigma X 39.9275 [mrad] D4Sigma Y 41.2370 [mrad] D86 37.5164 [mrad] Beam Ellipticity Ellipticity m/M - Judgement Tilt Angle (D) Beam Divergence Beam Ellipticity
For the external light angle measurement	
Set "Angle Type" in option settings to [Beam Angle]. Angle Type Type Beam Angle	It starts external light angle measurement. **Angle View** Beam Angle — Intensity Centroid Angle X -0.8183 [deg] Angle Y 0.8183 [deg] Angle D 1.1572 [deg] Beam Divergence D4Sigma 40.2099 [mrad] D4Sigma X 39.9293 [mrad] D4Sigma Y 40.4886 [mrad] D86 37.3848 [mrad] Beam Ellipticity Ellipticity m/M - Judgement Beam Angle (D) Beam Divergence Beam Ellipticity
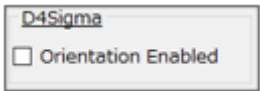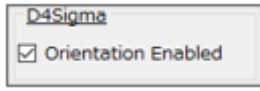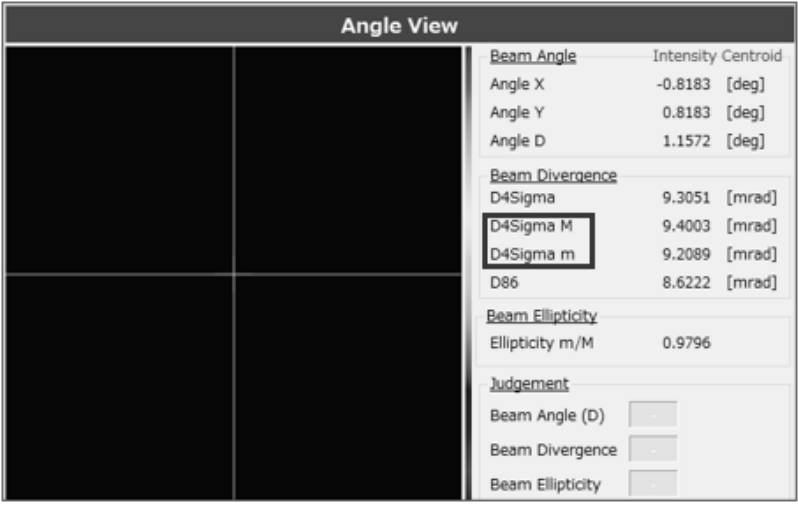
3.3.1.2   Divergence

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

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

This Products display divergence in a half-angle with mrad (milliradian).

It has two modes of measurement.

To measure D4σ beam diameter (elliptical beam) of divergence along with X-axis and Y-axis directions	
Set "Orientation Enabled" in the option settings to "Disabled". D4Sigma ☐ Orientation Enabled	Measures beam divergence with "D4Sigma X" and "D4Sigma Y" **Angle View** Beam Angle — Intensity Centroid Angle X -0.8183 [deg] Angle Y 0.8183 [deg] Angle D 1.1572 [deg] Beam Divergence D4Sigma 9.2866 [mrad] D4Sigma X 9.1816 [mrad] D4Sigma Y 9.3905 [mrad] D86 8.6078 [mrad] Beam Ellipticity Ellipticity m/M - Judgement Beam Angle (D) Beam Divergence Beam Ellipticity
To measure a D4σ beam diameter (elliptical beam) of divergence along with M (major: long axis) and m (minor: short axis)	
Set "Orientation Enabled" in the option settings to "Enabled". D4Sigma ☑ Orientation Enabled	「D4Sigma M」、「D4Sigma m」でダイバージェンスを測定します **Angle View** Beam Angle — Intensity Centroid Angle X -0.8183 [deg] Angle Y 0.8183 [deg] Angle D 1.1572 [deg] Beam Divergence D4Sigma 9.3051 [mrad] D4Sigma M 9.4003 [mrad] D4Sigma m 9.2089 [mrad] D86 8.6222 [mrad] Beam Ellipticity Ellipticity m/M 0.9796 Judgement Beam Angle (D) Beam Divergence Beam Ellipticity

3.3.1.3 Beam Centroid

The center position of a light spot can be selected from the types either beam area (area centroid) and beam intensity (luminance centroid) in the "Beam Centroid" in the option setting. We recommend selecting the type of "Beam Centroid" according to an object 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 objects such mirror with uniform surface and reflects 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.

Detection example
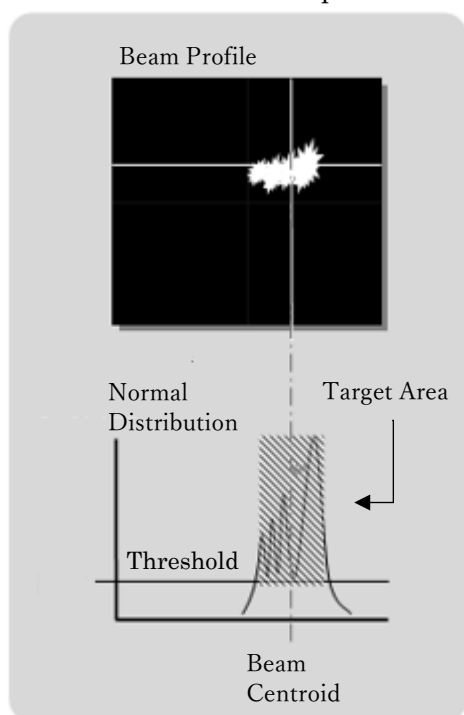
Recommended DUTs

Luminance Centroid

For luminance [Intensity] centroid, the centroid position of a light beam is calculated from the beam intensity with higher luminance than the denoising threshold value and results as an angle.

By lowering the threshold value, the Intensity Centroid can include the luminous point peripheral area causing blur or smudge.

We recommend selecting this type of measurement mode for objects such mirror with uniform surface which reflects a light beam without blur or smudge[*].

We recommend selecting this type of measurement mode for objects such as resin with non-uniform surfaces which reflects a light beam with blur or smudge.

Detection example

Beam Profile
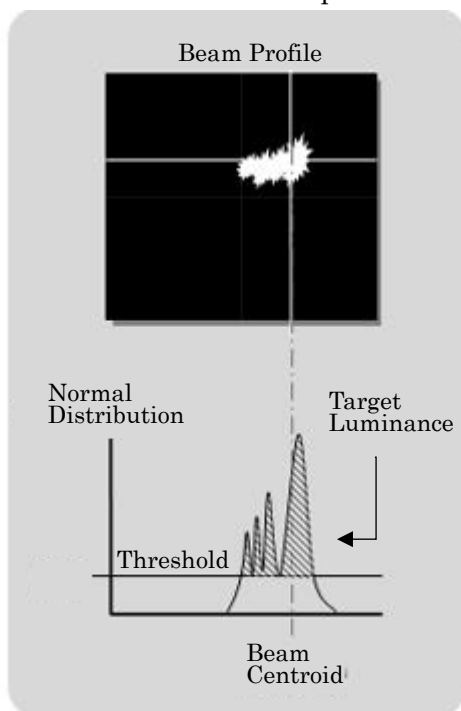
Recommended DUTs

Concave Lens

Normal Distribution

Target Luminance

Threshold

Beam Centroid

3.3.1.4   Beam Ellipticity

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

Beam ellipticity formula:

> Beam Ellipticity = D4 σ m (minor) beam diameter / D4 σ M (major) beam diameter

The following describes its use.

Beam Ellipticity Usages

Beam Ellipticity is used when you want to measure the parallelism of two or more devices.

1. The beam spots of "Sub 1" and "Sub 2" shown in the right are incident lights to 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.
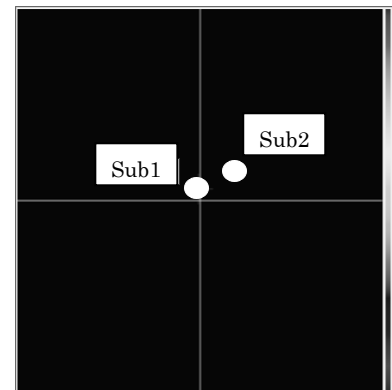
2. As the two beam spots move close together, the sensor begins to perceive them as a single elliptical beam.

    Therefore, it is no longer possible to measure their individual angle or their parallelism.
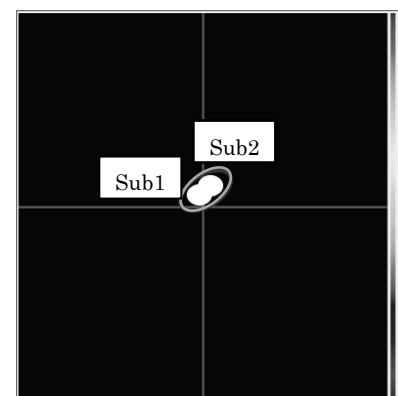
3. On this state as the previous, the beam ellipticity function comes to use.
The beam is measured in ellipticity.
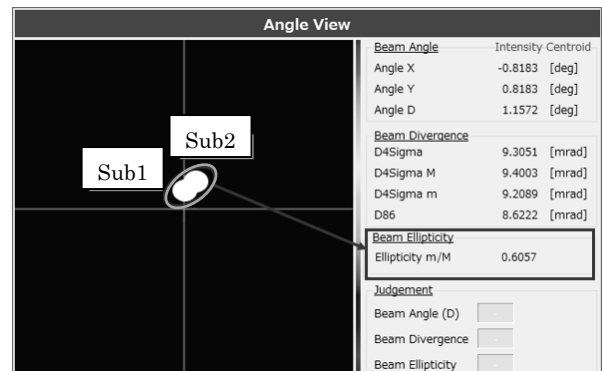
4. Move the two beams even closer together. Closer the ellipticity to 1.000, the two targets are nearer to parallel.
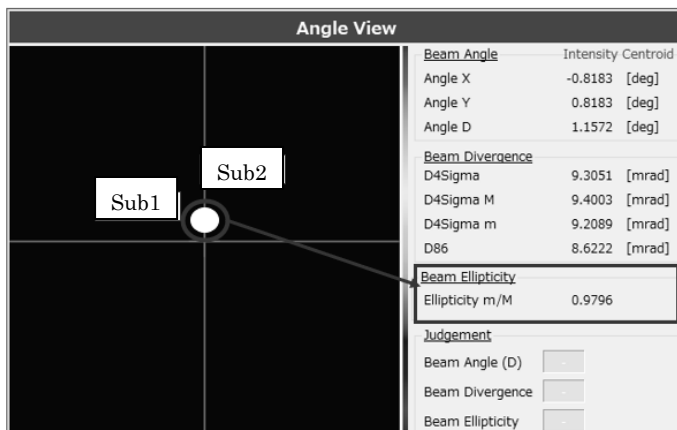
For ellipticity measurement	
Set "Orientation Enabled" in option settings to "Enabled".	
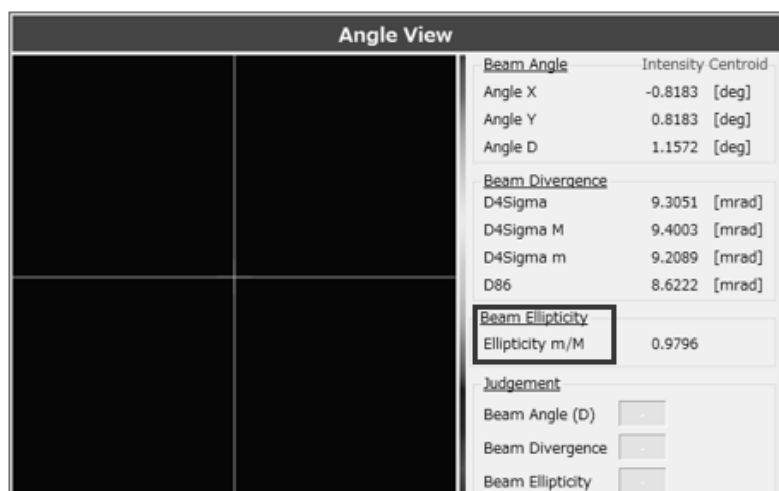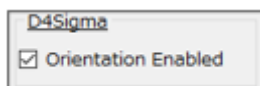
3.3.1.5   Judgement

The judgement function is available in an intuitively understandable expression of whether or not the measurement value is within the target range.
Here, as examples, we have the procedures for Angle (D) and Peak.

For Angle (D)

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

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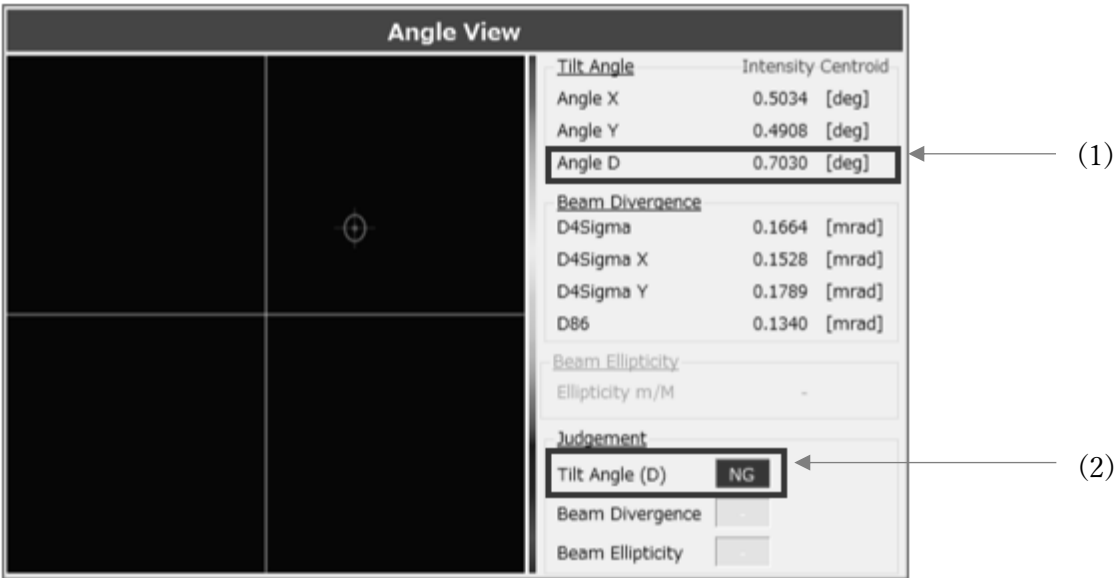
3. As a result of adjusting the angle one more time, the result of Angle D on the measurement screen is
   less than 0.5000 deg(1), so the judgment result of "Tilt Angle(D)" in "Judgement" is displayed as
   OK(2).
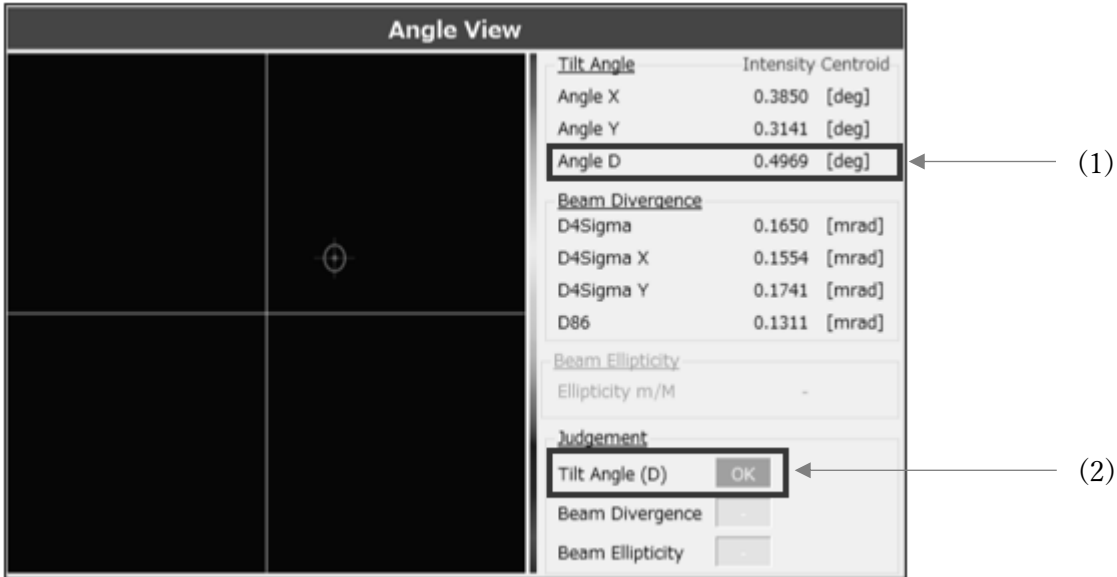
For the Peak

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 be "3500.0".
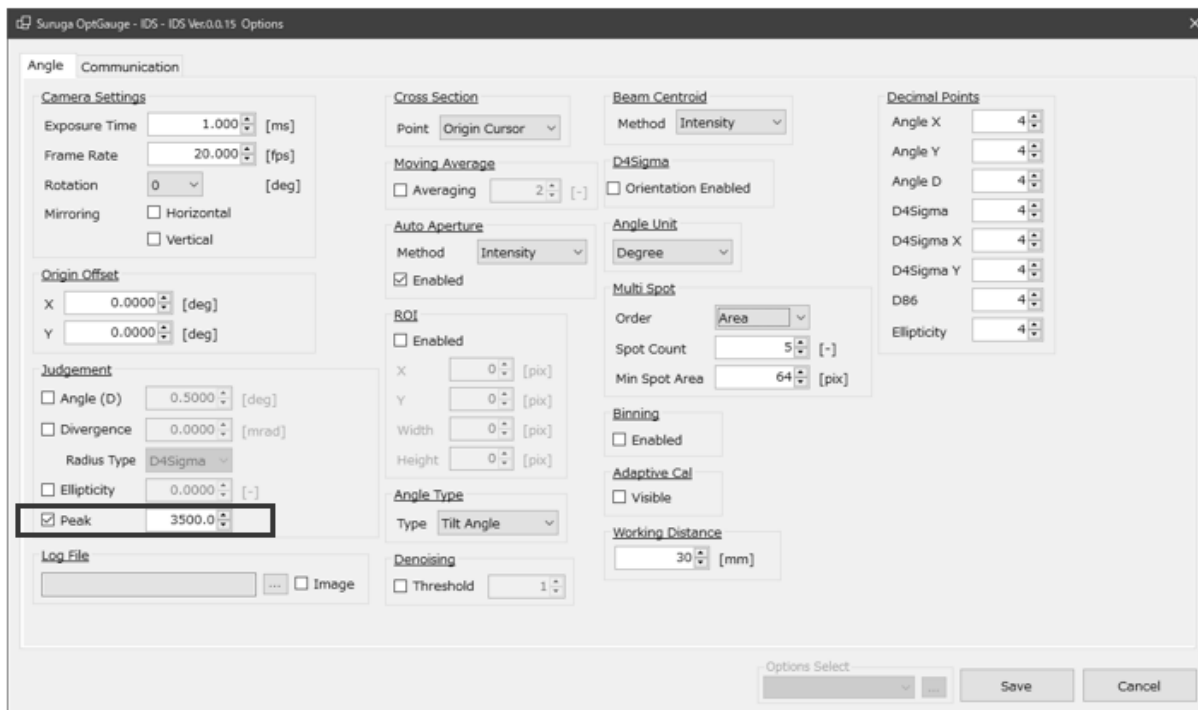
2. Because the result of Peak light intensity adjustment on the measurement screen is not less than 3500.0(1), the judgement result is "NG"(2), and the peak bar is in red.
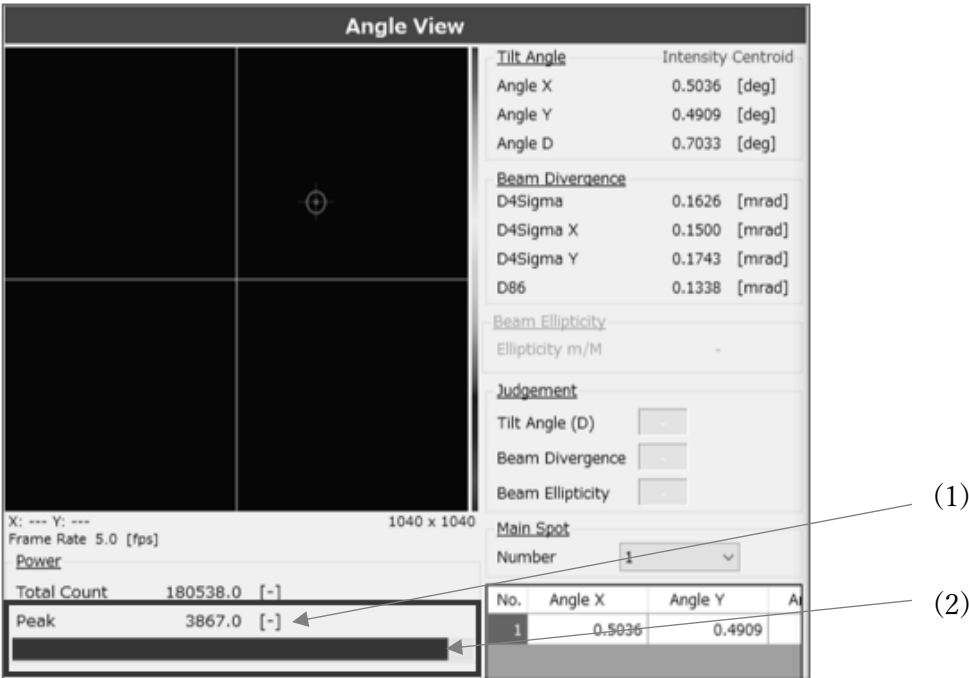
3. When the result of repeated Peak light intensity adjustment on the measurement screen is less than 3500.0(1), the judgement result is "OK"(2), and the peak bar is in green.
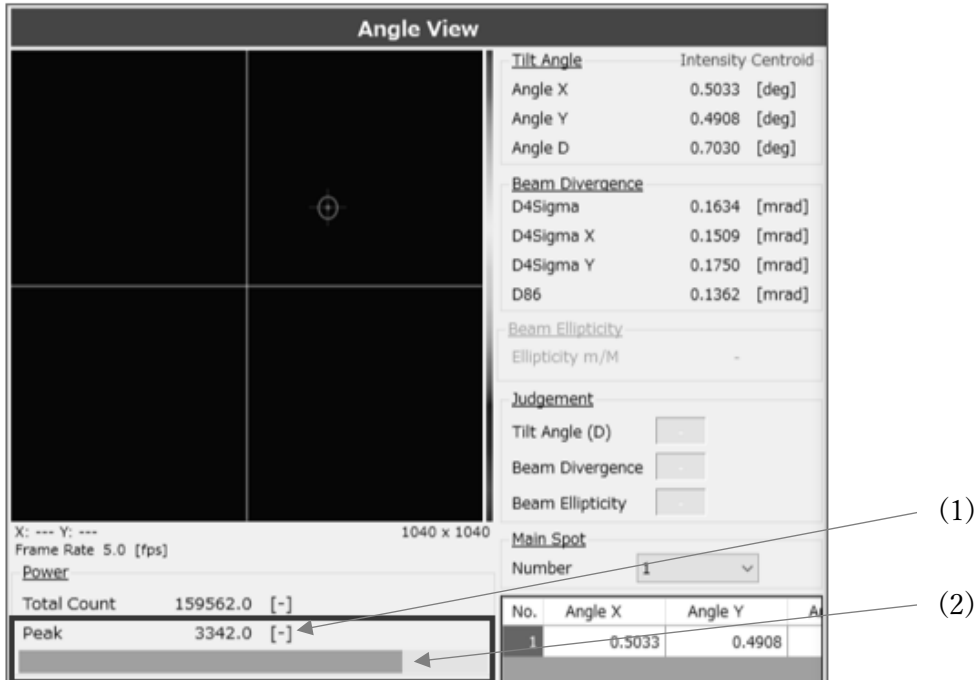
3.3.1.6 Adaptive Cal

The "Adaptive Cal" is a function that improves light 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.

It is recommended to run this function when starting up the application and every time the exposure time in the camera settings is changed.

1. Deflect the beam not to enter the product.
2. Click the "Adaptive Cal" button.
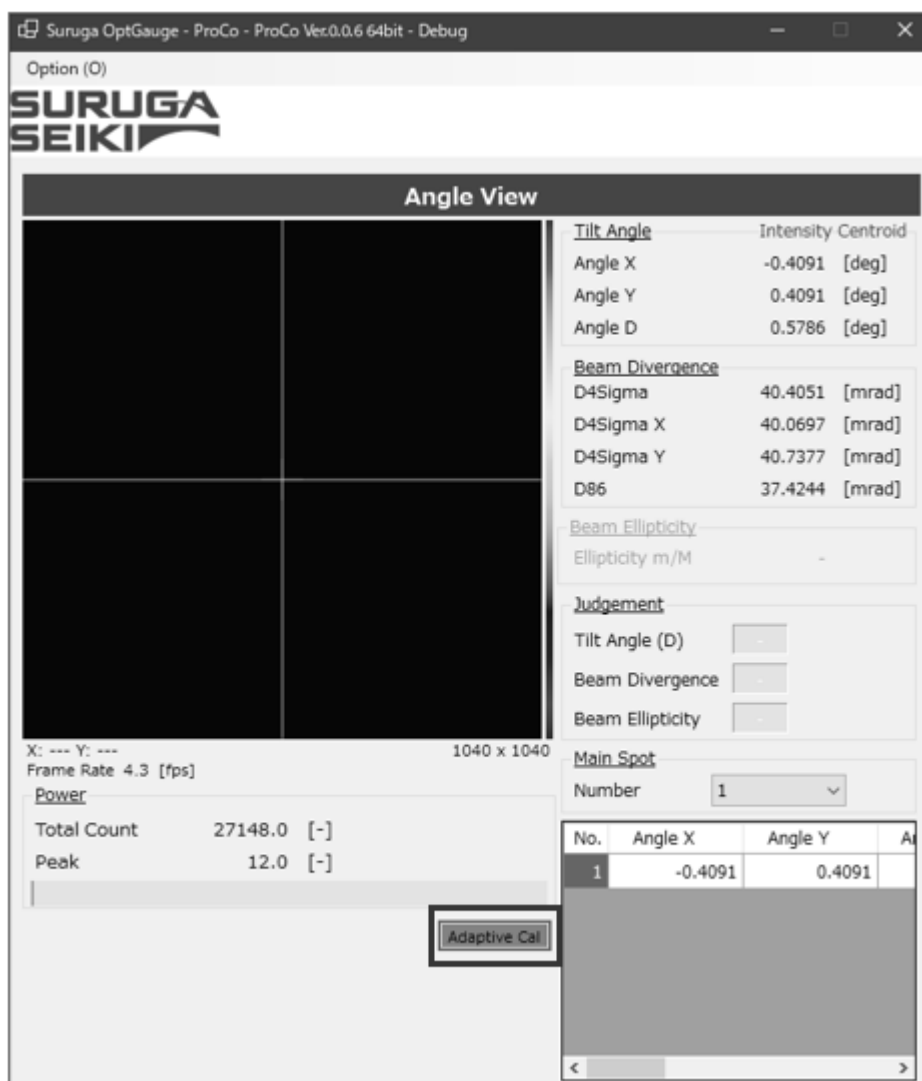
3. When adaptive calibration is executed, the button color changes.
4. When "Adaptive Calibration succeeded" is displayed in the System Log, the process is complete.
5. Thereafter, set the beam incoming to the product and begin measurement.
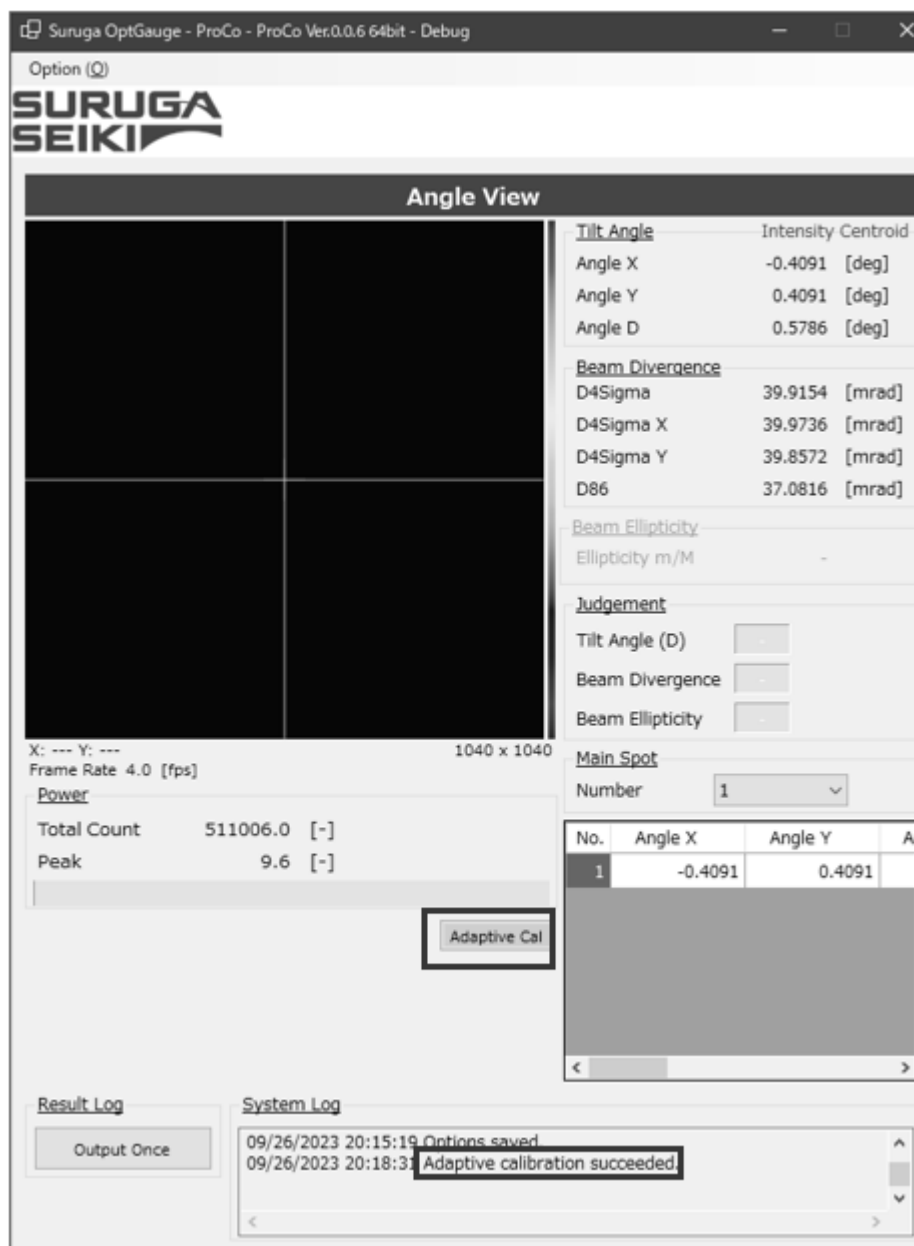
If the beam is incoming to the product or the ambient light is causing serious noise, the Adaptive Cal will not succeed. Execute it in an environment where light does not enter the sensor camera.

3.3.1.7 Aperture

The "Auto Aperture" and "ROI" settings are available to eliminate the effects of noise such as ambient light are not included in the beam divergence measurement results.
By using these two functions, measurement excluding ambient light, etc., can be done.
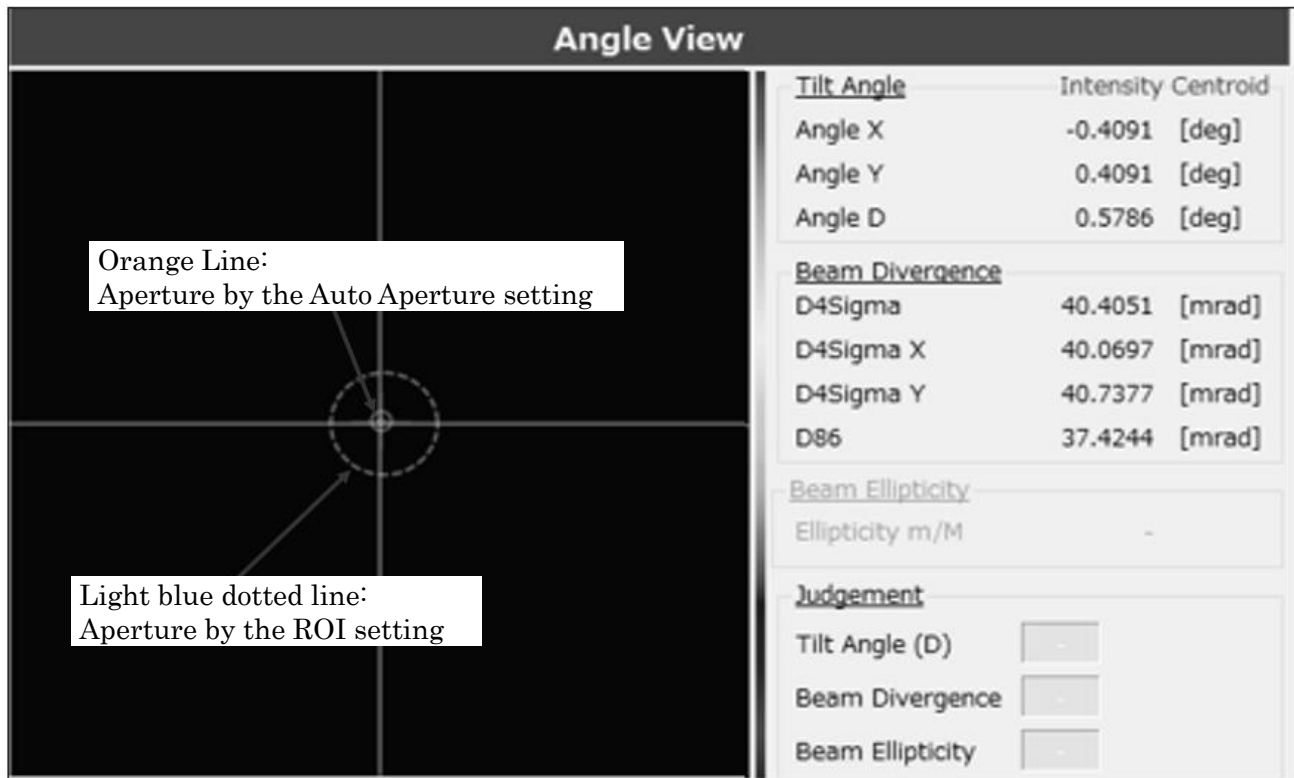
Aperture Explaination

Auto Aperture	This function is suitable for measuring dynamic beams where the position, size, shape, or intensity of the beam may vary over time. It automatically adjusts aperture.
ROI	This function is suitable for measuring beams whose position, size, shape, and intensity rarely vary with time. The aperture must be adjusted manually.

Auto Aperture and ROI together can enhance only the important parts of the beam intensity, shape, and position, and by minimizing noise and interference it improves the accuracy of measurement.
It is recommended that both be used simultaneously in situations where the beam position does not change.

Setting Auto Aperture	
Set "Auto Aperture" in option settings to [Enabled] Auto Aperture ☑ Enabled	
Setting ROI	
Enable "ROI" in the option settings and set the X, position, width, Height (size) to enclose the beam. ROI ☑ Enabled X 28 [pix] Y 137 [pix] Width 100 [pix] Height 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, Y (location), Width, and Height (size) of the "ROI".	
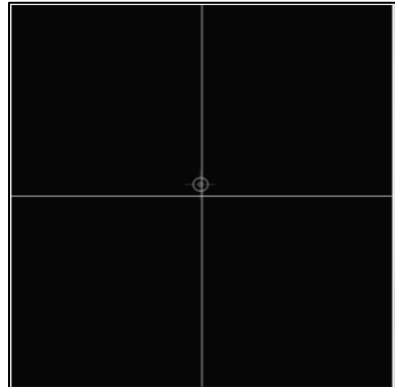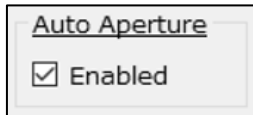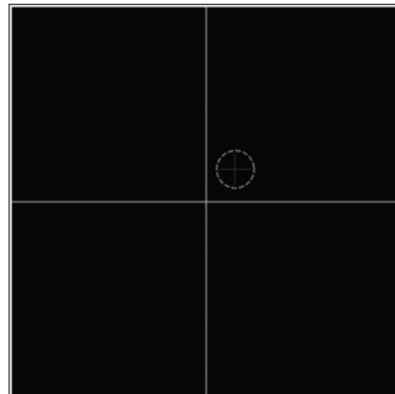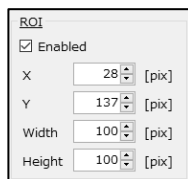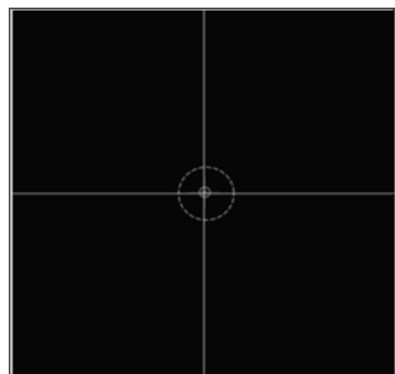
3.3.1.8 Origin Offset

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

By using the offset function, an arbitrary position can be aligned as the reference position.
There are two offset methods.

Setting Methods

Setting from the Option Screen	
Set "Origin Offset" in Option settings to the desired value Origin Offset X 0.0000 [deg] Y 0.0000 [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 - Offset white cursor at X=0.5 deg and Y=0.5 deg Beam Divergence Beam Ellipticity
Setting from the View Screen	
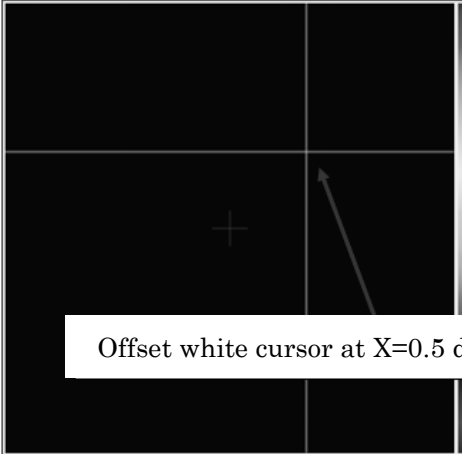
1. Open the option setting screen.
2. Target the view screen cross (white) cursor.
3. When the mouse icon changes, drag and drop.

