

ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Visit our website - *Click HERE*

KEYENCE

MLS19GB

High-speed, High-precision Micrometer Measuring Instrument

LS-9000 Series

User's Manual

Read this manual before use.
After you read this manual, keep it in a safe place for future reference.



1 Introduction
2 Installation and Connection
3 Basic Operations
4 Easy Setting Guide
5 Program Setting
6 Checking the Measurement Results
7 Environment Setting
8 Communication Interface and I/O Terminals
9 RS-232C
10 Timing Chart
11 Specifications
A Error Messages, Troubleshooting

Introduction

Read this user's manual before use.
After you read this manual, keep it in a safe place for future reference.

Symbols

In this manual, the following symbols alert you to important messages.
Be sure to read the messages.

DANGER	**It indicates a hazardous situation which, if not avoided, will result in death or serious injury.**
WARNING	**It indicates a hazardous situation which, if not avoided, could result in death or serious injury.**
CAUTION	**It indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.**
NOTICE	**It indicates a situation which, if not avoided, could result in product damage as well as property damage.**

Important **It indicates cautions and limitations that must be followed during operation.**

Point **It indicates additional information on proper operation.**

Reference It indicates tips for better understanding or useful information.

It indicates the reference pages and items in this manual.

Precautions

(1) Unauthorized reproduction of this manual in whole or part is prohibited.

(2) The contents of this manual may be changed for improvements without prior notice.

(3) An utmost effort has been made to ensure the contents of this manual are as complete as possible. If there are any mistakes or questions, please contact a KEYENCE office listed in the back of the manual.

(4) Regardless of item (3), KEYENCE will not be liable for any effect resulting from the use of this unit.

(5) Any manuals with missing pages or other paging faults will be replaced.

Trademarks

- The company names and product names used in this manual are registered trademarks or the trademarks of their respective companies.
- Microsoft, Windows, and Windows Vista are registered trademarks of Microsoft Corporation in the United States and other countries.
- Adobe, Adobe logo, Reader are trademarks or registered trademarks of Adobe Systems Incorporated in the United States and other countries.
- Other proper nouns such as product names used in this manual are registered trademarks or the trademarks of their respective companies. This manual does not use TM or ® mark for the trademarks or registered trademarks in the text.

Safety Information

General Precautions

WARNING	• Do not use this product for the purpose to protect a human body or part of a human body. • This product is not intended for use as an explosion-proof product. Do not use this product in a hazardous location and/or potentially explosive atmosphere.

CAUTION	• At startup and during operation, be sure to monitor the functions and performance of the LS-9000 Series. • We recommend that you take substantial safety measures to avoid any damage in the event of a problem occurring. • Do not allow the temperature to change sharply around the LS-9000 Series, including the accessories. Otherwise, condensation may lead to malfunction.

NOTICE	• Do not attempt to open or modify the LS-9000 Series or use it in any way other than as described in the specifications. If the LS-9000 Series is modified or used other than as described, the warranty will be voided. • When the LS-9000 Series is used in combination with other devices, functions and performance may be degraded, depending on the operating conditions and surrounding environment.

Important Instructions

Observe the following cautions to prevent malfunction of the LS-9000 series and to ensure that it is used properly.

Precautions for use

WARNING	• Do not use the controller (LS-9501/LS-9501P) at a voltage other than 24 V DC. Failure to do so may cause fire, electric shock, or a product damage. • Do not disassemble or modify this instrument. Doing so may cause fire and electric shock.

NOTICE	• The power of this instrument and peripherals connected to this instrument must be turned off when the head cable is plugged or unplugged. Failure to do so may cause product damage.
	• Do not connect and disconnect the expansion unit and the controller while the power is on. Failure to do so may cause product damage.
	• Do not turn off this instrument while this instrument is writing data to memory such as when settings are being modified. Failure to do so may cause loss of a part of or all of the setting data.
	• Do not block the vent holes on the instrument. Increase of internal temperature could cause failure.
	• The USB connector and a part of the input/output terminals are not insulated from the DC24V (-) terminal. Exercise caution not to produce a potential difference between the non-insulated terminals due to a positive grounding environment or a potential difference between the equipment. Otherwise, it may cause a malfunction in the LS-9000 Series or a malfunction in the connected computer or other external device.
	"Insulated condition between each I/O circuit" (page 8-33)
	• You are advised to back up the settings in LS-Navigator2 to prevent data loss in the event of system trouble or failure.
	• A change in the ambient temperature may cause the measurement to fluctuate. Be sure to keep the temperature stabilized. When the ambient temperature changes by 10 °C, it takes 60 minutes for the distribution of internal temperature to equalize.
	• Wait approximately 30 minutes after the power is turned on before using the LS-9000 Series. Otherwise, the measured value may gradually fluctuate because the circuit is not immediately stable after the power is turned on.
	• Do not operate this device near lighting fixtures. If the unit must be used in such a location, install a light shielding board or similar device so that the light will not affect the measurement.
	• When the target is vibrating, the measured value may fluctuate. In this case, increase the averaging of the profiles and the measurement averaging to achieve a more accurate value.
	• The measured value may fluctuate due to the slow fluctuation in the air. In this case, take the following countermeasures.
	  • Completely cover the head with a cover
	  • Stir the air between the head and the workpiece with a fan.

Precautions in Emergency

NOTICE	Turn the power off immediately in the following cases. Using the unit in an abnormal condition could cause fire, electric shock, or accident. Contact the KEYENCE office for repair. • If liquid, including water or chemicals, or debris enters the unit. • If the unit is dropped or the case is damaged. • If abnormal smoke or odor is present.

Precautions on installation

NOTICE	• To use this instrument correctly and safely, avoid installing it in the following locations. Installation in such locations may cause malfunction.
	  • Locations that are humid, dusty or poorly ventilated
	  • Locations where the temperature is high such as those exposed to direct sunlight
	  • Locations where there are flammable or corrosive gases
	  • Locations where the unit may be subject to vibration or impact
	  • Locations where water, oil, or chemicals may splash onto the instrument
	  • Locations that are prone to static electricity
	• Installing the instrument in the vicinity of an electrical noise source such as a power source and high-voltage line could cause malfunction and instrument damage due to noise. Take preventive actions such as using noise filters, separating cables, and insulating the controller and the head. Use single-conductor shielded cable for the analog output cable.
	In the following cases, foreign matter such as dust and debris or water and oil could cause differences in the measurement values.
	• Adhesion on the protective glass: Blow off the dirt on the cover glass with clean air. If dirt persists, wipe the glass surface gently using a soft cloth moistened with alcohol.
	• Adhesion on the surface of the measuring target: Blow the dirt off with clean air or wipe it off.
	• Intrusion of floating or sprinkled dust or dirt into the light-axis range: In this case, take corrective action with a protective cover or air purge.

Precautions in storing

NOTICE	Do not wipe the instrument with a wet wipe, benzene, or thinner. Doing so could change the color or shape of the instrument. If the instrument has a large amount of dirt on it, wipe it off with a cloth moistened with a mild detergent, then wipe with a soft dry cloth.

Precautions on Regulations and Standards

CE Marking

Keyence Corporation has confirmed that this product complies with the essential requirements of the applicable EC Directive, based on the following specifications. Be sure to consider the following specifications when using this product in the Member States of European Union.

● **EMC Directive (2004/108/EC)**

- Applicable standard EMI: EN61326-1, Class A
  EMS: EN61326-1
- All cables connected to the controller terminal side and BCD unit cannot exceed 30m in length.
- Wrap more than 1 TURN of the following ferrite core to the head cable connected to the head expansion unit within 200 mm from the head connector of the head expansion unit.
  Model ZCAT2035-0930A-BK (Manufactured by TDK)

Remarks: These specifications do not give any guarantee that the end-product with this product incorporated complies with the essential requirements of EMC Directive. The manufacturer of the end-product is solely responsible for the compliance on the end-product itself according to EMC Directive.

Software product license agreement

NOTICE TO USER: PLEASE READ THIS SOFTWARE LICENSE AGREEMENT (“”THIS AGREEMENT””) CAREFULLY. BY USING ALL OR ANY PORTION OF THE LS-Navigator2 (“”THIS SOFTWARE””), YOU ARE AGREEING TO BE BOUND BY ALL THE TERMS AND CONDITONS OF THIS AGREEMENT. IF YOU DO NOT AGREE TO THE TERMS OF THIS AGREEMENT, DO NOT USE THIS SOFTWARE.

If you install, copy and or use all or a portion of this Software on a device or computer, you will be deemed to have agreed to all the terms of this Agreement, and this Agreement will come into effect.

1. Definitions

1.1 “Use” or “using” refers to the accessing, installing, downloading, copying, operating and or otherwise benefiting from the utilization of this Software.

1.2 “This Software” denotes the software and all associated documentation provided by KEYENCE.

1.3 “User” or “User’s” infers the company or persons who have had the license to use this Software granted to them by KEYENCE.

2. Grant of License.

2.1 In compliance with all of the terms and conditions of this Agreement, KEYENCE grants the nonexclusive and non-transferable license to install and use this Software.

2.2 The granting of the license permits the single reproduction and or copying of this Software for the User’s backing up or archiving purposes.

2.3. This Software maybe installed on multiple devices and computers for the User’s benefit and use.

2.4. The transfer of this Software via devices and computers with this Software installed on them by the User to third parties is permitted. In such a case, the third party who receives this Software may continue to use this Software in the same manner as the previous User.

2.5. With the transfer of this Software to a third party, the original User may install this Software to additional devices and computers for further use as required. In such a case, the third party who receives this Software may continue to use this Software in the same manner as the previous User.

2.6. The User maintains and guarantees that any thirdparties (as detailed in the previous two sections) who receive and use this Software agree to this license Agreement and comply with all the terms and conditions.

3. Restrictions.

3.1. This Software may not be modified by the User in any form except from the installation of updates or new functions provided by KEYENCE.

3.2. The reverse engineering, decompiling or disassembling of this Software by any persons are not permitted.

3.3. Without the prior permission of KEYENCE, the User may not reproduce or copy this Software for selling or distributing to a third party

4. Intellectual Property Rights.

Except as stated herein, KEYENCE reserves all rights, titles and interests in this Software, along with all associated copyrights, trademarks, and other intellectual property rights.

5. Disclaimer.

This Software is licensed to the User “AS IS” and without any warranty of any kind. In no event does KEYENCE or its suppliers accept or assume any liability for any damages, claims, costs or profit loss as a result of operating this Software.

6. Termination.

6.1 Under this Agreement the User’s license will automatically terminate if this Software and any associated copies of this Software are destroyed or voluntarily returned to KEYENCE.

6.2 Under this Agreement the User’s license will terminate immediately and automatically without any notice from KEYENCE if there is any failure to comply with any of the terms and conditions of this Agreement. Upon termination, the using of this Software shall cease, and all copies (full or partial) of this Software should be destroyed or returned to KEYENCE.

6.3 Compensation will be sought by KEYENCE should any violation or breach of this Agreement result in any incurred costs or lost profit to KEYENCE.

7. Governing Law.

7.1 This Agreement will be governed by and construed in accordance with the substantive laws of Japan.

7.2 If any part of this Agreement is found void and unenforceable, the rest of this Agreement will remain intact, valid and enforceable according to the associated terms and conditions.

MEMO

Structure of the Manual

1	**Introduction**	This chapter describes the packaged items, optional parts, system configuration, and name and function of each part.
2	**Installation and Connection**	This chapter describes the installation and connection of each instrument.
3	**Basic Operations**	This chapter describes the basic operations of LS-Navigator 2 and the touch panel monitor.
4	**Easy Setting Guide**	This chapter describes the available measurements and their settings for different measurement purposes.
5	**Program Setting**	This chapter describes the contents and setup procedure for the program settings.
6	**Checking the Measurement Results**	This chapter describes the setup screen and operation procedure of functions available during the measurement.
7	**Environment Setting**	This chapter describes the details and setting procedures for the PC communication configuration, device information setting, and other options.
8	**Communication Interface and I/O Terminals**	This chapter describes the communication specifications of the available interface (Ethernet, USB, and RS-232C) and the input/output specifications.
9	**RS-232C**	This chapter describes the RS-232C communication commands.
10	**Timing Chart**	This chapter describes all kinds of input and output timing charts.
11	**Specifications**	This chapter describes the specifications, characteristics, and dimensions of the LS-9000 Series.
A	**Appendix**	

Contents

Introduction
Symbols
Precautions
Trademarks
Safety Information 1
General Precautions 1
Important Instructions 2
Precautions for use 2
Precautions in Emergency 2
Precautions on installation 3
Precautions in storing 3
Precautions on Regulations and Standards 4
CE Marking 4
Software product license agreement 5
Structure of the Manual 7

Chapter 1 Introduction

Checking the Package 1-2
Controller 1-2
■ LS-9501/LS-9501P 1-2
Head 1-2
■ LS-9006/LS-9006M 1-2
■ LS-9030/LS-9030M 1-2
■ LS-9120M 1-2
■ LS-9006D 1-3
■ LS-9030D 1-3
HMI Display panel 1-3
■ LS-D1000 1-3
Head expansion unit 1-3
■ LS-HA100 1-3
Expansion unit 1-4
■ CB-BD100 1-4
■ CB-EP100 1-4
■ CB-PN100 1-4
Head cable 1-4
40m connecting unit for cable extension 1-4
PC software LS-H2 1-4
Option list 1-5
■ Extension cable between the transmitter and receiver 1-5
■ Display panel cable 1-5
■ Target holder pulley 1-5
■ Display panel stand 1-5
■ Display panel support 1-5
■ Panel switch 1-6
■ 24 V DC power supply 1-6
■ RS-232C cable (2.5 m, straight) 1-6
■ RS-232C conversion adapter (9-pin, female) 1-6
■ USB cable (2 m) 1-6
■ Ethernet cable 1-6
■ Air purge unit 1-7
■ Replacement glass unit 1-7
■ Protective sheet 1-7
■ I/O extension cable (3m) for BCD unit 1-7
System Configuration 1-8
Part Names and Functions 1-9
Controller 1-9
Display panel 1-10
Head 1-11
■ LS-9006/LS-9006M 1-11
■ LS-9030/LS-9030M 1-11
■ LS-9120M 1-12
■ LS-9006D 1-13
■ LS-9030D 1-13
Head expansion unit 1-14
BCD unit 1-15
EtherNet/IP communication unit 1-16
PROFINET communication unit 1-17
Software Installation 1-18
Required system environment 1-18
Preparation for the Installation 1-18
■ Hard disk free space 1-18
■ Windows environment and installation destination 1-18
■ Help file 1-18
Installing LS-Navigator2 1-19
Uninstalling LS-Navigator 1-20

Chapter 2 Installation and Connection

Mounting the Head 2-2
Installation cautions 2-2
Suitable mounting for specific environments 2-2
■ If a light source is present near the head 2-2
Mounting method 2-3
■ Mounting with the TR base 2-3
■ Mounting without the TR base 2-3
■ Mounting LS-9006D/LS-9030D 2-4
Using the Air Purge Unit 2-5
How to use the air purge unit 2-5
■ LS-9006/LS-9006M 2-5
■ LS-9030/LS-9030M 2-6
■ LS-9120M 2-7
■ LS-9006D 2-8
■ LS-9030D 2-9
Using the Pulley Jig 2-10
For LS-9030/LS-9030M 2-10
For LS-9006/LS-9006M 2-10
For LS-9006D 2-11
For LS-9030D 2-11
Replacing the Glass of the Transmitter / Receiver 2-12
For LS-9030/LS-9030M 2-12
For LS-9006/LS-9006M 2-12
For LS-9120M 2-13
Attaching the Protective Sheet 2-14
How to attach the protective sheet 2-14
Mounting the Controller 2-15
Installation cautions 2-15
Mounting the controller to the DIN rail 2-16
Mounting to the bottom panel 2-16
Mounting the Panel 2-17
Using the Display Panel Stand 2-18
Setting up the unit vertically 2-18
Setting up the unit horizontally 2-18
Using the switches (OP-87611) 2-19
Using the Display Panel Support 2-20
■ Common to LS-9006D/LS-9030D 2-20
Connecting Various Components 2-21
Connecting the transmitter and the receiver of the head 2-22
Connecting the head and the controller 2-22
Using the 40m connecting unit for cable extension 2-23
Connecting the controller and the expansion unit 2-24
Connecting the controller and the display panel ... 2-24

Connecting the controller and the PC 2-25
■ Connecting using USB 2-25
■ Connecting using the Ethernet 2-25
Connecting the power supply to the controller 2-26
How to use the terminal block 2-26

Chapter 3 Basic Operations

Basic Operation Flow 3-2
Basic Operations of the Display Panel 3-3
Basic Operation of Setting 3-3
■ Selecting Items 3-3
■ Entering numeric values 3-3
■ Using Shortcuts 3-3
Screen transition 3-4
Description of Each Screen 3-6
■ Single OUT Display 3-6
■ Multi-OUT Display 3-6
■ Operation Setting Screen 3-7
■ Program Switching Screen 3-8
■ Display Setting Screen 3-8
■ Light Intensity Inspection Screen 3-9
■ Display OUT Selection Screen 3-9
■ Position Display Head Selection Screen 3-10
■ 2D Position Display Setting Screen 3-11
■ Key Lock Check Screen/Password Entry Screen 3-13
■ Buzzer Setting Screen 3-14
■ All Setting Initialization Screen 3-14
Basic Operations of LS-Navigator2 3-15
Startup 3-15
Shutdown 3-16
Sending/Reading Settings 3-16
■ Sending the settings to the controller 3-16
■ Reading Settings from Controller 3-17
Saving and Reading Setting File 3-17
Saving the setting file 3-17
Reading Setting File 3-18
■ From Startup Menu 3-18
■ From Main Screen 3-18
■ From [Program setting] Screen 3-19
Displaying Objective Screen 3-19
How to Use Help 3-20

Chapter 4 Easy Setting Guide

Flow of Measurement 4-2
Outer Diameter Measurement (1 head) 4-4
■ Setting values 4-4
Outer Diameter Measurement (2 Axes) 4-5
■ Setting values 4-5
Outer Diameter / Width Measurement (Large Diameter Measurement by Using 2 Heads) 4-6
■ Setting values 4-6
■ Steps 4-6
Inner Diameter / Gap Measurement 4-7
■ Setting values 4-7
Outer Diameter / Runout Measurement 4-8
■ Setting values 4-8
■ Steps 4-8
Edge Position Measurement 4-9
■ Setting values 4-9
Edge Position Measurement (Transparent Target) 4-10
■ Setting values 4-10
Pitch Measurement 4-11
■ Setting values 4-11
Group Determination 4-12
■ Setting values 4-12
Statistical Processing 4-13
■ Setting values 4-13

Chapter 5 Program Setting

Flow of the Program Setting 5-2
If you wish to create new program settings 5-2
If you wish to edit existing program settings 5-2
List of Initial Values and Setting Ranges 5-3
Basic settings 5-3
■ Set measure target 5-3
■ OUT setting 5-3
Calibration and Scaling 5-6
Common setting 5-7
■ Edge detection 5-7
■ Interference prevention 5-7
■ Sync setting 5-7
■ Data storage 5-7
■ Group calculation 5-8
■ I/O terminal setting 5-8
■ Stat process 5-9
Setting a different range and initial value for the minimum display unit 5-10
Different Initial Value for Setting Calibration and Scaling Points 5-14
Combined limitation for analog scaling (Ref. val mode) and minimum display unit 5-15
Limitation for combined analog scaling (Ref. val mode) and minimum display unit 5-15
Function Restriction of Each Head Model 5-16
Function Restriction of Each Head Model 5-16
[Program Setting] Screen 5-17
[Edit program list] dialog 5-18
Basic Operations of LS-Navigator2 5-18
Switching the program setting 5-18
Changing the program name 5-18
Copying the program setting 5-19
Initializing the program setting 5-19
Settings on the Display Panel 5-19
Copying the program setting 5-19
Initializing the program setting 5-20
[Basic settings] Tab: Set Measurement Target 5-21
[Set measure target] area 5-21
[Target] window 5-22
Set measure target 5-22
■ Outer diameter 5-22
■ Top edge/Bottom edge 5-23
■ Edge (pitch) number setting 5-24
■ Ultrafine outer DIA 5-25
■ Ultrafine gap 5-25
■ Tx-Rx Pos. 5-25
■ Center position 5-25
Optional setting 5-26
■ Tilt correction 5-26
■ Delay 5-26
■ Median filter 5-26
Basic Operations of LS-Navigator2 5-27
Adding more measurement targets 5-27

Editing the measurement target....5-27
Deleting any measurement target....5-27
Switching the display method of target....5-27
Display Panel Setting Method....5-28
Target setting method....5-28
Setting multiple measurement targets....5-28
Selecting the measuring head....5-29
Setting the measurement method....5-30
■ Switching the edge/pitch setting....5-30
Setting up the tilt correction....5-31
Setting up the delay....5-31
Setting up the median filter....5-31
[Basic settings] Tab: OUT Setting....5-32
[OUT setting] area....5-32
[Edit OUT list] dialog....5-33
[Measure mode] window....5-33
[OUT option setting] window....5-34
OUT setting....5-34
■ Minimum display unit....5-34
■ Tolerance mode....5-35
■ Add OUT....5-35
■ Delete OUT....5-35
■ Edit OUT list....5-35
■ OUTx....5-35
■ OUT name....5-35
■ Calculation method....5-36
■ Offset....5-36
■ Measurement mode....5-37
■ Filter....5-38
■ Tolerance....5-39
■ OUT option setting....5-40
Basic Operations of LS-Navigator2....5-41
Setting the minimum display unit....5-41
Setting the tolerance mode....5-41
Add OUT setting....5-41
Edit OUT setting....5-42
Delete OUT setting....5-42
Copy OUT setting....5-42
Modifying the OUT setting name in the edit list operation....5-42
Display Panel Setting Method....5-43
OUT setting method....5-43
Setting multiple OUTs....5-43
Calculation setting....5-44
■ No calculation setting....5-44
■ Combined calculation setting....5-45
■ Average setting....5-45
Minimum display unit....5-45
Outlier exclusion function....5-46
■ Outlier exclusion enable setting....5-46
Filter setting....5-47
Difference function setting....5-47
Abnormal value canceling function setting....5-48
Offset setting....5-49
Measurement mode setting....5-49
Tolerance setting....5-50
■ Switching the tolerance mode....5-50
[Calibration, Scaling] Tab: Calibration Setting....5-52
[Calibration setting] area....5-53
[Calibration setting] dialog....5-54
Calibration setting....5-54
■ Set from actual....5-54
■ Calibration pts....5-54
Basic Operations of LS-Navigator2....5-55
Registering the calibration setting....5-55
Restoring the calibration setting to its initial value....5-55
Canceling the registration of calibration setting....5-55
Display Panel Setting Method....5-56
Registering the calibration setting....5-56
[Calibration, Scaling] Tab: Scaling Setting....5-57
[Scaling] area....5-58
[Scaling] dialog....5-59
Scaling setting....5-59
■ Set from actual....5-59
■ Scaling pts....5-59
Basic Operations of LS-Navigator2....5-60
Register the scaling setting....5-60
Restoring the scaling setting to its initial value....5-60
Canceling the registration of scaling setting....5-60
Display Panel Setting Method....5-61
Register the scaling setting....5-61
[Common setting] Tab: Edge Detection....5-62
[Edge detection] area....5-62
[Calibration of received light intensity] dialog....5-63
Edge detection....5-64
■ Edge detection threshold....5-64
■ Mask setting....5-65
■ Check No. of edges....5-65
■ FOCUS monitor....5-66
■ Acquiring received light waveforms....5-67
■ Calibration of received light intensity....5-67
Basic Operations of LS-Navigator2....5-67
Setting edge detection....5-67
Acquiring received light waveforms....5-67
Performing calibration of received light intensity....5-68
Display Panel Setting Method....5-68
Edge detection setup....5-68
Setting edge detection....5-69
Setting a mask range....5-69
Setting the Check No. of edges function....5-70
Setting FOCUS monitor....5-70
Performing calibration of received light intensity....5-71
[Common setting] Tab: Interference Prevention....5-72
[Interference prevention] area....5-72
Interference prevention function....5-73
■ AB-ON....5-73
■ ABC-ON....5-73
Basic Operations of LS-Navigator2....5-73
Display Panel Setting Method....5-73
[Common setting] Tab: Sync Setting....5-75
[Sync setting] area....5-75
Sync measure target....5-76
Basic Operations of LS-Navigator2....5-76
Display Panel Setting Method....5-76
[Common setting] Tab: Data Storage....5-77
■ In case of storage cycle “x1”....5-77
■ In case of storage cycle “TIMING sync” or “Storage trg sync”....5-77
[Data storage] area....5-78
Data storage....5-79
■ Storage points....5-79
■ Storage cycle....5-79

■ Storage control method 5-79
■ Storage target OUT 5-79
■ Fail storage 5-79
Basic Operations of LS-Navigator2 5-80
Display Panel Setting Method 5-80
Setting data storage 5-80
Setting storage points 5-81
Setting storage cycle 5-81
Setting storage control 5-82
Setting storage target OUT 5-82
Setting fail storage 5-83
[Common setting] Tab: Group Calculation 5-84
[Group calculation] area 5-85
Group calculation 5-86
■ Calc. content 5-86
■ Original calc. OUT 5-86
■ Calc. point 5-86
Basic Operations of LS-Navigator2 5-86
Display Panel Setting Method 5-87
Setting group calculation 5-87
[Common setting] Tab: I/O Terminal Setting 5-89
[I/O terminal setting] area 5-89
[Encoder set] area 5-90
[I/O setting] area 5-90
[Analog output] area 5-91
[Analog output terminal setting] window 5-91
[Status output] area 5-91
[BCD unit] area 5-92
I/O terminal setting 5-93
Encoder set 5-93
■ Input mode 5-93
■ Sampling 5-95
■ Pitch unit 5-95
■ Pitch interval 5-95
■ Encoder TIM func 5-95
■ Pulse count preset 5-95
I/O setting 5-96
■ Strobe time 5-96
■ Off-delay time 5-96
■ No. of control Ch 5-96
■ Total judgment setting 5-97
Analog output 5-97
■ Ref value mode 5-97
■ Threshold mode 5-97
■ Analog scaling value 5-98
■ Volt of output waiting data 5-98
Status output 5-98
■ Output waiting 5-98
■ Outlier continue 5-98
■ FOCUS 5-98
■ Insufficient light 5-98
■ Check No. of edges: Fail 5-98
■ Stat processing 5-98
■ Pulse frequency error 5-98
BCD unit 5-99
■ Output selection function 5-99
■ OUT selection method 5-99
■ BCD strobe time 5-99
Basic Operations of LS-Navigator2 5-100
Setting the encoder 5-100
Setting judgment output 5-100
Setting analog output 5-100
Setting status output 5-100
BCD unit 5-100
Setting the display panel 5-101
I/O terminal setting 5-101
Setting the encoder 5-101
■ Input mode setting 5-101
■ Pulse count preset 5-102
■ Encoder TIM func setting 5-102
■ Sampling setting 5-103
I/O setting output 5-103
■ Strobe time 5-103
■ Off-delay time 5-103
■ No. of control Ch 5-104
Setting analog output 5-105
Setting status output 5-106
■ Upon selection of WAIT or OUTLIER 5-107
■ Upon selection of FOCUS, DARK, or EDGE-CHK 5-107
■ Upon selection of STAT-RUN 5-107
■ Upon selection of FREQ-ERR 5-107
BCD unit 5-107
■ When OUT-FUNC is selected 5-107
■ When INPUT is selected 5-108
■ When CH is selected 5-108
■ When STROBE is selected 5-108
[Common setting] Tab: Stat Process 5-109
[Stat process] area 5-109
Statistic process settings 5-110
■ Stat control method 5-110
■ No. of stat proc 5-110
■ Stat process Ch1 to Ch2 5-110
Setting LS-Navigator2 5-111
Setting the display panel 5-111
Statistical processing 5-111
Stat control method 5-112
Setting No. of stat proc 5-112
Stat process settings 5-113
[Setting list] Tab 5-114
Items in which any setting is updated 5-115
Setting list 5-115
Setting LS-Navigator2 5-115
Checking settings before update 5-115
Copying list of settings 5-115

Chapter 6 Checking the Measurement Results

Measurement Screen Outline and Switching Screens 6-2
Measurement screen outline 6-2
■ [Head information] screen 6-2
■ [Display measurement value] screen 6-2
■ [Total judgment] screen 6-2
■ [Target viewer] screen 6-2
■ [Trend graph] screen 6-2
■ [Data storage] screen 6-2
■ [Oval display] screen 6-2
■ [2D position display] screen 6-2
■ [Display stat process] screen 6-2
■ [SPC] screen 6-2
■ [Event logging] screen 6-2
■ [Display terminal status] screen 6-2
Head Information 6-3
Head information 6-3
Head indicator 6-3
■ Head status 6-3
Common indicator 6-3
■ Head common status 6-3

Display Measurement Value....6-4
[Display measurement value] screen....6-4
[OUT display setting] dialog....6-6
Display mode....6-6
■ Simple display....6-6
■ Detailed display (small-size)....6-6
■ Detailed display (large-size)....6-6
[Excel transfer - Logging settings] dialog....6-8
[Excel transfer] dialog (Click logging)....6-10
[Excel transfer] dialog box (Trigger logging)....6-10
[Excel transfer] (Click logging/Trigger logging)....6-10
■ Writing format to Excel....6-10
■ When any abnormal value exists....6-10
Total Judgment....6-12
[Total judgment] screen....6-12
■ When the total judgment is "Pass"....6-12
■ When the total judgment is "Fail"....6-12
Target Viewer....6-14
[Target viewer] screen....6-14
Trend Graph....6-16
[Trend graph] Screen....6-16
Graph display area....6-17
■ [Time/view] drop-down list....6-17
■ Graph display area....6-17
Data Storage....6-20
[Data storage] Screen....6-20
Graph display area....6-22
■ Vertical axis....6-22
■ Horizontal axis....6-22
■ OUT tag....6-22
■ Tolerance....6-22
■ Cursors A and B....6-22
Data display area....6-22
■ [Target]....6-22
■ [OUT name]....6-22
■ [Cursor A]....6-22
■ Judgment result of the cursor A position....6-22
■ [Cursor B]....6-22
■ Judgment result of the cursor B position....6-22
■ [Cursor A-B]....6-23
■ [Max A-B]....6-23
■ [Min A-B]....6-23
■ [Avg A-B]....6-23
■ [A-B deviation]....6-23
■ [Acq date]....6-23
■ [Pulse count]....6-23
[Excel transfer settings] dialog....6-24
[Data search] dialog....6-26
[Set comparison] window....6-26
Oval Display....6-28
[Oval display] screen....6-28
Oval display area....6-29
■ Radial axis....6-29
■ Tolerance....6-29
Data display area....6-29
■ [Target]....6-29
■ [OUT name]....6-29
■ [Max value]....6-29
■ [Min value]....6-29
■ [p-p value]....6-29
■ [Avg value]....6-29
2D Position Display....6-30
[2D position display] screen....6-30
Display Stat Process....6-32
[Display stat process] screen....6-32
Statistical information display area....6-33
■ [Average]....6-33
■ [Maximum value]....6-33
■ [Minimum value]....6-33
■ [Max-Min]....6-33
■ [Deviation]....6-33
■ [Parameter]....6-33
■ [HH]....6-33
■ [HI]....6-33
■ [GO]....6-33
■ [LO]....6-33
■ [LL]....6-33
SPC....6-34
[SPC] screen....6-34
SPC information....6-35
Graph display area....6-35
■ Vertical axis....6-35
■ Horizontal axis....6-35
■ X bar tag....6-35
■ R tag....6-35
■ Average....6-35
■ Upper Control Limit (UCL) / Lower Control Limit (LCL)....6-35
■ Out of spec....6-35
Data display area....6-36
■ [Target OUT]....6-36
■ [Data acq interval]....6-36
■ [SPC group points]....6-36
■ [SPC group interval]....6-36
■ [Copy SPC information] button....6-36
■ [No. of groups]....6-36
■ [Valid No. of groups]....6-36
■ [Last acq date]....6-36
■ [Final pulse count]....6-36
■ [X bar up standard]....6-36
■ [X bar low standard]....6-36
■ [X bar UCL]....6-36
■ [X bar LCL]....6-36
■ [X bar average]....6-36
■ [X maximum value]....6-36
■ [X minimum value]....6-36
■ [Deviation]....6-37
■ [CpK]....6-37
■ [Cp]....6-37
■ [R up standard]....6-37
■ [R UCL]....6-37
■ [R average]....6-37
■ [Acq date]....6-37
■ [Pulse count]....6-37
■ [Group No.]....6-37
■ [X bar]....6-37
■ [R]....6-37
[SPC setting] dialog....6-38
SPC setting....6-39
[SPC collection setting] area....6-39
■ Target OUT....6-39
■ Data acq interval....6-39
■ Group points....6-39
■ Group interval....6-39
■ Max. plot pts....6-39
[X bar graph] area....6-40
■ Vertical scale....6-40
■ Standard....6-40
[R graph] area....6-40
■ Vertical scale....6-40
■ Standard....6-40
Event Logging....6-42

[Event logging] screen 6-42
Event logging 6-43
Display Terminal Status 6-44
[Display terminal status] screen 6-44
[Controller] tab 6-44
[BCD Unit] tab 6-45
Outputting test data 6-46
Outputting test data 6-46

Chapter 7 Environment Setting

PC communication configuration 7-2
Communicate via USB 7-2
Communicate via Ethernet 7-2
Instrument information display setting 7-5
LS-Navigator2 setting method 7-5
■ Saving the device settings file 7-5
■ Loading the device settings file 7-6
■ Initializing the controller setting 7-6
[Common] tab 7-7
■ Program setting switching method 7-7
■ Panel lock 7-7
■ Password 7-7
LS-Navigator2 setting method 7-7
Display panel setting method 7-8
■ Method for Setting up the Environment Settings 7-8
■ Program switching setting 7-9
■ Panel lock setting 7-9
[Time and Date] tab 7-10
■ Time and Date setting 7-10
■ Daylight savings time setting 7-10
LS-Navigator2 setting method 7-10
[Ethernet] tab 7-11
■ Setting at next power ON 7-11
■ IP address/Subnet mask/Gateway 7-11
■ TCP port number 7-11
■ UDP port number 7-11
LS-Navigator2 setting method 7-11
Display panel setting method 7-12
■ Setting the ETHERNET 7-12
■ Setting the operation at next power ON 7-13
■ Setting the IP address 7-13
■ Setting the subnet mask 7-14
■ Setting the gateway 7-14
■ Setting the TCP port number 7-15
[RS232C] tab 7-15
■ Communication speed 7-15
■ Parity 7-15
■ Data send mode 7-15
LS-Navigator2 setting method 7-16
Display panel setting method 7-17
Optional settings 7-18
Changing the OUT display color 7-18
LS-Navigator2 setting method 7-18
Initializing the screen layout 7-19
LS-Navigator2 setting method 7-19
Displaying the start-up menu 7-19
LS-Navigator2 setting method 7-20
Language setting 7-21
Switching the display language 7-21
Help 7-22
Manual 7-22
Version information 7-22

Chapter 8 Communication Interface and I/O Terminals

Ethernet Interface 8-2
Basic specifications/Connector specifications 8-2
USB Interface 8-3
Basic specifications/Connector specifications 8-3
RS-232C Interface 8-4
Communication specifications 8-4
Connector specifications 8-4
Connection with the PLC link unit or PC 8-5
Outputting measurement values and changing settings using commands 8-6
■ Command types 8-6
■ Command format 8-6
I/O Terminal Names and Functions 8-7
Input terminal block 1 8-7
Input terminal block 2 8-9
Encoder signal input terminal block 8-11
Output terminal block 1 8-12
Output terminal block 2 8-13
Analog output terminal block 8-15
24V power input terminal block 8-16
Head expansion unit 8-17
BCD unit Input terminal block 1 8-18
BCD unit Input terminal block 2 8-19
BCD unit Expansion connector 8-21
■ Output connector 1 8-21
■ Output connector 2 8-22
■ Output connector 3 8-24
■ Output connector 4 8-25
I/O circuit 8-27
■ LS-9501 (NPN type) 8-27
■ LS-9501P (PNP) type 8-29
■ Common for LS-9501/LS-9501P/LS-HA100 8-31
■ CB-BD100 8-31
Encoder input 8-35

Chapter 9 RS-232C

RS-232C interface commands 9-2
Command format 9-2
Received command format 9-2
Reply command format 9-2
Reply command format in the event of an error 9-3
Measurement value formats 9-4
■ Measurement value format examples 9-4
Setting numeric value formats 9-4
■ Examples of setting numeric value formats 9-4
Specification of the automatic transmission 9-5
■ Output format 9-5
■ When output measurement values in synchronization with the TIMING1 terminal 9-6
■ When outputting measurement values using the “Self timing hold” mode 9-6
ASCII code table 9-7
Measurement control command list 9-8
■ Measurement value output (Single) 9-8
■ Measurement value output (Multiple) 9-9
■ Measurement value output (ALL) 9-9
■ Timing ON/OFF (Single) 9-10
■ Timing ON/OFF (Multiple) 9-10
■ Timing ON/OFF (Synchronization) 9-10

■ Auto zero ON/OFF (Single) 9-10
■ Auto zero ON/OFF (Multiple) 9-11
■ Auto zero ON/OFF (Synchronization) 9-11
■ Reset (Single) 9-11
■ Reset (Multiple) 9-11
■ Reset (Synchronization) 9-12
■ Statistics data output 9-12
■ Statistics start 9-12
■ Statistics stop 9-12
■ Statistics clear 9-13
Setting control command list 9-13
Settings change command list 9-14
■ Head setting 9-15
■ Setting the measurement target 9-17
■ OUT setting 9-19
■ Tolerance setting 9-22
■ Calibration/Scaling 9-23
■ Common settings 9-24
■ I/O terminal setting 9-27
■ Data storage 9-31
■ Statistics processing 9-33
Setting check command list 9-34
■ Head setting 9-34
■ Setting the measurement target 9-34
■ OUT setting 9-34
■ Tolerance setting 9-35
■ Calibration/Scaling 9-35
■ Common settings 9-35
■ I/O terminal setting 9-36
■ Data storage 9-36
■ Statistics processing 9-36
Other commands 9-37
List of command parameters 9-37
Time delay in response when sending and receiving commands 9-40

Chapter 10 Timing Chart

Measurement overview 10-2
■ Normal 10-2
■ Auto peak hold/Auto bottom hold/Auto peak to Peak hold 10-3
■ Peak hold/Bottom hold/Peak to Peak hold/Average hold (Hold 1) 10-4
■ Peak hold/Bottom hold/Peak to Peak hold/Average hold (Hold 2) 10-5
■ Peak hold/Bottom hold/Peak to Peak hold/Average hold (Hold 3) 10-6
■ Sample hold (Hold 1) 10-7
■ Sample hold (Hold 2) 10-8
■ Self timing hold 10-9
I/O details 10-10
■ Normal mode, Auto peak hold/Auto bottom hold/Auto peak to Peak hold 10-10
■ Normal mode, Auto peak hold/Auto bottom hold/Auto peak to Peak hold (Hold 1 to Hold 3) 10-11
■ Sample hold (Hold 1) 10-12
■ Sample hold (Hold 2) 10-13
■ Self timing hold 10-14
■ Encoder input 10-15
■ Encoder TIMING input (Pulse frequency error) 10-17
■ Statistics processing 10-18
■ Total judgement output 10-18
■ Data storage (Sampling frequency synchronization) 10-19
■ Data storage (TIMING synchronization/Storage trigger synchronization) 10-20
■ Group calculation 10-21
■ BCD unit 10-22
■ Sampling frequency 10-23

Chapter 11 Specifications

Specifications 11-2
Controller 11-2
Head 11-4
■ LS-9006M/LS-9006/LS-9030M/LS-9030/LS-9120M 11-4
■ LS-9006D/LS-9030D 11-6
Head expansion unit 11-7
BCD unit 11-7
EtherNet/IP communication unit 11-8
PROFINET communication unit 11-9
Display panel 11-10
Cable 11-11
Head cable/Extension cable 11-11
Extension cable between the transmitter and receiver 11-11
Dedicated display panel cable 11-11
LS-H2 (LS-Navigator2) operating system environment 11-12
Other options 11-13
40m connecting unit for cable extension 11-13
Target holder pulley 11-13
Display panel stand 11-13
Display panel support 11-13
Characteristics 11-14
Measurement range and accuracy 11-14
■ LS-9006/LS-9006M 11-14
■ LS-9030/LS-9030M 11-14
■ LS-9120M 11-15
■ LS-9006D 11-16
■ LS-9030D 11-17
Temperature characteristics 11-18
■ LS-9006/LS-9006M/LS-9006D 11-18
■ LS-9030/LS-9030M/LS-9030D 11-18
■ LS-9120M 11-18
State Table 11-20
Dimensions 11-23
Controller 11-23
Sensor Head 11-24
■ LS-9006/LS-9006M 11-24
■ LS-9030/LS-9030M 11-25
■ LS-9120M 11-26
■ LS-9006D 11-27
■ LS-9030D 11-28
HMI Display panel 11-29
■ LS-D1000 11-29
Head expansion unit 11-30
■ LS-HA100 11-30
BCD unit 11-31
■ CB-BD100 11-31
EtherNet/IP communication unit 11-32
PROFINET communication unit 11-32
Head extension cable 11-33
■ Cable between the controller and head CB-B3/CB-B10 11-33
■ Head extension cable CB-B5E/CB-B10E/CB-B20E 11-33

■ Cable between the transmitter and receiver OP-87686 (1 m cable)/OP-87687 (3 m cable) 11-33
40m connecting unit for cable extension 11-34
■ CB-BR01 11-34
Target holder pulley 11-34
■ OP-87609 (For LS-9030)..... 11-34
■ OP-87684 (For LS-9006)..... 11-35
■ OP-87749 (For LS-9030D)..... 11-35
■ OP-87750 (For LS-9006D)..... 11-36
Panel stand 11-36
■ OP-87610 11-36
Display panel support 11-37
■ OP-87757 11-37

Appendix

Measurement Conditions and Measurement Data Flow A-2
LS-Navigator2 Saved File List..... A-3
Transition diagram for the display panel operations setting screen A-4
Troubleshooting..... A-15
If a problem occurs A-15
Error Messages A-18
System error message.....A-18
Error messages in the RS-232C/display panel....A-21
Index..... A-23
Revision history A-32

MEMO

1

Introduction

This chapter describes the configurations, main parts and functions of the LS-9000 Series.

Checking the Package 1-2
System Configuration 1-8
Part Names and Functions 1-9
Software Installation 1-18

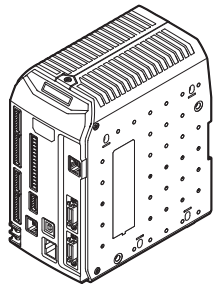
Checking the Package

Unpack the LS-9000 Series and check if the following parts are included in the package.
See “Option list” (page 1-5) regarding the separately sold optional products.
KEYENCE takes all possible measures to ensure correct packaging. If any parts are missing, please contact the nearest KEYENCE office.

Controller

■ LS-9501/LS-9501P

Controller

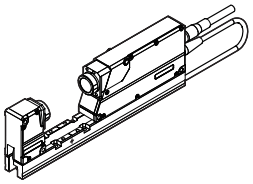


Flathead screwdriver
User’s manual (This document)

Head

■ LS-9006/LS-9006M

Sensor Head (includes air purge unit)



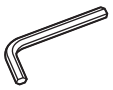
Hexagon socket bolts
(M3 x 35 washer included: x 5)



Hexagon socket bolts
(M4 x 20 : x 4)

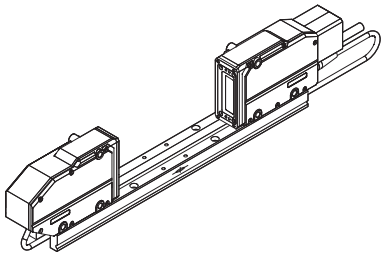


Hexagonal wrench



■ LS-9030/LS-9030M

Sensor Head (includes air purge unit)



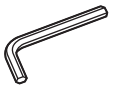
Hexagon socket bolts
(M5 x 45 washer included: x 6)



Hexagon socket bolts
(M4 x 20 : x 4)

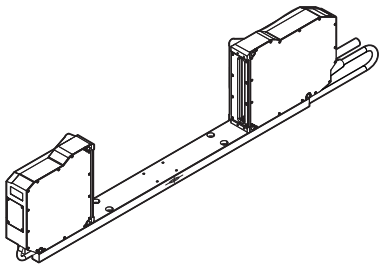


Hexagonal wrench



■ LS-9120M

Sensor Head



Hexagon socket bolts
(M6 x 65 washer included: x 6)

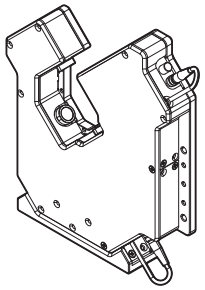


Hexagon socket bolts
(M6 x 20 : x 4)



■ **LS-9006D**

Sensor Head (includes air purge unit)

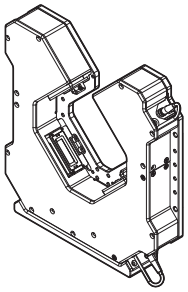


Hexagon socket bolts (M6 x 25 : x 4)



■ **LS-9030D**

Sensor Head (includes air purge unit)



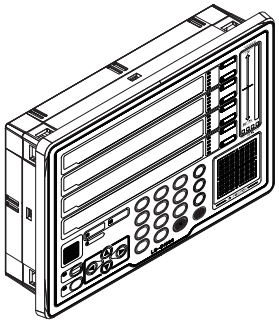
Hexagon socket bolts (M6 x 25 : x 4)



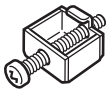
HMI Display panel

■ **LS-D1000**

HMI Display panel



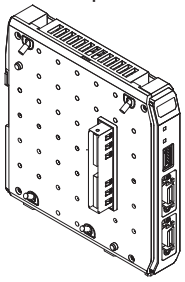
Panel mounting brackets (x 4)



Head expansion unit

■ **LS-HA100**

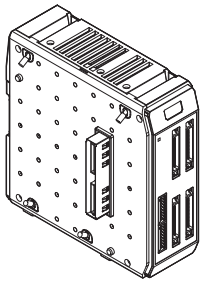
Head expansion unit



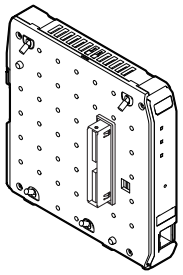
Flathead screwdriver
Ferrite core x2

Expansion unit

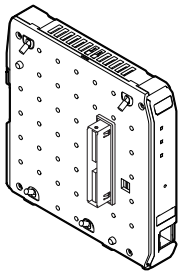
■ **CB-BD100**
BCD unit



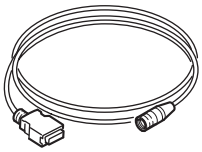
■ **CB-EP100**
EtherNet/IP unit



■ **CB-PN100**
PROFINET unit



Head cable



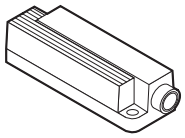
CB-B3 : 3 m cable x1
CB-B10 : 10 m cable x1



Head extension cable
CB-B5E : 5 m extension cable x 1
CB-B10E : 10 m extension cable x 1
CB-B20E : 20 m extension cable x 1

40m connecting unit for cable extension

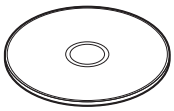
CB-BR01



Connection cable

PC software LS-H2

LS-H2
CD-ROM

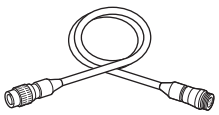


Option list

■ Extension cable between the transmitter and receiver

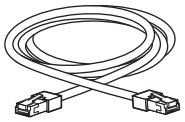
Up to three cables (maximum of 9 m) can be used at LS-9120M.
For other models, only one cable can be used.

OP-87686 : 1 m cable
OP-87687 : 3 m cable



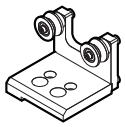
■ Display panel cable

OP-87602 : 2 m cable
OP-87603 : 5 m cable
OP-87604 : 10 m cable
OP-87605 : 20 m cable

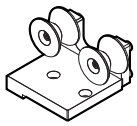


■ Target holder pulley

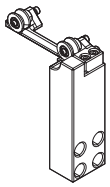
OP-87684 : For LS-9006
2 screws M4 x 8



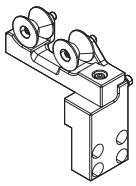
OP-87609 : For LS-9030
2 screws M4 x 8



OP-87750 : For LS-9006D
4 screws M5 x 15



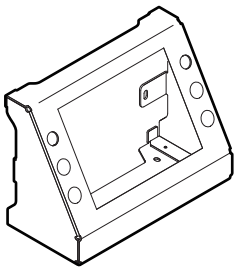
OP-87749 : For LS-9030D
4 screws M5 x 15



■ Display panel stand

OP-87610

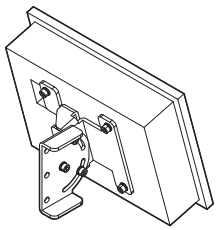
6 caps
1 DIN rail
(2 of each) screws, nuts, and washers
4 rubbers



■ Display panel support

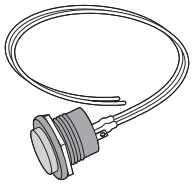
OP-87757

4 screws M4 x 10
3 screws M5 x 12



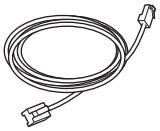
■ **Panel switch**

OP-87611



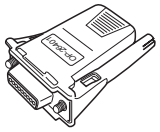
■ **RS-232C cable (2.5 m, straight)**

OP-96368



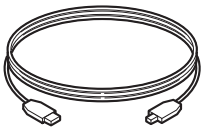
■ **RS-232C conversion adapter (9-pin, female)**

OP-26401



■ **USB cable (2 m)**

OP-66844

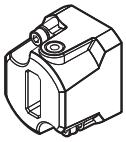


■ **Ethernet cable**

OP-66843

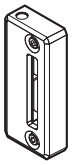
■ Air purge unit

OP-87696 (For LS-9006/LS-9006M)



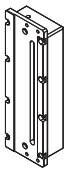
x 2
Hexagonal wrench

OP-87695 (For LS-9030/LS-9030M)



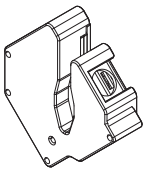
x 2
Hexagonal wrench

OP-87755 (For LS-9120M)



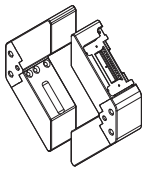
x 2
Hexagon socket bolts
(M3 x 10 : x 8)
Hexagonal wrench

OP-87752 (For LS-9006D)



Hexagon socket bolts
(M4 x 35 : x 4)

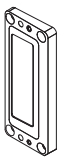
OP-87751 (For LS-9030D)



Hexagon socket bolts
(M5 x 50 : x 4)

■ Replacement glass unit

OP-87697 (For LS-9030/LS-9030M, common for transmitter and receiver)



x 1
4 pan head screws M2 x 4

OP-87756 (For LS-9120M, common for transmitter and receiver)



x 1
Hexagon socket bolts
(M2 x 4 : x 8)
Hexagonal wrench

OP-87698 (For LS-9006/LS-9006M transmitter)



x 1

OP-87699 (For LS-9006/LS-9030M receiver)

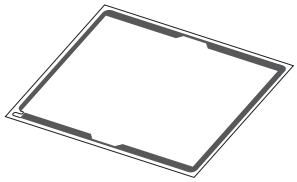


x 1

■ Protective sheet

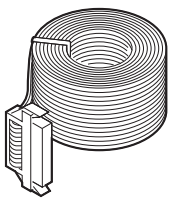
OP-87729 (For LS-D1000)

5 sheets



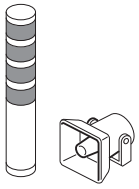
■ I/O extension cable (3m) for BCD unit

OP-51657

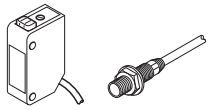


System Configuration

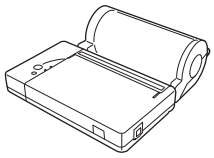
The LS-9000 Series can configure a system with the following devices and third party items.



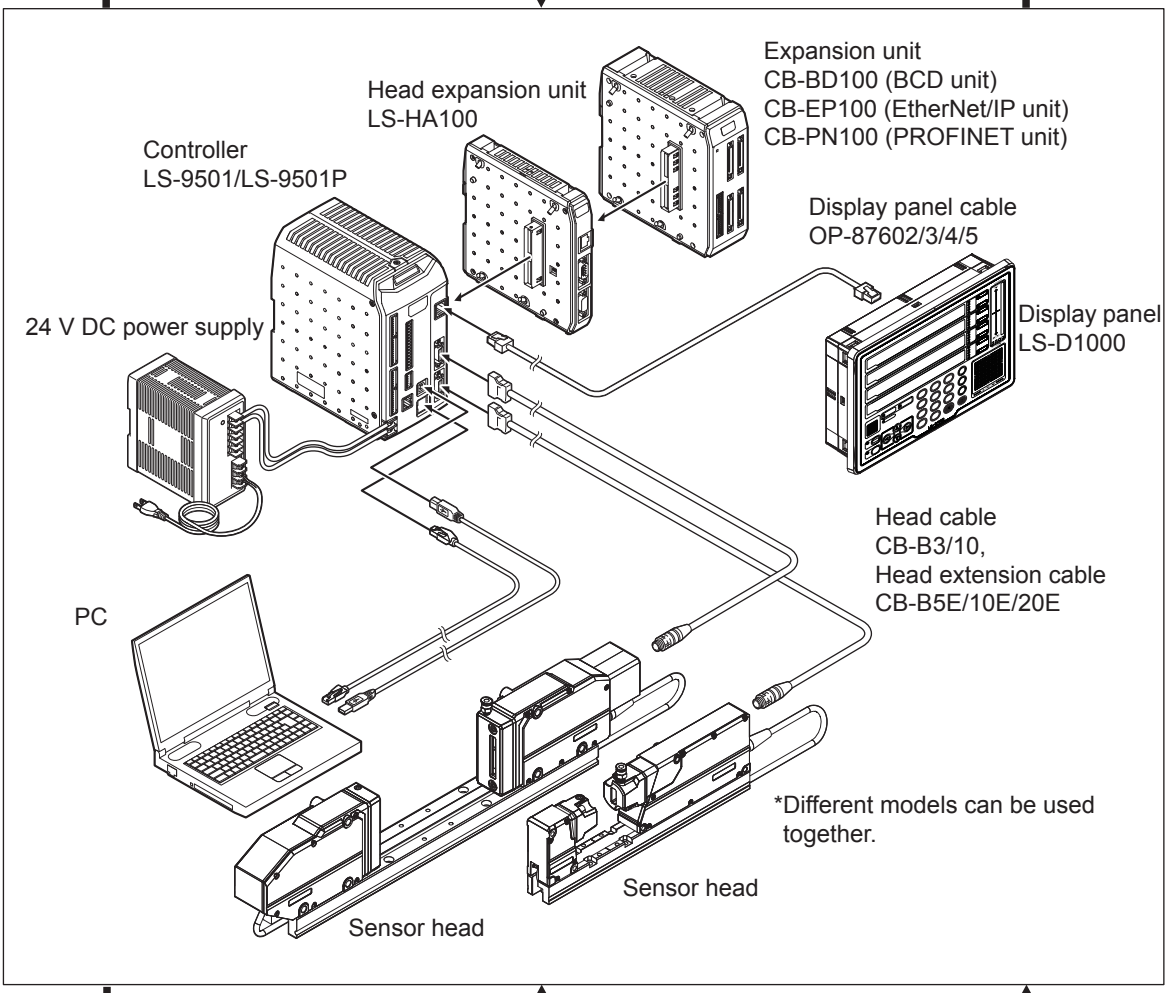
Stack light, buzzer, and others
Depending on the output of the determination result, notification such as warning can be generated.

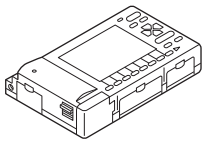


Encoder, photoelectric sensor, proximity sensor, and others
The sensors send a signal to the timing input when they detect any target object.

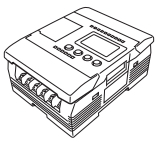


Printer
A printer prints out the measurement results.

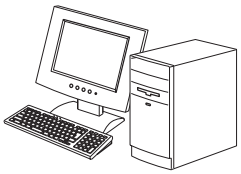




Data logger
A data logger can record the measurement values.



Programmable controller
A programmable controller can receive the control output and measurement values, as well as control the measurement timing and switch between the set program numbers.



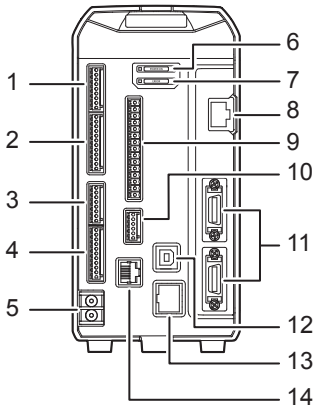
PC
A personal computer can control and receive the measurement values via RS-232C, USB, and Ethernet communication.

Part Names and Functions

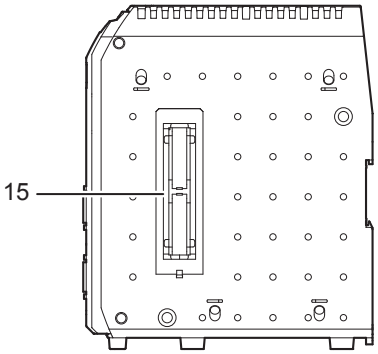
This section describes the part names and functions of the controller, display panel and heads.

Controller

Terminal side

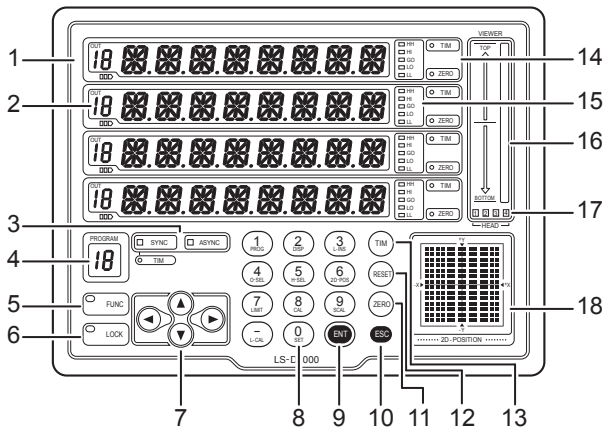


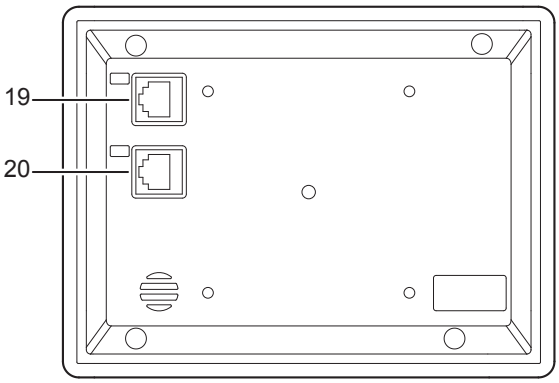
Left side



	Names	Contents
1	Input terminal block 1	Used for control signal input. 9-pole European terminal block
2	Input terminal block 2	Used for control signal input. 12-pole European terminal block
3	Output terminal block 1	Used for control signal output. 8-pole European terminal block
4	Output terminal block 2	Used for control signal output. 11-pole European terminal block
5	24V power input terminal block	Used for supply of the power source (DC24V). Upper side: +24 V, Lower side: +0 V
6	POWER ON LED	Lights green when the controller normally turned on.
7	ERROR LED	Shows the controller status. OFF: Normal operating state Lights red: Error status
8	Display panel connector	Connects to the display panel.
9	Encoder input terminal block	Used for pulse signal input from an encoder. 15-pole European terminal block
10	Analog output terminal block	Used for analog voltage/current output. 6-pole European terminal block
11	Head connector	Connects to the sensor head. Bottom: Head 1 connector, Upper side: Head 2 connector The head can be connected to either Head connector 1 or Head connector 2.
12	USB port	Connects to a personal computer with a USB cable. (Type B connector)
13	Ethernet port	Connects to a personal computer with the Ethernet cable. (RJ-45 connector)
14	RS-232C port	Connects to a personal computer or PLC with the RS-232C cable. (modular 6-pin connector)
15	Expansion unit connector	Connects to the expansion unit.

Display panel

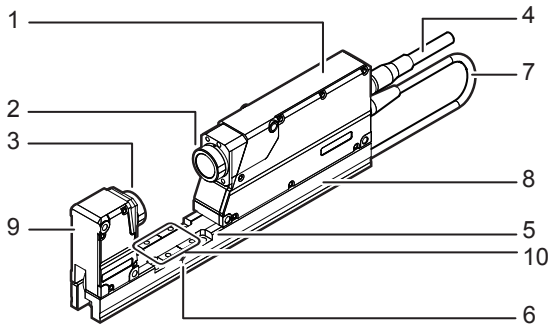




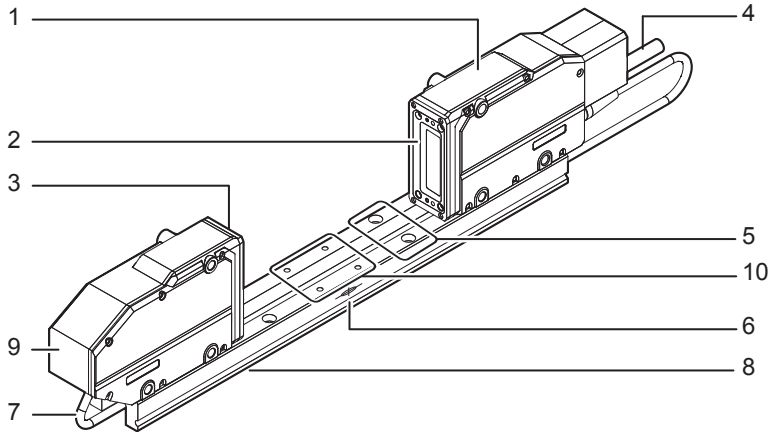
	Names	Contents
1	Main display area	During measurement: Displays the measurement value or tolerance setting. During setting: Displays the setting values.
2	OUT display	Displays the OUT number to be displayed in the main display area.
3	Control group information display	Displays the selection status of the synchronization input.
4	Program No. display	Displays the currently used program No.
5	[FUNC] key	Used in combination with [Numeric keys] to change the setting values.
6	[LOCK] key	Used for locking and unlocking the panel operations.
7	▲ / ▼ / ◀ / ▶ keys	Selects the setting contents.
8	Numeric keys	Used for entering numeric values.
9	[ENT] key	Used for confirming the setting items.
10	[ESC] key	Finishes the setting.
11	[ZERO] key	Inputs ZERO to the synchronized OUTs.
12	[RESET] key	Inputs RESET to the synchronized OUTs.
13	[TIM] key	Inputs TIMING to the synchronized OUTs.
14	Input status	Displays the TIMING and ZERO input statuses of the selected OUT.
15	Judgment result display	Indicates the judgment result in the main display area.
16	Position display	Displays location of target in measurement range.
17	HEAD information display	Displays the head number to be displayed in the position display.
18	2D position display	Displays the desired OUT result in the X and Y axes.
19	Display panel connector	Used for connecting multiple display panels.
20	Controller connector	Used for connecting the controller and the display panel.

Head

■ LS-9006/LS-9006M

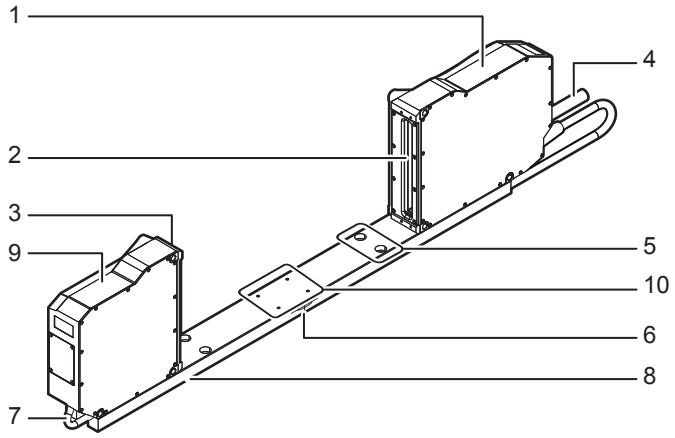


■ LS-9030/LS-9030M



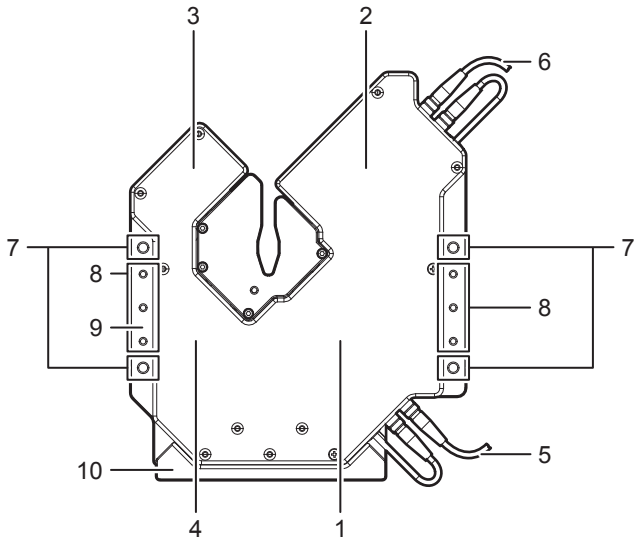
	Names	Contents
1	Receiver head (Model: LS-9xxxR)	Receives the light from the transmitter.
2	Receiver cover glass	-
3	Transmitter cover glass	-
4	Cable between the head and controller	Connects to the controller.
5	Mounting hole	Used for mounting the head.
6	Focus mark	Position at which the most accurate measurement values can be obtained with the head in the condition of being mounted at the timing of shipping.
7	Cable between the transmitter and the receiver	Connects the transmitter head cable to the receiver head cable.
8	TR base	Mounts and secures the transmitter and receiver.
9	Transmitter head (Model: LS-9xxxT)	Emits the light for the measurements.
10	Multi-purpose mounting hole	Used for attaching the mounting base, etc. for the measurement target as required.

■ LS-9120M

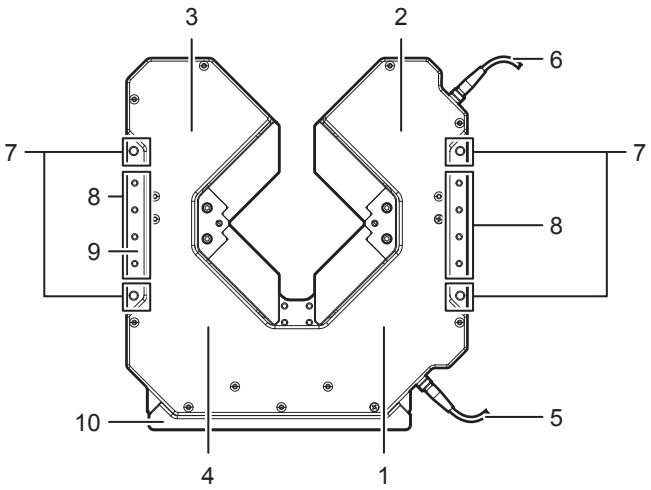


	Names	Contents
1	Receiver head (Model: LS-9120MR)	Receives the light from the transmitter.
2	Receiver cover glass	-
3	Transmitter cover glass	-
4	Cable between the head and controller	Connects to the controller.
5	Mounting hole	Used for mounting the head.
6	Focus mark	Position at which the most accurate measurement values can be obtained with the head in the condition of being mounted at the timing of shipping.
7	Cable between the transmitter and the receiver	Connects the transmitter head cable to the receiver head cable.
8	TR base	Mounts and secures the transmitter and receiver.
9	Transmitter head (Model: LS-9120MT)	Emits the light for the measurements.
10	Multi-purpose mounting hole	Used for attaching the mounting base, etc. for the measurement target as required.

■ LS-9006D

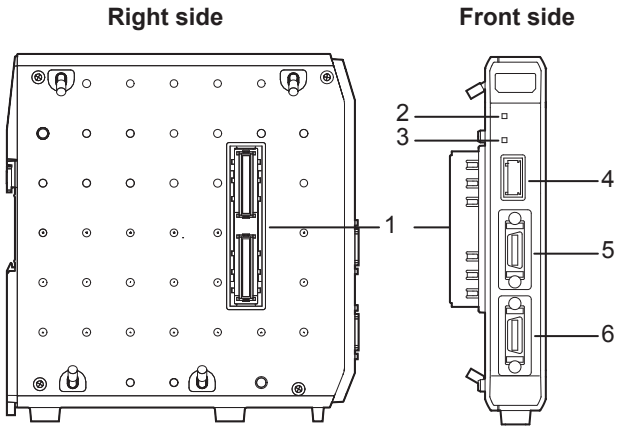


■ LS-9030D



	Names	Contents
1	X-axis receiver	Receives the light from the transmitter.
2	Y-axis receiver	Receives the light from the transmitter.
3	X-axis transmitter	Emits the light for the measurements.
4	Y-axis transmitter	Emits the light for the measurements.
5	Cable between the X-axis head and controller	Connects the X-axis head with the controller.
6	Cable between the Y-axis head and controller	Connects the Y-axis head with the controller.
7	Mounting hole	Used for mounting the head.
8	Display panel support mounting hole	Used for mounting the display panel support.
9	Base panel	Used when mounting the head from top.
10	Base bottom panel	Used when mounting the head from bottom.

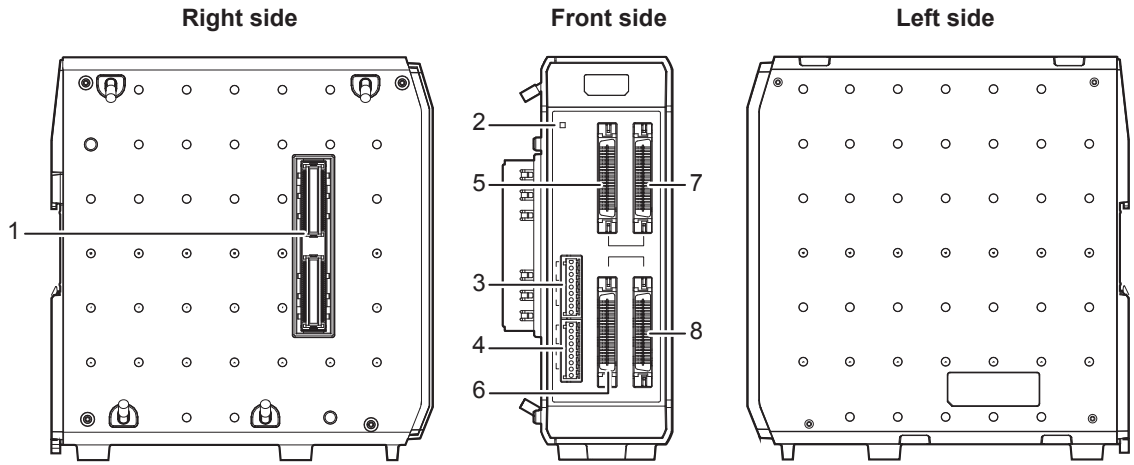
Head expansion unit



	Names	Contents
1	Controller connector	Connects to the controller.
2	POWER ON LED	Lights green: Measurement in progress; Setting change in progress; At power ON OFF: Error state
3	ERROR LED	Red light: Error state
4	Analog output terminal block	Used for analog voltage/current output. 6-pole European terminal block
5	Head connector 4	Connects to the sensor head.
6	Head connector 3	Connects to the sensor head.

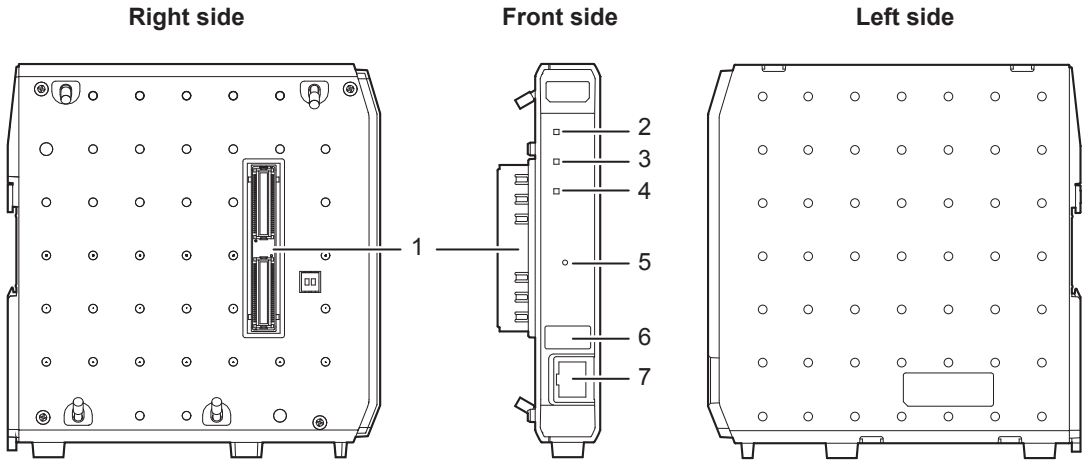
The sensor head can be connected to either Head connector 3 or Head connector 4.

BCD unit



	Names	Contents
1	Controller connector	Connects to the controller and the expansion unit.
2	POWER ON LED	Lights green: Measurement in progress; Setting change in progress Lights red: Error status OFF: Starting
3	Input terminal block 1	Used for control signal input to output connector 1/output connector 2. 9-pole European terminal block
4	Input terminal block 2	Used for control signal input to output connector 3/output connector 4. 9-pole European terminal block
5	Output connector 1	Used for output the measurement values or judgment results. Ch1 is supported.
6	Output connector 2	Used for output the measurement values or judgment results. Ch2 is supported.
7	Output connector 3	Used for output the measurement values or judgment results. Ch3 is supported.
8	Output connector 4	Used for output the measurement values or judgment results. Ch4 is supported.

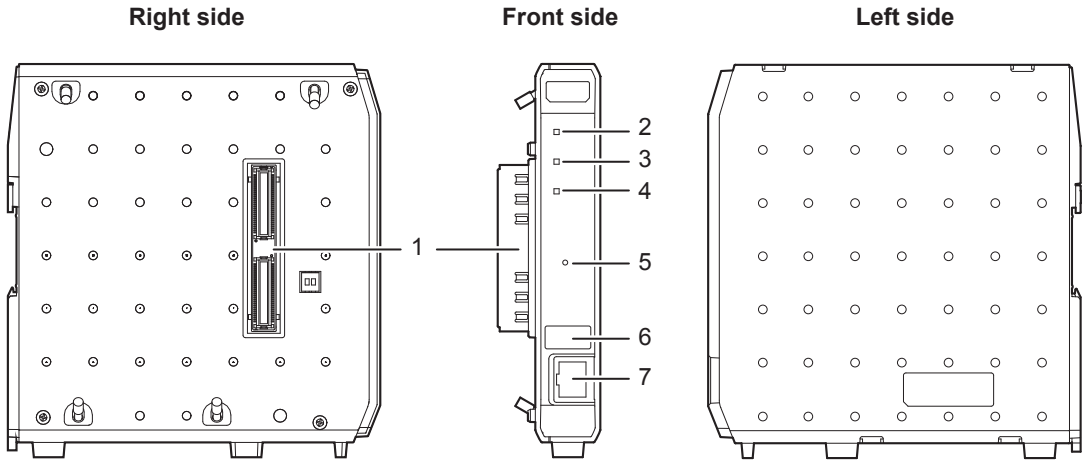
EtherNet/IP communication unit



	Names	Contents
1	Controller connector	Connects the controller.
2	LINC/ACT LED	Off : Not connected with the network. No power is supplied. Blinks green: Normally linked and sending and receiving data. Lights green: Normally linked.
3	MS LED	Shows the condition of the EtherNet/IP communication unit. Off : No power is supplied to the EtherNet/IP communication unit. Lights green: In the normal operation. Blinks red : Duplicated IP address or the connected controller in the error condition. Lights red : A system error occurred.
4	NS LED	Shows the condition of the EtherNet/IP communication unit. Off : No IP address is set on the controller. No power is supplied. Blinks green: The IP address is assigned but the connection has not been established. And the “Monitor data/External input” connection has not timed-out. Blinks red : The “Monitor data/External input” connection has timed-out. Lights red : It is detected that other device already uses the assigned IP address.
5	RESET button	Press and hold the button to reset the controller to the factory default.
6	MAC adress	Contains the MAC address of the controller.
7	Communication port	Connector for the Ethernet cable. (RJ-45 connector)

* For the details, refer to CB-EP100 User’s Manual.

PROFINET communication unit



	Names	Contents
1	Controller connector	Connects the controller.
2	LINC/ACT LED (Link/Activity indicator)	Shows whether the CB-PN100 is normally linked with the Ethernet. Blinks green or lights green : In the normal operation. Off : Not connected with the network or no power is supplied.
3	SF LED (System Failure indicator)	Shows the normal/malfunction condition of the CB-PN100 and the error condition of the controller. Lights red : There is a system error in this device or the controller. Blinks orange: The Flash LED was requested from the IO controller. Flashes four times with the frequency of approximately a second. Off : In the normal operation.
4	BF LED (Bus Failure indicator)	Shows the PROFINET communication status. Lights red : Data exchange via the data I/O communication does not operate normally. Off : In the normal operation.
5	RESET button	Press and hold the button at least three seconds to reset the device to the factory default.
6	MAC adress	Contains the MAC address of the device.
7	Communication port	Connector for the Ethernet cable. (RJ-45 connector)

* For the details, refer to CB-PN100 User's Manual.

Software Installation

This section describes the required system environment for the installation of the LS-Navigator2 and the USB driver, and the installation procedure for them.

Required system environment

To use LS-Navigator2, the following computer system environment is required.

Supported OS		• Windows 11 Pro • Windows 10[*1] • Windows 7 (SP1 or later)[*2] • Windows Vista (SP2 or later)[*3] • Windows XP (SP3 or later) *4)[*4]
Supported languages		Japanese, English, German, Chinese (Simplified), Chinese (Traditional)
CPU		Core2Duo 2GHz or higher
Memory capacity		2GB or more
L2 cache memory		2MB or more
Free hard disk space		10 GB or more
Display		XGA (1024×768 pixel) or more, 256-colors or more
Interface	**USB**	USB2.0 HI-SPEED supported (USB1.1 Full-SPEED compatible)[*5]
	Ethernet	Ethernet 1000BASE-T/100BASE-TX[*6]

*1 Compatible with each edition of Home, Pro, and Enterprise.
*2 Compatible with Home Premium, Professional, and Ultimate editions.
*3 Compatible with Ultimate, Business, Home Premium, and Home Basic editions.
*4 Compatible with Home Premium and Professional editions.
*5 Connection through a USB hub or converter is not guaranteed.
*6 Connections with a LAN through a router or converter are not guaranteed.

Preparation for the Installation

Please check the following before installing LS-Navigator2.

▶ Important **It is recommended to back up the master disk to account for accidental damage.**

■ Hard disk free space

LS-Navigator2 can be installed on a hard disk. The destination hard disk requires a free space of 10 GB or more. Make sure to allocate sufficient free disk space in advance.

■ Windows environment and installation destination

LS-Navigator2 runs on Windows and its installation is also performed on Windows. Check that a supported OS is installed on the computer and is working properly.

■ Help file

The help file of this system is a PDF file. To use the help file, install Adobe Reader, the PDF viewer supplied by Adobe System, on your computer.
Adobe Reader is available for free from the Adobe Systems web site (http: //www.adobe.com).

Installing LS-Navigator2

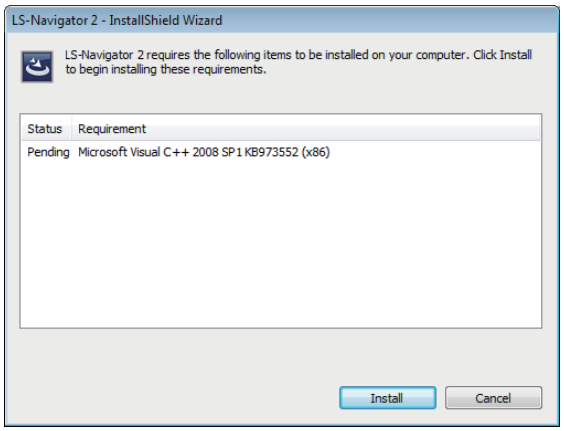
The following section describes the procedure to install LS-Navigator2 onto your computer.
The example here describes installation on Windows 7.
Microsoft .NET Framework 2.0 is required to run LS-Navigator2. If the OS of your PC is Windows 8 or later, install Microsoft .NET Framework 2.0 or 3.5 beforehand.

1 Start up Windows and insert "LS-H2" into the CD-ROM drive.

Items required for installation will appear.

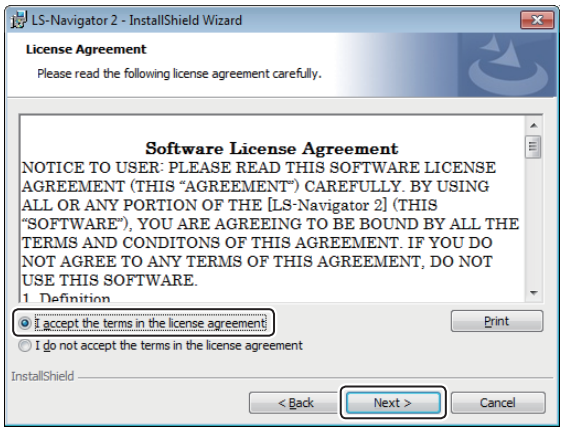
Reference The items will not appear if they had been previously installed.

2 Click the [Install] button.



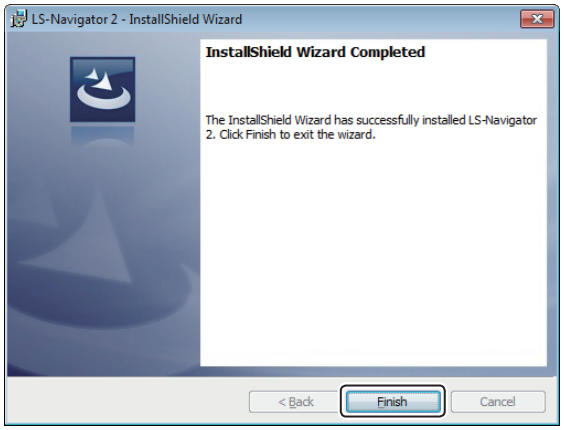
After the completion of the installation of all necessary items, “InstallShield Wizard" starts up and the "License Agreement" screen appears.

3 Read and check "Software License Agreement", select "I accept the terms in the license agreement" if you agree, and click the [Next] button.



Follow the instructions on the screen.
After the completion of the installation, the "InstallShield Wizard Completed" screen appears.

4 Click the [Finish] button.



5 Remove the CD-ROM.

The installation of LS-Navigator2 is completed.

Reference By default, LS-Navigator2 will be installed at “C: \Program files (x86)\KEYENCE\LS-Navigator 2\”.

Uninstalling LS-Navigator

The following section describes the procedure to uninstall LS-Navigator2 from your computer.
The example here describes uninstallation from Windows 7.

▶ Important

- **Before starting the uninstallation, terminate all other applications running on the computer.**
- **Log onto the computer with an account that has Administrator privileges.**

1 Click [Uninstall program] in the control panel.
The "Uninstall or Change Programs" screen appears.

2 Select LS-Navigator2 and click the [Uninstall] button.
The "Uninstallation confirmation" screen appears.

3 Click the [Yes] button.
The uninstallation starts.

2

Installation and Connection

This chapter describes the installation and connection of each instrument.

Mounting the Head 2-2
Using the Air Purge Unit 2-5
Using the Pulley Jig 2-10
Replacing the Glass of the Transmitter / Receiver 2-12
Attaching the Protective Sheet 2-14
Mounting the Controller 2-15
Mounting the Panel 2-17
Using the Display Panel Stand 2-18
Using the Display Panel Support 2-20
Connecting Various Components 2-21

Mounting the Head

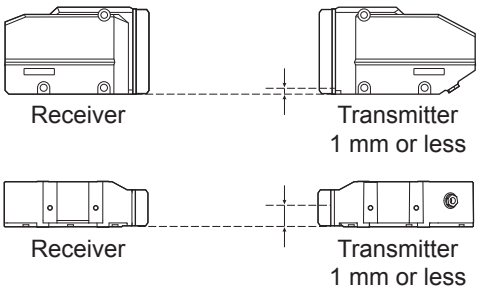
The head can be mounted to suit the measurement target type and the usage environment. The following describes the mounting methods with/without the included TR base.

Installation cautions

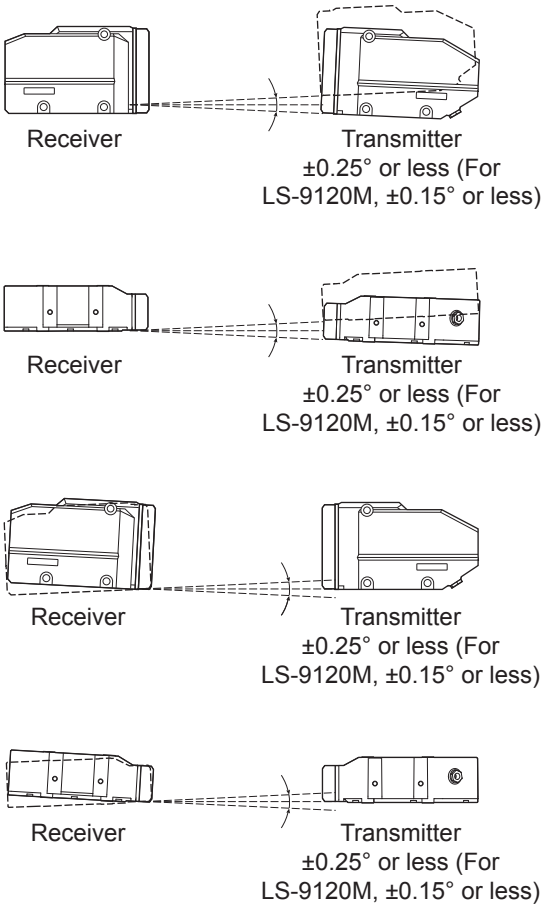
When mounting the head, make sure that the misalignment and tilt of the receiver and transmitter are less than the below.

Parallel misalignment

Values are the same in all of the following models:
LS-9006/LS-9006M/LS-9030/LS-9030M/LS-9120M



Tilt

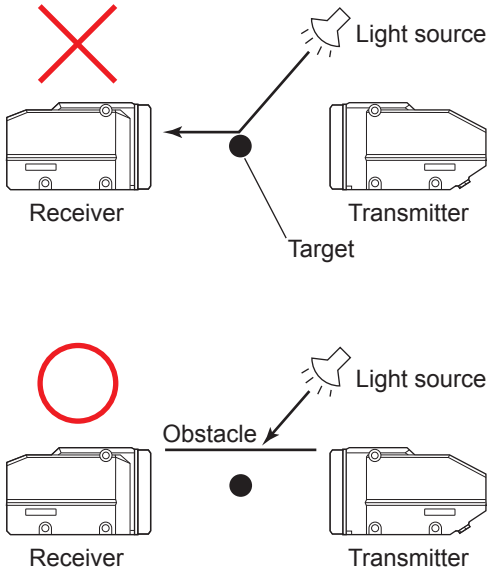


Suitable mounting for specific environments

■ If a light source is present near the head

The light reflected from the target may enter the receiver, resulting in errors in the measurement.
In such an event, take the following countermeasure:

- Shield the target from the light source (fluorescence lamp or sunlight).



Mounting method

■ Mounting with the TR base

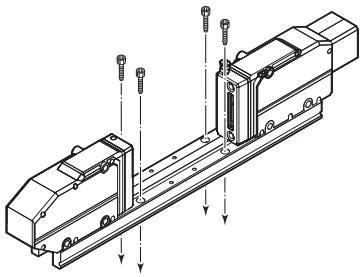
At the time of shipping, the transmitter and receiver are fixed to the TR base. The following describes the mounting method with the TR base, using LS-9030 as an example.

● Using the top mounting holes

Secure the transmitter and receiver with the hexagon socket bolts (included) using the mounting holes located at the top of the TR base.

Maximum tightening torque value

- LS-9006/LS-9006M : 1.5 N·m
- LS-9030/LS-9030M : 1.5 N·m
- LS-9120M : 5 N·m

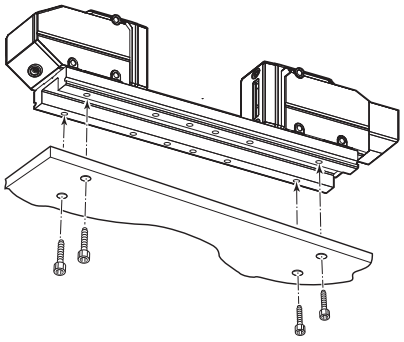


● Using the bottom mounting holes

Secure the transmitter and receiver using the mounting holes located on the bottom panel of the TR base (LS-9006/LS-9006M: M4 10 mm Depth, LS-9030/ LS-9030M: M4 10 mm Depth, LS-9120M: M6 15 mm Depth).

Maximum tightening torque value

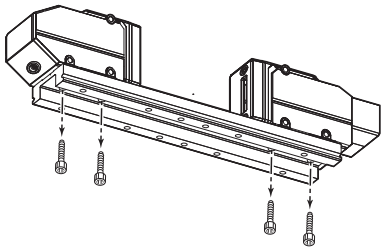
- LS-9006/LS-9006M : 1.5 N·m
- LS-9030/LS-9030M : 1.5 N·m
- LS-9120M : 5 N·m



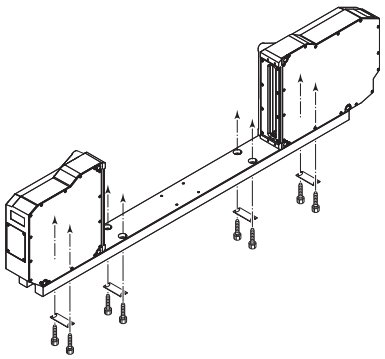
■ Mounting without the TR base

The following describes the mounting method for using the transmitter and receiver without the TR base, using LS-9030 as an example.

1 Loosen the bolts on the bottom panel of the TR base, and then remove the head.



Reference For LS-9120M, also remove the plate for locking the cable between TR.

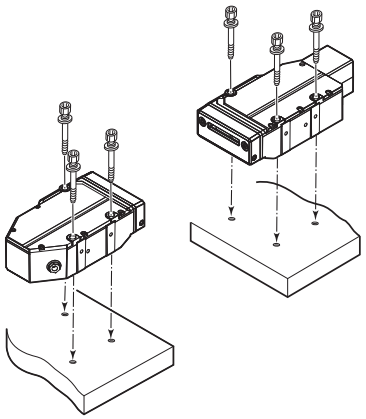


2 Mount the head.

Use the mounting holes located on the side panel as shown below. Use the hexagon socket bolts (included).

Maximum tightening torque value

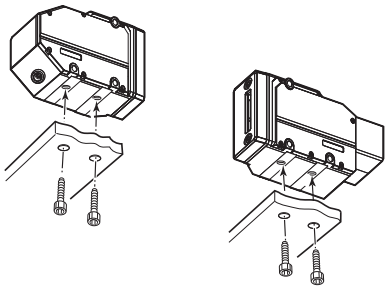
- LS-9006/LS-9006M : 0.6 N·m
- LS-9030/LS-9030M : 1.5 N·m
- LS-9120M : 5 N·m



Reference As shown below, you can also secure them using the mounting holes located on the bottom panel of the head (LS-9006/ LS-9006M: M4, Depth 3.5, LS-9030/ LS-9030M: M4, Depth 5, LS-9120M: M6, Depth 6).

Maximum tightening torque value

- LS-9006/LS-9006M : 2.5 N·m
- LS-9030/LS-9030M : 2.5 N·m
- LS-9120M : 1.5 N·m



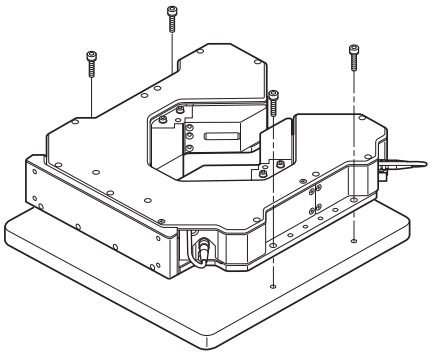
■ Mounting LS-9006D/LS-9030D

● Using the top mounting holes

Secure the head by inserting the provided hexagon socket bolts (M6 x 25) through the mounting holes on the base surface and tightening them.

Maximum tightening torque value

- LS-9006D : 5.2 N·m
- LS-9030D : 5.2 N·m



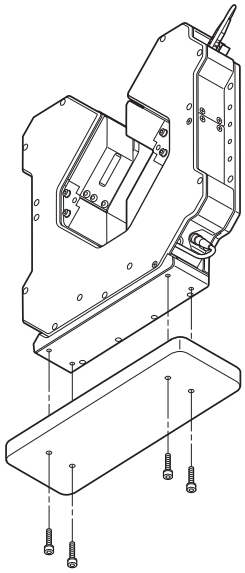
NOTICE	**Do not perform the operation while holding the cable between the transmitter and receiver.**

● Using the bottom mounting holes

Secure the head using the mounting holes located on the bottom panel of the base (M6 12 mm Depth).

Maximum tightening torque value

- LS-9006D : 5.2 N·m
- LS-9030D : 5.2 N·m



NOTICE	**Do not perform the operation while holding the cable between the transmitter and receiver.**

Using the Air Purge Unit

At the time of shipping, the air purge unit is attached to the transmitter and receiver for the models other than LS-9120M. By using the air purge unit, you can reduce the dirt on the transmitter and receiver caused by water, dust and other debris.

How to use the air purge unit

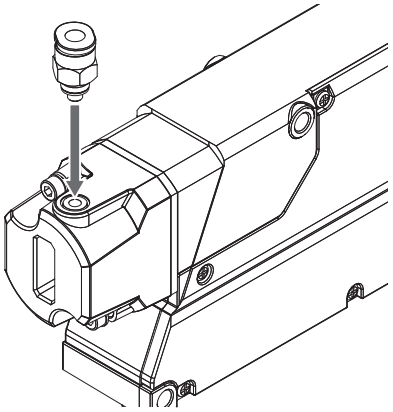
■ LS-9006/LS-9006M

To use LS-9006/LS-9006M's air purge unit, prepare the following off-the-shelf items:

- PC4-M3M (PISCO fitting) (Recommended)
- Air tube (Outer diameter ϕ4) (Same for the transmitter and receiver)

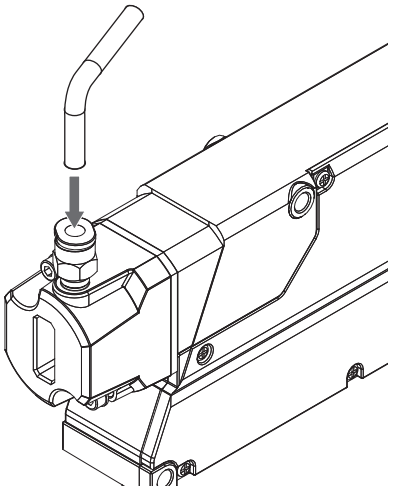
1 Attach the fitting on the air purge unit.

Recommended tightening torque: 0.7 N·m

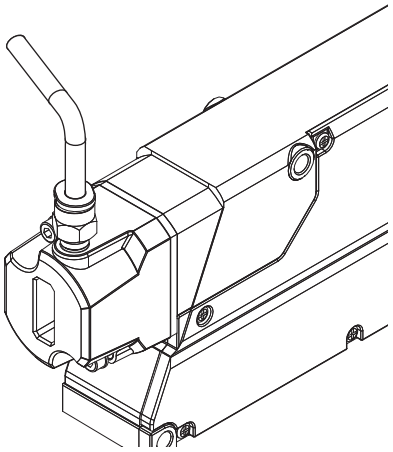


NOTICE	**If you use an L-shaped fitting, make sure that the threaded portion will not become loose due to twisting of the tube.**

2 Insert the air tube into the fitting.



3 Attach the tube towards the direction with enough room for the tube.



▶ Important

- **Supply air flow rate: 20 L/min (10 L/min per unit)**
- **Air pressure: Approx. 20 kPa The air pressure is measured before the air purge. The pressure will vary depending on the point of measurement. Be sure to check the performance based on the air flow.**
- **Be sure to use clean, dry air.**
- **The air purge performance and the measurement accuracy of the sizer can be affected by the usage environment and/or the condition of the air source. Determine the specifications for the air source and the glass cleaning schedule in accordance with the actual operating conditions.**
- **When the air purge unit is used, the visual field is narrowed. When using the air purge unit with the distance between the transmitter and the receiver increased, confirm the accuracy on the actual equipment.**

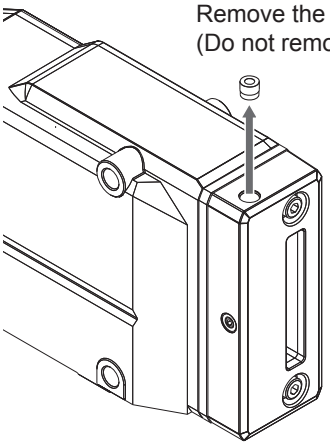
■ LS-9030/LS-9030M

To use LS-9030/LS-9030M's air purge unit, prepare the following off-the-shelf items:

- PC4-M3M (PISCO fitting) (Recommended)
- Air tube (Outer diameter ϕ4) (Same for the transmitter and receiver)

1 Remove the set screw from the inlet to which the fitting will be attached.

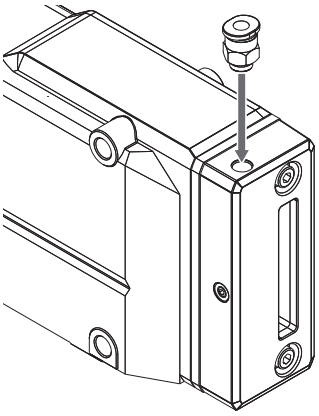
Remove the M3 set screw.
(Do not remove the other screws)



Point

- **At the time of shipping, three inlets are fitted with a M3 set screw to prevent air leakage. Remove the set screw from the inlet you wish to use, and then attach the fitting to this hole (Do not remove the other set screws).**
- **Be sure to supply air from only one inlet.**

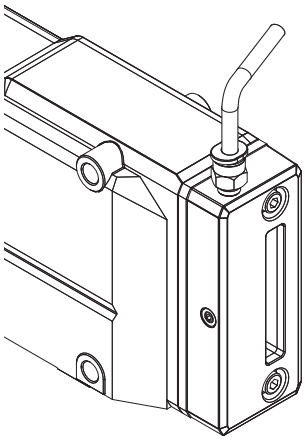
2 Attach the fitting on the air purge unit.
Recommended tightening torque: 0.7 N·m



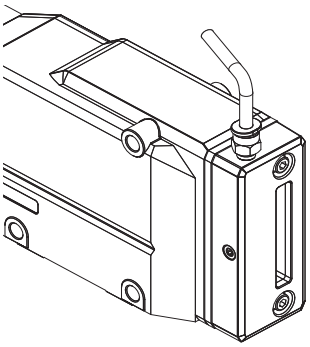
NOTICE

If you use an L-shaped fitting, make sure that the threaded portion will not become loose due to twisting of the tube.

3 Insert the air tube into the fitting.



4 Attach the tube towards the direction with enough room for the tube.



Important

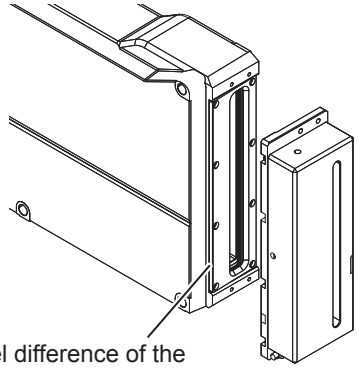
- **Supply air flow rate:**
  40 L/min (20 L/min per unit)
- **Air pressure:**
  Approx. 80 kPa.
  The air pressure is measured before the air purge. The pressure will vary depending on the point of measurement. Be sure to check the performance based on the air flow.
- **Be sure to use clean, dry air.**
- **The air purge performance and the sizer's measurement accuracy can be affected by the usage environment and/or the condition of the air source. Determine the specifications for the air source and the glass cleaning schedule in accordance with the actual operating conditions.**
- **When the air purge unit is used, the visual field is narrowed. When using the air purge unit with the distance between the transmitter and the receiver increased, confirm the accuracy on the actual equipment.**

■ LS-9120M

To use LS-9120M's air purge unit, prepare the following off-the-shelf items:

- PC6-M5 (PISCO fitting) (Recommended)
- Air tube (Outer diameter ϕ6) (Same for the transmitter and receiver)

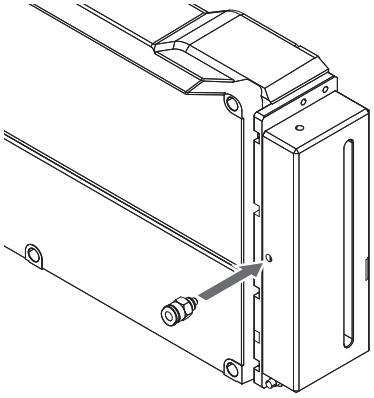
1 Put on the air purge unit.



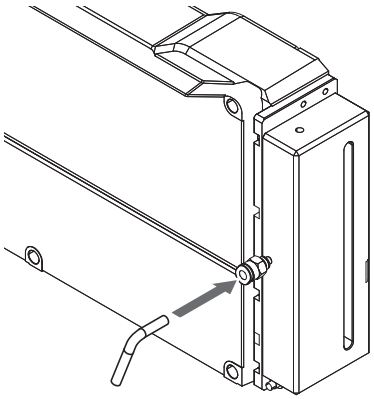
Hook the level difference of the case with that of the air purge.

2 Attach the fitting on the air purge.

Recommended tightening torque: 1 to 1.5N·m



3 Insert the air tube into the fitting.



NOTICE	**If you use an L-shaped fitting, make sure that the threaded portion will not become loose due to twisting of the tube.**

▶ Important

- **Supply air flow rate:**
  80 L/min to 160 L/min (40 L/min to 80 L/min for one unit)
- **Air pressure:**
  Approx. 180 kPa.
  The air pressure is measured before the air purge. The pressure will vary depending on the point of measurement. Be sure to check the performance based on the air flow.
- **Be sure to use clean, dry air.**
- **The air purge performance and the sizer's measurement accuracy can be affected by the usage environment and/or the condition of the air source. Determine the specifications for the air source and the glass cleaning schedule in accordance with the actual operating conditions.**
- **When the air purge unit is used, the visual field is narrowed. When using the air purge unit with the distance between the transmitter and the receiver increased, confirm the accuracy on the actual equipment.**

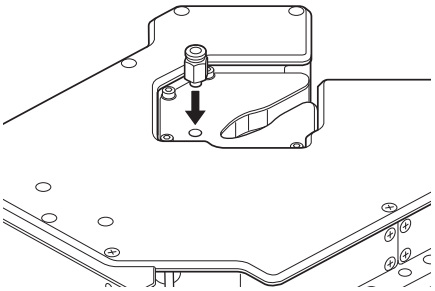
■ LS-9006D

To use LS-9006D's air purge unit, prepare the following off-the-shelf items:

- PC6-M5 (PISCO fitting) (Recommended)
- Air tube (Outer diameter ϕ6)

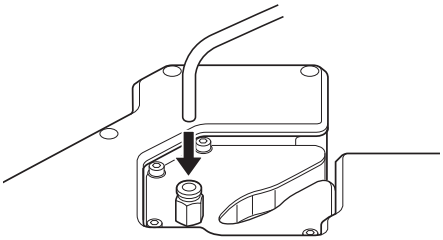
1 Attach the fitting on the air purge unit.

Recommended tightening torque: 1 to 1.5N·m



NOTICE	**If you use an L-shaped fitting, make sure that the threaded portion will not become loose due to twisting of the tube.**

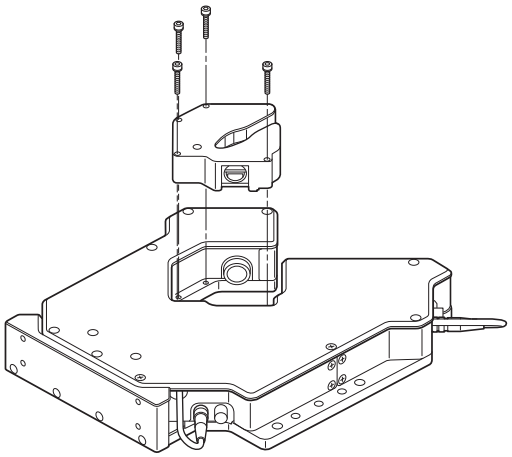
2 Insert the air tube into the fitting.



▶ Important

- **Supply air flow rate: 20 L/min to 40 L/min**
- **Air pressure: Approx. 60 kPa. The air pressure is measured before the air purge. The pressure will vary depending on the point of measurement. Be sure to check the performance based on the air flow.**
- **Be sure to use clean, dry air.**
- **The air purge performance and the sizer's measurement accuracy can be affected by the usage environment and/or the condition of the air source. Determine the specifications for the air source and the glass cleaning schedule in accordance with the actual operating conditions.**

When cleaning the receiver, remove the air purge unit that is secured with four screws as shown below. Maximum tightening torque for securing the unit: 1.5 N·m



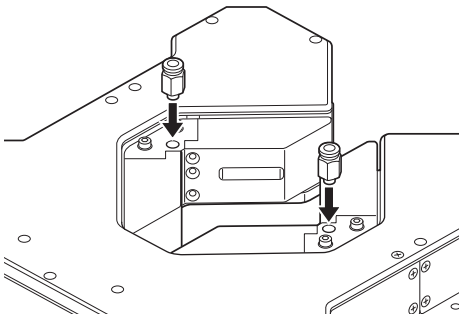
■ LS-9030D

To use LS-9030D's air purge unit, prepare the following off-the-shelf items:

- PC6-M5 (PISCO fitting) (Recommended)
- Air tube (Outer diameter ϕ6)

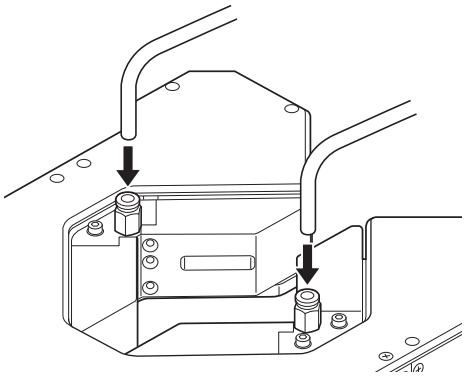
1 Attach the fitting on the air purge unit (2 mounting points).

Recommended tightening torque: 1 to 1.5N·m



NOTICE	**If you use an L-shaped fitting, make sure that the threaded portion will not become loose due to twisting of the tube.**

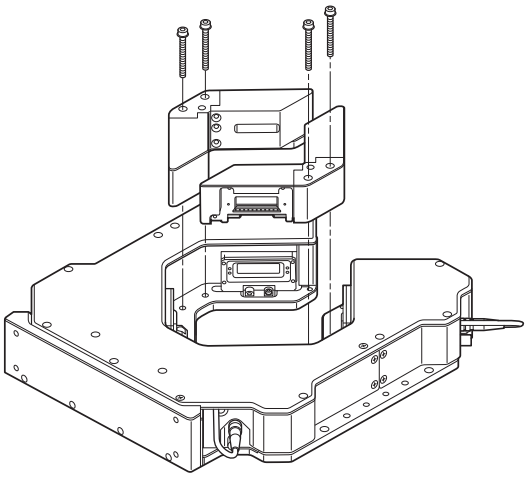
2 Insert the air tube into the fitting.



▶ Important

- **Supply air flow rate:**
  40 L/min to 80 L/min (20 L/min to 40 L/min per unit)
- **Air pressure:**
  Approx. 40 kPa.
  The air pressure is measured before the air purge. The pressure will vary depending on the point of measurement. Be sure to check the performance based on the air flow.
- **Be sure to use clean, dry air.**
- **The air purge performance and the sizer's measurement accuracy can be affected by the usage environment and/or the condition of the air source. Determine the specifications for the air source and the glass cleaning schedule in accordance with the actual operating conditions.**

When cleaning the receiver, remove the air purge unit that is secured with four screws as shown below.
Maximum tightening torque for securing the unit: 1.5 N·m



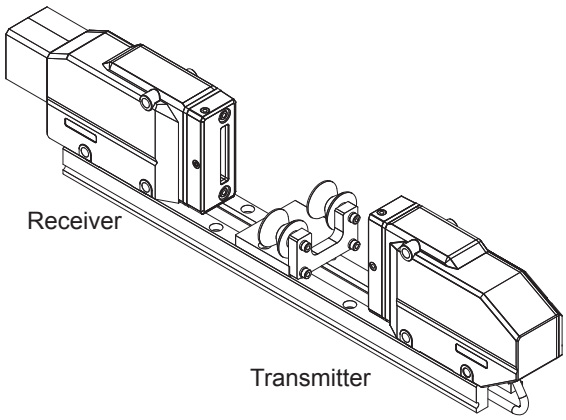
Using the Pulley Jig

The following describes how to mount the pulley jig to the TR base.

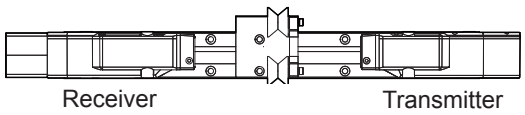
For LS-9030/LS-9030M

The pulley to be used is OP-87609.

1 Mount the pulley jig with the base facing the receiver.



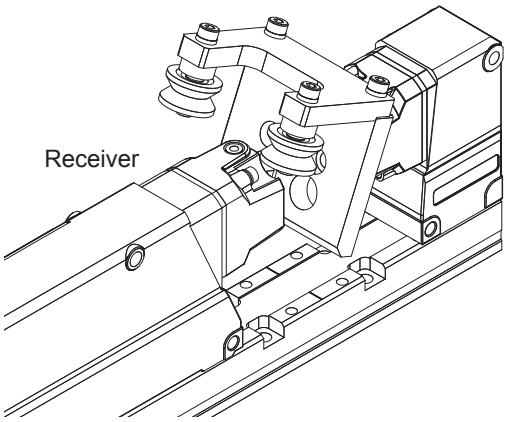
2 Secure the jig to the screw hole near the receiver with the hexagon socket bolt (included).



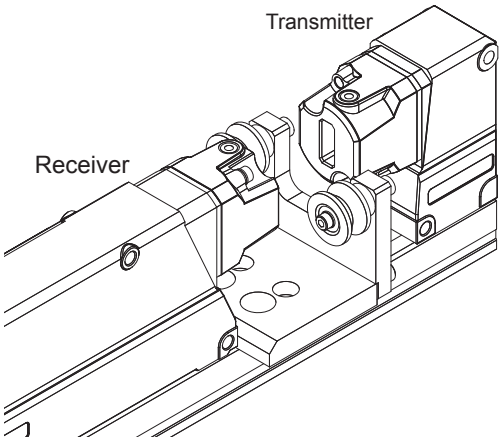
For LS-9006/LS-9006M

The pulley to be used is OP-87684.

1 Insert the jig through the gap of the air purge unit as shown below. Mount the pulley jig with the base facing the receiver.



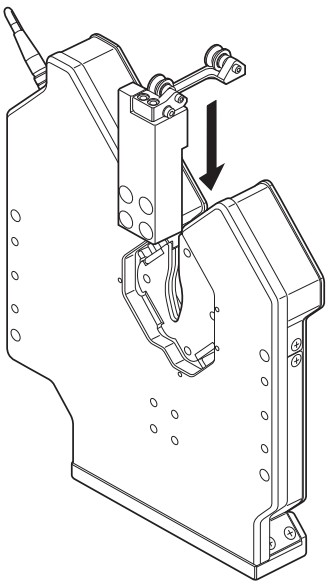
2 Secure it using the hexagon socket bolt (included).



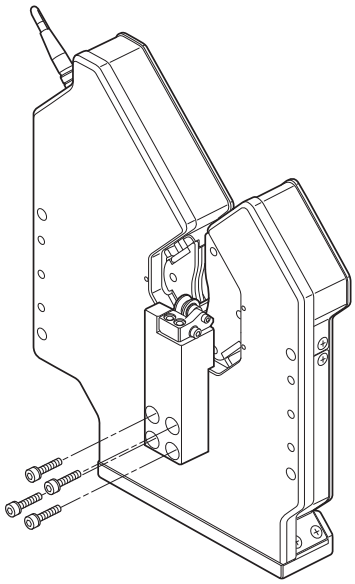
For LS-9006D

The pulley to be used is OP-87750.

1 Place the jig into the notched section of air purge unit.



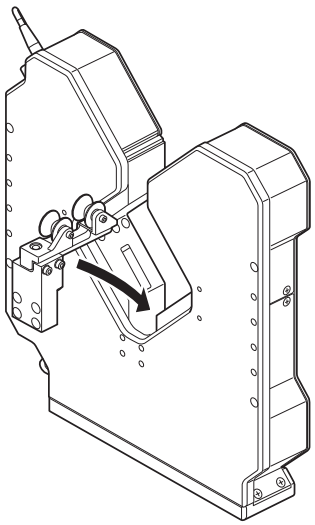
2 Secure it using the provided hexagon socket bolts (M5 x 15).



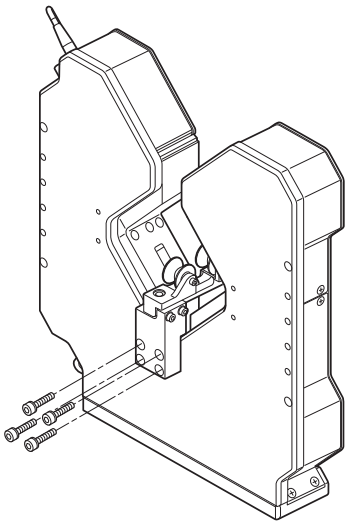
For LS-9030D

The pulley to be used is OP-87749.

1 Place the jig into the notched section of air purge unit.



2 Secure it using the provided hexagon socket bolts (M5 x 15).



Replacing the Glass of the Transmitter / Receiver

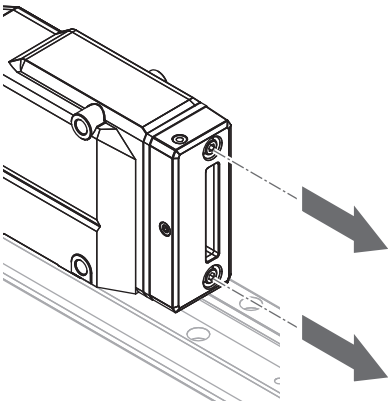
When the cover glass of the transmitter/receiver is broken, it can be replaced by the following procedure.

NOTICE	**• The measurement accuracy may be adversely affected if glass has entered inside the head when the cover glass is broken. In such an event, contact your nearest KEYENCE office.** **• If you replace the cover glass in an unsuitable environment, the dust may enter the head resulting in lower measurement accuracy. The IP performance is not guaranteed. Contact your nearest KEYENCE office if you wish to have the cover glass replaced by KEYENCE.**

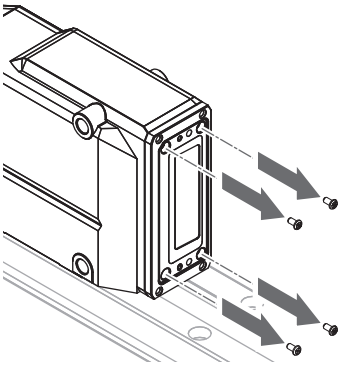
For LS-9030/LS-9030M

The OP-87697 cover glass should be used for both the transmitter and receiver.

1 Remove the air purge unit.

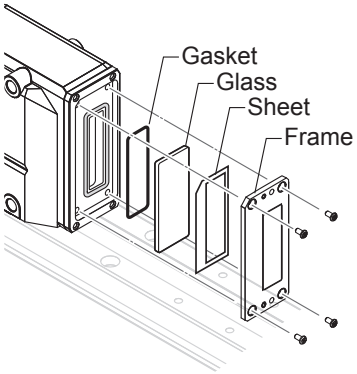


2 Loosen the screws in the four corners, and then remove the cover glass.



3 Screw on the replacement cover glass.

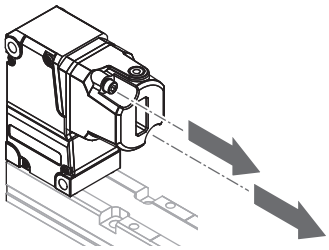
Maximum tightening torque value
- 30cN·m



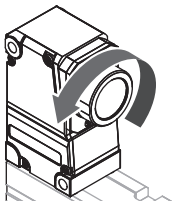
For LS-9006/LS-9006M

Use the following cover glass replacement options:
- Transmitter: OP-87698
- Receiver: OP-87699

1 Remove the air purge unit.

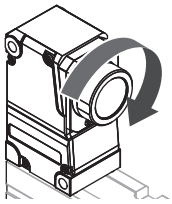


2 Remove the cover glass. The cover glass has a screw thread. Rotate the cover glass counterclockwise.



3 Secure the replacement cover glass by rotating it clockwise.

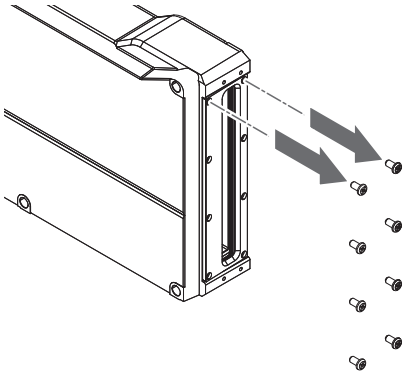
Maximum tightening torque value
- 20cN·m



For LS-9120M

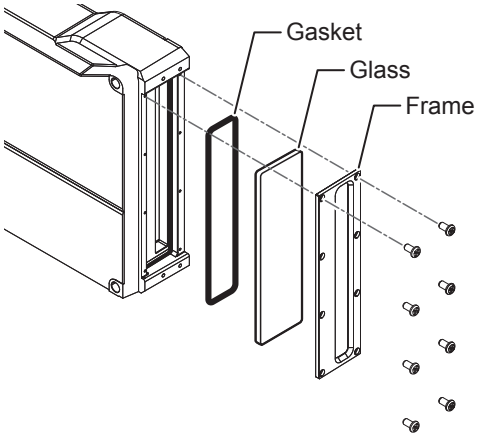
At the cover glass replacement, use OP-87756 on both the transmitter and receiver.

1 Turn 8 screws to remove the cover glass.



2 Secure the replacement cover glass with the screws.

Maximum tightening torque value
- 15 cN·m



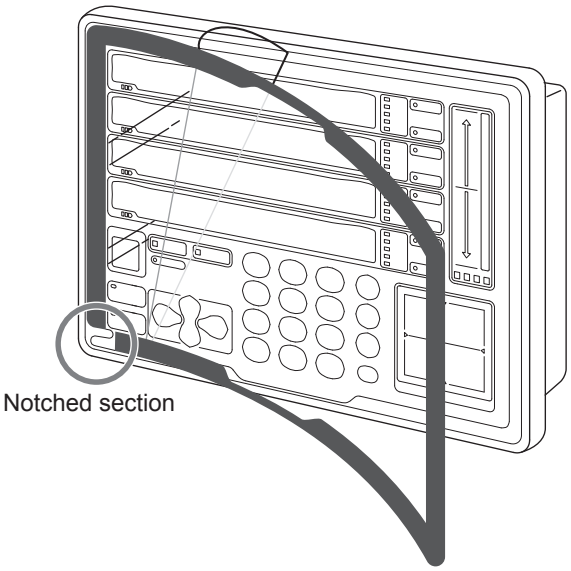
Attaching the Protective Sheet

How to attach the protective sheet

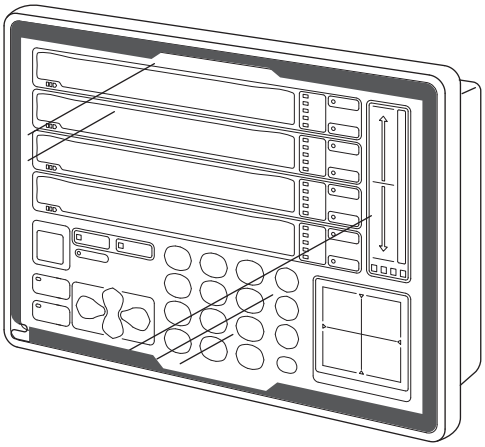
This following explains how to attach the protective sheet to the display panel.

1 Peel off a small amount of the backing paper from the edge of the protective sheet and attach it to the corner of the panel.

Attach the protective sheet such that its notched section is at the bottom left of the panel.



2 Attach the protective sheet by slowly peeling off the backing paper, such that no air is trapped between the protective sheet and the touch panel.

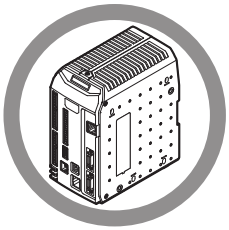


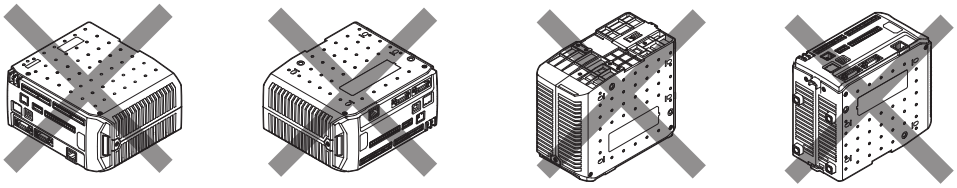
Mounting the Controller

Be sure to read the installation cautions carefully and install the controller correctly.
The controller unit should either be mounted on the DIN rail or installed by fixing the bottom panel with screws.

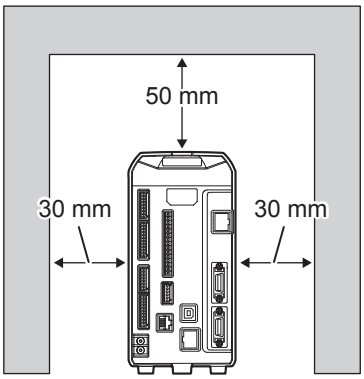
Installation cautions

The controller should be installed in the direction of the circled figure below. Do not install it in any other direction.

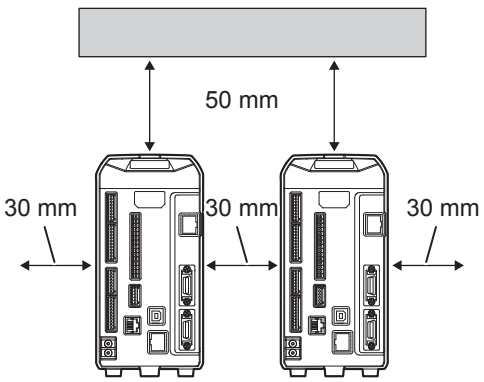




For proper ventilation, allow a space of 50 mm or more on top of the controller and a space of 30 mm or more on both sides.
In addition, allow a space of 90 mm or more in front of the terminal panel to ensure safe cable connection.



If you mount two or more controllers side by side, allow a space of 30 mm or more between the controllers and a space of 50 mm or more on top of the controllers.

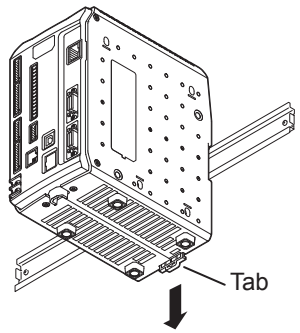


NOTICE	• **Do not block the ventilation holes located on the top and bottom panels of the controller unit. Doing so may cause heat to build up inside the unit, resulting in malfunction.** • **If the temperature inside the control panel exceeds the rated operating ambient temperature (50 °C: Head expansion unit not connected, 45 °C: Head expansion unit connected), lower the operating ambient temperature below the rating using forced air cooling or by creating more space around the unit.**

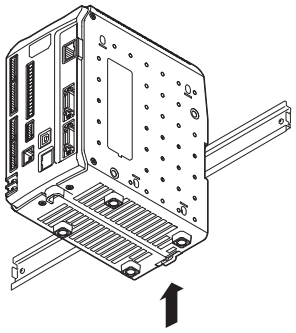
Mounting the controller to the DIN rail

This section describes the procedure for mounting the controller to a DIN rail.

1 Pull the tab on the back panel of the controller, and then attach the controller to the DIN rail.



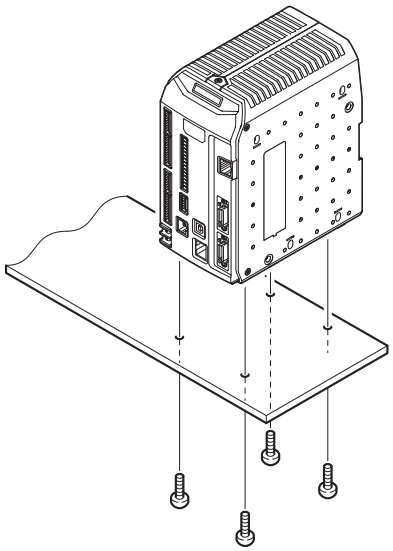
2 Push in the tab to fix the controller in place.



Mounting to the bottom panel

This section describes the procedure for mounting the controller using the bottom panel.

1 Fasten the screws into the mounting holes on the bottom panel.

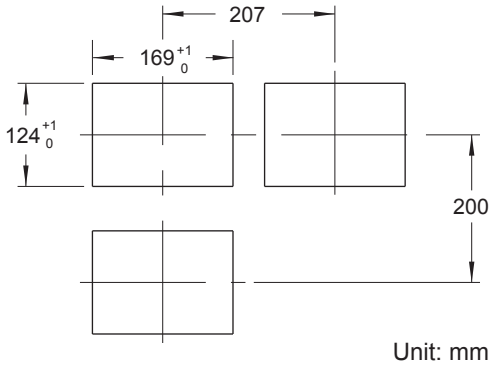


M4 screw x 4 (Screw depth 6 mm)

See 🕮 “Dimensions” (page 11-23) for the dimensions for installation.

Mounting the Panel

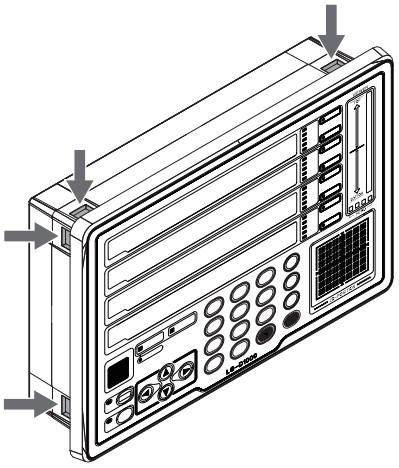
Use the included mounting brackets to mount the panel.
The dimensions of the panel are as shown below.



Unit: mm

1 Insert the mounting brackets into the mounting holes (8 holes) on the panel.

- Two each on top and bottom panels
- Two each on left and right panels



2 Fasten them using a Phillips screwdriver.

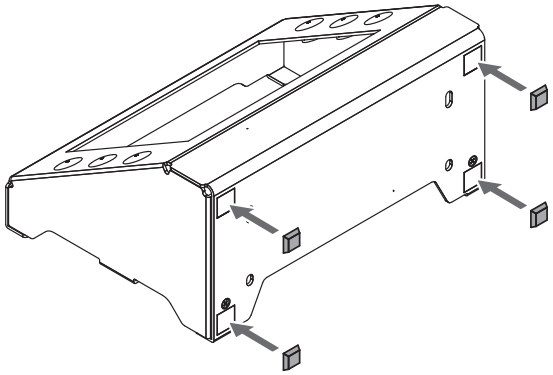
NOTICE	**• Tightening the mounting bracket screw too hard may result in deformation of the panel and/or the controller case. Set the tightening torque to 0.4 N·m or less.** **• Do not remove the gasket. Doing so will result in failure to meet the IP65 requirements.**

Using the Display Panel Stand

Secure the display panel using the display panel stand.
The panel can be mounted vertically or horizontally.
The display panel stand has a hole for securing the switch (OP-87611).
Cover the hole with the included cap if the switch will not be used.

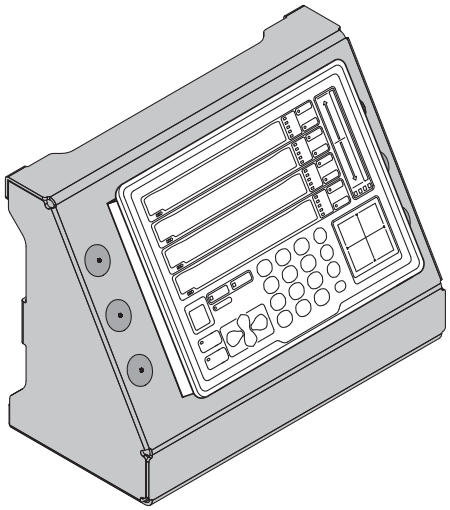
Setting up the unit vertically

1 Attach the rubber pads (included) in the positions shown below.



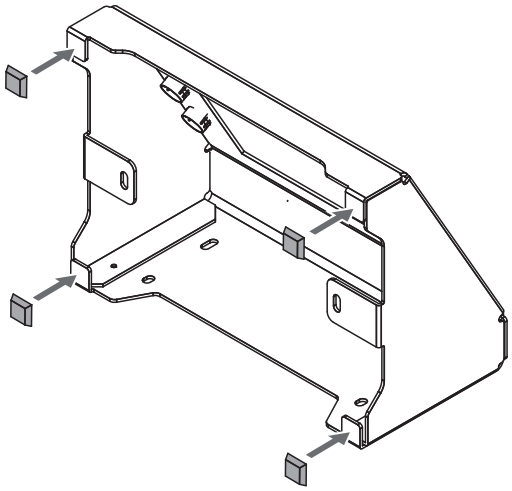
2 Mount the display panel on the display panel stand.

Use the included mounting bracket to secure the panel.



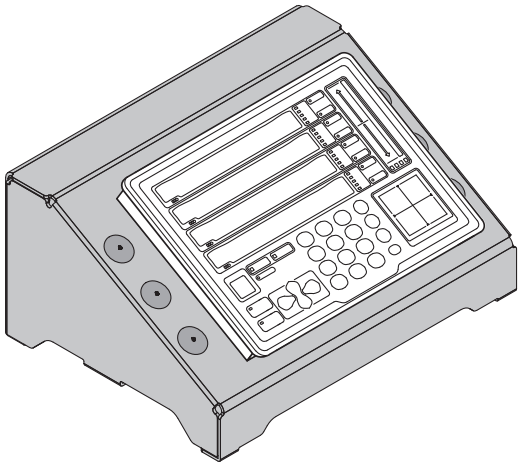
Setting up the unit horizontally

1 Attach the rubber pads (included) in the positions shown below.

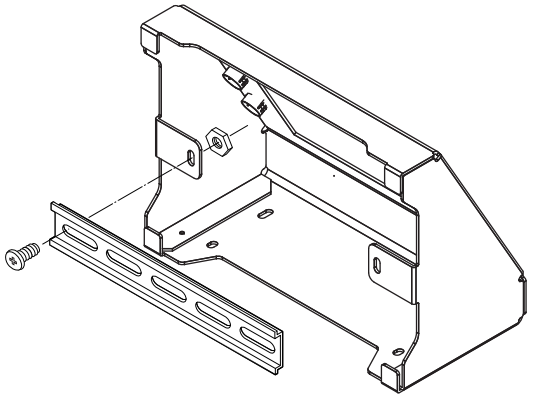


2 Mount the display panel on the display panel stand.

Use the included mounting bracket to secure the panel.



3 Mount the DIN rail on the back panel.
Secure the DIN rail to the panel stand using a screw and nut.

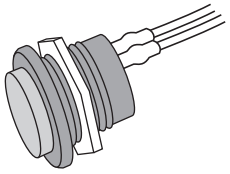


Point **You can mount the controller and/ or power supply in a simple and easy manner.**

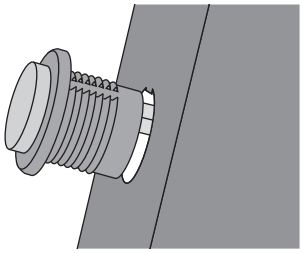
Using the switches (OP-87611)

Secure the switch to the display panel.

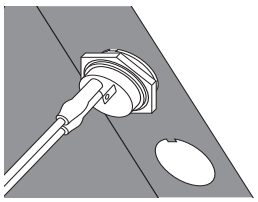
1 Remove the metal washer included with the switch.



2 Align the orientation of the notch on the switch with the mounting hole, and then insert the switch.



3 Secure the switch to the panel stand using the metal washer removed in step 1.



4 Connect the lead wire to the desired input terminal.

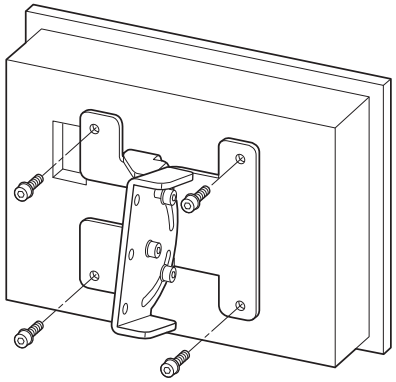
Using the Display Panel Support

■ Common to LS-9006D/LS-9030D

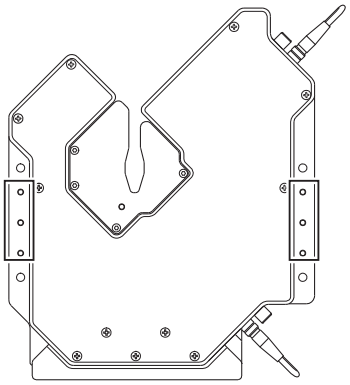
The following describes how to mount the display panel support (OP-87757) to the casing.

1 Mount the display panel support to the display panel (LS-D1000) using the provided bolts (M4 x 10).

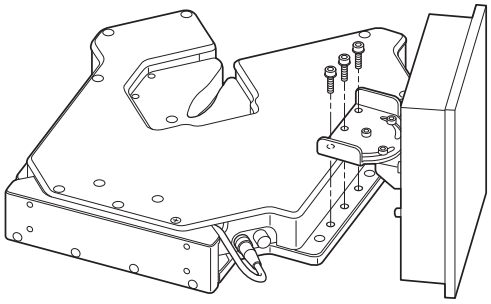
Maximum tightening torque for securing the unit: 0.75 N·m

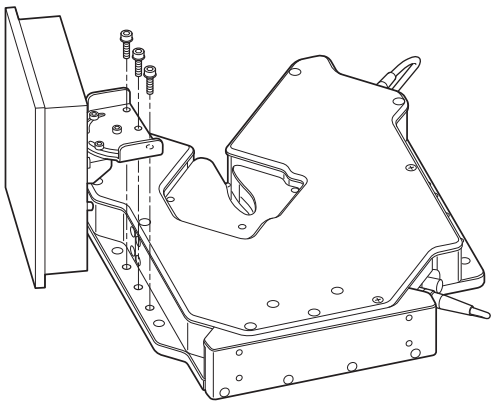


2 Mount the display panel support to the casing using the provided bolts (M5 x 12).



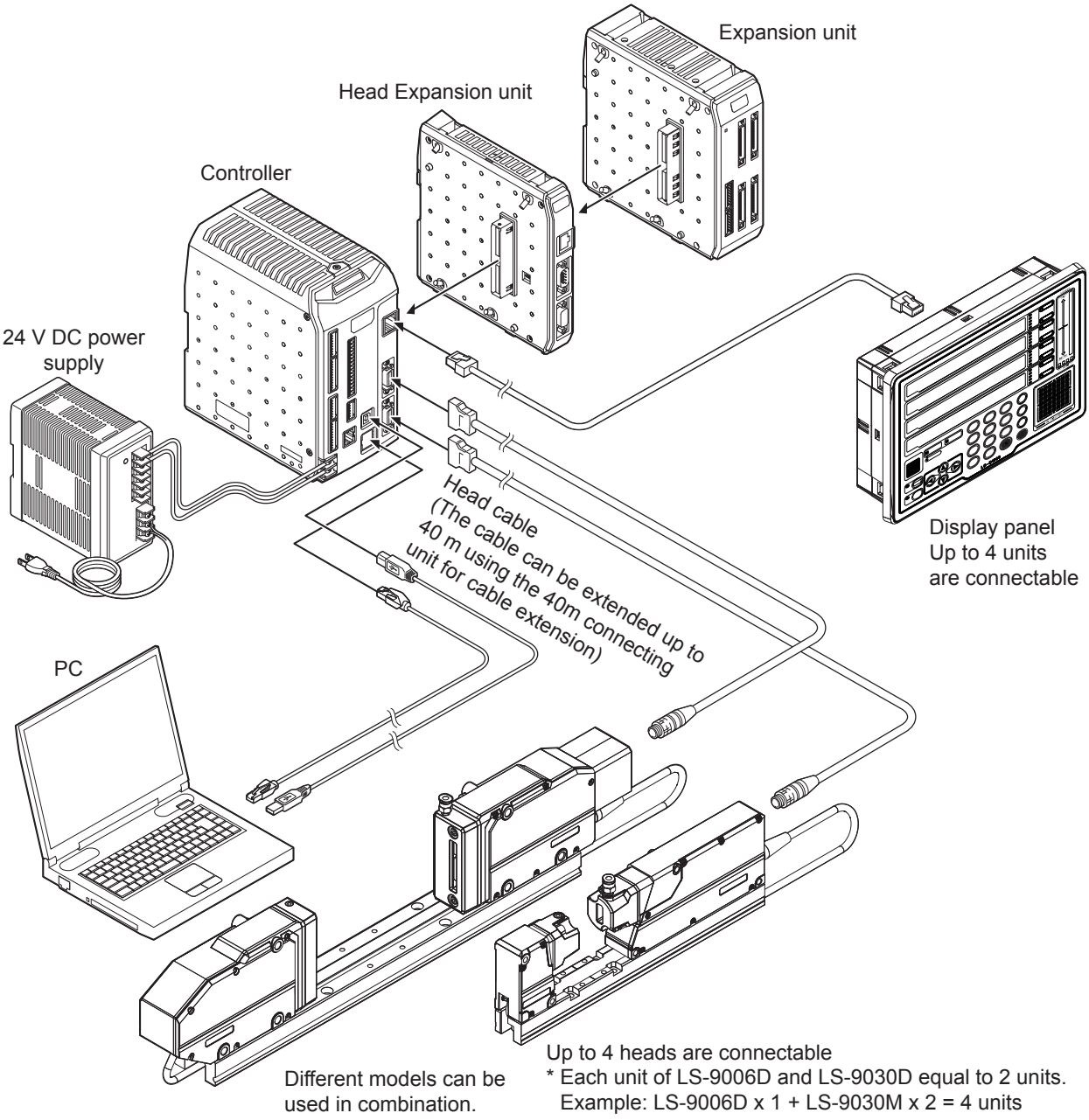
The panel support can be mounted on either side of the casing.





Connecting Various Components

This section describes the connection procedure for the configuration shown below.



⚠ CAUTION	**• Always make sure to switch OFF the controller before connecting or removing cables. Connecting or removing cables with the controller switched ON may result in a malfunction.** **• Plug in the connector making sure its orientation is correct. Inserting the connector in the wrong orientation may break the connector pins and result in a malfunction.** **• Always use a class D grounding for the frame ground terminal of the 24 V DC power supply.**

Connecting the transmitter and the receiver of the head

This allows you to adjust the distance between the transmitter and the receiver of the head.
The transmitter and receiver of the head are shipped in connected state.

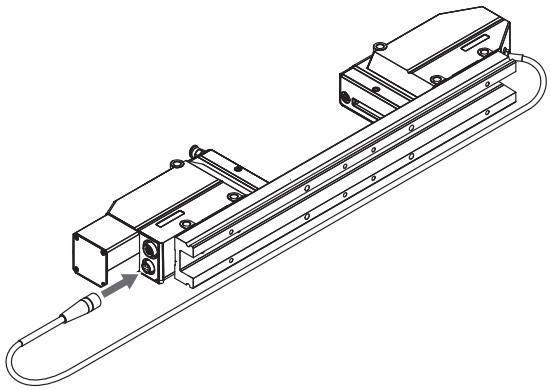
Point

- **For LS-9120M, the transmitter and receiver of the head are shipped in removed state.**
- **For LS-9006D and LS-9030D, the distance of the transmitter and receiver cannot be adjusted.**

1 Connect the cables coming out from the light transmitter and receiver of the head.

2 Align the notches on the connectors, and then plug them together.

Tighten the screw with a tightening torque of 0.5 N·m.



NOTICE

- **Plug in the connector making sure its orientation is correct. Inserting the connector in the wrong orientation may break the connector pins and result in a malfunction.**
- **Insert the connector without tilting it, and then tighten it firmly. If the connector is not tightened enough, it may become loose due to vibration, etc. resulting in poor contact.**

***Tighten it firmly by hand and then retighten approx. 15° to 20°.**

Connecting the head and the controller

This section describes the procedure for connecting the controller and the head.

NOTICE

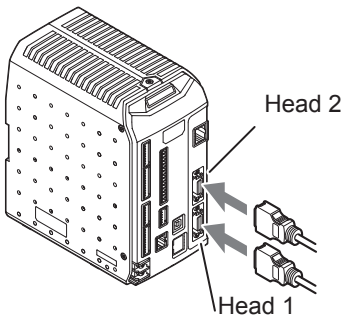
- **Do not supply power to the controller before connecting the head cable. Connecting the head cable while the controller is switched ON may damage the head and/or the controller.**
- **Maintain a minimum bend radius of 22 mm or more for the head cable.**
- **When using a cable tray, select a model with R100 or higher unless specified otherwise.**
- **When connecting the cable to the controller, connect it to the controller while thrusting down buttons on both sides of the connector of the head cable.**

1 Connect the head cable to the head connector of the controller.

If you are using only one head, connect it to the Head 1 connector.
Insert the cable firmly until you hear a clicking sound.

Point

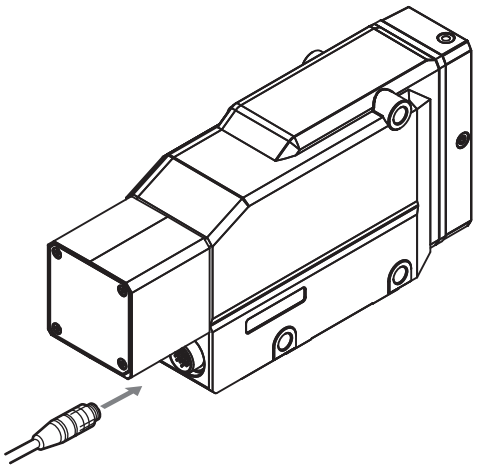
To unplug the connector, pull it out, pushing the buttons on both sides of the connector.



