SURUGA SEIKI

SG19-236-001E

Laser Auto-Collimator

H410 series

User's Manual

Thank you very much for purchasing this product.
Read this manual thoroughly before using the product.
After done reading this manual, store in a safe place for easy reference.

Safety Cautions

Introduction

This document is a “User’s Manual” of H410 series laser auto-collimator (hereinafter, referred to as “this product”).
In this “User’s Manual”, information and basic operation methods on this product are described. Read this document thoroughly to use this product effectively and safety, and sufficiently understand its contents.

Symbols and Meaning

In this document, items to be followed to avoid injuries of the operators who use this product and other people, and damage to physical properties are indicated with the following symbols.

⚠ Danger

If not followed, it indicates that “It is highly possible to cause death or serious injuries”.

⚠ Warning

If not followed, it indicates that “It is possible to cause death or serious injuries”.

⚠ Caution

If not followed, it indicates that “It is possible to cause light injuries or only physical property damages”.

NOTE

It describes items to pay attention when operating and handling this product.

Info

It describes reference items useful when operating and handling this product.

Handling of this Product

- Before starting or operating this product, please check the functions and performance of this product are operating correctly.
- If this product is not working properly, take sufficient safety measures to prevent various damages, and contact our sales office.
- When this product is used out of standards indicated in the specifications or in a modified state, be cautious that we cannot cover the functions and performance under the warranty.
- When this product is used by combining with other devices, please consider carefully, because its functions and performance may not be satisfied due to the use condition and environment.
- Do not use this product to protect human bodies and a part of human bodies.
- This product is not designed to be used in areas where explosion proof is necessary. Do not use this product in areas where explosion proof is necessary.
- Including peripheral devices, do not apply rapid temperature changes to each device. Condensation may cause the device to fail.
- IPU (Image Processing Unit) to connect to this product should be placed vertically. Do not place it side way.
- Do not wipe this product with wet cloth, benzine, and thinner. It may cause discolorization and deformation of this product. When heavy soil is present, soak a cloth to a diluted neutral detergent, wipe it by squeezing off the detergent well, and wipe it dry with a soft cloth.

Caution on Installation Environment

⚠ Caution

Do not install this product in the following places in order to use this product normally or safely.

- Highly humid place, dusty place, and place with bad ventilation.
- Places where temperature gets high such as by direct sunlight.
- Near flammable locations.
- Places where there are corrosive gases and inflammable gases.
- Places where vibration and shock are directly applied.
- Places where splash from water, oil, and drugs gets on this product.
- Places where static electricity is likely to be generated.
- Tilted and unstable places.

■ Measures Against Noise

⚠ Caution

When installing this product near noise sources such as a power source and high-voltage lines, the noise may cause malfunction and damage. Take measures such as use of noise filters, a separate piping of various cords, and attaching an insulation to the controller and measurement parts.

■ Effects of Ambient Temperature

⚠ Caution

Changes of ambient temperature may cause measurement errors. Always try to make it constant. The use environment temperature of this product is 0 to 40°C, and the performance guarantee temperature is 23°C ± 5°C.

■ Use of Ambient Lighting

⚠ Caution

Do not use this product near a lighting facility where ON/OFF in a high frequency is repeated. When it cannot be avoided, install a shielding plate to minimize its effect.

Caution When Using

⚠ Warning

- Use with a correct power source voltage. It may cause fire, electric shock, and damage.
- Do not disassemble/modify the unit. It may cause fire and electric shock.

⚠ Caution

- When attaching/detaching the cord, always turn the power source OFF of the main body and devices connected to the main body. It may cause damage.
- Do not turn the power source OFF while setting the items. A part or all of setting data may be lost.
- Do not block the ventilation hole of the main body. Inside temperature increases and it may result in damage.

■ Effects of Dirt and Dust

⚠ Caution

In the following cases, measurement errors may be generated due to the effect of dirt, dust, or water and oil.

- Adhesion to the cover glass: Blow a clean air to remove the dirt on the cover glass. If it is extremely dirty, wipe off with a soft cloth soaked in alcohol.
- Adhesion to a measurement target surface: Blow with a clean air, and wipe off the dirt.
- Penetration from floating to the optical axis region and by splash: Take measures by installing a protection cover and air purge.

■ Measured Target

When the shape of measured target and surface state are different, measurement errors may be generated. In the case, use an existing target object, and correct with the angle correction function.

■ Effects of Vibration

If a measurement target object is vibrating, the measured values may vary. In the case, a more precise measurement is possible by increasing the number of measurement values to calculate an average.

■ Effects of Air Fluctuation

A slow air fluctuation may cause measured values to vary.
In such a case, the following measure is effective.

- Cover the measurement part with a wind-proof cover.

Measures for Errors

⚠ Warning

In the next case, promptly turn the power source OFF. If this product is kept using in an abnormal state, it may cause damage.
Please contact our sales agency for repair.

- When water and foreign objects enter inside.
- This product is dropped and the case is damaged.
- Smoke comes from the controller and it smells strange.

CE Marking

This product comply with CE marking for the following complying standards and conditions. When this product is used in EU countries, keep the following conditions.

- EMI: EN61326-1 Class-A
- EMS: EN61326-1

* All cable lengths for input and output containing the power source cable to connect IPU are less than 30 m.

Safe Use of Laser Product

This product is laser class 1 product.
Use this product paying attention to the following items.

- Do not look laser light directly for a long time.
- Do not disassemble this product.

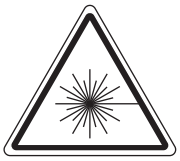
⚠ Caution

Use of controls or adjustments or performance of procedures other than those specified here in may result in hazardous radiation exposure.

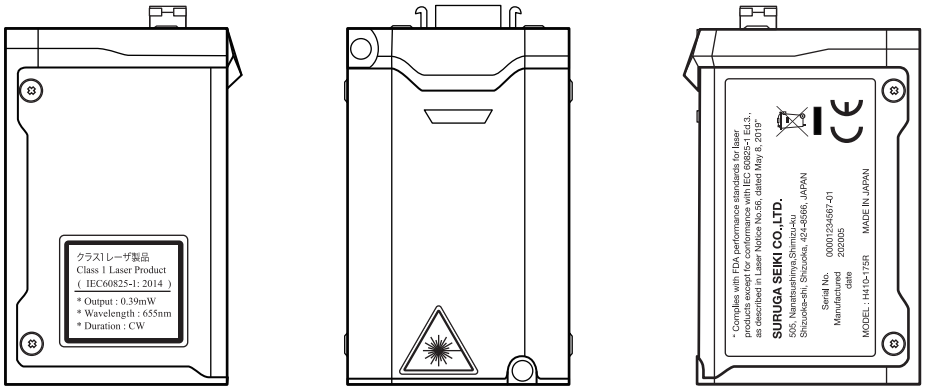
■ Warning Label

Display contents of this product's warning labels and their pasting positions are shown next.

● Display contents of laser label.



● Pasting location of laser label.



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1 Preparations

Preparations such as system configurations and function overview of this product that are necessary before using this product are explained.

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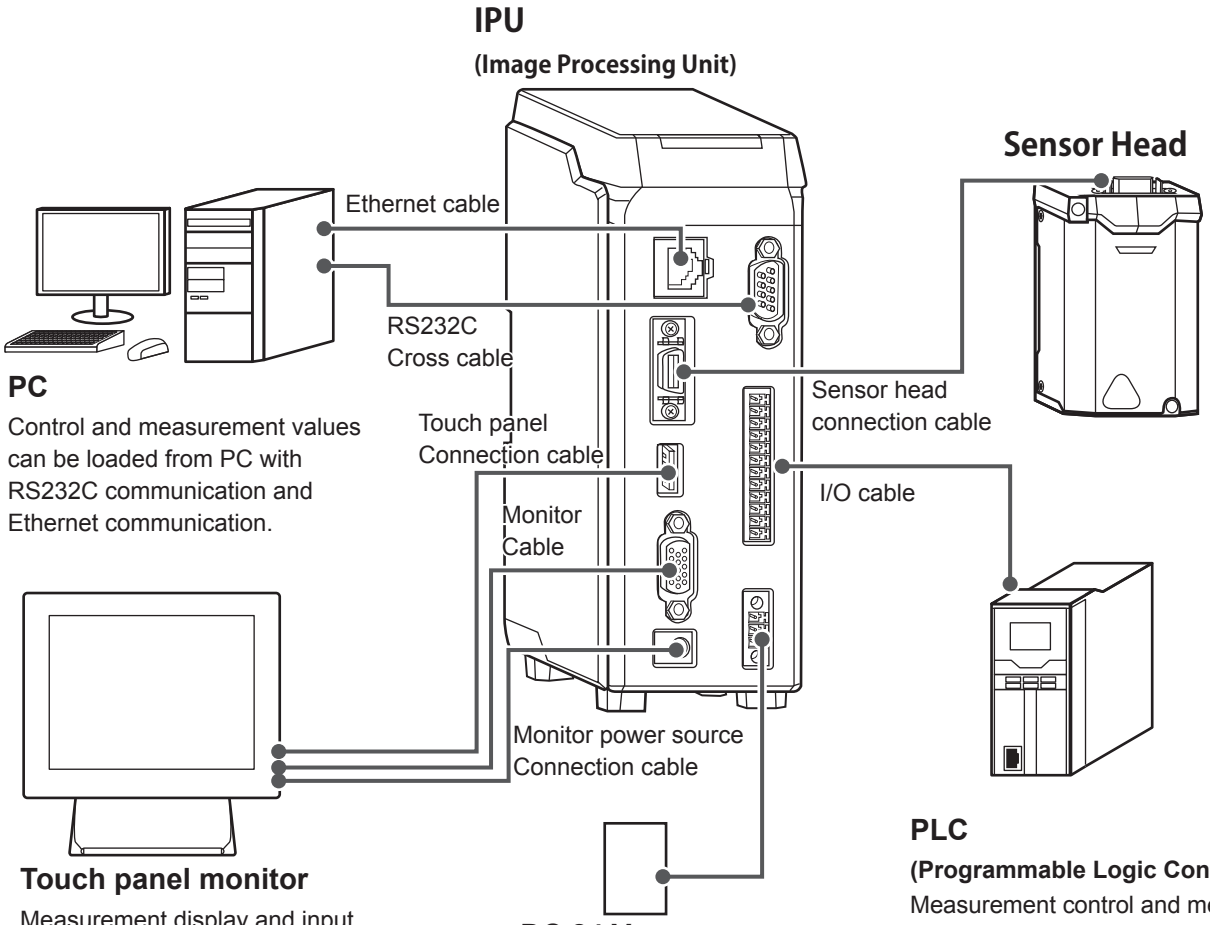
System Configurations

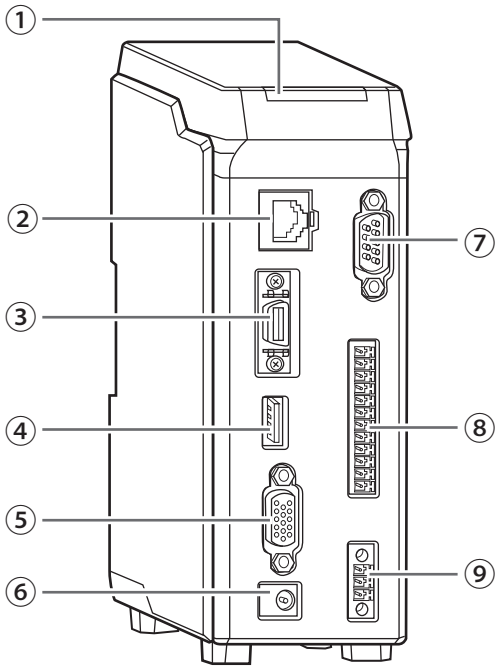
In addition to take measurement by itself, this product can be used according to purposes by combining with commercially available devices.



Each Part's Name and Function

Each part's name and function are described.

■ IPU



① State display lamp

Turns on in green when the power is ON.
Turns on in red when there are problems like errors.

② Ethernet connector

Connects to peripheral devices like PC. (→Page 5-1)

③ Head connector

Connects with the sensor head (1). (→Page 1-5)

④ USB connector

Connects the touch panel connection cable (USB cable). (→Page 1-7)

⑤ Monitor connector

Connects the monitor cable (VGA cable D-sub 15-pin). (→Page 1-7)

⑥ Monitor power source connector

Connects the monitor power source cable. (→Page 1-7)

⑦ RS232C connector

Connects to peripheral devices like PC. (→Page 5-1)

⑧ 12-core connector

Connects to a device that operates input/output signals such as PLC. (→Page 6-2)

⑨ DC 24 V power source connector

Connects to the DC 24 V power source. (→Page 1-8)

■ Sensor Head

① IPU connection connector

Connects to IPU.

② State display lamp

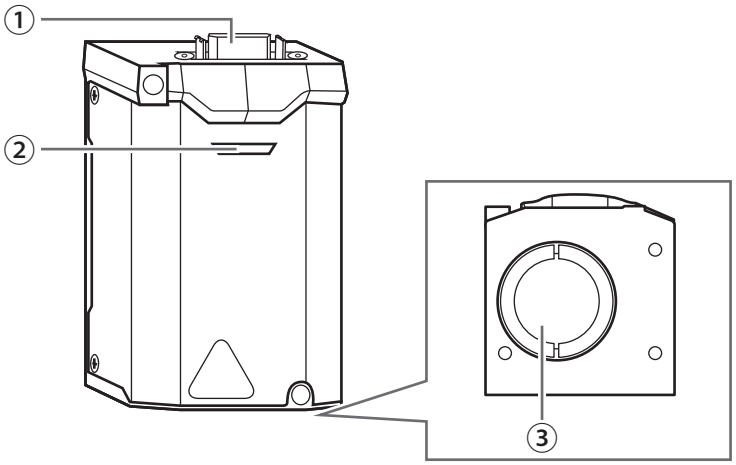
Turns on in green when the power is ON.
Turns on in red when there are problems like errors.

③ Laser emission port

Emits laser.

⚠ Warning

Do not direct the laser emission port to eyes.

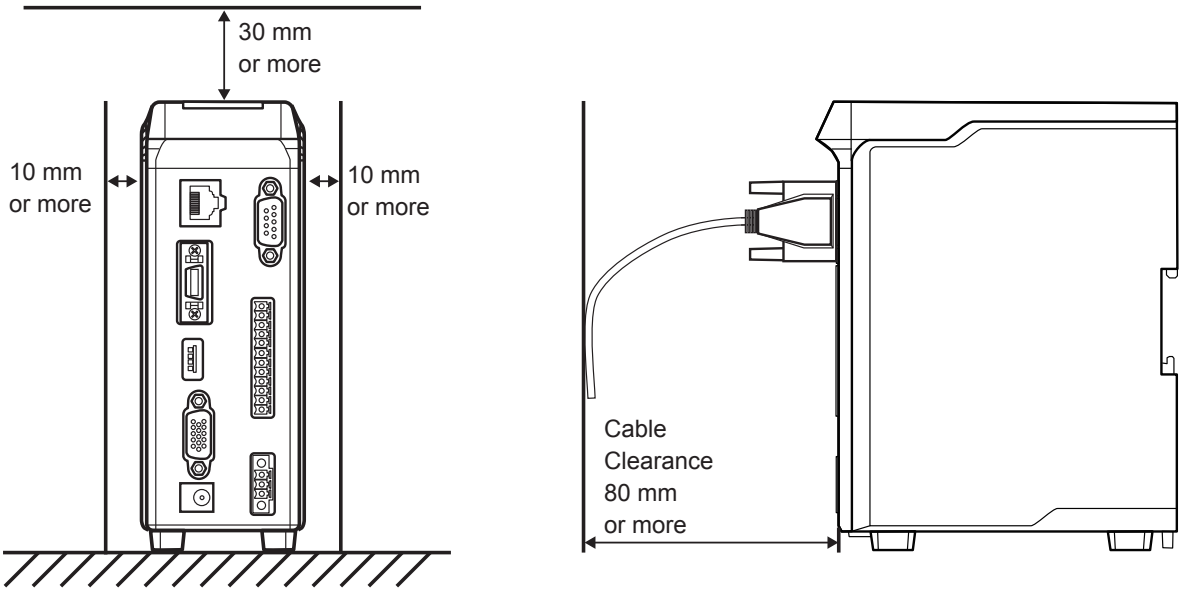


IPU Installation

IPU should be installed in the following environment.

NOTE

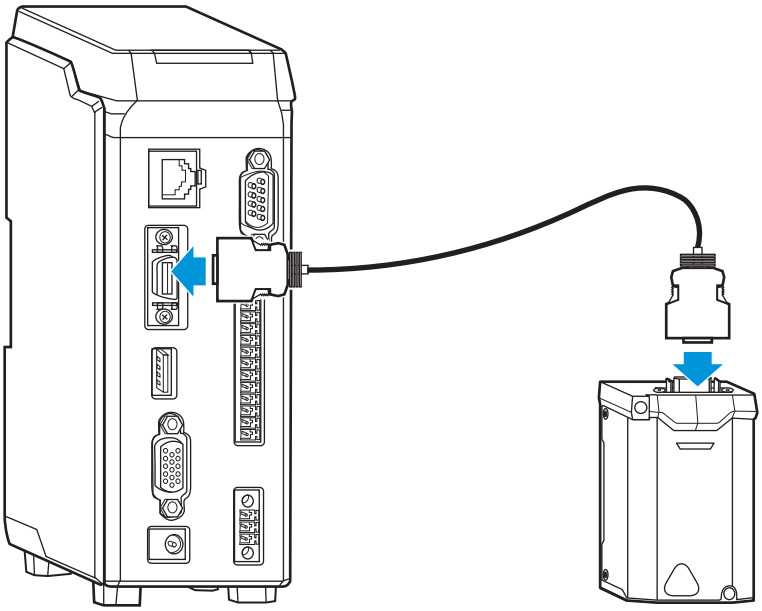
Do not place it side way.



Installation of Each Part

■ Installation of the sensor head

Connect by using the sensor head connection cable.

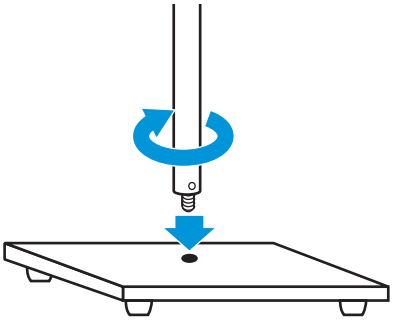


■ Mount the sensor head to the stand (HA-14)

When using the stand (HA-14), install by following the next steps.

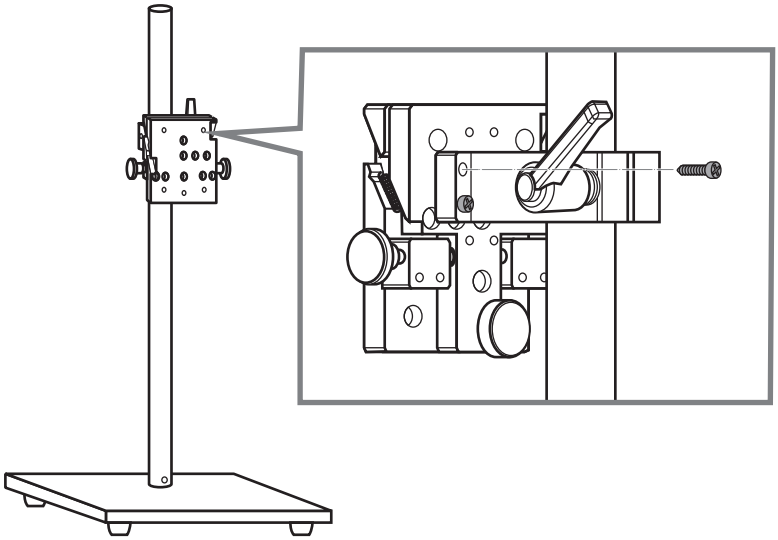
1 Assemble the stand.

Mount the rod on the base of the stand.



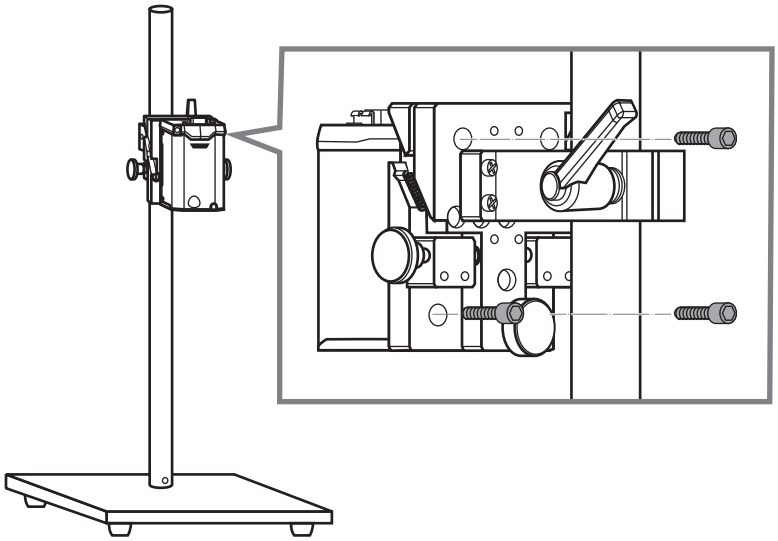
2 Mount the tilt stage to the stand.

Fix the tilt stage with the screws attached to the stand.



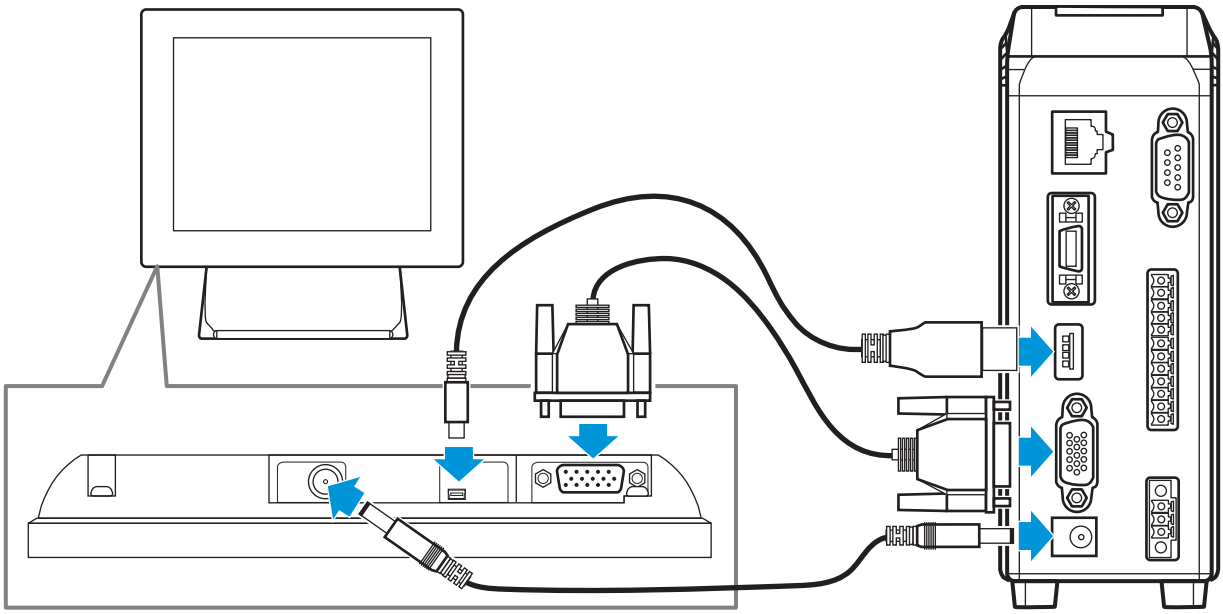
3 Mount the sensor head to the tilt stage.

Fix the sensor head with the screws attached to the tilt stage.



■ Installation of Touch Panel Monitor

Attach the monitor cable, touch panel connection cable, and power source connection cable to the connector respectively.



■ Installation of Peripheral Devices

● Installation of PC

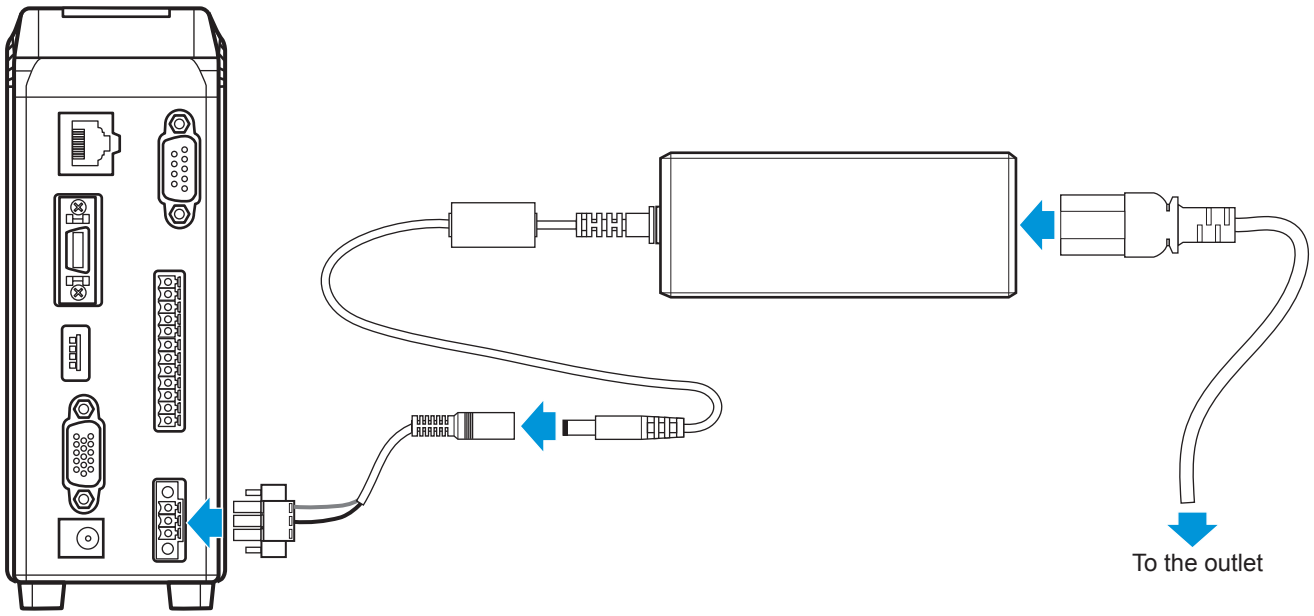
Attach by using the RS232C cable or the Ethernet cable.
For details, see “5 Control from Peripheral Devices” (→Page 5-1).

● Installation of PLC

Attach to the 12-core connector by using the I/O cable.
For details, see “6 Using Input/Output Terminal” (→Page 6-1).

Applying Power Source

Connect to the power source by using the AC adapter.



Function Overview

This product is an auto-collimator that finds tilting of the target object from the laser light entered to the CMOS (Complementary Metal Oxide Semiconductor) sensor.
It mainly has the following features.

- Able to measure five spots at maximum simultaneously.
- Light source besides a laser light can be used as an emission light.
- Operation can be performed with the touch panel monitor, and various settings and peripheral devices for measurement are not necessary.
- Can control from peripheral devices like PC.
- Able to utilize the command mode of the processing unit HIP-1200.

■ List of Functions

It is the function comparative table with HIP-1200.