4. Because "Origin Offset" has been changed, save the option settings.

Origin Offset
X 0.6747 [deg]
Y 0.4445 [deg]

3.3.1.9 Zoom In

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

1. Left-click the view screen.
2. A pop-up window will be displayed.
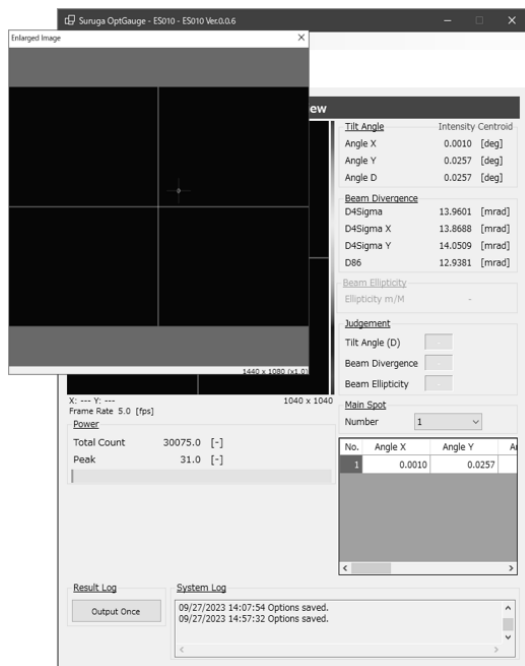
3. Drag and drop the display to be enlarged, and a zoomed area will appear.
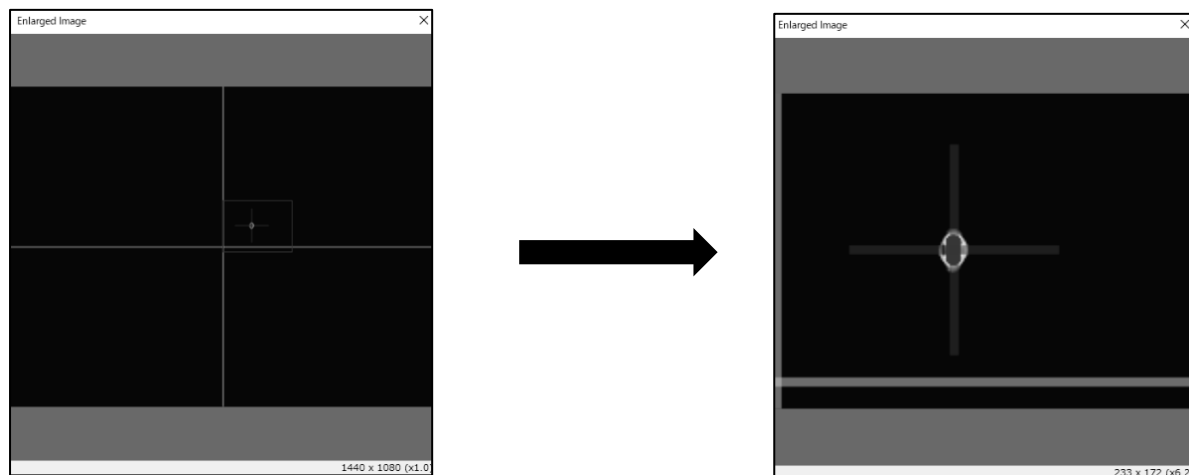
4. Right-click to quit the zooming display.
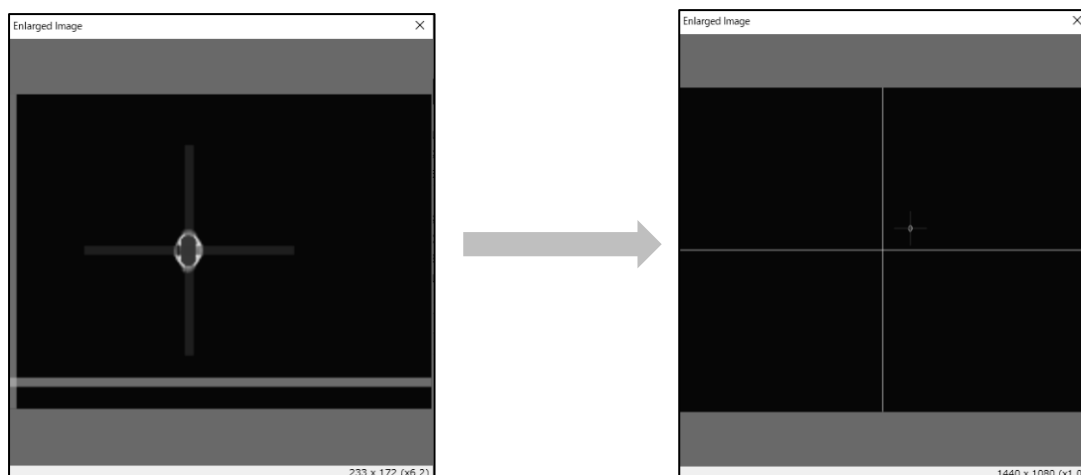
5. To close the pop-up window, click the [X] button.
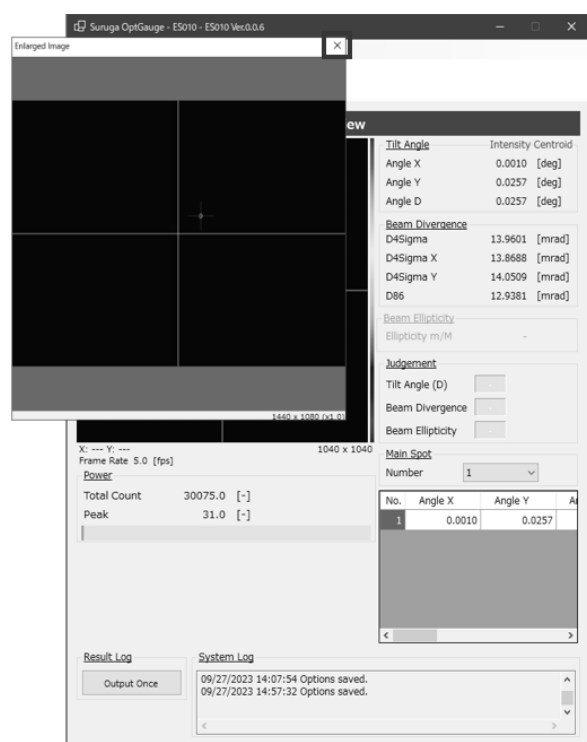
3.3.1.10 Multi Spot

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.
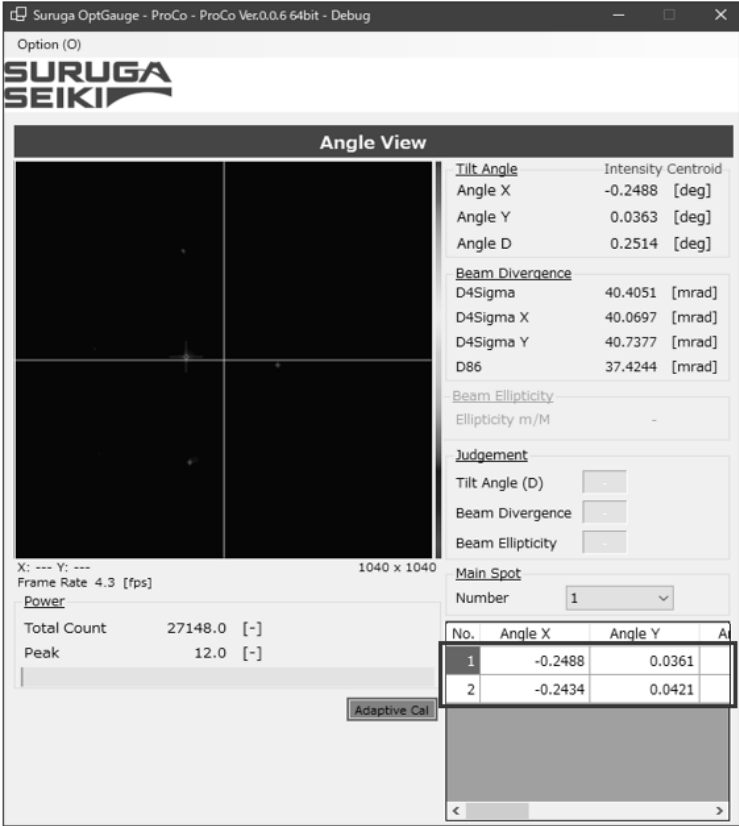
Setting Methods

To enter the number of measurement spots to be displayed	
Change "Spot Count" in option settings	Changing "Spot Count" enables the number displayed on the measurement results screen to be designated.

To enter the conditions (size) of the beams to be detected as measurement targets	60

Change "Min Spot Area" in option settings 	Changing "Min Spot Area" enables the conditions of the beams to be detected as measurement targets to be designated. Info Use pixels for the values set for beam conditions. The setting example detects beam areas of 200 pix or higher received by the camera as measurement targets.
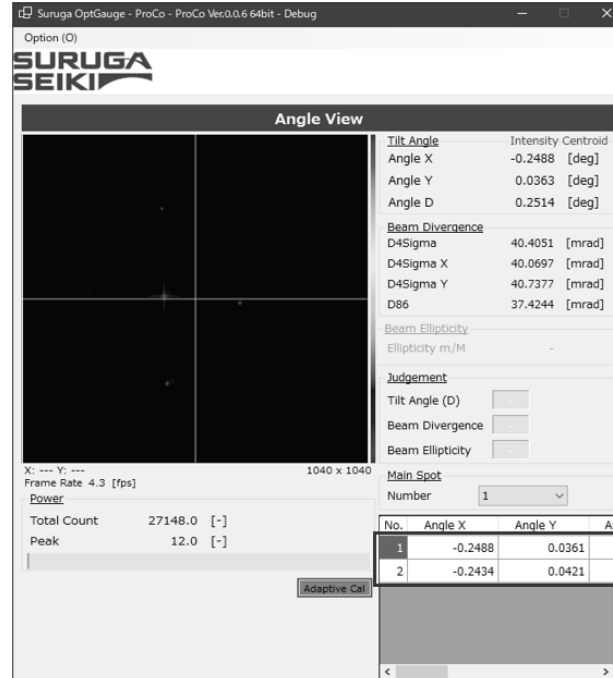
3.3.2   Profile View

3.3.2.1 Beam Centroid

Beam Centroid (light beam center) is available for measurement.

A beam center determines distance from the center of coordinates to an incident beam center.
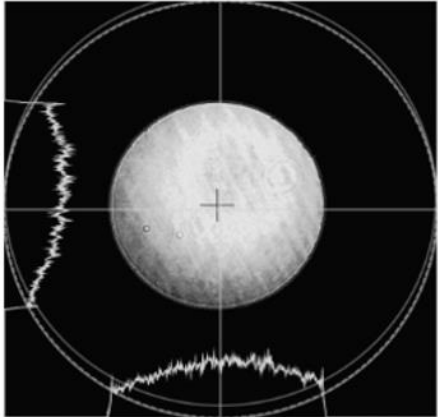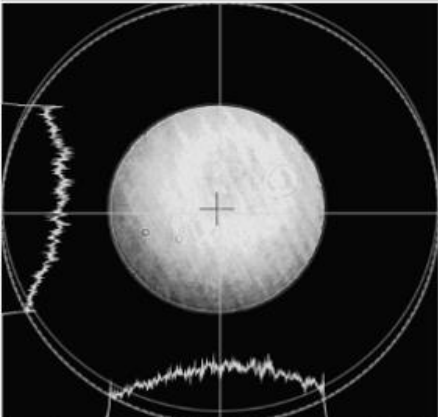
The center position of a light spot can be determined in either Area centroid or Intensity centroid at "Beam Centroid" in the Option settings. We recommend selecting the modes depending on a device under test.

3.3.2.2 Beam Diameter

Measuring beam diameter is available.
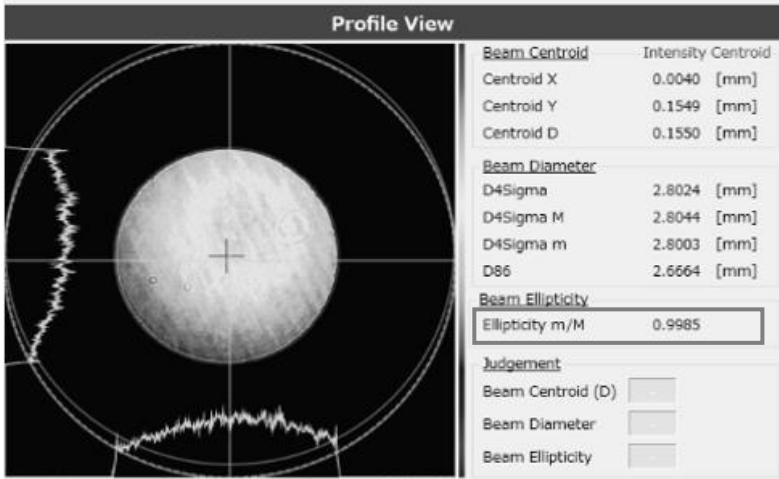
The beam diameter is the size measurement of an incident beam to the Profile sensor in "mm" or "μ m ".

The measurement consists of two modes.

To measure D4σ beam diameter (elliptical beam) in X-axis and Y-axis directions	
Set the "Orientation Enabled" in the Option settings to "Disabled". D4Sigma ☐ Orientation Enabled	To measure beam diameter with "D4Sigma X" and "D4Sigma Y"
To measure the M (major axis) and m (minor axis) beam diameters of D4σ beam (elliptical beam)	
Set the "Orientation Enabled" in the Option settings to "Enabled". D4Sigma ☑ Orientation Enabled	To measure beam diameter with "D4Sigma M" and"D4Sigma m"

3.3.2.3 Beam Ellipticity

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

To measure Ellipticity	
Set the "Orientation Enabled" in the Option settings to "Enabled". D4Sigma ☑ Orientation Enabled	

3.3.2.4 Judgement

The judgment function is provided to express in an intuitively understandable manner whether the measured value is within the target range.
See " Angle View->Judgement" In the Function Details for the settings.

3.3.2.5　Adaptive Cal

Adaptive Cal is a function that removes a certain amount of noise from the entire image data acquired by the sensor camera so that measurement errors caused by noise should be reduced. This function is an automatic noise reduction function that calculates the baseline correction value from the entire sensor and offsets the amount from each pixel data.

It is recommended to execute this function when starting up the application and every time the exposure time in the camera settings is changed.

1. Check the mark front of "Visible" at the Adaptive Cal in the Option setting.
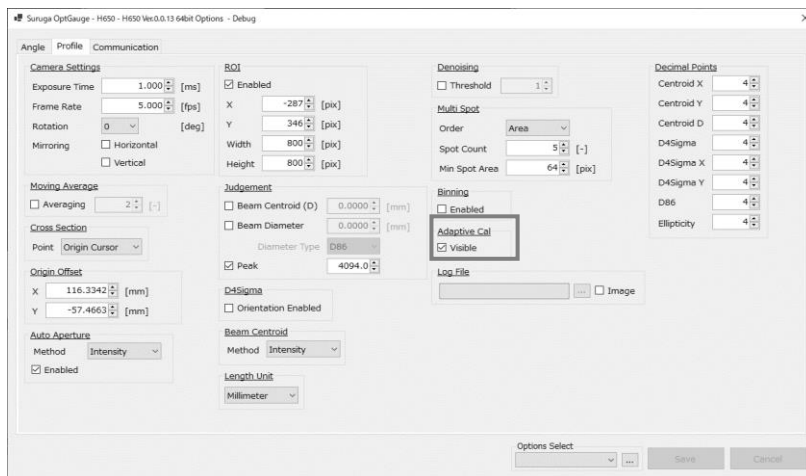
2. Block any incident beams to the Products.
3. Click the "Adaptive Cal" button.
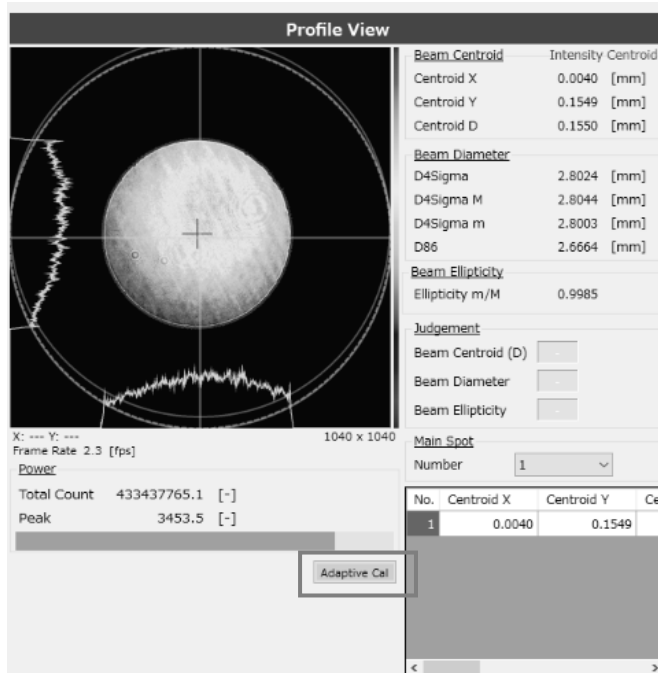
4. When the Adaptive Cal is executed, the color of the button changes.
5. When "[Profile View] Adaptive Calibration succeeded" appears in the System Log, it is completed.
6. Please start the measurement by irradiating a beam into the sensor body.
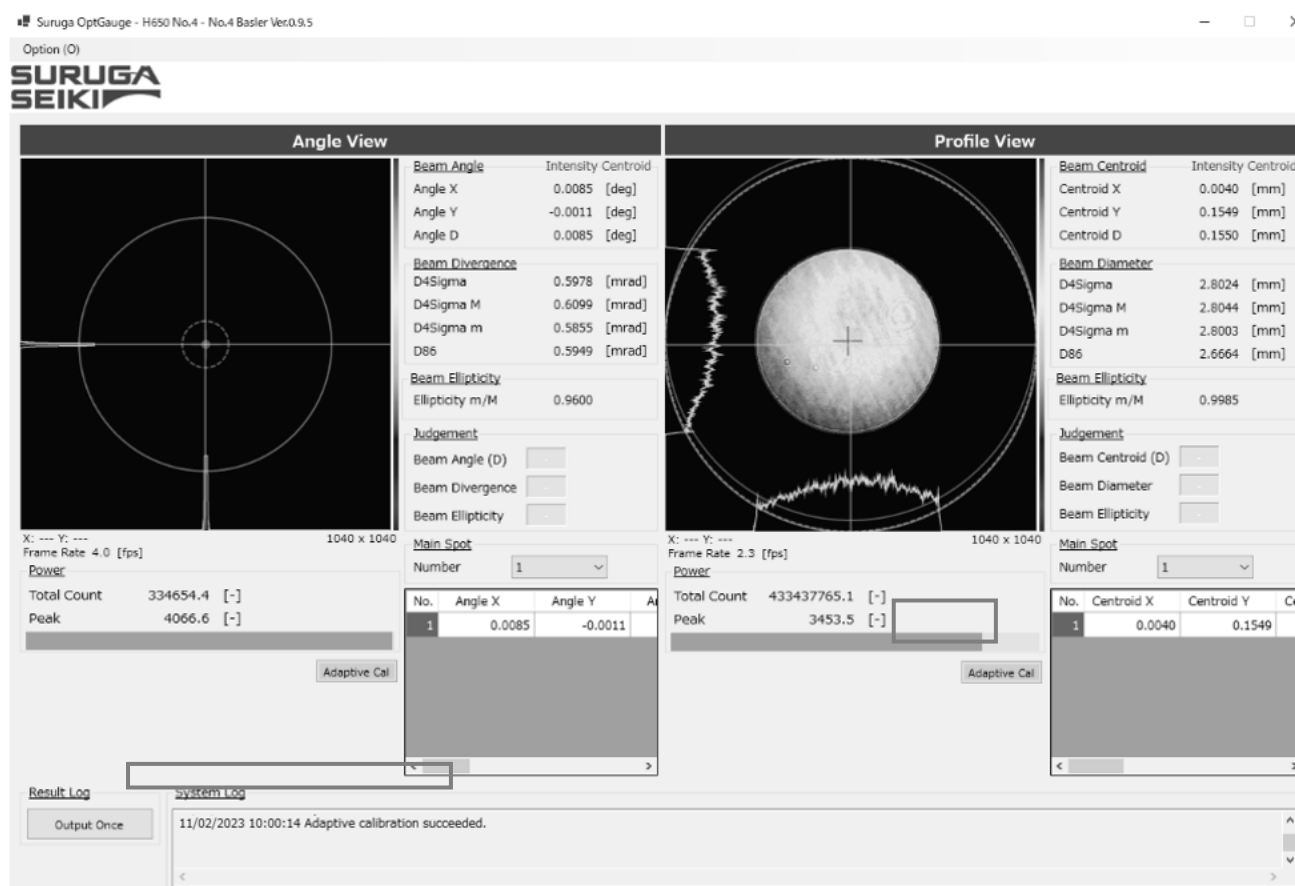
The Adaptive Cal will not succeed if the beam is entering the unit or if there is too much noise due to ambient light. Please execute the Adaptive Cal in an environment where light does not enter the sensor camera.

3.3.2.6 Aperture

To avoid having the effects of noise such as ambient light in the Beam Diameter measurement results, the "Auto Aperture" and "ROI" settings are available.
By using these two functions, noise such as ambient light is eliminated from the measurement.
See "Angle View ->Aperture" in the Function Details.

3.3.2.7 Origin Offset

Origin Offset is a function that offsets the center position of the sensor camera from its factory default position to an arbitrary position.
By using the Offset function, any desired position can be used as the reference position for alignment.
There are two methods to offset.
See "Angle View ->Origin Offset" in the Function Details.

3.3.2.8 Zoom View

The View screen has a Zoom function to observe the condition of a light beam.
See "Angle View -> Zoom View" in the Function Details.

3.3.2.9 Multi Spot

The Products support multi-spot measurement and can measure up to 100 points, simultaneously.
Using the Multi Spot setting, you can set the "display order" and "number of displays" to be displayed on the measurement result screen. Also, "detection criteria" can be set to narrow down targets to be measured.
See "Angle View ->Multi Spot" in the Function Details.

3.4 Names and Functions in the Option screen
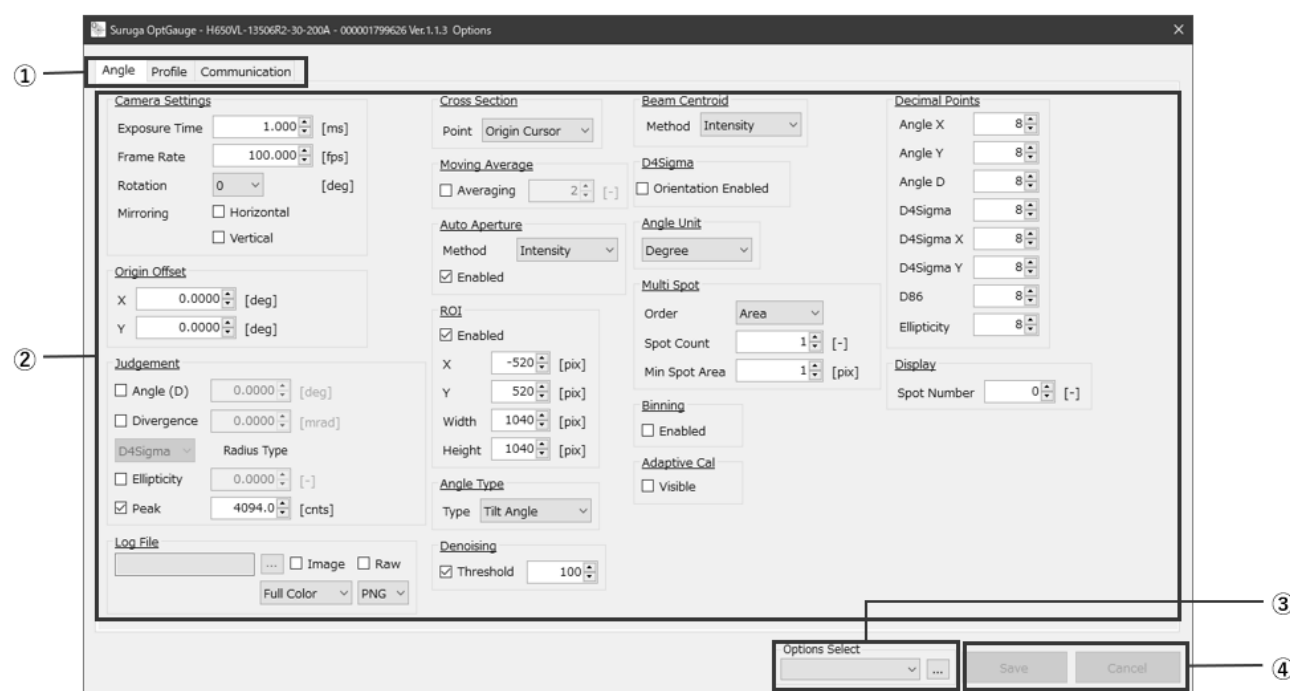
OptGauge Option screen

① Option tabs	Each option screen is displayed by selecting the tabs.
② Various Settings	Measurement criteria can be changed.
③ Option Select	Option lists can be created and operated while switching between them. (See "Option List")
④ Save/Cancel	The button is enabled when the option is changed. Clicking the "Save" button after changing the settings saves the changes. To cancel the changes, press "Cancel" button.

3.4.1　Measurement Option Settings Details

3.4.1.1　Angle
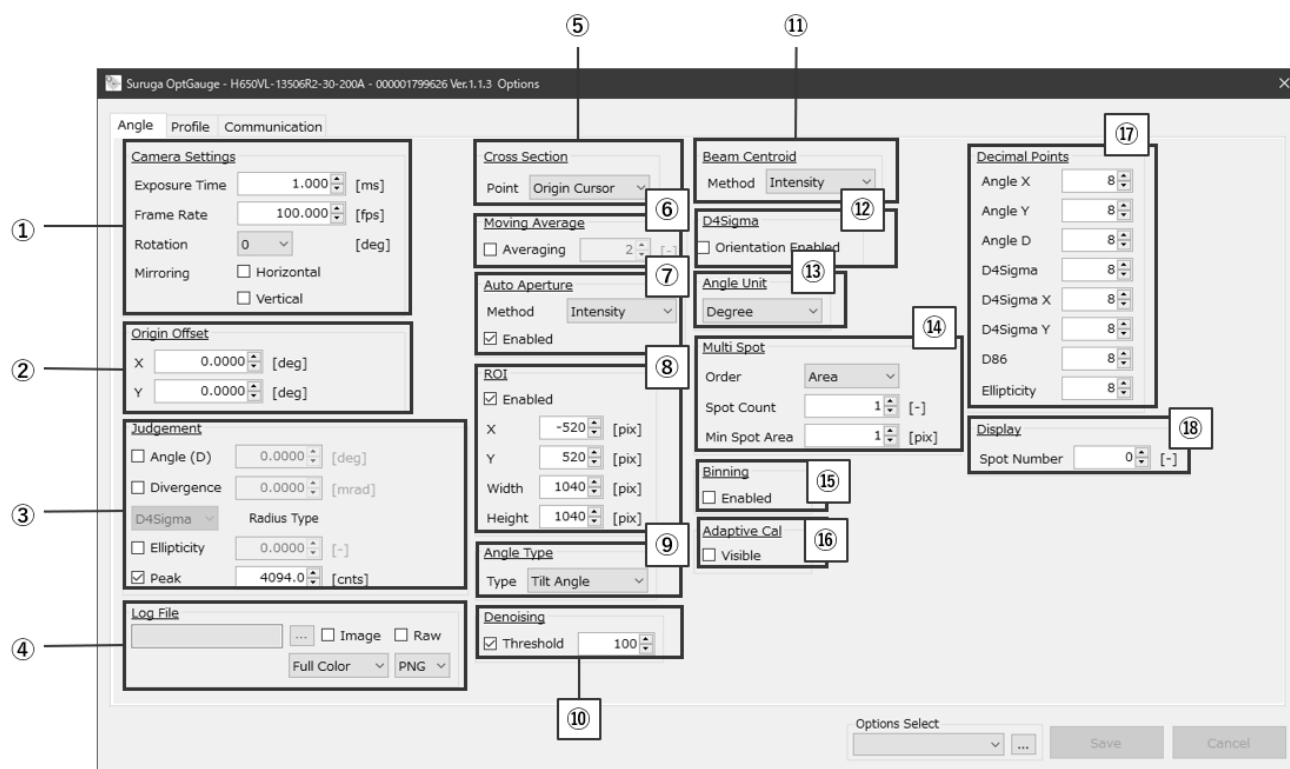
①　Camera Settings		
Exposure Time	Exposure time to the sensor camera（def.=1.0） Setting range：0.027～2000	
Frame Rate	Frame rate of the sensor camera（def.=100） Setting range：0.1～100	
	Rotation of captured image	
Rotation	0（def.）	No rotation。
	90	90° clockwise rotation at the center of the camera as origin.
	180	180° clockwise rotation at the center of the camera as origin.
	270	270° clockwise rotation at the center of the camera as origin.
	Horizontal	Vertical	Mirroring of an image
Mirroring	Blank(def.)	Blank(def.)	No mirroring
	Check	Blank	Horizontal mirroring
	Blank	Check	Vertical mirroring
	Check	Check	Horizontal and vertical mirroring

② Origin Offset	Offset the coordinate center position (cross(white)) *See "Origin Offset" in the Function Details	
	X	With the sensor camera center as "0.0000 (def.)", adjusts (offsets) white cross position in X direction. Setting range: -10.0000 to 10.0000
	Y	With sensor camera center as "0.0000 (def.)", adjusts (offsets) cross (white) position in Y direction. Setting range: -10.0000 to 10.0000
③ Judgement Settings		
Angle	Sets the Angle (D) OK/NG judgement for Tilt Angle or Beam Angle. Setting range: 0.0000 to 10.0000 (def. 0.0000) *See "Judgement" in the Function Details	
	Enabled	Enables the Judgement.
	Disabled (def.)	Disables the Judgement.
Divergence	Sets the D4Sigma or D86 OK/NG judgement for beam divergence. Setting range: 0.0000 to 1,000.0000 (def. 0.0000) *See "Judgement" in the Function Details	
	Enabled	Enables the Judgement.
	Disabled (def.)	Disables the Judgement.
Radius Type	D4Sigma	Sets D4 Sigma for the divergence to be judged.
	D86	Sets D86 for the divergence to be judged.
Ellipticity	Sets the ellipticity OK/NG judgement for beam ellipticity. Setting range: 0.0000 to 1.0000 (def. 0.0000) *See "Judgement" in the Function Details	
	Enabled	Enables the Judgement.
	Disabled (def.)	Disables the Judgement.
Peak	Sets the Peak OK/NG judgement for the Power. Setting range: 0.0 to 4095.0 (def. 4094.0) *See "Judgement" in the Function Details	
	Enabled	Enables the Judgement.
	Disabled (def.)	Disables the Judgement.

④ Log File		
...	To specify outputs and where to save the measurement results(CSV).	
Image	Enabled	Outputs image data at the Angle View (.png) along with the measurement results (.csv).
	Disabled (def.)	No output image data at Angle View (.png).
	Full Color (def.)	Outputs image data in 24-bit full color.
	Gray Scale	Outputs image data in 8-bit grayscale.
	PNG(def.)	Outputs image data in PNG format.
	BMP	Outputs image data in BMP format.
	TIFF	Outputs image data in TIFF format.
Raw	Enabled	Outputs Angle View raw image data (CSV)* with measurement results (CSV) * Outputs luminance values per pixel
	Disabled (def.)	No output raw image data at Angle View (.png).
⑤ Cross Section	Sets display locations for beam strength distribution.	
	Origin Cursor	Displays coordinate center position beam strength distribution.
	Beam Cursor	Displays the centroid of a beam strength distribution.
⑥ Moving Average	Sets averaging process (moving average) for measurement values. Setting range: 2 to 262,144 (def. = 2)	
	Enabled	Enables averaging setting.
	Disabled (def.)	Disables averaging setting.
⑦ Auto Aperture	Sets Auto Aperture. *See "Aperture" in the Function Details	
	Enabled	Enables Auto Aperture setting.
	Disabled (def.)	Disables Auto Aperture setting.
	Area	Sets Auto Aperture from the centroid position calculated with the Area Centroid process.
	Intensity(def.)	Sets Auto Aperture from centroid position calculated with intensity weighed process.

⑧ ROI	Sets ROI. *See "Aperture" in the Function Details	
	Enabled	Enables ROI setting.
	Disabled (def.)	Disables ROI setting
	X	Sets ROI X direction setting position. Range: -3,000 to 3,000 (def. = - 520)
	Y	Sets ROI Y direction setting position. Range: -3,000 to 3,000 (def. = +520)
	Width	Sets ROI horizontal width. Setting range: 0 to 3,000 (def. = 1040)
	Height	Sets ROI vertical width. Setting range: 0 to 3,000 (def. = 1040)
⑨ Angle Type	Sets targets for the angle measurement	
	Tilt Angle (def.)	Sets for the reflection angle measurement. Sets a half of the angle of an incident beam as the measured target angle.
	Beam Angle	Sets for the external light angle measurement. Sets the angle of an incident beam as the measured target angle.
⑩ Denoising	Sets thresholds. When enabled, it derives the measurement values by using the pixels with the pixel values higher than the set value. Setting range: 1 to 4,095 (def. = 100)	
	Enabled	Enables denoising setting.
	Disabled	Disables denoising setting.
⑪ Beam Centroid	Sets the calculation method for the Intensity Centroid position.	
	Area	Calculates the centroid position with the area of centroid process.
	Intensity (def.)	Calculates the centroid position with the intensity weighing process.
⑫ D4Sigma		
Orientation Enabled	Switches "Beam Divergence" measurement content and "Beam Ellipticity" enabled/disabled.	
	Enabled	・ Displays D4 Sigma M (major) and D4 Sigma m (minor) beam divergence. ・ Enables Beam Ellipticity.
	Disabled (def.)	・ Displays D4 Sigma X and D4 Sigma Y beam divergence. ・ Disables Beam Ellipticity.

⑬ Angle Unit	Sets angle unit display for measurement values.	
	Degree (def.)	Sets for decimal degree unit.
	DegMinSec	Sets for degrees-minutes-seconds unit.
	Milliradian	Sets for milli-radian unit.
⑭ Multi Spot *See "Multi Spot"in the Function Details		
Order	Sets the sorting type of the measurement results displayed when detecting multiple beams.	
	Area (def.)	Sorts beam area from the largest size.
	Angle	Sorts beam area from the smallest angle.
Spot Count	Sets the number to be displayed on the measurement results screen when detecting multiple beams. Setting range: 1 to 100 (def. = 1)	
Min Spot Area	Sets the threshold value for the beam size (pixels) conditions of the beam to be detected. Setting range：1～1023(def.=1)	
⑮ Binning	Sets the binning function 2x2) of the sensor camera. When binning is "enabled", adjacent pixels are combined to increase the noise sensitivity of the camera. It also improves the frame rate by reducing the image size by 1/4 and reducing the data volume.	
	Enabled	Enables binning function.
	Disabled (def.)	Disables binning function.
⑯ Adaptive Cal	Sets "Adaptive Cal" button show/hide.	
	Enabled	Displays the "Adaptive Cal" button.
	Disabled (def.)	Hides the "Adaptive Cal" button.

⑰ Decimal Points	Designates the number of decimal places when outputting measurement results. Setting range: 0 to 8 (def. = 8) *Measurement results output indicates the results (.csv) output with the [Output Once] button and the output from communication controlled from external devices.	
	Angle X	Sets the number of decimal places for Angle X measurement results output.
	Angle Y	Sets the number of decimal places for Angle Y measurement results output.
	Angle D	Sets the number of decimal places for Angle D measurement results output.
	D4Sigma	Sets the number of decimal places for D4Sigma measurement results output.
	D4SigmaX(M)	Sets the number of decimal places for D4SigmaX(M) measurement results output.
	D4SigmaY(m)	Sets the number of decimal places for D4SigmaY(m) measurement results output.
	D86	Sets the number of decimal places for D86 measurement results output.
	Ellipticity	Sets the number of decimal places for ellipticity measurement results output.
⑱ Display		
Spot Number	Sets the maximum number of beam numbers to be displayed in the Angle view. The numbers are sorted according to "Order" of "**Multi Spot**". Setting range: 00 to 100 (def.= 0)	

3.4.1.2 Profile
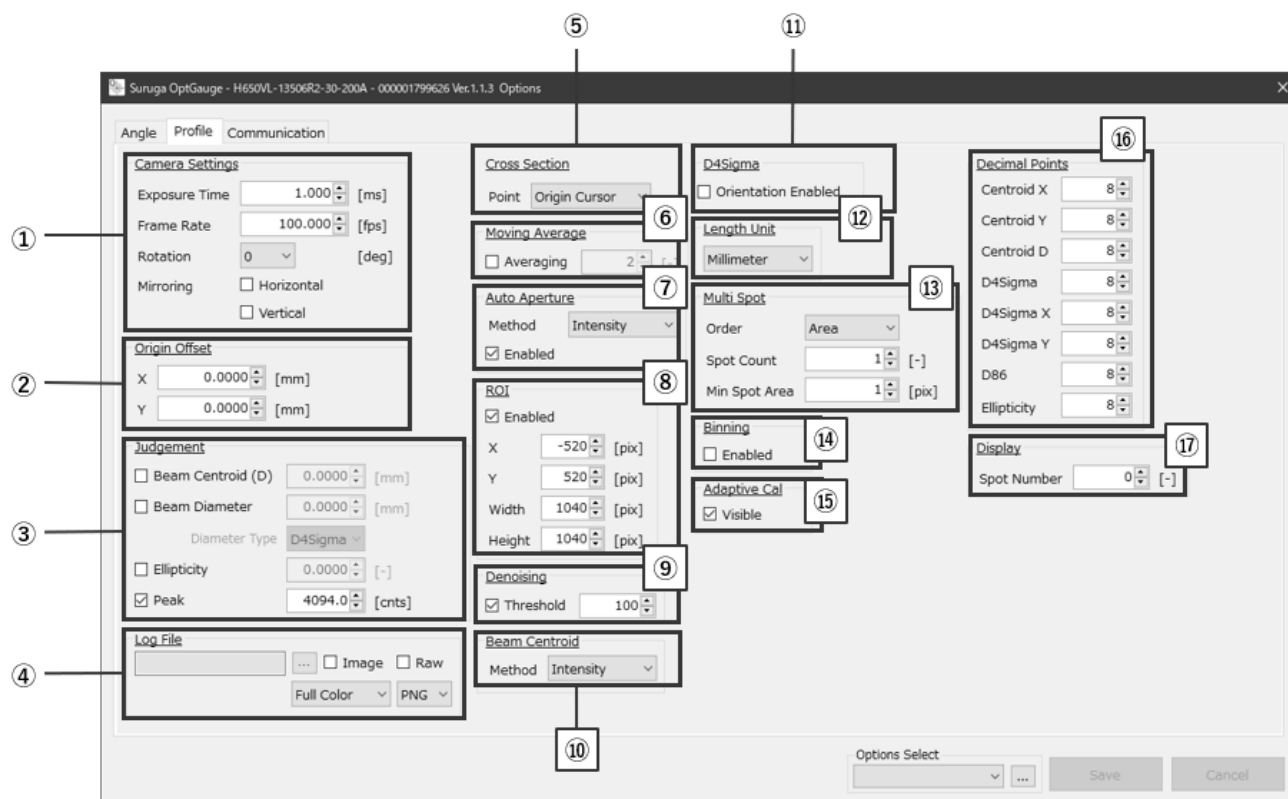
① Camera Settings	
Exposure Time	Sets the sensor camera exposure time. (def. = 1.0) Setting range: 0.027 to 2000
Frame Rate	Sets the sensor camera frame rate. (def. = 100) Setting range: 0.1 to 100
Rotation	Sets image rotation.

Rotation	0 (def.)	No Rotation.
	90	Rotate 90° clockwise with the center of the sensor camera as the origin.
	180	Rotate 180° clockwise with the center of the sensor camera as the origin.
	270	Rotate 270° clockwise with the center of the sensor camera as the origin.

Mirroring	Horizontal	Vertical	Sets mirroring
	Disabled (def.)	Disabled (def.)	No mirroring
	Enabled	Disabled	Horizontal mirroring
	Disabled	Enabled	Vertical mirroring
	Enabled	Enabled	Vertical and horizontal mirroring

		Offsets coordinate center position (white cross). *See "Origin Offset" in the Function Details	
② Origin Offset	X	With the sensor camera center as "0.0000 (def.)", adjusts (offsets) white cross position in X direction. Setting range: -20.0000 to +20.0000	
	Y	With sensor camera center as "0.0000 (def.)", adjusts (offsets) cross (white) position in Y direction. Setting range: -20.0000 to +20.0000	
③ Judgement Settings			
Beam Centroid(D)	Sets OK/NG judgement on the Beam Centroid->Beam Centroid(D) in the Beam Centroid. Setting range：0.0000～20.0000(def.0.0000) *See "Judgement" in the Function Details		
	Enabled	Enables the Judgement.	
	Disabled (def.)	Disables the Judgement.	
Beam Diameter	Sets OK/NG judgement on the D4Sigma in the Beam Diameter Setting range：0.0000～20.0000(def.0.0000) *See "Judgement" in the Function Details		
	Enabled	Enables the Judgement.	
	Disabled (def.)	Disables the Judgement.	
Ellipticity	Sets the ellipticity OK/NG judgement for beam ellipticity. Setting range: 0.0000 to 1.0000 (def. 0.0000) *See "Judgement" in the Function Details		
	Enabled	Enables the Judgement.	
	Disabled (def.)	Disables the Judgement.	
Peak	Sets the Peak OK/NG judgement for the Power. Setting range: 0.0 to 4095.0 (def. 4094.0) *See "Judgement" in the Function Details		
	Enabled	Enables the Judgement.	
	Disabled (def.)	Disables the Judgement.	

④ Log File		
···	To specify outputs where to save the measurement results(CSV).	
Image	Enabled	Outputs image data at the Profile View (.png) along with the measurement results (.csv).
	Disabled (def.)	Outputs only measurement results (.csv).
	Full Color (def.)	Outputs image data in 24-bit full color.
	Gray Scale	Outputs image data in 8-bit grayscale.
	PNG(def.)	Outputs image data in PNG format.
	BMP	Outputs image data in BMP format.
	TIFF	Outputs image data in TIFF format.
Raw	Enabled	Outputs Profile View raw image data (CSV)* with measurement results (CSV) * Outputs luminance values per pixel
	Disabled (def.)	No output raw image data at the Profile View.
⑤ Cross Section	Sets the sectional view display location.	
	Origin Cursor	Displays a cross-sectional view of the center of the coordinates.
	Beam Cursor	Displays a cross-sectional view of the centroid of a beam
⑥ Moving Average	Sets averaging process (moving average) for measurement values. Setting range: 2 to 262,144 (def. = 2)	
	Enabled	Enables the averaging process.
	Disabled (def.)	Disables the averaging process.
⑦ Auto Aperture	Sets the Auto Aperture. *See "Aperture" in the Function Details	
	Enabled	Enables the Auto Aperture setting.
	Disabled (def.)	Disables the Auto Aperture setting.