2 Connect the head and the head cable.

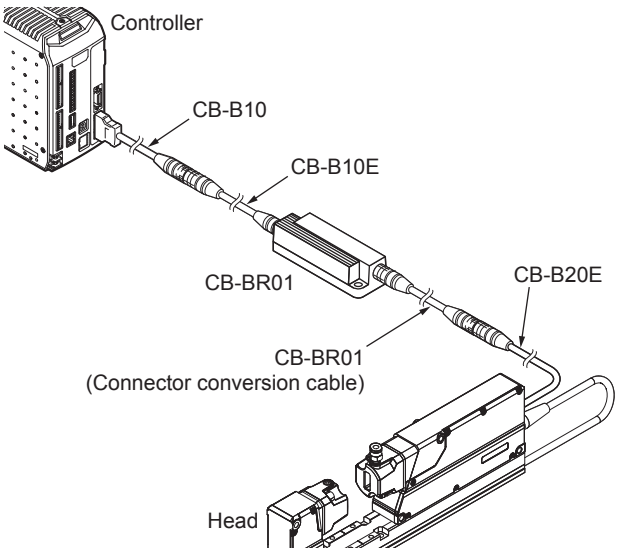
Check the orientation of the connector, and then insert it all the way while slowly rotating it. Tighten the screw with a tightening torque of 1 to 1.5 N·m.

NOTICE	• **Plug in the connector making sure its orientation is correct. Inserting the connector in the wrong orientation may break the connector pins and result in a malfunction.** • **Insert the connector without tilting it, and then tighten it firmly. If the connector is not tightened enough, it may become loose due to vibration, etc. resulting in poor contact.** ***Tighten it firmly by hand and then retighten approx. 45° to 60°.**



Using the 40m connecting unit for cable extension

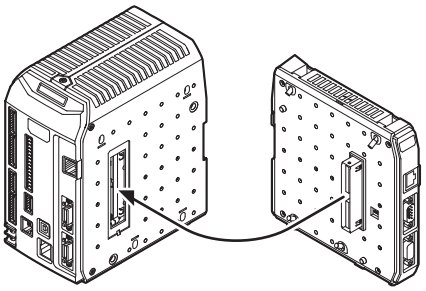
To connect the sensor head and the controller 40 m apart, connect the 40m connecting unit for cable extension, head connection cable, and head connection extension cable as shown below.



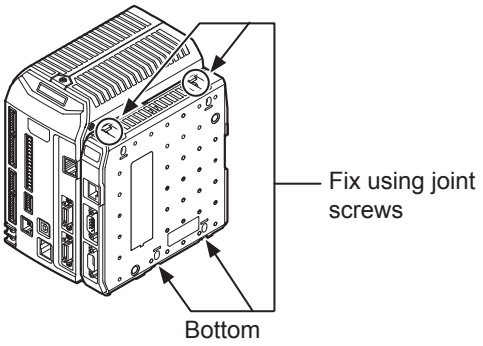
Connecting the controller and the expansion unit

This section describes the procedure for connecting the controller and the expansion unit.

1 Insert the controller connector on the expansion unit side into the expansion unit connector on the controller side.



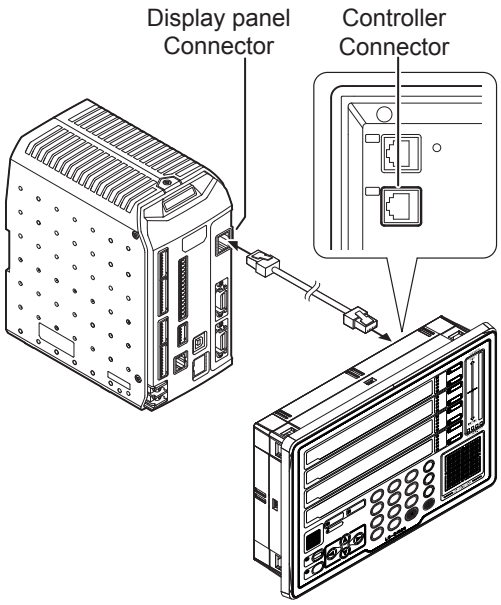
2 Tighten the joint screws of the expansion unit using a screwdriver.



Connecting the controller and the display panel

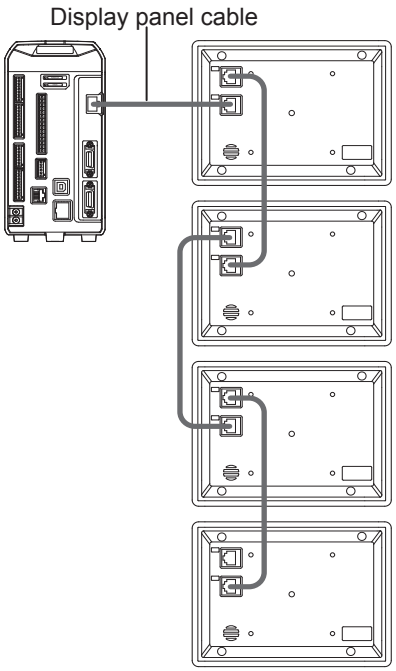
This section describes the procedure for connecting the controller and the display panel.

1 Connect the display panel connector of the controller and the controller connector of the display panel using the display panel cable.



● **Connecting two or more display panels to the controller**

You can connect up to four display panels by connecting the display panel connector of the display panel connected to the controller with the controller connector of the second display panel using the display panel cable. The total length of the display panel cable that can be connected is 60 m.



Connecting the controller and the PC

To communicate with the controller using LS-Navigator2, there are two methods for connecting with PC as below:

- [Connecting using USB]
- [Connecting using the Ethernet]

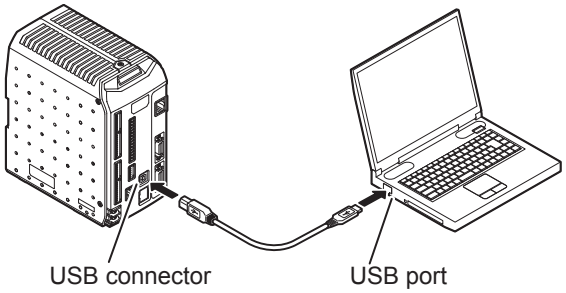
See "PC communication configuration" (page 7-2) for the communication settings.

Connecting using USB

This section describes the procedure for connecting the controller and the PC using USB.

Important **Do not unplug the USB cable while the controller is in operation. Doing so may cause the controller to function improperly or stop functioning. If the cable gets unplugged and the connection is lost, restart LS-Navigator2.**

1 Connect the connector of the controller and the USB port of the PC with a USB cable.



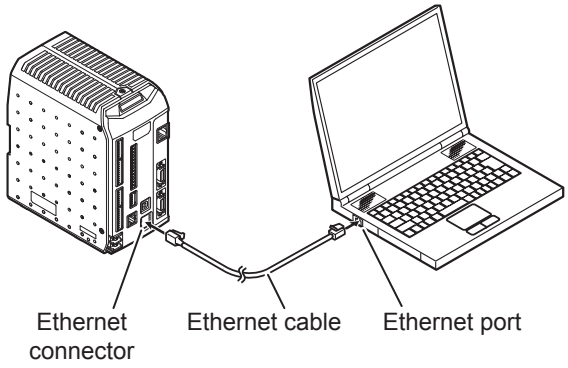
Connecting using the Ethernet

An Ethernet connection allows you to connect multiple controllers to a single PC. You can select one of the connected controllers for the communication. The communication protocol is TCP/IP; and the communication model is peer to peer.

Important
- **You must set the IP addresses of the controllers and the PCs such that they do not overlap with each other in the network.**
- **Proper operation is not guaranteed for connections to LAN and/or connections via a router.**

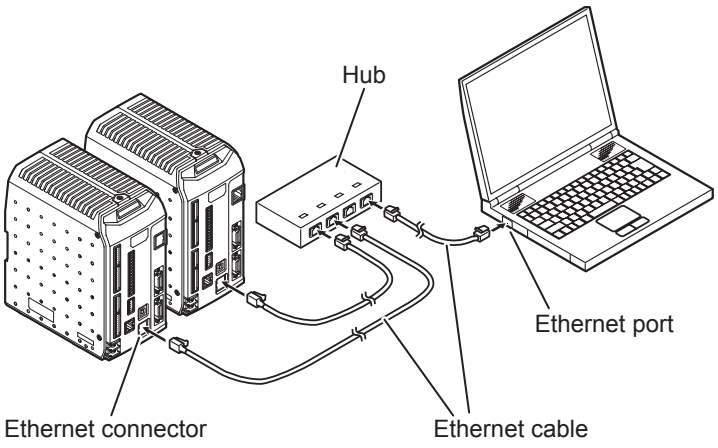
Connecting the controller and the PC one-to-one

For the connection, use the OP-66843 (Ethernet) cable.



Connecting two or more controllers to the PC

To connect two or more controllers, a hub supporting 100BASE-TX or 1000BASE-T is required.
For the connection between the controller and hub, or between the PC and hub, use the OP-66843 (Ethernet) cable.



Reference The controller supports the Auto MDI/MDI-X function (which automatically detects the required cable connection type and configures the connection appropriately), allowing you to use either a crossover or straight-through Ethernet cable.

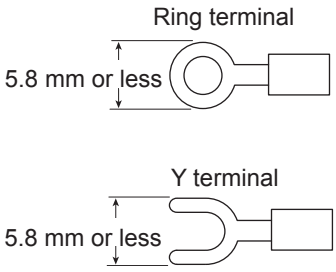
Connecting the power supply to the controller

This section describes the procedure for connecting the controller and the power supply.

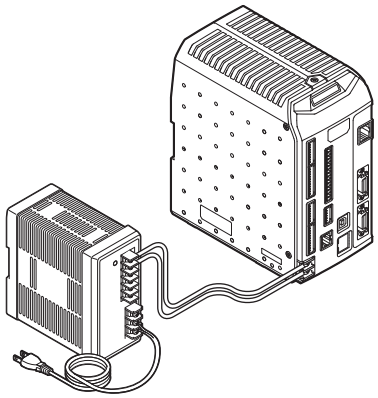
1 Connect the 24 V DC power supply to the 24 V power supply terminal of the controller.

▶ Important

- **Use a wire between AWG14 and AWG22.**
- **If you are using a solderless terminal, use a terminal that has the following size and suits the M3 screw:**



- **Tighten the screw firmly with a tightening torque of 0.5 to 0.75 N·m.**



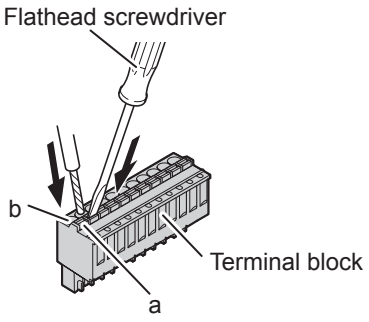
How to use the terminal block

This section describes how to use the terminal block.

▶ Important

- **Use the following wires according to the terminal block used:**
  - **For input terminal block (1, 2) and output terminal block (1,2): AWG20 to AWG28**
  - **For encoder input terminal block: AWG16 to AWG28**
- **The end of the wire should be processed to the following length:**
  - **For input terminal block (1, 2) and output terminal block (1,2): Approx. 8 mm**
  - **For encoder input terminal block: Approx. 9 mm**
- **Do not solder (pre-solder) the processed end of the wire.**
- **The wire should be inserted all the way into the terminal block.**
- **Attach the wire to the terminal block directly, without using a solderless terminal, etc.**

1 Insert the wire into “part b” while pushing in “part a” of the terminal block with a screwdriver.



2 When the wire is inserted to the end, remove the screwdriver.

▶ Important **Lightly pull the wire to make sure it is fixed firmly.**

3

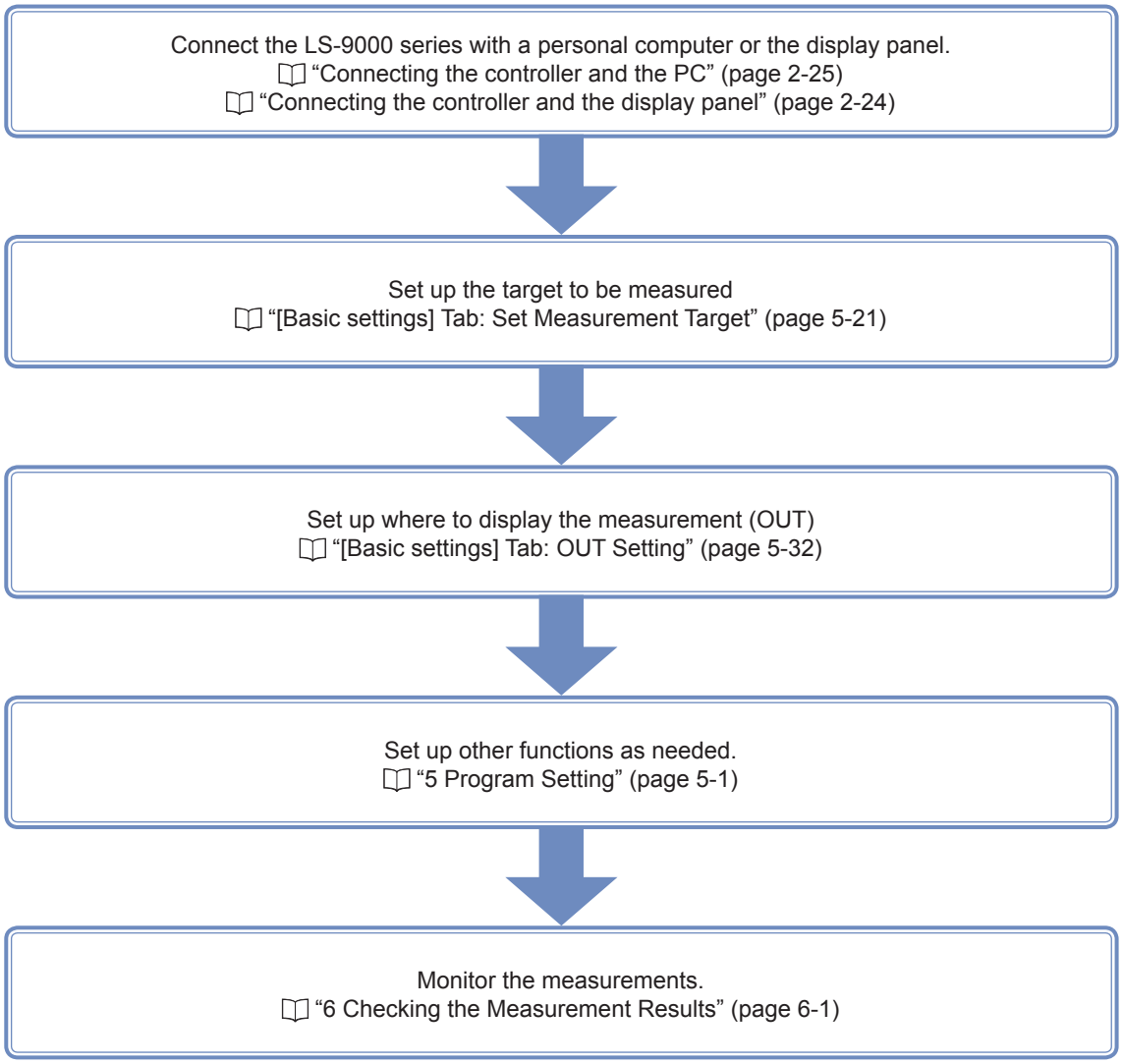
Basic Operations

This chapter describes the basic operation flow of LS-Navigator2 from the startup and the basic operations of the display panel.

Basic Operation Flow.....3-2
Basic Operations of the Display Panel.....3-3
Basic Operations of LS-Navigator2 3-15

Basic Operation Flow

The following part describes the operation flow from the startup of LS-Navigator2.



Basic Operations of the Display Panel

This part describes the basic operations of the display panel.

Basic Operation of Setting

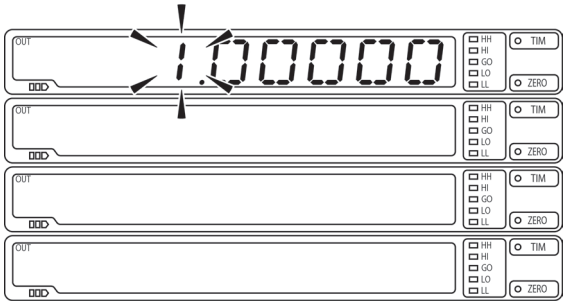
■ Selecting Items

On the display panel, use the [▲], [▼], [◀], and [▶] keys to move the cursor and use the [ENT] key to select the items.

■ Entering numeric values

To enter numeric values, operate the display panel as below.

1 Use the [◀] and [▶] keys to place the cursor onto any digit to which you enter the numeric value.



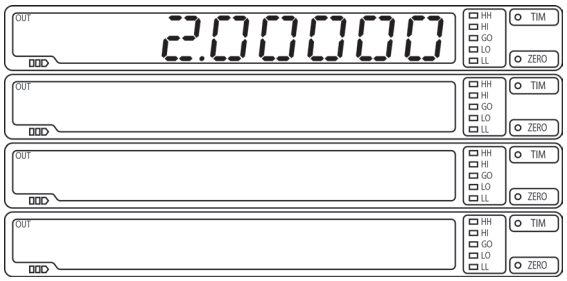
The selected digit blinks.

2 Use the numeric keys to enter the numeric values.

Reference
- Pressing the [ZERO] key enters "0" in all the digits.
- Pressing the [RESET] key restores all the digits to the last values before change.
- Press the [-] key to enter a negative value.

3 After changing the value, press the [ENT] key.

The entered numeric value is fixed.

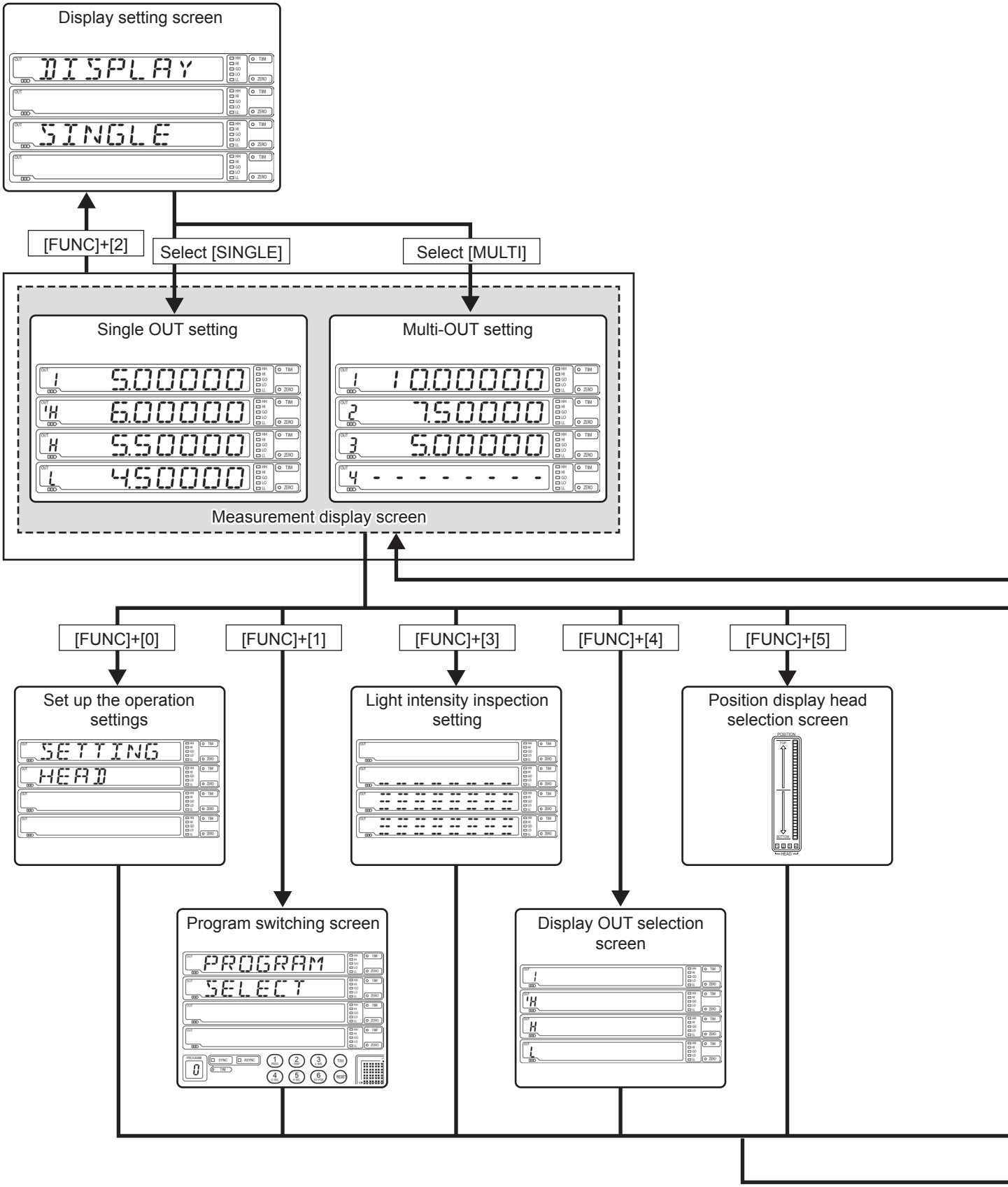


■ Using Shortcuts

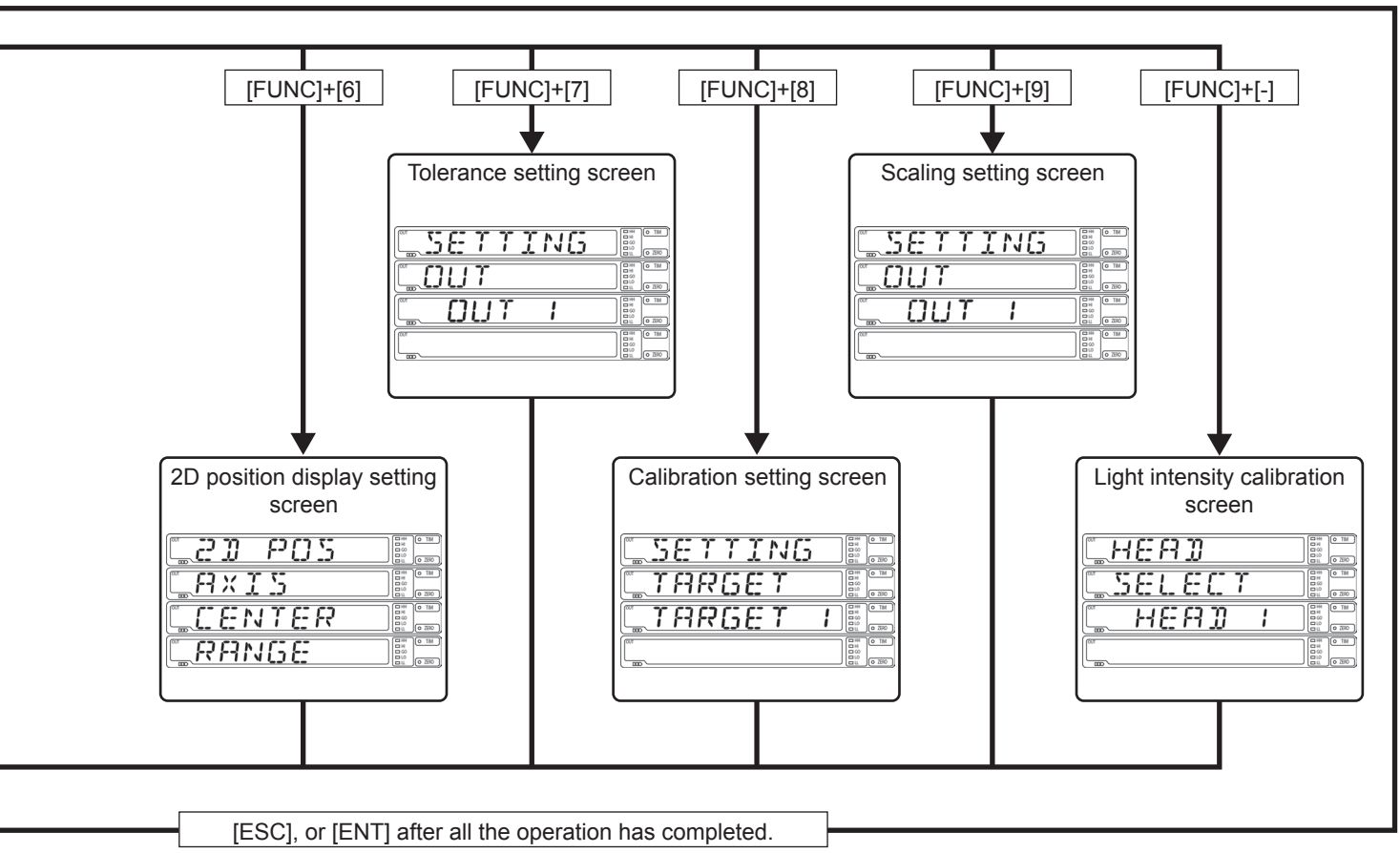
You can use the shortcuts combining the [FUNC] key and the numeric keys on the display panel. The screen can be switched using the shortcuts.

Operation	Screen
[FUNC]+[0]	Operation setting screen
[FUNC]+[1]	Program switching screen
[FUNC]+[2]	Display setting screen
[FUNC]+[3]	Light intensity inspection screen
[FUNC]+[4]	Display OUT selection screen
[FUNC]+[5]	Position display head selection screen
[FUNC]+[6]	2D position display setting screen
[FUNC]+[7]	Tolerance setting screen
[FUNC]+[8]	Area calibration screen
[FUNC]+[9]	OUT scaling screen
[FUNC]+[-]	Light intensity calibration screen

Screen transition



Display	Reference
Display setting	“Display Setting Screen” (page 3-8)
Single OUT setting	“Single OUT Display” (page 3-6)
Multi-OUT setting	“Multi-OUT Display” (page 3-6)
Set up the operation settings	“Operation Setting Screen” (page 3-7)
Switch the Program	“Program Switching Screen” (page 3-8)
Light intensity inspection setting	“Light Intensity Inspection Screen” (page 3-9)
Select the display OUT	“Display OUT Selection Screen” (page 3-9)
Position Display Head Selection	“Position Display Head Selection Screen” (page 3-10)
2D position display setting	“2D Position Display Setting Screen” (page 3-11)
Tolerance setting	“Tolerance setting” (page 5-50)
Calibration setting	“Registering the calibration setting” (page 5-56)
Scaling setting	“Register the scaling setting” (page 5-61)
Light intensity calibration	“Performing calibration of received light intensity” (page 5-71)



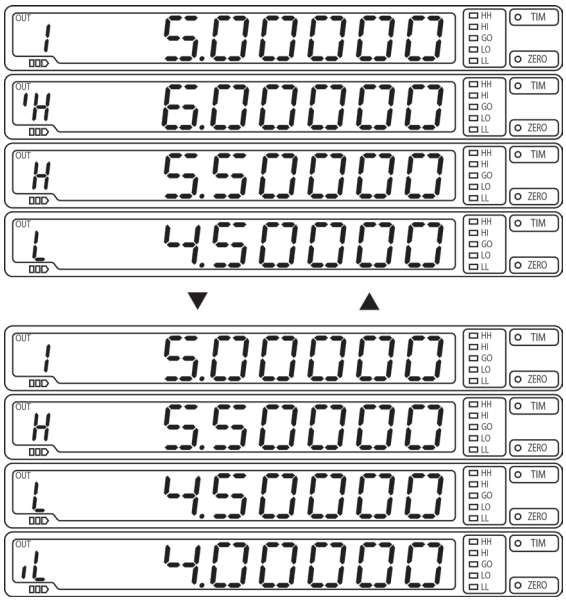
Description of Each Screen

■ Single OUT Display

When using the single OUT display, the main display section displays the OUT value on the top column and the associated tolerance threshold values in the following columns.
You can input a signal to the selected OUT by pressing the [TIM], [ZERO], or [RESET] key.

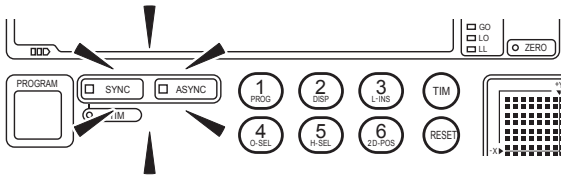
● Switching the tolerance threshold value to be displayed

When the tolerance mode to be displayed is [Threshold value], you can switch the display of the tolerance determination threshold value by pressing the [▲] or [▼] key.



● Switching the control group for the target to be controlled

You can switch the control group by pressing the [◀] or [▶] key.



Reference

The input targets when [TIM], [ZERO], and [RESET] keys are pressed depend on the control group which OUT display belongs to.
SYNC
The signal is input to the synchronized OUT.
ASYNC
The signal is input to the OUT displayed in the single OUT.

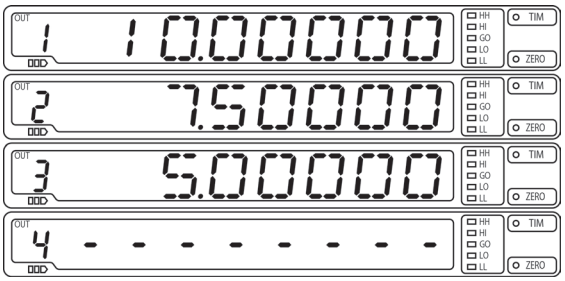
■ Multi-OUT Display

When 4 OUT's have been selected, the main display will show the OUT value and the associated input statuses.
You can input a signal to the selected OUT by pressing the [TIM], [ZERO], or [RESET] key.

● Temporarily displaying the tolerance threshold value of the displayed OUT

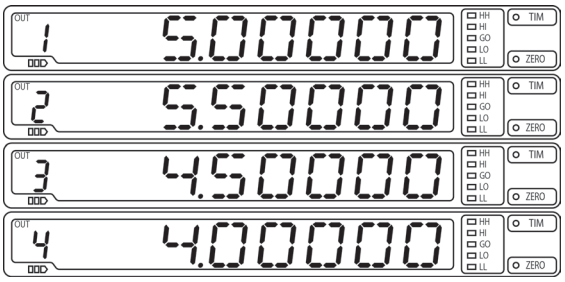
Pressing the [ENT] key temporarily displays the tolerance threshold value of the displayed OUT. The screen returns to the OUT display screen in 5 seconds or by any key operation.

Reference value mode
The displayed values are the upper limit, standard, and the lower limit from the top.



"Ref. value" (page 5-35)

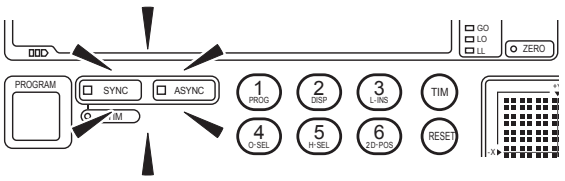
Threshold value mode
The values displayed are, from the top to the bottom columns, the most upper limit, upper limit, lower limit, and most lower limit values.



"Threshold" (page 5-35)

● Switching the control group of the target to be controlled

You can switch the control group by pressing the [◀] or [▶] key.



Reference The input targets when [TIM], [ZERO], and [RESET] keys are pressed depend on the control group which the selected OUT belongs to.

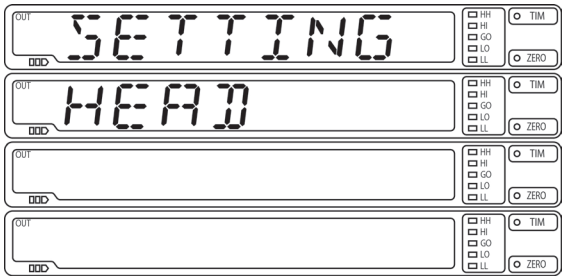
SYNC
The signal is input to the synchronized OUT.

ASYNC
The signal is input uniquely to the OUT selected by the multi-OUT.

■ Operation Setting Screen

This section describes how to apply the settings to the controller.

1 Press the [FUNC] key and then [0] key.
The setting item selection screen appears.



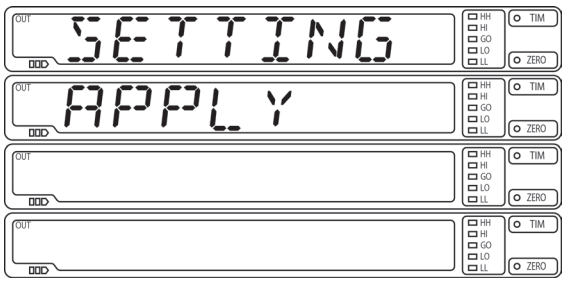
2 Press the [▲] or [▼] key to select the item you change the setting, and then press the [ENT] key.
The selectable items are the following:

- HEAD (Head setting)
- TARGET (Target setting)
- OUT (OUT setting)
- COMMON (Common setting)
- IO (IO setting)
- STAT (Statistical setting)
- ENV (Environment setting)
- APPLY (Apply the settings)

Reference Please refer to the following items for details on each setting item.

- HEAD (Page 3-10)
- TARGET (Page 5-21)
- OUT (Page 3-6)
- COMMON (Page 5-62)
- IO (Page 5-89)
- STAT (Page 5-52)
- ENV (Page 7-8)

3 Select [APPLY] after completing the settings.



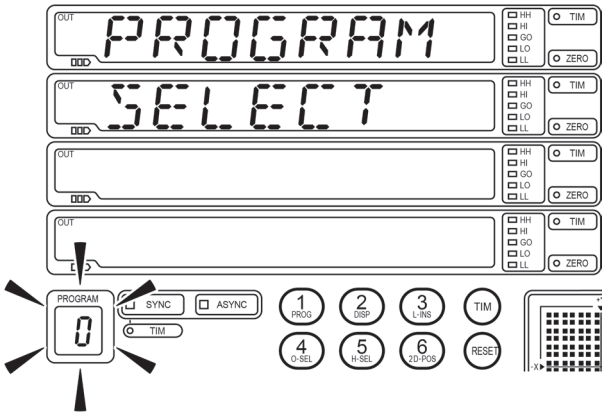
Select [EXECUTE] to apply the settings to the controller.

■ Program Switching Screen

This section describes how to switch the program used for the measurement.

1 Press the [FUNC] key and then [1] key.

[PROGRAM SELECT] appears and the PROGRAM display blinks.

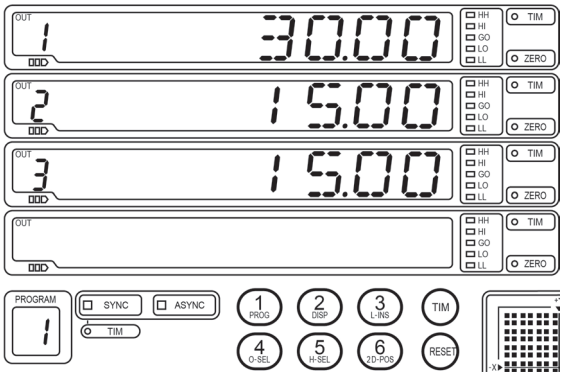


2 Press the [▲] or [▼] key to select the program number.

0 to 15 are available for the selection.

3 Press the [ENT] key.

The program changes to one selected at the PROGRAM display.

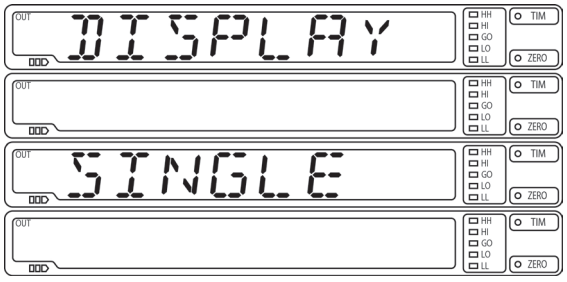


■ Display Setting Screen

This section describes how to select and change the display mode of the display panel between "Single OUT display" and "Multi-OUT display".

1 Press the [FUNC] key and then [2] key.

The display setting screen appears.



2 Press the [◀] or [▶] key to change the display setting.

The items you can select are:

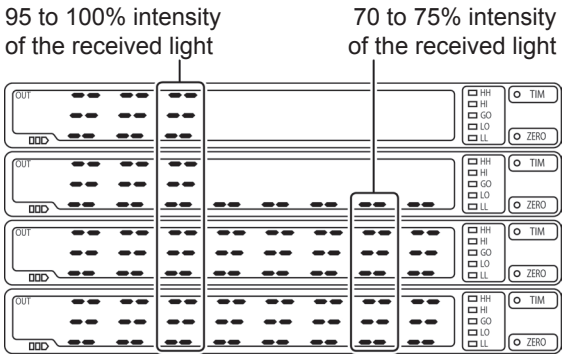
- SINGLE (Single OUT display)
  “Single OUT Display” (page 3-6)
- MULTI (Multi-OUT display)
  “Multi-OUT Display” (page 3-6)

3 Press the [ENT] key.

The display setting turns to the selected one.

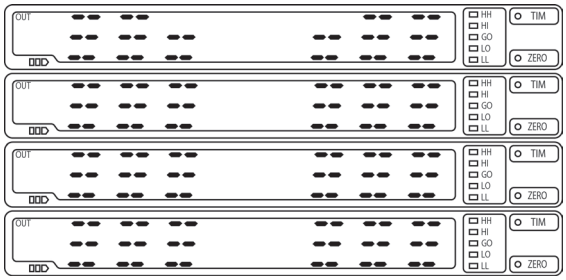
■ Light Intensity Inspection Screen

This section describes how to display the intensity distribution of the received light of the specified head on the main display. One "-" shows the light intensity of 5%. On this screen, you can check the 40 to 100% intensity of the received light.

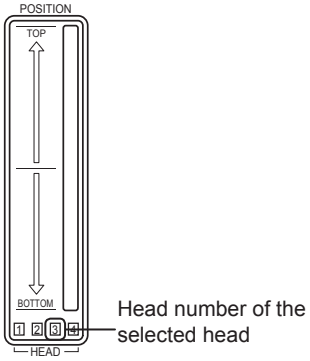


1 Press the [FUNC] key and then [3] key.

The light intensity inspection screen appears.



2 Press the [◀] or [▶] key to change the head to display.



The light intensity inspection screen for the head selected appears.

3 Press the [ESC] key.

The light intensity inspection screen returns to the last screen.

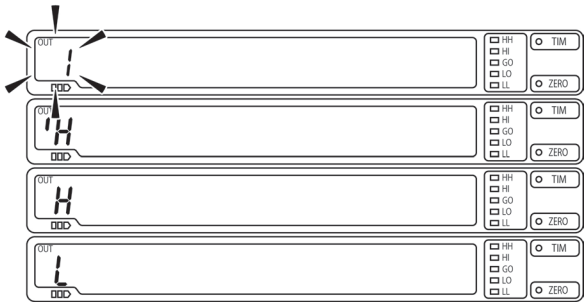
Reference The light intensity that the display panel can display is 40 to 100%. To check the status of the received light in more detail, use the target viewer.
“Target Viewer” (page 6-14)

■ Display OUT Selection Screen

● Single OUT Display

1 Press the [FUNC] key and then [4] key.

The display OUT selection screen appears and the OUT number blinks.

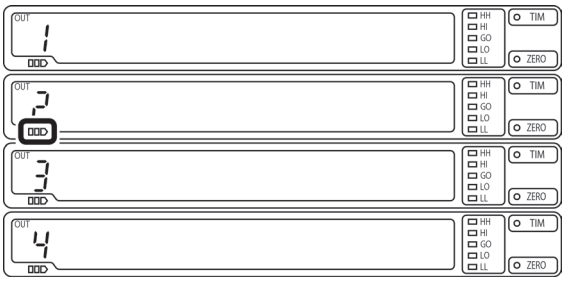


2 Press the [▲] or [▼] key to select OUT to be displayed, and then press the [ENT] key.

Point The OUT numbers not set cannot be selected.

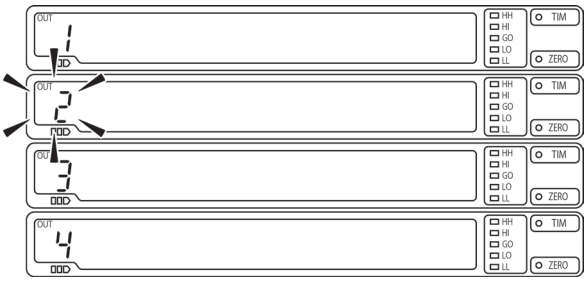
● Multi-OUT display

1 Press the [▲] or [▼] key to select OUT whose display OUT is changed.



2 Press the [FUNC] key and then [4] key.

The display OUT selection screen appears and the OUT number blinks.



3 Press the [▲] or [▼] key to select OUT to be displayed, and then press the [ENT] key.

Point

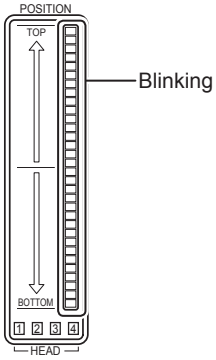
- The OUT numbers not set cannot be selected.
- You can hide the measurement values by selecting blank.

■ Position Display Head Selection Screen

This section describes how to check the position of the target. An area where the target exists appears in red and the other in green.

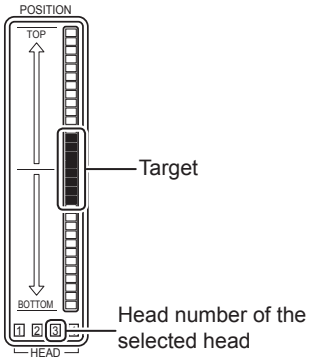
1 Press the [FUNC] key and then [5] key.

The indicator at the position display blinks.



2 Press the [◀] or [▶] key to select the head to be displayed, and then press the [ENT] key.

The position of the target of the selected head appears in red.



Reference

When the selected head does not exist, the entire indicator appears in red.

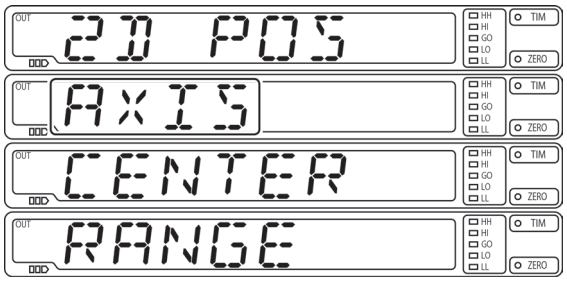
■ 2D Position Display Setting Screen

This section describes how to select the OUT numbers to be respectively displayed on the X and Y axes in the 2D position display.

1 Press the [FUNC] key and then [6] key.
The 2D position display setting screen appears.

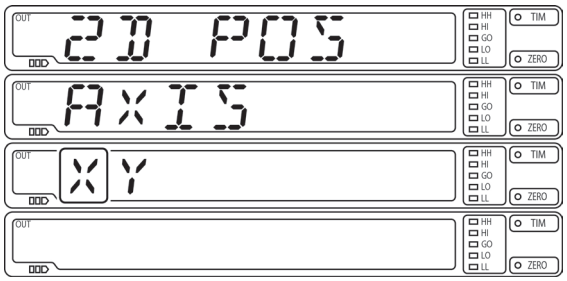
● Selecting OUT to be displayed on the X and Y axes

2 Press the [▲] or [▼] key to select [AXIS], and then press the [ENT] key.



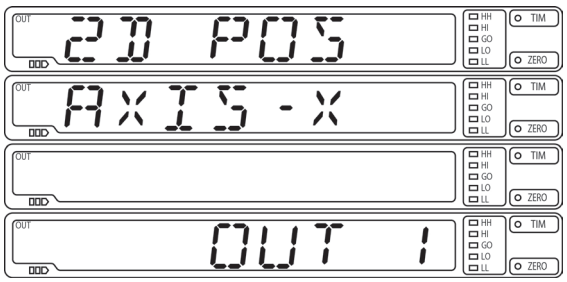
The X/Y axis selection screen appears.

3 Press the [◀] or [▶] key to select [AXIS], and then press the [ENT] key.



The X axis display target OUT selection screen appears.

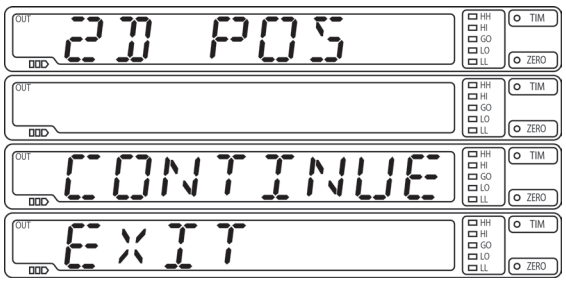
4 Press the [◀] or [▶] key to select OUT to be displayed, and then press the [ENT] key.



Point

- When any OUT not used is selected, the OUT does not appear in the 2D position display.
- When [--------] (OFF) is selected for the X axis, the 2D position display is limited to on the Y axis.
- When [--------] (OFF) is selected for the Y axis, the 2D position display is limited to on the X axis.
- When [--------] (OFF) is selected for both the X and Y axes, no OUT appears in the 2D position display.

5 Press the [▲] or [▼] key to select [CONTINUE], and then press the [ENT] key.

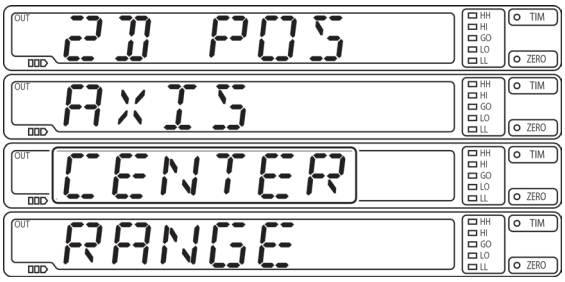


The screen returns to the 2D position display setting screen.

6 Follow the steps 2 to 4 again to select OUT to be displayed on the Y axis.

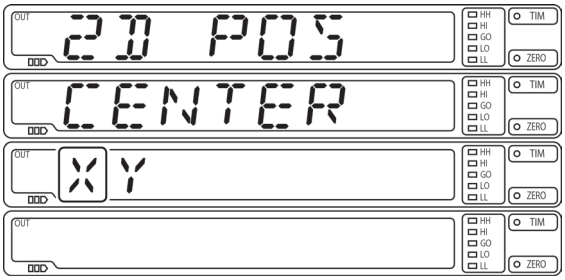
● **Setting the center positions of the X and Y axes**

2 Press the [▲] or [▼] key to select [CENTER], and then press the [ENT] key.



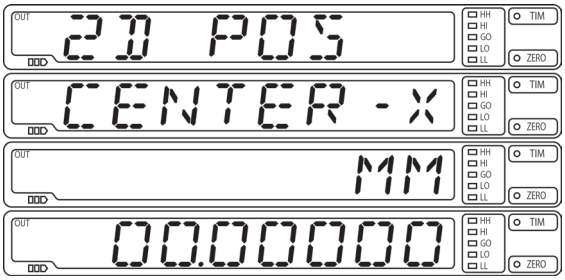
The X/Y axis selection screen appears.

3 Press the [◀] or [▶] key to select [X], and then press the [ENT] key.

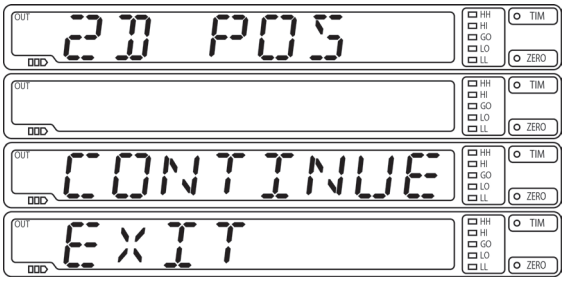


The X axis center position input screen appears.

4 Use the [◀] and [▶] keys to switch the digit to enter, the numeric key to enter the values, and then press the [ENT] key.



5 Press the [▲] or [▼] key to select [CONTINUE], and then press the [ENT] key.



The screen returns to the 2D position display setting screen.

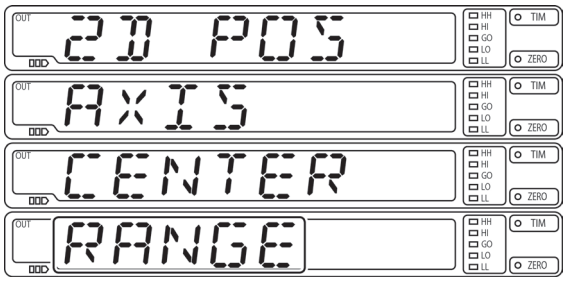
6 Follow the steps 2 to 4 again to set the center position for the Y axis.

● **Setting the display ranges of the X and Y axes**

You can set the ranges of the X and Y axes in the 2D position by ±.
Example:
CENTER (X): 0 mm/RANGE (X): 10 mm
CENTER (Y): 10 mm/RANGE (Y): 20 mm,

the 2D position displays the information below:
X axis: ±10 mm, and
Y axis: -10 to 30 mm

2 Press the [▲] or [▼] key to select [RANGE], and then press the [ENT] key.



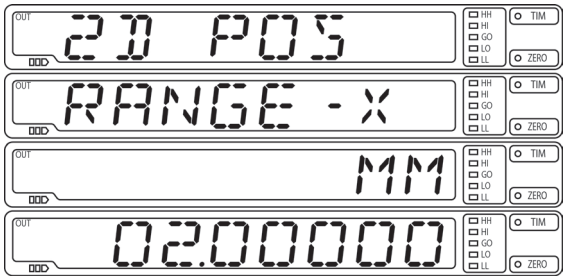
The X/Y axis selection screen appears.

3 Press the [◀] or [▶] key to select [X], and then press the [ENT] key.



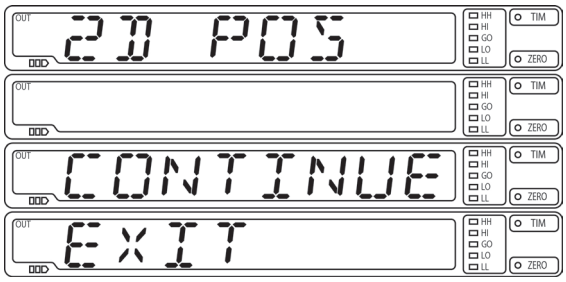
The X axis display range selection screen appears.

4 Use the [◀] and [▶] keys to switch the digit to enter, the numeric key to enter the values, and then press the [ENT] key.



Reference The default display range depends on the setting of the minimum display unit.

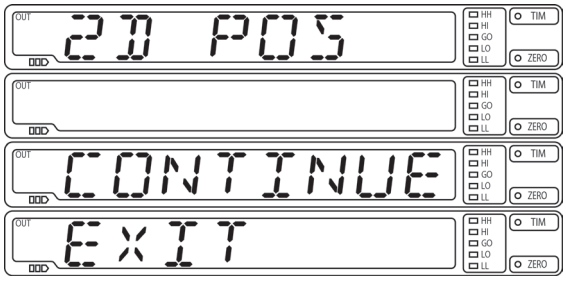
5 Press the [▲] or [▼] key to select [CONTINUE], and then press the [ENT] key.



The screen returns to the 2D position display setting screen.

6 Follow the steps 2 to 4 again to select the display range for the Y axis.

7 After setting the display OUT, the center positions, and the display ranges for both X and Y axes, press the [▲] or [▼] key to select [EXIT], and press the [ENT] key.



The settings are applied to the 2D position display, and the screen returns to the 2D position display setting screen.

Reference
- Even when you switch the program, the 2D position display settings are held.
- The 2D position display settings are initialized only when:
  - the minimum display unit is changed in the current program,
  - the minimum display unit is different from the one for the switched program, and
  - all the settings of the controller are initialized.

■ Key Lock Check Screen/Password Entry Screen

● Locking the keys

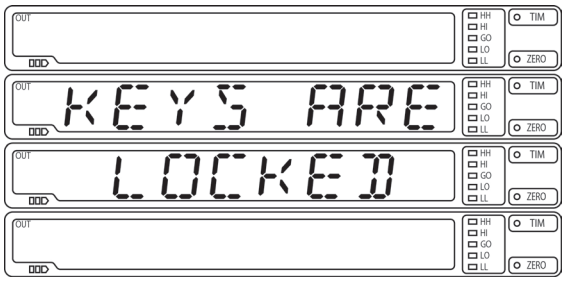
1 Press and hold the [LOCK] key (2 seconds or more).

The keys on the display panel are locked.



Lighting on

While the keys are locked, the [LOCK] button lights up in red. When you operate any key while the keys are locked, the key lock confirmation screen appears.



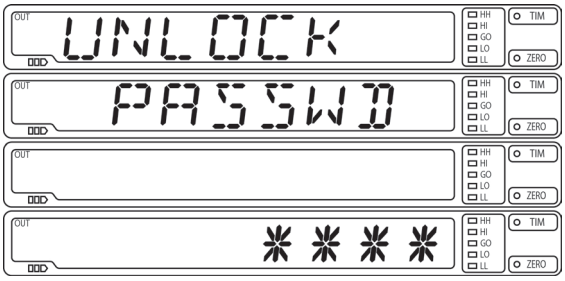
● **Canceling the key lock (when no password is set.)**

1 Press and hold the [LOCK] key (2 seconds or more) when the keys are locked.
The key lock is canceled.

● **Canceling the key lock (when the password is set.)**

1 Press and hold the [LOCK] key (2 seconds or more) when the keys are locked.
The password entry screen appears.

2 Enter the password by the numeric keys.



The key lock is canceled and the last screen appears.
The password can be set only from LS-Navigator2.
“Password” (page 7-7)

■ Buzzer Setting Screen

This section describes how to set the ON/OFF of the buzzer during the operation of the display panel.

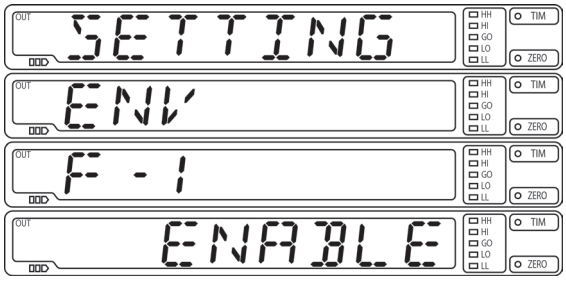
1 Press the [FUNC] key and then [0] key.

2 Press the [▲] or [▼] key to select [ENV], and then press the [ENT] key.

3 Press the [◀] or [▶] key to select [BUZZER], and then press the [ENT] key.

4 The buzzer ON/OFF selection screen appears.

5 Use the [▲], [▼], [◀], and [▶] keys to switch the buzzer setting.



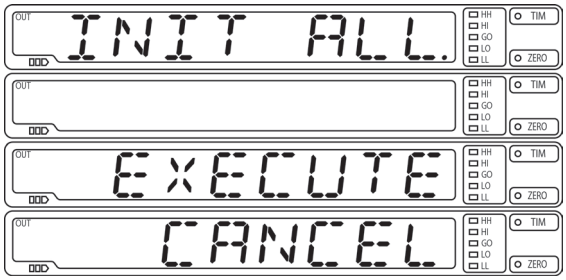
6 Press the [ENT] key.

■ All Setting Initialization Screen

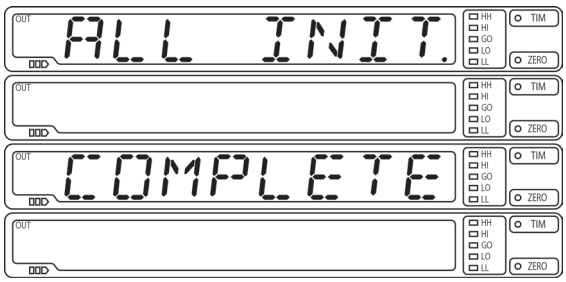
This section describes how to restore all the program and environmental settings to the factory default.

Reference To initialize only the program (restore to the factory default), please read “Initializing the program setting” (page 5-19).

1 Press and hold the [ESC] key and turn on the power.
The all setting initialization screen appears.



2 Press the [▲] or [▼] key to select [EXECUTE], and then press the [ENT] key.
Initialization starts up, and after the initialization the completion screen appears.



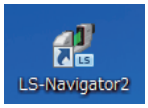
3 Press the [ENT] or [ESC] key.
The screen returns to the measurement screen.

Basic Operations of LS-Navigator2

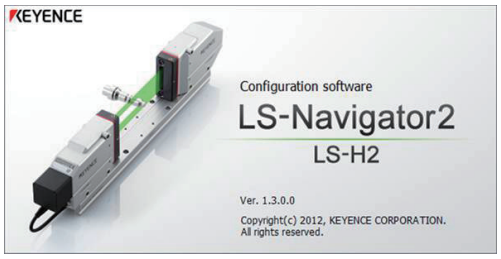
Startup

This section describes the procedure for starting up LS-Navigator2.

1 Double-click the [LS-Navigator2] shortcut icon on the desktop or select the start menu → [All Program] → [Keyence Applications] → [LS-Navigator2], to start up the software.



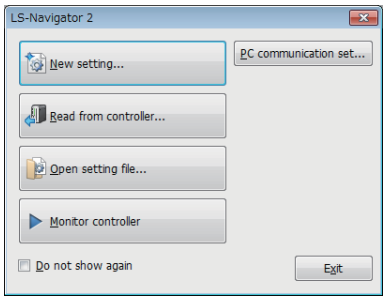
This screen appears.



The startup menu appears next.

2 Select the items to be set.

- New setting
- Read from controller
- Open setting file
- Monitor controller
- PC communication set



[New setting]
The [Program setting] screen appears.

Reference For details, refer to “[Program Setting] Screen” (page 5-17).

[Read from controller]
[Program setting] screen appears.
The current settings of the controller appear.

Reference For details, refer to “[Program Setting] Screen” (page 5-17).

[Open setting file]
The [Open file] dialog will appears. The setting file stored in the PC beforehand is read.

Reference For details, refer to “Reading Setting File” (page 3-18).

[Monitor controller]
The main window appears and monitoring starts.
The current settings of the controller is read.

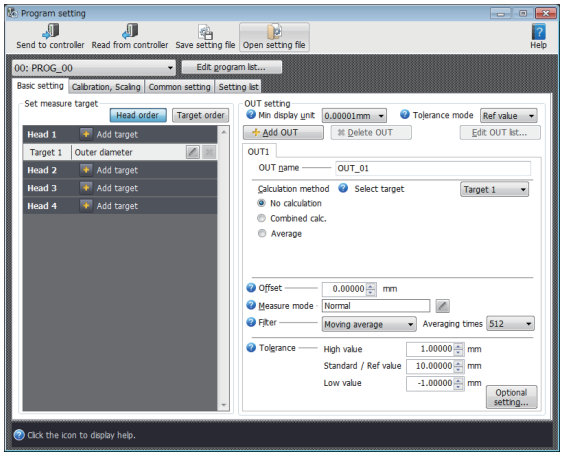
Reference For details, refer to “6 Checking the Measurement Results” (page 6-1).

[PC communication set]
The [PC communication set] dialog appears.

Reference For details, refer to “PC communication configuration” (page 7-2).

Point When the check box of [Do not show again] is checked, the startup menu does not appear at the next startup.
To show the startup menu at the startup, refer to “Displaying the start-up menu” (page 7-19).

3 Perform some operations such as displaying measurements, communicating the setting parameters, and saving and backup of the setting file.

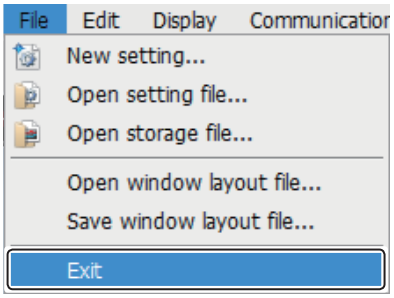


Reference For details, refer to “[Program Setting] Screen” (page 5-17).

Shutdown

This section describes the procedure for exiting LS-Navigator2.

1 Select the [File] menu and then [Exit] to exit LS-Navigator2.



The measurement screen closes and LS-Navigator2 exits.

Sending/Reading Settings

■ Sending the settings to the controller

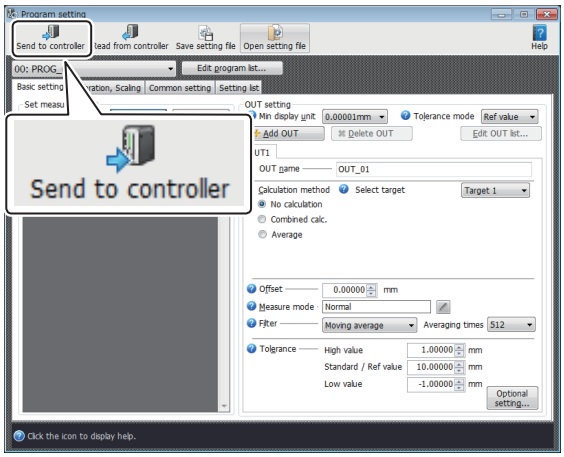
This section describes the procedure for sending (applying) the program settings created with LS-Navigator2 to the controller.

1 Display the [Program setting] screen and set up the program.

Change the settings arbitrary.

Reference For details, refer to “[Program Setting] Screen” (page 5-17).

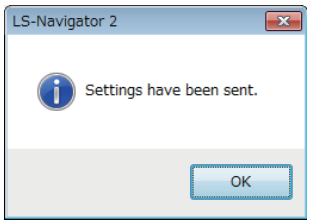
2 Click the [Send to controller] button.



The sending completion dialog appears.

3 Click the [OK] button.

The items set on LS-Navigator2 are applied to the controller.

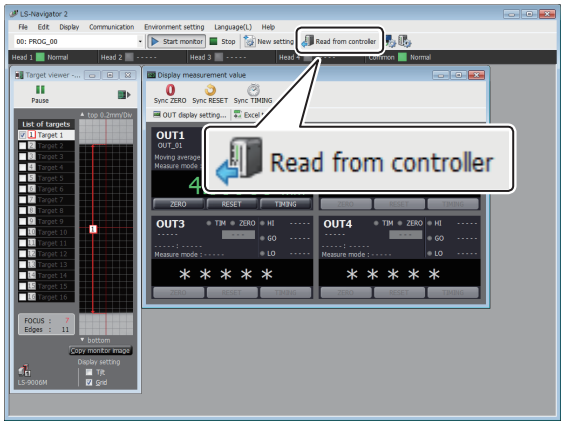


■ Reading Settings from Controller

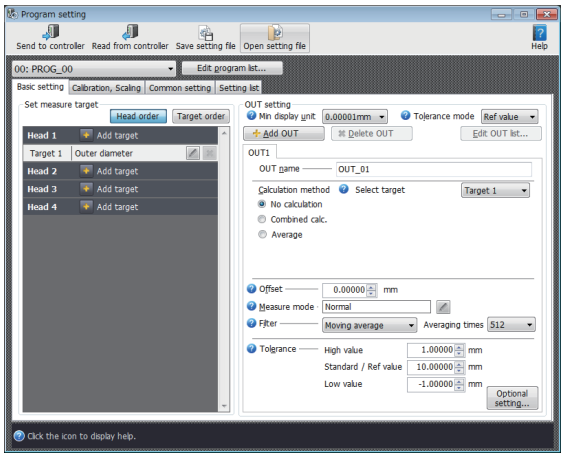
This section describes the procedure for reading out the settings of the controller.

1 Display the LS-Navigator2 screen.

2 Click the [Read from controller] button.



[Program setting] screen appears.
The program settings set in the controller are read and reflected to the [Program setting] screen.



Saving and Reading Setting File

Saving the setting file

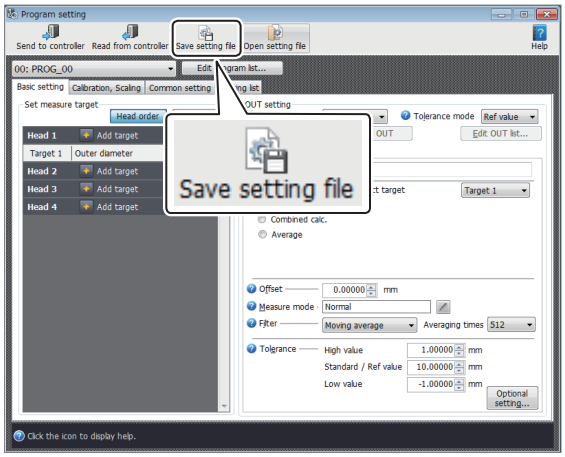
This section describes the procedure for saving the created program settings in a file.

1 Display the [Program setting] screen and set up the program.

Change the settings arbitrary.

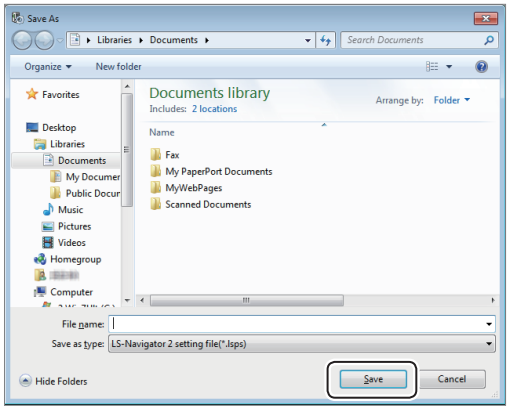
Reference For details, refer to “[Program Setting] Screen” (page 5-17).

2 Click the [Save setting file] button.



The [Save as] dialog appears.

3 Enter the file name and click the [Save] button.

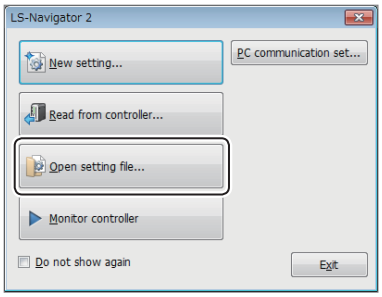


The setting file is saved.

Reading Setting File

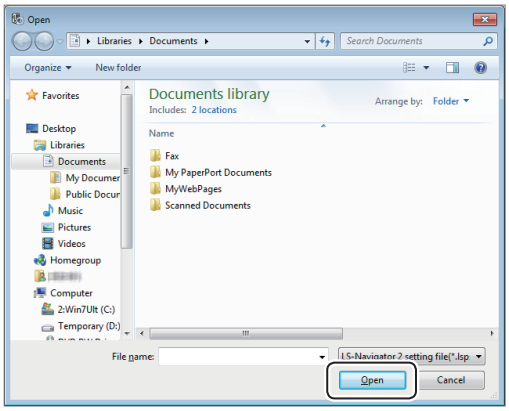
■ From Startup Menu

1 Click the [Open setting file] button.



The [Open] dialog appears.

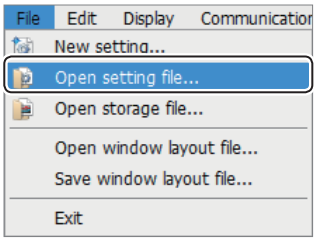
2 Select the setting file and click the [Open] button.



The [Program setting] screen appears, to which the content of the setting file has been applied.

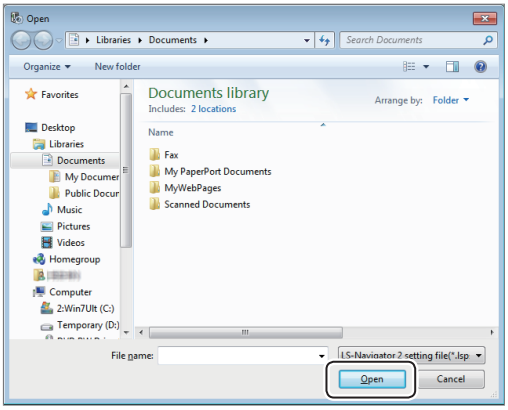
■ From Main Screen

1 Select the [File] menu and then [Open setting file].



The [Open] dialog appears.

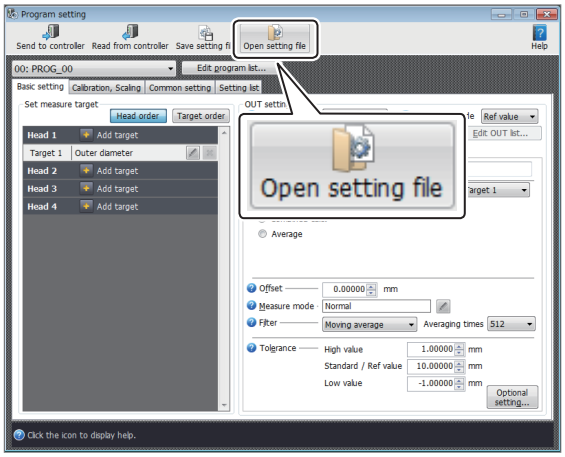
2 Select the setting file and click the [Open] button.



The [Program setting] screen appears, to which the content of the setting file has been applied.

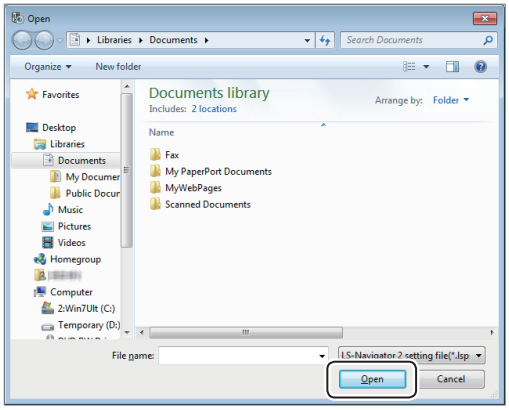
■ From [Program setting] Screen

1 Click the [Open setting file] button.



The [Open] dialog appears.

2 Select the setting file and click the [Open] button.



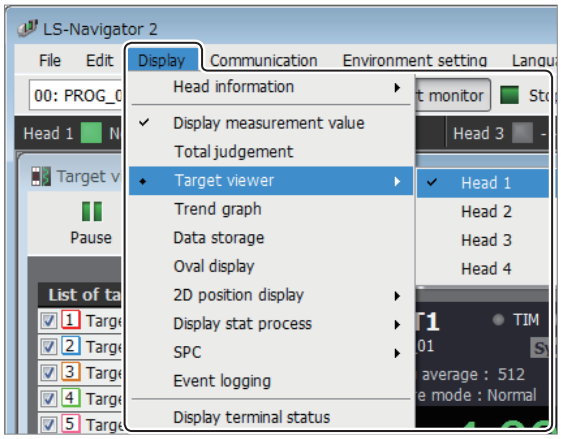
The content of the setting file is applied to the [Program setting] screen.

Displaying Objective Screen

You can display each screen to check the measurement results from the [Display] menu.

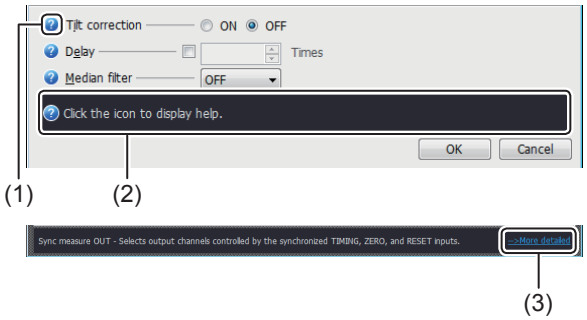
1 Select the screen name to display from the [Display] menu.

The screen being displayed has the ☑ icon displayed at the left of the screen name.
When an image in the sub menu is displayed, the ✚ icon appears at the left of the screen name.



Reference For the details of each screen that can be displayed from the [Display] menu, refer to “Measurement Screen Outline and Switching Screens” (page 6-2).

How to Use Help



(1) [?] Icons

By clicking the [?] icon at the left of the item name, descriptions of the item appear in the help display area of (2).

(2) Help display area

When the [?] icon is clicked, descriptions for the function appear.

(3) [More detailed] link

By clicking the link, more detailed description of the function appear in a new window.

4

Easy Setting Guide

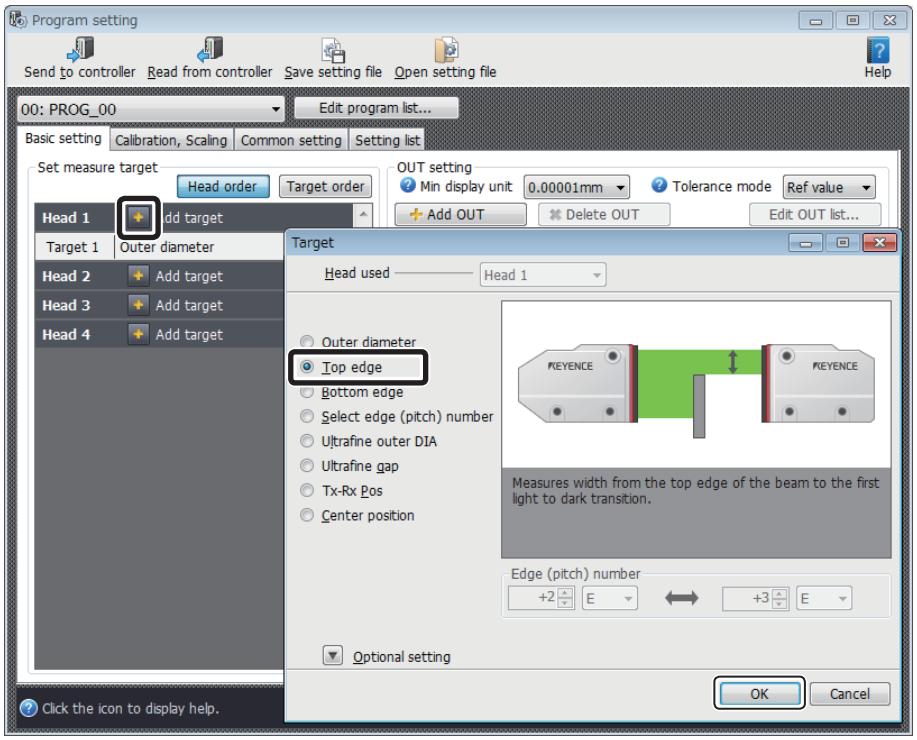
This chapter describes how to set measurements.

Flow of Measurement.....4-2
Outer Diameter Measurement (1 head).....4-4
Outer Diameter Measurement (2 Axes) 4-5
Outer Diameter / Width Measurement (Large Diameter Measurement by Using 2 Heads).....4-6
Inner Diameter / Gap Measurement 4-7
Outer Diameter / Runout Measurement.....4-8
Edge Position Measurement 4-9
Edge Position Measurement (Transparent Target).....4-10
Pitch Measurement.....4-11
Group Determination.....4-12
Statistical Processing 4-13

Flow of Measurement

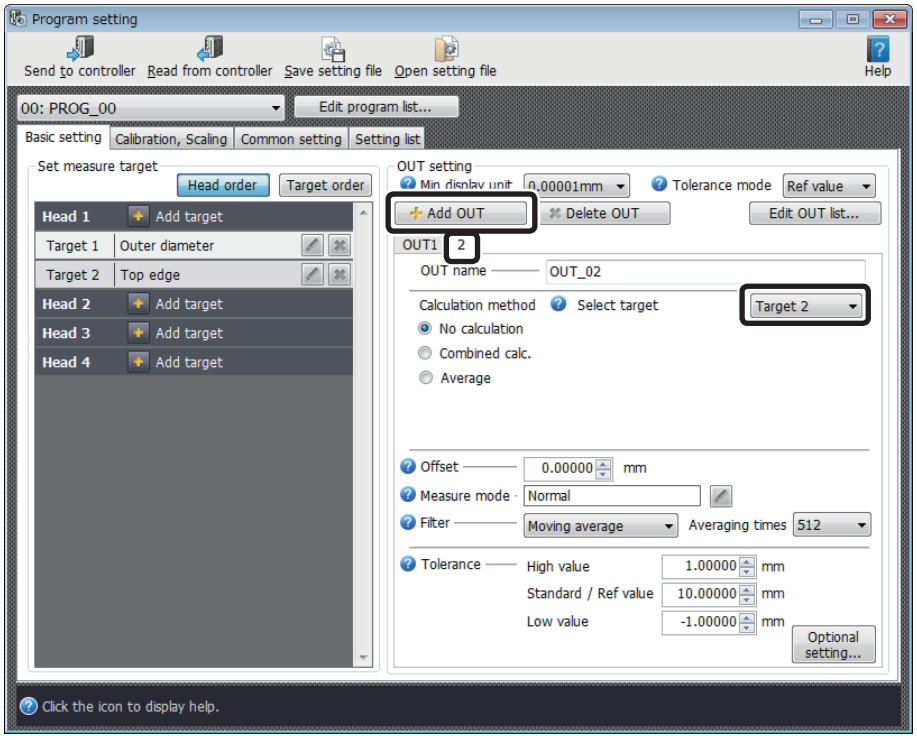
1 Select the measurement type in the measurement setting.

On clicking the [Add target] button, the [Target] window appears.
Select [Top edge] and click [OK] button.



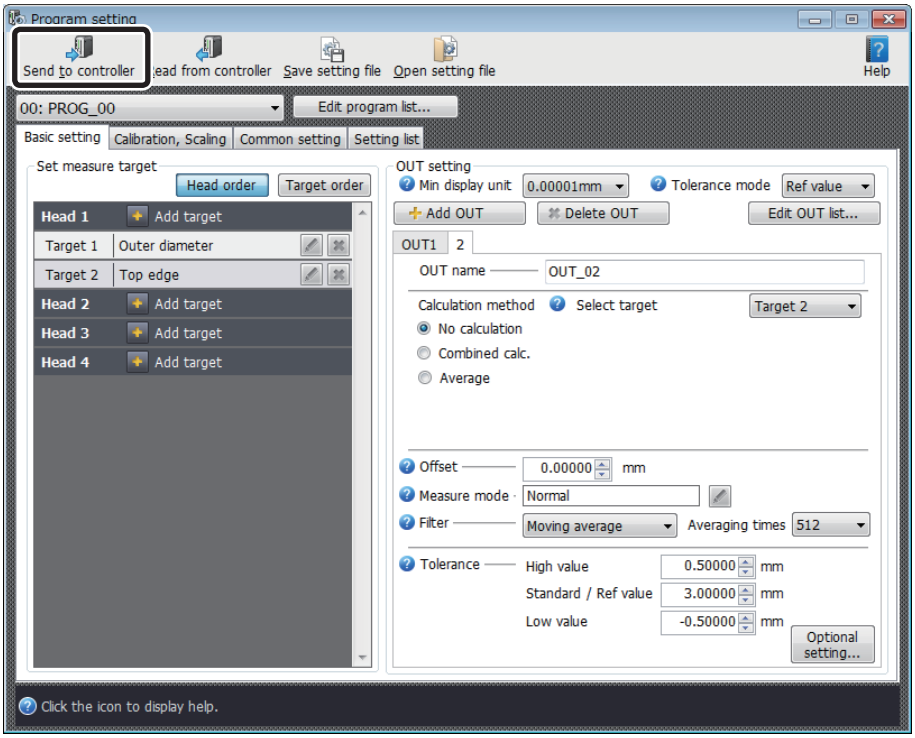
2 Select the OUT number to display the measurement value.

On clicking [Add OUT], [OUT2] is displayed.
Select [Target 2] for OUT2 target measurement.



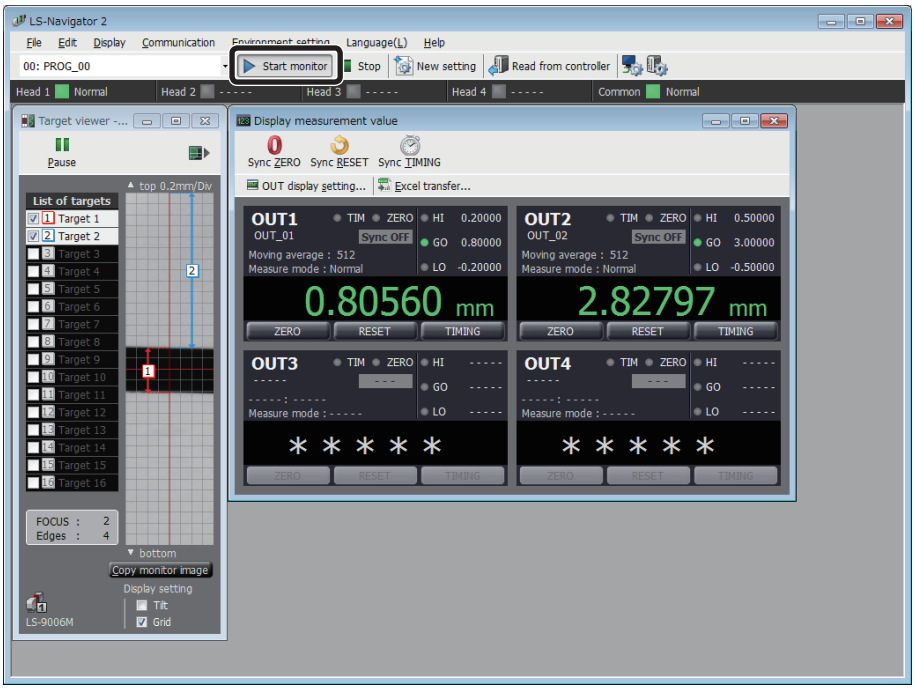
3 Send the setting to the controller.

Click [Send to controller].



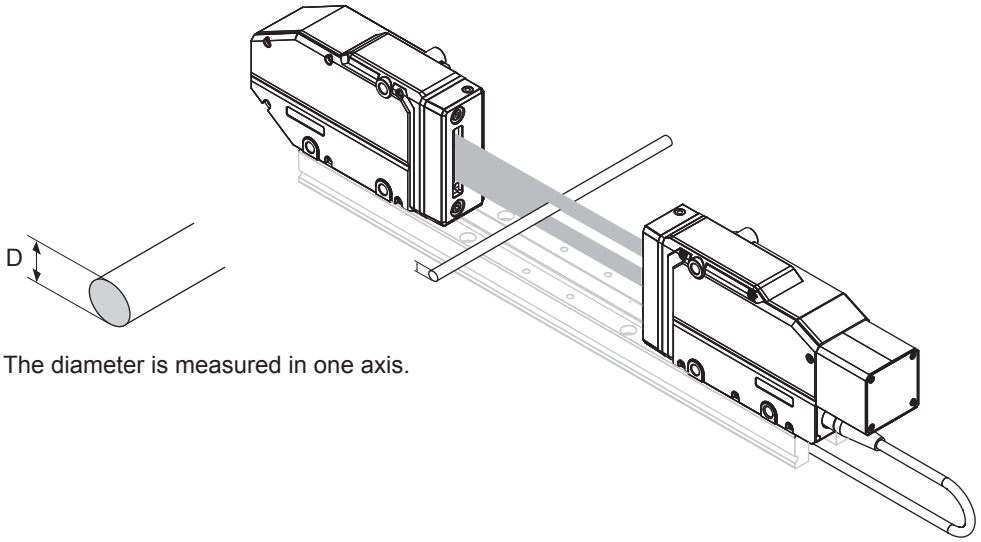
4 Display the measurement value.

Click [Start monitor] to display the measurement value.



Outer Diameter Measurement (1 head)

The diameter is measured by one head in one axis.
The measurement result is displayed in OUT1.



The diameter is measured in one axis.

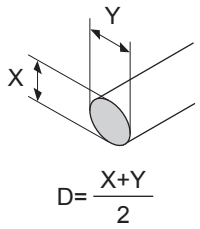
■ Setting values

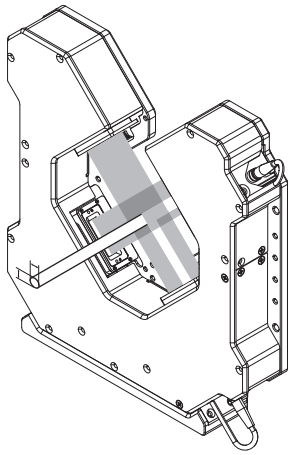
	Setting		Setting values
Setting the measurement target	Head 1	Target 1	Outer diameter
OUT setting	OUT1		Target 1

Reference “Outer diameter” (page 5-22)
“OUT setting” (page 5-34)

Outer Diameter Measurement (2 Axes)

The average outer diameter of two axes is measured.
The measurement result is displayed in OUT1.





The diameter is measured in two axes.

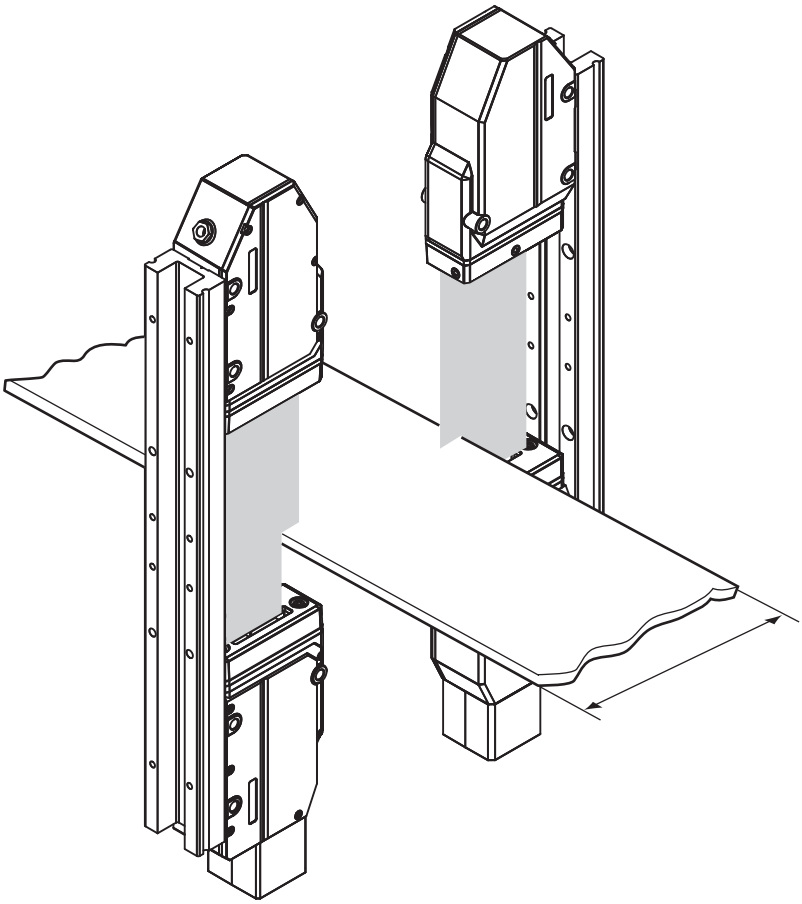
■ Setting values

	Setting		Setting values
Setting the measurement target	Head 1	Target 1	Outer diameter
	Head 2	Target 2	Outer diameter
OUT setting	OUT1	Average	[Target 1], [Target 2]

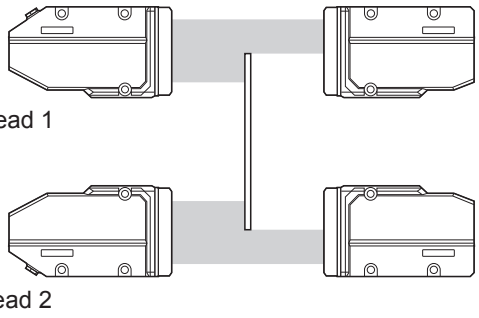
Reference “Outer diameter” (page 5-22)
“Combined calc.” (page 5-36)

Outer Diameter / Width Measurement (Large Diameter Measurement by Using 2 Heads)

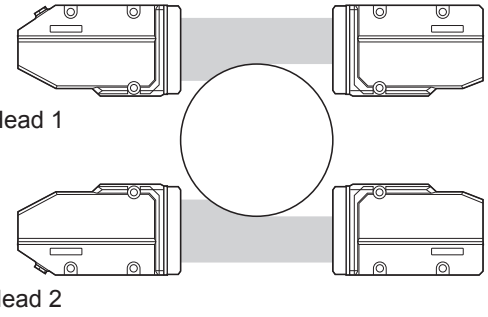
You can use two heads to measure width of a target that cannot be placed between two heads.
The measurement result is displayed in OUT1.



When you measure width.



When you measure diameter.



■ Setting values

	Setting		Setting values
Setting the measurement target	Head 1	Target 1	Bottom edge
	Head 2	Target 2	Bottom edge
OUT setting	OUT1	Combined calculation	[Target 1] × (-1) + [Target 2] × (-1)
		Offset	Dimension of the master target
Calibration and scaling setting	Scaling setting		Set up as needed.

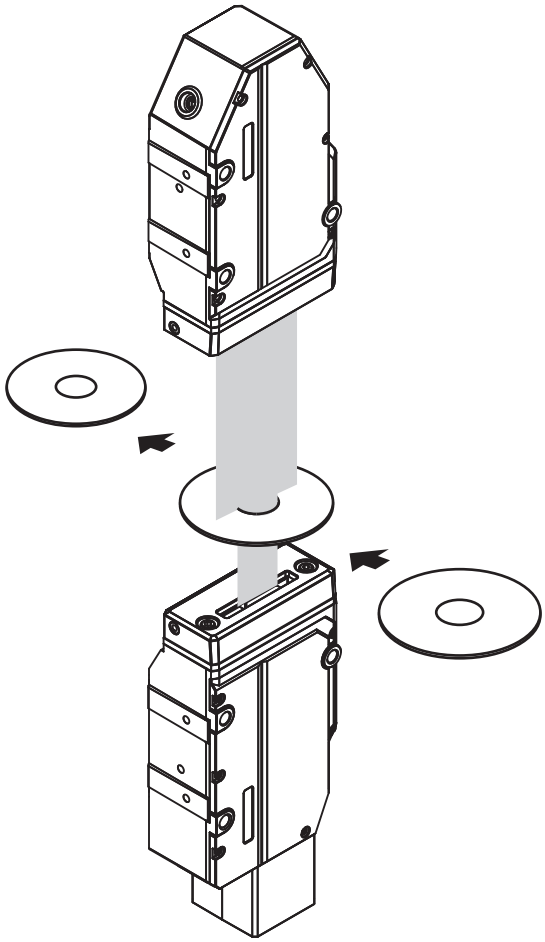
■ Steps

1. Set up as above.
2. Place the master target in the measurement area.
3. Perform the auto zero function.
4. Perform the scaling as needed.

Reference
“Top edge/Bottom edge” (page 5-23)
“Combined calc.” (page 5-36)
“Offset” (page 5-36)
“Scaling setting” (page 5-59)

Inner Diameter / Gap Measurement

The inner diameter of the measurement target is measured.
The target is moved and the maximum value of the measurement is measured as the inner diameter.
The measurement result is displayed in OUT1.



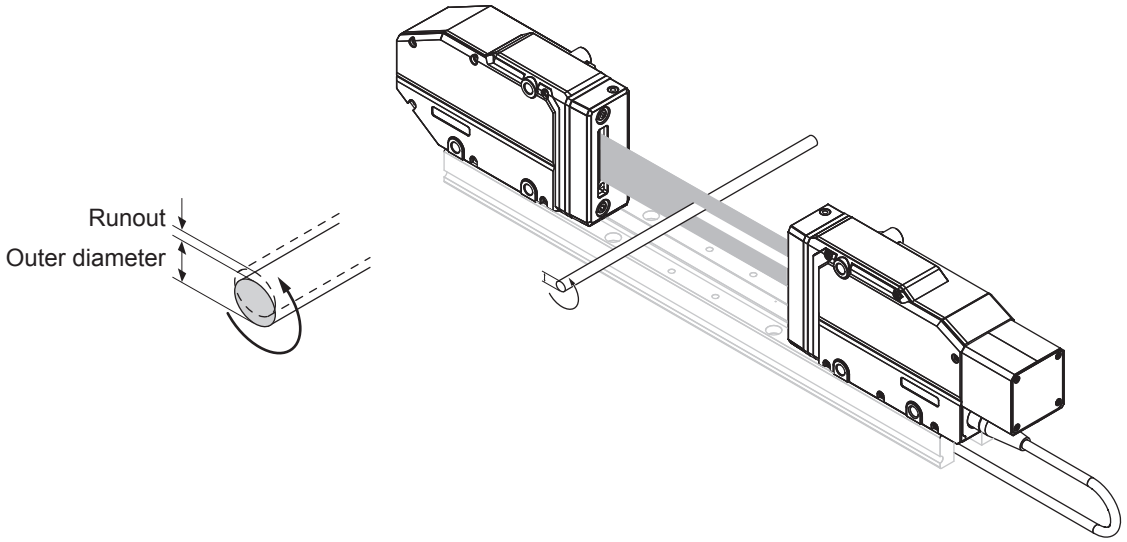
■ Setting values

	Setting		Setting values
Setting the measurement target	Head 1	Target 1	Select edge (pitch) number (+1E, +2E)
OUT setting	OUT1	-	Target 1
		Measure Mode	Peak hold

Reference “Edge (pitch) number setting” (page 5-24)
“Peak hold” (page 5-37)

Outer Diameter / Runout Measurement

The target is rotated to measure its outer diameter and runout.
The measurement results are displayed in OUT1 and OUT2.



■ Setting values

	Setting		Setting values
Setting the measurement target	Head 1	Target 1	Outer diameter
		Target 2	Center position
OUT setting	OUT1	-	Target 1
		Measure mode	Average hold
	OUT2	-	Target 2
		Measure mode	Peak to Peak hold
Calibration and scaling setting	Scaling setting		Set up as needed.

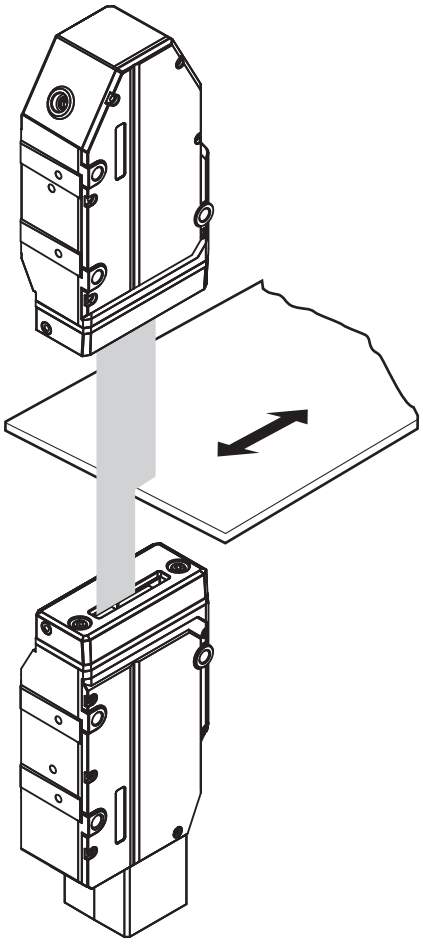
■ Steps

1. Place the target in the measurement area.
2. Rotate the target, then input the TIMING specified for the swing period to be measured.

Reference
“Set measure target” (page 5-22)
“Top edge/Bottom edge” (page 5-23)
“Average hold” (page 5-37)
“Peak-to-peak hold” (page 5-37)

Edge Position Measurement

The edge position of the target is measured.
The measurement result is displayed in OUT1.



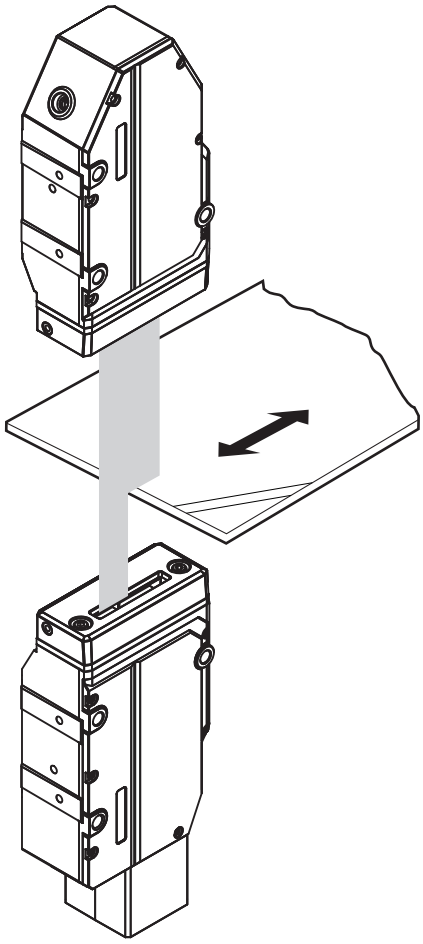
■ Setting values

	Setting		Setting values
Setting the measurement target	Head 1	Target 1	Bottom edge
OUT setting	OUT1	-	Target 1

Reference
“Top edge/Bottom edge” (page 5-23)
“OUT setting” (page 5-34)

Edge Position Measurement (Transparent Target)

The edge position of a transparent object is measured.
The measurement result is displayed in OUT1.



■ Setting values

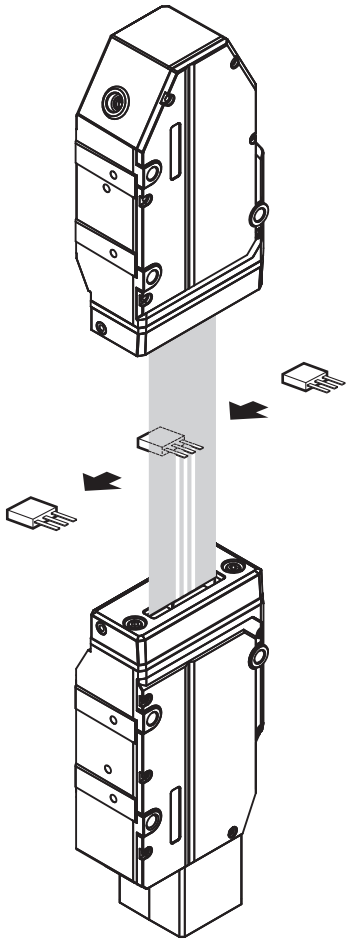
	Setting			Setting values
Setting the measurement target	Head 1	Target 1		Top edge
OUT setting	OUT1	-		Target 1
Common setting	Edge detection	Head 1	Edge detection threshold value	70% (depends on the transparency)

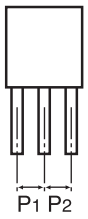
* Change the edge detection threshold value depending on the light volume (light intensity) at the receiver. The light intensity can be checked using the target viewer function.

Reference
“Top edge/Bottom edge” (page 5-23)
“OUT setting” (page 5-34)
“Average hold” (page 5-37)
“Edge detection threshold” (page 5-64)
“Target Viewer” (page 6-14)

Pitch Measurement

The pitch of the pins can be measured.
The measurement result can be displayed for each pair.





Two center pitches can be measured simultaneously.

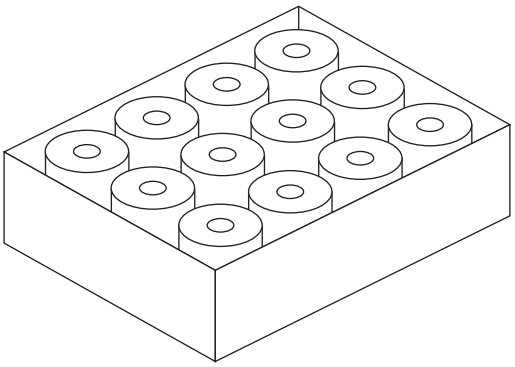
■ Setting values

	Setting		Setting values
Setting the measurement target	Head 1	Target 1	Select edge (pitch) number (+2P, +4P)
		Target 2	Select edge (pitch) number (+2P, +4P)
OUT setting	OUT1	-	Target 1
	OUT2	-	Target 2

Reference “Edge (pitch) number setting” (page 5-24)
“OUT setting” (page 5-34)

Group Determination

This process calculates a mean value from the measurements of a group consisting of multiple targets, and determines acceptance and rejection on the basis of the mean value.
The determination can also be made by the maximum or minimum value.
The group determination result is displayed in OUT16.



Acceptance or rejection is determined by the mean value of 12 shafts.

■ Setting values

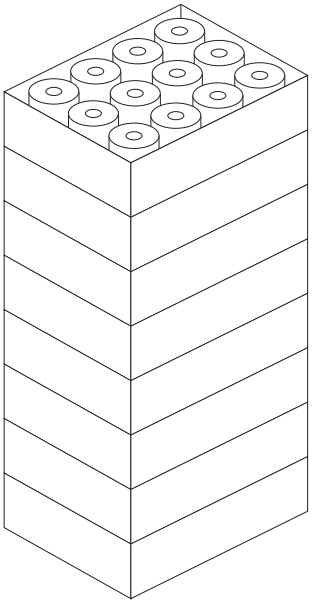
	Setting		Setting values
Setting the measurement target	Head 1	Target 1	Outer diameter
OUT setting	OUT1	-	Target 1
	OUT16	-	-
Common setting	Group calculation function	Calculation content	Average
		Original calculation OUT	OUT1
		Calculation point	12 pts (depends on the work point)

* The group determination function is calculated on the basis of the value fixed by the TIMING input.

Reference
“Outer diameter” (page 5-22)
“OUT setting” (page 5-34)
“Group calculation” (page 5-86)

Statistical Processing

From the measurements, the following are continuously calculated: maximum value, minimum value, mean value, maximum value - minimum value, standard deviation, no. of N (measurements), no. of HH judgements, no. of HI judgements, no. of GO judgements, no. of LO judgements and no. of LL judgements.
The measurement result can be checked either by LS-Navigator2 or by connecting with RS-232C.



The outer diameters of 96 sampled parts are measured and the results are continuously calculated.

■ Setting values

	Setting		Setting values
Setting the measurement target	Head 1	Target 1	Outer diameter
OUT setting	OUT1	-	Target 1
Common setting	Statistical processing setting	Statistical processing control method	Terminal or command
		No. of statistical processing	96 pts (varies according to the number of work points)
		Statistical processing Ch	OUT1

* The result of the statistical processing is calculated on the basis of the value fixed by the TIMING input.

Reference
“Outer diameter” (page 5-22)
“OUT setting” (page 5-34)
“Statistic process settings” (page 5-110)

MEMO

5

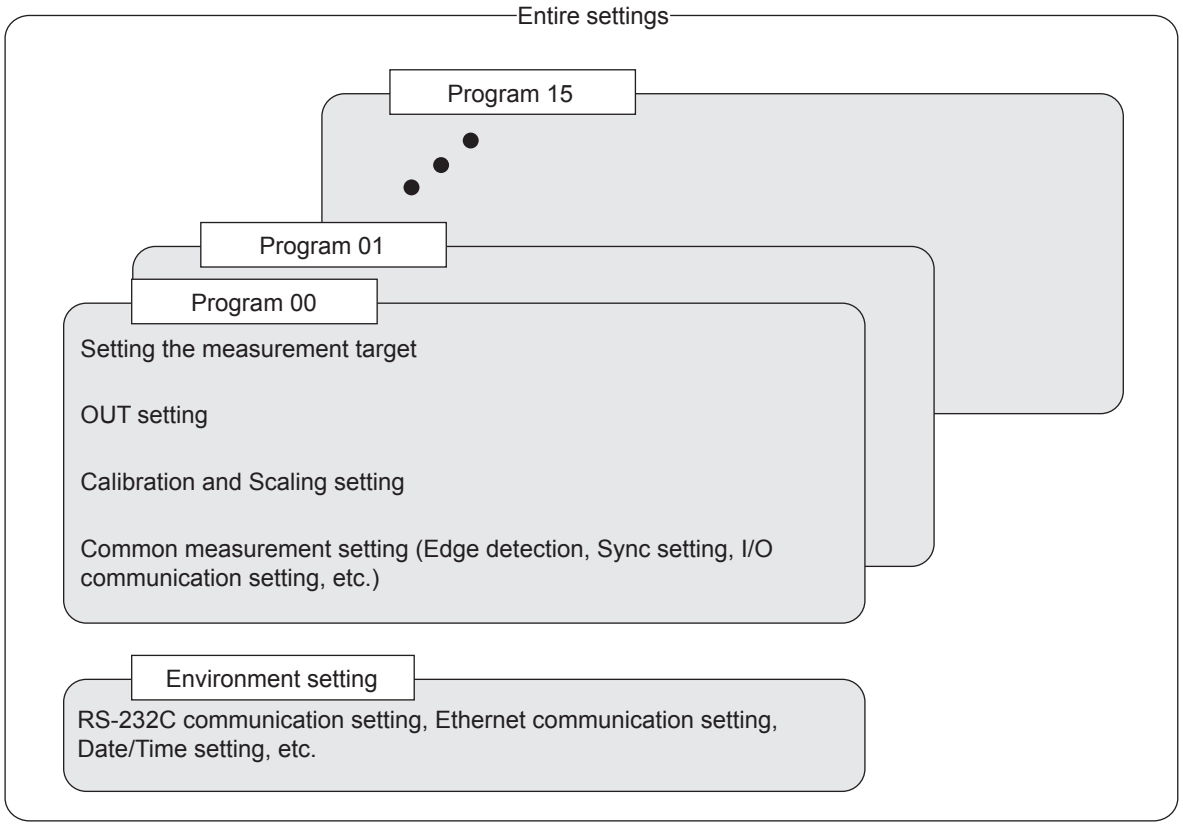
Program Setting

This chapter describes the contents and setup procedure for the program setting.

Flow of the Program Setting..... 5-2
List of Initial Values and Setting Ranges 5-3
Combined limitation for analog scaling (Ref. val mode) and minimum display unit 5-15
Function Restriction of Each Head Model 5-16
[Program Setting] Screen 5-17
[Basic settings] Tab: Set Measurement Target.... 5-21
[Basic settings] Tab: OUT Setting..... 5-32
[Calibration, Scaling] Tab: Calibration Setting 5-52
[Calibration, Scaling] Tab: Scaling Setting 5-57
[Common setting] Tab: Edge Detection 5-62
[Common setting] Tab: Interference Prevention... 5-72
[Common setting] Tab: Sync Setting..... 5-75
[Common setting] Tab: Data Storage 5-77
[Common setting] Tab: Group Calculation 5-84
[Common setting] Tab: I/O Terminal Setting..... 5-89
[Common setting] Tab: Stat Process..... 5-109
[Setting list] Tab..... 5-114

Flow of the Program Setting

Measurement programs explained in this chapter refer to the settings as shown in the figure below of all the settings stored in the Controller.



You can edit the common measurement and program settings to obtain optimum measurement results.

● **Program 00 to Program 15**

A [Program] combines the sequence of settings from the basic settings to common settings to define the measurement operation.
This unit can store up to 16 programs from which you can select the program you wish to use for the measurement. You can also switch to another program while the measurement is in progress.

If you wish to create new program settings

In the Main screen if you click on the [New setting] button, the [Program setting] screen will appear.

If you wish to edit existing program settings

If you click on the [Read from controller] button in the Main screen, the [Program setting] screen to which the settings read from the controller were applied will appear.

List of Initial Values and Setting Ranges

Basic settings

■ Set measure target

Item name			Default setting	Setting value
Target			Target 1	Target 1 to Target 16
Head used			Head 1	Head 1 to Head 4
Area type			Outer diameter	Outer diameter, Top edge, Bottom edge, Edge, Select pitch number, Ultrafine outer DIA, Ultrafine gap, Tx-Rx Pos, Center position
Edge (pitch) number				
	Edge (pitch) start number		+2E	-31E(P) to +31E(P)
	Edge (pitch) finish number		+3E	-31E(P) to +31E(P)
Tilt correction*			OFF	ON, OFF
Delay			OFF	OFF, 1 to 1023
Median filter			OFF	OFF, 7, 15, 31

* Available on LS-9006M/LS-9030M. When using this item on other model, the measurement value will be output waiting.

■ OUT setting

Item name			Default setting	Setting value
Minimum display unit			0.0001 mm	0.1 mm, 0.01 mm, 0.001 mm, 0.0001 mm, 0.00001 mm, 1 µm, 0.1 µm, 0.01 µm
Tolerance mode			Ref value	Ref value, Threshold value
OUT			OUT1	OUT1 to OUT16
OUT name			OUT_xx	In 24 one-byte/two-byte characters
Calculation method				
	Calculation mode		No calculation	No calculation, Combined calc, Average
	Calculation mode = No calculation			
		Target	Target 1	Target 1
	Calculation mode = Combined calc.			
		Coefficient	+1	9 kinds of 0, ±1, ±1/2, ±1/3 and ±1/4
		Coefficient	0	9 kinds of 0, ±1, ±1/2, ±1/3 and ±1/4
		Coefficient	0	9 kinds of 0, ±1, ±1/2, ±1/3 and ±1/4
		Coefficient	0	9 kinds of 0, ±1, ±1/2, ±1/3 and ±1/4
		Target	Target 1	Target 1 to Target 16
		Target	Unused	Target 1 to Target 16
		Target	Unused	Target 1 to Target 16
		Target	Unused	Target 1 to Target 16

Item name			Default setting	Setting value
	Calculation mode = Averaging			
		Target 1	ON	ON, OFF
		Target 2	OFF	ON, OFF
		… (omitted) …	OFF	ON, OFF
		Target 15	OFF	ON, OFF
		Target 16	OFF	ON, OFF
Offset			0.0000 mm	Minimum display unit: mm
Measurement mode				
	Measurement mode		Normal	Normal, Peak measurement, Bottom measurement, Peak-to-peak measurement, Auto peak measurement, Auto bottom measurement, Auto peak-to-peak measurement, Average measurement, Sample measurement, Self-timing measurement
	Hold mode		Hold 1	Hold 1, Hold 2, Hold 3
	Self-timing period		1000 ms	1 to 9999 ms
Filter				
	Filter		Moving average	Moving average, Simple average
	Averaging times		2048	1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768
Tolerance				
	Tolerance mode=Ref value			
		UPPER	+1.0000 mm	
		STANDARD	+10.0000 mm	
		LOWER	-1.0000 mm	
	Tolerance mode=Threshold			
		HH	+40.0000 mm	
		HI	+30.0000 mm	
		LO	0.0000 mm	
		LL	-10.0000 mm	
Difference function			OFF	ON, OFF
Outlier exclusion				
	Outlier exclusion function		OFF	ON, OFF
	Exclusion method		Output waiting data	Output waiting data, Prev val hold
	No continuous outlier		1	1 to 4095
	Upper limit		+1.0000 mm	
	Lower limit		-1.0000 mm	

Item name		Default setting	Setting value
Abnormal value canceling function			
	Abnormal value canceling function	OFF	ON, OFF
	Pts before cancellation	0	0 to 4095
	Pts after cancellation	0	0 to 4095
	Cancelling upper limit	+1.0000 mm	
	Cancellation lower limit	-1.0000 mm	

Calibration and Scaling

Item name		Default setting	Setting value
Target		Target 1	Target 1 to Target 16
Calibration setting			
	Calibration target	Target 1	Target 1 to Target 16
	Calibration pts	OFF	OFF, 1 point, 2 pts, 3 pts, 4 pts, 5 pts, 6 pts, 7 pts, 8 pts
	Input 1	-	
	Displayed 1	-	
	Input 2	-	
	Displayed 2	-	
	…		
	Input 8	-	
	Displayed 8	-	
Scaling			
	OUT	OUT1	OUT1 to OUT16
	Scaling pts	OFF	OFF, 1 point, 2 pts, 3 pts, 4 pts, 5 pts, 6 pts, 7 pts, 8 pts
	Input 1	-	
	Displayed 1	-	
	Input 2	-	
	Displayed 2	-	
	…		
	Input 8	-	
	Displayed 8	-	

Common setting

■ Edge detection

Item name		Default setting	Setting value
Head		Head 1	Head 1 to Head 4
Edge detection threshold T1		50%	1 to 99% (at 1% increments)
Edge detection threshold T2 setting		OFF	ON, OFF
Edge detection threshold T2		50%	1 to 99% (at 1% increments)
Calibration of received light intensity		(None)	(None)
Mask setting			
	Mask setting	OFF	ON, OFF
	Mask position M1	0.00	-9999.99 to +9999.99 (at 0.01 mm increments)
	Mask position M2	0.00	-9999.99 to +9999.99 (at 0.01 mm increments)
Check No. of edges pts		OFF	OFF, 2 to 31
FOCUS monitor setting*		5	0 to 9

* Not available on LS-9006D/LS-9030D/LS-9120M.

■ Interference prevention

Item name		Default setting	Setting value
Interference prevention			
	Interference prevention func.	OFF	OFF, AB-ON, ABC-ON
	Interference prevention group setting	In the order of ABCA from Head 1	For Heads 1 to 4, one of Group A, Group B and Group C can be selected.

■ Sync setting

Item name	Default setting	Setting value
Sync measure OUT	All OFF	For OUT1 to OUT16, either ON or OFF can be selected.

■ Data storage

Item name		Default setting	Setting value
Data storage			
	Storage points	30000	1 to 400,000 pts
	Storage cycle	1 point	x1, x2, x5, x10, x20, x50, x100, x200, x500, x1000, 1sec, TIMING sync, Storage trigger sync.
	Storage control method	Command	Terminal, Command
	Storage target OUT	All OUT: ON	For OUT1 to OUT16, either ON or OFF can be selected.
	Fail storage	OFF	ON, OFF

■ Group calculation

Item name		Default setting	Setting value
Group calculation			
	Group calc. func	OFF	ON, OFF
	Group calc. content	Maximum value	Maximum value, Minimum value, Max-Min, Average
	Original calc. OUT	OUT1	OUT1 to OUT16 (Select from OUTs which have been set for use.)
	Group calc pts	2	2 to 4095

■ I/O terminal setting

Item name			Default setting	Setting value
Encoder setting				
	Input mode		1-ph 1 TM	1-ph 1 TM, 2-ph 1 TM, 2-ph 2 TM, 2-ph 4 TM
	Sampling		OFF	OFF, 2 to 1000 pulses
	Pitch unit		No unit	No unit, µm, mm
	Pitch interval		0.10	0.01 to 100 (at 0.01 increments)
	Encoder TIMING func		OFF	ON/OFF
	Pulse count preset function			
		Preset function	OFF	Positive-true logic, Negative-true logic, OFF
		Preset value	0	32-bit signed integer
Control input and Judgment output settings				
	Strobe time		2 ms	2 ms, 5 ms, 10 ms, 20 ms, 50 ms, 100 ms, 200 ms, 500 ms
	Off-delay time		0	0, 2 ms, 5 ms, 10 ms, 20 ms, 50 ms, 100 ms, 200 ms, 500 ms, Hold
	Total judgment setting		All ON	For OUT1 to OUT16, either ON or OFF can be selected.
	No. of control Ch		2	2, 3, 4
	Control Ch 1		OUT1	OUT1 to OUT16 (Select from OUTs which have been set for use.)
	Control Ch 2		OUT1	OUT1 to OUT16 (Select from OUTs which have been set for use.)
	Control Ch 3		OUT1	OUT1 to OUT16 (Select from OUTs which have been set for use.)
	Control Ch 4		OUT1	OUT1 to OUT16 (Select from OUTs which have been set for use.)

Item name		Default setting	Setting value
Analog output terminal setting ch1 to ch4			
	Analog output terminal OUT setting	OUT1	OUT1 to OUT16 (Select from OUTs which have been set for use.)
	Tolerance mode=Ref value Analog scaling value	1000 [um/V]	1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000 [um/V]
	Tolerance mode=Threshold Analog scaling value +10V	+30.0000 mm	
	Tolerance mode=Threshold Analog scaling value -10V	0.0000 mm	
	Vol of output waiting data	-10.8 V	-10.8 V, +10.8 V, 0 V, Prev val hold
Status output ch1 to ch4			
	Select function	FOCUS	Output waiting data, Continuous outlier, FOCUS, Insufficient light, Check No. of edges: Fail, Stat processing, Pulse frequency error
	OUT No.	OUT1	OUT1 to OUT16
	Head No.	Head 1	Head 1 to Head 4
	Stat ch. No.	Ch1	ch1, ch2
BCD unit settings			
	Output function selection	BCD output	BCD output, Binary output, Judgment output
	OUT selection method	Controller settings	Controller settings, BCD unit terminal
	Ch1 to Ch4	OUT1	OUT1 to OUT16
	Strobe time	2 ms	2 ms, 5 ms, 10 ms, 20 ms, 50ms, 100ms, 200ms, 500ms

■ Stat process

Item name		Default setting	Setting value
Stat process			
	Stat control method	Command	Terminal, Command
	No. of stat proc	2	2 to 999999
	Stat proc ch1 OUT No.	OUT1	OUT1 to OUT16 (Select from OUTs which have been set for use.)
	Stat proc ch2 OUT No.	OUT1	OUT1 to OUT16 (Select from OUTs which have been set for use.)

Setting a different range and initial value for the minimum display unit

Settings affected by the minimum display unit setting			Minimum display unit⇨ 0.1 mm Default setting	0.1 mm Range for values that can be set	0.01 mm Default setting	0.01 mm Range for values that can be set
Calibration (*1)				-9999.9 mm to +9999.9 mm		-9999.99 mm to +9999.99 mm
	Input 1					
	Displayed 1					
	Input 2					
	Displayed 2					
	…					
	Input 8					
	Displayed 8					
Outlier exclusion						
	Upper limit		+1.0 mm		+1.00 mm	
	Lower limit		-1.0 mm		-1.00 mm	
Cancelling function						
	Cancelling upper limit		+1.0 mm		+1.00 mm	
	Cancellation lower limit		-1.0 mm		-1.00 mm	
Scaling (*1)						
	Input 1					
	Displayed 1					
	Input 2					
	Displayed 2					
	…					
	Input 8					
	Displayed 8					
Offset			0.0 mm		0.00 mm	
Tolerance						
	Tolerance mode=Ref value					
		UPPER	+1.0 mm		+1.00 mm	
		STANDARD	+10.0 mm		+10.00 mm	
		LOWER	-1.0 mm		-1.00 mm	
	Tolerance mode=Threshold					
		HH	+40.0 mm		+40.00 mm	
		HI	+30.0 mm		+30.00 mm	
		LO	0.0 mm		0.00 mm	
		LL	-10.0 mm		-10.00 mm	
Tolerance mode=Threshold Analog scaling value						
	+10V value		+100.0 mm		+30.00 mm	
	-10V value		-100.0 mm		0.00 mm	

*1 For initial value in case 1 to 8 points have been set in the Calibration and Scaling, refer to “Different Initial Value for Setting Calibration and Scaling Points” (page 5-14)

Settings affected by the minimum display unit setting			Minimum display unit⇨ 0.001 mm Default setting	0.001 mm Range for values that can be set	0.0001 mm Default setting	0.0001 mm Range for values that can be set
Calibration (*1)				-9999.999 mm to +9999.999 mm		-999.9999 mm to +999.9999 mm
	Input 1					
	Displayed 1					
	Input 2					
	Displayed 2					
	…					
	Input 8					
	Displayed 8					
Outlier exclusion						
	Upper limit		+1.000 mm		+1.0000 mm	
	Lower limit		-1.000 mm		-1.0000 mm	
Cancelling function						
	Cancelling upper limit		+1.000 mm		+1.0000 mm	
	Cancellation lower limit		-1.000 mm		-1.0000 mm	
Scaling (*1)						
	Input 1					
	Displayed 1					
	Input 2					
	Displayed 2					
	…					
	Input 8					
	Displayed 8					
Offset			0.000 mm		0.0000 mm	
Tolerance						
	Tolerance mode=Ref value					
		UPPER	+1.000 mm		+1.0000 mm	
		STANDARD	+10.000 mm		+10.0000 mm	
		LOWER	-1.000 mm		-1.0000 mm	
	Tolerance mode=Threshold					
		HH	+40.000 mm		+40.0000 mm	
		HI	+30.000 mm		+30.0000 mm	
		LO	0.000 mm		0.0000 mm	
		LL	-10.000 mm		-10.0000 mm	
Tolerance mode=Threshold Analog scaling value						
	+10V value		+30.000 mm		+30.0000 mm	
	-10V value		0.000 mm		0.0000 mm	

*1 For initial value in case 1 to 8 points have been set in the Calibration and Scaling, refer to “Different Initial Value for Setting Calibration and Scaling Points” (page 5-14)

Settings affected by the minimum display unit setting			Minimum display unit⇨ 0.00001 mm Default setting	0.00001 mm Range for values that can be set	1 µm Default setting	1 µm Range for values that can be set
Calibration (*1)				-99.99999 mm to +99.99999 mm		-9999999 µm to +9999999 µm
	Input 1					
	Displayed 1					
	Input 2					
	Displayed 2					
	…					
	Input 8					
	Displayed 8					
Outlier exclusion						
	Upper limit		+1.00000 mm		+1000 µm	
	Lower limit		-1.00000 mm		-1000 µm	
Cancelling function						
	Cancelling upper limit		+1.00000 mm		+1000 µm	
	Cancellation lower limit		-1.00000 mm		-1000 µm	
Scaling (*1)						
	Input 1					
	Displayed 1					
	Input 2					
	Displayed 2					
	…					
	Input 8					
	Displayed 8					
Offset			0.00000 mm		0 µm	
Tolerance						
	Tolerance mode=Ref value					
		UPPER	+1.00000 mm		+1000 µm	
		STANDARD	+10.00000 mm		+10000 µm	
		LOWER	-1.00000 mm		-1000 µm	
	Tolerance mode=Threshold					
		HH	+40.00000 mm		+40000 µm	
		HI	+30.00000 mm		+30000 µm	
		LO	0.00000 mm		0 µm	
		LL	-10.00000 mm		-10000 µm	
Tolerance mode=Threshold Analog scaling value						
	+10V value		+30.00000 mm		+30000 µm	
	-10V value		0.00000 mm		0 µm	

*1 For initial value in case 1 to 8 points have been set in the Calibration and Scaling, refer to “Different Initial Value for Setting Calibration and Scaling Points” (page 5-14)

Minimum display unit⇨

Settings affected by the minimum display unit setting			0.1 µm		0.01 µm	
			Default setting	Range for values that can be set	Default setting	Range for values that can be set
Calibration (*1)				-999999.9 µm to +999999.9 µm		-99999.99 µm to +99999.99 µm
	Input 1					
	Displayed 1					
	Input 2					
	Displayed 2					
	…					
	Input 8					
	Displayed 8					
Outlier exclusion						
	Upper limit		+1000.0 µm		+1000.00 µm	
	Lower limit		-1000.0 µm		-1000.00 µm	
Cancelling function						
	Cancelling upper limit		+1000.0 µm		+1000.00 µm	
	Cancellation lower limit		-1000.0 µm		-1000.00 µm	
Scaling (*1)						
	Input 1					
	Displayed 1					
	Input 2					
	Displayed 2					
	…					
	Input 8					
	Displayed 8					
Offset			0.0 µm		0.00 µm	
Tolerance						
	Tolerance mode=Ref value					
		UPPER	+1000.0 µm		+1000.00 µm	
		STANDARD	+10000.0 µm		+10000.00 µm	
		LOWER	-1000.0 µm		-1000.00 µm	
	Tolerance mode=Threshold					
		HH	+40000.0 µm		+40000.00 µm	
		HI	+30000.0 µm		+30000.00 µm	
		LO	0.0 µm		0.00 µm	
		LL	-10000.0 µm		-10000.00 µm	
Tolerance mode=Threshold Analog scaling value						
	+10V value		+30000.0 µm		+30000.00 µm	
	-10V value		0.0 µm		0.00 µm	

*1 For initial value in case 1 to 8 points have been set in the Calibration and Scaling, refer to “Different Initial Value for Setting Calibration and Scaling Points” (page 5-14)

Different Initial Value for Setting Calibration and Scaling Points

Minimum display unit: mm

	Calibration/Scaling pts								
	OFF	**1 point**	**2 point**	**3 point**	**4 point**	**5 point**	**6 point**	**7 point**	**8 point**
Input 1, Output 1		0 (mm)	0 (mm)	0 (mm)	0 (mm)	0 (mm)	0 (mm)	0 (mm)	0 (mm)
Input 2, Output 2			10 (mm)	5 (mm)	2 (mm)	1 (mm)	0.2 (mm)	0.2 (mm)	0.1 (mm)
Input 3, Output 3				10 (mm)	5 (mm)	2 (mm)	1 (mm)	0.5 (mm)	0.2 (mm)
Input 4, Output 4					10 (mm)	5 (mm)	2 (mm)	1 (mm)	0.5 (mm)
Input 5, Output 5						10 (mm)	5 (mm)	2 (mm)	1 (mm)
Input 6, Output 6							10 (mm)	5 (mm)	2 (mm)
Input 7, Output 7								10 (mm)	5 (mm)
Input 8, Output 8									10 (mm)

Minimum display unit:μm

	Calibration/Scaling pts								
	OFF	**1 point**	**2 point**	**3 point**	**4 point**	**5 point**	**6 point**	**7 point**	**8 point**
Input 1, Output 1		0 (μm)	0 (μm)	0 (μm)	0 (μm)	0 (μm)	0 (μm)	0 (μm)	0 (μm)
Input 2, Output 2			10000 (μm)	5000 (μm)	2000 (μm)	1000 (μm)	200 (μm)	200 (μm)	100 (μm)
Input 3, Output 3				10000 (μm)	5000 (μm)	2000 (μm)	1000 (μm)	500 (μm)	200 (μm)
Input 4, Output 4					10000 (μm)	5000 (μm)	2000 (μm)	1000 (μm)	500 (μm)
Input 5, Output 5						10000 (μm)	5000 (μm)	2000 (μm)	1000 (μm)
Input 6, Output 6							10000 (μm)	5000 (μm)	2000 (μm)
Input 7, Output 7								10000 (μm)	5000 (μm)
Input 8, Output 8									10000 (μm)

Combined limitation for analog scaling (Ref. val mode) and minimum display unit

Limitation for combined analog scaling (Ref. val mode) and minimum display unit

○ : Output is possible
× : +10.8 V fixed

μm/V	Output range	Setting the minimum display unit							
		0.01 μm	0.1 μm	1 μm	0.00001 mm	0.0001 mm	0.001 mm	0.01 mm	0.1 mm
1	± 10.0 μm	○	×	×	○	×	×	×	×
2	± 20.0 μm	○	○	×	○	○	×	×	×
5	± 50.0 μm	○	○	×	○	○	×	×	×
10	± 100.0 μm	○	○	×	○	○	×	×	×
20	± 200.0 μm	○	○	○	○	○	○	○	○
50	± 500.0 μm	○	○	○	○	○	○	○	○
100	± 1mm	○	○	○	○	○	○	○	○
200	± 2mm	○	○	○	○	○	○	○	○
500	± 5mm	○	○	○	○	○	○	○	○
1000	± 10mm	○	○	○	○	○	○	○	○
2000	± 20mm	○	○	○	○	○	○	○	○
5000	± 50mm	○	○	○	○	○	○	○	○
10000	± 100mm	○	○	○	○	○	○	○	○

Function Restriction of Each Head Model

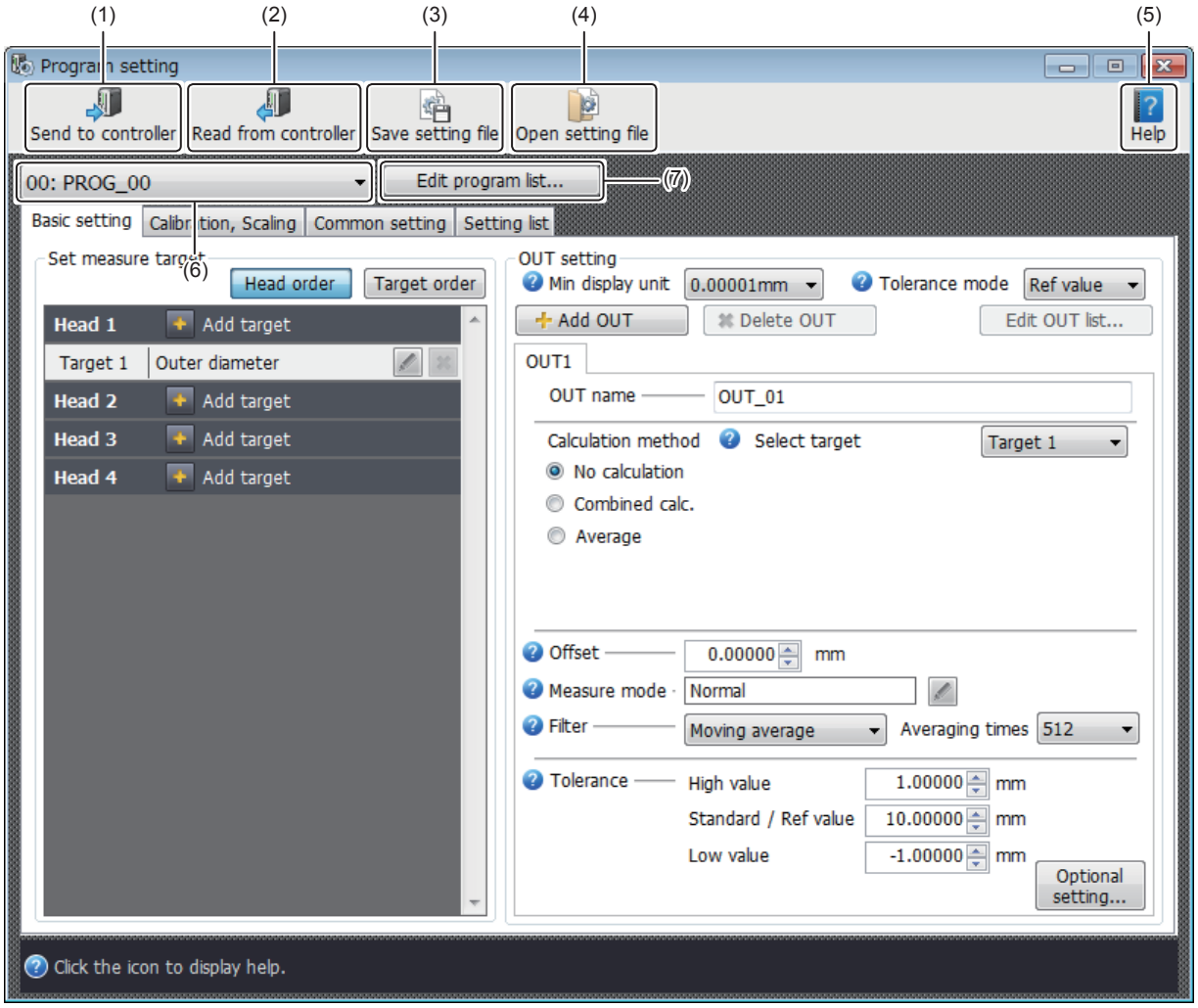
Function Restriction of Each Head Model

○: Available
×: Not available

Function	Head model						
	LS-9006	LS-9006M	LS-9030	LS-9030M	LS-9006D	LS-9030D	LS-9120M
Target viewer	×	○	×	○	×	×	○
Tilt correction	×	○	×	○	×	×	×
Ultrafine outer DIA, Ultrafine gap	○	○	○	○	×	×	○
Tx-Rx Pos	○	○	○	○	×	×	×
FOCUS monitor	○	○	○	○	×	×	×

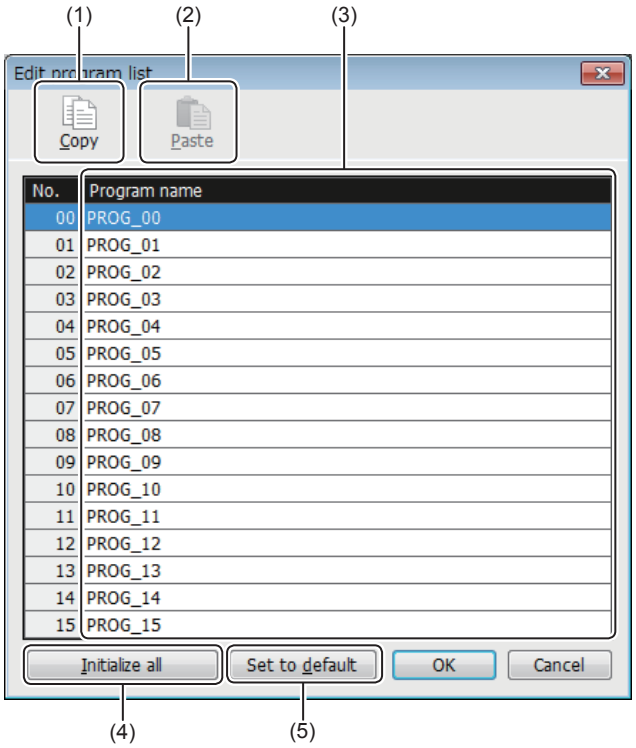
[Program Setting] Screen

This section describes the [Program Setting] screen.



No.	Name	Description
(1)	[Send to controller] button	Sends the program settings to the controller. “Sending the settings to the controller” (page 3-16)
(2)	[Read from controller] button	Reads the program settings from the controller. “Reading Settings from Controller” (page 3-17)
(3)	[Save setting file] button	Saves the program setting contents in the personal computer. “Saving the setting file” (page 3-17)
(4)	[Open setting file] button	Opens the program setting contents stored in the personal computer. “Reading Setting File” (page 3-18)
(5)	[Help] button	This opens the digital manual of this system.
(6)	[Program selection] dropdown list	Select the program to be edited.
(7)	[Edit program list] button	Either copies or initializes the program setting contents.

[Edit program list] dialog



No.	Name	Description
(1)	[Copy] button	Copies the selected program setting.
(2)	[Paste] button	Pastes the copied program setting into the selected program setting.
(3)	[Program name] setting	Enter the program setting name.
(4)	[Initialize all] button	Sets all program settings to the initial values.
(5)	[Set to default] button	Sets the selected program setting to the initial value.

Basic Operations of LS-Navigator2

Switching the program setting

1 Select the program to be switched from [Program selection] drop down list.

The [Program setting] screen turns to the contents of the selected program setting.

Changing the program name

1 Click the [Edit program list] button.

The [Edit program list] dialog appears.

2 Click the program name to be changed from the [Program name] list.

The selected program name will be highlighted to show that the program is ready to be edited.

3 Enter the program name from the keyboard and click the [OK] button.

The program name is now modified and the display returns to the [Program setting] screen.

Copying the program setting

1. Click the [Edit program list] button.
   The [Edit program list] dialog appears.
2. Select the source program of copying and click the [Copy] button.
3. Select the destination program of copying and click the [Paste] button.
   The confirmation dialog appears.
4. Click the [OK] button.
   The [Edit program list] dialog returns.
5. Click the [OK] button.
   The program setting is now copied and the [Program setting] screen returns.

Initializing the program setting

1. Click the [Edit program list] button.
   The [Edit program list] dialog appears.
2. Select the program to be initialized and click the [Initialize] button.
   The confirmation dialog appears.

   Reference When the [Initialize all] button is clicked, all the program settings will be initialized.

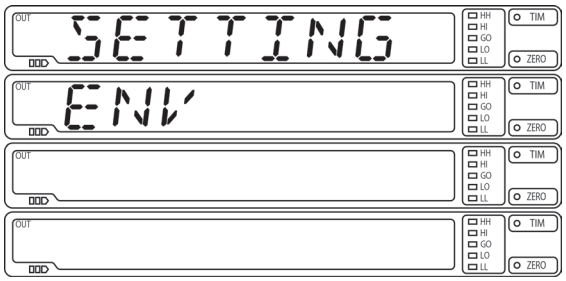
3. Click the [OK] button.
   The [Edit program list] dialog returns.
4. Click the [OK] button.
   The program setting is now initialized and the [Program setting] screen returns.

   Reference The “Calibration of received light intensity” will not be initialized. If you want to initialize the “Calibration of received light intensity”, performthe “Return calibration of received light intensity to the factory setting” function. (page 5-67)

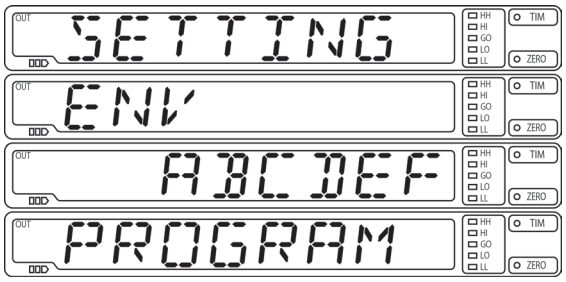
Settings on the Display Panel

Copying the program setting

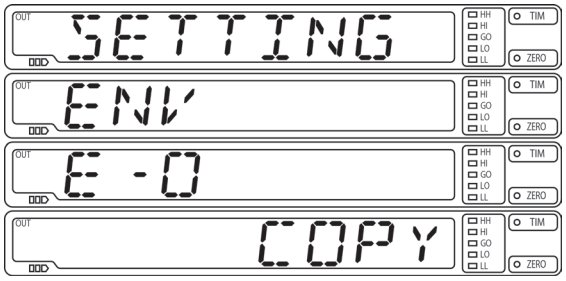
1. Press the [FUNC] key, then press the [0] key.
   The setting item selection screen appears.
2. Select [ENV] by pressing the [▲] or [▼] key, then press the [ENT] key.



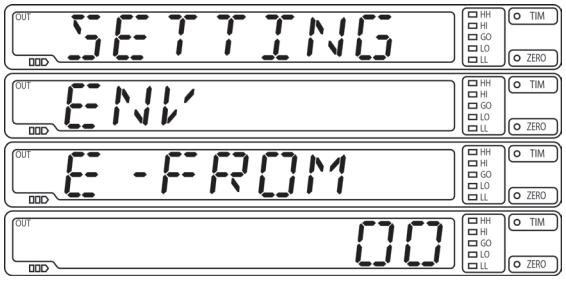
3. Select the program to be set, then press the [ENT] key.



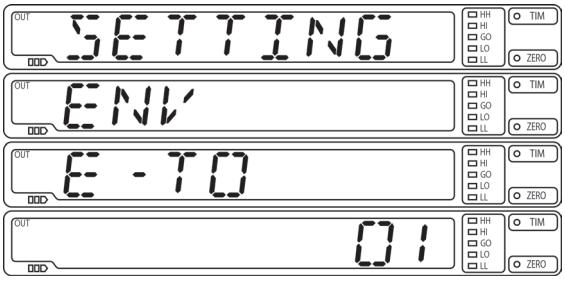
4. Select [COPY], then press the [ENT] key.



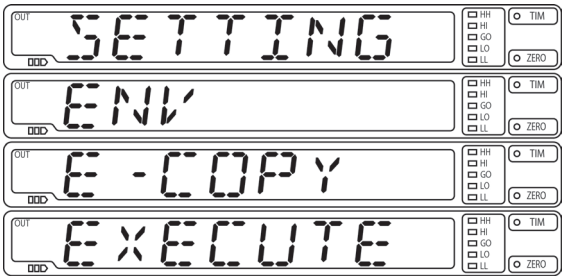
5. Select the source program of copying, then press the [ENT] key.



6 Select the destination program of copying, then press the [ENT] key.



7 When [EXECUTE] appears, press the [ENT] key.

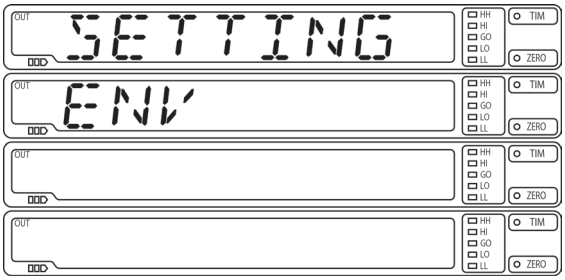


When [COMPLETE] appears, the setting operation is completed.

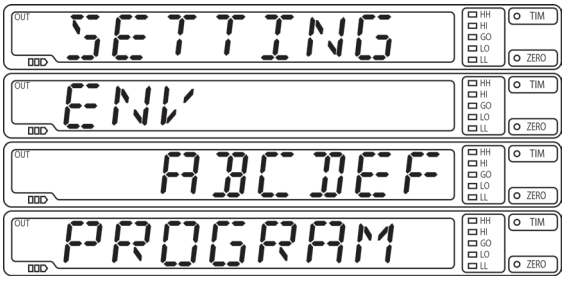
Initializing the program setting

1 Press the [FUNC] key, then press the [0] key.
The setting item selection screen appears.

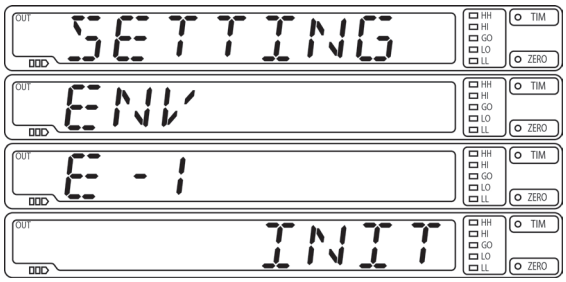
2 Select [ENV] by pressing the [▲] or [▼] then press the [ENT] key.



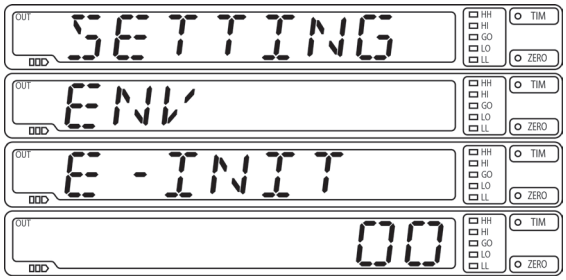
3 Select a [PROGRAM] to be set, then press the [ENT] key.



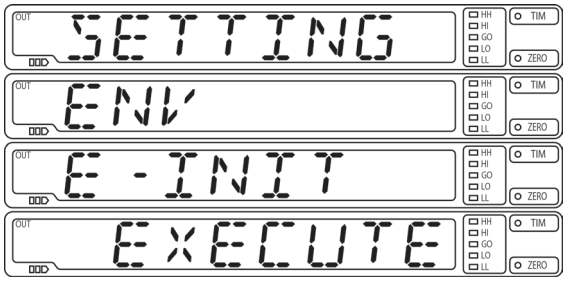
4 Select [INIT], then press the [ENT] key.



5 Select the program to initialize, then press the [ENT] key.



6 When [EXECUTE] appears, press the [ENT] key.

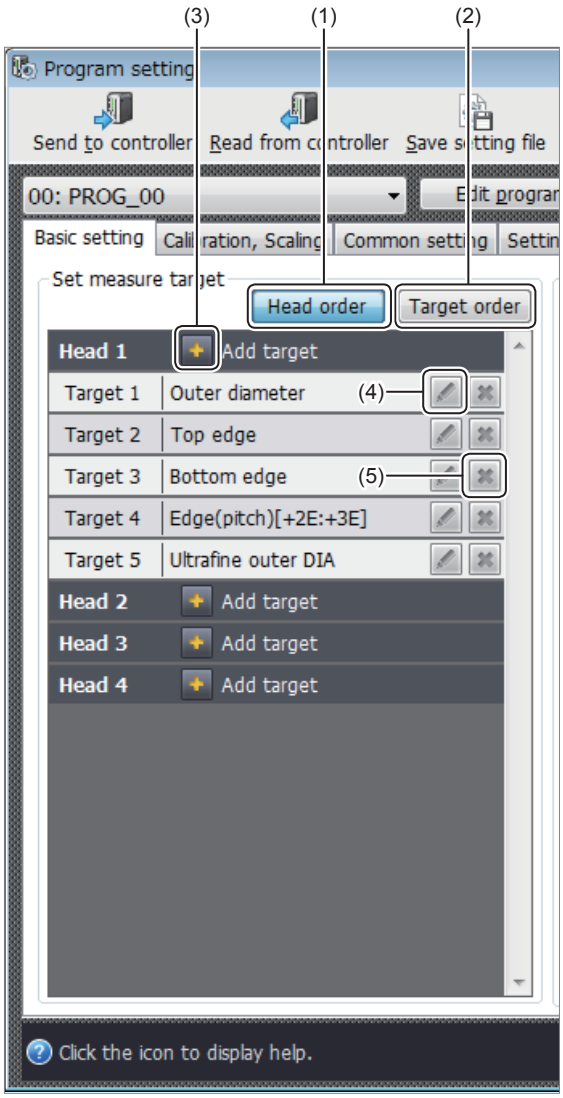


When [COMPLETE] appears, the setting operation is completed.