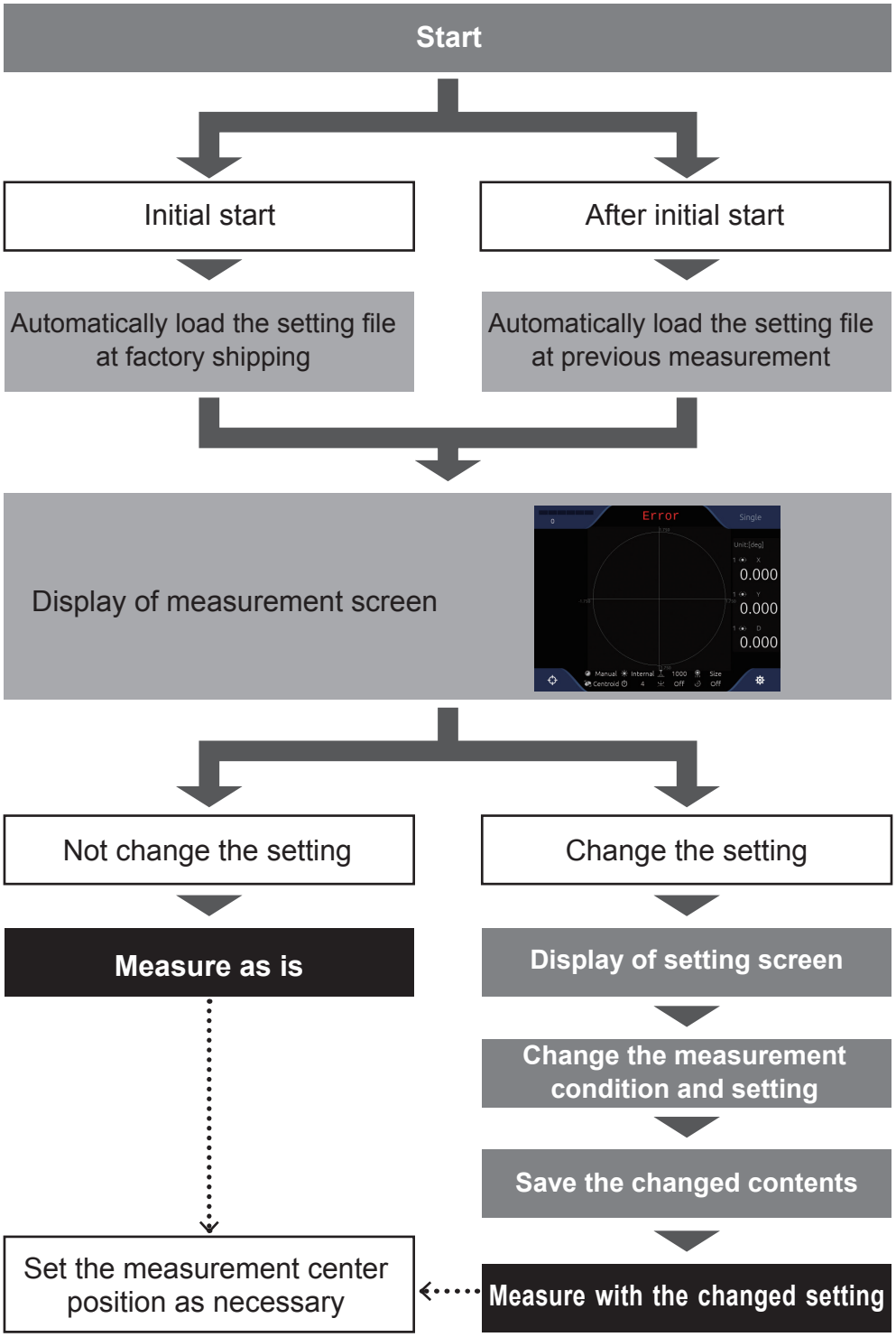
Function		This product	HIP-1200
Angle measurement (Standard measurement function)	Single spot	○	○
	Multi-spot (in label order)	5 spots at maximum (Order of sizes/Orders of angles from the origin spot)	3 spots at maximum (Order of sizes/Orders of angles from the origin spot)
Angle measurement (Application function)	Measurement (Precision motor variation measurement)	−	○
	DC tilt measurement (Tilt of actuator)	−	○
	3 beam measurement (Grating rotation adjustment)	−	○
Angle analysis	Area center of gravity	○	○
	Luminance center of gravity	○	○
	Luminance peak	○	○
Convenient function	Luminance value display	○	○
	Zoom function	○	○
	Image rotation (XY axis switching)	○	○
	Image inversion	○	○
Pass/fail judgment Judgment range	Circle	○	○
	Square (Rad/Tan)	○	○
Pass/fail judgment Judgment condition	Offset judgment	○	○
	Multi-spot Specified spot	○	○
	Multi-spot All spots	○	○

Continued to next page

Function		This product	HIP-1200
DIGITAL I/O	No. of output/input points	4/8	1/2
	Output 1 Common for output signal	○	–
	Output 2 Judgment result strobe	○	–
	Output 3 Judgment result	○	○
	Output 4 Trigger busy	○	–
	Input 1 Common for input signal	○	–
	Input 2 Result hold	○	○
	Input 3 Zero set	○	○
	Input 4 Measurement start trigger (24V)	○	–
	Input 5 Laser ON (+)	○	–
	Input 6 Laser ON (-)	○	–
	Input 7 Measurement start trigger (+)	○	–
	Input 8 Measurement start trigger (-)	○	–
Ethernet	Interface	TCP	–
	Command control	○	–
	Data output	CSV format	–
Serial communication	Interface	RS-232C	RS-232C
	Command control	○	○
	Data output	CSV format	CSV format

Flow of Measurement

The overview of measurement procedure is explained.



2 Setting

Various settings can be performed and measurement conditions can be changed on the screen by using the touch panel monitor of this product. In this section, the setting method utilizing the Graphical UI is explained.

Setting Method.....2-2

Use of Setting File 2-7

Setting of Basic Conditions.....2-13

Setting of Detail Conditions.....2-14

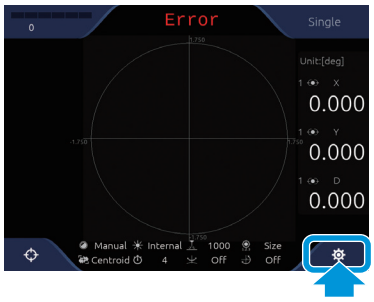
System Settings.....2-27

Setting Method

After the power source is turned ON, the basic procedure from changing the settings to start measurement, and the overview of setting items are explained.

■ Basic Flow of Setting

1 Touch ⚙ (Settings) in the measurement screen.



The [Settings] screen is displayed. (→ “■How to view the [Settings] screen (Page 2-4)”)

2 Touch a setting item’s tab in the menu area to change.

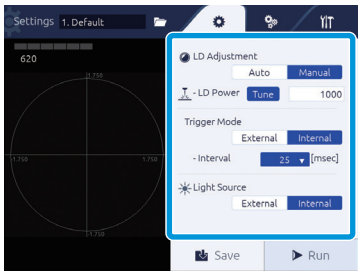
Touch the tab to display the setting content. (→ “■List of Settings Menu (Page 2-5)”)

Info

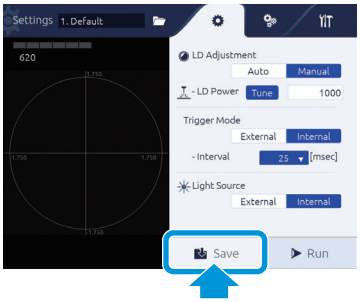
When changing a setting file to save the changed content, select a setting file first. (→ “Use of Setting File (Page 2-7)”)

3 Enter setting values.

Enter necessary information in each setting content.
For details, see “■Value Input Method” (Page 2-6)”.



4 After entry is done, touch the [Save] button.



The changed content is saved in the selected setting file.

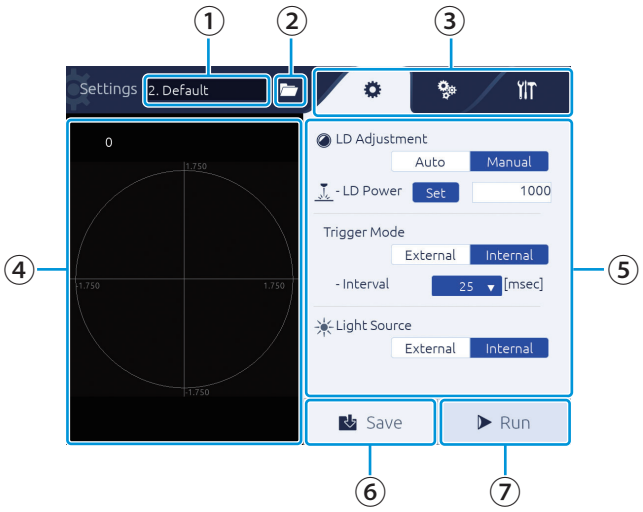
5 Touch the [Run] button, and measure with the changed content.

The measurement screen is displayed, and a measurement with the changed content is performed.

Info

- **When the setting content is not saved, the confirmation pop-up is displayed to confirm saving.**
- **The saved setting content can be loaded by reading the setting file. (→ "■Loading of Setting File (Page 2-7)")**

■ How to view the [Settings] screen



① Setting file name

The currently selected setting file name is displayed. (→Page 2-7)

② (Select File) button

Touch to bring up the dialog and load a setting file. (→Page 2-7)

③ Menu area

The setting item tabs are displayed.
Touch the item to display to display the setting content in ⑤ Setting area.
Tab: Basic setting
Tab: Detail setting
Tab: System setting

④ Image display area

Displays the measurement target.

⑤ Setting area

Displays the setting content.
Touch a numeric input area to display the software keyboard, and the user can enter a value.

⑥ [Save] button

Touch to save the changed content.

⑦ [Run] button

Touch to return to the measurement screen and start measurement.

■ List of Settings Menu

Overview of the setting items and each setting item are shown.

Tab	Group	Item	Overview	Reference
(Basic condition setting)	–	LD Adjustment	Sets the laser strength.	Page 2-13
		Trigger Mode	Sets the measurement timing.	
		Light Source	Sets the light source of the laser.	
(Detail condition setting)	Measurement (Setting of measurement conditions)	Mode	Sets the measurement mode.	Page 2-15
		Spot Sorting Rules	Sets a number assignment method of the light spot labels.	Page 2-16
		Tolerance	Sets the judgment standard area.	Page 2-18
		Detect Mode	Sets a detection method of the light spot.	Page 2-22
		Moving Average	Sets the number of processes for averaging of a judgment value.	Page 2-24
	Camera (Sets the camera)	Shutter Speed	Sets the exposure time.	Page 2-25
	Display (Sets the display)	Mirroring	Sets the mirroring display of an image.	Page 2-25
		Rotation	Sets the rotation display of an image.	
		Unit	Sets the display method of an measurement's angle.	
		Light Spot Pointer	Sets the display method of the pointer.	
		Viewing Angle	Sets the pseudo vision field angle display.	
		Auto Zoom	Sets the display magnification.	
(System settings)	Configuration (Settings of system configuration)	Output	Sets the output method of an measurement result.	Page 2-30
		Ethernet	Sets the connection environment of Ethernet.	
		Serial Port	Sets the serial communication speed.	
		Command Mode	Sets a command mode to use.	
		Strobe	Sets the strobe time.	
		Image Output (FTP)	Sets the destination FTP of an image.	
	Calibration (Settings of angle calibration)	Select Calibration Mode	Sets a calibration mode.	Page 2-30
	Information (Verification of system information)	–	Verifies system information.	Page 2-30

■ Value Input Method

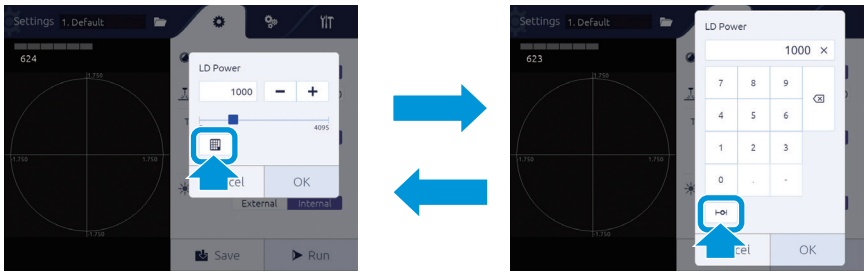
An input method for entering values as the setting values is explained.

1 Touch the value input field.

The value input screen is displayed.

2 Selects an value input method.

Every time you touch the icon in the bottom part of the screen, the input method switches.



Slider entry　　Value input

3 Entering a value.

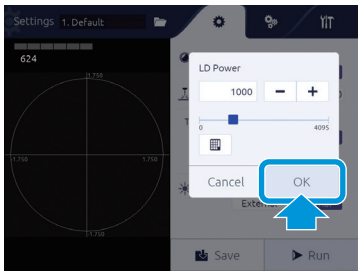
Slider entry

Touch +/- button or touch the slider.

Value entry

Enter a value with the numeric keyboard.

4 Touch the [OK] button.

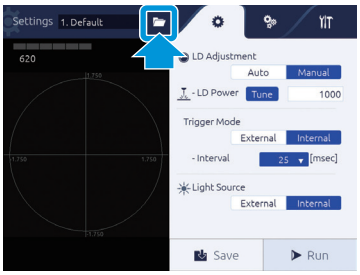


Use of Setting File

Load a saved setting file of measurement conditions to change the settings.

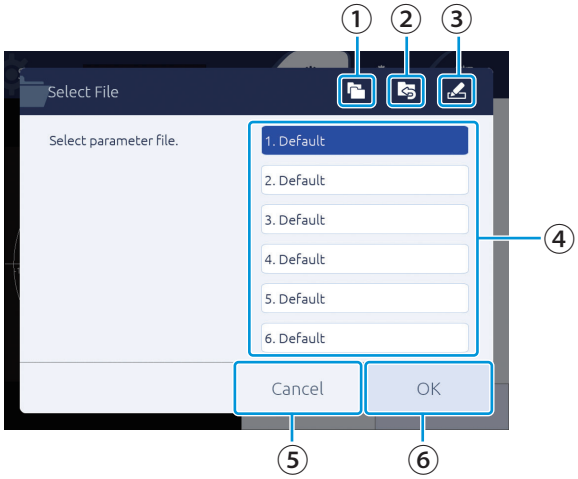
■ Loading of Setting File

1 In the [Settings] screen, touch the (Select File) button.



The [Select File] screen is displayed.

How to view the [Select File] screen



① (Copy) button

Touch to bring up the dialog and copy a file.

② (Reset) button

Touch to bring up the dialog and initialize a selected file.

③ (Rename) button

Touch to bring up the dialog and change a file name.

④ File name area

The file numbers and file names of the setting files are displayed, and the user can select a setting file.

⑤ [Cancel] button

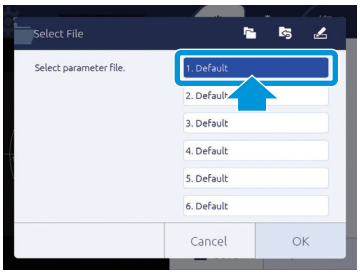
File selection is canceled.

Continued to next page

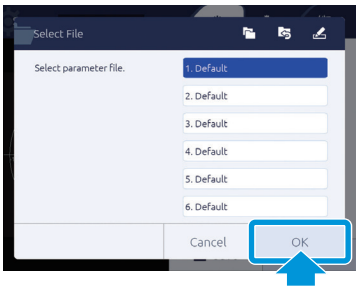
⑥ **[OK] button**

Execute a setting file loading.

2 Touch a setting file to use.



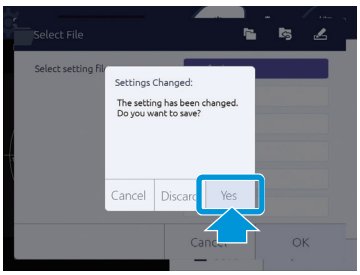
3 Touch the [OK] button.



The selected setting file is loaded.
When [Cancel] is touched, the setting file is not changed.

NOTE

When loading a setting file while the setting changes are not saved, [Setting Changed] dialog is displayed. To save the setting and load other file, touch [YES]. Touch [Discard] to cancel changes and load a file. When [Cancel] is touched, loading is canceled.



Info

When the power source is applied, it starts with the settings read previously.

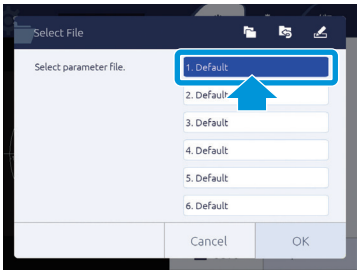
■ Copying Setting File

A setting file can be copied.

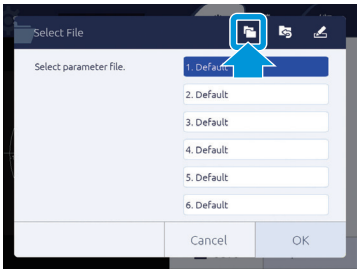
1 In the [Settings] screen, touch the (Select File) button.

The [Select File] screen is displayed.

2 Touch a file to copy.



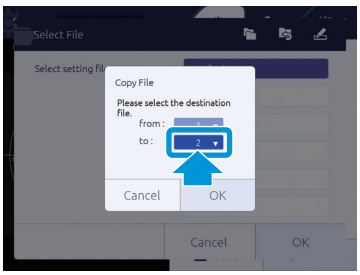
3 Touch the (Copy) button.



[File Copy Dialog] is displayed.

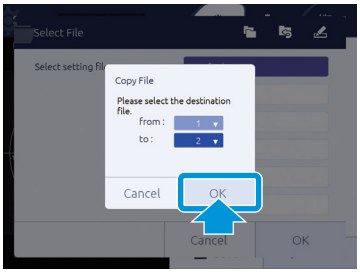
4 Select a file number to copy to.

Touch the number part in [to], and touch the number applicable in the list.



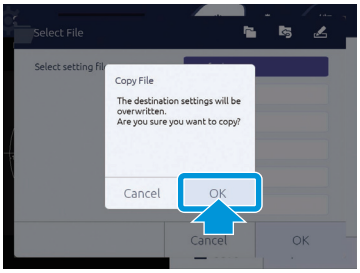
Continued to next page

5 Touch the [OK] button.



The confirmation screen is displayed.

6 Touch the [OK] button.



The setting content of the copy destination is copied to the selected file number.
When [Cancel] is touched, copying is canceled.

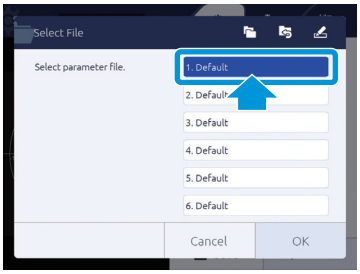
■ Resetting Setting File

The setting file can be returned to the setting file in the factory shipping state.

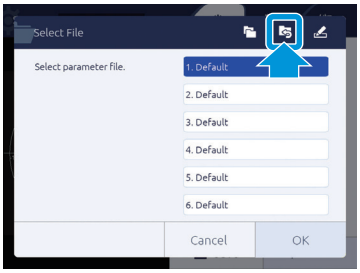
1 In the [Settings] screen, touch the (Select File) button.

The [Select File] screen is displayed.

2 Touch a file to reset.

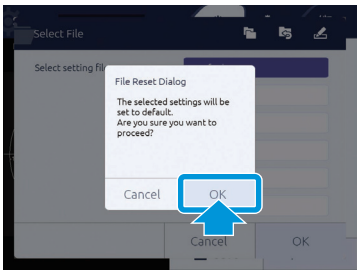


3 Touch the (Reset) button.



[File Reset Dialog] is displayed.

4 Touch the [OK] button.



The contents of the selected setting file is returned to the default setting in the factory shipping state.
Touch the [Cancel] button to cancel resetting.

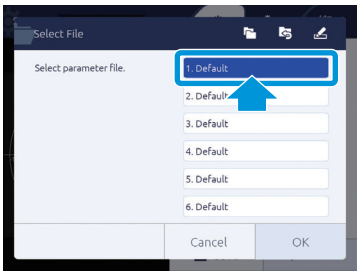
■ Name Change of Setting File

The name of a setting file can be changed to your choice.

1 In the [Settings] screen, touch the (Select File) button.

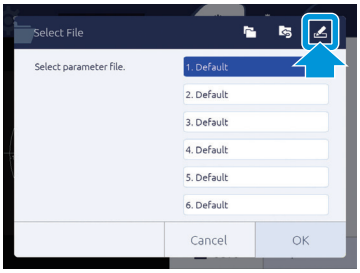
The [Select File] screen is displayed.

2 Touch a file to rename.



Continued to next page

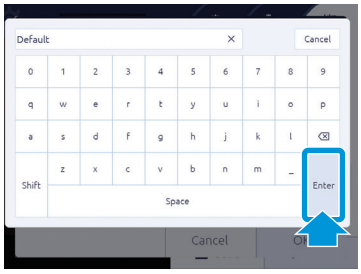
3 Touch the (Rename) button



The text input screen is displayed.

4 Enter a file name.

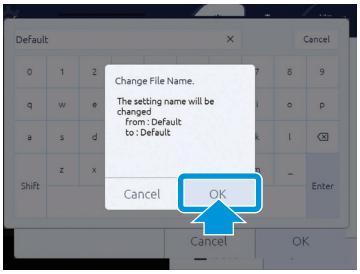
Use the software keyboard to enter.
After entry is done, touch the [Enter] button.



NOTE

- **The maximum number of characters that can be entered is 24.**
- **If no file name is entered, the file cannot be saved.**

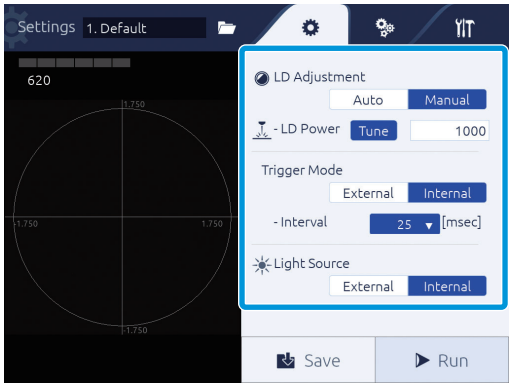
5 Touch the [OK] button.



The name of the selected setting file is changed to the entered content.
When [Cancel] is touched, file name change is canceled.

Setting of Basic Conditions

In the tab, measurement basic conditions such as laser strength and laser light source can be set.



Setting item	Setting value	
LD Adjustment Sets the laser strength.	Auto	Adjusts the strength automatically.
	Manual (def.)	Sets the strength with a value. Enter a value in the [LD Power] field to set the strength. Touch [Tune] to automatically adjust the strength once. **Info** **For the value input method, see "■Value Input Method" (Page 2-6)".**
Trigger Mode Sets the measurement timing.	External	Synchronizes to the measurement start trigger signal from a peripheral device, and performs measurement. **Info** **For DIO signal timing, see "Timing Chart (Page 6-6)".**
	Internal (def.)	Synchronizes with the internal timer and measures continuously. Selects a sampling period from the list.
Light Source Sets the light source of the laser.	External	Measures by using a peripheral light source. The measurement angle becomes the same value with the number of pixels of the tilting width in the pictured image.
	Internal (def.)	Measures by using the internal light source. The measurement angle becomes half of the number of pixels of the tilting width in the pictured image.

def. = default setting

NOTE

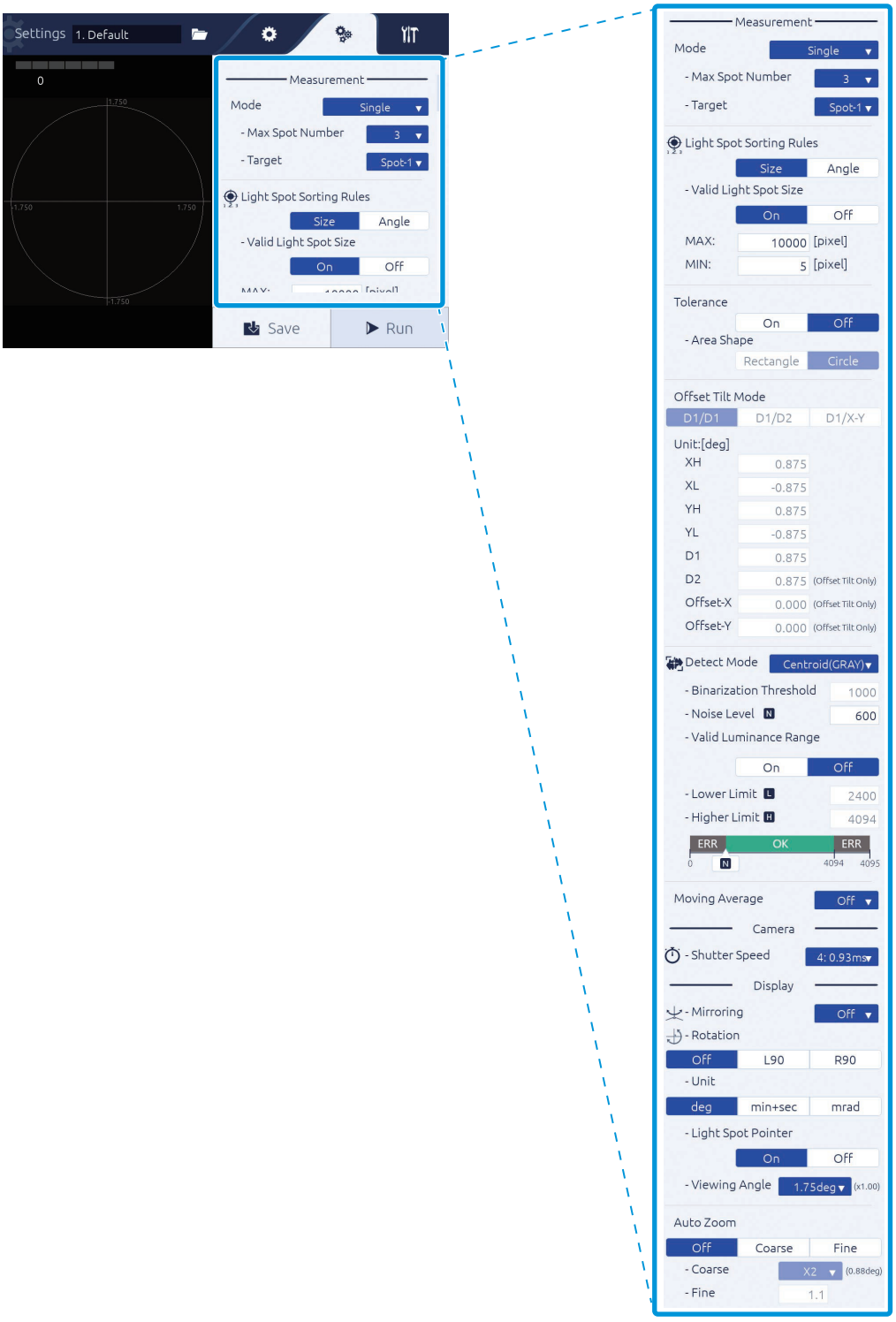
When automatic adjustment fails by selecting [Manual] in [LD Adjustment] and touching [Tune], the Warning dialog is displayed. Push the [OK] button to set the value again.

Continued to next page

Setting of Detail Conditions

With the tab, the following contents can be set.

- Setting of measurement conditions [Measurement] (→ Page 2-15)
- Setting of the camera [Camera] (→ Page 2-25)
- Setting of display state [Display] (→ Page 2-25)



■ Setting of Measurement Conditions [Measurement]

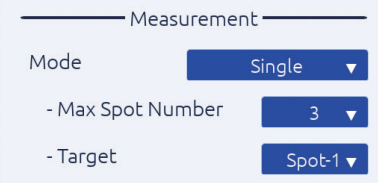
In [Measurement], the measurement mode and light spot label assignment can be set.

● Mode

Sets the measurement mode.
For the display of measurement results per measurement mode, see “Verification of Measurement and Judgment Results (Page 3-9)”.

Setting procedure

❶ Select a measurement mode with [Mode].
❷ Set the number of measurement spots (receiving light spot number) with [Max Spot Number].
❸ Select a spot to be the measurement target (label No.) with [Target].



Item explanation

Setting item	Setting value	
Mode	Single (def.)	Conduct measurement and judgment of the selected label No. **Setting range** Max Spot Number: 3 to 5 (def.=3) Target: Spot-1 (def.)/Spot-2/Spot-3/Spot-4/Spot-5 **Info** **The upper limit of [Target] label No. is the value set in Max Spot Number.**
	Offset Tilt	With continuous two measurements, each different reference (measurement center and range) is set and judged. The measurement mode is Single. The measurement switch between the first and second time is conducted with DIO zero set terminal or command control (RS232C, Ethernet). For the judgment reference setting, see “Offset Tilt Mode (Page 2-20)”.

Continued to next page

Setting item	Setting value	
Mode	Multi Relative	Two light or more reception spots (5 spots at maximum) are detected, and the relative angle between each spot is measured and judged. **Setting range** Spot Number: 3 to 5 (def.=3) Target: Spot-1 (def.)/Spot-2/Spot-3/Spot-4/Spot-5/All **Info** **• The measurement result contents are for each light reception spot the tilted angle around the X axis, the tilted angle of the Y axis, the tilted angle using the measurement center as reference, and the relative angle between the light reception.** **• Judgment is performed with the absolute angle value of the specified Target, and if light reception is not possible in the specified Target, it becomes ERROR, and even though light reception is possible but it is out of judgment range, it becomes NG. When the specified Target is ALL, if even one spot is out of judgment range, it becomes NG.**
	Multi Absolute	Two light or more reception spots (5 spots at maximum) are detected, and the absolute angle between each spot and the center spot is measured and judged. **Setting range** Spot Number: 3 to 5 (def.=3) Target: Spot-1 (def.)/Spot-2/Spot-3/Spot-4/Spot-5/All **Info** **• The measurement result contents are for each light reception spot, the tilted angle of the X axis, the tilted angle of the Y axis, and the tilted absolute angle using the measurement center as reference.** **• When the Target is not within the judgment range, it becomes an error. When the Target is ALL, if one spot is out of judgment range, it becomes NG.**

def. = default setting

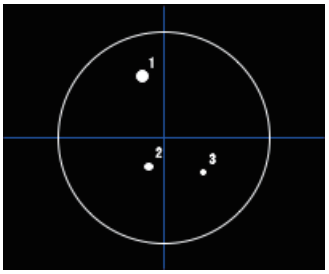
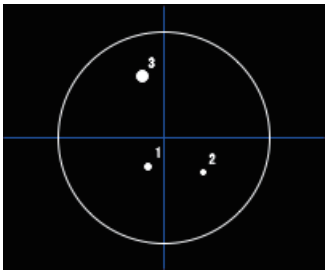
● Light Spot Sorting Rules

Sets a number assignment method of the light spot labels.