		Sets the ROI. *See "Aperture" in the Function Details	
⑧ ROI	Enabled	Enables ROI setting	
	Disabled (def.)	Disables ROI setting	
	X	Sets ROI X direction setting position. Range: -3,000 to 3,000 (def. = -520)	
	Y	Sets ROI Y direction setting position. Range: -3,000 to 3,000 (def. = +520)	
	Width	Sets ROI horizontal width. Setting range: 0 to 3,000 (def. = 1040)	
	Height	Sets ROI vertical width. Setting range: 0 to 3,000 (def. = 1040)	
⑨ Denoising	Sets thresholds. When enabled, it derives the measurement values using the pixels of the pixel values higher than the set value. Setting range: 1 to 4,095 (def. = 100)		
	Enabled	Enables denoising setting.	
	Disabled	Disables denoising setting.	
⑩ Beam Centroid	Sets the calculation method for the Centroid position of a light beam.		
	Area	Calculates the centroid position with the Area of Centroid process.	
	Intensity (def.)	Calculates the centroid position with the intensity weighing process.	
⑪ D4Sigma			
Orientation Enabled	Switches "Beam Divergence" measurement content and "Beam Ellipticity" enabled/disabled.		
	Enabled	・ Displays D4 Sigma M (major) and D4 Sigma m (minor) beam divergence. ・ Enables Beam Ellipticity.	
	Disabled (def.)	・ Displays D4 Sigma X and D4 Sigma Y beam divergence. ・ Disables the Beam Ellipticity.	

⑫ Length Unit	Sets the unit of distance for measurement values.	
	Millimeter(def.)	Unit of mm
	Micrometer	Unit of μ m
⑬ Multi Spot *See "Multi Spot"in the Function Details		
Order	Sets the sorting type of the measurement results displayed when detecting multiple beams.	
	Area(def.)	Sorts by beam area from the largest size.
	Centroid	Sorts by Centroid values closest to the center to outers.
Spot Count	Sets the number to be displayed on the measurement results screen when detecting multiple beams. Setting range: 1 to 100 (def. = 1)	
Min Spot Area	Sets the threshold value for the beam size (pixels) conditions of the beam to be detected. Setting range: 1 to 1023 (def. = 1)	
⑭ Binning	Sets the Binning function (2x2) of the sensor camera. When binning is "enabled", adjacent pixels are combined to increase the noise sensitivity of the camera. It also improves the frame rate by reducing the image size by 1/4 and reducing the data volume.	
	Enabled	Enables binning function.
	Disabled (def.)	Disables binning function.
⑮ Adaptive Cal	Sets "Adaptive Cal" button show and hide.	
	Enabled	Shows the "Adaptive Cal" button.
	Disabled (def.)	Hides the "Adaptive Cal" button.

		Designates the number of decimal places when outputting measurement results. Setting range: 0 to 8 (def. = 8) *Measurement results output indicates the results (.csv) output with the [Output Once] button and the output from communication controlled from external devices.
⑯ Decimal Points	Angle X	Sets the number of decimal places for Angle X measurement results output.
	Angle Y	Sets the number of decimal places for Angle Y measurement results output.
	Angle D	Sets the number of decimal places for Angle D measurement results output.
	D4Sigma	Sets the number of decimal places for D4Sigma measurement results output.
	D4SigmaX(M)	Sets the number of decimal places for D4SigmaX(M) measurement results output.
	D4SigmaY(m)	Sets the number of decimal places for D4SigmaY(m) measurement results output.
	D86	Sets the number of decimal places for D86 measurement results output.
	Ellipticity	Sets the number of decimal places for ellipticity measurement results output.
⑰ Display		
Spot Counter		Sets the maximum number of beam numbers to be displayed in the Angle view. The numbers are sorted according to "Order" of "**Multi Spot**". Setting range: 00 to 100 (def.= 0)

3.5   Option List

This software can store multiple option lists and switching among them.
If you want to apply different option settings to different measurement objects or different measurement wavelengths, you can switch option lists while the application is running.
This chapter explains how to switch, register, and delete multiple option lists.

3.5.1   Switching Option Lists

This section explains how to switch option lists.
1.   From the "Options Select" pulldown menu, select the desired option list name.
2.   Click the "Save" button.
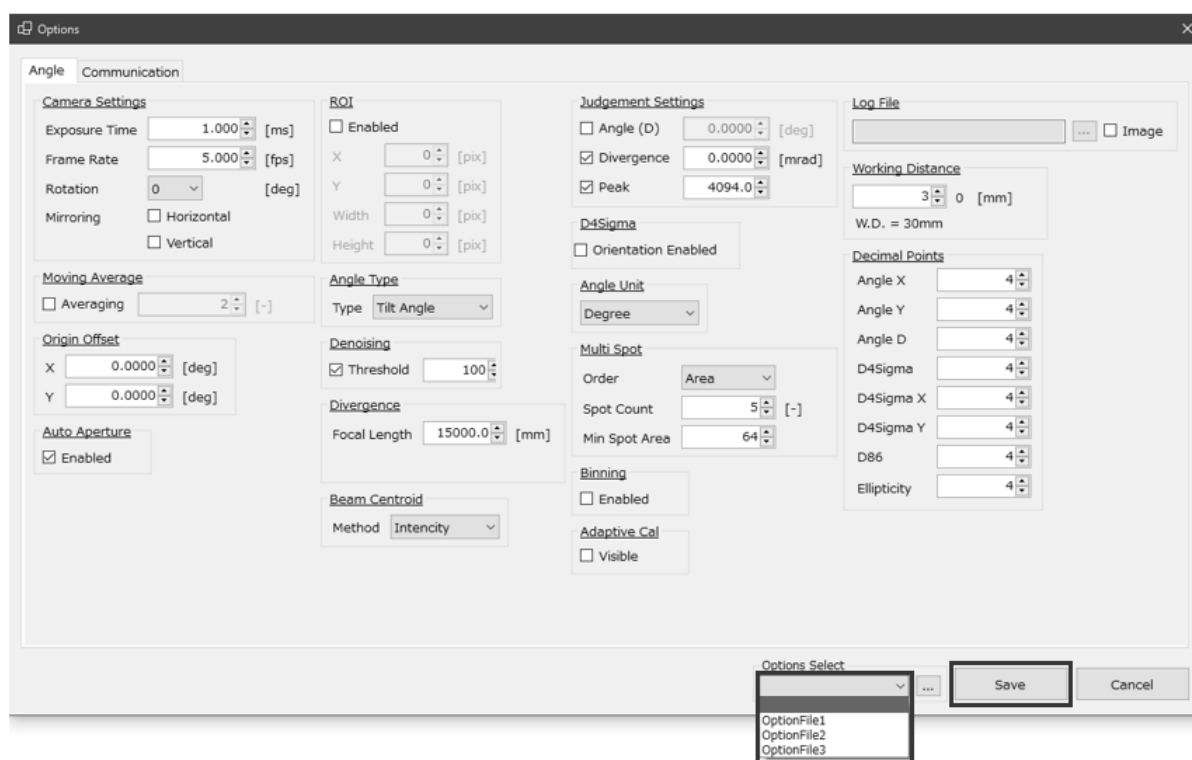
3.5.2 Registering Option Lists

This section explains how to register option lists. Up to 31 option lists can be registered.

1. Click the […] button.
2. Enter an arbitrary option name and click the [Add] button.
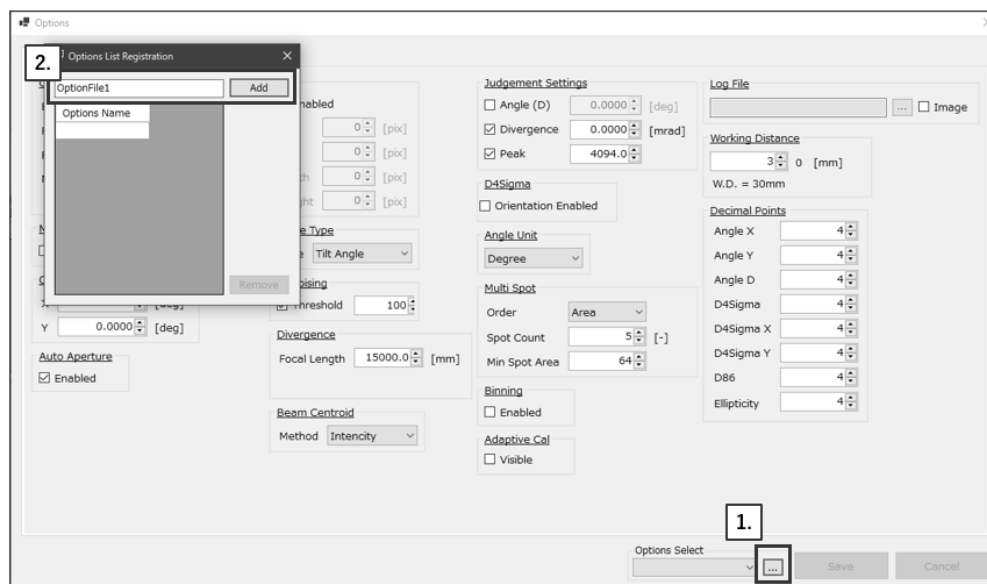
3. Click the [X] button.
4. Click the [Save] button.
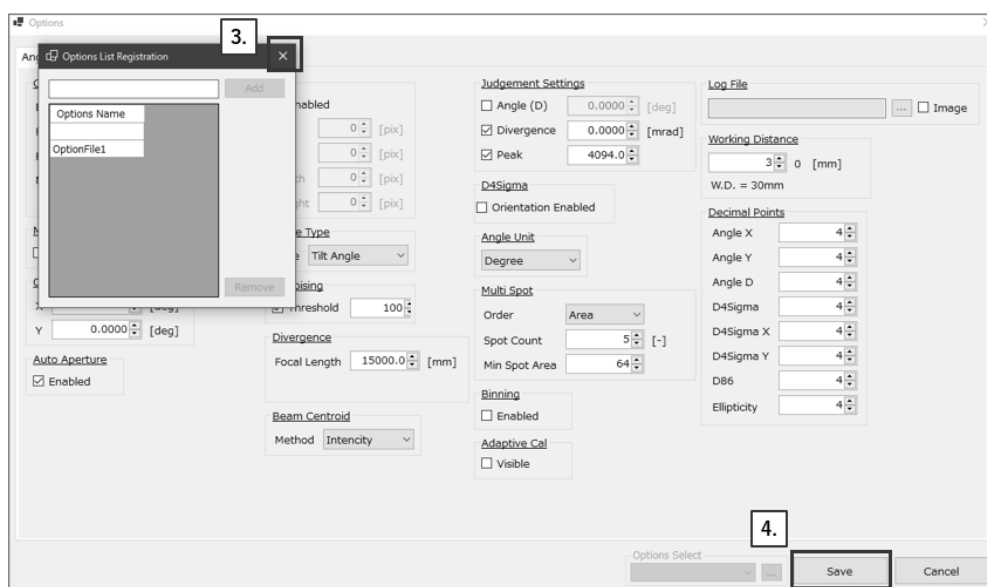
5. The list is now registered in "Options Select" for selection. (*See "Switching Option Lists")

3.5.3　Deleting Option Lists

This section explains how to delete option lists.

1.　Select all but the option name to be deleted and click the [...] button.
2.　Select the option name to be deleted and click the [Remove] button.
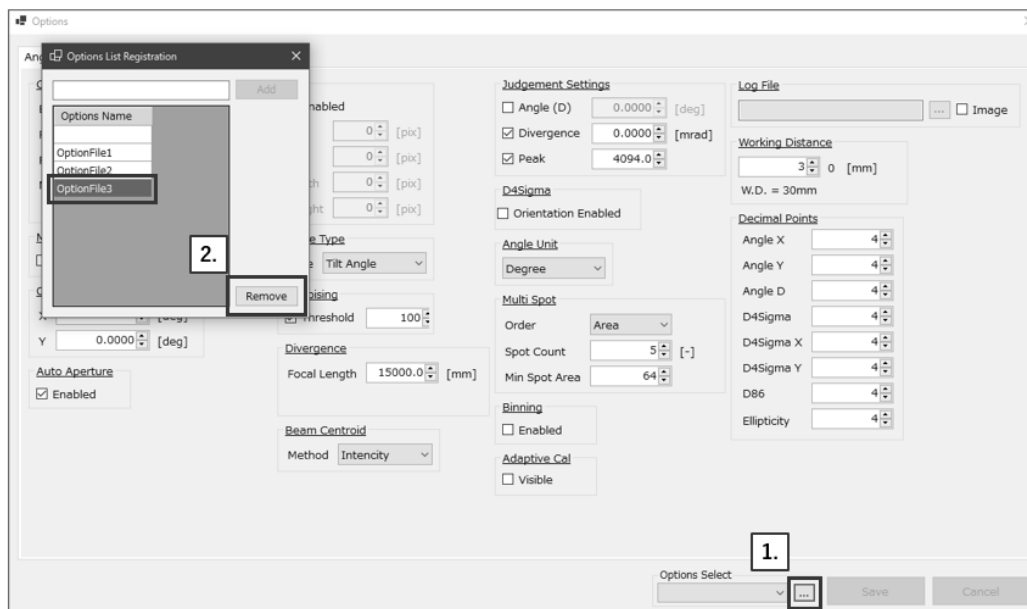
3.　Click the [X] button.
4.　Click the [Save] button.
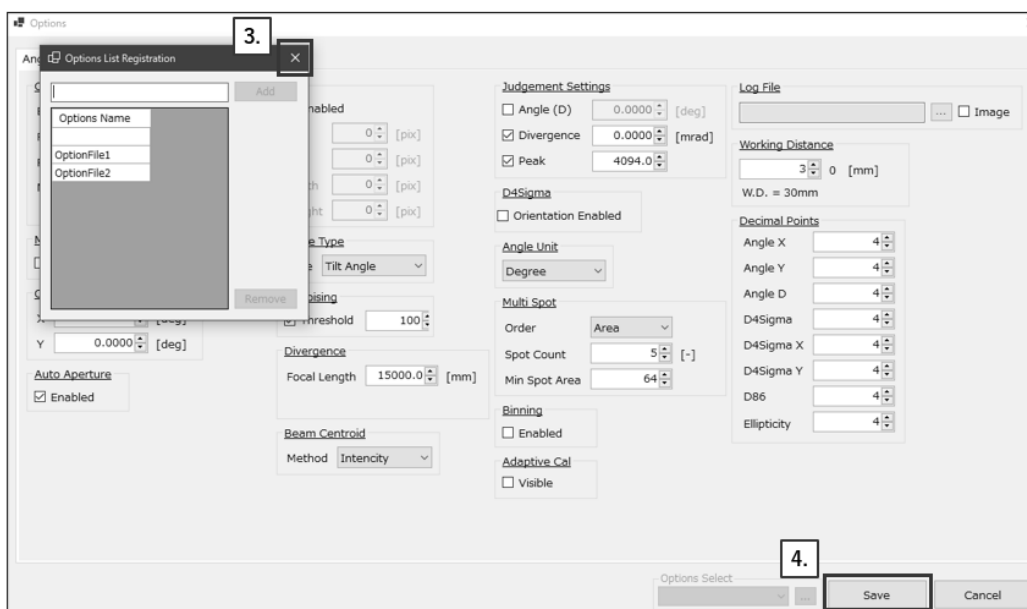
4. Measuring

4.1.   Overview of Measurement Methods

4.1.1   Angle

4.1.1.1   Angle Measurement using the Reflection Angle Measurement
See "Tilt Angle/Beam Angle" at **the reflection angle measurement** in the Function Details

4.1.1.2   Angle Measurement Using the External light angle Measurement
See "Tilt Angle/Beam Angle" at **the external light angle measurement** in the Function Details

4.1.1.3   Beam Divergence Measurement
See "Beam Divergence" in the Function Details

4.1.1.4   Multi Spot Measurement
See "Multi Spot" in the Function Details

4.1.2   Profile

4.1.2.1   Beam Diameter Measurement
See "Beam Diameter" in the Function Details

5. Cntrolling from External Devices

The Products can send and receive data through command communication with external devices via serial communication (or TCP/IP communication).

5.1 RS232C

There are two general patterns of RS232C connection. After connection, serial communication is used to send and receive data through terminal software* which exchanges commands with OptGauge.
*The customer is asked to provide their own terminal software.

5.1.1 Communication Specifications

Item	Details
Synchronization method	Start-stop synchronization
Transmission code	UTF-8
Data type	8 bits
Stop bit	1 bit
Parity	None
Flow control	None
Baud rate (bps)	9600 / 19200 / 38400 / 57600 / 115200

5.1.2 The Connections Illustrated

Using external devices for communication
1. Set up two computers and connect with an RS232C cable. 2. Connect this product to one of the computers, launch OptGauge, and start measurement. 3. Prepare terminal software on the other computer. 4. Set command communication and begin communication.
Using the same computer for communication
1. Connect this product to one computer and then connect the RS232C cable to your own computer. 2. Launch OptGauge and start measurement. 3. Prepare terminal software on the computer. 4. Set command communication and begin communication.
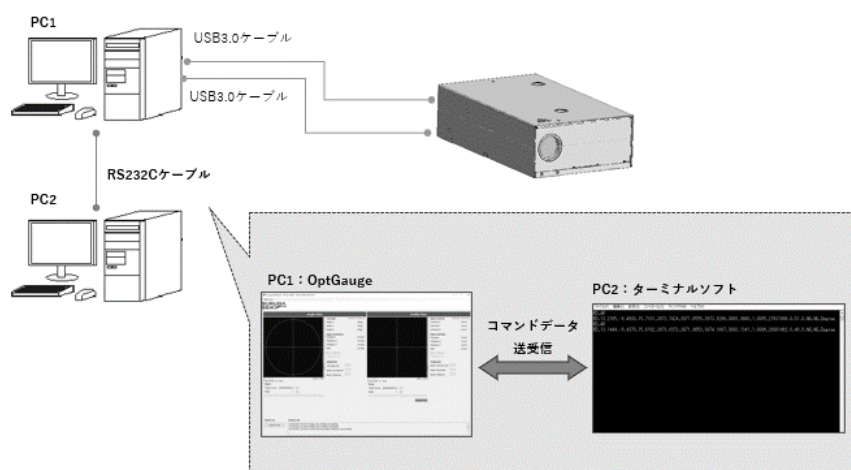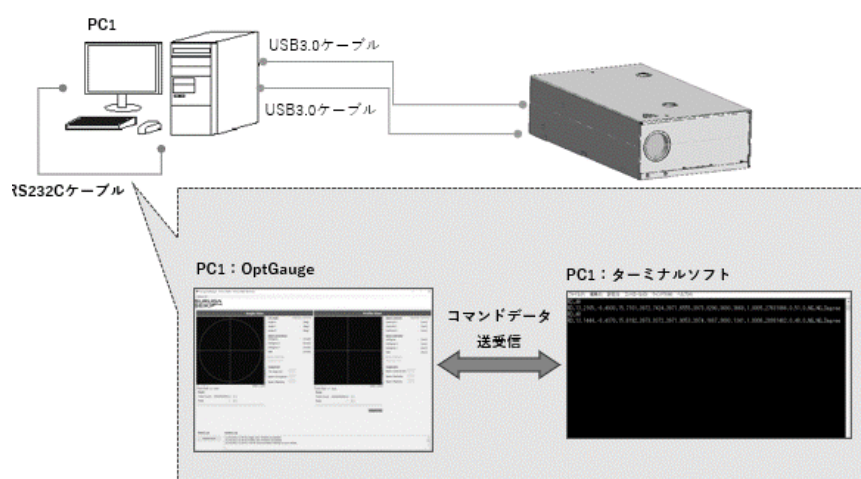
5.1.3 Command communication setting method

Settings for OptGauge and terminal software to conduct command communication are indicated here.

OptGauge

1. Select the [Communication] tab in option settings.
2. Set "Communication Type - Interface" to "COM".
3. Set "Port"* and "Baud Rate" (arbitrary) in COM settings.
※ "Port" automatically displays the connected port candidates when RS232C is connected.

Terminal Software

The terminal software, to be provided by the customer, is to be set as below.

1. Set the COM port which matches the "Port" setting in OptGauge
2. Set the same baud rate as the "Baud Rate" setting in OptGauge
3. For settings other than the above, see the "Communication Specifications"

5.2 TCP/IP

Generally, there are three patterns of TCP/IP connection. After connection established, TCP/IP communication is used to send and receive data through terminal software[*] which exchanges commands with OptGauge.

*The customer is asked to provide their own terminal software.

5.2.1 Communication Specifications

Items	Details
Protocol	TCP
IPv4 address	See "Command Communication Setting Method"
Subnet mask	
Default gateway	
DNS server address	
Port number	Private port (49152-65535) range

5.2.2 Connections Illustrated

Using External Devices for Communication: Ethernet

1. Set up two computers and connect them with an Ethernet cable.
2. Connect this product to one of the computers, launch OptGauge, and start measurement.
3. Prepare terminal software on the other computer.
4. Set command communication and begin communication.
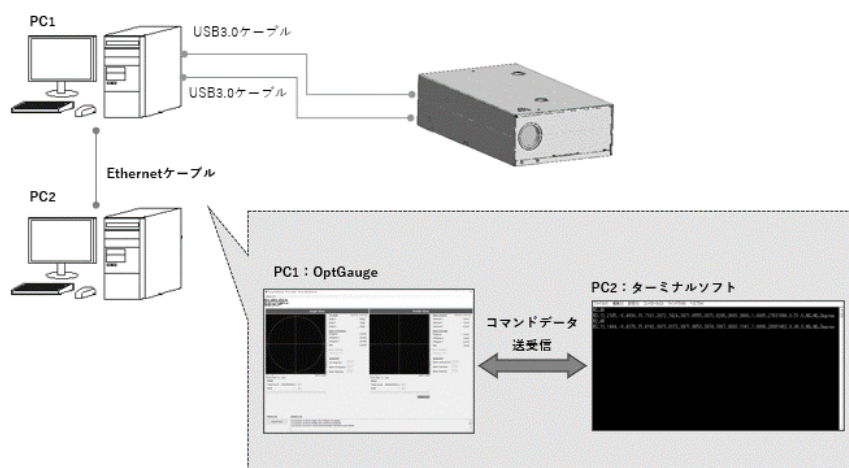
Using External Devices for Communication: Wireless Router

1. Set up two computers and connect with a wireless router.
2. Connect this product to one of the computers, launch OptGauge, and start measurement.
3. Prepare terminal software on the other computer.
4. Set command communication and begin communication.
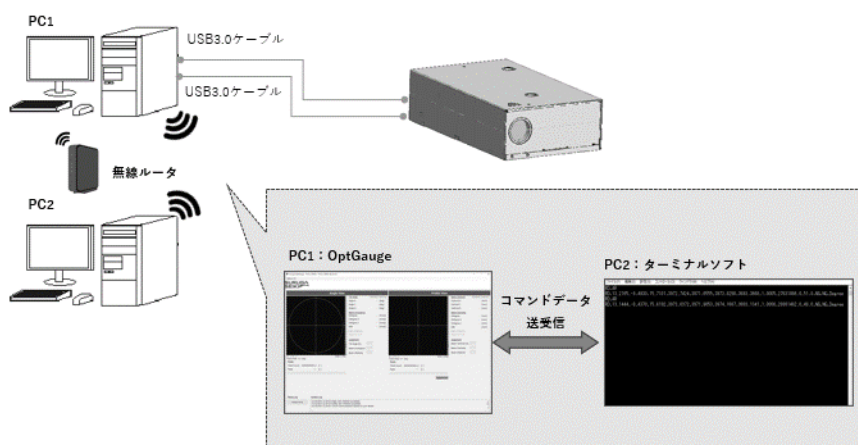
Using the Same Computer for Communication

1. Connect this product to one computer
   (there is nothing to connect, as the local host address is used).
2. Launch OptGauge and start measurement.
3. Prepare terminal software on the computer.
4. Set command communication and begin communication.
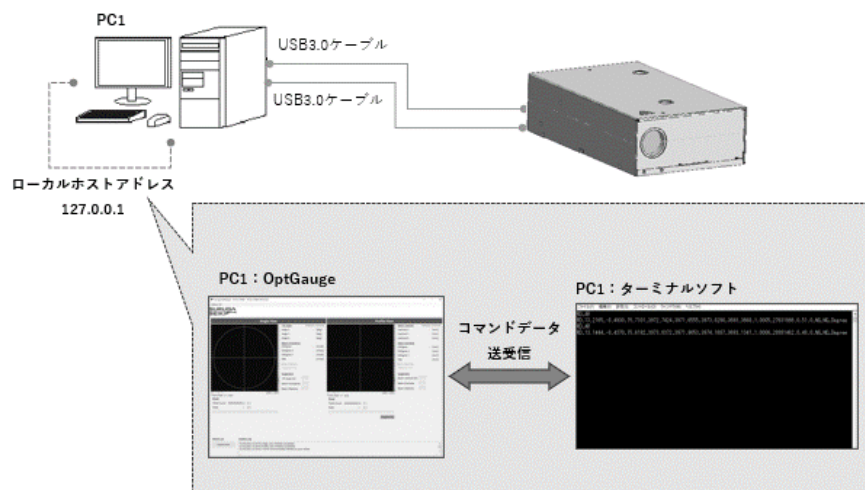
5.2.3 Command Communication Setting Method

Settings for a computer, OptGauge and terminal software to conduct command communication are indicated here.

Using external devices for communication

Computer Setting

1. Click the [Start] button on the computer to which this product is connected and select [Settings] from the start menu.
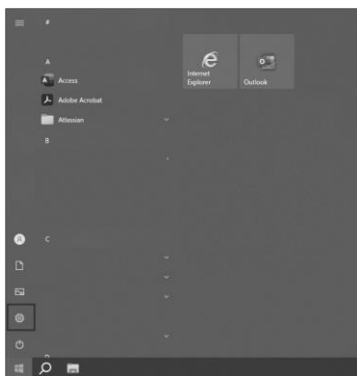
2. Click [Network and Internet] and select [Change adapter options].
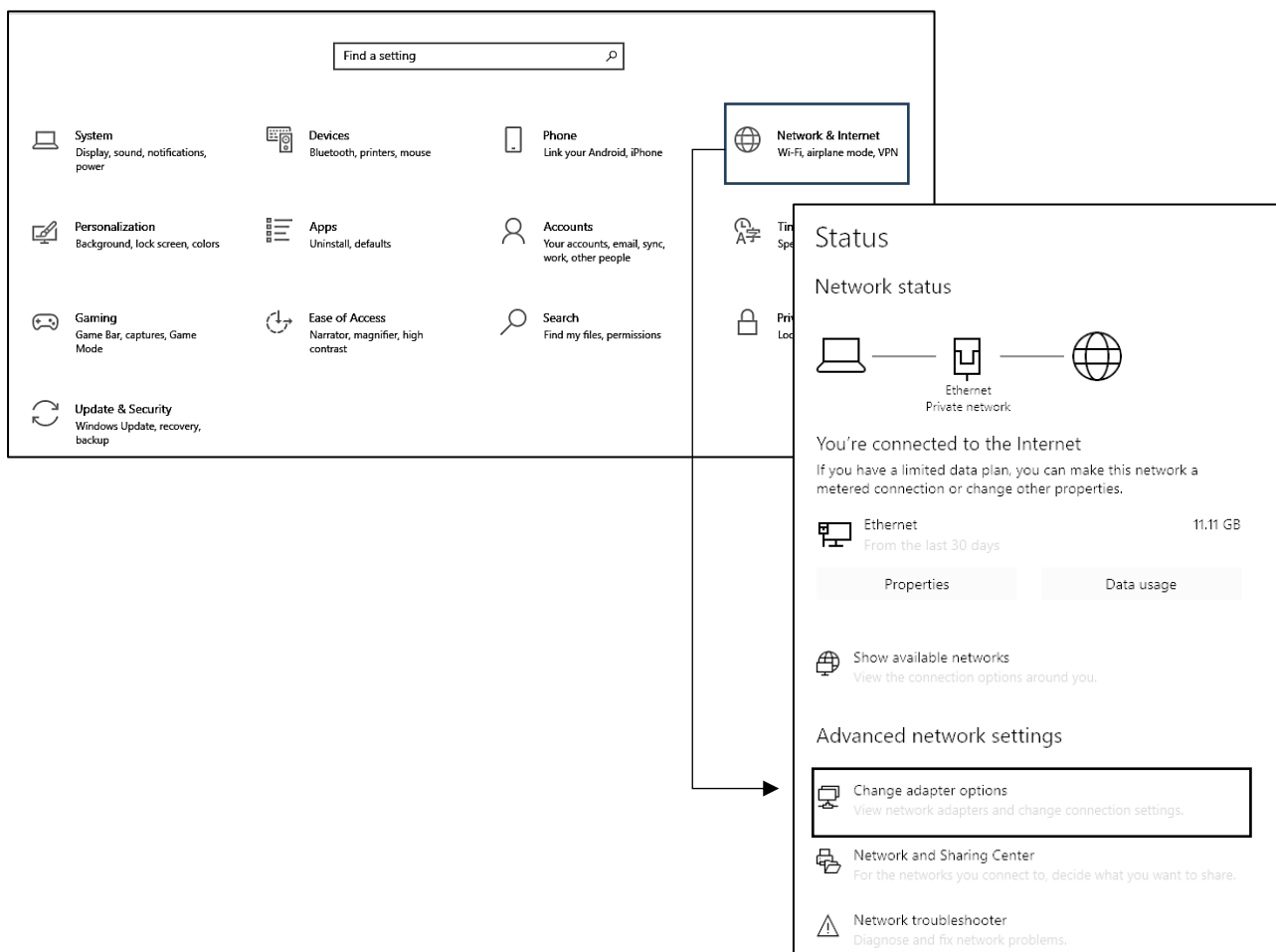
3. Select Wi-Fi, if using a wireless router, or right-click Ethernet and select Properties, if using an Ethernet cable.
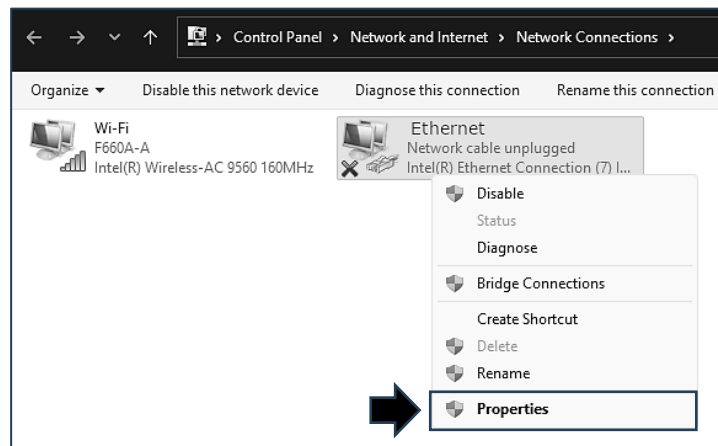
      Click Internet Protocol Version 4 (TCP/IPv4) and select [Properties].

4. Select [Use the following IP address:] and enter [IP address:] and [Subnet mask:].

    Ex.   IP address: 192.168.1.100

          Subnet mask: 255.255.255.0

          Default gateway: Not required.

5. Select [Use the following DNS server addresses:] (Not required).

6. Click [OK].

7. Follow steps 1 to 7 of this procedure for the other computer.

    However, do as follows to make sure that in step 5 the IP address settings are not duplicated.

    Ex. IP address: 192.168.1.**101** (*change only the last number)

          Subnet mask: 255.255.255.0
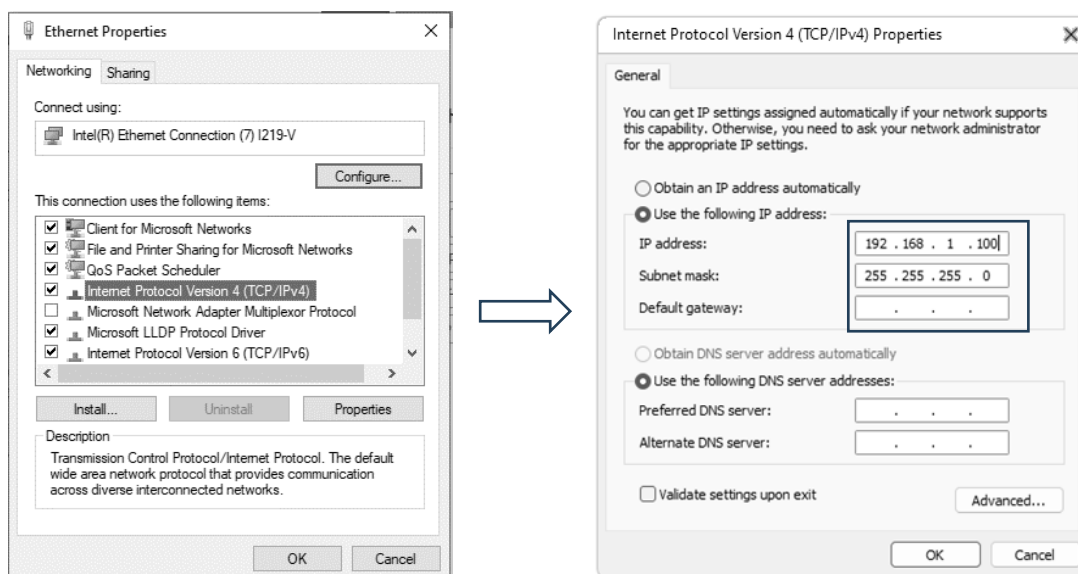
OptGauge

1. Select the [Communication] tab in option settings.
2. Set "Communication Type - Interface" to "TCP/IP".
3. Set "Port" (arbitrary) in TCP/IP settings.

Terminal Software

The terminal software, to be provided by the customer, is to be set as below.

・ Designate the IP address set on the computer to which this product is connected, in "Computer settings - When using external devices for communication," as the connection destination

・ Set the TCP port which matches the "Port" setting in OptGauge.

*This is the minimum setting required for command communication using TCP/IP communication. For network communication

The customer is asked to set as needed with consideration for applications such as security.

Using the Same Computer for Communication

OptGauge

1. Select the [Communication] tab in option settings.
2. Set "Communication Type - Interface" to "TCP/IP".
3. Set "Port" (arbitrary) in TCP/IP settings.

Terminal Software

The terminal software, to be provided by the customer, is to be set as below.

- Local host address: Set **127.0.0.1**
- Set the TCP port which matches the "Port" setting in OptGauge.

5.3 Command List

5.3.1 Read Commands List

5.3.1.1 Common Commands

\<Common Read Commands\>

Command Type	Command Parameter	Command Parameter1	Command Details
RD	VS		Read Version information
	OL		Read Option List information

5.3.1.2 Angle

\<Read Commands\>

Command Type	Command Parameter	Command Parameter1	Command Details
RD	AR		Reads measurement results
		MLT	Reads Angle Multi Spot measurement results
		ASC	Reads Angle Multi Spot Count
	AO	EXT	Reads sensor camera exposure time
		FRA	Reads sensor camera frame rate
		ROT	Reads Rotation setting information
		MHE	Reads Mirroring horizontal setting information
		MVE	Reads Mirroring vertical setting information
		MAV	Reads number of averaging times setting information
		MAE	Reads averaging processing enabled setting information
		CSP	Reads Cross Section Point setting information
		OOX	Reads Origin Offset X value setting information
		OOY	Reads Origin Offset Y value setting information
		AAM	Reads Auto Aperture method setting information
		AAE	Reads Auto Aperture enabled setting information
		ROE	Reads ROI enabled setting information
		RAX	Reads ROI X value setting information
		RAY	Reads ROI Y value setting information
		RAW	Reads ROI width setting information

Command Type	Command Parameter	Command Parameter1	Command Details
RD	AO	RAH	Reads ROI height setting information
		ANT	Reads Angle Type setting information
		AJE	Reads Judgement Angle enabled setting information
		AJV	Reads Judgement Angle Judgement value setting information
		DJE	Reads Judgement Divergence enabled setting information
		DJV	Reads Judgement Divergence Judgement value setting information
		BRT	Reads Judgement Radius type setting information
		EJE	Reads Judgement ellipticity enabled setting information
		EJV	Reads Judgement ellipticity judgement value setting information
		PJE	Reads judgement peak enabled setting information
		PJV	Reads judgement peak judgement value setting information
		RFP	Reads log file output path setting information
		IOE	Reads image file output enabled setting information
		RAE	Reads raw data output enabled setting information
		IOC	Reads image file output color setting information
		IOF	Reads image file output format setting information
		CNM	Reads beam centroid setting information
		ANU	Reads angle unit setting information
		DNE	Reads denoising enabled setting information
		DNT	Reads denoising threshold value setting information
		DAX	Reads angle X decimal place setting information
		DAY	Reads angle Y decimal place setting information
		DAD	Reads angle D decimal place setting information
		DDS	(Beam divergence) Reads D4Sigma decimal place setting information
		DDX	(Beam divergence) Reads D4Sigma X(M) decimal place setting information

Command Type	Command Parameter	Command Parameter1	Command Details
RD	AO	DDY	(Beam divergence) Reads D4Sigma Y(m) decimal place setting information
		DD8	(Beam divergence) Reads D86 decimal place setting information
		DEL	Reads ellipticity decimal place setting information
		MSO	(Multi Spot) Reads order setting information
		MSC	(Multi Spot) Reads spot count setting information
		MSM	(Multi Spot) Reads minimum spot area setting information
		ACE	Reads "Adaptive Cal" execute button display enabled setting information
		DOE	(Multi Spot) Reads spot count setting information
		BIE	Reads binning enabled setting information
		DSN	Reads display spot number setting information

5.3.1.3 Profile

\<Read Commands\>

Command Type	Command Parameter	Command Parameter1	Command Details
RD	PR		Reads measurement results
		MLT	Reads Profile Multi Spot measurement results
		PSC	Reads Profile Multi Spot Count
	PO	EXT	Reads exposure time of sensor camera
		FRA	Read frame rate of sensor camera
		ROT	Read Rotation information
		MHE	Read Mirroring Horizontal setting
		MVE	Read Mirroring Vertical setting
		MAV	Reads number of averaging times setting information
		MAE	Reads averaging processing enabled setting information
		CSP	Reads Cross Section Point setting information
		OOX	Reads Origin Offset X value setting information
		OOY	Reads Origin Offset Y value setting information
		AAM	Reads Auto Aperture method setting information
		AAE	Reads Auto Aperture enabled setting information
		ROE	Reads ROI enabled setting information
		RAX	Reads ROI X value setting information
		RAY	Reads ROI Y value setting information
		RAW	Reads ROI width setting information
		RAH	Reads ROI height setting information
		CJE	Reads Auto Aperture method setting information
		CJV	Reads Auto Aperture enabled setting information
		JDE	Reads ROI enabled setting information
		DJV	Reads ROI X value setting information
		DJT	Reads ROI Y value setting information
		EJV	Reads Judgement ellipticity enabled setting information
		EJE	Reads Judgement ellipticity judgement value setting information
		PJE	Reads judgement Peak enabled setting information

Command Type	Command Parameter	Command Parameter1	Command Details
RD	PO	PJV	Reads judgement Peak judgement value setting information
		RFP	Reads log file output path setting information
		IOE	Reads image file output enabled setting information
		RAE	Reads raw data output enabled setting information
		IOC	Reads image file output color setting information
		IOF	Reads image file output format setting information
		CNM	Reads beam centroid setting information
		LNU	Reads angle unit setting information
		DNE	Reads denoising enabled setting information
		DNT	Reads denoising threshold value setting information
		DCX	Reads angle X decimal place setting information
		DCY	Reads angle Y decimal place setting information
		DCD	Reads angle D decimal place setting information
		DDS	(Beam divergence) Reads D4Sigma decimal place setting information
		DDX	(Beam divergence) Reads D4Sigma X(M) decimal place setting information
		DDY	(Beam divergence) Reads D4Sigma Y(m) decimal place setting information
		DD8	(Beam divergence) Reads D86 decimal place setting information
		DEL	Reads ellipticity decimal place setting information
		MSO	(Multi Spot) Reads order setting information
		MSC	(Multi Spot) Reads spot count setting information
		MSM	(Multi Spot) Reads minimum spot area setting information
		ACE	Reads "Adaptive Cal" execute button display enabled setting information

Command Type	Command Parameter	Command Parameter1	Command Details
RD	PO	DOEACE	Reads Orientation Enabled setting informationReads "Adaptive Cal" execute button display enabled setting information
		BIEDOE	Reads Binning enabled setting informationReads Orientation Enabled setting information
		DSNBIE	Reads display spot number setting informationReads Binning enabled setting information

5.3.2 List of Write Commands

5.3.2.1 Angle

\<Write Commands\>

Command Type	Command Parameter	Command Parameter1	Command Details
WR	AO	EXT	Writes sensor camera exposure time
		FRA	Writes sensor camera frame rate
		ROT	Writes Rotation setting information
		MHE	Writes mirroring horizontal setting information
		MVE	Writes mirroring vertical setting information
		MAV	Writes number of averaging times setting information
		MAE	Writes averaging processing enabled setting information
		CSP	Writes cross section point setting information
		OOX	Writes Origin Offset X value setting information
		OOY	Writes Origin Offset Y value setting information
		AAM	Writes Auto Aperture method setting information
		AAE	Writes Auto Aperture enabled setting information
		ROE	Writes ROI enabled setting information
		RAX	Writes ROI X value setting information
		RAY	Writes ROI Y value setting information
		RAW	Writes ROI width setting information
		RAH	Writes ROI height setting information
		ANT	Writes angle type setting information
		AJE	Writes Judgement Angle enabled setting information
		AJV	Writes Judgement Angle judgement value setting information
		DJE	Writes Judgement Divergence enabled setting information
		DJV	Writes Judgement Divergence judgement value setting information
		BRT	Writes Judgement Radius Type setting information
		EJE	Writes Judgement Ellipticity enabled setting information