[Basic settings] Tab: Set Measurement Target

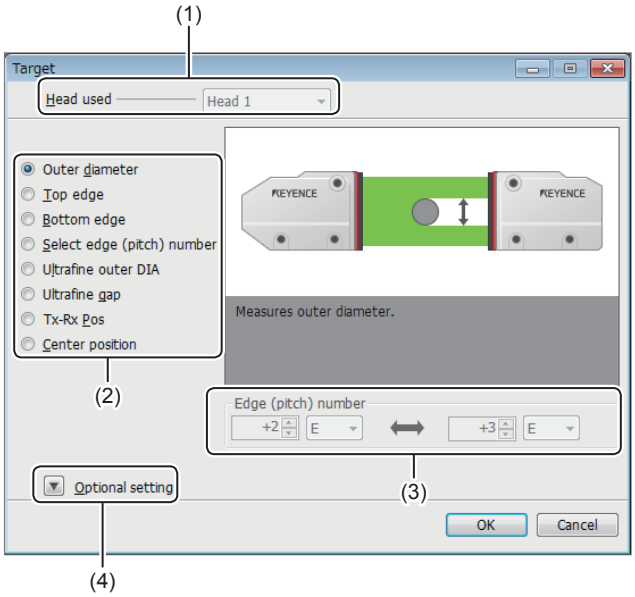
Select the [Basic settings] tab of the [Program setting] screen to display the basic settings.

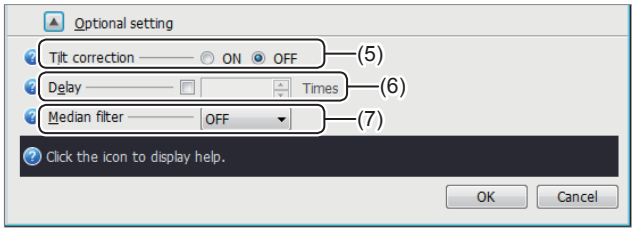
[Set measure target] area



No.	Name	Description
(1)	[Head order] button	Used to switch the method of displaying the measurement target shown in the [Set measure target] area in the order of head numbers.
(2)	[Target order] button	Used to switch the method of displaying the measurement target shown in the [Set measure target] area in the order of target numbers.
(3)	[Add target] button	Used to add another measurement target. Clicking on this button makes the [Set measure target] window appear.
(4)	[Edit target] button	Used to edit the measurement target. Clicking on this button makes the [Set measure target] window appear.
(5)	[Delete target] button	Used to delete the measurement target.

[Target] window





No.	Name	Description
(1)	[Head used] dropdown list	Used to select a head to be used for measurement.
(2)	[Target] radio button	Used to select the kind of measurement target.
(3)	[Edge (pitch) number] setting	If you have selected the "Edge (pitch) number" as the target, then enter the edge (pitch) number here.
(4)	[Optional setting] button	Used to switch between display and non-display of the optional setting area.
(5)	[Tilt correction] radio button	Used to select the application of tilt correction.
(6)	[Delay] setting	Used to set an appropriate delay.
(7)	[Median filter] dropdown list	Used to select the median filter.

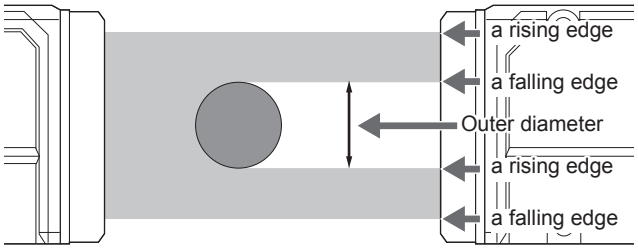
Set measure target

Measurement target

This is the setting to specify the area you wish to measure.

If any target is placed in the measurement area, two portions, one of which is where the light reaches to the receiver and the other is where the light is blocked by the target to make its shadow, are generated as shown in the figure below.

The boundary between the portions where it is irradiated and where it is shaded is called an "edge". An edge across which the shaded portion alters to the irradiated portion, if viewed from the top end of the head, is called a rising edge while the other across which the altering is the reverse is called a falling edge. You can set such an area as divided by the edge or edge itself as the target of measurement.

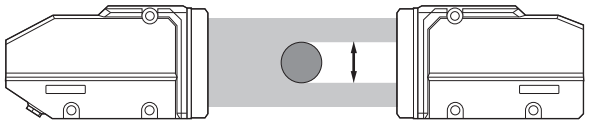


each of them can be measured as a target

■ Outer diameter

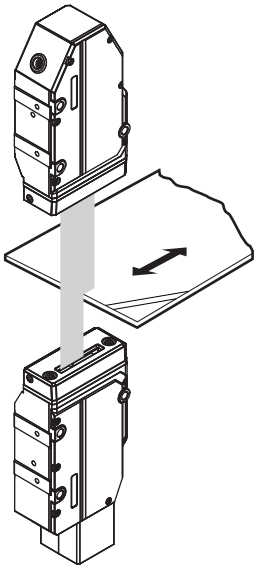
Select this for measuring the outer diameter of any cylindrical target such as a round bar, shaft, etc.

To do this, measure a width from the first falling edge to last rising edge as viewed from the top end of the head.

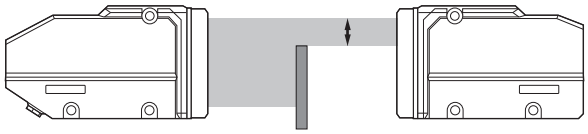


■ Top edge/Bottom edge

Select this for positioning any sheet or film-like material.

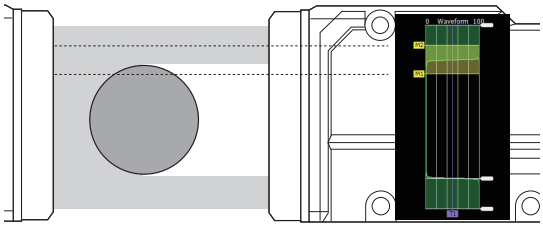


Top edge: Measure a width from the first rising edge to first falling edge as viewed from the top end of the head. Calculate the measurement if these two edges are successive.

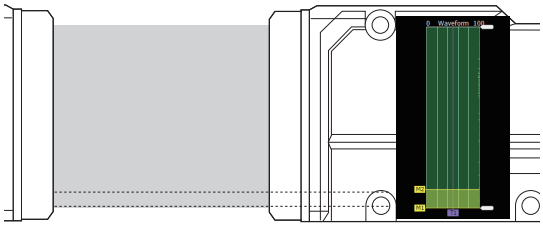


In the following cases, the measurement display enters the output waiting (------) condition.

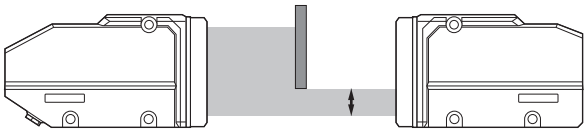
- The first rising edge is not followed by the first falling edge (masked).



- The first falling edge is masked.

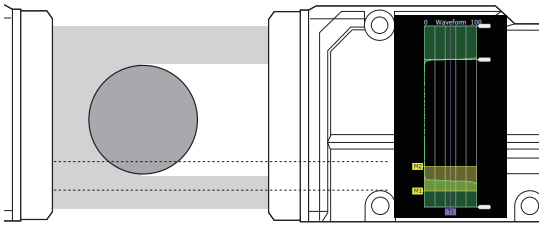


Bottom edge: Measure a width from the last rising edge to last falling edge as viewed from the top end of the head. Calculate the measurement if these two edges continue.

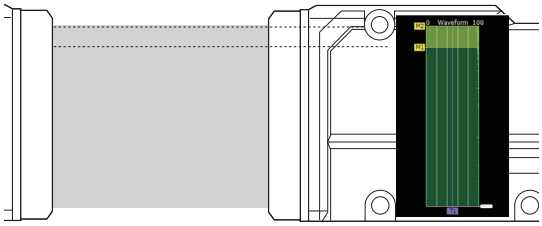


In the following cases, the measurement display enters the output waiting (------) condition.

- The last rising edge is not followed by the last falling edge (masked).



- The first rising edge is masked.



■ Edge (pitch) number setting

Use this to measure a distance between or positions of any edges (pitches).
For the edge (pitch) selection, "E (edge) mode" and "P (pitch) mode" are available. There is also an "Edge 0" used for measurement with a virtual center in the optical axis.

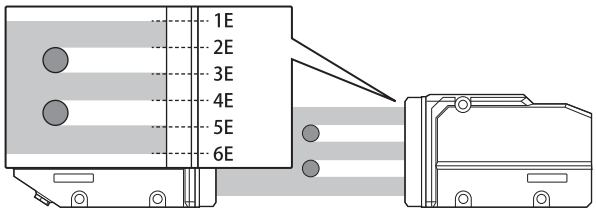
Reference If the specified number of edge or pitch does not exist, the measurement display enters the waiting data condition.

● Selectable range

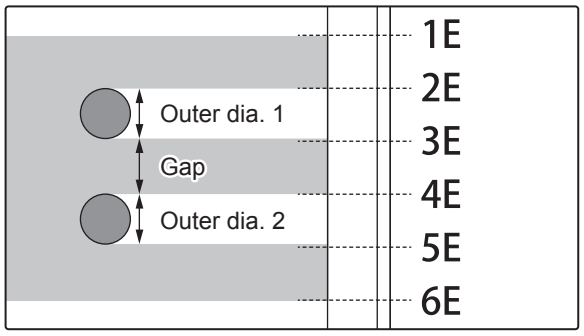
- Selectable edge (pitch) numbers are from -31 to +31.
- If the same edge (pitch) numbers are specified, the measurement will result in zero (0).
- If the order of edge (pitch) selection is reversed, the measurement takes a negative value.

● E (edge) mode

Measurement will be performed taking an edge as the datum.



To count the edges in the order from the top of the head, specify the edge numbers in positive values.
Measure the following portions in the example of the figure shown below.

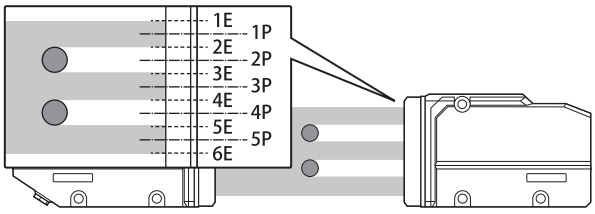


Outer dia. 1: Width from 2E to 3E
Outer dia. 2: Width from 4E to 5E
Gap: Width from 3E to 4E

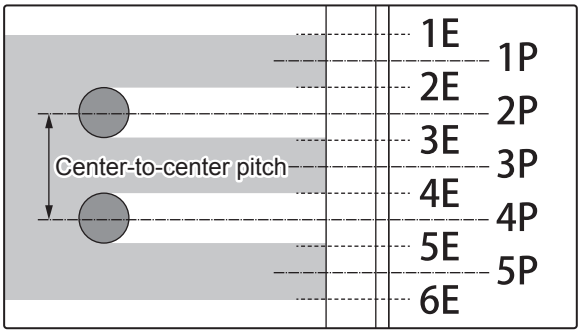
Reference To count the edges in the order from the bottom of the head, specify the edge numbers in negative values.

● If you wish to count the edges in the order from the bottom of the head, specify the edge numbers in negative values.

Measure the middle point between two edges.



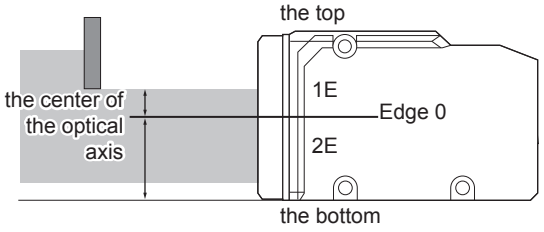
There are the following five pitch points in the example of the figure shown below.
With these pitches measure the center-to-center pitch of the measurement target.



Center-to-center pitch: Width from 2P to 4P

● Edge 0

"Edge 0" is a measurement method using the center of the optical axis as the virtual origin. With "0" entered as the edge number, it is possible to select this method disregarding the existence of any measurement target. Select this for positioning or measuring the amount of travel or deflection (runout) of the measurement target, etc.

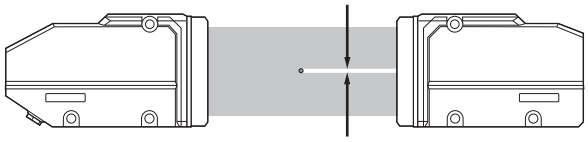


Target edge plane position: Width from 000-E to 001-E
Edge 0 can be used irrespective of the difference between the E (edge) mode and P (pitch) mode.

Reference
- Use of Edge 0 makes it possible to measure at a higher repeatability.
- Edge 0 can not be the subject of the Edge number check function.
  "Check No. of edges" (page 5-65)

■ Ultrafine outer DIA

Select this to measure the outer diameter of an ultra thin wire material.

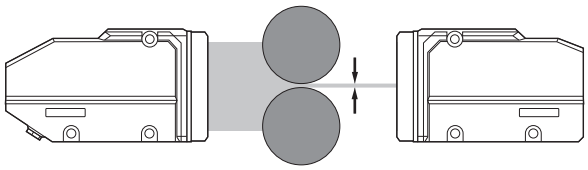


- Multiple thin wires cannot be measured at the same time.
- If there is anything other than the measurement target in the measurement range, use the mask setting to exclude it from the measurement target.
  "Mask setting" (page 5-65)
- Both the ultrafine outer diameter measurement and ultrafine gap measurement can not be performed at the same time within the same head.
  If doing so, the measurement value from the measurement area with a smaller target number will be displayed as the output waiting data.
- When using Ultrafine outer DIA with the LS-9120M, use the master workpiece to perform calibration.
  "Calibration" (page 5-52)

Point **If the measurement value is not displayed, it may not have been possible to recognize the edges. In this situation, adjust the edge detection threshold.**
"Edge detection" (page 5-64)

■ Ultrafine gap

Select this to measure the width of a single ultrafine gap.

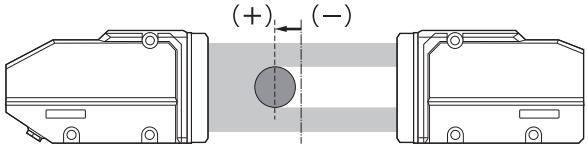


- Multiple gaps can not be measured at the same time.
- If there is anything other than the measurement target in the measurement range, use the mask setting to exclude it from the measurement target.
  "Mask setting" (page 5-65)
- Both the ultrafine outer diameter measurement and ultrafine gap measurement can not be performed at the same time within the same head.
  If doing so, the measurement value from the measurement area with a smaller target number will be displayed as the output waiting data.
- When using Ultrafine gap with the LS-9120M, use the master workpiece to perform calibration.
  "Calibration" (page 5-52)

Point **If the measurement value is not displayed, it may not have been possible to recognize the edges. In this situation, adjust the edge detection threshold.**
"Edge detection" (page 5-64)

■ Tx-Rx Pos

Select this for measuring "Tx-Rx Pos.", This means the position of a cylindrical target such as a shaft or wire material placed in between the transmitter and the receiver.
The origin of this Tx-Rx Pos is determined by taking the position of the receiver as the datum. A measurement value will take a positive value if the target is approaching the transmitter, and take a negative value if it is approaching the receiver, respectively.



Origin Pos.
- LS-9006/LS-9006M: 30 mm from the receiver
- LS-9030/LS-9030M: 80 mm from the receiver

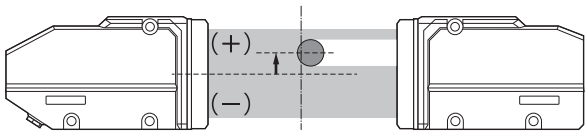
Reference While the interference prevention setting is used, the obtained measurement is displayed as the output waiting data.

Point **The detection ranges are shown below.**
LS-9006/LS9006M: 4 mm (horizontal) × 5 mm (vertical)
*** You cannot use the LS with targets that have diameters of 5 mm or more.**
LS-9030/LS9030M: 20 mm (horizontal) × 24 mm (vertical)
*** You cannot use the LS with targets that have diameters of 24 mm or more.**
The measurement value corresponds to the center between the transmitter and receiver with the direction toward the transmitter being positive and the direction toward the receiver being negative.

Point **Not available on LS-9120M, LS-9006D and LS-9030D. The measurement value will be output waiting.**

■ Center position

Measure the center position of the measurement target. This is used for position control or feedback for wire material, and deflection (runout) measurement of the target, etc.

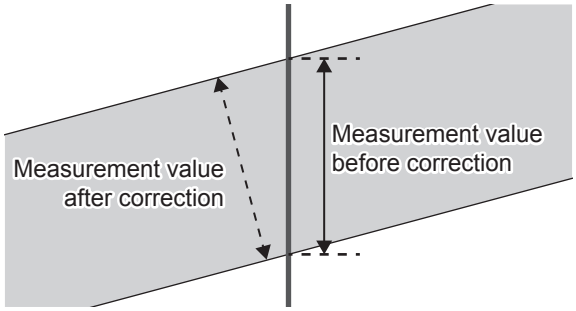


Optional setting

■ Tilt correction

This can be set where the measurement method is "Outer diameter" or "Ultrafine outer diameter". In this case, perform your measurement while correcting the tilt of the target.

- ON..... Enables the tilt correction.
- OFF.....Disables the tilt correction.



Tilt correction recognizes tilt in the following ranges according to the above figure, so do not position anything other than the target in these ranges.
LS-9006M: ±0.7 mm (horizontal), ±3 mm (vertical)
LS-9030M: ±1.8 mm (horizontal), ±15 mm (vertical)

Mask setting is disabled for Tilt correction.
"Mask setting" (page 5-65)

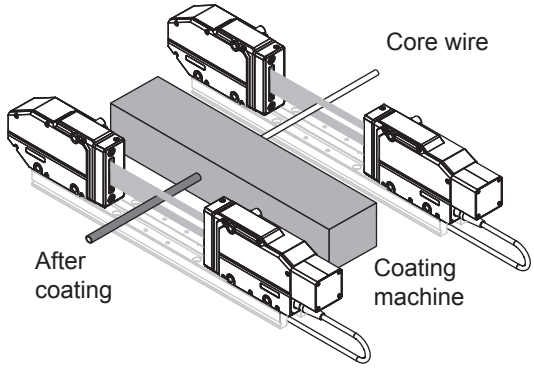
The correction factor of angle can be updated maximum 40 times/s.

Point **This is available only on LS-9006M and LS-9030M.**
When using this item on other model, the measurement value will be output waiting.

■ Delay

Use this setting with the combined calculation function. The subject measurement will be delayed as much as the specified number of sampling times.
By calculating between measurement targets which are different in the delay time setting, it is possible to check the difference between before and after the certain process.
Turn the check box to ON ☑ and specify the number of times.

Setting range: 0 to 1023
"Combined calc." (page 5-36)

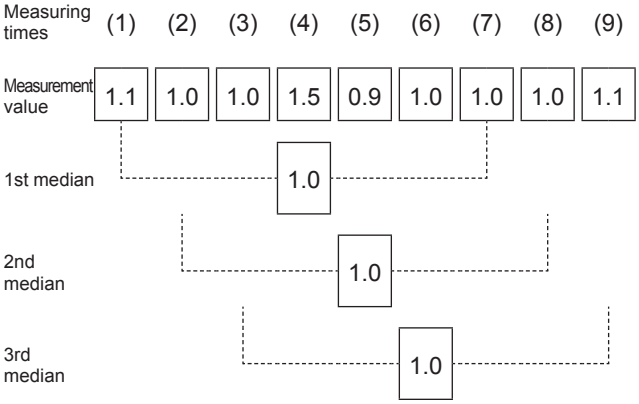


■ Median filter

This is effective for restricting the influence of dust and dirt which may cause any measurement to suddenly jump and reduces the errors in the measurements.

Setting range: OFF, 7, 15, 31

An example measurement using 7-point median filter
Sort 7 measurement values in the descending order and take the center value as the measurement.



Since, after the 1st median, the following order results if (1) to (7) are sorted,

1.5	1.1	1.0	1.0	1.0	1.0	0.9

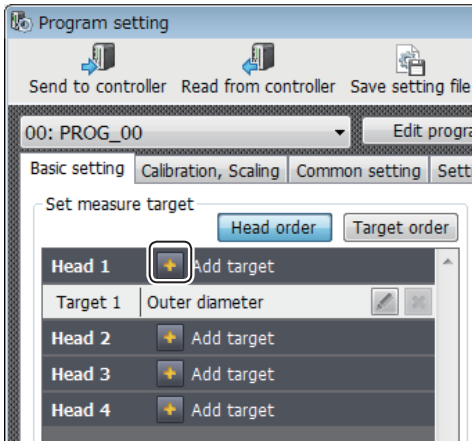
the center value of 1.0 will be taken as the measurement.

Reference
- If any output waiting data is included in the points of measurement for filtering, take the latest data which is not applied with median processing as the measurement.
- After starting measurement, and until the specified points of data for applying the median processing are gathered, use the latest data as the measurement.

Basic Operations of LS-Navigator2

Adding more measurement targets

1 Click the [Add target] button.



Reference When the display method of measurement target is set to "Head order", click the [Add target] button of the head to which you wish to add another target.

The [Target] window appears.

2 Select any head to which another target is added.

Point **If the display method of target is "Head order", this addition can not be designated. In this case, either try to add another target after changing the display method to "Target number order" or change the head for use in the [Edit target] screen after setting the conditions for other than the head.**

3 Select the measurement target.

If you have selected the "Edge (pitch) number", specify the edge (pitch) number in the [Edge (pitch) number] area.

4 In the [Display setting] area, set "Tilt correction", "Delay" and "Median filter".

Reference "Tilt correction" can be set where "Outer diameter" or "Ultrafine outer diameter" is used.

5 Click the [OK] button.

The target is now added and the [Program setting] screen returns.

Reference In the number setting of the measurement target to be added, the smallest number of all the unused numbers will be assigned to it.

Editing the measurement target

1 Click the [Edit target] button of the measurement target for which the setting is to be changed.

The [Target] window appears.

2 Edit the setting of the measurement target.

3 Click the [OK] button.

The setting for the target is now modified and the [Program setting] screen returns.

Deleting any measurement target

Reference When only one measurement target is used, it can not be deleted.

1 Click the [Delete target] button of the measurement target you wish to delete.

If the measurement target is being used in the program setting, click the [OK] button in the displayed confirmation dialog for deletion.

The measurement target is deleted.

Switching the display method of target

1 Click either the [Head order] button or the [Target order] button.

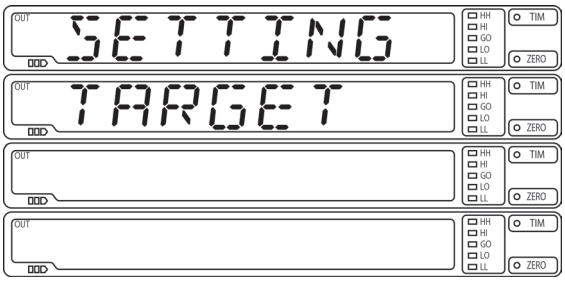
Display method of the measurement target switches to either head order or target order.

Display Panel Setting Method

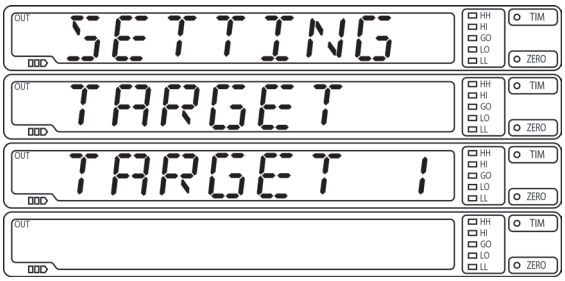
Target setting method

1 Press the [FUNC] key, then press the [0] key.
The setting item selection screen appears.

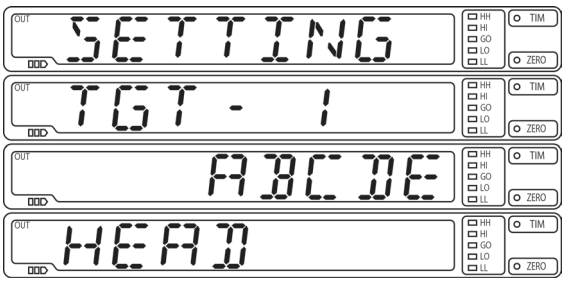
2 Select [TARGET] by pressing the [▲] or [▼] key, then press the [ENT] key.



3 Select any target on which the setting is to be performed, then press the [ENT] key.



4 Perform the settings according to your purpose.
Refer to the following items:

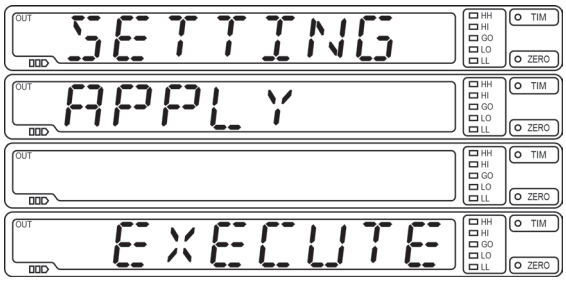


A: HEAD (Used head setting)
B: TYPE (Measurement content)
C: TILT-COR (TILT Correction)
D: MEDIAN (Median filter)
E: DELAY (Delay)

5 Press the [ESC] key to display the setting item selection screen.

6 Select [APPLY] by pressing the [▲] or [▼] key, then press the [ENT] key.

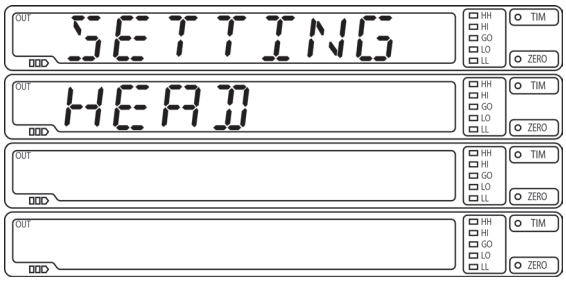
7 When [EXECUTE] appears, press the [ENT] key.



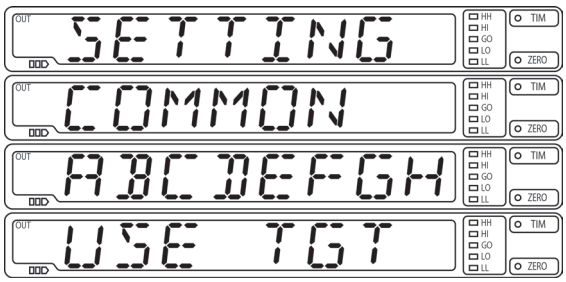
When [COMPLETE] appears, the setting operation is completed.

Setting multiple measurement targets

1 Press the [FUNC] key, then press the [0] key.
The setting item selection screen appears.

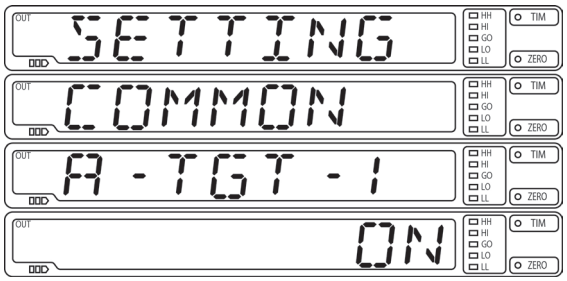


2 Select [COMMON] by pressing the [▲] or [▼] key, then press the [ENT] key.
As the selection screens from [A] to [H] are displayed, then select [A] and press the [ENT] key.



3 Turn the target item used for measurement to [ON] by pressing the [▲] or [▼] key.

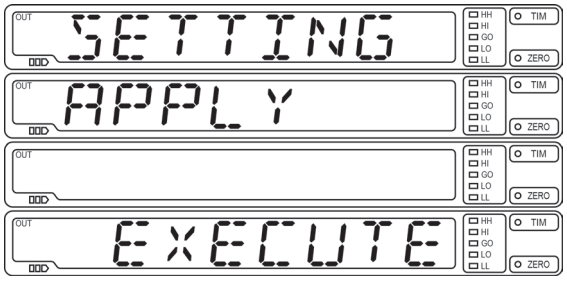
Make selection for all from [A-TGT-1] (Target 1) through [A-TGT-16] (Target 16).
Return to the screen of Step 2.



4 Press the [ESC] key to display the setting item selection screen.

5 Select [APPLY] by pressing the [▲] or [▼] key, then press the [ENT] key.

6 When [EXECUTE] appears, press the [ENT] key.

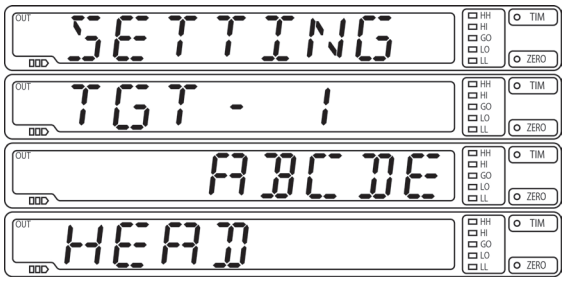


When [COMPLETE] appears, the setting operation is completed.

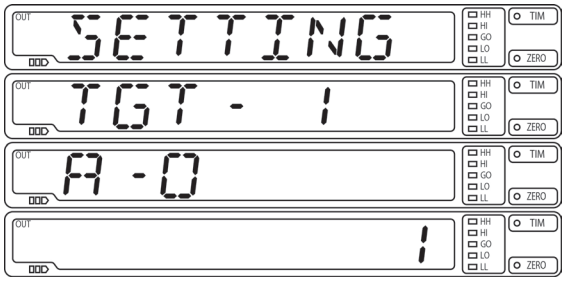
Selecting the measuring head

1 Select [Head setting], then press the [ENT] key.

"Target setting method" (page 5-28)



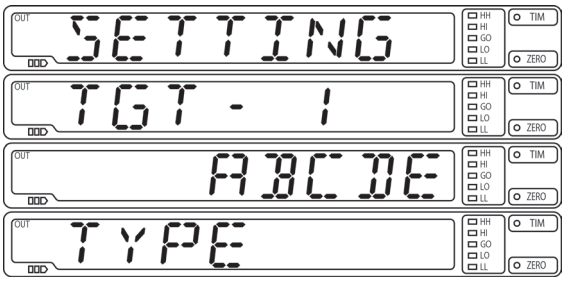
2 Select the head to use for measurement by pressing the [▲] or [▼] key, then press the [ENT] key.



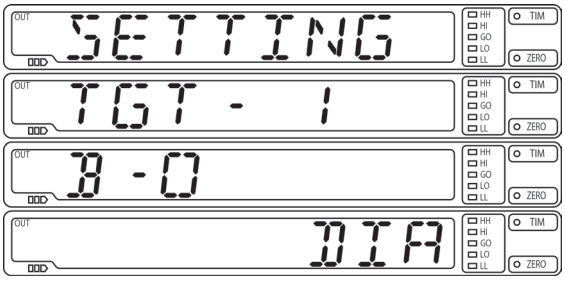
Setting the measurement method

1 Select [TYPE], then press the [ENT] key.

"Target setting method" (page 5-28)



2 Use the [▲], [▼], [◀] or [▶] key to select the measurement method, then press the [ENT] key.



The settable measurement methods are as follows:

- DIA (Outer diameter)
- T-EDGE (Top edge)
- B-EDGE (Bottom edge)
- EP-CALC (Edge (pitch) number)
- TR-POS (Tx-Rx Pos.)
- UF-DIA (Ultrafine outer diameter)
- UF-GAP (Ultrafine gap)
- CENTER (Center position)

■ Switching the edge/pitch setting

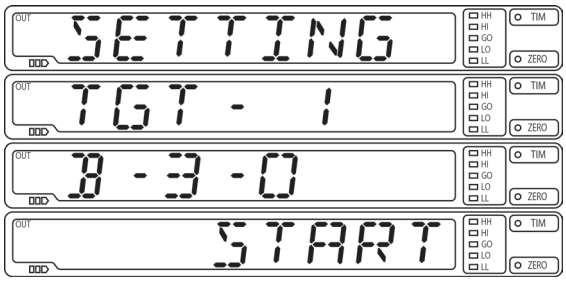
Selected [EP-CALC] from mesurement methods which may require specification of two points of edge/pitch as the measurement targets.

● Edge setting

1 Display the [Segment start/finish setting] selection screen.

2 Select [START] by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

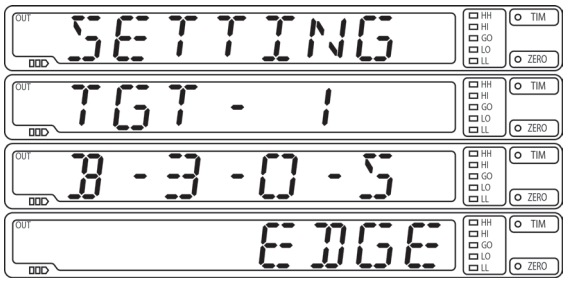
Select the first edge, here.



3 Switch the setting by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

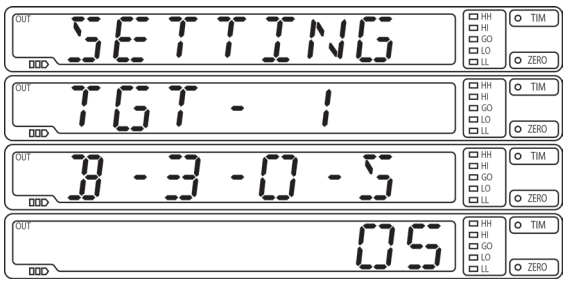
The settable measurement methods are as follows:

- EDGE
- PITCH



The [Number selection (start)] screen appears.

4 Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



This returns us to the [Segment start/finish setting] selection screen.

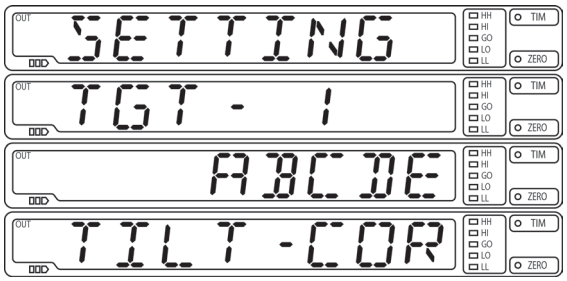
5 Return to Step 2 to select [END], and repeat the same procedure as required.

Select the second edge, now.

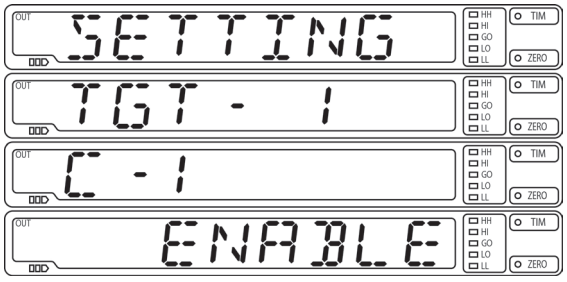
Setting up the tilt correction

1 Select [TILT-COR], then press the [ENT] key.

"Target setting method" (page 5-28)



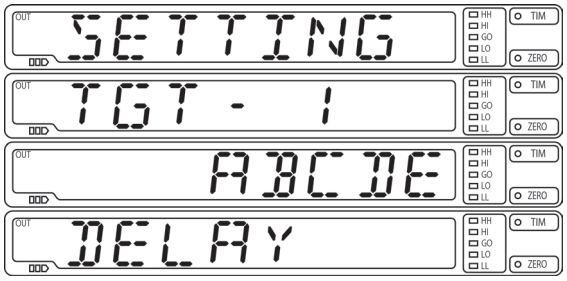
2 Select [ENABLE], then press the [ENT] key.



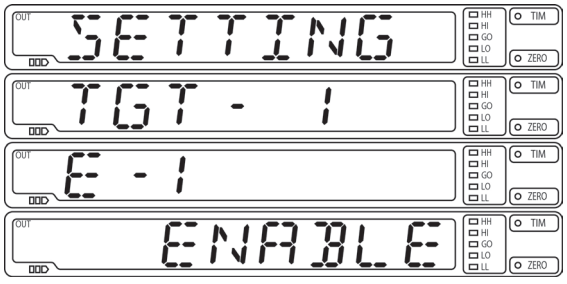
Setting up the delay

1 Select [DELAY], then press the [ENT] key.

"Target setting method" (page 5-28)

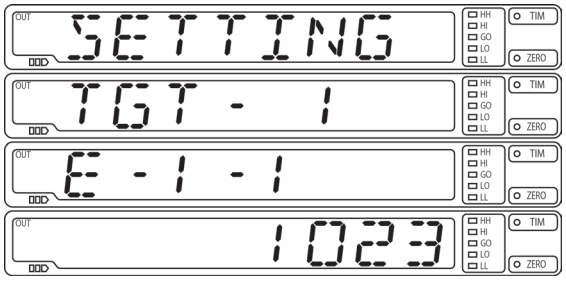


2 Select [ENABLE], then press the [ENT] key.



3 The [Delay times setting] screen appears.

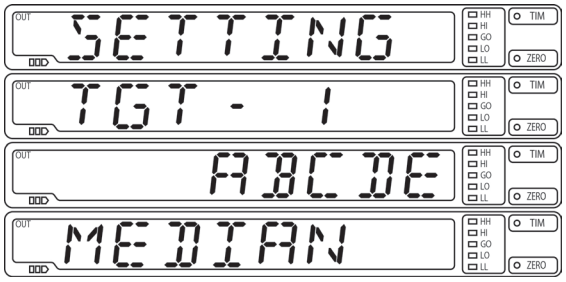
4 Use the numeric keys to enter the delay times, then press the [ENT] key.



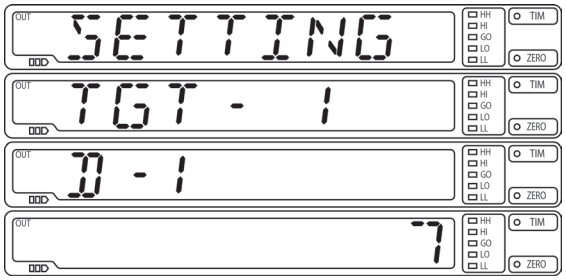
Setting up the median filter

1 Select [MEDIAN], then press the [ENT] key.

"Target setting method" (page 5-28)



2 Switch the setting by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

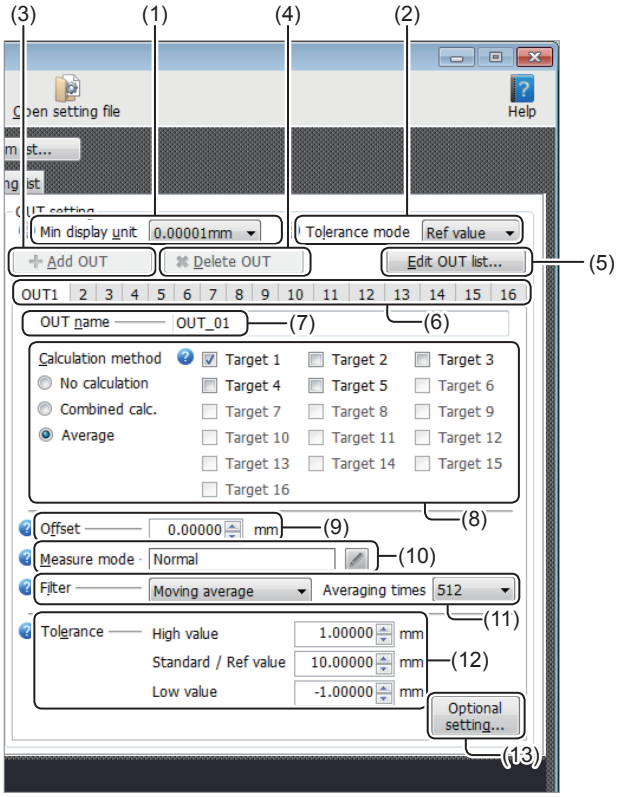


[Basic settings] Tab: OUT Setting

Select the [Basic settings] tab of the [Program setting] screen to display the basic settings.

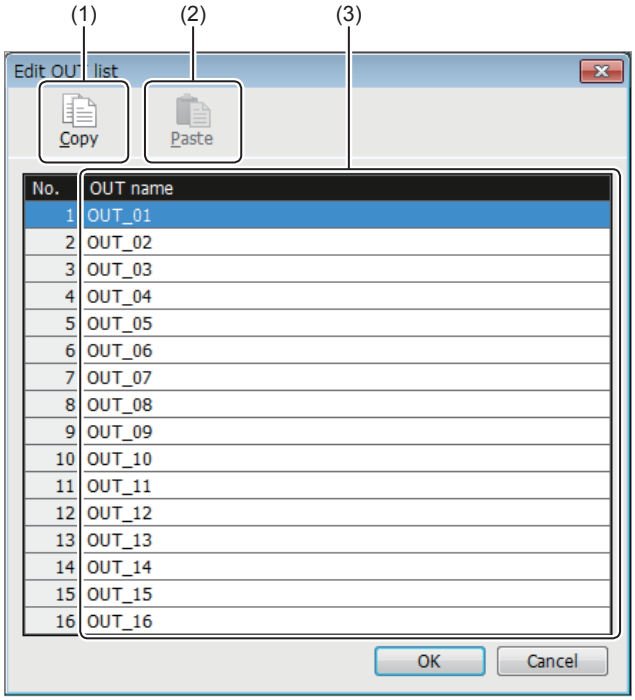
[OUT setting] area

Perform the OUT setting.



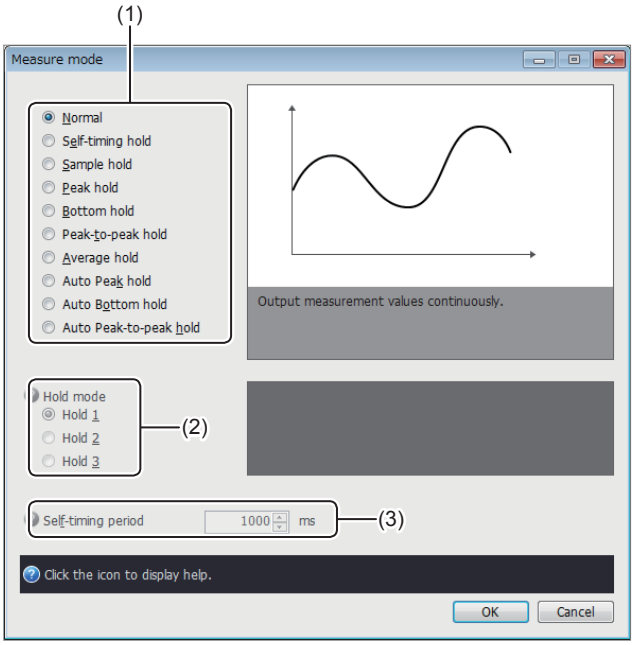
No.	Name	Description
(1)	[Min display unit] dropdown list	Select the minimum display unit.
(2)	[Tolerance mode] dropdown list	Select the tolerance mode.
(3)	[Add OUT] button	Add another OUT setting.
(4)	[Delete OUT] button	Used to delete any OUT setting.
(5)	[Edit OUT list] button	Edit the OUT settings in the list screen. Clicking on this button makes the [Edit OUT list] dialog appear.
(6)	[OUTx] tab	Used to switch the OUT setting to display.
(7)	[OUT name] setting	Enter the OUT setting name.
(8)	[Calculation method] setting	Used to set the calculation method.
(9)	Offset setting	Enter the set offset value.
(10)	[Measure mode] button	Set the measurement mode. Clicking on this button makes the [Measure mode] window appear.
(11)	Filter setting	Set the filter to apply.
(12)	[Tolerance] setting	Enter the tolerance limit values.
(13)	[Optional setting] button	Select any optional setting. Clicking on this button makes the [OUT optional setting] window appear.

[Edit OUT list] dialog



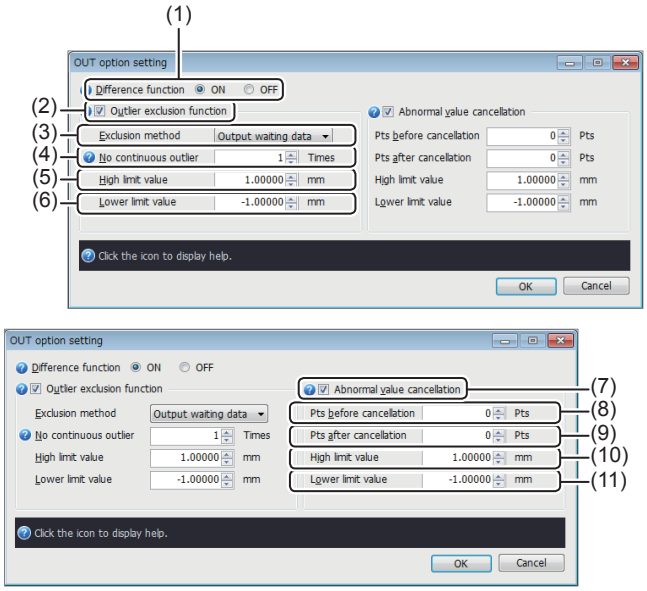
No.	Name	Description
(1)	[Copy] button	Used to copy the selected OUT setting.
(2)	[Paste] button	Used to paste the copied OUT setting to the selected OUT setting.
(3)	[OUT name] setting	Enter the OUT setting name.

[Measure mode] window



No.	Name	Description
(1)	[Measure mode] radio button	Used to select the measurement mode.
(2)	[Hold mode] radio button	Used to select the hold mode.
(3)	[Self-timing period] setting	Use this to enter the self-timing period.

[OUT option setting] window



No.	Name	Description
(1)	[Difference function] radio button	Select the use of difference function.
(2)	[Outlier exclusion function] check box	Used to select the use of outlier exclusion function.
(3)	[Exclusion method] dropdown list	Select the exclusion method to apply.
(4)	[No continuous outlier] setting	Enter the continuous outlier counts.
(5)	[High limit value] setting	Enter the upper limit value.
(6)	[Lower limit value] setting	Enter the lower limit value.
(7)	[Abnormal value cancellation] check box	Used to select the use of abnormal value canceling function.
(8)	[Pts before cancellation] setting	Enter the points before cancellation.
(9)	[Pts after cancellation] setting	Enter the points after cancellation.
(10)	[High limit value] setting	Enter the upper limit value.
(11)	[Lower limit value] setting	Enter the lower limit value.

OUT setting

"OUT" means the setting relating to the display and processing of measurement values.
Assign the measurement target to each OUT so that the dimension of the area specified for the target and edge position, etc. can be measured and displayed.
Thus obtained measurement can be further subject to filtering and calculation.
It is possible to set maximum 16 OUTs.
Increasing the number of OUTs to use makes the sampling frequency longer.

	Number of OUTs to use		
	1 to 4	5 to 12	13 to 16
Sampling frequency	62.5	125	187.5

Unit:µs

"Interference prevention function" (page 5-73)

Minimum display unit

Determine the minimum display unit for measurements. This is applied commonly to all OUTs.

Setting range: 0.1 mm, 0.01 mm, 0.0001 mm, 0.00001 mm, 1 µm, 0.1 µm, 0.01 µm

According to the selected minimum display unit, the number of significant digits, unit, and setting contents of a numeric value to be displayed for [Offset], [Tolerance], [Calibration setting], [Scaling], [OUT option setting], and [Analog output terminal option setting] will change as follows:

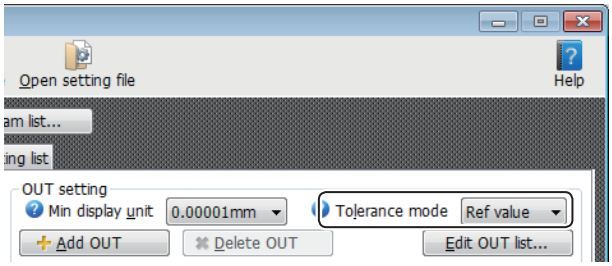
- Changes from Display panel or RS-232C
  All will be initialized.
- Changes from LS-Navigator2
  Those settings which can be displayed in the minimum display unit after modification can be taken over, while those which can not be done so will be initialized.

■ Tolerance mode

Select the tolerance setting method.
This can be selected from [Ref. value] and [Threshold].
Depending on the tolerance mode setting, the analog output terminal setting method varies accordingly.
"Analog output" (page 5-97)

● Ref. value

Set an appropriate tolerance based on the reference value.

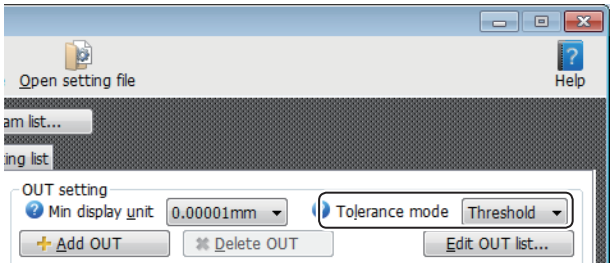


Measurement values will be judged into one of the three results of HI/GO/LO.
With the tolerance setting procedure, set [Ref. value], [Upper limit] and [Lower limit], respectively.
With the tolerance setting procedure, set [Ref. value], [Upper limit] and [Lower limit], respectively.

Criteria	Judgment result
Measurement value is "Output waiting data"	Output waiting
(Ref.value + Upper limit) < Measurement value	HI
(Ref.value + Lower limit) ≤ Measurement value ≤ (Ref.value + Upper limit)	GO
Measurement value < (Ref.value + Lower limit)	LO

● Threshold

Specify the tolerance in absolute values.



Measurement values will be judged into one of the five results of HH/HI/GO/LO/LL.
With the tolerance setting procedure, set [HH] (Highest limit), HI (Upper limit), LO (Lower limit), and [LL] (Lowest limit), respectively.
Tolerance and judgment results are as follows.

Criteria	Judgment result
Measurement value is "Output waiting data"	Output waiting
HH setting value < Measurement value	HH
HI setting value < Measurement value ≤ HH setting value	HI
LO setting value ≤ Measurement value ≤ HI setting value	GO
LL setting value ≤ Measurement value < LO setting value	LO
Measurement value < LL setting value	LL

■ Add OUT

Used to add another OUT setting.

■ Delete OUT

Used to delete any OUT setting. When only one OUT is used, it can not be deleted.

■ Edit OUT list

Used to edit the OUT settings in the list screen. When only one OUT is used, the [Edit OUT list] can not be specified.

■ OUTx

Used to switch the OUT setting to display.

■ OUT name

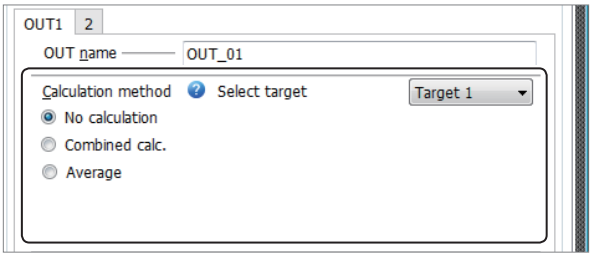
This is the name of OUT setting.
You can assign an arbitrary name to each OUT.

■ Calculation method

Configure the setting to link the measurement results with the OUT concerned. After any calculation method is set, the appropriate measurement value can be obtained.

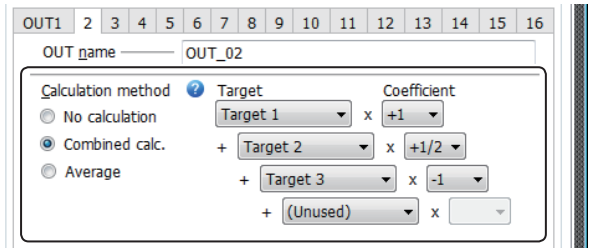
● No calculation

The raw measurement value of the target will be displayed.



● Combined calc.

Obtain the calculation result of the following: (Measurement target A x Factor A) + (Measurement target B x Factor B) … Maximum 4 measurement targets can be specified.



❍ Measurement target

Select any target to be used for calculation from the dropdown list.

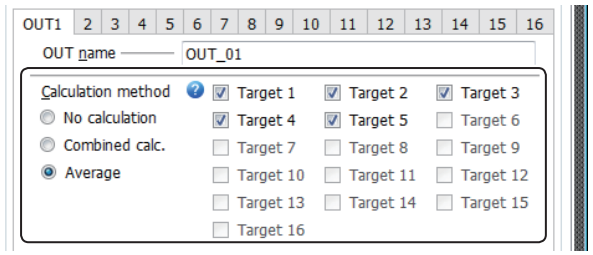
❍ factor

Select any factor from the dropdown list.

Reference If any output waiting data is included in the measurement values to be used for combined calculation, the calculation result will be the output waiting data.

● Average

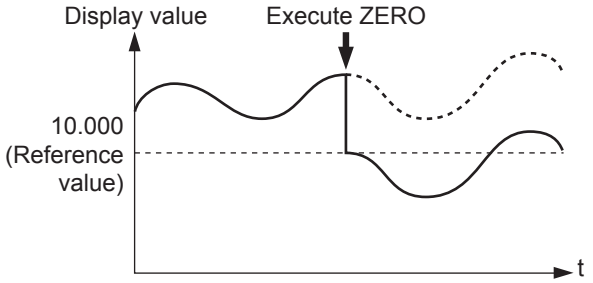
Used to obtain the mean of the measurement values from the selected target.



Reference If any output waiting data is included in the measurement values to be used for averaging, the calculation result will be the output waiting data.

■ Offset

This is a function to add an optional value to the measurement value. Combined use with the auto zero function can turn the current measurement value to an offset value.
This is useful for master alignment, etc.



Reference
- Even when the difference function is set to ON in the OUT option setting, the offset processing will be performed.
- This offset processing will not be applied to the output waiting data.

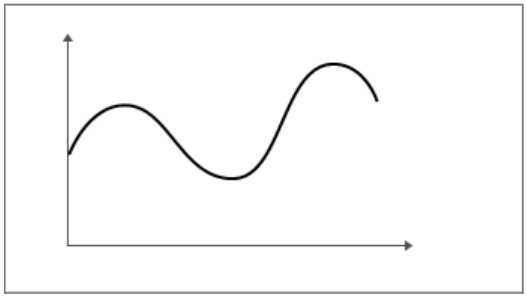
■ Measurement mode

Select this mode if you wish to perform measurement continuously or display the result of calculation specified for the data under sampling period which is specified by the TIMING input.

Reference The auto zero function is effective for the measurement values which measured under the Measurement mode. (Except for "Peak-to-peak hold" and "Auto Peak-to-peak hold".)

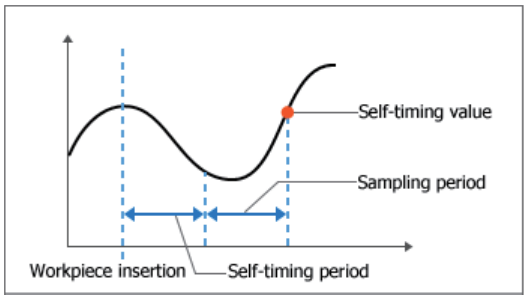
● Normal

Outputs measurement values continuously.



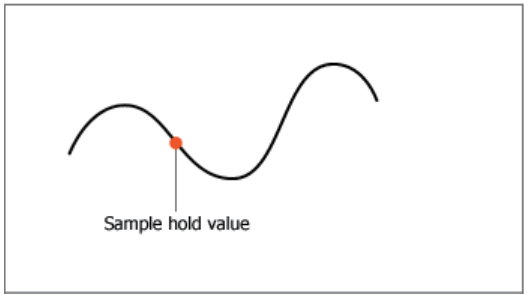
● Self-timing hold

After automatically detecting the target, the measurement concerned will be performed as to follow the self-timing period.



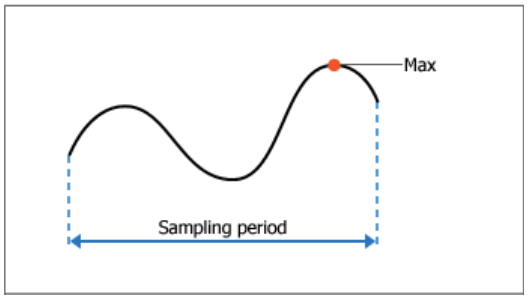
● Sample hold

Outputs measurement values in synchronization with the TIMING input.



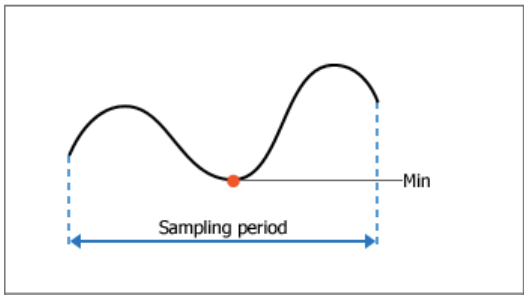
● Peak hold

Outputs the maximum value in the sampling period.



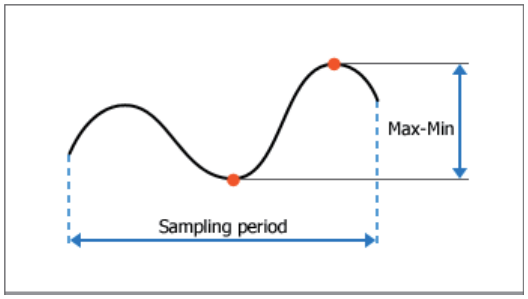
● Bottom hold

Outputs the minimum value in the sampling period.



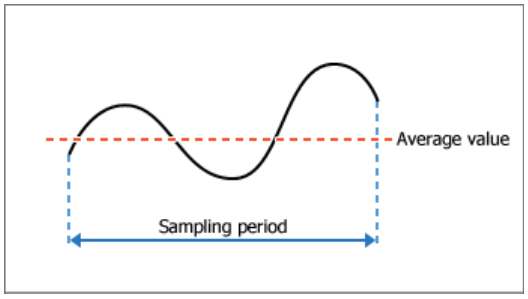
● Peak-to-peak hold

Outputs the maximum value - minimum value in the sampling period.



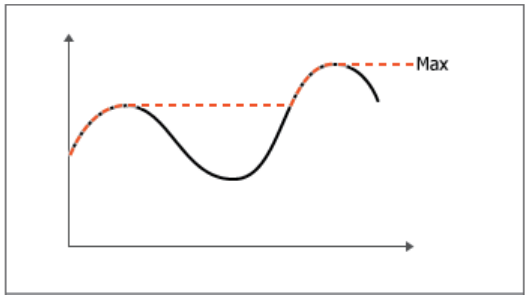
● Average hold

Outputs the mean (average) value in the sampling period.



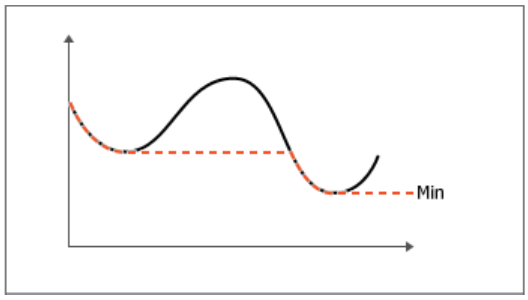
● **Auto Peak hold**

Continues updating the Max (maximum) value until this setting is reset.



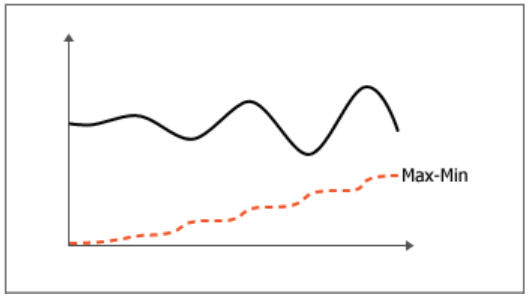
● **Auto Bottom hold**

Continues updating the Min (minimum) value until this setting is reset.



● **Auto Peak-to-peak hold**

Continues updating the Max and Min values and outputs the Max-Min values until this setting is reset.

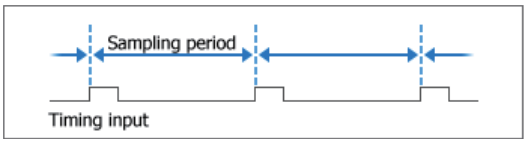


● **Hold mode**

Set an appropriate sampling period.

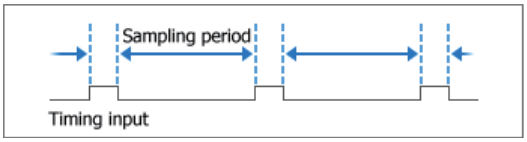
❍ **Hold 1**

From rise to rise of timing signal



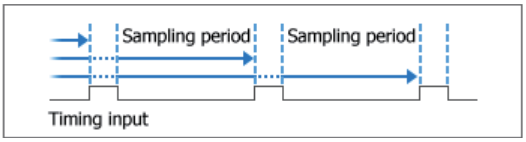
❍ **Hold 2**

From fall to rise of timing signal



❍ **Hold 3**

From measurement start to rise of timing signal. However, such a period that the timing is ON is not included in the sampling period.



● **Self-timing period**

Set the wait time after the target is inserted in the measurement range and until the measurement starts. Output interval should be entered in msec.

Setting range: 1 to 9999 msec

■ Filter

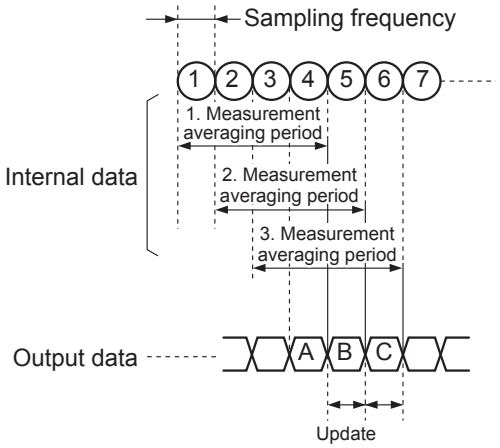
For stabilizing measurement this is used to determine the method and number of times of averaging measurement values.

● **Moving average**

Used to apply moving average on measurement values. Measurement values will be updated at every sampling frequency.

Setting range:1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768

As the result of averaging four times, the measurement values will be as follows:



1. Averages Data 1 to 4 and outputs Data A.
2. Averages Data 2 to 5 and outputs Data B.
3. Averages Data 3 to 6 and outputs Data C.

Reference

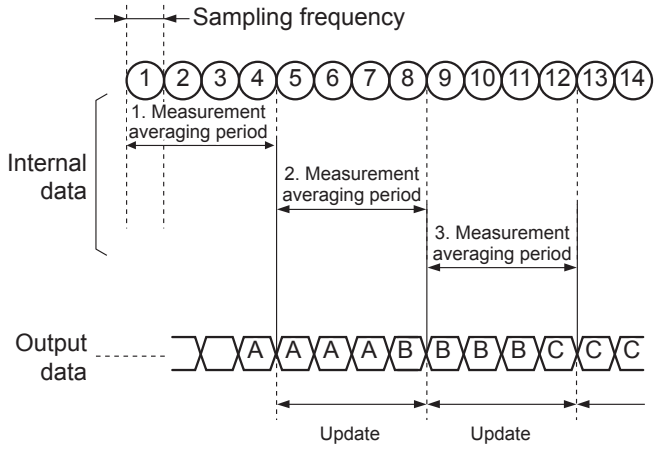
- After starting measurement, and until the specified number of averaging times of data are gathered, the output waiting data will be outputted.
- If any output waiting data is included in the target values of calculating the moving average, the output waiting data will be outputted.

● **Simple average**

Used to apply simple average on measurement values. Measurement values will be updated every time of averaging period.

Setting range:1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768

As the result of averaging four times, the measurement values will be as follows:



1. Averages Data 1 to 4 and outputs Data A.
2. Averages Data 5 to 8 and outputs Data B.
3. Averages Data 9 to 12 and outputs Data C.

Reference

- After starting measurement, and until the specified number of averaging times of data are gathered, the output waiting data will be outputted.
- If any output waiting data is included in the target values of calculating the simple average, the output waiting data will be outputted.

■ Tolerance

Determine the value (tolerance limit) for applying GO/NG judgment on measurements. Settable values will vary depending on the selected tolerance mode.

● **Where "Ref. value" is selected for [Tolerance mode]**

❍ **Upper / Upper limit**
This is the upper limit of tolerance value.

❍ **Standard / Ref value**
This is the standard value of tolerance value.

❍ **Lower / Lower limit**
This is the lower limit of tolerance value.

● **Where "Threshold" is selected for [Tolerance mode]**

❍ **HH / Highest limit**
This is the highest limit of tolerance value.

❍ **HI / Upper limit**
This is the upper limit of tolerance value.

❍ **LO / Lower limit**
This is the lower limit of tolerance value.

❍ **LL / Lowest limit**
This is the lowest limit of tolerance value.

■ OUT option setting

● Difference function

This is a function to detect a rapid change in the measurement value such as a protrusion formed on electric wires, etc.
The difference between the current measurement and the previous measurement will be outputted as a measurement value.

Setting range: ON, OFF

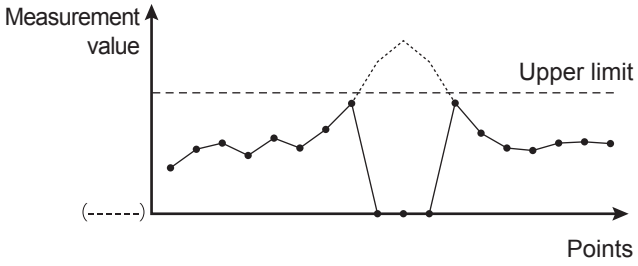
● Outlier exclusion function

This function is used to perform a measurement by excluding outlier values.
Outlier value means the measurement value exceeding the upper and lower limits, and the output waiting data.

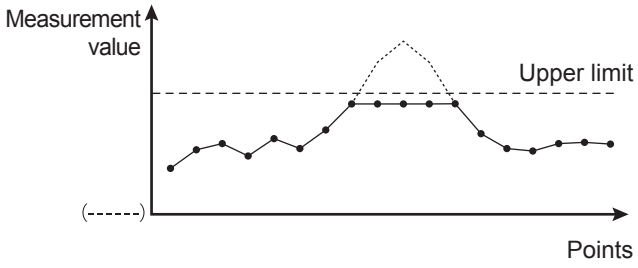
❍ Exclusion method

Handle with either of the following methods:

• Output waiting data: Substitutes outlier values with output waiting data.



• Hold the previous value: Substitutes outlier values with the last measured normal value.



Reference If the previous measurement falls in the output waiting data, the output waiting data will be outputted.

❍ Continuous outlier counts

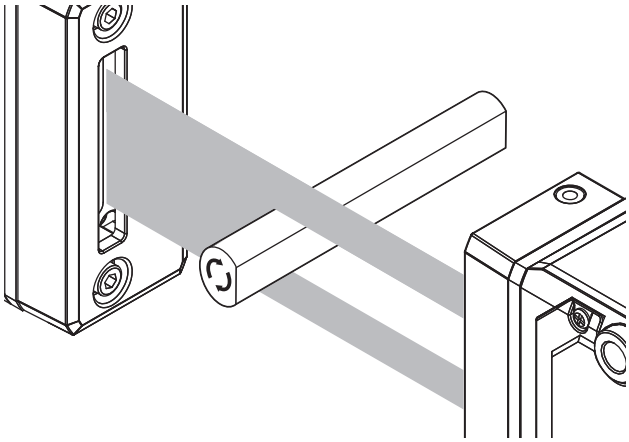
Outlier values are substituted according to the value of the setting value N as follows. The data after substitution are determined by "exclusion method".
In case that 1 ≤ N ≤ 4094
Consecutive N time(s) of outlier values from the last normal value are substituted. The consecutive data from the N+1 time are not substituted.
In case that N = 4095
All of outlier values are substituted.

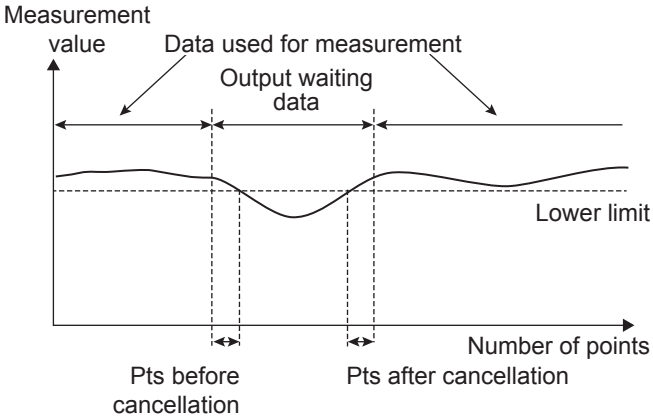
❍ Upper/Lower limit

Tolerance mode : Threshold
Any measurement value exceeding the upper (lower) limit is taken as an outlier value.
Tolerance mode : Ref val
Any measurement value exceeding [Tolerance Ref val] + [Upper (lower) limit] is taken as an outlier value.
When an outlier value is detected, the status output can be turned to ON.
"Outlier continue" (page 5-98)

● **Abnormal value canceling function**

In this function, an abnormal value (measurement outside the specified range) and optional points of measurements before and after the abnormal value are taken as the output waiting data. This is used for measuring targets such as having a "D-shape" cut or deflection due to protrusion, etc.





❍ **Pts before cancellation**

Such the data that has been measured before the specified number of points assuming one reference point from which the judgment of abnormality starts will be taken as the output waiting data.

❍ **Pts after cancellation**

Such the data that has been measured after the specified number of points assuming one reference point at which the judgment of abnormality ends will be taken as the output waiting data.

❍ **Upper limit**

Any data exceeding the upper limit is taken as an outlier value.

❍ **Lower limit**

Any data exceeding the lower limit is taken as an outlier value.

Basic Operations of LS-Navigator2

Setting the minimum display unit

1 Select the minimum display unit to be applied from the [Minimum display unit] dropdown list.

Setting the tolerance mode

1 Select the tolerance mode to be applied from the [Tolerance mode] dropdown list.

Reference Depending on the selected tolerance mode, the [Tolerance] display items will vary

Add OUT setting

1 Click the [Add OUT] button.

The selected OUT setting is added and its [OUT setting] tab will be displayed.

Reference To the OUT setting number of the OUT setting to be added, the smallest number of all the unused numbers will be assigned.

Edit OUT setting

1. Click the tab of the OUT setting to be edited.
2. Enter the OUT setting name.
3. Select the measurement method, then set the contents.
4. Enter the offset value.
5. Set the measurement mode.
6. Select the filter and its contents.
7. Enter the tolerance limit values.
8. Select the OUT optional setting.

Delete OUT setting

Reference When the existing OUT setting is only one, the [Delete OUT] button is disabled, and, the setting can not be deleted.

1. Select the tab of the OUT setting to be deleted.
2. Click the [Delete OUT] button.
   This makes the OUT setting deleted.

   Reference As to take the place of the deleted OUT setting, the tab of the OUT setting at the right will be displayed.
   When the OUT setting at the rightmost place is deleted, the tab of the OUT setting at the left will be displayed instead.

Copy OUT setting

Reference When the OUT setting being used is only one, the [Edit OUT list] button is disabled, and, the list of OUT setting can not be edited.

1. Click the [Edit OUT list] button.
   The [Edit OUT list] dialog appears.
2. Select and copy the required OUT setting.
3. Paste it to the OUT setting at the destination of copy.
   The confirmation dialog appears.
4. Click the [OK] button.
   This makes the OUT setting copied.
5. Click the [OK] button.
   The [Program setting] screen returns.

Modifying the OUT setting name in the edit list operation

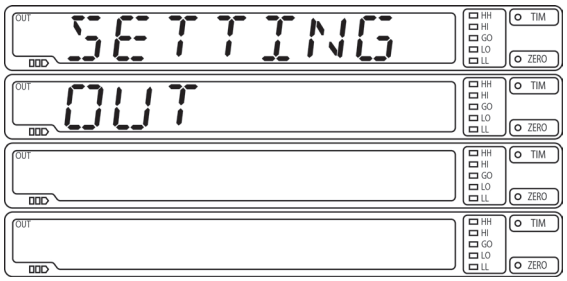
1. Click the [Edit OUT list] button.
   The [Edit OUT list] dialog appears.
2. Click the [OUT name] column of the OUT setting whose name it to be modified.
   The selected OUT setting is highlighted, and the [OUT name] column is ready for entering any text.
3. Enter the new OUT name.
4. Click the [OK] button.
   The [Program setting] screen returns.

Display Panel Setting Method

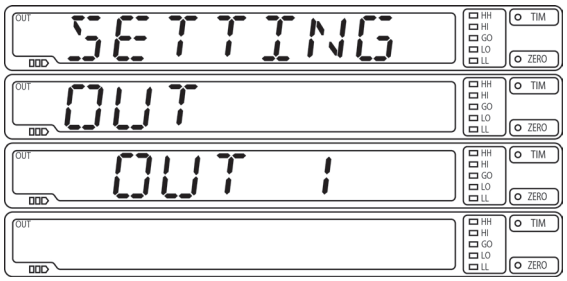
OUT setting method

1 Press the [FUNC] key, then press the [0] key.
The setting item selection screen appears.

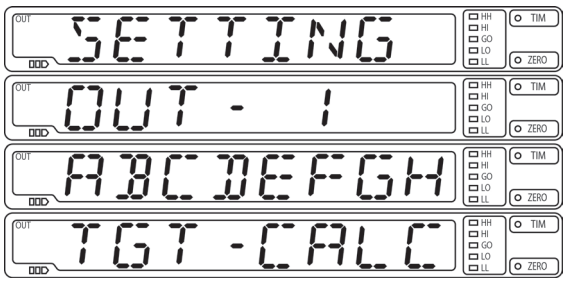
2 Select [APPLY] by pressing the [▲] or [▼] key, then press the [ENT] key.



3 Select any OUT on which the setting is to be performed, then press the [ENT] key.



4 Perform the settings according to your purpose.
Refer to the following items:

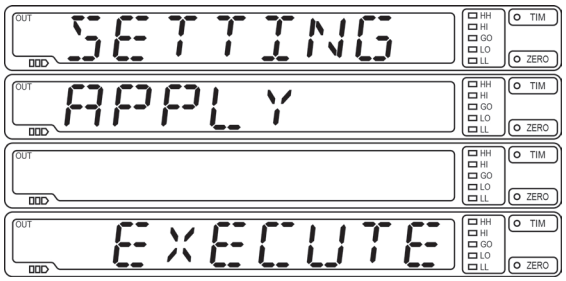


A: TGT-CALC (combined calculation)
B: OUTLIER (Outlier exclusion function)
C: FILTER (Filter)
D: DIF-FUNC (Difference function)
E: A-CANCEL (Abnormal value canceling function)
F: OFFSET (Offset)
G: M-MODE (Measurement mode)
H: TOL (Tolerance)

5 Press the [ESC] key to display the setting item selection screen.

6 Select [APPLY] by pressing the [▲] or [▼] key, then press the [ENT] key.

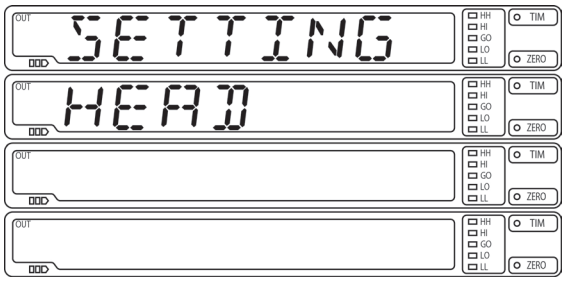
7 When [EXECUTE] appears, press the [ENT] key.



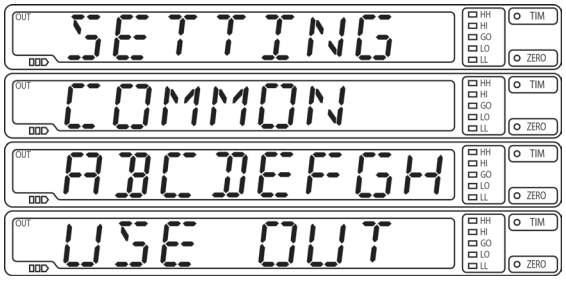
When [COMPLETE] appears, the setting operation is completed.

Setting multiple OUTs

1 Press the [FUNC] key, then press the [0] key.
The setting item selection screen appears.

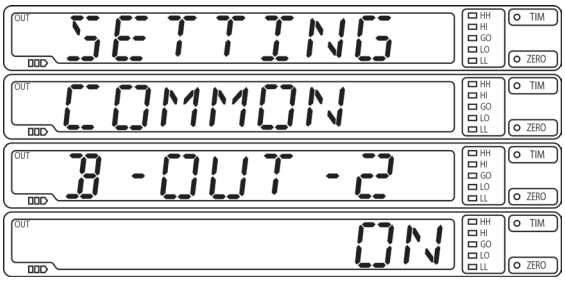


2 Select [COMMON] by pressing the [▲] or [▼] key, then press the [ENT] key.
As the selection screens from [A] to [H] are displayed, then select [B] and press the [ENT] key.



3 Turn the target item used for measurement to [ON] by pressing the [▲] or [▼] key.

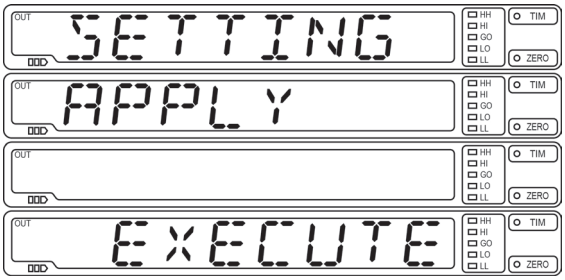
Set up all for from [B-OUT-2] (OUT2) to [B-OUT-16] (OUT16).
Return to the screen of Step 2.



4 Press the [ESC] key to display the setting item selection screen.

5 Select [APPLY] by pressing the [▲] or [▼] key, then press the [ENT] key.

6 When [EXECUTE] appears, press the [ENT] key.

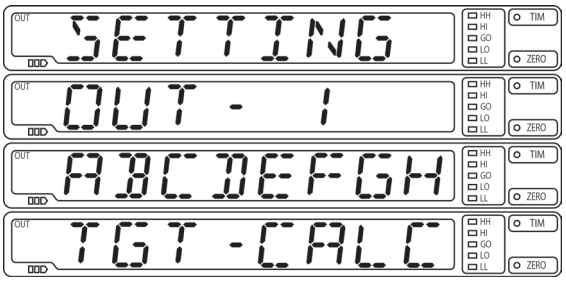


When [COMPLETE] appears, the setting operation is completed.

Calculation setting

1 Select [TGT-CALC], then press the [ENT] key.

"OUT setting method" (page 5-43)

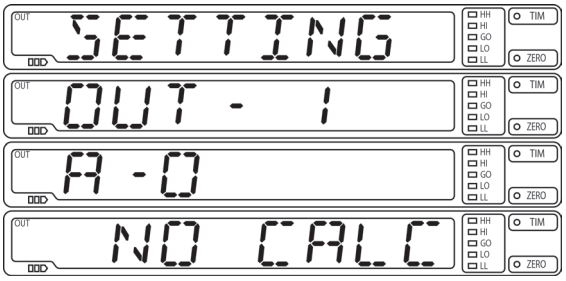


2 Select the calculation method by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

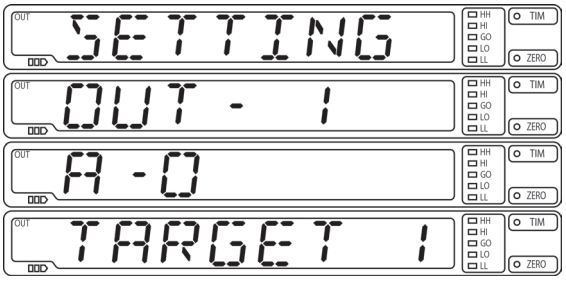
The settable calculation methods are as follows:
- NO CALC (No calculation)
- COMBO (combined calculation)
- AVERAGE (averaging)

■ No calculation setting

1 Select [NO CALC], then press the [ENT] key.



2 Select the area which is not the target of calculation by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

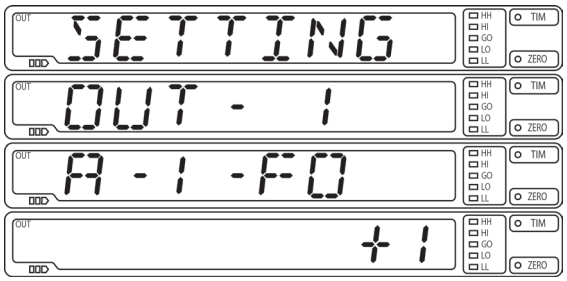


The Function selection screen appears.

5 Program Setting

■ Combined calculation setting

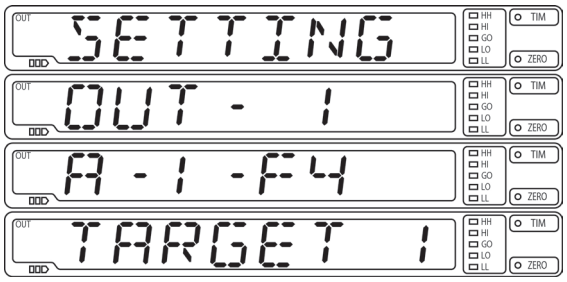
1 Select [COMBO], then press the [ENT] key.
There are eight combined calculation setting screens numbered from F0 to F7.
With F0 to F3 set the applicable factors.
With F4 to F7 set the measurement target (TARGET).



2 Select the factor by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.
Field 2 will be displayed.

3 In the similar way as Step 2, determine each factor for Fields 1 to 3, then press the [ENT] key.
Field 4 will be displayed.

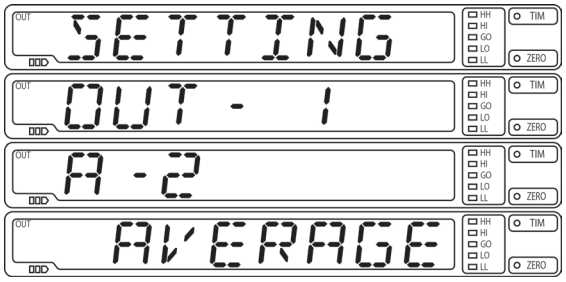
4 Select the measurement target (TARGET) which is the subject of calculation by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



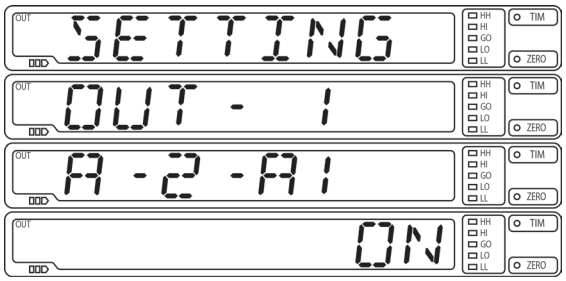
5 As in Step 4, set the measurement target (TARGET) for Fields 5 to 7, then press the [ENT] key.
The Function selection screen appears.

■ Average setting

1 Select [AVERAGE], then press the [ENT] key.



2 Select [ON], then press the [ENT] key.



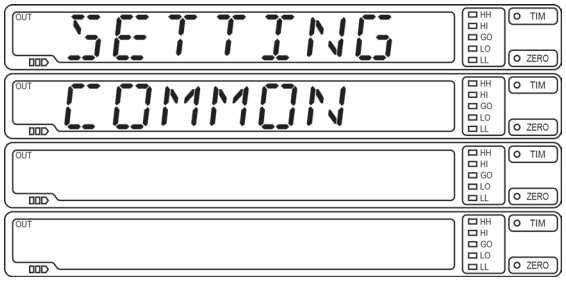
When the [ENT] key is pressed, the screen changes to that for the next measurement target (TARGET). If you press the [ENT] key after setting the last measurement target (TARGET), the Function selection screen will appear.

Reference Those measurement targets whose target setting for use is ON can only be selected as the measurement target (TARGET).

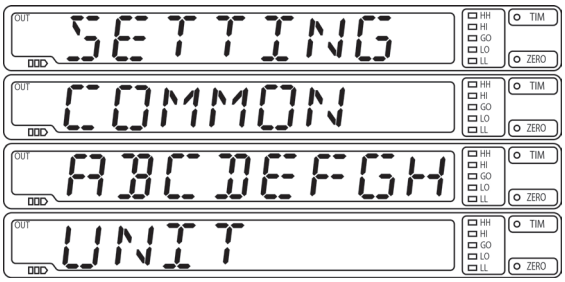
Minimum display unit

1 Press the [FUNC] key, then press the [0] key.
The setting item selection screen appears.

2 Press the [▲] and [▼] keys to select [COMMON], then press the [ENT] key.

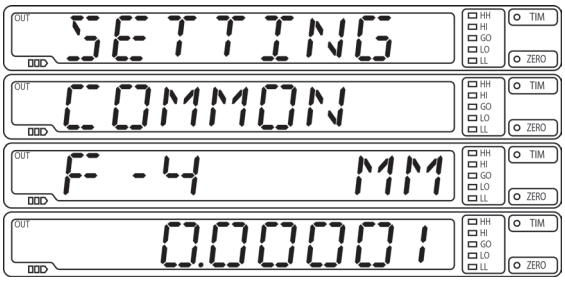


3 Use the [◀] and [▶] keys to select [UNIT], then press the [ENT] key.



4 Perform the settings according to your purpose, then press the [ENT] key.

Refer to the following items:

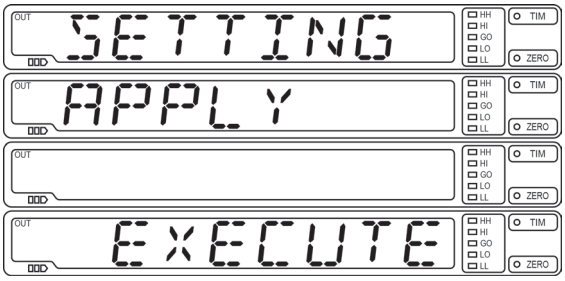


F-0: 0.1MM
F-1: 0.01MM
F-2: 0.001MM
F-3: 0.0001MM
F-4: 0.00001MM
F-5: 1UM
F-6: 0.1UM
F-7: 0.01UM

5 Press the [ESC] key to display the setting item selection screen.

6 Select [APPLY] by pressing the [▲] or [▼] key, then press the [ENT] key.

7 When [EXECUTE] appears, press the [ENT] key.



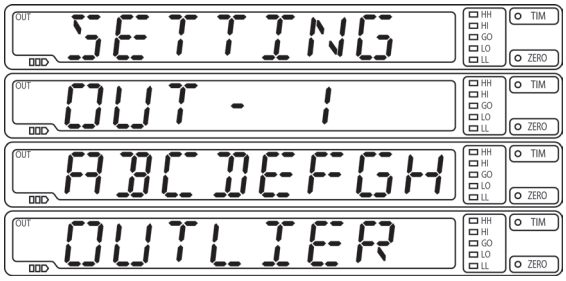
When [COMPLETE] appears, the setting operation is completed.

Outlier exclusion function

■ Outlier exclusion enable setting

1 Select [OUTLIER], then press the [ENT] key.

"OUT setting method" (page 5-43)

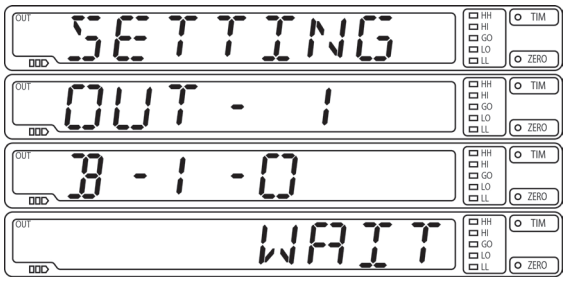


2 Select [ENABLE], then press the [ENT] key.

The [Outlier exclusion method setting] screen appears.

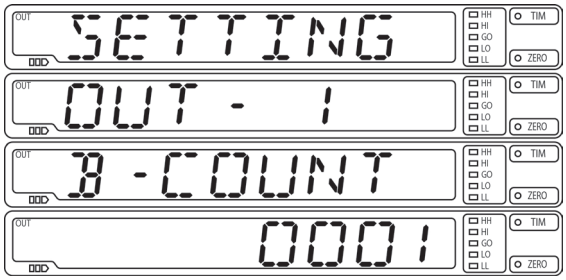
3 Select the exclusion method by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

- If this is selected, the outlier will be replaced with the output waiting data.
- If this is selected, the outlier will be replaced with the previous data and held as-is.



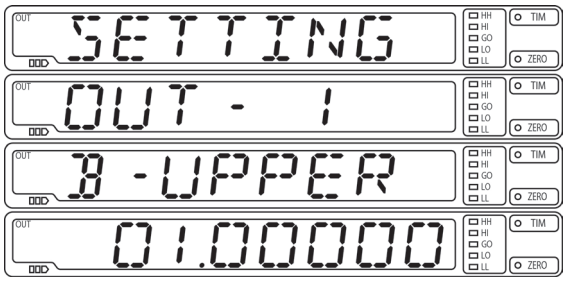
The [Continuous outlier counts setting] screen appears.

4 Enter the continuous outlier counts. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



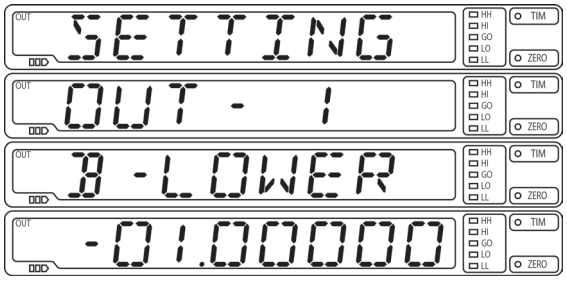
The [Outlier exclusion upper limit setting] screen appears.

5 Enter the outlier exclusion upper limit value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



The [Outlier exclusion lower limit setting] screen appears.

6 Enter the outlier exclusion lower limit value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

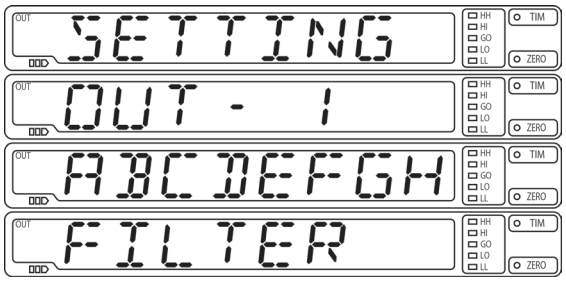


The Function selection screen appears.

Filter setting

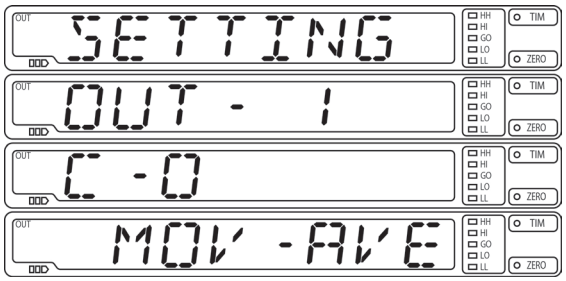
1 Select [FILTER], then press the [ENT] key.

"OUT setting method" (page 5-43)



2 Select the filter to apply by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

- MOV - AVE (Moving average)
- SMPL-AVE (simple averaging times)



The [Averaging times setting] screen appears.

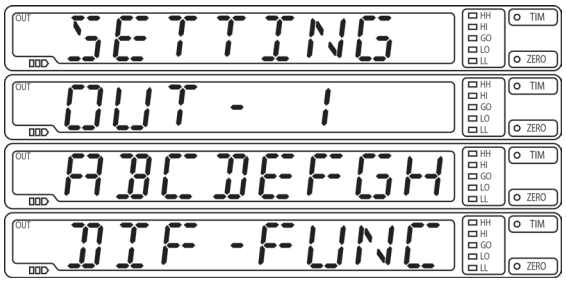
3 Select the averaging times by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

The Function selection screen appears.

Difference function setting

1 Select [DIF-FUNC], then press the [ENT] key.

"OUT setting method" (page 5-43)



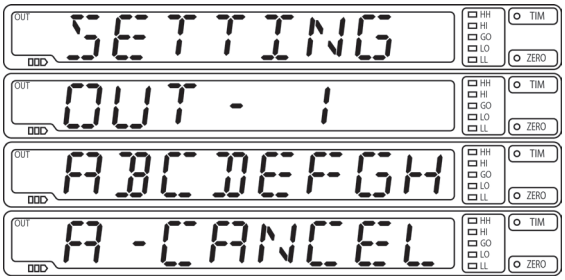
2 Select [ENABLE] by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

The Function selection screen appears.

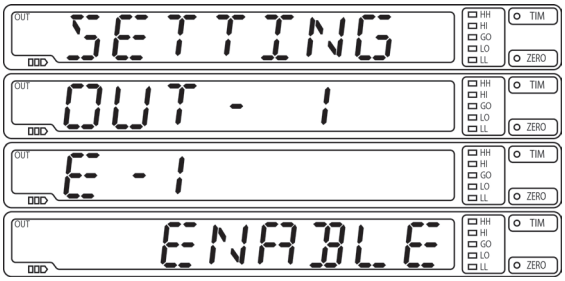
Abnormal value canceling function setting

1 Select [A-CANCEL], then press the [ENT] key.

"OUT setting method" (page 5-43)

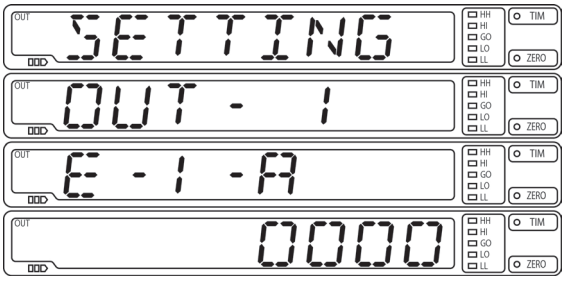


2 Select [ENABLE] by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



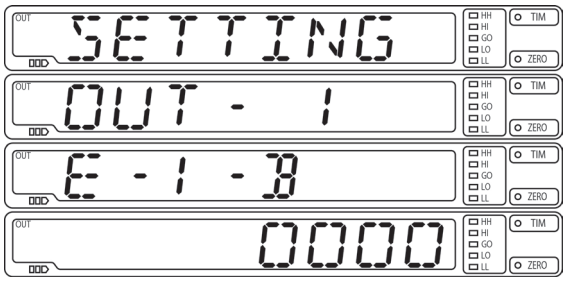
The [Pts before cancellation setting] screen appears.

3 Enter the points before cancellation. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



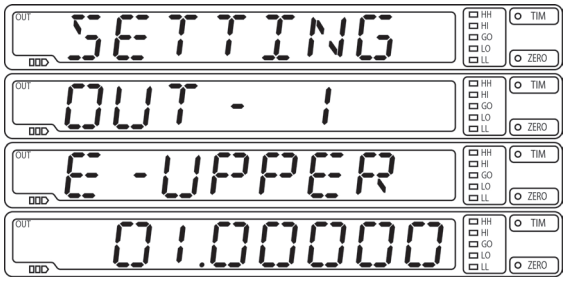
The [Pts after cancellation setting] screen appears.

4 Enter the points after cancellation. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



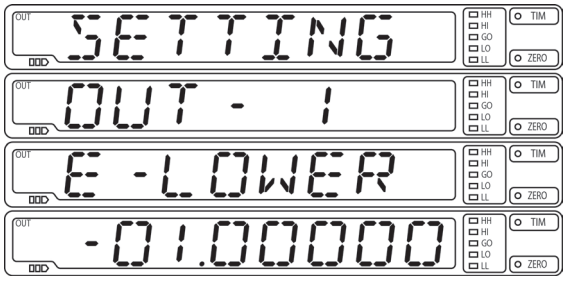
The [Outlier exclusion upper limit setting] screen appears.

5 Enter the upper limit value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



The [Outlier exclusion lower limit setting] screen appears.

6 Enter the lower limit value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

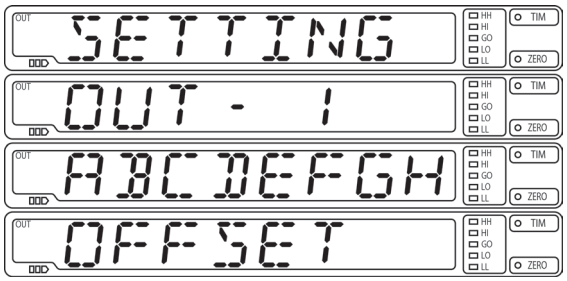


The Function selection screen appears.

Offset setting

1 Select [OFFSET], then press the [ENT] key.

"OUT setting method" (page 5-43)



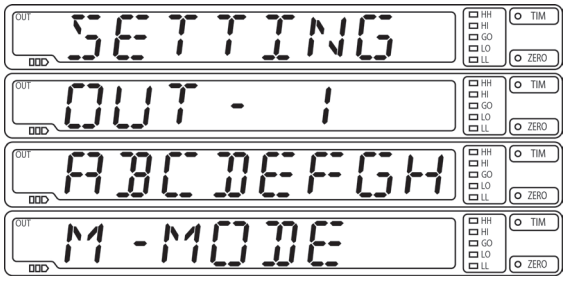
2 Enter the offset value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

The Function setting screen appears.

Measurement mode setting

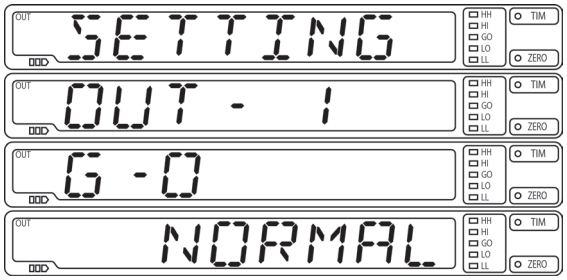
1 Select [M-MODE], then press the [ENT] key.

"OUT setting method" (page 5-43)



2 Select the measurement mode by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

- NORMAL (Normal)
- P-HOLD (Peak hold)
- B-HOLD (Bottom hold)
- PP-HOLD (Peak-to-peak hold)
- AVE-HOLD (Average hold)
- S-HOLD (Sample hold)
- AP-HOLD (Auto peak hold)
- AB-HOLD (Auto bottom hold)
- APP-HOLD (Auto peak-to-peak hold)
- ST-HOLD (Self-timing hold)

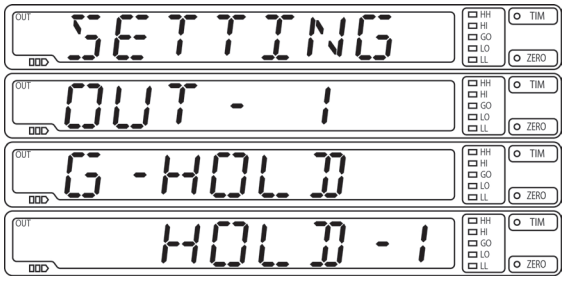


● **Switching the hold mode**

When any of [P-HOLD], [B-HOLD], [PP-HOLD], [AVE-HOLD] and [S-HOLD] is selected for the measurement mode, the Hold mode selection screen will appear.

3 Select the Hold mode by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

Selectable items will vary depending on the selected setting contents.
Case of [P-HOLD], [B-HOLD], [PP-HOLD], or [AVE-HOLD]:HOLD1, HOLD2, HOLD3
Case of [S-HOLD]: HOLD1, HOLD2

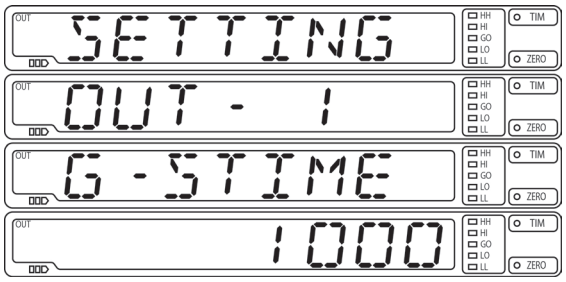


The Function selection screen appears.

● **Setting the self-timing period**

When [ST-HOLD] is selected for the measurement mode, then the [Self-timing period setting] screen will appear.

3 Use this to enter the self-timing period. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

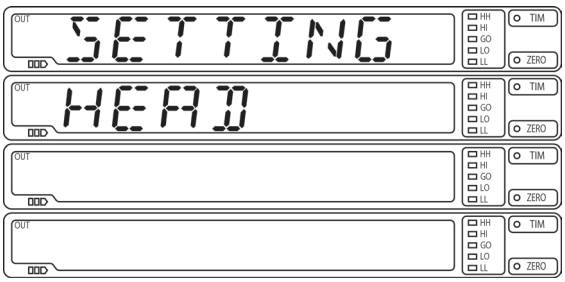


The Function selection screen appears.

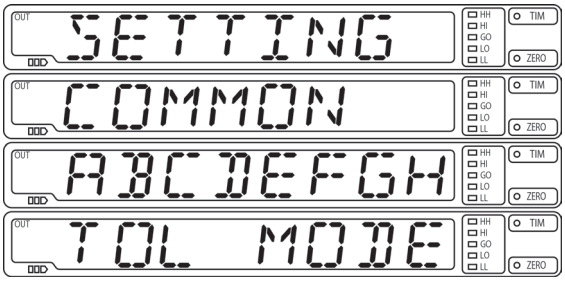
Tolerance setting

■ Switching the tolerance mode

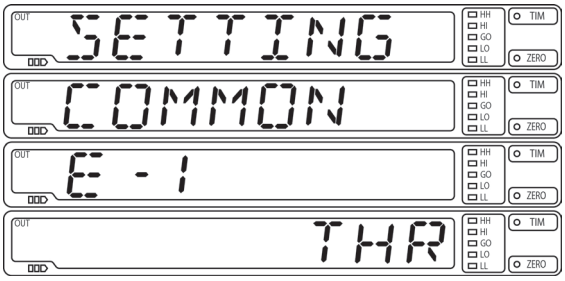
1 Press the [FUNC] key, then press the [0] key.
The [Measurement item setting] screen appears.



2 Press the [▲] and [▼] keys to select [COMMON], then press the [ENT] key.
As the selection screens from [A] to [H] are displayed, then select [E] and press the [ENT] key.



3 Press the [▲] and [▼] keys to select the tolerance mode, then press the [ENT] key.
[REF]: Reference value
[THR]: Threshold

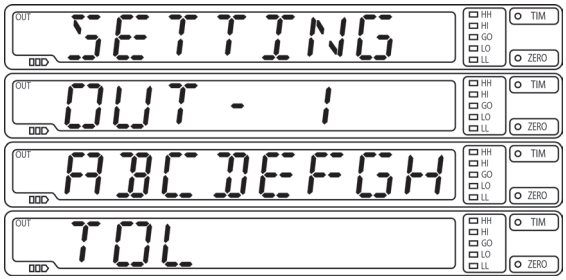


Return to the screen of Step 2.

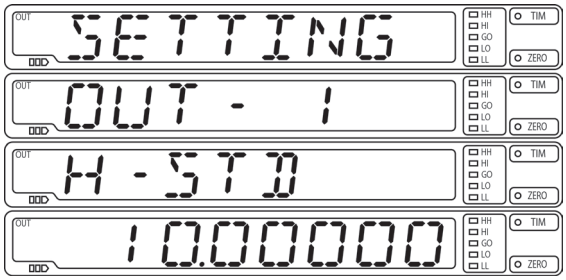
4 Press the [ESC] key to go back to procedure 2 screen of "OUT setting method" (page 5-43).

● **Where the tolerance setting mode is "Ref. value"**

1 Select [TOL], then press the [ENT] key.
"OUT setting method" (page 5-43)



2 Display the [Tolerance setting] screen.



3 Enter the reference value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.
The [Enter upper limit] screen appears.

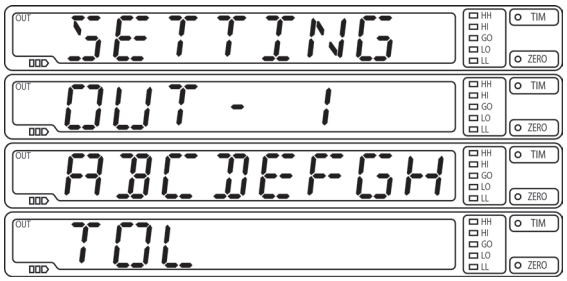
4 Enter the upper limit value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.
The [Enter lower limit] screen appears.

5 Enter the lower limit value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.
The Function selection screen appears.

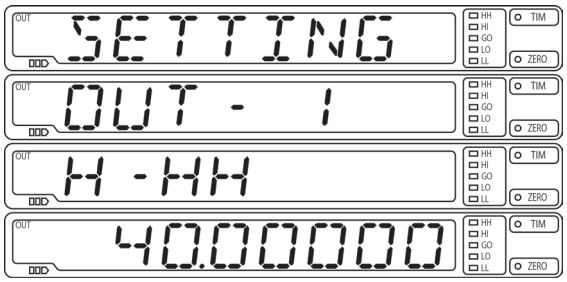
● **Where the tolerance setting mode is "Threshold"**

1 Select [TOL], then press the [ENT] key.

"OUT setting method" (page 5-43)



2 Display the [Tolerance setting] screen.



3 Enter the upper limit value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

The [Enter upper limit] screen appears.

4 Enter the upper limit value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

The [Enter lower limit] screen appears.

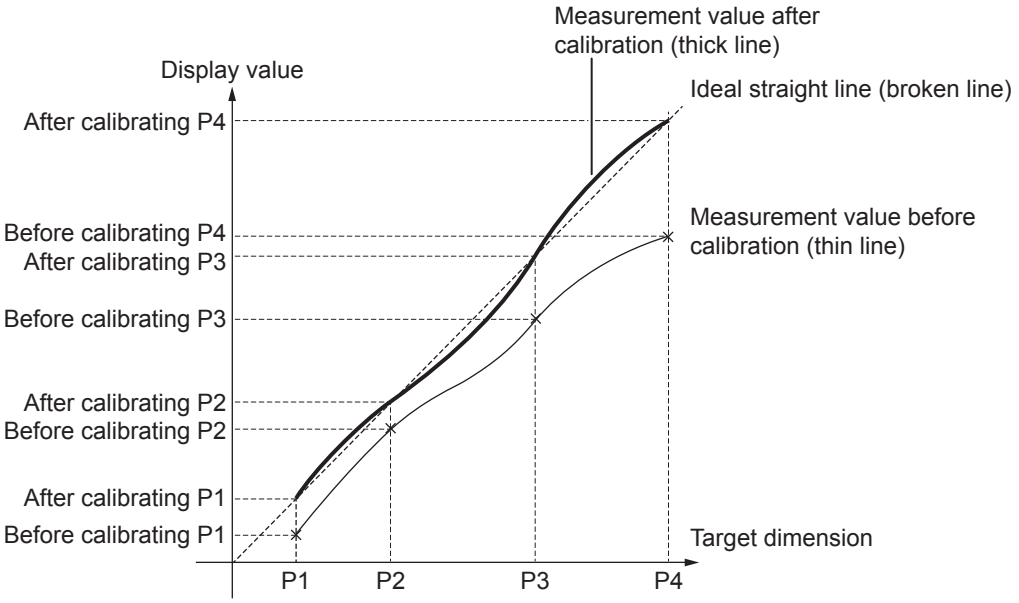
5 Enter the lower limit value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

6 Enter the lower limit value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

The Function selection screen appears.

[Calibration, Scaling] Tab: Calibration Setting

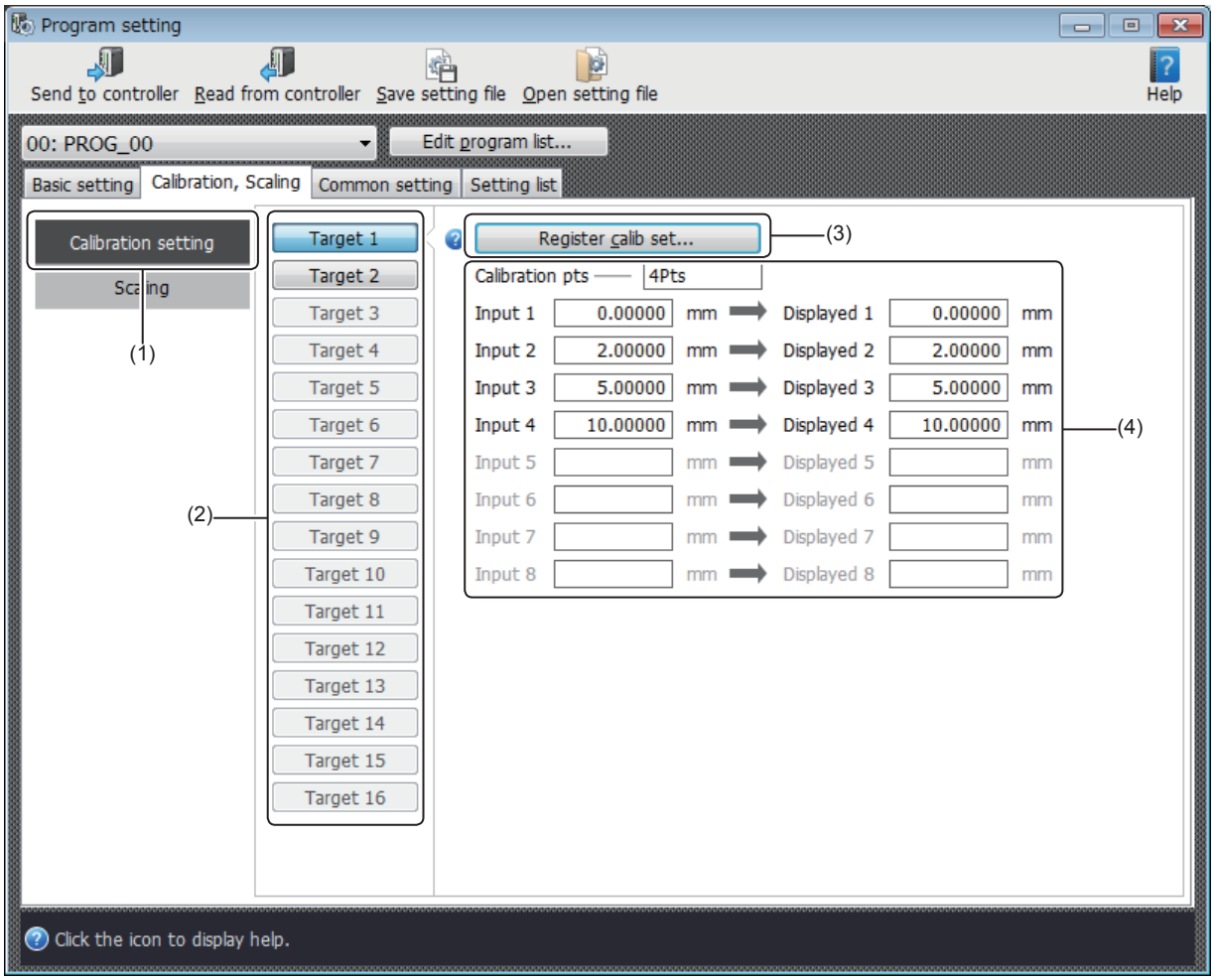
Depending on the mounting angle and position of sensor heads or the presentation angle and position of the target to be measured, there may be small errors produced in the measurement values. Such a setting that is used for correcting these errors is the calibration setting. This calibration is performed using maximum eight (8) points which are different in the location (dimension) of one target as the reference.
After this calibration, it is possible to calculate each value of span (tilt) and shift, which are then used to convert the display before calibration to the display after calibration.
Since each value of span and shift is calculated respectively from two neighboring calibration points, these values will be effective for measurements obtained from between these two points. It is possible to configure calibration setting for each measurement target.



Reference If a single measurement target is used for more than one OUT, such a setting as resulting from one time of alignment with the master may be reflected on them.
Therefore, unlike the scaling setting, it is not always necessary to perform correction for each OUT.

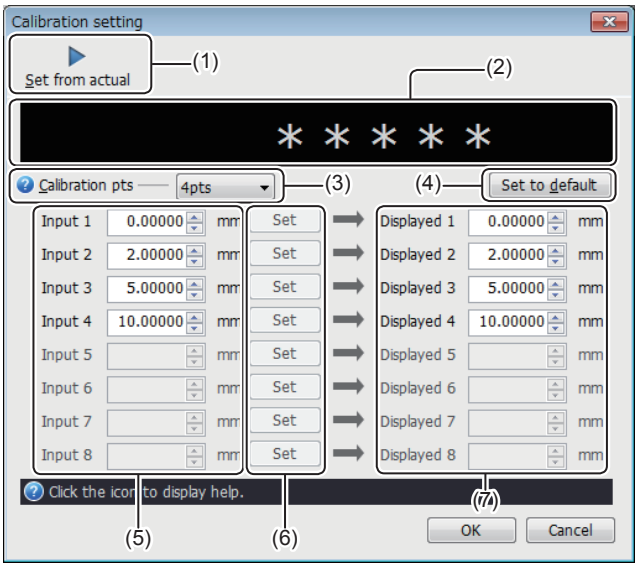
Point This calibration process will not be applied to the output waiting data.

[Calibration setting] area



No.	Name	Description
(1)	[Calibration setting] button	Displays the Calibration setting area.
(2)	[Target x] button	Select any target for which the calibration setting is registered. Clicking on this button makes the calibration setting for the measurement target appear in the Calibration setting display area.
(3)	[Register calib set] button	Used to register the calibration setting for the selected measurement target. Clicking on this button makes the [Calibration setting] dialog appear.
(4)	Calibration setting display area	Displays the calibration setting contents of the selected measurement target.

[Calibration setting] dialog



No.	Name	Description
(1)	[Set from actual] button	If this button is clicked to make it enable, the current measurement value will be acquired and displayed in the [Actual measurement] area.
(2)	Actual measurement area	The current measurement value will be displayed when the [Set from actual] button is turned to ON.
(3)	[Calibration pts] dropdown list	Select the number of calibration points.
(4)	[Set to default] button	When this button is clicked, the entered setting will be cleared and restored to its initial value.
(5)	[Input value x] setting	Enter the input value (measurement) to be calibrated.
(6)	[Set] button	The current measurement value will be taken as the input value if the [Set from actual] button is enabled.
(7)	[Display value x] setting	Enter the display value (theoretical value) to calibrate with.

Calibration setting

■ Set from actual

Actual (current) measurement value can be acquired and displayed on the screen, and can be set as an input value.
On clicking [Set from actual] button, the confirmation dialog appears.
Click the [OK] button to display the actual measurement value.

Reference
- The measurement value used for calibration is the value before Auto Zero, Offset or Filter processing is applied.
- To acquire stable numerical values, display values that 2048 times moving average has been applied to, regardless of the Filter processing.

■ Calibration pts

Select the required number of calibration points from the dropdown list.
According to the selected number of calibration points, configuration of the calibration settings becomes available.
- OFF
- 1 pt to 8 pts

● Input 1 to Input 8

Enter an appropriate input value (measurement value).
If the following conditions are not satisfied, the input value will be taken as an error and displayed in red characters.

Case of correcting with more than two points of k-point.
- Input value [k] - Input value [k - 1] > 0
- $\left|\frac{\text{(Displayed value [k] - Displayed value [k - 1])}}{\text{(Input value [k] - Input value [k - 1])}}\right| \leq 2$

● Set

This designation is effective when the [Set from actual] is set to ON.
Clicking on this button makes the actual (current) measurement value entered as the required input.

● Displayed 1 to Displayed 8

Enter an appropriate displayed value (theoretical value).
If the set displayed value is invalid, it will be shown in red characters.

Basic Operations of LS-Navigator2

Registering the calibration setting

1 Select any target for which the calibration setting is registered.

The calibration setting contents of the selected measurement target will be displayed at the right of the [Calibration setting] area.

2 Click the [Register calib set] button.

The [Calibration setting] dialog appears.

Reference The number of significant digits and unit of the currently displayed measurement value will vary depending on the minimum display unit selected by [Minimum display unit] of the [Basic setting] tab.

3 When setting the input value from the any actual measurement, click the [Set from actual] button.

Reference With the [Set from actual] button turned ON, the [Set] button effects according to the number of points selected with [Calibration pts].

4 Select the number of calibration points.

Reference If the number of calibration points is modified on a half way of establishing the calibration setting (in such a case where more than one input values or displayed values are changed from their initial value), the Confirmation dialog appears to initialize the contents having been set. If this is the case, click the [OK] or [Cancel] button, as required.

5 Enter the input value. In case of setting the input value from any actual measurement, click the [Set] button.

Reference For the input value, use a value larger than the previous input value.

6 Enter the displayed value.

Reference Use a calibration span within a range of ±2.0.

7 Click the [OK] button.

The calibration setting is now established and the [Program setting] screen returns.

Reference If the set input value or displayed value is invalid, the corresponding error dialog will appear.
As the [Calibration setting] dialog returns if the [OK] button is clicked, correct the input value or displayed value shown in red characters.

Restoring the calibration setting to its initial value

1 During the registration of calibration setting, click the [Set to default] button.

The input value and displayed value will be restored to their initial values.

Canceling the registration of calibration setting

1 Select any measurement target for which the calibration setting is registered.

The calibration setting contents of the selected measurement target will be displayed at the right of the [Calibration setting] area.

2 Click the [Register calib set] button.

The [Calibration setting] dialog appears.

3 Select [OFF] from the [Calibration pts] dropdown list.

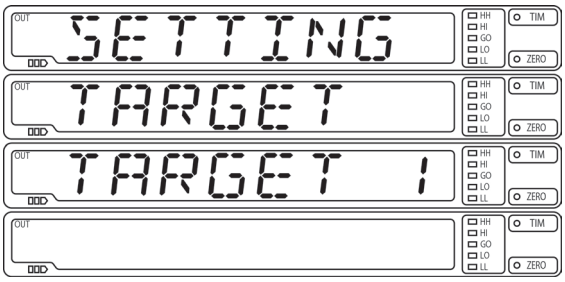
4 Click the [OK] button.

The calibration setting is now cancelled and the [Program setting] screen returns.

Display Panel Setting Method

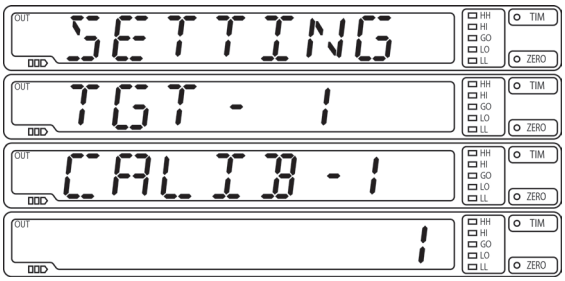
Registering the calibration setting

1 Press the [8] key after pressing the [FUNC] key, select the target to be calibrated and then press the [ENT] key.



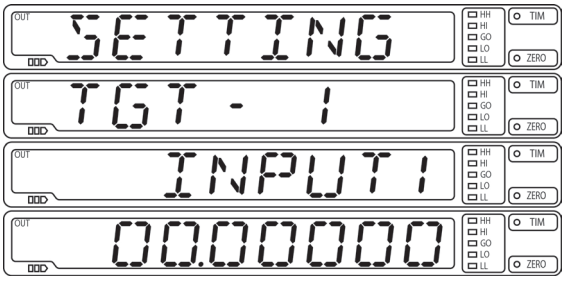
The Calibration points setting screen appears.

2 Select the number of calibration points by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



The Calibration value setting screen appears.
If you do not perform calibration, select [OFF].

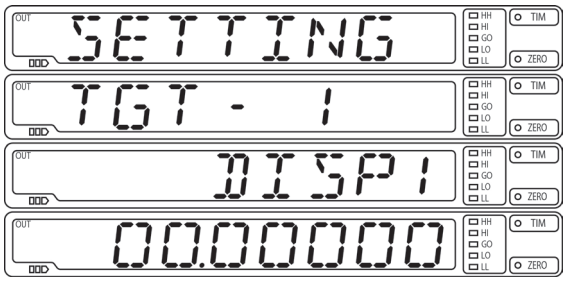
3 Enter the input value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



The Displayed value setting screen appears.

Reference In case of setting the input value from any actual measurement, press the [TIM] key.

4 Set the displayed value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

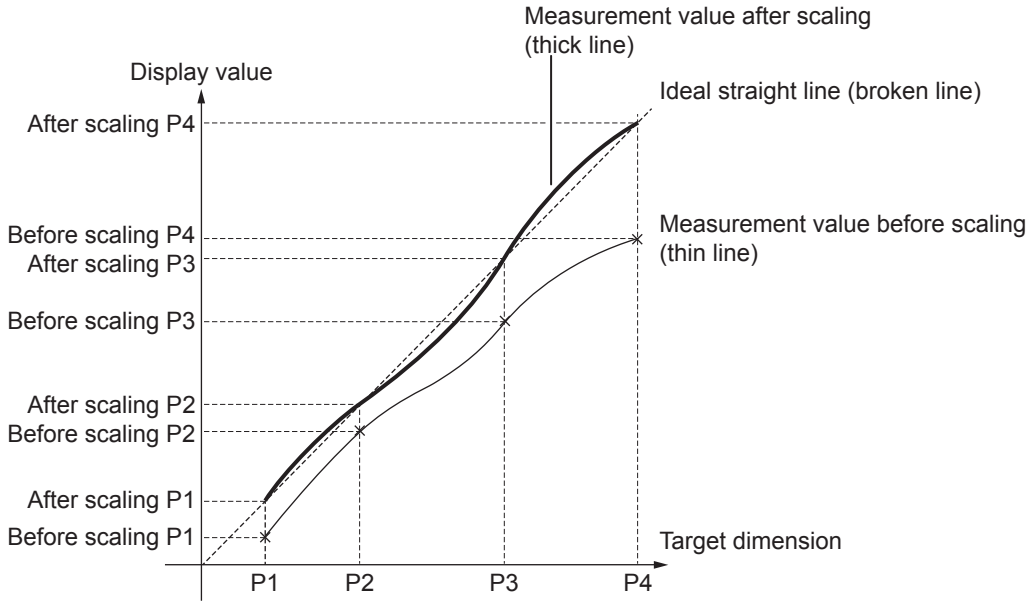


5 Repeat the setting of input value and displayed value as many times as the number of calibration points set with Step 2.

When you complete the settings as many as the number of calibration points, the Measurement screen will return.
These settings will be reflected on the Controller.

[Calibration, Scaling] Tab: Scaling Setting

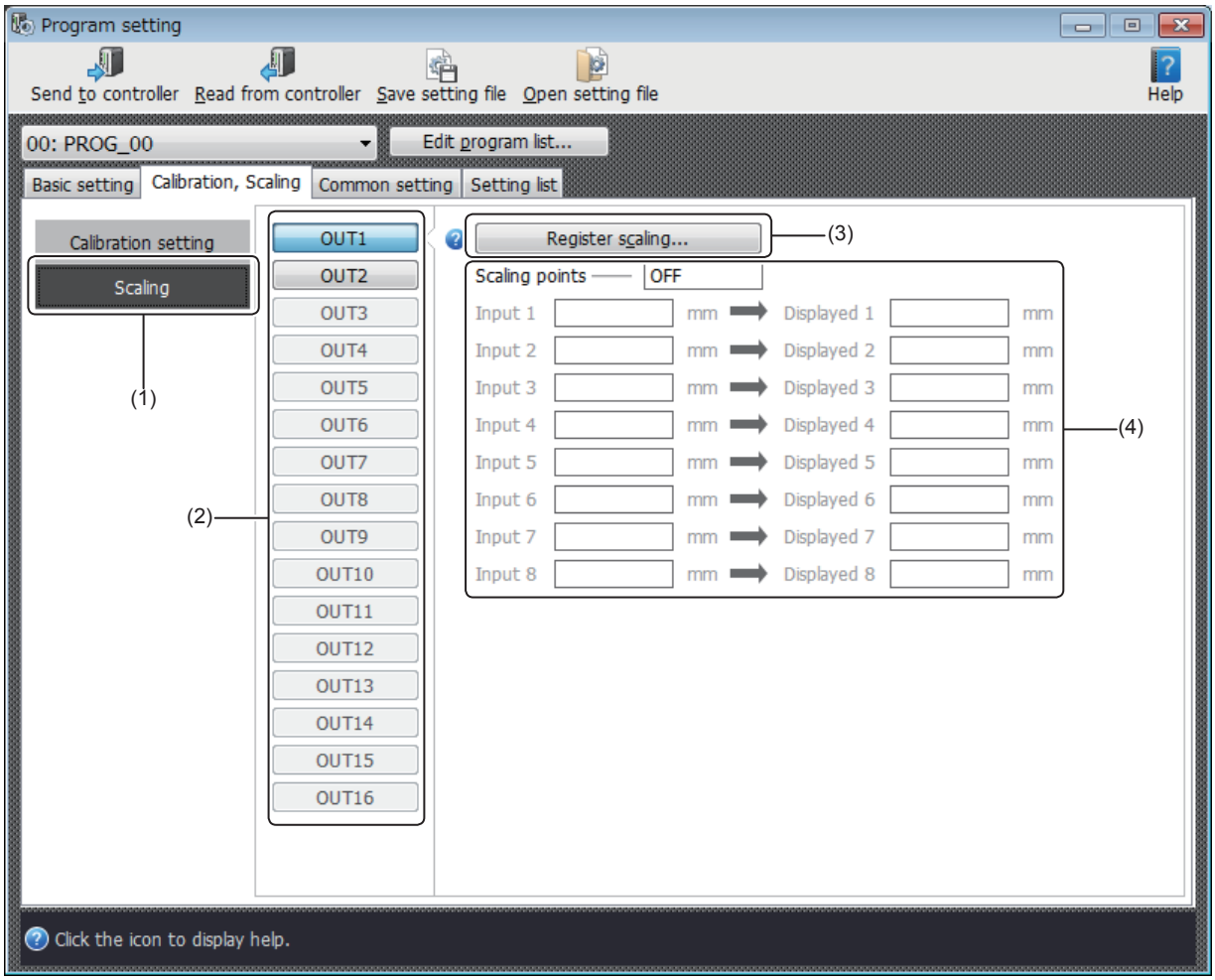
Depending on the surface conditions and application environment, etc. of the measurement target, there may be small errors produced in the measurement values. Such a setting that is used for correcting these errors is the scaling setting. This scaling is performed using a maximum of eight (8) points which are different in the location (dimension) of one target as the reference.
After this scaling, it is possible to calculate each value of span (tilt) and shift, which are then used to convert the display before scaling to the display after calibration.
Since each value of span and shift is calculated respectively from two neighboring scaling points, these values will be effective for measurements obtained from between these two points. It is possible to configure the scaling setting for each OUT.



Reference Use this method in such a case where multiple targets having a large diameter are measured using 2 heads and you wish to apply scaling to the calculation results obtained from them.

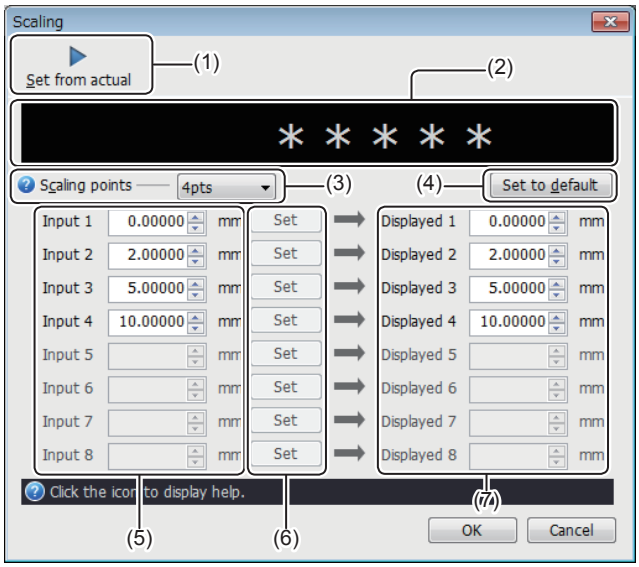
Point This scaling process will not be applied to the output waiting data.

[Scaling] area



No.	Name	Description
(1)	[Scaling] button	Used to display the [Scaling] area.
(2)	[OUTx] button	Select any OUT for which the scaling setting is registered. Clicking on this button makes the scaling for the OUT appear in the Scaling display area.
(3)	[Register scaling] button	Used to register the scaling setting for the selected OUT. Clicking on this button makes the [Scaling] dialog appear.
(4)	Scaling display area	In this area the scaling setting contents of the OUT will be displayed.

[Scaling] dialog



No.	Name	Description
(1)	[Set from actual] button	On clicking this to enable it, the current measurement value will be acquired and displayed in the [Actual measurement] area.
(2)	Actual measurement area	The current measurement value will be displayed when the [Set from actual] button is turned to ON.
(3)	[Scaling pts] dropdown list	Select the number of scaling points.
(4)	[Set to default] button	On clicking this button, the entered setting will be cleared and restored to its initial value.
(5)	[Input value x] setting	Enter the input value (measurement) to be scaled.
(6)	[Set] button	The current measurement value will be taken as the input value if the [Set from actual] button is enabled.
(7)	[Displayed value x] setting	Enter the display value (theoretical value) to apply scaling to.

Scaling setting

■ Set from actual

Actual (current) measurement value can be acquired and displayed on the screen, and can be set as an input value.
On clicking [Set from actual] button, the confirmation dialog appears.
Click the [OK] button to display the actual measurement value.

Reference
- The measurement value used for scaling is the value before Auto Zero, Offset or Filter processing is applied.
- To acquire stable numerical values, display values that 2048 times moving average has been applied to, regardless of the Filter processing.

■ Scaling pts

Select the number of scaling points from the dropdown list.
According to the selected number of scaling points, it is now possible to establish the scaling setting.
- OFF
- 1 pt to 8 pts

● Input 1 to Input 8

Enter an appropriate input value (measurement value).
If the following conditions are not satisfied, the input value will be taken as an error and displayed in red characters.

Case of correcting with more than two points of k-point.
- Input value [k] - Input value [k - 1] > 0
- $\left|\frac{\text{(Displayed value [k] - Displayed value [k - 1])}}{\text{(Input value [k] - Input value [k - 1])}}\right| \leq 2$

● Set

This designation is effective when the [Set from actual] is set to ON.
Clicking on this button makes the actual (current) measurement value entered as the required input.

● Displayed 1 to Displayed 8

Enter an appropriate displayed value (theoretical value).
If the set displayed value is invalid, it will be shown in red characters.

Basic Operations of LS-Navigator2

Register the scaling setting

1 Select the OUT number for which the scaling setting is registered.

The scaling setting contents of the selected OUT number will be displayed at the right of the [Scaling setting] area.

2 Click the [Register scaling] button.

The [Scaling setting] dialog appears.

Reference The number of significant digits and unit of the currently displayed measurement value will vary depending on the minimum display unit selected by [Minimum display unit] of the [Basic setting] tab.

3 When setting the input value from the any actual measurement, click to enable the [Set from actual] button.

Reference With the [Set from actual] button turned ON, the [Set] button is enabled according to the number of points selected with [Scaling pts].

4 Select the number of scaling points.

Reference If the number of scaling points is modified on a half way of establishing the scaling setting (in such a case where more than one input values or displayed values are changed from their initial value), the Confirmation dialog appears to initialize the contents having been set. If this is the case, click the [OK] or [Cancel] button, as required.

5 Enter the input value. In case of setting the input value from any actual measurement, click the [Set] button.

Reference For the input value, use a value larger than the previous input value.

6 Enter the displayed value.

7 Click the [OK] button.

The scaling setting is now established and the [Program setting] screen returns.

Reference If the set displayed value or displayed value is invalid, the corresponding error dialog will appear.
As the [Scaling setting] dialog returns if the [OK] button is clicked, correct the input value or displayed value shown in red characters.

Restoring the scaling setting to its initial value

1 During the registration of scaling setting, click the [Set to default] button.

The input value and displayed value will be restored to their initial values.

Canceling the registration of scaling setting

1 Select the OUT number for registering a scaling setting.

The scaling setting contents of the selected measurement target will be displayed at the right of the [Scaling setting] area.

2 Click the [Register scaling] button.

The [Scaling setting] dialog appears.

3 Select [OFF] from the [Scaling pts] dropdown list.

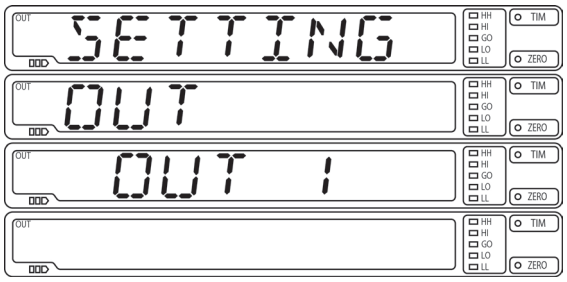
4 Click the [OK] button.

The scaling setting is now cancelled and the [Program setting] screen returns.

Display Panel Setting Method

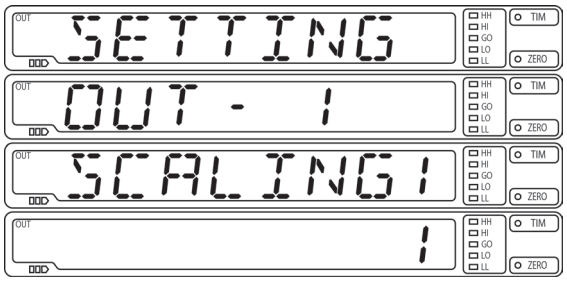
Register the scaling setting

1 Press the [9] key after pressing the [FUNC] key, select the OUT number for scaling and then press the [ENT] key.



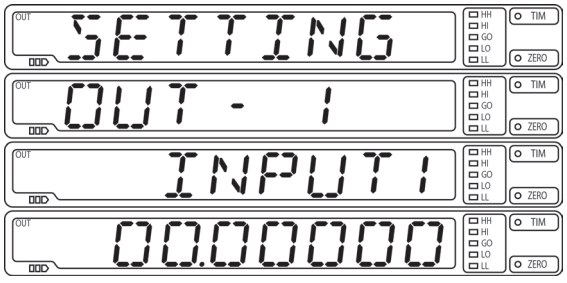
The [Scaling setting] screen appears.

2 Select the number of scaling points by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



The Scaling value setting screen appears.
If you do not perform scaling, select [OFF].

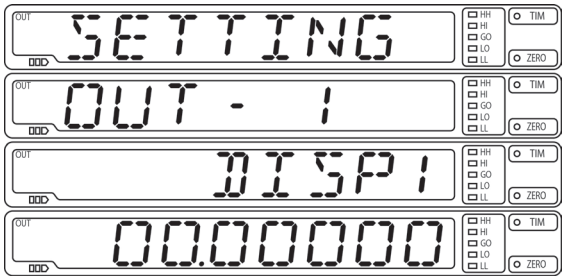
3 Enter the input value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



The Displayed value setting screen appears.

Reference In case of setting the input value from any actual measurement, press the [TIM] key.

4 Set the displayed value. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



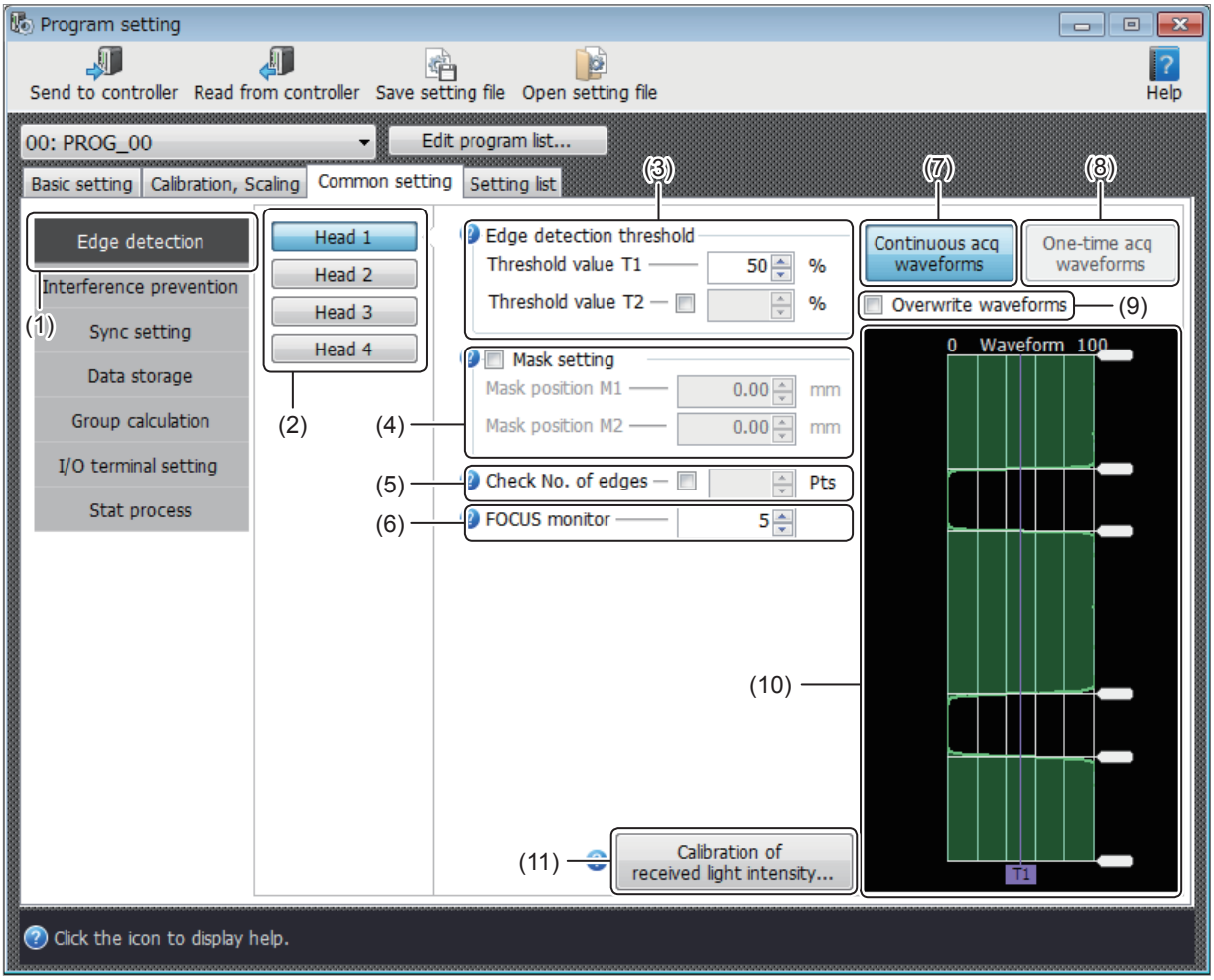
5 Repeat the setting of input value and displayed value as many times as the number of scaling points set with Steps 3 and 4.

When you complete the settings as many as the number of scaling points, the Measurement screen will return.
These settings will be reflected on the Controller.

[Common setting] Tab: Edge Detection

Select the [Common setting] tab in the [Program setting] screen to display the common settings.
Display the [Edge detection] area by clicking on the [Edge detection] button, and then perform setting for received light waveform and edge detection.

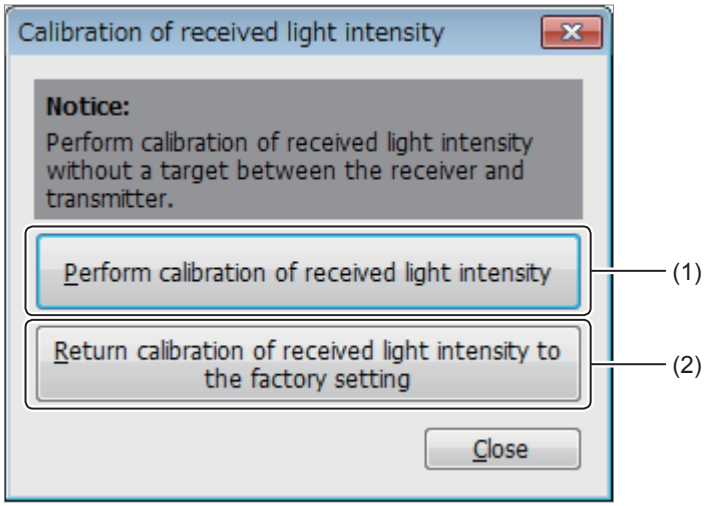
[Edge detection] area



No.	Name	Description
(1)	[Edge detection] area	Use this button to display the edge detection setting area.
(2)	[Head x] button	Select a head where to set edge detection. Clicking the button allows edge detection settings to appear.
(3)	[Edge detection threshold] setup	Select a check box ☑ to enter an edge detection threshold.
(4)	[Mask setting] setup	Select this check box ☑ to enter a mask setting.
(5)	[Check No. of edges] setting	Select this check box ☑ to set an OK/NG threshold for the number of edges.
(6)	[FOCUS monitor] setup	Set the detection sensitivity of FOCUS monitor.
(7)	[Continuous acq waveforms] button	Click this button to continuously acquire received light waveforms from the head periodically and show them in the received light waveform display area.
(8)	[One-time acq waveforms] button	Click this button to once acquire received light waveforms from the head and show them in the received light waveform display area.
(9)	[Overwrite waveforms] check box	Select this check box ☑ to overwrite received light waveforms.
(10)	Received light waveform display area	This area shows received light waveforms.

No.	Name	Description
(11)	[Calibration of received light intensity] button	This button performs calibration of received light intensity. Clicking the button allows the [Calibration of received light intensity] dialog to appear.

[Calibration of received light intensity] dialog



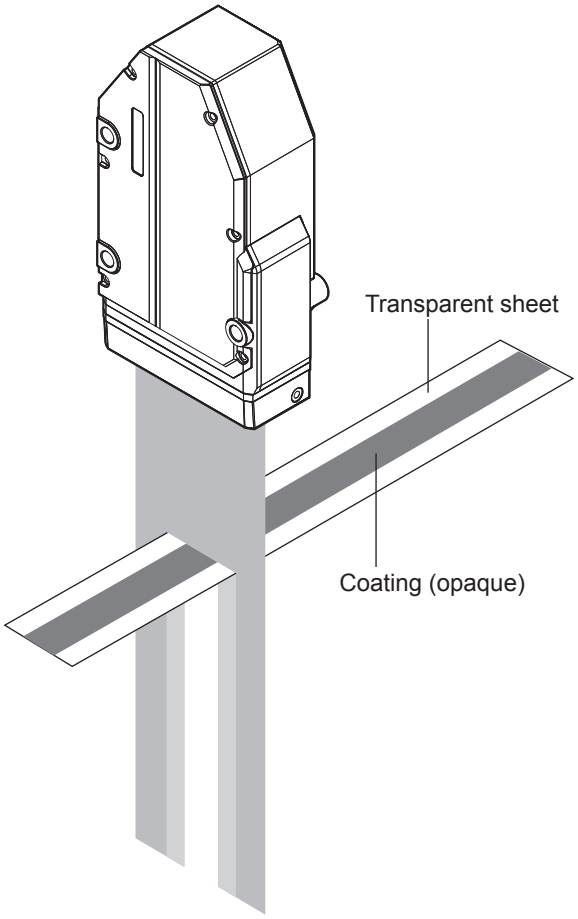
No.	Name	Description
(1)	[Perform calibration of received light intensity] button	This button performs calibration of received light intensity.
(2)	[Return calibration of received light intensity to the factory setting] button	Use this button to return calibration of received light intensity to the factory setting.

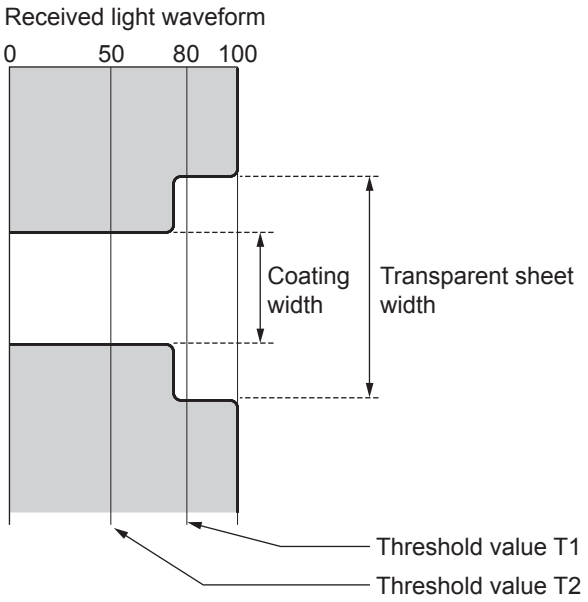
Point — Perform calibration of received light intensity without a target between the receiver and transmitter.