Setting procedure

❶ In [Spot Sorting Rules], select [Size]/[Angle].
❷ In [Valid Light Size], select [On]/[Off].
❸ When [On] is selected, the maximum value [MAX] and minimum value [MIN] of the effective light spot size are set.

Item explanation

Setting item	Setting value	
Light Spot Sorting Rules	Size (def.)	Numbers are assigned based on the area size of a light spot (area descending order). 
	Angle	Numbers are assigned in ascending order of angles from the measurement center (angle ascending order). 

def. = default setting

Auxiliary item

Setting item	Setting value	
Valid Light Spot Size Sets if the size of a light spot is used for valid/invalid judgment.	On	Uses the size of a light spot for judgment. The size of the light spot is set with [MAX] and [MIN]. If the size is within the range, it becomes valid. **Setting range** MAX:MIN+1 to 32627 (def.=10000) MIN:1 to MAX-1 (def.=5) **Info** **For the value input method, see "■Value Input Method" (Page 2-6)".**
	Off (def.)	Does not use the size of a light spot for judgment.

def. = default setting

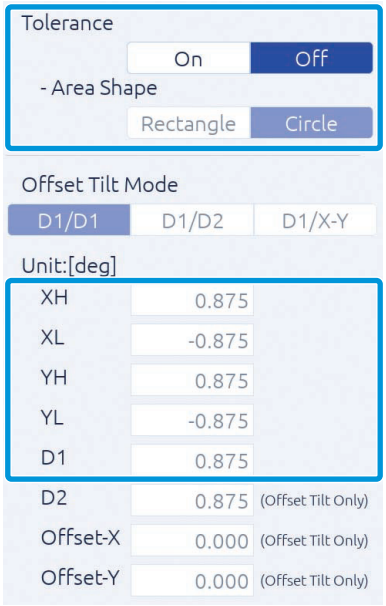
Continued to next page

● Tolerance (When Mode is Single, Multi Absolute, Multi Relative)

Sets the judgment standard area.

Setting procedure

❶ In [Tolerance], select [On]/[Off].
❷ In [Area Shape], select [Rectangle]/[Circle].
❸ When [Rectangle] is selected, set XH/XL/YH/YL.
When [Circle] is selected, set D1.



Item explanation

Setting item	Setting value	
Tolerance	On	Make the judgment standard area effective. Sets the area in [Area Shape].
	Off (def.)	Make the judgment standard area invalid.

def. = default setting

Auxiliary item of [On]

Setting item	Setting value	
Area Shape Sets the judgment standard area.	Rectangle	Uses a rectangle as the judgment standard area. Sets with an angle to the X and Y direction from the measurement center. Enter values in XH (right direction)/XL (left direction)/YH (upper direction)/YL (lower direction). **Setting range (Unit: deg)** XH: XL+0.001 to 1.75 (def.=0.875) XL: -1.75 to XH-0.001 (def.=-0.875) YH: YL+0.001 to 1.75 (def.=0.875) YL: -1.75 to YH-0.001 (def.=-0.875) **Setting range (Unit: mrad)** XH: XL+0.01 to 30.54 (def.=15.27) XL: -30.54 to XH-0.01 (def.=-15.27) YH: YL+0.01 to 30.54 (def.=15.27) YL: -30.54 to YH-0.01 (def.=-15.27) **Setting range (Unit: min+sec)** XH: XL+0′ 01” to 105′ 00” (def.= 52′ 30”) XL: -105′ 00” to XH-0′ 01” (def.= -52′ 30”) YH: YL+0′ 01” to 105′ 00” (def.= 52′ 30”) YL: -105′ 00” to YH-0′ 01” (def.= -52′ 30”)
	Circle (def.)	Uses a circle as the judgment standard area. Sets with a radius which reference is the angle from the measurement center. Enter a value in D1. **Setting range (Unit: deg)** D1: 0.001 to 1.75 (def.=0.875) **Setting range (Unit: mrad)** D1: 0.01 to 30.54 (def.=15.27) **Setting range (Unit: min+sec)** D1: 0′ 01” to 105′ 00” (def.= 52′ 30”)

def. = default setting

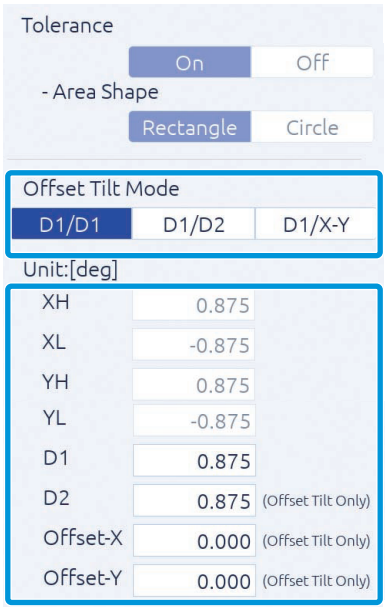
Continued to next page

● Offset Tilt Mode

Sets the measurement standard when the Mode is set to the Offset Tilt mode.

Setting procedure

❶ In [Offset Tilt Mode], select [D1/D1]/[D1/D2]/[D1/X-Y].
❷ When [D1/D1] is selected, set D1/Offset-X/Offset-Y.
When [D1/D2] is selected, set D1/D2/Offset-X/Offset-Y.
When [D1/X-Y] is selected, set XH/XL/YH/YL/D1/Offset-X/Offset-Y.



Item explanation

Setting item	Setting value	
Offset Tilt Mode	D1/D1 (def.)	As the judgment area, use the circle with its radius D1 for both first and second times. Enter the offset value of the second measurement center. **Setting range (Unit: deg)** D1: 0.001 to 1.75 (def.=0.875) Offset-X: -1.75 to 1.75 (def.=0) Offset-Y: -1.75 to 1.75 (def.=0) **Setting range (Unit: mrad)** D1: 0.01 to 30.54 (def.=15.27) Offset-X: -30.54 to 30.54 (def.=0) Offset-Y: -30.54 to 30.54 (def.=0) **Setting range (Unit: min+sec)** D1: 0′ 01” to 105′ 00” (def.= 52′ 30”) Offset-X: -105′ 00” to 105′ 00” (def.=0) Offset-Y: -105′ 00” to 105′ 00” (def.=0)

Setting item	Setting value	
Offset Tilt Mode	D1/D2	As the judgment area, use the circle with its radius D1 for the first time and the circle with its radius D2 for the second time. Enter the offset value of the second measurement center. **Setting range (Unit: deg)** D1: 0.001 to 1.75 (def.=0.875) D2: 0.001 to 1.75 (def.=0.875) Offset-X: -1.75 to 1.75 (def.=0) Offset-Y: -1.75 to 1.75 (def.=0) **Setting range (Unit: mrad)** D1: 0.01 to 30.54 (def.=15.27) D2: 0.01 to 30.54 (def.=15.27) Offset-X: -30.54 to 30.54 (def.=0) Offset-Y: -30.54 to 30.54 (def.=0) **Setting range (Unit: min+sec)** D1: 0′ 01” to 105′ 00” (def.= 52′ 30”) D2: 0′ 01” to 105′ 00” (def.= 52′ 30”) Offset-X: -105′ 00” to 105′ 00” (def.=0) Offset-Y: -105′ 00” to 105′ 00” (def.=0)
	D1/X-Y	As the judgment area, use the circle with its radius D1 for the first time and the rectangular with XY for the second time. Enter the offset value of the second measurement center. **Setting range (Unit: deg)** XH: XL+0.001 to 1.75 (def.=0.875) XL: -1.75 to XH-0.001 (def.=-0.875) YH: YL+0.001 to 1.75 (def.=0.875) YL: -1.75 to YH-0.001 (def.=-0.875) D1: 0.001 to 1.75 (def.=0.875) Offset-X: -1.75 to 1.75 (def.=0) Offset-Y: -1.75 to 1.75 (def.=0) **Setting range (Unit: mrad)** XH: XL+0.01 to 30.54 (def.=15.27) XL: -30.54 to XH-0.01 (def.=-15.27) YH: YL+0.01 to 30.54 (def.=15.27) YL: -30.54 to YH-0.01 (def.=-15.27) D1: 0.01 to 30.54 (def.=15.27) Offset-X: -30.54 to 30.54 (def.=0) Offset-Y: -30.54 to 30.54 (def.=0) **Setting range (Unit: min+sec)** XH: XL+0′ 01” to 105′ 00” (def.= 52′ 30”) XL: -105′ 00” to XH-0′ 01” (def.= -52′ 30”) YH: YL+0′ 01” to 105′ 00” (def.= 52′ 30”) YL: -105′ 00” to YH-0′ 01” (def.= -52′ 30”) D1: 0′ 01” to 105′ 00” (def.= 52′ 30”) Offset-X: -105′ 00” to 105′ 00” (def.=0) Offset-Y: -105′ 00” to 105′ 00” (def.=0)

def. = default setting

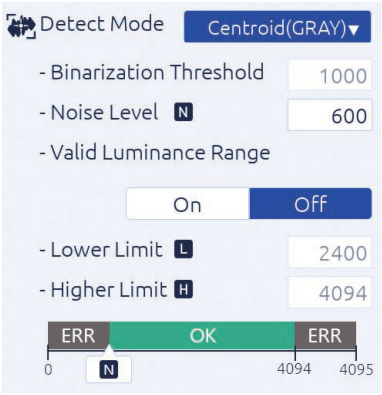
Continued to next page

● Detect Mode

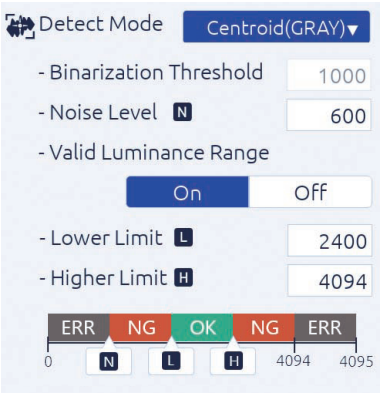
Sets a detection method of the light spot.

Setting procedure

❶ In [Detect Mode], select [Center (BIN)]/[Centroid (GRAY)]/[Peak].
❷ When [Center (BIN)] is selected, Binarization Threshold should be set.
When [Centroid] is selected, Noise Level and Valid Luminance Range should be set.

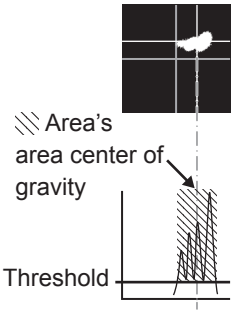
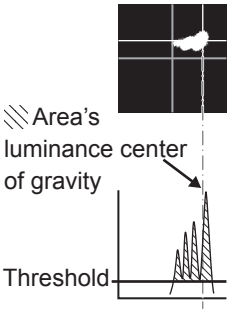


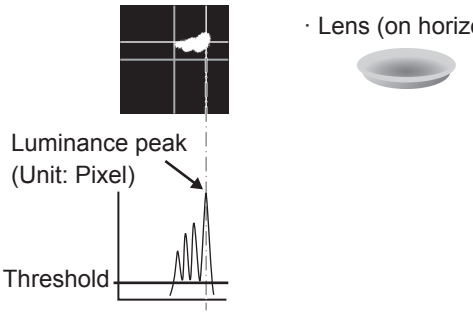
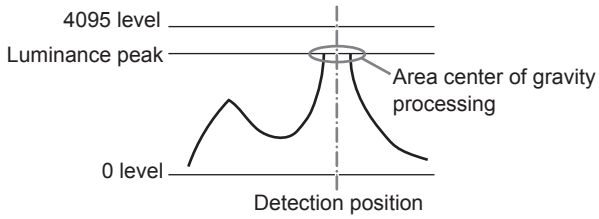
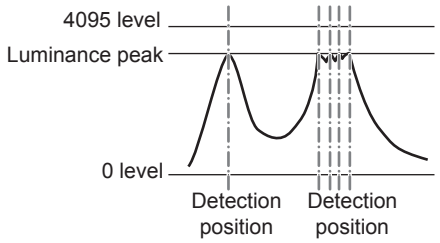
[Valid Luminance Range] is [Off]



[Valid Luminance Range] is [On]

Item explanation

Setting item	Setting value	
Detect Mode	Center (BIN)	An angle is calculated based on the area center of gravity formula of valid pixels that luminance is higher than the binary threshold value. Enter a binary threshold to [Binarizarion Threshold]. ■ Detection example  ■ Recommended measurement target · Mirror · Glass
	Centroid (GRAY) (def.)	An angle is calculated based on the luminance weighed center of gravity formula of valid pixels that luminance is higher than the noise level. Enter a noise level in [Noise Level] that becomes valid. ■ Detection example  ■ Recommended measurement target · Lens (on horizontal surface part)

Setting item	Setting value	
Detect Mode	Peak	The position of maximum luminance is detected. ■ Detection example ■ Recommended measurement target · Lens (on horizontal surface part)  When the pixel of the maximum luminance is continuous, its area center of gravity is detected. (*1) In case of *1  When there are multiple pixels of the maximum luminance and they are not continuous, it becomes an error. (*2) In case of *2 (Error)  **NOTE** **It supports when the Mode is Single Spot.**

def. = default setting

Auxiliary item

Setting item	Setting value	
Binarization Threshold When [Center (BIN)] is selected, the binary threshold is set.	–	**Setting range** 600 to 4095 (def.=1000) **NOTE** **When the number of valid pixels exceeds 32767, it becomes an error.**
Noise Level When [Centroid (GRAY)] is selected, set the noise level that becomes a reference.	–	It becomes invalid when it is less than the set noise level. **Setting range** 600 to Lower Level-1 (def.=600)

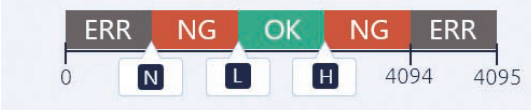
Continued to next page

Setting item	Setting value	
Valid Luminance Range When [Centroid (GRAY)] is selected, it is set to make the maximum luminance judgment valid.	On	Set the maximum luminance judgment to valid. The range is set with [Lower Level] and [Higher Level]. **Setting range** Lower Limit: Noise Level+1 to Higher Limit-1 (def.=2400) Higher Limit: Lower Limit+1 to 4095 (def.=4094)
	Off (def.)	Set the maximum luminance judgment to invalid

def. = default setting

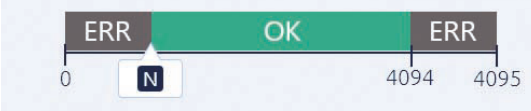
Info

Judgment image when [Valid Luminance Range] is [On].



When the maximum luminance judgment is valid, the setting range of N, L, and H are as follows.
Luminance value 600 ≤ N < L < H ≤ 4095 (When L < N, change N to L-1)

Judgment image when [Valid Luminance Range] is [Off].



When the maximum luminance judgment is invalid, the setting range of N is as follows.
Luminance value 600 ≤ N ≤ 4095

● Moving Average

Sets the number of processes for averaging (moving average) of a judgment value.

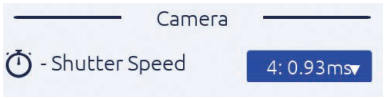
Item explanation

Setting item	Setting value	
Moving Average	–	Sets the number of processes for averaging of a judgment value. **Setting range** 2/4/8/16/Off (def.) **Info** **When a measurement becomes Error or NG, the number of processes is set to 1, and it is counted again.**

def. = default setting

■ Settings of Camera [Camera]

Perform settings of camera.



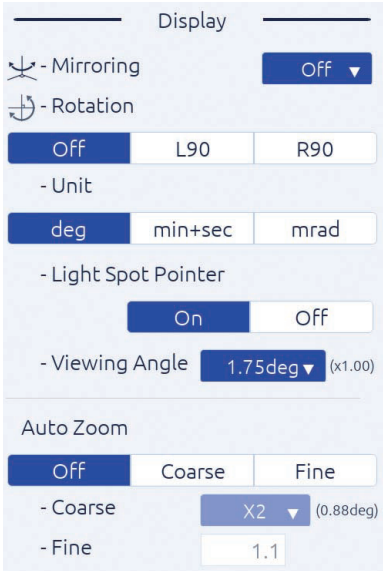
Item explanation

Setting item	Setting value	
Shutter Speed Sets the exposure time. **NOTE** **It is invalid when LD output auto-adjustment. (→ Page 2-13)**	–	Sets the exposure time. **Setting range** 1 to 8 (def.=4) **Info** **Each exposure time of 1 to 8 is as follows.** **1: 0.09 ms / 2: 0.20 ms / 3: 0.43 ms / 4: 0.93 ms / 5: 2.00 ms / 6: 4.31 ms / 7: 9.28 ms / 8: 20.00 ms**

def. = default setting

■ Settings of Display State [Display]

Display settings such as the display method and unit are set.



Item explanation

Setting item	Setting value	
Mirroring Sets the mirroring display of an image.	Off (def.)	No mirrored display.
	X	Mirrored to right and left.
	Y	Mirrored to top and bottom.
	X/Y	Mirrored to right and left and top and bottom.

Continued to next page

Setting item	Setting value	
Rotation Sets the rotation display of an image.	Off (def.)	No rotation display.
	L90	Turns 90° counterclockwise with the display coordinate origin spot as the center.
	R90	Turns 90° clockwise with the display coordinate origin spot as the center.
Unit Sets the display unit of an measurement value's angle. **Info** **The measurement result to be sent becomes also the setting unit.**	deg (def.)	Uses degree unit.
	min+sec	Uses minutes and seconds units.
	mrad	Uses milliradian unit.
Light Spot Pointer Sets the display method of the pointer.	On (def.)	A cross line is displayed on the light spot.
	Off	No cross line is displayed.
Viewing Angle Sets the pseudo vision field angle display.	−	**Setting range (Unit: deg)** 1.75 (def.)/1.00/0.50/0.25 **Info** **According to the selected angle, an image is zoomed in.**
Auto Zoom Sets the display magnification. **Info** **The measurement result to be sent becomes also the setting unit.**	Off (def.)	No zoom in display is performed.
	Coarse	Sets the magnification from the specified choices. **Setting range** × 2 (def.)/×4/x8
	Fine	Sets the magnification of your choice. **Setting range** 1.1 to 8.0 (def.=1.1)

def. = default setting

Info

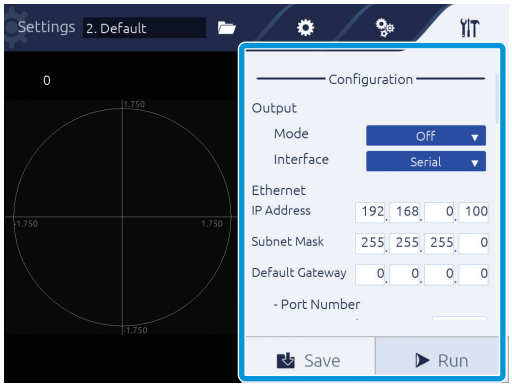
When zoom is valid, the following functions are conducted.

- **When a label No. is selected, automatically zoom in if the applicable label light spot is in the zoom-in range.**
- **When a label All is selected, automatically zoom in if all target light spots are in the zoom-in range.**
- **While zooming in, "ZOOM" is displayed on the monitor screen.**
- **When the judgment range is outside (wide) the zoom-in display range, no judgment frame display since it is judged as within all screen judgment range.**
- **Display the judgment range center with a light blue line.**
- **When a judgment range is a rectangle, zoom-in with the center of gravity of the rectangle area (≠ judgment center) as reference.**
- **According to the zoom-in magnification, the zoom-in display size is displayed with a yellow lined rectangle.**

System Settings

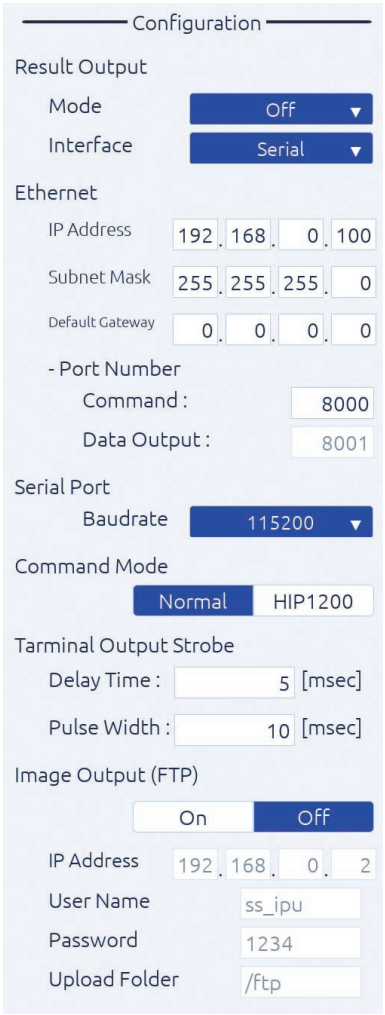
With the tab, the following items can be set.

- Settings of System Configuration [Configuration]
- Settings of angle calibration [Calibration]
- Verification of system information [Information]



■ Settings of System Configuration [Configuration]

Able to set communication connection and command mode.



Item explanation

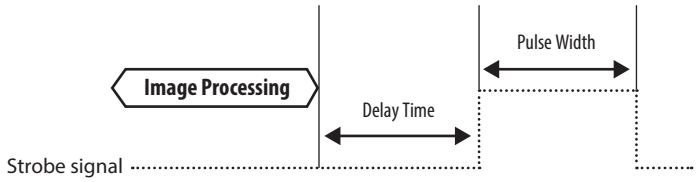
Setting item	Setting value	
Result Output - Mode Sets the output method of an measurement result.	Off (def.)	No output.
	Stream	Measurement results are always output.
	IO	Measurement results are output when the Hold command is entered.
Result Output - Interface Sets the output interface of an measurement result.	Serial (def.)	Measurement results are output to the serial communication.
	Ether	Measurement results are output to the Ethernet communication.
Ethernet Sets the environments of Ethernet such as connection settings.	IP Address	**Setting range** 0.0.0.0 to 255.255.255.255 (def.=192.168.0.100)
	Subnet Mask	**Setting range** 0.0.0.0 to 255.255.255.255 (def.=255.255.255.0)
	Default Gateway	**Setting range** 0.0.0.0 to 255.255.255.255 (def.=0.0.0.0)
	Port Number - Command	Sets the port number for command sending/receiving. **Setting range** 1024 to 65534 (def.=8000)
	Port Number - Data Output	Automatically sets the port number for data output. Sets the port number + 1 for command sending/receiving. (def.=8001)
Serial Port Sets the serial communication speed.	Baudrate	**Setting range** 9600/19200/38400/57600/115200 (def.)
Command Mode Sets a command mode to use.	Normal (def.)	Uses a current mode.
	HIP1200	Uses the HIP-1200 command mode.
Terminal Output Strobe Sets the strobe time.	Delay Time	Sets the time from the measurement result output start to Strobe launching is done after an image processing is done. **Setting range** 1 to 999 ms (def.= 5 ms) **NOTE** **Set for the Delay Time + Pulse Width is 1,000 ms or less.**
	Pulse Width	Sets the time from Strobe launch to Strobe powering down. **Setting range** 1 to 999 ms (def.=10ms) **NOTE** **Set for the Delay Time + Pulse Width is 1,000 ms or less.**

Setting item	Setting value	
Image Output (FTP) Sets the sending method of image data.	On	Sends image data with Ethernet. Sets the following information of the destination FTP server. - IP Address - Username - Password - Upload Folder **Info** **The format of images to be sent is as follows.** **• Image format: PNG format** **• Output file name: lac_rawimage_xxxxx.png** **xxxxx is a serial number and the maximum value is 99999. When it reaches the maximum value, it returns to 00000.**
	Off (def.)	No image data is sent with Ethernet.

def. = default setting

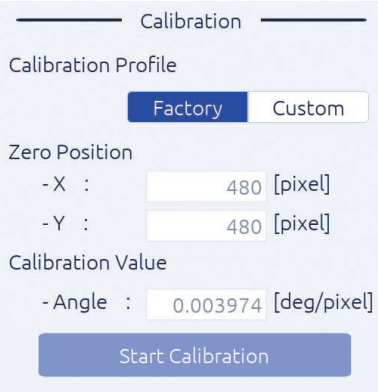
Info

The image of Strobe signal movement is as follows.



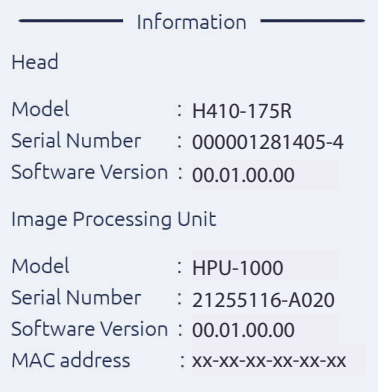
■ Settings of Angle Calibration [Calibration]

Touch the [Calibration] button to perform angle calibration.
For details of angle calibration, see “4 Angle Calibration” (Page 4-1).



■ Verification of System Information [Information]

The model name of the head unit and IPU, and serial number can be verified.



3 Measuring

In this product, measurement results are displayed on the touch panel monitor. In this section, measurement settings, and how to view the measurement screen and measurement results are explained.

Overview of Measurement Screen 3-2

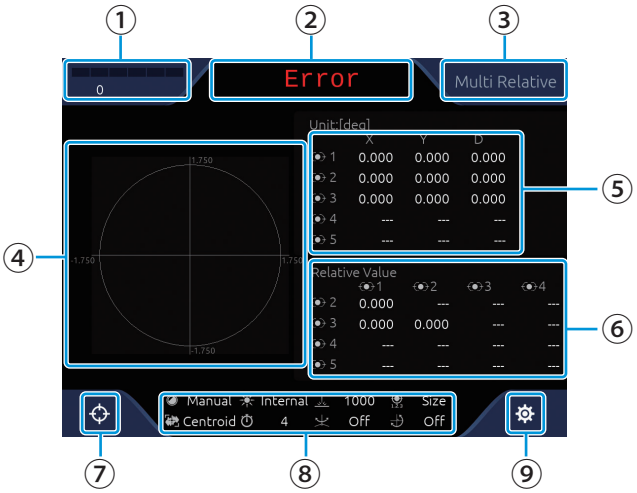
Settings of the Measurement Mode 3-3

Settings of the Judgment Area 3-5

Verification of Measurement and Judgment Results 3-9

Overview of Measurement Screen

In this product, after power source is applied, the specific data are read, which is displayed on the measurement screen, and a measurement starts.
Here, how to view the measurement screen is explained.



* The picture shows when the measurement mode is “Multi Relative”.

① Light quantity of light reception display

The light quantity of light reception is displayed with levels as follows.

Level display	State	Content
	Under (Error)	Since it does not reach the luminance level set in each Detect Mode, measurement is not possible. • Center (BIN): Binary threshold • Centroid (Gray): Noise level • Peak: Luminance value less than 600
	Weak	Though measurement can be conducted, measurement becomes unstable due to low luminance.
	Adequate	Luminance adequate for measurement.
	Best	Luminance best for measurement.
	Strong	Even though measurement is possible, luminance is starting to be saturated.
	Over (Error)	Since there are too many saturation pixels, measurement cannot be done. The number of pixels with 4095 or more is: • Centroid (GRAY)/Peak: 3 pixels or more • Center (BIN): 32768 pixels or more

② Display of measurement judgment

Measurement judgment results are displayed in the following contents.
In case of OK: OK (green)
In case of NG: NG (red)
In case of Error: Error (red)

③ Measurement mode display

A measurement mode during setting is displayed.

④ **Camera image display**

A camera image is displayed.

⑤ **Incident light measurement result (absolute value)**

Measurement center of each light reception spot and angle (tilting) around the X and Y axis are displayed.
For the display unit, the one selected in the [Unit] setting (→ Page 2-25) is used.

⑥ **Incident light measurement result (relative value)**

The surface's angle that is generated with multiple spots is displayed.

⑦ **(Zero set) button**

Touch this button to define the light point spot position as the measurement center. Touch this button again to revert the center point as the measurement center.

NOTE

When [Detect Mode] (→ Page 2-22) is [Center (BIN)] or [Centroid (GRAY)], the center position may change.

⑧ **Setting value display**

The setting state of the following items is displayed.
LD Adjustment, Light Source, LD Power, Spot Sorting Rules, Detect Mode, Trigger Interval, Mirroring, and Rotation

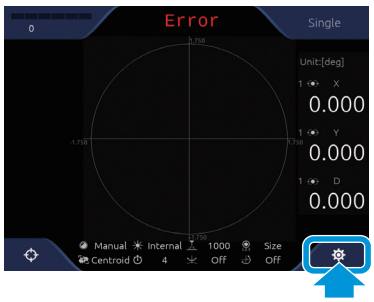
⑨ **(Settings) button**

Touch this button to display the [Settings] screen (→ Page 2-2).

Settings of the Measurement Mode

Depending on a measurement mode, the measurement and judgment standards differ.
When changing the measurement mode, conduct the following procedure. For details of setting contents, see Page 2-15.

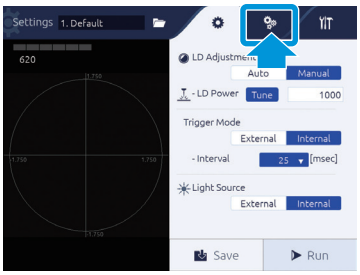
1 Touch (Settings) in the measurement screen.