Command Type	Command Parameter	Command Parameter1	Command Details
WR	AO	EJV	Writes Judgement Ellipticity judgement value setting information
		PJE	Writes Judgement Peak enabled setting information
		PJV	Writes Peak Judgement value setting information
		RFP	Writes Log File output path setting information
		IOE	Writes Image File output enabled setting information
		RAE	Writes Raw Data output enabled setting information
		IOC	Writes Image File output color setting information
		IOF	Writes Image File output format setting information
		CNM	Writes Beam Centroid setting information
		ANU	Writes Angle Unit setting information
		DNE	Writes Denoising enabled setting information
		DNT	Writes Denoising threshold value setting information
		DAX	Writes Angle X decimal place setting information
		DAY	Writes Angle Y decimal place setting information
		DAD	Writes Angle D decimal place setting information
		DDS	（Beam divergence）Writes D4Sigma decimal place setting information
		DDX	（Beam divergence）Writes D4Sigma X(M) decimal place setting information
		DDY	（Beam divergence）Writes D4Sigma Y(m) decimal place setting information
		DD8	（Beam divergence）Writes D86 decimal place setting information
		DEL	Writes ellipticity decimal place setting information
		MSO	（Multi Spot）Writes Order setting information
		MSC	（Multi Spot）Writes Spot Count setting information
		MSM	（Multi Spot）Writes minimum spot area setting information
		ACE	Writes "Adaptive Cal" execute button display enabled setting information

Command Type	Command Parameter	Command Parameter1	Command Details
WR	AO	DOE	Writes Orientation enabled setting information
		BIE	Writes Binning enabled setting information
		DSN	Writes Denoising threshold value setting information

5.3.2.2 Profile

\<Write Commands\>

Command Type	Command Parameter	Command Parameter1	Command Details
WR	PO	EXT	Writes sensor camera Exposure Time
		FRA	Writes sensor camera Frame Rate
		ROT	Writes Rotation setting information
		MHE	Writes Mirroring horizontal setting information
		MVE	Writes Mirroring vertical setting information
		MAV	Writes number of averaging times setting information
		MAE	Writes averaging processing enabled setting information
		CSP	Writes cross section point setting information
		OOX	Writes Origin Offset X value setting information
		OOY	Writes Origin Offset Y value setting information
		AAM	Writes Auto Aperture method setting information
		AAE	Writes Auto Aperture enabled setting information
		ROE	Writes ROI enabled setting information
		RAX	Writes ROI X value setting information
		RAY	Writes ROI Y value setting information
		RAW	Writes ROI width setting information
		RAH	Writes ROI height setting information
		CJE	Writes Judgement Centroid enable setting
		CJV	Writes Judgement Centroid judgement value setting
		DJE	Write Judgement Diameter enable setting
		DJV	Write Judgement Diameter judgement value setting
		BRT	Writes Judgement Radius Type setting
		EJE	Writes Judgement Ellipticity enable setting
		EJV	Writes Judgement Ellipticity judgment value setting
		PJE	Writes Judgement Peak enable setting information
		PJV	Writes Judgement Peak judgement value setting information
		RFP	Writes Log File output path setting information
		IOE	Writes Image File output enabled setting information
		RAE	Writes Raw Data output enabled setting information

Command Type	Command Parameter	Command Parameter1	Command Details
WR	PO	IOC	Writes Image File output color setting information
		IOF	Writes Image File output format setting information
		CNM	Writes Beam Centroid setting information
		LNU	Writes Length Unit setting information
		DNE	Writes Denoising enabled setting information
		DNT	Writes Denoising threshold value setting information
		DCX	Writes Centroid X decimal place setting information
		DCY	Writes Centroid Y decimal place setting information
		DCD	Writes Centroid D decimal place setting information
		DDS	(Beam Diameter) Writes D4Sigma decimal place setting information
		DDX	(Beam Diameter) Writes D4Sigma X(M) decimal place setting information
		DDY	(Beam Diameter) Writes D4Sigma Y(m) decimal place setting information
		DD8	(Beam Diameter) Writes D86 decimal place setting information
		DEL	Writes Ellipticity decimal place setting information
		MSO	(Multi Spot) Writes Order setting information
		MSC	(Multi Spot) Writes Spot Count setting information
		MSM	(Multi Spot) Writes minimum Spot Area setting information
		ACE	Writes Adaptive Cal execution button display enabled setting information
		DOE	Writes Orientation enabled setting information
		BIE	Writes Binning enabled setting information
		DSN	Writes Display Spot number setting information

5.3.3 List of Execute Commands

<Execute Commands>

Command Type	Command Parameter	Command Parameter1	Command Details
EX	SV		Executes Option save
	AR	MSN	Executes Angle Main Spot Number Switching
	PR	MSN	Executes Profile Main Spot Number Switching
	RO		Executes Measurement Result Log Output

5.4 Read Commands

5.4.1 Command Formats

5.4.1.1 Common Formats

[Read version information]
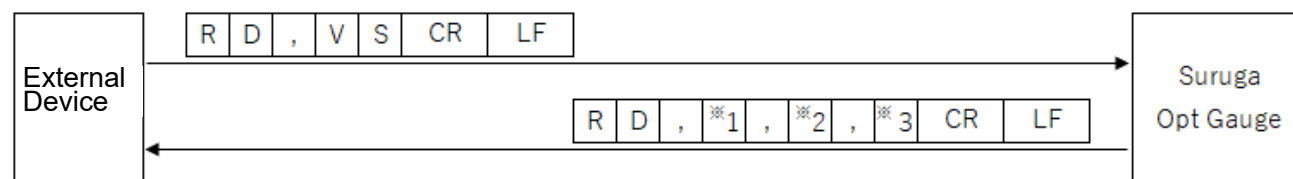
*1: Major number

*2: Minor number

*3: Build number

[Read option list information]
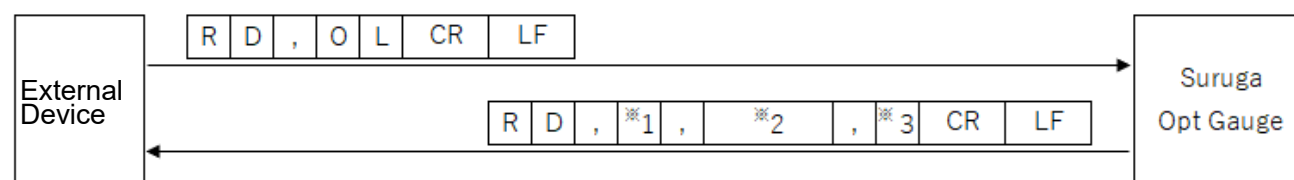
*1: Number of option lists

*2: Option name (includes as many option names as there are option lists, separated with commas)

*3: Index indicating selected options

5.4.1.2 Angle

[Read measurement results]

```
External Device → Suruga Opt Gauge:  R D , A R CR LF
Suruga Opt Gauge → External Device:  R D , *1 , *2 , *3 , *4 , *5 , *6 , *7 , *8 , *9 , *10 , *11 , *12 , *13 , *14 , *15 CR LF
```
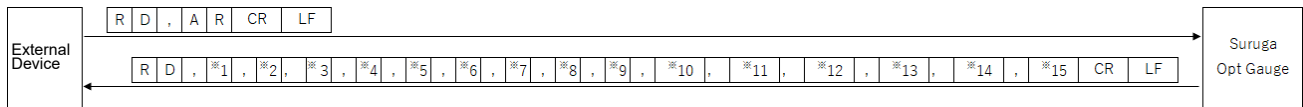
*1: Tilt Angle/Beam Angle: Angle X measurement value

*2: Tilt Angle/Beam Angle: Angle Y measurement value

*3: Tilt Angle/Beam Angle: Angle D measurement value

*4: Beam Divergence: D4Sigma measurement value

*5: Beam Divergence: D4Sigma X(M) measurement value

*6: Beam Divergence: D4Sigma Y (m) measurement value

*7: Beam Divergence: D86 measurement value

*8: Beam Ellipticity measurement value

*9: Beam: Total count value

*10: Beam: Peak value

*11: Judgement: Tilt angle (D) judgement result (OK/NG)

*12: Judgement: Beam divergence judgement result (OK/NG)

*13: Judgement: Ellipticity judgement result (OK/NG)

*14: Judgement: Peak judgement result (OK/NG)

*15: Angle Unit (degree/DegMinSec/milliradian)

[Read Multi Spot measurement results]

```
External Device → Suruga OptGauge:  R D , A R , M L T , *1 , *2
Suruga OptGauge → External Device:  R D , *3 , *4 , *5 , *6 , *7 , *8 , *9 , *10 , *11 , *12 , *13 , *14 , *15 , *16 , *17 *18 CR LF
```
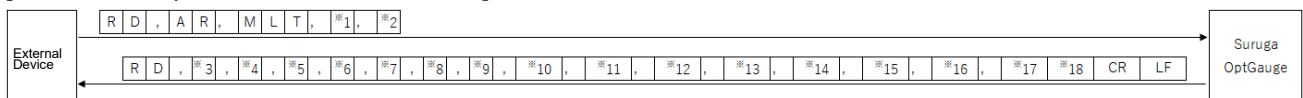
*1: Acquisition Start Spot Number (1 to 100)

*2: Consecutive Spot Count to Read from*1 (1 to 100)

*3: Tilt Angle/Beam Angle: Angle X measurement value

*4: Tilt Angle/Beam Angle: Angle Y measurement value

*5: Tilt Angle/Beam Angle: Angle D measurement value

*6: Beam Divergence: D4Sigma measurement value

*7: Beam Divergence: D4Sigma X(M) measurement value

*8: Beam Divergence: D4Sigma Y (m) measurement value

*9: Beam Divergence: D86 measurement value

*10: Beam Ellipticity measurement value

*11: Beam: Total count value

*12: Beam: Peak value

*13: Judgement: Tilt angle (D) judgement result (OK/NG)

*14: Judgement: Beam divergence judgement result (OK/NG)

*15: Judgement: Ellipticity judgement result (OK/NG)

*16: Judgement: Peak judgement result (OK/NG)

*17: Angle Unit (degree/DegMinSec/milli-radian)

*18: Measurement Results of *3 to *17 for the Number Specified in *2 (The specified number of results will be included, separated by ",")

< Read Angle Multi Spot Count >
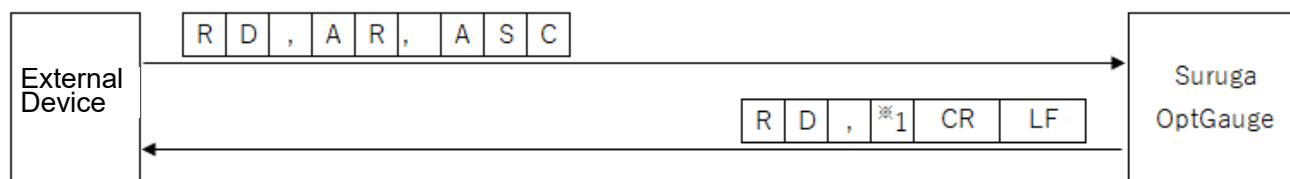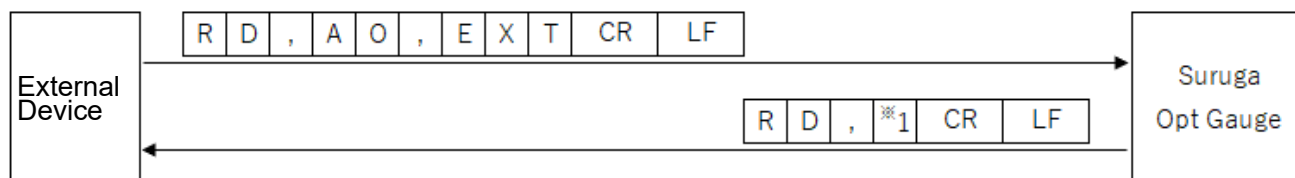
External Device	→ `R D , A R , A S C` →	Suruga OptGauge
	← `R D , ※1 CR LF` ←	

*1：Spot Count (1 to 100)

[Read sensor camera exposure time]

External Device	→ `R D , A O , E X T CR LF` →	Suruga Opt Gauge
	← `R D , ※1 CR LF` ←	

*1: Exposure time (0.027 to 2000)

[Read sensor camera frame rate]

External Device	→ `R D , A O , F R A CR LF` →	Suruga Opt Gauge
	← `R D , ※1 CR LF` ←	

*1: Frame rate (0.1 to 100)

[Read Rotation setting information]

External Device	→ `R D , A O , R O T CR LF` →	Suruga Opt Gauge
	← `R D , ※1 CR LF` ←	

*1: Rotation ("0" = OFF, "1" = Rotation right 90°, "2" = Rotation right 180°, "3" = Rotation right 270°)

[Read Mirroring Horizontal setting information]

| R | D | , | A | O | , | M | H | E | CR | LF |

External Device → Suruga Opt Gauge

| R | D | , | ※1 | CR | LF |

Suruga Opt Gauge → External Device

*1: Mirroring ("0" = OFF, "1" = Horizontal mirroring display)

[Reads mirroring vertical setting information]

| R | D | , | A | O | , | M | V | E | CR | LF |

External Device → Suruga Opt Gauge

| R | D | , | ※1 | CR | LF |

Suruga Opt Gauge → External Device
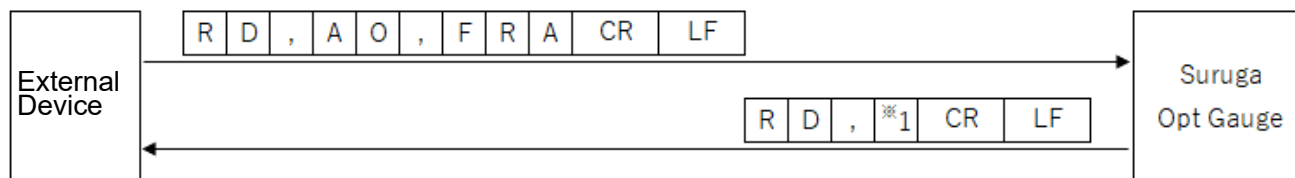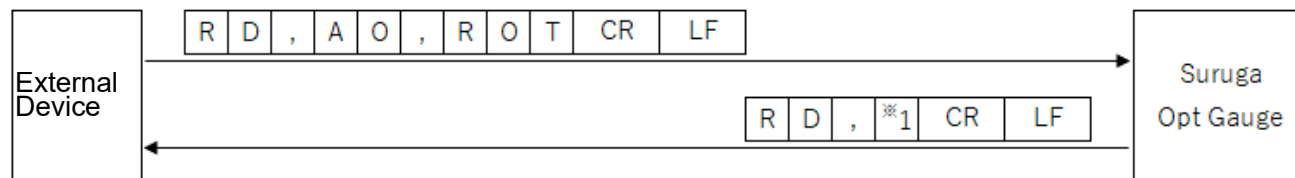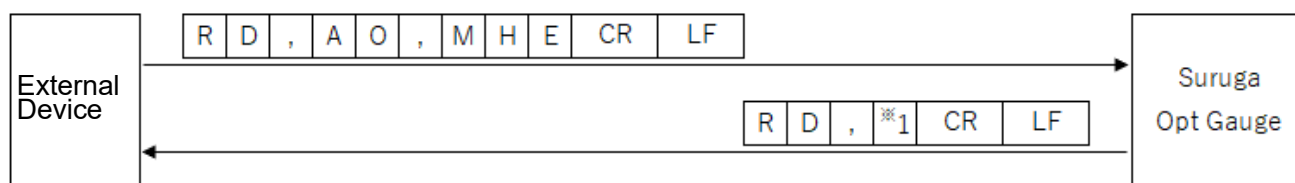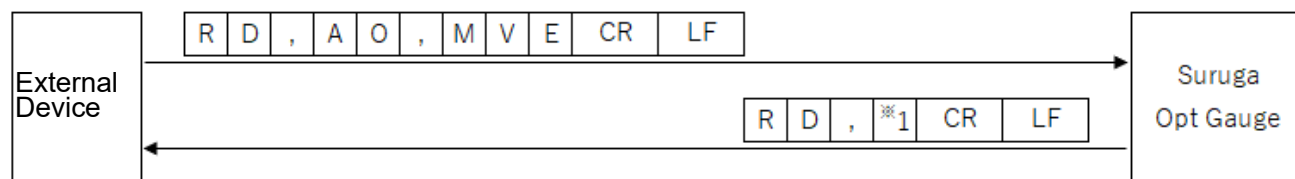
*1: Mirroring ("0" = OFF, "1" = Vertical mirroring display)

[Read number of averaging times setting information]
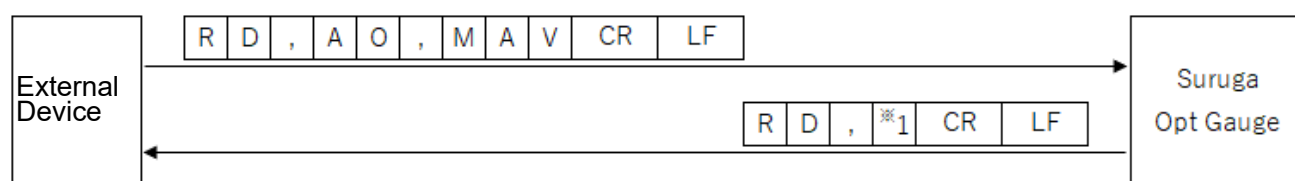
| R | D | , | A | O | , | M | A | V | CR | LF |

External Device → Suruga Opt Gauge

| R | D | , | ※1 | CR | LF |

Suruga Opt Gauge → External Device

*1: Number of averaging times (2 to 262,144)

[Read averaging processing enabled setting information]

| R | D | , | A | O | , | M | A | E | CR | LF |

External Device → Suruga Opt Gauge

| R | D | , | ※1 | CR | LF |

Suruga Opt Gauge → External Device

*1: Averaging processing ("0" = disabled, "1" = enabled)

[Read Cross Section point setting information]

| R | D | , | A | O | , | C | S | P | CR | LF |

External Device → Suruga Opt Gauge

| R | D | , | ※1 | CR | LF |

Suruga Opt Gauge → External Device

*1: Cross section point ("0" = origin cursor, "1" = beam cursor)

[Read Origin Offset X value setting information]

External Device	R	D	,	A	O	,	O	O	X	CR	LF				→	Suruga Opt Gauge

| | | | | | | | | R | D | , | ※1 | CR | LF | ← | |
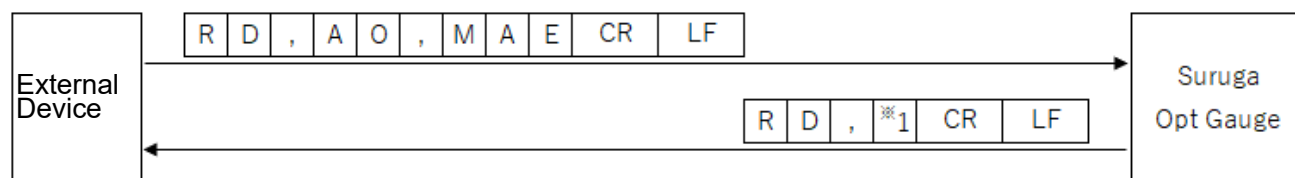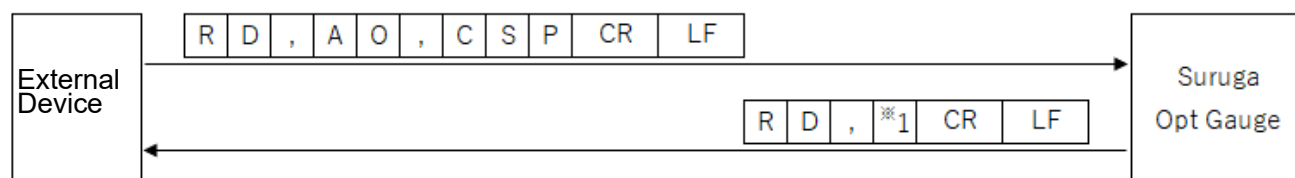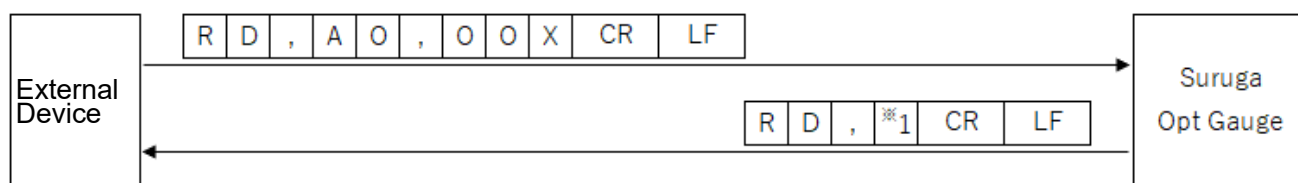
*1: Origin Offset X (-10 to 10)

[Read Origin Offset Y value setting information]

External Device	R	D	,	A	O	,	O	O	Y	CR	LF	→	Suruga Opt Gauge

| | R | D | , | ※1 | CR | LF | ← |
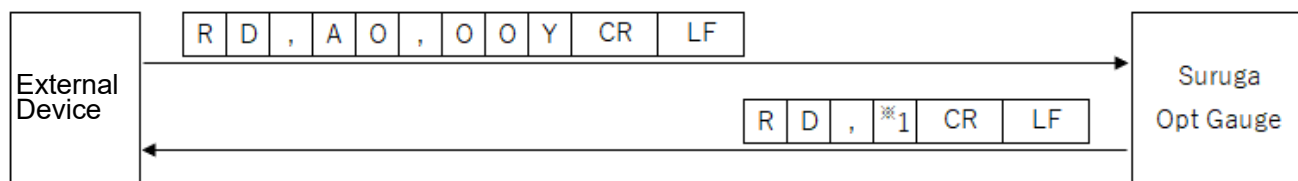
*1: Origin Offset Y (-10 to 10)

[Read Auto Aperture method setting information]
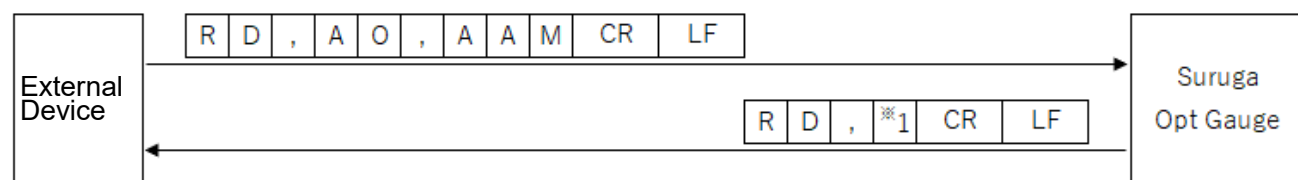
| External Device | R | D | , | A | O | , | A | A | M | CR | LF | → | Suruga Opt Gauge |

| | R | D | , | ※1 | CR | LF | ← |

*1: Auto Aperture method ("0" = area, "1" = luminance)

[Read Auto Aperture enabled setting information]

| External Device | R | D | , | A | O | , | A | A | E | CR | LF | → | Suruga Opt Gauge |

| | R | D | , | ※1 | CR | LF | ← |

*1: Auto Aperture ("0" = disabled, "1" = enabled)

[Read ROI Enabled setting information]

| External Device | R | D | , | A | O | , | R | O | E | CR | LF | → | Suruga Opt Gauge |

| | R | D | , | ※1 | CR | LF | ← |

*1: ROI ("0" = disabled, "1" = enabled)

[Read ROI X value setting information]

| External Device | R | D | , | A | O | , | R | A | X | CR | LF | → Suruga Opt Gauge |
| | | | | R | D | , | ※1 | CR | LF | | ← |

*1: ROI X value (-3,000 to 3,000)

[Read ROI Y value setting information]

| External Device | R | D | , | A | O | , | R | A | Y | CR | LF | → Suruga Opt Gauge |
| | | | | R | D | , | ※1 | CR | LF | | ← |

*1: ROI Y value (-3,000 to 3,000)

[Read ROI Width setting information]

| External Device | R | D | , | A | O | , | R | A | W | CR | LF | → Suruga Opt Gauge |
| | | | | R | D | , | ※1 | CR | LF | | ← |

*1: ROI width (0 to 3,000)

[Read ROI Height setting information]

| External Device | R | D | , | A | O | , | R | A | H | CR | LF | → Suruga Opt Gauge |
| | | | | R | D | , | ※1 | CR | LF | | ← |
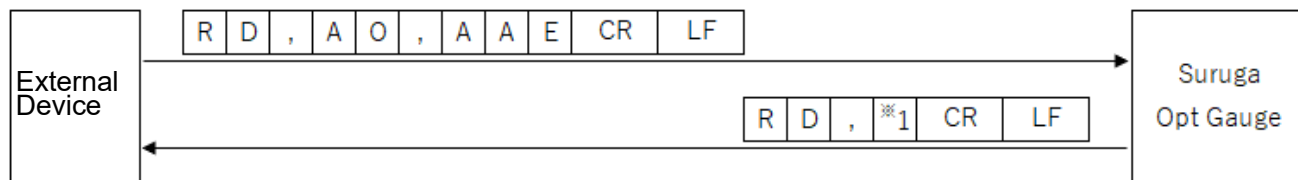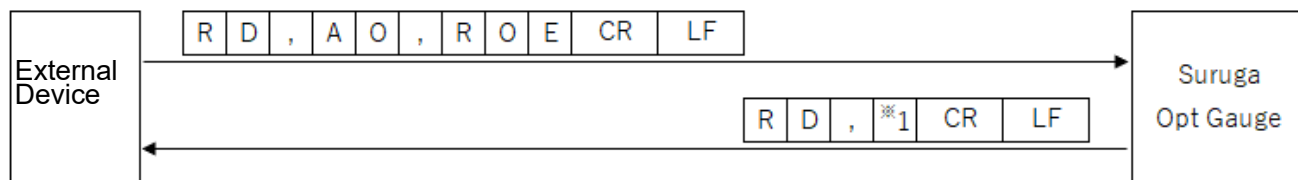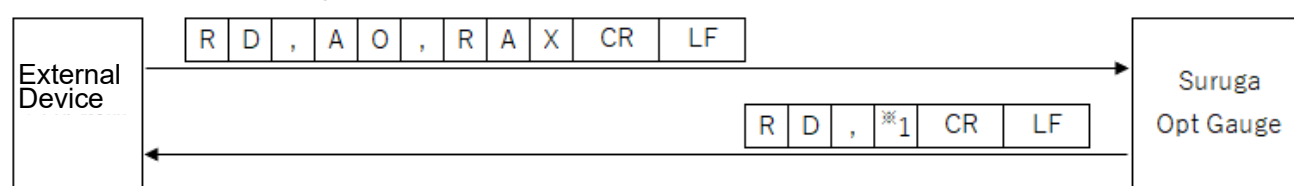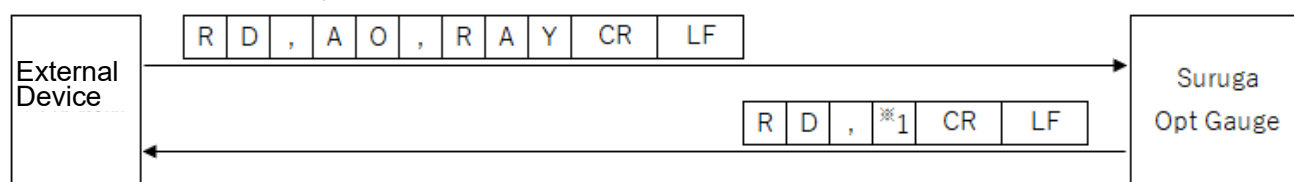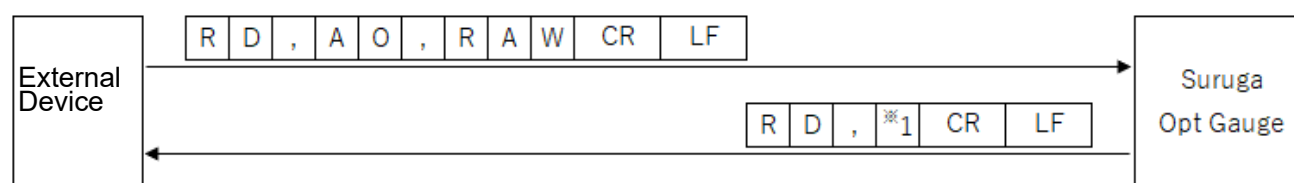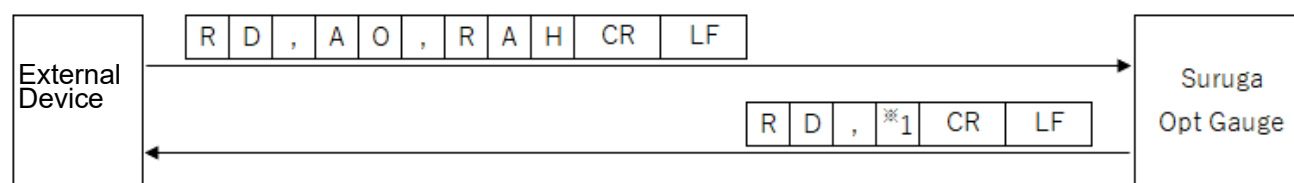
*1: ROI height (0 to 3,000)

[Read Angle Type setting information]

| External Device | R | D | , | A | O | , | A | N | T | CR | LF | → Suruga Opt Gauge |
| | | | | R | D | , | ※1 | CR | LF | | ← |
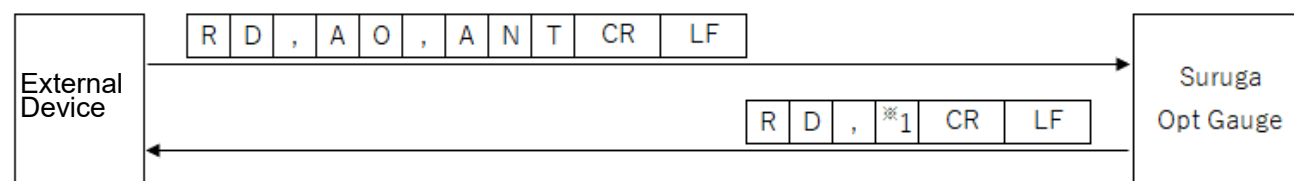
*1: Angle Type ("0" = Tilt Angle, "1" = Beam Angle)

[Read Judgement Angle enabled setting information]
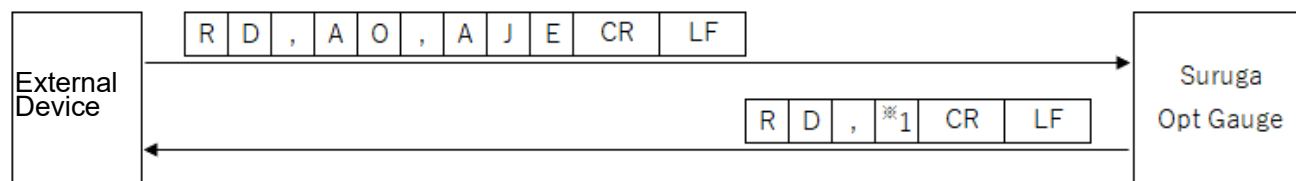
External Device	R	D	,	A	O	,	A	J	E	CR	LF	→ Suruga Opt Gauge
					R	D	,	※1	CR	LF		←

*1: Judgement Angle ("0" = disabled, "1" = enabled)

[Read judgement value setting information at the Judgement Angle]

External Device	R	D	,	A	O	,	A	J	V	CR	LF	→ Suruga Opt Gauge
					R	D	,	※1	CR	LF		←
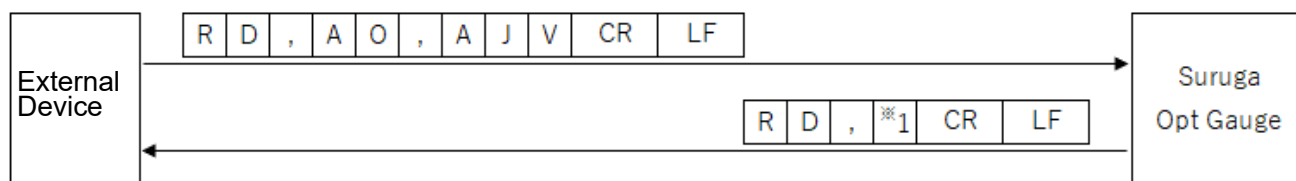
*1: Judgement Angle judgement value

[Read judgement value setting information at the Judgement Angle]

External Device	R	D	,	A	O	,	A	J	V	CR	LF	→ Suruga Opt Gauge
					R	D	,	※1	CR	LF		←
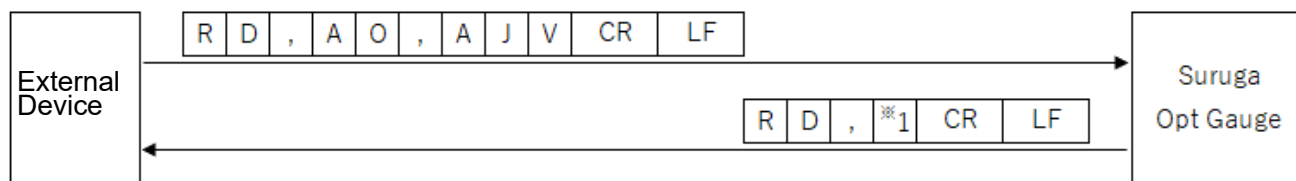
*1: Judgement value (0 to 10) at the Judgement Angle

[Read Judgement Divergence enabled setting information]
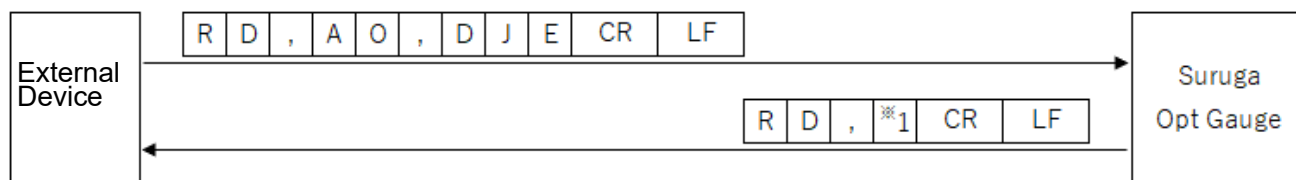
External Device	R	D	,	A	O	,	D	J	E	CR	LF	→ Suruga Opt Gauge
					R	D	,	※1	CR	LF		←

*1: Judgement Divergence ("0" = disabled, "1" = enabled)

[Read judgement value setting information at the Judgement Divergence]

External Device	R	D	,	A	O	,	D	J	V	CR	LF	→ Suruga Opt Gauge
					R	D	,	※1	CR	LF		←

*1: Judgement value (0.0000 to 1,000.0000) at Judgement Divergence

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[Read Judgement Radius Type setting information]

External Device	R	D	,	A	O	,	B	R	T	CR	LF				→ Suruga Opt Gauge

								R	D	,	※1	CR	LF	←
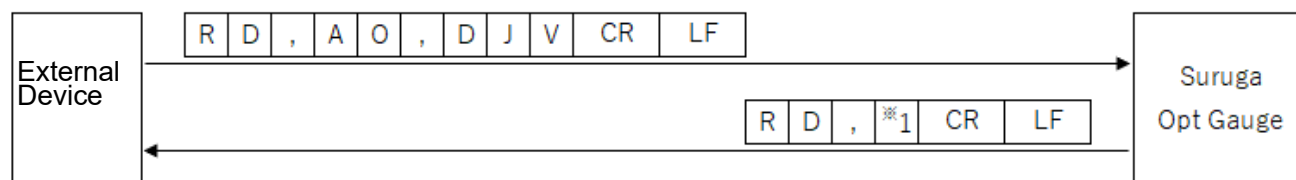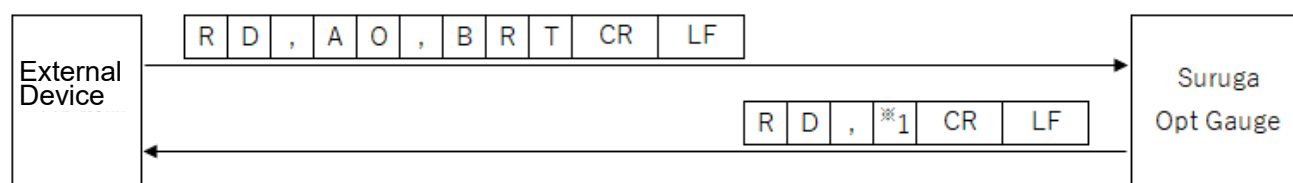
*1: Judgement Radius Type ("0" = D4Sigma, "1" = D86)

[Read Judgement Ellipticity enabled setting information]
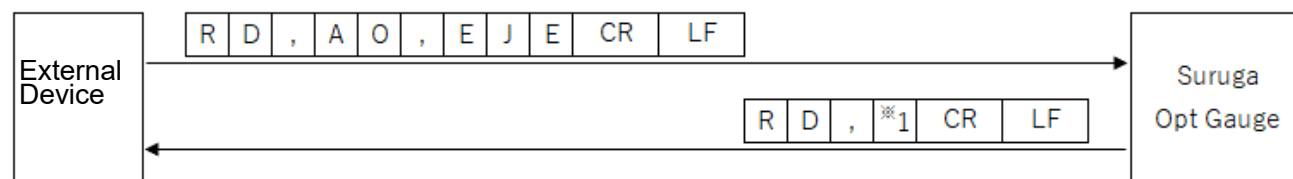
External Device	R	D	,	A	O	,	E	J	E	CR	LF				→ Suruga Opt Gauge

								R	D	,	※1	CR	LF	←

*1: Judgement Ellipticity ("0" = disabled, "1" = enabled)

[Read Judgement Ellipticity judgement value setting information]

External Device	R	D	,	A	O	,	E	J	V	CR	LF				→ Suruga Opt Gauge

								R	D	,	※1	CR	LF	←
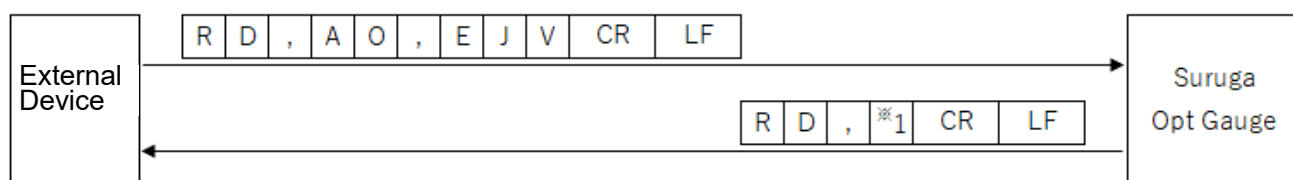
*1: Judgement Ellipticity judgement value (0.0000 to 1.0000)

[Read Judgement Peak enabled setting information]
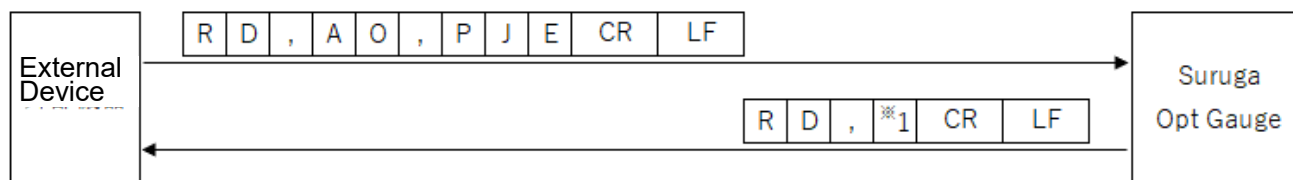
External Device	R	D	,	A	O	,	P	J	E	CR	LF				→ Suruga Opt Gauge

								R	D	,	※1	CR	LF	←

*1: Judgement Peak ("0" = disabled, "1" = enabled)

[Read judgement value setting information at the Judgement Peak]

External Device	R	D	,	A	O	,	P	J	V	CR	LF				→ Suruga Opt Gauge

								R	D	,	※1	CR	LF	←
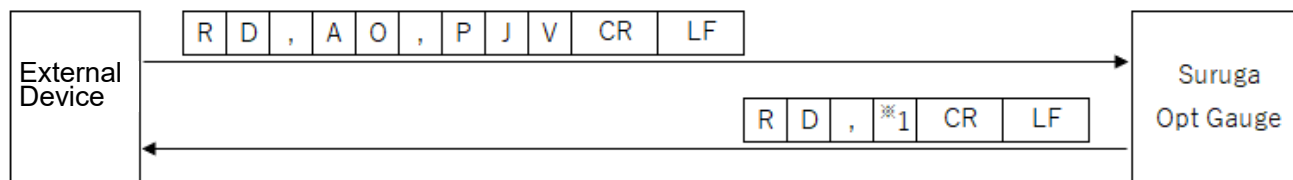
*1: Judgement Peak judgement value (0.0 to 4,095.0)