Edge detection

■ Edge detection threshold

You can set a threshold (ratio to the maximum received light intensity) for edge detection.
Change the threshold according to the light transmittance of a target to be measured such as a transparent body. Up to two edge-detection thresholds can be set.
This is usable particularly when the width of a coating on a transparent sheet and that of the sheet are measured at the same time.
To measure an opaque object, set the edge detection threshold to 50%.





Point

If the check box ☑ of [Edge detection threshold] is deselected, the entered threshold is cleared.
When the check box ☑ is selected next time, the threshold is returned to the default value.

● **Threshold value T1**

Enter a threshold value in units of %.

● **Threshold value T2**

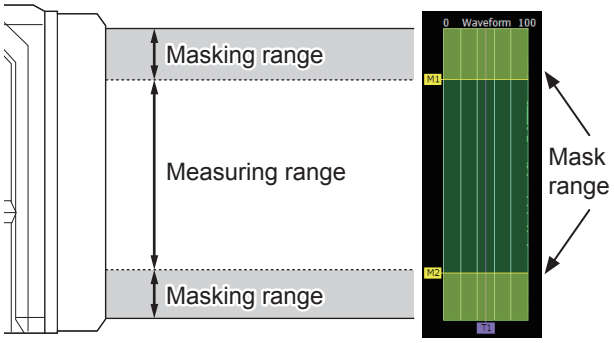
Select this check box ☑, then enter a threshold value in units of %.

■ Mask setting

Select this check box ☑ to specify the range of masking (neglecting) edges in units of mm.
Some edges you want to eliminate from a measurement target may appear depending on a target to be measured.
Use this mask function to neglect such edges not to be used for such measurement.

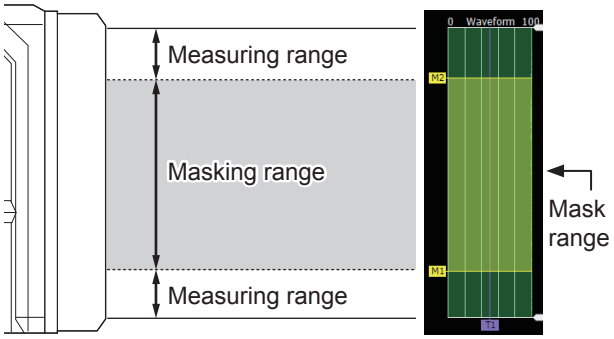
● In case of start point (M1) > end point (M2)

Masking ranges are set on both outsides of boundaries.



● In case of start point (M1) < end point (M2)

A masking range is set at the inside between boundaries.



● In case of start point (M1) = end point (M2)

The entire range is used for measurement (no masking range is set).

Reference

- After acquiring received light waveforms, you can change the masking range by dragging and dropping the tag of [M1] and/or [M2] being displayed in the received light waveform area.
- A masking range is displayed in yellow rectangle.
- If the check ☑ box has been selected, the line and tag in the mask position will appear in the received light waveform display area.

■ Check No. of edges

If the number of edges being detected differs from that you have set with the Check No. of edges function, measurement data is kept as output waiting data.
Select this check box ☑ to enter the number of edges to be detected.

Point

If this check box ☐ is deselected, the entered number of edges is cleared.
When the check box ☑ is selected next time, the number of edges is returned to the default value.

Reference

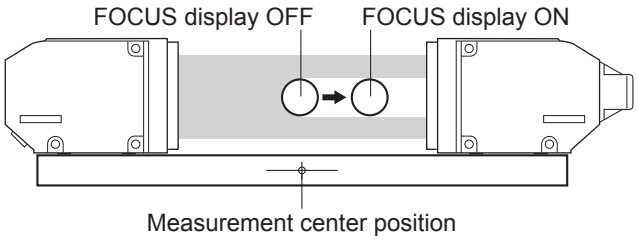
As long as the mask setting is effective, edges included in the mask range are not counted.

■ FOCUS monitor

This function is used in combination with status output "FOCUS". The FOCUS monitor function is usable when measuring cylindrical objects such as a shaft and a wire.
If a target to be measured is not included in the FOCUS monitor range, status output is turned to ON.
"Status output" (page 5-98)

Reference

- The FOCUS monitor function is only enabled when a round bar is measured.
- If the Interference prevention function is used, the FOCUS monitor is treated as focus NG.
- This is not available on LS-9120M, LS-9006D and LS-9030D. If used, it will be recognized as focus NG.



● For LS-9006/LS-9006M

Focus value	Target position X
+9	+2.7 mm < X ≤ +3.0 mm
+8	+2.4 mm < X ≤ +2.7 mm
+7	+2.1 mm < X ≤ +2.4 mm
+6	+1.8 mm < X ≤ +2.1 mm
+5	+1.5 mm < X ≤ +1.8 mm
+4	+1.2 mm < X ≤ +1.5 mm
+3	+0.9 mm < X ≤ +1.2 mm
+2	+0.6 mm < X ≤ +0.9 mm
+1	+0.3 mm < X ≤ +0.6 mm
0	-0.3 mm < X ≤ +0.3 mm
-1	-0.6 mm ≤ X < -0.3 mm
-2	-0.9 mm ≤ X < -0.6 mm
-3	-1.2 mm ≤ X < -0.9 mm
-4	-1.5 mm ≤ X < -1.2 mm
-5	-1.8 mm ≤ X < -1.5 mm
-6	-2.1 mm ≤ X < -1.8 mm
-7	-2.4 mm ≤ X < -2.1 mm
-8	-2.7 mm ≤ X < -2.4 mm
-9	-3 mm ≤ X < -2.7 mm

● For LS-9030/LS-9030M

Focus value	Target position X
+9	+13.5 mm < X ≤ +15 mm
+8	+12 mm < X ≤ +13.5 mm
+7	+10.5 mm < X ≤ +12 mm
+6	+9 mm < X ≤ +10.5 mm
+5	+7.5 mm < X ≤ +9 mm
+4	+6 mm < X ≤ +7.5 mm
+3	+4.5 mm < X ≤ +6 mm
+2	+3 mm < X ≤ +4.5 mm
+1	+1.5 mm < X ≤ +3 mm
0	-1.5 mm < X ≤ +1.5 mm
-1	-3 mm ≤ X < -1.5 mm
-2	-4.5 mm ≤ X < -3 mm
-3	-6 mm ≤ X < -4.5 mm
-4	-7.5 mm ≤ X < -6 mm
-5	-9 mm ≤ X < -7.5 mm
-6	-10.5 mm ≤ X < -9 mm
-7	-12 mm ≤ X < -10.5 mm
-8	-13.5 mm ≤ X < -12 mm
-9	-15 mm ≤ X < -13.5 mm

■ Acquiring received light waveforms

This instrument acquires received light waveforms from the head and shows them in the received light waveform display area.

Reference
- The items for which the check boxes ☑ of [Edge detection threshold] and [Mask setting] are selected appear in the received light waveform display area.
- After acquiring received light waveforms, you can change the thresholds and mask positions by dragging the tag of [T1], [T2], [M1] and/or [M2] being displayed in the received light waveform area.

● One-time acq waveforms

Received light waveforms are acquired once and shown in the received light waveform display area.

● Continuous acq waveforms

Received light waveforms are acquired continuously and periodically, and shown in the received light waveform display area.

● Overwrite waveforms

Received light waveforms can be overwritten by selecting this check box ☑.

■ Calibration of received light intensity

This button performs calibration of received light intensity.
Perform this calibration in cases where the transmitter and receiver are used with those removed from the TR base and the transmitter and receiver get soiled with time due to contamination.
Clicking the button makes the [Calibration of received light intensity] dialog to appear.
Perform calibration of received light intensity without a target to be measured between the receiver and transmitter.

● Perform calibration of received light intensity

This button allows the calibration of received light intensity to run.
Click the [OK] button in the dialog indicating completion of received light intensity calibration that appears after execution to restore the [Calibration of received light intensity] dialog.

● Return calibration of received light intensity to the factory setting

This button returns the calibration of received light intensity to the factory setting.
Click the [OK] button in the dialog indicating restoration of received light intensity calibration to the factory-setting that appears after execution to restore the [Calibration of received light intensity] dialog.

Basic Operations of LS-Navigator2

Setting edge detection

1. Select a head where to set edge detection.
   The edge detection settings of a selected head are displayed to the right of the [Edge detection] area.
2. Acquire the received light waveform as necessary.
3. Set edge detection thresholds.

Reference
- After acquiring the received light waveform, you can change the threshold(s) by dragging and dropping the tag of [T1] and/or [T2] being displayed in the received light waveform area.
- The line and tag in the threshold(s) of which the check box ☑ has been selected will appear in the received light waveform display area.

4. Set mask settings.
5. Set the Check No. of edges function.
6. Enter FOCUS monitor data.

Acquiring received light waveforms

1. Click the [Continuous acq waveforms] button or [One-time acq waveforms] button.
2. Select the check box of the [Overwrite waveforms] button as necessary.

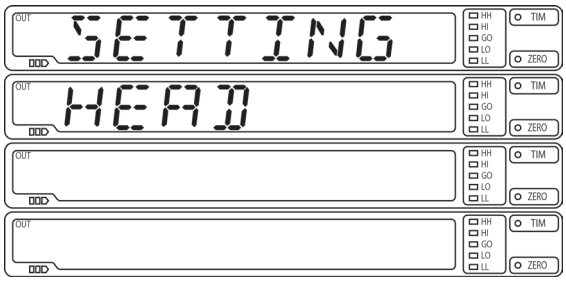
Performing calibration of received light intensity

1. Click the [Calibration of received light intensity] button.
   The [Calibration of received light intensity] dialog appears.
2. Click the [Perform calibration of received light intensity] button or [Return calibration of received light intensity to the factory setting] button.
   Message “Under calibration of received light intensity” appears on the Main window.
3. Click the [OK] button.
4. Click the [Close] button.

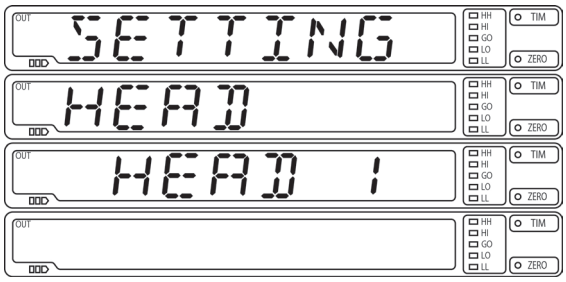
Display Panel Setting Method

Edge detection setup

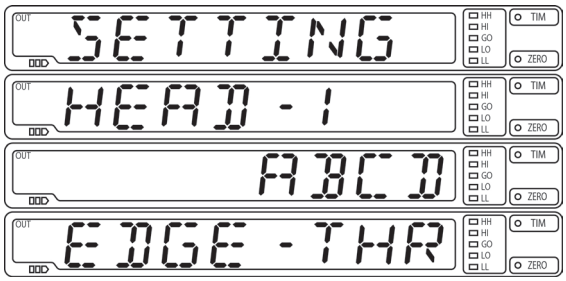
1. Press the [0] key after pressing the [FUNC] key, select [HEAD] and then press the [ENT] key.
   The setting item selection screen appears.



2. Select the HEAD number for which to perform setting, then press the [ENT] key.



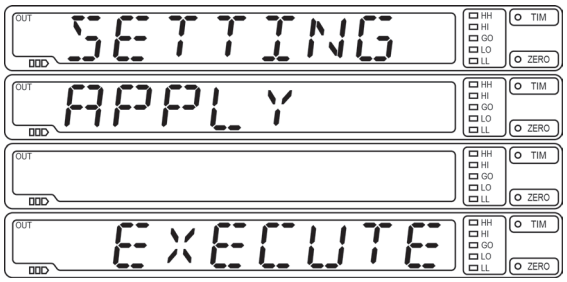
3. Perform setting for any purpose.
   Refer to the following items:



A: EDGE-THRE (Edge detection threshold)
B: MASK (Mask setting)
C: EDGE-CHK (Check No. of edges)
D: FOCUS-M (FOCUS monitor)

4. Press the [ESC] key to display the setting item selection screen.
5. Select [APPLY] by pressing the [▲] or [▼] key, then press the [ENT] key.

6 When [EXECUTE] appears, press the [ENT] key.

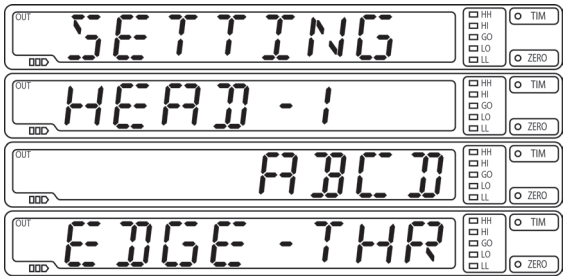


When [COMPLETE] appears, the setting operation is completed.

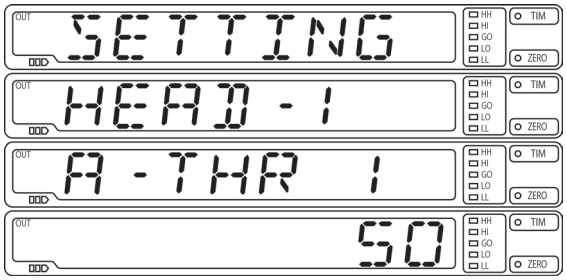
Setting edge detection

1 Select [EDGE-THR], then press the [ENT] key.

“Edge detection setup” (page 5-68)

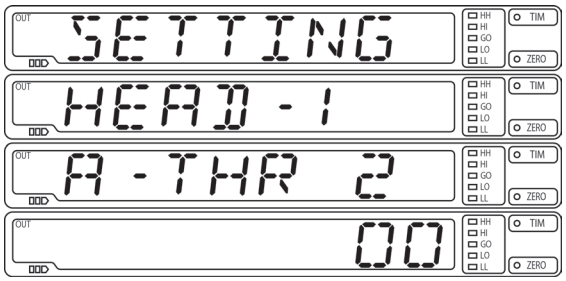


2 Set edge detection thresholds. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



The Threshold B setting screen appears.

3 Set edge detection thresholds. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

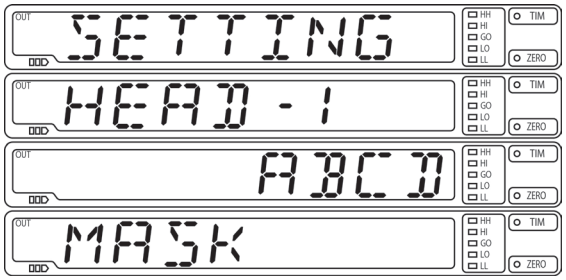


The Function selection screen appears.

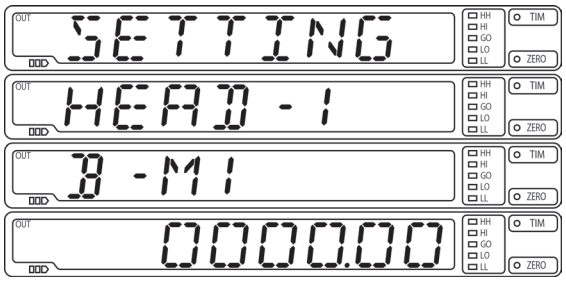
Setting a mask range

1 Select [MASK], then press the [ENT] key.

“Edge detection setup” (page 5-68)



2 Select [ENABLE] by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



3 Set a value of mask M1. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

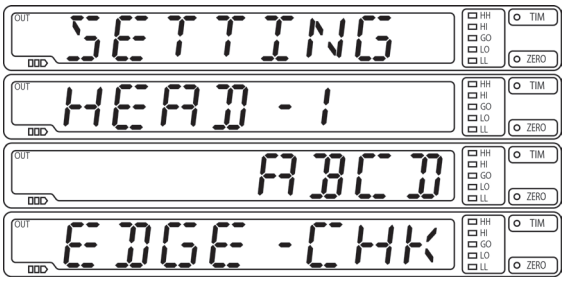
4 Set a value of mask M2. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

The Function selection screen appears.

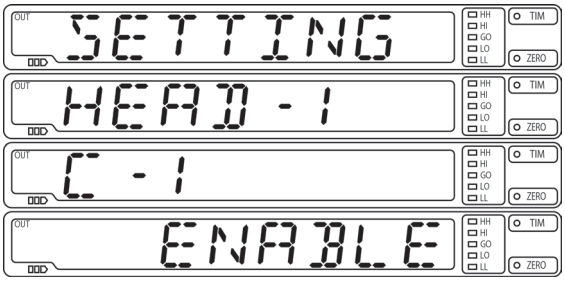
Setting the Check No. of edges function

1 Select [EDGE-CHK], then press the [ENT] key.

“Edge detection setup” (page 5-68)

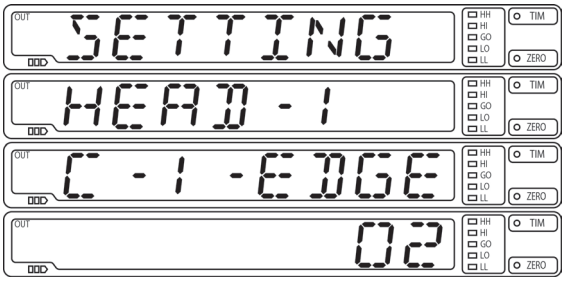


2 Select [ENABLE] by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



The Set No. of edges screen appears.

3 Set the number of edges. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

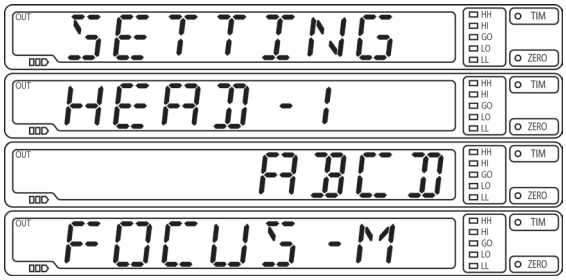


The Function selection screen appears.

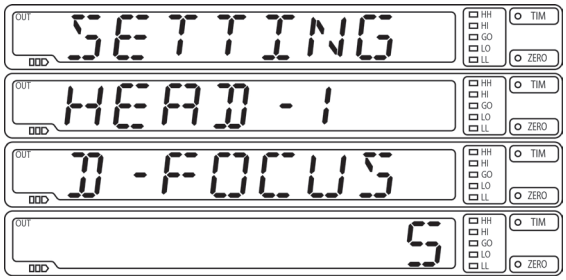
Setting FOCUS monitor

1 Select [FOCUS monitor] setup, then press the [ENT] key.

“Edge detection setup” (page 5-68)



2 Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key,then press the [ENT] key.

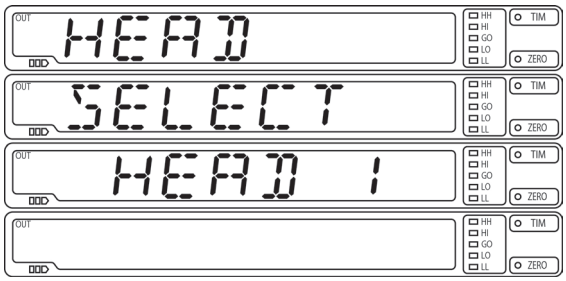


The Function selection screen appears.

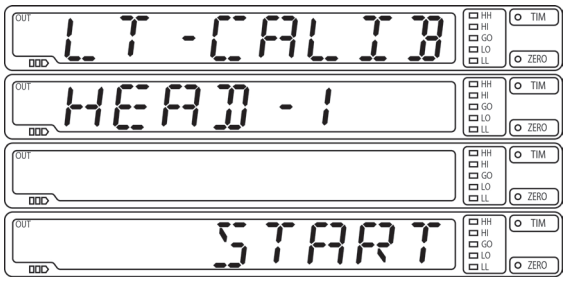
Performing calibration of received light intensity

1 Press the [FUNC] key, then press the [-] key.
The [Calibration of received light intensity] screen appears.

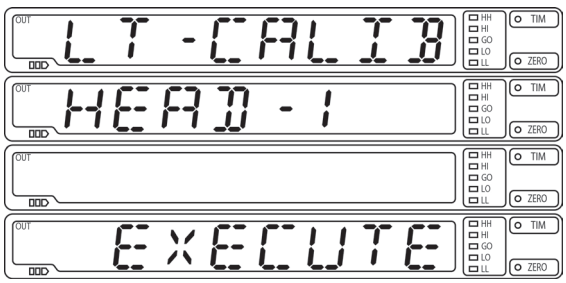
2 Select a head number by pressing the [▲] or [▼] key, then press the [ENT] key.



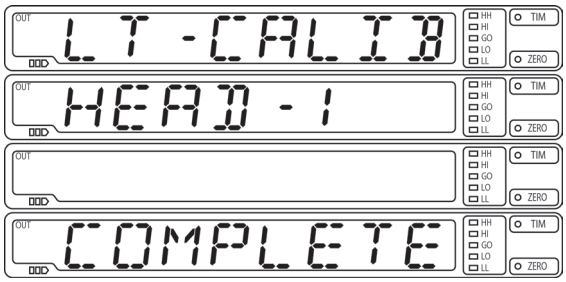
3 Select [START] by pressing the [▲] or [▼] key, then press the [ENT] key.
Check that no fixture or target exists within the measuring range.



4 Select [EXECUTE] by pressing the [▲] or [▼] key, then press the [ENT] key.



This executes calibration of received light intensity.
After execution the Completion screen appears.

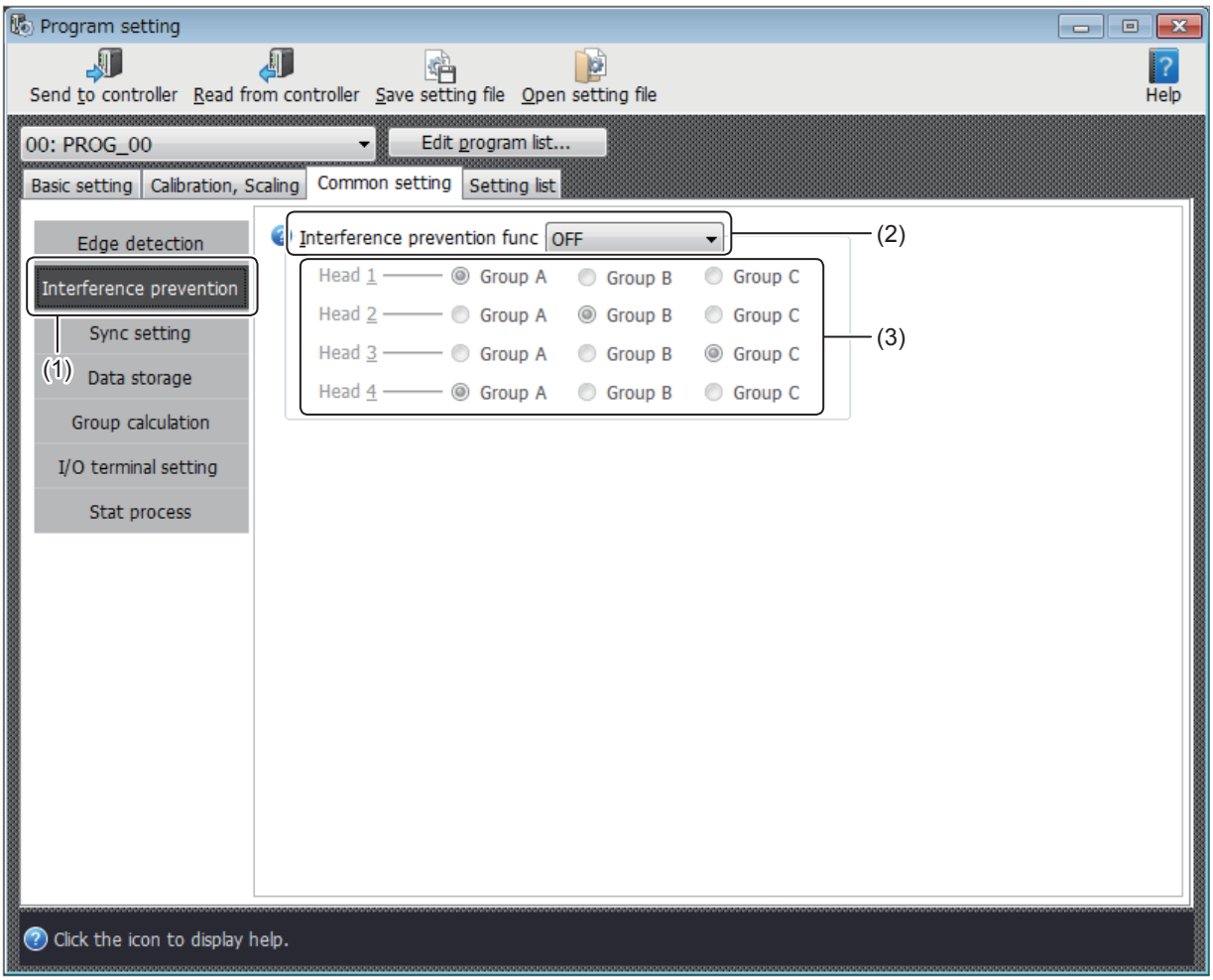


5 Press the [ENT] key.
The Measurement screen appears.

[Common setting] Tab: Interference Prevention

Select the [Common setting] tab in the [Program setting] screen to display the common settings.
Click the [Interference prevention] button to display the [Interference prevention] area, and then perform interference prevention setting.
If multiple heads are used concurrently and if LED light emitted from each head comes into other heads, an error may be observed in measurement data. This function is used to prevent such measuring errors.

[Interference prevention] area



No.	Name	Description
(1)	[Interference prevention] button	Use this button to display the [Interference prevention] area.
(2)	[Interference prevention func] drop-down list	This list is used to select a type of interference prevention function.
(3)	[Head-Group] setting	Specify a group to which each head belongs.

Interference prevention function

This function shifts the timing of light emission of multiple heads to be used by dividing them into 2 or 3 groups. Use this function if LED light from the heads interferes with each other and adversely affects measurements.

Reference
- Heads classified in the same group emit light in the same timing.
- If another setting item is selected from the drop-down list, the entered grouping settings are cleared.
  When this item is selected again, grouping settings return to the default values.
- If the Interference prevention function is used, position measurement data between the transmitter and receiver always becomes output waiting data.

■ AB-ON

The measurement timing is divided into 2 groups.
Divide multiple heads into 2 groups of group A and group B.
Click and select one of group name radio buttons to which each head is grouped.

■ ABC-ON

The measurement timing is divided into 3 groups.
Divide multiple heads into 3 groups of group A, group B, and group C.
Click and select one of group name radio buttons to which each head is grouped.

Reference A sampling frequency varies depending on the number of OUTs to use and interference prevention function setting.

Number of OUTs to use	Interference prevention function		
	OFF	AB-ON	ABC-ON
1 to 4	62.5	125	187.5
5 to 12	125	125	187.5
13 to 16	187.5	250	187.5

Unit:μs

Basic Operations of LS-Navigator2

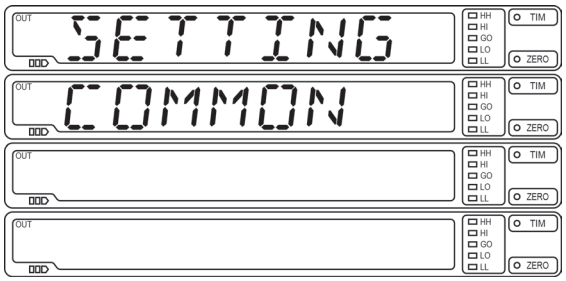
1 Select interference prevention function.

2 Group multiple heads.

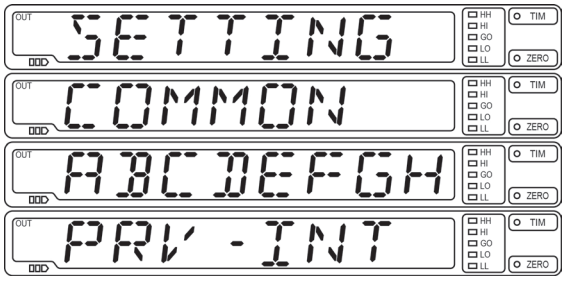
Display Panel Setting Method

1 Press [FUNC] key, then press [0] key.
Select settings screen appears.

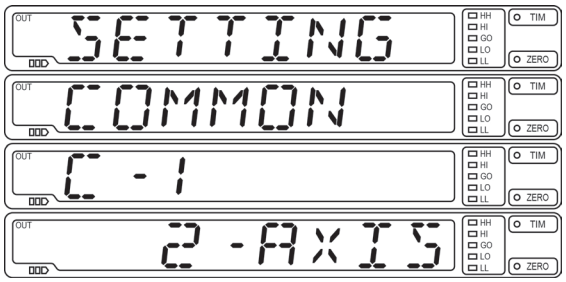
2 Select [COMMON] by pressing the [▲] or [▼] key, then press the [ENT] key.



3 Select [PRV-INT] by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

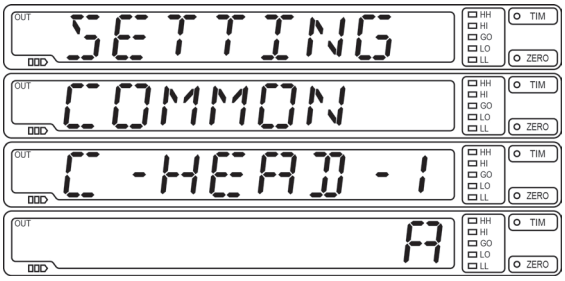


4 Select the number of axes by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



[2-AXIS] AB-ON
[3-AXIS] ABC-ON

5 Assign HEAD-1 to a group by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



Values that can be set in the Group setting screen differ depending on the selected head grouping.

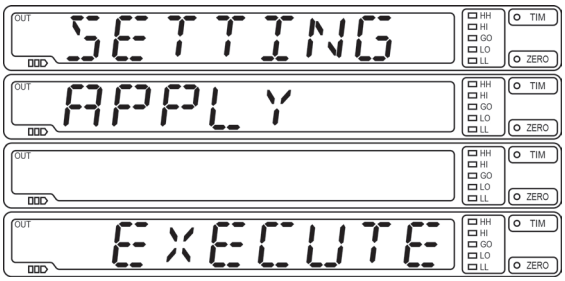
	2-AXIS	3-AXIS
Initial value	HEAD1: A HEAD2: B HEAD3: A HEAD4: B	HEAD1: A HEAD2: B HEAD3: C HEAD4: A
Setting value	A, B	A, B, C

6 Apply the same settings in procedure 5 to HEAD-2 to HEAD-4.

7 Press the [ESC] key, the settings screen appears.

8 Select [APPLY] by pressing the [▲] or [▼] key, then press the [ENT] key.

9 Press the [ENT] key when [EXECUTE] appears.

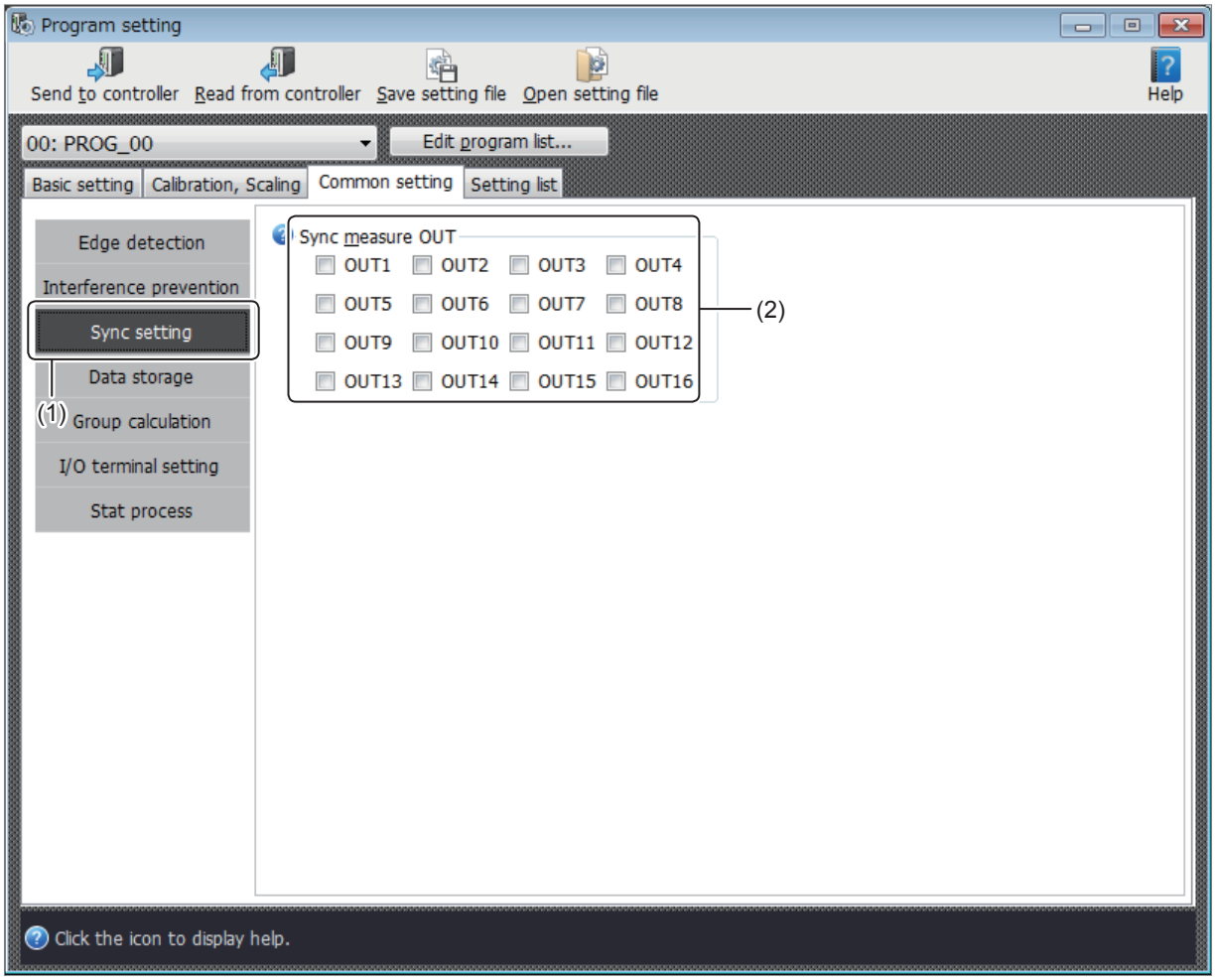


The process is complete when [COMPLETE] is displayed.

[Common setting] Tab: Sync Setting

Select the [Common setting] tab in the [Program setting] screen to display the common settings.
Click the [Sync setting] button to display the [Sync setting] area, and then perform synchronization setting.

[Sync setting] area



No.	Name	Description
(1)	[Sync setting] button	Use this button to display the Sync setting area.
(2)	[Sync measure OUT] check box	Select Sync measure outputs for which timing synchronization is enabled.

Sync measure target

Select target outputs (from among OUT1 to OUT16) for which sync timing, sync zero, and sync reset are enabled.
The sync signals can be entered from the external terminal, display panel, RS-232C, and LS-Navigator2.

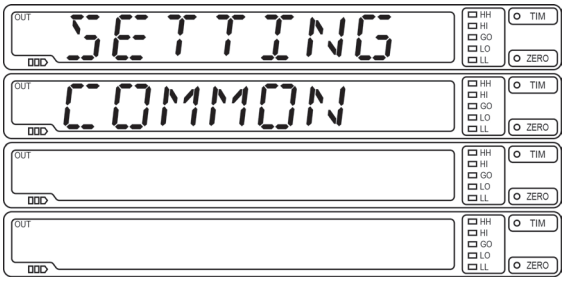
Basic Operations of LS-Navigator2

1 Select outputs to be a target for the TIMING sync processing.

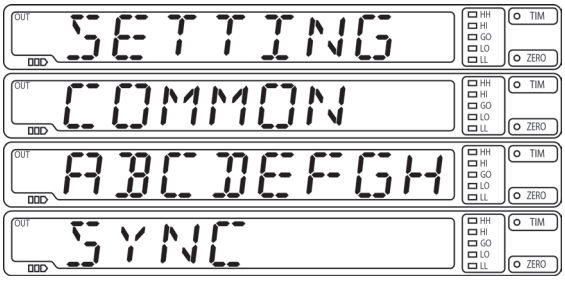
Display Panel Setting Method

1 Press the [FUNC] key, then press the [0] key.

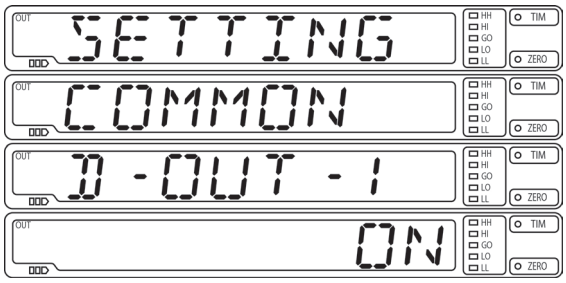
2 Select [COMMON] by pressing the [▲] or [▼] key, then press the [ENT] key.



3 Select [SYNC] by pressing the [◀] or [▶] key, then press the [ENT] key.



4 Select [ON] by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



Then, the OUT setting screen appears.

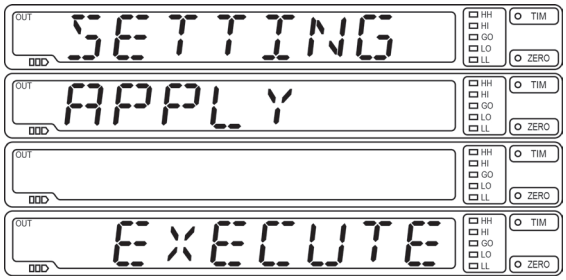
Reference Only the outputs for which any sync setting is currently enabled are displayed in the OUT setting screen.

5 Select Sync measure outputs for which timing synchronization is enabled by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.
When setting of all targeted outputs has been finished, the Function selection screen appears.

6 Display the select setting items screen by pressing the [ESC] key.

7 Select [APPLY] by pressing the [▲] or [▼] keys, then press the [ENT] key.

8 When [EXECUTE] is displayed, press the [ENT] key.

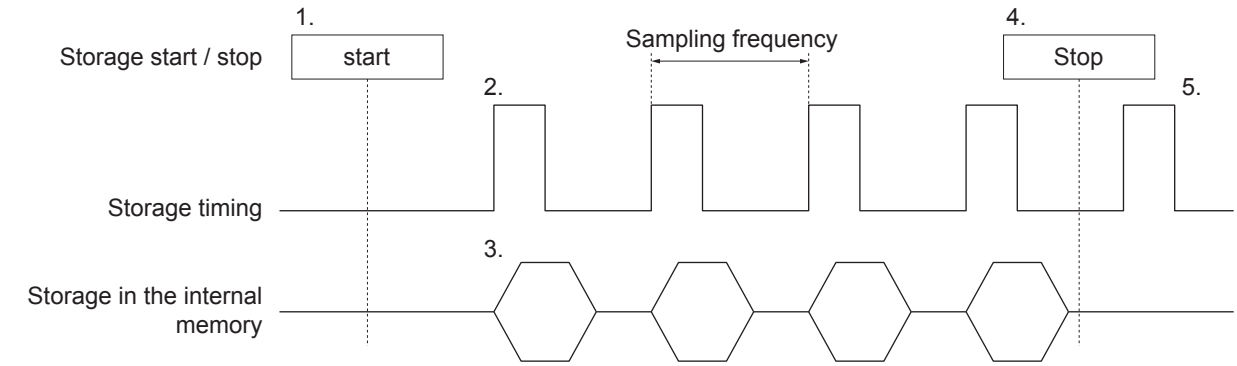


The setting is complete when [COMPLETE] is displayed.

[Common setting] Tab: Data Storage

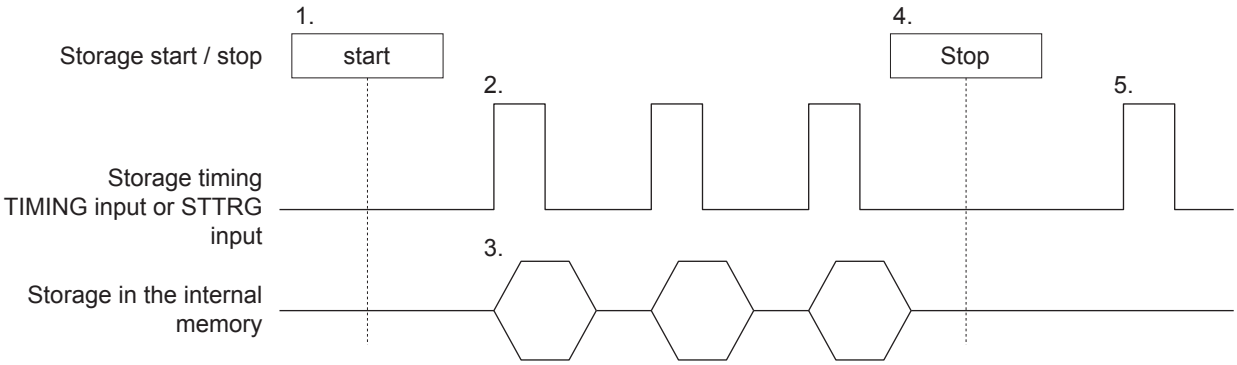
Select the [Common setting] tab in the [Program setting] screen to display the common settings.
Click the [Data storage] button to display the [Data storage] area, and then perform data storage setting.

■ In case of storage cycle “x1”



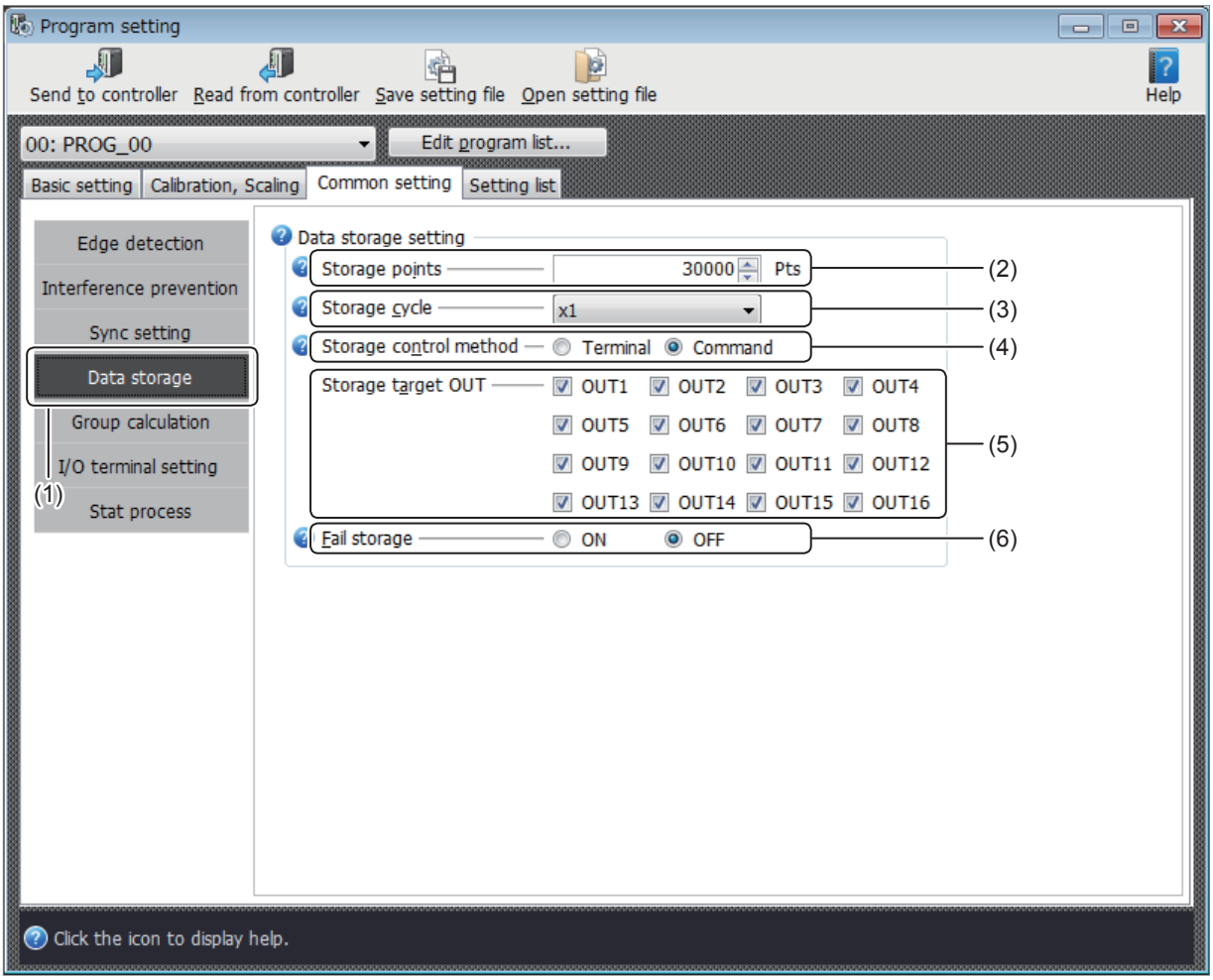
1. Storage starts according to the [storage start condition].
2. A measurement value to be stored is determined for each [sampling frequency].
3. A measurement result is stored in the internal memory.
4. Storage stops according to the [storage stop condition].
5. No measurement value is stored under the stop condition.

■ In case of storage cycle “TIMING sync” or “Storage trg sync”



1. Storage starts according to the [storage start condition].
2. A measurement value to be stored is determined according to the [TIMING input].
   TIMING1 input, input from the RS232C interface, and TIM button entry of LS-D1000 are available as TIMING input.
3. A measurement result is stored in the internal memory.
4. Storage stops according to the [storage stop condition].
5. No measurement value is stored under the stop condition.

[Data storage] area



No.	Name	Description
(1)	[Data storage] button	Use this button to display the data storage area
(2)	[Storage points] setting	Input the number of points to be stored in data storage.
(3)	[Storage cycle] drop-down list	Select a storage cycle to be stored in data storage.
(4)	[Storage control method] radio buttons	Select a method to control storage.
(5)	[Storage target OUT] check boxes	Select outputs (from among OUT1 to OUT16) where to store measurement data.
(6)	[Fail storage] radio buttons	Select a setting for fail storage.

Data storage

Set up a method of storing measurement data in the internal memory of this main unit.
With LS-Navigator2, retrieving and analyzing stored data, outputting them to an Excel file, etc. are available.
You can use 4 types of timing in which measurement data is stored.
The following data is stored.

- Measurement value
- Judgment value
- Pulse count value
- Time

Since the storage data is saved for each program, switching programs will not clear the storage data saved before the switch.
Also, the storage data clear instruction by LS-Navigator2, etc. will only clear the storage data stored in the currently used program.

● Storage start condition

- The STEN terminal is turned from OFF to ON.
- A storage start command is received.
- The storage start command from LS-Navigator2 is received.

● Storage stop condition

- A specified number of points of data are stored.
- The STEN terminal is turned from ON to OFF.
- A storage stop command is received.
- The storage stop command from LS-Navigator2 is received.

● Storage data clear condition

- The STCLR terminal inputs a command under the storage stop condition.
- The Setting reflection command is transmitted.
- Clearing stored data from LS-Navigator2
- Operation to restore factory-setting is performed.
- Power is turned OFF.

■ Storage points

Set the number of points of measurement data to be stored by the Data storage function.

Setting range: 1 to 400,000 points

■ Storage cycle

Select a type of timing to store measurement data.

Reference Start data storage setting to store measurement data.

● Multiples of sampling frequency

Data is stored in a frequency of a selected multiple of sampling frequency.
Setting range: x1, x2, x5, x10, x20, x50, x100, x200, x500, x1000

Reference If the data update cycle is longer than a selected storage cycle, the same data is stored until it is updated.

● TIMING sync

Measurement data is stored in synchronization with TIMING signal input.

Reference Measurement data is stored in all OUTs selected with “Storage target OUT” check boxes in timing for TIMING signal input.

● 1sec

Storage target OUT data is stored every second (1 sec).

● Storage trg sync

Updated data is stored in timing for STTRG terminal input or instruction by the communication command.

■ Storage control method

This setting specifies the method of data storage start, stop and clear.

● Terminal

Data storage is started when the SREN terminal is ON and stopped when it is OFF.
“I/O Terminal Names and Functions” (page 8-7)

● Command

Commands from LS-Navigator2 or via RS-232C communication are used.
“RS-232C interface commands” (page 9-2)

■ Storage target OUT

Select outputs (from among OUT1 to OUT16) where to store measurement data.

■ Fail storage

Measurement data is stored only if a total judgment result is not “GO”,
“Total judgment setting” (page 5-97)

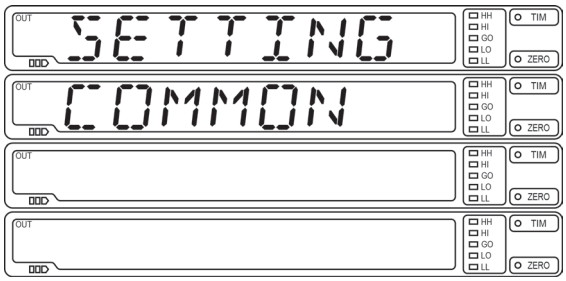
Basic Operations of LS-Navigator2

1. Enter the number of points of data to be stored in the Storage points box.
2. Select a storage cycle from the drop-down list.
3. Select one of the storage control methods.
4. Select storage target outputs (from among OUT1 to OUT16).
5. Select a setting for fail storage.

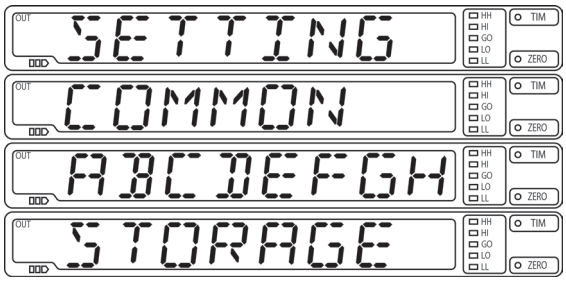
Display Panel Setting Method

Setting data storage

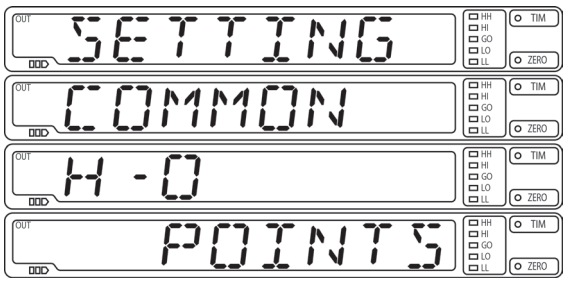
1. Press the [FUNC] key, then press the [0] key.
   The setting item selection screen appears.
2. Select [COMMON] by pressing the [▲] or [▼] key, then press the [ENT] key.



3. Select [STORAGE] by pressing the [◀] or [▶] key, then press the [ENT] key.



4. Perform setting for any purpose.
   Refer to the following items:

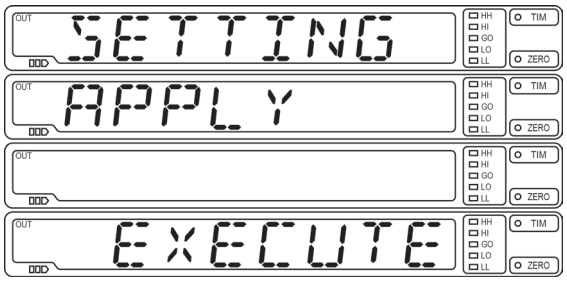


H-0: POINTS (Storage points)
H-1: CYCLE (Storage cycle)
H-2: CONTROL (Storage control method)
H-3: OUT (Setting storage target OUT)
H-4: NG-STRG (Fail storage)

5. Press the [ESC] key to display the setting item selection screen.

6 Select [APPLY] by pressing the [▲] or [▼] key, then press the [ENT] key.

7 When [EXECUTE] appears, press the [ENT] key.

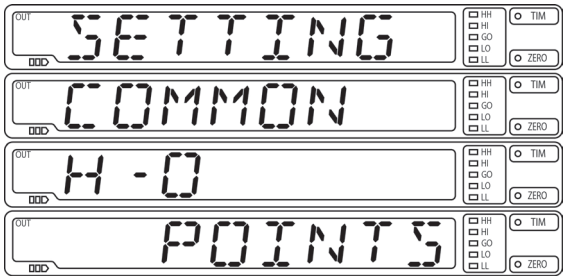


When [COMPLETE] appears, the setting operation is completed.

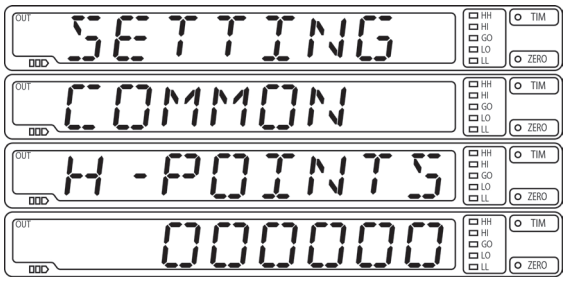
Setting storage points

1 Select [POINTS], then press the [ENT] key.

“Setting data storage” (page 5-80)



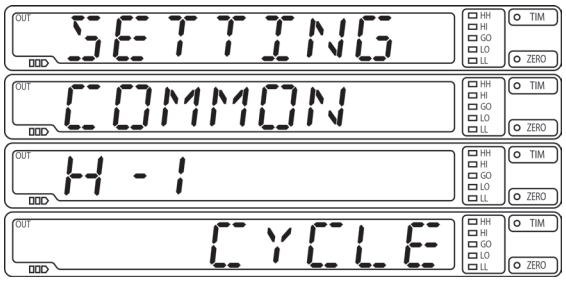
2 Enter the number of points of data to be stored. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



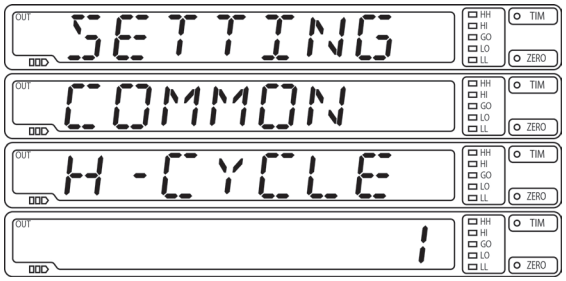
Setting storage cycle

1 Select [CYCLE], then press the [ENT] key.

“Setting data storage” (page 5-80)



2 Select a storage cycle by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

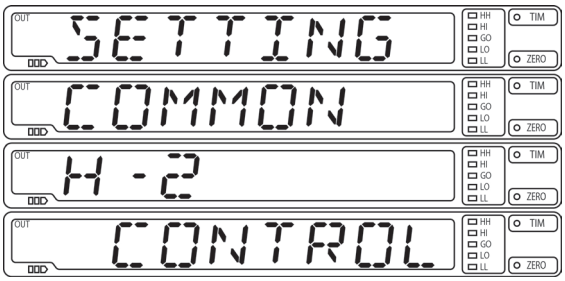


Setting range: 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 1SEC, TIM-SYNC, TRG-SYNC

Setting storage control

1 Select [CONTROL], then press the [ENT] key.

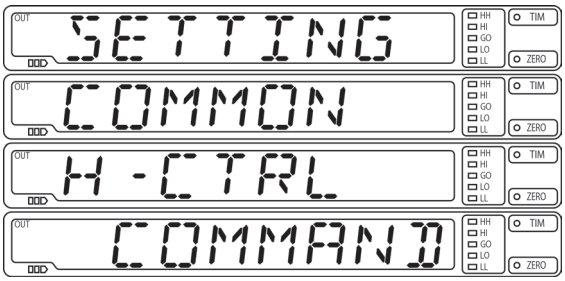
“Setting data storage” (page 5-80)



2 Select a storage control method by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

Storage control methods that can be set are as follows.

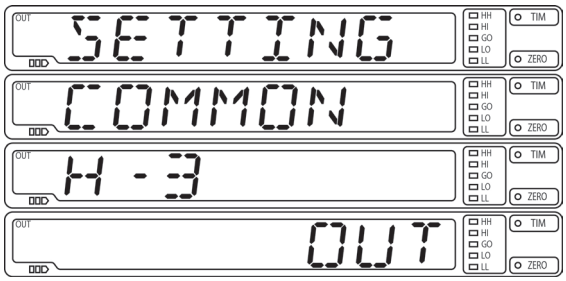
- COMMAND (Control with a command)
- TERMINAL (Terminal control)



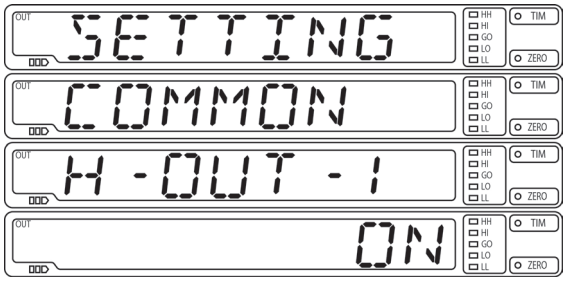
Setting storage target OUT

1 Select [OUT], then press the [ENT] key.

“Setting data storage” (page 5-80)



2 Select [ON] with the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

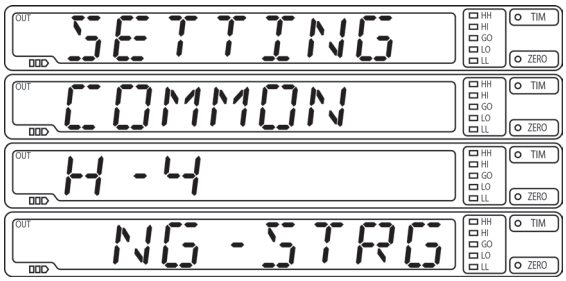


Perform the same setting as used in OUT1 for OUT2 to OUT16.

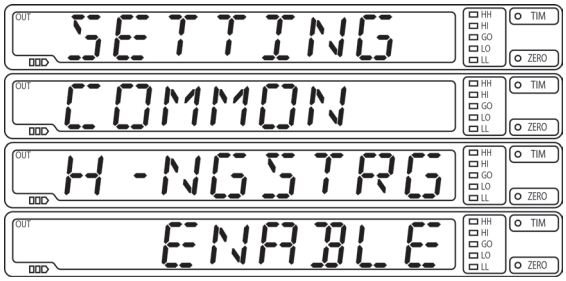
Setting fail storage

1 Select [NG-STRG], then press the [ENT] key.

“Setting data storage” (page 5-80)

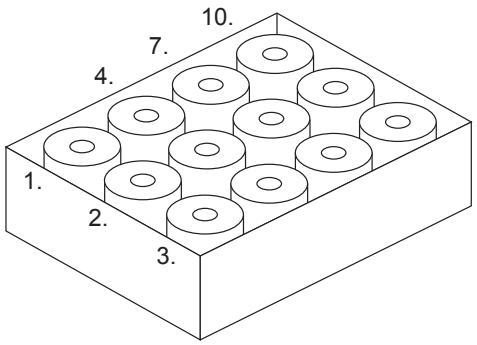


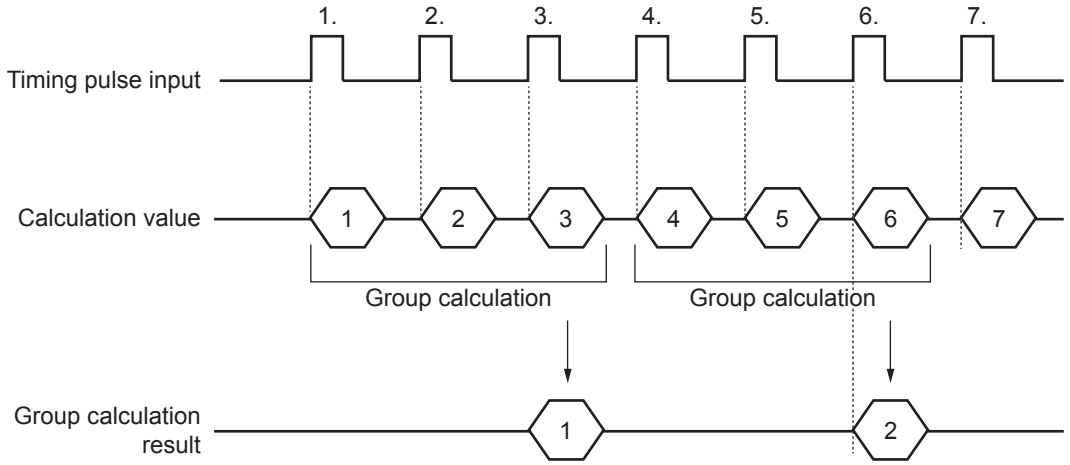
2 Select [ENABLE] with the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



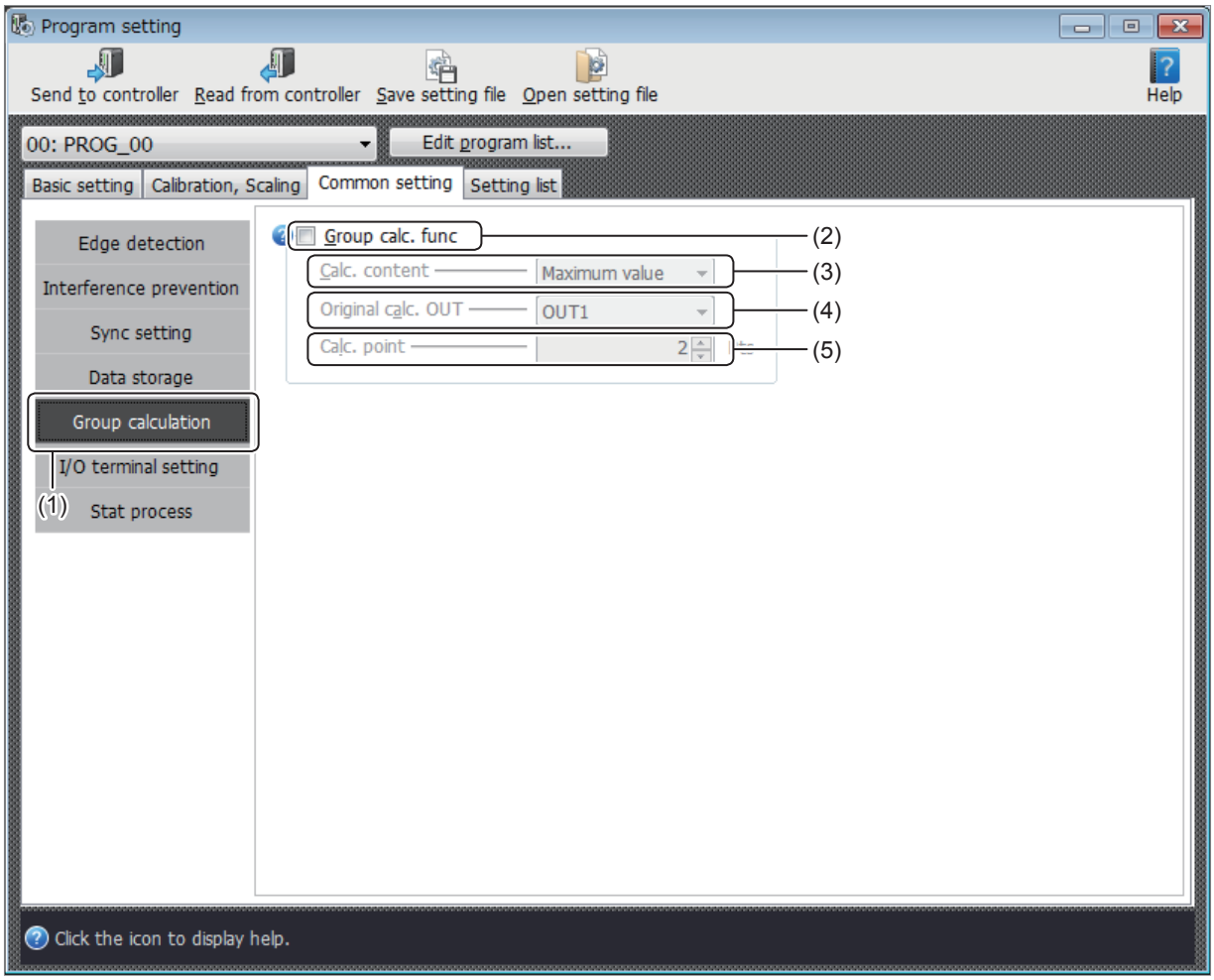
[Common setting] Tab: Group Calculation

Select the [Common setting] tab in the [Program setting] screen to display the common settings.
Click the [Group calculation] button to display the [Group calculation] area and then perform group calculation setting.
An average value, maximum value and others are calculated from measurement values of a group consisting of multiple targets to be measured. Based on these values, GO/NG judgment is performed. A group calculation result is displayed in OUT16.





[Group calculation] area



No.	Name	Description
(1)	[Group calculation] button	Use this button to display the [Group calculation] area.
(2)	[Group calc. func] check box	Select this check box to use the Group calculation function.
(3)	[Calc. content] drop-down list	Select a calculation processing content from this list.
(4)	[Original calc. OUT] drop-down list	Select an original calculation OUT from this list.
(5)	[Calc. point] setting	Enter the number of calculation points.

Group calculation

This function outputs the maximum value, average value, etc. of measurement data for the specified number of times. This function uses OUT16 to display a group calculation result. Apply this function when you measure multiple parts on the same target, make a GO/NG judgment from those results or GO/NG judgment on each lot of targets.

Reference

- The group calculation function uses measurement values that has been determined by TIMING input.
- Output waiting data is counted as one of calculation points, but measurement data is not used for calculation.
- While the group calculation function is being used, an auto-zero timing input to OUT16 is disabled.
- The group calculation function can not be switched ON when OUT 16 is being used.

■ Calc. content

Specify one of the following pieces of data to be outputted by the group calculation function.

● Maximum value

Outputs the maximum value from among pieces of data for the number entered in Calc. point setting.

● Minimum value

Outputs the minimum value from among pieces of data for the number entered in Calc. point setting.

● Maximum value - Minimum value

Outputs the maximum value minus minimum value from among pieces of data for the number entered in Calc. point setting.

● Average value

Outputs an average value from among pieces of data for the number entered in Calc. point setting.

■ Original calc. OUT

Select an original calculation OUT to be used for group calculation.

■ Calc. point

Specify the number of pieces of measurement data to be used for group calculation.

Basic Operations of LS-Navigator2

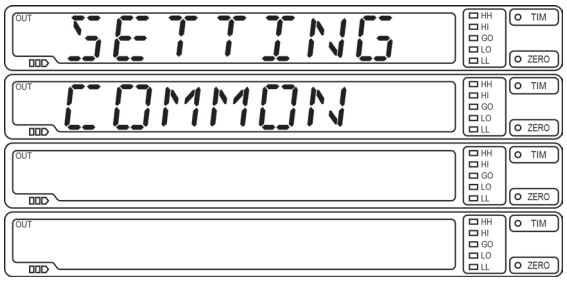
1. Enable the group calculation function by selecting the check box.
2. Select a calculation processing content from this list.
3. Select an original calculation OUT from this list.
4. Enter the number of calculation points.

Display Panel Setting Method

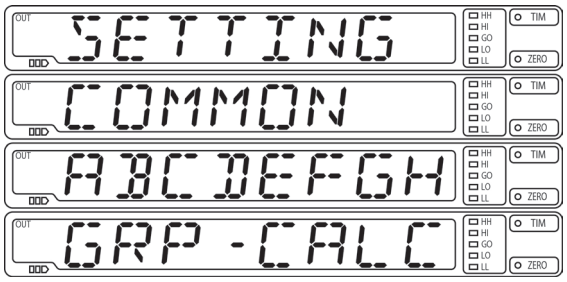
Setting group calculation

1 Press the [FUNC] key, then press the [0] key.
The setting item selection screen appears.

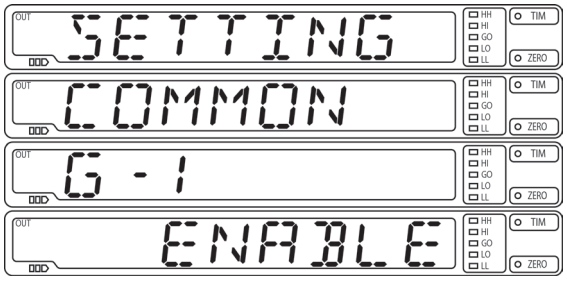
2 Select [COMMON] by pressing the [▲] or [▼] key, then press the [ENT] key.



3 Select [GRP-CALC], then press the [ENT] key.

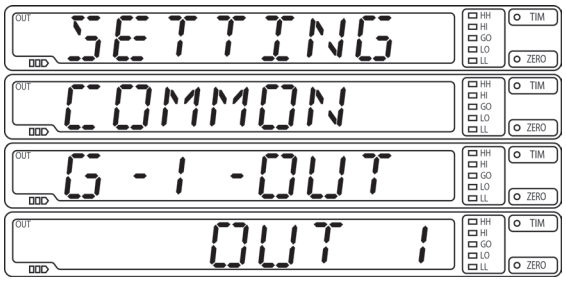


4 Select [ENABLE] by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



The group calculation target OUT selection screen appears.

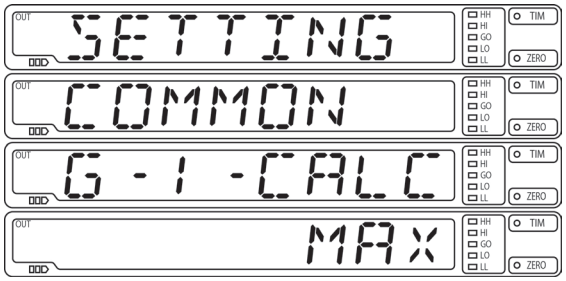
5 Select the target OUT number for a group calculation by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



Reference Select an OUT number to be available except for OUT16.

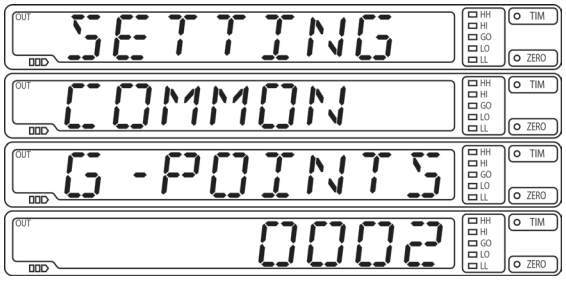
The group calculation item selection screen appears.

6 Select a calculation processing item by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



The group calculation point selection screen appears.

7 Enter the number of calculation points. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

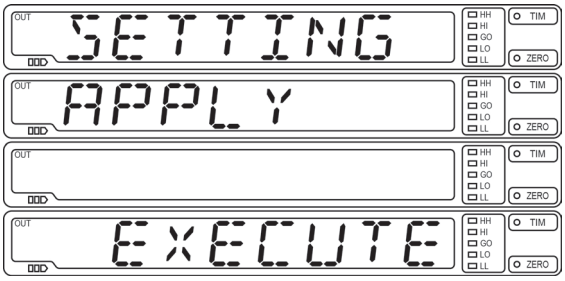


The Function selection screen appears.

8 Display the select setting items screen by pressing the [ESC] key.

9 Select [APPLY] by pressing the [▲] or [▼] keys, then press the [ENT] key.

10 When [EXECUTE] is displayed, press the [ENT] key.

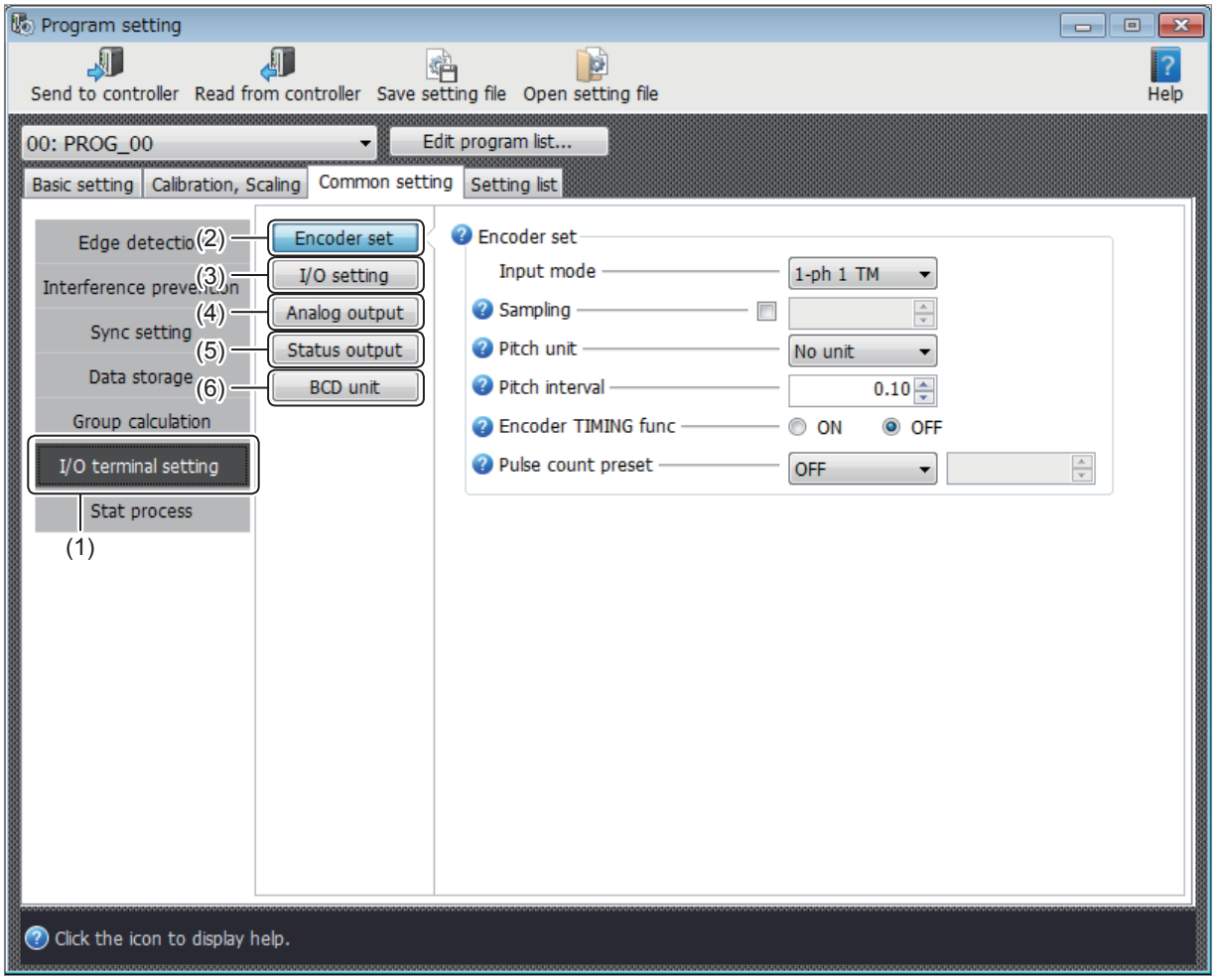


The setting is complete when [COMPLETE] is displayed.

[Common setting] Tab: I/O Terminal Setting

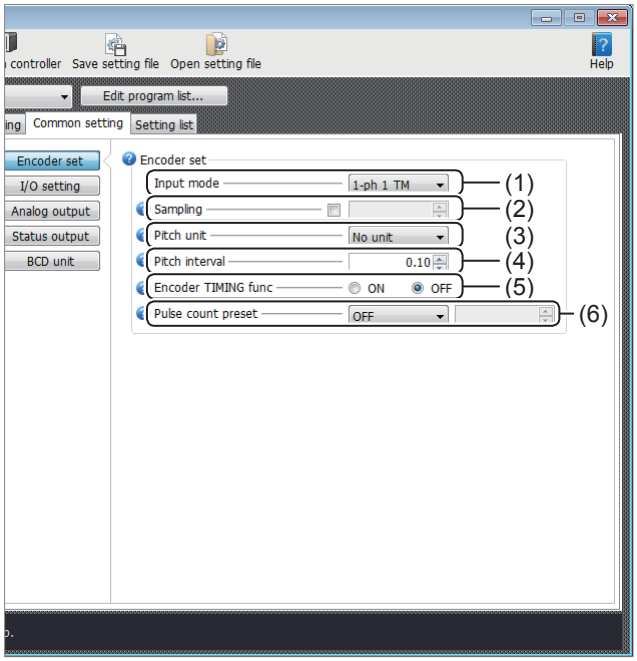
Select the [Common setting] tab in the [Program setting] screen to display the common settings.
Click the [I/O terminal setting] button to display the [I/O terminal setting] area and then perform I/O terminal setting.

[I/O terminal setting] area



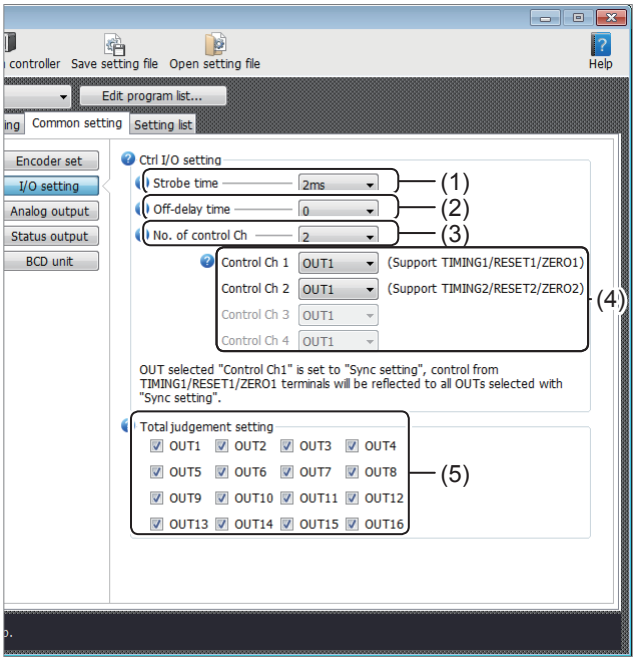
No.	Name	Description
(1)	[I/O terminal setting] button	Use this button to display the I/O terminal setting area.
(2)	[Encoder set] button	Use this button to display the Encoder set area.
(3)	[I/O setting] button	Use this button to display the I/O setting area.
(4)	[Analog output] button	Use this button to display the Analog output area.
(5)	[Status output] button	Use this button to display the Status output area.
(6)	[BCD unit] button	Use this button to display the BCD unit area.

[Encoder set] area



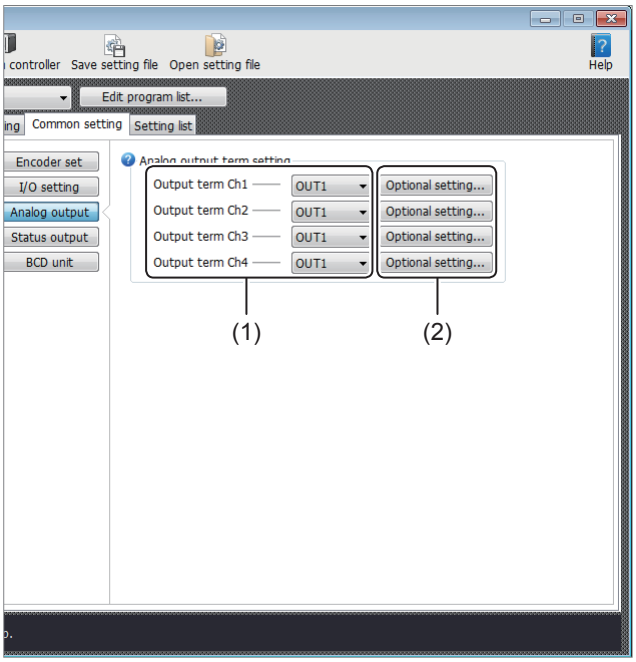
No.	Name	Description
(1)	[Input mode] drop-down list	Select an input mode of the encoder from this list.
(2)	[Sampling] setting	Enter the number of sampling points.
(3)	[Pitch unit] drop-down list	Select a pitch unit from this list.
(4)	[Pitch interval] setting	Enter a pitch interval by selecting from the list.
(5)	[Encoder TIMING func] radio button	Select encoder TIMING function.
(6)	[Pulse count preset] setting	Set the pulse count preset function.

[I/O setting] area



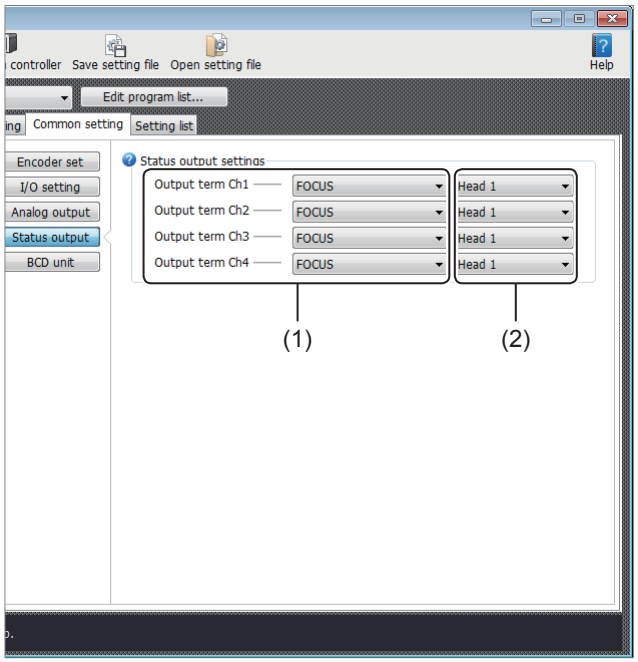
No.	Name	Description
(1)	[Strobe time] drop-down list	Select a strobe time from this list.
(2)	[Off-delay time] drop-down list	Select an off-delay time from this list.
(3)	[No. of control Ch] drop-down list	Select the number of control channels from this list.
(4)	[Control Chx] drop-down list	Select an OUT number where to output a judgment result and an OUT number where to reflect TIMING/ZERO/ RESET1 input.
(5)	[Total judgment setting] check boxes	Select outputs (OUT1 to OUT16) where to output a total judgment.

[Analog output] area



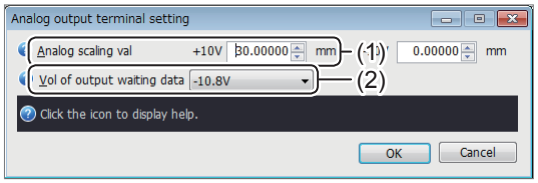
No.	Name	Description
(1)	[Output term Chx] drop-down list	Select an output (OUT1 to OUT16) where to output analog data from each output terminal.
(2)	[Optional setting] button	Use this button to display the [Analog output terminal setting] window.

[Status output] area



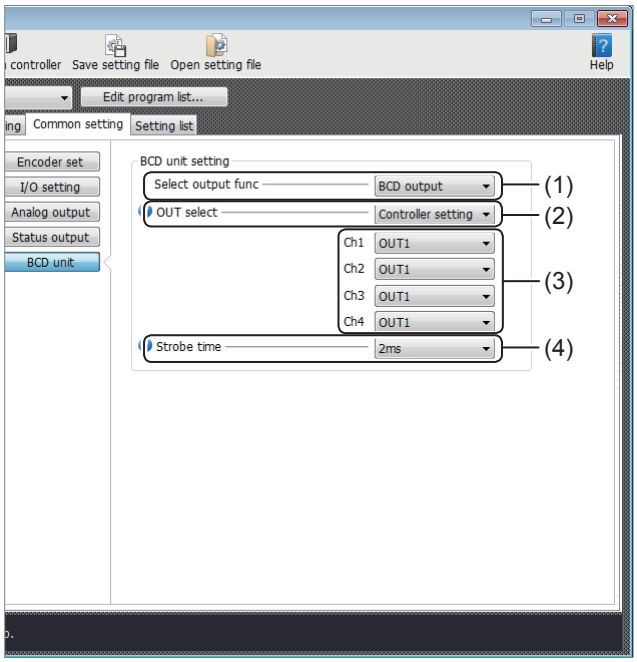
No.	Name	Description
(1)	[Output term Chx] drop-down list	Select a status to output from each output terminal.
(2)	[Head x] drop-down list	Select a head from this list.

[Analog output terminal setting] window



No.	Name	Description
(1)	[Analog scaling val] drop-down list	Select an analog scaling value from this list.
(2)	[Vol of output waiting data] drop-down list	Select a voltage of output waiting data from this list.

[BCD unit] area



No.	Name	Description
(1)	[Select output func] drop down list	Selects the signal type to be output from the output connector.
(2)	[OUT select] dropdown list	Select the OUT number selection method.
(3)	[Chx] drop down list	Select the OUT number.
(4)	[Strobe time] drop down list	Select the strobe time.

I/O terminal setting

Encoder set

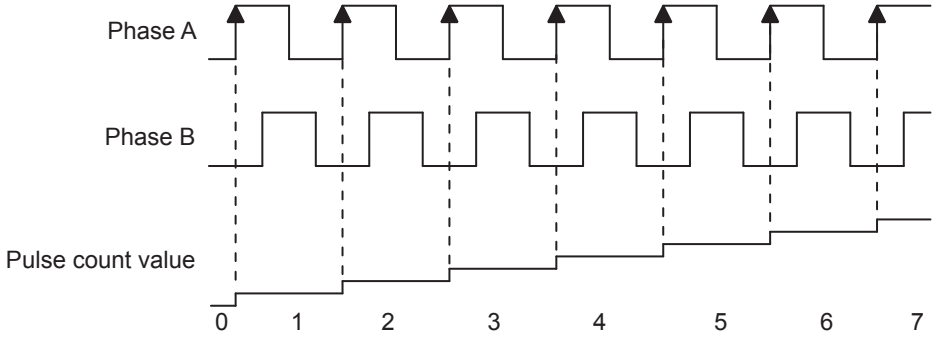
This is the function to use pulses inputted from the encoder for measurement.
This function inputs TIMING signals using input pulses (Encoder TIMING func) and stores measurement value by tying the number of pulses to a measurement value (Data storage func).
“[Common setting] Tab: Data Storage” (page 5-77)
“Pulse frequency error” (page 5-98)
“[Common setting] Tab: Sync Setting” (page 5-75)

■ Input mode

Select a method of updating a pulse count value from the pull-down list.

● 1-ph 1 TM

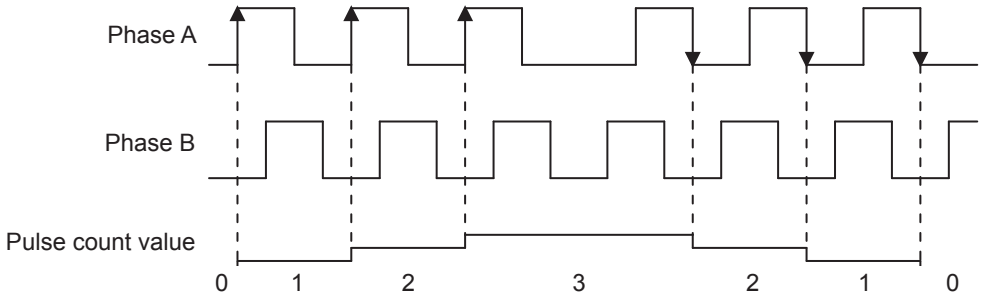
Irrespective of phase B pulse, signal input is recognized on the rising edge of phase A pulse, and a pulse count is counted up.



● 2-ph 1 TM

In case of phase B pulse OFF:
- Signal input is recognized on the rising edge of phase A pulse and a pulse count is counted up.
- Signal input is recognized on the falling edge of phase A pulse and a pulse count is counted down.

In case of phase B pulse ON, signal input is not recognized and a pulse count value will not be updated.



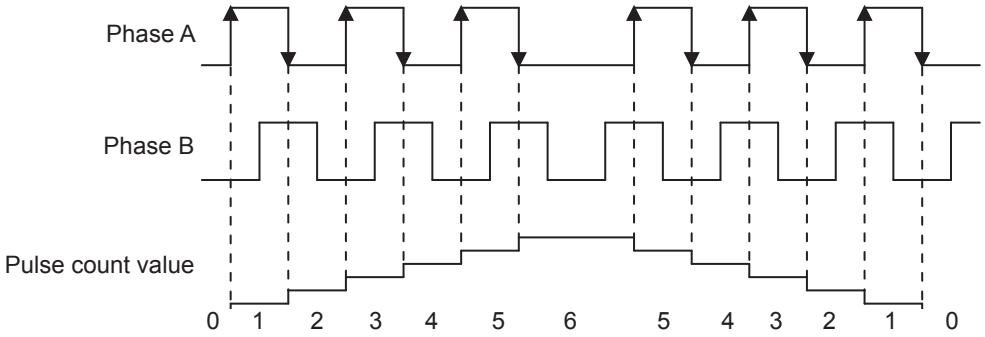
● **2-ph 2 TM**

In case of phase B pulse OFF:

- Signal input is recognized on the rising edge of phase A pulse and a pulse count is counted up.
- Signal input is recognized on the falling edge of phase A pulse and a pulse count is counted down.

In case of phase B pulse ON:

- Signal input is recognized on the rising edge of phase A pulse and a pulse count is counted down.
- Signal input is recognized on the falling edge of phase A pulse and a pulse count is counted up.



● **2-ph 4 TM**

In case of phase B pulse OFF:

- Signal input is recognized on the rising edge of phase A pulse and a pulse count is counted up.
- Signal input is recognized on the falling edge of phase A pulse and a pulse count is counted down.

In case of phase B pulse ON:

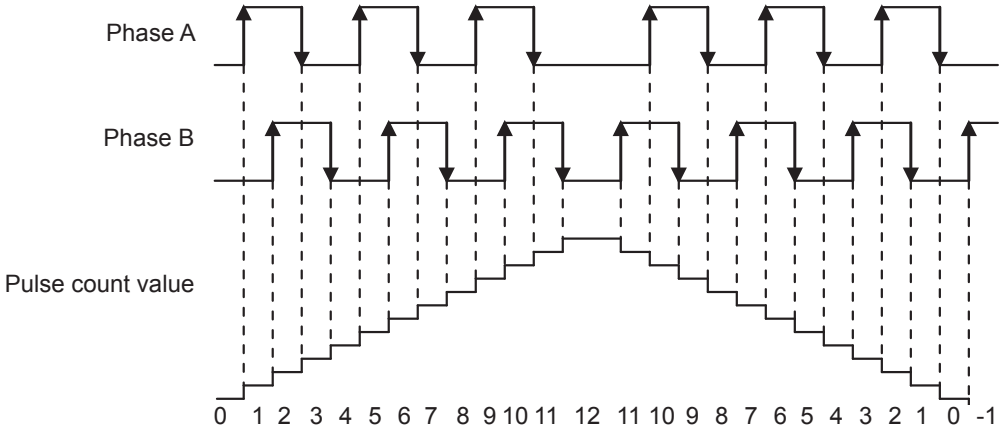
- Signal input is recognized on the rising edge of phase A pulse and a pulse count is counted down.
- Signal input is recognized on the falling edge of phase A pulse and a pulse count is counted up.

In case of phase A pulse OFF:

- Signal input is recognized on the rising edge of phase B pulse and a pulse count is counted down.
- Signal input is recognized on the falling edge of phase B pulse and a pulse count is counted up.

In case of phase A pulse ON:

- Signal input is recognized on the rising edge of phase B pulse and a pulse count is counted up.
- Signal input is recognized on the falling edge of phase B pulse and a pulse count is counted down.



■ Sampling

This is used in combination with the Encoder TIM function.
Specify a pulse count value necessary for inputting the TIMING signal once.

■ Pitch unit

This is used in combination with the Encoder TIM function.
This setting allows display of horizontal axis values in pitch unit when displaying measurement values with the Data storage function.
“Data storage” (page 5-79)

● **No unit**

No unit is set.

● **μm**

The unit of μm is used for the encoder.

● **mm**

The unit of mm is used for the encoder.

■ Pitch interval

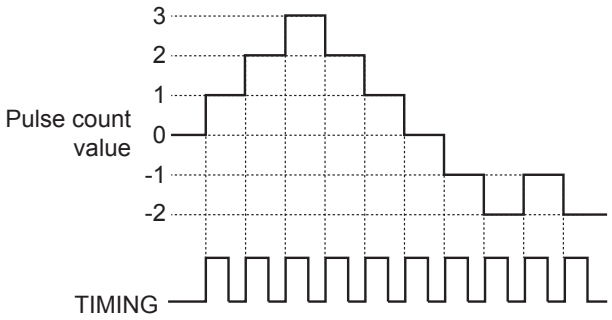
Shows the distance of the TIM interval of the encoder.

■ Encoder TIM func

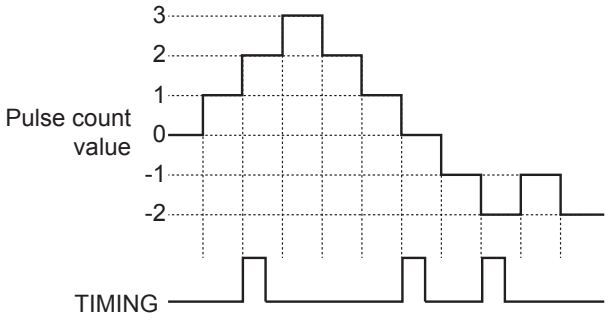
This is the function to convert a pulse input from the encoder, etc. to a TIM input.
A TIMING signal is turned ON every time a pulse count value is updated.
If sampling has been set up, a TIMING signal is turned ON when pulse count values change specified number of times since the encoder TIMING was ON last time.
If encoder TIMING is issued multiple times in a sampling frequency, a pulse frequency error will result and no pulse input is accepted.

Reference You can check whether a pulse frequency error occurs with the specified status output. When a pulse frequency error is output, the off-delay is disabled.

Sampling: None



Sampling: 2 times



Reference If the Encoder TIMING function is enabled, no TIMING input through the terminal or command will not be accepted.

■ Pulse count preset

This is the function to enter a pulse count value as a setting value upon Z-axis input of the encoder.
When power is turned on, a pulse count value is set to 0.

- Positive-true logic: A Z-axis input is recognized with the OFF-to-ON (rising) edge of a pulse and then an encoder pulse count value is preset.
- Negative-true logic: A Z-axis input is recognized with the ON-to-OFF (falling) edge of a pulse and then an encoder pulse count value is preset.

I/O setting

■ Strobe time

This setting is usable when the Measure mode is used for OUTs which are outputted from the STRB1/ STRB2 terminal. Set the length of a strobe signal to be outputted when a measurement value is updated.

Setting range: 2 ms, 5 ms, 10 ms, 20 ms, 50 ms, 100 ms, 200 ms, 500 ms

“I/O Terminal Names and Functions” (page 8-7)

■ Off-delay time

Set a time period during which to prolong the ON state of judgment output and Output waiting.

Setting range: 0, 2 ms, 5 ms, 10 ms, 20 ms, 50 ms, 100 ms, 200 ms, 500 ms, Hold

● 0

The judgment terminal is turned ON or OFF according to a sampling frequency.

● Hold

This setting retains the ON state of judgment output. Upon input of the RESET signal, a judgment signal is set to OFF.

■ No. of control Ch

Select the number of OUTs to output judgment results from among SIG1 to SIG10.
SIG terminal output data changes according to the selected number.

● Control Ch1 to Ch4

Select a Ch number of OUT where to output a judgment result from the drop-down list.

❍ Control Ch1/Control Ch2

- STRB1/STRB2 is outputted according to the measurement result of the OUT that has been set in Control Ch1/Ch2.
- Signal input from TIMING1/RESET1/ZERO1 is reflected to the OUT that has been set in Control Ch1.
- Signal input from TIMING2/RESET2/ZERO2 is reflected to the OUT that has been set in Control Ch2.
- If sync setting is performed for the OUT that has been selected in Control Ch1, each input from the TIMING1/RESET1/ZERO1 terminal is reflected to all sync-set OUTs.

● In case where No. of control Ch is 2

Pin	Judgment output channel	
SIG1	Ch1	HH
SIG2		HI
SIG3		GO
SIG4		LO
SIG5		LL
SIG6	Ch2	HH
SIG7		HI
SIG8		GO
SIG9		LO
SIG10		LL

If the tolerance judgment mode is set to “Ref value mode”, OFF is always outputted from the SIG terminals of HH and LL.

● In case where No. of control Ch is 3

Pin	Judgment output channel	
SIG1	Ch1	HH/HI
SIG2		GO
SIG3		LL/LO
SIG4	Ch2	HH/HI
SIG5		GO
SIG6		LL/LO
SIG7	Ch3	HH/HI
SIG8		GO
SIG9		LL/LO
SIG10	STATUS3	

STATUS3 is used for status output.

● **In case where No. of control Ch is 4**

Pin	Judgment output channel	
SIG1	Ch1	HH/HI/LO/LL
SIG2		GO
SIG3	Ch2	HH/HI/LO/LL
SIG4		GO
SIG5	Ch3	HH/HI/LO/LL
SIG6		GO
SIG7	Ch4	HH/HI/LO/LL
SIG8		GO
SIG9	STATUS4	
SIG10	STATUS3	

STATUS3/4 is used for status output.

■ Total judgment setting

Select outputs (OUT1 to OUT16) to be used for total judgment.
If all the output values of “Non-output waiting OUTs” among selected OUTs are GO, the total judgment result will be GO.
“Total Judgment” (page 6-12)

● **OUT1 to OUT 16**

Select the check boxes ☑ of OUTs to be included in total judgment outputs.

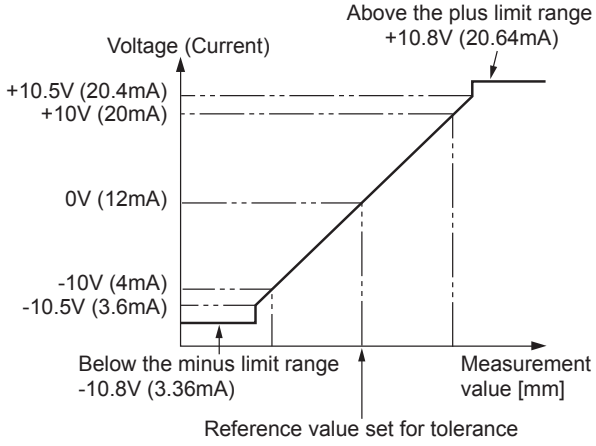
Analog output

This output function converts measurement values of selected OUTs to analog voltages within the range of ±10.5 V. The output method depends on the tolerance mode.
Current value from the analog current output (4 to 20mA) can be converted to voltage value by the following calculation formula.
Voltage value(V) = (Current value(mA) - 12mA) / 0.8
“Tolerance mode” (page 5-35)

■ Ref value mode

A voltage to be outputted when a measurement value equals the reference value is assumed as 0V in this mode.
This function outputs the difference of a measurement value from the reference value with + or - voltage.

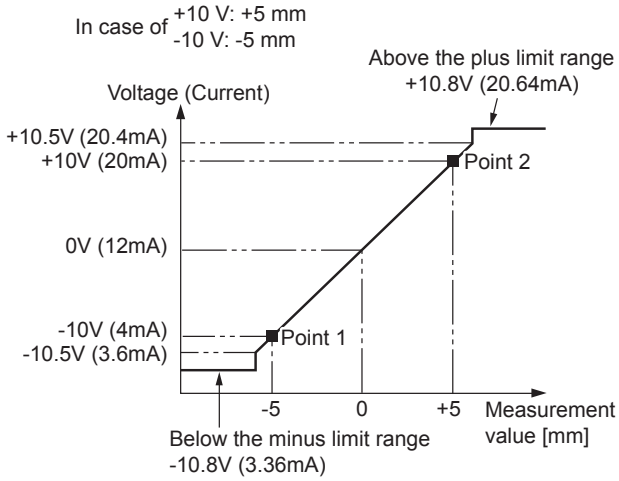
Scaling can be changed in 13 steps.



■ Threshold mode

This mode allows setting of a measurement value to output as +10 V and that to output as -10 V.
Set these measurement values so as to meet the following condition.

|(Measurement value at +10 V) - (Measurement value at -10 V)| ≥ 2000 x (Minimum display unit)

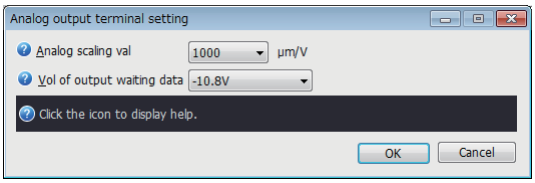


Reference
- If a measurement value does not fall within the range of ±10.5 V, it is referred to as the following.
  If a measurement value exceeds +10.5 V, it is referred to as “above the plus limit range”. If a measurement value exceeds -10.5 V, it is referred to as “below the minus limit range”.
  In such cases, analog voltages to be outputted are as follows.
  - Above the plus limit range: +10.8 V
  - Below the minus limit range: -10.8 V
- If no OUT is allocated to an analog output terminal or if no measurement mode of OUT is set, the analog voltage to be outputted is -10.8 V.
  “State Table” (page 11-20)

■ Analog scaling value

Set a voltage to be outputted from each analog output terminal.
A permissible setting range differs depending on the tolerance mode.

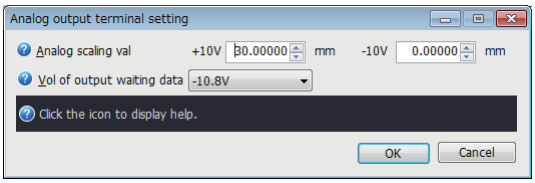
- Tolerance mode: Reference value



Setting range [m/V], [mm/V]:1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000
An output voltage depends on the setting of minimum display unit.
“Combined limitation for analog scaling (Ref. val mode) and minimum display unit” (page 5-15)

Reference Example when analog current output is in use: Select 1000 μm/V to output the voltage as 1000 μm/0.8 mA.

- Tolerance mode: Threshold



Setting range:Values compatible with upper limit value [+10V] / lower limit value [-10V]

■ Volt of output waiting data

Select a voltage to be outputted if a measurement value is output waiting data from the drop-down list.

Setting range: -10.8 V, +10.8 V, 0 V, last hold value

Status output

This is a setting for STATUS outputs.
You can check statuses of such as OUT, head and signal input from a maximum of 4 terminals.
Statuses to be checked are allocated to each terminal.
“No. of control Ch” (page 5-96)

■ Output waiting

The status output is turned ON if a target OUT to be selected is in the Output waiting state.

■ Outlier continue

The status output is turned ON if the OUT (data prior to outlier values processing) selected as target is an outlier value.
“Outlier exclusion function” (page 5-40)

■ FOCUS

The status output is turned ON if a measurement target of the selected head is not in the vicinity of the reference position.
This threshold can be set in the “FOCUS monitor” setting.
“FOCUS monitor” (page 5-66)

Point **Not available on LS-9120M, LS-9006D and LS-9030D.**

■ Insufficient light

The status output is turned ON if the maximum light intensity of the received light of the selected head has fallen below 50%.

■ Check No. of edges: Fail

The status output is turned ON if the Check No. of edges function of the selected head is failed.
“Check No. of edges” (page 5-65)

■ Stat processing

The status output is turned ON if a selected target Stat process Ch is under calculation.
“[Common setting] Tab: Stat Process” (page 5-109)

■ Pulse frequency error

The status output is turned ON if the Pulse frequency error occurs. (The off-delay is disabled.)
“Encoder set” (page 5-93)

BCD unit

■ Output selection function

Selects the signal type to be output from the output connector of the BCD unit. You can select from the following three types:

● **BCD output**

Outputs the measurement values in 29-bit (signed) BCD format.

● **Binary output**

Outputs the measurement values in 25-bit (negative value = a complement representation of 2) Binary format.

● **Judgment output**

Outputs the judgment result of each OUT.

Reference If "Judgment output" has been selected in the output selection function, the STROBE signal from the BCD unit will be output when the following OUTs are updated.
BCD_STROBE1 = OUT set in Ch1
BCD_STROBE2 = OUT set in Ch2
BCD_STROBE3 = OUT set in Ch3
BCD_STROBE4 = OUT set in Ch4
For details on the output, refer to page 8-26.

■ OUT selection method

Selects the method to be used to determine the OUT number for outputting signals from the output connector of the BCD unit.

● **Controller settings**

This method is used when you wish to fix the output OUT number. Also, set the OUT number to be output. You can perform this setting from the display panel, LS-Navigator2, and RS-232C.

❍ **Ch1 to Ch4**

Select the OUT number to be output. Ch1 corresponds to output connector 1.

● **BCD unit terminal**

This method is used when you wish to change the output OUT number via specification from terminals.
“BCD unit Expansion connector” (page 8-21)

■ BCD strobe time

Sets the output time of the strobe signal set up in the BCD unit.
It is enabled when measurement mode has been selected for the selected OUT.
BCD_STROBE1 to BCD_STROBE4 are all supported.
Setting range: 2 ms, 5 ms, 10 ms, 20 ms, 50 ms, 100 ms, 200 ms, 500 ms

Basic Operations of LS-Navigator2

Setting the encoder

1. Select an input mode of the encoder.
2. Enable the Sampling function.
3. Select a pitch unit.
4. Set a pitch interval.
5. Enable the Encoder TIMING function.
6. Enable the Pulse count preset function.

Setting judgment output

1. Select a strobe time.
2. Select an off-delay time.
3. Select the number of control channels.
4. Select an OUT to output to the output terminal.
5. Perform total judgment setting.

Setting analog output

1. Select an OUT to output to the output terminal.
2. Click the [Optional setting] button to set optional data as necessary.

   The [Analog output terminal setting] window appears.

(1) Set an analog scaling value.
(2) Select a voltage of output waiting data.

Setting status output

1. Select a status to output to the output terminal.
2. Select a target head.

BCD unit

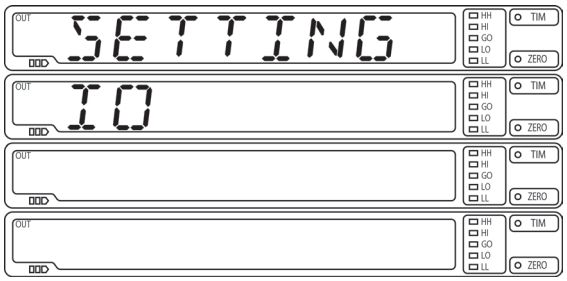
1. Select the output function.
2. Select the OUT selection method.
3. Select the BCD strobe time.

Setting the display panel

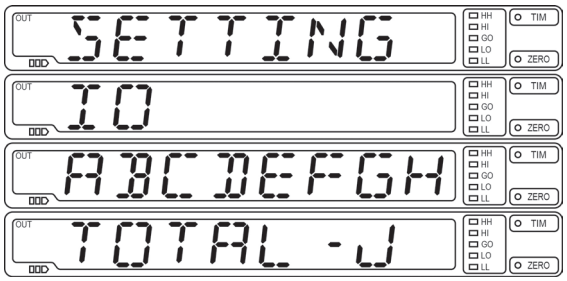
I/O terminal setting

1 Press the [0] key while holding down the [FUNC] key.
The setting item selection screen appears.

2 Select [IO] by pressing the [▲] or [▼] key, then press the [ENT] key.



3 Perform setting for any purpose.
Refer to the following items.

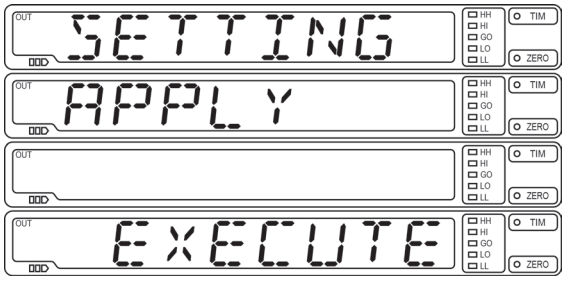


A: TOTAL-J (Total judgment setting)
B: STROBE (Strobe time setting)
C: OFFDELAY (Off-delay time setting)
D: IO-CH (I/O setting)
E: ANALOG (Analog output)
F: STATUS (Status output)
G: ENCODER (Encoder set)
H: BCD UNIT (Bcd unit)

4 Press the [ESC] key to display the setting item selection screen.

5 Select [APPLY] by pressing the [▲] or [▼] key, then press the [ENT] key.

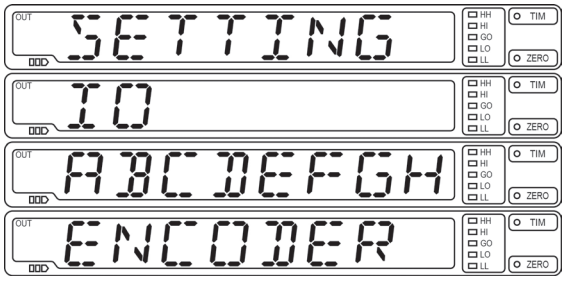
6 Upon display of [EXECUTE], press the [ENT] key.



When message [COMPLETE] appears, this completes item selection setup.

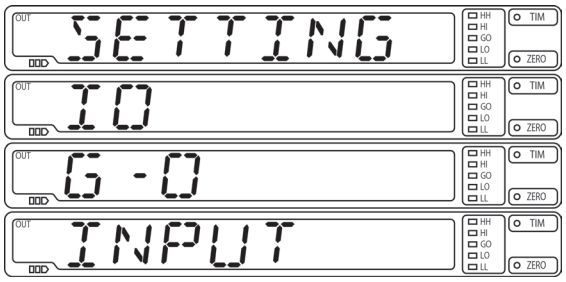
Setting the encoder

1 Select [ENCODER], then press the [ENT] key.
“I/O terminal setting” (page 5-101)



■ Input mode setting

1 Select [INPUT], then press the [ENT] key.

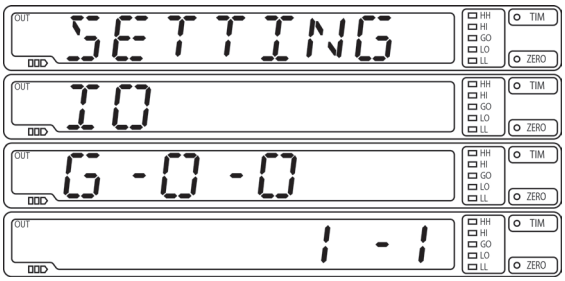


5 Program Setting

2 Select an input mode by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

Input modes that can be set are as follows.

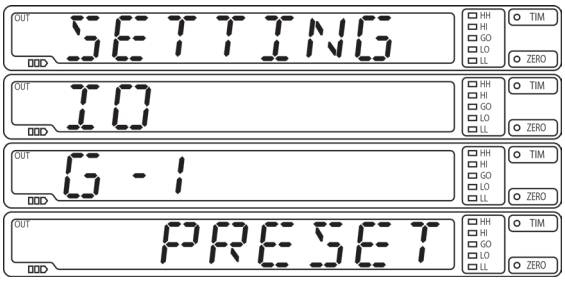
- 1-1 (1-ph 1 TM)
- 2-1 (2-ph 1 TM)
- 2-2 (2-ph 2 TM)
- 2-4 (2-ph 4 TM)



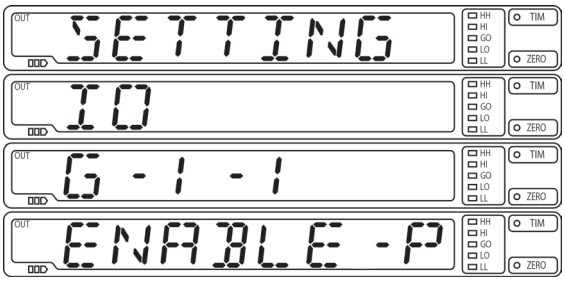
The setting item selection screen appears.

■ Pulse count preset

1 Select [PRESET], then press the [ENT] key.



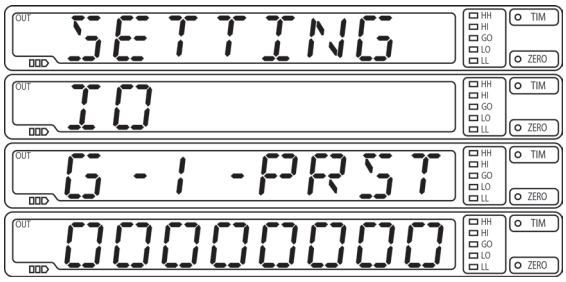
2 Select the desired input method by pressing the [▲], [▼], [◀] or [▶] key, then press [ENT] key.



- ENABLE-P Positive-true logic
- ENABLE-N Negative-true logic
- DISABLE OFF

The Preset screen appears.

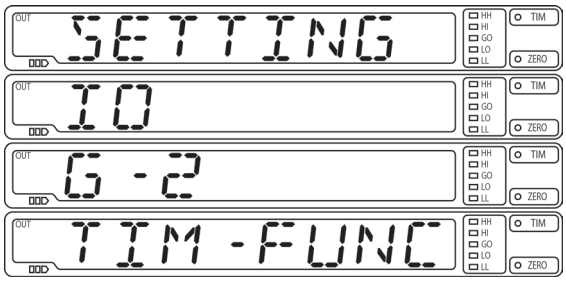
3 Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



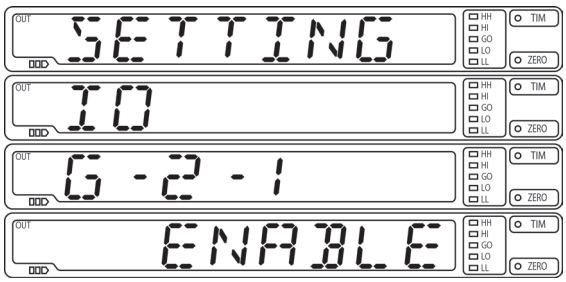
The setting item selection screen appears.

■ Encoder TIM func setting

1 Select [TIM-FUNC], then press the [ENT] key.

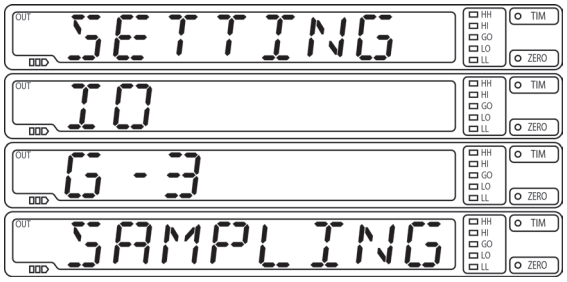


2 Select [ENABLE] by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

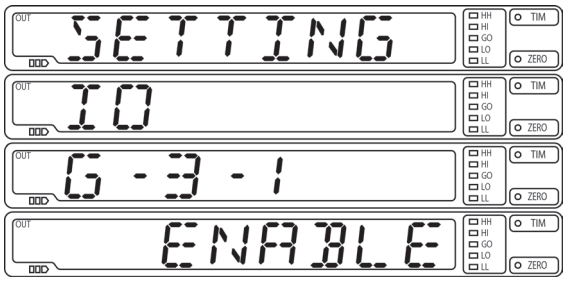


■ Sampling setting

1 Select [SAMPLING], then press the [ENT] key.

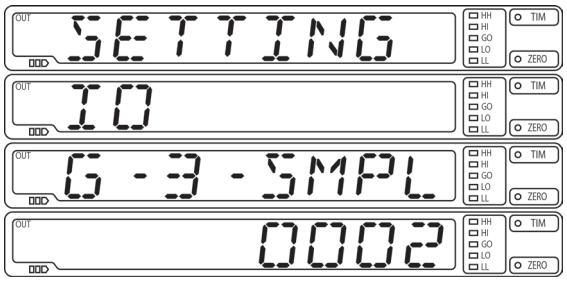


2 Select [ENABLE] by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



The Sampling point setting screen appears.

3 Set the number of sampling points. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.

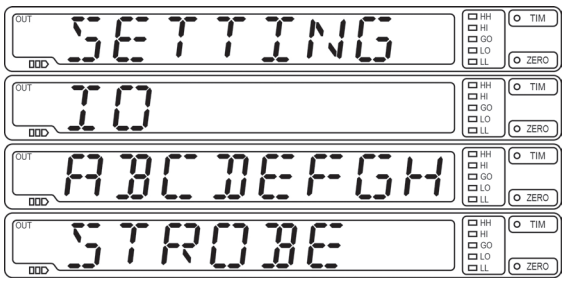


I/O setting output

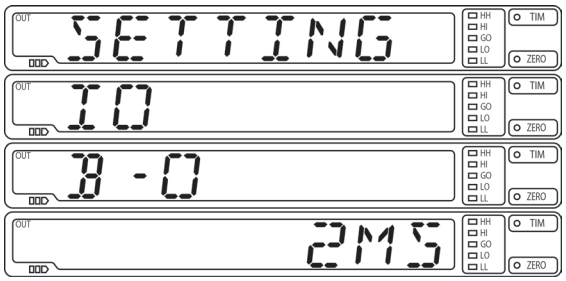
■ Strobe time

1 Select [STROBE], then press the [ENT] key.

“I/O terminal setting” (page 5-101)



2 Select a strobe output time by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

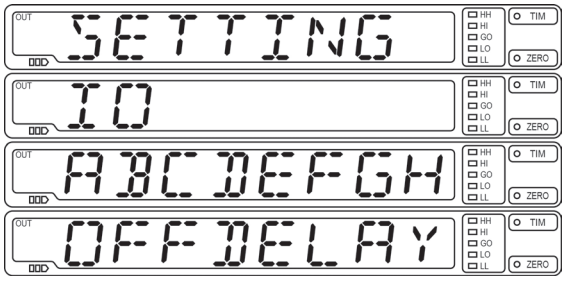


The Function selection screen appears.

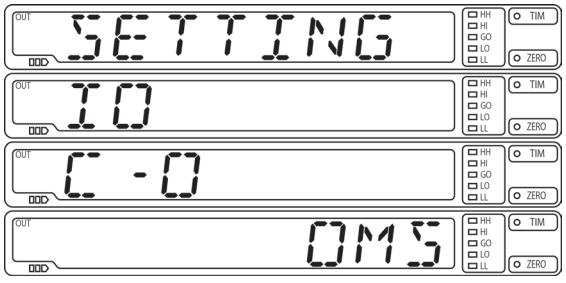
■ Off-delay time

1 Select [OFFDELAY], then press the [ENT] key.

“I/O terminal setting” (page 5-101)



2 Select an off-delay by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

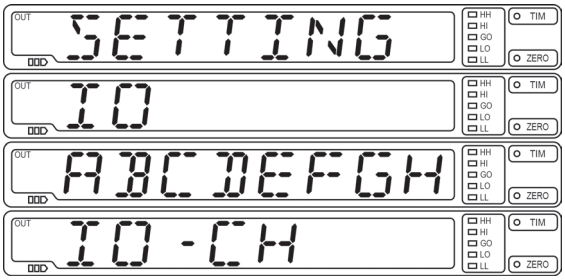


The Function selection screen appears.

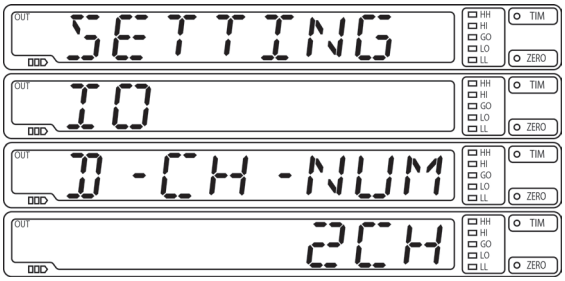
■ No. of control Ch

1 Select [IO-CH], then press the [ENT] key.

“I/O terminal setting” (page 5-101)

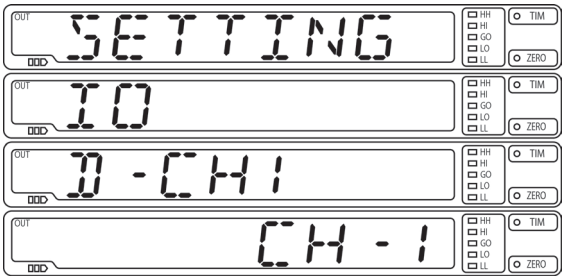


2 Select the number of control channels by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



The Channel selection screen appears.

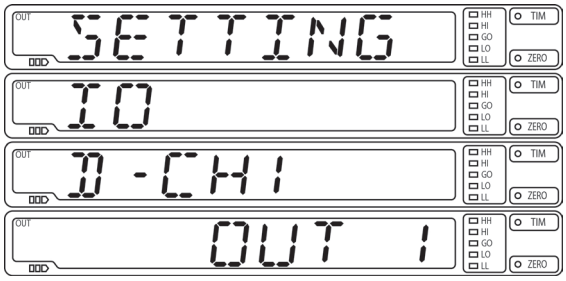
3 Select a channel by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



The Output target OUT selection screen appears.

Reference This OUT selection screen will appear repeatedly for the number of channels selected in procedure 2.

4 Select an OUT number by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



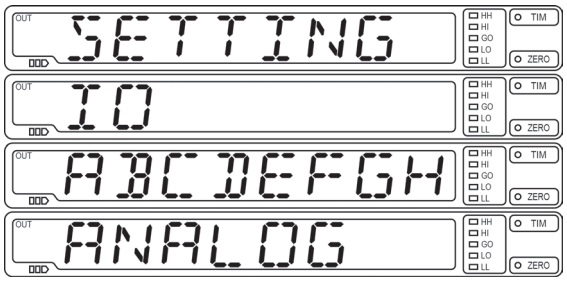
The Channel selection screen appears.

Reference The used OUT numbers are only displayed as candidates for selection.

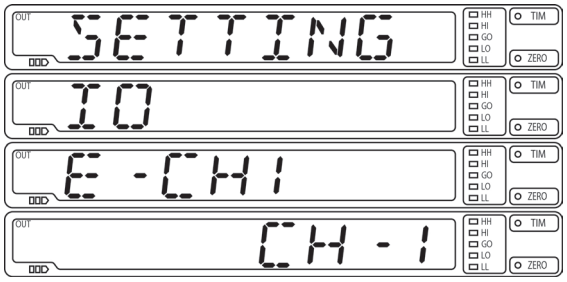
Setting analog output

1 Select [ANALOG], then press the [ENT] key.

"I/O terminal setting" (page 5-101)

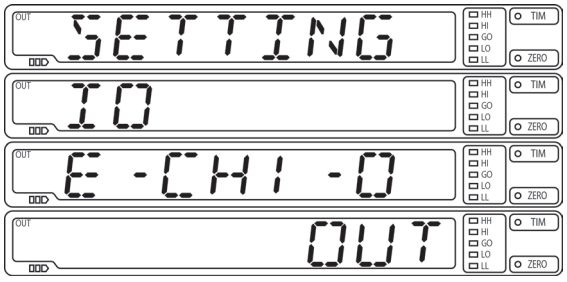


2 Select an analog output channel by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



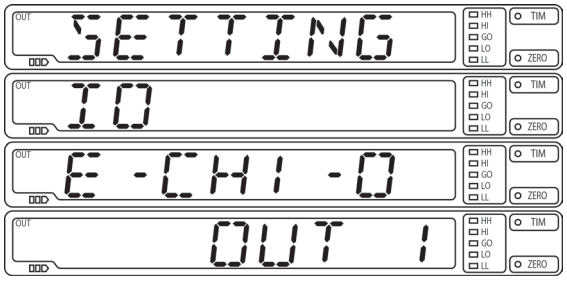
The setting item selection screen appears.

3 Select [OUT] by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



The Output target OUT selection screen appears.

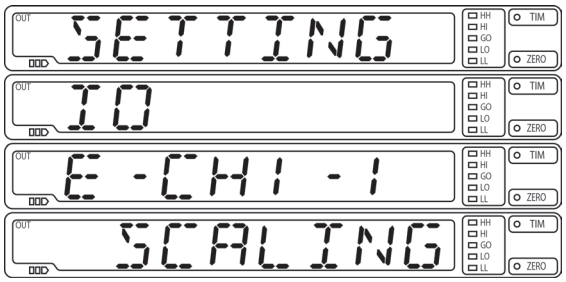
4 Select an OUT number by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



Reference The used OUT numbers are only displayed as candidates for selection.

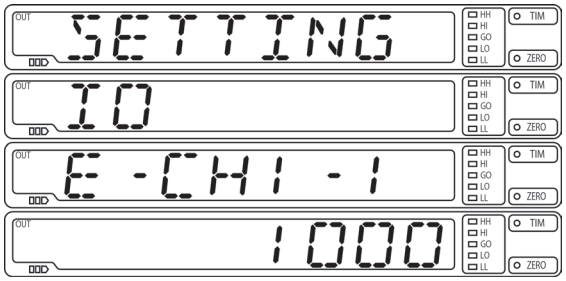
The setting item selection screen appears.

5 Select [SCALING] by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



● **In case where the tolerance mode is the reference value mode**

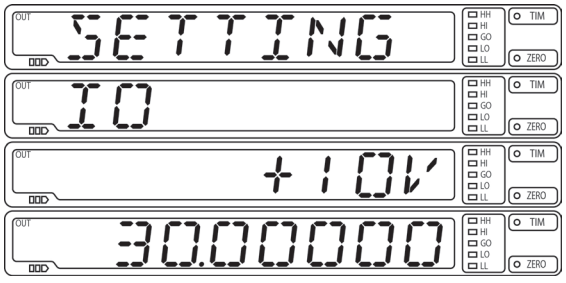
6 Select a scaling value by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



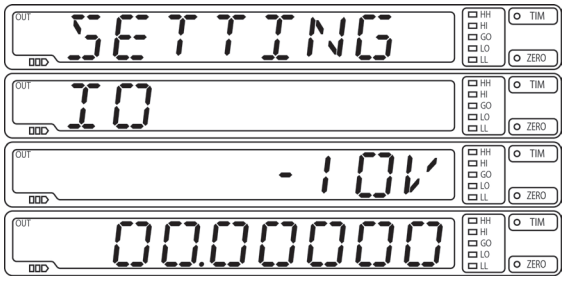
The setting item selection screen appears.

● **In case where the tolerance mode is the threshold mode**

6 Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



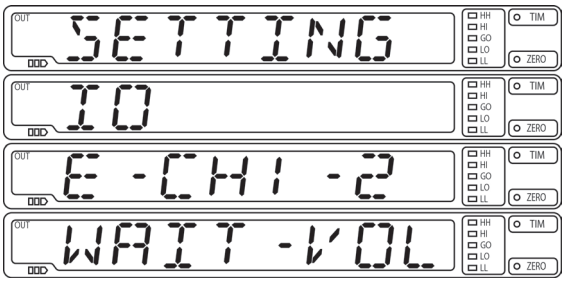
Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



The setting item selection screen appears.

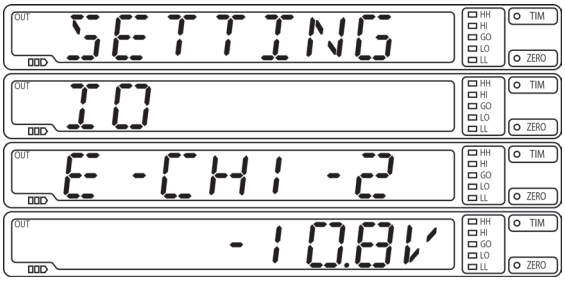
5 Program Setting

7 Select [WAIT-VOL] by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



The Output waiting value setting screen appears.

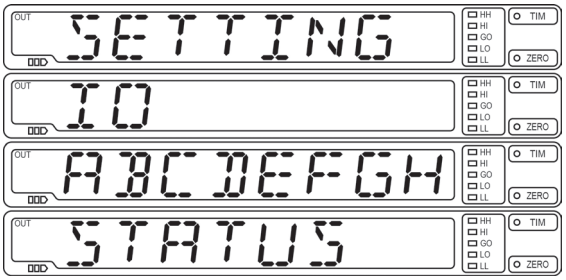
8 Select a voltage of output waiting data by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



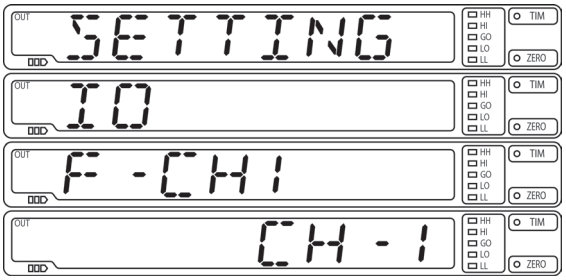
The setting item selection screen appears.

Setting status output

1 Select [STATUS], then press the [ENT] key.



2 Select the number of control channels by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

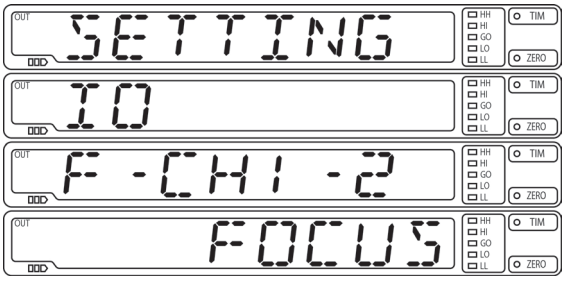


The Status function selection screen appears.

3 Select a status function by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

Status functions that can be set are as follows.

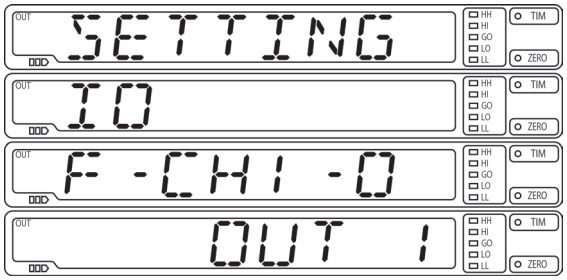
- WAIT (Output waiting)
- OUTLIER (Outlier continue)
- FOCUS (FOCUS)
- DARK (Insufficient light)
- EDGE-CHK (Check No. of edges: Fail)
- STAT-RUN (Stat processing)
- FREQ-ERR (Pulse frequency error)



■ **Upon selection of WAIT or OUTLIER**

The Output target OUT selection screen appears.

4 Select an OUT number by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

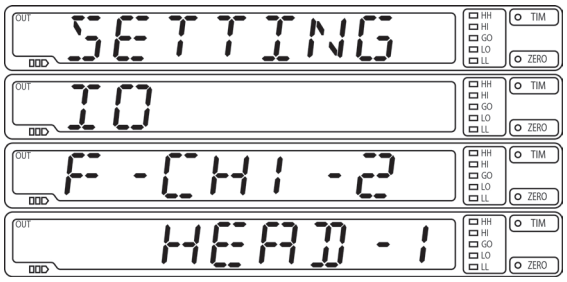


The Status output channel setting screen appears.

■ **Upon selection of FOCUS, DARK, or EDGE-CHK**

The Output head selection screen appears.

4 Select an output head number by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.

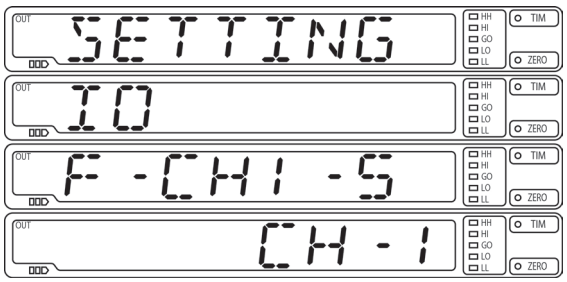


The Status output channel setting screen appears.

■ **Upon selection of STAT-RUN**

The Output statistic channel selection screen appears.

4 Select an output statistic channel by pressing the [▲], [▼], [◀] or [▶] key, then press the [ENT] key.



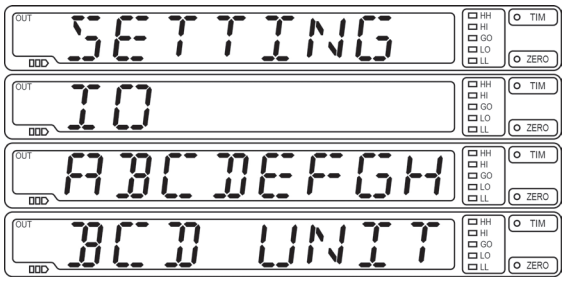
The Status output channel setting screen appears.

■ **Upon selection of FREQ-ERR**

The Status output channel setting screen appears.

BCD unit

1 Select [BCD UNIT] and press the [ENT] key.



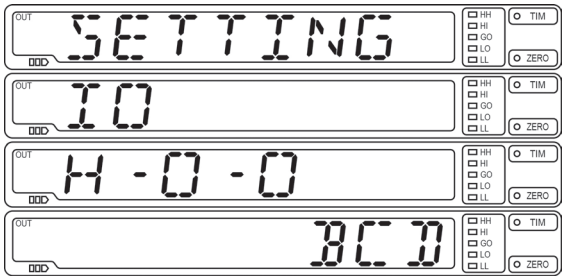
2 Select the item to set using the [▲] [▼] [◀] [▶] keys, and then press the [ENT] key.

The functions you can set are:
- OUT-FUNC (Output function setting)
- INPUT (OUT selection input)
- CH (ch)
- STROBE (BCD strobe time)

■ **When OUT-FUNC is selected**

3 Select the item to set using the [▲] [▼] [◀] [▶] keys, and then press the [ENT] key.

The functions you can set are:
- BCD (BCD output)
- BIN (Binary output)
- JUDGE (Judgment output)

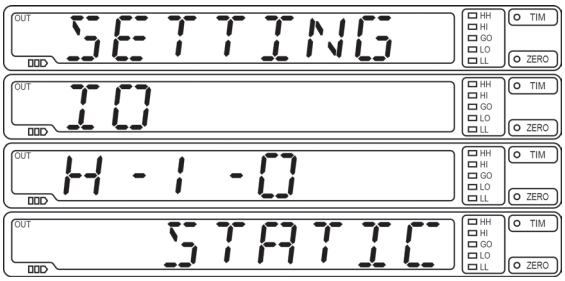


5 Program Setting

■ When INPUT is selected

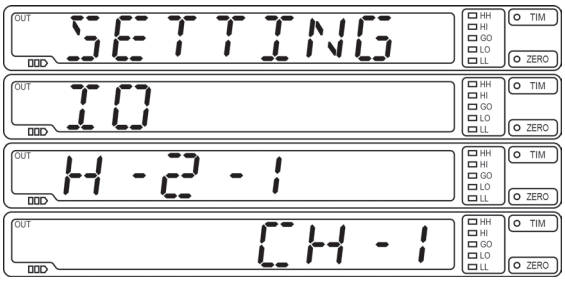
3 Select the input method using the [▲] [▼] [◀] [▶] keys, and then press the [ENT] key.

The functions you can set are:
- STATIC (Controller settings)
- TERMINAL (BCD unit terminal)

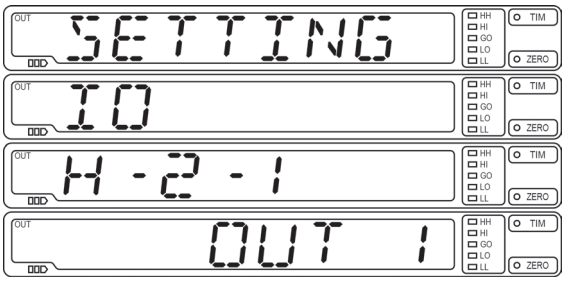


■ When CH is selected

3 Select the Ch number using the [▲] [▼] [◀] [▶] keys, and then press the [ENT] key.



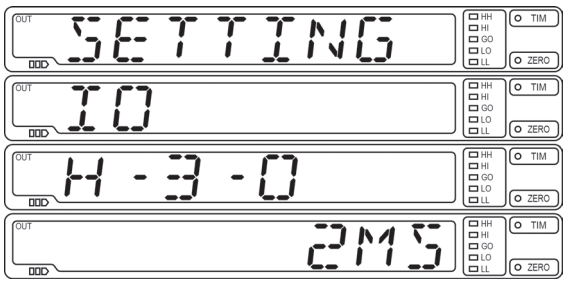
4 Select the OUT number to be output, and then press the [ENT] key.



■ When STROBE is selected

3 Select the BCD strobe time to set using the [▲] [▼] [◀] [▶] keys, and then press the [ENT] key.

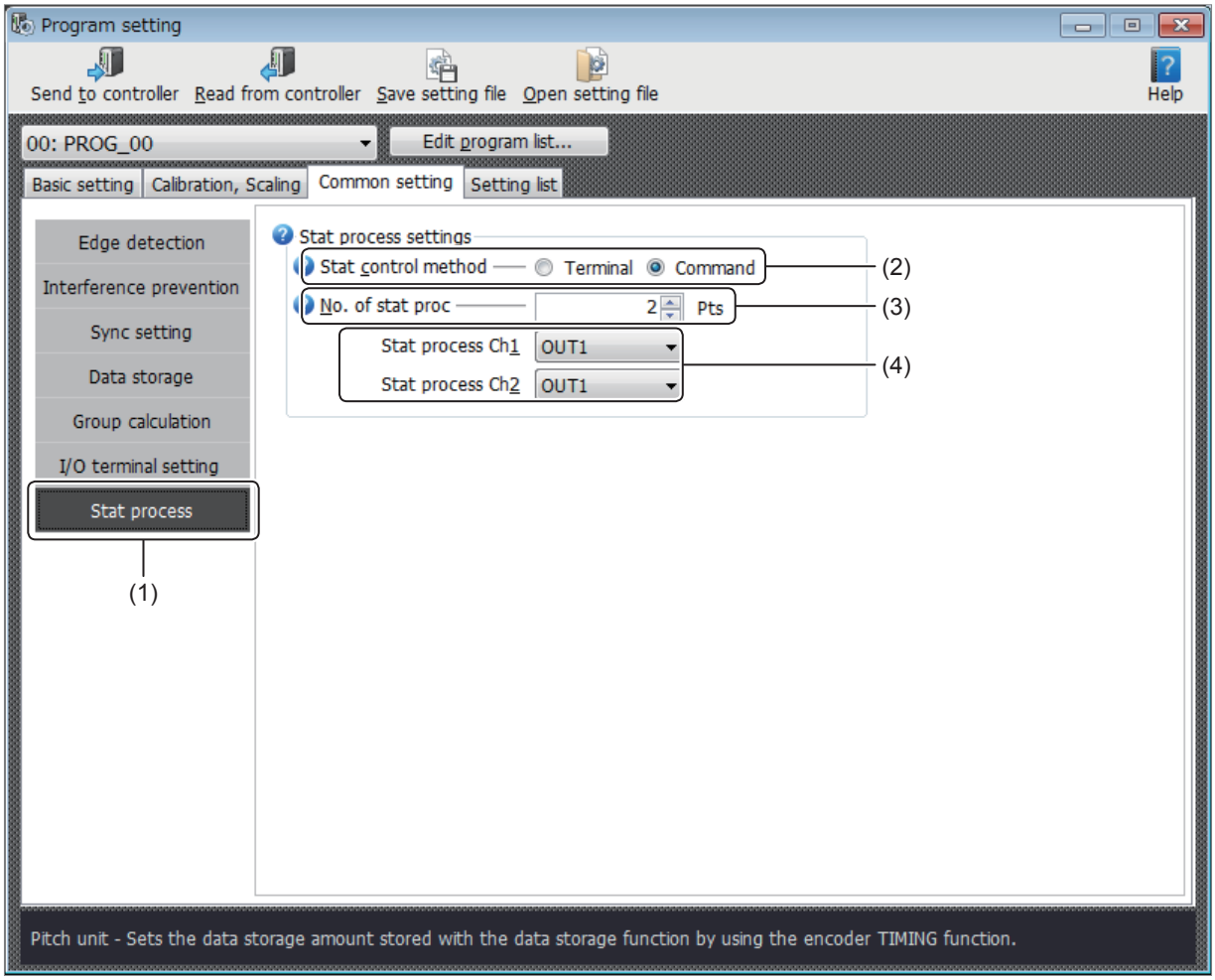
The values you can set are:
- 2MS (2ms)
- 5MS (5ms)
- 10MS (10ms)
- 20MS (20ms)
- 50MS (50ms)
- 100MS (100ms)
- 200MS (200ms)
- 500MS (500ms)



[Common setting] Tab: Stat Process

Select the [Common setting] tab in the [Program setting] screen to display the common settings.
Click the [Stat process] button to display the [Stat process] area, and then perform statistic process setting.

[Stat process] area



No.	Name	Description
(1)	[Stat process] button	Use this button to display the statistic process setting area.
(2)	[Stat control method] button	Use this button to select one of the statistic process control methods.
(3)	[No. of stat proc] setting	Used to set the number of statistic processes.
(4)	[Stat process Chx] drop-down list	Use this button to select the OUT to be used in stat process.

Statistic process settings

Statistical processing is performed for measurement values of a maximum of 2 OUTs.
Measurement values used for statistical processing are those to be retained by a TIMING signal.

- Average
- Maximum value
- Minimum value
- Maximum value - Minimum value
- Standard deviation
- Parameter (Number of pieces of data used for statistical processing)
- Number of instances of HH
- Number of instances of HI
- Number of instances of GO
- Number of instances of LO
- Number of instances of LL

If any measurement value is in output waiting data, it is not targeted for statistical processing. It is also excluded from the number of pieces of data used for statistical processing.
Any statistical value will be kept retained until it is cleared.
The conditions for clearing a statistical value are as follows.

- If a statistic control method is using a terminal: STAT_CLEAR terminal input is performed.
- If a statistic control method is using a command:
  - Stat process clear is performed from LS-Navigator2.
  - The Stat process clear command is received.
  - Stat process clear is performed through panel operation.
- Power is turned OFF.
- A program No. is changed.

■ Stat control method

Select a method of starting, stopping or clearing statistical processing.

● Terminal

Stat control terminals are used for control of statistical processing.

	Control Ch1	Control Ch2
Stat start / stop	SDO1	SDO2
Stat clear	SCLR1	SCLR2

● Command

Commands from LS-Navigator2 or via RS-232C communication are used for control of statistical processing.

■ No. of stat proc

Enter the number of pieces of statistical processing. During the statistic process period, statistic values are updated whenever necessary. When the number of measurement values used for statistical processing has reached the specified No. of stat proc, the statistical processing is complete.

■ Stat process Ch1 to Ch2

Select a target OUT to calculate statistic values from the drop-down list.

Setting LS-Navigator2

1 Select one of the statistic process control methods.

2 Set the number of pieces of statistical processing.

3 Select the OUT to be used in stat process.

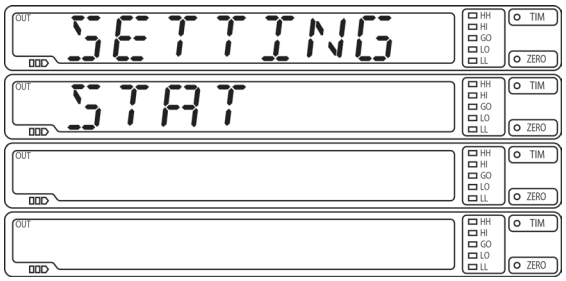
Setting the display panel

Statistical processing

1 Press the [0] key while holding down the [FUNC] key.

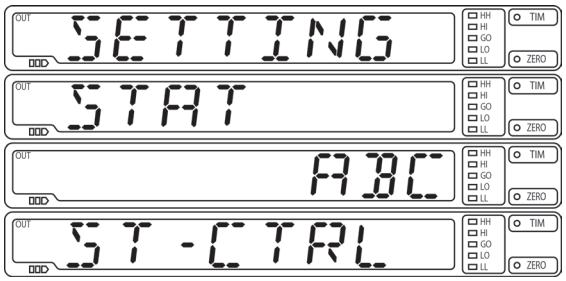
The setting item selection screen appears.