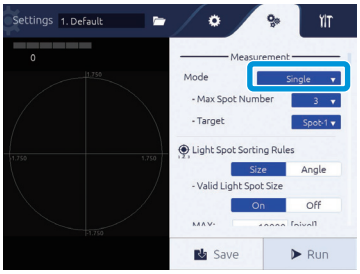
The [Settings] screen is displayed.

Continued to next page

2 In the menu area, touch the (Detail settings) tab.

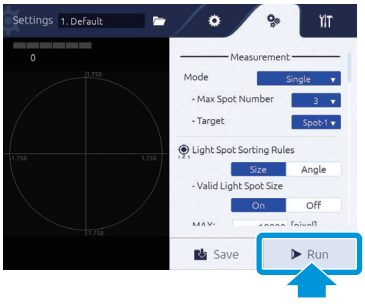


3 Select a measurement mode with [Mode].



4 Set the number of measurement spots with [Max Spot Number], and set the judgment target spot with [Target].

5 Touch the [Run] button.



It returns to the measurement screen.

Info

When saving the settings, touch the [Save] button before touching the [Run] button.

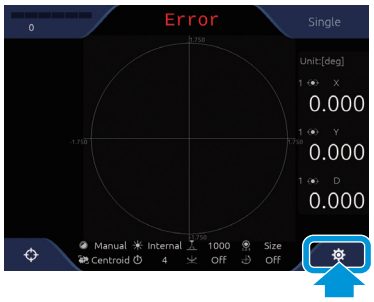
Settings of the Judgment Area

When an allowable limit is defined in measurement results, set the judgment area to be the standard. When setting the judgment area, conduct the following procedure. For details of setting contents, see Page 2-18.
Depending on a measurement mode, the setting method of judgment standards differs.

● When the measurement mode is Single, Multi Absolute, and Multi Relative

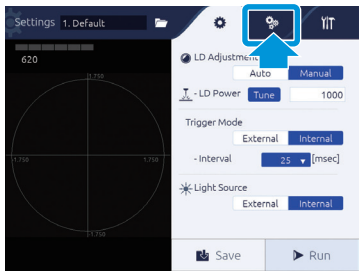
When judgment is conducted, the setting of the judgment area is necessary.

1 Touch ⚙ (Settings) in the measurement screen.



The [Settings] screen is displayed.

2 In the menu area, touch the ⚙⚙ (Detail settings) tab.

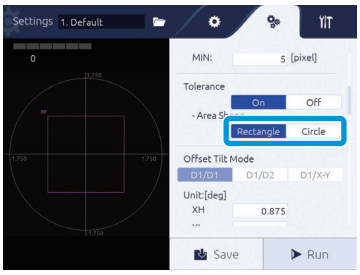


3 In [Tolerance], select [On].

Continued to next page

4 In [Area Shape], select [Rectangle]/[Circle].

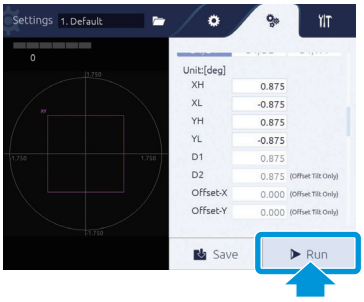
In case of [Rectangle], a rectangle with the tilting of the X and Y axis for the measurement center is the judgment area.
In case of [Circle], a circle with the tilting for the measurement center as the radius is the judgment area.



5 Set the size of the judgment area.

When [Rectangle] is selected, set the right and left side with XH/XL, and top and bottom with YH/YL.
In case of [Circle], set the radius with D1.

6 Touch the [Run] button.

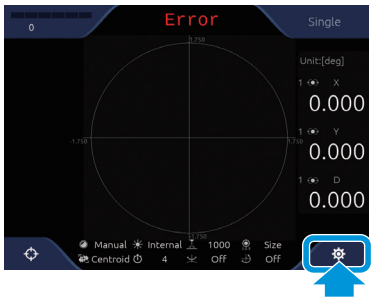


It returns to the measurement screen.

● The Measurement Mode is Offset Tilt

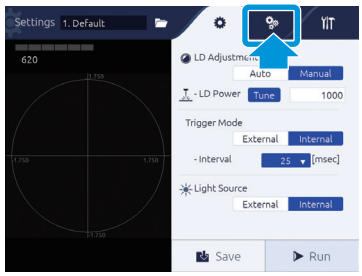
In case of the Offset Tilt, judgment is always done.

1 Touch ⚙ (Settings) in the measurement screen.



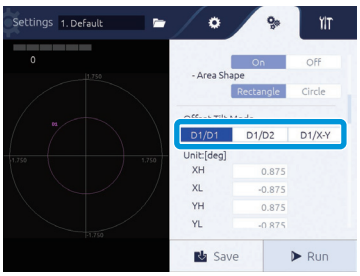
The [Settings] screen is displayed.

2 In the menu area, touch the ⚙ (Detail settings) tab.



3 In [Offset Tilt Mode], select [D1/D1]/[D1/D2]/[D1/X-Y].

In case of [D1/D1], use the circle with the same radius is the judgment area for both first and second times.
In case of [D1/D2], use the circle with the different radius for the first time and second time is the judgment area.
In case of [D1/ X-Y], use the circle for the first time and the rectangle for the second time as the judgment area.



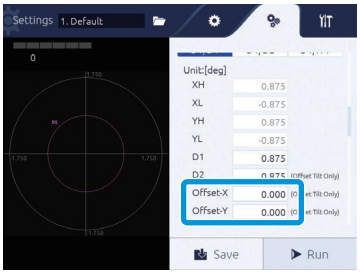
Continued to next page

4 Set the size of the judgment area.

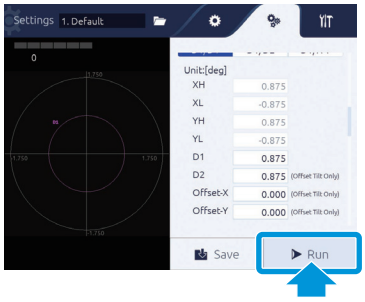
In case of [D1/D1], set the radius with D1.
In case of [D1/D2], set the radius with D1 and D2.
In case of [D1/X-Y], set the radius with D1, the right and left side with XH/XL, and top and bottom with YH/YL.

5 Set the measurement center of the second time.

Set the right and left direction movement with Offset-X, and the top and bottom direction movement with Offset-Y.



6 Touch the [Run] button.



It returns to the measurement screen.

Verification of Measurement and Judgment Results

Depending on a measurement mode, the measurement and judgment standards differ.
In this section, the measurement results per mode and calculation method of judgment results are explained.

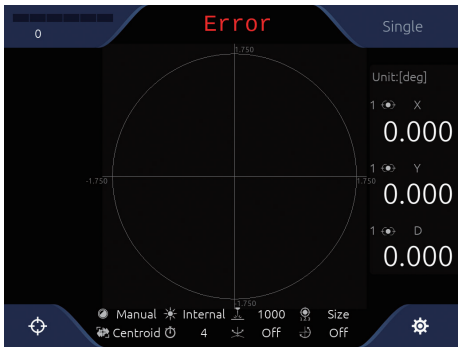
Info

In case of below, the judgment becomes "Error".

- **The light spot is not in the measurement range and a spot cannot be detected due to lack of light quantity.**
- **The number of detected spots do not satisfy the Target's label No.**

■ The Measurement Mode is Single

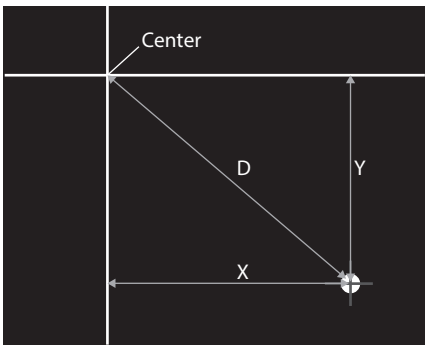
Regardless of the number of light reception spots, only one spot with the specified label number is detected, and the judgment results and measurement results are displayed.



Measurement results display

In the incident measurement results (absolute value), the following values are displayed.,

- X: Angle toward the X axis direction from the measurement center
- Y: Angle toward the Y axis direction from the measurement center
- D: Angle from the measurement center

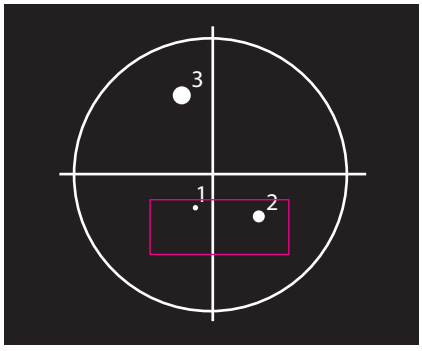


Measurement results display

When the judgment area (Tolerance) is [On], the judgment results are also displayed.

<Display example of measurement results>

The judgment examples for the following camera image are shown next.

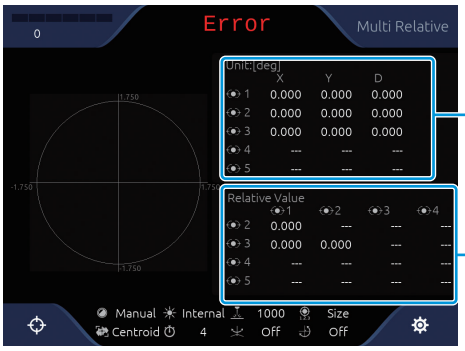


Target: Spot-1→OK
Target: Spot-2→OK
Target: Spot-3→NG

Continued to next page

■ When the Measurement Mode is Multi Relative

Multiple spots (5 spots at maximum) are detected, and judgment results and measurement results are displayed.



Measurement results display

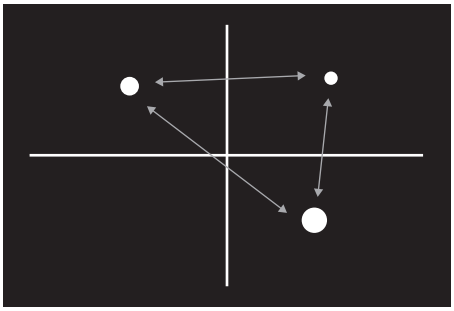
On the incident measurement results (absolute value and relative value), the angle between each light spot is displayed.

Measurement results (absolute value)

- X: Angle toward the X axis direction from the measurement center
- Y: Angle toward the Y axis direction from the measurement center
- D: Angle from the measurement center

Measurement results (relative value)

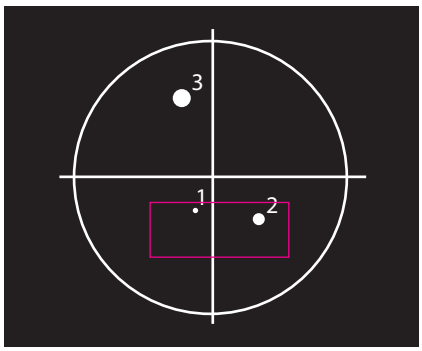
- Angle from each spot of previous label No.



Measurement results display

When the judgment area (Tolerance) is [On], the judgment results are also displayed.

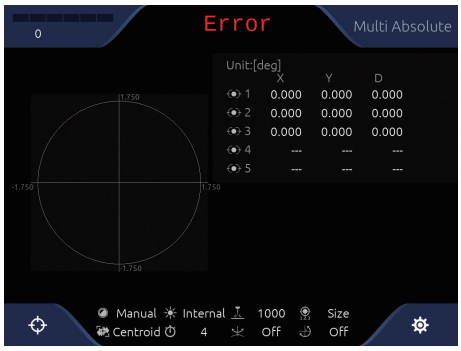
<Display example of measurement results>
The judgment examples of each Target setting for the following image are shown next.



Target: Spot-1→OK
Target: Spot-2→OK
Target: Spot-3→NG
Target: Spot-4→Error
Target: All→NG

■ The Measurement Mode is Multi Absolute

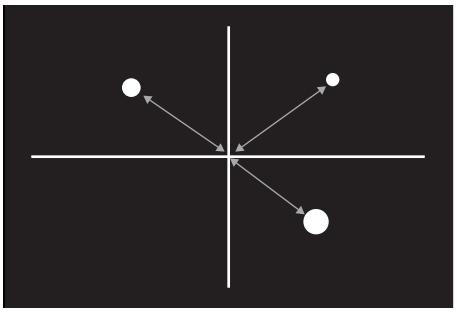
Multiple spots (5 spots at maximum) are detected, and judgment results and measurement results are displayed.



Measurement results display

On the incident measurement results (absolute value), the angle with each light spot and the measurement center as reference is displayed.

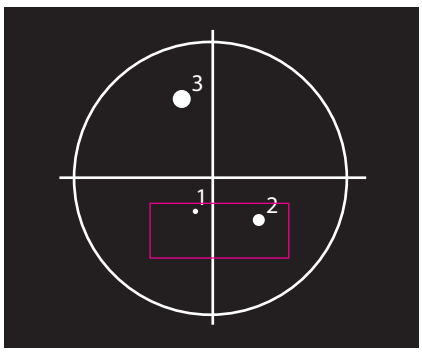
- X: Angle toward the X axis direction from the measurement center
- Y: Angle toward the Y axis direction from the measurement center
- D: Angle from the measurement center



Measurement results display

When the judgment area (Tolerance) is [On], the judgment results are also displayed.

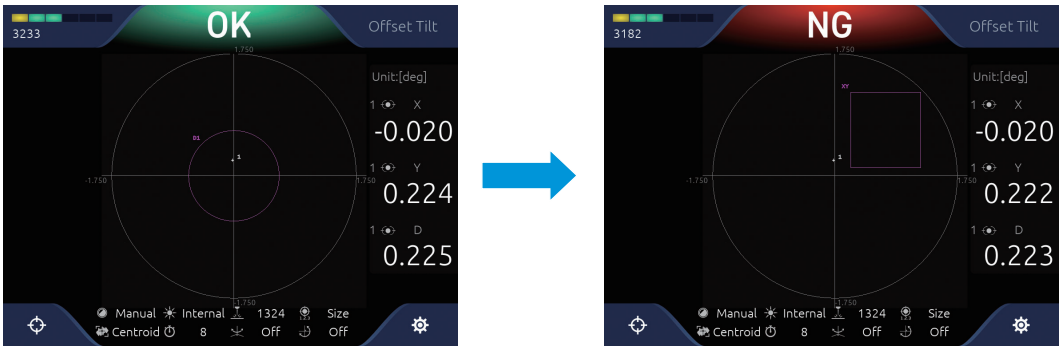
<Display example of measurement results>
The judgment examples of each Target setting for the following image are shown next.



Target: Spot-1→OK
Target: Spot-2→OK
Target: Spot-3→NG
Target: Spot-4→Error
Target: All→NG

■ The Measurement Mode is Offset Tilt

With continuous two measurements, each different reference (measurement center and range) is set and judged.
The measurement switch between the first and second time is conducted with DIO zero set terminal + command control (RS232C and Ethernet).
The measurement method is Single, and the measurement data are sent continuously with the Single format.
At Offset Tilt measurement only, D1/D2/X-Y and judgment range label are displayed.



Info

When commands are in continuously like DIO → command (or command → DIO), the latter command becomes valid.
For example, when the first measurement command comes in from the command immediately after the second judgment standard is set in DIO zero set starting, the judgment standard becomes the first time measurement.

4 Angle Calibration

When the auto-collimator is changed and angle adjustment is necessary, angle calibration is conducted. In this section, the angle calibration procedure is explained.

To perform angle calibration, a parallel mirror (HS-0) to be the horizontal standard and a wedge substrate (made by Suruga Seiki or equivalent product available commercially) to be the standard angle are necessary.

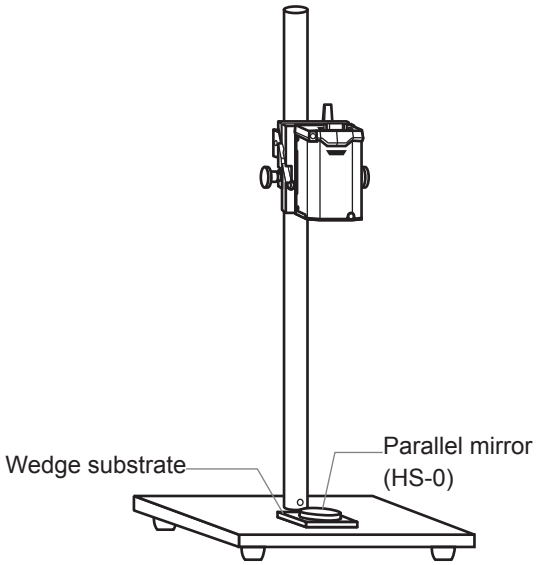
Overview of Angle Calibration 4-2

Angle Calibration.....4-3

Overview of Angle Calibration

Angle calibration is an operation to find the angle displacement (pixel resolution) per one pixel of the CMOS sensor built in the auto-collimator.

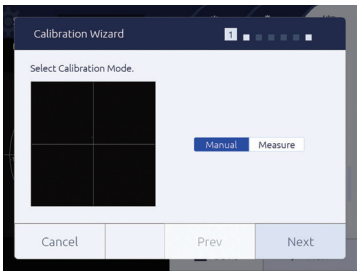
To perform calibration, install a parallel mirror (HS-0) to be the horizontal standard and the standard substrate of a wedge substrate (made by Suruga Seiki or equivalent product available commercially) to be the standard angle as shown below.



Guarantee condition of linearity performance (±2% F.S.)

- F.S.= ±1.75°: Measurement distance < 120 mm
- F.S.= ±1.00°: Measurement distance < 200 mm
- F.S.= ±0.50°: Measurement distance < 300 mm

According to the Calibration Wizard displayed on the screen, angle calibration is performed.



The correction value of angle calibration is calculated according to the following formula.

$$\frac{\text{Wedge substrate angle (deg)}}{\text{Light spot - measurement range center (pixel)}} = \text{Angle per pixel (deg/pixel)}$$

■ Wedge Substrate and Wedge Mirror that can be Used (made by Suruga Seiki)

● Wedge substrate

Model No.	Angle
HS-010	0.10 degrees
HS-020	0.20 degrees
HS-025	0.25 degrees
HS-050	0.50 degrees
HS-100	1.00 degrees
HS-175	1.75 degrees

● Wedge mirror

Model No.	Angle
HS-010AL	0.10 degrees
HS-020AL	0.20 degrees
HS-025AL	0.25 degrees
HS-050AL	0.50 degrees
HS-100AL	1.00 degrees
HS-175AL	1.75 degrees

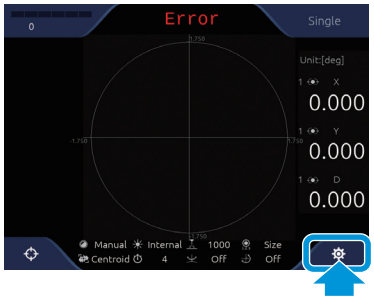
Angle Calibration

In this section, the angle calibration procedure is explained.
Prepare a parallel mirror (HS-0) to be the horizontal standard and a wedge substrate (made by Suruga Seiki or equivalent product available commercially) to be the standard angle beforehand.

NOTE

- **Match the distance from the laser emission port of the auto-collimator to the parallel mirror on the target object measurement distance shown in the catalog.**
- **When a wedge substrate is used, place a parallel mirror on the wedge substrate, and adjust by verifying the light spot is one. When a wedge mirror is used, it can be used as it is.**

1 Touch ⚙ (Settings) in the measurement screen.



The [Settings] screen is displayed.

2 In the [Settings] screen, touch the (System) tab button.

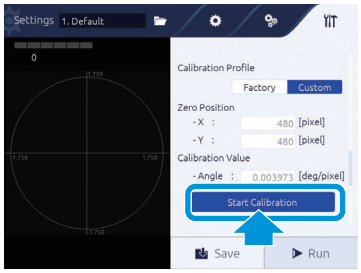
The system settings are displayed.

3 In [Calibration Profile], touch [Custom].

When the settings are not changed, select [Factory].

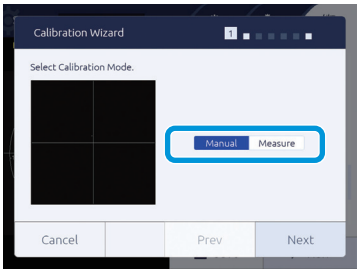
Continued to next page

4 Touch the [Start Calibration] button.



[Calibration Wizard] is displayed.

5 Select a calibration method, and touch the [Next] button.

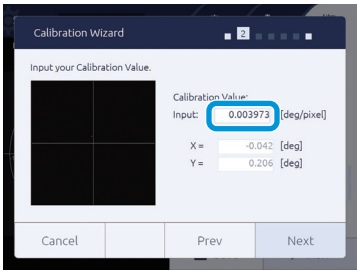


[Manual]: Select when there are value information of calibration values, and entering values directly.Go to Page 4-4: “Manual is selected”.

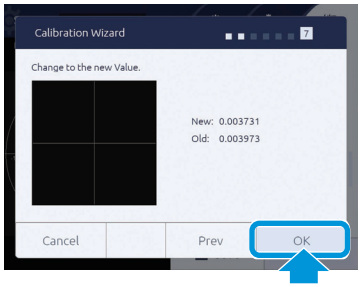
[Measure]: Select when calibration is done by measuring a wedge mirror that wedge angle is already known. Go to Page 4-5: “Measure is selected”.

● Manual is selected

6 Select a calibration value, and touch the [Next] button.

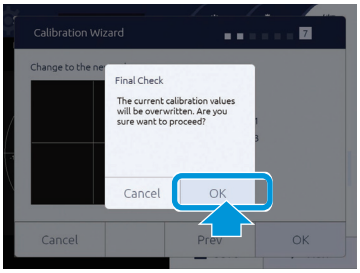


7 Check the content, and touch the [OK] button.



The confirmation dialog is displayed.

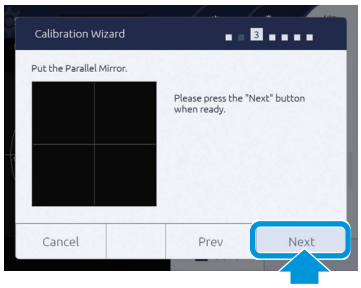
8 Touch the [OK] button.



The angle calibration value is applied.
When [Cancel] is touched, it ends without calibration.

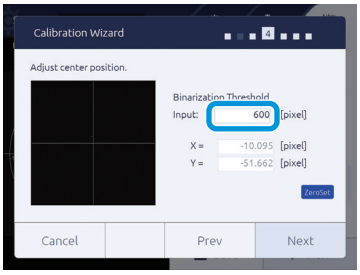
● Measure is selected

6 Set a parallel mirror, and touch the [Next] button.



7 Set the measurement center, and touch the [Next] button.

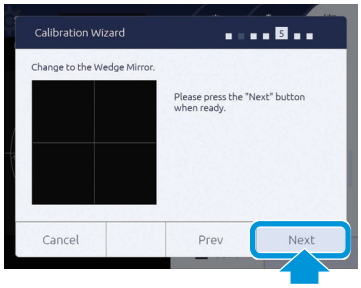
Adjust to match the light spot to the displayed center line, and touch [ZeroSet] to set the measurement center.
Enter a threshold to [Binarizarion Threshold].



Continued to next page

8 Set a wedge substrate, and touch the [Next] button.

Set a wedge substrate on the reference surface and a parallel mirror on the wedge substrate.

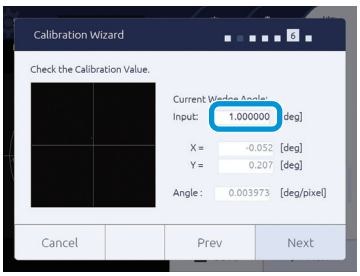


Info

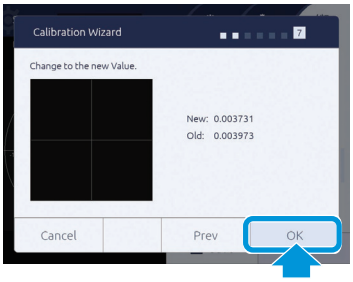
Instead of the wedge substrate and parallel mirror, a wedge mirror can be used.

9 Enter a wedge substrate angle, and touch the [Next] button.

By entering the wedge substrate angle in [Input], the calibration value is calculated.

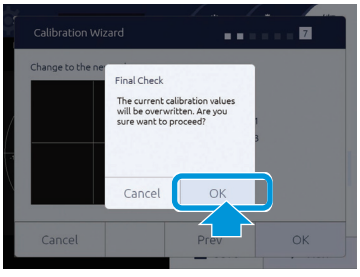


10 Check the content, and touch the [OK] button.



The confirmation dialog is displayed.

11 Touch the [OK] button.



The angle calibration value is applied.
When [Cancel] is touched, it ends without calibration.

5 Control from Peripheral Devices

This product can be operated with commands from peripheral devices by using serial communication (RS232C) and Ethernet communication.
In this section, commands and various settings used in communication with peripheral devices are explained.

Connection Specifications with Peripheral Devices..5-2

Data Communication Format 5-4

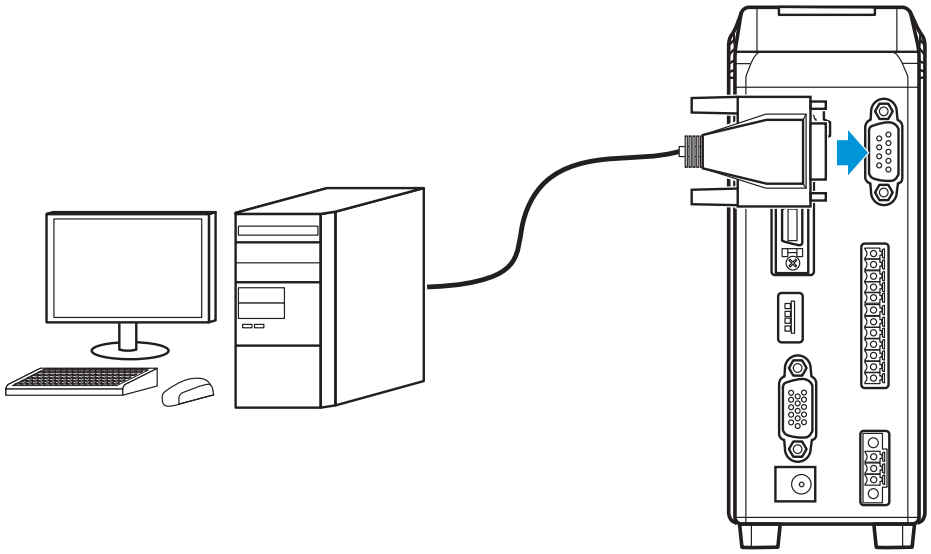
Device Control with External Commands 5-5

Connection Specifications with Peripheral Devices

This product connects with peripheral devices via serial connection (RS232C) or Ethernet connection.

■ Connection with RS232C

Connection specifications of RS232C are explained.
Command sending is conducted by using communication application. The port to connect is checked through system information of PC.



Communication conditions

Item	Content
Baud rate	9600/19200/38400/57600/115200 bps
Data length	8 bit
Parity	Non
Stop bit length	1 bit
Flow control	Non

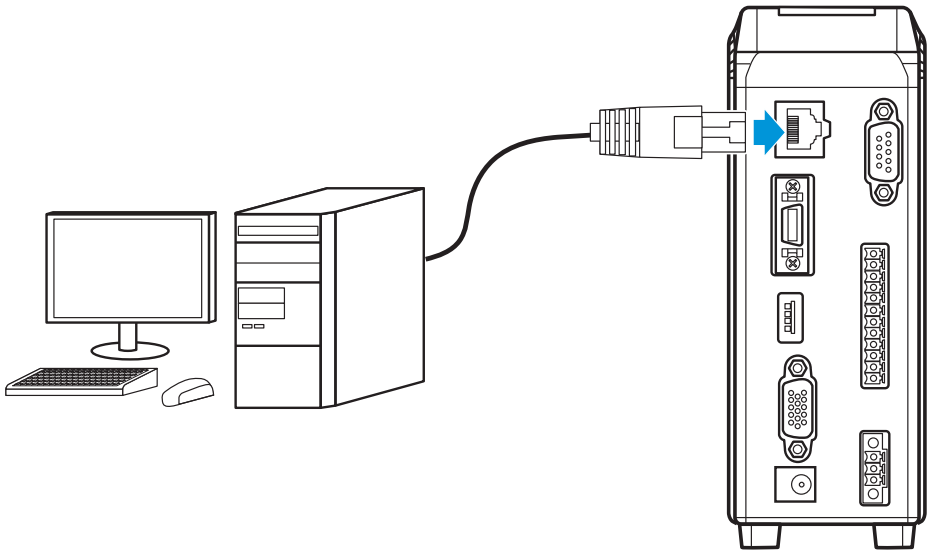
RS232C connector pin assignment

Use D-sub 9-pin cross cable for the RS232C cable to connect with peripheral devices.
7-pin and 8-pin are short circuit inside the main body.

Pin No.	Signal name	Remarks
1		
2	RxD	Receiving data
3	TxD	Sending data
4		
5	GND	
6		
7	RTS	Send request
8	CTS	Send permission
9		

■ Connection with Ethernet

Connection specifications of Ethernet are explained.
Command sending is conducted by using communication application. IP address and port number to connect is set with the system settings (→ Page 2-27).