[Read Log File output path setting Information]
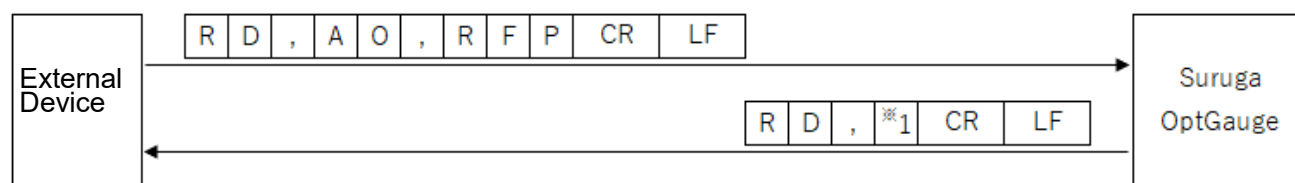
External Device	R	D	,	A	O	,	R	F	P	CR	LF	→ Suruga OptGauge
						R	D	,	※1	CR	LF	←

*1：Log File Path String

[Read Image File output enabled setting Information]

External Device	R	D	,	A	O	,	I	O	E	CR	LF	→ Suruga OptGauge
						R	D	,	※1	CR	LF	←

*1：Image File Output ("0" = disabled, "1" = enabled)

[Read RAW Data output enabled setting Information]

External Device	R	D	,	A	O	,	R	A	E	CR	LF	→ Suruga OptGauge
						R	D	,	※1	CR	LF	←

*1：RAW Data Output ("0" = disabled, "1" = enabled)

[Read Image File output color setting Information]

External Device	R	D	,	A	O	,	I	O	C	CR	LF	→ Suruga OptGauge
						R	D	,	※1	CR	LF	←

*1：Image File Output Color ("0"= Full Color、"1"= Grayscale)

[Read Image File output format setting information]

External Device	R	D	,	A	O	,	I	O	F	CR	LF	→ Suruga OptGauge
						R	D	,	※1	CR	LF	←

*1：Image File Output Format ("0"= png、"1"= bmp、"2"= tiff)

[Read Beam Centroid setting information]

External Device	R	D	,	A	O	,	C	N	M	CR	LF							Suruga Opt Gauge
												R	D	,	※1	CR	LF	
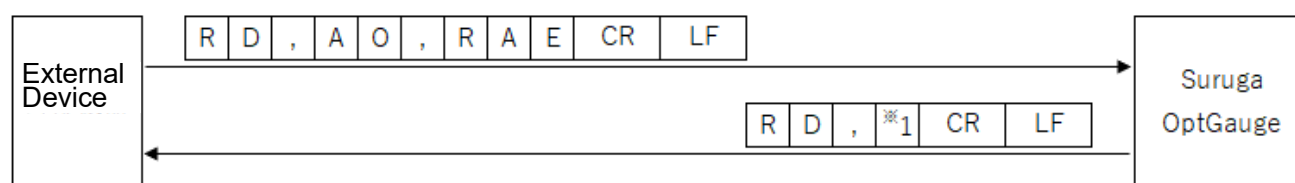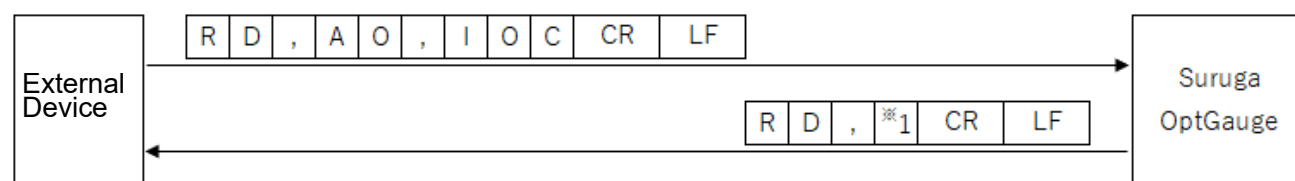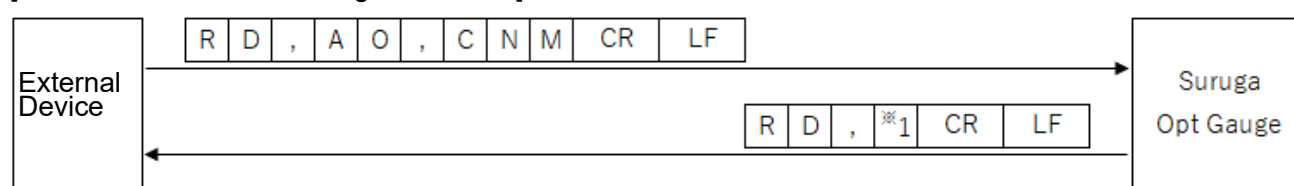
*1: Beam Centroid ("0" = Area, "1" = Intensity)

[Read Angle Unit setting information]

External Device	R	D	,	A	O	,	A	N	U	CR	LF							Suruga Opt Gauge
												R	D	,	※1	CR	LF	
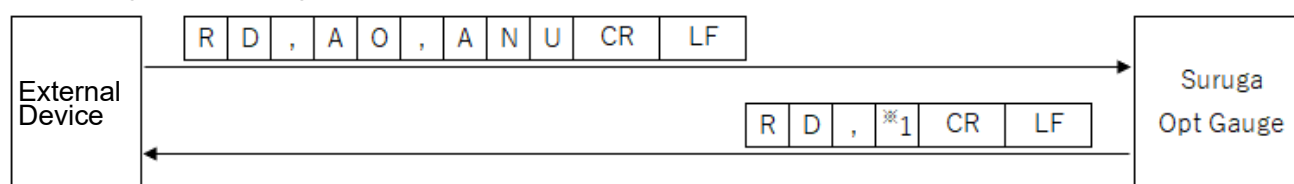
*1: Angle Unit ("0" = degree, "1" = DegMinSec, "2" = Milliradian)

[Read Denoising enabled setting information]

External Device	R	D	,	A	O	,	D	N	E	CR	LF							Suruga Opt Gauge
												R	D	,	※1	CR	LF	
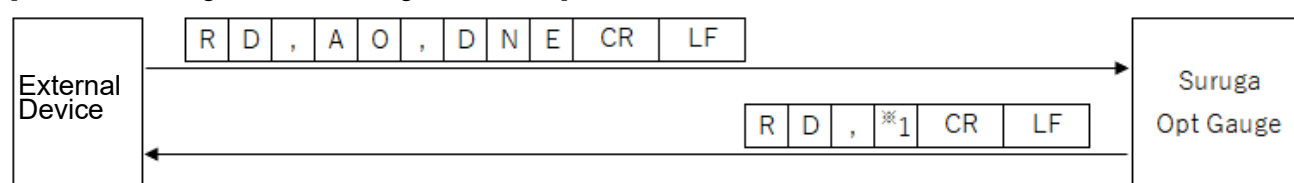
*1: Denoising function ("0" = disabled, "1" = enabled)

[Read Denoising threshold value setting information]

External Device	R	D	,	A	O	,	D	N	T	CR	LF							Suruga Opt Gauge
												R	D	,	※1	CR	LF	
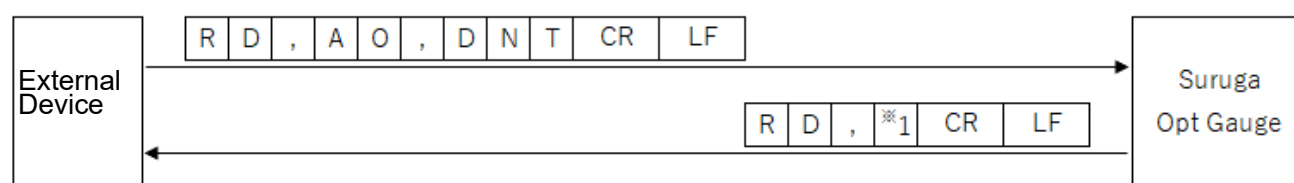
*1: Denoising threshold value (1 to 4,095)

[Read Angle X decimal place setting information]

External Device	R	D	,	A	O	,	D	A	X	CR	LF							Suruga Opt Gauge
												R	D	,	※1	CR	LF	
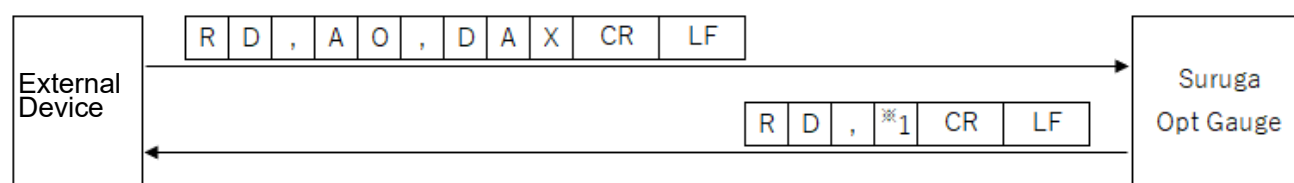
*1: Angle X decimal place (0 to 8)

[Read Angle Y decimal place setting information]

External Device	R	D	,	A	O	,	D	A	Y	CR	LF			Suruga Opt Gauge
							R	D	,	※1	CR	LF		
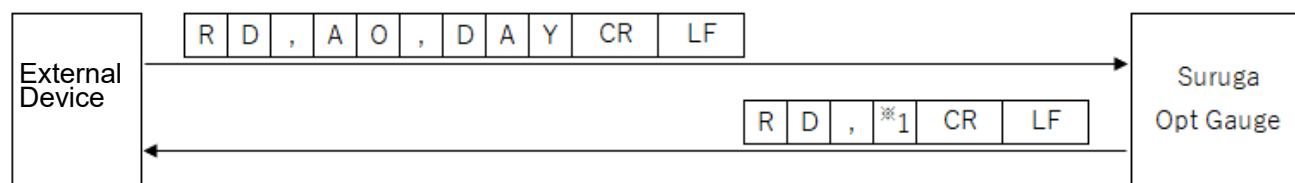
*1: Angle Y decimal place (0 to 8)

[Read Angle D decimal place setting information]

External Device	R	D	,	A	O	,	D	A	D	CR	LF			Suruga Opt Gauge
							R	D	,	※1	CR	LF		
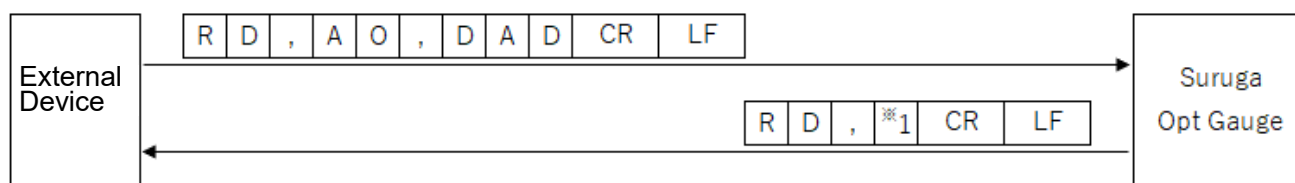
*1: Angle D decimal place (0 to 8)

[(Beam Divergence) Read D4Sigma decimal place setting information]

External Device	R	D	,	A	O	,	D	D	S	CR	LF			Suruga Opt Gauge
							R	D	,	※1	CR	LF		
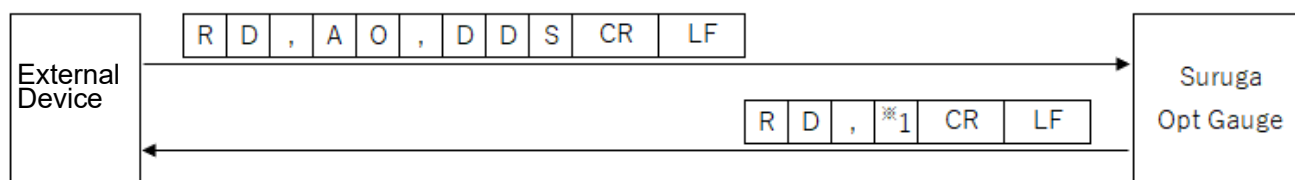
*1: D4Sigma decimal place (0 to 8)

[(Beam Divergence) Read D4Sigma X(M) decimal place setting information]

External Device	R	D	,	A	O	,	D	D	X	CR	LF			Suruga Opt Gauge
							R	D	,	※1	CR	LF		
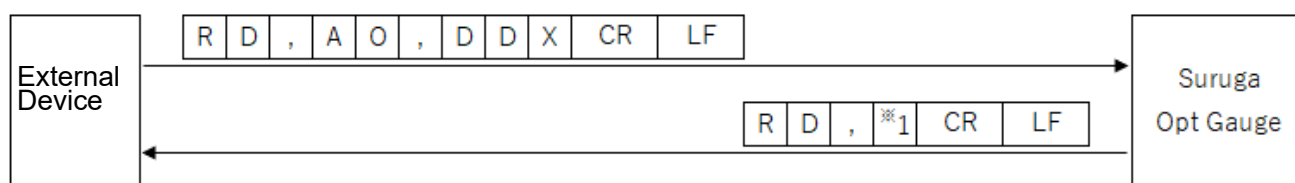
*1: D4Sigma X(M) decimal place (0 to 8)

[(Beam Divergence) Read D4Sigma Y(m) decimal place setting information]

External Device	R	D	,	A	O	,	D	D	Y	CR	LF			Suruga Opt Gauge
							R	D	,	※1	CR	LF		
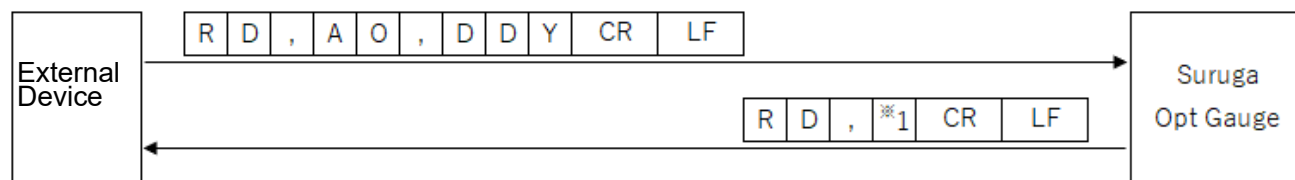
*1: D4Sigma Y(m) decimal place (0 to 8)

[(Beam Divergence) Read D86 decimal place setting information]
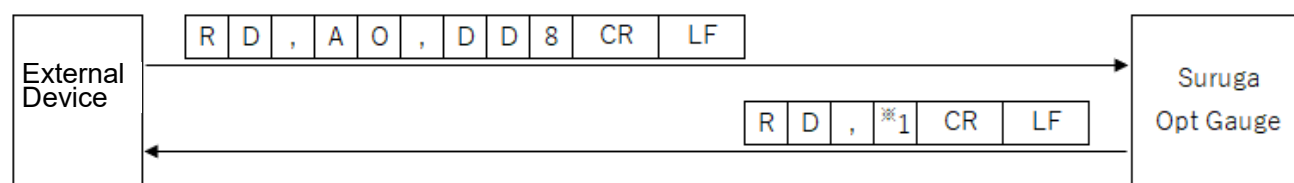
| External Device | R | D | , | A | O | , | D | D | 8 | CR | LF | → | Suruga Opt Gauge |

| | R | D | , | ※1 | CR | LF | ← | Suruga Opt Gauge |

*1: D86 decimal place (0 to 8)

[Read Ellipticity decimal place setting information]

| External Device | R | D | , | A | O | , | D | E | L | CR | LF | → | Suruga Opt Gauge |

| | R | D | , | ※1 | CR | LF | ← |
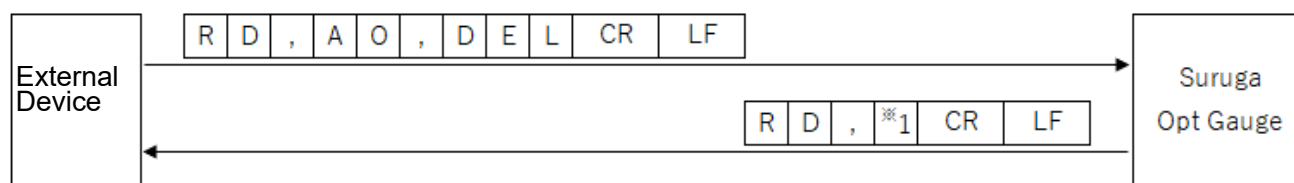
*1: Ellipticity decimal place (0 to 8)

[(Multi Spot) Read Order setting information]

| External Device | R | D | , | A | O | , | M | S | O | CR | LF | → | Suruga Opt Gauge |

| | R | D | , | ※1 | CR | LF | ← |
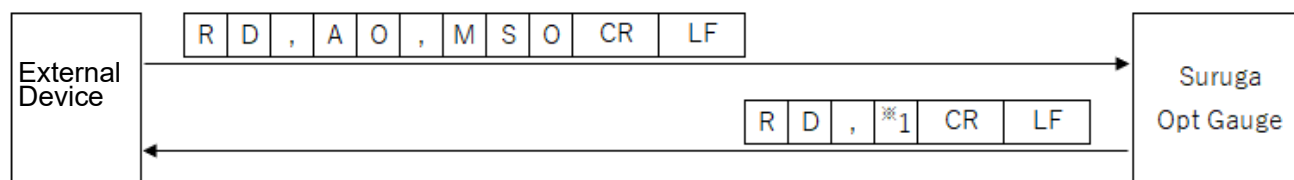
*1: (Multi Spot) List sort type ("0" = area, "1" = angle)

[(Multi Spot) Read Spot Count setting information]

| External Device | R | D | , | A | O | , | M | S | C | CR | LF | → | Suruga Opt Gauge |

| | R | D | , | ※1 | CR | LF | ← |
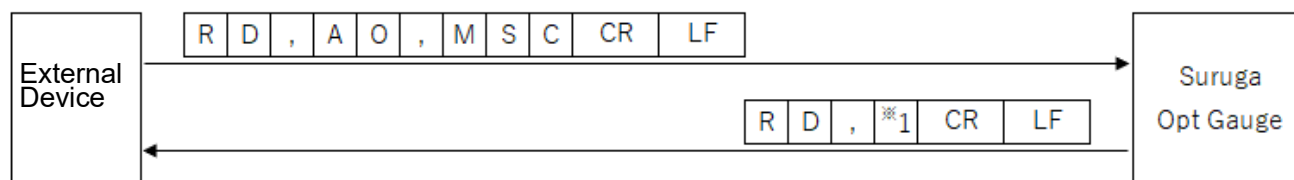
*1: Spot count (1 to 100)

[(Multi Spot) Read Minimum Spot Area setting information]
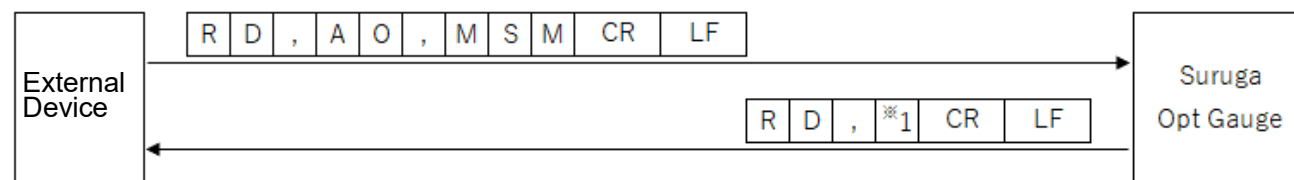
| External Device | R | D | , | A | O | , | M | S | M | CR | LF | → | Suruga Opt Gauge |

| | R | D | , | ※1 | CR | LF | ← |

*1: Minimum spot area (1 to 1023)

[Read Adaptive Cal execute button display enabled setting information]

| External Device | R | D | , | A | O | , | A | C | E | CR | LF | → Suruga Opt Gauge |

| External Device | ← | R | D | , | ※1 | CR | LF | Suruga Opt Gauge |

*1: Adaptive Cal execute button display ("0" = disabled, "1" = enabled)

[Read orientation enabled setting information]

| External Device | R | D | , | A | O | , | D | O | E | CR | LF | → Suruga Opt Gauge |

| External Device | ← | R | D | , | ※1 | CR | LF | Suruga Opt Gauge |

*1: Orientation enabled ("0" = disabled, "1" = enabled)

[Read Binning enabled setting information]

| External Device | R | D | , | A | O | , | B | I | E | CR | LF | → Suruga Opt Gauge |

| External Device | ← | R | D | , | ※1 | CR | LF | Suruga Opt Gauge |

*1: Binning setting ("0" = disabled, "1" = enabled)

[Read Display Spot Number setting information]

| External Device | R | D | , | A | O | , | D | S | N | CR | LF | → Suruga Opt Gauge |

| External Device | ← | R | D | , | ※1 | CR | LF | Suruga Opt Gauge |
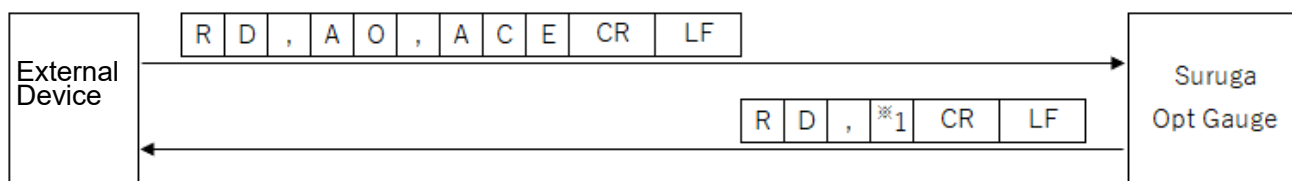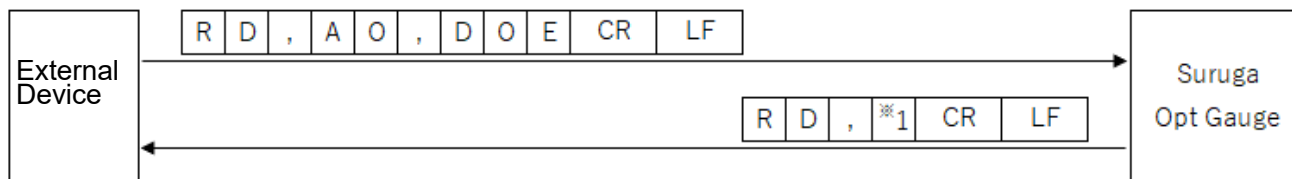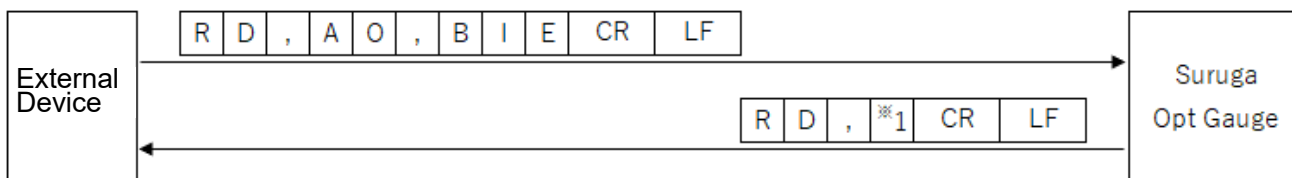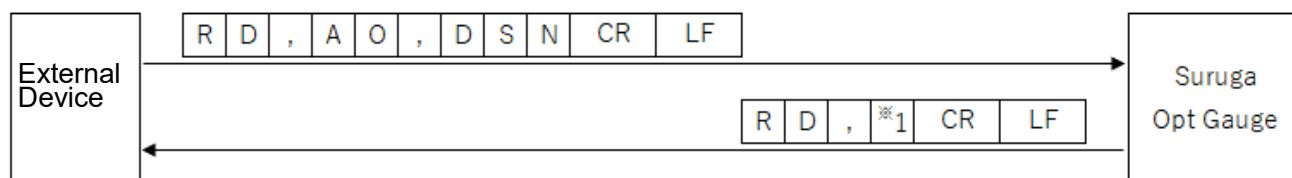
*1: Display Spot Number (0 to 100)

5.4.1.3 Profile

[Read measurement results]

External Device		Suruga Opt Gauge
R D , P R CR LF →		
← R D , *1 , *2 , *3 , *4 , *5 , *6 , *7 , *8 , *9 , *10 , *11 , *12 , *13 , *14 , *15 CR LF		
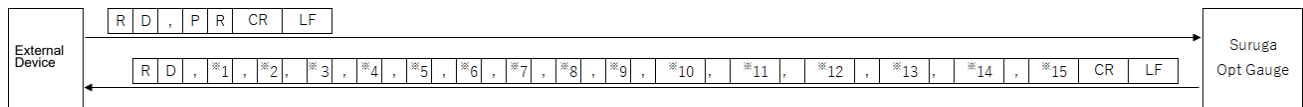
*1: Beam Centroid：Centroid X measurement value

*2: Beam Centroid：Centroid Y measurement value

*3: Beam Centroid：Centroid D measurement value

*4: Beam Diameter：D4Sigma measurement value

*5: Beam Diameter：D4Sigma X(M) measurement value

*6: Beam Diameter：D4Sigma Y(m) measurement value

*7: Beam Diameter：D86 measurement value

*8: Beam Ellipticity measurement value

*9: Beam：Total Count value

*10: Beam：Peak value

*11: Judgement：Centroid(D)judgement result (OK/NG)

*12: Judgement：Diameter judgement result (OK/NG)

*13: Judgement: Ellipticity judgement result (OK/NG)

*14: Judgement: Peak judgement result (OK/NG)

*15: distance unit(Millimeter / Micrometer)

[Read Multi Spot measurement results]

External Device		Suruga OptGauge
R D , P R , M L T , *1 , *2 →		
← R D , *3 , *4 , *5 , *6 , *7 , *8 , *9 , *10 , *11 , *12 , *13 , *14 , *15 , *16 , *17 *18 CR LF		
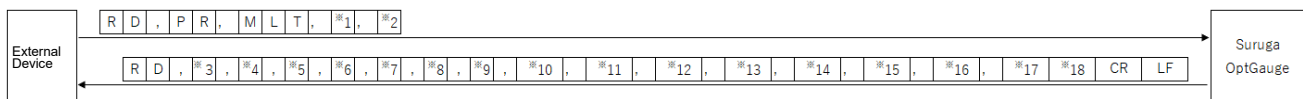
*1: Acquisition Start Spot Number (1 to 100)

*2: Consecutive Spot Count to Read from*1 (1 to 100)

*3: Beam Centroid：Centroid X measurement value

*4: Beam Centroid：Centroid Y measurement value

*5: Beam Centroid：Centroid D measurement value

*6: Beam Diameter：D4Sigma measurement value

*7: Beam Diameter：D4Sigma X(M) measurement value

*8: Beam Diameter：D4Sigma Y(m) measurement value

*9: Beam Diameter：D86 measurement value

*10: Beam Ellipticity measurement value

*11: Beam: Total count value

*12: Beam: Peak value

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*13: Judgement：Centroid(D)judgement result (OK/NG)

*14: Judgement：Diameter judgement result (OK/NG)

*15: Judgement: Ellipticity judgement result (OK/NG)

*16: Judgement: Peak judgement result (OK/NG)

*17: distance unit(Millimeter / Micrometer)

*18: Measurement Results of *3 to *17 for the Number Specified in *2 (The specified number of results will be included, separated by ",")

< Read Profile Multi Spot Count >
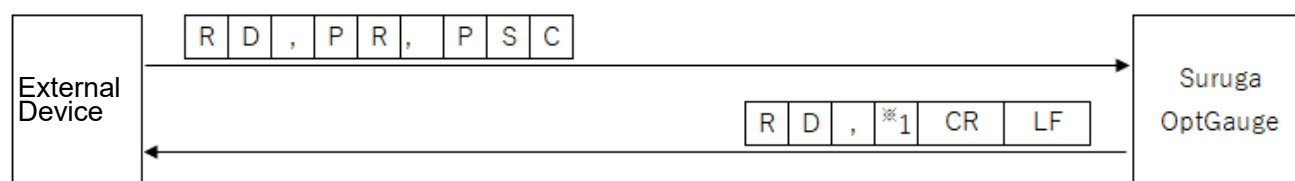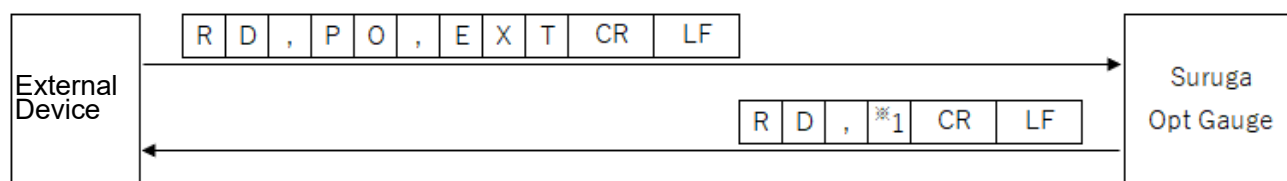
| External Device | RD , PR , PSC → Suruga OptGauge |
| | ← RD , ※1 CR LF |

*1：Spot Count (1 to 100)

[Read sensor camera Exposure Time]

| External Device | RD , PO , EXT CR LF → Suruga Opt Gauge |
| | ← RD , ※1 CR LF |

*1: Exposure Time (0.027 to 2000)

[Read sensor camera Frame Rate]

| External Device | RD , PO , FRA CR LF → Suruga Opt Gauge |
| | ← RD , ※1 CR LF |

*1: Frame Rate (0.1 to 100)

[Read Rotation setting information]

| External Device | RD , PO , ROT CR LF → Suruga Opt Gauge |
| | ← RD , ※1 CR LF |

*1: Rotation ("0" = OFF, "1" = Rotation right 90°, "2" = Rotation right 180°, "3" = Rotation right 270°)

[Read Mirroring Horizontal setting information]

| External Device | | | | | | | | | | | | | → Suruga Opt Gauge |

```
External Device  → R D , P O , M H E CR LF →  Suruga Opt Gauge
External Device  ←        R D , ※1 CR LF    ←  Suruga Opt Gauge
```

*1: Mirroring ("0" = OFF, "1" = Horizontal Mirroring display)

[Reads Mirroring Vertical setting information]

```
External Device  → R D , P O , M V E CR LF →  Suruga Opt Gauge
External Device  ←        R D , ※1 CR LF    ←  Suruga Opt Gauge
```
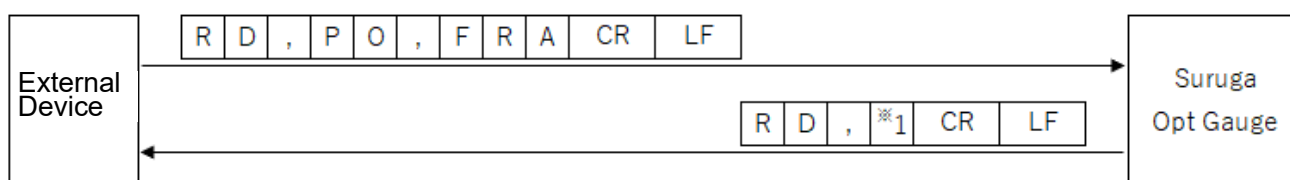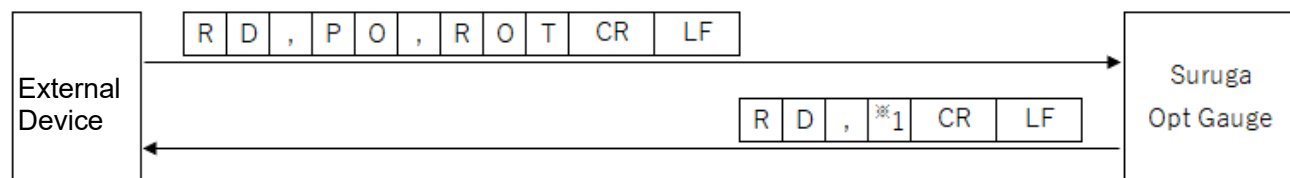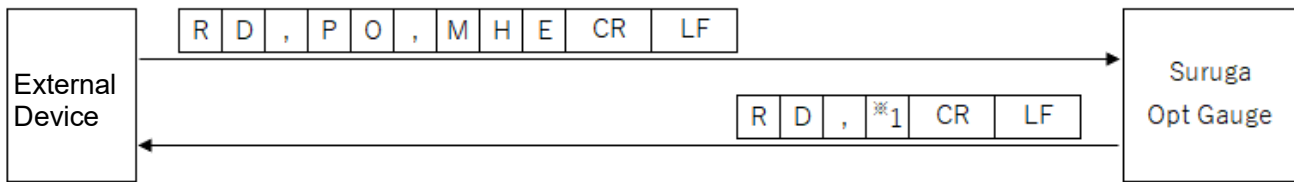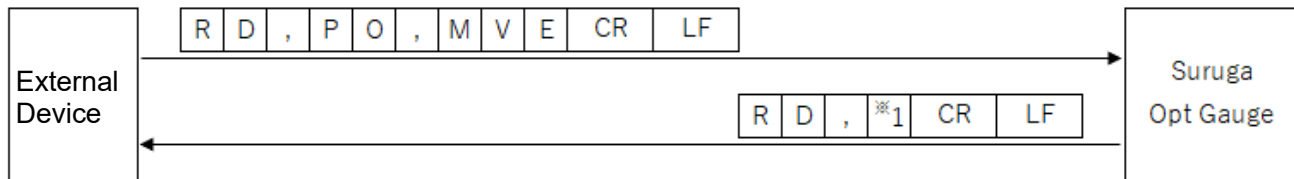
*1: Mirroring   ("0" = OFF, "1" = Vertical Mirroring)

[Read number of Averaging Times setting information]
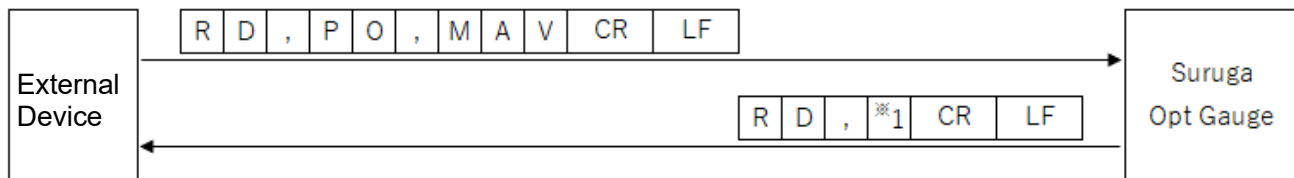
```
External Device  → R D , P O , M A V CR LF →  Suruga Opt Gauge
External Device  ←        R D , ※1 CR LF    ←  Suruga Opt Gauge
```

*1: Number of Averaging Times (2 to 262,144)

[Read Averaging Processing enabled setting information]

```
External Device  → R D , P O , M A E CR LF →  Suruga Opt Gauge
External Device  ←        R D , ※1 CR LF    ←  Suruga Opt Gauge
```

*1: Averaging Processing ("0" = disabled, "1" = enabled)

[Read Cross Section Point setting information]

```
External Device  → R D , P O , C S P CR LF →  Suruga Opt Gauge
External Device  ←        R D , ※1 CR LF    ←  Suruga Opt Gauge
```

*1: Cross Section Point ("0" = Origin Cursor, "1" = Beam Cursor)

[Read OriginOffset X value setting information]

External Device		R	D	,	P	O	,	O	O	X	CR	LF		→	Suruga Opt Gauge

External Device ← R D , ※1 CR LF Suruga Opt Gauge
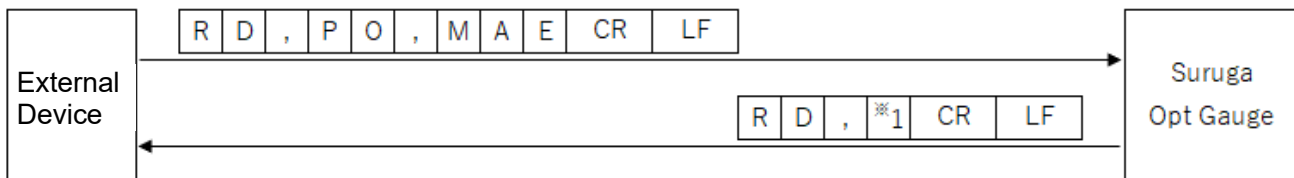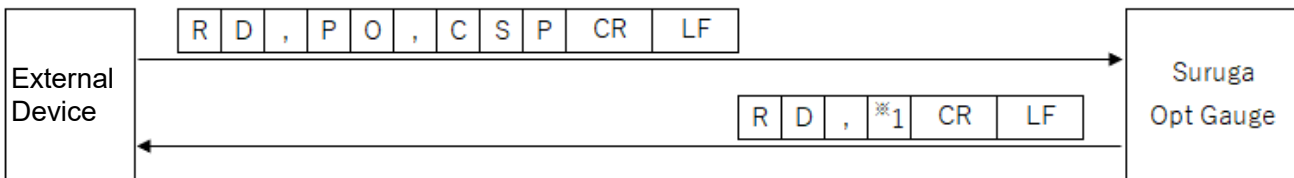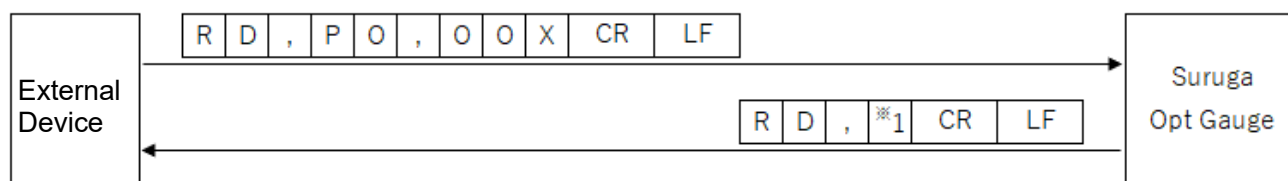
*1：OriginOffset X (-20 to +20)

[Read OriginOffset Y value setting information]

External Device → R D , P O , O O Y CR LF Suruga Opt Gauge

External Device ← R D , ※1 CR LF Suruga Opt Gauge
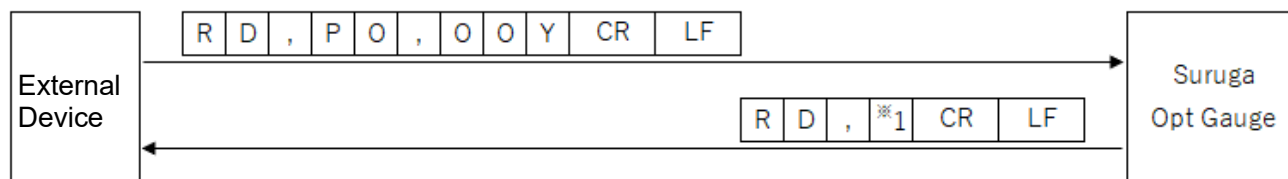
*1：OriginOffset Y (-20 to +20)

[Read Auto Aperture method setting information]
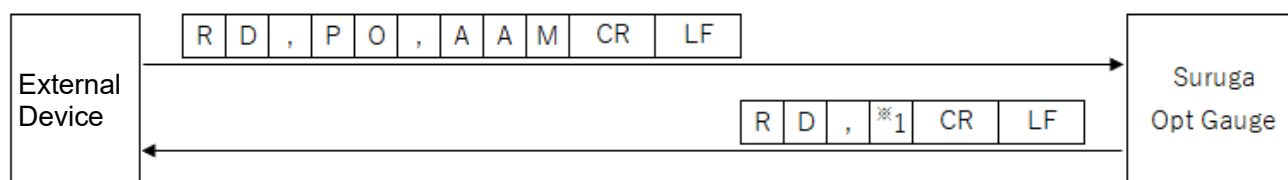
External Device → R D , P O , A A M CR LF Suruga Opt Gauge

External Device ← R D , ※1 CR LF Suruga Opt Gauge

*1：Auto Aperture Method ("0"= Area、"1"= Luminance)

[Read Auto Aperture enabled setting information]

External Device → R D , P O , A A E CR LF Suruga Opt Gauge

External Device ← R D , ※1 CR LF Suruga Opt Gauge

*1：Auto Aperture ("0"=Disabled、"1"= Enabled)

[Read ROI enabled setting information]

External Device → R D , P O , R O E CR LF Suruga Opt Gauge

External Device ← R D , ※1 CR LF Suruga Opt Gauge

*1: ROI ("0" = disabled, "1" = enabled)

[Read ROI X value setting information]

| External Device | → | R | D | , | P | O | , | R | A | X | CR | LF | → | Suruga Opt Gauge |
| | ← | | | | R | D | , | ※1 | CR | LF | | | ← | |

*1: ROI X value (-3,000 to +3,000)

[Read ROI Y value setting information]

| External Device | → | R | D | , | P | O | , | R | A | Y | CR | LF | → | Suruga Opt Gauge |
| | ← | | | | R | D | , | ※1 | CR | LF | | | ← | |

*1: ROI Y value (-3,000 to +3,000)