2 Select [STAT] by pressing the [▲] or [▼] key, then press the [ENT] key.



3 Perform setting for any purpose.

Refer to the following items.

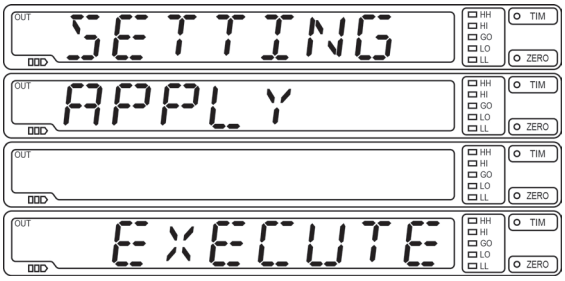


A: ST-CTRL (Stat control method)
B: ST-NUM (No. of stat proc)
C: ST-CH (Stat process Ch)

4 Press the [ESC] key to display the setting item selection screen.

5 Select [APPLY] by pressing the [▲] or [▼] key, then press the [ENT] key.

6 Upon display of [EXECUTE], press the [ENT] key.

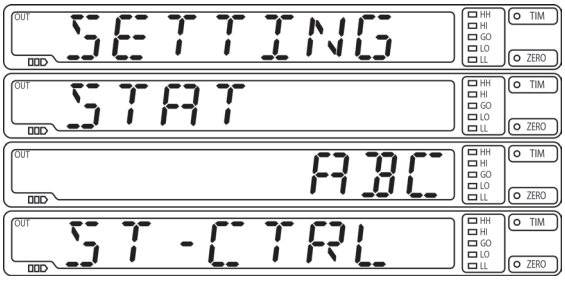


When message [COMPLETE] appears, this completes item selection setup.

Stat control method

1 Select [ST-CTRL], then press the [ENT] key.

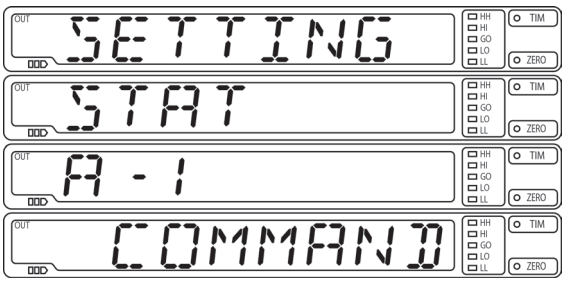
“Statistical processing” (page 5-111)



2 Select a statistic control method by pressing the [▲], [▼], [◀] OR [▶] key, then press the [ENT] key.

Statistic control methods that can be set are as follows.

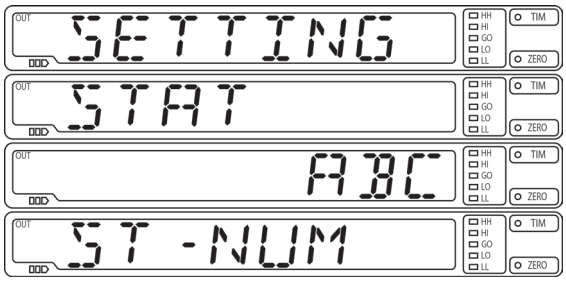
- TERMINAL (Terminal control)
- COMMAND (Control with a command)



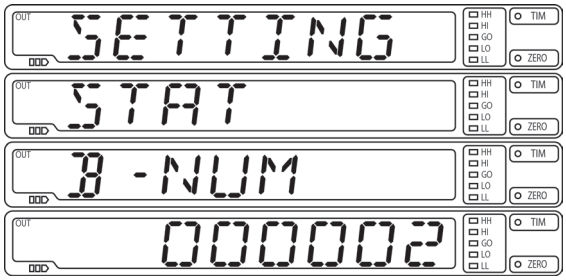
Setting No. of stat proc

1 Select [ST-NUM], then press the [ENT] key.

“Statistical processing” (page 5-111)



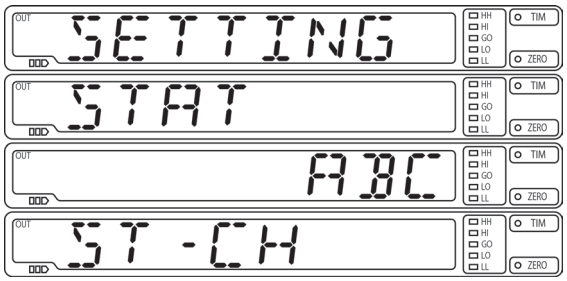
2 Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key, then press the [ENT] key.



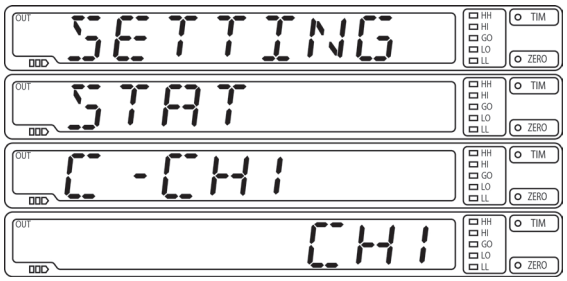
Stat process settings

1 Select [ST-CH], then press the [ENT] key.

“Statistical processing” (page 5-111)

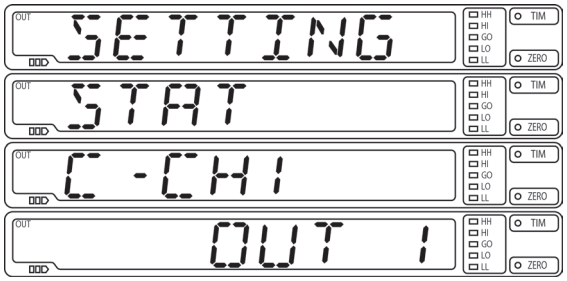


2 Select a stat process target channel by pressing the [▲], [▼], [◀] OR [▶] key, then press the [ENT] key.



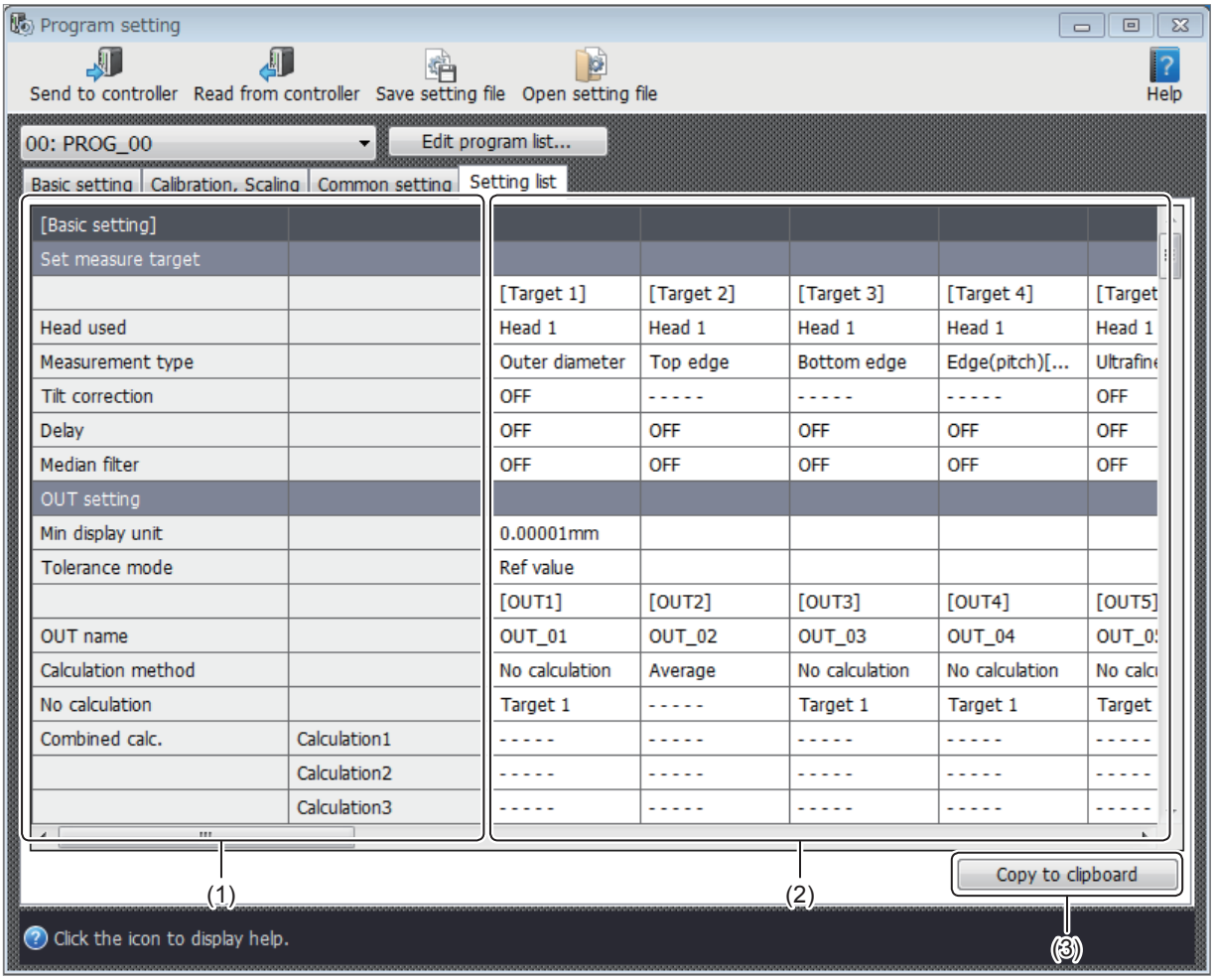
The target OUT selection screen appears.

3 Select a target OUT by pressing the [▲], [▼], [◀] OR [▶] key, then press the [ENT] key.



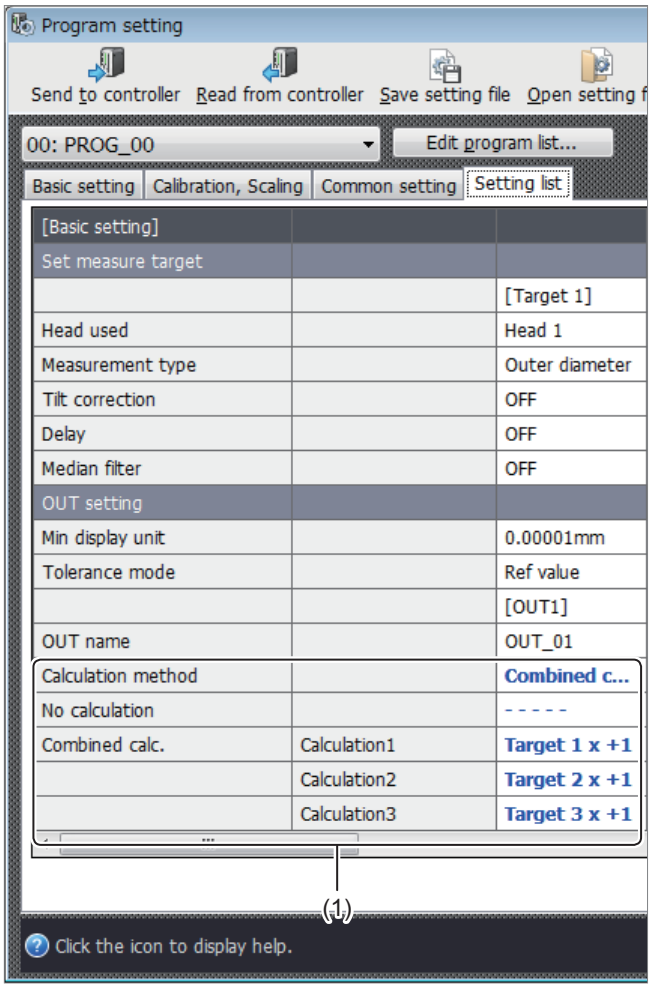
[Setting list] Tab

Select the [Setting list] tab in the [Program setting] screen to display the Setting list.



No.	Name	Description
(1)	Setting item display area	This area lists setting item names.
(2)	Setting content display area	This area lists the setting contents of each item.
(3)	[Copy to clipboard] button	This button copies the setting lists of items and contents to a clipboard.

Items in which any setting is updated



No.	Name	Description
(1)	Setting-updated item	Updated contents of item settings are displayed blue.

Setting list

The Setting list screen lists the current settings of the Program setting.
Updated items are displayed blue.

Reference The Program settings during editing, if not synchronized to the controller even once, use initial settings.

Setting LS-Navigator2

Checking settings before update

1 Place the mouse cursor on an item being displayed blue.

The setting value before update is displayed on a tool tip.

Copying list of settings

1 Click the [Copy to clipboard] button.

The contents of settings displayed in the Setting list screen are copied to a clipboard.
The setting contents copied to the clipboard are of tab-delimited text.

MEMO

6

Checking the Measurement Results

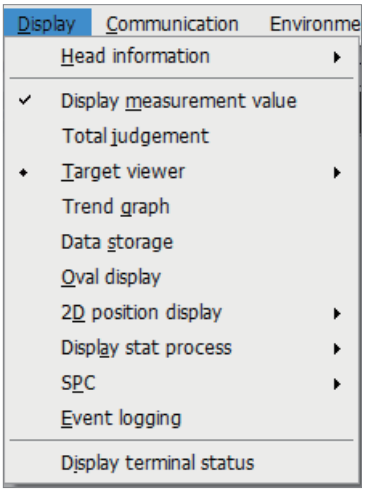
This chapter describes how to read the setup screen and operation procedure of functions available during the measurement.

Measurement Screen Outline and Switching Screens 6-2
Head Information 6-3
Display Measurement Value 6-4
Total Judgment 6-12
Target Viewer 6-14
Trend Graph 6-16
Data Storage 6-20
Oval Display 6-28
2D Position Display 6-30
Display Stat Process 6-32
SPC 6-34
Event Logging 6-42
Display Terminal Status 6-44

Measurement Screen Outline and Switching Screens

Measurement screen outline

LS-9000 series provides several screens for checking the measurement results.
The following types of measurement screens are available. Each measurement screen can be called from the [Display] menu of the main screen.



This section outlines each screen.
Please refer to the following items for details of each screen.

■ [Head information] screen

The screen displays the status of all heads connected to the controller. The screen displays the head status in green when the status is "normal", black while monitoring has ceased, and red in other cases.
“Head Information” (page 6-3)

■ [Display measurement value] screen

The screen displays the measurement value set by the program setting. The screen displays the OUT names, judgment results, measurement values, auto-zero status, and timing input status.
“Display Measurement Value” (page 6-4)

■ [Total judgment] screen

The screen displays the total judgment result. Depending on the content of [Total judgment result], the screen displays "OK" in green in case of "GO" and "NG" in red in case of "NG".
“Total Judgment” (page 6-12)

■ [Target viewer] screen

The screen displays the monitor image while monitoring.
“Target Viewer” (page 6-14)

■ [Trend graph] screen

The screen arranges the measurement values in time series to display the trend of the data.
“Trend Graph” (page 6-16)

■ [Data storage] screen

The screen displays the measurement value stored by the storage function.
The screen can start/stop the storage and read and display the stored data. The read data can be stored in a file.
“Data Storage” (page 6-20)

■ [Oval display] screen

The screen displays the storage data in a circular pattern.
The screen can start/stop the storage and read and display the stored data.
“Oval Display” (page 6-28)

■ [2D position display] screen

The screen plots the measurements of specified OUT on a graph by the X and Y axes.
“2D Position Display” (page 6-30)

■ [Display stat process] screen

The screen displays the statistical result of the measurement values.
The screen also displays number of judgment results other than the maximum and minimum values.
“Display Stat Process” (page 6-32)

■ [SPC] screen

The screen displays the Statistical Process Control information on the basis of the measurement values of the specified OUT.
“SPC” (page 6-34)

■ [Event logging] screen

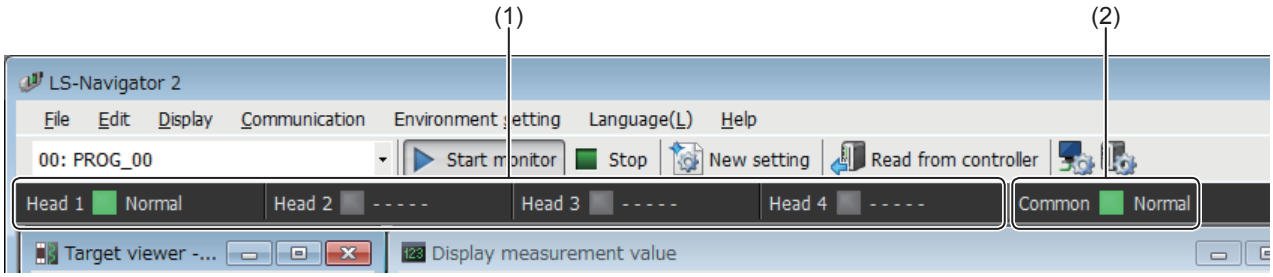
The screen displays the log of the events occurred at the controller and LS-Navigator2.
“Event Logging” (page 6-42)

■ [Display terminal status] screen

The screen displays the terminal status of the controller. You can output test data for checking the status of wiring of the terminals and check the signal input.
“Display Terminal Status” (page 6-44)

Head Information

The head information can be displayed on the measurement screen.



No.	Names	Description
(1)	Head indicator	The head indicator shows the status of each head.
(2)	Common indicator	The common indicator shows the status common to the heads.

Head information

Head indicator

The head indicator lights up in green and shows "Normal" when each head is in the normal status, and lights up in red and shows a warning message when in an abnormal status.
While monitoring has ceased, the indicator appears in black.

■ Head status

The statuses below are considered as abnormal. When these statuses occur at the same time, the upper status is output first.

- An abnormal value is present (this status is displayed on all heads related to the detected OUT).
- Insufficient light intensity of the received light.

When monitoring ceases, "---" appears.

Common indicator

The common indicator lights up in green and shows "Normal" when each head is in the normal status, and lights up in red and shows a warning message when in an abnormal status.
When monitoring ceases, the indicator appears in black.

■ Head common status

The head common status detects the following status as abnormal.

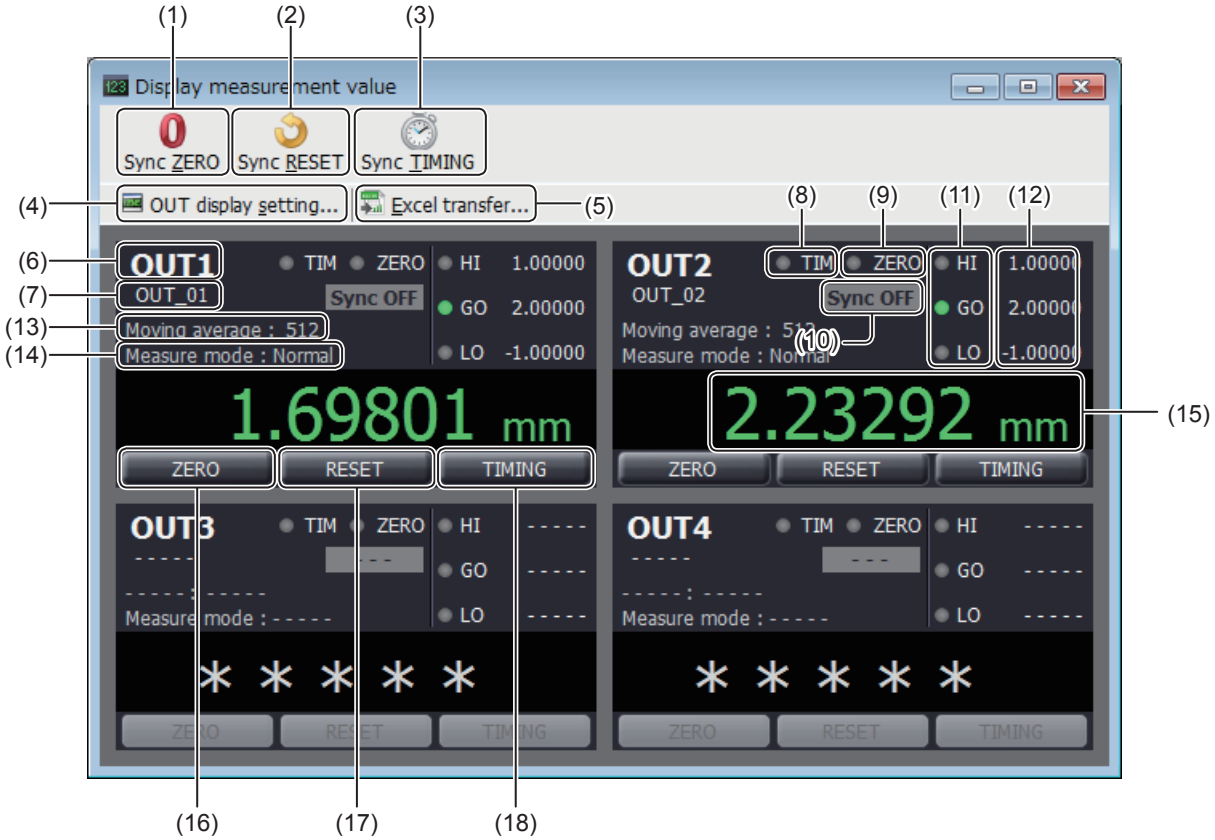
- Pulse maximum frequency rate error

When monitoring ceases, "---" appears.

Display Measurement Value

[Display measurement value] screen

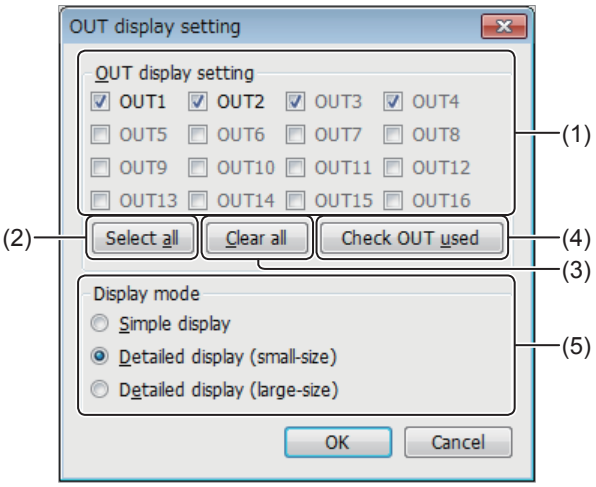
The screen displays the measurement value on the measurement screen.



No.	Names	Description
(1)	[Sync ZERO] button	The button alternately turns ON/OFF the synchronous auto zero signal.
(2)	[Sync RESET] button	The button inputs the synchronous reset signal.
(3)	[Sync TIMING] button	The button alternately turns ON/OFF the synchronous timing signal.
(4)	[OUT display setting] button	The button displays the [OUT display setting] dialog.
(5)	[Excel transfer] button	The button displays the [Logging setting] dialog.
(6)	OUT number	The OUT number is displayed.
(7)	OUT name	The OUT name is displayed.
(8)	[TIM] indicator	The indicator lights up in yellow when the timing is on. The indicator turns off when OFF.
(9)	[ZERO] indicator	The indicator lights up in light blue when the auto zero is on. The indicator turns off when OFF.
(10)	[Sync ON] / [Sync OFF]	The contents of the synchronization setting are displayed. OUT selected at "Synchronization setting" is displayed as "Sync. ON". This OUT is a target of Sync. ZERO/Sync. RESET/Sync. TIMING.
(11)	Tolerance indicator	The indicator shows the result of the judgment whether the measurement is within the tolerance or not. The indicator lights up in green in case of GO, and in red in other cases.
(12)	Tolerance setting	The tolerance values are displayed. No values appear during the simple display mode.
(13)	Filter	The filter type and its setting are displayed. It is not displayed in simple display mode. “Filter” (page 5-38)

No.	Names	Description
(14)	Measure mode	The area shows the measure mode. It is not displayed in simple display mode. “Measurement mode” (page 5-37)
(15)	Measurement value	The measurement value is displayed. The color of the characters depends on the result of the judgment whether the measurement is within the tolerance or not. - Within the tolerance: Green - Out of the tolerance: Red - Output waiting: White (-----)
(16)	[ZERO] button	The button alternately turns ON/OFF the auto zero signal.
(17)	[RESET] button	The button inputs the reset signal.
(18)	[TIMING] button	The button alternately turns ON/OFF the timing signal.

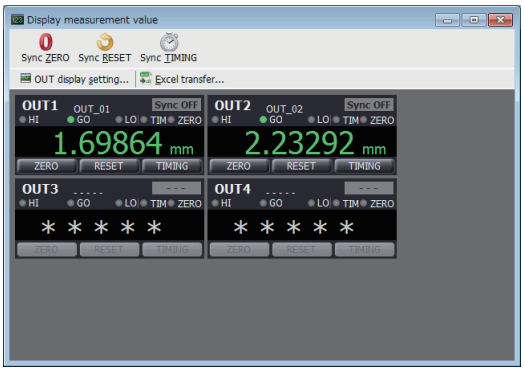
[OUT display setting] dialog



No.	Names	Description
(1)	[OUT display setting] check box	The selected OUT appears on the [Display measurement value] screen.
(2)	[Select all] button	The button checks all the [OUT display setting] check boxes.
(3)	[Clear all] button	The button un-checks all the [OUT display setting] check boxes.
(4)	[Check OUT used] button	The button checks the check boxes of all OUT being used by the running program.
(5)	[Display mode] radio button	The button selects the display mode of OUT in the [Display measurement value] screen.

Display mode

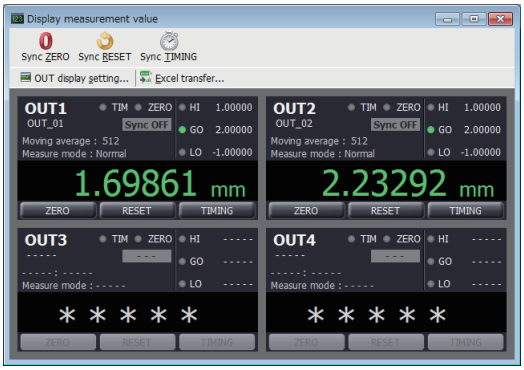
■ Simple display



Compared with the detailed display, the simple display omits the following items from the screen.

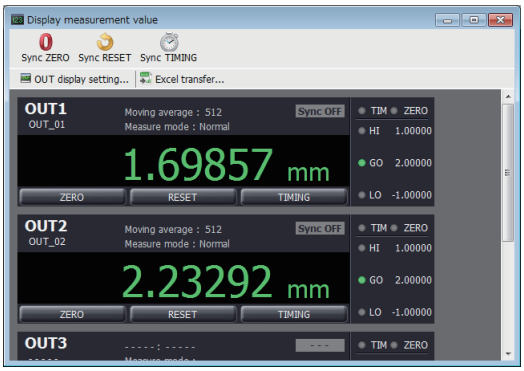
- Tolerance value
- Filter
- Measurement mode

■ Detailed display (small-size)



The detailed display is the default display mode.

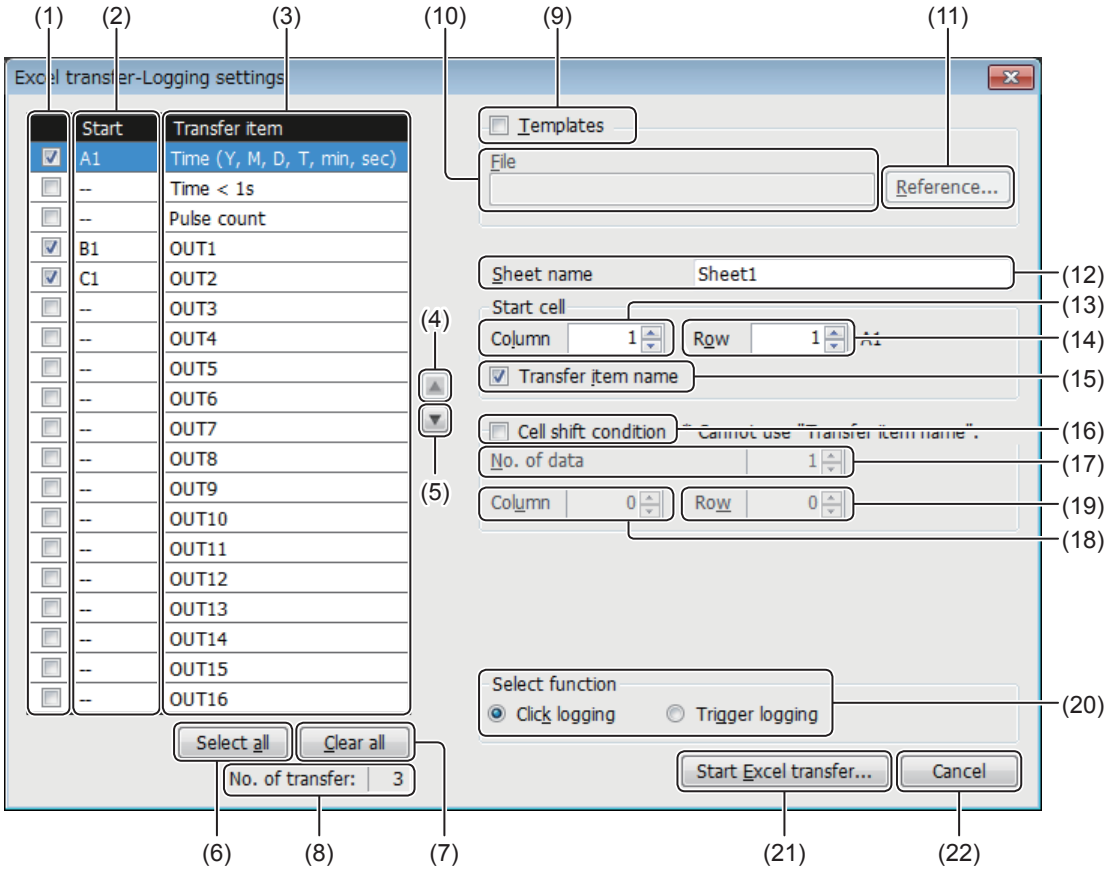
■ Detailed display (large-size)



The detailed display (large size) has a different layout and text size from those of the detailed display (small size), except the items displayed with "detailed display (small size)".

MEMO

[Excel transfer - Logging settings] dialog



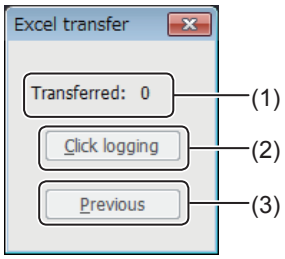
No.	Names	Description
(1)	[Transfer setting] check box	The check box selects the items to be transferred to Excel.
(2)	[Start]	The area displays the start cell on Excel of the transfer item (*1).
(3)	[Transfer item]	The area displays the items to be transferred to Excel.
(4)	button	Clicking the button moves the transfer item in the selected line one line up.
(5)	button	Clicking the button moves the transfer item in the selected line one line down.
(6)	[Select all] button	Clicking the button checks the check boxes of all the transfer items.
(7)	[Clear all] button	Clicking the button un-checks the check boxes of all the transfer items.
(8)	[No. of transfer]	The area displays the number of transfer items whose check boxes are checked.
(9)	[Templates] check box	The check box selects whether to use a template (Excel file) for the Excel sheet to which the items are transferred.
(10)	[File]	When any template has been specified, the area displays its file path. Entries can be up to 256 characters.
(11)	[Reference] button	Clicking the button displays the reference dialog to specify the template.
(12)	[Sheet name] setting	The work sheet name can be entered, to which the transfer is performed. Entries can be up to 31 characters.
(13)	[Column] setting	Enter the first column to which the transfer item is written (*2).
(14)	[Row] setting	Enter the first row to which the transfer item is written (*3).
(15)	[Transfer item name] check box	The check box selects whether to transfer the item or not.

No.	Names	Description
(16)	[Cell shift condition] check box	The check box sets the condition that shifts the columns or rows to which data are transformed every time when the specified number of data are transferred.
(17)	[No. of data] setting	Enter the number of data whose cell is shifted (*3).
(18)	[Column] setting	Enter the number of columns whose cell is shifted (*2).
(19)	[Row] setting	Enter the number of rows whose cell is shifted (*3).
(20)	[Select function] radio button	The button selects the method for logging. Click logging:Every time when the [Click logging] button is clicked, the transfer item is transferred to the Excel file. Trigger logging:In response to the input from the TIMING terminal, the measurement value is transferred to the Excel file.
(21)	[Start Excel transfer] button	Clicking the button displays the [Excel transfer] dialog. The [Excel transfer] dialog (click logging) or the [Excel transfer] dialog (trigger logging) appears depending on the selection of the [Select function] radio button. The Excel file automatically starts up.
(22)	[Cancel] button	The button closes the dialog.

*1: All the transfer items may not be displayed on the Excel because of limitation in the display area of Excel. In this case, "--" appears and an error occurs.
*2: The range you can enter is:
- Excel 2007 or later: 1 to 16384
- Excel 2003 or older: 1 to 256

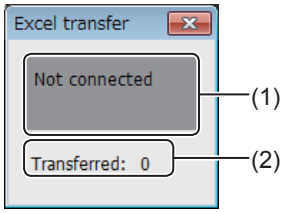
*3: The range you can enter is:
- Excel 2007 or later: 1 to 1048576
- Excel 2003 or older: 1 to 65536

[Excel transfer] dialog (Click logging)



No.	Names	Description
(1)	[Transferred]	The area displays the number of data transferred to Excel.
(2)	[Click logging] button	Clicking the button writes data at that time onto Excel according to the setting on the [Excel transfer - Logging setting] dialog.
(3)	[Previous] button	Clicking the button deletes the latest transferred item from Excel.

[Excel transfer] dialog box (Trigger logging)



No.	Names	Description
(1)	Logging information display	The screen displays the status of the trigger logging. While the TIMING input is being accepted, "Trigger logging ..." appears.
(2)	[Transferred]	The area displays the number of data transferred to Excel.

[Excel transfer] (Click logging/Trigger logging)

■ Writing format to Excel

- The transfer item "time (year, month, date, hours, minutes, and seconds)" is written as a text.
- The transfer item "time (under seconds)" is written as a value after the decimal point.

■ When any abnormal value exists

When any abnormal value exists, the data is written as below.

● Output waiting data, Minus-range on the minus side

The data is written as the minimum value of the minimum display unit.
(Example)
When the minimum display unit is 0.01µm: -99999.99

● Plus-range on the plus side

The data is written as the maximum value of the minimum display unit.
(Example)
When the minimum display unit is 0.01µm: 99999.99

Reference

In the following cases, the error message appears and no data is written.

- When you are going to write data exceeding the input range of Excel.
  - In the click logging, the [Click logging] button and the [Previous] button appears in gray.
  - In the trigger logging, "An error occurred" appears in the logging information display area.
- When you have edited the Excel file to which the data have been transferred.
- When you have terminated Excel.

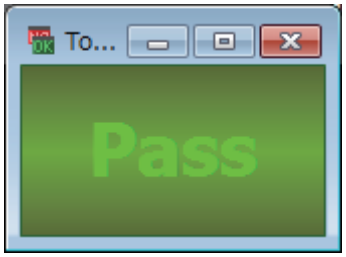
MEMO

Total Judgment

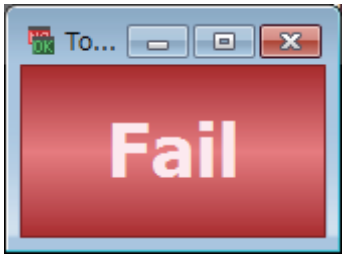
[Total judgment] screen

The total judgment appears on the measurement screen.
“Total judgment setting” (page 5-97)

■ When the total judgment is "Pass"



■ When the total judgment is "Fail"

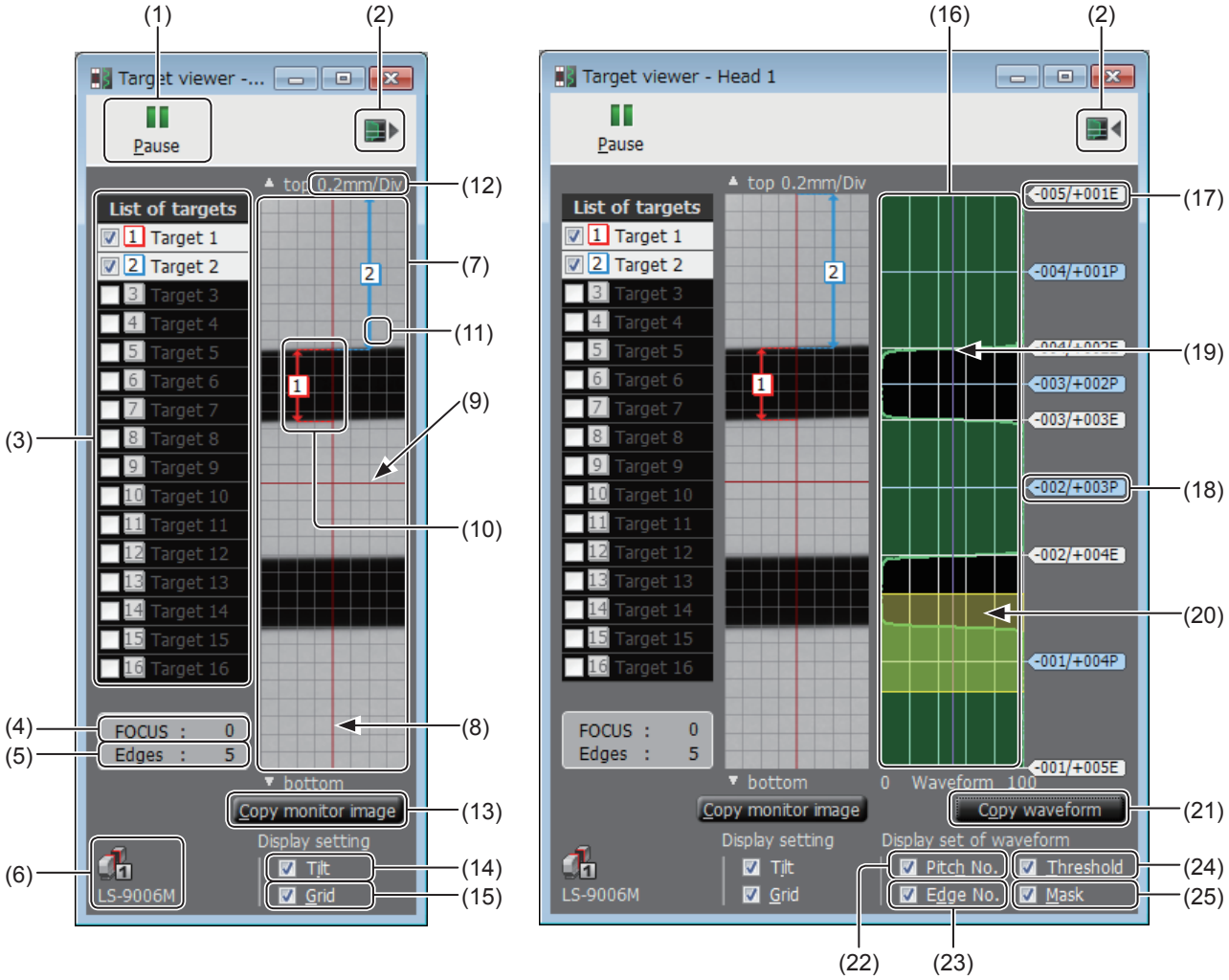


MEMO

Target Viewer

[Target viewer] screen

The target viewer appears on the measurement screen.



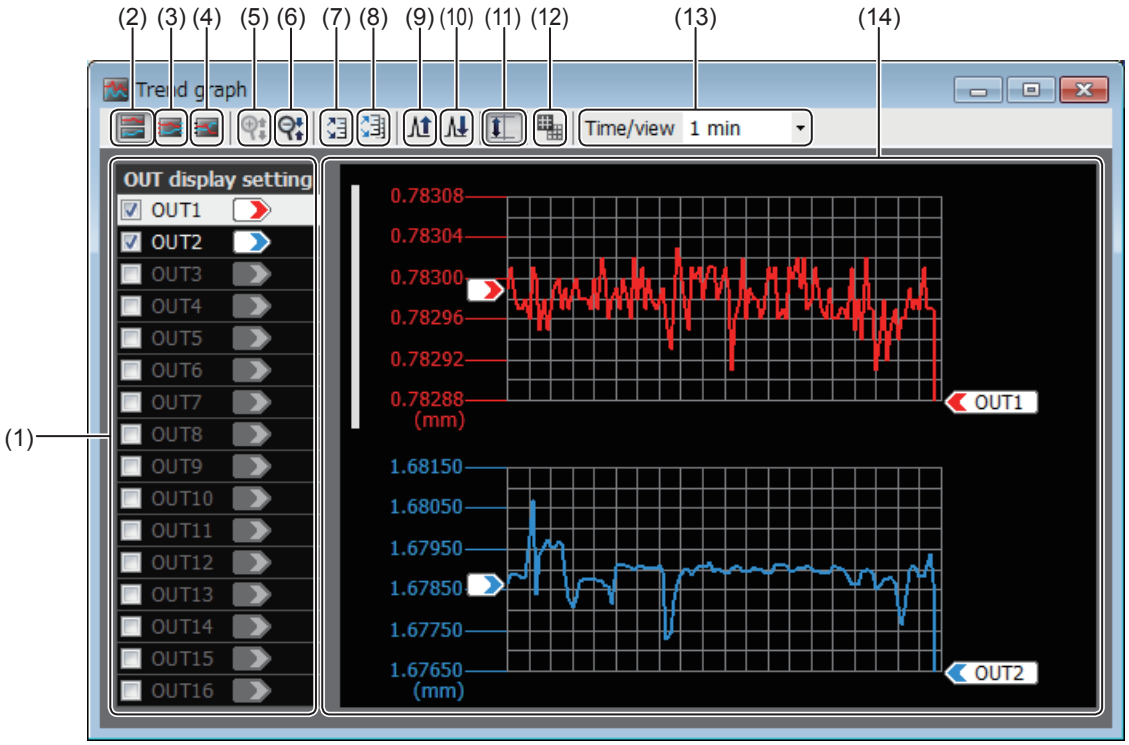
No.	Names	Description
(1)	[Pause] button	The button suspends updates of the monitor screen and the waveform.
(2)	[Display waveform]/[Hide waveform] button	The button switches display/hide of the waveform on the target viewer.
(3)	[List of targets] area	The area displays the measurement targets that have been set. Turning the check box on ☑ displays the selected targets on the target viewer.
(4)	[FOCUS]	The area displays a number showing the Tx-Rx position of the target. The number appears in black when the number is within the [Focus monitor] setting, in red when out of the setting.
(5)	[Edges]	The area displays the number of edges detected.
(6)	[Head type]	The image measured by the displayed type appears on the target viewer.
(7)	Target viewer/Monitor screen	The screen displays the image captured by the camera in the head.
(8)	Target viewer/Scan line	The line shows the position where the target is measured.
(9)	Target viewer/0E line	The line shows the position of the 0 edge.
(10)	Target viewer/Target area	The area displays information showing the target.
(11)	Target viewer/Grid	The grid shows the monitor screen size.

No.	Names	Description
(12)	Target viewer/Grid scale	The area displays the grid resolution.
(13)	[Copy monitor image] button	The button copies the displayed monitor image to the clipboard.
(14)	Display setting/[Tilt]	The check box is active when the target is the outer diameter and uses the correction function. Turning the check box on ☑ displays the target area after the tilt correction.
(15)	Display setting/[Grid]	Turning the check box on ☑ displays the grid on the target viewer.
(16)	Waveform image/Waveform	The area displays the waveform measured.
(17)	Edge No. tag	This displays the line showing the edge no. and the position detected.
(18)	Pitch No. tag	This displays the line showing the pitch no. and the position detected.
(19)	Threshold	The line displays the current edge detection threshold on the waveform. “Edge detection threshold” (page 5-64)
(20)	Mask area	The area shows the mask area set on the waveform. “Mask setting” (page 5-65)
(21)	[Copy waveform] button	The button copies the waveform to the clipboard.
(22)	Display set of waveform/ [Pitch No.]	Turning the check box on ☑ displays the pitch no. tag on the waveform image.
(23)	Display set of waveform/ [Edge No.]	Turning the check box on ☑ displays the edge no. tag on the waveform image.
(24)	Display set of waveform/ [Threshold]	Turning the check box on ☑ displays the edge detection threshold on the waveform image.
(25)	Display set of waveform/[Mask]	Turning the check box on ☑ displays the mask area on the waveform image.

Trend Graph

This function automatically acquires the latest measurements and plots them on the graph. The function is used for monitoring the trend of the measurements.

[Trend graph] Screen



No.	Names	Description
(1)	OUT display setting	Select OUT to display the trend graph.
(2)	[Arranged display] button	The button arranges the OUT graphs vertically.
(3)	[Layered display (individual scale)] button	The button cascades the OUT graphs. The scale of the vertical axis depends on the graph.
(4)	[Layered display (same scale)] button	The button overlays the OUT graphs. The scale of the vertical axis is common to all the graphs.
(5)	[Enlarge in vertical direction] button	The button enlarges the vertical axis of the selected graph. The area per grid narrows.
(6)	[Reduce in vertical direction] button	The button reduces the vertical axis of the selected graph. The area per grid widens.
(7)	[Automatic adjustment in vertical direction] button	The button automatically adjusts the vertical axis of the selected graph.
(8)	[Automatic adjustment in vertical direction (batch)] button	The button automatically adjusts the vertical axis of all the graphs. When the graph is displayed by [Layered display (same scale)], the adjustment is done such that data of all the graphs are displayed.
(9)	[Move up the graph] button	The button scrolls the selected graph upward. When the graph is displayed by [Layered display (same scale)], the button scrolls all the graphs.
(10)	[Move down the graph] button	The button scrolls the selected graph downward. When the graph is displayed by [Layered display (same scale)], the button scrolls all the graphs.
(11)	[Tolerance display] button	The button switches display/hide of the tolerance value, a line and area showing the tolerance value.

No.	Names	Description
(12)	[Inversion of background color] button	The button inverts the background color of the graph display area.
(13)	[Time/view] drop-down list	Select the time range of the graph displayed on one screen of the display area.
(14)	Graph display area	The area displays the graph.

Graph display area

■ [Time/view] drop-down list

Select the time range of the graph displayed on one screen of the display area from the following.

- 1 minute
- 2 minutes
- 5 minutes
- 10 minutes
- 30 minutes
- 1 hour
- 2 hours
- 6 hours
- 12 hours
- 24 hours

■ Graph display area

● Vertical axis

The division number of the grid depends on the number of the graphs to be displayed.

● Horizontal axis

The number and interval of the measurement points to be plotted on one screen depends on the time/view.

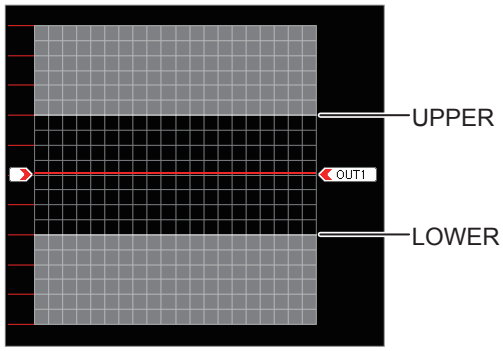
Time/view	Plot interval	Plot points of one screen
1 minute	0.5 seconds	120 points
2 minutes	0.5 seconds	240 points
5 minutes	0.5 seconds	600 points
10 minutes	0.5 seconds	1200 points
30 minutes	1 second	1800 points
1 hour	2 seconds	1800 points
2 hours	4 seconds	1800 points
6 hours	6 seconds	3600 points
12 hours	6 seconds	7200 points
24 hours	12 seconds	7200 points

● OUT tag

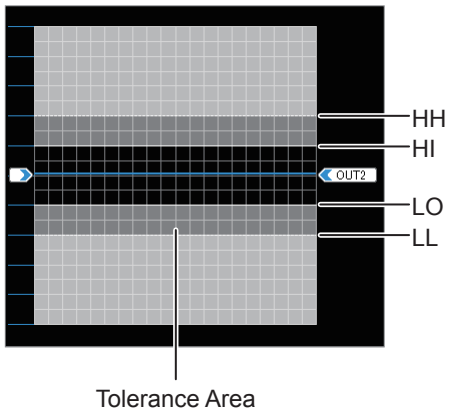
Clicking the OUT tag selects the graph.
Dragging the OUT tag scrolls the graph vertically.
When the graphs are overlaid, the selected OUT tag appears to the front of the display. When no OUT tag is selected, the OUT tag with smaller OUT no. appears to the front of the display.

● Tolerance

A line showing the tolerance is displayed.
HH and LL are indicated by dotted lines.
HI, LO, UPPER, and LOWER are indicated by solid lines.
The backgrounds of the areas of the tolerance appear in different colors.
Tolerance mode: Reference value



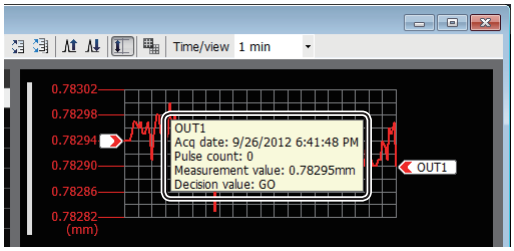
Tolerance mode: Threshold



● Graph information

Putting the mouse cursor on the graph you desired to check displays the following information in a pop up window.

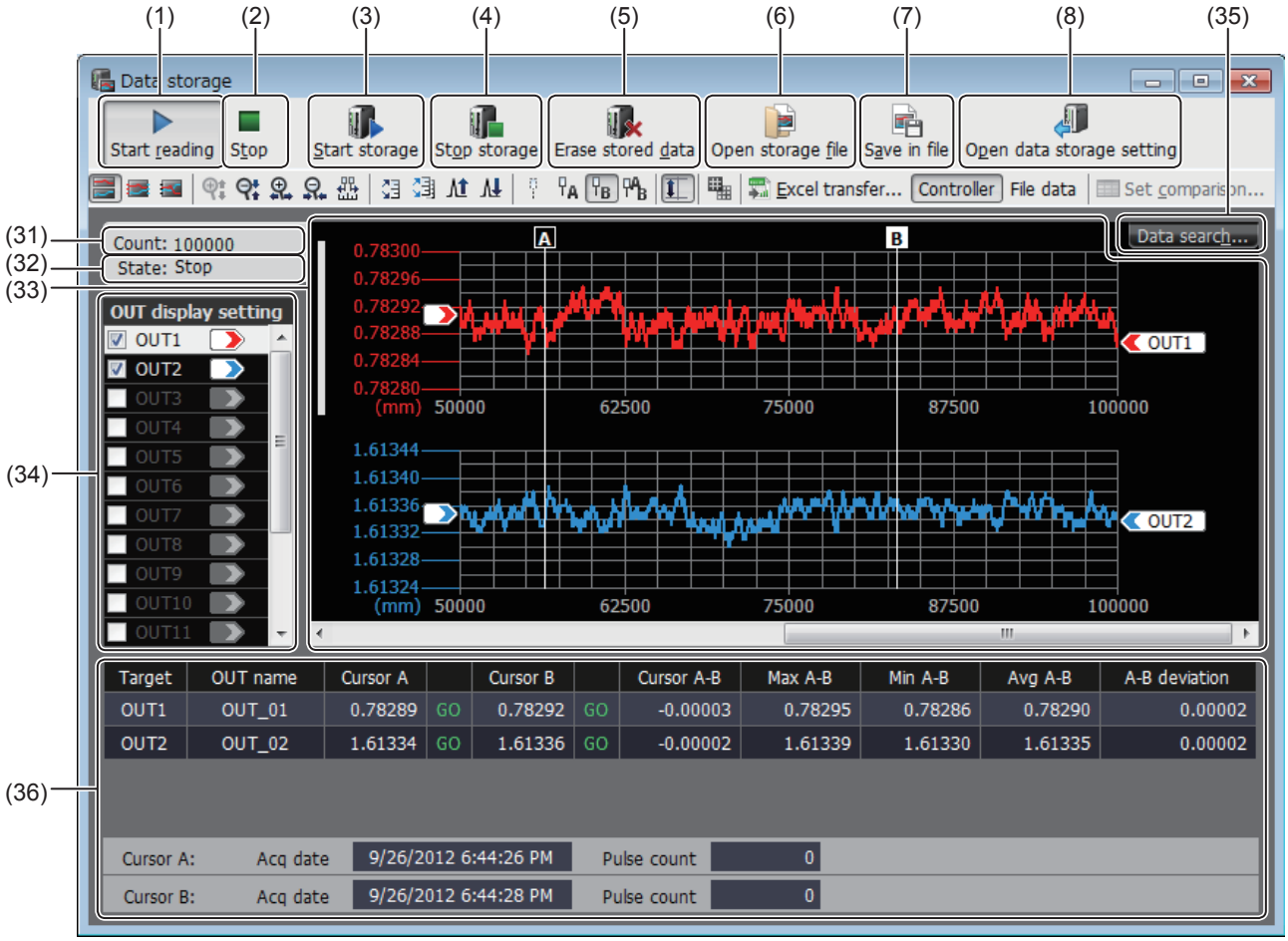
- Target OUT
- Acquisition date
- Pulse count
- Measurement value
- Decision value

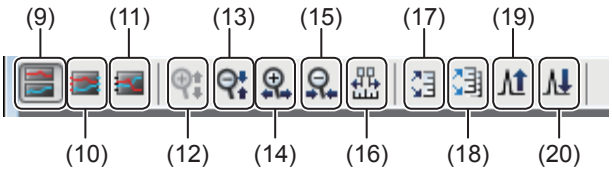


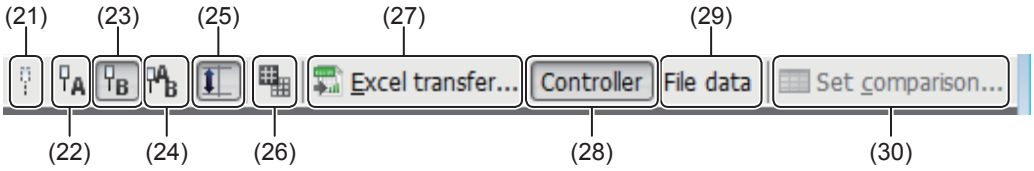
MEMO

Data Storage

[Data storage] Screen







No.	Names	Description
(1)	[Start reading] button	The button reads the data.
(2)	[Stop] button	The button stops reading the data.
(3)	[Start storage] button	The button extracts the stored data.
(4)	[Stop storage] button	The button stops extracting the stored data.
(5)	[Erase stored data] button	The button clears the stored data.
(6)	[Open storage file] button	The button reads the data previously stored in a file and displays the graph.
(7)	[Save in file] button	The button saves the storage data displayed in a storage file.

No.	Names	Description
(8)	[Open data storage setting] button	Reads the current settings in use from the controller and opens the data storage settings.
(9)	[Arranged display] button	The button displays the storage data for each OUT vertically.
(10)	[Layered display (individual scale)] button	The button layers and displays the stored data of all OUTs at respective scales on one graph display area.
(11)	[Layered display (same scale)] button	The button layers and displays the stored data of all OUTs at the same scale on one graph display area.
(12)	[Enlarge in vertical direction] button	The button enlarges the vertical axis of the selected graph.
(13)	[Reduce in vertical direction] button	The button reduces the vertical axis of the selected graph.
(14)	[Enlarge in horizontal direction] button	The button enlarges the horizontal axis of the selected graph.
(15)	[Reduce in horizontal direction] button	The button reduces the horizontal axis of the selected graph.
(16)	[Horizontal direction to cursor AB] button	The button aligns the grid of the horizontal axis with the cursors A and B.
(17)	[Automatic adjustment in vertical direction] button	The button automatically adjusts the vertical axis of the selected graph.
(18)	[Automatic adjustment in vertical direction (batch)] button	The button automatically adjusts the vertical axis of all the graphs.
(19)	[Move up the graph] button	The button scrolls the selected graph upward.
(20)	[Move down the graph] button	The button scrolls the selected graph downward.
(21)	[Hide cursor] button	The button hides the cursor on the graph display area.
(22)	[Select cursor A] button	The button displays the cursors A and B, and activates the cursor A.
(23)	[Select cursor B] button	The button displays the cursors A and B, and activates the cursor B.
(24)	[Select cursor AB] button	The button displays and activates the cursors A and B. The cursors A and B moves together by dragging.
(25)	[Tolerance display] button	The button displays the tolerance area on the graph display area. “Tolerance” (page 5-39)
(26)	[Inversion of background color] button	The button inverts the background color of the graph display area.
(27)	[Excel transfer] button	The button displays the [Excel transfer setting] dialog.
(28)	[Controller] button	The button switches the screen to display the data read from the controller.
(29)	[File data] button	The button switches the screen to display the data read from the storage file.
(30)	[Set comparison] button	The button displays the [Set comparison] window.
(31)	Count	The area displays the number of stored data acquired.
(32)	State	The area displays the current storage status. The statuses to be displayed are: • Storing • Stop • Not connected • File (the status where a file selected from [Open storage file] has been opened.)
(33)	Graph display area	The area displays the graph of the storage.
(34)	[OUT display setting] area	Selects OUT to display the trend graph.

No.	Names	Description
(35)	[Data search] button	The button displays the [Data search] dialog.
(36)	Data display area	The area displays the data of the storage.

Graph display area

■ Vertical axis

The measurement value is displayed.
When you click the [Enlarge in vertical direction] or [Reduce in vertical direction] button, the range per grid narrows or widens.

■ Horizontal axis

The horizontal axis displays 50000 points of data.
When you click the [Horizontal direction to cursor AB] button and if the number of data points between the cursors A and B is smaller than 100 points, 100 points from the left end between the cursors A and B becomes the display area.

■ OUT tag

Click an OUT tag to select the corresponding graph.
Dragging the OUT tag scrolls the graph vertically.
When the graphs are overlaid, the selected OUT tag appears to the front of the display. When no OUT tag is selected, the OUT tag with smaller OUT no. appears to the front of the display.

■ Tolerance

A line showing the tolerance is displayed.
HH and LL are drawn by the dotted lines.
HI, LO, UPPER, and LOWER are drawn by solid lines.
The backgrounds of the tolerance area to be displayed is translucent.

■ Cursors A and B

The cursors A and B appear.
You can check the measurement information at an arbitrary point by dragging the cursor.
If the cursors A and B are overlapped each other when you click the [Select cursor A] or [Select cursor B] button, the selected cursor appears to the front.
If the cursors A and B are overlapped each other when you click the [Select cursor AB] button, the cursor A appears to the front.

Data display area

■ [Target]

OUT is displayed.

■ [OUT name]

The OUT name is displayed.

■ [Cursor A]

The measurement value of the position of the cursor A is displayed.

Reference "------" appears in case of the output waiting data.

■ Judgment result of the cursor A position

The judgment result of the position of the cursor A is displayed.

Reference "------" appears in case of the output waiting data.

■ [Cursor B]

The measurement of the position of the cursor B is displayed.

Reference "------" appears in case of the output waiting data.

■ Judgment result of the cursor B position

The judgment result of the position of the cursor B is displayed.

Reference "------" appears in case of the output waiting data.

■ [Cursor A-B]

The value after subtracting the measurement of the cursor B position from that of the cursor A position is displayed.

■ [Max A-B]

The maximum value between the cursors A and B is displayed.

■ [Min A-B]

The minimum value between the cursors A and B is displayed.

■ [Avg A-B]

The average of measurements between the cursors A and B is displayed.

■ [A-B deviation]

The standard deviation of measurements between the cursors A and B is displayed.

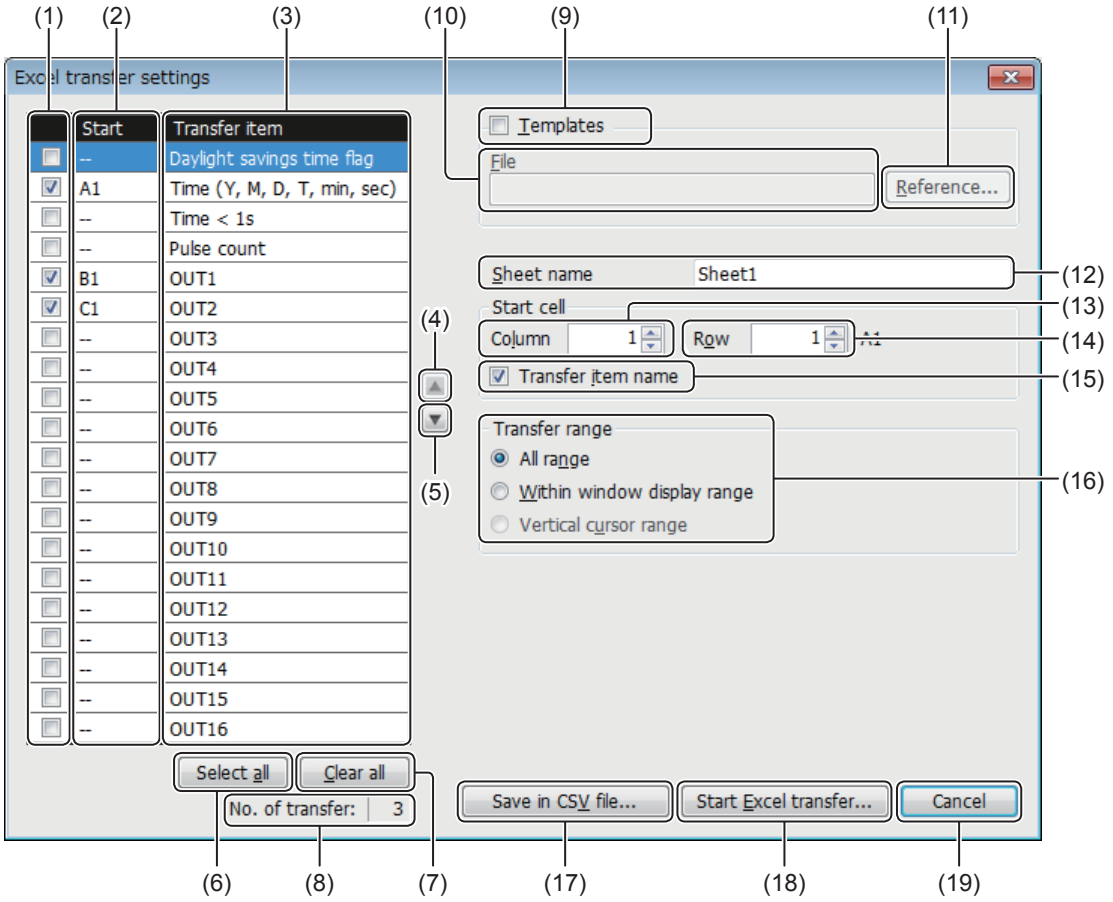
■ [Acq date]

Date and time (year, month, date, hour, minute, and second) when the measurements of the positions of the cursors A and B are displayed.

■ [Pulse count]

The pulse count of the positions of the cursors A and B are displayed when the encoder is used.
“[Encoder set] area” (page 5-90)

[Excel transfer settings] dialog



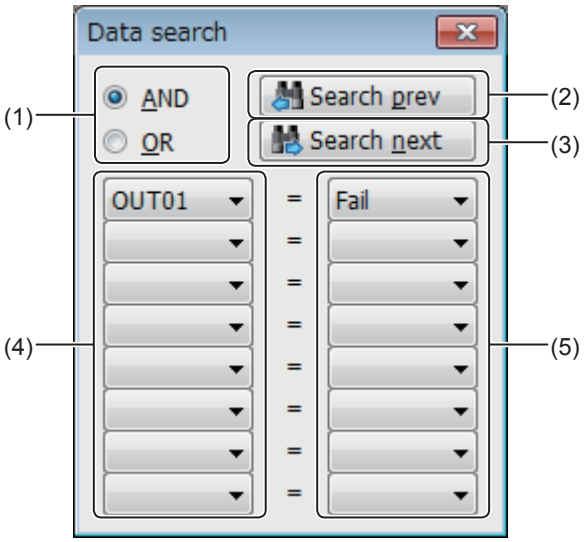
No.	Names	Description
(1)	[Transfer setting] check box	The check box selects the items to be transferred to Excel.
(2)	[Start]	The area shows the start cell on Excel of the transfer item (*1).
(3)	[Transfer item]	The area displays the items to be transferred to Excel.
(4)	button	Clicking the button moves the transfer item in the selected line one line up.
(5)	button	Clicking the button moves the transfer item in the selected line one line down.
(6)	[Select all] button	Clicking the button checks the check boxes of all the transfer items.
(7)	[Clear all] button	Clicking the button un-checks the check boxes of all the transfer items.
(8)	[No. of transfer]	The area displays the number of transfer items whose check boxes are checked.
(9)	[Templates] check box	The check box selects whether to use a template (Excel file) for the Excel sheet to which the items are transferred.
(10)	[File]	When any template is specified, the area displays its file path. Entries can be up to 256 characters.
(11)	[Reference] button	Clicking the button displays the reference dialog to specify the template.
(12)	[Sheet name] setting	The work sheet name can be entered, to which the transfer is performed. Entries can be up to 31 characters.
(13)	[Column] setting	Enter the first column to which the transfer item is written (*2).
(14)	[Row] setting	Enter the first row to which the transfer item is written (*3).

No.	Names	Description
(15)	[Transfer item name] check box	The check box selects whether to transfer the item or not.
(16)	[Transfer range] radio button	The button specifies the range of data to be transferred to Excel. • All range: All the accumulated data are transferred. • Within window display range: Data displayed on the screen are transferred. • Vertical cursor range: Data between the cursors A and B are transferred. This option can be selected when both the cursors A and B are displayed on the graph display area.
(17)	[Save in CSV file] button	The button saves the measurements in a CSV file.
(18)	[Start Excel transfer] button	Send measurement value to Excel.
(19)	[Cancel] button	The button closes the dialog.

*1: All the transfer items may not be displayed on the Excel because of limitation in the display area of Excel. In this case, "--" appears and an error occurs.
*2: The range you can enter is:
- Excel 2007 or later: 1 to 16384
- Excel 2003 or older: 1 to 256

*3: The range you can enter is:
- Excel 2007 or later: 1 to 1048576
- Excel 2003 or older: 1 to 65536

[Data search] dialog

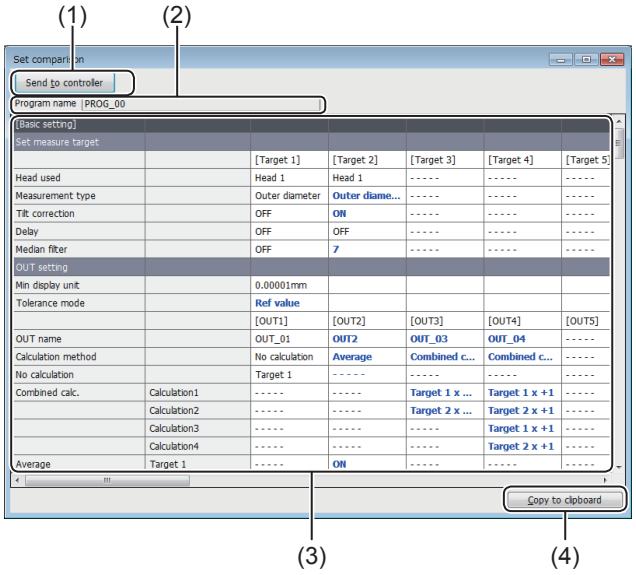


No.	Names	Description
(1)	[AND] and [OR] radio buttons	The buttons select the condition to search the measurements. [AND]: Search the measurements meeting all the search conditions set. [OR]: Search the measurements meeting any of the search conditions set.
(2)	[Search prev] button	The button searches previous data.
(3)	[Search next] button	The button searches next data.
(4)	Target OUT drop-down list	OUT to be searched is selected from the list.
(5)	Judgment result drop-down list	The judgment result of the search target is selected from the list.

* When the measurements meeting the condition exist continuously, the change point of the condition is detected.

[Set comparison] window

The window displays the setting for the search of the file selected from [Open storage file].



No.	Names	Description
(1)	[Send to controller] button	The button sends the displayed settings to the controller.
(2)	[Program name]	The program name is displayed.
(3)	Setting list	The list displays the settings (*1).
(4)	[Copy to clipboard] button	The button copies the contents displayed on the setting list screen to the clipboard. The setting list is copied in a tab-delimited text format.

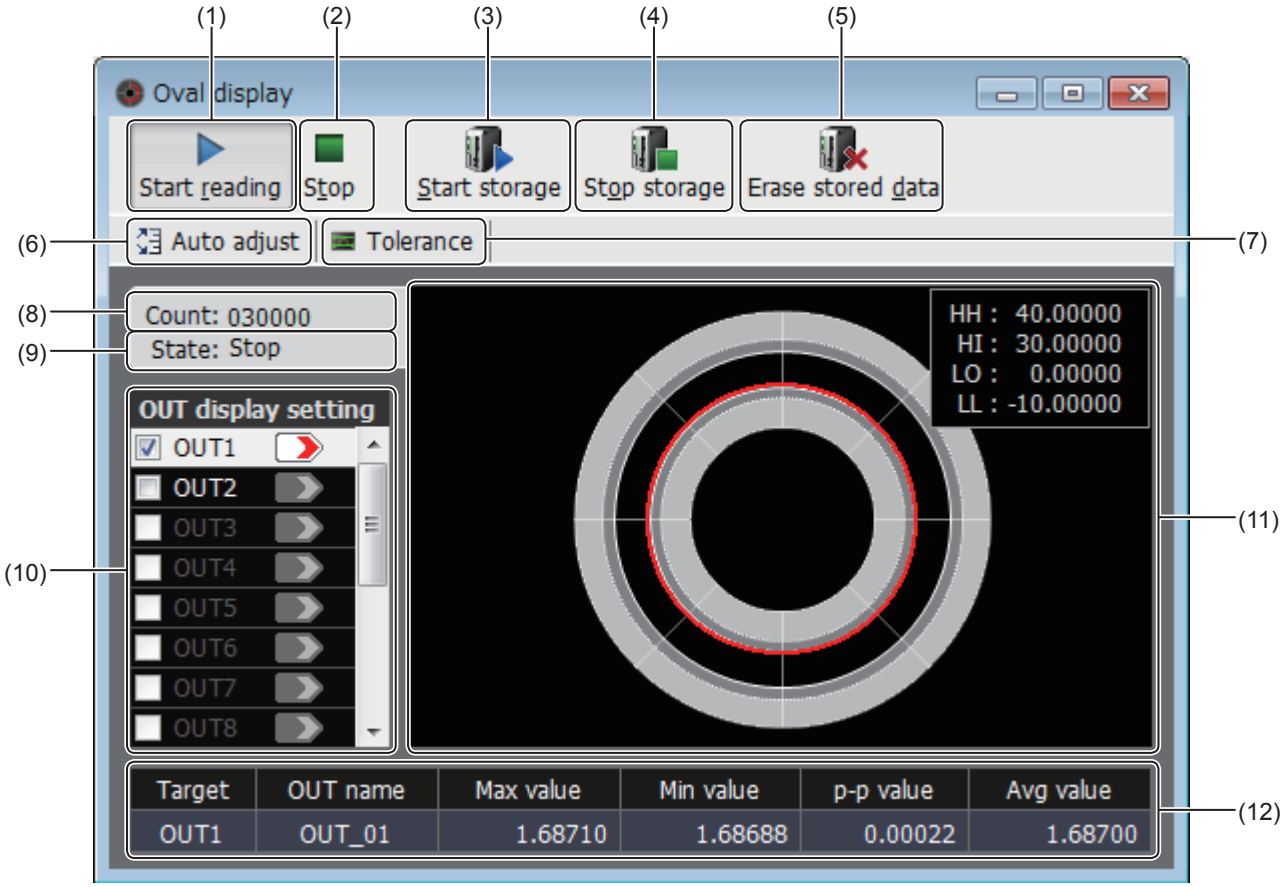
*1: Updated items are displayed in blue. When you put the mouse cursor on the item in blue, in case there is communication with the controller, the controller setting before the change appears as a tooltip. When no synchronization has ever been done in case there is communication with the controller, the running program uses the default value for the setting. Also, no comparison is done for the setting change.

MEMO

Oval Display

The oval display is used together with the data storage function. The oval display displays the measurement result on the oval graph. 360 degrees is evenly divided by "Storage points" of the data storage setting, and the measurements are plotted for each point.

[Oval display] screen



No.	Names	Description
(1)	[Start reading] button	The button starts storing the data.
(2)	[Stop] button	The button stops storing the data.
(3)	[Start storage] button	The button reads the storage data.
(4)	[Stop storage] button	The button stops reading the storage data.
(5)	[Erase stored data] button	The button clears the storage data.
(6)	[Auto adjust] button	The button adjusts the graph's radial axis so as to display all data.
(7)	[Tolerance] button	The button puts the radial axis in line with the tolerance.
(8)	[Count]	The area displays the number of storage data acquired.
(9)	[State]	The area displays the current storage status. The statuses to be displayed are: - Storing - Stop - Not connected
(10)	[OUT display setting] area	Select which OUT to display in the oval graph. You can display one OUT at a time.
(11)	Oval display area	The area displays the oval graph.
(12)	Data display area	The area displays the data of the oval graph displayed.

Oval display area

■ Radial axis

The radial axis is a graph's scale shown by the radius of the oval graph.
The scale is calculated and displayed by the stored data or the tolerance.

■ Tolerance

A line to show the tolerance is displayed.
“Tolerance” (page 6-18)

Data display area

■ [Target]

Which OUT is displayed.

■ [OUT name]

The name of the OUT to be displayed.

■ [Max value]

The maximum value of the data storage is displayed.

■ [Min value]

The minimum value of the data storage is displayed.

■ [p-p value]

The difference between the maximum and minimum values is displayed.

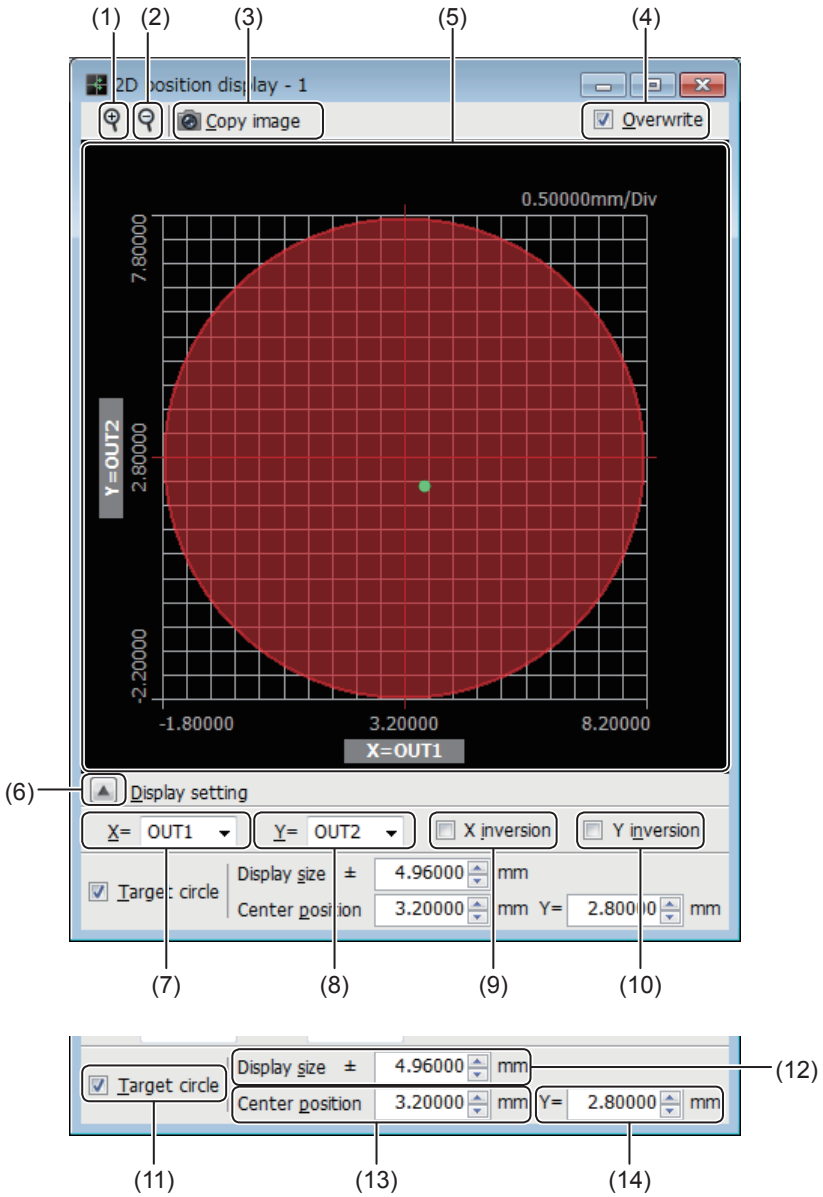
■ [Avg value]

The average value of the data storage is displayed.

2D Position Display

The function checks and adjusts the positional relationship between the target and the sensor head.
The function assigns OUT to the X and Y axes of the display screen and displays the objective position.

[2D position display] screen



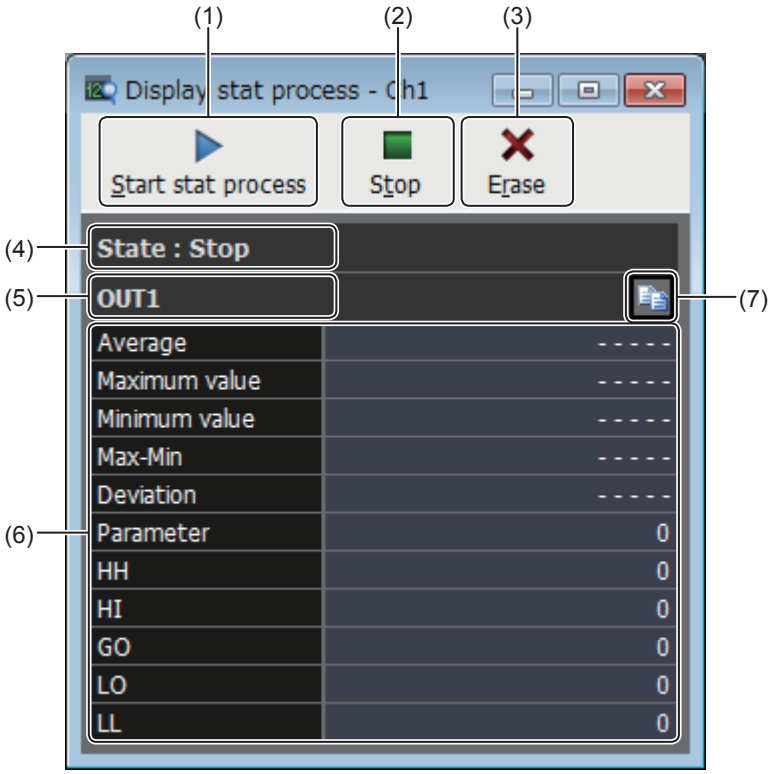
No.	Names	Description
(1)	Enlarge button	The button enlarges the graph.
(2)	Reduce button	The button reduces the graph.
(3)	[Copy image] button	The button copies the graph image to the clipboard.
(4)	[Overwrite] check box	Turning the check box on draws the record points up to 6000. After that, the old record points are overwritten.
(5)	2D position graph	The positional information corresponding to the measurements of OUT1/ OUT2 are plotted.
(6)	Display setting area display/hide button	This button switches between display/hide of the display setting area.
(7)	[X] drop-down list	OUT to be displayed on the X axis of the 2D position graph is selected from the drop-down list.

No.	Names	Description
(8)	[Y] drop-down list	OUT to be displayed on the Y axis of the 2D position graph is selected from the drop-down list.
(9)	[X inversion] check box	Turning the check box on inverts the displayed X axis.
(10)	[Y inversion] check box	Turning the check box on inverts the displayed Y axis.
(11)	[Target circle] check box	Turning the check box on displays the target circle on the basis of the numeric values entered in [Display size] and [Center position]. The target circle appears in translucent red on the 2D position graph.
(12)	[Display size] setting	Enter the radius of the target circle.
(13)	[Center position X] setting	Enter the X coordinate of the center of the 2D graph (target circle).
(14)	[Center position Y] setting	Enter the Y coordinate of the center of the 2D graph (target circle).

Display Stat Process

“Statistic process settings” (page 5-110)

[Display stat process] screen



No.	Names	Description
(1)	[Start stat process] button	The button starts the statistical processing.
(2)	[Stop] button	The button stops the statistical processing.
(3)	[Erase] button	The button clears the statistical data.
(4)	[State]	The area displays the current status. The statuses are as below. • Processing • Stop • Complete
(5)	OUT	OUT to be processed statistically is displayed.
(6)	Statistical information display area	The area displays the statistical information.
(7)	[Copy] button	The button copies the statistical information displayed on the statistical information display area to the clipboard.

Statistical information display area

The stat process takes place with the data that was confirmed during the TIMING input. Several kinds of results are displayed for the acquired data.

Reference The number of data that the statistical processing can acquire is 999999 at maximum.

■ [Average]

The average value is displayed.

■ [Maximum value]

The maximum value is displayed.

■ [Minimum value]

The minimum value is displayed.

■ [Max-Min]

A value after subtraction of the minimum value from the maximum value is displayed.

■ [Deviation]

The standard deviation is displayed.

■ [Parameter]

The total number of the data used for the statistics is displayed.

■ [HH]

The number of data points whose judgment is HH.

■ [HI]

The number of data points whose judgment is HI.

■ [GO]

The number of data points whose judgment is GO.

■ [LO]

The number of data points whose judgment is LO.

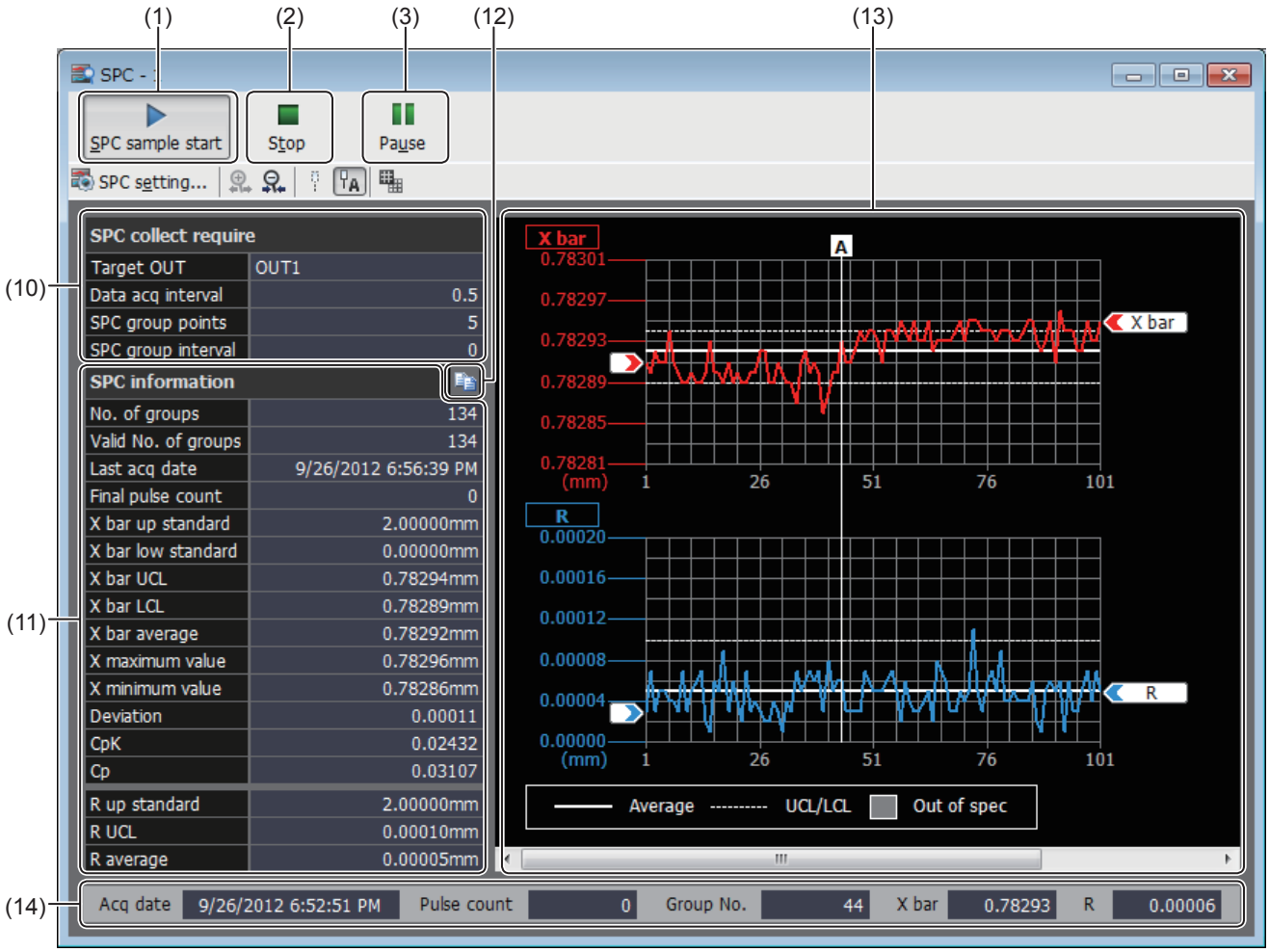
■ [LL]

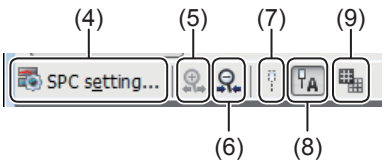
The number of data points whose judgment is LL.

SPC

The screen performs the statistical process control (SPC) for one arbitrary OUT. Use SPC to check the process performance of a target manufactured continuously.

[SPC] screen



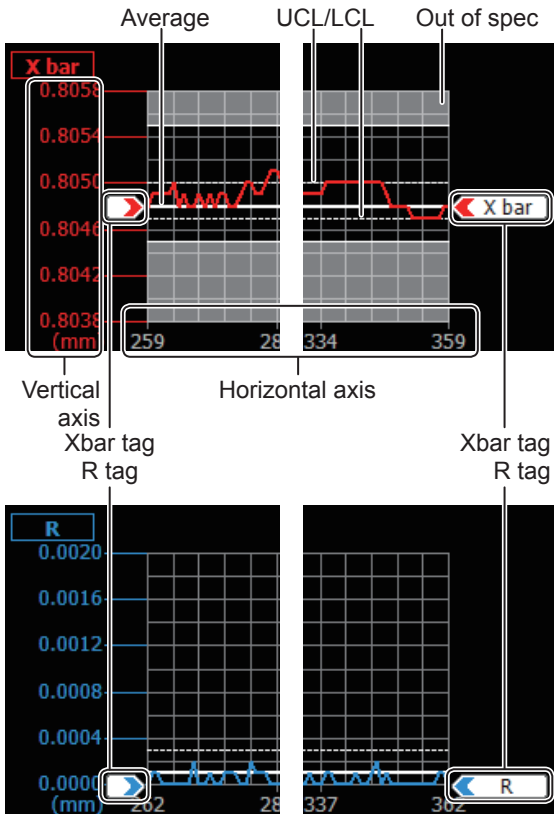


No.	Names	Description
(1)	[SPC sample start] button	The button starts the acquisition of samples for SPC.
(2)	[Stop] button	The button stops the acquisition of the samples for SPC.
(3)	[Pause] button	The button suspends the acquisition of the samples for SPC.
(4)	[SPC setting] button	The button displays the dialog to set the collection of SPC and the display of the graph.
(5)	[Enlarge in horizontal direction] button	The button enlarges the horizontal axis of the graph. The area per grid narrows.
(6)	[Reduce in horizontal direction] button	The button reduces the horizontal axis of the graph. The area per grid widens.
(7)	[Hide cursor] button	The button hides the cursor on the graph display area.

No.	Names	Description
(8)	[Select cursor A] button	The button displays and activates the cursors A in the graph display area. You can check the measurement information at an arbitrary point by dragging the cursor.
(9)	[Inversion of background color] button	The button inverts the background color of the graph display area.
(10)	[SPC collect require] display area	The area displays the collection conditions for SPC.
(11)	[SPC information] display area	The area displays the collected SPC information.
(12)	[Copy SPC information] button	The button copies the SPC information to the clipboard.
(13)	Graph display area	The area displays the graph of the collected SPC information.
(14)	Cursor data display area	The area displays the SPC information at a cursor position on the graph.

SPC information

Graph display area



■ Vertical axis

The measurement value is displayed.

■ Horizontal axis

The horizontal axis displays 10000 points of data at maximum.
The initial status of the display range depends on [Max. plot pts] set by the [SPC setting] dialog. When the maximum point is smaller than 100, the display range becomes 100 points.

■ X bar tag

The tags show the values displayed at the right and left ends on the Xbar graph.

■ R tag

The R tags show the values displayed at the right and left ends on the R graph.

■ Average

The averages of the Xbar and R are displayed by bold lines, respectively.

■ Upper Control Limit (UCL) / Lower Control Limit (LCL)

UCLs/LCLs of Xbar and R are displayed by dotted lines, respectively.

■ Out of spec

The area (translucent) shows an area out of the specification.

Data display area

■ [Target OUT]

The OUT number to which SPC is performed is displayed.

■ [Data acq interval]

The acquisition interval for the data used for SPC is displayed.

Setting range: 0.5 to 12 seconds

■ [SPC group points]

Xbar and R are calculated from the number of points set.

■ [SPC group interval]

The interval to display Xbar and R are set.

■ [Copy SPC information] button

The button copies the SPC information displayed on the data display area to the clipboard.

■ [No. of groups]

The number of data points to be plotted on the Xbar and R graphs is displayed.

■ [Valid No. of groups]

The number of valid values (abnormal value not included) plotted on the Xbar and R graphs is displayed.

■ [Last acq date]

Date and time (year, month, date, hour, minute, and second) of the data acquired lastly is displayed from among the data plotted on the Xbar and R graphs.

■ [Final pulse count]

The pulse count of the last data acquired is displayed from among the data plotted on the Xbar and R graphs.

■ [X bar up standard]

The upper limit of the Xbar standard is displayed.

■ [X bar low standard]

The lower limit of the Xbar standard is displayed.

■ [X bar UCL]

Upper Control Limit (UCL) of Xbar is displayed.
The calculation formula for Xbar UCL is as below:

Xbar UCL = Xbar average + (K×R average)

SPC group points	K
2	1.880
3	1.023
4	0.729
5	0.577
6	0.483
7	0.419
8	0.373
9	0.337
10	0.308

■ [X bar LCL]

Lower Control Limit (LCL) of Xbar is displayed.
The calculation formula for Xbar LCL is as below:

Xbar LCL = Xbar average - (K×R average)

SPC group points	K
2	1.880
3	1.023
4	0.729
5	0.577
6	0.483
7	0.419
8	0.373
9	0.337
10	0.308

■ [X bar average]

The average value of the data plotted on the Xbar is displayed.

■ [X maximum value]

The maximum value of the data plotted on the Xbar is displayed.

■ [X minimum value]

The minimum value of the data plotted on the Xbar is displayed.

■ [Deviation]

The standard deviation of the data plotted on the Xbar is displayed.
The calculation formula for the standard deviation is as below:

σ = R average/d

SPC group points	d
2	1.128
3	1.693
4	2.059
5	2.326
6	2.534
7	2.704
8	2.847
9	2.970
10	3.078

■ [CpK]

OUT is displayed.
Among the following calculation results, the smaller one is CpK.

- (Xbar up standard - Xbar average)/3σ
- (Xbar average - Xbar low standard)/3σ

Reference Depending on the calculation result, the following appears:

- For 10000000 or more: "+INF"
- For -10000000 or smaller: "-INF"
- When the standard deviation is very small and the formula nearly equals division by zero: "*****"

■ [Cp]

Cp is displayed.
The calculation formula for Cp is as below:

(Xbar up standard - Xbar low standard)/6σ

Reference Depending on the calculation result, the following appears:

- For 10000000 or more: "+INF"
- For -10000000 or smaller: "-INF"
- When the standard deviation is very small and the formula nearly equals division by zero: "*****"

■ [R up standard]

The upper limit of the R standard is displayed.
The calculation formula for the R standard upper limit is either one of the following. It depends on the selection of [Standard] in the [SPC setting] dialog.

- Target OUT tolerance "HI - LO"
- Xbar up standard - Xbar low standard

■ [R UCL]

UCL of the data plotted on the R graph is displayed.
The calculation formula for R UCL is as below:

R UCL = D×R average

SPC group points	D
2	3.267
3	2.574
4	2.282
5	2.114
6	2.004
7	1.924
8	1.864
9	1.816
10	1.777

■ [R average]

The average value of the data plotted on the R graph is displayed.

■ [Acq date]

The acquisition date of the position of the cursor A is displayed.

■ [Pulse count]

The pulse count of the position of the cursor A is displayed.

■ [Group No.]

The group number of the position of the cursor A is displayed.

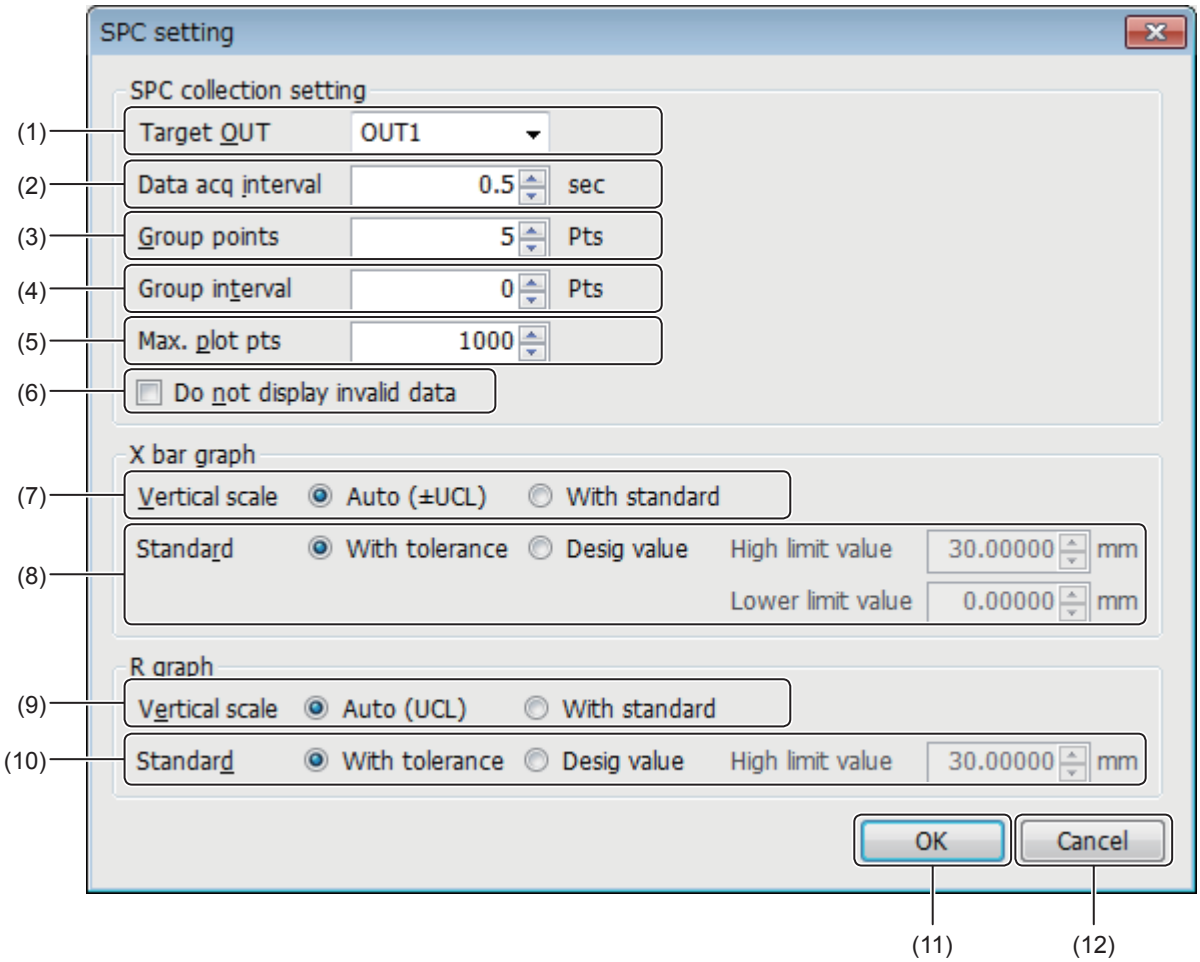
■ [X bar]

Xbar of the position of the cursor A is displayed.
When one data within the group includes an abnormal value, the following appears.
Even a single case of [***] : [***]
No [***], but even a single case of [---] : [---]
1 or more cases of +OVER(-OVER) only : +OVER(-OVER)
In case of both +OVER and -OVER : ***

■ [R]

R of the position of the cursor A is displayed.
When one data within the group includes an abnormal value, the following appears.
Even a single case of [***] : [***]
No [***], but even a single case of [---] : [---]
One or more cases of +OVER or -OVER : ***

[SPC setting] dialog



No.	Names	Description
(1)	[Target OUT] drop-down list	Select OUT to be a base for SPC calculation.
(2)	[Data acq interval] setting	Enter the interval to acquire the data.
(3)	[Group points] setting	Xbar and R are calculated from the data of the set points.
(4)	[Group interval] setting	Set the interval to display Xbar and R.
(5)	[Max. plot pts] setting	Set the upper value of the plot points to be displayed on the graph.
(6)	[Do not display invalid data] check box	Select whether or not to display invalid data on the graph display area.
(7)	[Vertical scale] radio button	Select the method to draw the vertical axis.
(8)	[Standard] radio button	Select the standard value.
(9)	[Vertical scale] radio button	Select the method to draw the vertical axis.
(10)	[Standard] radio button	Select the standard value.
(11)	[OK] button	Fix the SPC setting after editing.
(12)	[Cancel] button	Cancel the SPC setting after editing.

SPC setting

[SPC collection setting] area

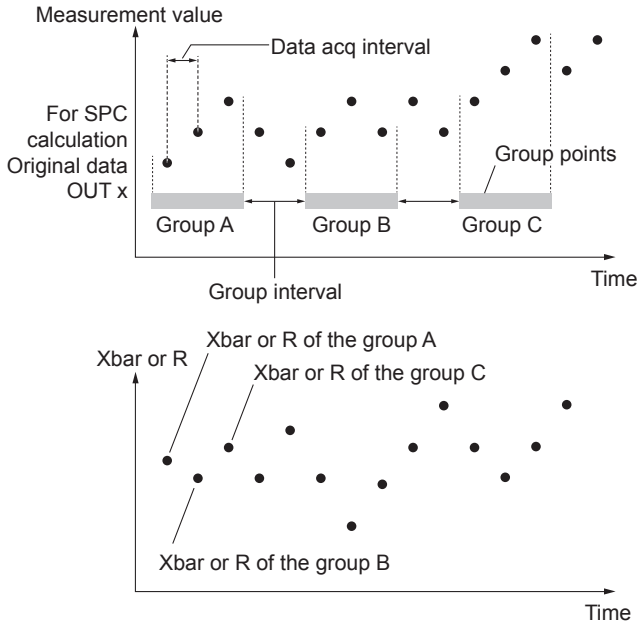
This area sets the collection of SPC.
You can set the SPC collection setting only when the sample acquisition is suspended.

● **Screen examples of SPC**

The following four relationship are shown as below.

- Data acq interval
- Group points
- Group interval
- Xbar, R graph

When Group points: 3, and Group interval: 2,



■ **Target OUT**

OUT not used for the program setting appears in gray.

■ **Data acq interval**

The acquisition interval for the data used for SPC is displayed.

Setting range: 0.5 to 1.2

■ **Group points**

Xbar and R are calculated from the data of the set points.

Setting range: 2 to 10

■ **Group interval**

Set the data interval to display Xbar and R on the graph.

Setting range: 0 to 1000

■ **Max. plot pts**

Max. plot pts is the upper limit value of the points to be displayed on the graph. When the points reaches the upper limit, oldest points are deleted.

Setting range: 1 to 10000

[X bar graph] area

Settings for displaying the graph.

■ Vertical scale

● **[Auto (±UCL)]**

The graph is automatically plotted in accordance with the upper and lower limit of UCL.

● **[With standard]**

The graph is plotted relative to the standard.

■ Standard

● **[With tolerance]**

The standard related to the tolerance is used.

● **[Design value]**

The values entered in [High limit value] and [Low limit value] are used as the standard.
Set the value so as to keep the relationship "[High limit value] > [Low limit value]".

[R graph] area

Settings for displaying the R graph.

■ Vertical scale

● **[Auto (±UCL)]**

The graph is automatically plotted in accordance with UCL.

● **[With standard]**

The graph is plotted relative to the standard.

■ Standard

● **[With tolerance]**

The standard related to the tolerance is used.

● **[Design value]**

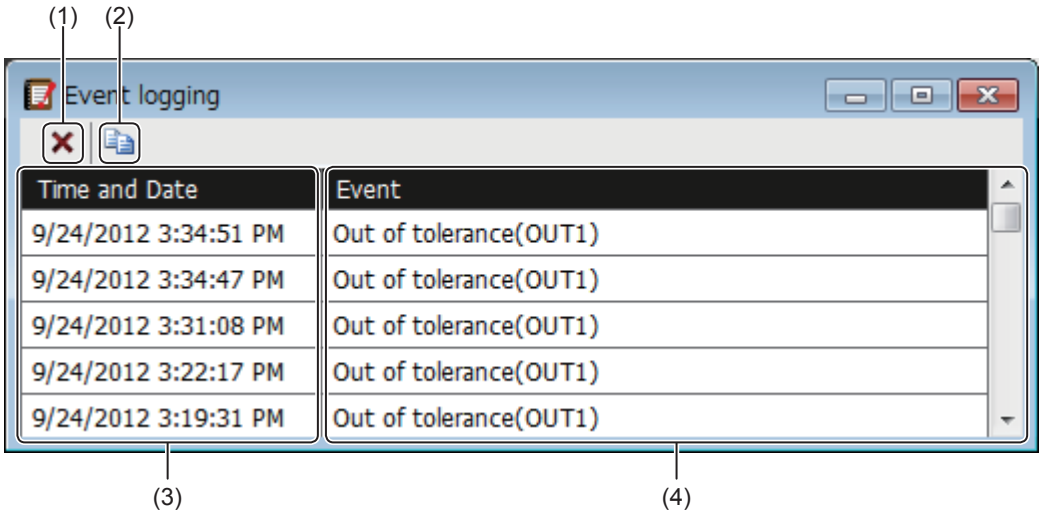
The value entered in [High limit value] is used as the standard.

MEMO

Event Logging

The event logging function records the setting changes and changes in the measurement condition.
The condition change is continually stored in the controller and automatically displayed when the event logging window is opened.

[Event logging] screen



No.	Names	Description
(1)	[Clear event log] button	The button clears the event log displayed.
(2)	[Copy] button	The button copies the displayed event log to the clipboard.
(3)	[Time and Date]	Time and date of the occurred event is displayed with year, month, date, hour, minute, and second.
(4)	[Event]	The content of the occurred event is displayed.

Event logging

When the following changes occur, the changes are logged as the event log data.

Event name	Contents
No event	"No event" is logged when no event has occurred.
Clear event log data	"Clear event log data" is logged when the event log data is cleared.
Change time and date	"Change time and date" is logged when time and date are changed. This event is logged according to the setting before the change of time and date.
Program setting change	"Program setting change" is logged when the setting of the running program is changed.
Program switch	"Program switching" is logged when the program is switched.
Clear key lock	"Clear key lock" is logged when the key lock of the display panel is cleared.
Auto zero	"Auto zero" is logged when the auto zero is turned on or off.
Status output generation	"Status output generation" is logged when the status output turns on or off. The status change is monitored every second.
Out of tolerance	"Out of tolerance" is logged when the tolerance is out of the tolerance range. The status change is monitored every second.
Light intensity calibration	"Light intensity calibration" is logged when "Stop (restore to the factory default)" or "Stop (save)" of the light intensity calibration is performed.
Disconnection detection	"Disconnection detection" is logged when disconnection (coming off) of the following devices is detected. • Head - Controller • Expansion unit - Controller • Extension unit - Controller

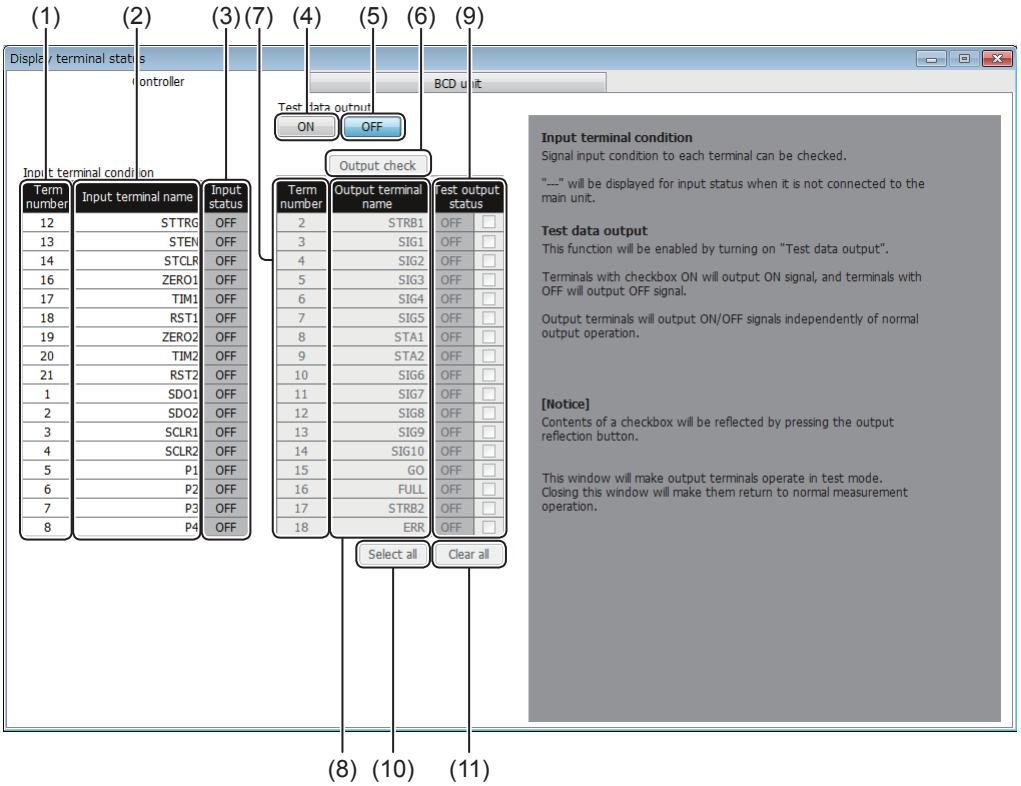
Up to 100 logs can be stored in the controller. When LS-Navigator2 and the controller communicate and the event logging screen is opened, the log data in the controller is automatically read.
LS-Navigator2 can log up to 1000 events.

Display Terminal Status

The display provides a function to check the state of the input and output terminals.
The input signal shows ON/OFF of the signal from an external device. The output signal outputs the test signal of ON/OFF to check the status.

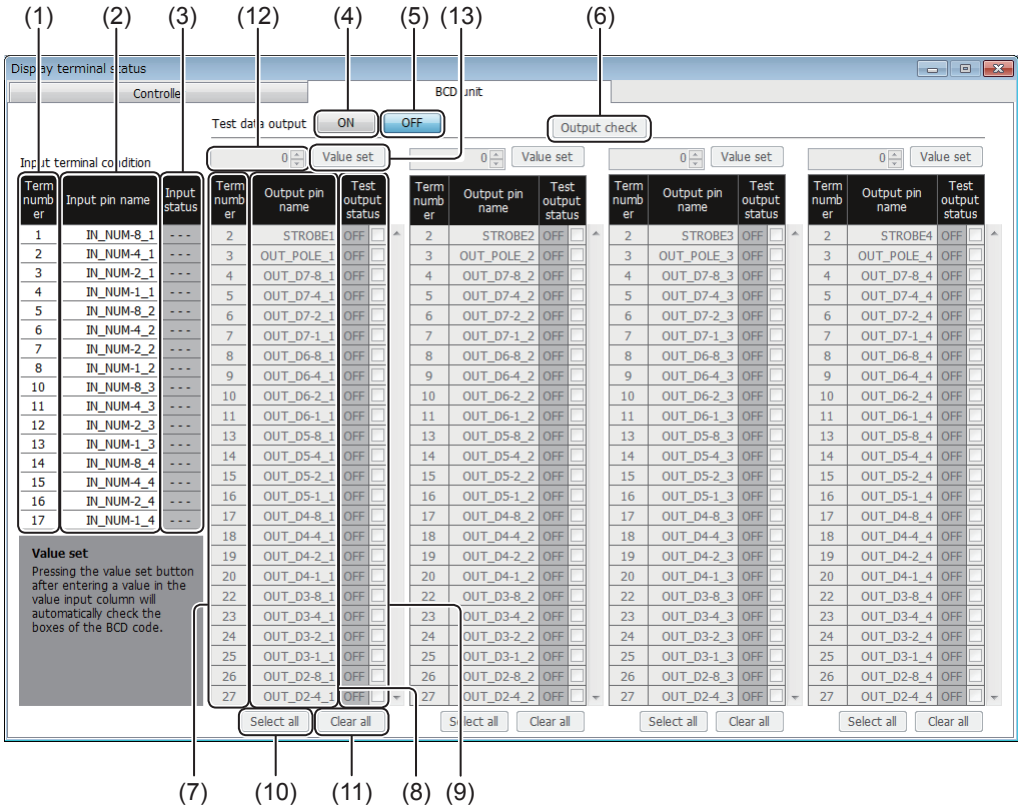
[Display terminal status] screen

[Controller] tab



No.	Names	Description
(1)	[Term number]	The area displays the input terminal number.
(2)	[Input terminal name]	The area displays the input terminal name.
(3)	[Input status]	The area displays the input status.
(4)	[ON] button	Turn on the button when you use the test data output function.
(5)	[OFF] button	Turn off the button when you stop use of the test data output function.
(6)	[Output check] button	The button outputs the test data.
(7)	[Term number]	The area displays the output terminal number.
(8)	[Output terminal name]	The area displays the output terminal name.
(9)	[Test output status]	The area displays the data from the output terminal.
(10)	[Select all] button	The button checks the check boxes of all the output terminals.
(11)	[Clear all] button	The button clears the check boxes of all the output terminals.

[BCD Unit] tab



No.	Names	Description
(1)	[Term number]	The area displays the input terminal number.
(2)	[Input terminal name]	The area displays the input terminal name.
(3)	[Input status]	The area displays the input status.
(4)	[ON] button	Turn on the button when you use the test data output function.
(5)	[OFF] button	Turn off the button when you stop use of the test data output function.
(6)	[Output check] button	The button outputs the test data.
(7)	[Term number]	The area displays the output terminal number.
(8)	[Output terminal name]	The area displays the output terminal name.
(9)	[Test output status]	The area displays the data from the output terminal.
(10)	[Select all] button	The button checks the check boxes of all the output terminals.
(11)	[Clear all] button	The button clears the check boxes of all the output terminals.
(12)	[Numerical value input] setting	Enter the numerical values to be output as the test data.
(13)	[Value set] button	[Test output status] will be selected according to the number entered in the [Numerical value input] setting.

Outputting test data

Outputting test data

1 Click the [OK] button of the test data output item.

2 Check or clear the check box of the test output status.

Reference

- When you enter a numeric value into the [Numerical value input] field and then pressing the [Value set] button, the BCD code corresponding to the numeric value will be set in the checkbox field.
- Clicking the [Select all] button checks the check boxes of all the terminals.
- Clicking the [Clear all] button clears the check boxes of all the terminals.

3 Click the [Output check] button.

The test data are output such that the terminal whose [Test output status] is ON becomes High, and the terminal of OFF becomes Low.

7

Environment Setting

This section describes the details and setting procedures for the PC communication configuration, instrument information setting and other options.

PC communication configuration 7-2
Instrument information display setting 7-5
Optional settings 7-18
Language setting 7-21
Help 7-22

PC communication configuration

Configures the communication settings for connecting the PC and the controller. LS-Navigator2 is used to perform the setting.

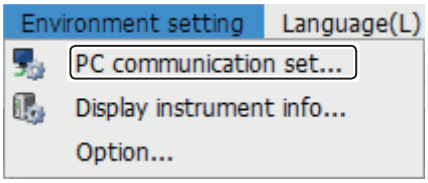
You can select from the following communication modes:

- USB “Communicate via USB” (page 7-2)
- Ethernet ”Communicate via Ethernet” (page 7-2)

Communicate via USB

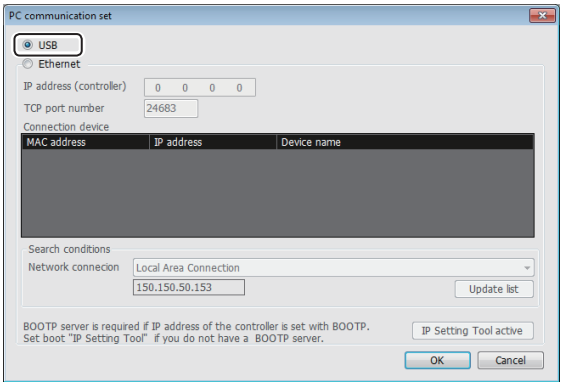
This section describes the setting procedure for connecting the PC to the controller using USB.

1 Select [PC communication set] under the [Environment Setting] menu.

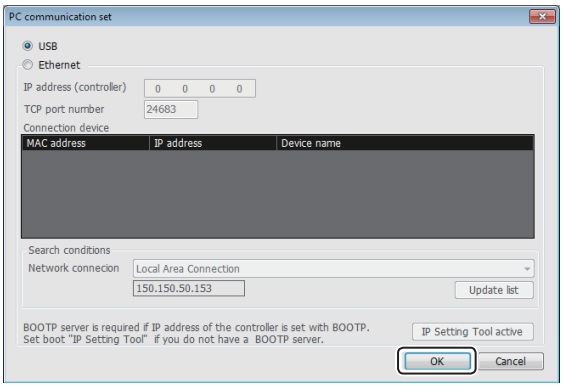


The [PC communication set] screen appears.

2 Select [USB].



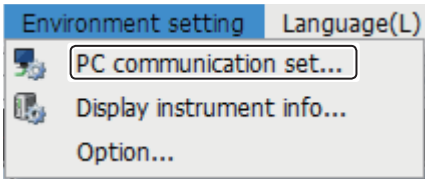
3 Click the [OK] button.



Communicate via Ethernet

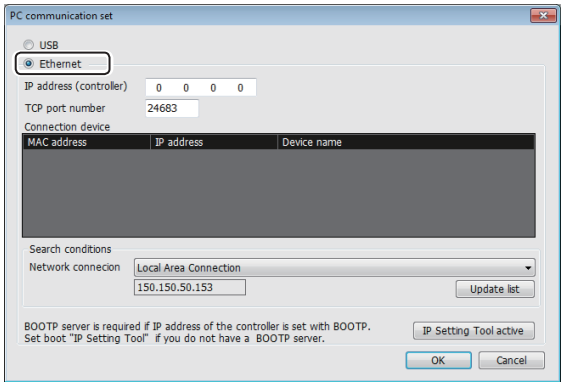
This section describes the setting procedure for connecting the PC to the controller using Ethernet.

1 Select [PC communication set] under the [Environment setting] menu.



The [PC communication set] screen appears.

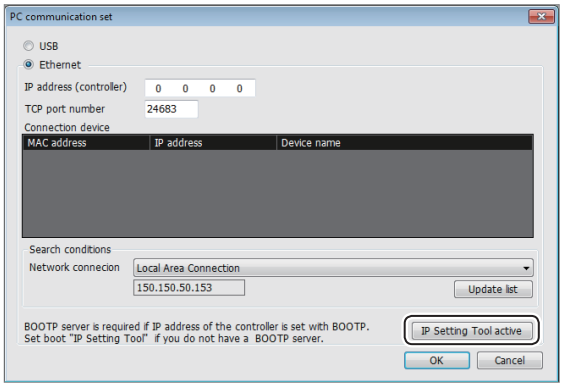
2 Select [Ethernet].



If you are connecting to the controller using Ethernet for the first time (i.e. in the factory default state), either use a BOOTP server or configure the communication setting using the included IP Setting Tool.
The following describes the procedure for starting and setting the IP Setting Tool.

Point **If the controller you wish to connect is shown in the [Connection device] field, proceed to 9.**

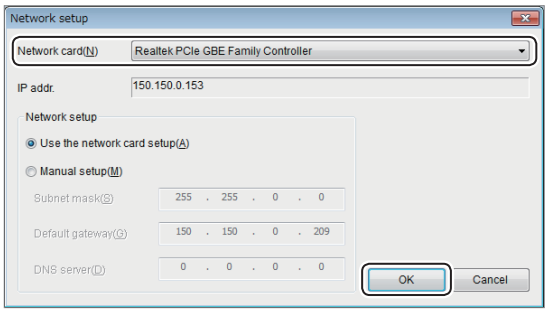
3 Click the [IP Setting Tool active] button.



Point **If the IP Setting Tool is not installed, the [IP Setting Tool active] button will be grayed out. The IP Setting Tool is included on the LS-H2 CD-ROM. Install the IP Setting Tool and then open the [PC communication set] screen again.**

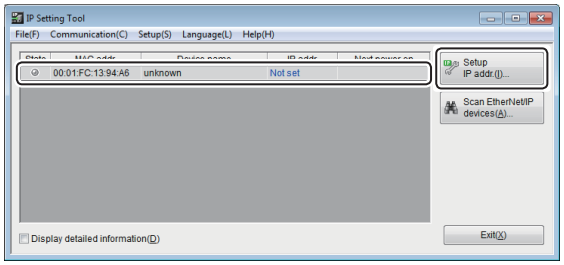
The IP Setting Tool starts and the [Network setup] screen is displayed.

4 Select a network card and click the [OK] button.



Reference You can perform this setting when the PC has two or more Ethernet connectors.

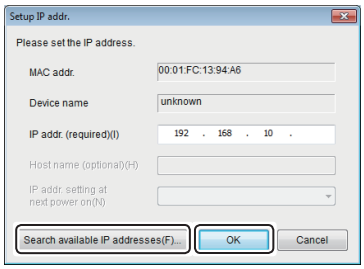
5 A start-up of BOOTP on an Ethernet device with no allocated IP address will be detected and displayed on the screen. Select the controller you wish to connect to, and click the [Setup IP addr.] button.



Reference If the controller you wish to connect to is not shown, check the following:

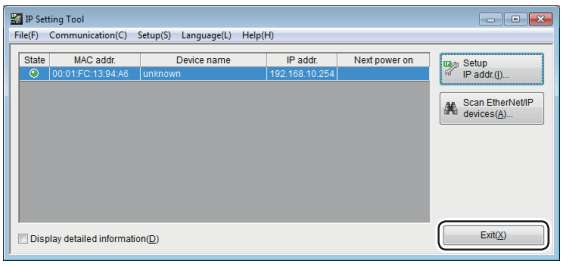
- Check whether the PC and the controller are properly connected to the network.
- Make sure that the firewall of the PC is not blocking the IP Setting Tool.
- Make sure that the [The next power-on operation] setting of the controller is not set to [Fixed IP address].
  To check this, you need to connect the PC to the controller using USB.
  "Setting at next power ON" (page 7-11)

6 Click the [Search available IP addresses] button to search for available IP addresses. When an available IP address is found, enter it in the [IP addr. (required)] field and click the [OK] button.

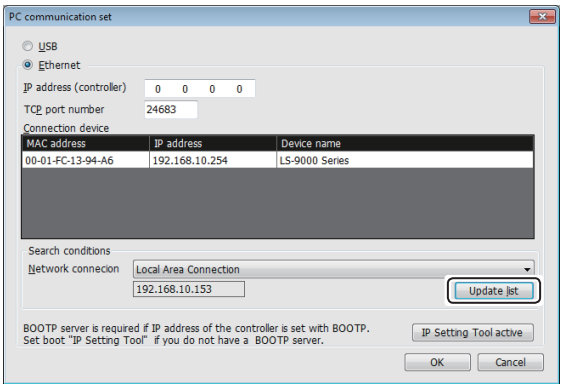


7 When the screen showing that the IP address was successfully set appears, click the [OK] button.

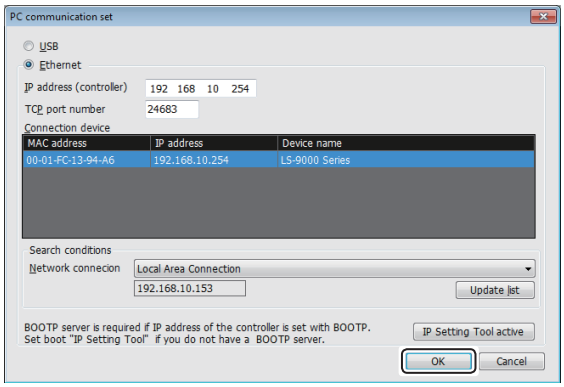
8 Click the [Exit] button to shut down the IP Setting Tool.



9 Click the [Update list] button to show the controller you have just set in the [Connection device] field.

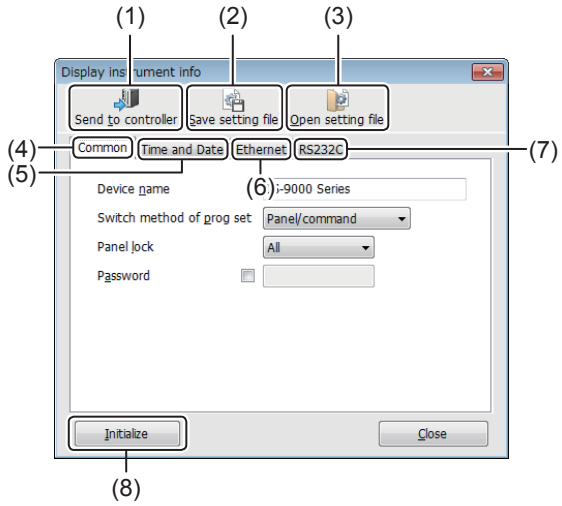


10 When you select the controller you wish to connect from the [Connection device] field, the IP address will be set to [IP address (controller)]. Click the [OK] button to close the screen.



Instrument information display setting

This section describes the items that can be configured on the [Display instrument info] screen.
The [Instrument Information display setting] can be set only when the controller is communicating with PC.

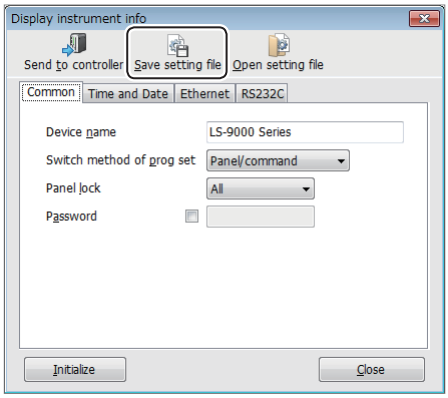


Number	Description
1	Sends the settings to the controller.
2	Saves the device settings file.
3	Loads a device settings file from the PC and reflects the settings to the on-screen items. The device settings files have the .lsus extension.
4	Sets the program switching method and panel lock.
5	Sets the date and time.
6	Set the Ethernet communication settings.
7	Sets the RS-232C communication settings.
8	Resets the settings of the connected controller to their default values.

LS-Navigator2 setting method

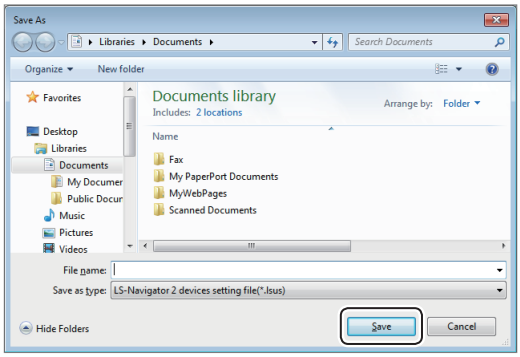
■ Saving the device settings file

1 Click the [Save settings file] button.



The [Save As] dialog will appear.

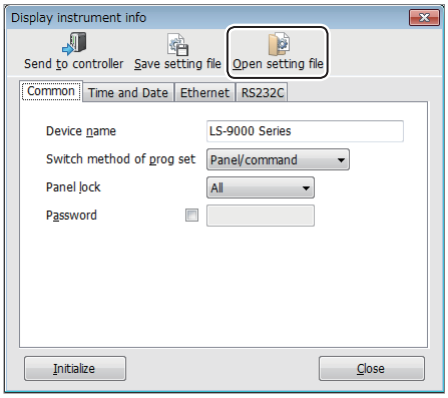
2 Enter a file name and click the [Save] button.



The device settings file is saved.

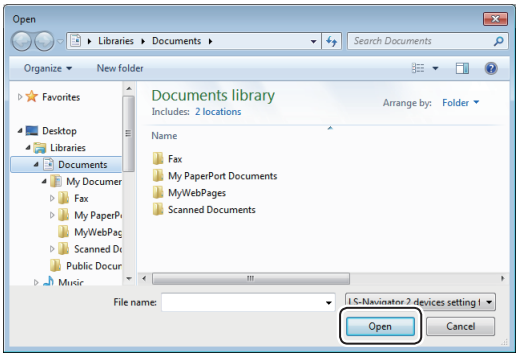
■ Loading the device settings file

1 Click the [Open setting file] button.



The [Open] dialog will appear.

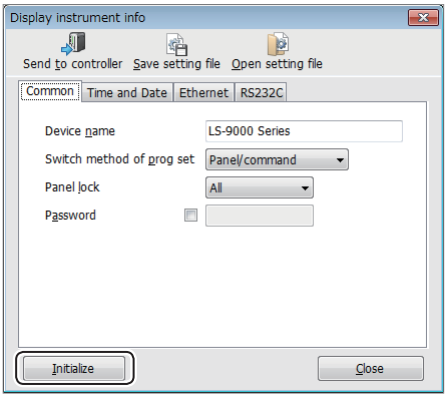
2 Select a settings file, and then click the [Open] button.



The content of the device settings file will be reflected to the [Display instrument info] screen.

■ Initializing the controller setting

1 Click the [Initialize] button.



A confirmation dialog will appear.

2 Click the [OK] button.

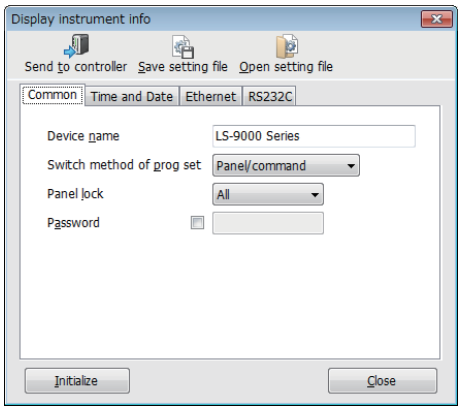
The settings of the controller will be initialized to their factory default values.
A completion dialog will appear.

3 Click the [OK] button.

You will return to the [Display instrument info] screen.

Reference The “Calibration of received light intensity” will not be initialized. If you want to initialize the “Calibration of received light intensity”, performthe “Return calibration of received light intensity to the factory setting” function. (page 5-67)

[Common] tab



■ Program setting switching method

Select the program setting switching method.
The items you can set are:

● Terminal

Switch the program from the P1 to P4 terminal.
“Input terminal block 1” (page 8-7)

● Panel/Command

Switch the program from the display panel, via an RS-232C command, or using LS-Navigator2.

■ Panel lock

You can specify the panel operations to be locked.
The items you can specify are:

● All

All keys will be locked.

● Part

- Display switching ([FUNC]+[2])
- Tolerance setting ([FUNC]+[7])
- TIMING input
- Panel unlock

All keys other than the above will be locked.

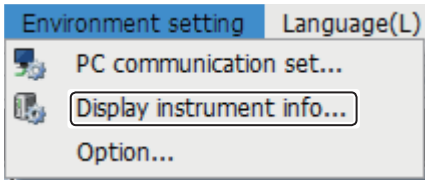
■ Password

Checking this check box will allow you to set a password required to cancel the panel lock.
Specify a 4-digit number for the password.

Reference The password can only be set in LS-Navigator2.

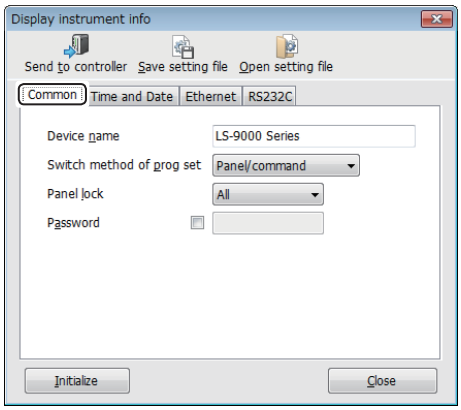
LS-Navigator2 setting method

1 Select [Display instrument info] under the [Environment Setting] menu.

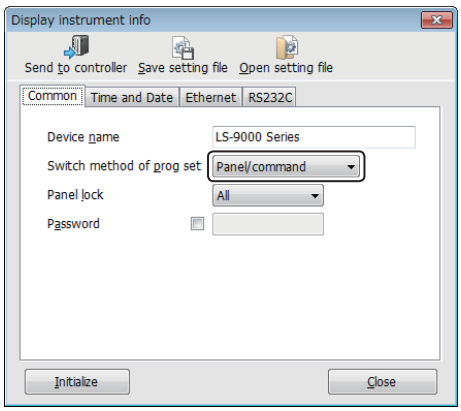


The [Display instrument info] screen will appear.

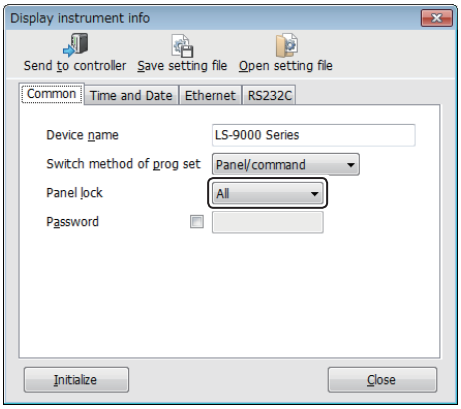
2 Click the [Common] tab.



3 Set the [Switch method of prog set].

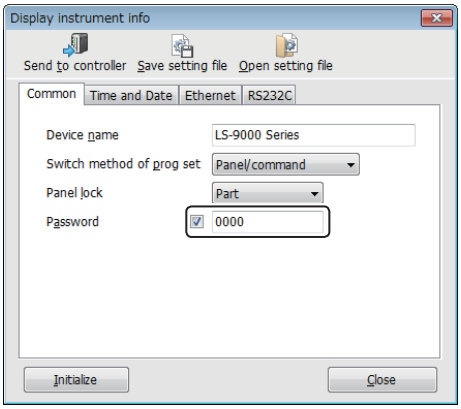


4 Set the [Panel lock].



5 Set the [Password].

Set a password only if it should be required to cancel the panel lock.



6 Click the [Send to controller] button.

The setting will be sent to the destination controller.

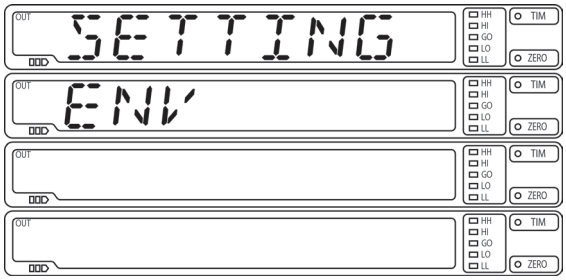
Display panel setting method

■ Method for Setting up the Environment Settings

1 Press [FUNC] key then press [0] key.

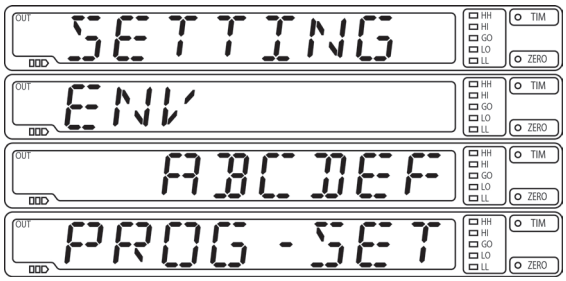
The setting item selection screen appears.

2 Press the [▲] or [▼] keys to select [ENV] and then press the [ENT] key.



3 Configure desired settings and then press [ENT] key.

Refer to the subsequent items.

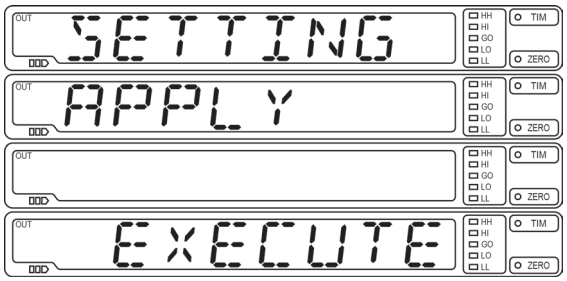


A: PROG-SET (Program switching settings)
B: LOCK-SET (Panel lock settings)
C: RS-232C (RS232C settings)
D: ETHERNET (ETHERNET settings)
E: PROGRAM (Edit program settings)
F: BUZZER (Buzzer settings)

4 Press the [ESC] key, and then the setting item selection screen appears.

5 Press the [▲] or [▼] keys to select [APPLY] and then press the [ENT] key.

6 When [EXECUTE] is displayed, press the [ENT] key.

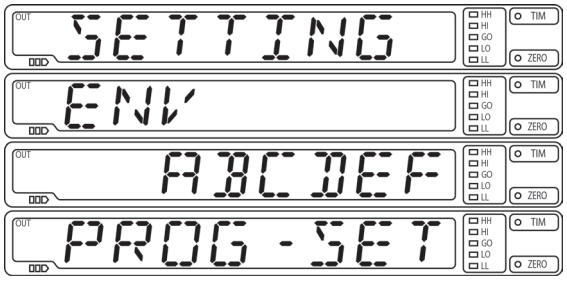


The setting is complete when [COMPLETE] is displayed.

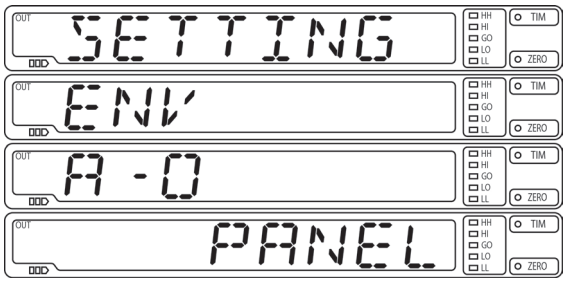
■ Program switching setting

1 Select [PROG-SET] and press the [ENT] key.

“Method for Setting up the Environment Settings” (page 7-8)



2 Set the program switching using the [▲], [▼], [◀], or [▶] keys.



- PANEL
- TERMINAL

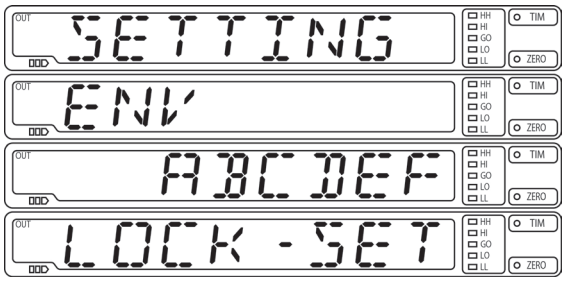
3 Press the [ENT] key.

The function settings screen appears.

■ Panel lock setting

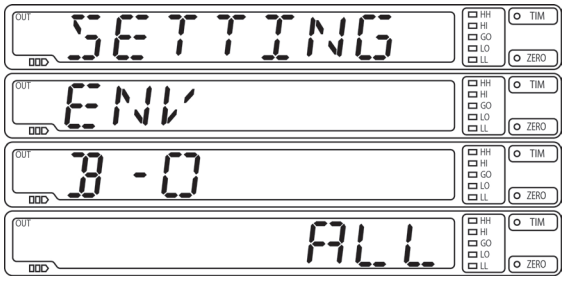
1 Select [LOCK-SET] and press the [ENT] key.

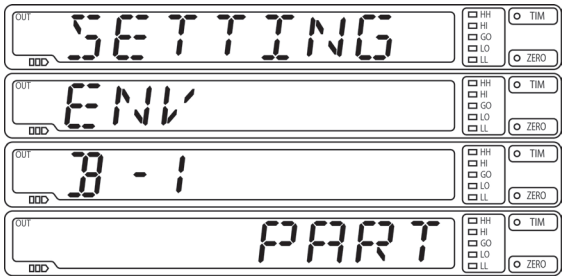
“Method for Setting up the Environment Settings” (page 7-8)



2 Switch the panel lock setting using the [▲], [▼], [◀], and [▶] keys.

- All
- PART

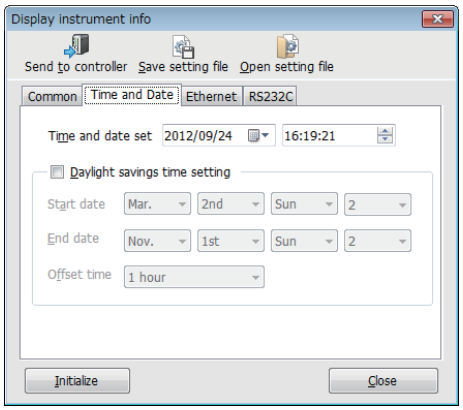




3 Press the [ENT] key.

The function settings screen appears.

[Time and Date] tab



■ Time and Date setting

You can set the date/time in the controller.

■ Daylight savings time setting

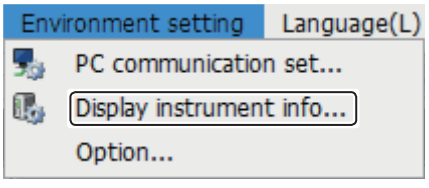
Checking this check box will allow you to set the Daylight savings time setting.
The time specified in [Offset time] will be added to the current time, starting from the date specified in [Start date rule] until the date specified in [End date rule].

Reference

The date/time and Daylight savings time settings can only be set in LS-Navigator2. When setting date/time while the Daylight savings time setting is set, set it in accordance with standard time.

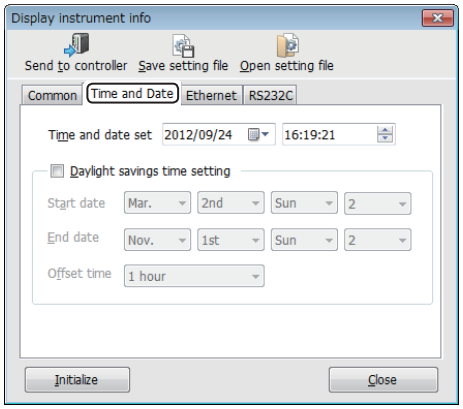
LS-Navigator2 setting method

1 Select [Display instrument info] under the [Environment Setting] menu.

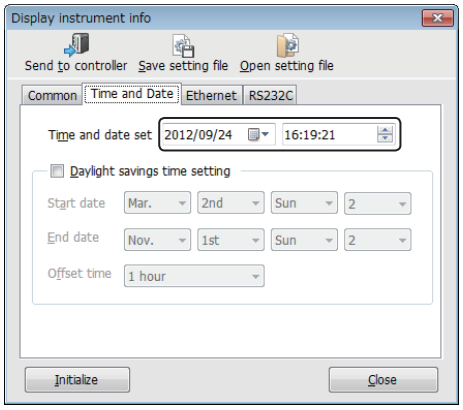


The [Display instrument info] screen will appear.

2 Click the [Time and Date] tab.

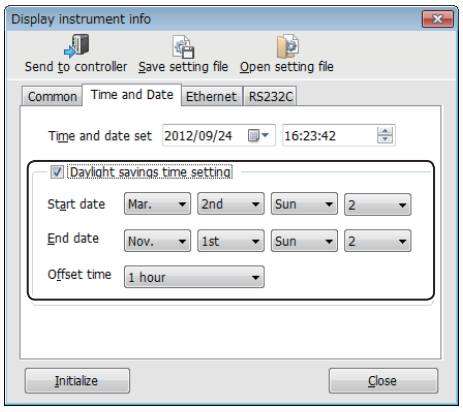


3 Set the [Time and Date set].



4 Check the [Daylight savings time setting] check box, and then set the [Start date], [End date], and [Offset time].

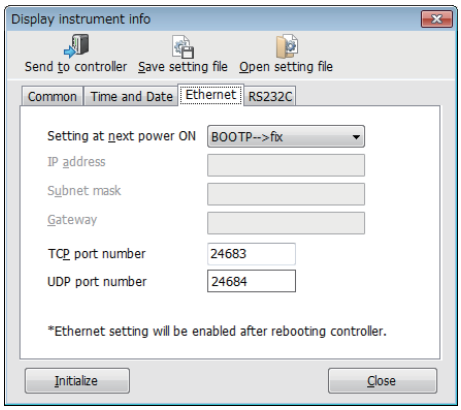
This option should only be enabled when using LS-Navigator2 in an environment where Daylight savings time is used.



5 Click the [Send to controller] button.

The setting will be sent to the destination controller.

[Ethernet] tab



Point

The changes to the Ethernet setting will take effect after you restart the controller.

■ Setting at next power ON

You can set how the controller will acquire the IP address at the next power-on.

● **BOOTP → Fix**

Once you start the controller using the IP address, subnet mask and gateway acquired from BOOTP, the acquired values will be stored as the network setting of the controller. At the next power ON, those information will be used as the [Fixed IP address] setting.

● **Fixed IP add**

The system will start using the set IP address, subnet mask and gateway.

● **BOOTP**

The system will ignore the set IP address, subnet mask and gateway and will start automatically acquiring a new network setting.

■ IP address/Subnet mask/Gateway

Set the IP address, subnet mask, and gateway of the controller at the next power ON.

Reference These are only valid when [Setting at next power ON] is set to [Fixed IP add].

Point

- **The following IP addresses are treated as invalid IP addresses:**
  - **0.0.0.0**
  - **224.0.0.0 to 255.255.255.255**
- **The following addresses are treated as invalid subnet masks:**
  - **There are no consecutive “1” bits from the beginning (Example: 255.255.255.64 = 11111111.11111111.11111111.01000000 is an error)**
- **The following addresses are treated as invalid gateway:**
  - **224.0.0.0 to 255.255.255.255**

■ TCP port number

Set the port number to be used by the controller for sending and receiving commands.

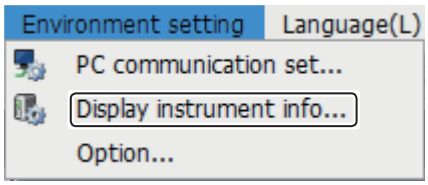
Setting range: 1 to 65535

■ UDP port number

This is the port number to be used by the controller for sending and receiving commands. The UDP port number is a fixed number and cannot be edited.

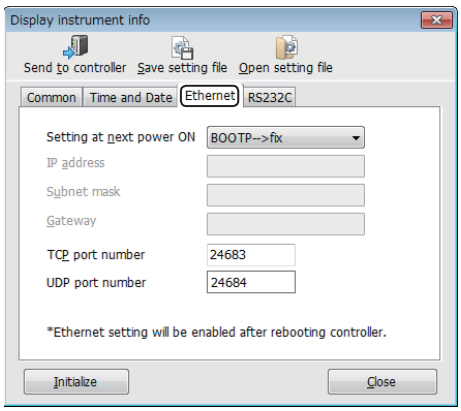
LS-Navigator2 setting method

1 Select [Display instrument info] under the [Environment Setting] menu.

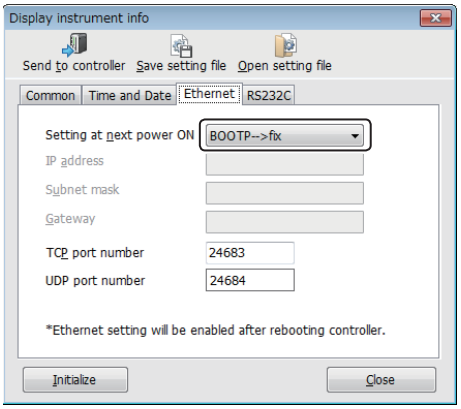


The [Display instrument info] screen will appear.