Communication items

- Output of measurement results (Data Output port)
- Control command and input/output of response (Command port)
- Raw image data output used for measurement (FTP)

Info

In Data Output Port, a number (Command Port + 1) is automatically set.

Communication specifications

- 1000base-T and 100Base-TX[*1]
- TCP/IP socket communication
- FTP communication

[*1] At image data output, 1000Base-T is required.

Continued to next page

Data Communication Format

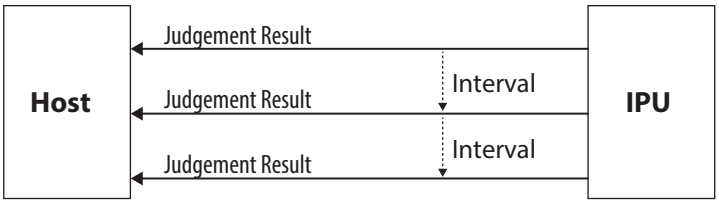
For details of formats, see “■Command Format” (Page 5-8)”.
In this section, examples of data receiving images by each mode are introduced.

Info

The same communication format is used for H410 and HIP-1200 mode.

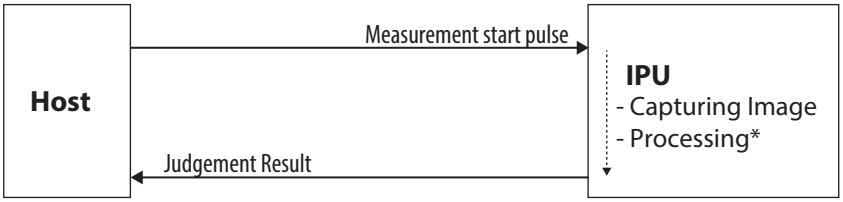
● In case of Internal Mode

Judgment results and measurement values are sent to output destination with a specified cycle.



● In case of Trigger Mode

Judgment results and measurement values are sent to output destination, if pulse is input to DI (Measurement start trigger).



*The process time differs depending on the measurement condition.

■ Measurement Results Output Formats

Each measurement result is output with the following formats. Each character is written with ASCII code.

Info

Output data are output after being stored inside the buffer. When measurement speed is faster than an output speed, BUSY is output until output becomes possible with filled internal buffer.

Example of single measurement data

<Basic Alignment>

G	,	*S	,	*X	,	*Y	,	*D	CR	LF

G: Header
*S: Judgment result
*X, *Y and *D: Measurement result

- In case of Judgment = OK, Unit = deg, X = +0.123, Y = -0.001 and D = 0.020
  G,O,+0.123,-0.001,0.020CRLF
  ASCII (hexadecimal notation):
  472c4f2c2b302e3132332c2d302e3030312c20302e3032300d0a

- Judgment = In case of NG
  G,N,999999,999999,999999CRLF
  ASCII (hexadecimal notation):
  472c4e2c3939393939392c3939393939392c3939393939390d0a

Info

In case of judgment is “NG“ and “ERROR”, the measurement value characters are “999999”. However, when measurement is possible even with a luminance exceeding error, its measurement value is output.

Device Control with External Commands

This product can control with commands from peripheral devices connected by RS232C and Ethernet. In this section, the commands and command formats that can be used are explained.

Info

For default setting of IPU, data output at the maximum frame rate (25 ms) for both Normal Mode/HIP-1200 Mode in RS232C communication and Ethernet communication is supported. However, for data acquisition in command communication, as it depends on the PC environment you are using, a little delay may be generated. When need to conduct stable data reception equivalent to the frame rate, please use the Stream function.

■ List of External Commands

The external commands that can be used are introduced.

● In case of normal mode (at factory shipping settings)

Identification character	Command content	Process on the IPU side
R000	File readout command	Sends the setting values of the specified file
R001	File basic information reading command	Sends the basic information of a file
R102	Setting value individual request command	Sends the setting values of the specified item
R103	Setting value batch request command	Sends the setting values as batch
R109	Measurement value request command	Sends measurement results
R111	LD output setting values request command	Sends the setting values of LD output
R112	LD output automatic adjustment mode request command	Sends the setting values of LD output automatic adjustment mode
R113	LD external output mode request command	Sends the setting values of LD external output
R114	External trigger mode request command	Sends the setting values of external trigger mode
R115	Camera internal trigger interval time request command	Sends the setting values of internal trigger mode
R116	Camera exposure time request command	Sends the setting values of exposure time
R119	Measurement luminance readout command	Sends a luminance value
R120	Display setting request command	Sends the setting values of display settings
R121	Zoom setting request command	Sends the setting values of Zoom settings
R122	Measurement value output setting request command	Sends the setting values of measurement output settings
R123	GPIO Strobe setting request command	Sends the setting values of GPIO Strobe settings
R124	Binary threshold for pixel calibration request command	Sends a binary threshold used for calibration

Continued to next page

Identification character	Command content	Process on the IPU side
R125	Pixel calibration mode request command	Sends the setting values of calibration mode
R126	Pixel calibration value for user settings request command	Sends the pixel calibration value when the calibration mode is the user settings
R127	Zero calibration value mode request command	Sends the setting values of zero calibration value mode
R128	Zero calibration value for user settings request command	Sends zero calibration value for user settings
R129	RAW image output mode request command	Sends the setting values of RAW image output mode
R130	LD output automatic adjustment result request command	Sends the results of LD output automatic adjustment
R080	System information readout command	Sends system information
R081	RS232C setting request command	Sends the setting values of RS232C settings
R082	Ethernet setting request command	Sends the setting values of Ethernet settings
R083	FTP server setting request command	Sends the setting values of FTP server settings
R099	Command mode request command	Sends the setting values of command mode
W000	File saving command	Sends ACK after saving the specified file
W102	Setting value individual change command	Sends ACK after changing the setting values of the specified item
W103	Setting value batch change command	Sends ACK after batch changing the setting values
W111	LD output setting values change command	Sends ACK after changing the LD output setting values
W112	LD output automatic adjustment mode change command	Sends ACK after changing the LD output automatic adjustment mode
W113	LD external output mode change command	Sends ACK after changing the LD external output mode
W114	External trigger mode change command	Sends ACK after changing the external trigger mode
W115	Camera internal trigger interval time change command	Sends ACK after changing the interval time of the internal trigger mode
W116	Camera exposure time change command	Sends ACK after changing the exposure time
W120	Display setting change command	Sends ACK after changing the display settings
W121	Zoom setting change command	Sends ACK after changing the Zoom settings
W122	Measurement value output setting change command	Sends ACK after changing the measurement output settings
W123	GPIO Strobe setting change command	Sends ACK after changing the GPIO Strobe settings
W124	Binary threshold for pixel calibration request command	Sends ACK after changing the binary threshold used for calibration
W125	Pixel calibration mode change command	Sends ACK after changing the calibration mode
W126	Pixel calibration value for user settings change command	Sends ACK after changing the pixel calibration value when the calibration mode is user settings
W127	Zero calibration value mode change command	Sends ACK after changing the Zero calibration mode
W128	Zero calibration value for user settings change command	Sends ACK after changing the zero calibration value for user settings
W129	RAW image output mode change command	Sends ACK after changing the RAW image output mode
W081	RS232C setting change command	Sends ACK after changing the RS232C settings
W082	Ethernet setting change command	Sends ACK after changing the Ethernet settings
W083	FTP sever setting change command	Sends ACK after changing the FTP server settings
W099	Command mode change command	Sends ACK after changing the command mode
S100	Measurement stop command	Sends ACK after measurement is stopped
S101	Measurement start command	Sends ACK after measurement is started
S105	LD output automatic adjustment command	Sends ACK after automatically adjusting the LD output
S106	Zero reset	Sends ACK after zero reset

Identification character	Command content	Process on the IPU side
S107	Zero set	Sends ACK after zero set
S108	Offset Tilt judgment 1 change command	Sends ACK after changing the judgment area to judgment 1 at Offset Tilt
S109	Offset Tilt judgment 2 change command	Sends ACK after changing the judgment area to judgment 2 at Offset Tilt

● In case of HIP-1200 mode

Identification character	Command content	Process on the IPU side
W000	Zero reset command	Sends ACK after ZERO RESET
W001	Zero set command	Sends ACK after successful ZERO SET
W003	Measurement function switch command	Sends ACK after changing the mode
W020	Remote OFF command	Sends ACK after remote OFF
R022	Calibration value request command	Sends the setting values
W022	Calibration value change command	Sends ACK after changing the calibration value
W030	File saving command	Sends ACK after successful saving
W031	File readout command	Sends ACK after successful readout & mode change
R032	System data Request command	Sends system data
W032	System data Setting command	Sends ACK after changing the system data
R*00	Measurement value request command	Sends measurement results
R*01	Setting value individual request command	Sends the specified item data
R*02	Setting value batch request command	Sends the settings as batch
W*01	Setting value individual change command	Sends ACK after changing the specified item
W*02	Setting value batch change command	Sends ACK after changing
W111	OFFSETTILT judgment 1 Change command	Sends ACK after changing
W112	OFFSETTILT judgment 2 Change command	Sends ACK after changing

The following value is entered in *.
1: Angle measurement, 2: Variation measurement, and 3: Beam measurement (This product only supports “1. Angle measurement”).

Info

The following command system of HIP-500 is also supported.

Identification character	Command content	Process after receiving
RA	Measurement value readout	Sends measurement results
RC	Present setting value readout	Sends the present setting values
WA	Zero set	Sends ACK after zero set
WB	Judgment circle area setting	Sends ACK after changing the judgment circle area
WC	Judgment rectangular area setting	Sends ACK after changing the judgment rectangular area
WD	Binary level setting	Sends ACK after changing the binary level
WE	File saving	Sends ACK after successful saving

Continued to next page

Identification character	Command content	Process after receiving
WF	Zero reset	Sends ACK after zero reset
WG	Noise level setting	Sends ACK after changing the noise level

■ Command Format

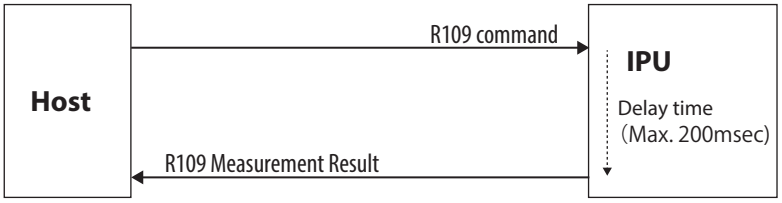
Output formats of each command are explained.
Each character of a format is written with ASCII code.

● In case of normal mode (at factory shipping settings)

A.Readout system

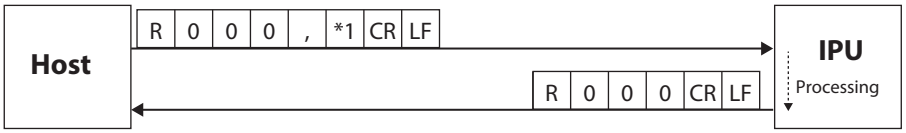
Command formats on readout are explained.

Example: R109 command



<File readout>

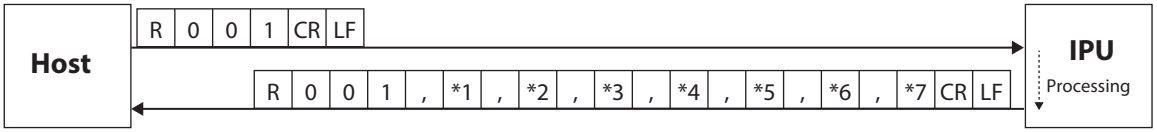
Outputs the setting values to the specified file.



*1: File No. [0] (“0” = Selected file, “1” to “6” = File 1 to 6)

<File basic information readout>

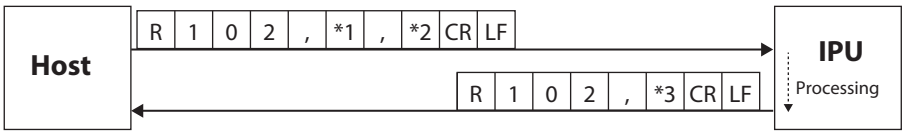
Outputs the basic information of a file.



*1: No. of files [1] (1 to 6)
*2: File name 1 (The maximum number of characters = 24)
*3: File name 2 (The maximum number of characters = 24)
*4: File name 3 (The maximum number of characters = 24)
*5: File name 4 (The maximum number of characters = 24)
*6: File name 5 (The maximum number of characters = 24)
*7: File name 6 (The maximum number of characters = 24)

<Setting value individual readout>

Outputs the present setting value per item.



*1: Measurement mode (Here, since it is the angle measurement, “0” becomes the fixed value)

*2: Item code (see the list of item codes shown below)

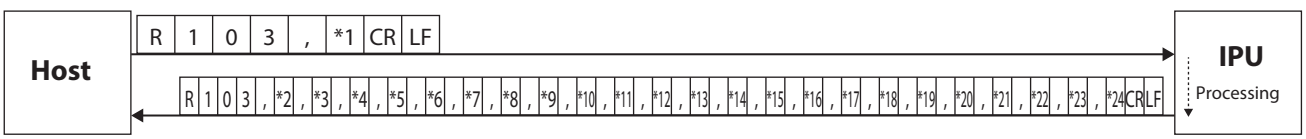
*3: The setting contents (Value differs depending on items. See <Setting value batch readout>)

List of item codes

Code	Item name
00	Binary level
01	Noise level
02	Effective luminance upper limit value
03	Effective luminance lower limit value
04	Effective luminance judgment mode
05	Judgment type
06	Circle-radius
07	Rectangular-XL
08	Rectangular-XH
09	Rectangular-YH
10	Rectangular-YL
11	Circle2-radius
12	Offset-X
13	Offset-Y
14	Label measurement mode
15	Numbering
16	Judgment label
17	Maximum No. of light spots
18	Center of gravity calculation method
19	Average
20	Effective light spot size mode
21	Effective light spot pixel upper limit value
22	Effective light spot pixel lower limit value

<Setting value batch readout>

Outputs all present setting values.



*1: Measurement mode (Here, since it is the angle measurement, “0” becomes the fixed value)

*2: Binary level 1 1 1 1 (600 to 4095)

*3: Noise level 1 1 1 1 (600 to effective luminance lower limit value-1)

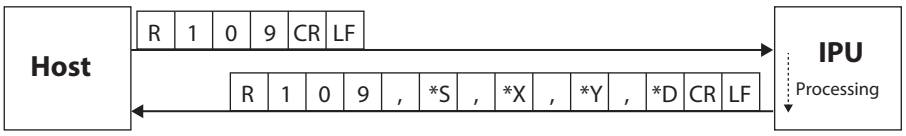
*4: Effective luminance upper limit value 1 1 1 1 (Effective luminance lower limit value+1 to 4095)

Continued to next page

*5: Effective luminance lower limit value [1][1][1][1] (Noise level+1 to effective luminance upper limit value-1)
*6: Effective luminance judgment mode [0] (“0”= OFF, “1”=ON)
*7: Judgment type [0] (“0”=OFF, “1”=Circle, “2”=Rectangular)
*8: Circle-radius [+][0][.][1][0][0] (0.001 to 1.750)
*9: Rectangular-XL [±][0][.][1][0][0] (-1.750 to XH-1)
*10: Rectangular-XH [±][0][.][1][0][0] (XL+1 to 1.750)
*11: Rectangular-YH [±][0][.][1][0][0] (YL+1 to 1.750)
*12: Rectangular-YL [±][0][.][1][0][0] (-1.750 to YH-1)
*13: Circle 2-radius [+][0][.][1][0][0] (0.001 to 1.750)
*14: Offset-X [±][0][.][1][0][0] (-1.750 to 1.750)
*15: Offset-Y [±][0][.][1][0][0] (-1.750 to 1.750)
*16: Label measurement mode [1] (“0”=Single, “1”=Multi Relative, “2”=Multi Absolute, “3”=Offset Tilt D1/D1, “4”=Offset Tilt D1/D2, “5”=Offset Tilt D1/X-Y)
*17: Numbering [1] (“0”=Area descending order, “1”=Angle ascending order)
*18: Judgment label [1] (“0”=ALL, “1”=Label1, “2”=Label2, “3”=Label3, “4”=Label4, “5”=Label5)
*19: Maximum No. of light spots [1] (3 to 5)
*20: Center of gravity calculation method [1] (“0”=Area center of gravity, “1”=Luminance center of gravity and “2”=Luminance peak)
*21: Average [1] (“0”=OFF, “1”=2 times, “2”=4 times, “3”=8 times, “4”=16 times)
*22: Effective light spot size mode [1] (“0” = OFF, “1” = ON)
*23: Effective light spot pixel upper limit value [1][1][1][1][1][1] (Effective light spot pixel lower limit value+1 to 32767)
*24: Effective light spot pixel lower limit value [1][1][1][1][1][1] (1 to Effective light spot pixel upper limit value-1)

<Measurement value readout>

Outputs the present angle measurement value.
The return example is in case of angle measurement (1 spot measurement).



S: Judgment result (“O”=OK, “N”=NG, “E”=ERROR, “”=Judgment OFF)
*X: Angle around the X axis [±][0][.][0][0][0]
*Y: Angle around the Y axis [±][0][.][0][0][0]
*D: Angle from the measurement center [+][0][.][1][0][0]

Info

- **The unit of measurement value follows the menu settings.**
- **At external incident settings, the notation is twice the reflection measurement range when an internal light source, that is a normal setting, is used.**

<LD output setting value readout>
Outputs the LD output setting values.

*1: LD output value [1][1][1][1] (0 to 4095)

<LD output automatic adjustment mode readout>
Outputs the LD output automatic adjustment mode.

*1: LD output automatic adjustment mode [1] (“0”=OFF, “1”=ON)

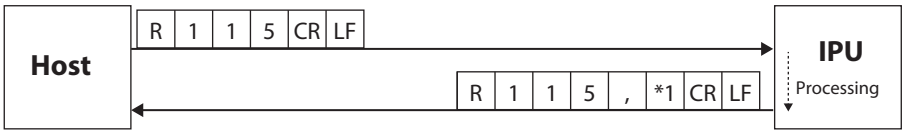
<LD external light source mode readout>
Outputs the LD external light source mode.

*1: LD external light source mode [1] (“0”=OFF, “1”=ON)

<Camera external trigger mode readout>
Outputs the camera external trigger mode.

*1: Camera external trigger mode [1] (“0”=OFF, “1”=ON)

<Camera external trigger interval time readout>
Outputs the interval time of camera external trigger.



*1: Camera external trigger interval time [1][1][1][1] (25 to 1000)

Continued to next page

<Camera exposure time readout>

Outputs the exposure time of the camera.

*1: Camera exposure time [1] (“0”=93µs, “1”=200µs, “2”=431µs, “3”=928µs, “4”=2000µs, “5”=4309µs, “6”=9283µs, “7”=20000µs)

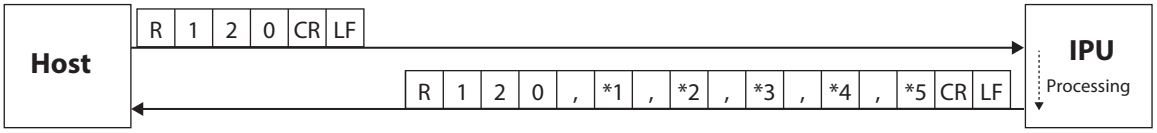
<Measurement luminance value readout>

Outputs the measurement luminance values.

*1: Measurement luminance value [1][1][1][1] (0 to 4095)

<Display setting readout>

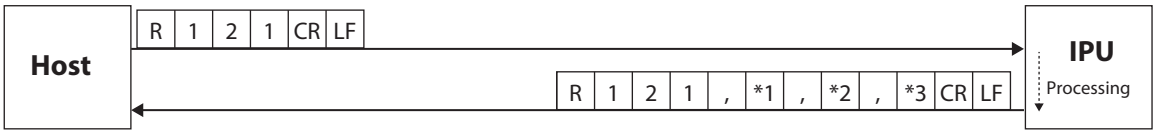
Outputs the display settings.



*1: Rotation [1] (“0”=OFF, “1”=Rotate 90° counterclockwise, “2”=Rotate 90° clockwise)
*2: Revert [1] (“0”=OFF, “1”=X On, “2”=Y On, “3”=XY On)
*3: Unit [1] (“0”=deg, “1”=min+sec, “2”=mrad)
*4: Light spot cross display [1] (“0”=OFF, “1”=ON)
*5: Viewing angle [1] (“0”=1.75deg, “1”=1.00deg, “2”=0.50deg, “3”=0.25deg)

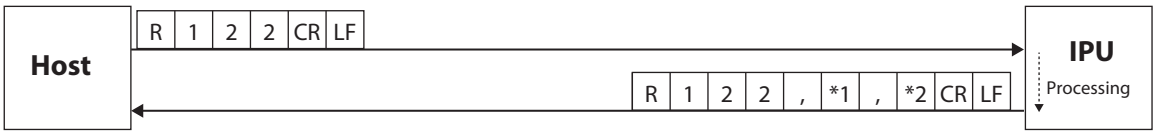
<Zoom setting readout>

Outputs the zoom settings.



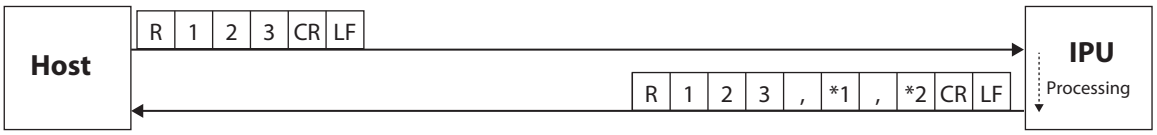
*1: Zoom mode [1] (“0”=OFF, “1”=Fixed value, “2”=Input value)
*2: Fixed value setting [1] (“0”=x2, “1”=x4, “2”=x8)
*3: Input value setting [1][.][1] (1.1 to 8)

<Measurement value output setting readout>
Outputs the output setting of measurement values.



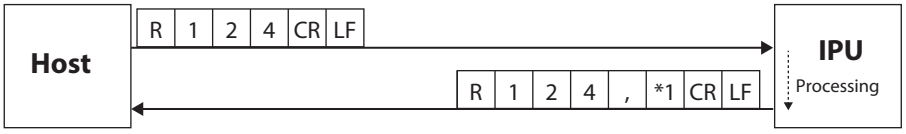
*1: Data output mode [1] (“0”=Stream, “1”=I/O input, “2”=OFF)
*2: Data output port [1] (“0”=Serial, “1”=Ethernet)

<GPIO Strobe setting readout>
Outputs GPIO Strobe setting.



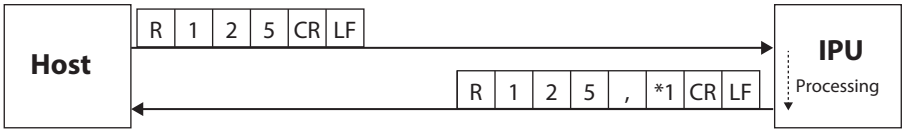
*1: Strobe delay time [1][1][1] (1 to 999)
*2: Strobe output width [1][1][1] (1 to 999)

<Binary threshold for pixel calibration value readout>
Outputs the binary threshold for pixel calibration value.



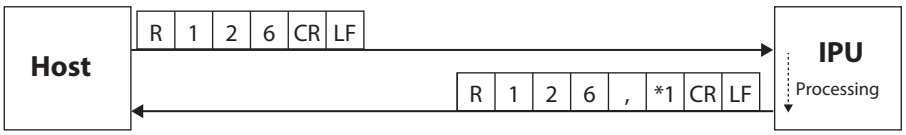
*1: Binary threshold for pixel calibration value [1][1][1][1] (600 to 4095)

<Pixel calibration value readout>
Outputs the pixel calibration value mode.



*1: Pixel calibration value mode [1] (“0”=Factory shipping mode, “1”=User setting mode)

<Pixel calibration value for user setting readout>
Outputs the pixel calibration value for user setting mode.



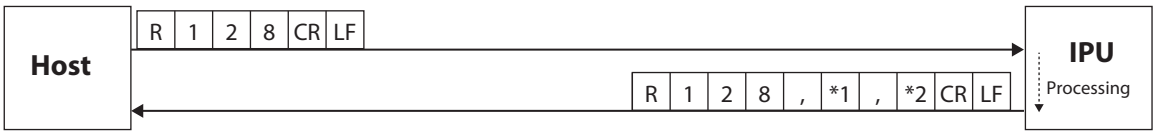
*1: Pixel calibration value [0][.][0][0][0][0][0][0] (0.001000 to 0.010000)

Continued to next page

<Zero point calibration value mode readout>
Outputs the zero point calibration value mode.

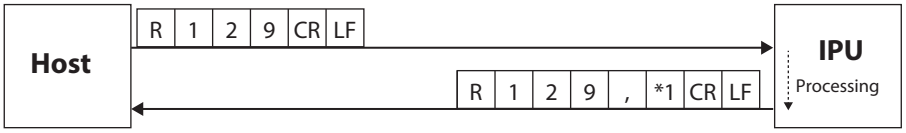
*1: Zero point calibration value mode [1] (“0”=Factory shipping mode, “1”=User setting mode)

<Zero point calibration value for user setting readout>
Outputs zero point calibration value for user settings.



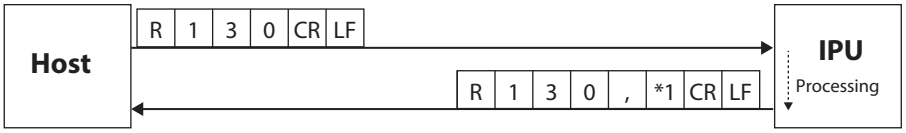
*1: Zero point calibration value X [0 0 0 . 0 0 0] (0 to 960)
*2: Zero point calibration value Y [0 0 0 . 0 0 0] (0 to 960)

<RAW image output mode readout>
Outputs the RAW image output mode.



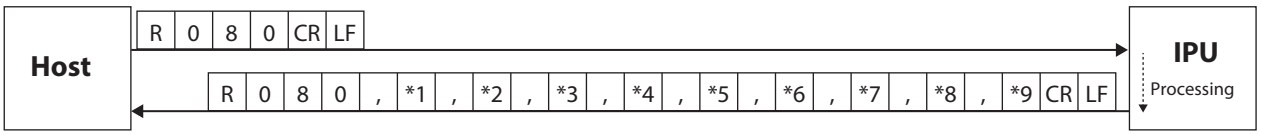
*1: RAW image output mode [1] (“0”=OFF, “1”=ON)

<LD output automatic adjustment result readout>
Outputs the result of LD output automatic adjustment.



*1: LD output automatic adjustment result [1] (“0”=OFF or Not adjusted, “1”=Under automatic adjustment, “2”=Successful automatic adjustment, “3”=Failed automatic adjustment)

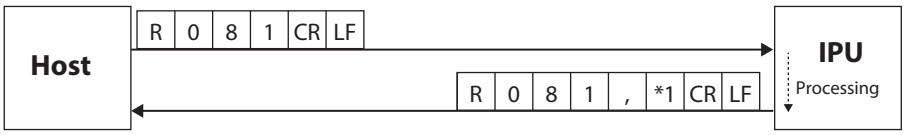
<System information readout>
Outputs the system information.



*1: IPU model name
*2: IPU serial number
*3: IPU version
*4: IPU MAC address
*5: IPU manufactured date (yyyymmdd)

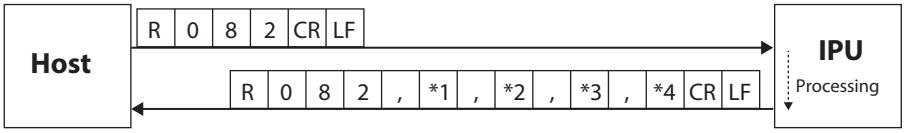
*6: Sensor head model name
*7: Sensor head serial number
*8: Sensor head version
*9: Sensor head manufactured date (yyyymmdd)

<RS232C setting readout>
Outputs the RS232C settings.



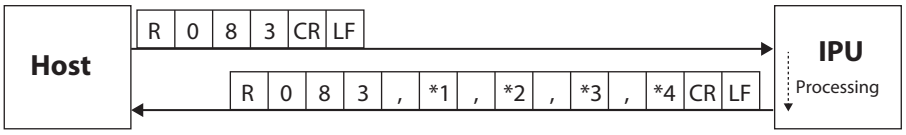
* 1: Baud rate: 1 (“0”=9600, “1”= 19200, “2”= 38400, “3”= 57600, “4”= 115200)

<Ethernet setting readout>
Outputs Ethernet settings.



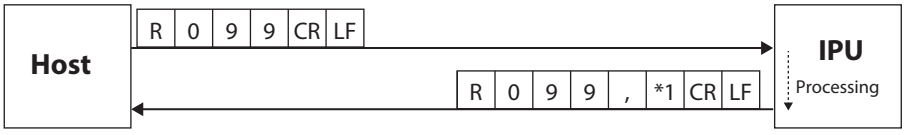
*1: IP address
*2: Subnet mask
*3: Default gateway
*4: Port number for command 1 1 1 1 1 (1024 to 65534)

<FTP server setting readout>
Outputs the FTP server settings.