[Read ROI Width setting information]

| External Device | → | R | D | , | P | O | , | R | A | W | CR | LF | → | Suruga Opt Gauge |
| | ← | | | | R | D | , | ※1 | CR | LF | | | ← | |

*1: ROI Width (0 to +3,000)

[Read ROI Height setting information]

| External Device | → | R | D | , | P | O | , | R | A | H | CR | LF | → | Suruga Opt Gauge |
| | ← | | | | R | D | , | ※1 | CR | LF | | | ← | |
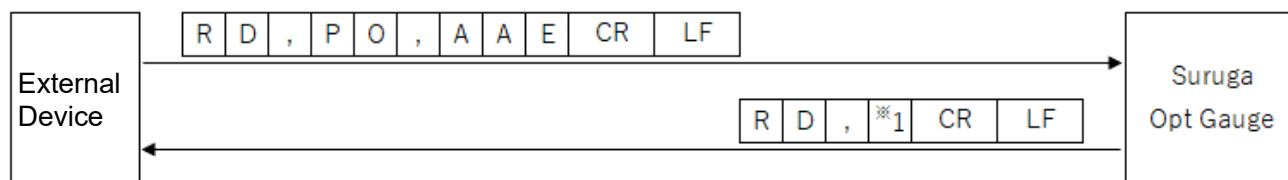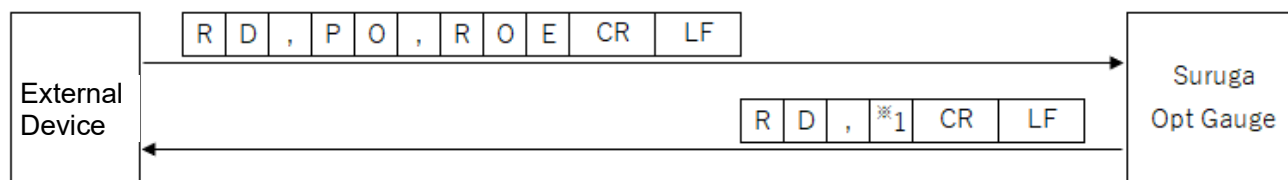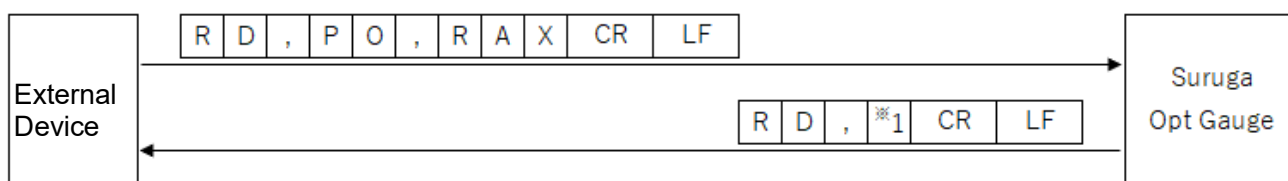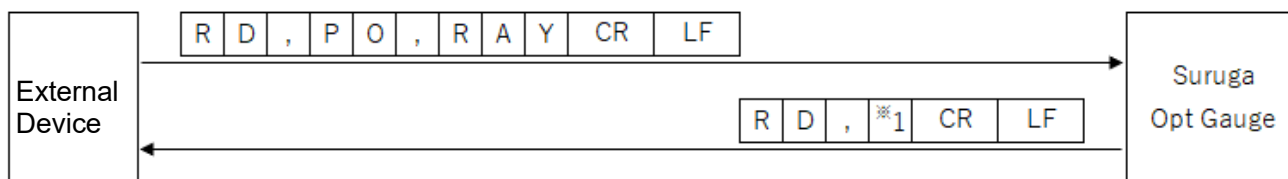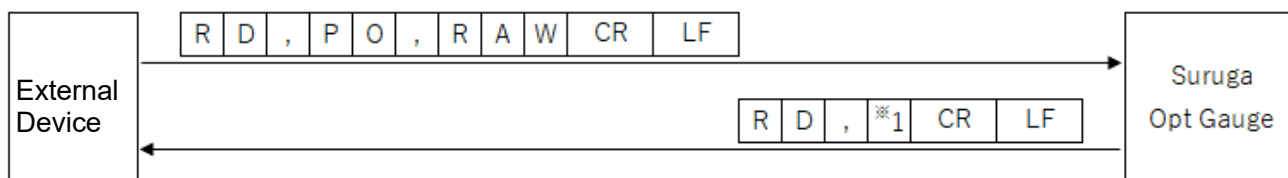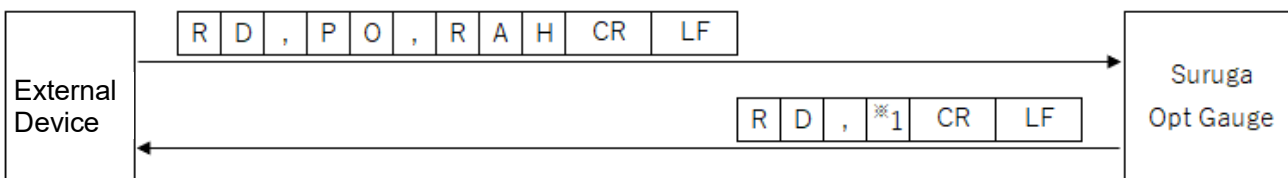
*1: ROI height (0 to +3,000)

[Read Judgement Centroid enabled setting information]
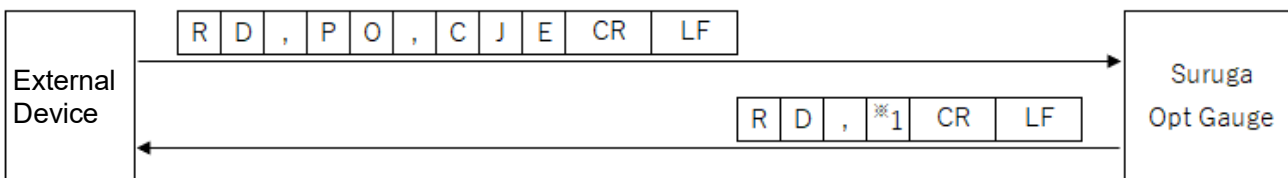
| External Device | → | R | D | , | P | O | , | C | J | E | CR | LF | → | Suruga Opt Gauge |
| | ← | | | | R | D | , | ※1 | CR | LF | | | ← | |

*1：Judgement Centroid ("0" = disabled, "1" = enabled)

[Read Judgement Centroid judgement value setting information]

	R	D	,	P	O	,	C	J	V	CR	LF	

External Device

R	D	,	※1	CR	LF

Suruga Opt Gauge

*1: Judgement Centroid judgement value (0 to +20)

[Read Judgement Diameter enabled setting information]

	R	D	,	P	O	,	J	D	E	CR	LF	

External Device

R	D	,	※1	CR	LF

Suruga Opt Gauge

*1：Judgement Diameter ("0" = disabled, "1" = enabled)

[Read Judgement Diameter judgement value setting information]

	R	D	,	P	O	,	D	J	V	CR	LF	

External Device

R	D	,	※1	CR	LF

Suruga Opt Gauge

*1：Judgement Diameter judgement value (0 to +20)

[Read Judgement Diameter Type setting information]

	R	D	,	P	O	,	D	J	T	CR	LF	

External Device

R	D	,	※1	CR	LF

Suruga Opt Gauge
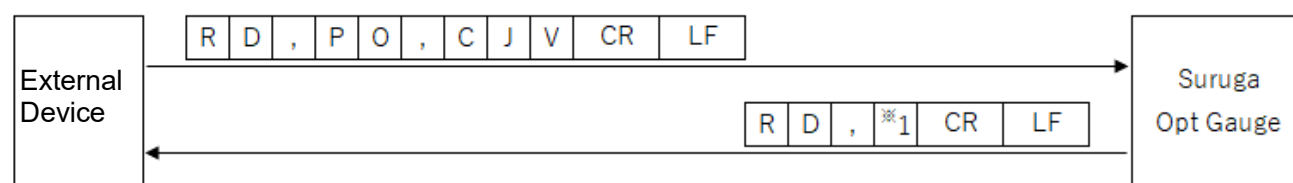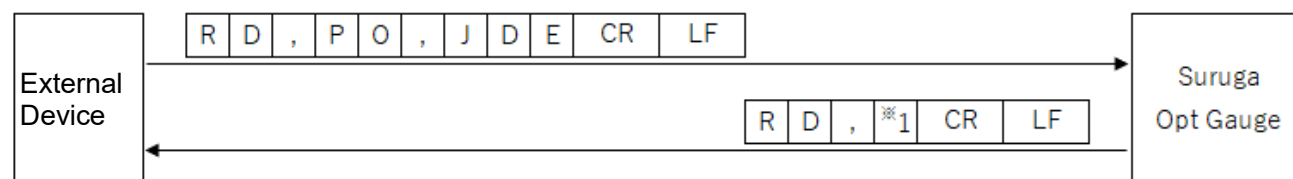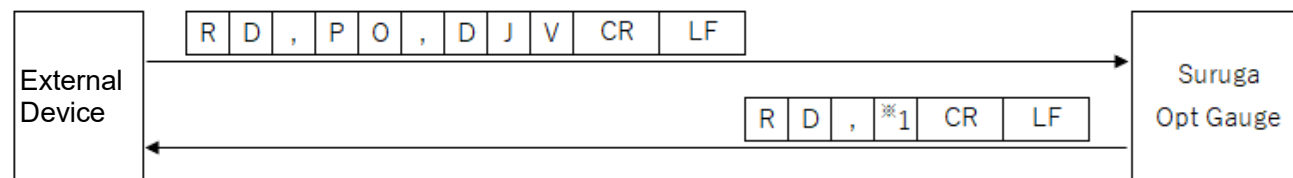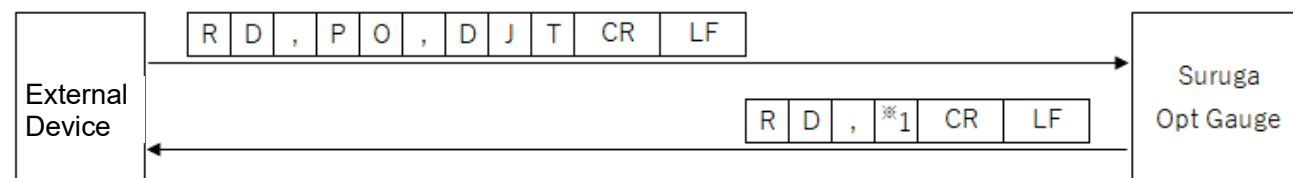
*1：Judgement Diameter Type ("0" = D4Sigma、"1"= D86)

< Judgement Ellipticity enable setting information]

	R	D	,	P	O	,	E	J	E	CR	LF	

External Device

R	D	,	※1	CR	LF

Suruga Opt Gauge
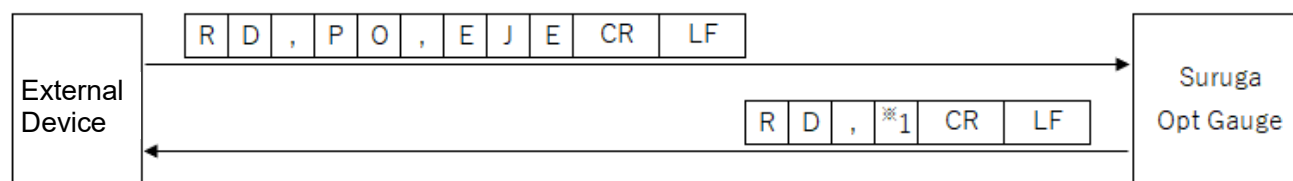
*1：Judgement Ellipticity ("0" = disable、"1" = enable)

[Read Judgement Ellipticity judgement value setting information]

External Device											→							Suruga Opt Gauge

RD , PO , EJV CR LF →

← RD , ※1 CR LF
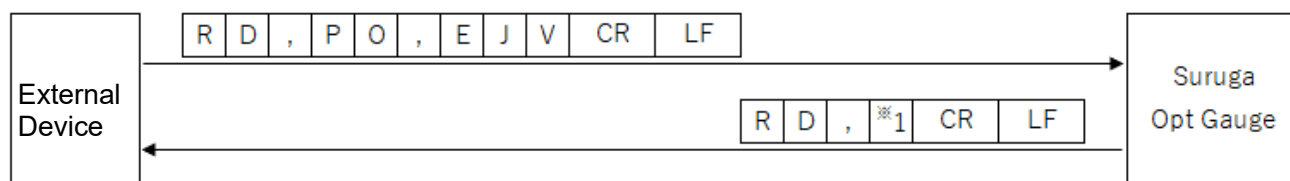
*1：Judgement Ellipticity judgement value (0.0000～1.0000)

[Read Judgement Peak enable setting information]

RD , PO , PJE CR LF →

← RD , ※1 CR LF

External Device / Suruga Opt Gauge
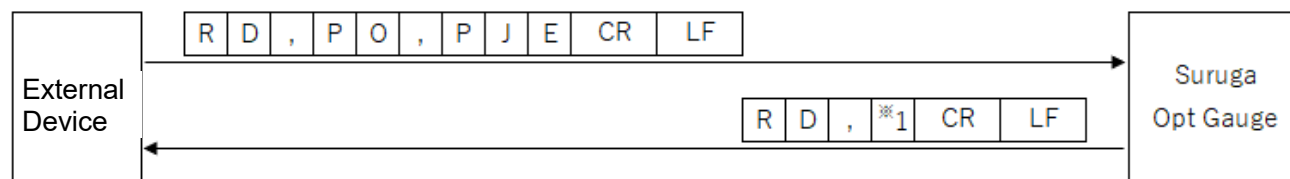
*1：Judgement Peak ("0"= disable、"1"= enable)

[Read Judgement Peak judgement value setting information]

RD , PO , PJV CR LF →

← RD , ※1 CR LF

External Device / Suruga Opt Gauge
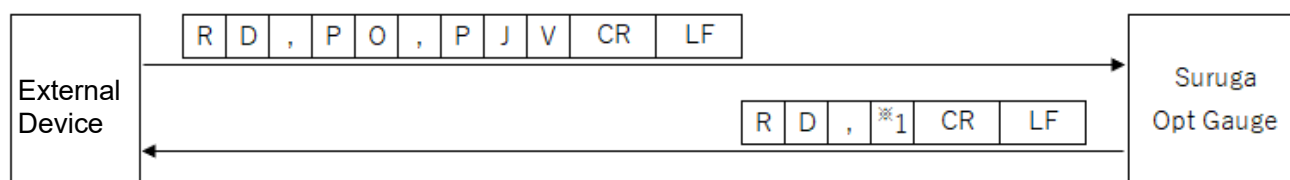
*1：Judgement Peak judgement value (0.0～4,095.0)

[Read Log File output path setting Information]
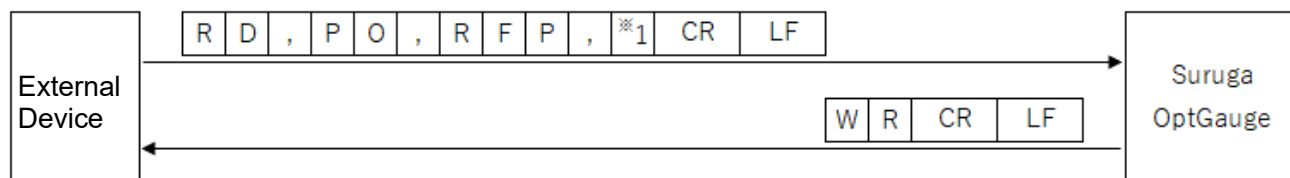
RD , PO , RFP , ※1 CR LF →

← WR CR LF

External Device / Suruga OptGauge

＊1：Log File Path String

[Read Image File output enabled setting Information]

RD , PO , IOE , ※1 CR LF →

← WR CR LF

External Device / Suruga OptGauge

*1：Image File Output ("0" = disabled, "1" = enabled)

[Read RAW Data output enabled setting Information]

| External Device | → | R | D | , | P | O | , | R | A | E | , | ※1 | CR | LF | → | Suruga OptGauge |

| | ← | | | | | | | | W | R | CR | LF | ← | | Suruga OptGauge |

*1：RAW Data Output ("0" = disabled, "1" = enabled)

[Read Image File output color setting Information]

| External Device | → | R | D | , | P | O | , | I | O | C | , | ※1 | CR | LF | → | Suruga OptGauge |

| | ← | | | | | | | W | R | CR | LF | ← | | Suruga OptGauge |

*1：Image File Output Color ("0"= Full Color、"1"= Grayscale)

[Read Image File output format setting information]

| External Device | → | R | D | , | P | O | , | I | O | F | , | ※1 | CR | LF | → | Suruga OptGauge |

| | ← | | | | | | | W | R | CR | LF | ← | | Suruga OptGauge |

*1：Image File Output Format ("0"= png、"1"= bmp、"2"= tiff)

[Read Beam Centroid setting information]

| External Device | → | R | D | , | P | O | , | C | N | M | CR | LF | → | Suruga Opt Gauge |

| | ← | | | | R | D | , | ※1 | CR | LF | ← | | Suruga Opt Gauge |
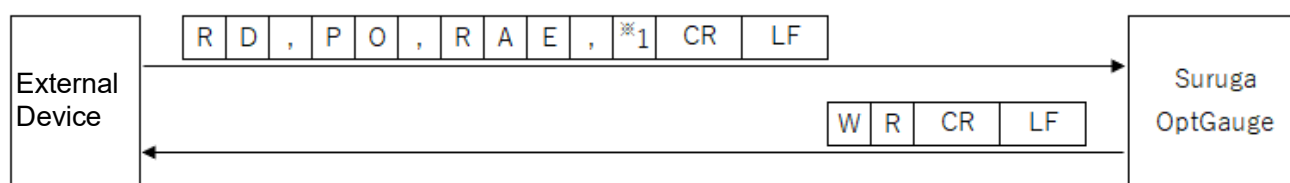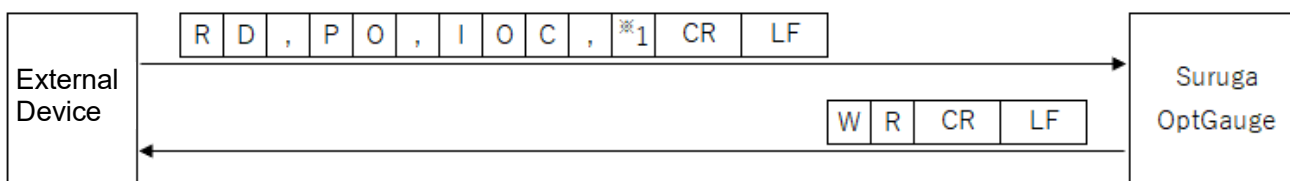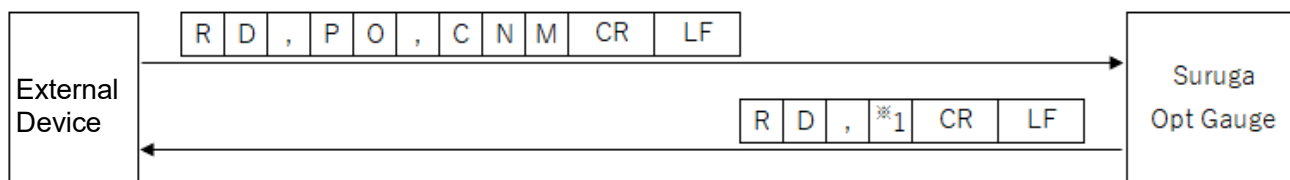
*1：Beam Centroid ("0"= Area、"1"= Intensity)

[Read Length Unit setting information]

| External Device | → | R | D | , | P | O | , | L | N | U | CR | LF | → | Suruga Opt Gauge |

| | ← | | | | R | D | , | ※1 | CR | LF | ← | | Suruga Opt Gauge |
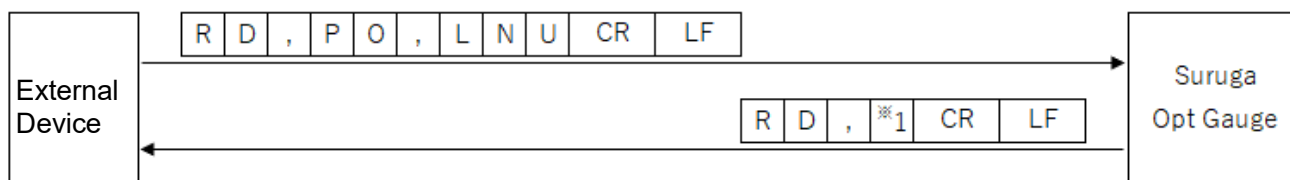
*1：Distance Unit ("0"= Millimeter、"1"= Micrometer)

[Read Denoising enable setting information]

| R | D | , | P | O | , | D | N | E | CR | LF |

External Device → Suruga Opt Gauge

| R | D | , | ※1 | CR | LF |

Suruga Opt Gauge → External Device
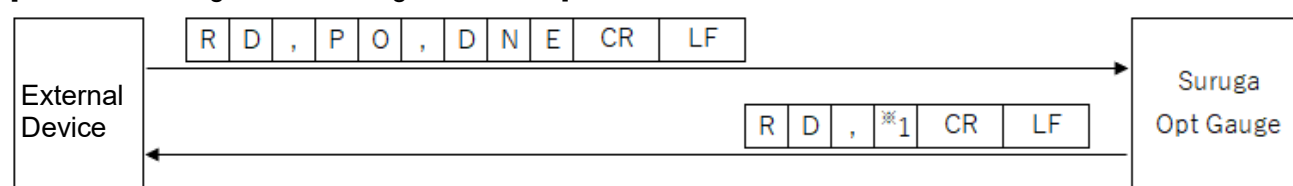
*1：Denoising function ("0"= disable, "1"= enable)

[Read Denoising setting information]

| R | D | , | P | O | , | D | N | T | CR | LF |

External Device → Suruga Opt Gauge

| R | D | , | ※1 | CR | LF |

Suruga Opt Gauge → External Device
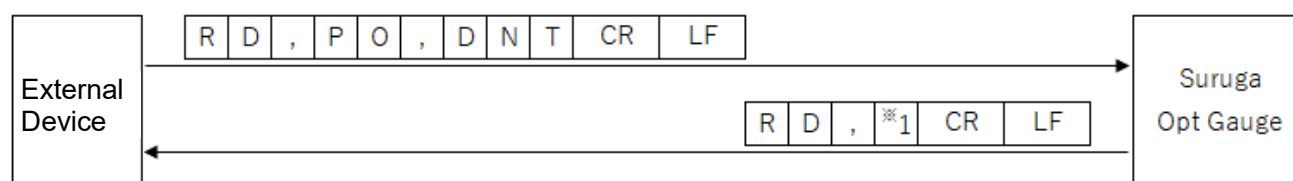
*1：Denoising threshold (1～4,095)

[Read Centroid X decimal place setting information]

| R | D | , | P | O | , | D | C | X | CR | LF |

External Device → Suruga Opt Gauge

| R | D | , | ※1 | CR | LF |

Suruga Opt Gauge → External Device
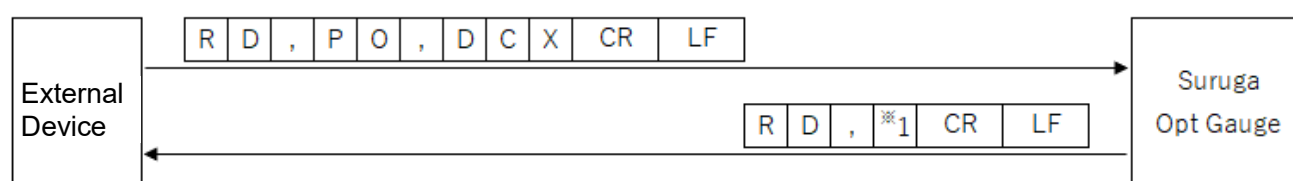
*1：Centroid X decimal place (0～8)

[Centroid Y decimal place setting information]

| R | D | , | P | O | , | D | C | Y | CR | LF |

External Device → Suruga Opt Gauge

| R | D | , | ※1 | CR | LF |

Suruga Opt Gauge → External Device
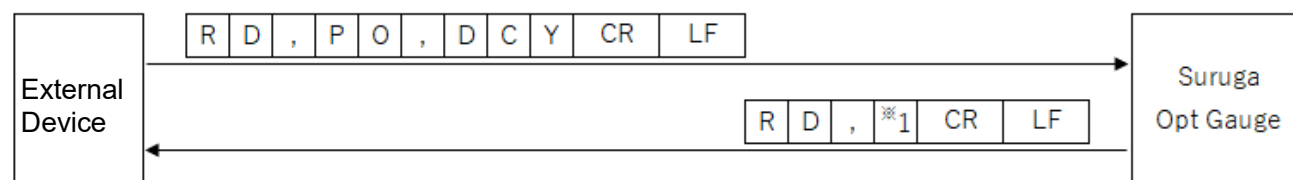
*1：Centroid Y decimal place (0～8)

[Read Centroid D decimal place setting information]
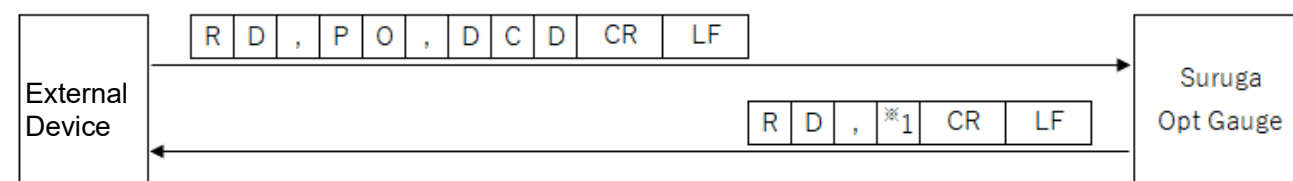
| R | D | , | P | O | , | D | C | D | CR | LF |

External Device → Suruga Opt Gauge

| R | D | , | ※1 | CR | LF |

Suruga Opt Gauge → External Device

*1：Centroid D decimal place (0～8)

[Read (Beam Diameter) D4Sigma decimal place setting information]

External Device → Suruga Opt Gauge

| R | D | , | P | O | , | D | D | S | CR | LF |

Suruga Opt Gauge → External Device

| R | D | , | ※1 | CR | LF |

*1：D4Sigma decimal place (0～8)

[Read (Beam Diameter) D4Sigma X(M) decimal place setting information]

External Device → Suruga Opt Gauge

| R | D | , | P | O | , | D | D | X | CR | LF |

Suruga Opt Gauge → External Device

| R | D | , | ※1 | CR | LF |

*1：D4Sigma X(M) decimal place (0～8)

[Read (Beam Diameter) D4Sigma Y(m) decimal place setting information]

External Device → Suruga Opt Gauge

| R | D | , | P | O | , | D | D | Y | CR | LF |

Suruga Opt Gauge → External Device

| R | D | , | ※1 | CR | LF |

*1：D4Sigma Y(m) decimal place (0～8)

[Read (Beam Diameter) D86 decimal place setting information]

External Device → Suruga Opt Gauge

| R | D | , | P | O | , | D | D | 8 | CR | LF |

Suruga Opt Gauge → External Device

| R | D | , | ※1 | CR | LF |

*1：D86 decimal place (0 to 8)

[Read Ellipticity decimal place setting information]

External Device → Suruga Opt Gauge

| R | D | , | P | O | , | D | E | L | CR | LF |

Suruga Opt Gauge → External Device

| R | D | , | ※1 | CR | LF |
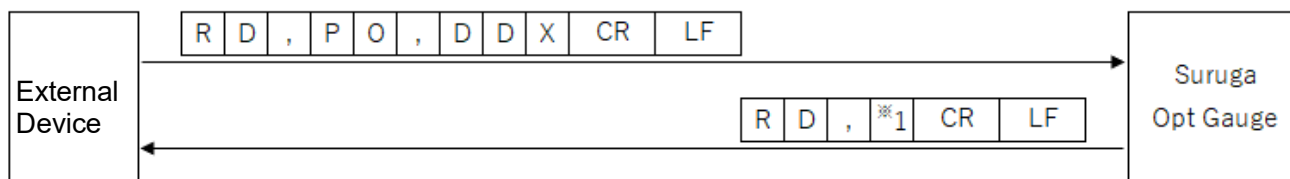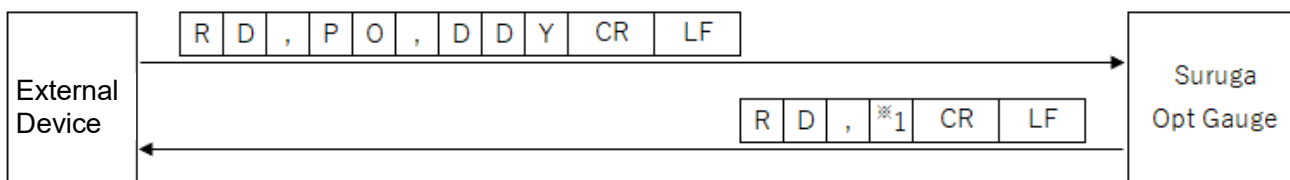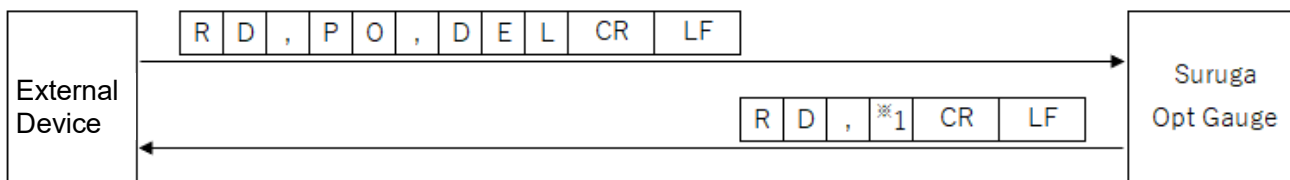
*1：Ellipticity decimal place (0 to 8)

[Read (Multi Spot) Order setting information]

| External Device | R | D | , | P | O | , | M | S | O | CR | LF | → Suruga Opt Gauge |
| | | | | | | R | D | , | ※1 | CR | LF | ← |
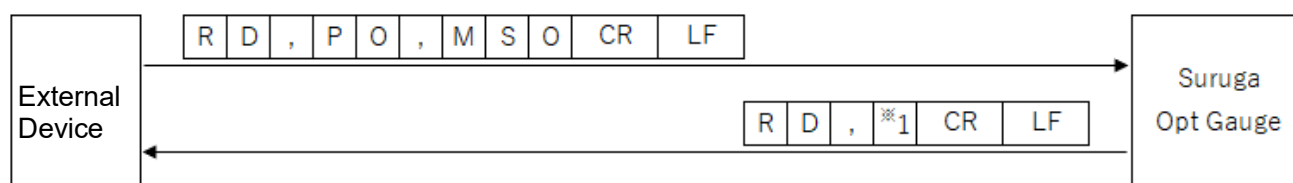
*1：(Multi Spot) List Sort type ("0"= Area、"1"= Centroid)

[Read (Multi Spot) Spot Count setting information]

| External Device | R | D | , | P | O | , | M | S | C | CR | LF | → Suruga Opt Gauge |
| | | | | | | R | D | , | ※1 | CR | LF | ← |
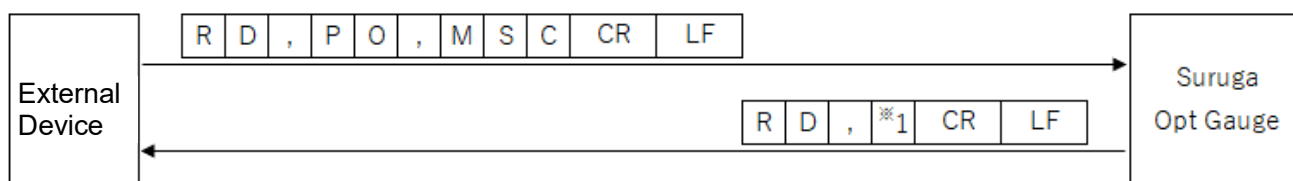
*1：Spot Count (1 to 100)

[Read (Multi Spot) Min Spot Area setting information]
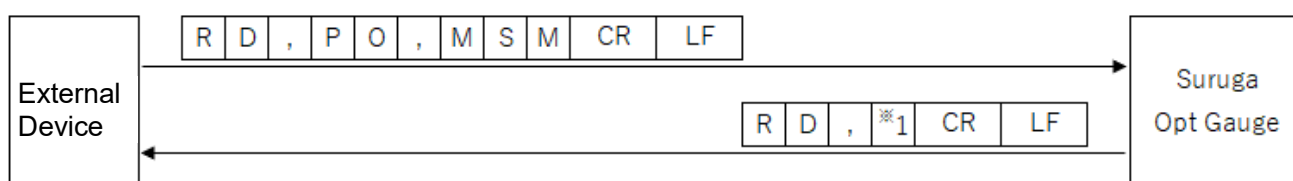
| External Device | R | D | , | P | O | , | M | S | M | CR | LF | → Suruga Opt Gauge |
| | | | | | | R | D | , | ※1 | CR | LF | ← |

*1：Min Spot Area (1 to 1023)

[Read Adaptive Cal execution button display enabled setting information]

| External Device | R | D | , | P | O | , | A | C | E | CR | LF | → Suruga Opt Gauge |
| | | | | | | R | D | , | ※1 | CR | LF | ← |

*1: Adaptive Cal execute button display ("0" = disabled, "1" = enabled)

[Read Orientation Enabled setting information]

| External Device | R | D | , | P | O | , | D | O | E | CR | LF | → Suruga Opt Gauge |
| | | | | | | R | D | , | ※1 | CR | LF | ← |

*1: Orientation Enabled ("0" = disabled, "1" = enabled)

[Read Binning enabled setting information]

| R | D | , | P | O | , | B | I | E | CR | LF |

External Device → Suruga Opt Gauge

| R | D | , | ※1 | CR | LF |

Suruga Opt Gauge → External Device

*1: Binning setting ("0" = disabled, "1" = enabled)

[Read Display Spot Number setting information]

| R | D | , | P | O | , | D | S | N | CR | LF |

External Device → Suruga Opt Gauge

| R | D | , | ※1 | CR | LF |

Suruga Opt Gauge → External Device
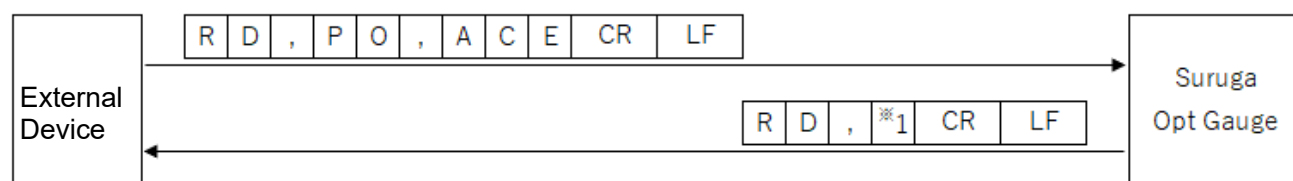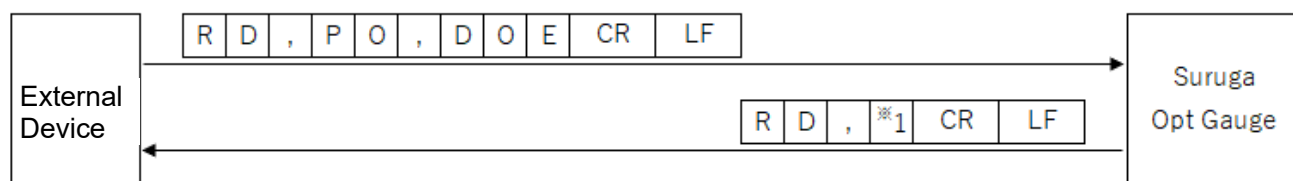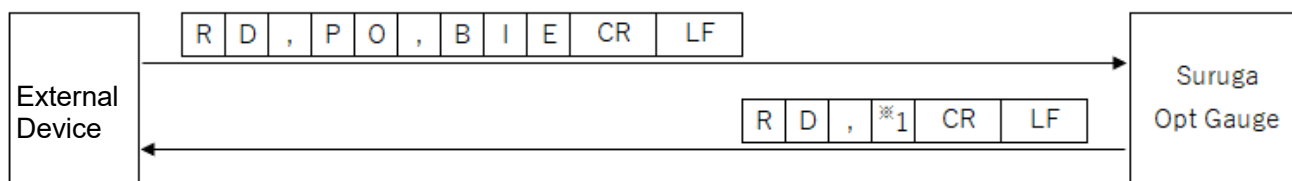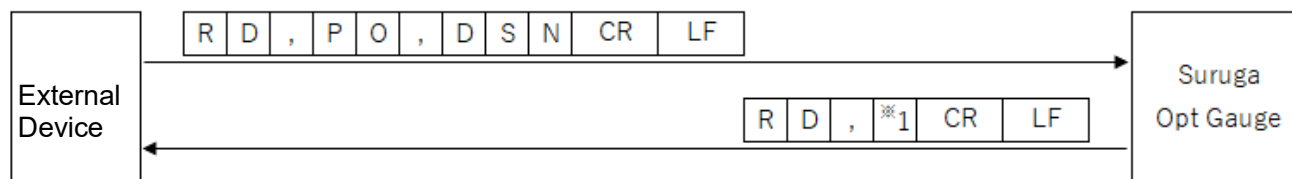
*1: Display Spot Number (0 to 100)

5.5 Write Commands

5.5.1 Command Formats

5.5.1.1 Angle

[Write sensor camera Exposure Time]

W	R	,	A	O	,	E	X	T	,	※1	CR	LF

External Device → Suruga Opt Gauge

W	R	CR	LF

Suruga Opt Gauge → External Device

*1: Exposure time (0.027 to 2000)

[Write sensor camera Frame Rate]

W	R	,	A	O	,	F	R	A	,	※1	CR	LF

External Device → Suruga Opt Gauge

W	R	CR	LF

Suruga Opt Gauge → External Device

*1: Frame Rate (0.1 to 100)

[Write Rotation setting information]

W	R	,	A	O	,	R	O	T	,	※1	CR	LF

External Device → Suruga Opt Gauge

W	R	CR	LF

Suruga Opt Gauge → External Device

*1: Rotation ("0" = OFF, "1" = Rotation right 90°, "2" = Rotation right 180°, "3" = Rotation right 270°)

[Write mirroring horizontal setting information]

W	R	,	A	O	,	M	H	E	,	※1	CR	LF

External Device → Suruga Opt Gauge

W	R	CR	LF

Suruga Opt Gauge → External Device

*1: Mirroring ("0" = OFF, "1" = Horizontal Mirroring)

[Write Mirroring Vertical setting information]

| W | R | , | A | O | , | M | V | E | , | ※1 | CR | LF |

| W | R | CR | LF |

External Device → Suruga Opt Gauge

*1: Mirroring ("0" = OFF, "1" = vertical mirroring)

[Write number of Averaging Times setting information]

| W | R | , | A | O | , | M | A | V | , | ※1 | CR | LF |

| W | R | CR | LF |

External Device → Suruga Opt Gauge

*1: Number of Averaging Times (2 to 262,144)

[Write Averaging Processing enabled setting information]

| W | R | , | A | O | , | M | A | E | , | ※1 | CR | LF |

| W | R | CR | LF |

External Device → Suruga Opt Gauge

*1: Averaging Processing ("0" = disabled, "1" = enabled)

[Write Cross Section Point setting information]

| W | R | , | A | O | , | C | S | P | , | ※1 | CR | LF |

| W | R | CR | LF |

External Device → Suruga Opt Gauge

*1: Cross Section Point ("0" = Origin Cursor, "1" = Beam Cursor)

[Write OriginOffset X value setting information]

| W | R | , | A | O | , | O | O | X | , | ※1 | CR | LF |

| W | R | CR | LF |

External Device → Suruga Opt Gauge

*1: OriginOffset X (-10 to +10)

[Write OriginOffset Y value setting information]

| External Device | W | R | , | A | O | , | O | O | Y | , | ※1 | CR | LF | → Suruga Opt Gauge |

| | W | R | CR | LF | ← |
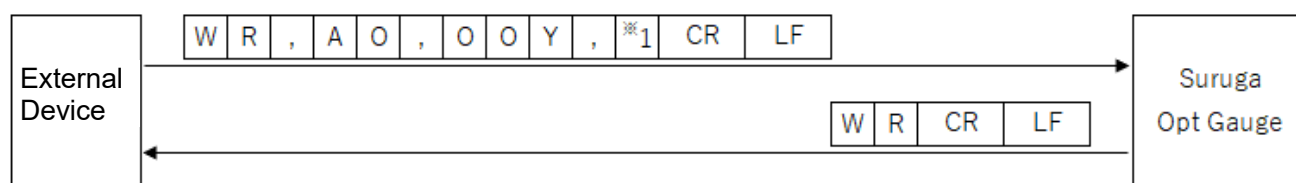
*1: OriginOffset Y (-10 to +10)