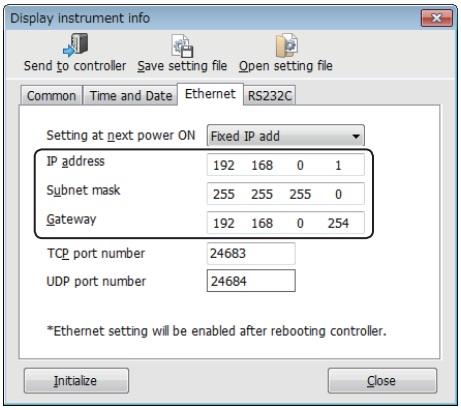
2 Click the [Ethernet] tab.



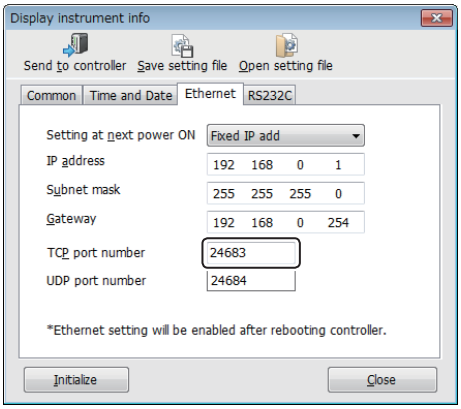
3 Set the [Setting at next power ON].



If you have selected [Fixed IP address] then also set the [IP address], [Subnet mask], and [Gateway].



4 Set the [TCP port number].

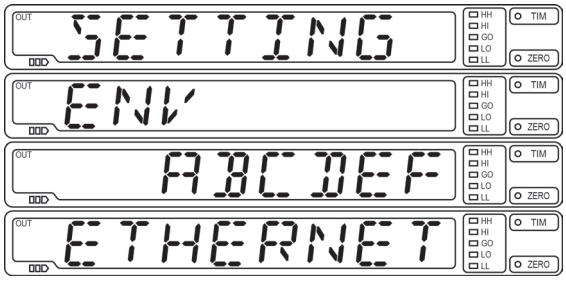


5 Click the [Send to controller] button.
The setting will be sent to the destination controller.

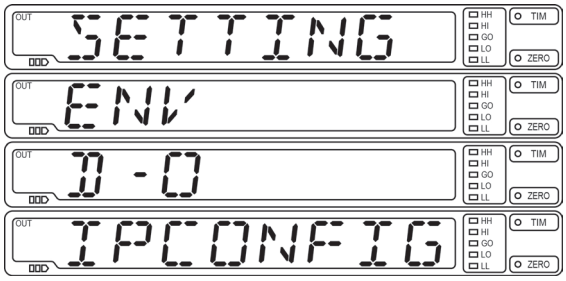
Display panel setting method

■ Setting the ETHERNET

1 Select [ETHERNET], then press the [ENT] key.
“Method for Setting up the Environment Settings” (page 7-8)



2 Perform the settings according to your purpose.
Refer to the subsequent items.

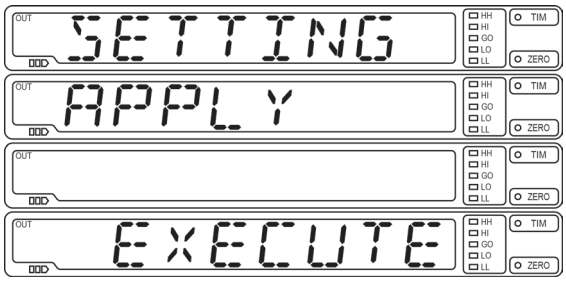


- IPCONFIG (Setting at next power ON)
- IP (IP setting)
- SUBNET-M (Subnetmask setting)
- GATEWAY (GATEWAY setting)
- TCP-PORT (TCP port number setting)

3 Press the [ESC] key twice to show the settings screen.

4 Select [APPLY] by pressing the[▲] or [▼] keys, then press the [ENT] key.

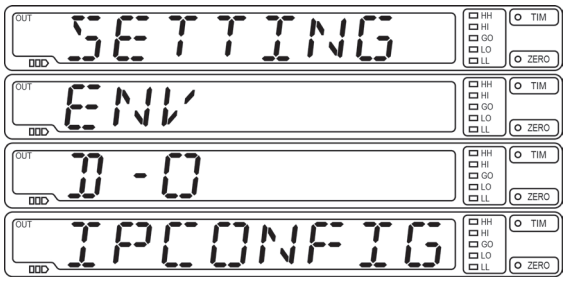
5 When [EXECUTE] is displayed, press the [ENT] key.



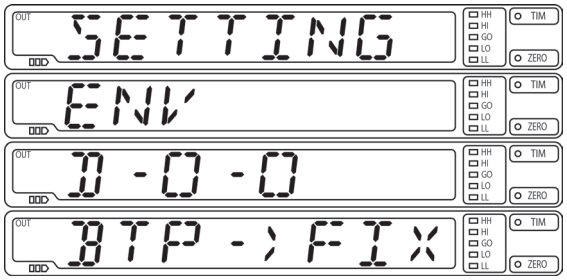
The process is complete when [COMPLETE] is displayed.

■ Setting the operation at next power ON

1 Select [IPCONFIG] and press the [ENT] key.



2 Specify the IP address specification method at the next power ON using the [▲], [▼], [◀], and [▶] keys.



- BTP → FIX (BOOTP -> Fix)
- FIXED IP (fixed IP add)
- BOOTP

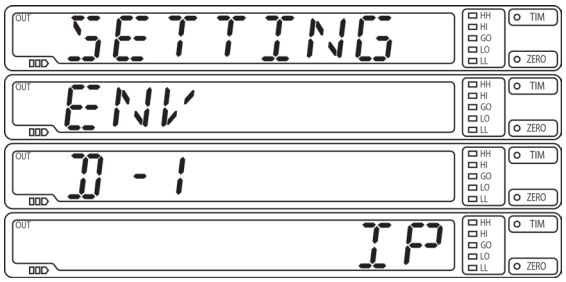
3 Press the [ENT] key.

The [ETHERNET Setting] screen appears.

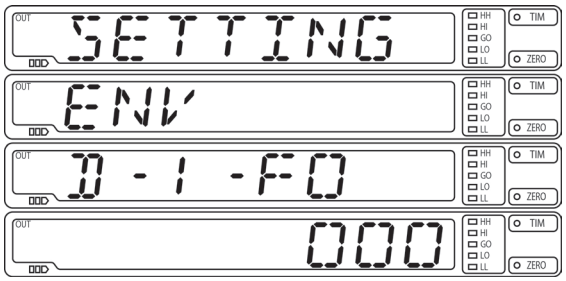
■ Setting the IP address

1 Select [IP] and press the [ENT] key.

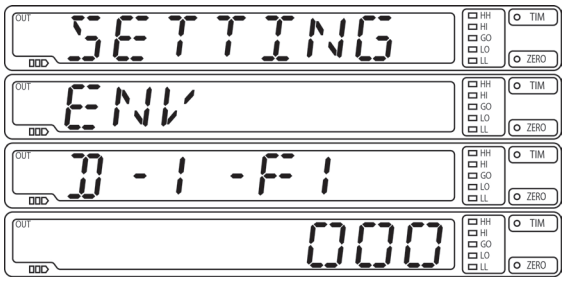
”Setting the ETHERNET” (page 7-12)



2 Set the first segment of the IP address. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key.



3 Press the [ENT] key.



The screen for setting the second segment of the IP address will appear.

4 Enter the second, third and fourth segments of the IP address in the same manner as in steps ***2*** to ***3***.

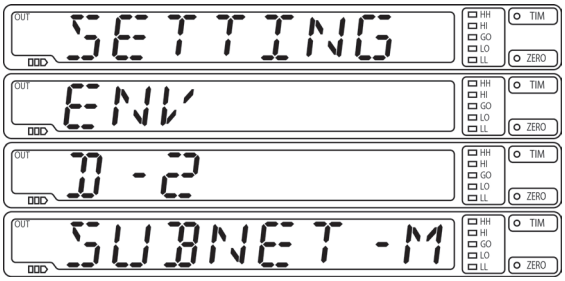
5 Once you have entered all four segments, press the [ENT] key.

The [ETHERNET setting] screen will appear.

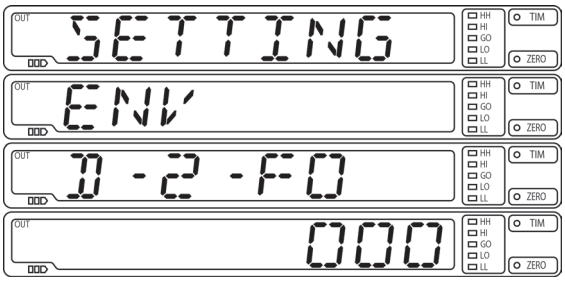
■ Setting the subnet mask

1 Select [SUBNET-M] and press the [ENT] key.

”Setting the ETHERNET” (page 7-12)



2 Set the subnet mask in the same manner as in “■Setting the IP address”.



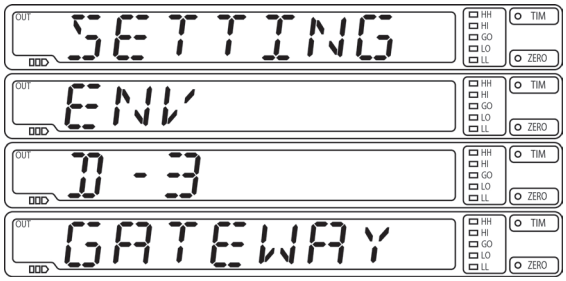
3 Once you have entered all four segments of the subnet mask, press the [ENT] key.

The [ETHERNET setting] screen will appear.

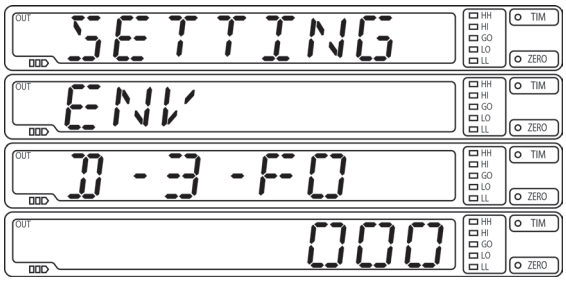
■ Setting the gateway

1 Select [GATEWAY] and press the [ENT] key.

”Setting the ETHERNET” (page 7-12)



2 Set the gateway in the same manner as in “■Setting the IP address”.



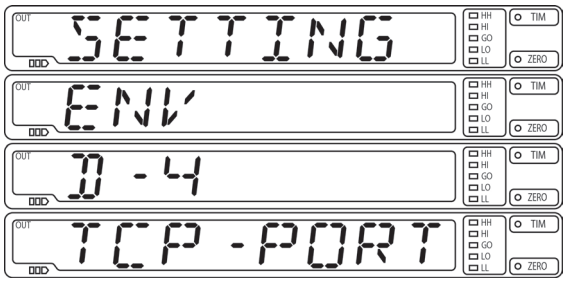
3 Once you have entered all four segments of the gateway, press the [ENT] key.

The [ETHERNET setting] screen will appear.

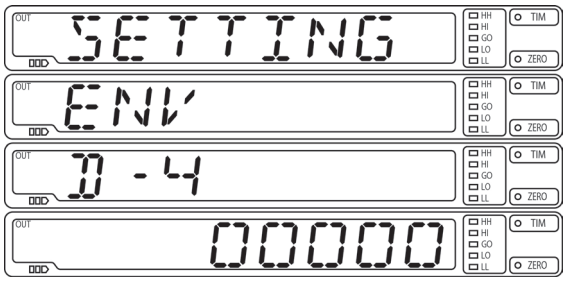
■ Setting the TCP port number

1 Select [TCP-PORT] and press the [ENT] key.

"Setting the ETHERNET" (page 7-12)

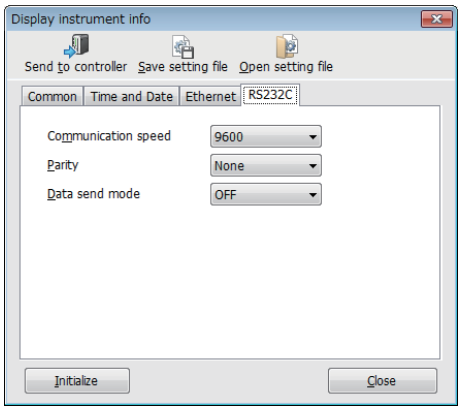


2 Set the TCP port number. Select an input digit by pressing the [◀] or [▶] key, input a value with a numeric key.



3 Press the [ENT] key.

[RS232C] tab



■ Communication speed

Set the baud rate for the RS-232C communication

Setting range (bps): 9600, 19200, 38400, 57600, 115200

■ Parity

Set the parity of the RS-232C communication.

Setting range: None, Even, Odd

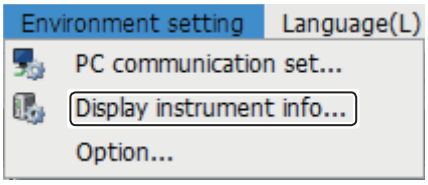
■ Data send mode

Set the data send mode for the RS-232C communication.

Setting range: OFF, S1, S2

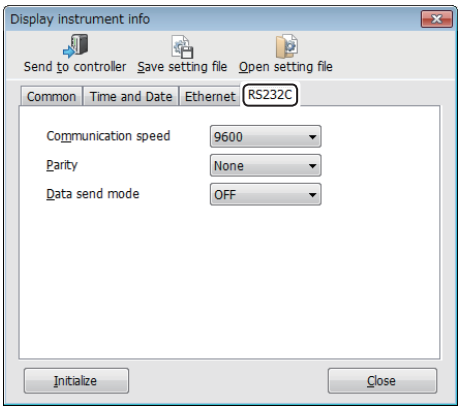
LS-Navigator2 setting method

1 Select [Display instrument info] under the [Environment Setting] menu.

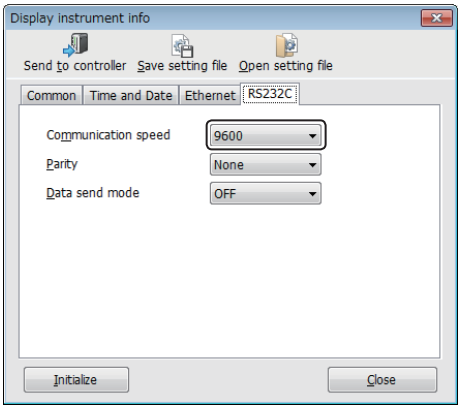


The [Display instrument info] screen will appear.

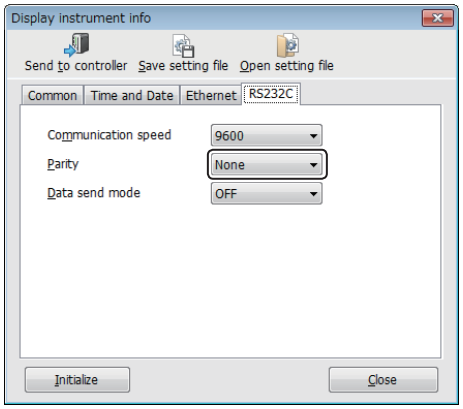
2 Click the [RS232C] tab.



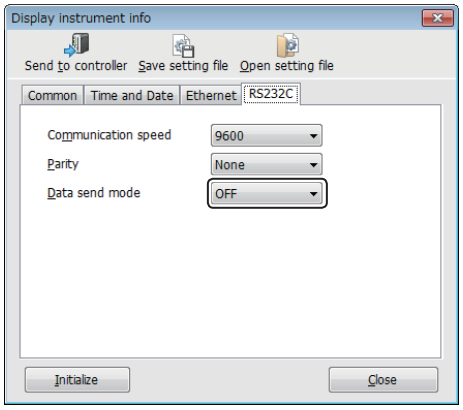
3 Sets the communication speed.



4 Set the [Parity].



5 Set the [Data send mode].

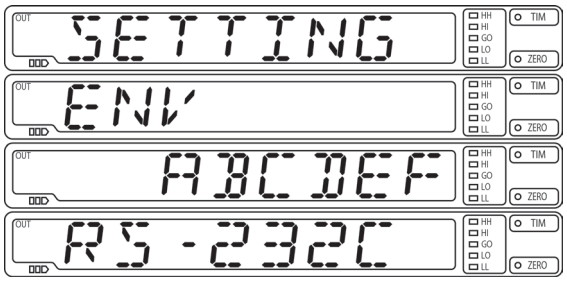


6 Click the [Send setting to controller] button.
The setting will be sent to the destination controller.

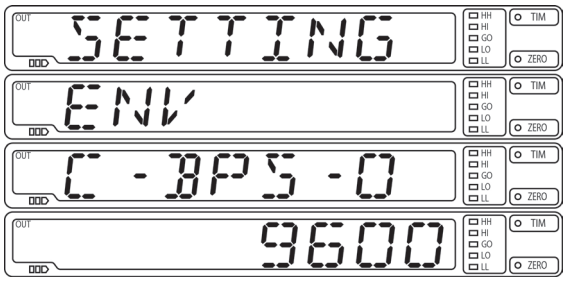
Display panel setting method

1 Select [RS-232C] and press the [ENT] key.

"Method for Setting up the Environment Settings" (page 7-8)



2 Switch the baud rate setting using the [▲], [▼], [◀], and [▶] keys.

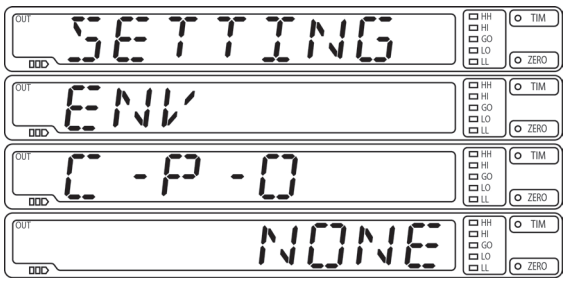


3 Press the [ENT] key.

The parity settings screen will appear.

4 Switch the parity setting using the [▲], [▼], [◀], and [▶] keys.

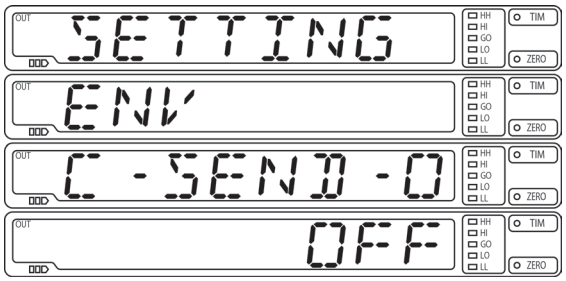
- NON (None)
- EVEN (Even)
- ODD (Odd)



5 Press the [ENT] key.

The transmission mode settings screen will appear.

6 Switch the transmission mode setting using the [▲], [▼], [◀], and [▶] keys.

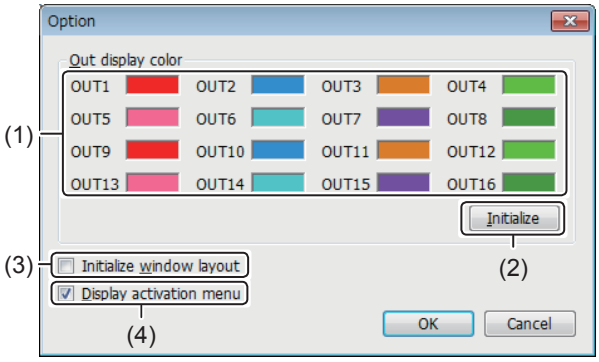


7 Press the [ENT] key.

You will return to the [Function selection] screen.

Optional settings

This section describes the items that can be configured on the [Option] screen.



Number	Description
1	Sets the display color for each OUT.
2	Initializes the OUT display color setting.
3	Initializes the window layout.
4	Displays the start-up menu if enabled. “Startup” (page 3-15)

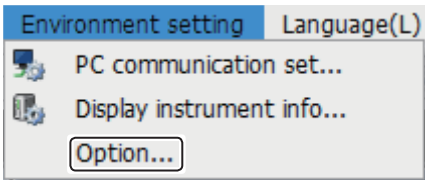
Changing the OUT display color

You can change the display color of the trend graph and the graphs on the data storage screen and the oval display screen for each OUT.
Clicking the [Initialize] button will initialize the OUT display color setting.

Reference You can only set the OUT display color in LS-Navigator2.

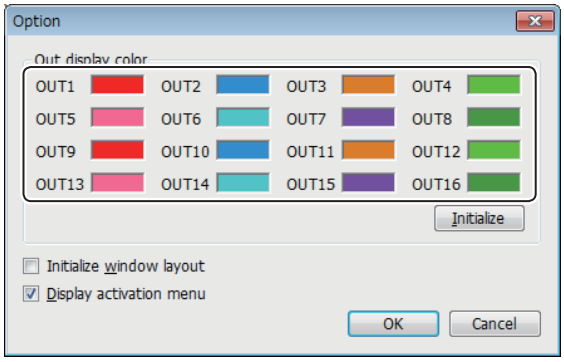
LS-Navigator2 setting method

1 Select [Option] under the [Environment Setting] menu.



The [Option] screen will appear.

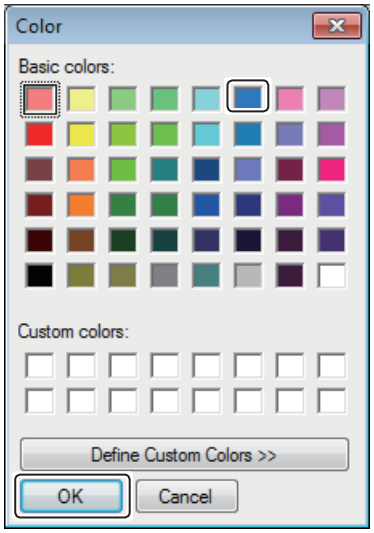
2 Click the OUT display color you wish to change.



The [Color] screen will appear.

Reference Clicking the [Initialize] button will initialize the OUT display color setting.

3 Select the color you wish to change, and then click the [OK] button.



You will return to the [Option] screen.

4 Click the [OK] button.

Reference If the trend graph, the data storage screen or the oval display screen is currently being shown, the OUT display color of the corresponding graph will change to the new color.

Initializing the screen layout

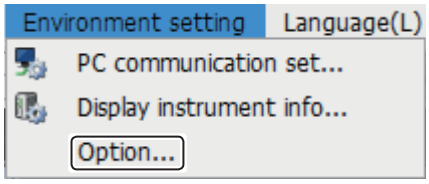
If you check the [Initialize window layout] check box, the display position setting of the main screen and the display and display position settings of the following screens will be initialized at the next start-up of LS-Navigator2:

- [Display measurement value] screen
- [Overall judgment] screen
- [Target viewer]
- [Display trend graph] Screen
- [Data storage] screen
- [Oval display] screen
- [2D position display] screen
- [Statistics processing display] screen
- [SPC] screen
- [Event logging] screen
- [Terminal condition check] screen

Reference You can only initialize the screen layout in LS-Navigator2.

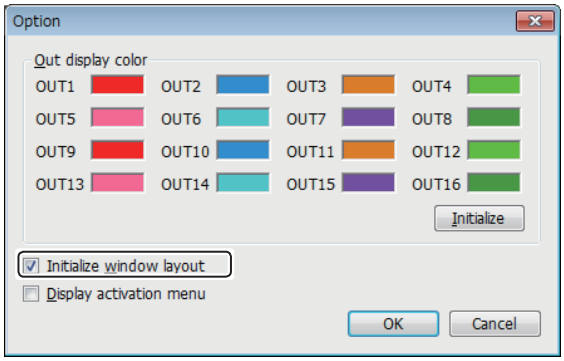
LS-Navigator2 setting method

1 Select [Option] under the [Environment Setting] menu.



The [Option] screen will appear.

2 Check the [Initialize window layout] check box.

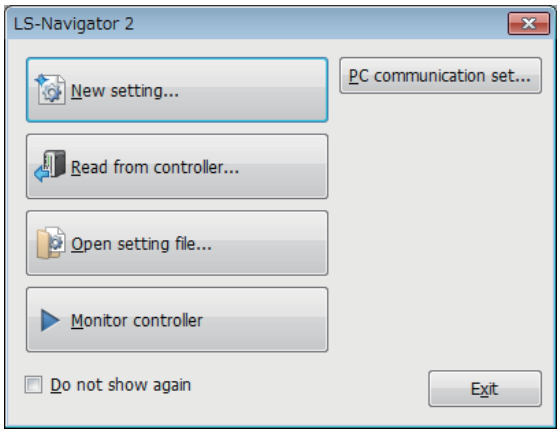


3 Click the [OK] button.

4 Restart LS-Navigator2.

Displaying the start-up menu

If you check the [Display activation menu] check box, the start-up menu will be displayed at the next start-up of LS-Navigator2. If you un-check the check box, LS-Navigator2 will start with the [Monitor controller] option selected.

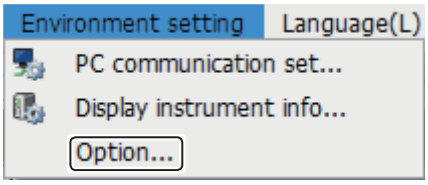


Reference The start-up menu will not be displayed if LS-Navigator2 is started using the following methods:

- If LS-Navigator2 was launched by double-clicking the LS-Navigator2 settings file or data storage file
- If LS-Navigator2 was launched by dragging & dropping an associated file onto the LS-Navigator2 executable file or its shortcut

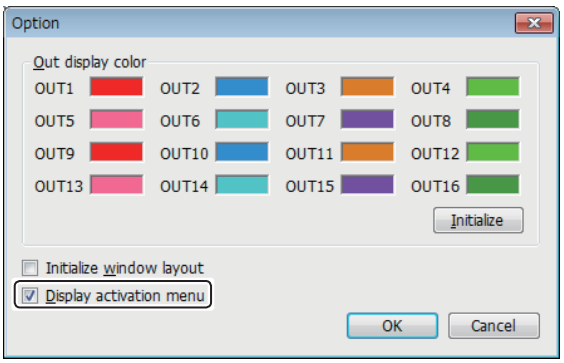
LS-Navigator2 setting method

1 Select [Option] under the [Environment Setting] menu.



The [Option] screen will appear.

2 Check the [Displaying the start-up menu] check box.



3 Click the [OK] button.

Language setting

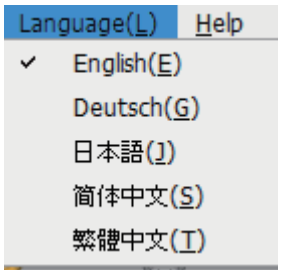
Switching the display language

The LS-9000 series supports a variety of languages.
Available languages are:

- English
- Deutsch
- Japanese
- Simplified Chinese
- Traditional Chinese

Reference When the system is started for the first time, it will follow the language setting of the operating system.

1 Go to the [Language] menu and select the language you wish to switch to.



A dialog indicating that the selected language will be active from the next start-up will appear.

2 Click the [OK] button.

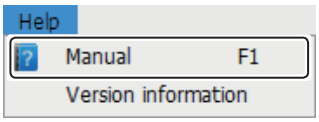
3 Restart LS-Navigator2.

Help

Manual

You can view the manual of this device.

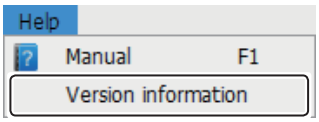
1 Select [Manual] under the [Help] menu.



Version information

You can view the version information of the system software.

1 Select [Version information] under the [Help] menu.



The [LS-Navigator2 version information] dialog will appear.

8

Communication Interface and I/O Terminals

This section describes the specifications of the communication interface and I/O terminals.

Ethernet Interface **8-2**
USB Interface **8-3**
RS-232C Interface **8-4**
I/O Terminal Names and Functions **8-7**

Ethernet Interface

Basic specifications/Connector specifications

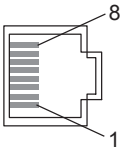
The IP address, port number, subnet mask, gateway, etc. in the system settings of the controller will be used.
See "[Ethernet] tab" (page 7-11) for details.

● Basic specifications

- Connector: RJ-45
- Medium: 100BASE-TX/1000BASE-T
- Communication protocol:
  - TCP/IP (Free transmission)
  - UDP (Free transmission)

● Connector specifications

The specifications of the Ethernet port of this unit are as shown below.



No.	100BASE-TX		1000BASE-T	
	Signal	Signal direction	Signal	Signal direction
1	TX +	Output	TRX +	I/O
2	TX -	Output	TRX -	I/O
3	RX +	Input	TRX +	I/O
4	Not used	—	TRX +	I/O
5	Not used	—	TRX -	I/O
6	RX -	Input	TRX -	I/O
7	Not used	—	TRX +	I/O
8	Not used	—	TRX -	I/O

USB Interface

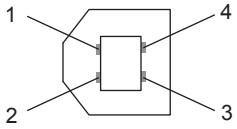
Basic specifications/Connector specifications

● Basic specifications

- Connector: Type B female connector
- Standards: USB Ver.2.0 compliant; High-Speed supported (USB Ver.1.1 Full-Speed compatible)

● Connector specifications

The specifications of the USB port of this unit are as shown below.



No.	Signal	Signal description	Signal direction
1	VBUS	VBUS	—
2	D -	Differential signal -	I/O
3	D +	Differential signal +	I/O
4	GND	GND	—

RS-232C Interface

Communication specifications

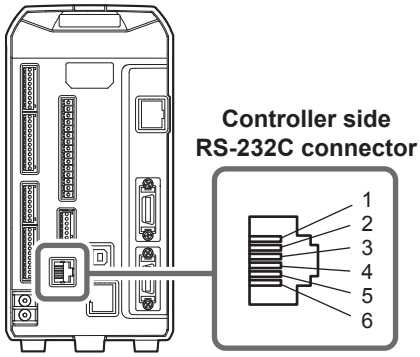
EIA RS-232C compliant (Modem defined)

Communication mode	Full duplex
Synchronization mode	Start-stop synchronization
Transmission code	ASCII
Data length	8 bit
Stop length	1 bit
Parity *	None (Initial value), Even, Odd
Baud rate*	9600 (Initial value), 19200, 38400, 57600, 115200 bps
Data Delimiter	CR
Flow control	None

*: The parity and baud rate in the system settings of the controller will be used.
"[RS232C] tab" (page 7-15)

Connector specifications

Compatible connector specifications: Modular 6-pin plug connector
A 2.5 m RS-232C straight-through cable (OP-96368) is provided.
"Option list" (page 1-5)



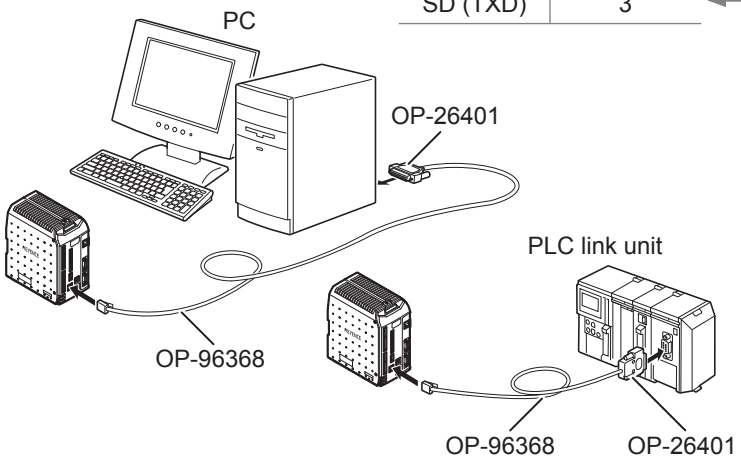
Terminal No.	Signal name	Contents
1	(Not used)	—
2	(Not used)	—
3	SD (TXD)	Receive from external instrument (Input)
4	SG (GND)	GND
5	RD (RXD)	Send to external instrument (Output)
6	(Not used)	—

*: Do not use unused terminals as it may result in a malfunction.
*: 24 V DC (-) and SG (GND) are insulated.
*: SD will be receiving (input to this unit) and RD will be sending (output from this unit) respectively as defined by the modem.

Connection with the PLC link unit or PC

Dedicated cables OP-96368 (Straight-through cable, 2.5 m) and OP-26401 (D-sub, 9 pins) are used in combination for the connections.
Before connecting the instruments, read the instruction manuals of the PC and the PLC link unit.
"Option list" (page 1-5)

LS-9000 series side		PC side	
		OP-26401	Signal name
RD (RXD)	5	2	RD (RXD)
SG (GND)	4	5	SG (GND)
SD (TXD)	3	3	SD (TXD)
		7	RS (RTS)
		8	CS (CTS)
		6	DR (DSR)
			CD (DCD)
		4	ER (DTR)



Outputting measurement values and changing settings using commands

By connecting this unit to external instruments such as the PC or PLC link unit, you can export measurement values and modify the settings of this unit.

Point **When creating a control program, check the reply command from this unit and then send the following command to the unit.**

■ Command types

The following four types of commands are available:

● Measurement control commands

These commands are used for controlling the measurement. You can perform operations such as measurement value output, timing input, auto zero input, reset etc.
"Measurement control command list" (page 9-8)

● Settings control commands

These commands are used for controlling the settings. You can perform operations such as setting save request, setting save completion check, program initialization, program switching, etc.
"Setting control command list" (page 9-13)

● Settings change command

These commands are used for editing the measurement program settings. You can change the filter setting, measurement mode setting, and tolerance setting.
"Settings change command list" (page 9-14)

● Setting check command

These commands are used for checking the measurement program settings.
"Setting check command list" (page 9-34)

■ Command format

This unit performs the controls specified in the command received from the external instruments, and then returns a reply command to the external instrument.
A CR (carriage return) is used for separating the received and reply command data.
"Command format" (page 9-2)

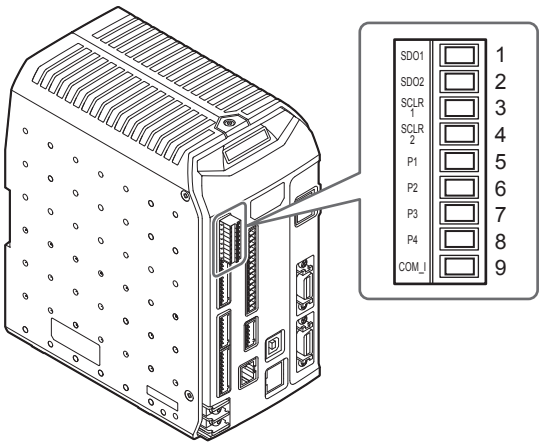
NOTICE	**After switching on the power and RS-232C communication starts, clear the external device communication buffer. Unnecessary data may be received in the external device after the power is switched on.**

I/O Terminal Names and Functions

This section describes the names of the I/O terminals (Input terminal block 1, Input terminal block 2, Encoder signal input terminal block, Output terminal block 1, Output terminal block 2, Analog voltage terminal block, 24 V power supply terminal block) of this unit and their arrangements.

Input terminal block 1

- Compatible socket block: FK-MC0.5/9-ST-2.5 (Phoenix contact)
- Compatible cable specification: AWG20 to 28, Tip processing length 8 mm



No.	Terminal symbol	Signal name	Signal description	Circuit diagram	
				LS-9501	LS-9501P
1	SDO1	STATISTICS_DO1	Statistics 1 execution input The statistics processing will be executed when the signal is ON. If you are starting the statistics processing from the terminal, set the [Statistics processing control method] to [Terminal].	Non-voltage input	Voltage input
2	SDO2	STATISTICS_DO2	Statistics 2 execution input The statistics processing will be executed when the signal is ON. If you are starting the statistics processing from the terminal, set the [Statistics processing control method] to [Terminal].		
3	SCLR1	STATISTICS_ CLEAR1	Statistics 1 clear input Clears the statistics processing contents.		
4	SCLR2	STATISTICS_ CLEAR2	Statistics 2 clear input Clears the statistics processing contents.		
5	P1	P1	Program No. switching input If you are switching programs from the terminal, set the [Program setting switching method] to [Terminal].		
6	P2	P2			
7	P3	P3			
8	P4	P4			
9	COM_I	COM_IN	Common for input	—	—

"[Common setting] Tab: Stat Process" (page 5-109)
"[Program Setting] Screen" (page 5-17)

Point **No insulation exists between each I/O circuit. Exercise caution to prevent a potential difference from occurring.**
"Insulated condition between each I/O circuit" (page 8-33)

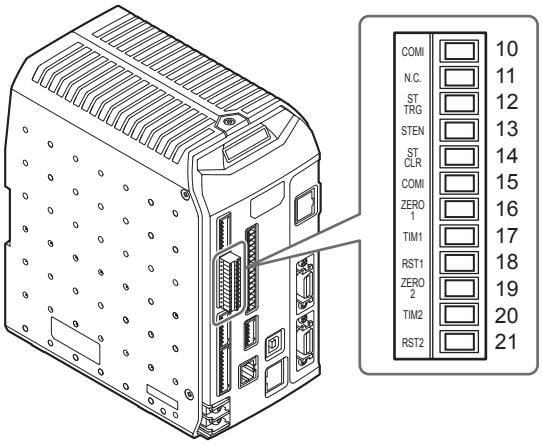
To switch between the program numbers, maintain P1 to P4 terminals in the following states:

Program No.	P4	P3	P2	P1
00	OFF	OFF	OFF	OFF
01	OFF	OFF	OFF	ON
02	OFF	OFF	ON	OFF
03	OFF	OFF	ON	ON
04	OFF	ON	OFF	OFF
05	OFF	ON	OFF	ON
06	OFF	ON	ON	OFF
07	OFF	ON	ON	ON
08	ON	OFF	OFF	OFF
09	ON	OFF	OFF	ON
10	ON	OFF	ON	OFF
11	ON	OFF	ON	ON
12	ON	ON	OFF	OFF
13	ON	ON	OFF	ON
14	ON	ON	ON	OFF
15	ON	ON	ON	ON

- LS-9501 (NPN type)
  ON: Short circuit with the COM_I terminal
  OFF: Open state
- LS-9501P (PNP type)
  ON: Voltage applied state
  OFF: Open state

Input terminal block 2

Compatible socket block: FK-MC0.5/12-ST-2.5 (Phoenix contact)
Compatible cable specification: AWG20 to 28, Tip processing length 8 mm



No.	Terminal symbol	Signal name	Signal description	Circuit diagram	
				LS-9501	LS-9501P
10	COMI	COM_IN	Common for input	—	—
11	N.C.	—	Not used	—	—
12	STTRG	STORAGE_ TRIGGER	The measurement values will be accumulated after each trigger input.	Non-voltage input	Voltage input
13	STEN	STORAGE_ ENABLE	Storage start input The storage will be executed when the signal is ON.		
14	STCLR	STORAGE_ CLEAR	Storage clear input Clears the storage data.		
15	COMI	COM_IN	Common for input	—	—
16	ZERO1	ZERO1	Auto zero 1 input The auto zero signal will be input to the OUT selected in control Ch 1 and all its synchronized OUTs (if synchronization is enabled for the selected OUT). Auto zero will be cleared if it is ON for two seconds or longer.	Non-voltage input	Voltage input
17	TIM1	TIMING1	Timing 1 input The TIMING signal will be input to the OUT selected in control Ch 1 and all its synchronized OUTs (if synchronization is enabled for the selected OUT).		

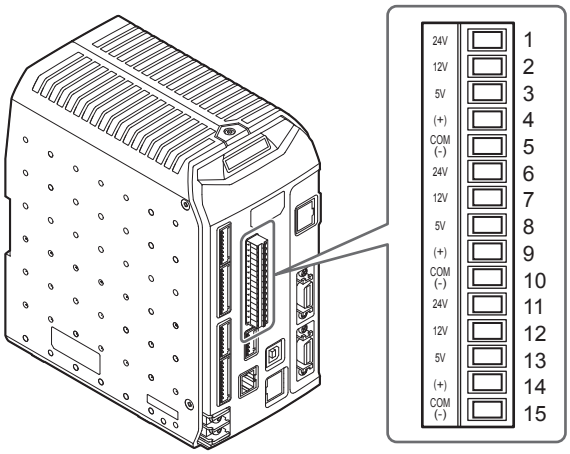
No.	Terminal symbol	Signal name	Signal description	Circuit diagram	
				LS-9501	LS-9501P
18	RST1	RESET1	Reset 1 input The reset signal will be input to the OUT selected in control Ch 1 and all its synchronized OUTs (if synchronization is enabled for the selected OUT). The measurement data will be output waiting data until the measurement value is updated.	Non-voltage input	Voltage input
19	ZERO2	ZERO2	Auto zero 2 input The auto zero signal will be input to the OUT selected in the control Ch2. Auto zero will be cleared if it is ON for two seconds or longer.		
20	TIM2	TIMING2	Timing 2 input The TIMING signal will be input to the OUT selected in the control Ch2.		
21	RST2	RESET2	Reset 2 input The reset signal will be input to the OUT selected in the control Ch2. The measurement data will be output waiting data until the measurement value is updated.		

"[Common setting] Tab: Data Storage" (page 5-77)
"[I/O setting] area" (page 5-90)

Point **No insulation exists between each I/O circuit. Exercise caution to prevent a potential difference from occurring.**
"Insulated condition between each I/O circuit" (page 8-33)

Encoder signal input terminal block

Compatible socket block: FK-MCP1.5/15-ST-3.5 (Phoenix contact)
Compatible cable specification: AWG16 to 28, Tip processing length 9 mm



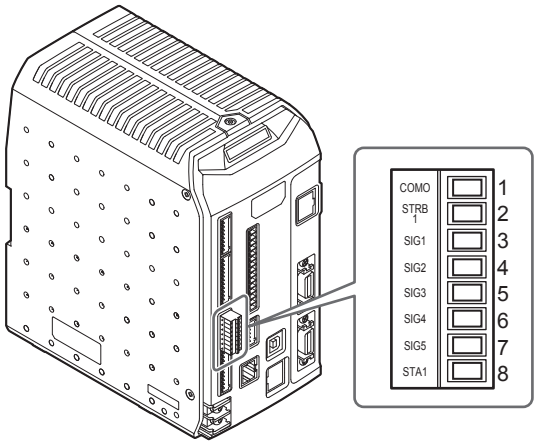
No.	Terminal symbol	Signal name	Signal description	Circuit diagram	
				LS-9501	LS-9501P
1	24 V	ENCODER_A + (24 V)	Encoder phase A input (24 V)	Encoder input circuit (Open collector output support)	
2	12 V	ENCODER_A + (12 V)	Encoder phase A input (12 V)		
3	5 V	ENCODER_A + (5 V)	Encoder phase A input (5 V)		
4	(+)	ENCODER_A +	Encoder phase A input (Line driver)	Encoder input circuit (Line driver output supported)	
5	COM(-)	ENCODER_A -	Encoder phase A input (-)	Encoder input circuit	
6	24 V	ENCODER_B + (24 V)	Encoder phase B input (24 V)	Encoder input circuit (Open collector output support)	
7	12 V	ENCODER_B + (12 V)	Encoder phase B input (12 V)		
8	5 V	ENCODER_B + (5 V)	Encoder phase B input (5 V)		
9	(+)	ENCODER_B +	Encoder phase B input (Line driver)	Encoder input circuit (Line driver output supported)	
10	COM(-)	ENCODER_B -	Encoder phase B input (-)	Encoder input circuit	
11	24 V	ENCODER_Z + (24 V)	Encoder phase Z input (24 V)	Encoder input circuit (Open collector output support)	
12	12 V	ENCODER_Z + (12 V)	Encoder phase Z input (12 V)		
13	5 V	ENCODER_Z + (5V)	Encoder phase Z input (5 V)		
14	(+)	ENCODER_Z+	Encoder phase Z input (Line driver)	Encoder input circuit (Line driver output supported)	
15	COM(-)	ENCODER_Z-	Encoder phase Z input (-)	Encoder input circuit	

"[Encoder set] area" (page 5-90)

Point **No insulation exists between each I/O circuit. Exercise caution to prevent a potential difference from occurring.**
"Insulated condition between each I/O circuit" (page 8-33)

Output terminal block 1

Compatible socket block: FK-MC0.5/8-ST-2.5 (Phoenix contact)
Compatible cable specification: AWG20 to 28, Tip processing length 8 mm



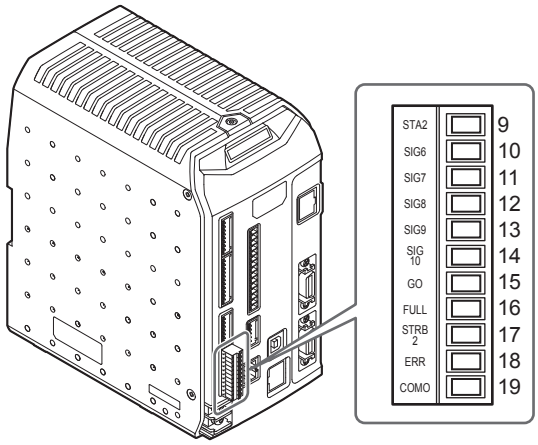
No.	Terminal symbol	Signal name	Signal description	Circuit diagram	
				LS-9501	LS-9501P
1	COMO	COM_OUT	Common for output	—	—
2	STRB1	STROBE1	Strobe output This signal will be output in synchronization with the updating of the measurement value.	NPN Open Collector Output	PNP Open Collector Output
3	SIG1	SIGNAL1	The output signal will be determined by the no. of control Ch setting.		
4	SIG2	SIGNAL2			
5	SIG3	SIGNAL3			
6	SIG4	SIGNAL4			
7	SIG5	SIGNAL5			
8	STA1	STATUS1	Status output 1		

Point **No insulation exists between each I/O circuit. Exercise caution to prevent a potential difference from occurring.**
"Insulated condition between each I/O circuit" (page 8-33)

The STRB1/STRB2 signals operate in the following manner:
- When the measurement mode is Normal
  Share the same timing input.
- When the measurement mode is other than Normal
  STRB1: Operates in the timing when the OUT value selected in control Ch1 is finalized.
  STRB2: Operates in the timing when the OUT value selected in control Ch2 is finalized.

Output terminal block 2

Compatible socket block: FK-MC0.5/11-ST-2.5 (Phoenix contact)
Compatible cable specification: AWG20 to 28, Tip processing length 8 mm



No.	Terminal symbol	Signal name	Signal description	Circuit diagram	
				LS-9501	LS-9501P
9	STA2	STATUS2	Status output 2	NPN Open Collector Output	PNP Open Collector Output
10	SIG6	SIGNAL6	The output signal will be determined by the no. of control Ch setting.		
11	SIG7	SIGNAL7			
12	SIG8	SIGNAL8			
13	SIG9	SIGNAL9			
14	SIG10	SIGNAL10			
15	GO	GO	Overall judgment output		
16	FULL	MEMORY_FULL	Memory full output This signal will be output when the data storage memory is full.		
17	STRB2	STROBE2	Strobe output 2 This signal will be output in synchronization with the updating of the measurement value.		
18	ERR	ERROR	System error output (N.C.) It is output when the power is switched on and when a system error occurs.		
19	COMO	COM_OUT	Common for output 2	–	–

Point **No insulation exists between each I/O circuit. Exercise caution to prevent a potential difference from occurring.**
"Insulated condition between each I/O circuit" (page 8-33)

The STRB1/STRB2 signals operate in the following manner:
- When the measurement mode is Normal
  Share the same timing input.
- When the measurement mode is other than Normal
  STRB1: Operates in the timing when the OUT value selected in control Ch1 is finalized.
  STRB2: Operates in the timing when the OUT value selected in control Ch2 is finalized.

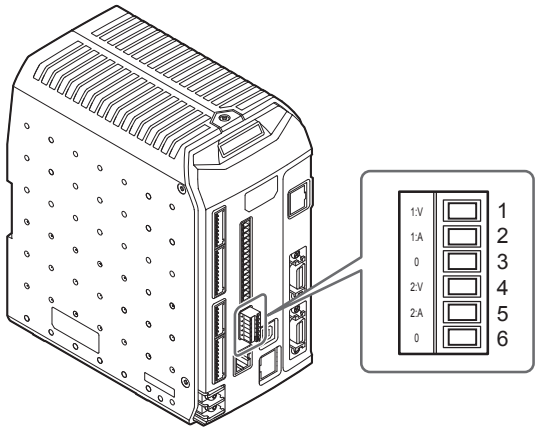
Based on the no. of control Ch setting, the signal output from SIG1 to SIG10 will be designated as shown below.
Set the OUT numbers to be output from each channel in the control/judgment output setting.
Set the STATUS output from the status output setting.

Pin name	No. of controlled Ch = 2		No. of controlled Ch = 3		No. of controlled Ch = 4	
SIG1	Ch1	HH	Ch1	HH/HI	Ch1	HH/HI/LO/LL
SIG2		HI		GO		GO
SIG3		GO		LO/LL	Ch2	HH/HI/LO/LL
SIG4		LO	Ch2	HH/HI		GO
SIG5		LL		GO	Ch3	HH/HI/LO/LL
SIG6	Ch2	HH		LO/LL		GO
SIG7		HI	Ch3	HH/HI	Ch4	HH/HI/LO/LL
SIG8		GO		GO		GO
SIG9		LO		LO/LL	STATUS4	
SIG10		LL	STATUS3		STATUS3	

"[I/O setting] area" (page 5-90)
"[Status output] area" (page 5-91)

Analog output terminal block

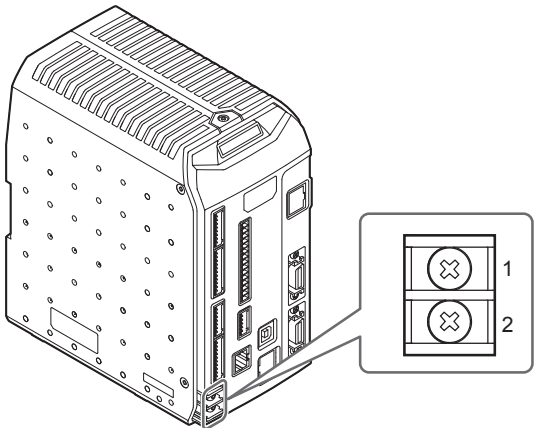
Compatible socket block: FK-MC0.5/6-ST-2.5 (Phoenix contact)
Compatible cable specification: AWG20 to 28, Tip processing length 8 mm



No.	Terminal symbol	Signal name	Signal description	Circuit diagram	
				LS-9501	LS-9501P
1	1: V	CH1_(V)	Analog voltage output + side terminal for CH1 The output will be within the range ±10.5 V.	Analog voltage output/ Analog current output circuit	
2	1: A	CH1_(A)	Analog current output + side terminal for CH1 The output will be within the range of 3.36 mA to 20.64 mA.		
3	0	GND1	Analog GND for CH1		
4	2: V	CH2_(V)	Analog voltage output + side terminal for CH2 The output will be within the range ±10.5 V.		
5	2: A	CH2_(A)	Analog current output + side terminal for CH2 The output will be within the range of 3.36 mA to 20.64 mA.		
6	0	GND2	Analog GND for CH2		

Point **No insulation exists between each I/O circuit. Exercise caution to prevent a potential difference from occurring.**
"Insulated condition between each I/O circuit" (page 8-33)

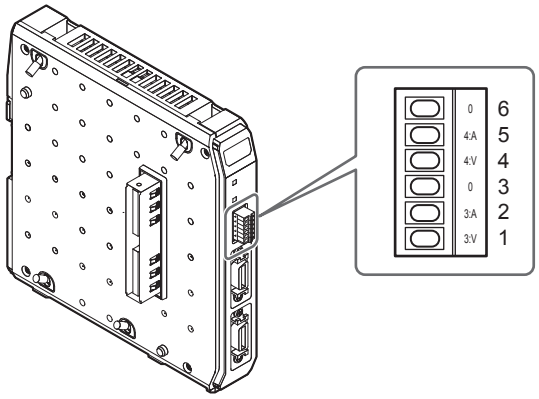
24V power input terminal block



No.	Terminal symbol	Signal name	Signal description	Circuit diagram	
				LS-9501	LS-9501P
1	24 V DC (+)	24 V DC (+)	24 V input for the power supply	—	—
2	24 V DC (-)	24 V DC (-)	0 V input for the power supply	—	—

Point **No insulation exists between each I/O circuit. Exercise caution to prevent a potential difference from occurring.**
"Insulated condition between each I/O circuit" (page 8-33)

Head expansion unit

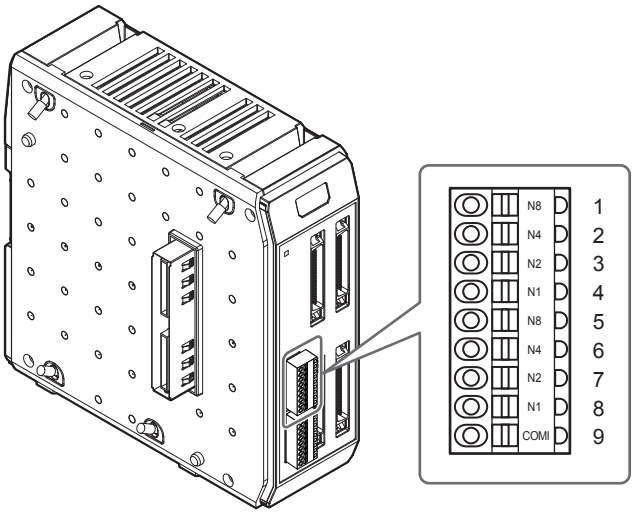


No.	Terminal symbol	Signal name	Signal description	Circuit diagram	
				LS-9501	LS-9501P
1	3: V	CH3_(V)	Analog voltage output + side terminal for CH3 The output will be ±10.5 V of the displayed value.	Analog voltage output/ Analog current output circuit	
2	3: A	CH3_(A)	Analog current output + side terminal for CH3 The output will be 3.36 mA to 20.64 mA of the displayed value.		
3	0	GND3	Analog GND for CH3		
4	4: V	CH4_(V)	Analog voltage output + side terminal for CH4 The output will be ±10.5 V of the displayed value.		
5	4: A	CH4_(A)	Analog current output + side terminal for CH4 The output will be 3.36 mA to 20.64 mA of the displayed value.		
6	0	GND4	Analog GND for CH4		

Point **No insulation exists between each I/O circuit. Exercise caution to prevent a potential difference from occurring.**
"Insulated condition between each I/O circuit" (page 8-33)

BCD unit Input terminal block 1

Compatible socket block: FK-MC0.5/9-ST-2.5 (Phoenix contact)
Compatible cable specification: AWG20 to 28, Tip processing length 8 mm



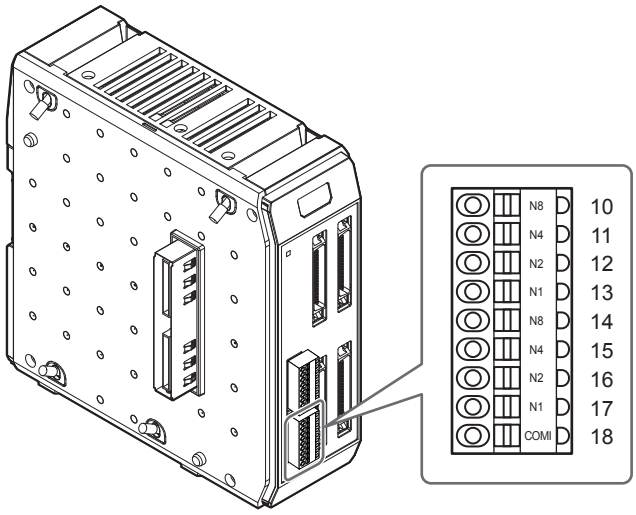
No.	Terminal symbol	Signal name	Signal description	Circuit diagram
1	N8	IN_NUM-8_1	Corresponds to output connector 1.	BCD unit Non-voltage input
2	N4	IN_NUM-4_1		
3	N2	IN_NUM-2_1		
4	N1	IN_NUM-1_1		
5	N8	IN_NUM-8_2	Corresponds to output connector 2.	
6	N4	IN_NUM-4_2		
7	N2	IN_NUM-2_2		
8	N1	IN_NUM-1_2		
9	COMI	COM_IN	Common for input	

Selects the OUT number using which the measurement values will be output from the output connector. If you are determining the OUT number from the terminal, set the [OUT selection method] to [BCD unit terminal].

Point **No insulation exists between each I/O circuit. Exercise caution to prevent a potential difference from occurring.**
"Insulated condition between each I/O circuit" (page 8-33)

BCD unit Input terminal block 2

Compatible socket block: FK-MC0.5/9-ST-2.5 (Phoenix contact)
Compatible cable specification: AWG20 to 28, Tip processing length 8 mm



No.	Terminal symbol	Signal name	Signal description	Circuit diagram
10	N8	IN_NUM-8_3	Corresponds to output connector 3.	BCD unit Non-voltage input
11	N4	IN_NUM-4_3		
12	N2	IN_NUM-2_3		
13	N1	IN_NUM-1_3		
14	N8	IN_NUM-8_4	Corresponds to output connector 4.	
15	N4	IN_NUM-4_4		
16	N2	IN_NUM-2_4		
17	N1	IN_NUM-1_4		
18	COMI	COM_IN	Common for input	

Selects the OUT number using which the measurement values will be output from the output connector. If you are determining the OUT number from the terminal, set the [OUT selection method] to [BCD unit terminal].

Point **No insulation exists between each I/O circuit. Exercise caution to prevent a potential difference from occurring.**
"Insulated condition between each I/O circuit" (page 8-33)

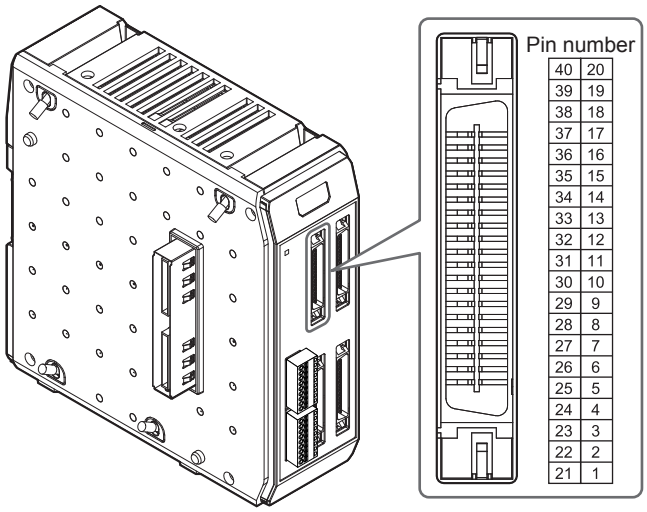
To switch between the OUT numbers, maintain N8 to N1 terminals in the following states:

I/O OUT	N8	N4	N2	N1
1	OFF	OFF	OFF	OFF
2	OFF	OFF	OFF	ON
3	OFF	OFF	ON	OFF
4	OFF	OFF	ON	ON
5	OFF	ON	OFF	OFF
6	OFF	ON	OFF	ON
7	OFF	ON	ON	OFF
8	OFF	ON	ON	ON
9	ON	OFF	OFF	OFF
10	ON	OFF	OFF	ON
11	ON	OFF	ON	OFF
12	ON	OFF	ON	ON
13	ON	ON	OFF	OFF
14	ON	ON	OFF	ON
15	ON	ON	ON	OFF
16	ON	ON	ON	ON

ON: Short circuited with the COMI terminal
OFF: Open state

BCD unit Expansion connector

Compatible connector: FX2B-40SA-1.27R (Hirose Electric Co., Ltd.)
I/O extension cable (OP-51657: Cable length 3 m)



Point **No insulation exists between each I/O circuit. Exercise caution to prevent a potential difference from occurring.**
"Insulated condition between each I/O circuit" (page 8-33)

■ Output connector 1

No.	Terminal name	Signal description			Code color	Circuit
		When BCD output is selected	When Binary output is selected	When Judgment output is selected		
1	COM_OUT	COM_OUT			Brown	NPN open collector output
2	BCD_STROBE1	BCD_strobe output 1			Red	
3	OUT_POLE_1	Ch1 sign	N.O.	N.O.	Orange	
4	OUT_D7-8_1	Ch1 DIGIT7-8		OUT16 HH	Yellow	
5	OUT_D7-4_1	Ch1 DIGIT7-4		OUT16 H	Green	
6	OUT_D7-2_1	Ch1 DIGIT7-2		OUT16 GO	Blue	
7	OUT_D7-1_1	Ch1 DIGIT7-1	Ch1 binary(24)	OUT16 L	Purple	
8	OUT_D6-8_1	Ch1 DIGIT6-8	Ch1 binary(23)	OUT16 LL	Grey	
9	OUT_D6-4_1	Ch1 DIGIT6-4	Ch1 binary(22)	OUT15 HH	White	
10	OUT_D6-2_1	Ch1 DIGIT6-2	Ch1 binary(21)	OUT15 H	Black	
11	OUT_D6-1_1	Ch1 DIGIT6-1	Ch1 binary(20)	OUT15 GO	Brown	
12	COM_OUT	COM_OUT			Red	
13	OUT_D5-8_1	Ch1 DIGIT5-8	Ch1 binary(19)	OUT15 L	Orange	
14	OUT_D5-4_1	Ch1 DIGIT5-4	Ch1 binary(18)	OUT15 LL	Yellow	
15	OUT_D5-2_1	Ch1 DIGIT5-2	Ch1 binary(17)	OUT14 HH	Green	
16	OUT_D5-1_1	Ch1 DIGIT5-1	Ch1 binary(16)	OUT14 H	Blue	
17	OUT_D4-8_1	Ch1 DIGIT4-8	Ch1 binary(15)	OUT14 GO	Purple	
18	OUT_D4-4_1	Ch1 DIGIT4-4	Ch1 binary(14)	OUT14 L	Grey	

No.	Terminal name	Signal description			Code color	Circuit
		When BCD output is selected	When Binary output is selected	When Judgment output is selected		
19	OUT_D4-2_1	Ch1 DIGIT4-2	Ch1 binary(13)	OUT14 LL	White	NPN open collector output
20	OUT_D4-1_1	Ch1 DIGIT4-1	Ch1 binary(12)	OUT13 HH	Black	
21	COM_OUT	COM_OUT			Brown	
22	OUT_D3-8_1	Ch1 DIGIT3-8	Ch1 binary(11)	OUT13 H	Red	
23	OUT_D3-4_1	Ch1 DIGIT3-4	Ch1 binary(10)	OUT13 GO	Orange	
24	OUT_D3-2_1	Ch1 DIGIT3-2	Ch1 binary(9)	OUT13 L	Yellow	
25	OUT_D3-1_1	Ch1 DIGIT3-1	Ch1 binary(8)	OUT13 LL	Green	
26	OUT_D2-8_1	Ch1 DIGIT2-8	Ch1 binary(7)	OUT12 HH	Blue	
27	OUT_D2-4_1	Ch1 DIGIT2-4	Ch1 binary(6)	OUT12 H	Purple	
28	OUT_D2-2_1	Ch1 DIGIT2-2	Ch1 binary(5)	OUT12 GO	Grey	
29	OUT_D2-1_1	Ch1 DIGIT2-1	Ch1 binary(4)	OUT12 L	White	
30	COM_OUT	COM_OUT			Black	
31	OUT_D1-8_1	Ch1 DIGIT1-8	Ch1 binary(3)	OUT12 LL	Brown	
32	OUT_D1-4_1	Ch1 DIGIT1-4	Ch1 binary(2)	OUT11 HH	Red	
33	OUT_D1-2_1	Ch1 DIGIT1-2	Ch1 binary(1)	OUT11 H	Orange	
34	OUT_D1-1_1	Ch1 DIGIT1-1	Ch1 binary(0)	OUT11 GO	Yellow	
35	OUT_NUM-8_1	Ch1 OUT number-8		OUT11 L	Green	
36	OUT_NUM-4_1	Ch1 OUT number-4		OUT11 LL	Blue	
37	OUT_NUM-2_1	Ch1 OUT number-2		N.O.	Purple	
38	OUT_NUM-1_1	Ch1 OUT number-1			Grey	
39	COM_OUT	COM_OUT			White	
40		N.C.			Black	Not used

■ Output connector 2

No.	Terminal name	Signal description			Code color	Circuit
		When BCD output is selected	When Binary output is selected	When Judgment output is selected		
1	COM_OUT	COM_OUT			Brown	NPN open collector output
2	BCD_STROBE2	BCD_strobe output 2			Red	
3	OUT_POLE_2	Ch2 sign	N.O.	N.O.	Orange	
4	OUT_D7-8_2	Ch2 DIGIT7-8		OUT10 HH	Yellow	
5	OUT_D7-4_2	Ch2 DIGIT7-4		OUT10 H	Green	
6	OUT_D7-2_2	Ch2 DIGIT7-2		OUT10 GO	Blue	
7	OUT_D7-1_2	Ch2 DIGIT7-1	Ch2 binary(24)	OUT10 L	Purple	
8	OUT_D6-8_2	Ch2 DIGIT6-8	Ch2 binary(23)	OUT10 LL	Grey	
9	OUT_D6-4_2	Ch2 DIGIT6-4	Ch2 binary(22)	OUT9 HH	White	

No.	Terminal name	Signal description			Code color	Circuit
		When BCD output is selected	When Binary output is selected	When Judgment output is selected		
10	OUT_D6-2_2	Ch2 DIGIT6-2	Ch2 binary(21)	OUT9 H	Black	NPN open collector output
11	OUT_D6-1_2	Ch2 DIGIT6-1	Ch2 binary(20)	OUT9 GO	Brown	
12	COM_OUT	COM_OUT			Red	
13	OUT_D5-8_2	Ch2 DIGIT5-8	Ch2 binary(19)	OUT9 L	Orange	
14	OUT_D5-4_2	Ch2 DIGIT5-4	Ch2 binary(18)	OUT9 LL	Yellow	
15	OUT_D5-2_2	Ch2 DIGIT5-2	Ch2 binary(17)	OUT8 HH	Green	
16	OUT_D5-1_2	Ch2 DIGIT5-1	Ch2 binary(16)	OUT8 H	Blue	
17	OUT_D4-8_2	Ch2 DIGIT4-8	Ch2 binary(15)	OUT8 GO	Purple	
18	OUT_D4-4_2	Ch2 DIGIT4-4	Ch2 binary(14)	OUT8 L	Grey	
19	OUT_D4-2_2	Ch2 DIGIT4-2	Ch2 binary(13)	OUT8 LL	White	
20	OUT_D4-1_2	Ch2 DIGIT4-1	Ch2 binary(12)	OUT7 HH	Black	
21	COM_OUT	COM_OUT			Brown	
22	OUT_D3-8_2	Ch2 DIGIT3-8	Ch2 binary(11)	OUT7 H	Red	
23	OUT_D3-4_2	Ch2 DIGIT3-4	Ch2 binary(10)	OUT7 GO	Orange	
24	OUT_D3-2_2	Ch2 DIGIT3-2	Ch2 binary(9)	OUT7 L	Yellow	
25	OUT_D3-1_2	Ch2 DIGIT3-1	Ch2 binary(8)	OUT7 LL	Green	
26	OUT_D2-8_2	Ch2 DIGIT2-8	Ch2 binary(7)	OUT6 HH	Blue	
27	OUT_D2-4_2	Ch2 DIGIT2-4	Ch2 binary(6)	OUT6 H	Purple	
28	OUT_D2-2_2	Ch2 DIGIT2-2	Ch2 binary(5)	OUT6 GO	Grey	
29	OUT_D2-1_2	Ch2 DIGIT2-1	Ch2 binary(4)	OUT6 L	White	
30	COM_OUT	COM_OUT			Black	
31	OUT_D1-8_2	Ch2 DIGIT1-8	Ch2 binary(3)	OUT6 LL	Brown	
32	OUT_D1-4_2	Ch2 DIGIT1-4	Ch2 binary(2)	OUT5 HH	Red	
33	OUT_D1-2_2	Ch2 DIGIT1-2	Ch2 binary(1)	OUT5 H	Orange	
34	OUT_D1-1_2	Ch2 DIGIT1-1	Ch2 binary(0)	OUT5 GO	Yellow	
35	OUT_NUM-8_2	Ch2 OUT number-8		OUT5 L	Green	
36	OUT_NUM-4_2	Ch2 OUT number-4		OUT5 LL	Blue	
37	OUT_NUM-2_2	Ch2 OUT number-2		N.O.	Purple	
38	OUT_NUM-1_2	Ch2 OUT number-1			Grey	
39	COM_OUT	COM_OUT			White	
40		N.C.			Black	Not used

■ Output connector 3

No.	Terminal name	Signal description			Code color	Circuit
		When BCD output is selected	When Binary output is selected	When Judgment output is selected		
1	COM_OUT	COM_OUT			Brown	NPN open collector output
2	BCD_STROBE3	BCD_strobe output 3			Red	
3	OUT_POLE_3	Ch3 sign	N.O.	N.O.	Orange	
4	OUT_D7-8_3	Ch3 DIGIT7-8		OUT4 HH	Yellow	
5	OUT_D7-4_3	Ch3 DIGIT7-4		OUT4 H	Green	
6	OUT_D7-2_3	Ch3 DIGIT7-2		OUT4 GO	Blue	
7	OUT_D7-1_3	Ch3 DIGIT7-1	Ch3 binary(24)	OUT4 L	Purple	
8	OUT_D6-8_3	Ch3 DIGIT6-8	Ch3 binary(23)	OUT4 LL	Grey	
9	OUT_D6-4_3	Ch3 DIGIT6-4	Ch3 binary(22)	OUT3 HH	White	
10	OUT_D6-2_3	Ch3 DIGIT6-2	Ch3 binary(21)	OUT3 H	Black	
11	OUT_D6-1_3	Ch3 DIGIT6-1	Ch3 binary(20)	OUT3 GO	Brown	
12	COM_OUT	COM_OUT			Red	
13	OUT_D5-8_3	Ch3 DIGIT5-8	Ch3 binary(19)	OUT3 L	Orange	
14	OUT_D5-4_3	Ch3 DIGIT5-4	Ch3 binary(18)	OUT3 LL	Yellow	
15	OUT_D5-2_3	Ch3 DIGIT5-2	Ch3 binary(17)	OUT2 HH	Green	
16	OUT_D5-1_3	Ch3 DIGIT5-1	Ch3 binary(16)	OUT2 H	Blue	
17	OUT_D4-8_3	Ch3 DIGIT4-8	Ch3 binary(15)	OUT2 GO	Purple	
18	OUT_D4-4_3	Ch3 DIGIT4-4	Ch3 binary(14)	OUT2 L	Grey	
19	OUT_D4-2_3	Ch3 DIGIT4-2	Ch3 binary(13)	OUT2 LL	White	
20	OUT_D4-1_3	Ch3 DIGIT4-1	Ch3 binary(12)	OUT1 HH	Black	
21	COM_OUT	COM_OUT			Brown	
22	OUT_D3-8_3	Ch3 DIGIT3-8	Ch3 binary(11)	OUT1 H	Red	
23	OUT_D3-4_3	Ch3 DIGIT3-4	Ch3 binary(10)	OUT1 GO	Orange	
24	OUT_D3-2_3	Ch3 DIGIT3-2	Ch3 binary(9)	OUT1 L	Yellow	
25	OUT_D3-1_3	Ch3 DIGIT3-1	Ch3 binary(8)	OUT1 LL	Green	
26	OUT_D2-8_3	Ch3 DIGIT2-8	Ch3 binary(7)	N.O.	Blue	
27	OUT_D2-4_3	Ch3 DIGIT2-4	Ch3 binary(6)		Purple	
28	OUT_D2-2_3	Ch3 DIGIT2-2	Ch3 binary(5)		Grey	
29	OUT_D2-1_3	Ch3 DIGIT2-1	Ch3 binary(4)		White	
30	COM_OUT	COM_OUT			Black	
31	OUT_D1-8_3	Ch3 DIGIT1-8	Ch3 binary(3)	N.O.	Brown	
32	OUT_D1-4_3	Ch3 DIGIT1-4	Ch3 binary(2)		Red	
33	OUT_D1-2_3	Ch3 DIGIT1-2	Ch3 binary(1)		Orange	
34	OUT_D1-1_3	Ch3 DIGIT1-1	Ch3 binary(0)		Yellow	

No.	Terminal name	Signal description			Code color	Circuit
		When BCD output is selected	When Binary output is selected	When Judgment output is selected		
35	OUT_NUM-8_3	Ch3 OUT number-8		N.O.	Green	NPN open collector output
36	OUT_NUM-4_3	Ch3 OUT number-4			Blue	
37	OUT_NUM-2_3	Ch3 OUT number-2			Purple	
38	OUT_NUM-1_3	Ch3 OUT number-1			Grey	
39	COM_OUT	COM_OUT			White	
40		N.C.			Black	Not used

■ **Output connector 4**

No.	Terminal name	Signal description			Code color	Circuit
		When BCD output is selected	When Binary output is selected	When Judgment output is selected		
1	COM_OUT	COM_OUT			Brown	NPN open collector output
2	BCD_STROBE4	BCD_strobe output 4			Red	
3	OUT_POLE_4	Ch4 sign	N.O.	N.O.	Orange	
4	OUT_D7-8_4	Ch4 DIGIT7-8			Yellow	
5	OUT_D7-4_4	Ch4 DIGIT7-4			Green	
6	OUT_D7-2_4	Ch4 DIGIT7-2			Blue	
7	OUT_D7-1_4	Ch4 DIGIT7-1	Ch4 binary(24)		Purple	
8	OUT_D6-8_4	Ch4 DIGIT6-8	Ch4 binary(23)		Grey	
9	OUT_D6-4_4	Ch4 DIGIT6-4	Ch4 binary(22)		White	
10	OUT_D6-2_4	Ch4 DIGIT6-2	Ch4 binary(21)		Black	
11	OUT_D6-1_4	Ch4 DIGIT6-1	Ch4 binary(20)		Brown	
12	COM_OUT	COM_OUT			Red	
13	OUT_D5-8_4	Ch4 DIGIT5-8	Ch4 binary(19)	N.O.	Orange	
14	OUT_D5-4_4	Ch4 DIGIT5-4	Ch4 binary(18)		Yellow	
15	OUT_D5-2_4	Ch4 DIGIT5-2	Ch4 binary(17)		Green	
16	OUT_D5-1_4	Ch4 DIGIT5-1	Ch4 binary(16)		Blue	
17	OUT_D4-8_4	Ch4 DIGIT4-8	Ch4 binary(15)		Purple	
18	OUT_D4-4_4	Ch4 DIGIT4-4	Ch4 binary(14)		Grey	
19	OUT_D4-2_4	Ch4 DIGIT4-2	Ch4 binary(13)		White	
20	OUT_D4-1_4	Ch4 DIGIT4-1	Ch4 binary(12)		Black	
21	COM_OUT	COM_OUT			Brown	

No.	Terminal name	Signal description			Code color	Circuit
		When BCD output is selected	When Binary output is selected	When Judgment output is selected		
22	OUT_D3-8_4	Ch4 DIGIT3-8	Ch4 binary(11)	N.O.	Red	
23	OUT_D3-4_4	Ch4 DIGIT3-4	Ch4 binary(10)		Orange	
24	OUT_D3-2_4	Ch4 DIGIT3-2	Ch4 binary(9)		Yellow	
25	OUT_D3-1_4	Ch4 DIGIT3-1	Ch4 binary(8)		Green	
26	OUT_D2-8_4	Ch4 DIGIT2-8	Ch4 binary(7)		Blue	
27	OUT_D2-4_4	Ch4 DIGIT2-4	Ch4 binary(6)		Purple	
28	OUT_D2-2_4	Ch4 DIGIT2-2	Ch4 binary(5)		Grey	
29	OUT_D2-1_4	Ch4 DIGIT2-1	Ch4 binary(4)		White	
30	COM_OUT	COM_OUT			Black	NPN open collector output
31	OUT_D1-8_4	Ch4 DIGIT1-8	Ch4 binary(3)	N.O.	Brown	
32	OUT_D1-4_4	Ch4 DIGIT1-4	Ch4 binary(2)		Red	
33	OUT_D1-2_4	Ch4 DIGIT1-2	Ch4 binary(1)		Orange	
34	OUT_D1-1_4	Ch4 DIGIT1-1	Ch4 binary(0)		Yellow	
35	OUT_NUM-8_4	Ch4 OUT number-8			Green	
36	OUT_NUM-4_4	Ch4 OUT number-4			Blue	
37	OUT_NUM-2_4	Ch4 OUT number-2			Purple	
38	OUT_NUM-1_4	Ch4 OUT number-1			Grey	
39	COM_OUT	COM_OUT			White	
40		N.C.			Black	Not used

[BCD POLE (sign) output]
OFF: Positive data
ON: Negative data

[BCD DIGIT output]
Outputs the BCD numeric value of each digit. (The decimal point is ignored.)
Negative-true logic ("1" when the NPN open collector output is ON)
Output waiting status (all digits "-"): All digits = 0xB (1011), sign bit = 0
Above the plus limit range: All digits = 0xF (1111), sign bit = 0
Below the minus limit range: All digits = 0xF (1111), sign bit = 1

[BCD OUT number output]
The same as terminals N1 to N8 on page 8-20.

[Binary output]
Outputs the measurement value as binary data. The two's complement is output using 25 bits. (The decimal point is ignored.)
Negative-true logic ("1" when the NPN open collector output is ON)
Output waiting status (all digits "-"): 0x01500000
Above the plus limit range: 0x00AA0000
Below the minus limit range: 0x01560000

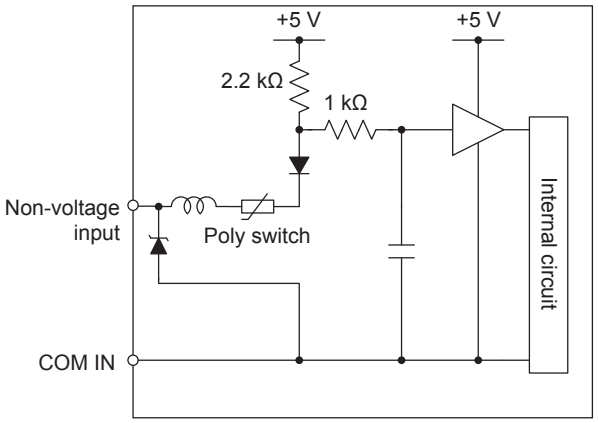
[Binary output, OUT number output]
The same as terminals N1 to N8 on page 8-20.

Point **The "Display Terminal Status" function is useful in checking the output status. (page 6-44)**

I/O circuit

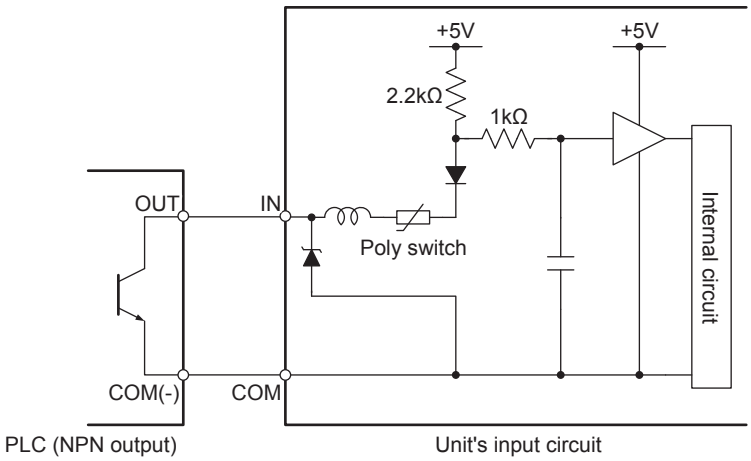
■ LS-9501 (NPN type)

● Non-voltage input

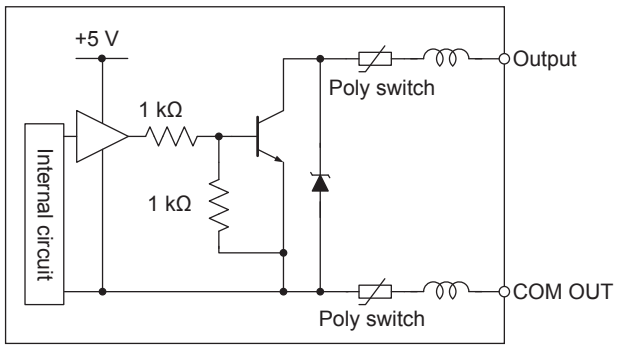


ON voltage	1 V or lower
OFF current	0.6 mA or less
Short-circuit current (Typ.)	2 mA

A connection example for an NPN output PLC that is connected to the unit's non-voltage input.

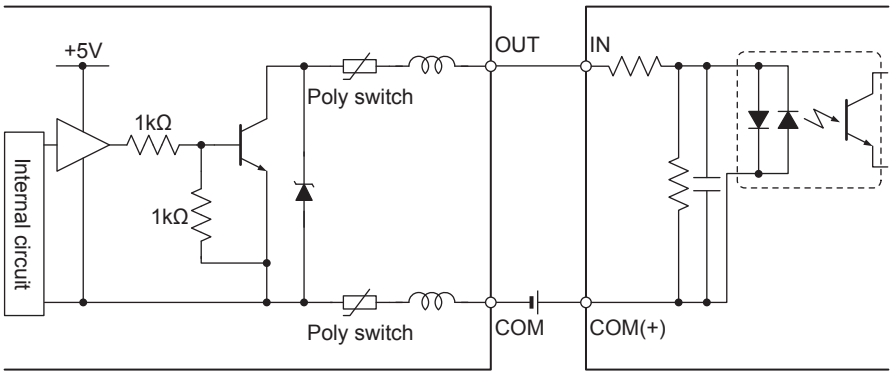


● **NPN open collector output**

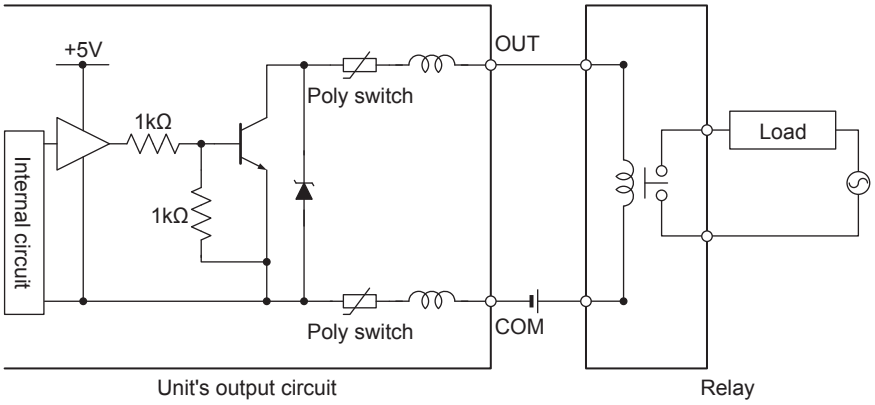


Maximum applied voltage	40 V
Maximum sink current	50 mA
Residual voltage	1.0 V or lower (50 mA) 0.5 V or lower (20 mA)
Leak current	0.1 mA or less

A connection example for inputting the unit's NPN output into the PLC via the positive common terminal.

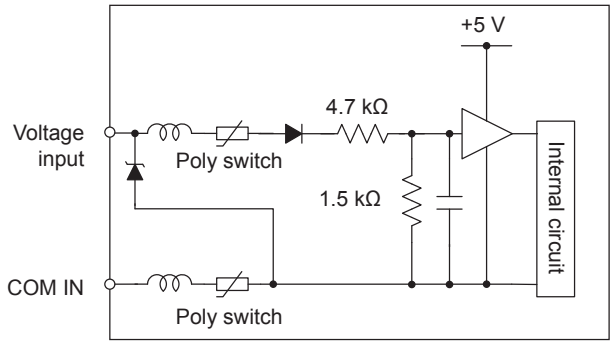


A connection example for inputting the unit's NPN output into the relay.



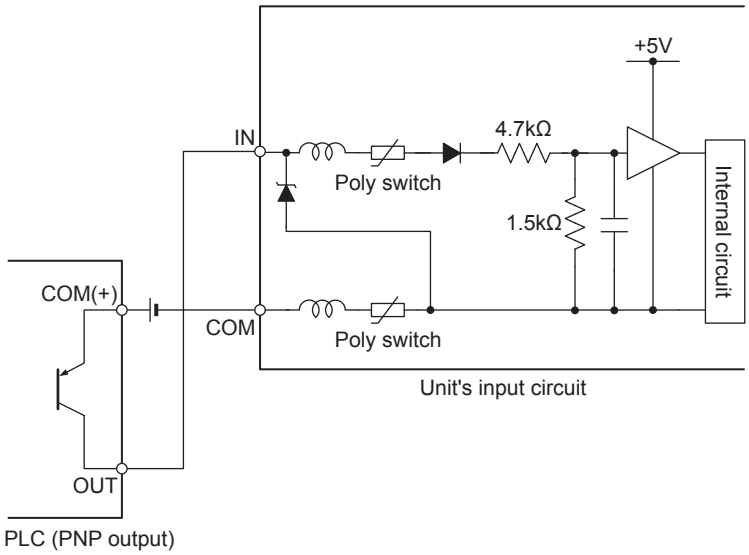
■ LS-9501P (PNP) type

● Voltage input

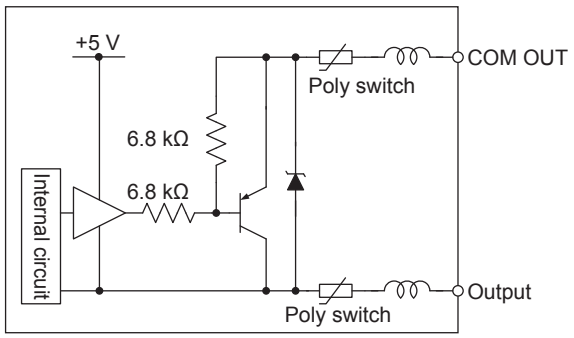


Maximum rated input	26.4 V
ON voltage	10.8 V or higher
ON current (Typ.)	2 mA or more
OFF current	0.6 mA or less

A connection example for an PNP output PLC that is connected to the unit's voltage input.

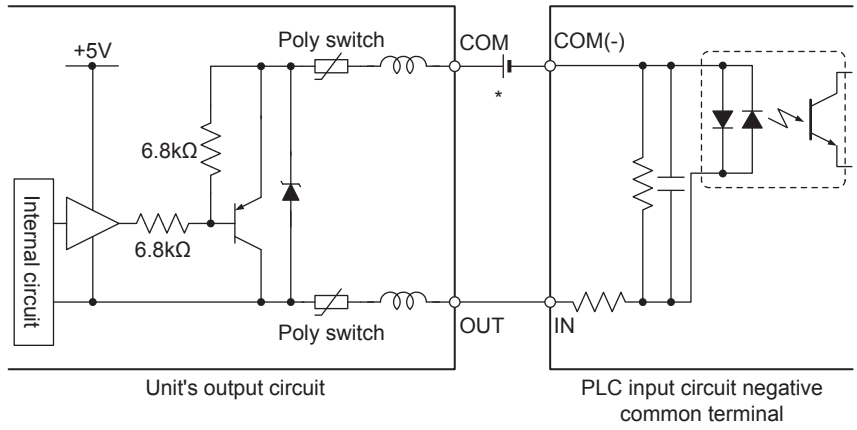


● **PNP open collector output**

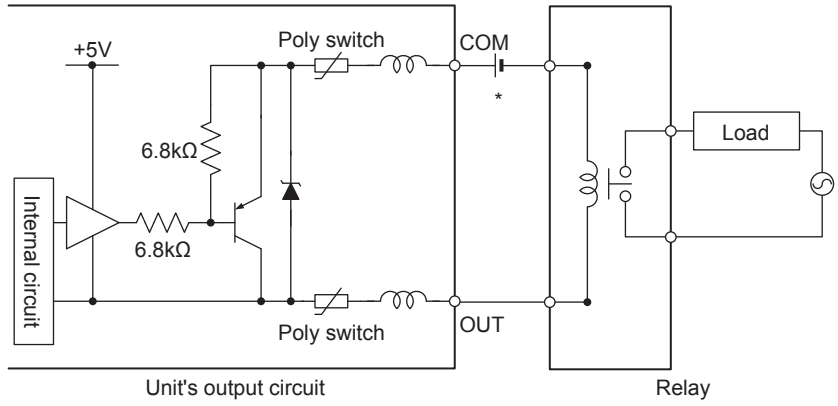


Maximum applied voltage	30 V
Maximum source current	50 mA
Residual voltage	1.0 V or lower (50 mA) 0.5 V or lower (20 mA)
Leak current	0.1 mA or less

A connection example for inputting the unit's PNP output into the PLC via the negative common terminal.



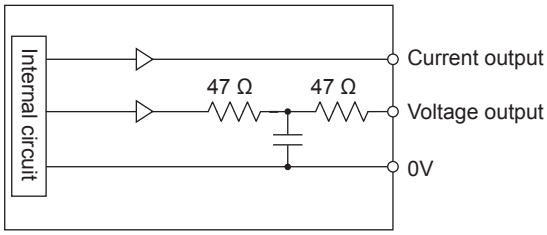
A connection example for inputting the unit's PNP output into the relay.



* Make the ground of the external power supply and the ground of the unit's power supply common.

■ Common for LS-9501/LS-9501P/LS-HA100

● Analog voltage output/Analog current output



Voltage output

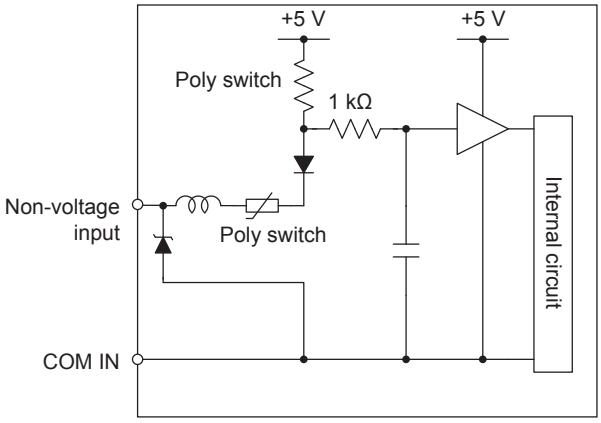
Output range	±10.8 V (Measurement value: ±10.5 V)
Resolution	2 mV
Accuracy	±0.05% of F.S. (F.S. = 20 V; Accuracy against displayed value)
Output impedance	Approx. 100 Ω
Response delay time	Approx. 2 μs (after updating the measurement value)

Current output

Output range	3.36 to 20.64mA (Measurement data: 3.6 to 20.4mA)
Resolution	40 μA
Accuracy	±0.25% of F.S. (F.S. = 16 mA; Accuracy against displayed value)
Matched load	Max. 350 Ω
Response delay time	Approx. 20 μs (after updating the measurement value)

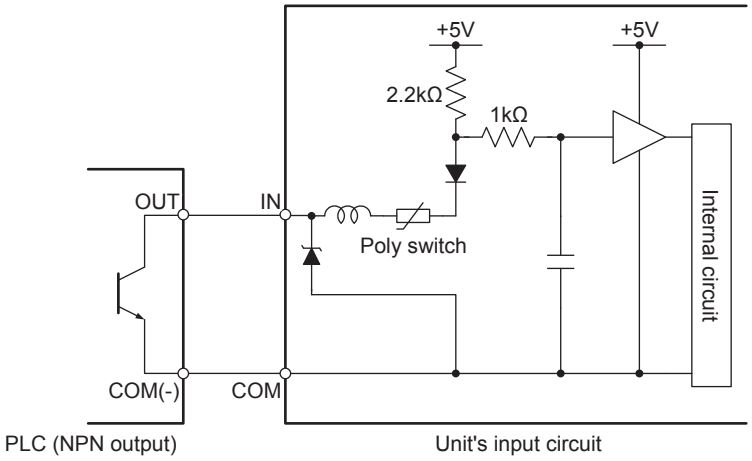
■ CB-BD100

● Non-voltage input

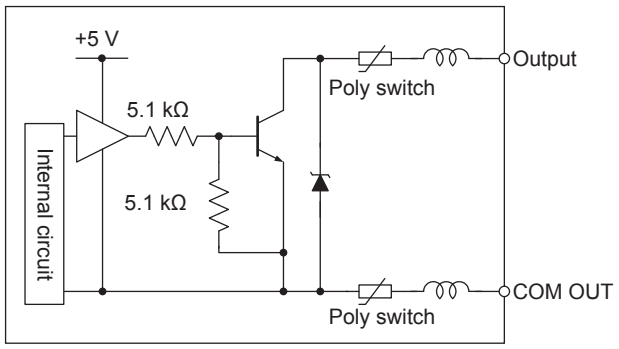


ON voltage	1 V or lower
OFF current	0.6 mA or less
Short-circuit current (Typ.)	2 mA

A connection example for an NPN output PLC that is connected to the unit's non-voltage input.

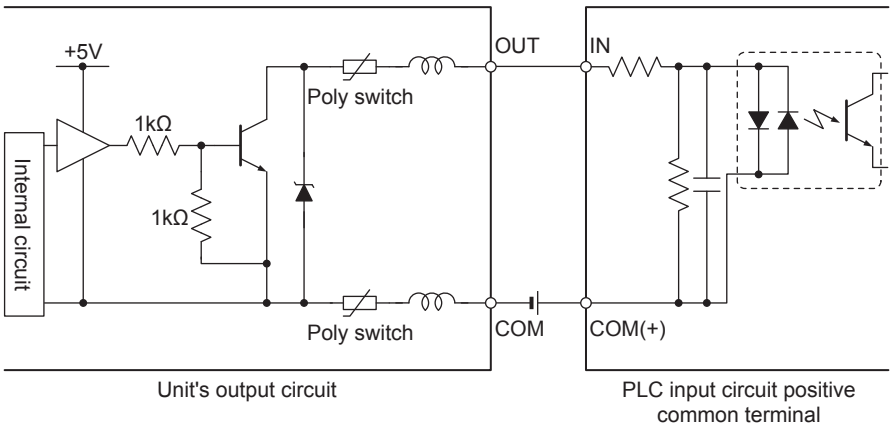


● **NPN open collector output**



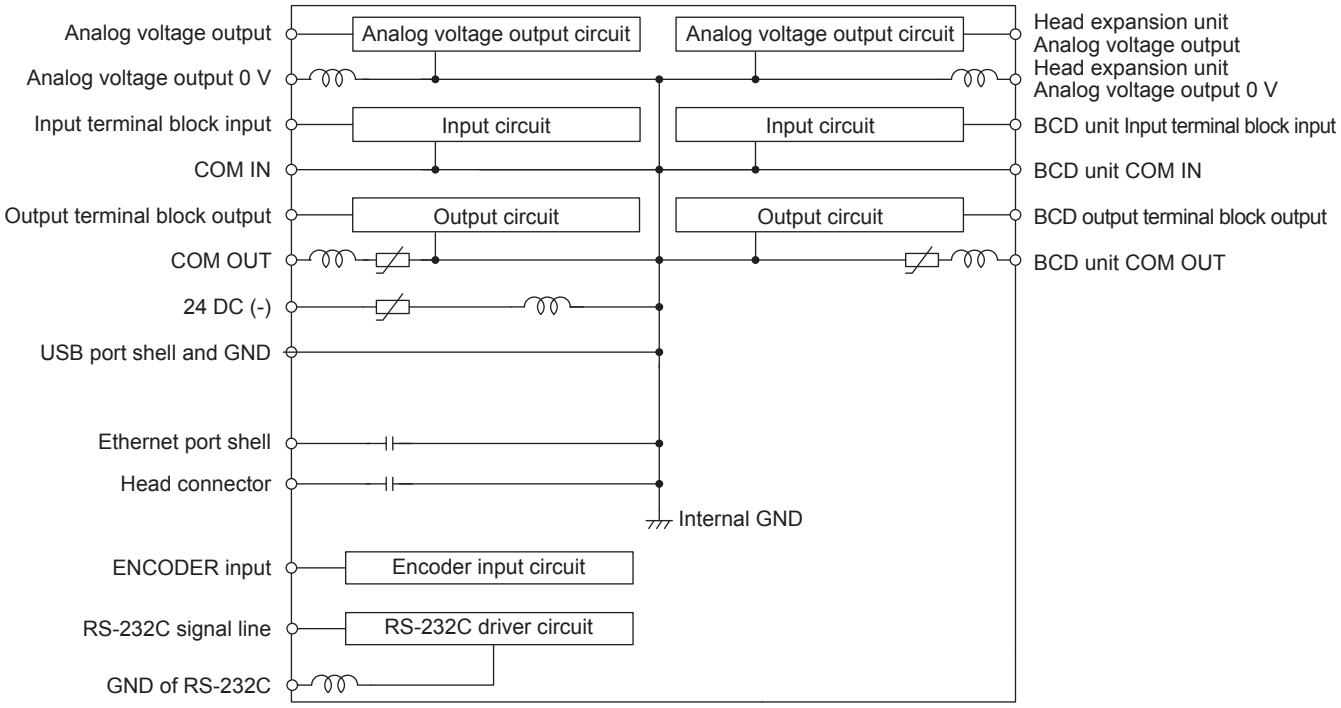
Maximum applied voltage	30 V
Maximum sink current	30 mA
Residual voltage	0.5V or less
Leak current	0.1 mA or less

A connection example for inputting the unit's NPN output into the PLC via the positive common terminal.



● **Insulated condition between each I/O circuit**

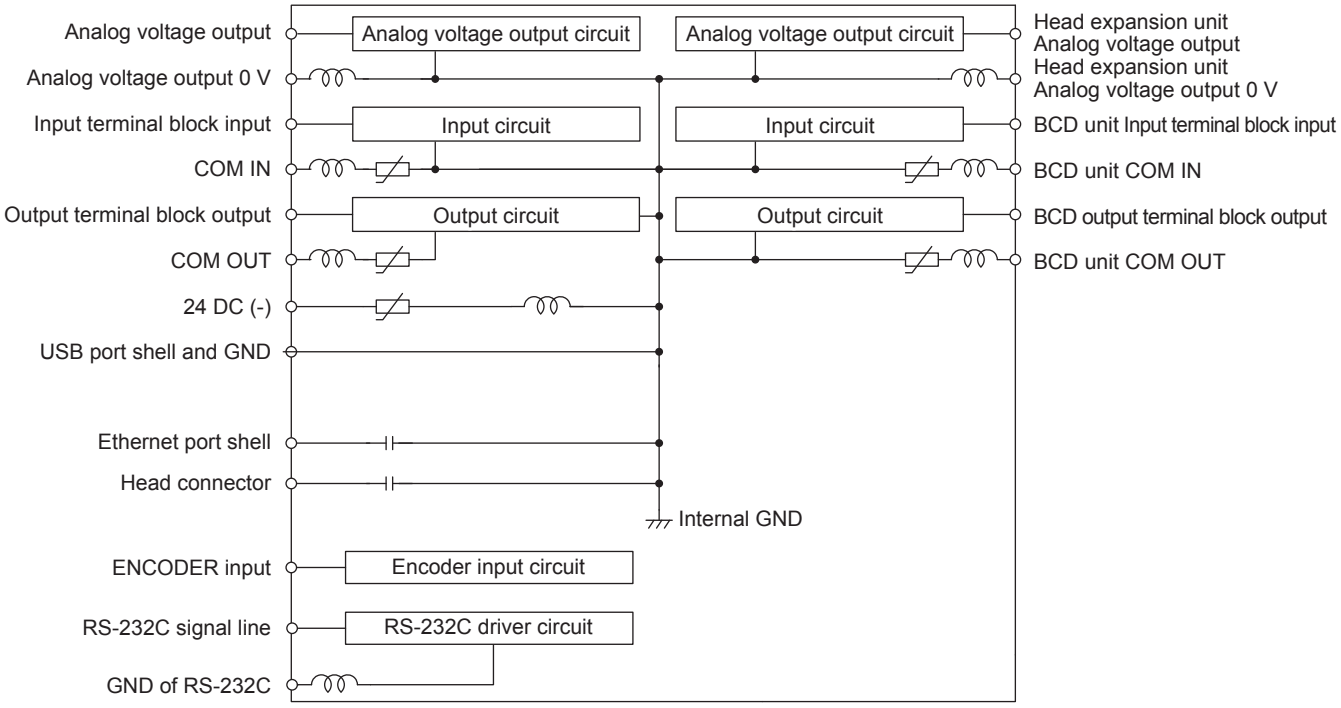
LS-9501 (NPN open collector type)



- The Ethernet port shell and the head connector are coupled with the internal GND and the capacitor, respectively.
- RS-232C and ENCODER inputs are insulated from the internal GND.

NOTICE	**24 V DC (-), COM_IN, COM_OUT, analog voltage output 0 V, head expansion unit analog voltage output 0 V, BCD unit COM_IN and BCD unit COM_OUT are not insulated.** **Also, 24 V DC (-), the metallic USB port shell and GND are not insulated.** **Exercise caution to avoid a potential difference between the common internal terminals due to the + grounding environment or potential difference between the instruments.** **It may result in malfunction of the unit or the external instruments connected to the unit such as the PC.**

LS-9501P (PNP open collector type)



- The Ethernet port shell and the head connector are coupled with the internal GND and the capacitor, respectively.
- RS-232C and ENCODER inputs are insulated from the internal GND.

NOTICE	**BCD unit is an NPN open collector type.** **24 V DC (-), COM_IN, analog voltage output 0 V, head expansion unit analog voltage output 0 V, BCD unit COM_IN and BCD unit COM_OUT are not insulated.** **Also, 24 V DC (-), the metallic USB port shell and GND are not insulated.** **Exercise caution to avoid a potential difference between the common internal terminals due to the + grounding environment or potential difference between the instruments.** **It may result in malfunction of the unit or the external instruments connected to the unit such as the PC.**

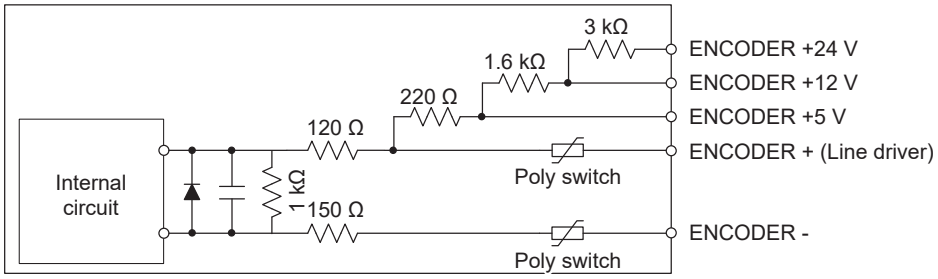
Encoder input

Electric specifications and input circuit example of encoder input

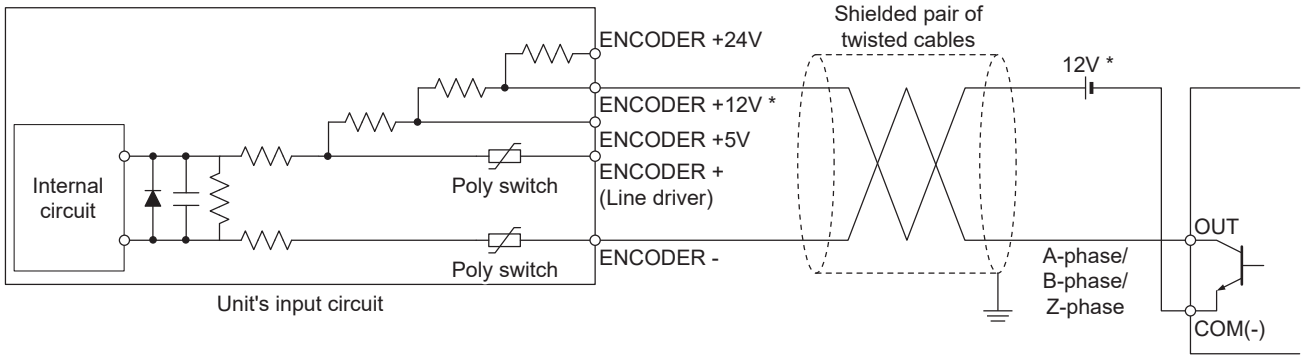
Encoder input specifications

Encoder input channels	Open collector power voltage			Line driver
	24 V DC	12 V DC	5V DC	
Maximum rated input	26.4 V DC	13.2 V DC	5.5 V DC	Equivalent to AM26LS31
Minimum ON voltage	21.6 V DC	10.8 V DC	3.5 V DC	
Maximum OFF voltage	3.6 V DC	2.4 V DC	1.0 V DC	
Minimum ON current	2 mA			

The encoder input circuit diagram is common for phase A, phase B, and phase Z.



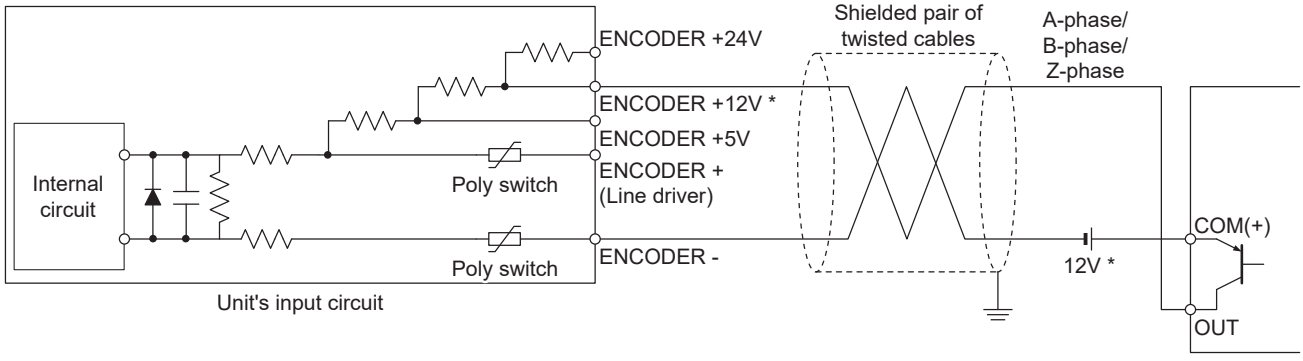
Connection example : When the encoder is an NPN open collector output



* 12 V are used in this example. Match the power with the 5 V/12 V/24 V.

Encoder's NPN open collector output

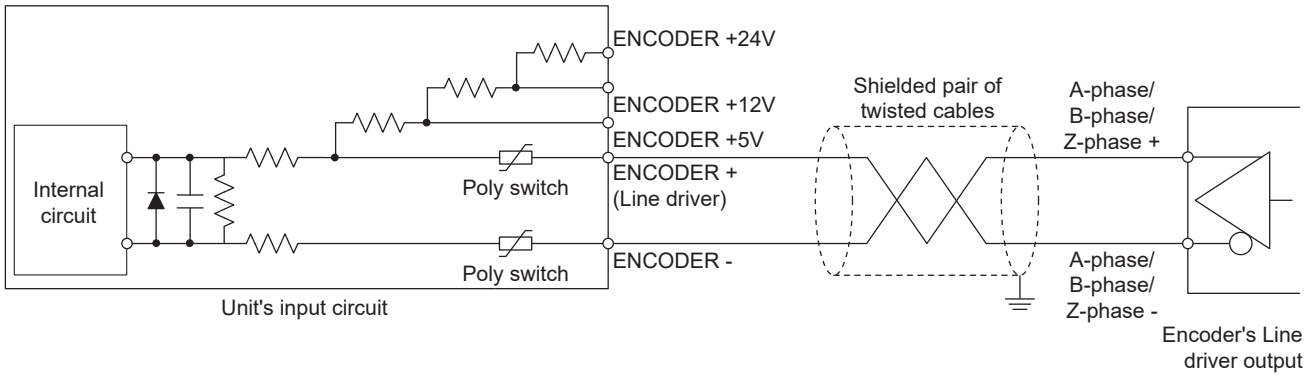
Connection example : When the encoder is an PNP open collector output



* 12 V are used in this example. Match the power with the 5 V/12 V/24 V.

Encoder's PNP open collector output

Connection example : When the encoder is a line driver output



9

RS-232C

This section describes the RS-232C communication commands.

RS-232C interface commands..... 9-2

RS-232C interface commands

This section describes the commands that may be sent or received on this unit.

Command format

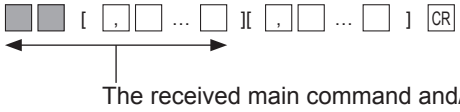
This unit performs the controls specified in the command received from the external instruments, and then returns a reply command to the external instrument.
A CR (carriage return) is used for separating the received and reply command data.

NOTICE	**After switching on the power and RS-232C communication starts, clear the external device communication buffer. Unnecessary data may be received in the external device after the power is switched on.**

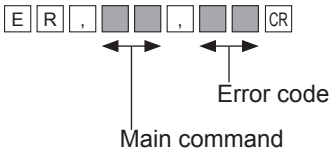
Received command format



Reply command format



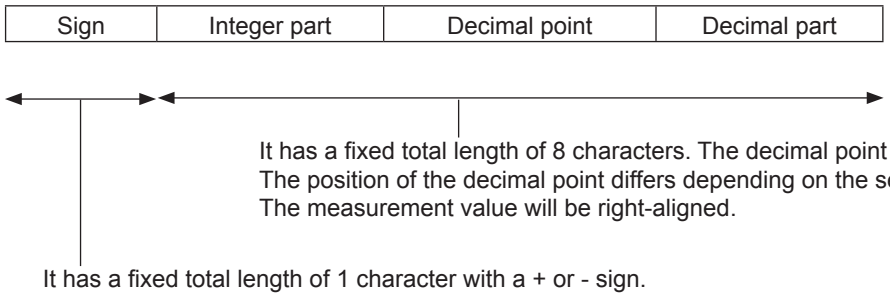
Reply command format in the event of an error



Error code	Contents
00	Command error
01	Status error
20	Command length error
21	Parameter error
22	Parameter error (OUT number)
23	Parameter error (Measurement target number)
40	Head not connected error
41	Head mismatch error
70	Consistency error in display units
71	Consistency error in setting (Scaling)
72	Consistency error in setting (Calibration)
73	Consistency error in setting (Tolerance setting)
74	Consistency error in setting (Analog scaling)
88	Timeout error
99	Another error

“Error messages in the RS-232C/display panel” (page A-21)

Measurement value formats



■ Measurement value format examples

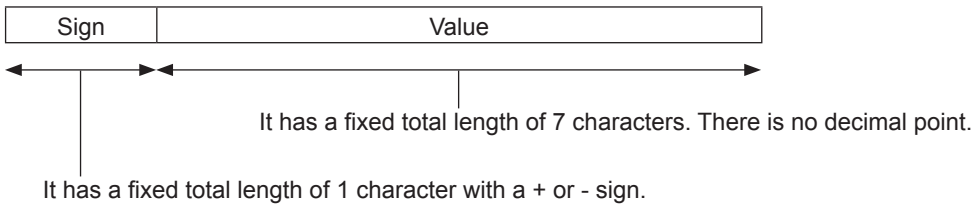
Displayed value	Output format
1.23450	+01.23450
-123.450	-0123.450
1.2	+000001.2
-0.120	-0000.120
+OVER	+99.99999 (*)
- OVER	-99.99999 (*)
--------	-99.99999 (*)

* The position of the decimal point differs depending on the minimum unit display setting. If the minimum display unit has no decimal point (e.g. 1 µm), the output will be aligned to the right, i.e. “+09999999”.

9

RS-232C

Setting numeric value formats



■ Examples of setting numeric value formats

Set numerical value	Format
1.23450	+0123450

Specification of the automatic transmission

- The measurement values will be output without requiring a received command.
- Only the synchronized OUTs will output measurement values.
- No measurement values will be output if there are no synchronized OUTs.
- Measurement values are output in synchronization with the input from the TIMING1 terminal (does not synchronize with the TIMING input from LS-Navigator2).

Point

- **The measurement control commands cannot be used if the automatic transmission function has been enabled.**
- **The trigger logging function cannot be used in LS-Navigator2 if the automatic transmission function has been enabled.**
- **Do not confirm the next measurement value while outputting a measurement value from RS-232C. The measurement value will not be output even if it has been confirmed.**

■ Output format

The setting can be modified from the “Data transmission mode” in the environment setting.

“Data send mode” (page 7-15)

● Data transmission mode: OFF

The automatic transmission function will be disabled.

● Data transmission mode: S1

All confirmed measurement values will be output.

● Data transmission mode: S2

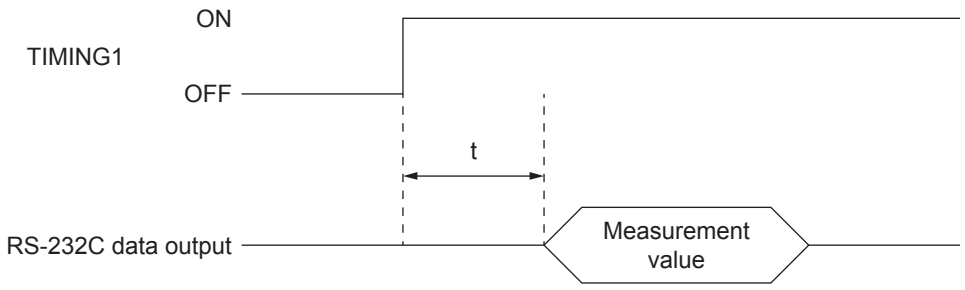
Of the confirmed measurement values, only those with a judgment result other than GO will be output.

M	J	,	o	o	,	m	m	m	m	m	m	m	m	m	,	v	,	j	j	CR

oo : OUT number (01 to 16)
mmmmmmmmm : Measurement value formats
v : Measurement result information (0 =Normal value, 1 = Over-range data, 2 = Output waiting data)
jj : Judgment result (HH/HI/GO/LO/LL/WT)

■ When output measurement values in synchronization with the TIMING1 terminal

Point **Make sure that "Measurement mode = Self timing hold" is not included in the synchronized OUTs.**



● **If Sample hold 2 is not included in the synchronized OUTs**

t = T7+7 ms

● **If Sample hold 2 is included in the synchronized OUTs**

t = T7+T5+7 ms
T5 : [Sampling frequency] × ([Averaging times] - 1)
T7 : Max 2ms

If the controller is processing commands (such as when communicating with LS-Navigator2) or connected to a display panel, the response speed may be slower than shown above.

■ When outputting measurement values using the “Self timing hold” mode

▶ Important **Set the synchronization setting as follows:**
- **Set the synchronization setting ON for only one OUT.**
- **Set the measurement mode for the OUT to “Self timing hold”.**

The measurement value output will start 5 ms after the values have been confirmed in the “Self timing hold” mode.

ASCII code table

		Upper order 4 bits							
		0	1	2	3	4	5	6	7
Lower bit	0	$^{N}_{U_L}$	$^{D}_{L_E}$	S_P	0	@	P	`	p
	1	$^{S}_{O_H}$	$^{D}_{C_1}$	!	1	A	Q	a	q
	2	$^{S}_{T_X}$	$^{D}_{C_2}$	″	2	B	R	b	r
	3	$^{E}_{T_X}$	$^{D}_{C_3}$	#	3	C	S	c	s
	4	$^{E}_{O_T}$	$^{D}_{C_4}$	$	4	D	T	d	t
	5	$^{E}_{N_Q}$	$^{N}_{A_K}$	%	5	E	U	e	u
	6	$^{A}_{C_K}$	$^{S}_{Y_N}$	&	6	F	V	f	v
	7	$^{B}_{E_L}$	$^{E}_{T_B}$	'	7	G	W	g	w
	8	B_S	$^{C}_{A_N}$	(	8	H	X	h	x
	9	H_T	E_M	)	9	I	Y	i	y
	A	L_F	$^{S}_{U_B}$	*	:	J	Z	j	z
	B	V_T	$^{E}_{S_C}$	+	;	K	[	k	{
	C	F_F	→	,	<	L	¥	l	|
	D	C_R	←	-	=	M	]	m	}
	E	S_O	↑	.	>	N	^	n	~
	F	S_I	↓	/	?	O	_	o	$^{D}_{E_L}$

Measurement control command list

This section describes the details of the measurement control commands that are sent/received by the controller on the measurement screen (i.e. measurement in progress).
There are two types of measurement control commands: received commands and reply commands. Reply commands are sent (returned) when the received commands were processed correctly.
The symbols with a background color in the command list are also explained in the table below.

Measurement control command
“Measurement value output (Single)” (page 9-8)
“Measurement value output (Multiple)” (page 9-9)
“Measurement value output (ALL)” (page 9-9)
“Timing ON/OFF (Single)” (page 9-10)
“Timing ON/OFF (Multiple)” (page 9-10)
“Timing ON/OFF (Synchronization)” (page 9-10)
“Auto zero ON/OFF (Single)” (page 9-10)
“Auto zero ON/OFF (Multiple)” (page 9-11)
“Auto zero ON/OFF (Synchronization)” (page 9-11)
“Reset (Single)” (page 9-11)
“Reset (Multiple)” (page 9-11)
“Reset (Synchronization)” (page 9-12)
“Statistics data output” (page 9-12)
“Statistics start” (page 9-12)
“Statistics stop” (page 9-12)
“Statistics clear” (page 9-13)

■ Measurement value output (Single)

Only outputs a single specified OUT value.

Received command	M S , r , o o CR
Reply command	M S , m m m m m m m m m m , v , j j CR
Parameter description	• r : Indicates the output content. • 0: Measurement value only • 1: Measurement value + Measurement result information • 2: Measurement value + Measurement result • 3: Measurement value + Measurement result information + Decision result • o o : Indicates the OUT number (01 to 16). • m m m m m m m m m : Measurement format is displayed. • v : Measurement result information is displayed. • 0: Normal value • 1: Over range data • 2: Output waiting data • j j : Judgement result (HH/HI/GO/LO/LL/WT) is displayed.

■ Measurement value output (Multiple)

Outputs the specified OUT values.

Received command	M M , r , i i i i i i i i i i i i i i i i CR
Reply command	M M , m m m m m m m m m , v , j j , m m m m m m m m m , v , j j … , m m m m m m m m m , v , j j CR
Parameter description	• r : Indicates the output content. • 0: Measurement value only • 1: Measurement value + Measurement result information • 2: Measurement value + Measurement result • 3: Measurement value + Measurement result information + Judgment result • i i i i i i i i i i i i i i i i : Indicates the OUT specification. Specify [1] on the OUTPUT for the measurement and judgement result you want to output, and [0] on the OUT you do not want to output. The latest OUT number comes to the front. Example: If you want to output the measurement and judgement results for OUT1 and OUT 5, specify [1000100000000000]. • m m m m m m m m m : Measurement format is displayed. • v : Measurement result information is displayed. • 0: Normal value • 1: Over range data • 2: Output waiting data • j j : Judgement result (HH/HI/GO/LO/LL/WT) is displayed.

■ Measurement value output (ALL)

Outputs all the OUT measurement values currently in use.

Received command	M A , r CR
Reply command	M A , m m m m m m m m m , v , j j , m m m m m m m m m , v , j j … , m m m m m m m m m , v , j j CR
Parameter description	• r : Indicates the output content. • 0: Measurement value only • 1: Measurement value + Measurement result information • 2: Measurement value + Measurement result • 3: Measurement value + Measurement result information + Judgment result • m m m m m m m m m : Measurement format is displayed. • v : Measurement result information is displayed. • 0: Normal value • 1: Over range data • 2: Output waiting data • j j : Judgement result (HH/HI/GO/LO/LL/WT) is displayed.

■ Timing ON/OFF (Single)

Switch ON/OFF one of the timings of specified OUT.

Received command	T S , p , o o CR
Reply command	T S CR
Parameter description	• p : Indicates the ON/OFF specification. • 0: OFF • 1: ON • o o : Indicates the OUT number (01 to 16).

■ Timing ON/OFF (Multiple)

Switch ON/OFF the timings of specified OUT.

Received command	T M , p , i i i i i i i i i i i i i i i i CR
Reply command	T M CR
Parameter description	• p : Indicates the ON/OFF specification. • 0: OFF • 1: ON • i i i i i i i i i i i i i i i i : Indicates the OUT specification. Specify [1] on the OUT whose TIMING you want to switch ON and [0] on the OUT you want to switch OFF. The latest OUT number comes to the front. Example: If you want to switch on the TIMING for OUT 1 and OUT 5, specify [1000100000000000].

■ Timing ON/OFF (Synchronization)

Switch ON/OFF OUT Timings that have been set to synchronize.

Received command	T p CR
Reply command	T p CR
Parameter description	• p : Indicates the ON/OFF specification. • 0: OFF • 1: ON

■ Auto zero ON/OFF (Single)

Switch ON/OFF one of the auto zero in specified OUT.

Received command	Z S , p , o o CR
Reply command	Z S CR
Parameter description	• p :Indicates the ON/OFF specification. • 0: OFF • 1: ON • o o : Indicates the OUT number (01 to 16).

■ Auto zero ON/OFF (Multiple)

Switch ON/OFF the auto zeros in specified OUT.

Received command	Z M , p , i i i i i i i i i i i i i i i i CR
Reply command	Z M CR
Parameter description	• p : Indicates the ON/OFF specification. • 0: OFF • 1: ON • i i i i i i i i i i i i i i i i : Indicates the OUT specification. Specify [1] on the OUT that you want to switch the auto zero ON, and [0] on the OUT that you want to switch the auto zero OFF. The latest OUT number comes to the front. Example: If you want to switch ON the auto zero for OUT 1 and OUT 5, specify [1000100000000000].

■ Auto zero ON/OFF (Synchronization)

Switch ON/OFF auto zeros of OUT that have been set to synchronize.

Received command	Z p CR
Reply command	Z p CR
Parameter description	• p : Indicates the ON/OFF specification. • 0: OFF • 1: ON

■ Reset (Single)

Reset one of the specified OUT.

Received command	R S , o o CR
Reply command	R S CR
Parameter description	• o o : Indicates the OUT number (01 to 16).

■ Reset (Multiple)

Reset specified OUT.

Received command	R M , i i i i i i i i i i i i i i i i CR
Reply command	R M CR
Parameter description	• i i i i i i i i i i i i i i i i : Indicates the OUT specification. Specify [1] on the OUT you want to RESET and [0] on the OUT you do not want to RESET. The latest OUT number comes to the front. Example: If you want to RESET OUT 1 and OUT 5, specify [1000100000000000].

■ Reset (Synchronization)

Reset OUT that have been set to synchronized.

Received command	R 1 CR
Reply command	R 1 CR
Parameter description	-

■ Statistics data output

Outputs the statistics data.

Received command	D O , a CR
Reply command	D O , m m m m m m m m m m MAX , m m m m m m m m m m MIN , m m m m m m m m m m AVE , m m m m m m m m m m PP , m m m m m m m m m m Standard deviation , n n n n n n Count , n n n n n n HH decision count , n n n n n n HI decision count , n n n n n n GO decision count , n n n n n n LO decision count , n n n n n n CR LL decision count
Parameter description	• a : Statistics Ch number (1 to 2) are displayed. • m m m m m m m m m m : Indicates the measurement format. • n n n n n n : Displays the numbers in 6 integral digits. Example: If the number is 12, [000012] is output.

■ Statistics start

Starts statistics processing.

Received command	D S , a CR
Reply command	D S CR
Parameter description	• a : Indicates the statistics Ch number (1 to 2).

■ Statistics stop

Stops statistics processing.

Received command	D P , a CR
Reply command	D P CR
Parameter description	• a : Indicates the statistics Ch number (1 to 2).

■ Statistics clear

Clears statistics data.

Received command	D Q , a CR
Reply command	D Q CR
Parameter description	• a : Indicates the statistics Ch number (1 to 2).

Setting control command list

This section describes the details of the setting control commands that are sent/received by the controller on the measurement screen (i.e. measurement in progress).
There are two types of setting control commands: received commands and reply commands. Reply commands are sent (returned) when the received commands were processed correctly.
The symbols with a background color in the command list are explained in the table below.

Control	Received command	Reply command
Setting save requisition	S S , b CR	S S CR
Setting save completion check	S M CR	S M , c CR
Program initialization	P I CR	P I CR
Program No. check	P R CR	P R , p p CR
Program switching	P W , p p CR	P W CR

Symbol	
b	Destination of the setting value is displayed. • 0: Settings write area • 1: Active measurement area • 2: Save area
c	Saving flag is displayed. • 0: Not saving • 1: Saving
p p	Program No. (00 to 15) is displayed.

Explanation for operations that take place when each area is selected.

Settings write area	Rewrites the values for Settings write area. When rewriting or reading, the reset process does not take place and therefore there is no impact on the measurement operation.
Active measurement area	After rewriting the value for settings write area, the contents of settings write area are reflected in the active measurement area. When reflecting the settings, reset process takes place and the active settings change. When reading the settings, reset process does not take place and therefore there is no impact on the measurement operation. When the power is switched off, the reflected settings are erased.
Save area	After rewriting the value for settings write area, the contents of settings write area and save area are reflected in the active measurement area. When reflecting the settings, reset process takes place and the active settings change. When reading the settings, reset process does not take place and therefore there is no impact on the measurement operation. Even when the power is switched off, the reflected settings are still maintained.

NOTICE	**Switching off the power soon after reflecting the operation settings may cause the set data to break down.** **If rewriting is done more than 100,000 times, the memory may break down.**

Settings change command list

This section describes the setting change commands that are used for changing the settings.

Settings change command	
“Head setting” (page 9-15)	“Edge detection threshold value” (page 9-15)
	“Mask setting” (page 9-16)
	“No. of edges check count” (page 9-16)
	“Focus monitor” (page 9-16)
“Setting the measurement target” (page 9-17)	“Reference head” (page 9-17)
	“Measurement types” (page 9-17)
	“Edge (Pitch) number” (page 9-17)
	“Tilt correction” (page 9-18)
	“Median filter” (page 9-18)
	“Delay” (page 9-18)
“OUT setting” (page 9-19)	“Calculation method” (page 9-19)
	“Filter” (page 9-19)
	“Offset” (page 9-20)
	“Difference output” (page 9-20)
	“Outlier exclusion function” (page 9-20)
	“Abnormal value cancellation” (page 9-21)
	“Measurement mode” (page 9-21)
	“Self timing period” (page 9-21)
“Tolerance setting” (page 9-22)	“Reference value mode” (page 9-22)
	“Threshold value mode” (page 9-22)
“Calibration/Scaling” (page 9-23)	“Calibration” (page 9-23)
	“OUT scaling” (page 9-23)
“Common settings” (page 9-24)	“Minimum display unit” (page 9-24)
	“Tolerance mode” (page 9-24)
	“Measurement target” (page 9-24)
	“Used OUT” (page 9-25)
	“Mutual interference prevention” (page 9-25)
	“OUT Synchronization” (page 9-25)
	“Group calculation” (page 9-26)

Settings change command	
“I/O terminal setting” (page 9-27)	“Analog output channel” (page 9-27)
	“Reference value mode - Analog scaling” (page 9-27)
	“Threshold value mode - Analog scaling” (page 9-27)
	“Encoder input mode / Points to skip” (page 9-28)
	“Encoder TIMING function” (page 9-28)
	“Pulse count value preset function” (page 9-28)
	“Total judgment output” (page 9-29)
	“Strobe output time” (page 9-29)
	“Off delay time” (page 9-29)
	“No. of control channels” (page 9-29)
	“Control channel” (page 9-30)
	“Status output” (page 9-30)
	“BCD unit settings” (page 9-31)
“Data storage” (page 9-31)	“Storage target OUT” (page 9-31)
	“Accumulation cycle / Points / NG storage” (page 9-32)
	“Storage control method” (page 9-32)
“Statistics processing” (page 9-33)	“Statistics processing target OUT” (page 9-33)
	“Statistics processing count” (page 9-33)
	“Statistics processing control method” (page 9-33)

■ Head setting

● Edge detection threshold value

Received command	S W , H T , b , h , t , d d CR
Reply command	S W , H T CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • h : Indicates the head number (1 to 4). • t : Indicates the threshold value T1, threshold value T2 selection. • 0: Threshold value T1 • 1: Threshold value T2 • d d : Indicates the edge detection threshold value. • 00: OFF (Threshold value T1 cannot be set to OFF) • 1 to 99: Edge detection threshold value (%)

● **Mask setting**

Received command	S W , H M , b , h , f , s s s s s s s s , s s s s s s s s CR
Reply command	S W , H M CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • h : Indicates the head number (1 to 4). • f : Indicate the function enable flag. • 0: Invalid • 1: Valid • s s s s s s s s : The format for the set numerical value is displayed.

● **No. of edges check count**

Received command	S W , H E , b , h , e e CR
Reply command	S W , H E CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • h : Indicates the head number (1 to 4). • e e : Indicates the no. of edges. • 00: No. of edges check function disabled • 02 to 31: No. of edges

● **Focus monitor**

Received command	S W , H F , b , h , F CR
Reply command	S W , H F CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • h : Indicates the head number (1 to 4). • F : Indicate the function enable flag. • 0: Invalid • 1: Valid

■ Setting the measurement target

● Reference head

Received command	S W , T H , b , t t , h CR
Reply command	S W , T H CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • t t : Indicates the measurement target number (01 to 16). • h : Indicates the head number (1 to 4).

● Measurement types

Received command	S W , T Y , b , t t , y CR
Reply command	S W , T Y CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • t t : Indicates the measurement target number (01 to 16). • y :Indicates the measurement type. • 0: DIA • 1: T-EDGE • 2: B-EDGE • 3: Select edge (Pitch) number • 4: Position between the transmitter and receiver • 5: Ultrafine DIA • 6: Ultrafine GAP • 7: Center position

● Edge (Pitch) number

Received command	S W , T P , b , t t , d d d , e , d d d , e CR
Reply command	S W , T P CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • t t : Indicates the measurement target number (01 to 16). • d d d : Indicates the edge (pitch) number (-31 to +31. It consists of one sign digit and two numeric digits.). • e : Indicates the edge (pitch) specification. • 0: Edge • 1: Pitch

● **Tilt correction**

Received command	S W , T T , b , t t , f CR
Reply command	S W , T T CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • t t : Indicates the measurement target number (01 to 16). • f : Indicate the function enable flag. • 0: Invalid • 1: Valid

● **Median filter**

Received command	S W , T M , b , t t , m CR
Reply command	S W , T M CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • t t : Indicates the measurement target number (01 to 16). • m : Indicates the median filter points. • 0: OFF • 2: 15 points • 1: 7 points • 3: 31 points

● **Delay**

Received command	S W , T D , b , t t , d d d d CR
Reply command	S W , T D CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • t t : Indicates the measurement target number (01 to 16). • d d d d : Indicates the no. of delay points. • 0000: OFF • 0001 to 1023: No. of delay points

■ OUT setting

● Calculation method

Received command	S W , O C , b , o o , M , t t , c t t , c t t , c t t , c t t , t t t t t t t t t t t t t t t t CR
Reply command	S W , O C CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • o o : Indicates the OUT number (01 to 16). • M : Indicates the calculation method. • 0: Combining calculations • 1: Average calculation • 2: No calculation • t t : Indicates the measurement target number (01 to 16). • c : Indicates the calculation factor. • 0: 0 • 3: +1/3 • 6: -1/2 • 1: +1 • 4: +1/4 • 7: -1/3 • 2: +1/2 • 5: -1 • 8: -1/4 • t t t t t t t t t t t t t t t t : Indicates the OUT specification. Specify [1] on the OUT to be used and [0] on the OUT not to be used accordingly. The latest OUT number comes to the front. Example: If you want to use OUT 1 and OUT 5, specify [1000100000000000].

● Filter

Received command	S W , A V , b , o o , v , w w CR
Reply command	S W , A V CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • o o : Indicates the OUT number (01 to 16). • v : Indicates the filter type. • 0: Moving average • 1: Simple average • w w : Indicates the averaging count. • 00: Once • 04: 16 times • 08: 256 times • 12: 4096 times • 01: Twice • 05: 32 times • 09: 512 times • 13: 8192 times • 02: 4 times • 06: 64 times • 10: 1024 times • 14: 16384 times • 03: 8 times • 07: 128 times • 11: 2048 times • 15: 32768 times

● **Offset**

Received command	S W , O F , b , o o , S S S S S S S S CR
Reply command	S W , O F CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • o o : Indicates the OUT number (01 to 16). • S S S S S S S S : Indicates the setting value format.

● **Difference output**

Received command	S W , D F , b , o o , f CR
Reply command	S W , D F CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • o o : Indicates the OUT number (01 to 16). • f :Indicate the function enable flag. • 0: Invalid • 1: Valid

● **Outlier exclusion function**

Received command	S W , O E , b , o o , f , x , x x x x , s s s s s s s s , s s s s s s s s CR
Reply command	S W , O E CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • o o : Indicates the OUT number (01 to 16). • f : Indicate the function enable flag. • 0: Invalid • 1: Valid • x : Indicates the exclusion method. • 0: Output waiting • 1: Hold the previous value • x x x x : Indicates the no. of abnormal value continuation counts (0001 to 4095). • s s s s s s s s : Indicates the setting value format.

● **Abnormal value cancellation**

Received command	S W , O A , b , o o , f , b b b b , a a a a , s s s s s s s s s , s s s s s s s s s CR
Reply command	S W , O A CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • o o : Indicates the OUT number (01 to 16). • f : Indicate the function enable flag. • 0: Invalid • 1: Valid • b b b b : Indicates the no. of points before cancellation (0000 to 4095). • a a a a : Indicates the no. of points after cancellation (0000 to 4095). • s s s s s s s s : Indicates the setting value format.

● **Measurement mode**

Received command	S W , M M , b , o o , m m , d CR
Reply command	S W , M M CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • o o : Indicates the OUT number (01 to 16). • m m : Indicates the measurement mode. • 00: Normal • 01: Peak hold • 02: Bottom hold • 3: Peak to Peak hold • 04: Auto peak hold • 05: Auto bottom hold • 06: Auto peak to Peak hold • 07: Average hold • 08: Sample hold • 09: Self timing hold • d : Indicates the hold mode (1, 2, 3).

● **Self timing period**

Received command	S W , S T , b , o o , t t t t CR
Reply command	S W , S T CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • o o : Indicates the OUT number (01 to 16). • t t t t : Indicates the self timing period (0001 to 9999 ms).

■ Tolerance setting

● Reference value mode

Received command	S W , U P , b , o o , s s s s s s s s CR
	S W , S D , b , o o , s s s s s s s s CR
	S W , L W , b , o o , s s s s s s s s CR
Reply command	S W , U P CR
	S W , S D CR
	S W , L W CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • o o : Indicates the OUT number (01 to 16). • s s s s s s s s : Indicates the setting value format.

● Threshold value mode

Received command	S W , H H , b , o o , s s s s s s s s CR
	S W , H I , b , o o , s s s s s s s s CR
	S W , L O , b , o o , s s s s s s s s CR
	S W , L L , b , o o , s s s s s s s s CR
Reply command	S W , H H CR
	S W , H I CR
	S W , L O CR
	S W , L L CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • o o : Indicates the OUT number (01 to 16). • s s s s s s s s : Indicates the setting value format.

■ Calibration/Scaling

● Calibration

Received command	S W , T C , b , t t , p , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s CR
Reply command	S W , T C CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • t t : Indicates the measurement target number (01 to 16). • p : Indicates the no. of points used. • 0: OFF • 1 to 8: No. of points used • s s s s s s s s : Indicates the setting value format.

● OUT scaling

Received command	S W , S C , b , o o , p , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s , s s s s s s s s CR
Reply command	S W , S C CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • o o : Indicates the OUT number (01 to 16). • p : Indicates the no. of points used. • 0: OFF • 1 to 8: No. of points used • s s s s s s s s : Indicates the setting value format.

■ Common settings

● Minimum display unit

Received command	S W , M U , b , u u CR
Reply command	S W , M U CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • u u : Indicates the minimum display unit. • 00: 0.1 mm • 04: 0.00001 mm • 01: 0.01 mm • 05: 1 µm • 02: 0.001 mm • 06: 0.1 µm • 03: 0.0001 mm • 07: 0.01 µm

● Tolerance mode

Received command	S W , L M , b , L CR
Reply command	S W , L M CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • L : Indicates the tolerance mode. • 0: Reference value mode • 1: Threshold value mode

● Measurement target

Received command	S W , U T , b , t t t t t t t t t t t t t t t t t t t t CR
Reply command	S W , U T CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • t t t t t t t t t t t t t t t t : Indicates the measurement target number specification. Specify [1] on the measurement target to be used and [0] on the measurement target not to be used. The latest measurement target number comes to the front. Example: If you want to use the measurement target 1 and measurement target 5, specify [1000100000000000]

● **Used OUT**

Received command	S W , U O , b , i i i i i i i i i i i i i i i i CR
Reply command	S W , U O CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • i i i i i i i i i i i i i i i i : Indicates the OUT specification. Specify [1] on the OUT to be used and [0] on the OUT not to be used. The latest OUT number comes to the front. Example: If you want to use OUT 1 and OUT 5, specify [1000100000000000]

● **Mutual interference prevention**

Received command	S W , M I , b , i , g g g g CR
Reply command	S W , M I CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • i : Indicates the mutual interference prevention mode. • 0: OFF • 1: AB-ON • 2: ABC-ON • g g g g : Indicates the head group. Specify [0] on group A Head, [1] on group B Head and [2] on group C head. The latest Head number comes to the front. Example: If Head 1 is group A, Head 2 and head 3 are group B, and Head 4 is group C, specify [0112].

● **OUT Synchronization**

Received command	S W , S Y , b , i i i i i i i i i i i i i i i i CR
Reply command	S W , S Y CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • i i i i i i i i i i i i i i i i : Indicates the OUT specification. Specify [1] on the OUT to be synchronized and [0] on the OUT not to be synchronized. The latest OUT number comes to the front. Example: If you want to synchronize OUT 1 and OUT 5, specify [1000100000000000].

● **Group calculation**

Received command	S W , G R , b , q q q q , Q , r r CR
Reply command	S W , G R CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • q q q q : Indicates the calculation points. • 0000: OFF • 0002 to 4095: calculation points • Q : Indicates the calculation contents. • 0: Maximum value • 1: Minimum value • 2: Maximum - Minimum value • 3: Average value • r r : Indicates the group calculation source OUT number (01 to 15). *The group calculation result will be output to OUT16. You can select from OUT1 to OUT15 for the calculation source OUT.

■ I/O terminal setting

● Analog output channel

Received command	S W , A N , b , a , o o , w CR
Reply command	S W , A N CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • a : Indicates the analog Ch number (1 to 4). • o o : Indicates the OUT number (01 to 16). • w : Indicates the voltage of output waiting data. • 0: -10.8 V • 2: 0 V • 1: +10.8 V • 3: Hold the previous value

● Reference value mode - Analog scaling

Received command	S W , A S , b , a , s s CR
Reply command	S W , A S CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • a : Indicates the analog Ch number (1 to 4). • s s : Indicates the analog scaling (Reference value mode). Values from 00 to 12 correspond to the below. • In case of mm/μm (Unit: μm/V) • 00: 1 • 03: 10 • 06: 100 • 09: 1000 • 12: 10000 • 01: 2 • 04: 20 • 07: 200 • 10: 2000 • 02: 5 • 05: 50 • 08: 500 • 11: 5000

● Threshold value mode - Analog scaling

Received command	S W , A T , b , a , s s s s s s s s , s s s s s s s s CR
Reply command	S W , A T CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • a : Indicates the analog Ch number (1 to 4). • s s s s s s s s : Indicates the setting value format.

● **Encoder input mode / Points to skip**

Received command	S W , E I , b , z , n n n n CR
Reply command	S W , E I CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • z : Indicates the encoder input mode. • 0: 1-phase 1 TM • 1: 2-phase 1 TM • 2: 2-phase 2 TM • 3: 2-phase 4 TM • n n n n : Indicates the no. of encoder skipping points. • 0000: OFF • 0002 to 1000: encoder skipping points

● **Encoder TIMING function**

Received command	S W , E T , b , f CR
Reply command	S W , E T CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • f : Indicate the function enable flag. • 0: Invalid • 1: Valid

● **Pulse count value preset function**

Received command	S W , P P , b , A , p p p p p p p p p p p CR
Reply command	S W , P P CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • A : Indicate the function enable flag. • 0: Invalid • 1: Valid (Positive-true logic) • 2: Valid (Negative-true logic) • p p p p p p p p p p p : Indicates the pulse count value (-2147483648 to +2147483647. It consists of one sign digit and ten numeric digits.).

● **Total judgment output**

Received command	S W , T J , b , i i i i i i i i i i i i i i i i CR
Reply command	S W , T J CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • i i i i i i i i i i i i i i i i : Indicates the OUT specification. Specify [1] on the OUT to be used and [0] on the OUT not to be used. The latest OUT number comes to the front. If you want to use OUT 1 and OUT 5 for the total Judgement, specify [1000100000000000]

● **Strobe output time**

Received command	S W , S B , b , r CR
Reply command	S W , S B CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • r : Indicates the strobe output time. • 0: 2 ms • 2: 10 ms • 4: 50 ms • 6: 200 ms • 1: 5 ms • 3: 20 ms • 5: 100 ms • 7: 500 ms

● **Off delay time**

Received command	S W , O D , b , Y CR
Reply command	S W , O D CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • Y : Indicates the off delay time. • 0: 0 • 2: 5 ms • 4: 20 ms • 6: 50 ms • 8: 200 ms • 1: 2 ms • 3: 10 ms • 5: Hold • 7: 100 ms • 9: 500 ms

● **No. of control channels**

Received command	S W , U J , b , u CR
Reply command	S W , U J CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • u : Indicates the no. of control Ch (2 to 4).

● **Control channel**

Received command	S W , C J , b , j , o o CR
Reply command	S W , C J CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • j : Indicates the control Ch number (1 to 4). • o o : Indicates the OUT number (01 to 16).

● **Status output**

Received command	S W , C S , b , U , V , o o , h , s CR
Reply command	S W , C S CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • U : Indicates the status output Ch number (1 to 4). • V : Indicates the status output function selection. • 0: Output waiting • 1: Outlier continue • 2: FOCUS • 3: Insufficient light • 4: Check No. of edges: Fail • 5: Stat processing ON • 6: Pulse frequency error • o o : Indicates the OUT number (01 to 16). • h : Indicates the head number (1 to 4). • s : Indicates the statistics processing Ch number (1 to 2).

● **BCD unit settings**

Received command	S W , X T , b , X , Xr , Xk , o o , o o , o o , o o CR
Reply command	S W , X T CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • X : Indicates the output selection function. • 0: BCD output • 1: Binary output • 2: Judgment output • Xr : BCD strobe time • 0: 2 ms • 2: 10 ms • 4: 50 ms • 6: 200 ms • 1: 5 ms • 3: 20 ms • 5: 100 ms • 7: 500 ms • Xk : OUT selection method • 0: Controller settings • 1: BCD unit terminal • o o : Indicates the OUT number (01 to 16). (Example) Output connector 1: OUT3 Output connector 2: OUT4 Output connector 3: OUT6 Output connector 4: To specify OUT10, use “03,04,06,10”.

■ Data storage

● **Storage target OUT**

Received command	S W , G T , b , i i i i i i i i i i i i i i i i CR
Reply command	S W , G T CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • i i i i i i i i i i i i i i i i : Indicates the OUT specification. Specify [1] on the OUT that is a storage target and [0] on the OUT that is not a storage target. The latest OUT number comes to the front. Example: If you want to make OUT 1 and OUT 5 storage targets, specify [1000100000000000].