*1: FTP server IP address
*2: FTP server user name (32 characters at maximum)
*3: FTP server password (32 characters at maximum)
*4: FTP server upload path (32 characters at maximum)

<Command mode readout>
Outputs the command mode.



*1: Command mode 1 (“0”=Normal mode, “1”=HIP mode)

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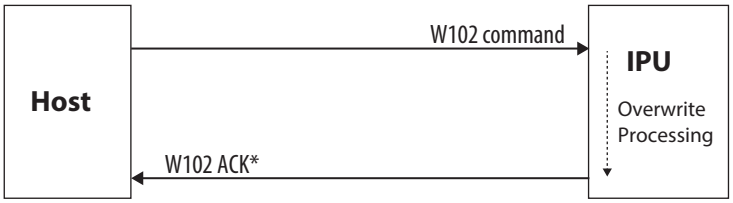
B.Writing type

Command formats on writing such as settings are explained.

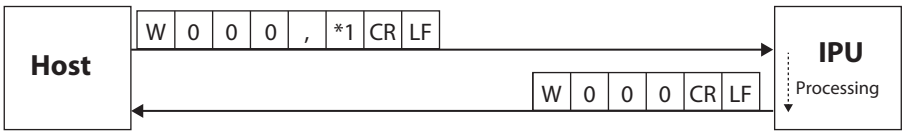
Example: W102 command



*When a communication error is generated, IPU returns the error command.

<File saving>

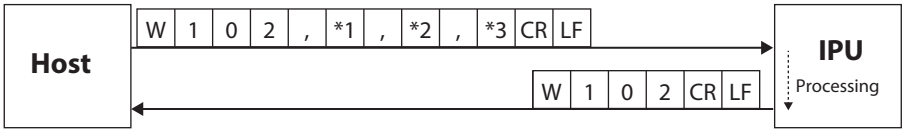
Saves the present setting values to the specified file number.



*1: File No. [0] (“0”=Selected file, “1” to “6”=File 1 to 6)

<Setting value individual writing>

Changes the setting values per item.



*1: Measurement mode (Here, since it is the angle measurement, “0” becomes the fixed value)
*2: Item code (see the list of item codes shown below)
*3: The setting contents (Value differs depending on items. See <Setting value batch writing>)

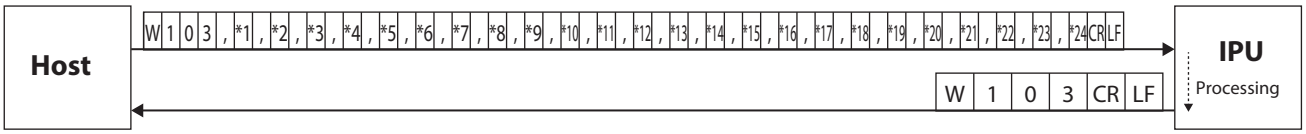
List of item codes

Code	Item name
00	Binary level
01	Noise level
02	Effective luminance upper limit value
03	Effective luminance lower limit value
04	Effective luminance judgment mode
05	Judgment type
06	Circle-radius
07	Rectangle-XL
08	Rectangle-XH
09	Rectangle-YH
10	Rectangle-YL
11	Circle2-radius
12	Offset-X
13	Offset-Y
14	Label measurement mode

Code	Item name
15	Numbering
16	Judgment label
17	Maximum No. of light spots
18	Center of gravity calculation method
19	Average
20	Effective light spot size mode
21	Effective light spot pixel upper limit value
22	Effective light spot pixel lower limit value

<Setting value batch writing>

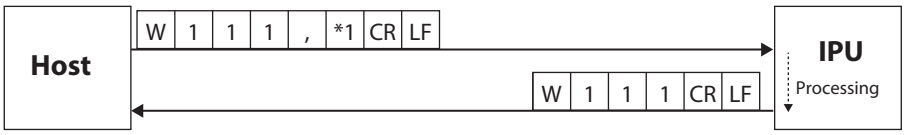
Changes the setting data in batch.



*1: Measurement mode (Here, since it is the angle measurement, “0” becomes the fixed value)
*2: Binary level [1][1][1][1] (600 to 4095)
*3: Noise level [1][1][1][1] (600 to effective luminance lower limit value-1)
*4: Effective luminance upper limit value [1][1][1][1] (Effective luminance lower limit value+1 to 4095)
*5: Effective luminance lower limit value [1][1][1][1] (Noise level+1 to effective luminance upper limit value-1)
*6: Effective luminance judgment mode [0] (“0”=OFF, “1”=ON)
*7: Judgment type [0] (“0”=OFF, “1”=Circle, “2”=Rectangular)
*8: Circle-radius [+][0][.][1][0][0] (0.001 to 1.750)
*9: Rectangle-XL [±][0][.][1][0][0] (-1.750 to XH-1)
*10: Rectangular-XH [±][0][.][1][0][0] (XL+1 to 1.750)
*11: Rectangular-YH [±][0][.][1][0][0] (YL+1 to 1.750)
*12: Rectangular-YL [±][0][.][1][0][0] (-1.750 to YH-1)
*13: Circle 2-radius [+][0][.][1][0][0] (0.001 to 1.750)
*14: Offset-X [±][0][.][1][0][0] (-1.750 to 1.750)
*15: Offset-Y [±][0][.][1][0][0] (-1.750 to 1.750)
*16: Label measurement mode [1] (“0”=Single, “1”=Multi Relative, “2”=Multi Absolute, “3”=Offset TIlt D1/D1, “4”=Offset TIlt D1/D2, “5”=Offset TIlt D1/X-Y)
*17: Numbering [1] (“0”=Area descending order, “1”=Angle ascending order)
*18: Judgment label [1] (“0”=ALL, “1”=Label1, “2”=Label2, “3”=Label3, “4”=Label4, “5”=Label5)
*19: Maximum No. of light spots [1] (3 to 5)
*20: Center of gravity calculation method [1] (“0”=Area center of gravity, “1”=Luminance center of gravity, “2”=Luminance peak)
*21: Average [1] (“0”=OFF, “1”=2 times, “2”=4 times, “3”=8 times, “4”=16 times)
*22: Effective light spot size mode [1] (“0”=OFF, “1”=ON)
*23: Effective light spot pixel upper limit value [1][1][1][1][1][1] (Effective light spot pixel lower limit value+1 to 32767)
*24: Effective light spot pixel lower limit value [1][1][1][1][1][1] (1 to Effective light spot pixel upper limit value-1)

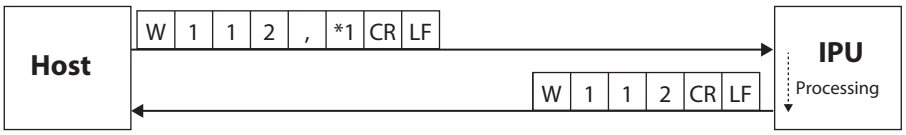
Continued to next page

<LD output setting value writing>
Changes the LD output setting values.



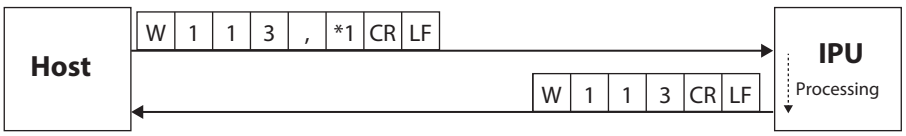
*1: LD output value [1][1][1][1] (9 to 4095)

<LD output automatic adjustment mode writing>
Changes the LD output automatic adjustment mode.



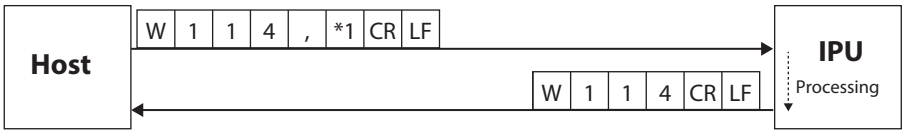
*1: LD output automatic adjustment mode [1] (“0”=OFF, “1”=ON)

<LD external light source mode writing>
Changes the LD external light source mode.



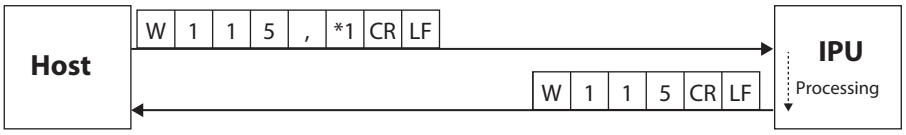
*1: LD external light source mode [1] (“0”=OFF, “1”=ON)

<Camera external trigger mode writing>
Changes the camera external trigger mode.



*1: Camera external trigger mode [1] (“0”=OFF, “1”=ON)

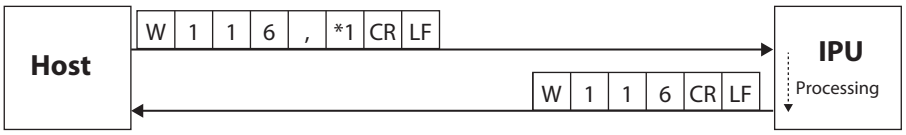
<Camera external trigger interval time writing>
Changes the interval time of camera external trigger.



*1: Camera external trigger interval time [1][1][1][1] (25 to 1000)

<Camera exposure time writing>

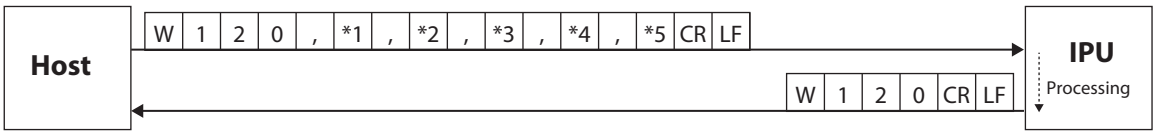
Changes the exposure time of the camera.



*1: Camera exposure time [1] (“0”=93μs, “1”=200μs, “2”=431μs, “3”=928μs, “4”=2000μs, “5”=4309μs, “6”=9283μs, “7”=20000μs)

<Display setting writing>

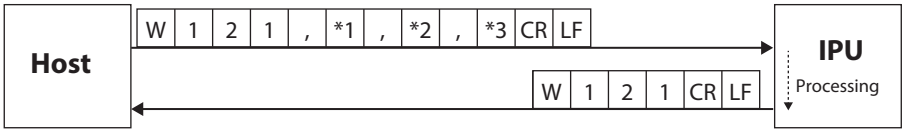
Changes the display settings.



*1: Rotation [1] (“0”=OFF, “1”=Rotate 90° counterclockwise, “2”=Rotate 90° clockwise)
*2: Revert [1] (“0”=OFF, “1”=X On, “2”=Y On, “3”=XY On)
*3: Unit [1] (“0”=deg, “1”=min+sec, “2”=mrad)
*4: Light spot cross display [1] (“0”=OFF, “1”=ON)
*5: Viewing angle [1] (“0”=1.75deg, “1”=1.00deg, “2”=0.50deg, “3”=0.25deg)

<Zoom setting writing>

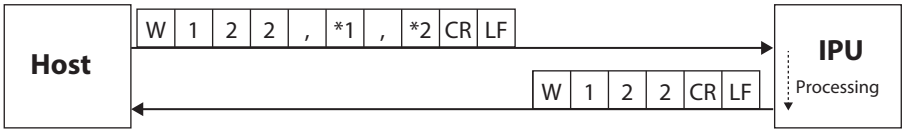
Changes the zoom settings.



*1: Zoom mode [1] (“0”=OFF, “1”=Fixed value, “2”=Input value)
*2: Fixed value setting [1] (“0”=x2, “1”=x4, “2”=x8)
*3: Input value setting [1] . [1] (1.1 to 8)

<Measurement value output setting writing>

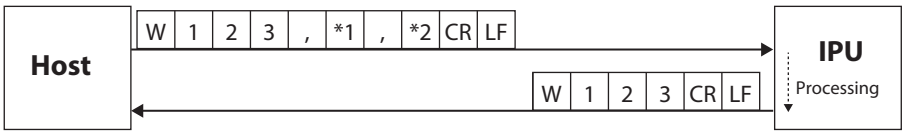
Changes the output setting of measurement values.



*1: Data output mode [1] (“0”=Stream, “1”=I/O input, “2”=OFF)
*2: Data output port [1] (“0”=Serial, “1”=Ethernet)

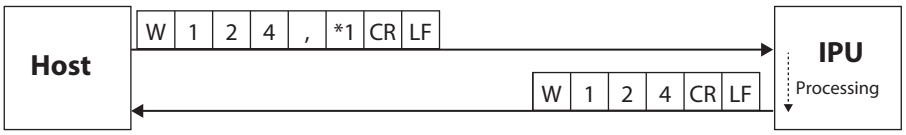
Continued to next page

<GPIO Strobe setting writing>
Changes GPIO Strobe setting.



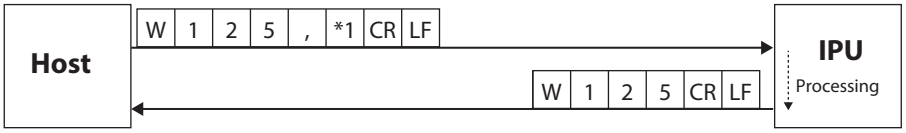
*1: Strobe delay time [1][1][1] (1 to 999)
*2: Strobe output width [1][1][1] (1 to 999)

<Binary threshold for pixel calibration value writing>
Changes the binary threshold for pixel calibration.



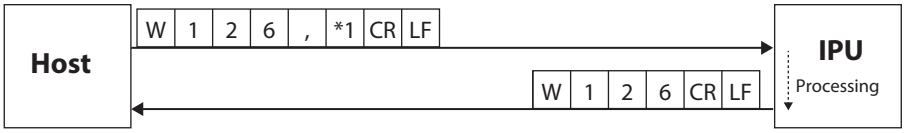
*1: Binary threshold for pixel calibration value [1][1][1][1] (600 to 4095)

<Pixel calibration value mode writing>
Changes the pixel calibration value mode.



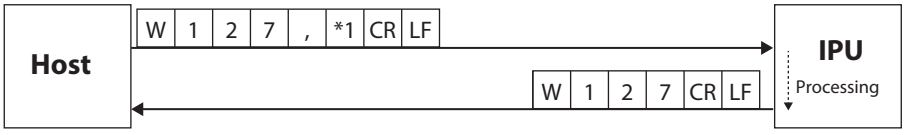
*1: Pixel calibration value mode [1] (“0”=Factory shipping mode, “1”=User setting mode)

<Pixel calibration value for user setting writing>
Changes the pixel calibration value for user setting mode.



*1: Pixel calibration value [0][.][0][0][0][0][0][0] (0.001000 to 0.010000)

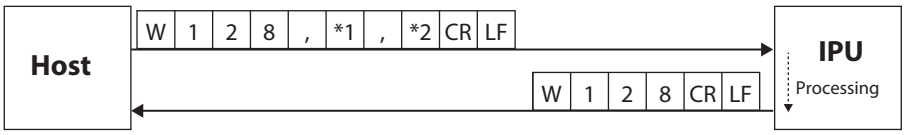
<Zero point calibration value mode writing>
Changes the zero point calibration value mode.



*1: Zero point calibration value mode [1] (“0”=Factory shipping mode, “1”=User setting mode)

<Zero point calibration value for user setting writing>

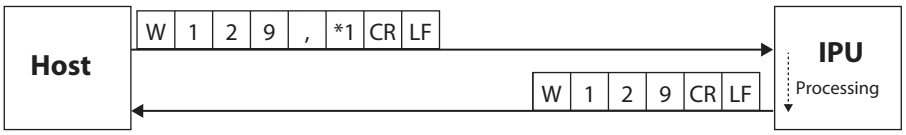
Changes the zero point calibration value for user setting mode.



*1: Zero point calibration value X [0 0 0 . 0 0 0] (0 to 960)
*2: Zero point calibration value Y [0 0 0 . 0 0 0] (0 to 960)

<RAW image output mode writing>

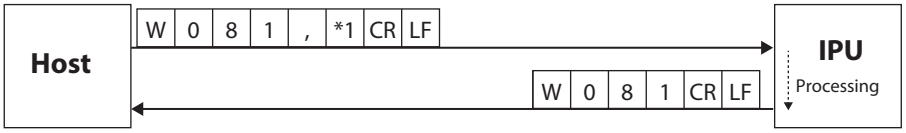
Changes the RAW image output mode.



*1: RAW image output mode [1] (“0”=OFF, “1”=ON)

<RS232C setting writing>

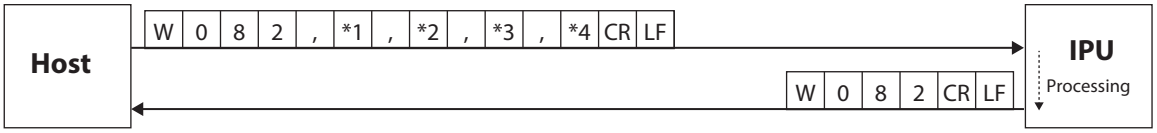
Changes the RS232C settings.



* 1: Baud rate: [1] (“0”=9600, “1”= 19200, “2”= 38400, “3”= 57600, “4”= 115200)

<Ethernet setting writing>

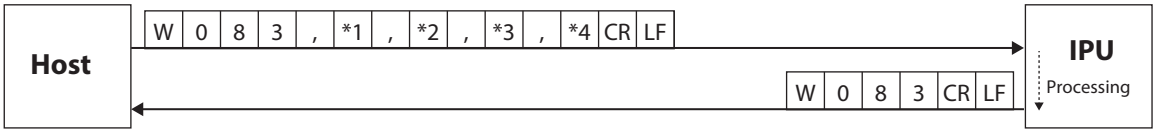
Changes Ethernet settings.



*1: IP address
*2: Subnet mask
*3: Default gateway
*4: Port number for command [1 1 1 1 1] (1024 to 65534)

<FTP server setting writing>

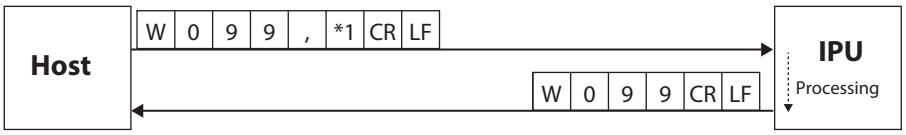
Changes the FTP server settings.



*1: FTP server IP address
*2: FTP server user name (32 characters at maximum)
*3: FTP server password (32 characters at maximum)
*4: FTP server upload path (32 characters at maximum)

Continued to next page

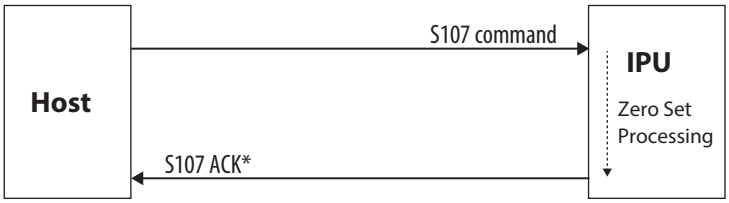
<Command mode writing>
Changes the command mode.



*1: Command mode 1 (“0”=Normal mode, “1”=HIP mode)

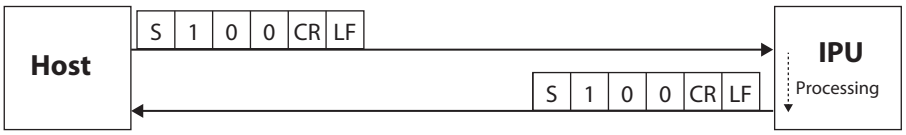
C.Execution type
Command formats to execute operations such as measurement start and stop are explained.

Example: S107 command

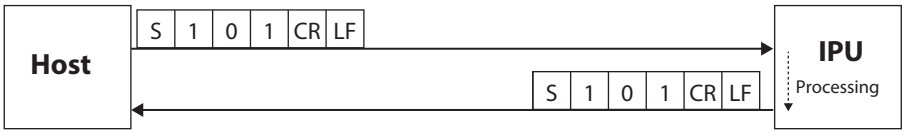


*When a communication error is generated, IPU returns the error command.

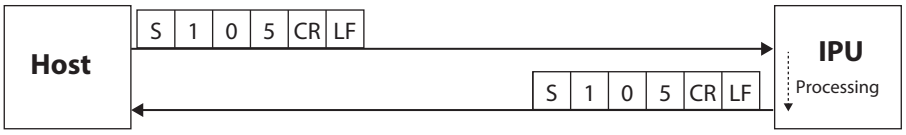
<Measurement stop>
Stops a measurement.



<Measurement start>
Starts a measurement.

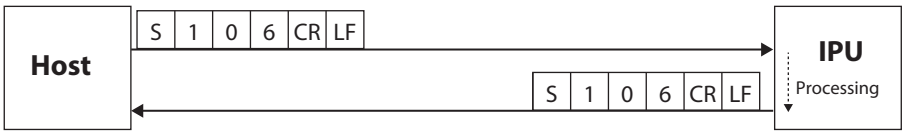


<LD output automatic adjustment>
Adjusts the LD output automatically.



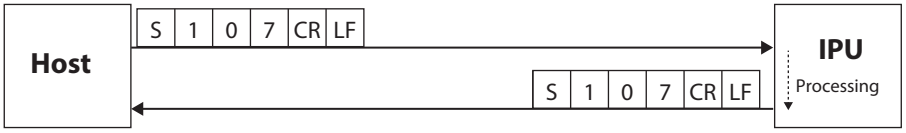
<Zero reset>

Sets the measurement center in the measurement range center.



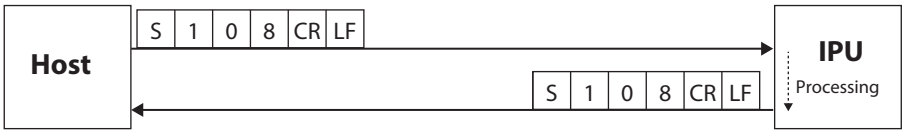
<Zero set>

Sets the measurement center in the light spot on the monitor.



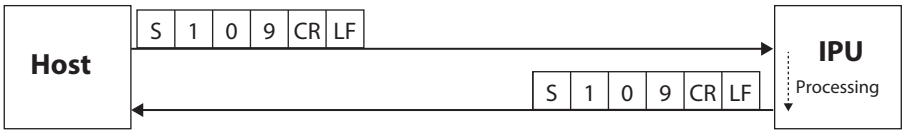
<OFFSETTILT judgment 1 switch>

At OFFSET TILT measurement, switch the judgment area from judgment 2 (D1, D2, X-Y) to judgment 1 (D1).



<OFFSETTILT judgment 2 switch>

At OFFSET TILT measurement, switch the judgment area from judgment 1 (D1) to judgment 2 (D1, D2, X-Y).

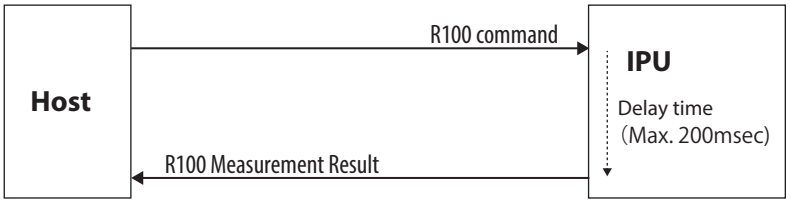


● In case of HIP-1200 mode

A. Readout type

Command formats on readout are explained.

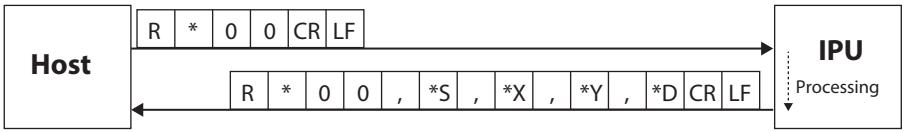
Example: R100 command



Continued to next page

<Measurement value readout>

Outputs the present angle measurement value.
The return example is in case of angle measurement (1 spot measurement).
After the identification character (G) of the return content is the same format.



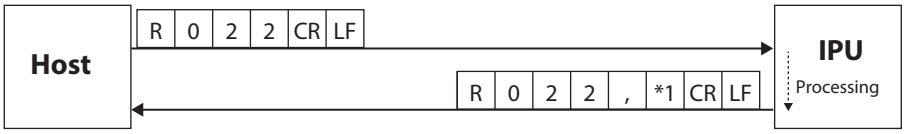
*: Identification character (Here, since it is the angle measurement, “1” becomes the fixed value).
*S: Judgment result (“O”=OK, “N”=NG, and “E”=ERROR)
*X: Angle around the X axis [±][0][.][0][0][0]
*Y: Angle around the Y axis [±][0][.][0][0][0]
*D: Angle from the measurement center [SP][0][.][0][0][0]

Info

- **The unit of measurement value follows the menu settings.**
- **At external incident settings, the notation is twice the reflection measurement range when an internal light source, that is a normal setting, is used.**

<Calibration value readout>

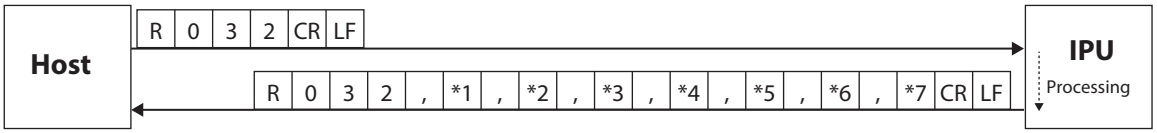
Outputs the calibration value.



*1: Calibration value [0][.][0][0][0][0][0][0]

<System data readout>

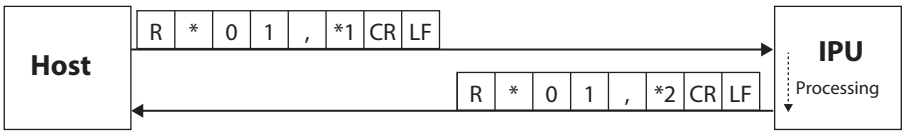
Outputs the system data.



*1: BINARY [2][0][0] (30 to 254)
*2: LAC type [0][1] (0 to 11 (2.0 to 0.16))
*3: ROTATION [0] (“0”=OFF, “1”=90° rotation counterclockwise, “2”=90° rotation clockwise)
*4: MIRRORING [0] (“0”=X-Y OFF, “1”=X ON, “2”=Y ON, and “3”=X-Y ON)
*5: DISPLAY [1] (“0”=Measurement result display OFF, “1”=Measurement result display ON)
*6: UNIT [1] (“0”=deg, “1”=min+sec, “2”=mrad)
*7: DATA OUT [1] (“0”=Continuous sending mode, “1”= I/O input)

<Measurement setting data individual readout>

Outputs the present measurement setting data per item.



*1: Item code (see the list of item codes shown below)

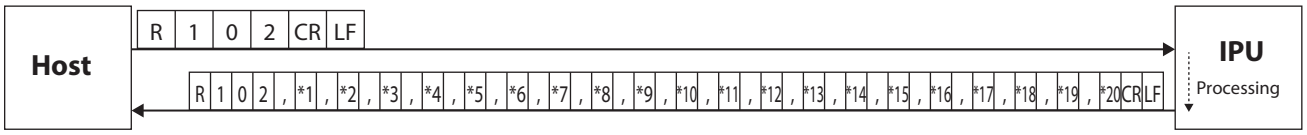
*2: The setting contents (Value differs depending on items. See <Each measurement setting data batch readout>).

List of item codes

Code	Item name
01	Binary level
02	Noise level
03	Judgment condition
04	Circle-radius
05	Rectangle-XL
06	Rectangle-XH
07	Rectangle-YH
08	Rectangle-YL
09	Circle2-radius
0A	Judgment X_Offset
0B	Judgment Y_Offset
0C	Noise level judgment yes/no
0D	Upper limit noise level
0E	Lower limit noise level
20	Measurement target (1 spot or multiple spots)
21	Light spot number assignment method (area or angle)
22	Judgment target light spot number
23	Center of gravity calculation method
24	Average yes/no
25	Zoom yes/no
2O	Luminance judgment yes/no
2P	Upper limit luminance
2Q	Lower limit luminance

<Each measurement setting data batch readout>

Outputs all present measurement setting data.