[Write Auto Aperture method setting information]

| External Device | W | R | , | A | O | , | A | A | M | , | ※1 | CR | LF | → Suruga Opt Gauge |

| | W | R | CR | LF | ← |
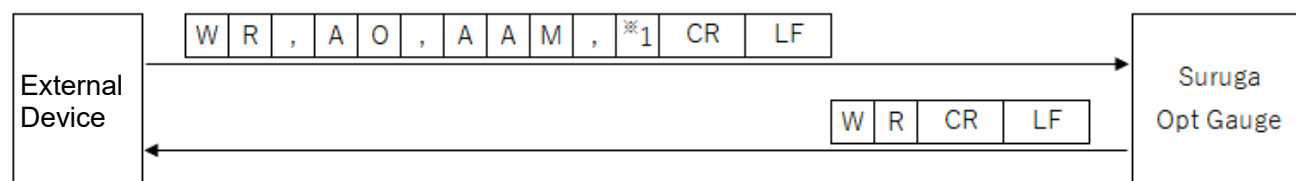
*1: Beam Centroid ("0" = area, "1" = luminance)
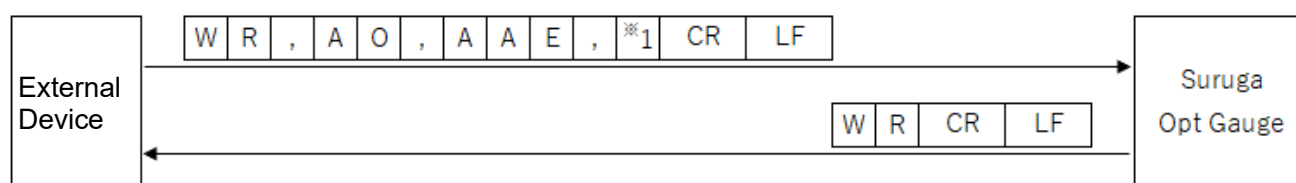
[Write Auto Aperture enabled setting information]

| External Device | W | R | , | A | O | , | A | A | E | , | ※1 | CR | LF | → Suruga Opt Gauge |

| | W | R | CR | LF | ← |

*1: Auto Aperture ("0" = disabled, "1" = enabled)

[Write ROI enabled setting information]

| External Device | W | R | , | A | O | , | R | O | E | , | ※1 | CR | LF | → Suruga Opt Gauge |

| | W | R | CR | LF | ← |

*1: ROI ("0" = disabled, "1" = enabled)

[Write ROI X value setting information]

| External Device | W | R | , | A | O | , | R | A | X | , | ※1 | CR | LF | → Suruga Opt Gauge |

| | W | R | CR | LF | ← |

*1: ROI X value (-3,000 to +3,000)

[Write ROI Y value setting information]

| W | R | , | A | O | , | R | A | Y | , | ※1 | CR | LF |

| W | R | CR | LF |

External Device → Suruga Opt Gauge

*1: ROI Y value (-3,000 to +3,000)

[Write ROI Width setting information]

| W | R | , | A | O | , | R | A | W | , | ※1 | CR | LF |

| W | R | CR | LF |

External Device → Suruga Opt Gauge

*1: ROI width (0 to 3,000)

[Write ROI Height setting information]

| W | R | , | A | O | , | R | A | H | , | ※1 | CR | LF |

| W | R | CR | LF |

External Device → Suruga Opt Gauge
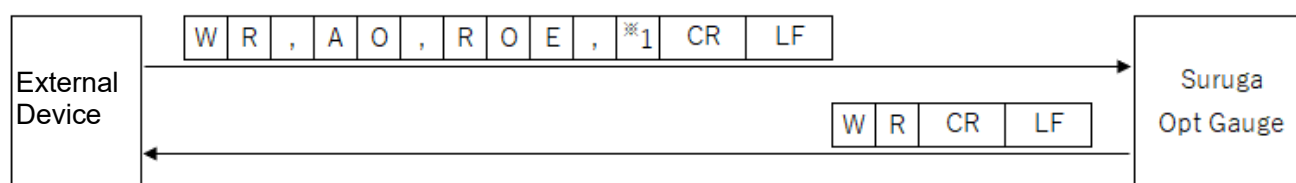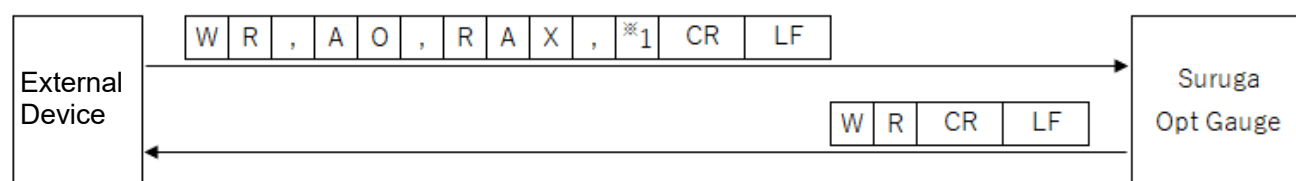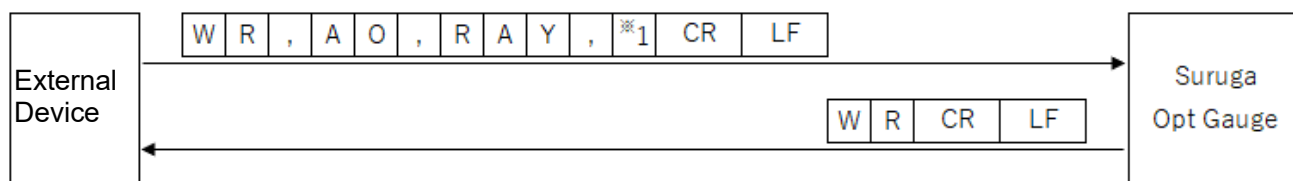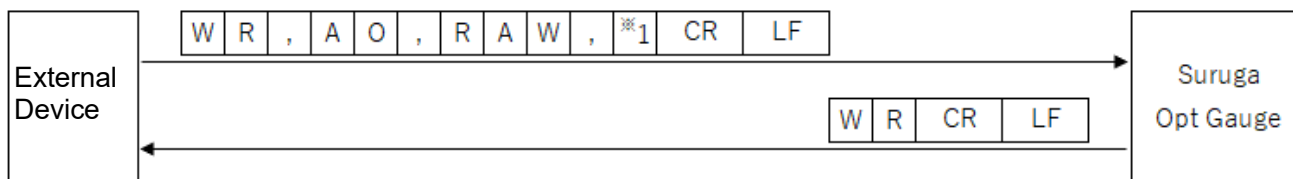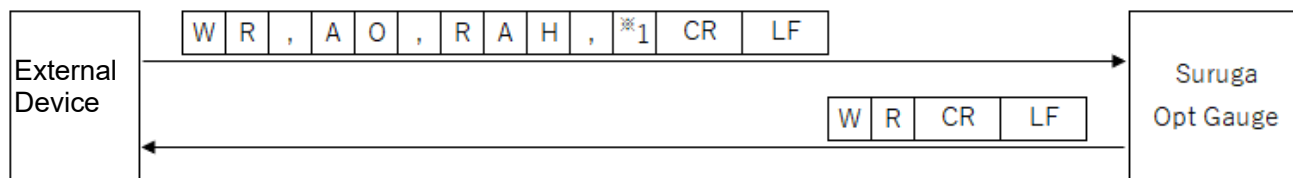
*1 : ROI Height (0～3,000)

[Write Angle Type setting information]

| W | R | , | A | O | , | A | N | T | , | ※1 | CR | LF |

| W | R | CR | LF |

External Device → Suruga Opt Gauge
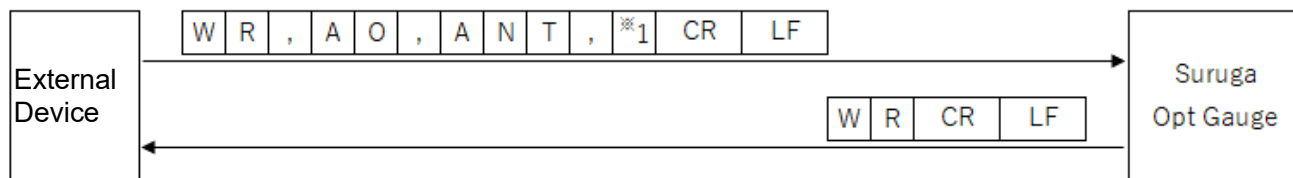
*1: Angle Type ("0" = tilt angle, "1" = beam angle)

[Write Judgement Angle enabled setting information]
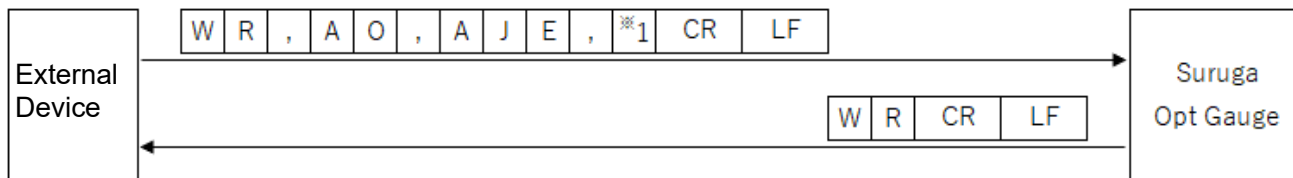
| W | R | , | A | O | , | A | J | E | , | ※1 | CR | LF |

| W | R | CR | LF |

External Device → Suruga Opt Gauge

*1: Judgement Angle ("0" = disabled, "1" = enabled)

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[Write judgement value setting information at Judgement Angle]

```
External        W  R  ,  A  O  ,  A  J  V  ,  ※1  CR  LF        Suruga
Device                                      W  R  CR  LF        Opt Gauge
```
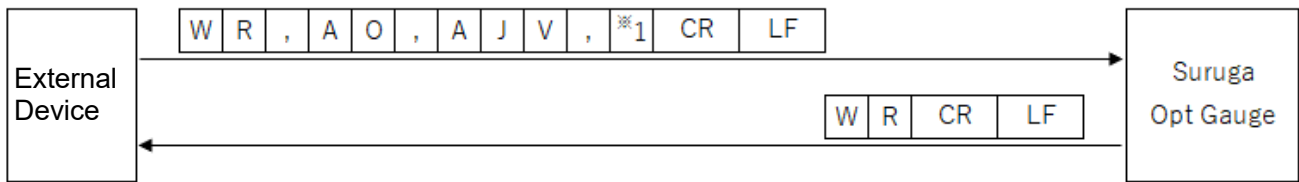
*1: Judgement Angle judgement value (0 to 10)

[Write Judgement Divergence enabled setting information]
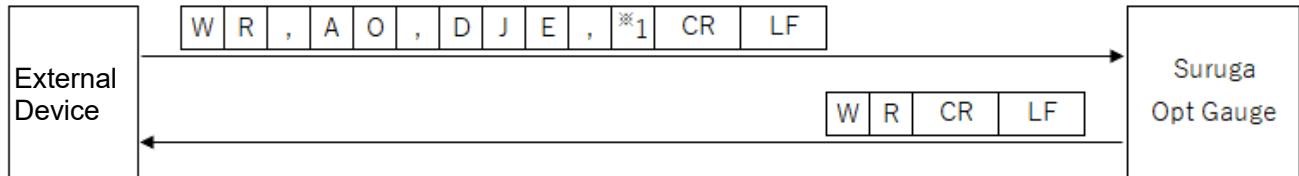
```
External        W  R  ,  A  O  ,  D  J  E  ,  ※1  CR  LF        Suruga
Device                                      W  R  CR  LF        Opt Gauge
```

*1: Judgement Divergence ("0" = disabled, "1" = enabled)

[Write judgement value setting information at Judgement Divergence]

```
External        W  R  ,  A  O  ,  D  J  V  ,  ※1  CR  LF        Suruga
Device                                      W  R  CR  LF        Opt Gauge
```
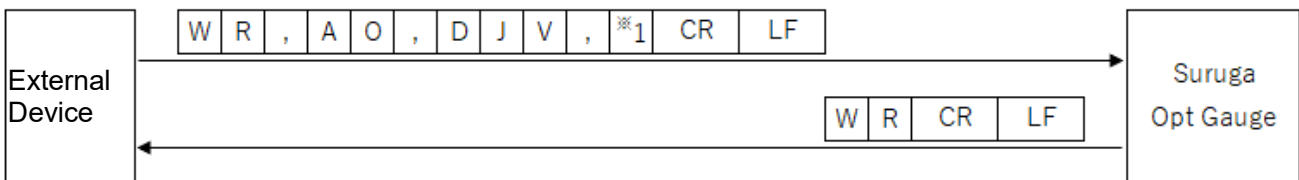
*1: judgement value (0.0000 to 1,000.0000) at Judgement Divergence

[Write Judgement RadiusType setting information]
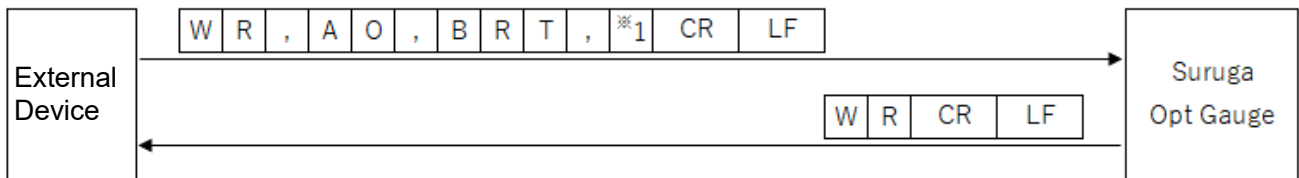
```
External        W  R  ,  A  O  ,  B  R  T  ,  ※1  CR  LF        Suruga
Device                                      W  R  CR  LF        Opt Gauge
```

*1: Judgement RadiusType ("0" = D4Sigma, "1" = D86)

[Write Judgement Ellipticity enabled setting information]

```
External        W  R  ,  A  O  ,  E  J  E  ,  ※1  CR  LF        Suruga
Device                                      W  R  CR  LF        Opt Gauge
```

*1: Judgement Ellipticity ("0" = disabled, "1" = enabled)

[Write judgement value setting information at Judgement Ellipticity]

| External Device | W | R | , | A | O | , | E | J | V | , | ※1 | CR | LF | → Suruga Opt Gauge |

| W | R | CR | LF | ← |
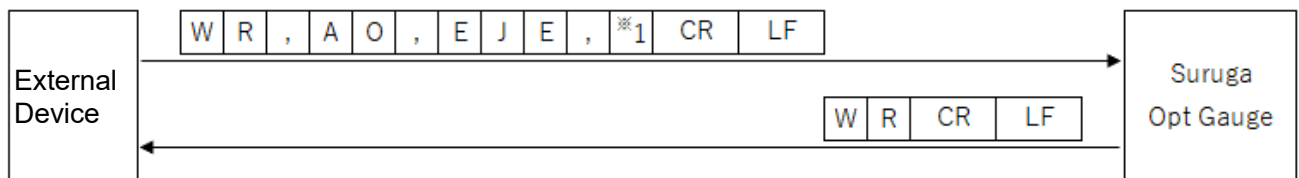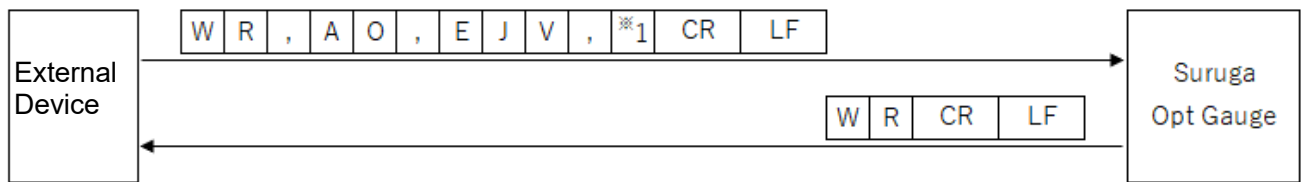
*1: Judgement Ellipticity judgement value (0.0000 to 1.0000)

[Write Judgement Peak enabled setting information]

| External Device | W | R | , | A | O | , | P | J | E | , | ※1 | CR | LF | → Suruga Opt Gauge |

| W | R | CR | LF | ← |

*1: Judgement Peak ("0" = disabled, "1" = enabled)

[Write judgement value setting information at Judgement Peak]

| External Device | W | R | , | A | O | , | P | J | V | , | ※1 | CR | LF | → Suruga Opt Gauge |

| W | R | CR | LF | ← |

*1: Judgement Peak judgement value (0.0 to 4,095.0)

[Write Log File output path setting Information]

| External Device | W | R | , | A | O | , | R | F | P | , | ※1 | CR | LF | → Suruga OptGauge |

| W | R | CR | LF | ← |

*1 : Log File Path String

[Write Image File output enabled setting Information]

| External Device | W | R | , | A | O | , | I | O | E | , | ※1 | CR | LF | → Suruga OptGauge |

| W | R | CR | LF | ← |

*1 : Image File Output ("0" = disabled, "1" = enabled)

[Write RAW Data output enabled setting Information]

External Device		Suruga OptGauge
	WR , AO , RAE , ※1 CR LF →	
	← WR CR LF	

*1 : RAW Data Output ("0" = disabled, "1" = enabled)

[Write Image File output color setting Information]

External Device		Suruga OptGauge
	WR , AO , IOC , ※1 CR LF →	
	← WR CR LF	

*1 : Image File Output Color ("0"= Full Color、"1"= Grayscale)

[Write Image File output format setting information]

External Device		Suruga OptGauge
	WR , AO , IOF , ※1 CR LF →	
	← WR CR LF	

*1 : Image File Output Format ("0"= png、"1"= bmp、"2"= tiff)

[Write Beam Centroid setting information]

External Device		Suruga Opt Gauge
	WR , AO , CNM , ※1 CR LF →	
	← WR CR LF	

*1: Beam Centroid ("0" = area, "1" = Intensity)

[Write Angle Unit setting information]
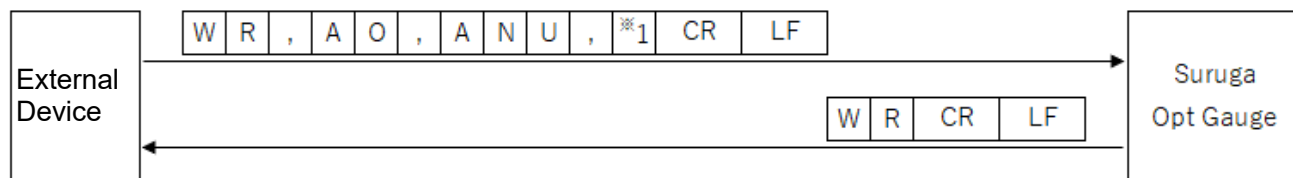
External Device		Suruga Opt Gauge
	WR , AO , ANU , ※1 CR LF →	
	← WR CR LF	

*1: Angle Unit ("0" = degree, "1" = DegMinSec, "2" = milliradian)

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[Write Denoising enabled setting information]

| External Device | → | `W` `R` `,` `A` `O` `,` `D` `N` `E` `,` `※1` `CR` `LF` | → | Suruga Opt Gauge |
| | ← | `W` `R` `CR` `LF` | ← | |

*1: Denoising function ("0" = disabled, "1" = enabled)

[Write Denoising threshold value setting information]

| External Device | → | `W` `R` `,` `A` `O` `,` `D` `N` `T` `,` `※1` `CR` `LF` | → | Suruga Opt Gauge |
| | ← | `W` `R` `CR` `LF` | ← | |
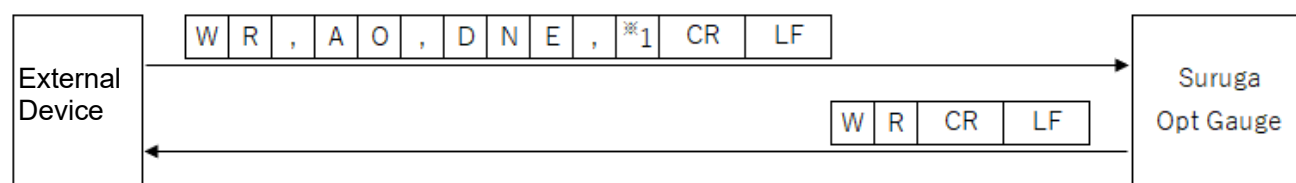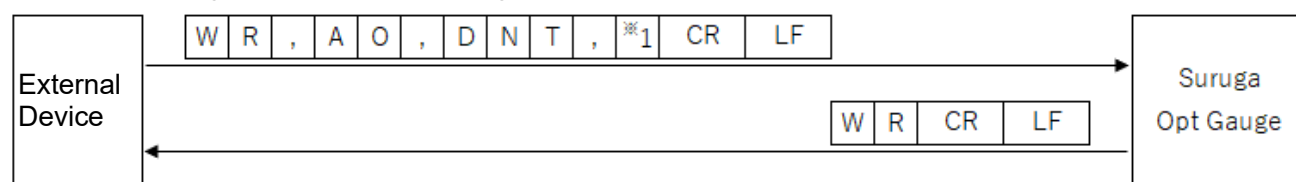
*1: Denoising threshold value (1 to 4,095)

[Write Angle X decimal place setting information]

| External Device | → | `W` `R` `,` `A` `O` `,` `D` `A` `X` `,` `※1` `CR` `LF` | → | Suruga Opt Gauge |
| | ← | `W` `R` `CR` `LF` | ← | |
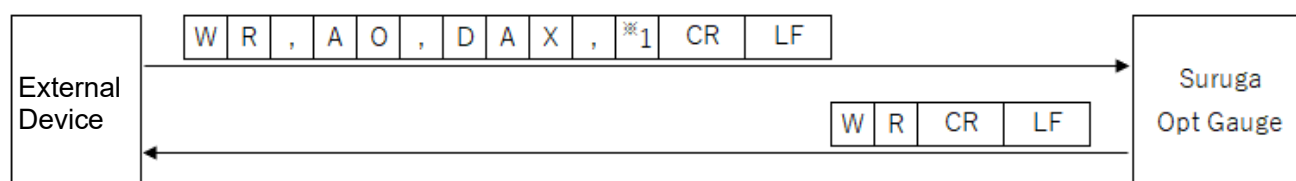
*1: Angle X decimal place (0 to 8)

[Write Angle Y decimal place setting information]

| External Device | → | `W` `R` `,` `A` `O` `,` `D` `A` `Y` `,` `※1` `CR` `LF` | → | Suruga Opt Gauge |
| | ← | `W` `R` `CR` `LF` | ← | |
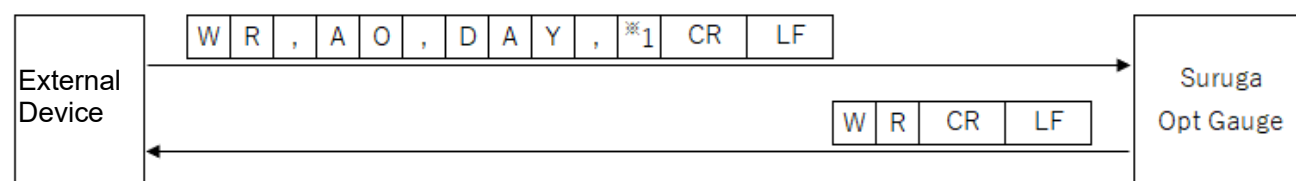
*1: Angle Y decimal place (0 to 8)

[Write Angle D decimal place setting information]

| External Device | → | `W` `R` `,` `A` `O` `,` `D` `A` `D` `,` `※1` `CR` `LF` | → | Suruga Opt Gauge |
| | ← | `W` `R` `CR` `LF` | ← | |
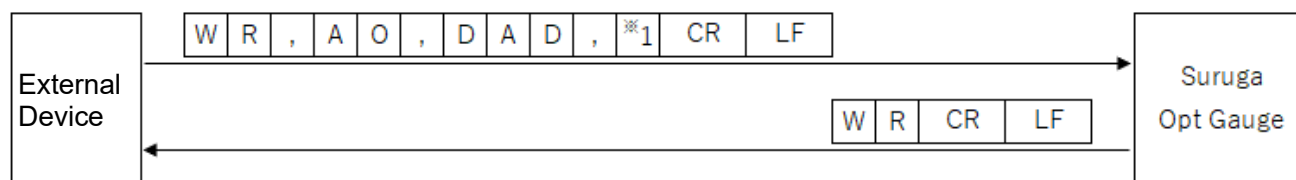
*1: Angle D decimal place (0 to 8)

[(Beam divergence) Write D4Sigma decimal place setting information]

External Device												→	Suruga Opt Gauge

```
WR , AO , DDS , ※1 CR LF  →
                    WR CR LF  ←
```
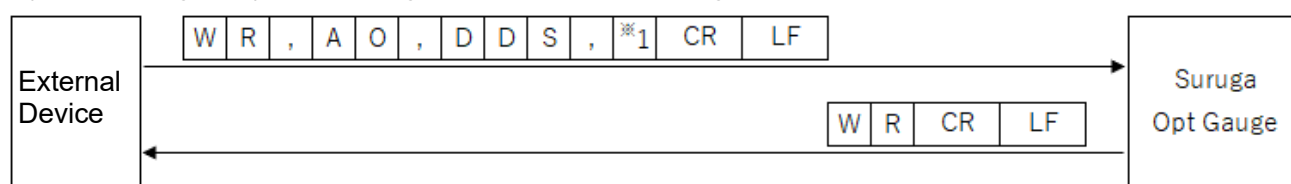
*1: D4Sigma decimal place (0 to 8)

[(Beam divergence) Write D4Sigma X(M) decimal place setting information]

```
WR , AO , DDX , ※1 CR LF  →
                    WR CR LF  ←
```
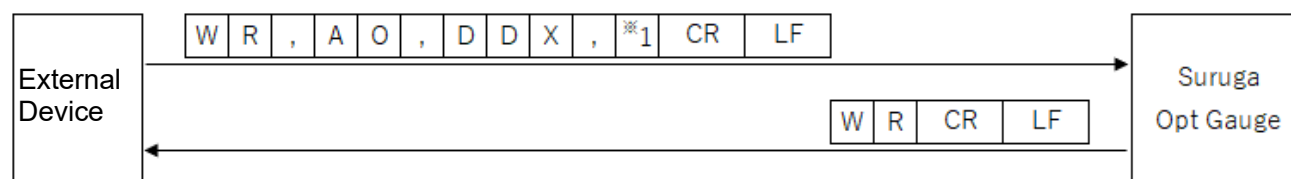
*1: D4Sigma X(M) decimal place (0 to 8)

[(Beam divergence) Write D4Sigma Y(m) decimal place setting information]

```
WR , AO , DDY , ※1 CR LF  →
                    WR CR LF  ←
```
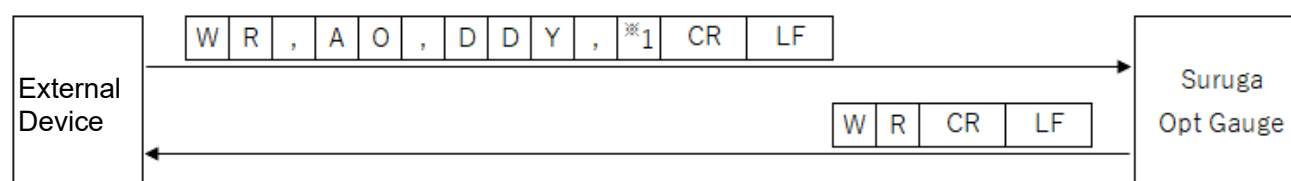
*1: D4Sigma Y(m) decimal place (0 to 8)

[(Beam divergence) Write D86 decimal place setting information]
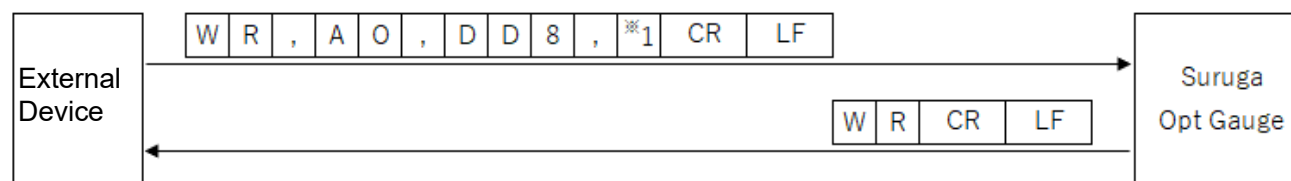
```
WR , AO , DD8 , ※1 CR LF  →
                    WR CR LF  ←
```

*1: D86 decimal place (0 to 8)

[Write Ellipticity decimal place setting information]

```
WR , AO , DEL , ※1 CR LF  →
                    WR CR LF  ←
```
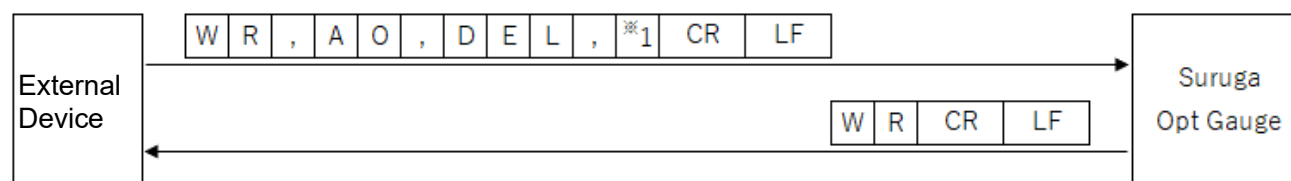
*1: Ellipticity decimal place (0 to 8)

[(Multi Spot) Write Order setting information]

External Device													Suruga Opt Gauge
	W	R	,	A	O	,	M	S	O	,	※1	CR	LF
								W	R	CR	LF		
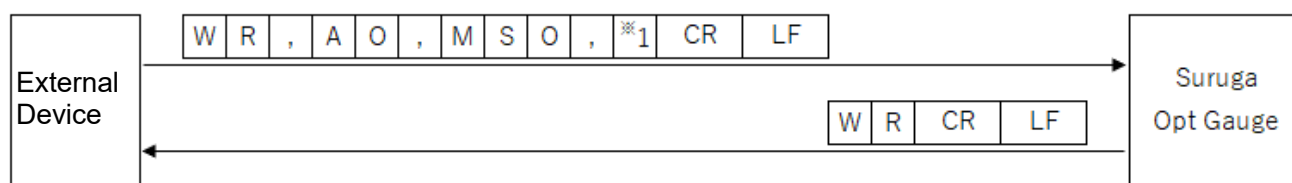
*1: (Multi Spot) list sort type ("0" = Area, "1" = Angle)

[(Multi Spot) Write Spot Count setting information]
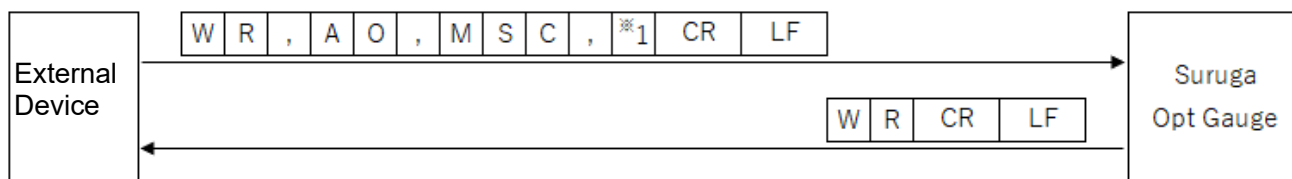
External Device													Suruga Opt Gauge
	W	R	,	A	O	,	M	S	C	,	※1	CR	LF
								W	R	CR	LF		

*1: Spot Count (1 to 100)

[(Multi Spot) Write Minimum Spot Area setting information]

External Device													Suruga Opt Gauge
	W	R	,	A	O	,	M	S	M	,	※1	CR	LF
								W	R	CR	LF		

*1: Minimum Spot Area (1 to 1023)

[Write Adaptive Cal execute button display enabled setting information]

External Device													Suruga Opt Gauge
	W	R	,	A	O	,	A	C	E	,	※1	CR	LF
								W	R	CR	LF		

*1: Adaptive Cal execution button display ("0" = disabled, "1" = enabled)

[Write Orientation Enabled setting information]

External Device													Suruga Opt Gauge
	W	R	,	A	O	,	D	O	E	,	※1	CR	LF
								W	R	CR	LF		

*1: Orientation Enabled ("0" = disabled, "1" = enabled)

[Write Binning enabled setting information]

| | External
Device | | W | R | , | A | O | , | B | I | E | , | ※1 | CR | LF | | | | | | Suruga
Opt Gauge |
| | | | | | | | | | | | | | W | R | CR | LF | | | |

*1: Binning setting ("0" = disabled, "1" = enabled)

[Write Display Spot Number setting information]

| | External
Device | | W | R | , | A | O | , | D | S | N | , | ※1 | CR | LF | | | | | | Suruga
Opt Gauge |
| | | | | | | | | | | | | | W | R | CR | LF | | | |
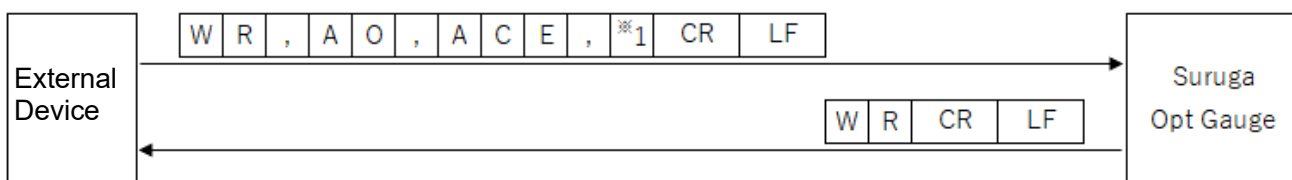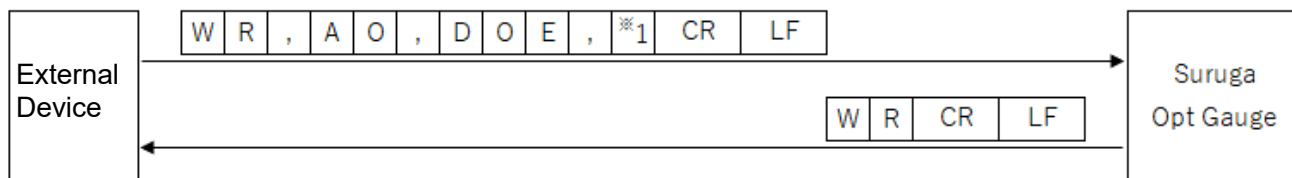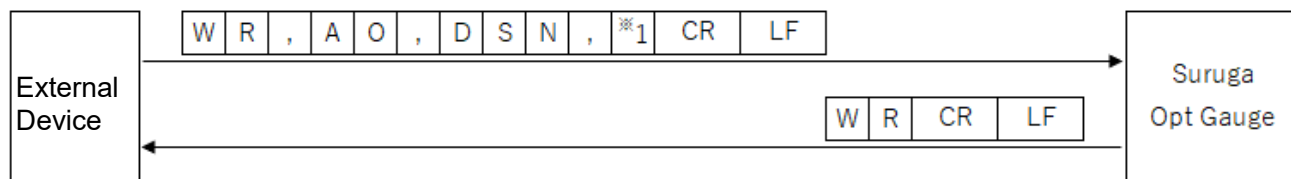
*1: Display Spot Number setting value (0 to 100)

5.5.1.2 Profile

[Write sensor camera Exposure Time]

| W | R | , | P | O | , | E | X | T | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

Suruga Opt Gauge → External Device

*1: Exposure time (0.027 to 2000)

[Write sensor camera Frame Rate]

| W | R | , | P | O | , | F | R | A | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

Suruga Opt Gauge → External Device

*1: Frame Rate (0.1 to 100)

[Write Rotation setting information]

| W | R | , | P | O | , | R | O | T | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

Suruga Opt Gauge → External Device

*1: Rotation ("0" = OFF, "1" = Rotation right 90°, "2" = Rotation right 180°, "3" = Rotation right 270°)

[Write Mirroring Horizontal setting information]

| W | R | , | P | O | , | M | H | E | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

Suruga Opt Gauge → External Device

*1: Mirroring ("0" = OFF, "1" = horizontal mirroring)

[Write Mirroring Vertical setting information]

| W | R | , | P | O | , | M | V | E | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

Suruga Opt Gauge → External Device

*1: Mirroring ("0" = OFF, "1" = vertical mirroring)

[Write number of Averaging Times setting information]

External Device	W	R	,	P	O	,	M	A	V	,	※1	CR	LF					Suruga Opt Gauge
											W	R	CR	LF				

*1: Number of Averaging Times (2 to 262,144)

[Write Averaging Processing enabled setting information]

External Device	W	R	,	P	O	,	M	A	E	,	※1	CR	LF					Suruga Opt Gauge
											W	R	CR	LF				

*1: Averaging Processing ("0" = disabled, "1" = enabled)

[Write Cross Section Point setting information]

External Device	W	R	,	P	O	,	C	S	P	,	※1	CR	LF					Suruga Opt Gauge
											W	R	CR	LF				

*1: Cross Section Point ("0" = Origin Cursor, "1" = Beam Cursor)

[Write OriginOffset X value setting information]

External Device	W	R	,	P	O	,	O	O	X	,	※1	CR	LF					Suruga Opt Gauge
											W	R	CR	LF				

*1：OriginOffset X (-20 to +20)

[Write OriginOffset Y value setting information]

External Device	W	R	,	P	O	,	O	O	Y	,	※1	CR	LF					Suruga Opt Gauge
											W	R	CR	LF				
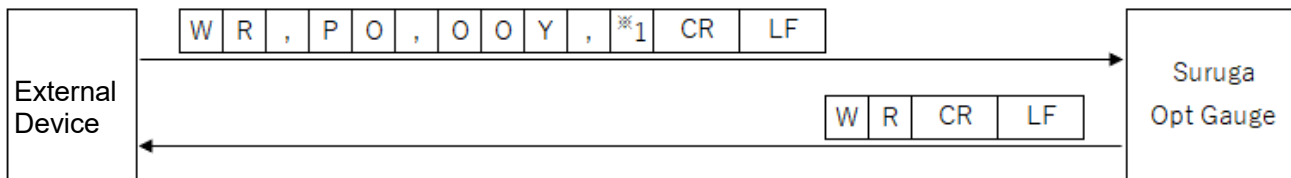
※1：OriginOffset Y (-20 to +20)

[Write Auto Aperture Method setting information]
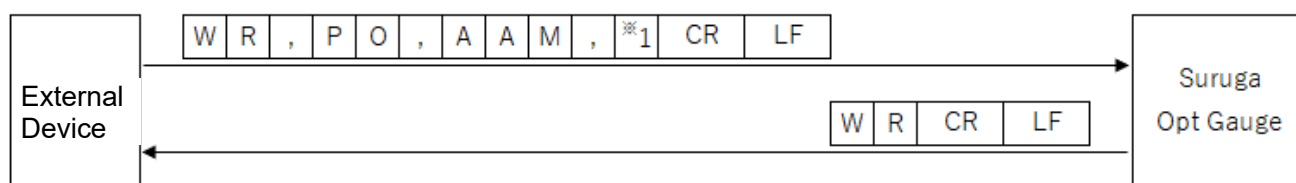
| W | R | , | P | O | , | A | A | M | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

Suruga Opt Gauge → External Device

*1: Auto Aperture Method ("0" = area, "1" = luminance)

[Write Auto Aperture enabled setting information]

| W | R | , | P | O | , | A | A | E | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

*1: Auto Aperture ("0" = disabled, "1" = enabled)

[Write ROI enabled setting information]

| W | R | , | P | O | , | R | O | E | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

*1: ROI ("0" = disabled, "1" = enabled)

[Write ROI X value setting information]

| W | R | , | P | O | , | R | A | X | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

*1: ROI X value (-3,000 to +3,000)

[Write ROI Y value setting information]

| W | R | , | P | O | , | R | A | Y | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

*1：ROI Y value (-3,000 to +3,000)

[Write ROI Width setting information]

| W | R | , | P | O | , | R | A | W | , | ※1 | CR | LF |

| | | | | W | R | CR | LF |

External Device → Suruga Opt Gauge

*1: ROI Width (0 to 3,000)