● **Accumulation cycle / Points / NG storage**

Received command	S W , G P , b , y y , g g g g g g , f CR
Reply command	S W , G P CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • y y : Indicates the accumulation cycle. • 00: ×1 • 01: ×2 • 02: ×5 • 03: ×10 • 04: ×20 • 05: ×50 • 06: ×100 • 07: ×200 • 08: ×500 • 09: ×1000 • 10: 1 sec • 11: Timing synchronization • 12: Storage trigger synchronization • g g g g g g : Indicates the no. of accumulated points (000001 to 400000 points). • f: Indicate the NG storage enable flag. • 0: Invalid • 1: Valid

● **Storage control method**

Received command	S W , G K , b , k CR
Reply command	S W , G K CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • k : Indicates the control method. • 0: Terminal • 1: Command

■ Statistics processing

● Statistics processing target OUT

Received command	S W , S O , b , s , o o CR
Reply command	S W , S O CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • s : Indicates the statistics processing Ch number (1 to 2). • o o : Indicates the OUT number (01 to 16).

● Statistics processing count

Received command	S W , S P , b , q q q q q q CR
Reply command	S W , S P CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • q q q q q q : Indicates the no. of statistics processing points (000002 to 999999 points).

● Statistics processing control method

Received command	S W , S K , b , k CR
Reply command	S W , S K CR
Parameter description	• b : Indicates the destination of the setting value. • 0: Settings write area • 1: Active measurement area • 2: Save area • k : Indicates the control method. • 0: Terminal • 1: Command

Setting check command list

This section describes the command format for checking the contents of the settings.

■ Head setting

Changes	Received command	Reply command
Edge detection threshold value	SR,HT,b,h,t CR	SR,HT,h,t,dd CR
Mask	SR,HM,b,h CR	SR,HM,h,f ,Setting value formats ,Setting value formats CR
No. of edges check count	SR,HE,b,h CR	SR,HE,h,ee CR
Focus monitor	SR,HF,b,h CR	SR,HF,h,F CR

■ Setting the measurement target

Changes	Received command	Reply command
Reference head	SR,TH,b,tt CR	SR,TH,tt,h CR
Measurement types	SR,TY,b,tt CR	SR,TY,tt,y CR
Edge/Pitch number	SR,TP,b,tt CR	SR,TP,tt,ddd,e ,ddd,e CR
Tilt correction	SR,TT,b,tt CR	SR,TT,tt,f CR
Median filter	SR,TM,b,tt CR	SR,TM,tt,m CR
Delay	SR,TD,b,tt CR	SR,TD,tt,dddd CR

■ OUT setting

Changes	Received command	Reply command
Calculation	SR,OC,b,oo CR	SR,OC,oo,M,tt,ctt ,ctt,ctt,ctt ,Select target CR
Filter	SR,AV,b,oo CR	SR,AV,oo,v,ww CR
Offset	SR,OF,b,oo CR	SR,OF,oo,Setting value formats CR
Difference function	SR,DF,b,oo CR	SR,DF,oo,f CR
Outlier exclusion function	SR,OE,b,oo CR	SR,OE,oo,f,x,xxxx ,Setting value formats ,Setting value formats CR
Abnormal value cancellation	SR,OA,b,oo CR	SR,OA,oo,f,bbbb ,aaaa,Setting value formats ,Setting value formats CR
Hold mode	SR,MM,b,oo CR	SR,MM,oo,mm,d CR
Self timing period	SR,ST,b,oo CR	SR,ST,oo,tttt CR

■ Tolerance setting

Changes	Received command	Reply command
Reference value	SR,UP,b,oo CR	SR,UP,oo,Setting value formats CR
	SR,SD,b,oo CR	SR,SD,oo,Setting value formats CR
	SR,LW,b,oo CR	SR,LW,oo,Setting value formats CR
Threshold value	SR,HH,b,oo CR	SR,HH,oo,Setting value formats CR
	SR,HI,b,oo CR	SR,HI,oo,Setting value formats CR
	SR,LO,b,oo CR	SR,LO,oo,Setting value formats CR
	SR,LL,b,oo CR	SR,LL,oo,Setting value formats CR

■ Calibration/Scaling

Changes	Received command	Reply command
Measurement target calibration	SR,TC,b,tt CR	SR,TC,tt,p ,Setting value formats,Setting value formats ,Setting value formats,Setting value formats ,Setting value formats,Setting value formats ,Setting value formats,Setting value formats ,Setting value formats,Setting value formats ,Setting value formats,Setting value formats ,Setting value formats,Setting value formats CR
OUT scaling	SR,SC,b,oo CR	SR,SC,oo,p ,Setting value formats,Setting value formats ,Setting value formats,Setting value formats ,Setting value formats,Setting value formats ,Setting value formats,Setting value formats ,Setting value formats,Setting value formats ,Setting value formats,Setting value formats ,Setting value formats,Setting value formats CR

■ Common settings

Changes	Received command	Reply command
Minimum display unit	SR,MU,b CR	SR,MU,uu CR
Tolerance mode	SR,LM,b CR	SR,LM,L CR
Measurement target	SR,UT,b CR	SR,UT,Measurement target number specification CR
Used OUT	SR,UO,b CR	SR,UO,OUT specification CR
Mutual interference prevention	SR,MI,b CR	SR,MI,i,gggg CR
Sync measure OUT	SR,SY,b CR	SR,SY,OUT specification CR
Group calculation	SR,GR,b CR	SR,GR,qqqq,Q,rr CR

■ I/O terminal setting

Changes	Received command	Reply command
Analog output terminal setting	S R , A N , b , a CR	S R , A N , a , o o , w CR
Reference value mode - Analog scaling	S R , A S , b , a CR	S R , A S , a , s s CR
Threshold value mode - Analog scaling	S R , A T , b , a CR	S R , A T , a , Setting value formats , Setting value formats CR
Encoder input mode / Points of skipping	S R , E I , b CR	S R , E I , z , n n n n CR
Encoder TIMING function	S R , E T , b CR	S R , E T , f CR
Pulse count value preset function	S R , P P , b CR	S R , P P , f , Pulse count value CR
Overall judgment	S R , T J , b CR	S R , T J , OUT specification CR
Strobe output time	S R , S B , b CR	S R , S B , r CR
Off delay time	S R , O D , b CR	S R , O D , Y CR
No. of control channels	S R , U J , b CR	S R , U J , u CR
Control channel	S R , M J , b , j CR	S R , M J , j , o o CR
Status output channel	S R , M S , b , U CR	S R , M S , U , V , o o , h , s CR
BCD unit settings	S R , X T , b CR	S R , X T , b , X , Xr , Xk , o o , o o , o o , o o CR

■ Data storage

Changes	Received command	Reply command
Storage target OUT	S R , G T , b CR	S R , G T , OUT specification CR
Accumulation cycle / Points / NG storage function	S R , G P , b CR	S R , G P , y y , g g g g g g , f CR
Storage control method	S R , G K , b CR	S R , G K , k CR

■ Statistics processing

Changes	Received command	Reply command
Statistics processing target OUT	S R , S O , b , s CR	S R , S O , s , o o CR
Statistics processing count	S R , S P , b CR	S R , S P , q q q q q q CR
Statistics processing control method	S R , S K , b CR	S R , S K , k CR

Other commands

Control	Received command	Reply command
Execute calibration of light intensity	L C , S , h CR	L C , S CR
Initialize calibration of light intensity	L C , I , h CR	L C , I CR

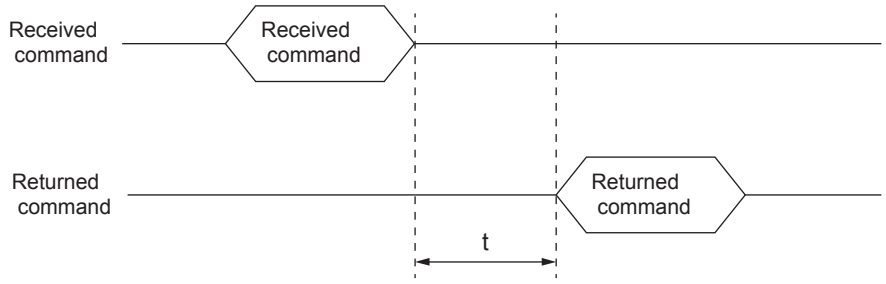
List of command parameters

Symbol	Summary	Remarks
b	Destination of the setting value	0: Settings write area, 1: Active measurement area, 2: Save area
h	Head number	1 to 4
t	Threshold value T1-T2 selection	0: Threshold value T1, 1: Threshold value T2
d d	Edge detection threshold value	00: OFF, 1 to 99%
f	Function enable flag	0: Invalid, 1: Valid
s s s s s s s s (Setting value formats)	Setting value formats	It consists of one sign digit and seven numeric digits.
e e	No. of edges	00: No. of edges check function disabled, 02 to 31: No. of edges
F	Focus range	0 to 9
t t	Measurement target number	01 to 16
y	Measurement types	0: DIA, 1: T-EDGE, 2: B-EDGE, 3: Select edge (pitch) number, 4: Position between the transmitter and receiver, 5: Ultrafine DIA, 6: Ultrafine GAP, 7: Center position
d d d	Edge/Pitch number	-31 to +31. It consists of one sign digit and two numeric digits.
e	Edge/Pitch specification	0: Edge, 1: Pitch
m	Median filter points	0: OFF, 1: 7 points, 2: 15 points, 3: 31 points
d d d d	Delay points	0000: OFF, 0001 to 1023 points
o o	OUT number	01 to 16
M	Calculation method	0: Combining calculations, 1: Average, 2: No calculation
c	Calculation factor	0: “0”, 1: “+1”, 2: “+1/2”, 3: “+1/3”, 4: “+1/4”, 5: “-1”, 6: “-1/2”, 7: “-1/3”, 8: “-1/4”
i i i i i i i i i i i i i i i i (OUT specification)	OUT specification	1: ‘Output’ or 0: ‘Do not output’ is specified for each OUT. Set the sequence starting from the younger OUT number. (Example)To output the values for OUT1 and OUT5, set the parameter as “1000100000000000”.
v	Filter types	0: Moving average, 1: Simple average

Symbol	Summary	Remarks
w w	Averaging count	00: Once, 01: Twice, 02: 4 times, 03: 8 times, 04: 16 times, 05: 32 times, 06: 64 times, 07: 128 times, 08: 256 times, 09: 512 times, 10: 1024 times, 11: 2048 times, 12: 4096 times, 13: 8192 times, 14: 16384 times, 15: 32768 times
x	Exclusion method	0: Output waiting, 1: Hold the previous value
x x x x	Abnormal value continuation count	0001 to 4095
b b b b	Points before cancellation	0000 to 4095
a a a a	Points after cancellation	0000 to 4095
m m	Hold mode	00: Normal, 01: Peak hold, 02: Bottom hold, 3: Peak to Peak hold, 04: Auto peak hold, 05: Auto bottom hold, 06: Auto peak to Peak hold, 07: Average hold, 08: Sample hold, 09: Self timing hold
d	Hold mode	1, 2, 3
t t t t	Self timing period	0001 to 9999 ms
p	No. of points used	0: OFF, 1 to 8 points
u u	Minimum display unit	00: 0.1 mm, 01: 0.01 mm, 02: 0.001 mm, 03: 0.0001 mm, 04: 0.00001 mm, 05: 1 µm, 06: 0.1 µm, 07: 0.01 µm
L	Tolerance mode	0: Reference value mode, 1: Threshold value mode
t t t t t t t t t t t t t t t t (Measurement target number specification)	Measurement target number specification	1 per target: 'Output' or 0: 'Do not output' is specified for each OUT. Set the sequence starting from the younger measurement target number. (Example)To output Measurement target 1 and Measurement target 5, set the parameter as "1000100000000000".
i	Mutual interference prevention mode	0: OFF, 1: AB-ON, 2: ABC-ON
g g g g	Head group	0 per head: Group A, 1: Group B, 2: Group C is specified for each head. Set the sequence starting from the younger head number. (Example)Set the parameter as "0112" is head 1 is A, head 2/3 are B, and head 4 is C.
q q q q	Group calculation points	0000: OFF, 0002 to 4095 points
Q	Group calculation method	0: Maximum value, 1: Minimum value, 2: Maximum - Minimum value, 3: Average value
r r	Group calculation source OUT number	01 to 15 *The group calculation result will be output to OUT16. You can select from OUT1 to OUT15 for the calculation source OUT.
a	Analog Ch number	1 to 4
w	Voltage of output waiting data	0: -10.8 V, 1: +10.8 V, 2: 0 V, 3: Hold the previous value
s s	Analog scaling (Reference value mode)	Values from 00 to 12 correspond to the below. 00: 1, 01: 2, 02: 5, 03: 10, 04: 20, 05: 50, 06: 100, 07: 200, 08: 500, 09: 1000, 10: 2000, 11: 5000, 12: 10000 [µm/V]
z	Encoder input mode	0: 1-phase 1 TM, 1: 2-phase 1 TM, 2: 2-phase 2 TM, 3: 2-phase 4 TM
n n n n	No. of encoder skipping points	0000: OFF, 0002 to 1000 pulse

Symbol	Summary	Remarks
p p p p p p p p p p p (Pulse count value)	Pulse count value	-2147483648 to +2147483647. It consists of one sign digit and ten numeric digits.
A	Pulse count preset	0: Invalid 1: Valid(Positive-true logic) 2: Valid(Negative-true logic)
r	Strobe output time	0: 2 ms, 1: 5 ms, 2: 10 ms, 3: 20 ms, 4: 50 ms, 5: 100 ms, 6: 200 ms, 7: 500 ms
Y	Off delay time	0: 0, 1: 2 ms, 2: 5 ms, 3: 10 ms, 4: 20 ms, 5: Hold, 6: 50 ms, 7: 100 ms, 8: 200 ms, 9: 500 ms
u	No. of judgment output Ch	2 to 4
j	Judgment output Ch number	1 to 4
U	Status output Ch number	1 to 4
V	Status output function selection	0: Output waiting, 1: Abnormal value continuation, 2: FOCUS, 3: Insufficient light volume, 4: No. of edges check NG, 5: Statistics processing in progress ON, 6: Pulse count preset
X	BCD unit output function selection	0: BCD output, 1: Binary output, 2: Judgment value output
Xr	BCD strobe time	0: 2 ms, 1: 5 ms, 2: 10 ms, 3: 20 ms, 4: 50 ms, 5: 100 ms, 6: 200 ms, 7: 500 ms
Xk	BCD unit OUT selection method	0: Controller settings, 1: BCD unit terminal
y y	Accumulation cycle	00: ×1, 01: ×2, 02: ×5, 03: ×10, 04: ×20, 05: ×50, 06: ×100, 07: ×200, 08: ×500, 09: ×1000, 10: 1 sec, 11: Timing synchronization, 12: Storage trigger synchronization
g g g g g g	Storage pts	000001 to 400000 points
k	Control method	0: Terminal, 1: Command
s	Statistics processing Ch number	1 to 2
q q q q q q	Statistics processing count	000002 to 999999 points

Time delay in response when sending and receiving commands



Command		Time delay in response (t)
Measurement control command		t = 3ms or less
Measurement control	Request to save the settings	(*) Depends on where the set value is written
	Confirm that saving of the settings is complete	t = 3ms or less
	Initialize the program	t = No. of heads x 250ms + 1800ms or less
	Confirm program number	t = 3ms or less
	Switch program	t = No. of heads x 250ms + 50ms or less
Change settings command		(*) Depends on where the set value is written
Confirm settings command		t = 16ms or less
Others	Perform light intensity calibration	t = No. of heads x 250ms + 4750ms or less
	Initialize light intensity calibration	t = No. of heads x 250ms + 1250ms or less

(*)

In case of writing the setting range	t = 8ms or less
In case of range when in operation setting or range for save setting	t = No. of heads x 250ms + 50ms or less

If the controller is processing a command (Communicating with LS-Navigator2 e.t.c.), the response speed will be slower than as indicated in the above table.
The response delay time will be longer than shown above when communicating with LS-Navigator2 or connected to the expansion unit.

- When communicating with LS-Navigator2, when the display panel is connected, when CB-EP100 is connected, and when CB-PN100 is connected: Max. approx. 100 ms
- When BCD unit is connected: Max. 10 ms

10

Timing Chart

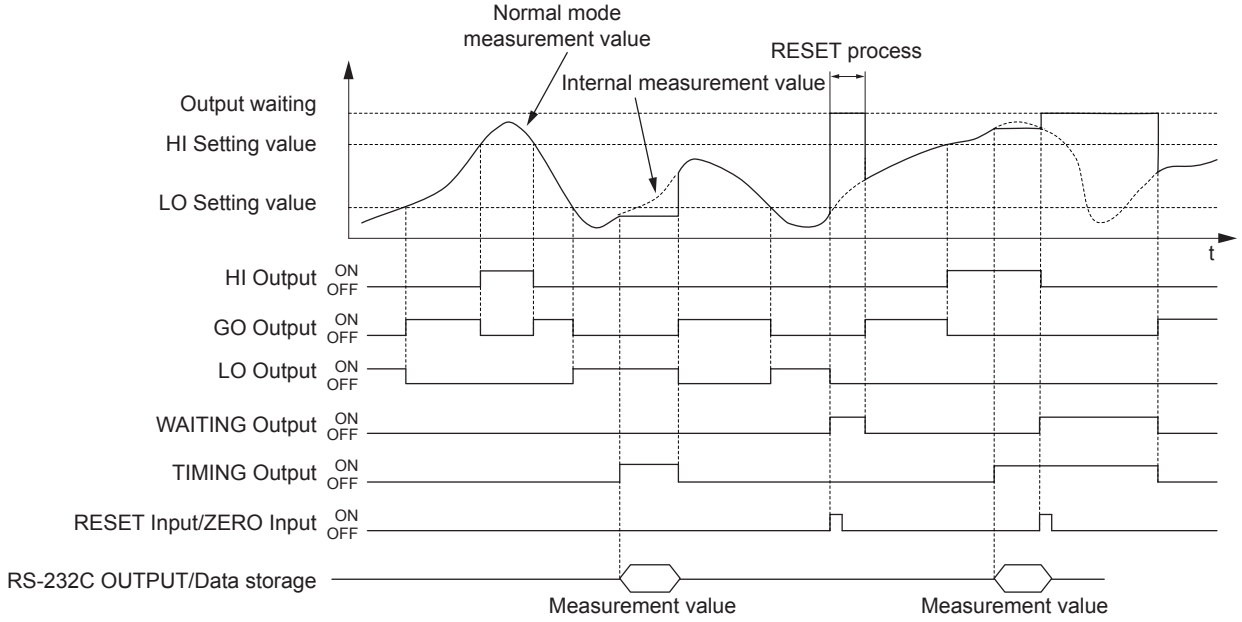
This section describes the measurement mode and the I/O terminal timing charts.

Measurement overview 10-2
I/O details 10-10

Measurement overview

■ Normal

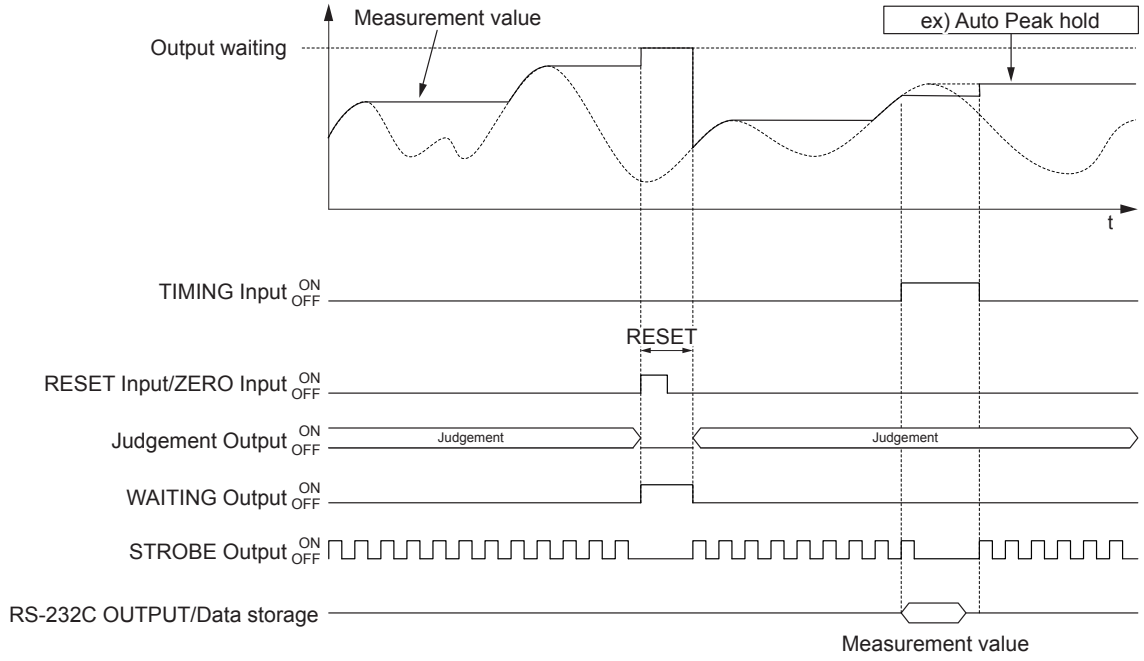
The measurement will be performed continuously, displaying and outputting measurement values at all times.



- The ON status of each output refers to the status in which the NPN/PNP open collector output is ON.
- The ON status of each input indicates a short-circuit between the COM terminals for LS-9501 (NPN type); and it indicates a voltage-applied status between the COM terminals for LS-9501P (PNP type).
- The RS-232C output will be synchronized with the TIMING input when the "Data transmission mode" in the environment setting is set to S1 or S2. “Data send mode” (page 7-15)
- The data storage will be saved in synchronization with the TIMING input when the “Accumulation cycle” in the data storage is set to TIMING synchronization in the common settings.
- If the RESET input is switched ON while the TIMING input is ON, the measurement value will remain in the output waiting status until the TIMING input is switched OFF.
- Off delay time can be set for the judgment output. “Off-delay time” (page 5-96)
- The TIMING input, RESET input, and ZERO input can be controlled from RS-232C, LS-Navigator2, or the display panel.

■ Auto peak hold/Auto bottom hold/Auto peak to Peak hold

Hold mode	Measurement value
Auto peak hold	Calculates the maximum value of the measurement data.
Auto bottom hold	Calculates the minimum value of the measurement data.
Auto peak to Peak hold	Calculates the maximum minus the minimum values of the measurement data.

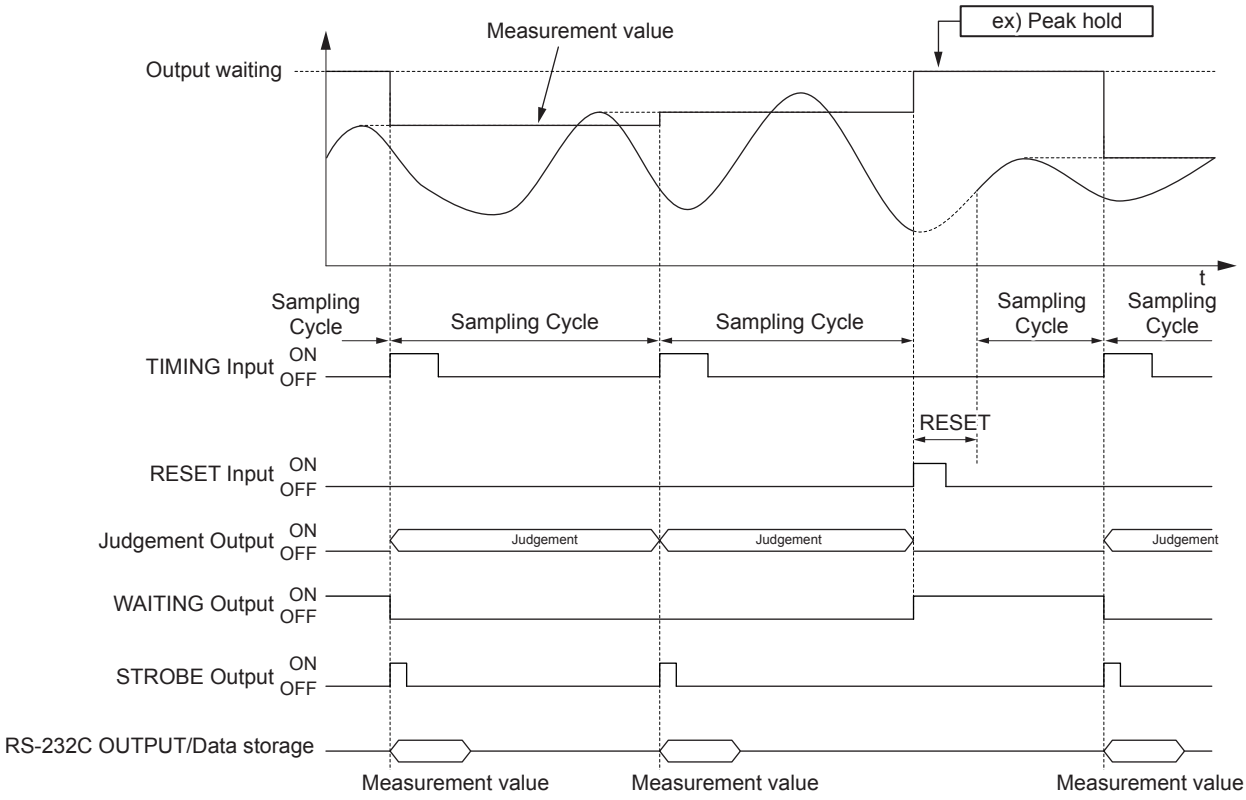


- Peak (Bottom/Peak to Peak) will be updated continuously.
- When the TIMING input turns ON, the last measurement value will be held.
- In the following cases, the measurement value will remain in the output waiting status until it is confirmed:
  - When the power is switched ON / When the setting is modified / When the program No. is changed
  - When RESET is input / When ZERO is input
- The ON status of each output refers to the status in which the NPN/PNP open collector output is ON.
- The ON status of each input indicates a short-circuit between the COM terminals for LS-9501 (NPN type); and it indicates a voltage-applied status between the COM terminals for LS-9501P (PNP type).
- The RS-232C output will be synchronized with the TIMING input when the "Data transmission mode" in the environment setting is set to S1 or S2. “Data send mode” (page 7-15)
- The data storage will be saved in synchronization with the TIMING input when the “Accumulation cycle” in the data storage is set to TIMING synchronization in the common settings.
- If the RESET input is switched ON while the TIMING input is ON, the measurement value will remain in the output waiting status until the TIMING input is switched OFF.
- Off delay time can be set for the judgment output. “Off-delay time” (page 5-96)
- The TIMING input, RESET input, and ZERO input can be entered from RS-232C, LS-Navigator2, or the display panel.

■ Peak hold/Bottom hold/Peak to Peak hold/Average hold (Hold 1)

The measurement will be performed for the duration specified by the external TIMING input (sampling cycle). The measurement values will then be displayed/output.

Hold mode	Measurement value
Peak hold	Calculates the maximum value during the sampling cycle.
Bottom hold	Calculates the minimum value during the sampling cycle.
Peak to Peak hold	Calculates the maximum minus the minimum values during the sampling cycle.
Average hold	Calculates the average value during the sampling cycle.

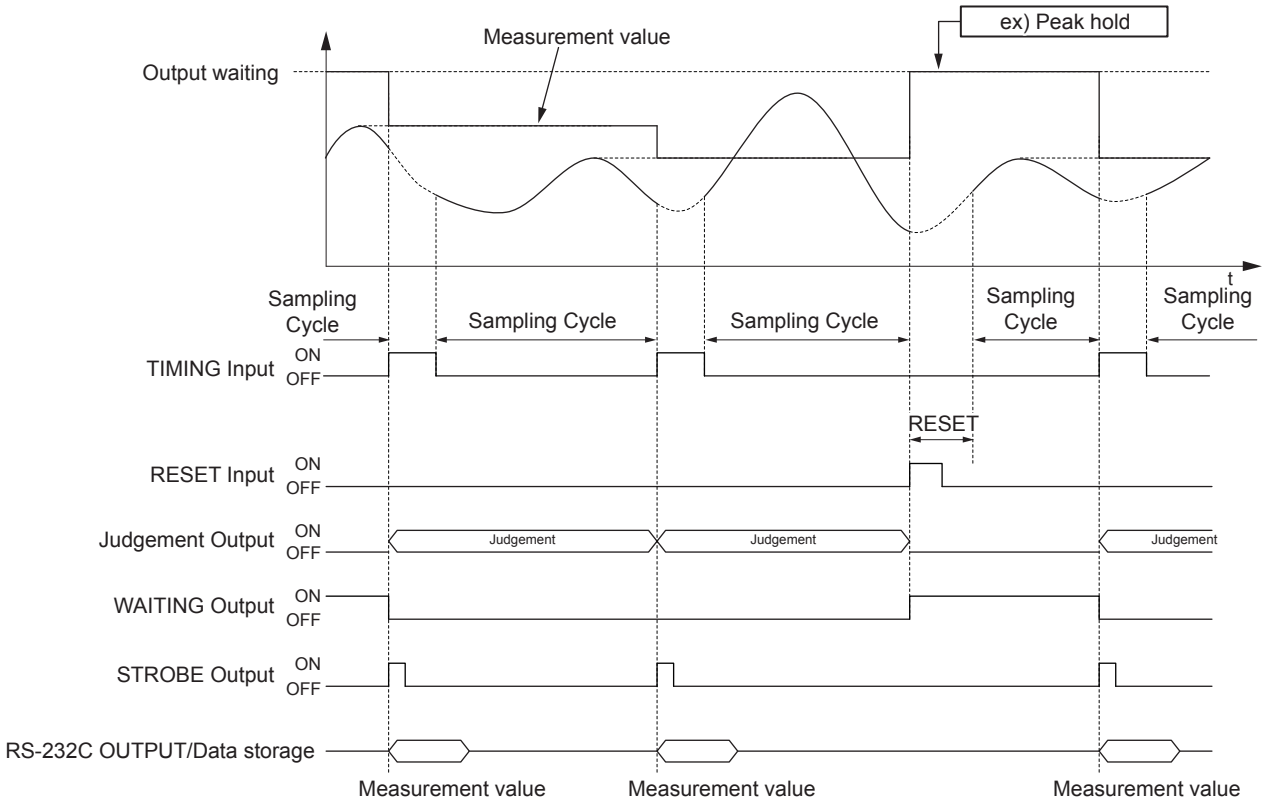


- The sampling cycle will be from the rising of the TIMING input to the rising of the next TIMING input.
- When the TIMING input rises, the peak of the last sampling cycle (Bottom/Peak to Peak/Average) will be output.
- In the following cases, the measurement value will remain in the output waiting status until it is confirmed:
  - When the power is switched ON / When the setting is modified / When the program No. is changed
  - When RESET is input / When ZERO is input
- The ON status of each output refers to the status in which the NPN/PNP open collector output is ON.
- The ON status of each input indicates a short-circuit between the COM terminals for LS-9501 (NPN type); and it indicates a voltage-applied status between the COM terminals for LS-9501P (PNP type).
- The RS-232C output will be synchronized with the TIMING input when the "Data transmission mode" in the environment setting is set to S1 or S2. “Data send mode” (page 7-15)
- The data storage will be saved in synchronization with the TIMING input when the “Accumulation cycle” in the data storage is set to TIMING synchronization in the common settings.
- If the RESET input is switched ON while the TIMING input is ON, the measurement value will remain in the output waiting status until the TIMING input is switched OFF.
- Off delay time can be set for the judgment output. “Off-delay time” (page 5-96)
- The TIMING input, RESET input, and ZERO input can be entered from RS-232C, LS-Navigator2, or the display panel.

■ Peak hold/Bottom hold/Peak to Peak hold/Average hold (Hold 2)

The measurement will be performed for the duration specified by the external TIMING input (sampling cycle). The measurement values will then be displayed/output.

Hold mode	Measurement value
Peak hold	Calculates the maximum value during the sampling cycle.
Bottom hold	Calculates the minimum value during the sampling cycle.
Peak to Peak hold	Calculates the maximum minus the minimum values during the sampling cycle.
Average hold	Calculates the average value during the sampling cycle.

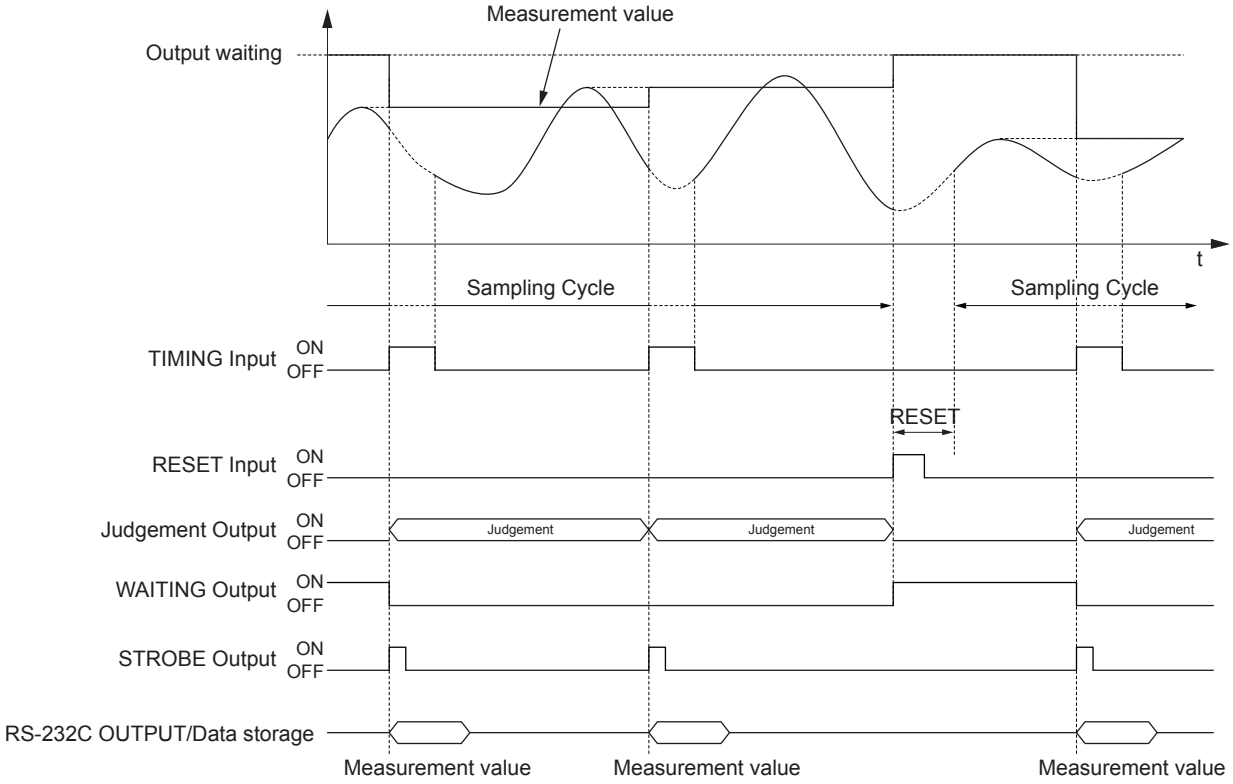


- The sampling cycle will be from the falling of the TIMING input to the rising of the next TIMING input.
- When the TIMING input rises, the peak of the last sampling cycle (/Bottom/Peak to Peak/Average) will be output.
- In the following cases, the measurement value will remain in the output waiting status until it is confirmed:
  - When the power is switched ON / When the setting is modified / When the program No. is changed
  - When RESET is input / When ZERO is input
- The ON status of each output refers to the status in which the NPN/PNP open collector output is ON.
- The ON status of each input indicates a short-circuit between the COM terminals for LS-9501 (NPN type); and it indicates a voltage-applied status between the COM terminals for LS-9501P (PNP type).
- The RS-232C output will be synchronized with the TIMING input when the "Data transmission mode" in the environment setting is set to S1 or S2. “Data send mode” (page 7-15)
- The data storage will be saved in synchronization with the TIMING input when the “Accumulation cycle” in the data storage is set to TIMING synchronization in the common settings.
- If the RESET input is switched ON while the TIMING input is ON, the measurement value will remain in the output waiting status until the TIMING input is switched OFF.
- Off delay time can be set for the judgment output.“Off-delay time” (page 5-96)
- The TIMING input, RESET input, and ZERO input can be entered from RS-232C, LS-Navigator2, or the display panel.

■ Peak hold/Bottom hold/Peak to Peak hold/Average hold (Hold 3)

The measurement will be performed for the duration specified by the external TIMING input (sampling cycle). The measurement values will then be displayed/output.

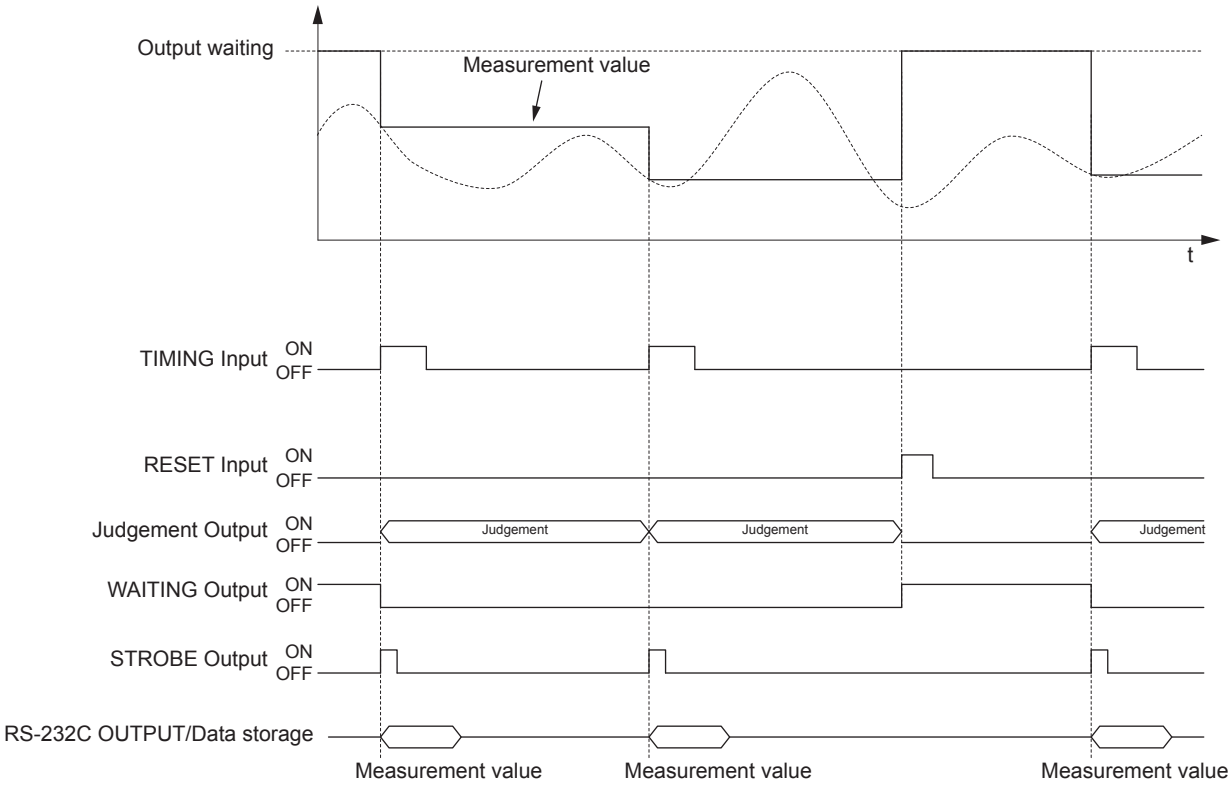
Hold mode	Measurement value
Peak hold	Calculates the maximum value during the sampling cycle.
Bottom hold	Calculates the minimum value during the sampling cycle.
Peak to Peak hold	Calculates the maximum minus the minimum values during the sampling cycle.
Average hold	Calculates the average value during the sampling cycle.



- The sampling cycle will always be active except while the TIMING input is ON.
- When the TIMING input rises, the peak of the last sampling cycle (/Bottom/Peak to Peak/Average) will be output.
- In the following cases, the measurement value will remain in the output waiting status until it is confirmed:
  - When the power is switched ON / When the setting is modified / When the program No. is changed
  - When RESET is input / When ZERO is input
- The ON status of each output refers to the status in which the NPN/PNP open collector output is ON.
- The ON status of each input indicates a short-circuit between the COM terminals for LS-9501 (NPN type); and it indicates a voltage-applied status between the COM terminals for LS-9501P (PNP type).
- The RS-232C output will be synchronized with the TIMING input when the "Data transmission mode" in the environment setting is set to S1 or S2. “Data send mode” (page 7-15)
- The data storage will be saved in synchronization with the TIMING input when the “Accumulation cycle” in the data storage is set to TIMING synchronization in the common settings.
- If the RESET input is switched ON while the TIMING input is ON, the measurement value will remain in the output waiting status until the TIMING input is switched OFF.
- Off delay time can be set for the judgment output.“Off-delay time” (page 5-96)
- The TIMING input, RESET input, and ZERO input can be entered from RS-232C, LS-Navigator2, or the display panel.

■ Sample hold (Hold 1)

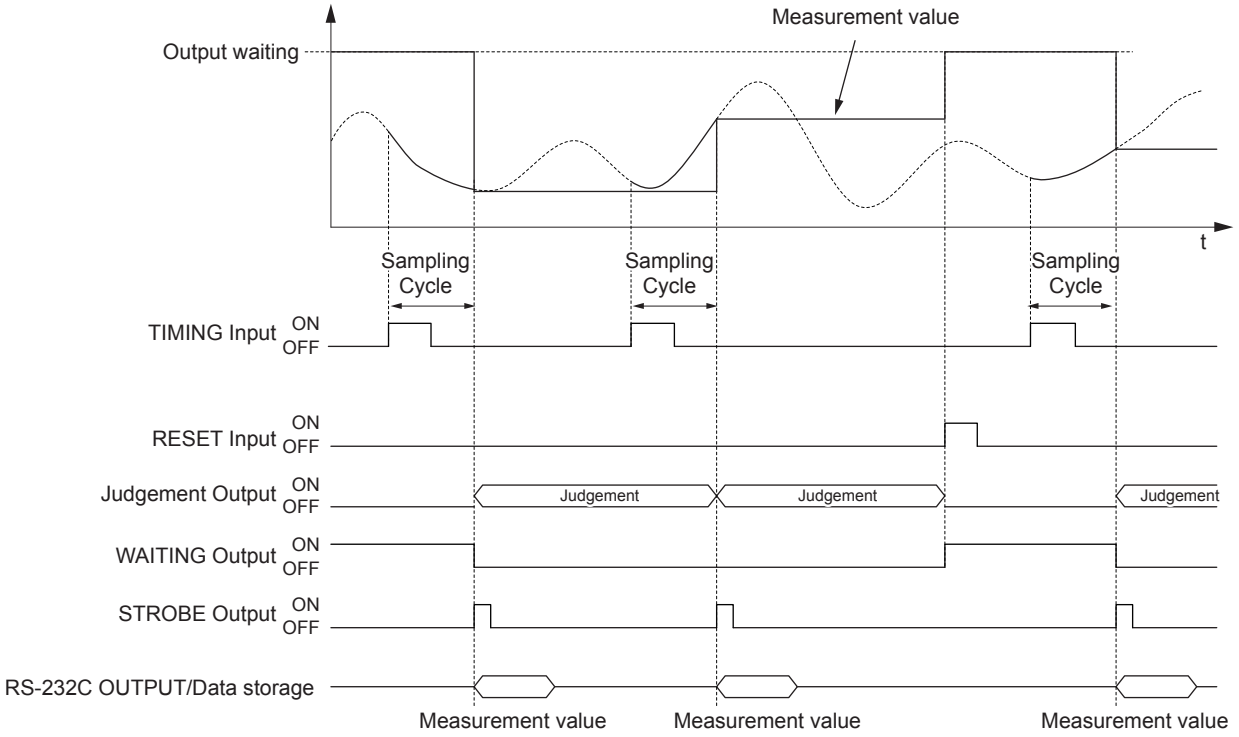
The measurement value at the instant specified by the external TIMING input will be displayed/output.



- When the TIMING input rises, the measurement value at that instant will be output.
- In the following cases, the measurement value will remain in the output waiting status until it is confirmed:
  - When the power is switched ON / When the setting is modified / When the program No. is changed
  - When RESET is input / When ZERO is input
- The ON status of each output refers to the status in which the NPN/PNP open collector output is ON.
- The ON status of each input indicates a short-circuit between the COM terminals for LS-9501 (NPN type); and it indicates a voltage-applied status between the COM terminals for LS-9501P (PNP type).
- The RS-232C output will be synchronized with the TIMING input when the "Data transmission mode" in the environment setting is set to S1 or S2. “Data send mode” (page 7-15)
- The data storage will be saved in synchronization with the TIMING input when the “Accumulation cycle” in the data storage is set to TIMING synchronization in the common settings.
- If the RESET input is switched ON while the TIMING input is ON, the measurement value will remain in the output waiting status until the TIMING input is switched OFF.
- Off delay time can be set for the judgment output. “Off-delay time” (page 5-96)
- The TIMING input, RESET input, and ZERO input can be entered from RS-232C, LS-Navigator2, or the display panel.

■ Sample hold (Hold 2)

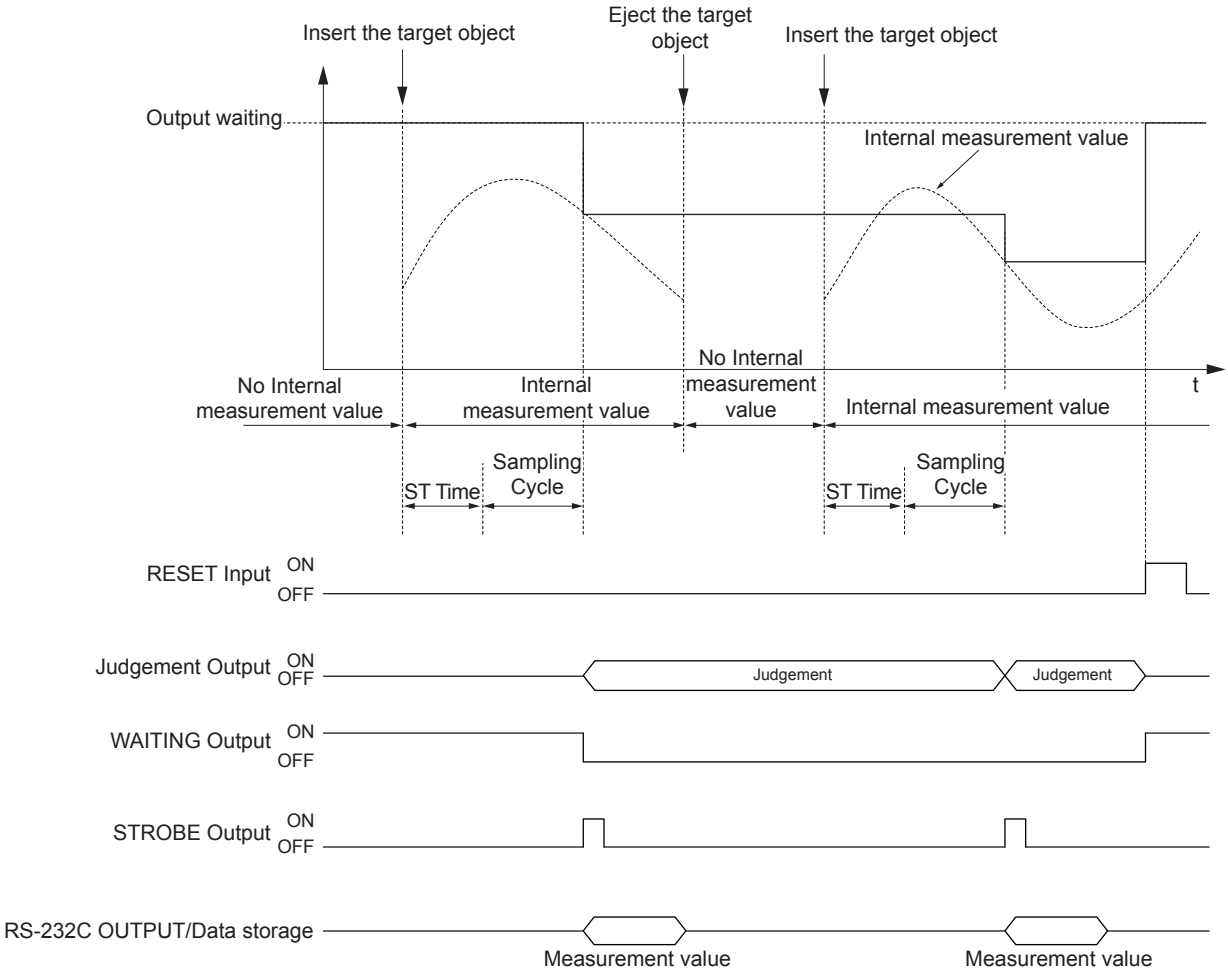
The measurement will start from the instant specified by the external TIMING input; and the first confirmed measurement value will be displayed/output.



- The measurement value will be output by sampling the sampling cycle and measurement value from the rising point of the TIMING signal.
- The sampling cycle will be determined by the filter setting. “Filter” (page 5-38)
  - When the power is switched ON / When the setting is modified / When the program No. is changed
  - When RESET is input / When ZERO is input
- The ON status of each output refers to the status in which the NPN/PNP open collector output is ON.
- The ON status of each input indicates a short-circuit between the COM terminals for LS-9501 (NPN type); and it indicates a voltage-applied status between the COM terminals for LS-9501P (PNP type).
- The RS-232C output will be synchronized with the TIMING input when the "Data transmission mode" in the environment setting is set to S1 or S2. “Data send mode” (page 7-15)
- The data storage will be saved in synchronization with the TIMING input when the “Accumulation cycle” in the data storage is set to TIMING synchronization in the common settings.
- If the RESET input is switched ON while the TIMING input is ON, the measurement value will remain in the output waiting status until the TIMING input is switched OFF.
- Off delay time can be set for the judgment output. “Off-delay time” (page 5-96)
- The TIMING input, RESET input, and ZERO input can be entered from RS-232C, LS-Navigator2, or the display panel.

■ Self timing hold

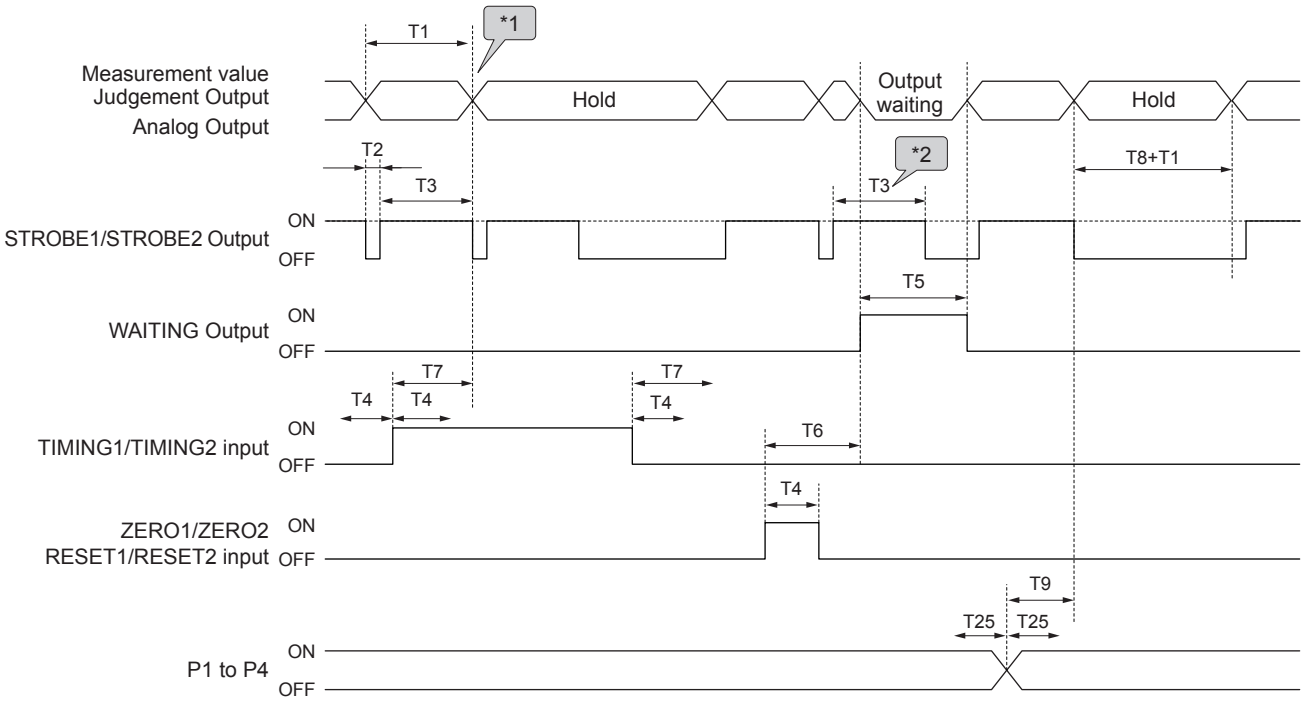
The measurement will be triggered by the insertion of a target item into the measurement range. The measurement values will then be displayed/output.



- The measurement will be triggered by the change from “Internal measurement value" to “No internal measurement value" which occurs when the target item is inserted. Subsequently, the measurement values for the averaging count specified after the set self timing (ST) time will be sampled. The final result will then be held and output.
- In the following cases, the measurement value will remain in the output waiting status until it is confirmed:
  - When the power is switched ON / When the setting is modified / When the program No. is changed
  - When RESET is input / When ZERO is input
- The ON status of each output refers to the status in which the NPN/PNP open collector output is ON.
- The ON status of each input indicates a short-circuit between the COM terminals for LS-9501 (NPN type); and it indicates a voltage-applied status between the COM terminals for LS-9501P (PNP type).
- The RS-232C output will be synchronized with the TIMING input when the "Data transmission mode" in the environment setting is set to S1 or S2. “Data send mode” (page 7-15)
- The data storage will be saved in synchronization with the TIMING input when the “Accumulation cycle” in the data storage is set to TIMING synchronization in the common settings.
- If the RESET input is switched ON while the TIMING input is ON, the measurement value will remain in the output waiting status until the TIMING input is switched OFF.
- Off delay time can be set for the judgment output. “Off-delay time” (page 5-96)
- The TIMING input, RESET input, and ZERO input can be entered from RS-232C, LS-Navigator2, or the display panel.

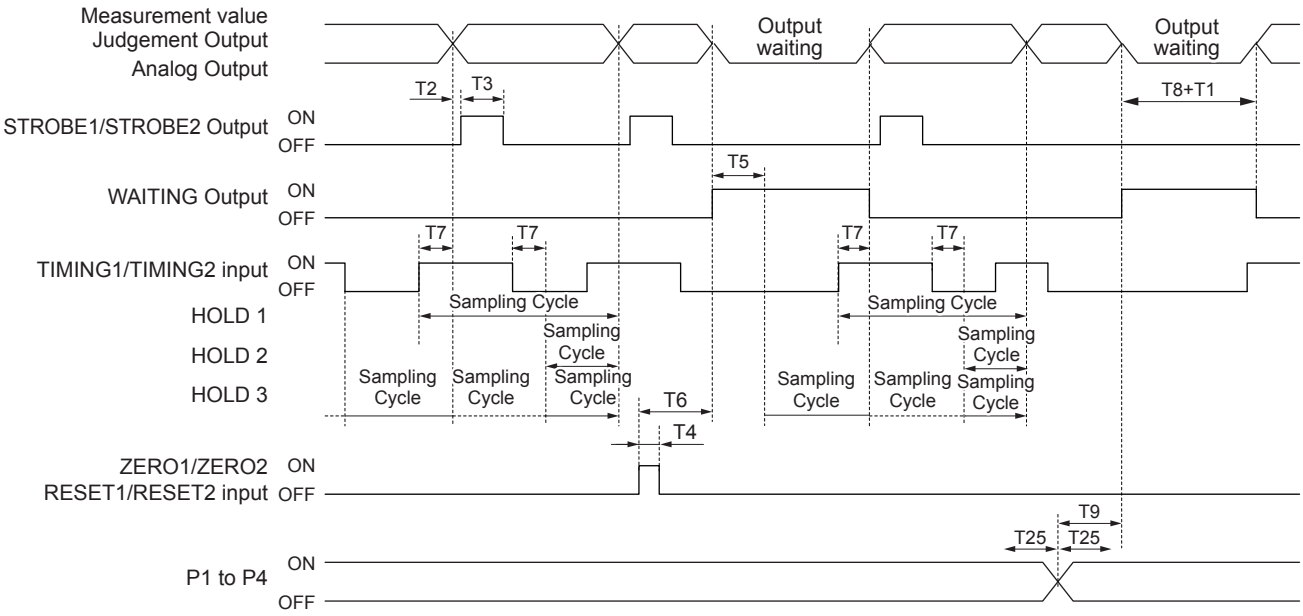
I/O details

■ Normal mode, Auto peak hold/Auto bottom hold/Auto peak to Peak hold



*1: The measurement value will be held at the value updated after the input response delay time T7 has elapsed after the TIMING signal input.
*2: Depends on the STROBE output status when the ZERO1/ZERO2/RESET1/RESET2 signal is input.
When the STROBE signal is ON: Holds the value between T3s.
When the STROBE signal is OFF: Maintains the OFF status.
T1: Simple average: Sampling frequency x Averaging count
Moving average: Sampling frequency
T2: Max 30µs
T3: T1-T2 (When T1-T2 < [Strobe time])
[Strobe time] (T1-T2 ≥ [Strobe time])
T4: Min 500µs
T5: [Sampling frequency] × ([Averaging times]-1)
T6: Max 2 ms (When CB-EP100 or CB-PN100 is connected: Max 4 ms)
T7: Max 2 ms
T8: 200 ms+200 × [No. of head connections] ms
T9: Max 60 ms
T25: 1 ms

■ Normal mode, Auto peak hold/Auto bottom hold/Auto peak to Peak hold (Hold 1 to Hold 3)



• The RESET signal will be enabled regardless of the TIMING ON/OFF status.

*1: The measurement value will be held at the value updated after the input response delay time T7 has elapsed after the TIMING signal input.

*2: Varies depending on the STROBE output status when the ZERO1/ZERO2/RESET1/RESET2 signal is input.
When the STROBE signal is ON: Holds the value between T3s.
When the STROBE signal is OFF: Maintains the OFF status.

T1: Simple average: Sampling frequency x Averaging count
Moving average: Sampling frequency

T2: Max 30 µs

T3: T1-T2 (When T1-T2 < [Strobe time])
[Strobe time] (T1-T2 ≥ [Strobe time])

T4: Min 500 µs

T5: [Sampling frequency] × ([Averaging times]-1)

T6: Max 2 ms (When CB-EP100 or CB-PN100 is connected: Max 4 ms)

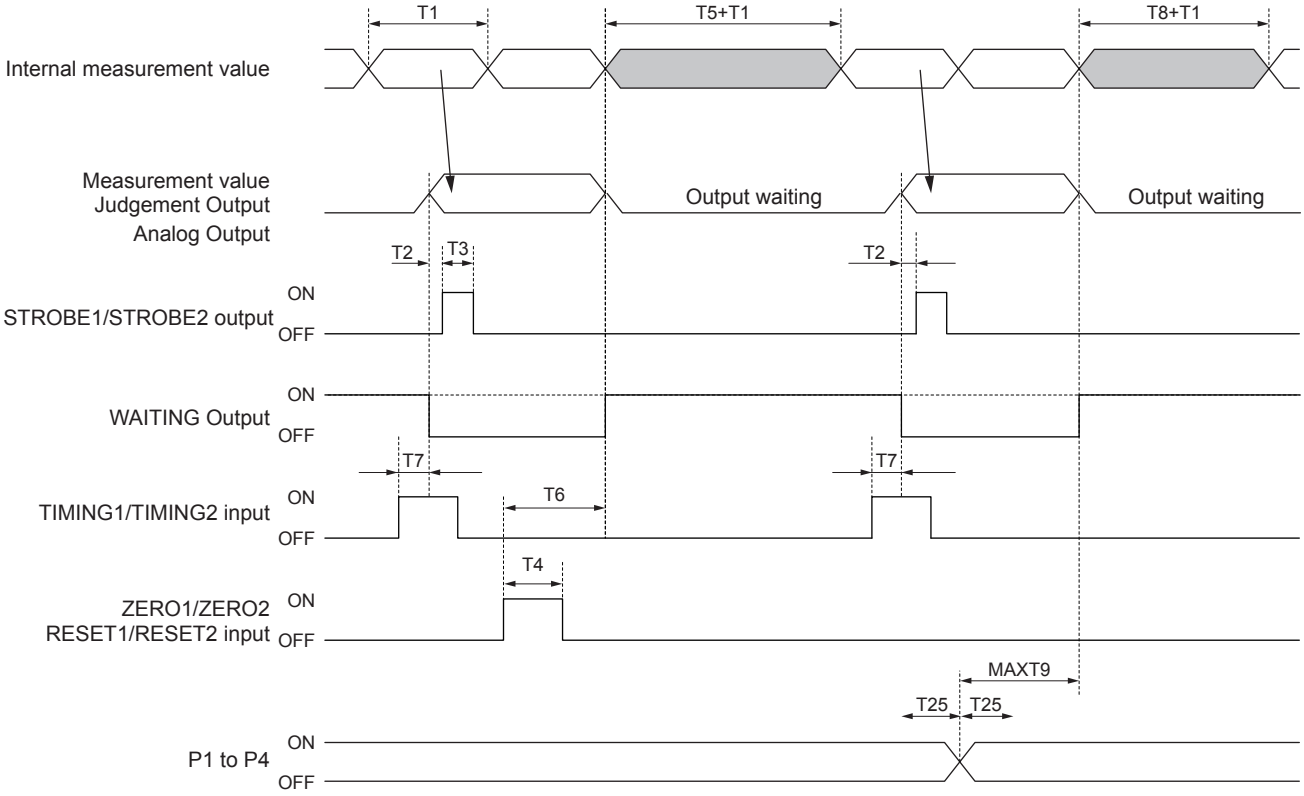
T7: Max 2 ms

T8: 200 ms+200 × [No. of head connections] ms

T9: Max 60 ms

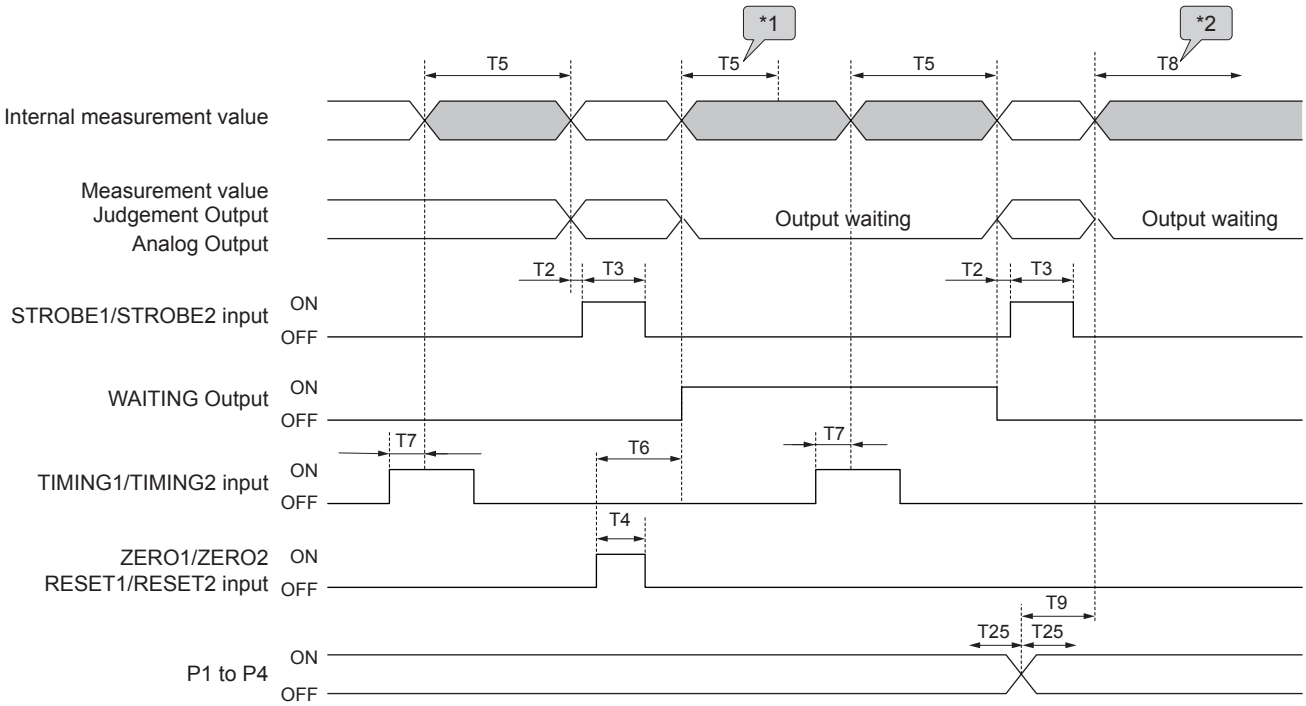
T25: 1 ms

■ Sample hold (Hold 1)



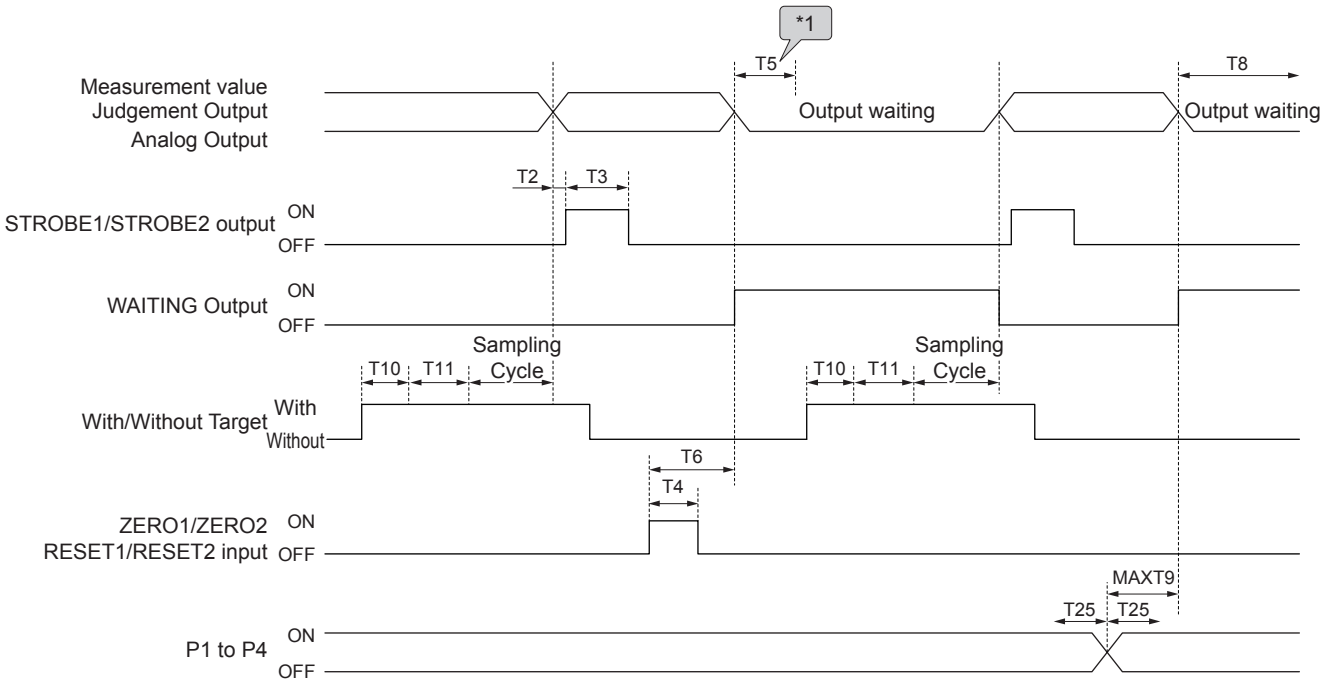
T1: Simple average: Sampling frequency x Averaging count
Moving average: Sampling frequency
T2: Max 30 µs
T3: T1-T2 (When T1-T2 < [Strobe time])
[Strobe time] (T1-T2 ≥ [Strobe time])
T4: Min 500 µs
T5: [Sampling frequency] × ([Averaging times]-1)
T6: Max 2 ms (When CB-EP100 or CB-PN100 is connected: Max 4 ms)
T7: Max 2 ms
T8: 200 ms+200 × [No. of head connections] ms
T9: Max 60 ms
T25: 1 ms

■ Sample hold (Hold 2)



*1: The TIMING input will be accepted after the RESET time has elapsed.
*2: The TIMING input will be accepted after the program switching time has elapsed.
T1: Simple average: Sampling frequency x Averaging count
Moving average: Sampling frequency
T2: Max 30 µs
T3: T1-T2 (When T1-T2 < [Strobe time])
[Strobe time] (T1-T2 ≥ [Strobe time])
T4: Min 500 µs
T5: [Sampling frequency] × ([Averaging times]-1)
T6: Max 2 ms (When CB-EP100 or CB-PN100 is connected: Max 4 ms)
T7: Max 2 ms
T8: 200 ms+200 × [No. of head connections] ms
T9: Max 60 ms
T25: 1 ms

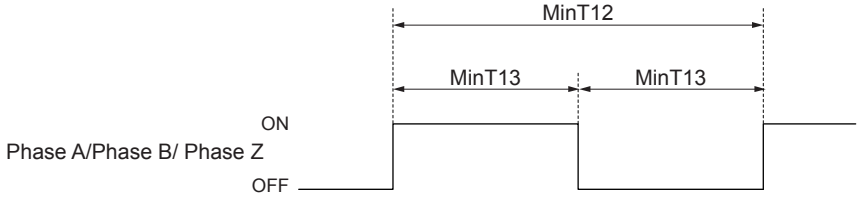
■ Self timing hold



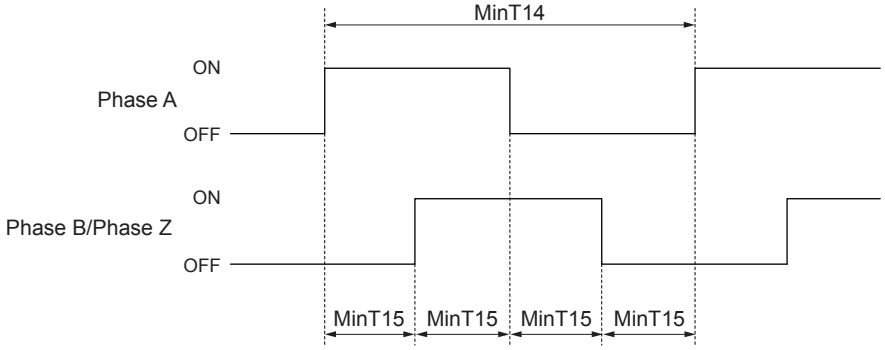
*1: The TIMING input will be accepted after the RESET time has elapsed.
T2: Max 30 µs
T3: T1-T2 (When T1-T2 < [Strobe time])
[Strobe time] (T1-T2 ≥ [Strobe time])
T4: Min 500 µs
T5: [Sampling frequency] × ([Averaging times]-1)
T6: Max 2 ms (When CB-EP100 or CB-PN100 is connected: Max 4 ms)
T7: Max 2 ms
T8: 200 ms+200 × [No. of head connections]ms
T9: Max 60 ms
T10: 2 ms
T11: Self timing period
T25: 1 ms

■ Encoder input

● Encoder minimum input time (Single-phase [1-phase 1 TM])



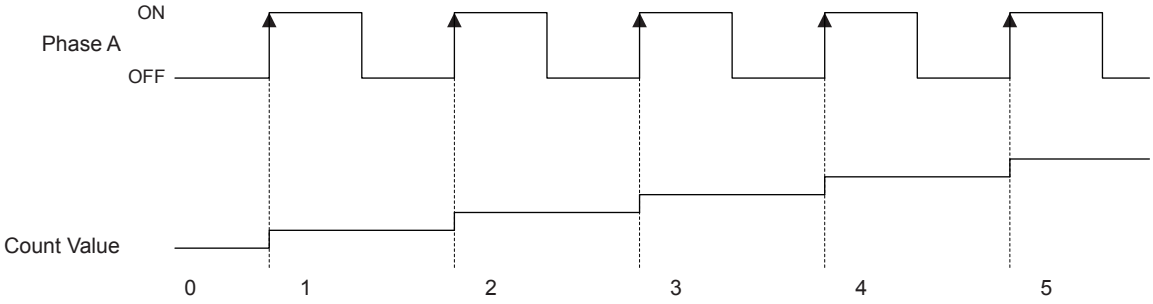
● Encoder minimum input time (2-phase n TM)



T12: Encoder shortest cycle (Single-phase) 312.5 ns
T13: Minimum input time (Single-phase) 135 ns
T14: Encoder shortest cycle (2-phase n TM) 625 ns
T15: Encoder minimum input time (2-phase n TM) 125 ns

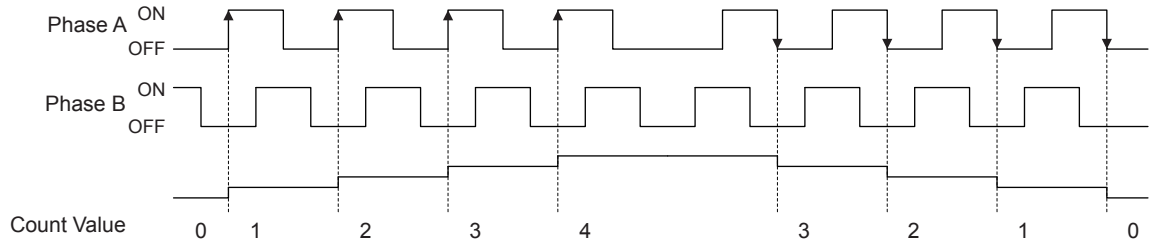
● Pulse count for 1-phase 1 TM (no dir.)

Counts the rising of phase A.



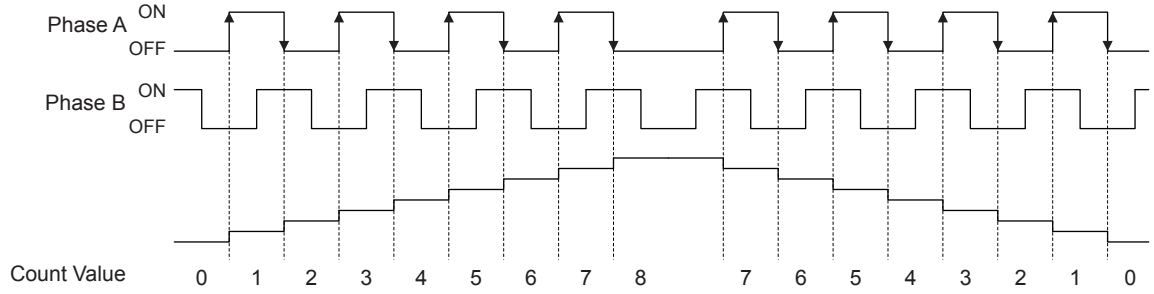
● **Pulse count for 2-phase 1 TM**

When phase B is OFF, the count value will be incremented by the rising of phase A.
When phase B is OFF, the count value will be decremented by the falling of phase A.



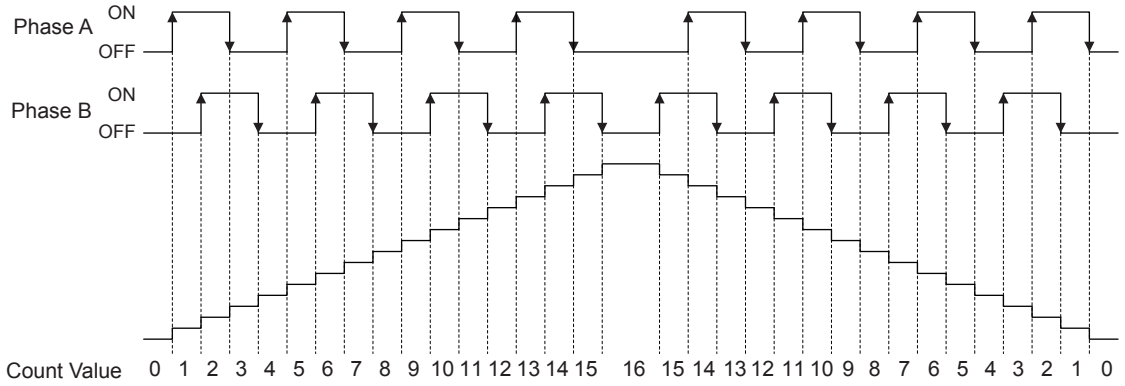
● **Pulse count for 2-phase 2 TM**

When phase B is OFF, the count value will be incremented by the rising of phase A.
When phase B is OFF, the count value will be decremented by the falling of phase A.
When phase B is ON, the count value will be decremented by the rising of phase A.
When phase B is ON, the count value will be incremented by the falling of phase A.

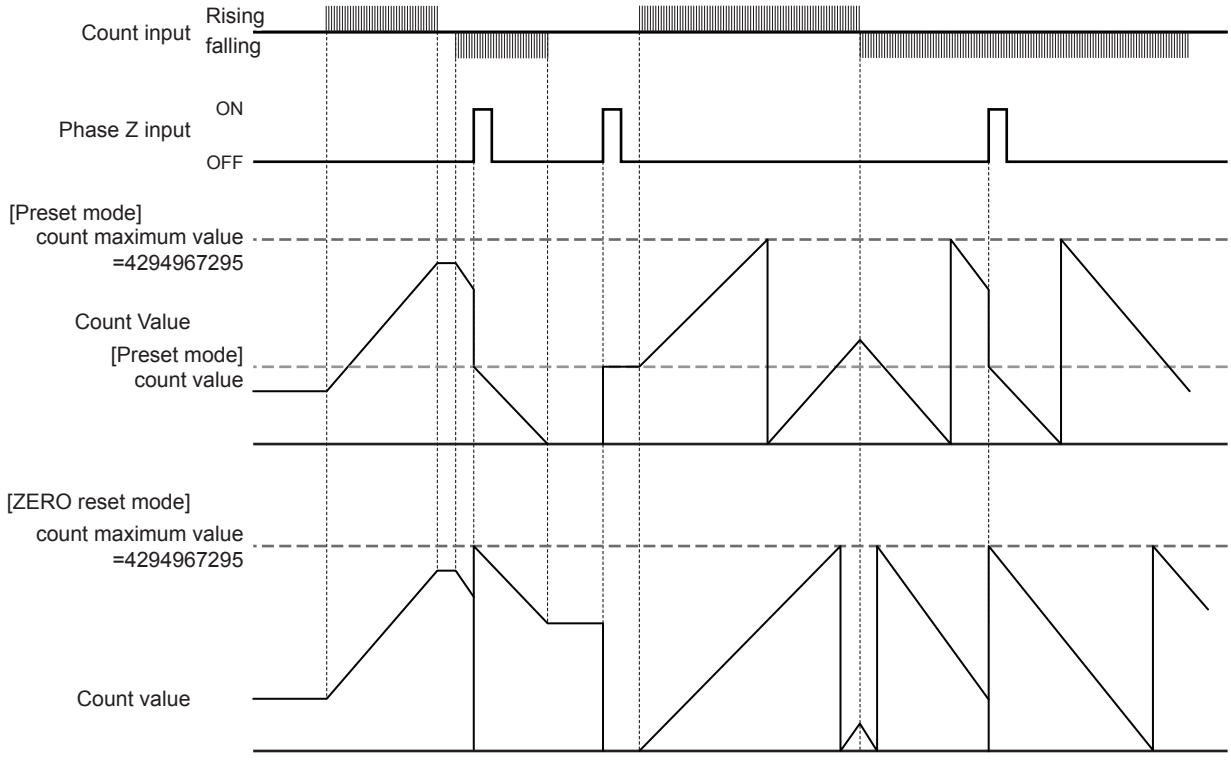


● **Pulse count for 2-phase 4 TM**

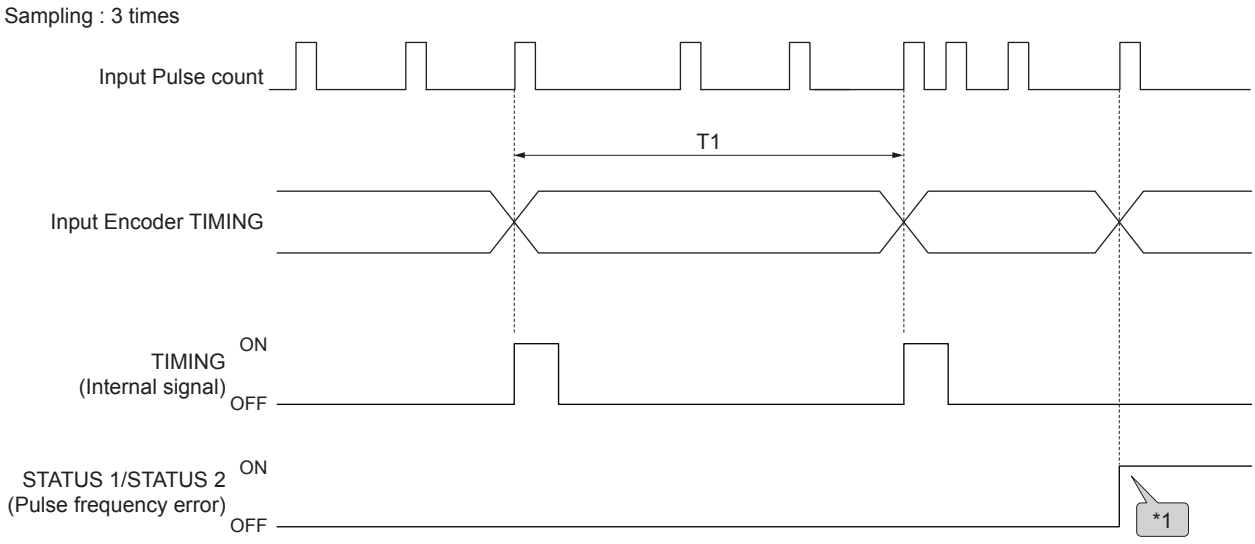
When phase B is OFF, the count value will be incremented by the rising of phase A.
When phase B is OFF, the count value will be decremented by the falling of phase A.
When phase B is ON, the count value will be decremented by the rising of phase A.
When phase B is ON, the count value will be incremented by the falling of phase A.
When phase A is ON, the count value will be incremented by the rising of phase B.
When phase A is ON, the count value will be decremented by the falling of phase B.
When phase A is OFF, the count value will be decremented by the rising of phase B.
When phase A is OFF, the count value will be incremented by the falling of phase B.



● **Phase Z input**



■ **Encoder TIMING input (Pulse frequency error)**

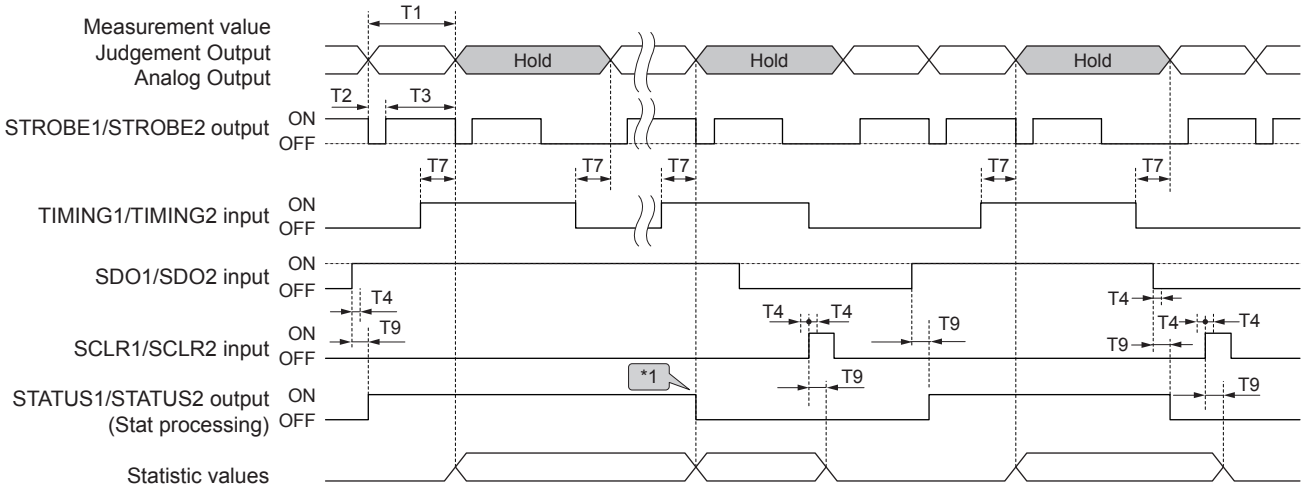


The TIMING input will become ON when the “Skipping” count setting pulse in the encoder setting is input.

*1: If the encoder TIM is put ON multiple times within a sampling frequency. it will be treated as the pulse frequency error; and the corresponding status signal will be output. (If the status output for the pulse frequency error is set) The off-delay is disabled.

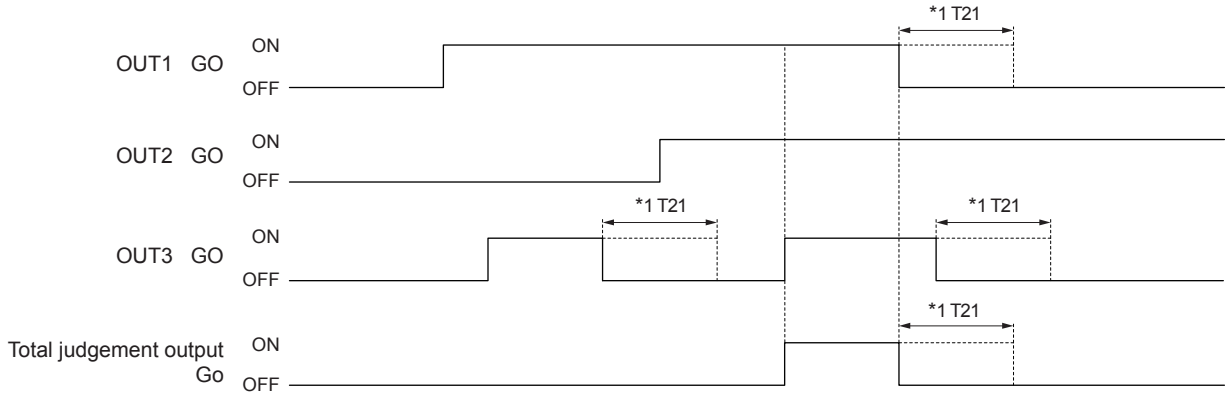
T1: Sampling frequency

■ Statistics processing



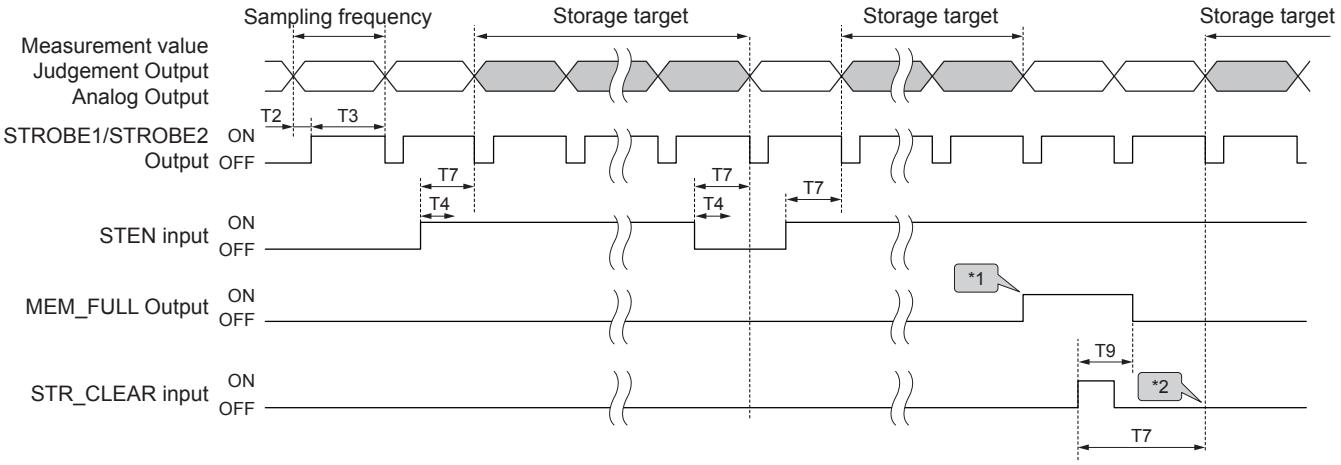
*1: The statistics processing will end one the specified number of statistics processing data have been accumulated.
The SCLR input will only be accepted while the SDO terminal is OFF.
T1: Simple average: Sampling frequency x Averaging count
Moving average: Sampling frequency
T2: Max 30 µs
T3: T1-T2 (When T1-T2 < [Strobe time])
[Strobe time] (T1-T2 ≥ [Strobe time])
T4: Min 500 µs
T7: Max 2 ms
T9: Max 60 ms

■ Total judgement output



• The overall judgment will be output based on the judgment result of each OUT before the off delay.
*1: When the off delay is set
T21: When the off delay is set “Off-delay time” (page 5-96)

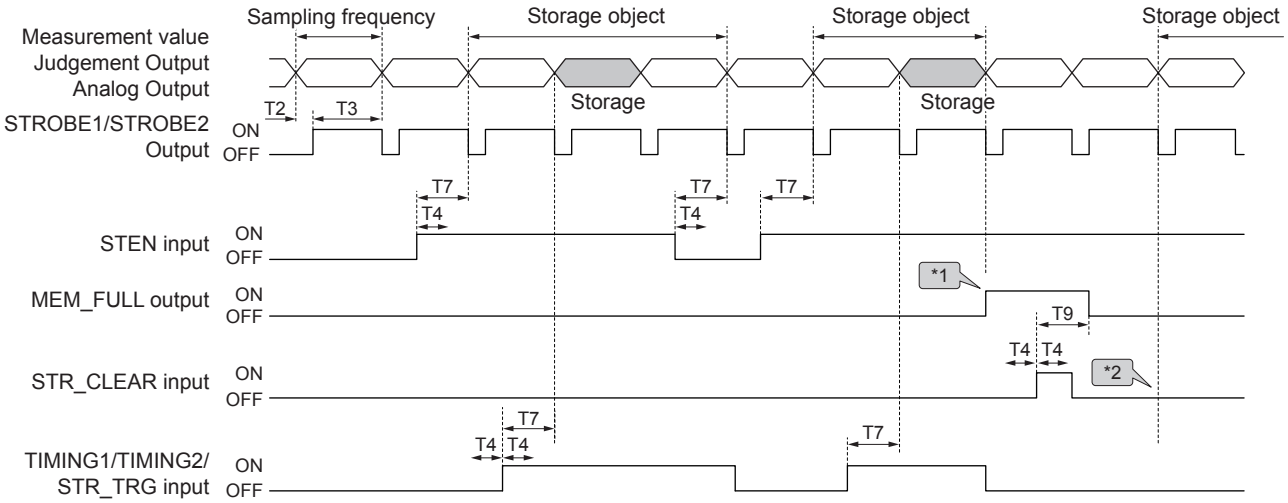
■ Data storage (Sampling frequency synchronization)



*1: The accumulation will stop while the MEM_FULL signal in ON, regardless of the input status of the STEN terminal.
*2: The accumulation will be started if the STEN terminal is ON at the timing when the internal memory has been cleared.
- The measurement values will accumulated for each multiple of the accumulation cycle.
- The STR_CLEAR signal will be accepted in the following cases:
  - When the STEN signal is OFF
  - When MEM_FULL is ON

T2: Max 30 µs
T3: T1-T2 (When T1-T2 < [Strobe time])
[Strobe time] (T1-T2 ≥ [Strobe time])
T4: Min 500 µs
T7: Max 2 ms
T9: Max 60 ms

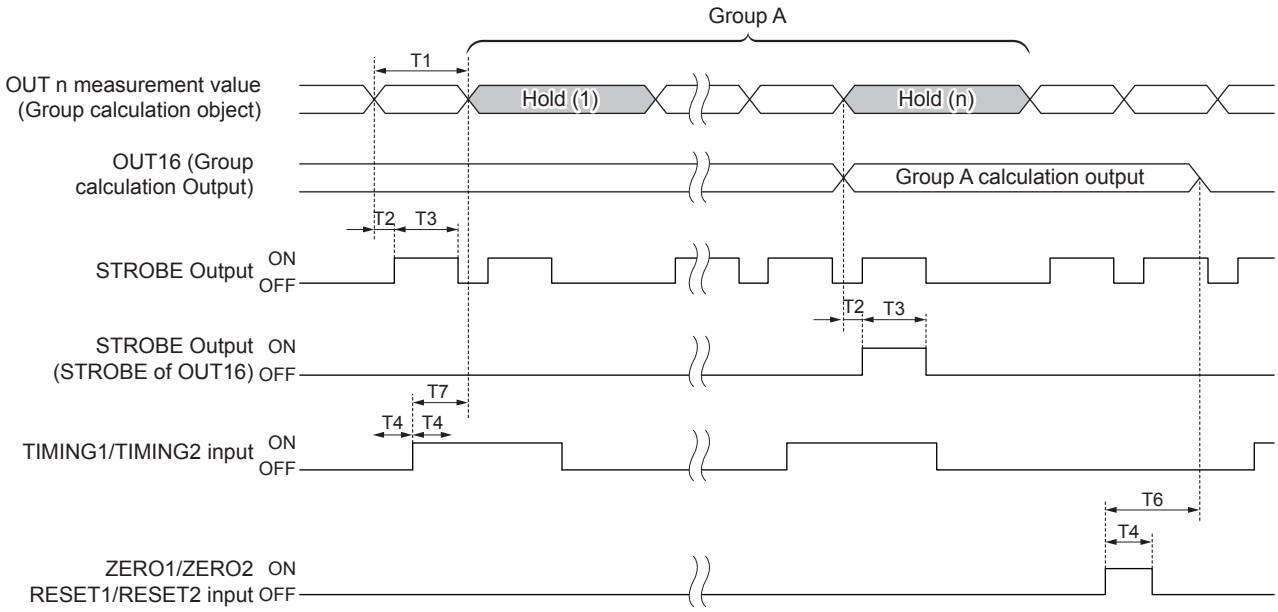
■ Data storage (TIMING synchronization/Storage trigger synchronization)



- The STR_CLEAR signal will be accepted in the following cases:
  - When the STEN signal is OFF
  - When MEM_FULL is ON

*1: The accumulation will stop while the MEM_FULL signal in ON, regardless of the input status of the STEN terminal.
*2: The accumulation will be started if the STEN terminal is ON at the timing when the internal memory has been cleared.
T2: Max 30 µs
T3: T1-T2 (When T1-T2 < [Strobe time])
[Strobe time] (T1-T2 ≥ [Strobe time])
T4: Min 500 µs
T7: Max 2 ms
T9: Max 60 ms

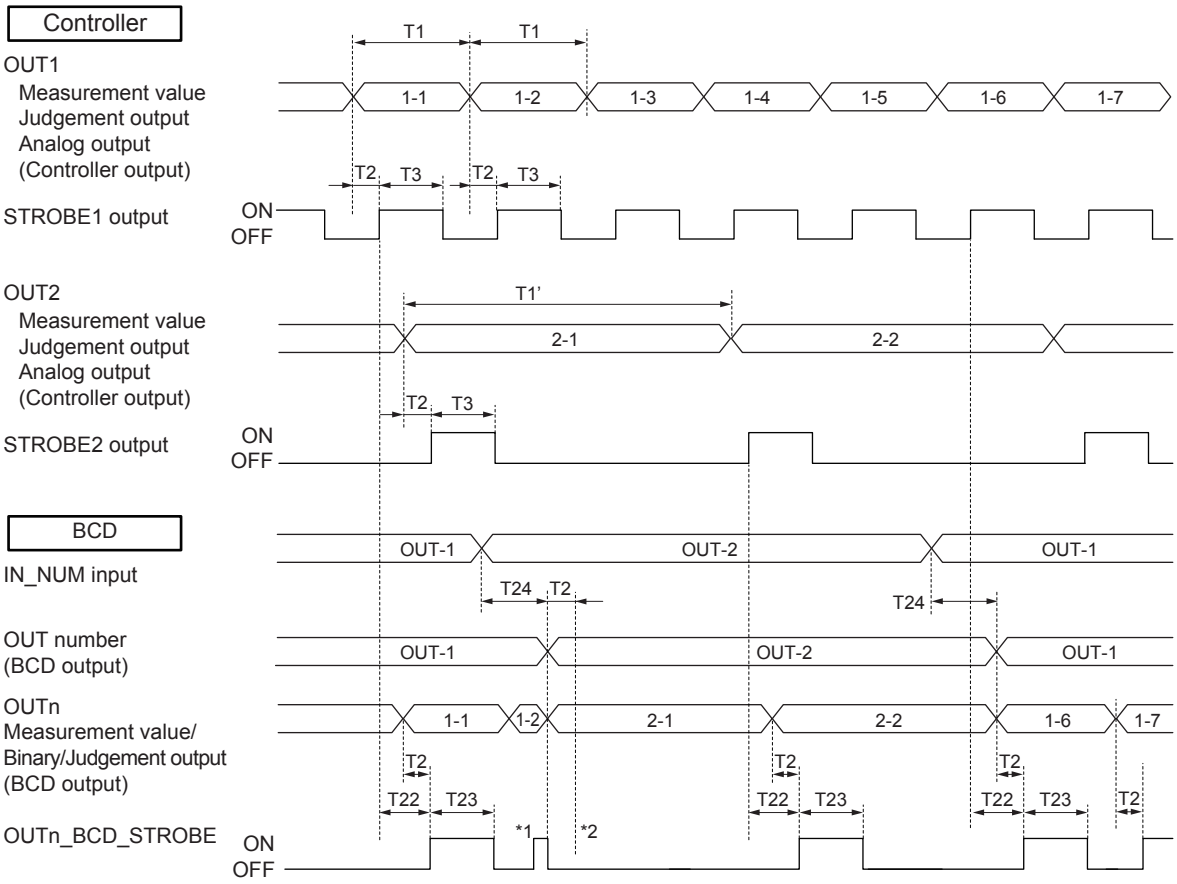
■ Group calculation



T1: Simple average: Sampling frequency x Averaging count
Moving average: Sampling frequency
T2: Max 30 µs
T3: T1-T2 (When T1-T2 < [Strobe time])
[Strobe time] (T1-T2 ≥ [Strobe time])
T4: Min 500 µs
T6: Max 2 ms (When CB-EP100 or CB-PN100 is connected: Max 4 ms)
T7: Max 60 ms

■ BCD unit

(Example: For OUT1, OUT2 normal output)



*1: If the switching timing of the OUT number overlaps with the strobe update timing, the strobe time will be T23 or less.

*2: STROBE does not become ON until OUT is updated after the switching.
When loading the measurement value immediately after the switching without using STROBE, wait at least (T24+T2) after the IN_NUM input before you load the value.

- Switching of OUTs using the IN_NUM input is only possible when the OUT selection method has been set to “BCD unit terminal”.
  Read “OUT selection method” (page 5-99) for details.
- Switching of OUT using the IN_NUM input is not possible when the output function has been set to “Judgment output”.
  You can set the corresponding relationships between the STROBE signal outputs from STROBE 1 to 4 and the OUTs using the display panel or LS-Navigator2.
  Read “Output selection function” (page 5-99) for details.
- T23 (BCD strobe time) can be set independently of T3 (Strobe time).
  Read “BCD strobe time” (page 5-99) for details.

T1: Simple average: Sampling frequency x Averaging count Moving average: Sampling frequency
T2: Max 30µs
T3: T1-T2 (When T1-T2 < [Strobe time])
[Strobe time] (When T1-T2 ≥ [Strobe time])
T22: Max 60µs
T23: T1-T2 (When T1-T2 < [BCD strobe time])
[BCD strobe time] (When T1-T2 ≥ [BCD strobe time])
T24: 2 ms

■ Sampling frequency

units : μs

No. of used OUTs	Mutual interference prevention setting		
	OFF	AB-ON	ABC-ON
1 to 4	62.5	125	187.5
5 to 12	125	125	187.5
13 to 16	187.5	250	187.5

MEMO

11

Specifications

This chapter describes the specifications, characteristics and dimensions of the LS-9000 Series.

Specifications 11-2
Characteristics..... 11-14
State Table..... 11-20
Dimensions 11-23

Specifications

Controller

Model		LS-9501	LS-9501P
No. of connected heads		Up to 2 units	
Head compatibility		Available	
Display	Minimum display unit	0.01 µm	
	Maximum display unit	±99999.99 µm ~ ±9999.9 mm	
	LED display	POWER ON indicator, ERROR indicator	
Input terminal block	Encoder input	NPN open collector output / PNP open collector output (5 V/12 V/24 V), line driver output	
	Timing 1, 2 input	Non-voltage input	Voltage input
	Auto zero 1, 2 input		
	Reset 1, 2 input		
	Storage trigger input		
	Storage enable input		
	Storage data clear input		
	Statistics 1, 2 input		
	Statistics clear 1, 2 input		
	Program switching input	Non-voltage input x 4 inputs	Voltage input x 4 inputs
Output terminal	Analog voltage output	±10 V × 2 outputs; Output impedance 100 Ω	
	Analog current output	4 to 20 mA x 2 outputs Maximum matched load 350 Ω	
	General-purpose output	NPN open collector output x 10 (Tolerance judgment output can be allocated)	PNP open collector output x 10 (Tolerance judgment output can be allocated)
	Status 1, 2 output	NPN open collector output	PNP open collector output
	Total judgment output		
	Memory FULL output		
	Strobe 1, 2 output		
	Error output	NPN open collector output (N.C.)	PNP open collector output (N.C.)
Ethernet interface		1000BASE-T / 100BASE-TX	
USB interface		USB2.0 HI-SPEED supported (USB1.1 Full-SPEED compatible)	
RS-232C Interface		Measurement data output; Control I/O; Setting change (Baud rate setting up to 115200 bit/s can be selected)	
Dedicated display panel interface		Up to 4 LS-D1000 units are connectable	
Rating	Power supply voltage	24 V DC ±10% Incl. ripple (P-P)	
	Maximum current consumption*1	When LS-HA100 is not used : One head: 1.0 A or less Two heads: 1.4 A or less When LS-HA100 is used : Three heads: 2.0 A or less Four heads: 2.3 A or less	

Model		LS-9501	LS-9501P
Environment resistance	Operating ambient temperature	When LS-HA100 is not used : 0 to +50 ºC When LS-HA100 is used : 0 to +45 ºC	
	Operating ambient humidity	20 to 85% RH (No condensation)	
Weight		Approx. 1500 g	

- The rating of the NPN open collector output is max. 50 mA (40 V or less) and 1 V or less residual voltage.
- The rating of the PNP open collector output is max. 50 mA (30 V or less) and 1 V or less residual voltage.
- The rating of the non-voltage input is ON voltage 1V or less and OFF current 0.6 mA or less.
- Thee rating of the voltage input is maximum input voltage 26.4 V, minimum ON voltage 10.8 V, and OFF current 0.6 mA or less.

* 1: When connecting display panels or expansion units, add the current consumption for each of those devices. When connecting LS-9006D or LS-9030D, it will be counted as 2 units.

Head

■ LS-9006M/LS-9006/LS-9030M/LS-9030/LS-9120M

Model		LS-9006M (with monitor)	LS-9006 (without monitor)	LS-9030M (with monitor)	LS-9030 (without monitor)
Measurement range		0.04 mm (0.01 mm) to 6 mm		0.3 mm (0.08 mm) to 30 mm	
Minimum object sensitivity		0.04 mm (0.01 mm)		0.3 mm (0.08 mm)	
Distance between the transmitter and receiver		60 ± 5 mm		160 ± 40 mm	
Repeatability		± 0.03 µm*1		± 0.1 µm*2	
Measurement accuracy		± 0.5 µm*4		± 2 µm*5	
Sampling frequency*9		16000 times/sec			
Detection of emitting and receiving light directions	Detection range	4 mm × 5 mm		20 mm × 24 mm	
	Minimum object sensitivity	0.04 mm		0.3 mm	
	Repeatability	± 0.02 mm*7		± 0.2 mm*8	
	Sampling frequency	4000 times/sec			
Light source		InGaN green LED			
Monitor function		Available	Unavailable	Available	Unavailable
Environment resistance	Operating ambient temperature	0 to + 50 ºC			
	Operating ambient humidity	20 to 85% RH (No condensation)			
	Ambient luminance	Incandescent lamp/Fluorescent lamp: 3000 lx or less			
	Vibration resistance	10 to 55 Hz, double amplitude 1.5 mm; 2 hrs in X, Y and Z directions			
	Impact resistance	15 G/6 ms			
Protective structure		IP 67 (including the connector part)			
Material		Aluminum			
Weight		Transmitter: Approx. 130 g Receiver: Approx. 300 g Base: Approx. 180 g	Transmitter: Approx. 130 g Receiver: Approx. 280 g Base: Approx. 180 g	Transmitter: Approx. 440 g Receiver: Approx. 500 g Base: Approx. 430 g	Transmitter: Approx. 440 g Receiver: Approx. 440 g Base: Approx. 430 g

The values in the brackets ( ) are for cases where ultrafine mode was used for measuring. For details on the accuracy of ultrafine mode, contact us.

*1: A ± 2σ margin of error when measuring ϕ1.0 mm round bars in the center of the measurement area using outer diameter mode with the average measurement number set as 2048 times.

*2: A ± 2σ margin of error when measuring ϕ10 mm round bars in the center of the measurement area using outer diameter mode with the average measurement number set as 2048 times.

*3: A ± 2σ margin of error when measuring ϕ40 mm round bars in the center of the measurement area using outer diameter mode with the average measurement number set as 2048 times.

*4: Margin of error when a moving ϕ1.0 mm round bar is measured in the 2 mm × 4 mm measurement area using outer diameter mode.

*5: Margin of error when a moving ϕ10 mm round bar is measured in the 10 mm × 20 mm measurement area using outer diameter mode.

*6: Margin of error when a moving ϕ40 mm round bar is measured in the 40 mm × 120 mm measurement area using outer diameter mode.

	LS-9120M
	0.8 mm to 120 mm
	0.8 mm
	400 ± 100 mm
	± 0.3 µm*3
	± 8.0 µm*6
	16000 times/sec
	-
	-
	-
	-
	InGaN green LED
	Available
	0 to + 50 ºC
	20 to 85% RH (No condensation)
	Incandescent lamp/Fluorescent lamp: 3000 lx or less
	10 to 55 Hz, double amplitude 1.5 mm; 2 hrs in X, Y and Z directions
	15 G/6 ms
	IP 67 (including the connector part)
	Aluminum
	Transmitter: Approx. 1,800 g Receiver: Approx. 2,800 g Base: Approx. 1,600 g

*7: A ± 2σ margin of error when measuring the outer diameter of ϕ1.0 round bars in the center of the measurement area with the average measurement number set as 512 times.
*8: A ± 2σ margin of error when measuring the outer diameter of ϕ10 round bars in the center of the measurement area with the average measurement number set as 512 times.
*9: The sampling frequency will vary according to the number of OUTs that have been set and the use of the mutual interference prevention function.
See "OUT setting" (page 5-34), "Interference prevention function" (page 5-73) for details.

■ LS-9006D/LS-9030D

Model		LS-9006D	LS-9030D
Measurement range		0.04 mm to 6 mm	0.3 mm to 30 mm
Minimum object sensitivity		0.04 mm	0.3 mm
Repeatability		± 0.03 μm*1	± 0.1 μm*2
Measurement accuracy		± 0.5 μm*3	± 2 μm*4
Sampling frequency*5		16000 times/sec	
Light source		InGaN green LED	
Monitor function		Unavailable	
Environment resistance	Operating ambient temperature	0 to + 50 ºC	
	Operating ambient humidity	20 to 85% RH (No condensation)	
	Ambient luminance	Incandescent lamp/Fluorescent lamp: 3000 lx or less	
	Vibration resistance	10 to 55 Hz, double amplitude 1.5 mm; 2 hrs in X, Y and Z directions	
	Impact resistance	15 G/6 ms	
Protective structure		IP 67 (including the connector part)	
Material		Aluminum	
Weight		Approx. 4,800 g	Approx. 9,000 g

*1: A ± 2σ margin of error when measuring the outer diameter of ϕ1.0 mm round bars in the center of the measurement area with the average measurement number set as 2048 times.
*2: A ± 2σ margin of error when measuring the outer diameter of ϕ10 mm round bars in the center of the measurement area with the average measurement number set as 2048 times.
*3: Margin of error when a moving ϕ1.0 mm round bar is measured in the 2 mm × 2 mm measurement area.
*4: Margin of error when a moving ϕ10 mm round bar is measured in the 10 mm × 10 mm measurement area.
*5: The sampling frequency will vary according to the number of OUTs that have been set and the use of the mutual interference prevention function.
See 🕮 "OUT setting" (page 5-34), "Interference prevention function" (page 5-73) for details.

Head expansion unit

Model		LS-HA100
No. of connected heads		2 units (Each unit of LS-9006D and LS-9030D equal to 2 units.)
Head compatibility		Available
LED display		POWER ON indicator, ERROR indicator
Analog voltage output		±10 V × 2 outputs; Output impedance 100 Ω
Analog current output		4 to 20 mA x 2 outputs Maximum matched load 350 Ω
Power supply		Supplied from the controller
Environment resistance	Operating ambient temperature	0 to +45 ºC
	Operating ambient humidity	20 to 85% RH (No condensation)
Weight		Approx. 600 g

BCD unit

Model		CB-BD100
LED display		POWER-ON LED
Output terminal	BCD output*1	NPN open collector output x 4 channels
	STROBE output	NPN open collector output x 4 channels
	OUT selection output	NPN open collector output x 4 channels
Input terminal	OUT selection input	Non-voltage input x 4 inputs
Power supply		Supplied from the controller
Rating	Maximum current consumption	0.16 A or less
Environment resistance	Operating ambient temperature	0 to +50 ºC
	Operating ambient humidity	20 to 85% RH (No condensation)
Weight		800g

- Only one unit of this product can be connected per controller.
- Rated NPN open collector output: Max. 30 mA (30 V or less), Residual voltage 0.5 V or less
- Rated non-voltage input: ON voltage 1 V, OFF current 0.6 mA or less

* 1: You can select from "BCD output" (29-bit, signed), "Binary output" (25-bit; negative value = a complement representation of 2), or "Judgment output".

EtherNet/IP communication unit

Name		EtherNet/IP communication unit
Model		CB-EP100
Compatible network		EtherNet/IP and displacement meter specific protocol (Socket communication)
EtherNet	Compatible standard	IEEE802.3 (10BASE-T) IEEE802.3u (100BASE-TX)
	Transmission rate	10Mbps (10BASE-T) 100Mbps (100BASE-TX)
	Transmission medium	STP, or UTP in category 3 or higher (10BASE-T) STP, or UTP in category 5 or higher (100BASE-TX)
	Max. cable length	100m (between the controller and EtherNet switch)
	Max. number of connection stages*1	4 (10BASE-T) 2 (100BASE-TX)
EtherNet/IP	Supported functions	Cyclic communication (Implicit message)
		Message communication (Explicit message), UCMM and Class3
	Number of connections	64
	RPI	0.5 to 10000ms (by 0.5ms)
	Cyclic communication allowable bandwidth	6000pps
	Message communication	UCMM and Class3
	Conformance test	Version.A9 compatible
Connection of measuring unit	Connectable units*2	LJ-V7000 series controller LS-9000 series controller
	Number of connectable units	1
Indicators		Link/Activity (LINK/ACT): Green LED Module status (MS): Two-color LED (Green/Red) Network status (NS): Two-color LED (Green/Red)
Power supply voltage		DC24V ± 10%, ripple (P-P) included (supplied from the measuring unit controller)
Maximum current consumption		0.12A or less
Environment resistance	Operating ambient temperature	0 to +50°C
	Operating ambient humidity	20 to 85 % RH (No dew condensation)
Mass		Approx. 470 g

*1:When a switching hub is used, the number of units to be connected has no restriction.
*2:The software of the controller must be Ver.3.00 or later.

PROFINET communication unit

Name		PROFINET communication unit
Model		CB-PN100
Compatible network		PROFINET IO communication
EtherNet	Compatible standard	IEEE 802.3u*1
	Transmission rate	100Mbps full duplex (100BASE-TX)
	Transmission medium	STP, or UTP cable in category 5e or higher
	Max. cable length	100m
PROFINET IO	Supported functions	Data I/O communication
		Record data communication
	Number of connectable PROFINET IO controller	1
	Update Time	2ms to 2048ms
	GSDML	Version V2.25
	Conformance class	Conformance Class A compatible
	Conformance test version	V2.2.4 compatible
	Compatible protocols	LLDP, DCP
Connection of measuring unit	Connectable units*2	LJ-V7000 series controller LS-9000 series controller
	Number of connectable units	1
Indicators		LINK/ACTIVITY indicator(LINK/ACT): Green LED System Failure indicator(SF): Red LED Bus Failure indicator(BF): Red LED
Power supply voltage		24V ± 10% (supplied from the measuring unit controller)
Maximum current consumption		0.12A or less
Mass		Approx. 170 g

*1:This machine supports IEEE 802.3u, and it is available to establish the 100Mbps full duplex communication with AutoNegotiation function, but the AutoCrossOver function and AutoPolaroty function usually-needed for PROFINET IO specification are not bundled. Select and connect the straight cable and crossing cable to suit to the connecting Ethernet port.
*2:The software of the controller must be Ver.3.00 or later.

Display panel

Model		LS-D1000
Display interface	Measurement value display part	Measurement value display: 2-color, 8 digits, 16SEG display OUT number display: Single color, 2 digits, 7SEG display Tolerance judgment display: HH, HI, GO, LO, LL, Single-color display Status output display: TIM, ZERO indicator, Single-color display
	Program No. display part	Single color, 2 digits, 7SEG display
	Position monitor display part	One-dimensional display: 2-color, 32-level display Two-dimensional display: Single color, 7 x 7 matrix display
	Display update cycle	5 times/sec
Operation input interface part		Numeric keys, Function keys, Lock key, Timing input key, Zero input key, Reset input key, Enter key, ESC key, Arrow keys (x 4)
Dedicated display panel connection port		2
Power supply		Supplied from the controller
Rating	Maximum current consumption	0.19 A or less
Environment resistance	Operating temperature range	0 to +50 ºC
	Operating humidity range	20 to 85% RH (No condensation)
Protection structure		IP65 (During panel mounting; Front part only)
Weight		Approx. 400 g

Cable

Head cable/Extension cable

Model	CB-B3	CB-B10	CB-B5E	CB-B10E	CB-B20E
Cable type	Head cable		Extension cable		
Cable length	3 m	10 m	5 m	10 m	20 m
Minimum bend R	22 mm				
Protection structure*1	IP67 (IEC60529)				
Material (External coat)	PVC				
Weight	Approx. 250 g	Approx. 750 g	Approx. 400 g	Approx. 800 g	Approx. 1500 g

*1: This is only applicable when connected to the sensor head. However, the connector part on the controller side is not included.

▶ Important **Extension of the cable: There should be a maximum of two CB-B*E connections, and the total length should be kept under 30 m.**
The cabling can be extended up to 40 m using the 40m connecting unit for cable extension CB-BR01.

Extension cable between the transmitter and receiver

Model	OP-87686	OP-87687
Cable length	1m	3 m
Minimum bend R	10 mm	
Protection structure*1	IP67 (IEC60529)	
Material (External coat)	PVC	
Weight	Approx. 60 g	Approx. 130 g

*1: This is only applicable when both T and R sides are connected.

Dedicated display panel cable

Model	OP-87602	OP-87603	OP-87604	OP-87605
Cable length	2m	5 m	10 m	20 m
Minimum bend R	24 mm			
Protection structure	Nothing			
Material (External coat)	PVC			
Weight	Approx. 150 g	Approx. 350 g	Approx. 700 g	Approx. 1400 g

LS-H2 (LS-Navigator2) operating system environment

Item		Required environment
Supported OS		Windows 11 Pro Windows 10*1 Windows 7 (SP1 or later)*2 Windows Vista (SP2 or later)*3 Windows XP (SP3 or later)*4
Supported languages		Japanese, English, German, Chinese (Simplified), Chinese (Traditional)
CPU		Core2Duo 2 GHz or higher
Memory capacity		2 GB or more
L2 cache memory		2 MB or more
Free hard disk space		10 GB or more
Display resolution		XGA (1024×768 pixels) or higher, 256 colors or more
PC interface	**USB**	USB2.0 HI-SPEED supported (USB1.1 Full-SPEED compatible)*5
	Ethernet	1000BASE-T / 100BASE-TX*6

- *1 : Compatible with each edition of Home, Pro, and Enterprise.
- *2 : Supports all Editions of Home Premium, Professional and Ultimate.
- *3 : Supports all Editions of Ultimate, Business, Home Premium and Home Basic.
- *4 : Supports Home Edition and Professional Edition.
- *5 : Connection via USB hub is not guaranteed.
- *6 : Connections via LAN and router are not guaranteed.

Other options

40m connecting unit for cable extension

Model	CB-BR01
Function	Communication expansion between the sensor head and controller
Minimum bend R	22 mm
Power supply	Supplied from the controller
Operating ambient temperature	0 to +50 ºC
Operating ambient humidity	20 to 85% RH (No condensation)
Protection structure	Nothing
Weight	Approx. 150 g

Target holder pulley

Model	OP-87609	OP-87684	OP-87749	OP-87750
Material	Aluminum (Main unit), SUS (Pulley part)			
Weight	Approx. 100 g	Approx. 150 g	Approx. 300 g	

Display panel stand

Model	OP-87610
No. of mountable display panels	1
Material	Steel
Weight	Approx. 1500 g

Display panel support

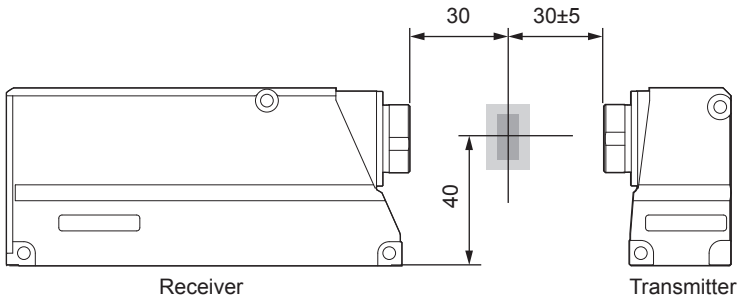
Model	OP-87757
No. of mountable display panels	1
Material	SUS
Weight	Approx. 250 g

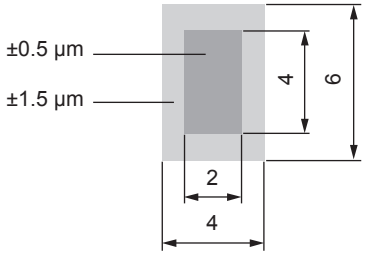
Characteristics

Measurement range and accuracy

■ LS-9006/LS-9006M

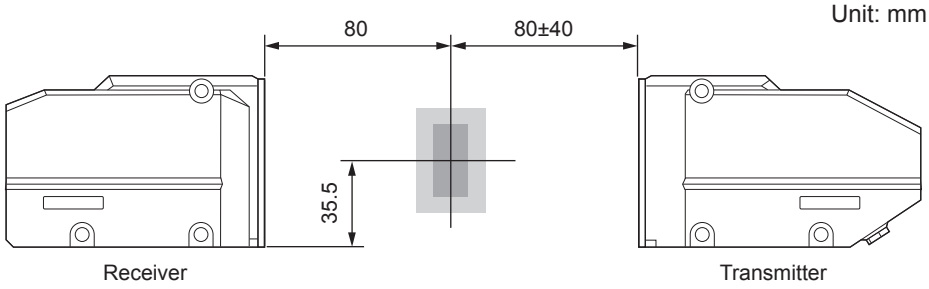
Unit: mm

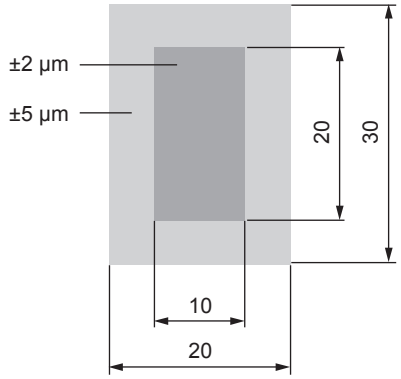




■ LS-9030/LS-9030M

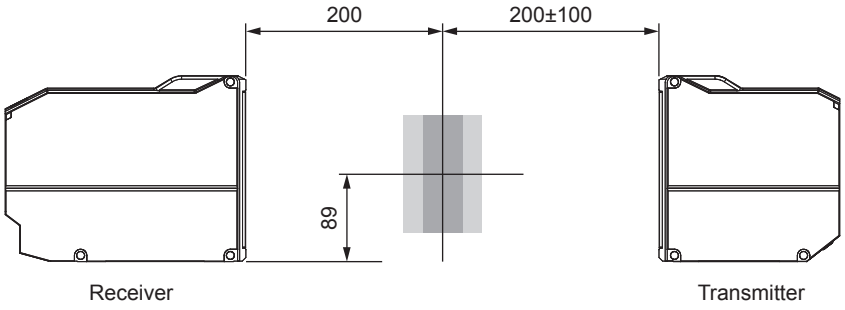
Unit: mm

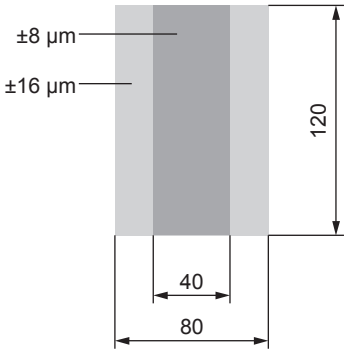




■ LS-9120M

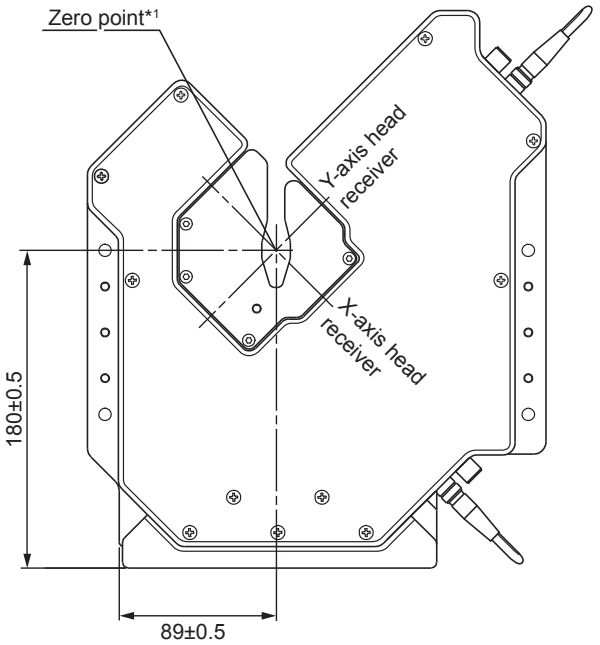
Unit: mm

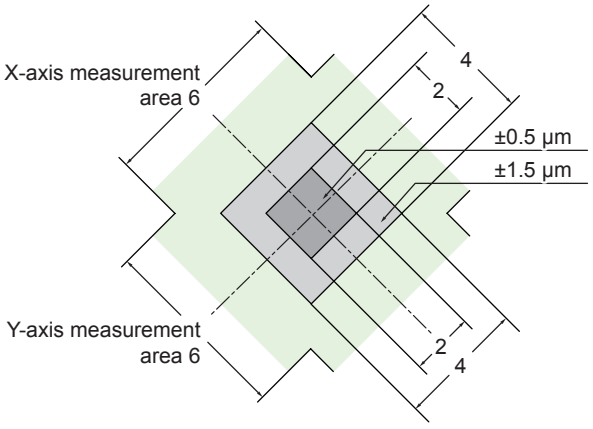




■ LS-9006D

Unit: mm

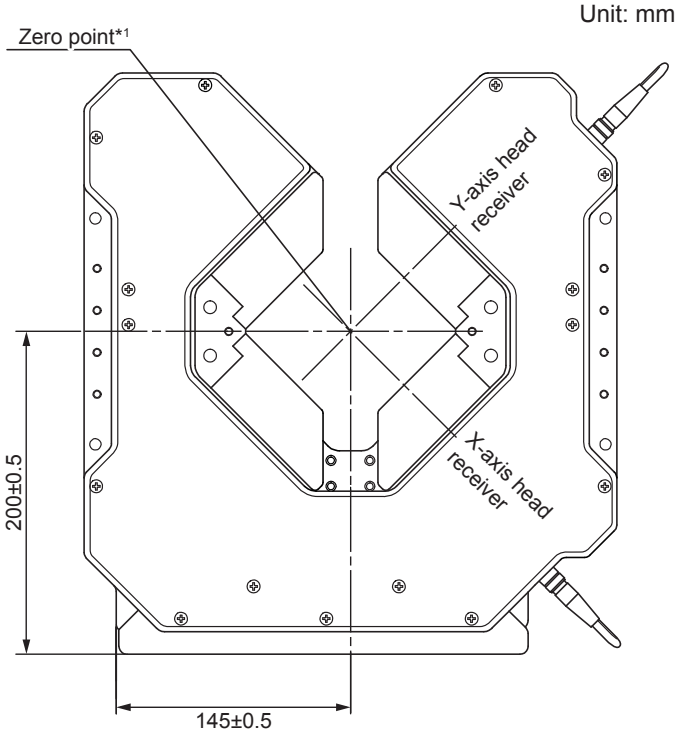


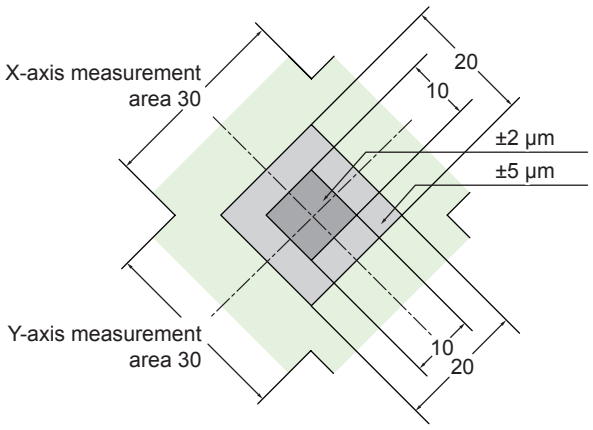


*1: Zero point is the intersection of the optical center of each X and Y axis measurement range.

■ LS-9030D

Unit: mm





*1: Zero point is the intersection of the optical center of each X and Y axis measurement range.

Temperature characteristics

The following shows the typical examples of the temperature characteristics.

■ LS-9006/LS-9006M/LS-9006D

Temperature	0 ºC	10 ºC	20 ºC	30 ºC	40 ºC	50 ºC
Drift	-0.18	-0.06	0.00	0.08	0.12	0.19

Unit: µm

* When a ϕ1 round bar is measured in the center of the measurement area with the measurement target set to "Outer diameter" (20 ºC as reference)

■ LS-9030/LS-9030M/LS-9030D

Temperature	0 ºC	10 ºC	20 ºC	30 ºC	40 ºC	50 ºC
Drift	0.28	0.14	0.00	-0.07	-0.25	-0.4

Unit: µm

* When a ϕ10 round bar is measured in the center of the measurement area with the measurement target set to "Outer diameter" (20 ºC as reference)

■ LS-9120M

Temperature	0 ºC	10 ºC	20 ºC	30 ºC	40 ºC	50 ºC
Drift	8.0	4.0	0.0	-4.0	-8.0	-12.0

Unit: µm

* When a ϕ40 round bar is measured in the center of the measurement area with the measurement target set to "Outer diameter" (20 ºC as reference)

MEMO

State Table

Statuses		Display panel		Output					
		Measurement value	Decision	Decision SIG1 to 10 (*2)	STRB	GO	FULL	STA	
Test data output in progress (Forced output from terminal) "Display Terminal Status" (page 6-44)		Measurement value	Judgment result	Depends on the test data output					
Measuring	Normal			Depends on the measurement value	When judgment result is updated	Overall judgment result	Depends on the measurement (*4)	Depends on the measurement (*5)	
	+ Over-range	+OVER	HI (Reference value mode) HH (Threshold value mode)						
	- Over-range	- OVER	LO (Reference value mode) LL (Threshold value mode)						
	Output waiting	--------	All OFF						
Calibration of received light intensity in progress				Hold					
Updating settings		Hold							
Error occurring		Error display	All OFF						
At power ON (Starting)		--------		OFF					

*1 ○ and × in the table have the following meanings. ○: Valid, x: Invalid. [Invalid] means that the input will be ignored.
*2 The output content can be specified by the corresponding setting.
*3 It will be ±10.8 V if ±10.5 V is exceeded.
*4 This output becomes ON when the number of data storage points reaches the storage points.
*5 The output content can be specified by the corresponding setting. "Status output" (page 5-98)
*6 Enabled when the output function is “BCD output” or “Binary output”. N.O. (OFF) for “Judgment output”.
*7 Enabled when the output function is “Judgment output”. N.O. (OFF) for “BCD output” or “Binary output”.
*8 Enabled when the output function is “BCD output” or “Binary output” AND the OUT selection method is “BCD unit terminal”.

	Output		Input (*1)					
	Analog output voltage	**ERROR (N.C)**	**ZERO**	**TIM/RST/ P1 to P4**	**STEN STTRG**	**STCLEAR**	**SDO**	**SCLR**
	Depends on the output value (*3)	Depends on the test data output	○	○	○	○	○	○
		ON	○	○	○	○	○	○
	+10.8 V		○					
	-10.8 V		○					
	Depends on the settings (0 V/±10.8 V/ Hold the previous value)		× (Auto zero can be cancelled)					
	Hold		×	×	×	×	×	×
			×	×	×	×	×	×
		OFF	×	×	×	×	×	×
	Value undefined until measurement start		×	×	×	×	×	×

<table>
<tr><th colspan="2" rowspan="2">Statuses</th><th colspan="4">Output</th><th>Input</th></tr>
<tr><th>BINARY/ BCD output value</th><th>Judgment output HH to LL</th><th>STROBE</th><th>OUT-NUM</th><th>OUT number selection IN-NUM</th></tr>
<tr><td colspan="2">Test data output in progress
(Forced output from terminal)
"Display Terminal Status" (page 6-44)</td><td colspan="4">Depends on the test data output</td><td>○ (*8)</td></tr>
<tr><td rowspan="4">Measuring</td><td>Normal</td><td rowspan="4">Measurement value (*6)</td><td rowspan="4">Depends on the measurement value (*7)</td><td rowspan="4">When judgment result is updated</td><td rowspan="4">○ (*6)</td><td rowspan="4">○ (*8)</td></tr>
<tr><td>+ Over-range</td></tr>
<tr><td>- Over-range</td></tr>
<tr><td>Judgment standby</td></tr>
<tr><td colspan="2">Calibration of received light intensity in progress</td><td colspan="4" rowspan="3">Hold</td><td>×</td></tr>
<tr><td colspan="2">Updating settings</td><td>×</td></tr>
<tr><td colspan="2">Error occurring</td><td>×</td></tr>
<tr><td colspan="2">At power ON (Starting)</td><td colspan="4">Value undefined until measurement start</td><td>×</td></tr>
</table>

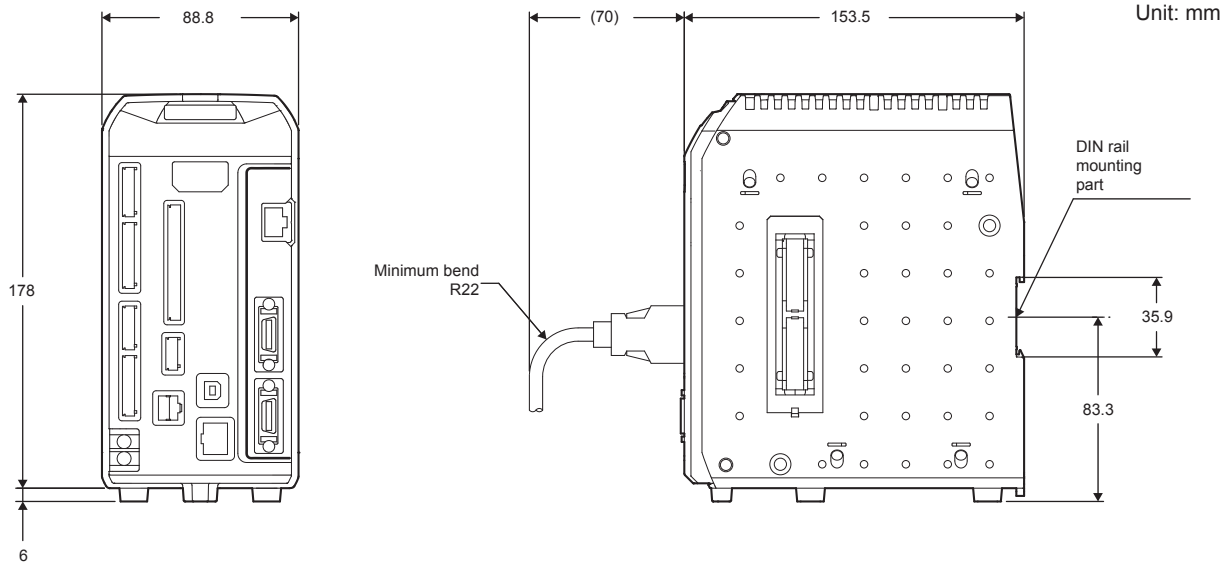
*6 Enabled when the output function is “BCD output” or “Binary output”. N.O. (OFF) for “Judgment output”.
*7 Enabled when the output function is “Judgment output”. N.O. (OFF) for “BCD output” or “Binary output”.
*8 Enabled when the output function is “BCD output” or “Binary output” AND the OUT selection method is “BCD unit terminal”.