*1: BINARY 1 1 1 (30 to 254)

*2: NOISE LEVEL 1 1 1 (30 to 254 or 30 to NCK LOW)

*3: NCHECK HIGH 1 1 1 (NCK LOW to 254)

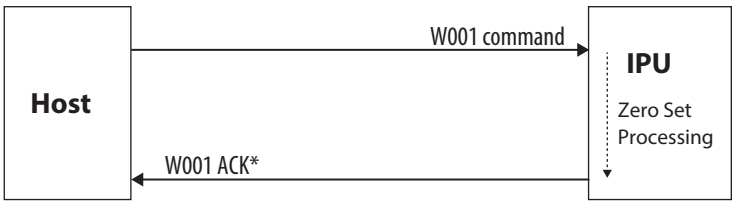
Continued to next page

*4: NCHECK LOW [1][1][1] (30 to NCK HIGH)
*5: NOISE CHECK [0] (“0”=OFF, “1”=ON)
*6: AREA [0] (“0”=OFF, “1”=Circle, “2”=Rectangular)
*7: d1 [±][0][.][1][0][0] (0.001 to LAC angle)
*8: X-Y-XL [±][0][.][1][0][0] (-LAC angle to XH)
*9: X-Y-XH [±][0][.][1][0][0] (XL to LAC angle)
*10: X-Y-YH [±][0][.][1][0][0] (YL to LAC angle)
*11: X-Y-YL [±][0][.][1][0][0] (-LAC angle to YH)
*12: d2 [±][0][.][1][0][0] (0.001 to LAC angle)
*13: X-OFFSET [±][0][.][1][0][0] (-LAC angle to 0.000 to LAC angle)
*14: Y-OFFSET [±][0][.][1][0][0] (-LAC angle to 0.000 to LAC angle)
*15: LABEL SEL. [1] (“0”=Single, “1”=Multi Relative, “2”=Multi Absolute)
*16: NUMBERING [1] (“0”=Area descending order, “1”=Angle descending order)
*17: NUMBER [1] (“0”=ALL, “1”=1, “2”=2, “3”=3)
*18: MODE [1] (“0”=Area center of gravity, “1”=Luminance center of gravity, “2”=Luminance peak)
*19: AVERAGE [1] (“0”=OFF, “1”=2 times, “2”=4 times, “3”=8 times)
*20: ZOOM [1] (“0”=OFF, “1”=4 times, “2”=8 times, “3”=16 times)

B.Setting system

Command formats on settings are explained.

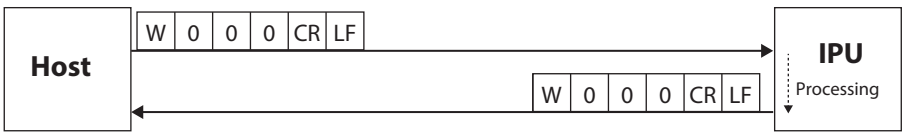
Example: W001 command



*When a communication error is generated, IPU returns the error command.

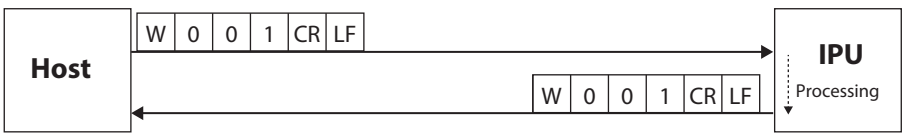
<Zero reset>

Sets the measurement center in the measurement range center.



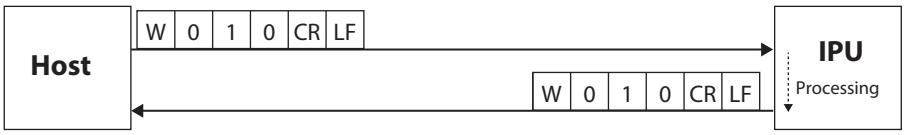
<Zero set>

Sets the measurement center in the light spot on the monitor.



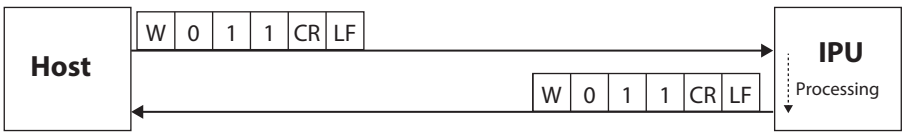
<Measurement stop>

Stops a measurement.



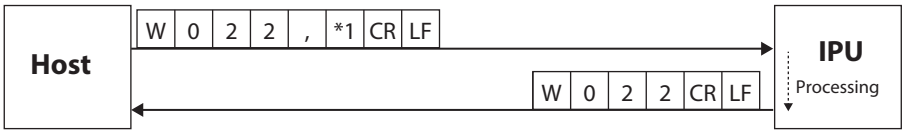
<Measurement start>

Starts a measurement.



<Calibration value change>

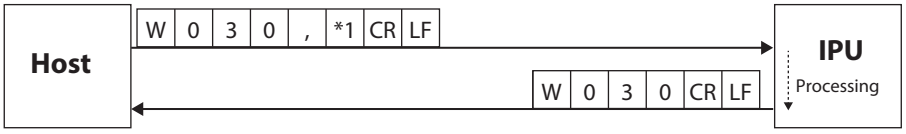
Changes the calibration value to the specified value.



*1: Calibration value 0 . 0 0 0 0 0 0

<File saving>

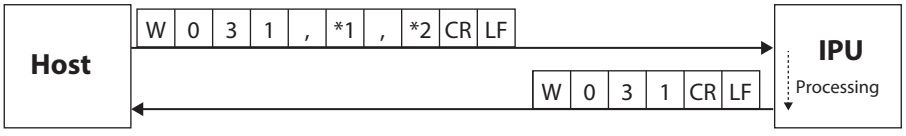
Saves the present setting values to the specified file number.



*1: File number 1 (1 to 6)

<Change file & Switch mode>

Changes to the specified file and measurement mode. (For the measurement mode, only changing to the angle measurement mode is valid)

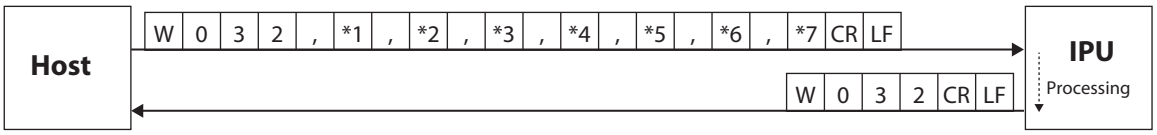


*1: Load file number 1 (1 to 6)
*2: MODE (“1”=Angle measurement mode (fixed value))

Continued to next page

<System data change>

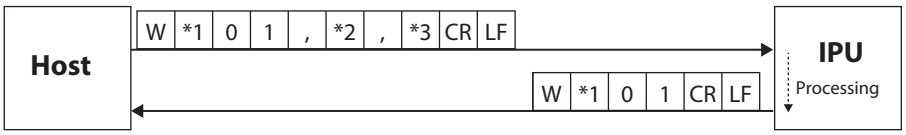
Changes the system data.



*1: BINARY [2][0][0] (30 to 254)
*2: LAC type [0][1] (0 to 11 (2.0 to 0.16))
*3: ROTATION [0] (“0”=OFF, “1”=90° rotation counterclockwise, “2”=90° rotation clockwise)
*4: MIRRORING [0] (“0”=X-Y OFF, “1”=X ON, “2”=Y ON, “3”=X-Y ON)
*5: DISPLAY [1] (“0”=Measurement result display OFF, “1”=Measurement result display ON)
*6: UNIT [1] (“0”=deg, “1”=min+sec, “2”=mrad)
*7: DATA OUT [1] (“0”=Continuous sending mode, “1”=I/O input)

<Measurement setting data individual change>

Changes the measurement setting data per item.



*1: Identification code (“1”=ANGLE (fixed value))
*2: Item code (see the list of item codes shown below)
*3: The changing values (A value differs depending on items. See <Measurement setting data batch change>.)

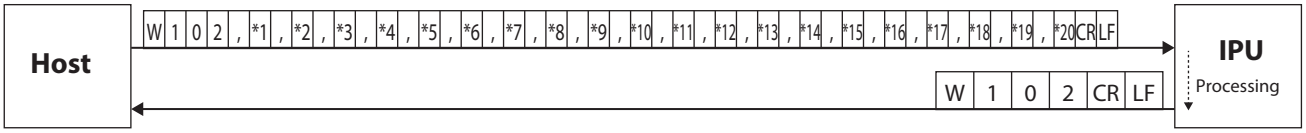
List of item codes

Code	Item name
01	Binary level
02	Noise level
03	Judgment condition
04	Circle-radius
05	Rectangular-XL
06	Rectangular-XH
07	Rectangular-YH
08	Rectangular-YL
09	Circle2-radius
0A	Judgment X_Offset
0B	Judgment Y_Offset
0C	Noise level judgment yes/no
0D	Upper limit noise level
0E	Lower limit noise level
20	Measurement target (1 spot or multiple spots)
21	Light spot number assignment method (area or angle)
22	Judgment target light spot number
23	Center of gravity calculation method

Code	Item name
24	Average yes/no
25	Zoom yes/no
2O	Luminance judgment yes/no
2P	Upper limit luminance
2Q	Lower limit luminance

<Measurement setting data batch change>

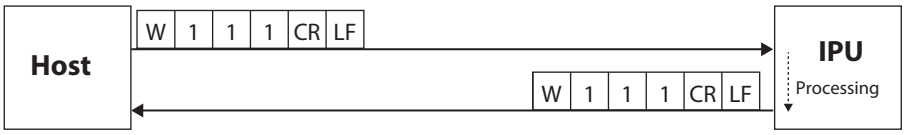
Changes the measurement setting data in batch.



*1: BINARY [1][1][1] (30 to 254)
*2: NOISE LEVEL [1][1][1] (30 to 254 or 30 to NCK LOW)
*3: NCHECK HIGH [1][1][1] (NCK LOW to 254)
*4: NCHECK LOW [1][1][1] (30 to NCK HIGH)
*5: NOISE CHECK [0] (“0”=OFF, “1”=ON)
*6: AREA [0] (“0”=OFF, “1”=Circle, “2”=Rectangular)
*7: d1 [±][0][.][1][0][0] (0.001 to LAC angle)
*8: X-Y-XL [±][0][.][1][0][0] (-LAC angle to XH)
*9: X-Y-XH [±][0][.][1][0][0] (XL to LAC angle)
*10: X-Y-YH [±][0][.][1][0][0] (YL to LAC angle)
*11: X-Y-YL [±][0][.][1][0][0] (-LAC angle to YH)
*12: d2 [±][0][.][1][0][0] (0.001 to LAC angle)
*13: X-OFFSET [±][0][.][1][0][0] (-LAC angle to 0.000 to LAC angle)
*14: Y-OFFSET [±][0][.][1][0][0] (-LAC angle to 0.000 to LAC angle)
*15: LABEL SEL. [1] (“0”=Single, “1”=Multi Relative, “2”=Multi Absolute)
*16: NUMBERING [1] (“0”=Area descending order, “1”=Angle descending order)
*17: NUMBER [1] (“0”=ALL, “1”=1, “2”=2, “3”=3)
*18: MODE [1] (“0”=Area center of gravity, “1”=Luminance center of gravity, “2”=Luminance peak)
*19: AVERAGE [1] (“0”=OFF, “1”=2 times, “2”=4 times, “3”=8 times)
*20: ZOOM [1] (“0”=OFF, “1”=4 times, “2”=8 times, “3”=16 times)

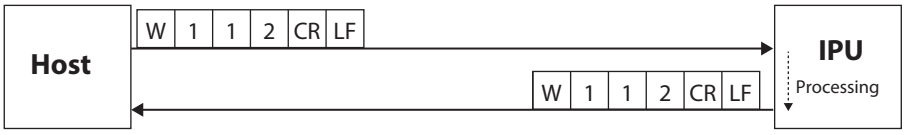
<OFFSETTILT judgment 1 switch>

At OFFSET TILT measurement, switch the judgment area from judgment 2 (D1, D2, X-Y) to judgment 1 (D1).



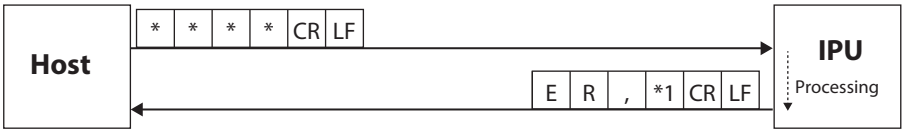
<OFFSETTILT judgment 2 switch>

At OFFSET TILT measurement, switch the judgment area from judgment 1 (D1) to judgment 2 (D1, D2, X-Y).



■ Communication Error

When a command cannot be received normally or executed, the error information is sent from this product with the following format.



The following error code is entered in *1.

“1”: Communication error

- The number of received characters from the header to [CRLF] is 60 or more.
- After receiving a header, the next character cannot be received for 1 second or more.
- An overrun error or framing error has occurred.

“2”: Setting data error

- Values out of the setting range are set. (It also occurs when the size relationship is incorrect in case of the setting command)

“3”: Command format error

- The number of commas from the header to [CRLF] does not match.
- Setting data are missing or not numeric characters in the setting command.
- Characters after a header contains characters except for those mentioned above.

“4”: Execution error

- At zero set command execution, zero set was not executed since a light spot is not detected.
- When reading a file, data are not saved in the specified file number.

“5”: Condition error

- Could not be executed as it is measuring.
- Prohibited by other settings.

6 Using Input/Output Terminal

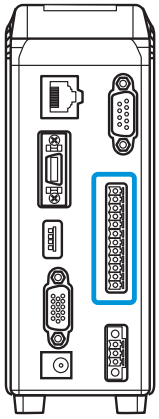
In this section, the specification of the input/output terminal and timing chart are explained.

Name of Input/Output Terminal and Function ...6-2

Timing Chart 6-6

Name of Input/Output Terminal and Function

This product is equipped with a 12-core connector. In this section, the name of the input/output terminal and function are explained.



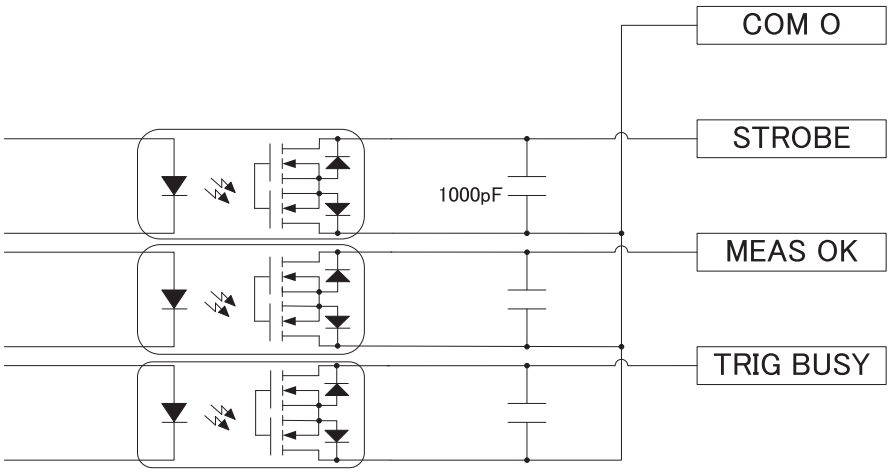
Terminal No.	Signal	Content
Output 1	Output Common (COM O)	Common terminal for output signal.
Output 2	Strobe (STROBE)	Outputs the Strobe signal for judgment result. In case of “H”, after judgment, an output is made after passing the time set by the user.
Output 3	Measurement (MEAS OK)	Measurement results are output. In case of “H”, it is OK, and in case of “L”, it is NG.
Output 4	Busy (TRIG BUSY)	Outputs the trigger busy. In case of “H”, new Start Trigger is ignored. **Info** **“H” continues from starting of Start Trigger to the image capture complete.**
Input 1	Input Common (COM I)"	Common terminal for input signal.
Input 2	Hold (HOLD)	Measurement results are held. At the Internal Trigger Mode, when the result hold input is “H”, the process continues; however, the measurement results output (RS232C and Ethernet) functions as follows. In IO mode: Result immediately before is output once. In Stream mode: No output is made. **Info** **The result hold is not used in the External Trigger Mode.**
Input 3	Zero Set (ZERO)	It is used for setting/resetting of the measurement origin point. In case of the Offset Tilt measurement, judgment standard is switched.
Input 4	Measure Trigger 24V (TRIG 24V)	When the measurement start trigger is “H”, a measurement starts. **Info** **It is valid only when the trigger mode is set to External.**
Input 5	Laser (+) (LASER ON (+))	By short circuiting +/- terminal, laser emission can be done.
Input 6	Laser (-) (LASER ON (-))	
Input 7	Measure Trigger 5V (+) (TRIG 5V (+))	When the measurement start trigger is “H”, a measurement starts. **Info** **It is valid only when the trigger mode is set to External.**
Input 8	Measure Trigger 5V (-) (TRIG 5V (-))	

“H”=Contact point ON, “L”=Contact point OFF.

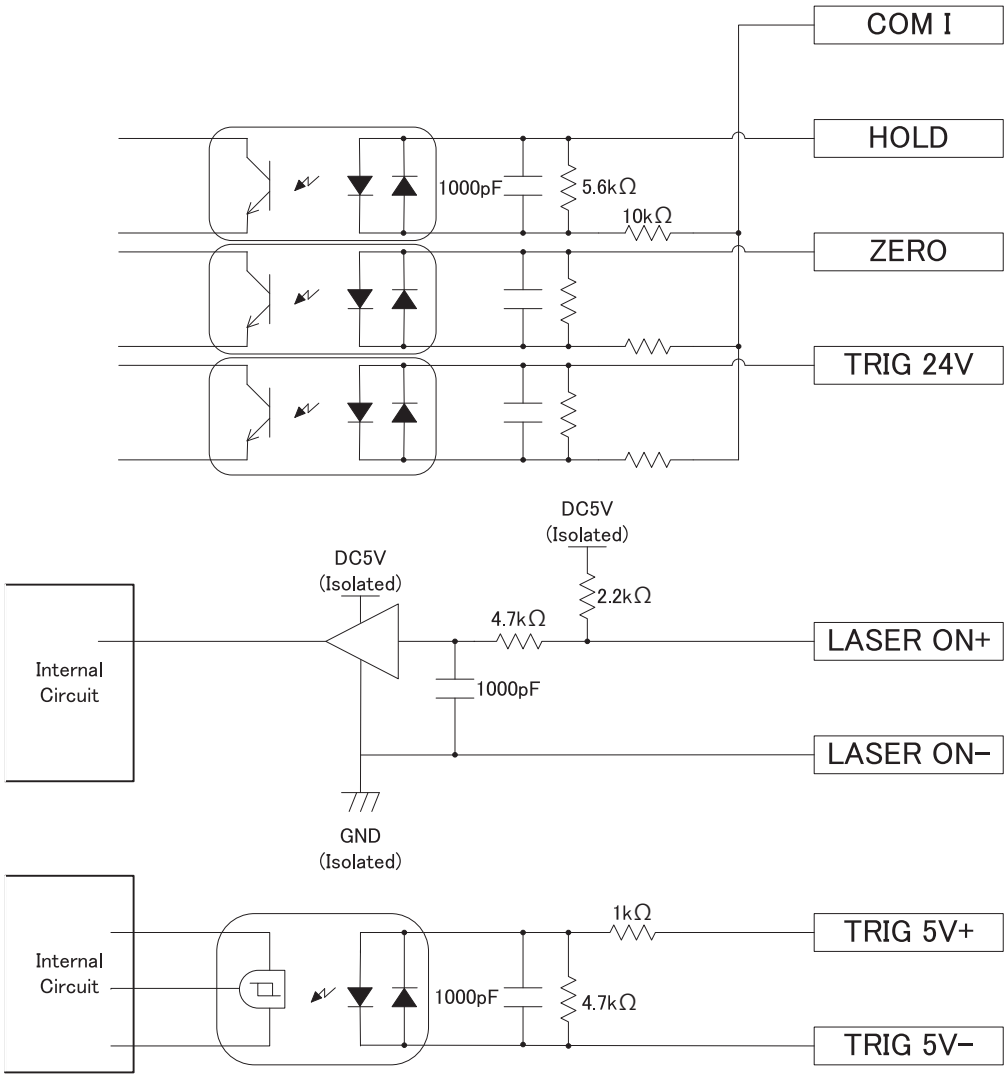
■ Equivalent Circuit Scheme

The circuit diagram of input/output terminals and connection examples are explained.

● IO Output

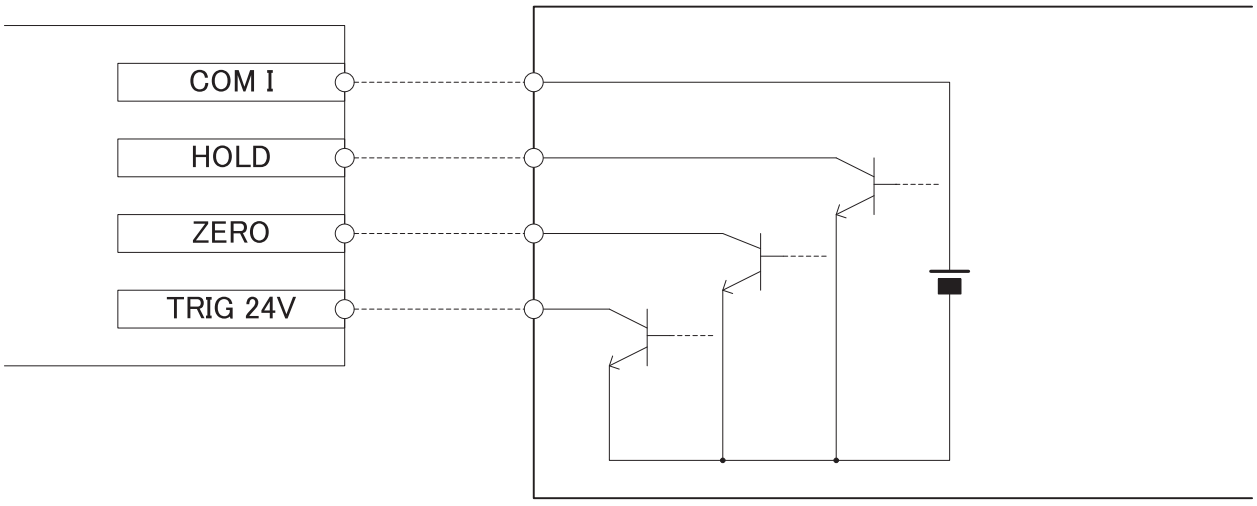


● IO Input

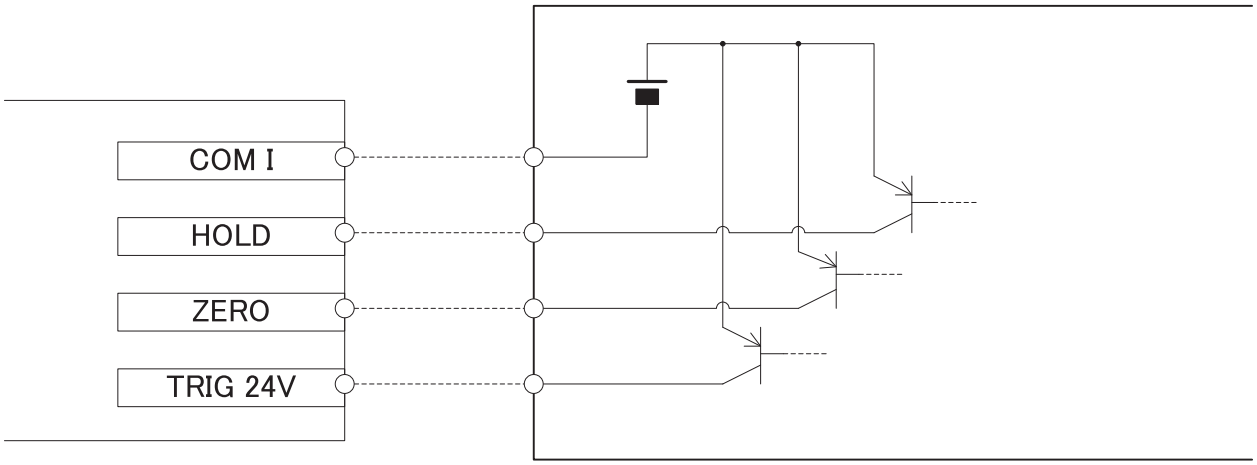


Continued to next page

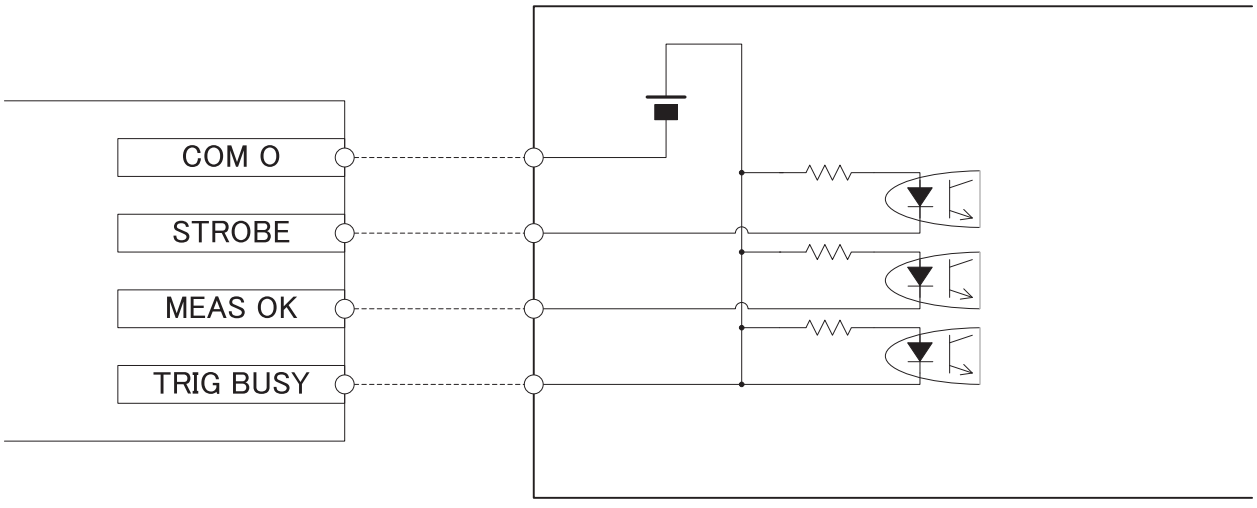
● IO Input connection example (Connection from NPN output)



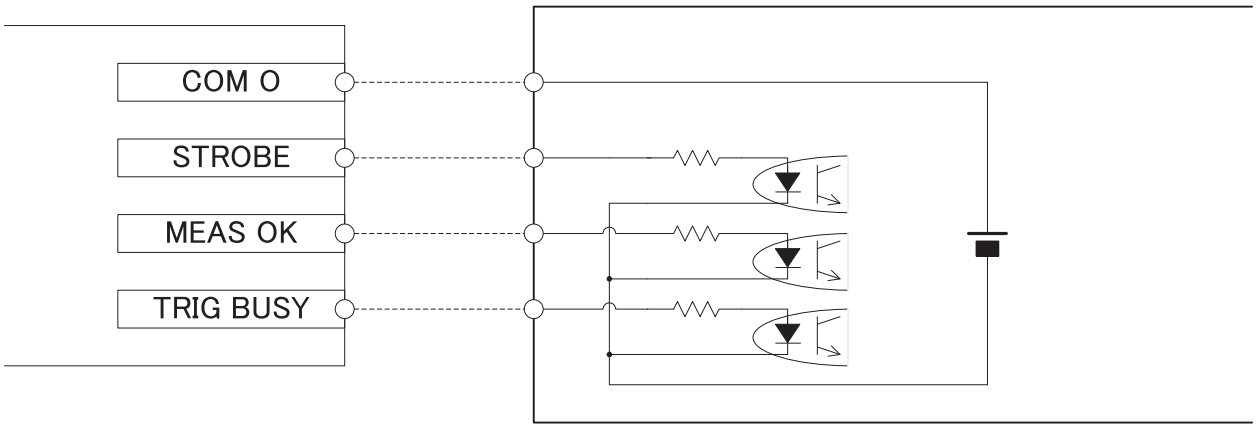
● IO Input connection example (Connection from PNP output)



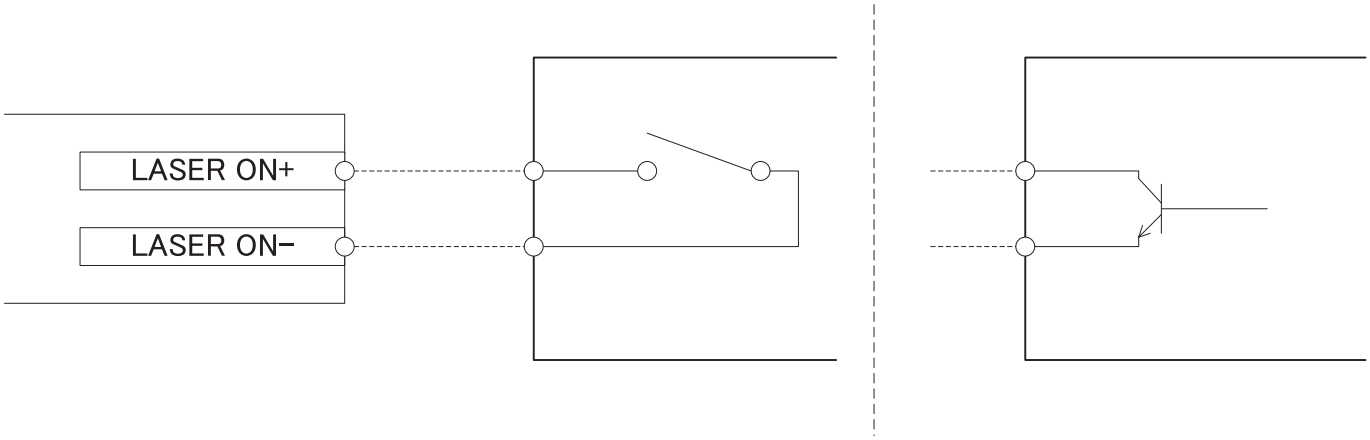
● IO Output connection example (Connection to NPN input)



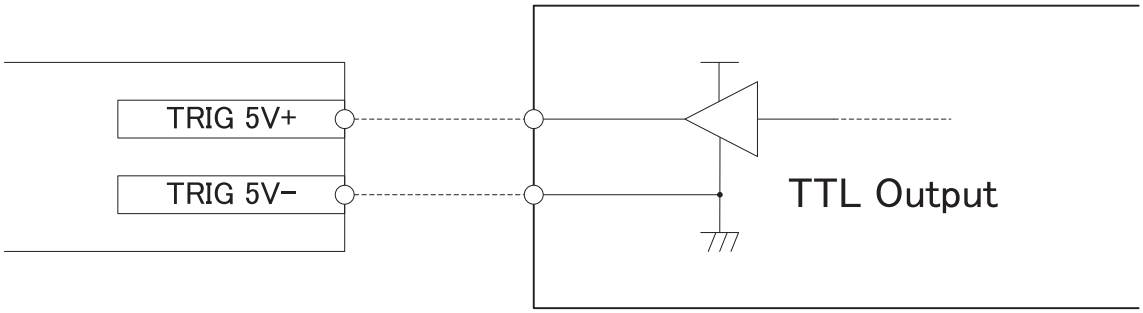
● IO Output connection example (Connection to PNP input)



● LASER ON +/- Connection Example



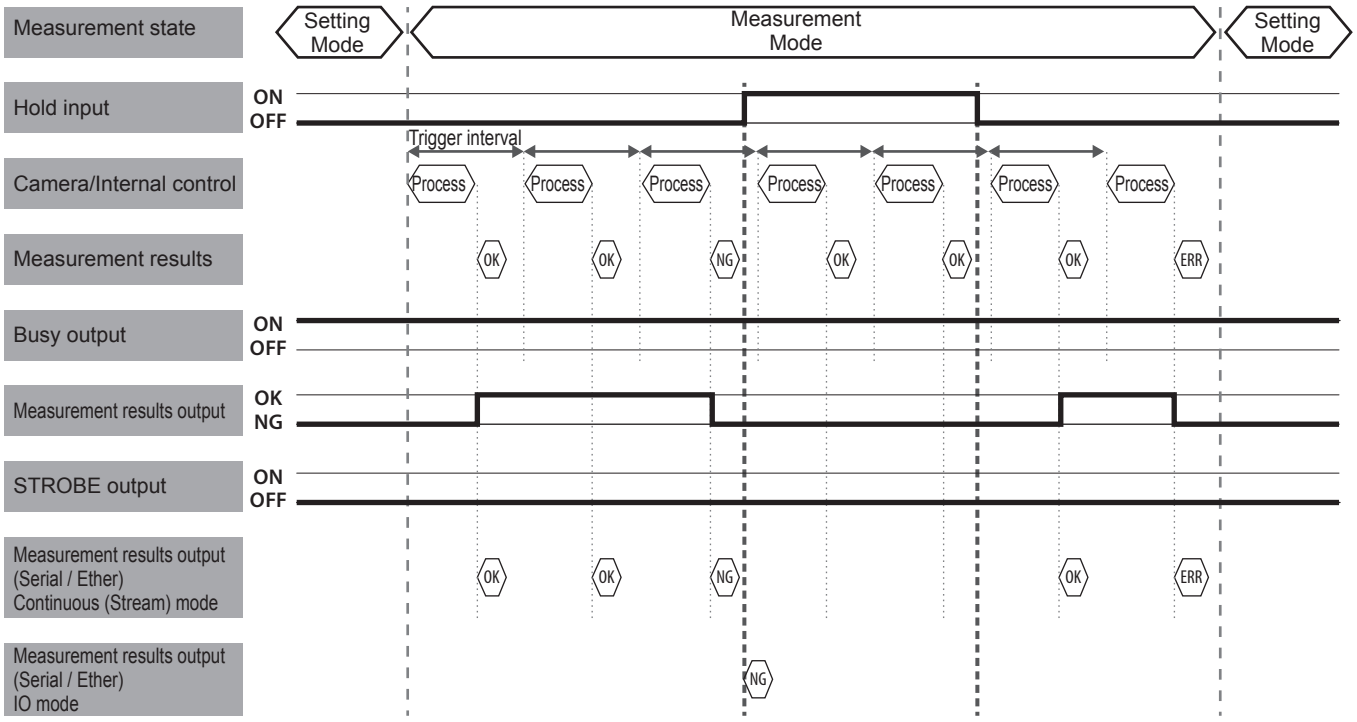
● TRIG 5V +/- Connection Example



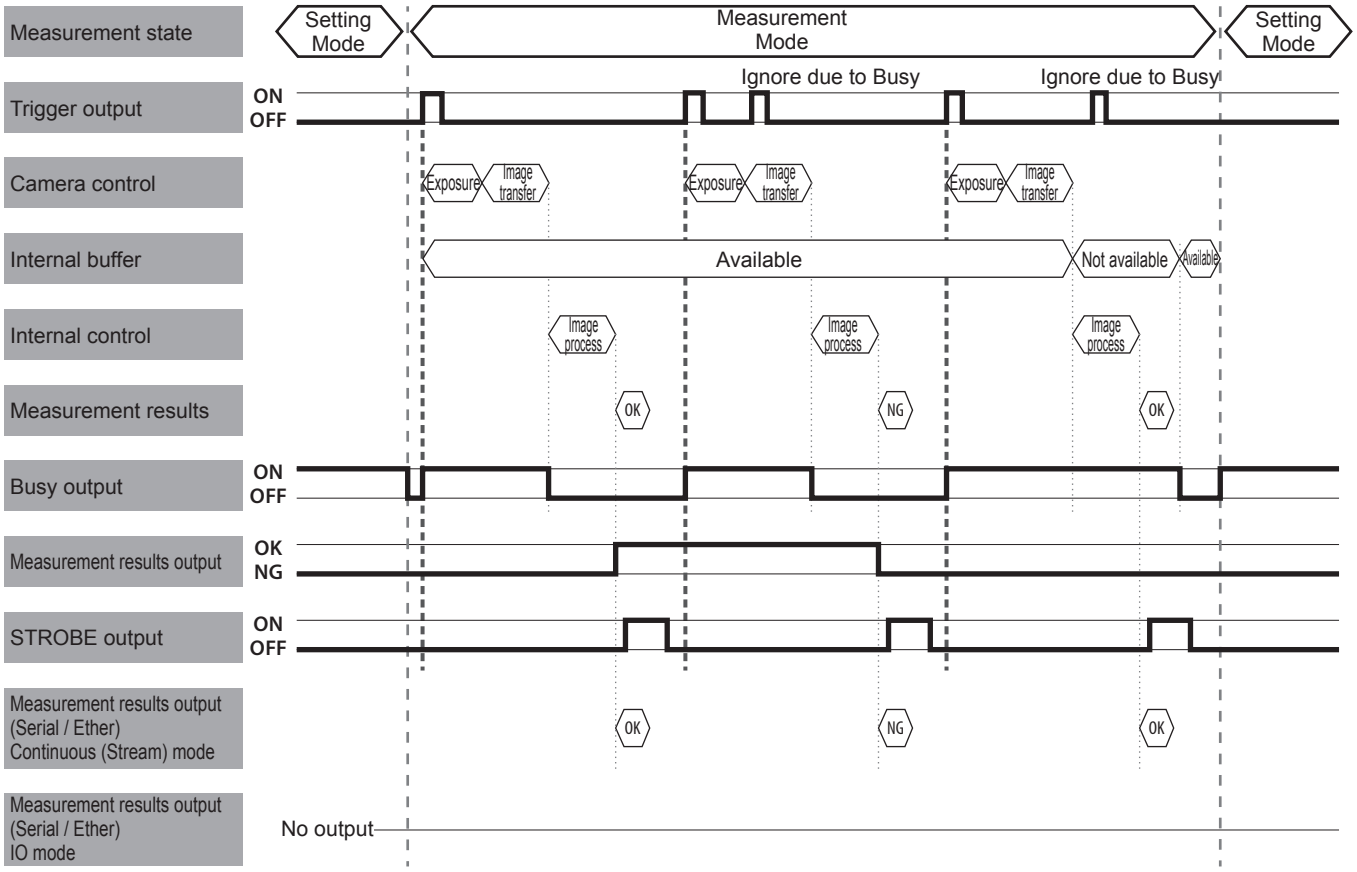
Timing Chart

In this section, the timing of input/output signal is explained.

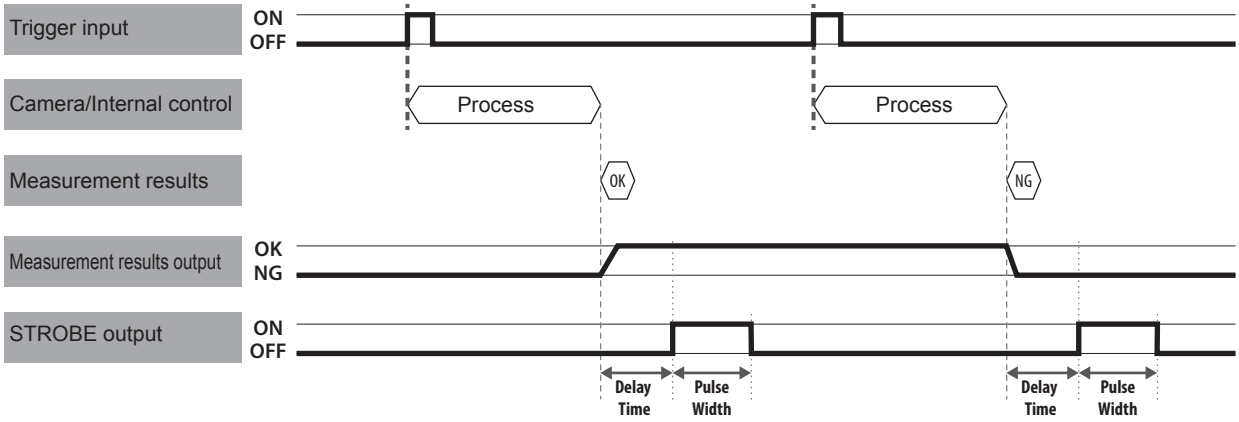
■ Internal Trigger Mode



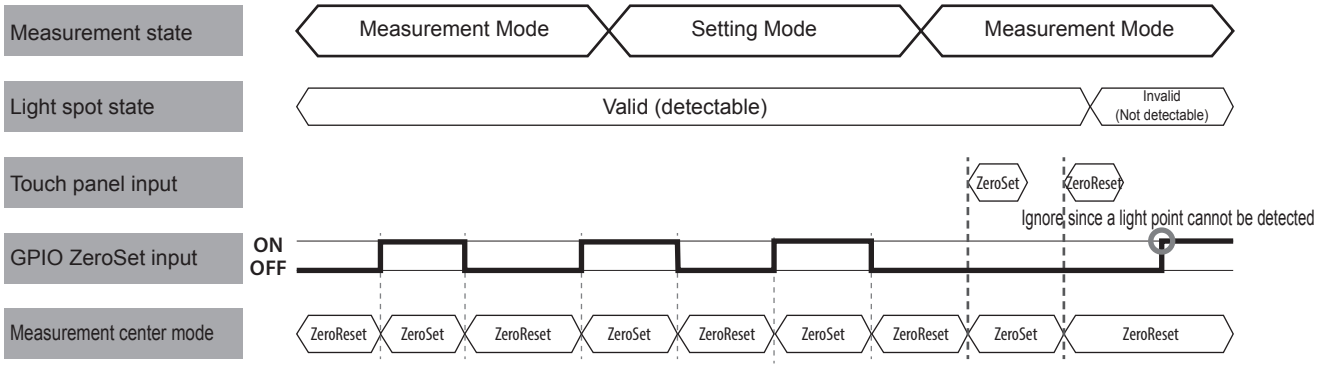
■ External Trigger Mode



■ Details of Strobe Signal



■ Details of Zero Set Signal



7 Specification

In this section, specifications of IPU and head, and external dimensions figure are explained.

Main Specifications 7-2

External Dimensions 7-4

Main Specifications

NOTE

Please note that a part of specifications in this product may be changed without prior notice to improve performance.

■ IPU

Item		Specification
Model No.		HPU-1000
Connection sensor head		H410-175R
No. of sensor head connections		1
Rating	Power source voltage	DC 24 V ± 10% *Power source ripple 10% or less (<12 Vp-p)
	Input current	1.8 A or less
	Output	Sensor head power source supply: 12 V, 0.5 A Touch panel monitor power source supply: 12 V, 0.5 A
12-core connector (DIGITAL I/O)	Output circuit (Output 2, Output 3, Output 4)	NPN/PNP common open drain output Withstand voltage: 30 V or less Driving maximum current: 50 mA or less Residual voltage: 0.5 V or less Leaking current at OFF output: 0.1 mA or less
	Input circuit (Input 2, Input 3, Input 4)	NPN/PNP common voltage input Input maximum voltage: 30 V Input current: 2.3 mA On voltage: 15 V or more OFF voltage: 2 V or less
	Input circuit (Input 5 (+), Input 6 (-))	Laser on input (no voltage contact, laser output with short circuit of +/-) Internal voltage: 5 V Short circuit current: 2 mA OFF (open) input condition: 10 KΩ or more or 4 V or more ON (short) input condition: 0.5 KΩ or less or 1 V or less
	Input circuit (Input 7 (+), Input 8 (-))	Measurement start trigger input (measure with 5 V system signal and starting edge detection) Input voltage: 0 to 6 V Input current: 4 mA (5 V input) On voltage: 3.5 V or more OFF voltage: 1 V or less
	Function	Output 1: Common for output signal Output 2: Judgment result strobe output Output 3: Judgment results output Output 4: Trigger busy output Input 1: Common for input signal Input 2: Result hold input Input 3: Zero set input Input 4: Measurement start trigger input (24 V system signal) Input 5 (+) / Input 6 (-): Laser on input (no voltage contact point) Input 7 (+) / Input 8 (-): Measurement start trigger input (5 V system signal)
Monitor output	Output specification	Analog RGB output
	Resolution	1024×768 pixels
	Connector	High density D-sub 15-pin
Operation input	USB	USB 2.0 Type-A connector Operation input from the touch panel monitor and mouse

Item		Specification
External communication	RS232C	D-sub 9-pin connector (use the cross cable) Baud rate: 9600, 19200, 38400, 57800, and 115200 Measurement data output and control command input/output
	Ethernet	RJ-45 connector Transmission method: 1000Base-T and 100Base-TX Communication method: TCP/IP, FTP and socket communication Measurement data output and control command input/output
Display		LED (Green/Red)
Environment condition	Ambient temperature for use	0 to 40°C
	Ambient humidity for use	35 to 85% RH
	Storing temperature	-10 to +60°C
	Vibration resistance	Frequency range: 10 to 500 Hz Maximum acceleration: 2 G and X/Y/Z axis
External dimensions		60 mm x 150 mm x 120 mm (W x H x D)
Weight		Approx. 900 g

■ Sensor Head

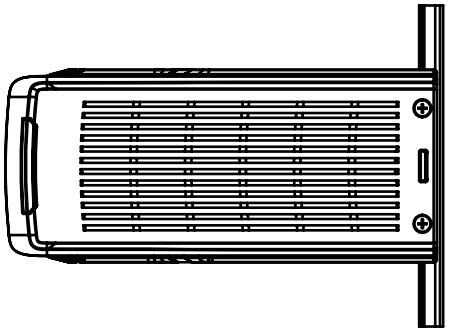
Item		Specification
Model No.		H410-175R
Angle measurement range		1.75 degrees: Measurement distance < 120 mm 1.00 degrees: Measurement distance < 200 mm 0.50 degrees: Measurement distance < 300 mm
Light source	Wave length	Red semiconductor laser 655 nm
	Output	0.39 mW laser class 1
	Emission position	20±0.5 mm or less (Distance from the reference surface 1) 15±0.5 mm or less (Distance from the reference surface 2)
	Emission angle	±0.05 degrees or less
Spot diameter		Approx. ϕ1.0 mm
Measurement reproducibility		3.6 seconds
Linearity		± 2% of F.S. F.S.= ± 1.75 degrees (When measurement distance is < 120 mm) ± 1.00 degrees (When measurement distance is < 200mm) ± 0.50 degrees (When measurement distance is < 300mm)
Measurement sampling cycle		25 msec to
Display		LED (Green/Red)
Environment condition	Ambient temperature for use	0 to 40°C
	Ambient humidity for use	35 to 85% RH
	Performance guarantee temperature	23 ± 5°C
	Storing temperature	-10 to +60°C
	Vibration resistance	Frequency range: 10 to 500 Hz Maximum acceleration: 2 G and X/Y/Z axis
External dimensions		40 mm x 60 mm x 40 mm (W x H x D)
Weight		Approx. 160 g

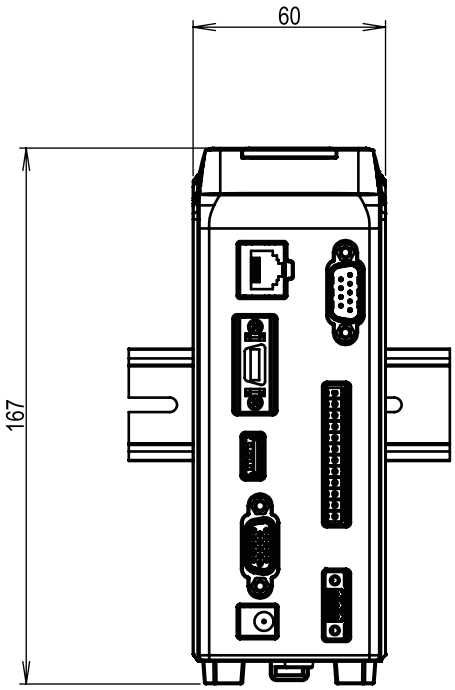
■ Sensor Head Cable

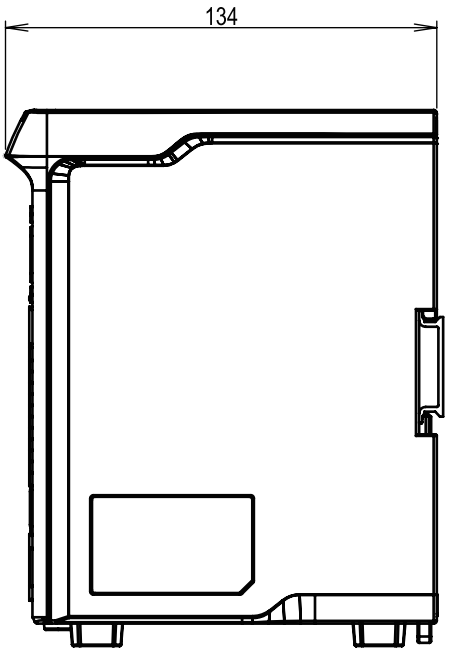
Model	Length	Weight
HSHC1-1.5	Approx. 1.5 m	120 g
HSHC1-4	Approx. 4 m	250 g
HSHC1-10	Approx. 10 m	600 g

External Dimensions

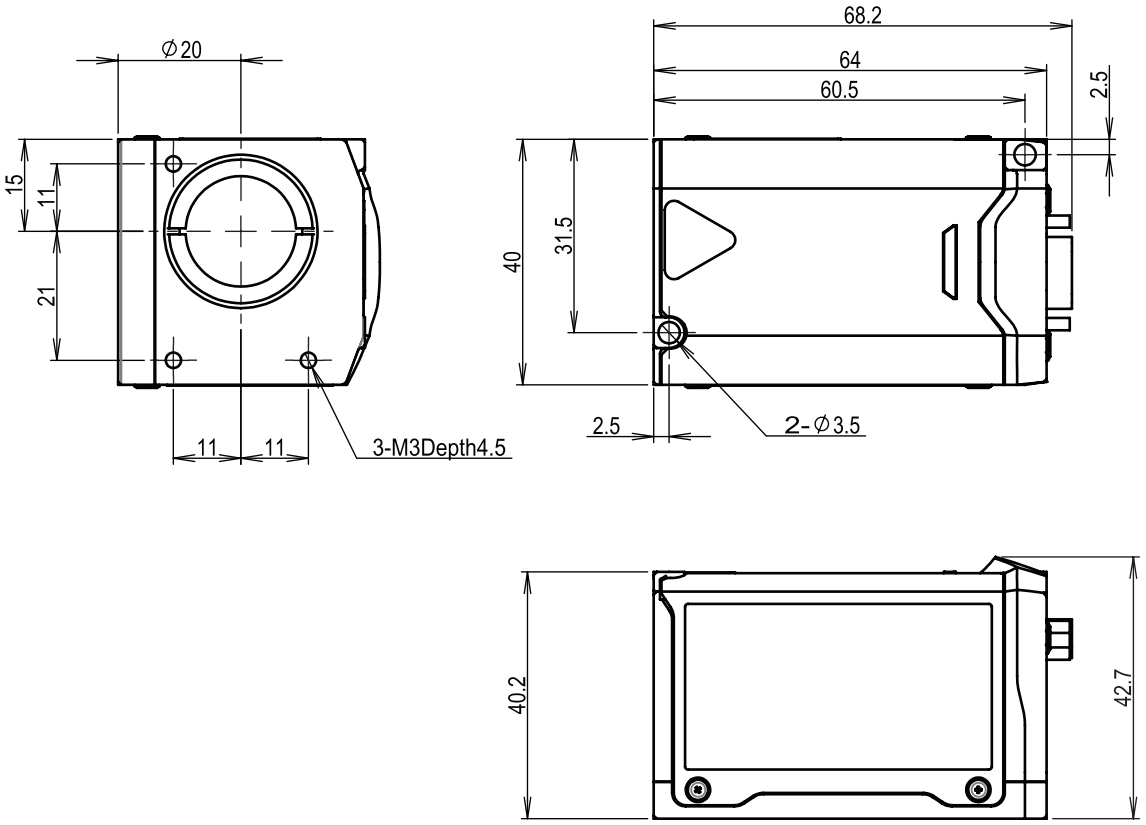
■ IPU HPU-1000







■ Sensor Head H410-175R



8 Troubleshooting

When errors and trouble are generated on the operation of this product, please read this section.

LED display state.....8-2

Error messages 8-2

Phenomena and measures.....8-3

LED display state

The state of this product can be checked with the LED.
When errors and trouble are observed, always check the LED display first.

Display state (IPU/Head)	Meaning	Measures
Red ON	Disconnected communication with the sensor Head	Check if the sensor head is connected properly.
Red ON	EE-PROM failure	When the symptom remains even after turning the power OFF and ON, it is possible that there is a failure. Please contact our sales agency.
Red ON	Damaged saved data	Since the saved setting data are damaged, create and save the setting data again.

Error messages

Depending on the state of this product, an error message may be displayed on the touch panel monitor.
Examples of display contents are explained below.

Display state	Meaning	Measures
System Error 381: EEPROM read error.	EEPROM readout error (At power source launching)	Restart this product. When the symptom remains even after turning the power OFF and ON, it is possible that there is a failure. Please contact our sales agency.
System Error 624: EEPROM write error.	EEPROM writing error (At saving the setting)	Restart this product. When the symptom remains even after turning the power OFF and ON, it is possible that there is a failure. Please contact our sales agency.
System Error 831: Serial Number and Product Data not found.	MAC Address / Serial Number unwritable error.	Restart this product. When the symptom remains even after turning the power OFF and ON, it is possible that there is a failure. Please contact our sales agency.
System Error 100: Failed to load from EEPROM. System Settings have been initialized.	EEPROM readout data error (At system setting readout)	The system settings are damaged. Restart this product. When the symptom remains even after turning the power OFF and ON, it is possible that there is a failure. Please contact our sales agency.
System Error 10* Failed to load from EEPROM. Setting * has been initialized. (*= 1 to 6)	EEPROM readout data error (At readout of each setting file)	Since the saved setting data are damaged, create and save the setting data again.
The sensor head has been disconnected. Please reboot.	Sensor head not connected error	Turn the power source OFF, and connect the sensor head. Turn the power source ON again.
Failed to connect to the FTP server.	FTP server connection error	• Check the FTP settings. • Check the connection of the Ethernet cable.

Phenomena and measures

Information that is helpful for troubleshooting is described below.
Check if the generated trouble is found in the list below.

Phenomenon	Cause	Measures
The power does not turn ON.	The AC adapter and power source code are not connected correctly.	Connect the AC adapter and power source code correctly.
	DC24V is not supplied.	Connect to DC24V power source correctly.
Nothing appears on the monitor.	Not connected to the power source correctly.	Connect the monitor power source connection cable correctly.
	The monitor cable is not connected correctly.	Connects the monitor cable (VGA cable D-sub 15-pin) correctly.
	The monitor's power source is OFF.	Turn the power source button on the back of the monitor ON.
The touch panel does not work.	The touch panel cable is not connected correctly.	Connect the touch panel connection cable (USB cable) correctly.
No light spot is displayed on the monitor / the light reception amount is not stable.	Input 5 (LASER ON (+)) of the 12-core connector and input 6 (LASER ON (-)) are not short circuited.	Short circuit Input 5 (LASER ON (+)) of the 12-core connector and input 6 (LASER ON (-)) with a short pin.
	The shutter speed is too fast / too slow.	Adjust the shutter speed to adequate speed.
	The tilt of measurement target object is large.	Adjust the tilt of measurement target object so that the reflection light enters within the visual angle ±1.75°. *When setting the Zoom, it is the incident of visual angle according to the magnification.
	The reflection rate of the measurement target object is low.	Adjust the LD power or shutter speed to make the light reception amount adequate.
	The LD Power setting is low.	Adjust so that the LD power setting value is adequate.
	The setting of [Light Source] is [External].	When external light source is not used, set the setting of [Light Source] to [Internal].
	Zoom magnification is large.	Adjust the Zoom magnification or viewing angle so that the tilt of the measurement target object is within the range of visual field. *The maximum value of visual angle is ±1.75°.
	The effective range of [Valid Light Spot Pointer] is narrow.	Set the effective range sufficient for the actual light spot size.
	End of lifespan of the laser.	Please contact our sales agency.
Measurement results show error.	There are more pixels than the specified number which luminance value is saturated.	Adjust the LD power or shutter speed to make the luminance value adequate. *The specified number of saturated pixels differ depending on [Detect Mode].
	The luminance value is out of the range of the effective light spot judgment threshold.	Set so that the effective judgment threshold is adequate. *The effective light spot judgment threshold differs depending on [Detect Mode].
Unable to conduct RS232C communication.	The RS232C cable is not connected correctly.	Connect the RS232C cable (D-sub 9-pin) correctly.
	An adequate cable is not used.	Use an RS232C cross cable.
	Communication conditions on the PC are not set correctly.	Set the communication conditions on the PC correctly.

Continued to next page

8 Troubleshooting

Phenomenon	Cause	Measures
Unable to conduct Ethernet communication.	The Ethernet cable is not connected correctly.	Connect the Ethernet cable correctly.
	An adequate communication cable is not used.	Use an adequate Ethernet cable. This product supports 1000base-T and 100base-TX.
	Communication conditions on the PC are not set correctly.	Set the communication conditions on the PC correctly.
Error is returned in command.	The screen is in the operation mode.	In the operation screen, a part of commands that influence measurement cannot be received. Move to the setting screen and send the command.
Trigger input is not accepted.	A connection to the input 4 (TRIG 24 V) of the 12-core connector or input 7 (TRIG 5V (+))/input8 (TRIG 5 V (-)) wiring is not correct.	Connect to the input 4 (TRIG 24 V) of the 12-core connector or input 7 (TRIG 5V (+))/input 8 (TRIG 5 V (-)) wiring correctly.
	The setting of [Trigger Mode] is [Internal].	Change [Trigger Mode] to [External].
	The screen is in the setting mode.	Switch to the operation screen.
The image does not get updated.	The setting of [Trigger Mode] is [External].	Conduct trigger input or change [Trigger Mode] to [Internal].

Warranty

● Warranty Period and Range

When contacting our service office, please let us know the serial number of this product.
The warranty period is one year after delivery.
However, it becomes out of warranty range for the following cases, and a fee is required for a repair.

- Damage and failure caused by incorrect use, modification and repair carried out by those who are not our company's personnel.
- When the modification prevention seal is broken.
- Damage and failure caused by a drop at transferring and moving, and inappropriate handling.
- Damage and failure caused by fires, salt damage, harmful gases, abnormal voltage, and earthquake, and other natural disasters such as lightning, wind and water disaster.
- Damage and failure generated by handling against the explanations and cautions mentioned in this manual.

● After Sales Service

Before contacting our service office, check the items listed in Page 8-2: "Error messages".
If you have questions, please contact the optical system division, sales section of our company.
<<During 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 a repair.
<<Warranty Period has Passed>>
When functions can be maintained with repairs, a repair is conducted with a fee if requested.

● Repairable period

The minimum possessing period of performance parts used for repairs of this product (necessary parts required to maintain functions) shall be one year from the end of manufacturing of this product. This period is the repairable period. A repair may be possible even after passing the possessing period of parts, please contact the optical system division, sales section of our company.
*Regarding the damage generated in this product, our company shall not be held responsible except for the repair based on this warranty.

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