[Write ROI Height setting information]

| W | R | , | P | O | , | R | A | H | , | ※1 | CR | LF |

| | | | | W | R | CR | LF |

External Device → Suruga Opt Gauge
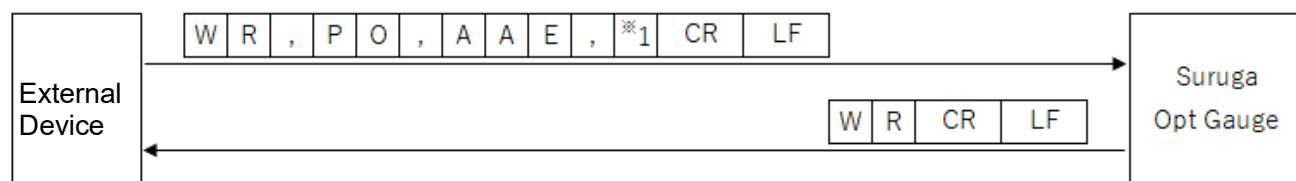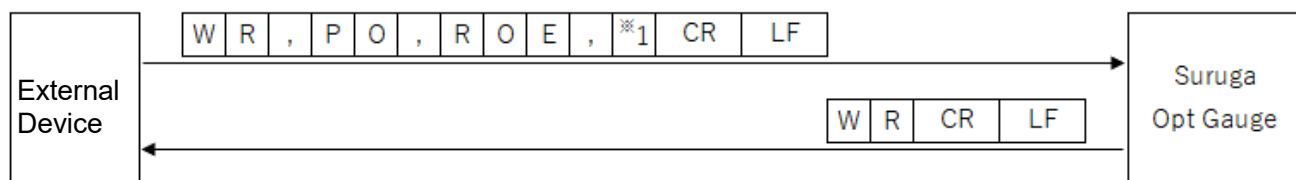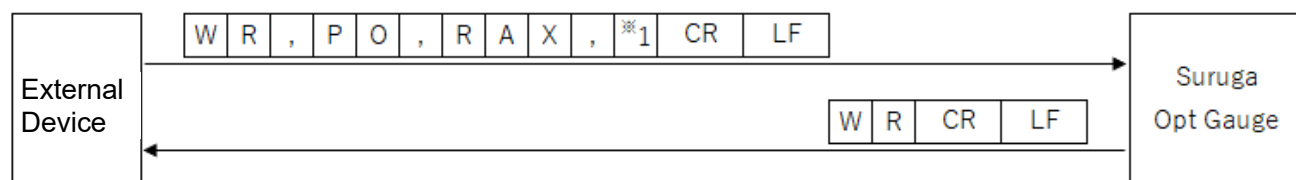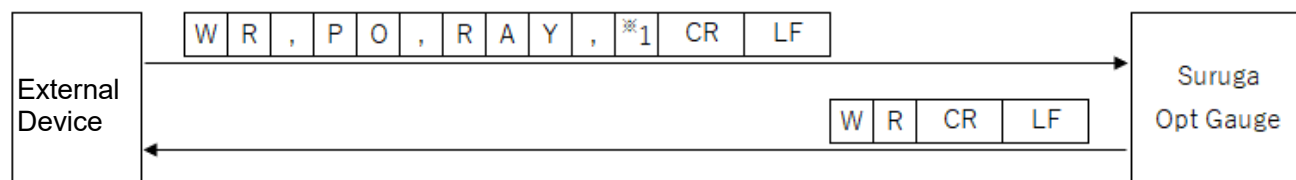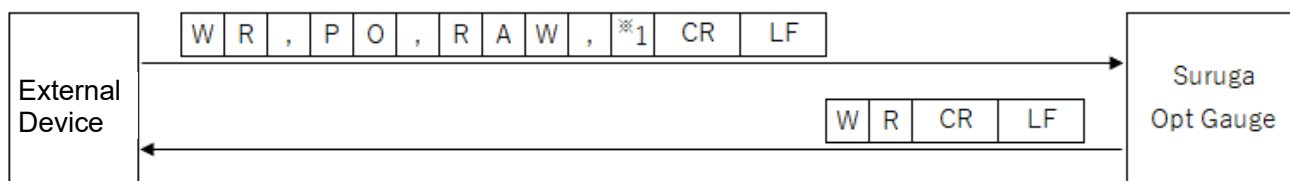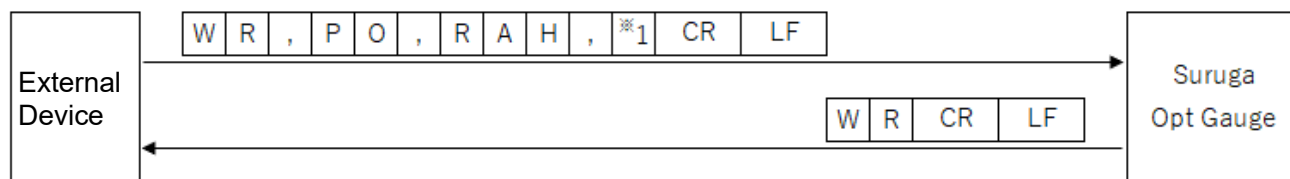
*1：ROI Height (0 to 3,000)

< Judgement Centroid enabled setting information]

| W | R | , | P | O | , | C | J | E | , | ※1 | CR | LF |

| | | | | W | R | CR | LF |

External Device → Suruga Opt Gauge
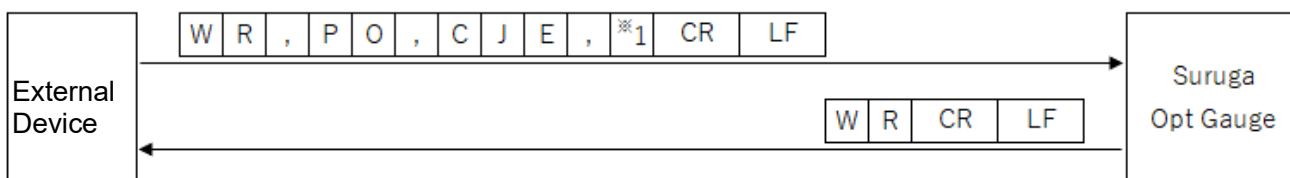
*1：Judgement Centroid ("0" = disabled, "1" = enabled)

< judgement value information at Judgement Centroid >

| W | R | , | P | O | , | C | J | V | , | ※1 | CR | LF |

| | | | | W | R | CR | LF |

External Device → Suruga Opt Gauge
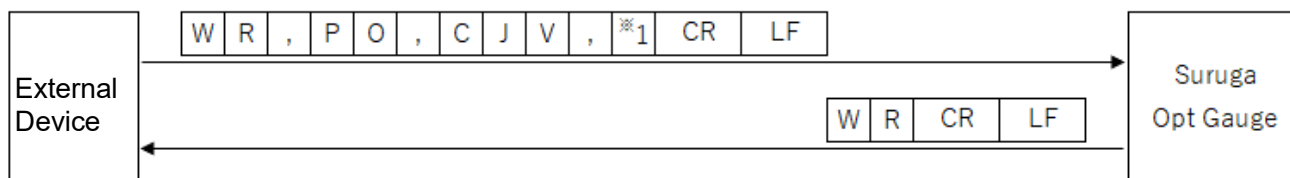
*1：judgement value (0 to 20) at Judgement Centroid

< Judgement Diameter enabled setting information >
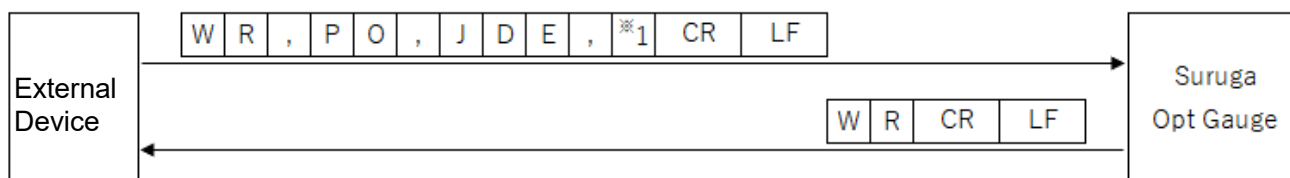
| W | R | , | P | O | , | J | D | E | , | ※1 | CR | LF |

| | | | | W | R | CR | LF |

External Device → Suruga Opt Gauge

*1：Judgement Diameter ("0" = disabled, "1" = enabled)

[Write judgement value setting information at Judgement Diameter]

| W | R | , | P | O | , | D | J | V | , | ※1 | CR | LF |

| | | | | | | | W | R | CR | LF |

External Device → Suruga Opt Gauge
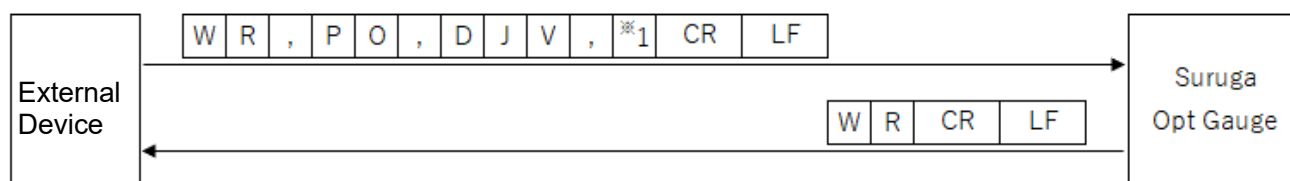
*1：Judgement Diameter judgement value (0 to 20)

[Write Judgement Diameter Type setting information]
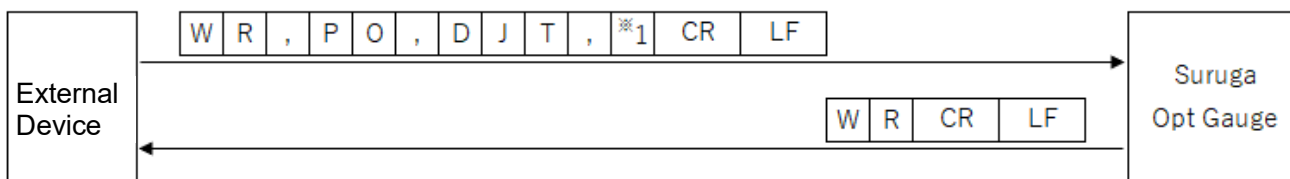
| W | R | , | P | O | , | D | J | T | , | ※1 | CR | LF |

| | | | | | | | W | R | CR | LF |

External Device → Suruga Opt Gauge

*1：Judgement Diameter Type ("0"= D4Sigma、"1"= D86)

[Write Judgement Ellipticity enable setting information]

| W | R | , | P | O | , | E | J | E | , | ※1 | CR | LF |

| | | | | | | | W | R | CR | LF |

External Device → Suruga Opt Gauge

*1：Judgement Ellipticity ("0" = disabled, "1" = enabled)

[Write judgement value setting information at Judgement Ellipticity]

| W | R | , | P | O | , | E | J | V | , | ※1 | CR | LF |

| | | | | | | | W | R | CR | LF |

External Device → Suruga Opt Gauge
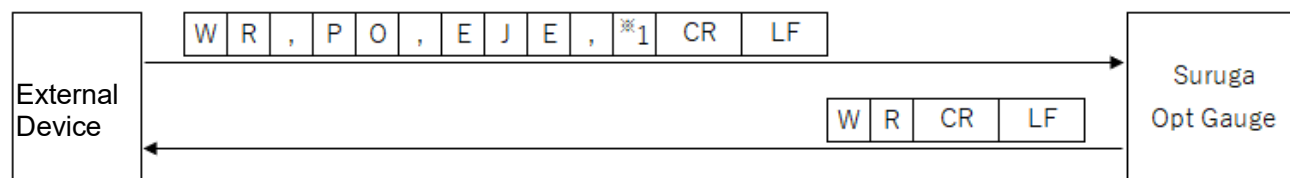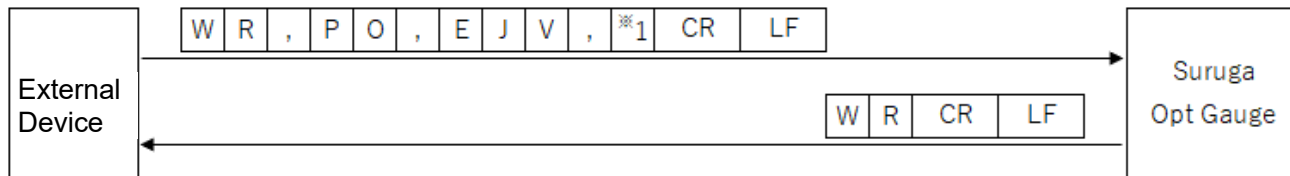
*1： judgement value (0.0000 to 1.0000) at Judgement Ellipticity

[Write Judgement Peak enable setting information]

| W | R | , | P | O | , | P | J | E | , | ※1 | CR | LF |

| | | | | | | | W | R | CR | LF |

External Device → Suruga Opt Gauge

*1：Judgement Peak ("0" = disabled, "1" = enabled)

[Write judgement value setting information at Judgement Peak]

| W | R | , | P | O | , | P | J | V | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

External Device ← Suruga Opt Gauge

*1：Judgement Peak judgement value (0.0 to 4,095.0)

[Write Log File output path setting Information]

| W | R | , | P | O | , | R | F | P | , | ※1 | CR | LF |

External Device → Suruga OptGauge

| W | R | CR | LF |

External Device ← Suruga OptGauge

*1：Log File Path String

[Write Image File output enabled setting Information]

| W | R | , | P | O | , | I | O | E | , | ※1 | CR | LF |

External Device → Suruga OptGauge

| W | R | CR | LF |

External Device ← Suruga OptGauge

*1：Image File Output （"0" = disabled, "1" = enabled）

[Write RAW Data output enabled setting Information]

| W | R | , | P | O | , | R | A | E | , | ※1 | CR | LF |

External Device → Suruga OptGauge

| W | R | CR | LF |

External Device ← Suruga OptGauge

*1：RAW Data Output （"0" = disabled, "1" = enabled）

[Write Image File output color setting Information]

| W | R | , | P | O | , | I | O | C | , | ※1 | CR | LF |

External Device → Suruga OptGauge

| W | R | CR | LF |

External Device ← Suruga OptGauge

*1：Image File Output Color （"0"= Full Color、 "1"= Grayscale）

[Write Image File output format setting information]

| W | R | , | P | O | , | I | O | F | , | ※1 | CR | LF |

External Device → Suruga OptGauge

| W | R | CR | LF |

External Device ← Suruga OptGauge

*1：Image File Output Format ("0"= png、"1"= bmp、"2"= tiff)

[Write Beam Centroid setting information]

| W | R | , | P | O | , | C | N | M | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

External Device ← Suruga Opt Gauge

*1：Beam Centroid ("0"= Area、"1"= Intensity)

[Write Length Unit setting information]

| W | R | , | P | O | , | L | N | U | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

External Device ← Suruga Opt Gauge
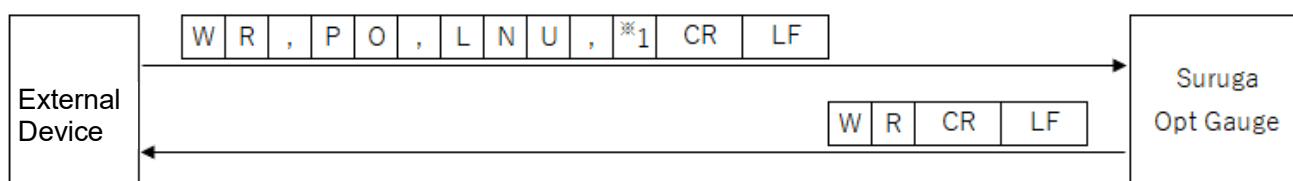
*1：Length Unit("0"= Millimeter、"1"= Micrometer)

[Write Denoising enabled setting information]

| W | R | , | P | O | , | D | N | E | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

External Device ← Suruga Opt Gauge
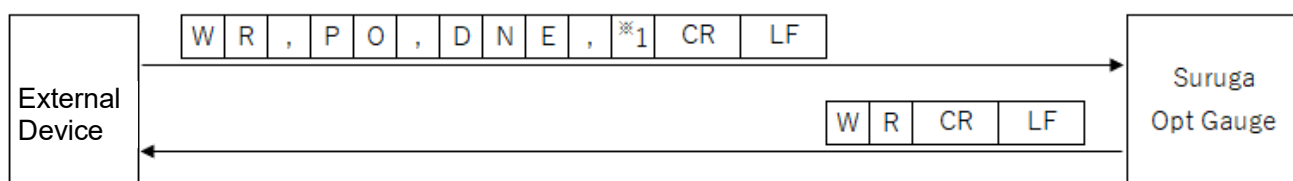
*1：Denoising function ("0" = disabled, "1" = enabled)

[Write Denoising Threshold setting information]

| W | R | , | P | O | , | D | N | T | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

External Device ← Suruga Opt Gauge
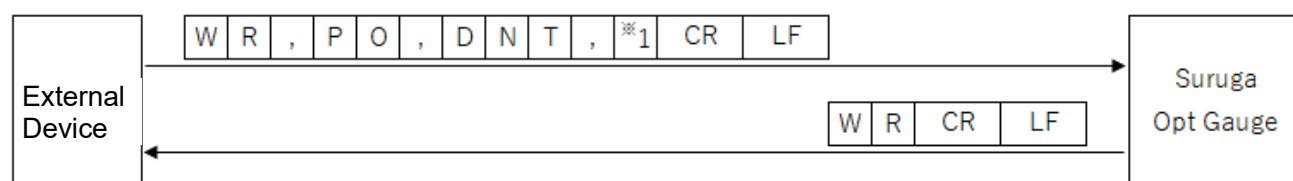
*1：Denoising Threshold (1 to 4,095)

[Write Centroid X decimal place setting information]

External Device		W	R	,	P	O	,	D	C	X	,	※1	CR	LF					Suruga Opt Gauge
											W	R	CR	LF				
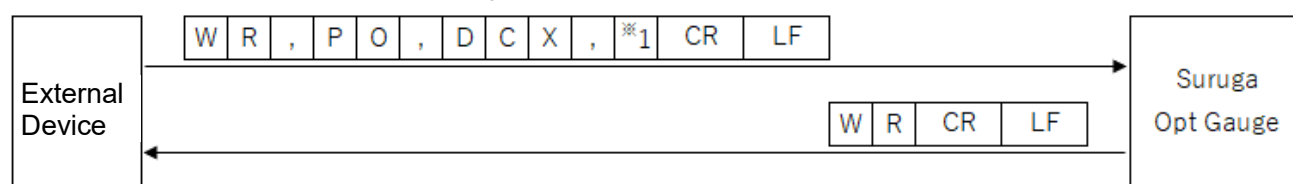
*1：Centroid X decimal place (0 to 8)

[Write Centroid Y decimal place setting information]

External Device		W	R	,	P	O	,	D	C	Y	,	※1	CR	LF					Suruga Opt Gauge
											W	R	CR	LF				
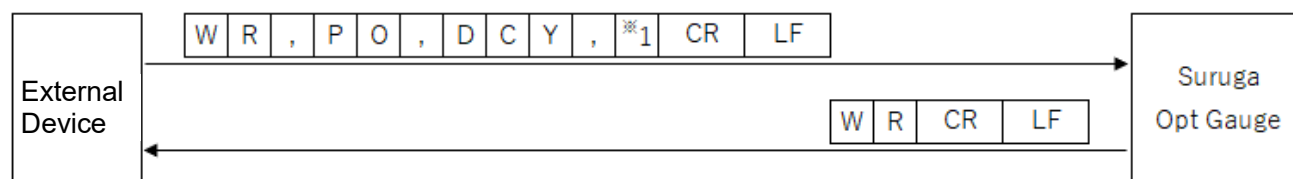
*1：Centroid Y decimal place (0 to 8)

[Write Centroid D decimal place setting information]
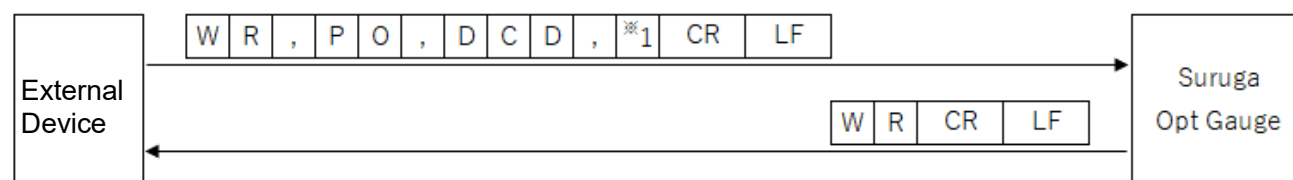
External Device		W	R	,	P	O	,	D	C	D	,	※1	CR	LF					Suruga Opt Gauge
											W	R	CR	LF				

*1：Centroid D decimal place (0 to 8)

[Write (Beam Diameter) D4Sigma decimal place setting information]

External Device		W	R	,	P	O	,	D	D	S	,	※1	CR	LF					Suruga Opt Gauge
											W	R	CR	LF				
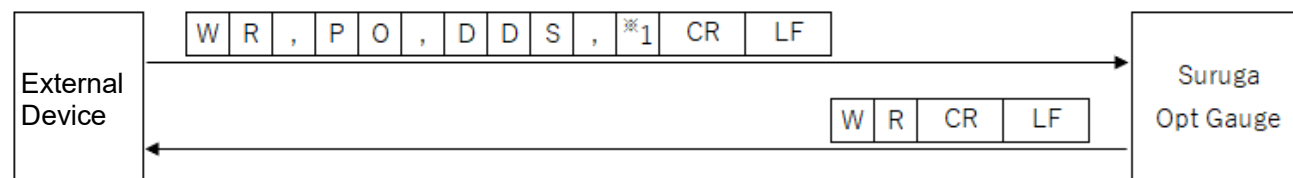
*1：D4Sigma 小数点以下桁数 (0 to 8)

[Write (Beam Diameter) D4Sigma X(M) decimal place setting information]
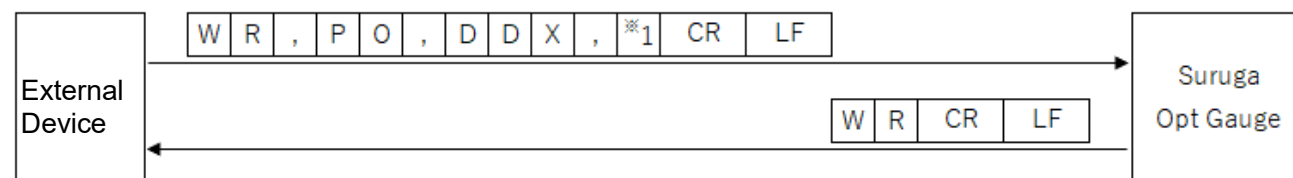
External Device		W	R	,	P	O	,	D	D	X	,	※1	CR	LF					Suruga Opt Gauge
											W	R	CR	LF				

*1：D4Sigma X(M) decimal place (0 to 8)

[Write (Beam Diameter) D4Sigma Y(m) decimal place setting information]

| W | R | , | P | O | , | D | D | Y | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

External Device ← Suruga Opt Gauge

*1：D4Sigma Y(m) decimal place (0 to 8)

[Write (Beam Diameter) D86 decimal place setting information]

| W | R | , | P | O | , | D | D | 8 | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

External Device ← Suruga Opt Gauge

*1：D86 decimal place (0 to 8)

[Write Ellipticity decimal place setting information]

| W | R | , | P | O | , | D | E | L | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

External Device ← Suruga Opt Gauge
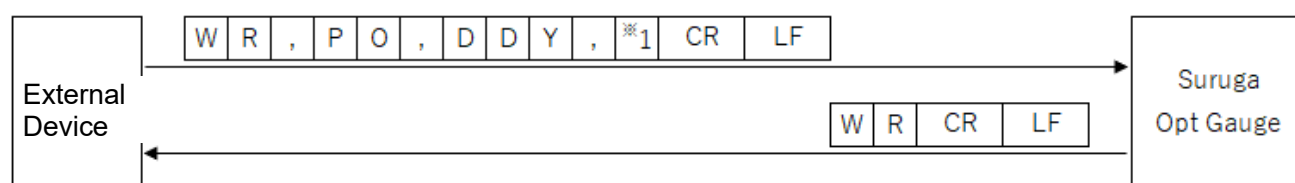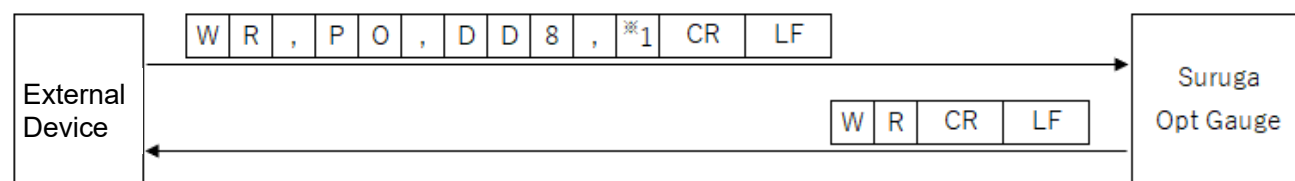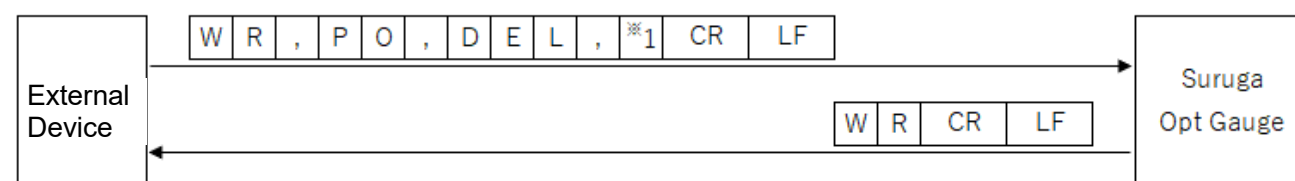
*1：Ellipticity decimal place (0 to 8)

[Write (Multi Spot)Order decimal place setting information]

| W | R | , | P | O | , | M | S | O | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

External Device ← Suruga Opt Gauge
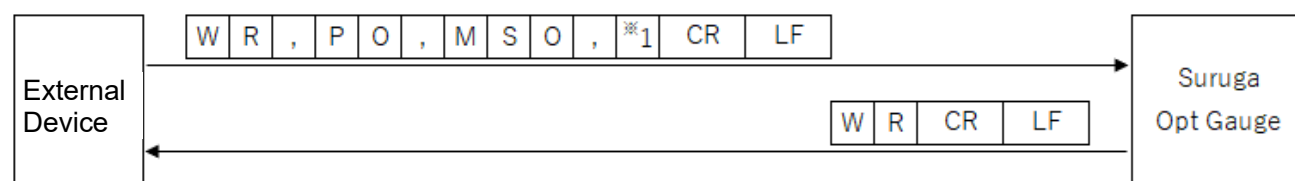
*1：(Multi Spot) List sort type ("0"= Area、"1"= Centroid)

[Write (Multi Spot)Spot Count decimal place setting information]
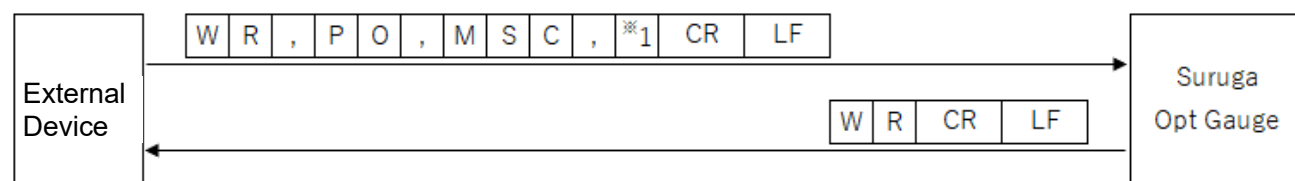
| W | R | , | P | O | , | M | S | C | , | ※1 | CR | LF |

External Device → Suruga Opt Gauge

| W | R | CR | LF |

External Device ← Suruga Opt Gauge

*1：Spot Count (1 to 100)

[(Multi Spot) Write Minimum Spot Area setting information]

| External Device | | W | R | , | P | O | , | M | S | M | , | ※1 | CR | LF | | → | Suruga Opt Gauge |
| | | | | | | | | | W | R | CR | LF | | | ← | |

*1: Minimum Spot Area (1 to 1023)

[Write Adaptive Cal execution button display enabled setting information]

| External Device | | W | R | , | P | O | , | A | C | E | , | ※1 | CR | LF | | → | Suruga Opt Gauge |
| | | | | | | | | | W | R | CR | LF | | | ← | |

*1: Adaptive Cal execution button display ("0" = disabled, "1" = enabled)

[Write Orientation Enabled setting information]

| External Device | | W | R | , | P | O | , | D | O | E | , | ※1 | CR | LF | | → | Suruga Opt Gauge |
| | | | | | | | | | W | R | CR | LF | | | ← | |

*1: Orientation Enabled ("0" = disabled, "1" = enabled)

[Write Binning enabled setting information]

| External Device | | W | R | , | P | O | , | B | I | E | , | ※1 | CR | LF | | → | Suruga Opt Gauge |
| | | | | | | | | | W | R | CR | LF | | | ← | |

*1: Binning setting ("0" = disabled, "1" = enabled)

[Write Display Spot Number setting information]

| External Device | | W | R | , | P | O | , | D | S | N | , | ※1 | CR | LF | | → | Suruga Opt Gauge |
| | | | | | | | | | W | R | CR | LF | | | ← | |
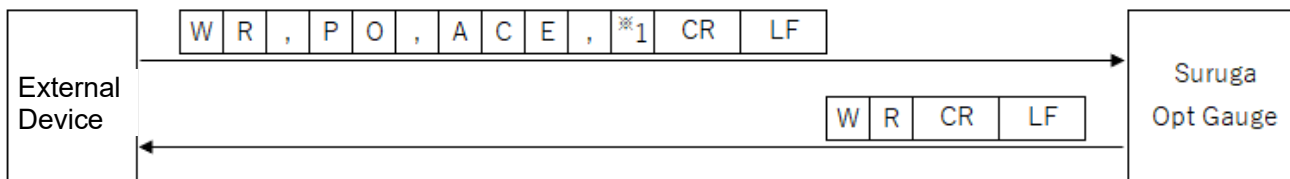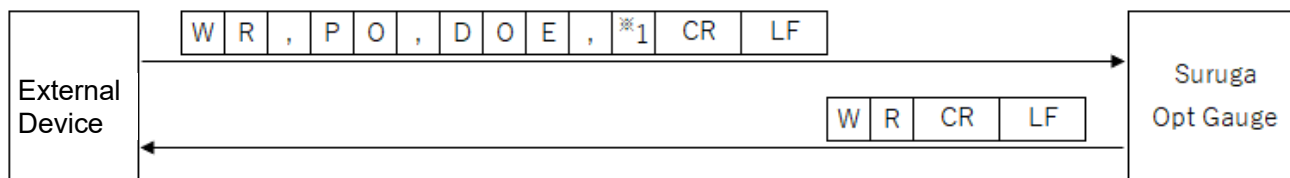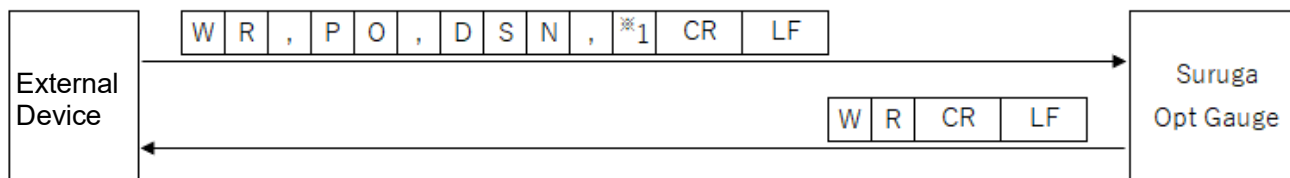
*1: Display Spot Number setting value (0 to 100)

5.6 Execution Commands

5.6.1 Command Formats

[Save Option]

| External Device | | | E | X | , | S | V | CR | LF | → | Suruga Opt Gauge |
| | E | X | CR | LF | ← | |

[Angle Main Spot Number Switching]

| External Device | E | X | , | A | R | , | M | S | N | , | ※1 | CR | LF | → | Suruga OptGauge |
| E | X | CR | LF | ← | |
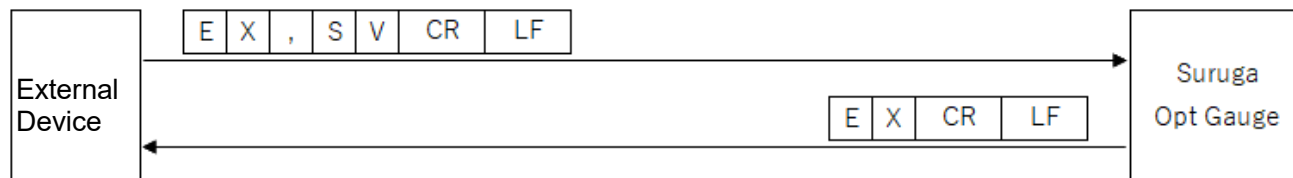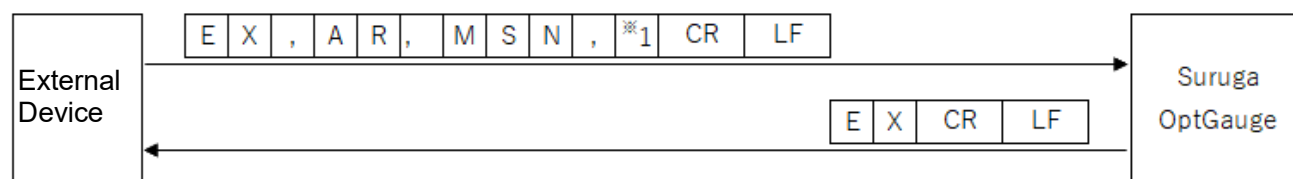
*1：Main Spot Number(1～100)

[Profile Main Spot Number Switching]

| External Device | E | X | , | P | R | , | M | S | N | , | ※1 | CR | LF | → | Suruga OptGauge |
| E | X | CR | LF | ← | |
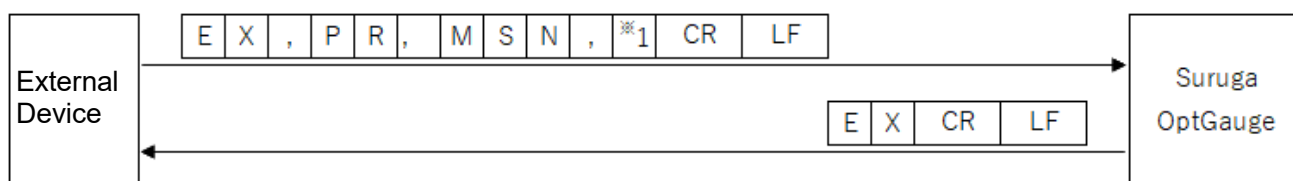
*1：Main Spot Number(1～100)

< Measurement Result Log Output >

| External Device | E | X | , | R | O | CR | LF | → | Suruga OptGauge |
| E | X | CR | LF | ← | |
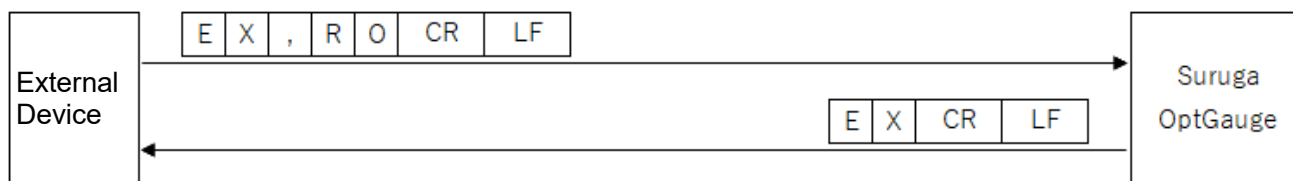
5.7 Communication Eror

When a command cannot be normally received or executed, the Products will return error information in the following format.

| ※ | ※ | ※ | ※ | CR | LF |

External Device

| E | R | , | ※1 | CR | LF |

Suruga Opt Gauge
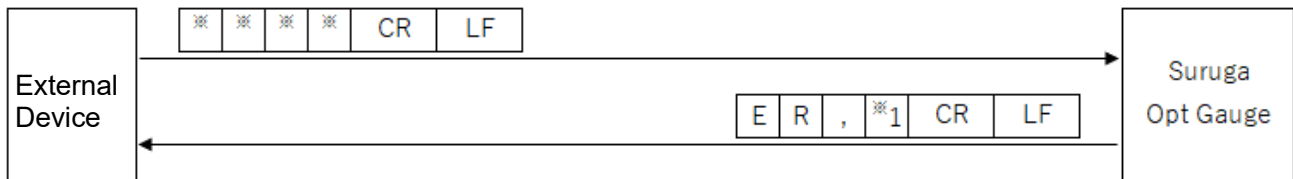
The error codes below appear in ※1.

"2": Setting data error.
  - Value outside setting range was set.
"3": Command format error
  - Number of commas from header to [CRLF] does not match.
  - Command not in command list, or non-alphanumeric characters.
  - Text after header includes characters not in list above.
"5": Condition error
  - Value outside setting range was set.

6. System Log

6.1 System Log List

System Log	Details
Angle view initialize succeeded	Angle view initialization was successful. Measurements start normally.
Profile view initialize succeeded	Profile view initialization was successful. Measurements start normally.
Angle view initialize failed. Please check the connection with SurugaOptGauge	Angle view initialization failed. Check the sensor head and computer connection.
Profile view initialize failed. Please check the connection with SurugaOptGauge	Profile view initialization failed. Check the sensor head and computer connection.
Angle result output succeeded	Angle measurement results output with [Output Once] button was successful.
Profile result output succeeded	Profile measurement results output with [Output Once] button was successful.
Angle result output failed	Angle measurement results output with [Output Once] button was failed.
Profile result output failed	Profile measurement results output with [Output Once] button was failed.
Adaptive Cal succeeded	Adaptive calibration with [Adaptive Cal] button was successful.
Adaptive Cal failed	Adaptive calibration with [Adaptive Cal] button was failed.
It is necessary to block the light	Adaptive Cal failure: Block the light.

6.2 Error Messages and Countermeasures

Error Message	Cause	Countermeasure
Angle view initializing failed. Please check the connection with SurugaOptGauge.	Sensor head and computer are not connected.	Check that sensor head and computer are connected and restart OptGauge.
Profile view initializing failed. Please check the connection with SurugaOptGauge.		If this error is repeatedly generated, the sensor head interior camera may not be working properly. Contact the Suruga Seiki Optical Device Business Division Sales Section.
Angle result output failed.	Measurement results output file (.csv) is open. Output destination file path or file cannot be found.	If the measurement results output file (.csv) is open, close it and output measurement results.
Profile result output failed.		Check that the output destination file path or file exists.
Adaptive calibration failed. It is necessary to block the light.	Because the light is not blocked, the Adaptive Cal cannot be executed.	Check that the beam is not incoming to the sensor head. Also, make sure before measurement that there is no unwanted exterior light or other laser light source interfering with the sensor.

7. Specifications for H650 Series Sensor Head and Accessories

7.1 Sensor Head Specifications

Item		Specifications	
Model No.		H650VL-13506R2-30-200A	H650NL-13506R2-30-200A
Measurable External Light Source	Wavelength	VIS: 400 to 700 nm	NIR: 700 to 1000 nm
	Mix. Diameter	6 mm	
	Light Intensity	0.05 to 1.0 mW	
Internal Light Source	Wavelength	660 nm	
	Diameter	Φ3 mm	
	Emission Intensity	1 mW or less（Class2）	
	Emission Position	16 mm×25 mm（Distance from the reference plane）（See "H650 Series External Dimensions"）	
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	Range	20 mrad or less	
	Linearity	5% of F.S.（F.S.=20 mrad）	
Location Measurement	Viewing Range	Φ6 mm	
	Repeatability	1μm（6σ）	
	Linearity	+/- 0.5% of F.S.（F.S.=3 mm）	
Beam Diameter Measurement	Actual Spot Size*4	Φ0.06 mm toΦ6mm	
Working Distance		200 mm +/- 4 mm	
Frame Rate		8〜10 Hz （@ recommended PC spec.）	
Environment Conditions	Operating Condition*5	0 to +40℃、35 to 85% RH	
	Storing Condition	-10 to +60 ℃	
	Vibration Resistance	Frequency range: 10 Hz to 500 Hz Max. acceleration: 2 G in X,Y,Z 3 directions @10 sweeps	
Weight		1.0 kg	

*1 When measuring with Φ3 mm external laser beam

*2 When measuring with wavelength at 660 +/- 10 nm

*3 When measuring with an averaging number of 256 times

*4 With Auto Aperture, we recommend that measuring SPOT diameter at 1/2 or less of the field of view

*5 Factory Inspection Environment: 22 to 24 ° C, 35 to 85% RH

7.2 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)	99mm x 50mm x 33mm
DC Cable Length	1.5 m +/- 30 ㎜
DC Plug Polarity	Center Positive

7.3 Sensor Head and Cable Electrical Specifications

Sensor Head 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

8. Failures? Frequently Asked Questions

Symptoms and Countermeasures

Below is information useful for troubleshooting.

Check whether the issue at hand is listed below.

Symptom	Cause	Countermeasure
Internal light source power is not turn 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.
Beam is not displayed on screen.	Exposure Time 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 centroid is unstable.	Noise is causing serious effects	Enable denoising setting threshold and adjust threshold value.
RS232C communication is not working.	RS232C cable is not correctly connected	Correctly connect RS232C cable.
	Computer communication conditions are not set correctly.	Set the computer communication settings correctly.
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.

9. Warranty - After-Sales Service

9.1 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.

9.2 After-Sales Service

Before requesting repair, please check "8. Please check the items in "8. 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, a repair is done for free. For any damages out of warranty period mentioned above, a fee is required for such repair.

<After the Warranty Period>
A repair service is available with a fee to maintain the functionaries 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

SURUGA SEIKI CO., LTD.