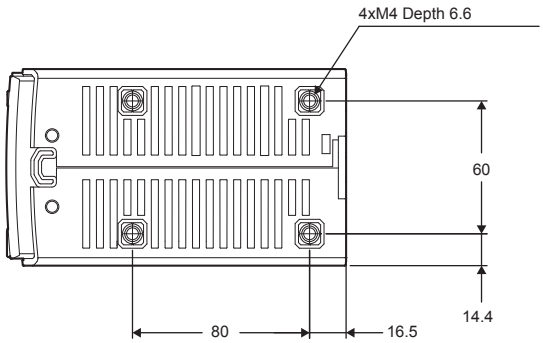
Dimensions

The CAD data can be downloaded from the KEYENCE web site.
Web page URL: http: //www.keyence.co.jp/cad

Controller

Unit: mm

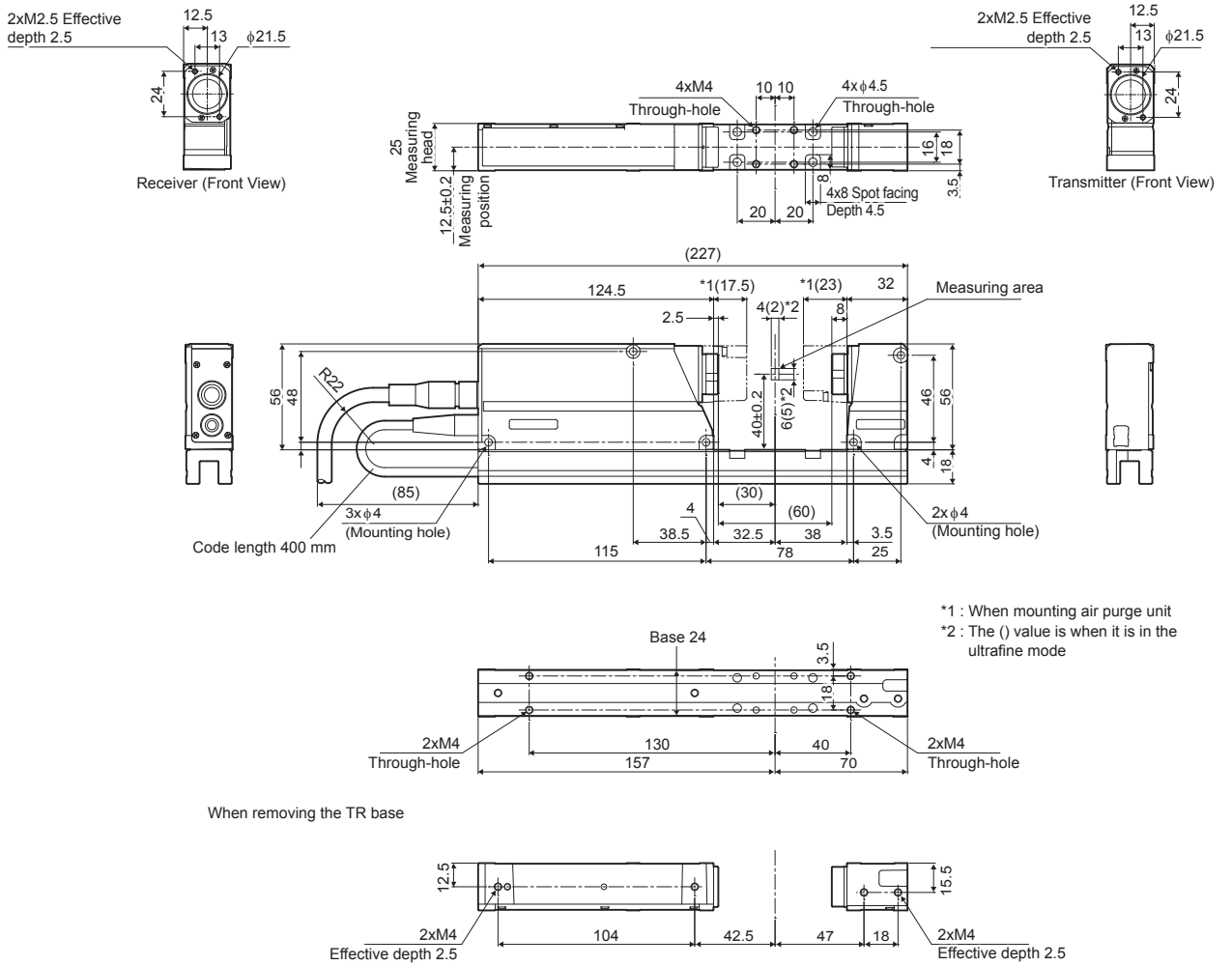




Sensor Head

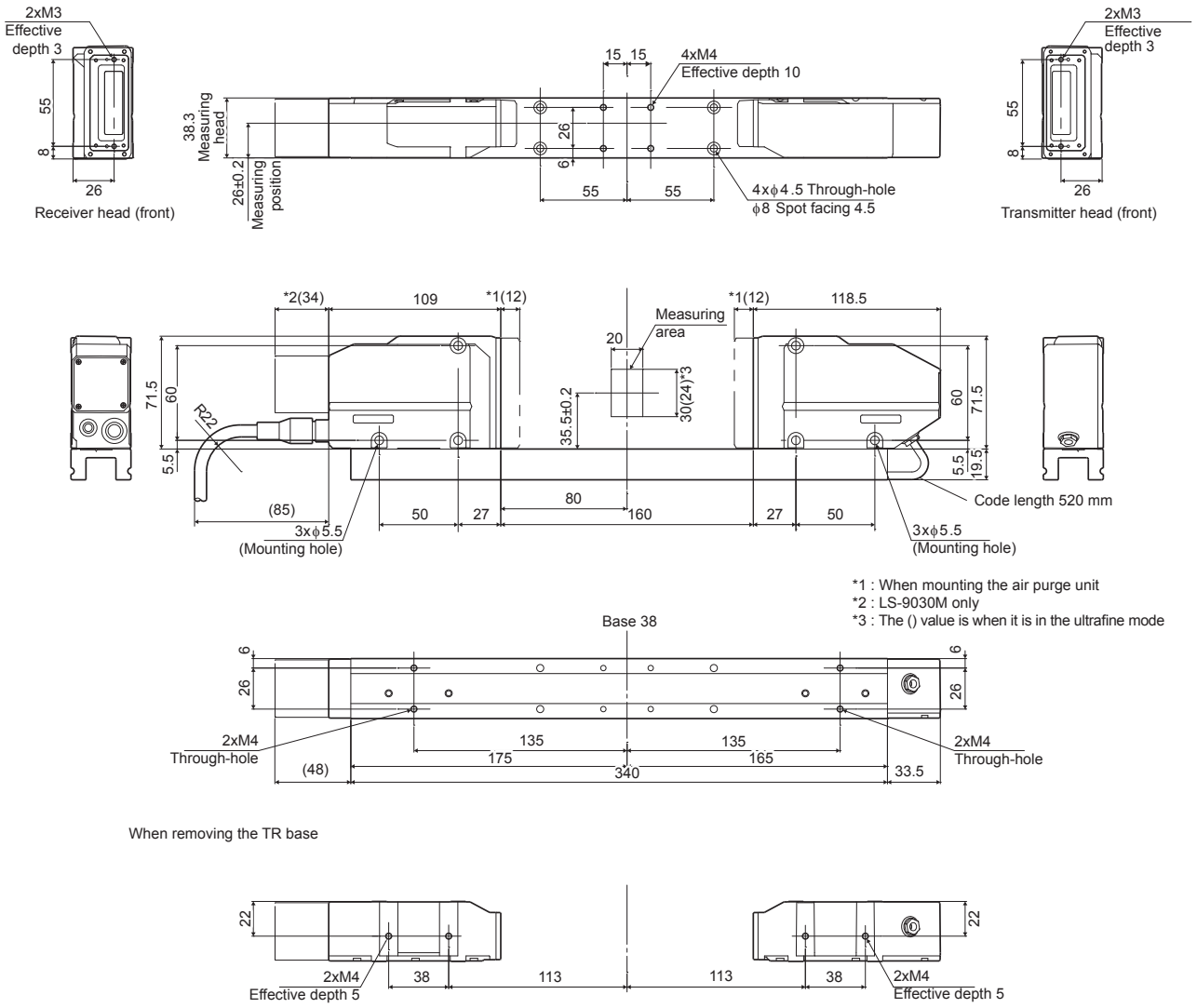
■ LS-9006/LS-9006M

Unit: mm



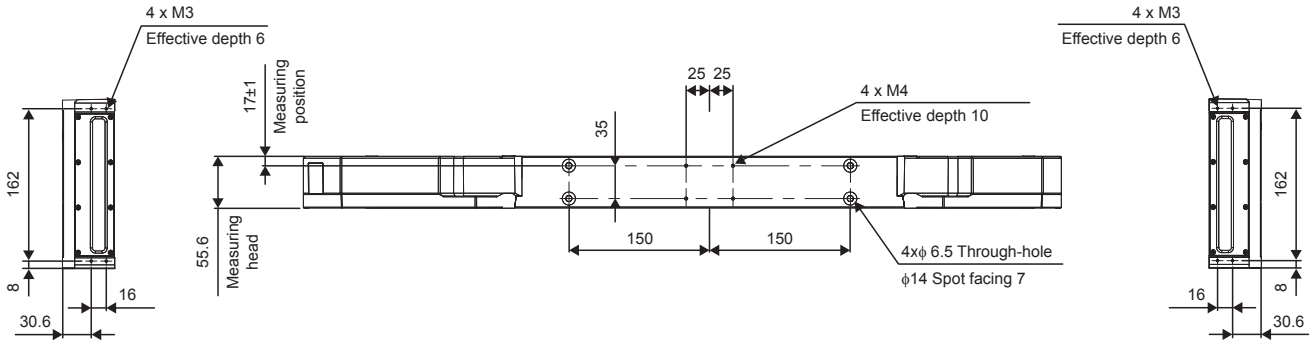
■ LS-9030/LS-9030M

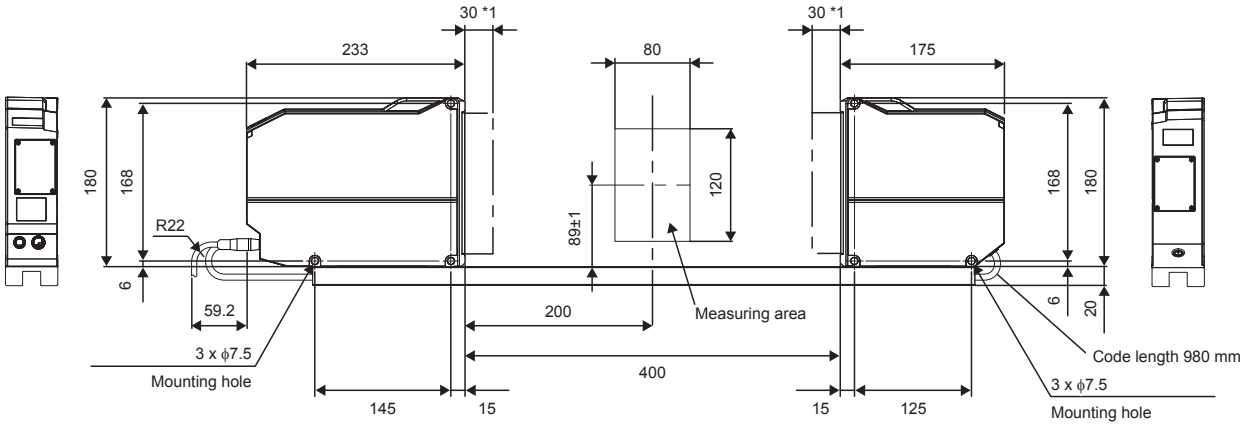
Unit: mm



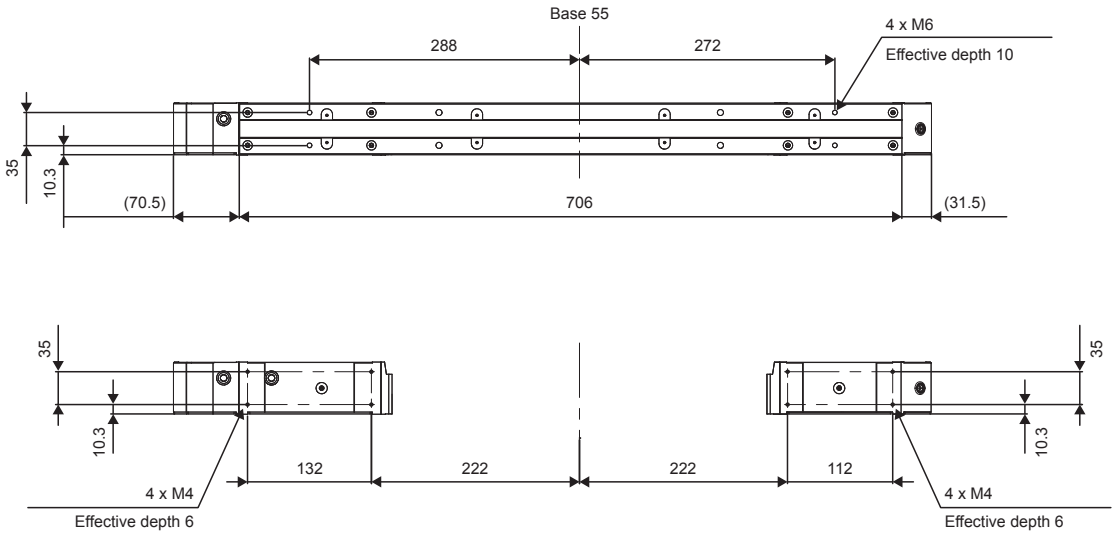
■ LS-9120M

Unit: mm



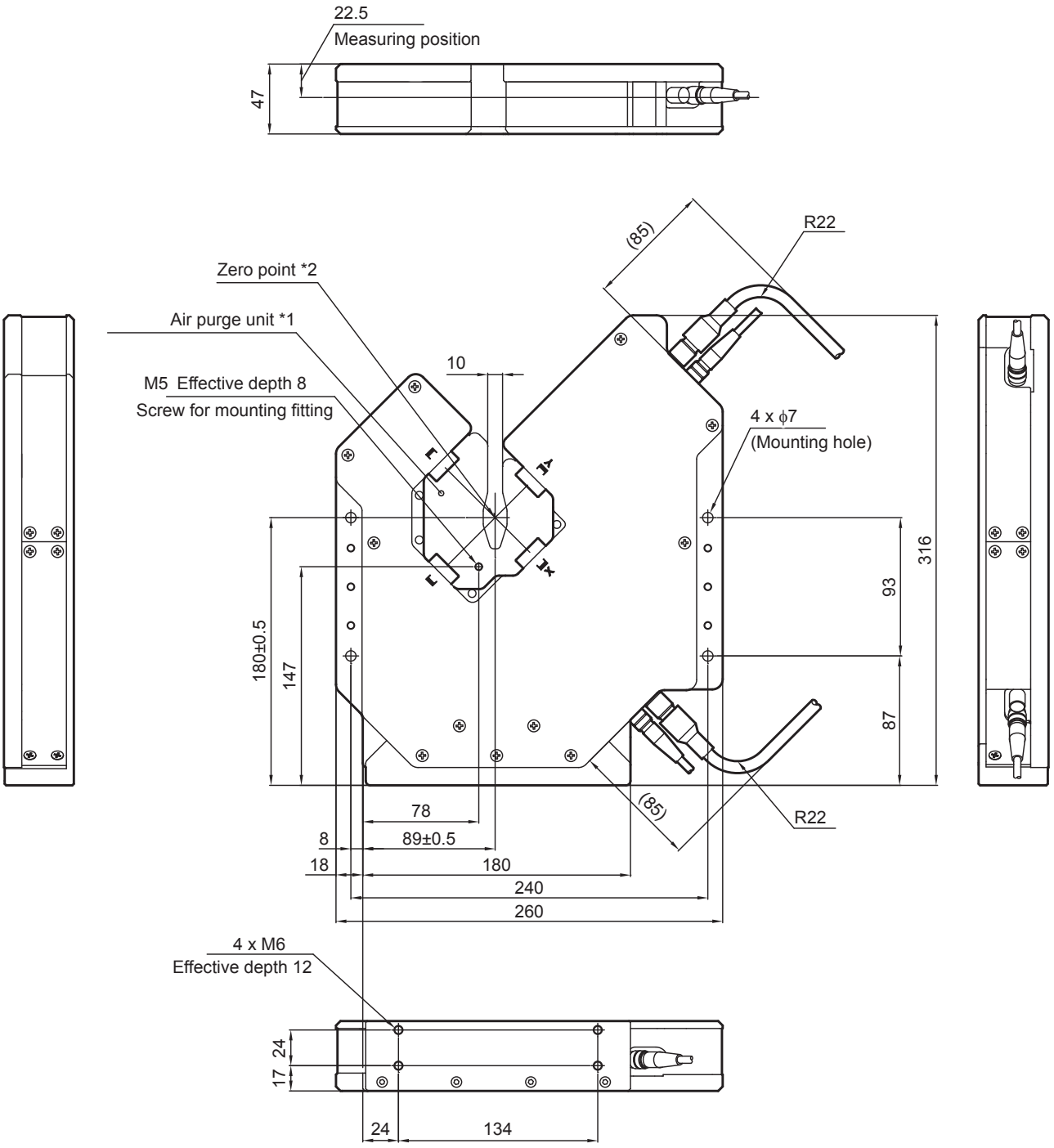


*1: When mounting the air purge unit



■ LS-9006D

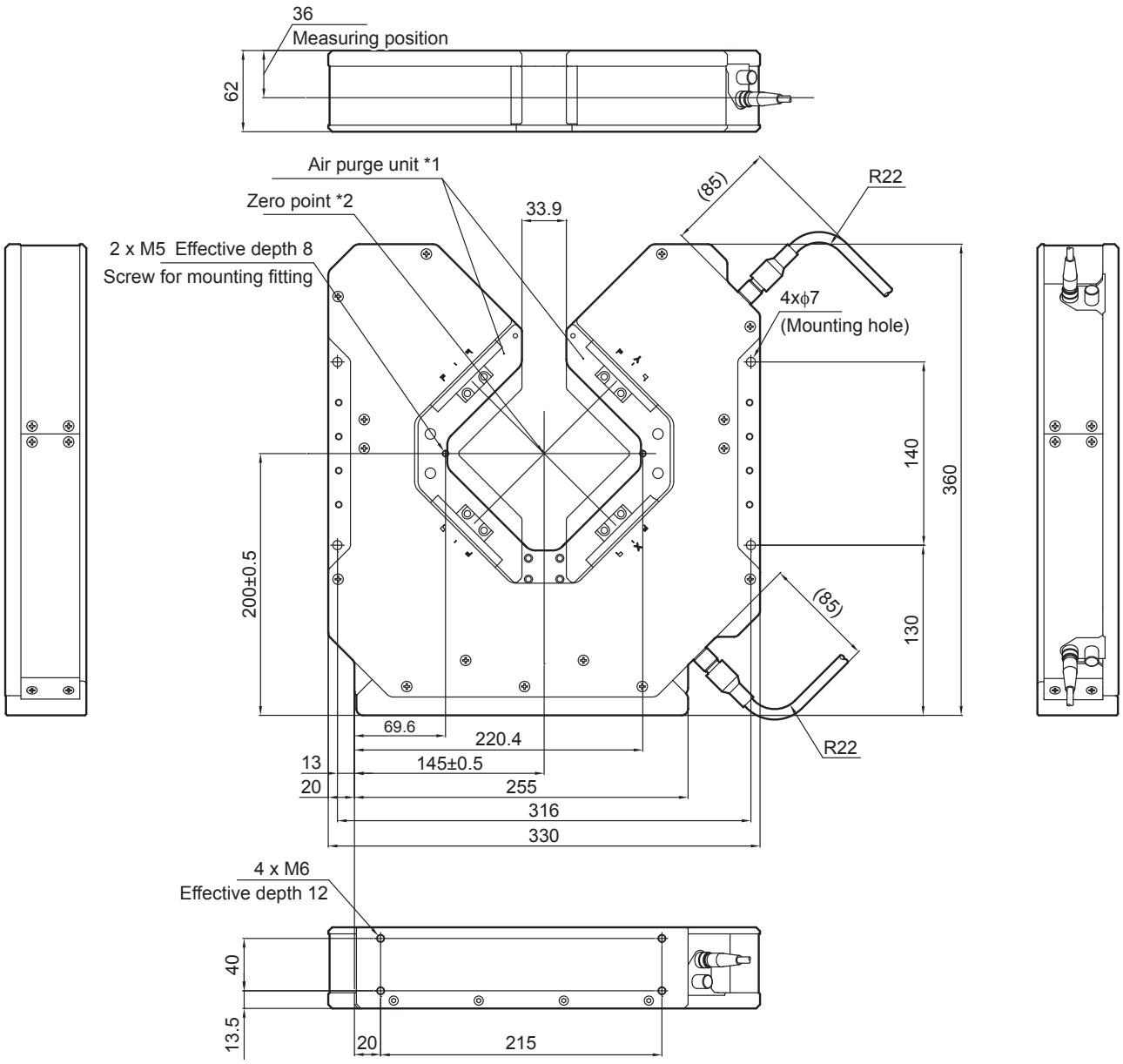
Unit: mm



*1: When mounting the air purge unit
*2: Zero point is the intersection of the optical center of each X and Y axis measurement range.

■ LS-9030D

Unit: mm

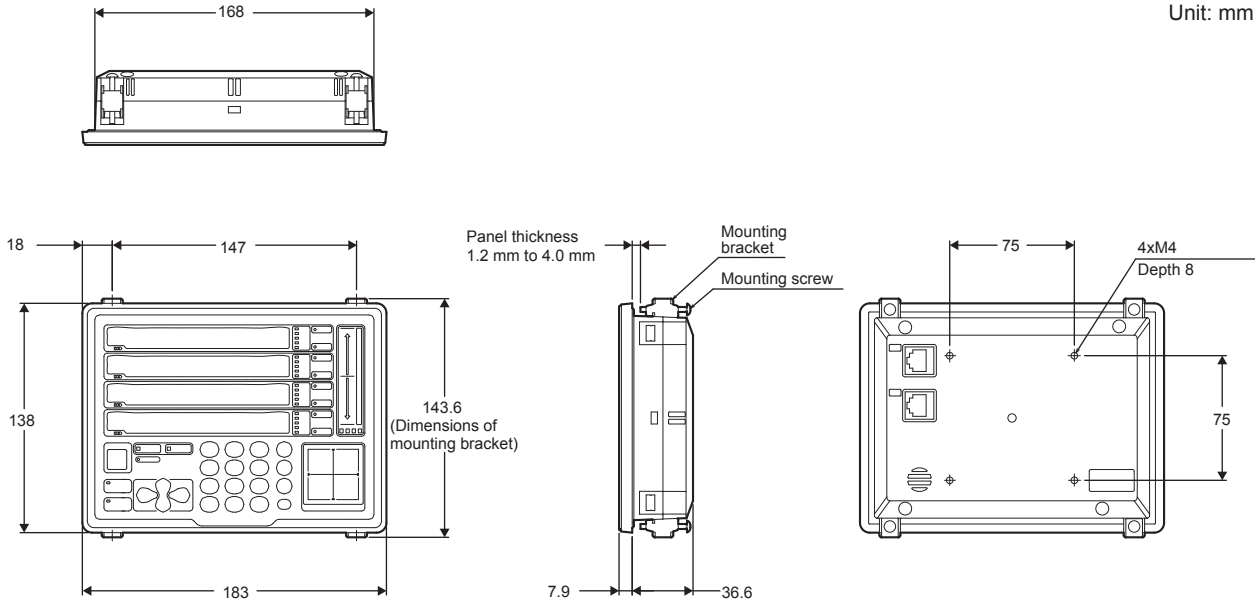


*1: When mounting the air purge unit
*2: Zero point is the intersection of the optical center of each X and Y axis measurement range.

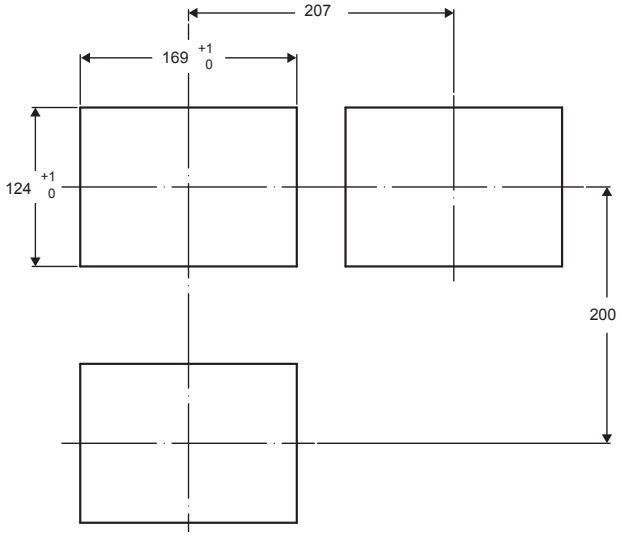
HMI Display panel

■ LS-D1000

Unit: mm

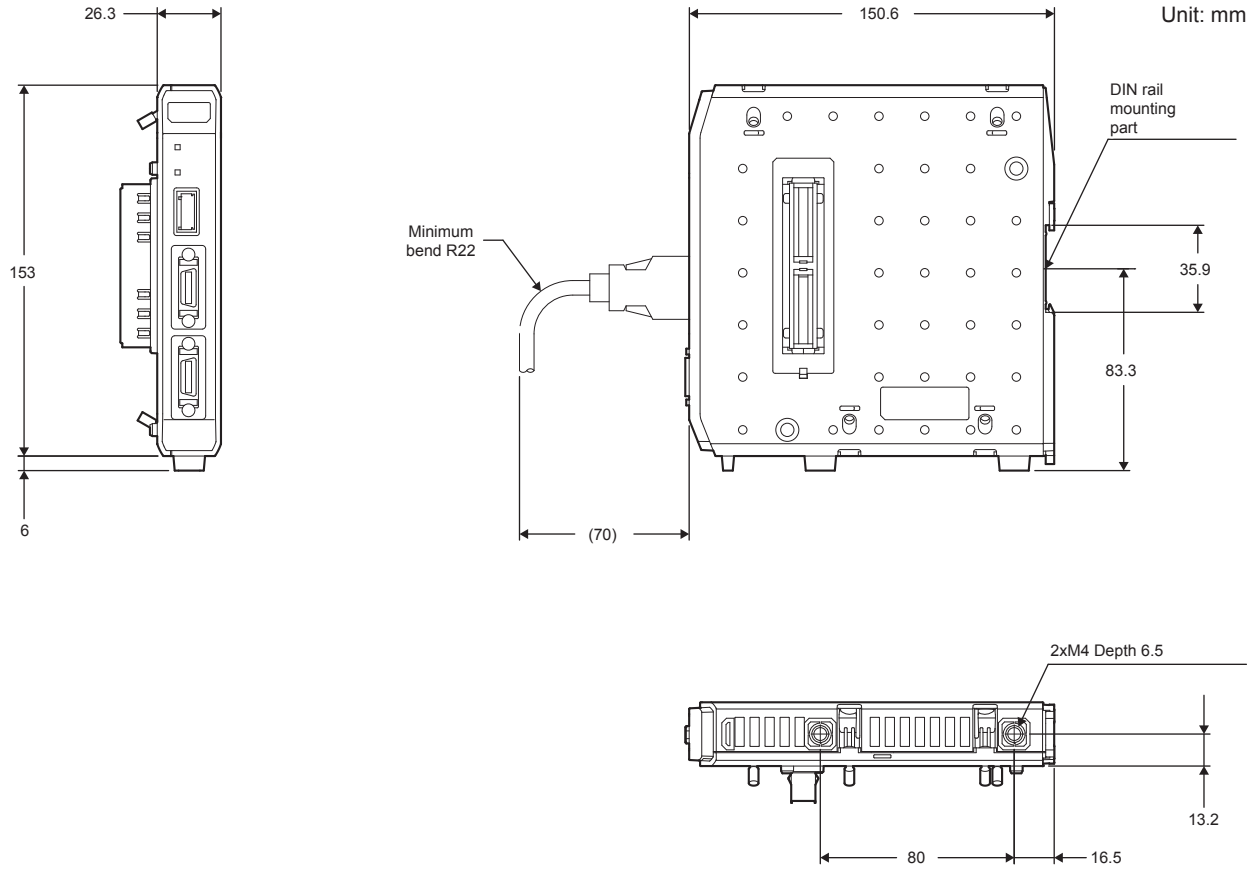


Panel cut dimensions



Head expansion unit

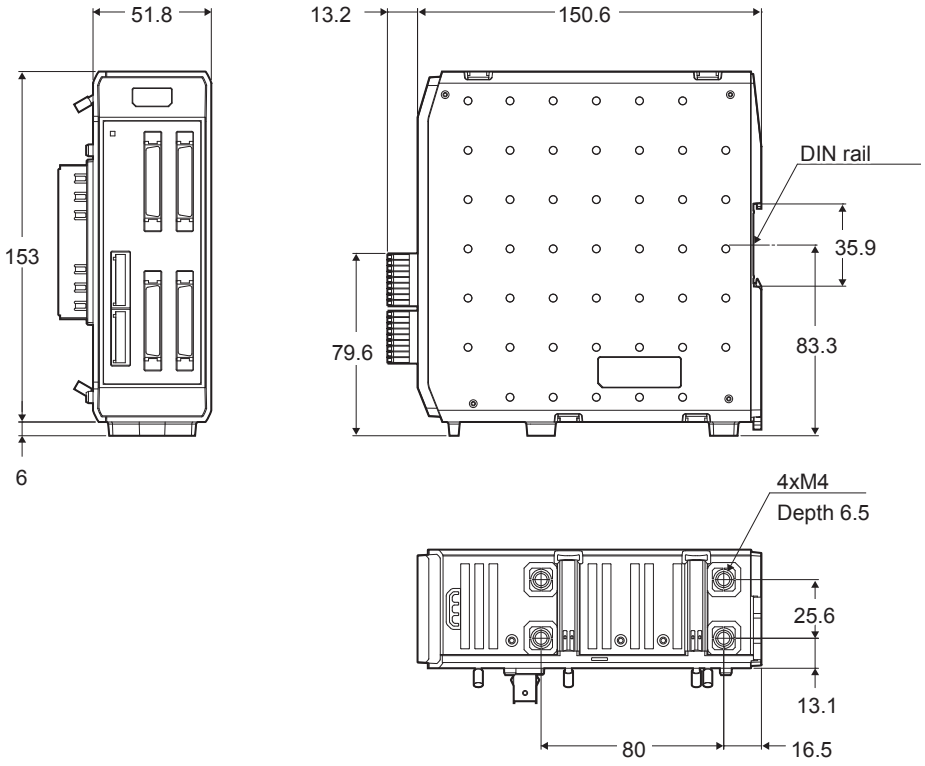
■ LS-HA100



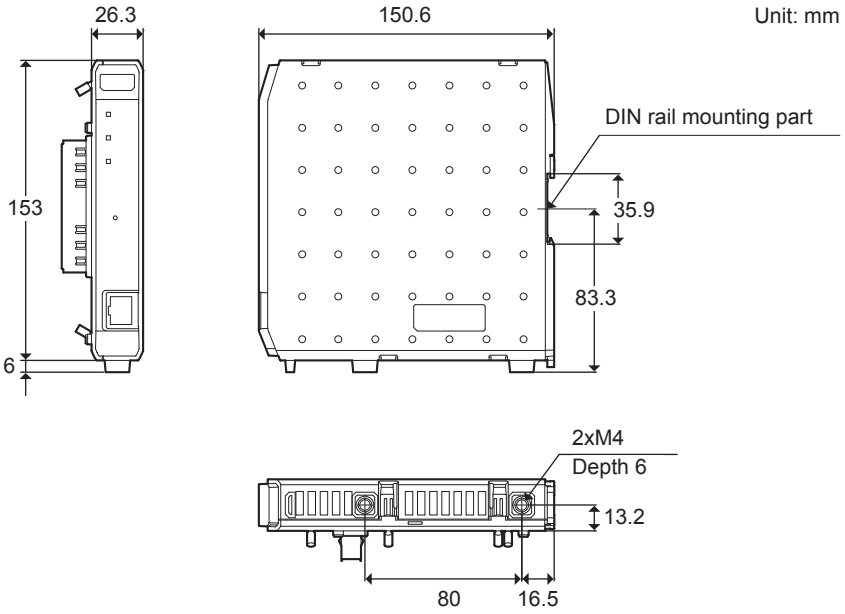
BCD unit

■ CB-BD100

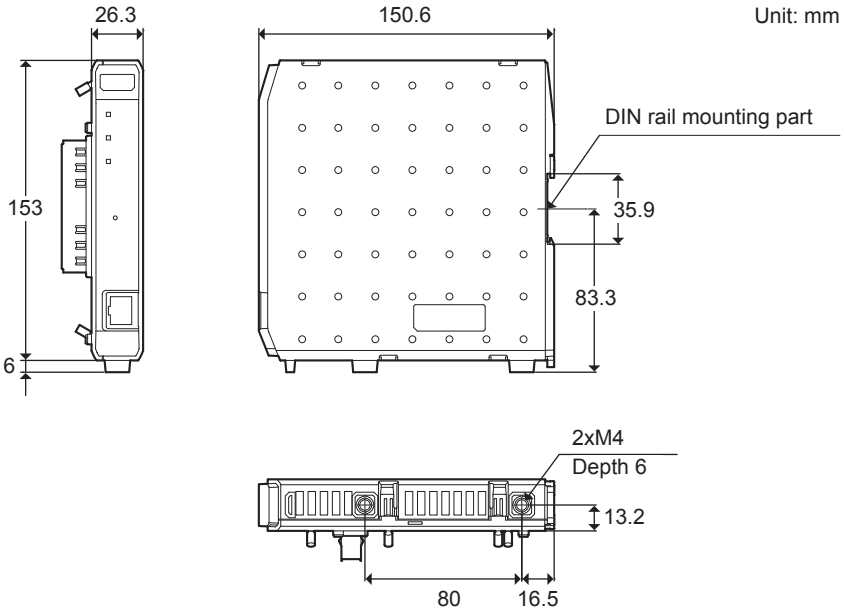
Unit: mm



EtherNet/IP communication unit



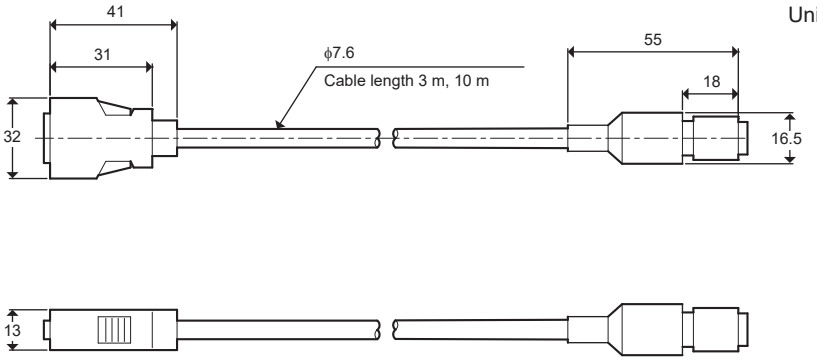
PROFINET communication unit



Head extension cable

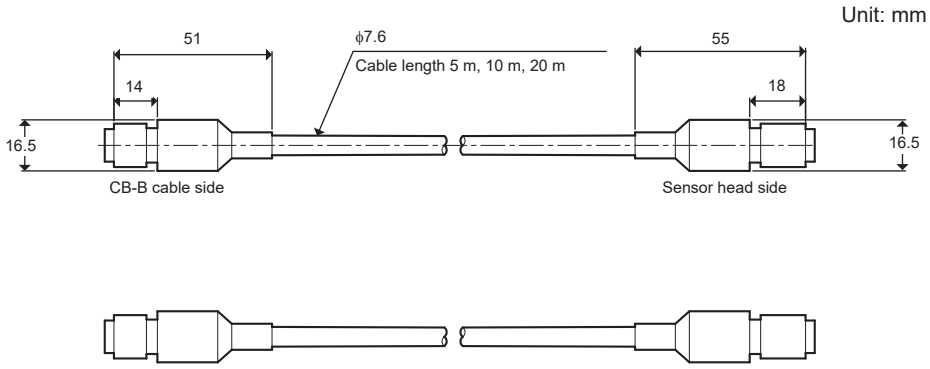
■ Cable between the controller and head CB-B3/CB-B10

Unit: mm



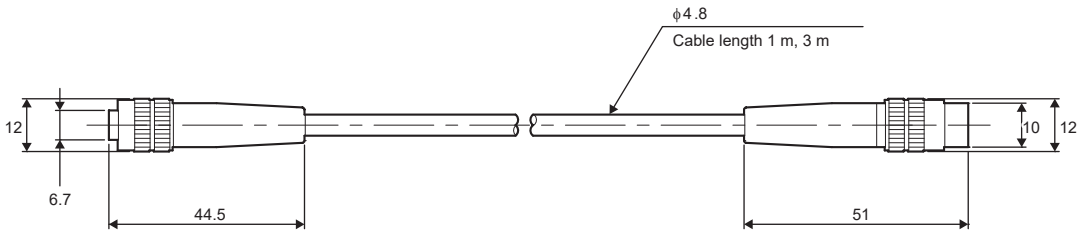
■ Head extension cable CB-B5E/CB-B10E/CB-B20E

Unit: mm



■ Cable between the transmitter and receiver OP-87686 (1 m cable)/OP-87687 (3 m cable)

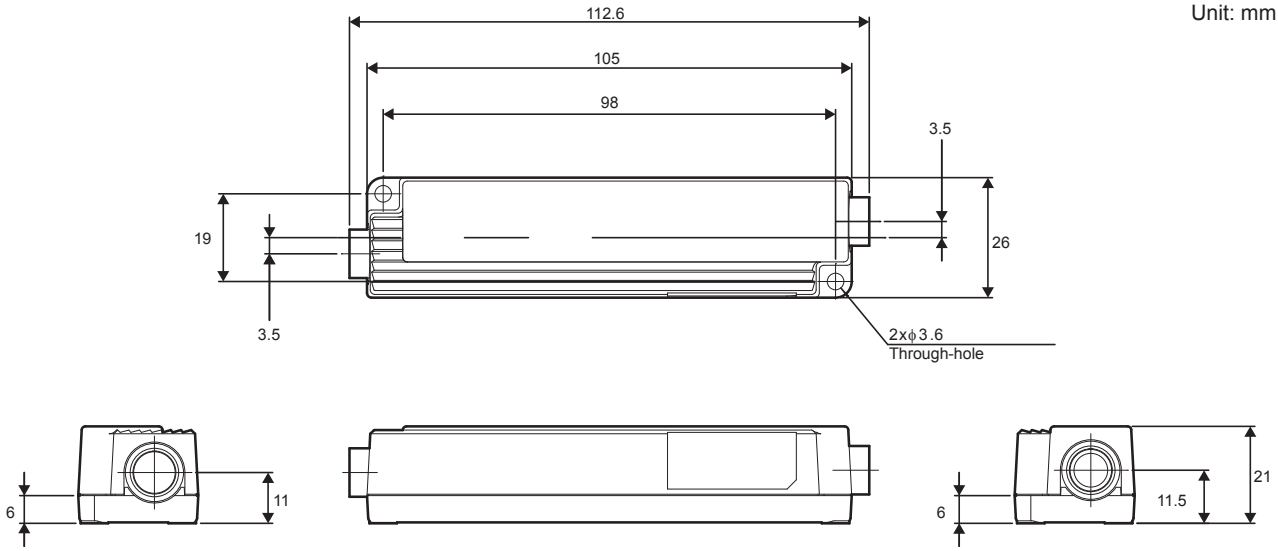
Unit: mm



40m connecting unit for cable extension

■ CB-BR01

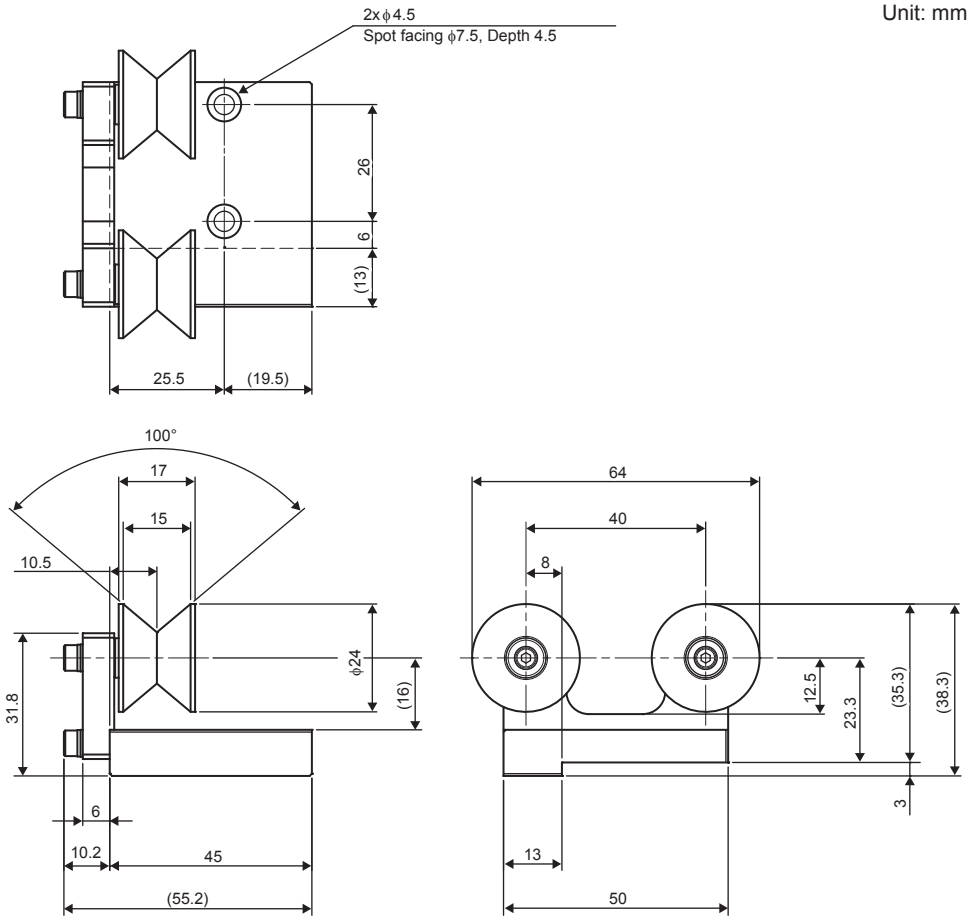
Unit: mm



Target holder pulley

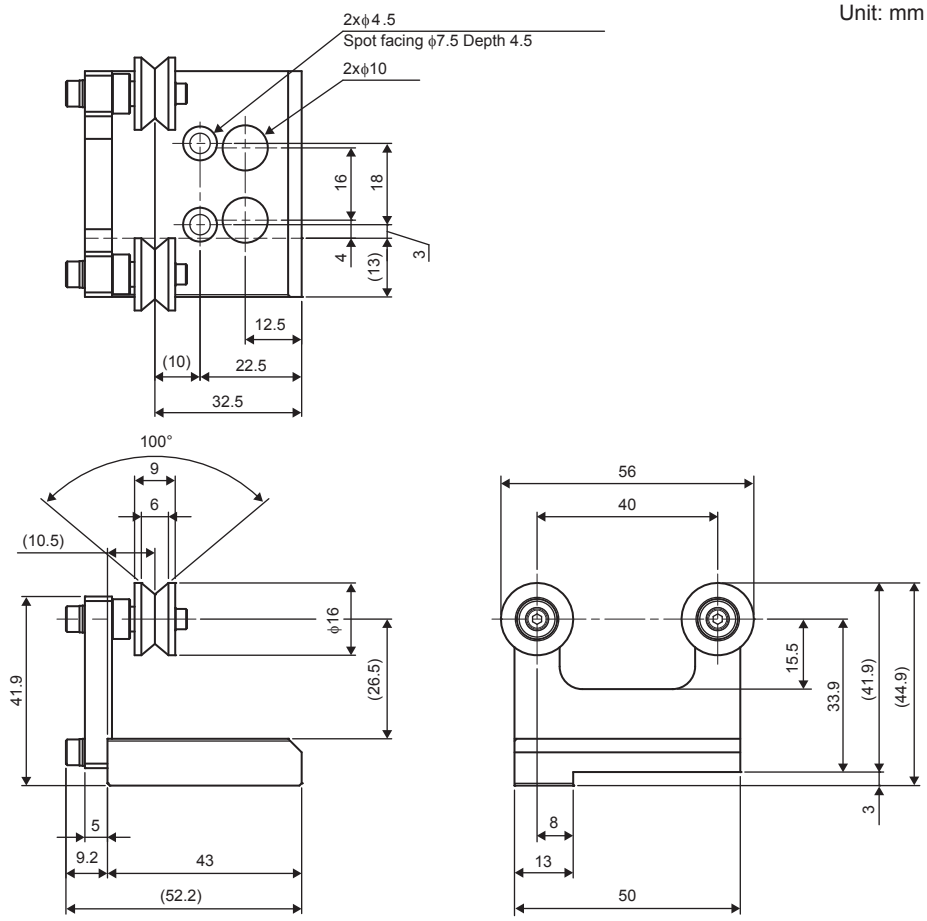
■ OP-87609 (For LS-9030)

Unit: mm



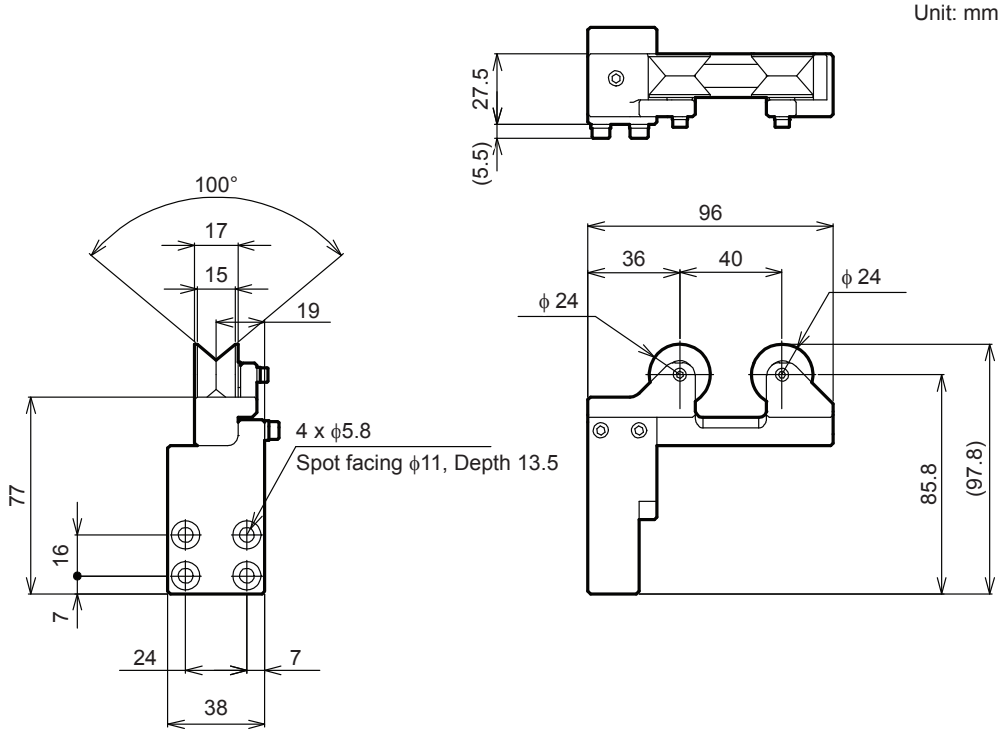
■ OP-87684 (For LS-9006)

Unit: mm



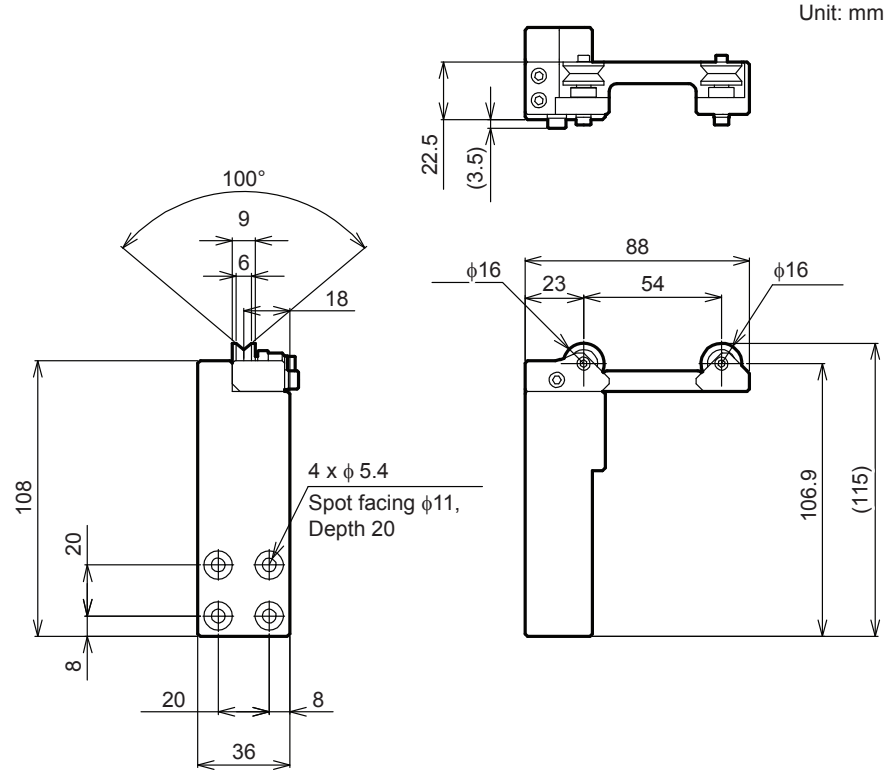
■ OP-87749 (For LS-9030D)

Unit: mm



■ OP-87750 (For LS-9006D)

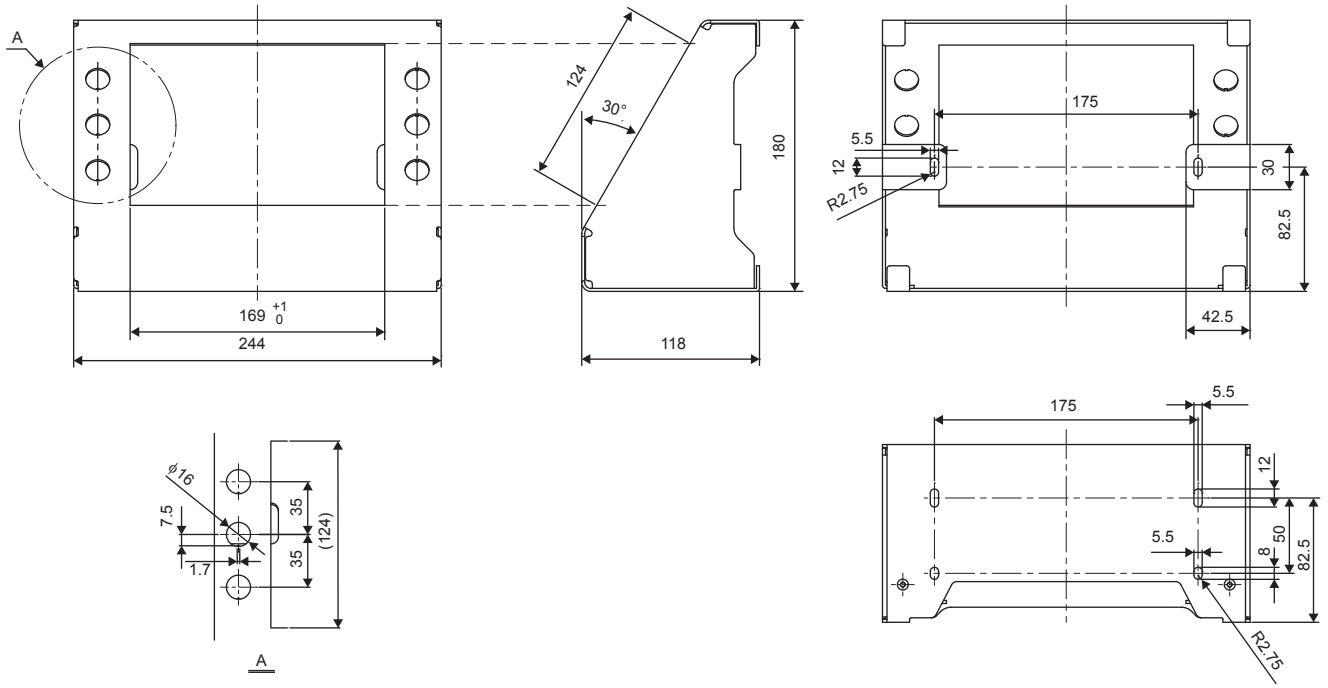
Unit: mm



Panel stand

■ OP-87610

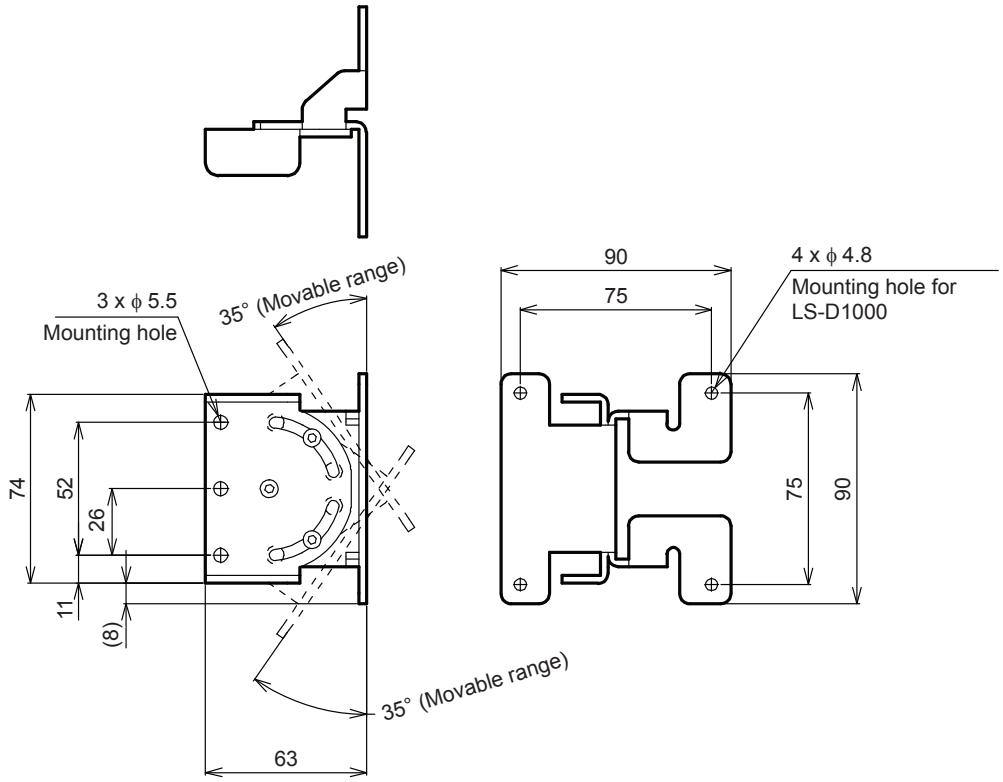
Unit: mm



Display panel support

■ **OP-87757**

Unit: mm

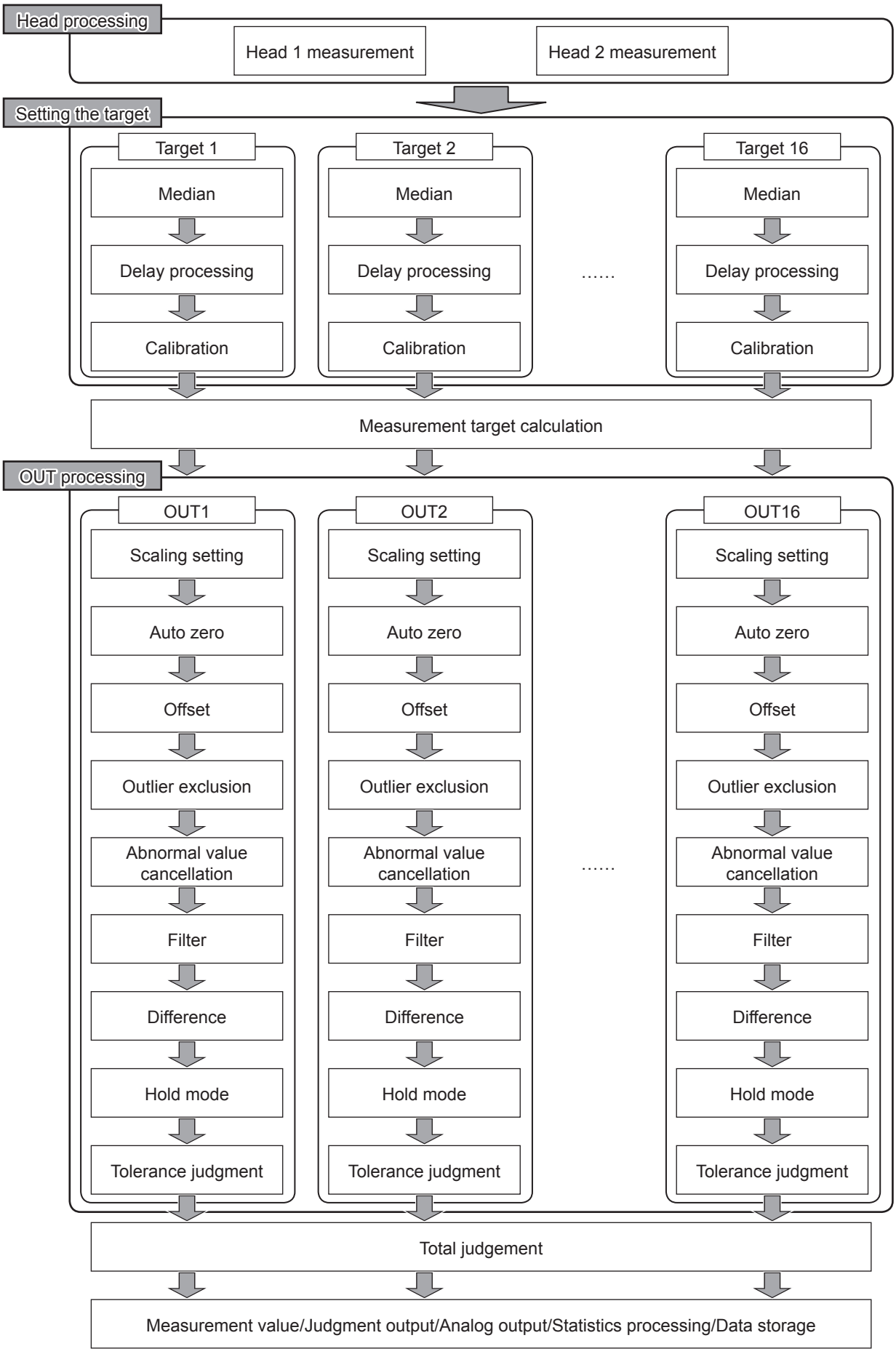


MEMO

Appendix

Measurement Conditions and Measurement Data Flow A-2
LS-Navigator2 Saved File List A-3
Transition diagram for the display panel operations setting screen A-4
Troubleshooting A-15
Error Messages A-18
Index A-23
Revision history A-32

Measurement Conditions and Measurement Data Flow

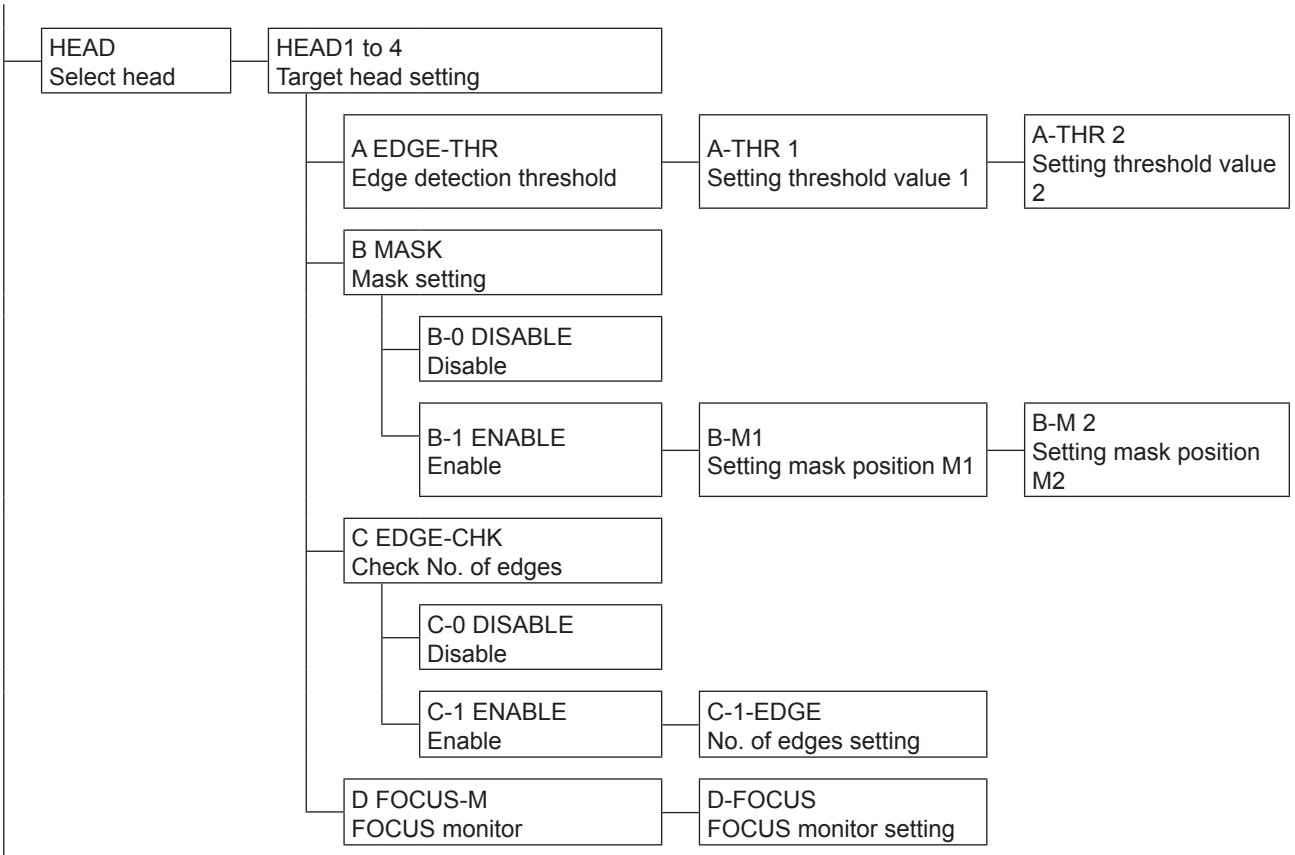


LS-Navigator2 Saved File List

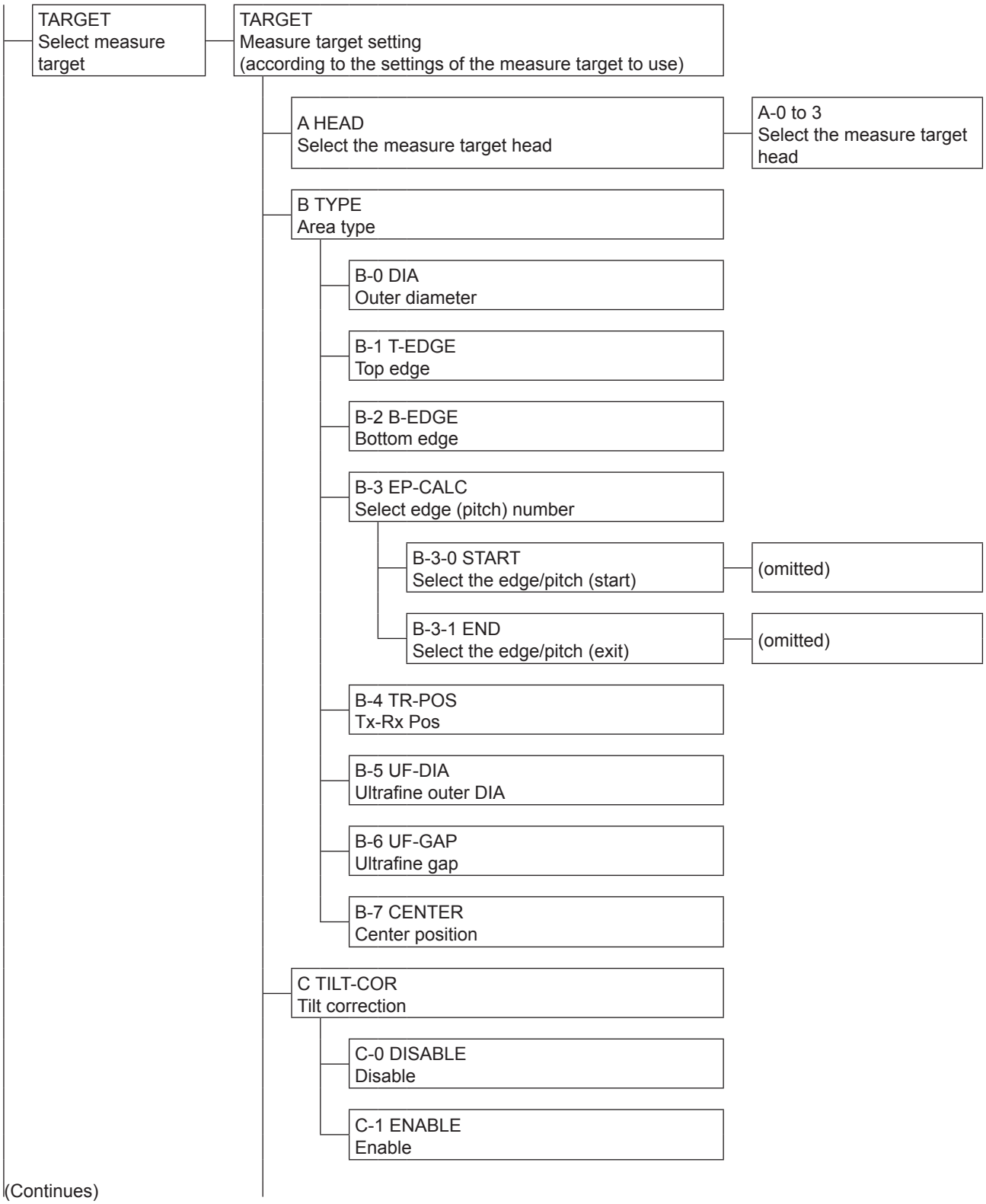
Files	Icons	Extension	Contents
Device settings file		.lsus	This file contains the information of the device information settings screen.
Program settings file		.lsps	This file contains the information of the program settings (16 settings in total).
Screen layout file		.lswl	This file contains the layout and display status of the main screen.
Data storage file		.lsds	This file contains the stored data and the program setting (1 setting) used for the data storage.

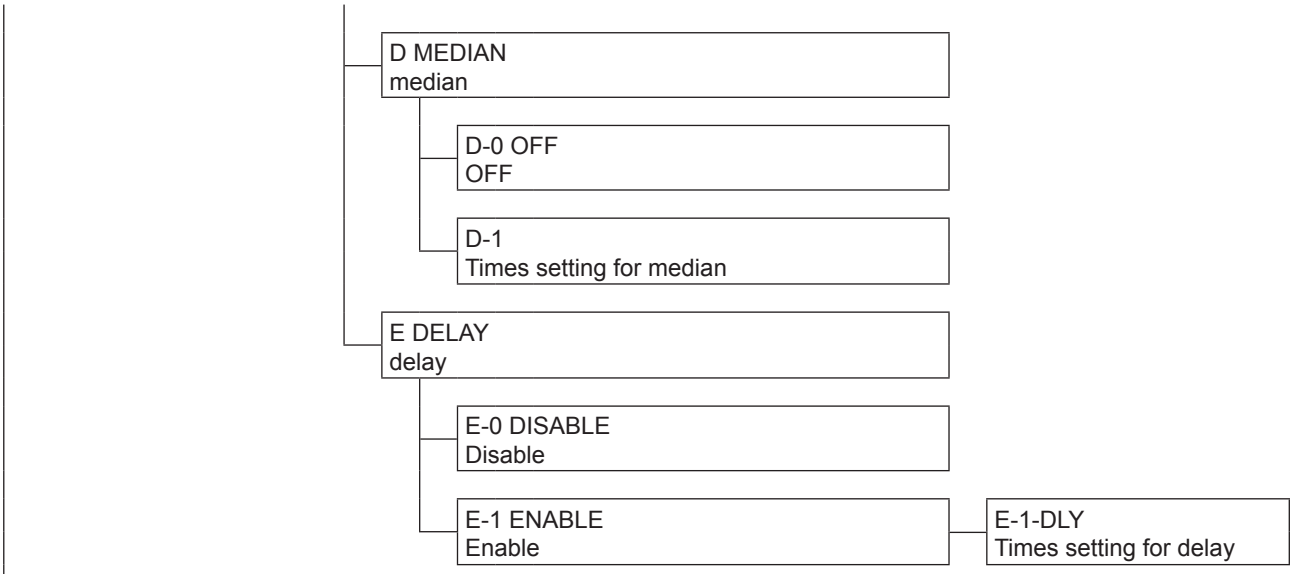
Transition diagram for the display panel operations setting screen

Use the [FUNC] + [0] keys to transit to the screen below.

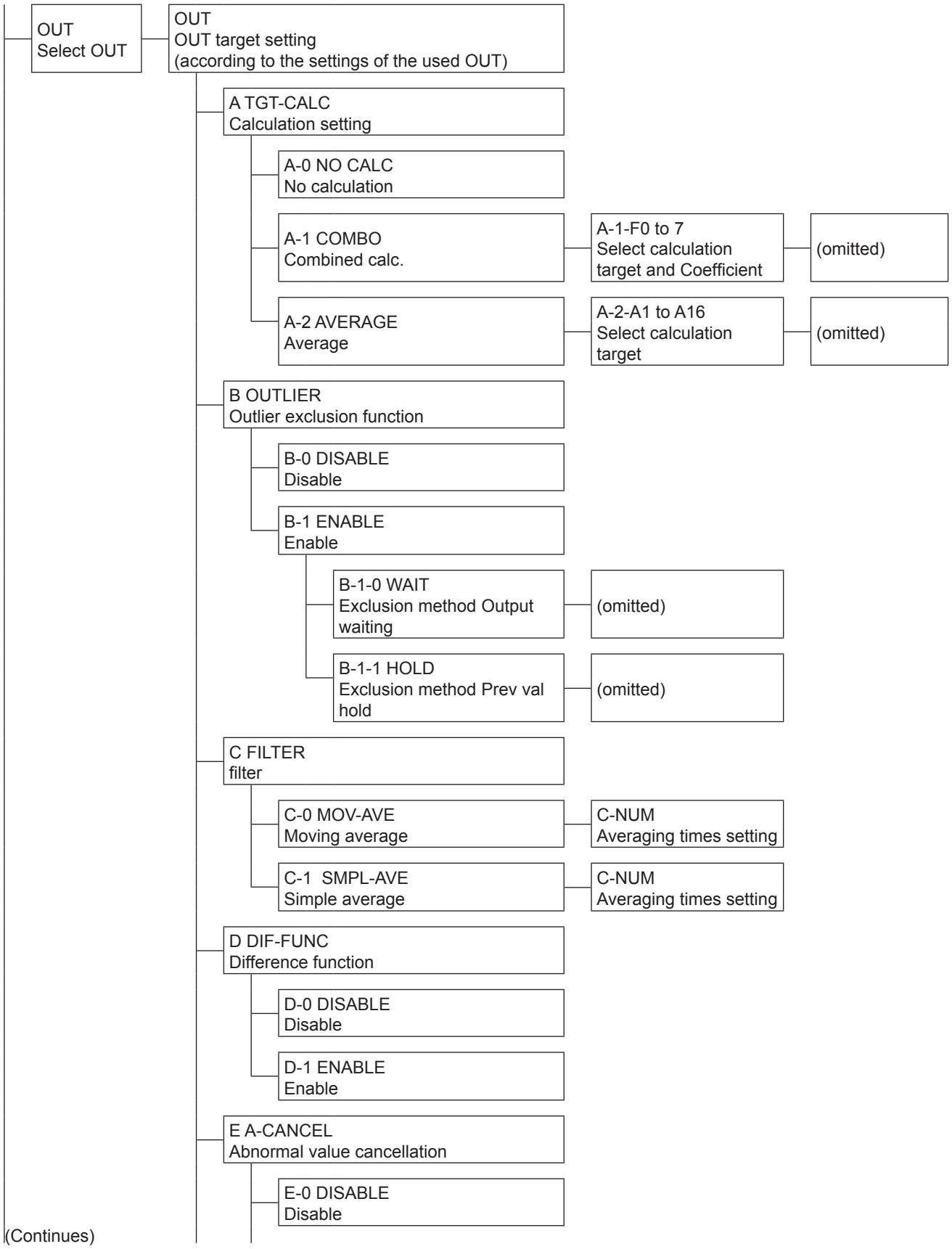


(Continues)

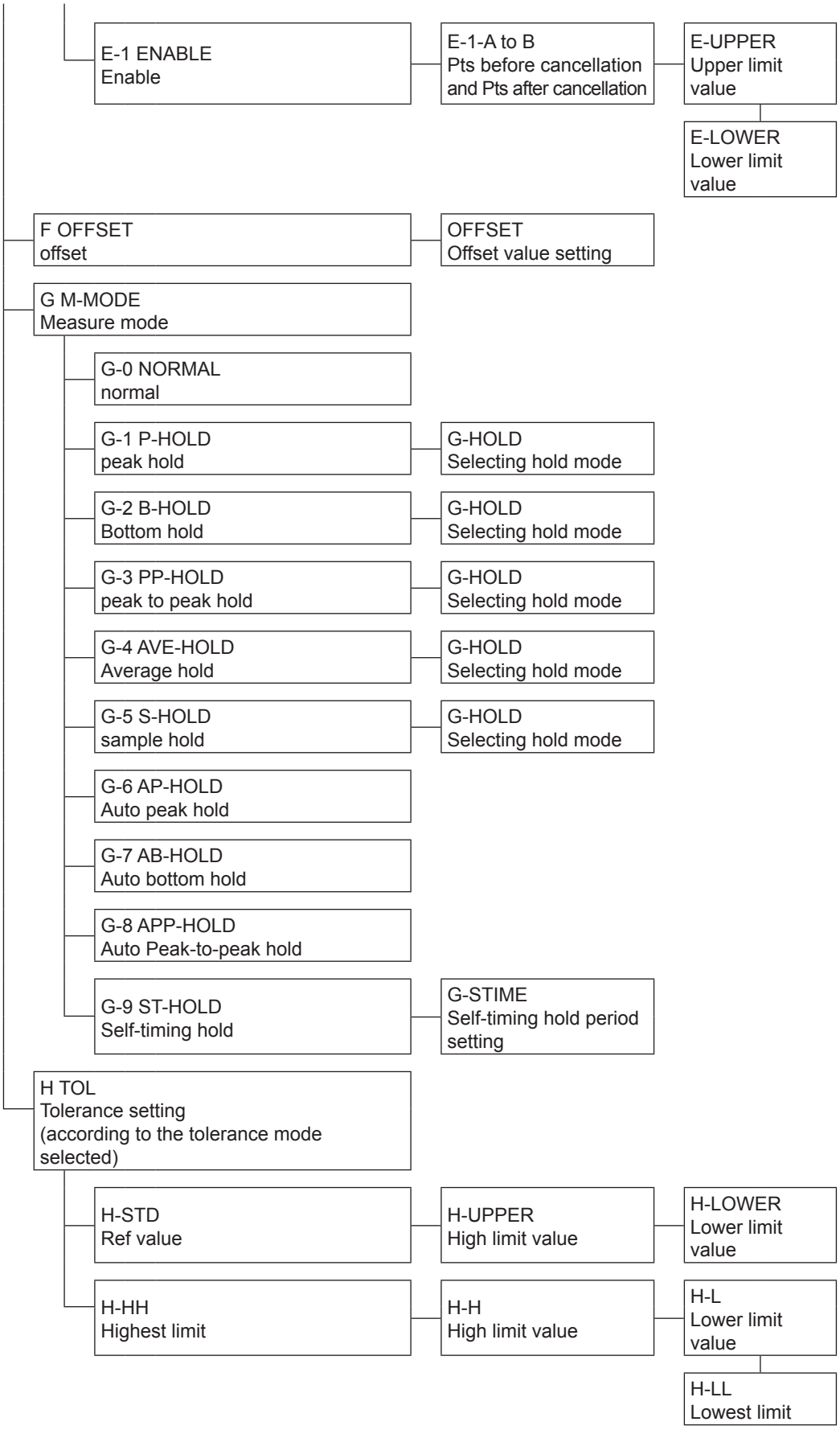

TARGET
Select measure target
TARGET
Measure target setting
(according to the settings of the measure target to use)
A HEAD
Select the measure target head
A-0 to 3
Select the measure target head
B TYPE
Area type
B-0 DIA
Outer diameter
B-1 T-EDGE
Top edge
B-2 B-EDGE
Bottom edge
B-3 EP-CALC
Select edge (pitch) number
B-3-0 START
Select the edge/pitch (start)
(omitted)
B-3-1 END
Select the edge/pitch (exit)
(omitted)
B-4 TR-POS
Tx-Rx Pos
B-5 UF-DIA
Ultrafine outer DIA
B-6 UF-GAP
Ultrafine gap
B-7 CENTER
Center position
C TILT-COR
Tilt correction
C-0 DISABLE
Disable
C-1 ENABLE
Enable
(Continues)


D MEDIAN
median
D-0 OFF
OFF
D-1
Times setting for median
E DELAY
delay
E-0 DISABLE
Disable
E-1 ENABLE
Enable
E-1-DLY
Times setting for delay

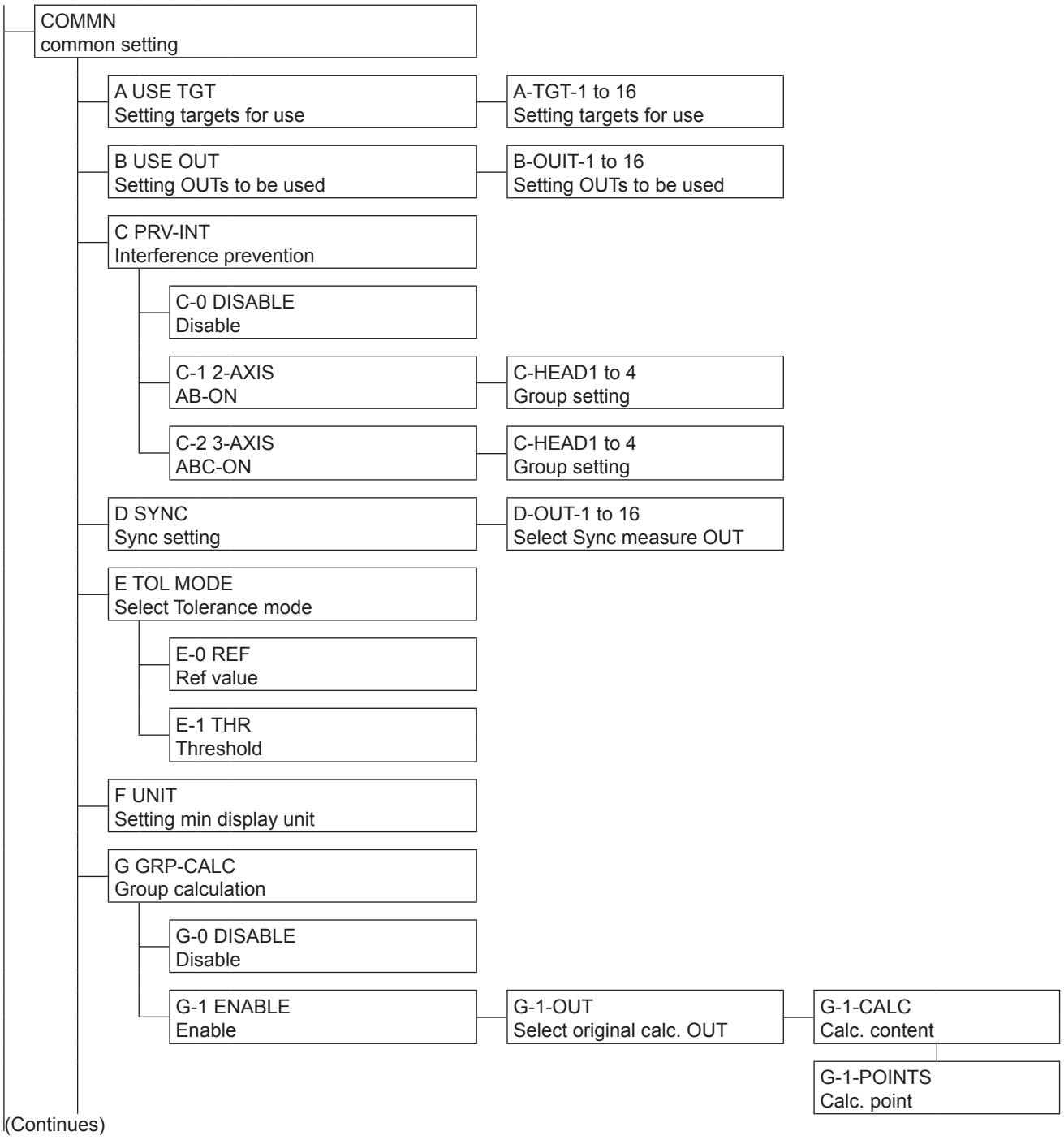
(Continues)

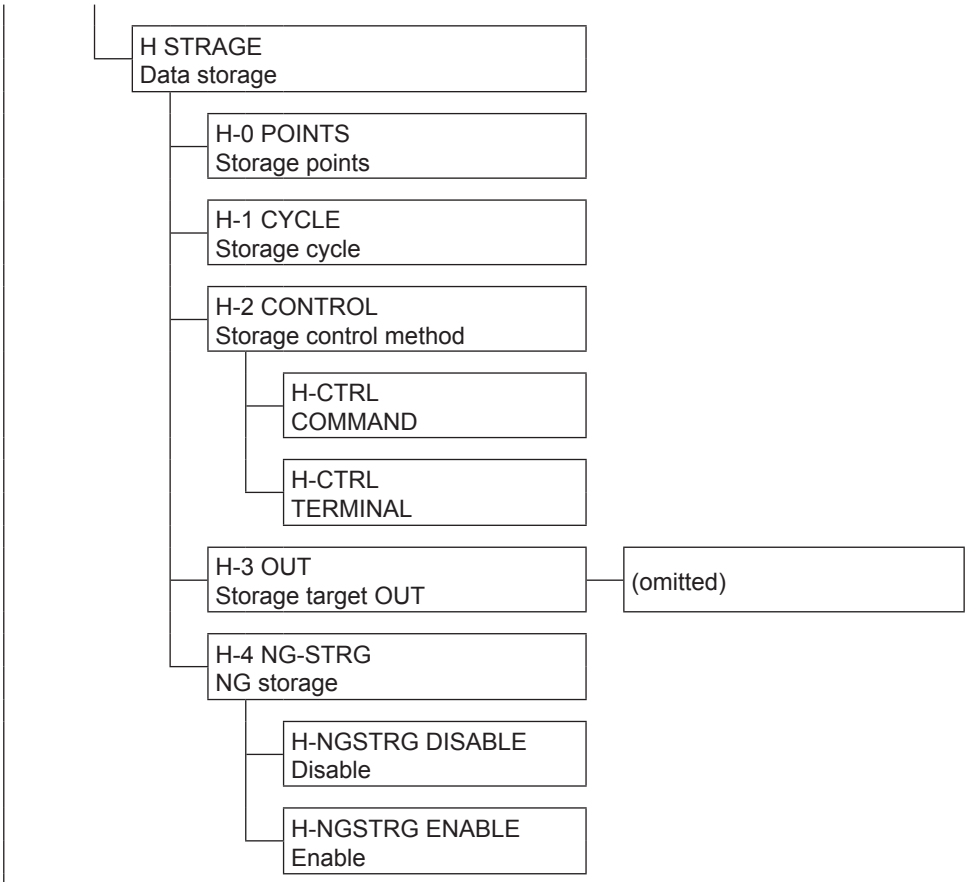

OUT
Select OUT
OUT
OUT target setting
(according to the settings of the used OUT)
A TGT-CALC
Calculation setting
A-0 NO CALC
No calculation
A-1 COMBO
Combined calc.
A-1-F0 to 7
Select calculation target and Coefficient
(omitted)
A-2 AVERAGE
Average
A-2-A1 to A16
Select calculation target
(omitted)
B OUTLIER
Outlier exclusion function
B-0 DISABLE
Disable
B-1 ENABLE
Enable
B-1-0 WAIT
Exclusion method Output waiting
(omitted)
B-1-1 HOLD
Exclusion method Prev val hold
(omitted)
C FILTER
filter
C-0 MOV-AVE
Moving average
C-NUM
Averaging times setting
C-1 SMPL-AVE
Simple average
C-NUM
Averaging times setting
D DIF-FUNC
Difference function
D-0 DISABLE
Disable
D-1 ENABLE
Enable
E A-CANCEL
Abnormal value cancellation
E-0 DISABLE
Disable

(Continues)

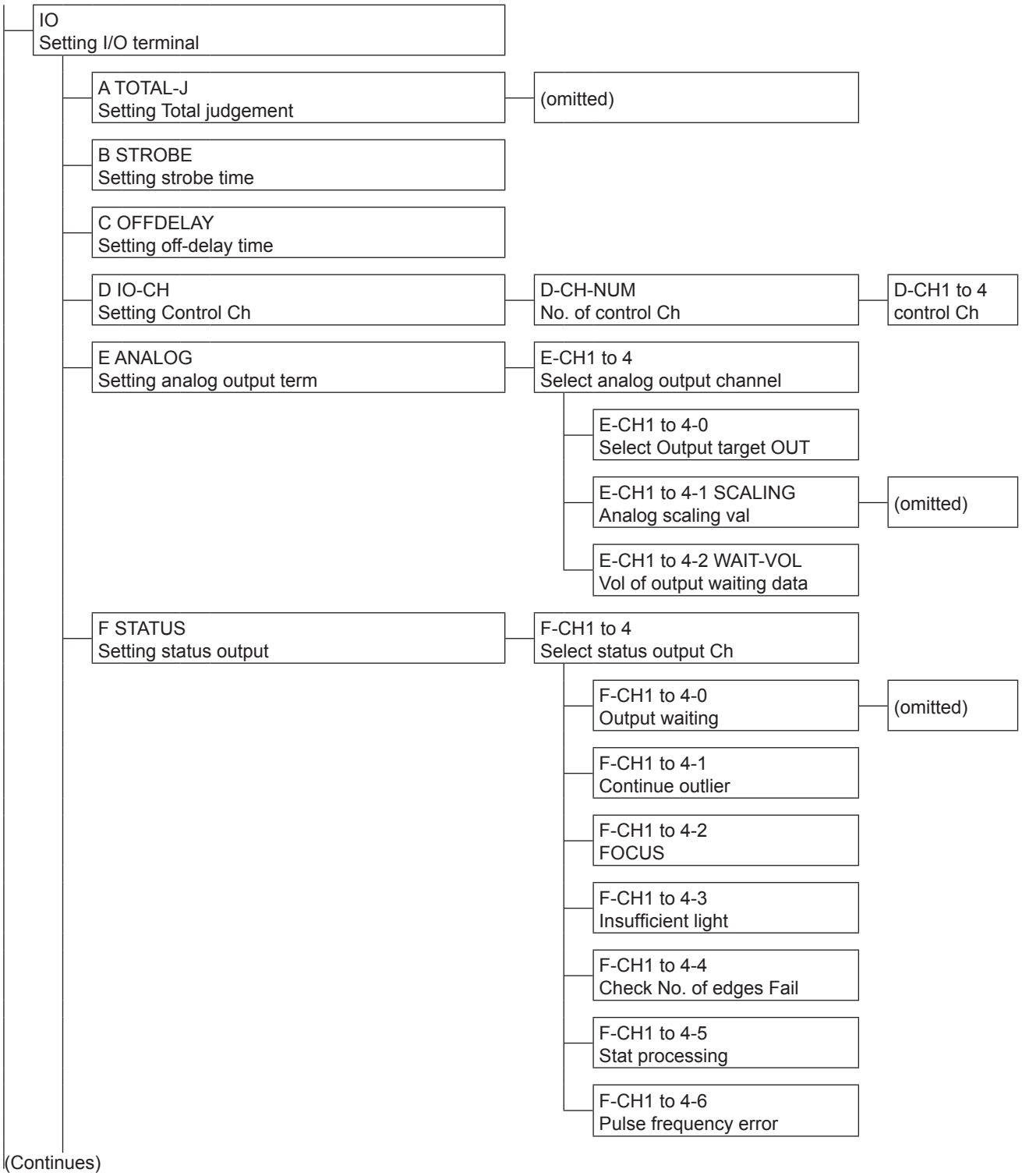

E-1 ENABLE
Enable
E-1-A to B
Pts before cancellation and Pts after cancellation
E-UPPER
Upper limit value
E-LOWER
Lower limit value
F OFFSET
offset
OFFSET
Offset value setting
G M-MODE
Measure mode
G-0 NORMAL
normal
G-1 P-HOLD
peak hold
G-HOLD
Selecting hold mode
G-2 B-HOLD
Bottom hold
G-HOLD
Selecting hold mode
G-3 PP-HOLD
peak to peak hold
G-HOLD
Selecting hold mode
G-4 AVE-HOLD
Average hold
G-HOLD
Selecting hold mode
G-5 S-HOLD
sample hold
G-HOLD
Selecting hold mode
G-6 AP-HOLD
Auto peak hold
G-7 AB-HOLD
Auto bottom hold
G-8 APP-HOLD
Auto Peak-to-peak hold
G-9 ST-HOLD
Self-timing hold
G-STIME
Self-timing hold period setting
H TOL
Tolerance setting
(according to the tolerance mode selected)
H-STD
Ref value
H-UPPER
High limit value
H-LOWER
Lower limit value
H-HH
Highest limit
H-H
High limit value
H-L
Lower limit value
H-LL
Lowest limit

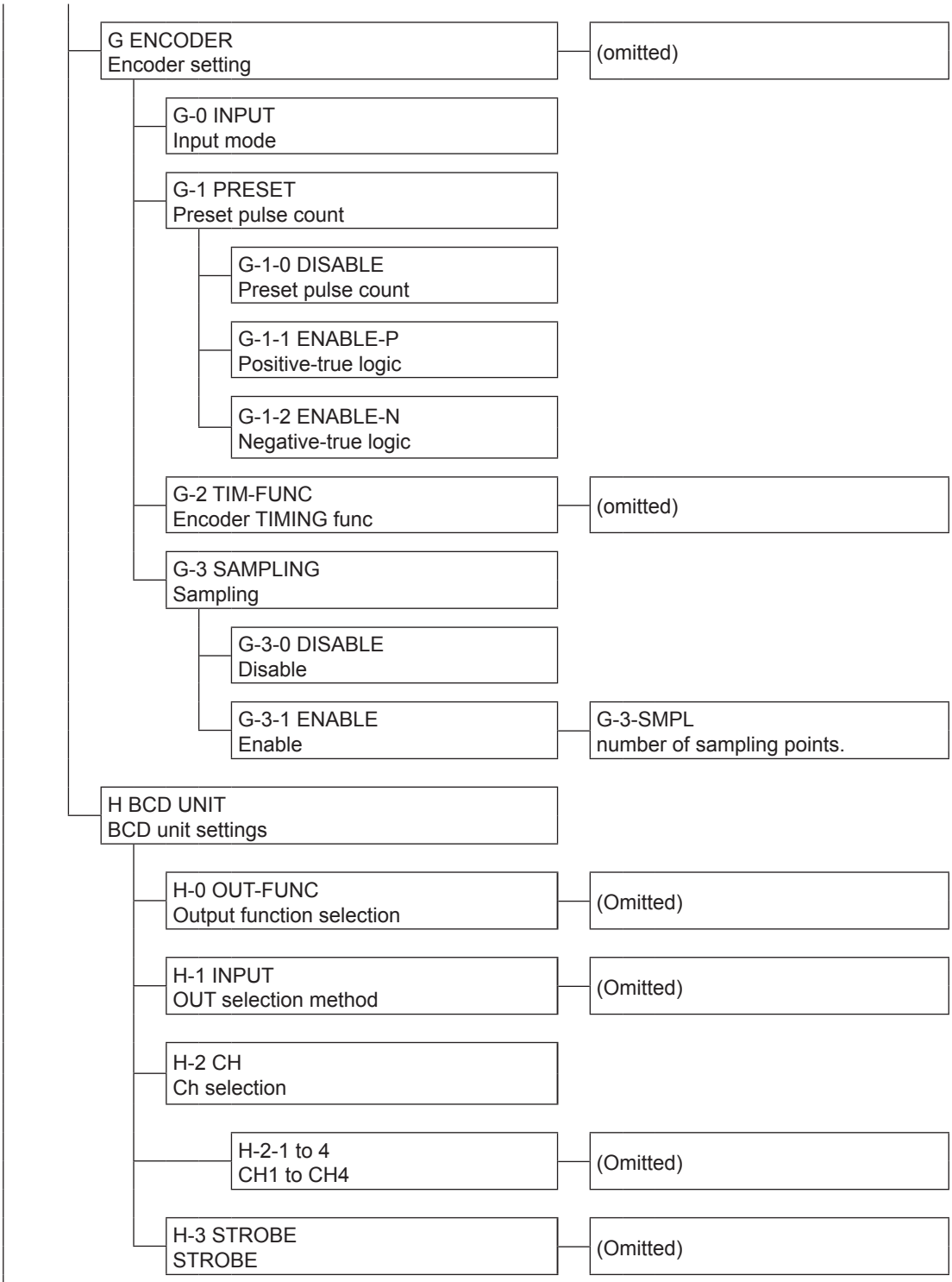
(Continues)


COMMN
common setting
A USE TGT
Setting targets for use
A-TGT-1 to 16
Setting targets for use
B USE OUT
Setting OUTs to be used
B-OUIT-1 to 16
Setting OUTs to be used
C PRV-INT
Interference prevention
C-0 DISABLE
Disable
C-1 2-AXIS
AB-ON
C-HEAD1 to 4
Group setting
C-2 3-AXIS
ABC-ON
C-HEAD1 to 4
Group setting
D SYNC
Sync setting
D-OUT-1 to 16
Select Sync measure OUT
E TOL MODE
Select Tolerance mode
E-0 REF
Ref value
E-1 THR
Threshold
F UNIT
Setting min display unit
G GRP-CALC
Group calculation
G-0 DISABLE
Disable
G-1 ENABLE
Enable
G-1-OUT
Select original calc. OUT
G-1-CALC
Calc. content
G-1-POINTS
Calc. point
(Continues)

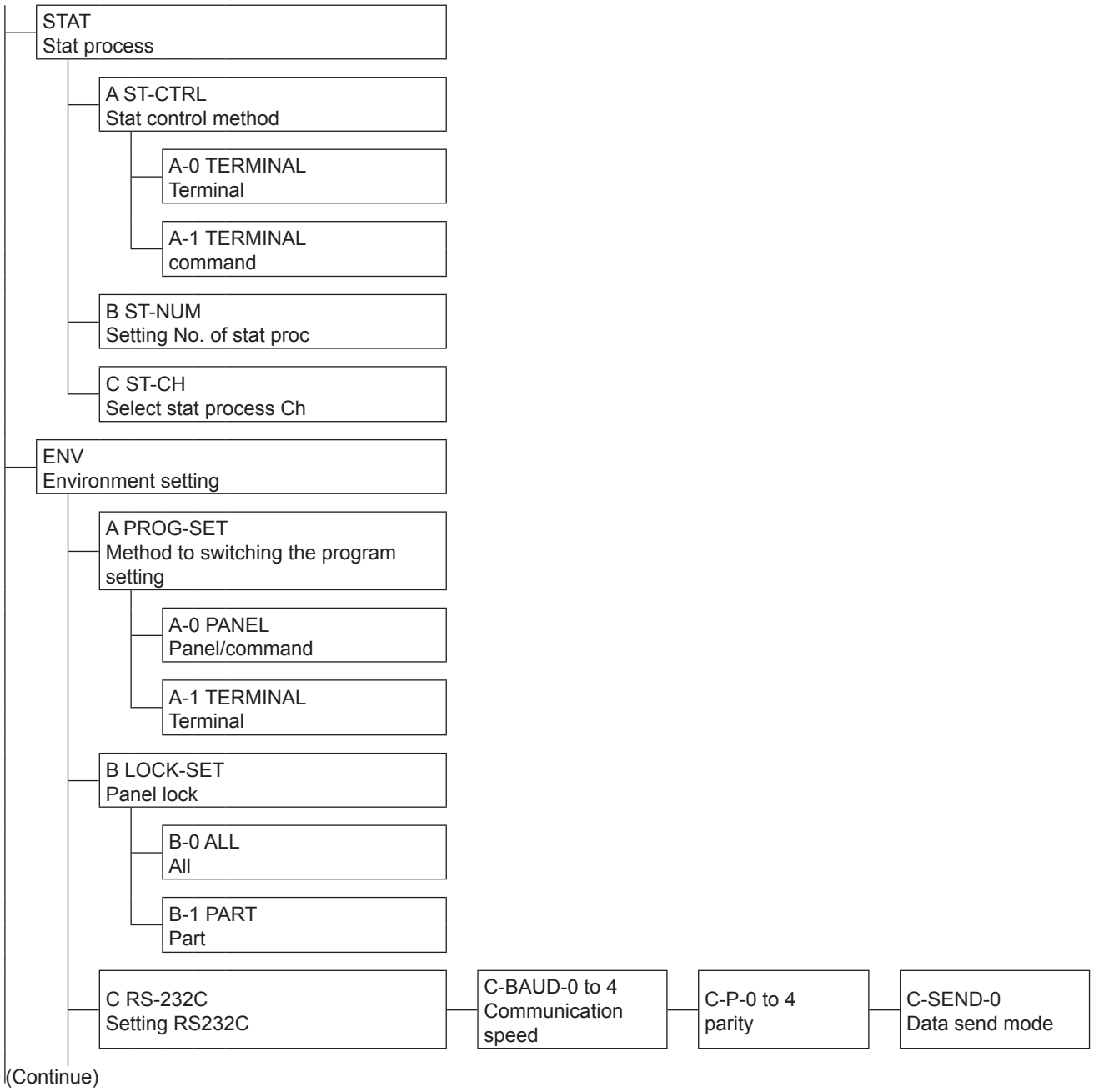

H STRAGE
Data storage
H-0 POINTS
Storage points
H-1 CYCLE
Storage cycle
H-2 CONTROL
Storage control method
H-CTRL
COMMAND
H-CTRL
TERMINAL
H-3 OUT
Storage target OUT
(omitted)
H-4 NG-STRG
NG storage
H-NGSTRG DISABLE
Disable
H-NGSTRG ENABLE
Enable

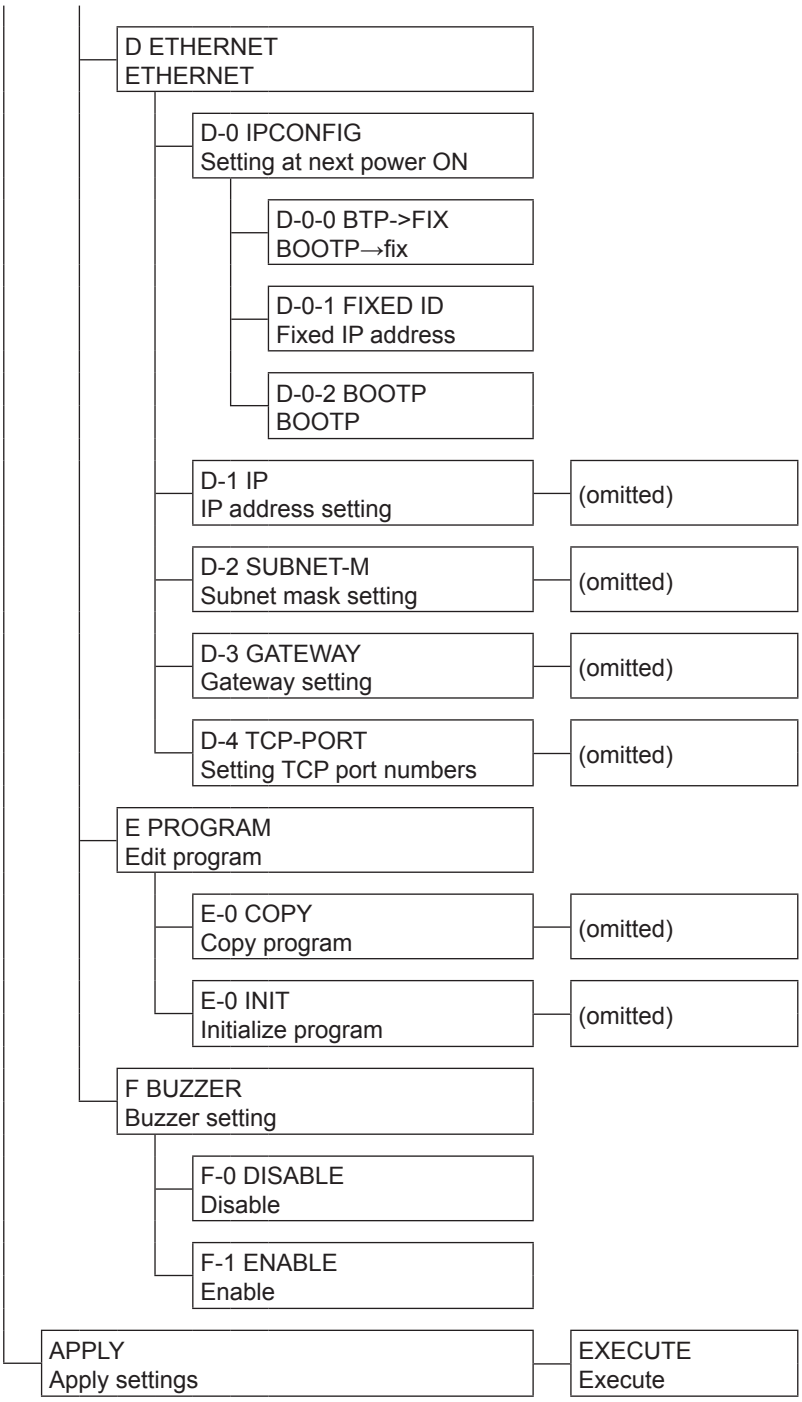
(Continues)


IO
Setting I/O terminal
A TOTAL-J
Setting Total judgement
(omitted)
B STROBE
Setting strobe time
C OFFDELAY
Setting off-delay time
D IO-CH
Setting Control Ch
D-CH-NUM
No. of control Ch
D-CH1 to 4
control Ch
E ANALOG
Setting analog output term
E-CH1 to 4
Select analog output channel
E-CH1 to 4-0
Select Output target OUT
E-CH1 to 4-1 SCALING
Analog scaling val
(omitted)
E-CH1 to 4-2 WAIT-VOL
Vol of output waiting data
F STATUS
Setting status output
F-CH1 to 4
Select status output Ch
F-CH1 to 4-0
Output waiting
(omitted)
F-CH1 to 4-1
Continue outlier
F-CH1 to 4-2
FOCUS
F-CH1 to 4-3
Insufficient light
F-CH1 to 4-4
Check No. of edges Fail
F-CH1 to 4-5
Stat processing
F-CH1 to 4-6
Pulse frequency error
(Continues)


G ENCODER
Encoder setting
(omitted)
G-0 INPUT
Input mode
G-1 PRESET
Preset pulse count
G-1-0 DISABLE
Preset pulse count
G-1-1 ENABLE-P
Positive-true logic
G-1-2 ENABLE-N
Negative-true logic
G-2 TIM-FUNC
Encoder TIMING func
(omitted)
G-3 SAMPLING
Sampling
G-3-0 DISABLE
Disable
G-3-1 ENABLE
Enable
G-3-SMPL
number of sampling points.
H BCD UNIT
BCD unit settings
H-0 OUT-FUNC
Output function selection
(Omitted)
H-1 INPUT
OUT selection method
(Omitted)
H-2 CH
Ch selection
H-2-1 to 4
CH1 to CH4
(Omitted)
H-3 STROBE
STROBE
(Omitted)

(Continues)


STAT
Stat process
A ST-CTRL
Stat control method
A-0 TERMINAL
Terminal
A-1 TERMINAL
command
B ST-NUM
Setting No. of stat proc
C ST-CH
Select stat process Ch
ENV
Environment setting
A PROG-SET
Method to switching the program setting
A-0 PANEL
Panel/command
A-1 TERMINAL
Terminal
B LOCK-SET
Panel lock
B-0 ALL
All
B-1 PART
Part
C RS-232C
Setting RS232C
C-BAUD-0 to 4
Communication speed
C-P-0 to 4
parity
C-SEND-0
Data send mode
(Continue)


D ETHERNET
ETHERNET
D-0 IPCONFIG
Setting at next power ON
D-0-0 BTP->FIX
BOOTP→fix
D-0-1 FIXED ID
Fixed IP address
D-0-2 BOOTP
BOOTP
D-1 IP
IP address setting
(omitted)
D-2 SUBNET-M
Subnet mask setting
(omitted)
D-3 GATEWAY
Gateway setting
(omitted)
D-4 TCP-PORT
Setting TCP port numbers
(omitted)
E PROGRAM
Edit program
E-0 COPY
Copy program
(omitted)
E-0 INIT
Initialize program
(omitted)
F BUZZER
Buzzer setting
F-0 DISABLE
Disable
F-1 ENABLE
Enable
APPLY
Apply settings
EXECUTE
Execute

Troubleshooting

If a problem occurs

This section describes the troubles that may occur during the use of this device and their remedies. Make sure to check the items covered below before calling Keyence.

Trouble	Check item	Remedy
The POWER ON LED and ERROR LED do not light after switching ON the power of the controller.	Is the power cable connected properly?	Connect the power cable properly.
	Are you using a power supply that meets the specification range?	Be sure to use a power supply that meets the specification range.
The power to the controller drops suddenly.	Are instantaneous power interruptions occurring?	Use a stable power supply with no instantaneous power interruptions.
	Does the capacity of the power supply meet the specification range?	If the current capacity of the power supply is insufficient, replace it with a power supply with a greater capacity.
An error is displayed on the screen.	-	Take the necessary measures by following the instructions in the displayed error message.
The PC freezes while using LS-Navigator2.	Does the system environment of the PC meet the specification range?	Be sure to use it under a system environment that meets the specifications.
The measurement value is not displayed.	Is the target located within the measurement range?	Place the measurement target in the measurement range correctly.
	Is the entire measurement area blocked?	Do not block the point of measurement with any object other than the measurement target.
	Are the transmitter and receiver mounted in the correct position?	Mount the transmitter and receiver correctly.
	Is the measurement target setting set correctly?	Set the measurement according to the point of measurement.
	Is there any dust or dirt on the cover glass of the receiver or transmitter?	Remove the dust or dirt on the cover glass.
	Are there any scratches or cracks on the receiver or transmitter?	Replace the cover glass.
	Is timing control set correctly according to the hold mode setting?	Set the timing control according to the hold mode setting.
	Is the display setting correct?	Check the display setting.
	Is there condensation (of dew)?	Make sure to conduct the measurement under a suitable environment.
	Is the transmitter's LED lit?	The light source will need to be replaced if the wiring is correct. Contact your nearest KEYENCE office for repair.
	Is the sensor head connected properly?	Connect the cable properly.
	Is the mask setting being used?	Make sure that the measurement area is not being masked.
	Is the length of the cable between the head and controller 40 m?	Use a 40m cable extension unit if the cable between the head and controller is 40m long.

Trouble	Check item	Remedy
The measurement value display is inconsistent.	Is the averaging count set correctly?	Set the averaging count to an appropriate value.
	Is the target object located within the measurement area?	Place the measurement target object in the measurement range correctly.
	Is there any dust or dirt on the cover glass of the receiver or transmitter?	Remove the dust or dirt on the cover glass.
	Are there any scratches or cracks on the cover glass of the receiver or transmitter?	Replace the cover glass.
	Are there any dirt, dust, burrs, water droplets, or oil droplets on the measurement target?	Remove the dirt, dust, burrs, water droplets or oil droplets. Use the abnormal value exclusion function and/or the no. of edges check function.
	Are there water and/or oil droplets in the operating ambient environment?	Remove the droplets using an air purge, etc.
	Is there any mutual interference?	Use the mutual interference prevention function. Mount the sensor head in a different position.
	Is there a strong light source near?	Shield off the receiver from the ambient light.
	Are there fluctuations in the air?	Minimize the effect of the fluctuations using the following methods: • Put a cover over the sensor head. • Agitate the air between the transmitter and receiver with a fan, etc.
	Is there sufficient amount of light reaching the receiver?	Check the light volume using the light amount inspection function.
The measurement value display is incorrect.	Is there any dust or dirt on the cover glass of the receiver or transmitter?	Remove the dust or dirt on the cover glass.
	Is the measurement target object located within the measurement range?	Place the measurement target object in the measurement range correctly.
	Is the measurement target object tilted or displaced?	Place the measurement target object in the measurement range correctly. It the outer diameter measurement is being affected by a tilt, use the tilt correction function.
	Are the transmitter and receiver mounted in the correct position?	Mount the transmitter and receiver correctly.
	Has the calibration been performed correctly?	Try performing the calibration again.
	Are there rapid temperature changes in the operating ambient environment?	Keep the operating ambient temperature constant.
	Is there sufficient amount of light reaching the receiver?	Check the light volume using the light amount inspection function.
	Has the received light volume calibration been performed when the target object is in the measurement range?	Perform the received light volume calibration again when nothing is in the measurement range.
Program No. cannot be changed.	Is the program switching method set appropriately?	Enter a setting that is suitable for the program switching method.
The keys do not work.	Is the key lock ON?	Switch the key lock to OFF.

Trouble	Check item	Remedy
The judgment output is not output correctly.	Is the wiring correct?	Check the wiring using the terminal block monitor function.
	Is the tolerance judgment set correctly?	Ensure that the tolerance mode and tolerance judgment values are input correctly.
	Is the I/O terminal setting set correctly?	Enter a setting that will yield the desired output.
The analog output is not output correctly.	Is the wiring correct?	Check and connect the wiring correctly.
	Is the tolerance mode set correctly?	Select a suitable tolerance setting for the desired output method.
	Has the voltage exceeded +10.8 V or fallen below -10.8 V?	Set the analog scaling correctly according to the measurement value.
	Are you using an oscilloscope and/or a fast-speed A/D board?	The resolution may be lower for these instruments. Reduce its influence by changing the analog scaling.
RS-232C communication does not work.	Is the communication cable connected properly?	Connect the communication cable properly.
	Is the communication setting set correctly?	Configure the settings such that the communication specifications of this unit and the external instrument are the same.
	Is the communication program correct?	Verify that commands and delimiters can be sent/received correctly.
The measurement target image is not displayed.	Is the camera cable connected properly?	Check the camera cable.

Error Messages

System error message

System error messages appear when an error causing the measurement to stop has occurred.
If a message prompting you to replace the instrument appears, contact your nearest KEYENCE office.

Error code	Displayed content	Cause	Remedy
0x0020 - 0x0026	There is an abnormality in the internal memory of controller. Replace the controller and cycle power.	The internal memory of the controller may be malfunctioning.	Replace the controller and switch the power back ON. “Mounting the Controller” (page 2-15) The replaced controller requires an inspection and/or a repair. Contact your nearest KEYENCE office.
0x0027	There is an abnormality in the internal timer. Replace the controller and cycle power.	The internal timer of the controller may be malfunctioning.	Replace the controller and switch the power back ON. “Mounting the Controller” (page 2-15) The replaced controller requires an inspection and/or a repair. Contact your nearest KEYENCE office.
0x0028	There is an abnormality in RS-232C communication device of controller. Replace the controller and cycle power.	The RS-232C communication device of the controller may be malfunctioning.	Replace the controller and switch the power back ON. “Mounting the Controller” (page 2-15) The replaced controller requires an inspection and/or a repair. Contact your nearest KEYENCE office.
0x0029	There is an abnormality in USB communication device of controller. Replace the controller and cycle power.	The USB communication device of the controller may be malfunctioning.	Replace the controller and switch the power back ON. “Mounting the Controller” (page 2-15) The replaced controller requires an inspection and/or a repair. Contact your nearest KEYENCE office.
0x002A	There is an abnormality in Ethernet communication device of controller. Replace the controller and cycle power.	The Ethernet communication device of the controller may be malfunctioning.	Replace the controller and switch the power back ON. “Mounting the Controller” (page 2-15) The replaced controller requires an inspection and/or a repair. Contact your nearest KEYENCE office.
0x002B	There is an abnormality in the internal device of controller. Replace the controller and cycle power.	The internal device of the controller may be malfunctioning.	Replace the controller and switch the power back ON. “Mounting the Controller” (page 2-15) The replaced controller requires an inspection and/or a repair. Contact your nearest KEYENCE office.

Error code	Displayed content	Cause	Remedy
0xA180 - 0xA181	Failed in communicating with head expansion unit. Confirm the connection and turn on the power again. If the abnormality persists, change the head expansion unit and then switch the power back ON.	The connector in between the head expansion unit controller connection is faulty, or the internal components of the head expansion unit may be broken down.	Confirm the connection in between the head expansion unit controller and turn on the power again. If the abnormality persists, change the head expansion unit and turn on the power again. “Connecting the controller and the expansion unit” (page 2-24) The replaced head expansion unit requires inspection and/or repair. Contact your nearest KEYENCE office.
0x0040 - 0x0045 0x0060 - 0x0061	There is an abnormality in the internal data of controller. Replace the controller and cycle power.	There may be a data abnormality due to noise, or a component inside the controller may be malfunctioning.	Replace the controller and switch the power back ON. “Mounting the Controller” (page 2-15) The replaced controller requires an inspection and/or a repair. Contact your nearest KEYENCE office.
0x0046 - 0x0047	There is an abnormality in the setting data of controller.	There may be settings data abnormality due to a power-off while writing settings data, noise and/or the battery life of the back-up battery.	Return the controller to default settings and turn on the power again. If the abnormality persists, change the controller and turn on the power again. “All Setting Initialization Screen” (page 3-14) The replaced controller requires inspection and/or repair. Contact your nearest KEYENCE office.
0x0**K**20 - 0x0**K**22	There is an abnormality in the internal memory of head **K**. Replace the head **K** and cycle power.	The internal memory of Head **K** may be malfunctioning.	Replace the head and switch the power back ON. “Mounting the Head” (page 2-2) The replaced head requires an inspection and/or a repair. Contact your nearest KEYENCE office.
0x0**K**23 - 0x0**K**24	There is an abnormality in the internal device of head **K**. Replace the head **K** and cycle power.	The internal device of Head **K** may be malfunctioning.	Replace the head and switch the power back ON. “Mounting the Head” (page 2-2) The replaced head requires an inspection and/or a repair. Contact your nearest KEYENCE office.
0x0**K**40 - 0x0**K**42 0x0**K**60	There is an abnormality in the internal memory of head **K**. Replace the head **K** and cycle power.	There may be a data abnormality due to electrical noise, or a component inside Head **K** may be malfunctioning.	Replace the head and switch the power back ON. “Mounting the Head” (page 2-2) The replaced head requires an inspection and/or a repair. Contact your nearest KEYENCE office.
0x0**K**80	Failed in initializing the head **K**. Confirm the connection or replace the cables, and cycle power. If the abnormality persists after replacing the cable, replace Head **K** and then switch the power back ON.	The head cable may be disconnected or a component inside Head **K** may be malfunctioning.	Check the connection between the head and the controller, replace the cable, and then switch the power back ON. If the error persists after replacing the cable, replace Head K and then switch the power back ON. “Connecting the head and the controller” (page 2-22) “Mounting the Head” (page 2-2) The replaced head requires an inspection and/or a repair. Contact your nearest KEYENCE office.

Error code	Displayed content	Cause	Remedy
0x0**K**81 - 0x0**K**82	Failed in communicating with head **K**. Confirm the connection or replace the cables, and cycle power. If the abnormality persists after replacing the cable, replace Head **K** and then switch the power back ON.	The head cable may be disconnected or a component inside Head **K** may be malfunctioning.	Check the connection between the head and the controller, replace the cable, and then switch the power back ON. If the error persists after replacing the cable, replace Head **K** and then switch the power back ON. “Connecting the head and the controller” (page 2-22) “Mounting the Head” (page 2-2) The replaced head requires an inspection and/or a repair. Contact your nearest KEYENCE office.
0x0**K**83	Temporary blackout of head **K** was detected. The system will be rebooted.	Electrical noise may have entered Head **K**.	Take the necessary measures to prevent noise from entering the head, and then switch the power back ON.
0x8180	Failed in communicating with the expansion unit. Confirm the connection, and cycle power. If the abnormality persists, replace the expansion unit and switch the power back ON.	The cable connection between the connector connecting the expansion unit and the controller may be broken, or a component inside the expansion unit may be malfunctioning.	Check the connection between the expansion unit and the controller, and then switch the power back ON. If the abnormality persists, replace the expansion unit and switch the power back ON. The replaced expansion unit requires an inspection and/or a repair. Contact your nearest KEYENCE office.

K: Head number is recorded.
Example: In case of 0x0K20, if an error occurs at No. 3, 0x0320 is displayed.

- When a system error occurs, the error output (Normal close) will become ON.
- If an error message other than the above appears, contact your nearest KEYENCE office.

Error messages in the RS-232C/display panel

Error messages only appear on the display monitor. They do not appear on the LS-Navigator2 screen.
The controller will continue to function normally as these are not system errors of the controller.
In the table below, the interfaces in which each of the error codes appear are marked with "○".

Error code	Displayed content	Cause	RS-232C	Display Panel	Remedies provided in the display panel
0000	Command error	This error will be displayed when a command not included in the command list is being transmitted via RS-232C communication.	○	-	Use a command defined in the command list.
0001	Status error	This error will be displayed when the operation performed on the display panel or the command sent via RS-232C cannot be processed. The following status are possible: • The settings were reflected while the controller was calibrating the light volume. • The settings were reflected while the controller was in system error status. • An operation related to the light volume calibration was performed on the display panel, but the controller has already exited the light volume calibration status (via operation on another display panel or PC application).	○	○	Retry the communication making sure that the controller is able to accept commands.
0020	Command length error	This error is displayed when the no. of characters of the transmitted command or parameter is insufficient.	○	-	Retry the communication using the no. of characters specified in the command format.
0021	Parameter error	This error is displayed when the setting value sent via the display panel or RS-232C is outside the possible setting range.	○	○	Retry the communication using the settings value specified in the command format.
0022	Parameter error (OUT number)	This error is displayed when an unused OUT number has been specified.	○	○	Specify an OUT number that has already been set to the controller.
0023	Parameter error (Measurement target number)	This error is displayed when an unused measurement target number has been specified.	○	○	Specify a measurement target number that has already been set to the controller.
0040	Head not connected error	This error is displayed when a light volume calibration is attempted on a non-connected head.	○	○	Specify a head that is connected to the controller.
0041	Head mismatch error	This error is displayed when a light volume calibration is attempted on a head while a light volume calibration on another head is still in progress.	○	○	Perform the light volume calibration on one head at a time.

Error code	Displayed content	Cause	RS-232C	Display Panel	Remedies provided in the display panel
0070	Consistency error in dispaly units	This error is displayed when the setting value sent from the display panel does not match the display unit setting of the controller.	-	○	Do not modify the settings via RS-232C while the settings are being changed on the display panel.
0071	Consistency error in setting (Scaling)	This error is displayed when the scaling setting does not satisfy the following condition: When calibrating using two or more k points • Input value [k] - Input value [k-1]>0 • $\left\| \frac{\text{(Displayed value [k] - Displayed value [k-1])}}{\text{(Input value [k] - Input value [k-1])}} \right| \leq 2$	○	○	Enter a setting which satisfies the condition described on the left.
0072	Consistency error in setting (Calibration)	This error is displayed when the calibration setting does not satisfy the following condition: When calibrating using two or more k points • Input value [k] - Input value [k-1]>0 • $\left\| \frac{\text{(Displayed value [k] - Displayed value [k-1])}}{\text{(Input value [k] - Input value [k-1])}} \right| \leq 2$	○	○	Enter a setting which satisfies the condition described on the left.
0073	Consistency error in setting (Tolerance setting)	This error is displayed when the tolerance setting does not satisfy the following condition: Tolerance mode: Threshold value • When Threshold value HH > Threshold value HI > Threshold value LI > Threshold value LL is not satisfied • Tolerance mode: Reference value • When [Reference + Upper limit value] and [Reference + Lower limit value] exceed the input range for each minimum display unit • When [Reference + Upper limit value] > [Reference + Lower limit value] is not satisfied	○	○	Enter a setting which satisfies the condition described on the left.
0074	Consistency error in setting (Analog scaling)	This error is displayed when the analog scaling setting does not satisfy the following condition: | (Measurement value at +10 V) - (Measurement value at -10 V) | ≥ 2000 x (Minimum display unit)	○	○	Enter a setting which satisfies the condition described on the left.
0088	Timeout error	This error is displayed when if no data is exchanged for 10 seconds or longer between when characters were sent to the controller until the next characters are sent.	○	-	Verify that a reply command has been returned to the input command.
0099	Another error	Another error	○	○	All errors other than the above

• Error messages briefly describe the error contents and countermeasures.
• If an error message other than the above appears, contact your nearest KEYENCE office.

Index

Numerics

2D Position Display 6-30
[2D position display] screen..... 6-2, 6-30
2D Position Display Setting Screen..... 3-11
24 V DC power supply..... 1-6
24V power input terminal block 8-16
40m connecting unit for cable extension ... 1-4, 11-13, 11-34

A

ABC-ON..... 5-73
[A-B deviation] 6-23
Abnormal value canceling function setting 5-48
AB-ON 5-73
[Acq date] 6-23, 6-37
Acquiring received light waveforms 5-67
Adding more measurement targets 5-27
Add OUT..... 5-35
Add OUT setting 5-41
Air purge unit 1-7
All Setting Initialization Screen 3-14
Analog output 5-97
[Analog output] area 5-91
Analog output terminal block 8-15
[Analog output terminal setting] window 5-91
Analog scaling value..... 5-98
Appendix..... A-1
ASCII code table..... 9-7
Attaching the Protective Sheet 2-14
Auto peak hold/Auto bottom hold/Auto peak to Peak hold..... 10-3
Auto zero ON/OFF (Multiple)..... 9-11
Auto zero ON/OFF (Single) 9-10
Auto zero ON/OFF (Synchronization)..... 9-11
[Average] 6-33
Average 6-35
Average setting..... 5-45
[Avg A-B]..... 6-23
[Avg value]..... 6-29

B

Basic Operation Flow 3-2
Basic Operation of Setting..... 3-3
Basic Operations 3-1
Basic Operations of LS-Navigator2 .....3-15, 5-18, 5-27, 5-41, 5-55, 5-60, 5-67, 5-73, 5-76, 5-80, 5-86, 5-100
Basic Operations of the Display Panel 3-3
Basic settings 5-3
[Basic settings] Tab: OUT Setting..... 5-32
[Basic settings] Tab: Set Measurement Target 5-21
Basic specifications/Connector specifications 8-2, 8-3
BCD strobe time 5-99
BCD unit 1-15, 5-99, 5-100, 5-107, 10-22, 11-7, 11-31
BCD unit Expansion connector..... 8-21
BCD unit Input terminal block 1 8-18
BCD unit Input terminal block 2 8-19
[BCD unit] area 5-92
[BCD Unit] tab..... 6-45
Buzzer Setting Screen..... 3-14

C

Cable 11-11
Cable between the controller and head CB-B3/CB-B10 11-33
Cable between the transmitter and receiver OP-87686 (1 m cable)/OP-87687 (3 m cable)..... 11-33
Calc. content..... 5-86
Calc. point..... 5-86
Calculation method..... 5-36
Calculation setting 5-44
Calibration and Scaling..... 5-6
Calibration of received light intensity..... 5-67
[Calibration of received light intensity] dialog 5-63
Calibration pts..... 5-54
Calibration/Scaling..... 9-23, 9-35
[Calibration, Scaling] Tab: Calibration Setting 5-52
[Calibration, Scaling] Tab: Scaling Setting..... 5-57
Calibration setting..... 5-54
[Calibration setting] area..... 5-53
[Calibration setting] dialog 5-54
Canceling the registration of calibration setting..... 5-55
Canceling the registration of scaling setting..... 5-60
CB-BD100 ..... 1-4, 8-31, 11-31
CB-BR01 11-34
CB-EP100..... 1-4
CB-PN100 1-4
Center position 5-25
Changing the OUT display color..... 7-18
Changing the program name..... 5-18
Characteristics..... 11-14
Checking settings before update 5-115
Checking the Measurement Results..... 6-1
Checking the Package..... 1-2
Check No. of edges 5-65
Check No. of edges: Fail 5-98
Combined calculation setting..... 5-45
Combined limitation for analog scaling (Ref. val mode) and minimum display unit 5-15

Command format....8-6, 9-2
Command types....8-6
Common for LS-9501/LS-9501P/LS-HA100....8-31
Common indicator....6-3
Common setting....5-7
Common settings....9-24, 9-35
[Common setting] Tab: Data Storage....5-77
[Common setting] Tab: Edge Detection....5-62
[Common setting] Tab: Group Calculation....5-84
[Common setting] Tab: Interference Prevention....5-72
[Common setting] Tab: I/O Terminal Setting....5-89
[Common setting] Tab: Stat Process....5-109
[Common setting] Tab: Sync Setting....5-75
[Common] tab....7-7
Common to LS-9006D/LS-9030D....2-20
Communicate via Ethernet....7-2
Communicate via USB....7-2
Communication Interface and I/O Terminals....8-1
Communication specifications....8-4
Communication speed....7-15
Connecting the controller and the display panel....2-24
Connecting the controller and the expansion unit....2-24
Connecting the controller and the PC....2-25
Connecting the head and the controller....2-22
Connecting the power supply to the controller....2-26
Connecting the transmitter and the receiver of the head....2-22
Connecting using the Ethernet....2-25
Connecting using USB....2-25
Connecting Various Components....2-21
Connection with the PLC link unit or PC....8-5
Connector specifications....8-4
Controller....1-2, 1-9, 11-2, 11-23
[Controller] tab....6-44
Copying list of settings....5-115
Copying the program setting....5-19
Copy OUT setting....5-42
[Copy SPC information] button....6-36
[Cp]....6-37
[CpK]....6-37
[Cursor A]....6-22
[Cursor A-B]....6-23
[Cursor B]....6-22
Cursors A and B....6-22

D

[Data acq interval]....6-36
Data acq interval....6-39
Data display area....6-22, 6-29, 6-36
[Data search] dialog....6-26
Data send mode....7-15
Data storage....5-7, 5-79, 9-31, 9-36
Data Storage....6-20
[Data storage] area....5-78
Data storage (Sampling frequency synchronization)....10-19
[Data storage] screen....6-2, 6-20
Data storage (TIMING synchronization/Storage trigger synchronization)....10-20
Daylight savings time setting....7-10
Dedicated display panel cable....11-11
Delay....5-26
Delete OUT....5-35
Delete OUT setting....5-42
Deleting any measurement target....5-27
Description of Each Screen....3-6
Detailed display (large-size)....6-6
Detailed display (small-size)....6-6
[Deviation]....6-33, 6-37
Difference function setting....5-47
Different Initial Value for Setting Calibration and Scaling Points....5-14
Dimensions....11-23
Displaying Objective Screen....3-19
Displaying the start-up menu....7-19
Display Measurement Value....6-4
[Display measurement value] screen....6-2, 6-4
Display mode....6-6
Display OUT Selection Screen....3-9
Display panel....1-10, 11-10
Display panel cable....1-5
Display panel setting method....7-8, 7-12, 7-17
Display Panel Setting Method....5-28, 5-43, 5-56, 5-61, 5-68, 5-73, 5-76, 5-80, 5-87
Display panel stand....1-5, 11-13
Display panel support....1-5, 11-13, 11-37
Display Setting Screen....3-8
Display Stat Process....6-32
[Display stat process] screen....6-2, 6-32
Display Terminal Status....6-44
[Display terminal status] screen....6-2, 6-44

E

Easy Setting Guide....4-1
Edge detection....5-7, 5-64
[Edge detection] area....5-62
Edge detection setup....5-68
Edge detection threshold....5-64
Edge (pitch) number setting....5-24

Edge Position Measurement 4-9
Edge Position Measurement (Transparent Body) 4-10
Editing the measurement target 5-27
Edit OUT list 5-35
[Edit OUT list] dialog 5-33
Edit OUT setting 5-42
[Edit program list] dialog 5-18
Encoder input 8-35, 10-15
Encoder set 5-93
[Encoder set] area 5-90
Encoder signal input terminal block 8-11
Encoder TIM func 5-95
Encoder TIM func setting 5-102
Encoder TIMING input (Pulse frequency error) 10-17
Entering numeric values 3-3
Environment setting 7-1
Error Messages A-18
Error messages in the RS-232C/display panel A-21
Ethernet cable 1-6
Ethernet Interface 8-2
EtherNet/IP communication unit 1-16, 11-8, 11-32
[Ethernet] tab 7-11
Event logging 6-43
Event Logging 6-42
[Event logging] screen 6-2, 6-42
Examples of setting numeric value formats 9-4
[Excel transfer] (Click logging/Trigger logging) 6-10
[Excel transfer] dialog box (Trigger logging) 6-10
[Excel transfer] dialog (Click logging) 6-10
[Excel transfer - Logging settings] dialog 6-8
[Excel transfer settings] dialog 6-24
Expansion unit 1-4
Extension cable between the transmitter and receiver 1-5, 11-11

F

Fail storage 5-79
Filter 5-38
Filter setting 5-47
[Final pulse count] 6-36
Flow of Measurement 4-2
Flow of the Program Setting 5-2
FOCUS 5-98
FOCUS monitor 5-66
For LS-9006D 2-11
For LS-9006/LS-9006M 2-10, 2-12
For LS-9030D 2-11
For LS-9030/LS-9030M 2-10, 2-12
For LS-9120M 2-13
From Main Screen 3-18
From [Program setting] Screen 3-19
From Startup Menu 3-18
Function Restriction of Each Head Model 5-16

G

GO 6-33
Graph display area 6-17, 6-22, 6-35
Group calculation 5-8, 5-86, 10-21
[Group calculation] area 5-85
Group Determination 4-12
Group interval 6-39
[Group No.] 6-37
Group points 6-39

H

Hard disk free space 1-18
Head 1-2, 1-11, 11-4
Head cable 1-4
Head cable/Extension cable 11-11
Head common status 6-3
Head expansion unit 1-3, 1-14, 8-17, 11-7, 11-30
Head extension cable 11-33
Head extension cable CB-B5E/CB-B10E/CB-B20E 11-33
Head indicator 6-3
Head information 6-3
Head Information 6-3
[Head information] screen 6-2
Head setting 9-15, 9-34
Head status 6-3
Help 7-22
Help file 1-18
[HH] 6-33
[HI] 6-33
HMI Display panel 1-3, 11-29
Horizontal axis 6-22, 6-35
How to attach the protective sheet 2-14
How to Use Help 3-20
How to use the air purge unit 2-5
How to use the terminal block 2-26

I

If a light source is present near the head 2-2
If a problem occurs A-15
If you wish to create new program settings 5-2
If you wish to edit existing program settings 5-2
In case of storage cycle “TIMING sync” or “Storage trg sync” 5-77

In case of storage cycle “x1” 5-77
Initializing the controller setting 7-6
Initializing the program setting 5-19, 5-20
Initializing the screen layout 7-19
Inner Diameter / Gap Measurement 4-7
Input mode 5-93
Input mode setting 5-101
Input terminal block 1 8-7
Input terminal block 2 8-9
Installation and Connection 2-1
Installation cautions 2-2, 2-15
Installing LS-Navigator2 1-19
Instrument information display setting 7-5
Insufficient light 5-98
Interference prevention 5-7
[Interference prevention] area 5-72
Interference prevention function 5-73
Introduction 1-1
I/O circuit 8-27
I/O details 10-10
I/O extension cable (3m) for BCD unit 1-7
I/O setting 5-96
[I/O setting] area 5-90
I/O setting output 5-103
I/O Terminal Names and Functions 8-7
I/O terminal setting 5-8, 5-93, 5-101, 9-27, 9-36
[I/O terminal setting] area 5-89
IP address/Subnet mask/Gateway 7-11
Items in which any setting is updated 5-115

J

Judgment result of the cursor A position 6-22
Judgment result of the cursor B position 6-22

K

Key Lock Check Screen/Password Entry Screen 3-13

L

Language setting 7-21
[Last acq date] 6-36
Light Intensity Inspection Screen 3-9
Limitation for combined analog scaling (Ref. val mode) and minimum display unit 5-15
List of command parameters 9-37
List of Initial Values and Setting Ranges 5-3
[LL] 6-33
[LO] 6-33
Loading the device settings file 7-6
LS-9006D 1-3, 1-13, 2-8, 11-16, 11-27
LS-9006D/LS-9030D 11-6
LS-9006/LS-9006M 1-2, 1-11, 2-5, 11-14, 11-24
LS-9006/LS-9006M/LS-9006D 11-18
LS-9006M/LS-9006/LS-9030M/LS-9030/LS-9120M 11-4
LS-9030D 1-3, 1-13, 2-9, 11-17, 11-28
LS-9030/LS-9030M 1-2, 1-11, 2-6, 11-14, 11-25
LS-9030/LS-9030M/LS-9030D 11-18
LS-9120M 1-2, 1-12, 2-7, 11-15, 11-18, 11-26
LS-9501/LS-9501P 1-2
LS-9501 (NPN type) 8-27
LS-9501P (PNP) type 8-29
LS-D1000 ..... 1-3, 11-29
LS-H2 (LS-Navigator2) operating system environment 11-12
LS-HA100 ..... 1-3, 11-30
LS-Navigator2 Saved File List A-3
LS-Navigator2 setting method 7-5, 7-7, 7-10, 7-11, 7-16, 7-18, 7-19, 7-20

M

Manual 7-22
Mask setting 5-65
[Max A-B] 6-23
[Maximum value] 6-33
[Max-Min] 6-33
Max. plot pts 6-39
[Max value] 6-29
Measurement Conditions and Measurement Data Flow A-2
Measurement control command list 9-8
Measurement mode 5-37
Measurement mode setting 5-49
Measurement overview 10-2
Measurement range and accuracy 11-14
Measurement screen outline 6-2
Measurement Screen Outline and Switching Screens 6-2
Measurement value format examples 9-4
Measurement value formats 9-4
Measurement value output (ALL) 9-9
Measurement value output (Multiple) 9-9
Measurement value output (Single) 9-8
[Measure mode] window 5-33
Median filter 5-26
Method for Setting up the Environment Settings 7-8
[Min A-B] 6-23
Minimum display unit 5-34, 5-45
[Minimum value] 6-33
[Min value] 6-29

Modifying the OUT setting name in the edit list operation....5-42
Mounting LS-9006D/LS-9030D....2-4
Mounting method....2-3
Mounting the Controller....2-15
Mounting the controller to the DIN rail....2-16
Mounting the Head....2-2
Mounting the Panel....2-17
Mounting to the bottom panel....2-16
Mounting without the TR base....2-3
Mounting with the TR base....2-3
Multi-OUT Display....3-6

N

No calculation setting....5-44
No. of control Ch....5-96, 5-104
[No. of groups]....6-36
No. of stat proc....5-110
Normal....10-2
Normal mode, Auto peak hold/Auto bottom hold/ Auto peak to Peak hold....10-10
Normal mode, Auto peak hold/Auto bottom hold/ Auto peak to Peak hold (Hold 1 to Hold 3)....10-11

O

Off-delay time....5-96, 5-103
Offset....5-36
Offset setting....5-49
OP-87609 (For LS-9030)....11-34
OP-87610....11-36
OP-87684 (For LS-9006)....11-35
OP-87749 (For LS-9030D)....11-35
OP-87750 (For LS-9006D)....11-36
OP-87757....11-37
Operation Setting Screen....3-7
Optional setting....5-26
Optional settings....7-18
Option list....1-5
Original calc. OUT....5-86
Other commands....9-37
Other options....11-13
[OUT display setting] dialog....6-6
Outer diameter....5-22
Outer Diameter Measurement (1 head)....4-4
Outer Diameter Measurement (2 Axes)....4-5
Outer Diameter / Runout Measurement....4-8
Outer Diameter / Width Measurement (Large Diameter Measurement by Using 2 Heads)....4-6
Outlier continue....5-98
Outlier exclusion enable setting....5-46
Outlier exclusion function....5-46
[OUT name]....6-22, 6-29
OUT name....5-35
Out of spec....6-35
OUT option setting....5-40
[OUT option setting] window....5-34
Output connector 1....8-21
Output format....9-5
Output selection function....5-99
Output terminal block 1....8-12
Output terminal block 2....8-13
Outputting measurement values and changing settings using commands....8-6
Outputting test data....6-46
Output waiting....5-98
OUT selection method....5-99
OUT setting....5-3, 5-34, 9-19, 9-34
[OUT setting] area....5-32
OUT setting method....5-43
OUT tag....6-22
OUTx....5-35
Oval Display....6-28
Oval display area....6-29
[Oval display] screen....6-2, 6-28

P

Panel lock....7-7
Panel lock setting....7-9
Panel stand....11-36
Panel switch....1-6
[Parameter]....6-33
Parity....7-15
Part Names and Functions....1-9
Password....7-7
PC communication configuration....7-2
PC software LS-H2....1-4
Peak hold/Bottom hold/Peak to Peak hold/ Average hold (Hold 1)....10-4
Peak hold/Bottom hold/Peak to Peak hold/ Average hold (Hold 2)....10-5
Peak hold/Bottom hold/Peak to Peak hold/ Average hold (Hold 3)....10-6
Performing calibration of received light intensity....5-68, 5-71
Pitch interval....5-95
Pitch Measurement....4-11
Pitch unit....5-95
Position Display Head Selection Screen....3-10
[p-p value]....6-29

Preparation for the Installation....1-18
PROFINET communication unit 1-17, 11-9, 11-32
Program Setting....5-1
[Program Setting] Screen 5-17
Program setting switching method 7-7
Program Switching Screen 3-8
Program switching setting 7-9
Protective sheet....1-7
[Pulse count]....6-23, 6-37
Pulse count preset....5-95, 5-102
Pulse frequency error 5-98

R

[R]....6-37
Radial axis....6-29
[R average]....6-37
Reading Setting File 3-18
Reading Settings from Controller 3-17
Received command format....9-2
Ref value mode 5-97
Registering the calibration setting 5-55, 5-56
Register the scaling setting 5-60, 5-61
Replacement glass unit 1-7
Replacing the Glass of the Transmitter / Receiver 2-12
Reply command format 9-2
Reply command format in the event of an error 9-3
Required system environment....1-18
Reset (Multiple) 9-11
Reset (Single)....9-11
Reset (Synchronization) 9-12
Restoring the calibration setting to its initial value....5-55
Restoring the scaling setting to its initial value....5-60
[R graph] area....6-40
RS-232C....9-1
RS-232C cable (2.5 m, straight)....1-6
RS-232C conversion adapter (9-pin, female)....1-6
RS-232C Interface....8-4
RS-232C interface commands 9-2
[RS232C] tab....7-15
R tag....6-35
[R UCL]....6-37
[R up standard]....6-37

S

Sample hold (Hold 1)....10-7, 10-12
Sample hold (Hold 2)....10-8, 10-13
Sampling....5-95
Sampling frequency....10-23
Sampling setting....5-103
Saving and Reading Setting File 3-17
Saving the device settings file 7-5
Saving the setting file 3-17
[Scaling] area....5-58
[Scaling] dialog 5-59
Scaling pts....5-59
Scaling setting 5-59
Screen transition....3-4
Selecting Items....3-3
Selecting the measuring head....5-29
Self timing hold....10-9, 10-14
Sending/Reading Settings....3-16
Sending the settings to the controller 3-16
Sensor Head....11-24
[Set comparison] window....6-26
Set from actual 5-54, 5-59
Set measure target....5-3, 5-22
[Set measure target] area....5-21
Setting a different range and initial value for the minimum display unit....5-10
Setting a mask range....5-69
Setting analog output....5-100, 5-105
Setting at next power ON 7-11
Setting check command list....9-34
Setting control command list 9-13
Setting data storage 5-80
Setting edge detection....5-67, 5-69
Setting fail storage....5-83
Setting FOCUS monitor....5-70
Setting group calculation 5-87
Setting judgment output....5-100
Setting list....5-115
[Setting list] Tab 5-114
Setting LS-Navigator2 ....5-111, 5-115
Setting multiple measurement targets....5-28
Setting multiple OUTs....5-43
Setting No. of stat proc....5-112
Setting numeric value formats....9-4
Settings change command list....9-14
Settings on the Display Panel....5-19
Setting status output....5-100, 5-106
Setting storage control....5-82
Setting storage cycle 5-81
Setting storage points....5-81
Setting storage target OUT....5-82
Setting the Check No. of edges function 5-70
Setting the display panel 5-101, 5-111
Setting the encoder 5-100, 5-101

Setting the ETHERNET 7-12
Setting the gateway 7-14
Setting the IP address 7-13
Setting the measurement method 5-30
Setting the measurement target 9-17, 9-34
Setting the minimum display unit 5-41
Setting the operation at next power ON 7-13
Setting the subnet mask 7-14
Setting the TCP port number 7-15
Setting the tolerance mode 5-41
Setting up the delay 5-31
Setting up the median filter 5-31
Setting up the tilt correction 5-31
Setting up the unit horizontally 2-18
Setting up the unit vertically 2-18
Setting values 4-4, 4-5, 4-6, 4-7, 4-8, 4-9, 4-10, 4-11, 4-12, 4-13
Shutdown 3-16
Simple display 6-6
Single OUT Display 3-6
Software Installation 1-18
SPC 6-34
[SPC collection setting] area 6-39
[SPC group interval] 6-36
[SPC group points] 6-36
SPC information 6-35
[SPC] screen 6-2, 6-34
SPC setting 6-39
[SPC setting] dialog 6-38
Specification of the automatic transmission 9-5
Specifications 11-1, 11-2
Standard 6-40
Startup 3-15
Stat control method 5-110, 5-112
State Table 11-20
Statistical information display area 6-33
Statistical processing 5-111
Statistical Processing 4-13
Statistic process settings 5-110
Statistics clear 9-13
Statistics data output 9-12
Statistics processing 9-33, 9-36, 10-18
Statistics start 9-12
Statistics stop 9-12
Stat process 5-9
[Stat process] area 5-109
Stat process Ch1 to Ch2 5-110
Stat processing 5-98
Stat process settings 5-113
Status output 5-98
[Status output] area 5-91
Steps 4-6, 4-8
Storage control method 5-79
Storage cycle 5-79
Storage points 5-79
Storage target OUT 5-79
Strobe time 5-96, 5-103
Suitable mounting for specific environments 2-2
Switching the display language 7-21
Switching the display method of target 5-27
Switching the edge/pitch setting 5-30
Switching the program setting 5-18
Switching the tolerance mode 5-50
Sync measure target 5-76
Sync setting 5-7
[Sync setting] area 5-75
System Configuration 1-8
System error message A-18

T

[Target] 6-22, 6-29
Target holder pulley 1-5, 11-13, 11-34
[Target OUT] 6-36
Target OUT 6-39
Target setting method 5-28
Target Viewer 6-14
[Target viewer] screen 6-2, 6-14
[Target] window 5-22
TCP port number 7-11
Temperature characteristics 11-18
Threshold mode 5-97
Tilt correction 5-26
Time and Date setting 7-10
[Time and Date] tab 7-10
Time delay in response when sending and receiving commands 9-40
[Time/view] drop-down list 6-17
Timing chart 10-1
Timing ON/OFF (Multiple) 9-10
Timing ON/OFF (Single) 9-10
Timing ON/OFF (Synchronization) 9-10
Tolerance 5-39, 6-22, 6-29
Tolerance mode 5-35
Tolerance setting 5-50, 9-22, 9-35
Top edge/Bottom edge 5-23
Total judgement output 10-18
Total Judgment 6-12
[Total judgment] screen 6-2, 6-12

Total judgment setting....5-97
Transition diagram for the display panel operations setting screen....A-4
Trend Graph....6-16
[Trend graph] screen....6-2, 6-16
Troubleshooting....A-15
Tx-Rx Pos....5-25

U

UDP port number....7-11
Ultrafine gap....5-25
Ultrafine outer DIA....5-25
Uninstalling LS-Navigator....1-20
Upon selection of FOCUS, DARK, or EDGE-CHK....5-107
Upon selection of FREQ-ERR....5-107
Upon selection of STAT-RUN....5-107
Upon selection of WAIT or OUTLIER....5-107
Upper Control Limit (UCL) / Lower Control Limit (LCL)....6-35
USB cable (2 m)....1-6
USB Interface....8-3
Using Shortcuts....3-3
Using the 40m connecting unit for cable extension....2-23
Using the Air Purge Unit....2-5
Using the Display Panel Stand....2-18
Using the Display Panel Support....2-20
Using the Pulley Jig....2-10
Using the switches (OP-87611)....2-19

V

[Valid No. of groups]....6-36
Version information....7-22
Vertical axis....6-22, 6-35
Vertical scale....6-40
Volt of output waiting data....5-98

W

When any abnormal value exists....6-10
When CH is selected....5-108
When INPUT is selected....5-108
When OUT-FUNC is selected....5-107
When output measurement values in synchronization with the TIMING1 terminal....9-6
When outputting measurement values using the “Self timing hold” mode....9-6
When STROBE is selected....5-108
When the total judgment is "Fail"....6-12
When the total judgment is "Pass"....6-12
Windows environment and installation destination....1-18
Writing format to Excel....6-10

X

[X bar]....6-37
[X bar average]....6-36
[X bar graph] area....6-40
[X bar LCL]....6-36
[X bar low standard]....6-36
X bar tag....6-35
[X bar UCL]....6-36
[X bar up standard]....6-36
[X maximum value]....6-36
[X minimum value]....6-36

MEMO

Revision history

Date of printing	Version number	Revision contents
January, 2013	2nd edition	
April, 2013	3rd edition	• Addition of the BCD unit
July, 2013	2nd revision 1st edition	• Handling of Ethernet/IP unit, PROFINET unit • Change of the abnormal value exclusion specifications function
November, 2013	2nd revision 2nd edition	
February, 2014	3rd revision 1st edition	
March, 2014	3rd revision 2st edition	
January, 2015	3rd revision 3rd edition	
February, 2015	3rd revision 4th edition	
March, 2016	3rd revision 5th edition	
May, 2016	3rd revision 6th edition	
November, 2016	3rd revision 7th edition	
February, 2017	3rd revision 8th edition	
March, 2019	4th revision 1st edition	
October, 2020	4th revision 2nd edition	
April, 2023	4th revision 3rd edition	

WARRANTIES AND DISCLAIMERS

(1) KEYENCE warrants the Products to be free of defects in materials and workmanship for a period of one (1) year from the date of shipment. If any models or samples were shown to Buyer, such models or samples were used merely to illustrate the general type and quality of the Products and not to represent that the Products would necessarily conform to said models or samples. Any Products found to be defective must be shipped to KEYENCE with all shipping costs paid by Buyer or offered to KEYENCE for inspection and examination. Upon examination by KEYENCE, KEYENCE, at its sole option, will refund the purchase price of, or repair or replace at no charge any Products found to be defective. This warranty does not apply to any defects resulting from any action of Buyer, including but not limited to improper installation, improper interfacing, improper repair, unauthorized modification, misapplication and mishandling, such as exposure to excessive current, heat, coldness, moisture, vibration or outdoors air. Components which wear are not warranted.

(2) KEYENCE is pleased to offer suggestions on the use of its various Products. They are only suggestions, and it is Buyer's responsibility to ascertain the fitness of the Products for Buyer's intended use. KEYENCE will not be responsible for any damages that may result from the use of the Products.

(3) The Products and any samples ("Products/Samples") supplied to Buyer are not to be used internally in humans, for human transportation, as safety devices or fail-safe systems, unless their written specifications state otherwise. Should any Products/Samples be used in such a manner or misused in any way, KEYENCE assumes no responsibility, and additionally Buyer will indemnify KEYENCE and hold KEYENCE harmless from any liability or damage whatsoever arising out of any misuse of the Products/Samples.

(4) OTHER THAN AS STATED HEREIN, THE PRODUCTS/SAMPLES ARE PROVIDED WITH NO OTHER WARRANTIES WHATSOEVER. ALL EXPRESS, IMPLIED, AND STATUTORY WARRANTIES, INCLUDING, WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF PROPRIETARY RIGHTS, ARE EXPRESSLY DISCLAIMED. IN NO EVENT SHALL KEYENCE AND ITS AFFILIATED ENTITIES BE LIABLE TO ANY PERSON OR ENTITY FOR ANY DIRECT, INDIRECT, INCIDENTAL, PUNITIVE, SPECIAL OR CONSEQUENTIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, ANY DAMAGES RESULTING FROM LOSS OF USE, BUSINESS INTERRUPTION, LOSS OF INFORMATION, LOSS OR INACCURACY OF DATA, LOSS OF PROFITS, LOSS OF SAVINGS, THE COST OF PROCUREMENT OF SUBSTITUTED GOODS, SERVICES OR TECHNOLOGIES, OR FOR ANY MATTER ARISING OUT OF OR IN CONNECTION WITH THE USE OR INABILITY TO USE THE PRODUCTS, EVEN IF KEYENCE OR ONE OF ITS AFFILIATED ENTITIES WAS ADVISED OF A POSSIBLE THIRD PARTY'S CLAIM FOR DAMAGES OR ANY OTHER CLAIM AGAINST BUYER. In some jurisdictions, some of the foregoing warranty disclaimers or damage limitations may not apply.

BUYER'S TRANSFER OBLIGATIONS:

If the Products/Samples purchased by Buyer are to be resold or delivered to a third party, Buyer must provide such third party with a copy of this document, all specifications, manuals, catalogs, leaflets and written information provided to Buyer pertaining to the Products/Samples.

Specifications are subject to change without notice.

KEYENCE CORPORATION

1-3-14, Higashi-Nakajima, Higashi-Yodogawa-ku, Osaka, 533-8555, Japan PHONE: +81-6-6379-2211

www.keyence.com/glb

AUSTRIA
Phone: +43 (0)2236 378266 0

BELGIUM
Phone: +32 (0)15 281 222

BRAZIL
Phone: +55-11-3045-4011

CANADA
Phone: +1-905-366-7655

CHINA
Phone: +86-21-3357-1001

CZECH REPUBLIC
Phone: +420 220 184 700

FRANCE
Phone: +33 1 56 37 78 00

GERMANY
Phone: +49-6102-3656-0

HONG KONG
Phone: +852-3104-1010

HUNGARY
Phone: +36 1 802 7360

INDIA
Phone: +91-44-4963-0900

INDONESIA
Phone: +62-21-2966-0120

ITALY
Phone: +39-02-6688220

KOREA
Phone: +82-31-789-4300

MALAYSIA
Phone: +60-3-7883-2211

MEXICO
Phone: +52-55-8850-0100

NETHERLANDS
Phone: +31 (0)40 206 6100

PHILIPPINES
Phone: +63-(0)2-8981-5000

POLAND
Phone: +48 71 368 61 60

ROMANIA
Phone: +40 (0)269 232 808

SINGAPORE
Phone: +65-6392-1011

SLOVAKIA
Phone: +421 (0)2 5939 6461

SLOVENIA
Phone: +386 (0)1 4701 666

SWITZERLAND
Phone: +41 (0)43 455 77 30

TAIWAN
Phone: +886-2-2721-1080

THAILAND
Phone: +66-2-078-1090

UK & IRELAND
Phone: +44 (0)1908-696-900

USA
Phone: +1-201-930-0100

VIETNAM
Phone: +84-24-3772-5555

A4WW1-MAN-2033

Copyright (c) 2019 KEYENCE CORPORATION. All rights reserved. 15623GB 2043-3 15623GB Printed in Japan

15623GB-3

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP