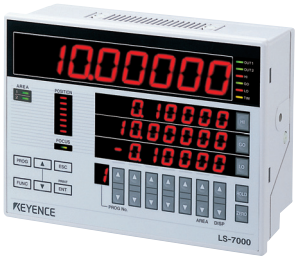
KEYENCE

96M11341

User's Manual

High-speed, High-precision Digital Micrometer

LS-7000 Series



Preface

This instruction manual provides necessary information on the operation and maintenance of the LS-7000 Series along with precautions. Please read the manual carefully and be sure you understand the information provided before attempting to install and operate the LS-7000 Series. Keep this manual handy for future reference.
Please make sure that the end users are provided with this manual.

Symbols

The following symbols are used for the list of precautions to ensure safety and to prevent personal injury and/or property damage when using the LS-7000 Series.
The following symbols alert you to important messages. Be sure to read these messages carefully.

⚠ DANGER	Failure to follow instructions may lead to death or serious injury.
⚠ WARNING	Failure to follow instructions may lead to injury.
⚠ CAUTION	Failure to follow instructions may lead to product damage (product malfunctions, etc.).
Important:	Provides important precautions and restrictions on proper operation.
Note:	Provides additional information on proper operation.
Tips	Provides useful information on proper operation.
Reference:	Provides reference pages.

General precautions

1. No part of this manual may be reprinted or reproduced in any form or by any means without the prior written permission of KEYENCE CORPORATION.
2. The content of this manual is subject to change without notice.
3. KEYENCE has thoroughly checked and reviewed this manual. Please contact the sales office listed at the end of this manual if you have any questions or comments regarding this manual, or if you find an error.
4. KEYENCE assumes no liability for damages resulting from the use of the information in this manual, item 3 above notwithstanding.
5. KEYENCE will replace any incomplete or incorrectly collated manual.
6. All company names and product names in this manual are registered trademarks or trademarks of their respective owners.

Safety Precautions

■ General precautions

- At startup and during operation, be sure to monitor the functions and performance of the LS-7000 Series.
- Take sufficient safety measures to prevent damage to the human body and/or equipment that may be caused if this product should fail to operate properly.
- Do not modify the LS-7000 Series or use it in any way other than as described in the specifications. Its functions and performance are not guaranteed under said conditions.
- When the LS-7000 Series is used in combination with other instruments, its functions and performance may be degraded, depending on the operating conditions and surrounding environment.
- Do not use the LS-7000 Series for the purpose of protecting the human body.
- Do not expose the LS-7000 Series and peripheral devices to sudden temperature change, as this may cause condensation.

■ Precautions

⚠ WARNING

■ Operation

- Always use the LS-7000 Series at 24 VDC, otherwise a fire, electric shock or product failure may result.
- Prepare the applicable AC power supply cable if you use LS-S11.
- Secure the GND line of the power cable of the AC power supply stand to protective ground, otherwise an electric shock or product failure may result.
- Do not disassemble or modify the LS-7000 Series. This may cause fire or electric shock.

■ When abnormal conditions are encountered

If the following conditions are encountered, immediately turn off the power. Continuing to use the LS-7000 Series. under abnormal conditions may cause fire, electric shock or equipment failure.

Contact your nearest KEYENCE sales office for repairs.

- When water or foreign matter enters the controller.
- When the LS-7000 Series. is dropped or the housing is damaged.
- When the controller produces smoke or an abnormal smell.

CAUTION

■ **Usage**

- Be sure to turn off the power to the LS-7000 Series and any connected devices before connecting or disconnecting the cables. Otherwise, the camera and connected devices may be damaged.
- Do not turn off the power while setting a parameter. Otherwise, the settings may be partially or completely lost.
- Do not block the ventilation slots on the LS-7000 Series and peripheral devices. A rise in inner temperature may cause equipment failure.

■ **Proper environment and conditions**

To use the LS-7000 Series properly and safely, do not install the LS-7000 Series in locations with the following conditions. Use of this equipment in an improper environment may cause fire, electric shock, or equipment failure.

- Locations with high humidity, a large amount of dust, or poor ventilation
- Locations where the temperature rises excessively due to direct sunlight, etc.
- Locations where corrosive or flammable gas exists
- Locations where the LS-7000 Series is directly subjected to vibration or impact
- Locations where water, oil or chemicals may splash the LS-7000 Series
- Locations where static electricity is easily built up

■ **Countermeasures against Noise**

The LS-7000 Series may malfunction or fail to operate due to noise generated from power lines or high-tension lines. If the LS-7000 Series is operated close to such noise sources, use a noise filter, wire the cable of the LS-7000 Series in an independent conduit, or locate the LS-7000 Series in an area with proper insulation from noise.

Note:

■ **Influence of Ambient Operating Temperature**

Ensure that the ambient operating temperature is constant. A change in the ambient operating temperature may result in measurement errors. If the ambient operating temperature changes by 10°C, it will take approximately 60 minutes for the interior temperature distribution of the LS-7000 Series to be uniform.

■ **Warming Up**

Do not operate the LS-7000 Series for approximately 30 minutes after it is turned on. The internal circuitry of the LS-7000 Series is not stable immediately after it is turned on. The measured value drifts gradually as a result.

■ **Influence of Dust and Dirt**

A measurement error may result due to dirt, dust, water, or oil in any of the following cases.

- Cover glass: Blow off the dirt, dust, water or oil on the cover glass with clean air. If the cover glass is excessively dirty, wipe the glass with a soft cloth moistened with isopropyl alcohol.
- Target surface: Blow off the dirt, dust, water or oil on the surface with clean air or wipe the surface.
- Intrusion of dirt, dust, water or oil blown or sprayed into optical sensing area: Install a protection cover or perform air purging.

■ **Influence of Vibration**

The measured value of an object may fluctuate if the object is vibrating. If that happens, increase the averaging number. This will ensure highly accurate measurement.

■ **Targets**

The measured value of an object may have an error due to the shape and surface condition. Locate a reference object within the measuring area and use the calibration function of the LS-7000 Series to correct the error if that happens.

■ **Influence of Air Flow**

The measured value of an object may fluctuate due to a slow flow of air. In that case, the following countermeasures are effective.

- Protect the measuring head with a cover.
- Use a fan to mix the air vigorously between the transmitter and receiver.

■ **Maintenance**

Do not wipe the LS-7000 Series with a damp cloth or a cloth moistened with benzine or paint thinner. This may cause the discoloration or deformation of the LS-7000 Series. If the LS-7000 Series is excessively dirty, use a tightly squeezed cloth moistened with thin neutral detergent. Then wipe the LS-7000 Series with a soft dry cloth.

■ Precautions for LED

The LS-7010/LS-7030/LS-7070 Measuring Head uses an LED light source. Abide by the following precautions when using the unit.

⚠ CAUTION

- Do not look at the LED light source for a long time.
  The LED used as the light source is classified into class 1 according to IEC60825-1 standards. Basically the light beam of the LED is safe, but do not look at the LED for a long time.
- Do not disassemble the unit.
  The unit does not incorporate a mechanism to stop the emission of the LED when the unit is disassembled. Never attempt to disassemble the unit, otherwise you will be exposed to LED light.

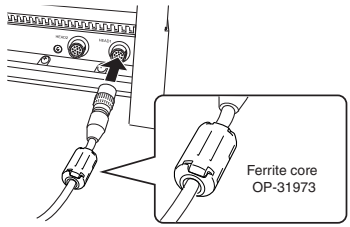
Precautions for CE Markings

Keyence confirms that the LS-7000 Series meets EC directive requirements. The LS-7000 Series bears CE markings. Keep the following conditions if the LS-7000 Series is used in European countries.

■ EMC Directives

Keep the following condition so that the LS-7000 Series will satisfy EN61326-1 requirements.

- The power cable and I/O cable connected to the controller are both less than 30m in length.
- Attach the OP-31973 Clamp-type Ferrite Core to the cable between the controller and measuring head. The attaching position is as close as possible to the cable end on the controller side, where the core must be snapped onto the cable to form a one-turn loop.



■ Low-voltage Directives

When using the LS-S11 AC Power Supply Stand as a dedicated power supply to the LS-7000 Series, keep the following conditions so that the LS-S11 will satisfy EN61010-1 requirements. The LS-S11 satisfies EN60825-1 (LED Class 1) requirements with no conditions attached.

Environment Conditions

Installation category (Overvoltage category): II (see note 1)
Pollution degree: 2 (see note 2)

Operation and Installation Conditions

- The LS-S11 AC Power Stand is a dedicated power supply for the LS-7000 Series. Never use the LS-S11 for other purposes.
- When using the LS-7000 Series in European countries, check that the AC power supply cable satisfies EC directive requirements certified by an authorized third party. Consult your Keyence representative for the AC power supply cable in detail.
- Before turning the LS-7000 Series on, connect the ground terminal of the AC power supply cable to the protective ground terminal of the power supply.
- Be sure to use a time lag fuse rated 250 V, 3.15 A for the replaceable fuse of the LS-S11.

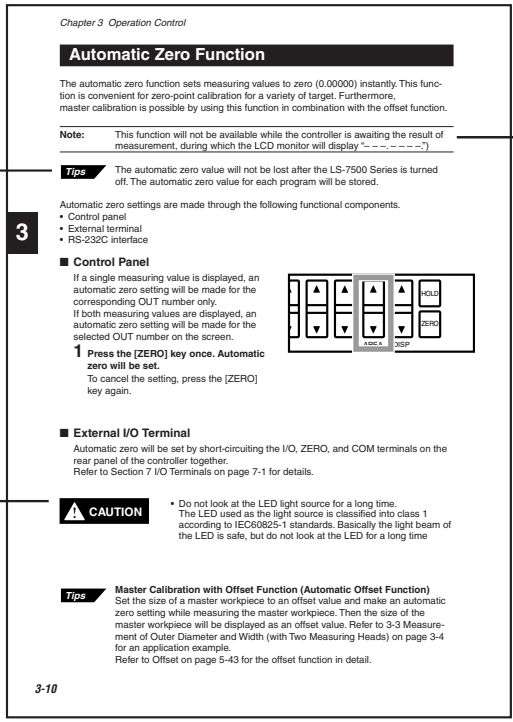
Note 1: Installation categories (overvoltage categories) include impulse overvoltage regulations at transient overvoltage levels specified by EC directives.
Installation category II indicates a level where power is provided from fixed installations, such as distribution panels.

Note 2: The pollution degree refers to the level of solid, liquid, or gas contamination that deteriorates the dielectric strength or surface resistance of the LS-7000 Series.
Pollution degree 2 indicates the normal indoor environment (free of non-conductive contamination).

About this Manual

The following section provides information on the configuration of each page of this manual along with symbols and terms used in this manual.

Page Configuration and Symbols



Chapter 3 Operation Control

Automatic Zero Function

The automatic zero function sets measuring values to zero (0.00000) instantly. This function is convenient for zero-point calibration for a variety of target. Furthermore, master calibration is possible by using this function in combination with the offset function.

Note: This function will not be available while the controller is awaiting the result of measurement, during which the LCD monitor will display "– – –.– – – – –".)

Tips The automatic zero value will not be lost after the LS-7500 Series is turned off. The automatic zero value for each program will be stored.

Automatic zero settings are made through the following functional components.
- Control panel
- External terminal
- RS-232C interface

3

■ **Control Panel**

If a single measuring value is displayed, an automatic zero setting will be made for the corresponding OUT number only.
If both measuring values are displayed, an automatic zero setting will be made for the selected OUT number on the screen.

1 Press the [ZERO] key once. Automatic zero will be set.
To cancel the setting, press the [ZERO] key again.

HOLD
ZERO
A.DIC A
DISP

■ **External I/O Terminal**

Automatic zero will be set by short-circuiting the I/O, ZERO, and COM terminals on the rear panel of the controller together.
Refer to Section 7 I/O Terminals on page 7-1 for details.

CAUTION

- Do not look at the LED light source for a long time. The LED used as the light source is classified into class 1 according to IEC60825-1 standards. Basically the light beam of the LED is safe, but do not look at the LED for a long time

Tips **Master Calibration with Offset Function (Automatic Offset Function)**
Set the size of a master workpiece to an offset value and make an automatic zero setting while measuring the master workpiece. Then the size of the master workpiece will be displayed as an offset value. Refer to 3-3 Measurement of Outer Diameter and Width (with Two Measuring Heads) on page 3-4 for an application example.
Refer to Offset on page 5-43 for the offset function in detail.

3-10

Tips: Describes information that will deepen the user's comprehension of the manual along with other useful information.

Note: Describes items that need the user's attention in order to prevent mistakes in the operation of the LS-7000 Series.

Caution: Indicates information that, if not heeded, could result in relatively serious or minor injury, damage to the LS-7000 Series, or faulty operation.

❊ The above page sample is for your reference only. It does not coincide with any of the actual pages of this manual.

Definition of Terms

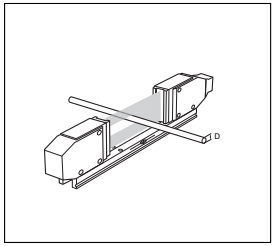
This manual uses the following terms.

Term	Description
LS-7000 Series	Refers to the LS-7001 controller and the measuring head as a set.
Controller	Refers to the LS-7001 controller.
Measuring head	Refers to the LS-7010/LS-7030/LS-7070 measuring head.

Optimum Measurement Methods

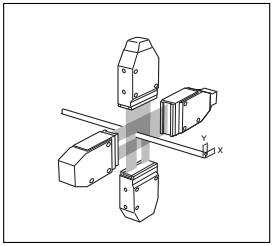
Refer to the following methods, and select the optimum measurement method according to the type of target.

Measurement of Outer Diameter of a Round Bar or Wire



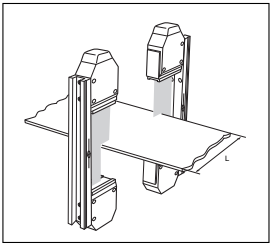
Measurement of outer diameter and width (with single measuring head) (Page 2-2)

Measurement of Average Outer Diameter of Round Bar or Wire



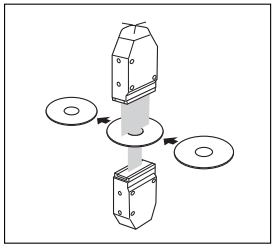
Measurement of outer diameter and width (with two measuring heads in X and Y directions) (Page 2-3)

Measurement of Sheet Width



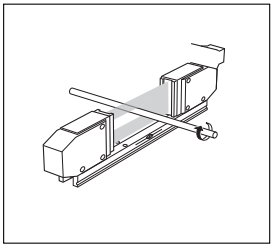
Measurement of outer diameter and width (with two measuring heads for larger objects) (Page 2-4)

Measurement of Inner Diameter of a Disc



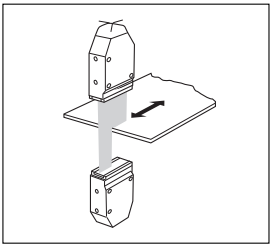
Measurement of inner diameter and clearance (Page 2-5)

Measurement of Outer Diameter and Eccentricity of a Roller



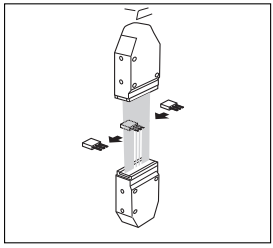
Measurement of outer diameter and eccentricity (Page 2-6)

Measuring Robot Movement and Positioning of LCD Plate



Measurement of movement and positioning (Page 2-7)

Measurement of Connector Pins and IC Pins



Measurement of pitch (Page 2-8)

Configuration of Manual

Chapter 1 Getting Started
Provides information on precautions and necessary preparations required.

Chapter 2 Easy Setting Guide
Provides information on targets and settings for typical applications respectively.

Chapter 3 Operation Control
Provides information on setting control items on the control panel while the LS-7000 Series is in measurement operation.

Chapter 4 Function Settings
Provides information on the overview of program settings and setting methods.

Chapter 5 Environment Settings
Provides information on basic operation settings.

Chapter 6 I/O Terminals
Provides information on the specifications of the I/O terminals and timing charts.

Chapter 7 RS-232C
Provides information on how to connect external devices and the communications function to operate the LS-7000 Series through the external devices.

Chapter 8 Specifications
Provides the specifications, characteristics, and external dimensions of the LS-7000 Series.

Chapter 9 Troubleshooting
Provides information on troubleshooting and error messages.

Appendix
Provides a list of options and the index of the manual.

LS-7001 Operation Map

Select the area (See page 3-4)

▲ / ▼ AREA

Press the Up or Down key to select the area.

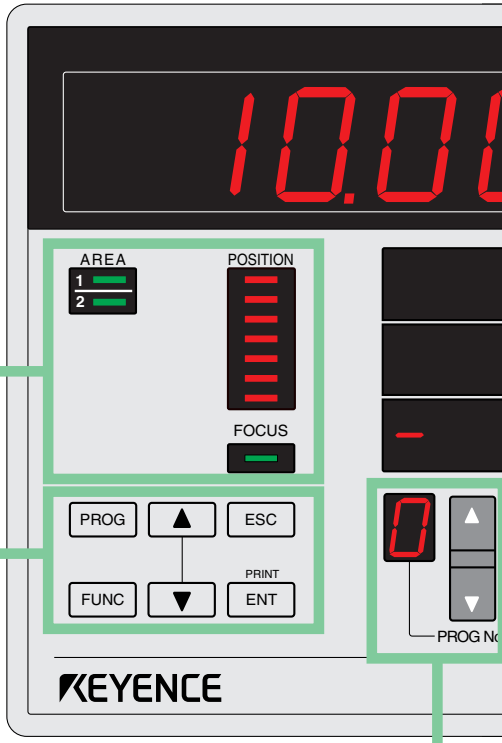
The selected area appears on the AREA display.

POSITION monitor

The POSITION monitor is lit according to the position and size of the target.

FOCUS monitor

The FOCUS monitor is lit according to the distance between the transmitter and receiver.
To make lit range changes, refer to page 4-14.



Program Settings

Area, calibration, output, or option setting:

Press the PROG key and select the item with FUNC key.

Environment setting:

Press the PROG key while pressing the FUNC key.

Set item selection:

Press the ▲ or ▼ key.

Set item cancellation:

Press the ESC key.

Entering set item:

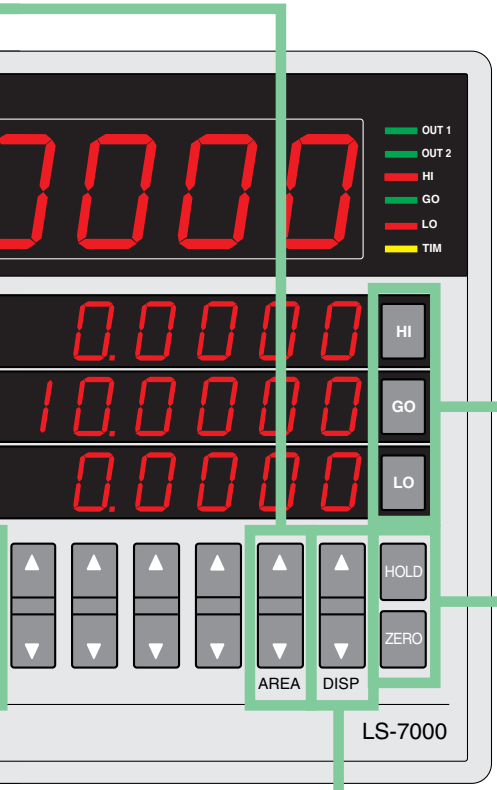
Press the ENT key.

Program selection

▲ / ▼ PROG No.

Press the Up or Down key.

0 → 1 → 2 → 3 → 4 → 5 → 6 → 7
F ← E ← d ← C ← b ← A ← 9 ← 8



Tolerance setting (See page 4-50)

Reference value mode

Upper limit setting: ➡ Press the HI key.

Reference value setting: ➡ Press the GO key.

Lower limit setting: ➡ Press the LO key.

Threshold setting

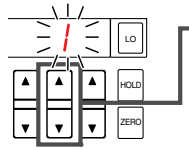
HI value setting: ➡ Press the HI key.

HH value setting: ➡ Press the HI key 2X.

LO value setting: ➡ Press the LO key.

LL value setting: ➡ Press the LO key 2X.

Value change while setting



Press the key below the value flashing.

Measured value display selection

Press the Up or Down key.

Measured value display varies between the reference value mode and threshold mode for tolerance setting. (See page 3-2)

Hold function (See page 3-5)

Press the HOLD key.

Auto zero function (See page 3-6)

Press the ZERO key.

To cancel the function, press the ZERO key again.

Contents

Chapter 1 Getting Started

Chapter 2 Easy Setting Guide

Chapter 3 Operation Control

Chapter 4 Function Settings

Chapter 5 Environment Settings

Chapter 6 I/O Terminals

Chapter 7 RS-232C

Chapter 8 Specifications

Chapter 9 Troubleshooting

Appendix

Chapter 1

Getting Started

This section provides information on the configuration of the LS-7000 Series, precautions, and necessary preparations required before operating the LS-7000 Series. Familiarize yourself with this section before using the LS-7000 Series.

Outline and Features of LS-7000 Series

The LS-7000 Series is a high-speed, high-accuracy digital micrometer used for the dimensional measurement of objects without coming into contact with the objects. It is such a versatile model that it has a wide range of applications including in-line measurement and offline measurement.

■ Special Features

High-speed Sampling of 2400 Times per Second

Ensures high-speed sampling that is twice as fast as the sampling speed of conventional models. The continuous measurement of extruded products and the in-line measurement of moving workpieces are possible.

Repeat Accuracy of ±0.15μm

Incorporates the latest optical system, thus ensuring excellent repeat accuracy that is twice as high as the accuracy of conventional models, thus supporting the manufacture of high-precision products.

Connecting Two Measuring Heads for two-channel Simultaneous Measurement

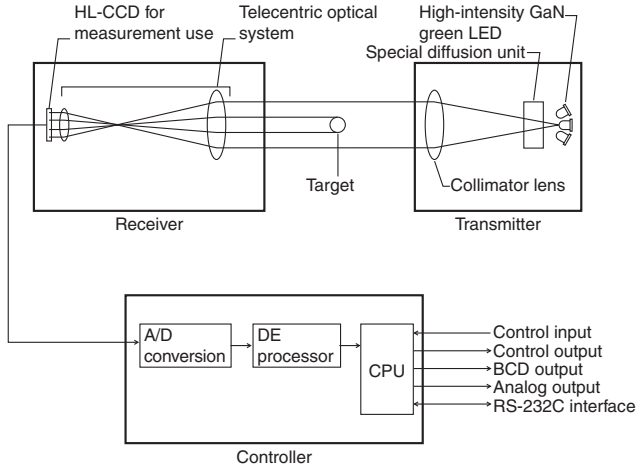
Two measuring heads can be used in combination for the simultaneous measurement of two targets.

Stable Detection of Transparent Objects with Threshold Change

The threshold change function supported by the DE processor makes it possible to detect transparent objects stably.

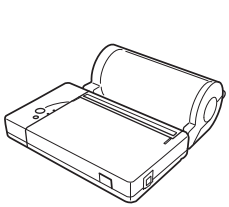
■ Principle of Measurement

The high-intensity GaN green LED radiates light, which will be changed into uniform parallel light through the special diffusion unit and collimator lens and emitted to the target in the measuring range. Then the shadow image of the target will appear on the HL-CCD (high-speed linear CCD) through the telecentric optical system. The output incident signal of the HL-CCD will be processed by the DE (digital edge-detection) processor in the controller and CPU. As a result, the dimensions of the target will be displayed and output.

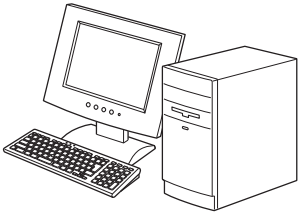


System Applications

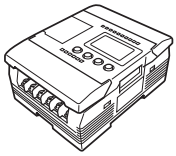
The LS-7000 Series has a wide range of applications when used in combination with commercially available peripheral devices.



Printer
The results of measurement are printed.



PC
Control values or measuring values are retrieved over RS-232C.



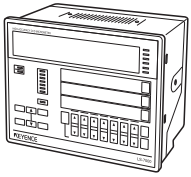
Programmable Logic Controller
Control output and measured values are retrieved and programs for measurement timing control are changed.

RS-232C

RS-232C

Comparator output
BCD output
RS-232C
Timing input
Auto zero input
Reset input
Program number selection

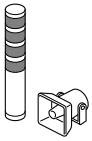
LS-7001



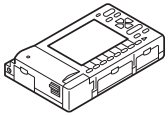
Comparator output

Analog output

Timing input



Indicator Light and Buzzer
Alarms are generated according to the output of discrimination results.



Recorder
The results of measurement are recorded.

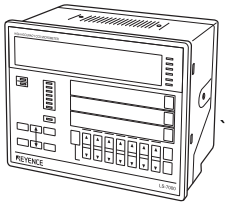
Photoelectric Sensor or Proximity Sensor
Timing input signals are sent whenever objects are detected.

Package Checks

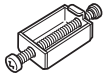
Check that nothing is missing from the LS-7000 Series package before use.

LS-7001

Controller



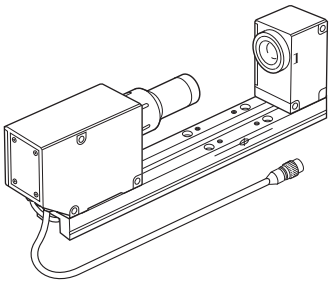
Four Panel Mounting Brackets



LS-7000 Series User's Manual

LS-7010

Measuring Head

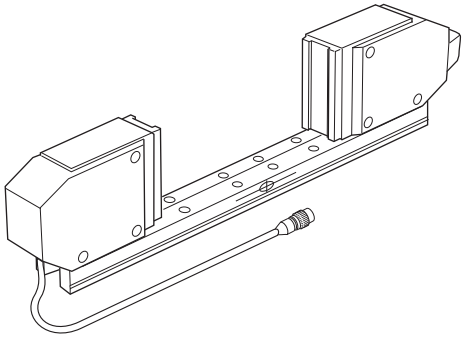


Allen-head bolt (Five, M3 x 45 with a washer)

Allen-head bolt (Four, M4 x 20)

LS-7030

Measuring Head

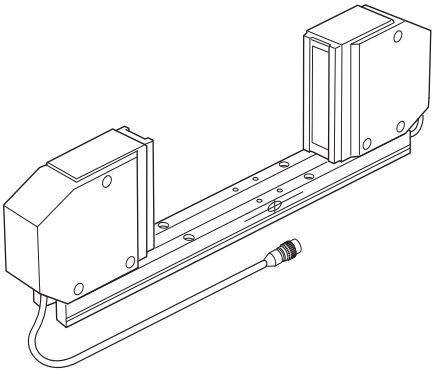


Allen-head bolt (Six, M5 x 45 with a washer)

Allen-head bolt (Four, M4 x 20)

LS-7070

Measuring Head

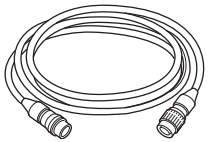


Allen-head bolt
(Six, M4 x 50 with a washer)

Allen-head bolt
(Four, M5 x 20)

LS-C**A

Extension Cable (Cable between the controller and measuring head)

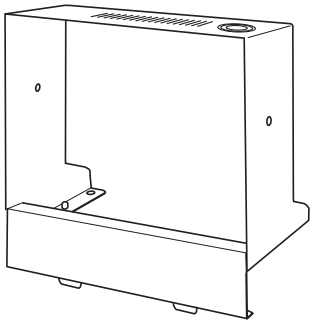


LS-C3A: 3-m cable
LS-C10A: 10-m cable
LS-C30A: 30-m cable

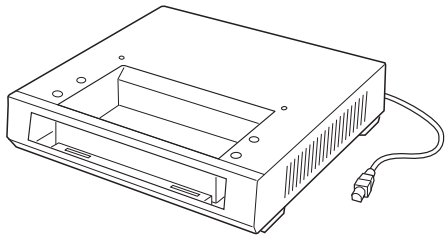
Up to two cables are connectable, provided that the total length of the cables does not exceed 40 m.

LS-S11

Stand Unit



Base Unit



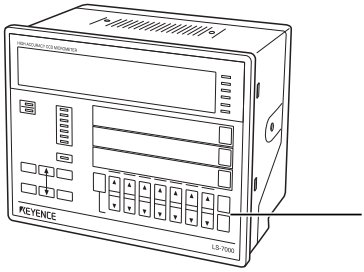
Screws (Four, M4 x 8)

❊ Keyence ships each package with utmost care and attention. If there should be any improper or damaged product, contact your Keyence representative.

Functions and Nomenclature

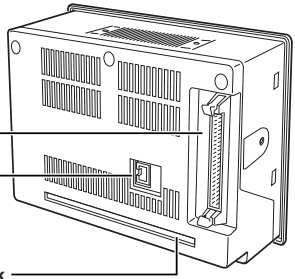
The following section provides information on the functions and nomenclature of the controller and measuring head.

Controller



Control Panel
(Page 1-8, Control Panel)

Controller (Rear Side)

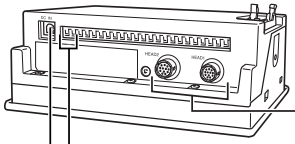


Connector I/O
Used for signal I/O
(Page 6-2, Section 6 I/O Pin)

Modular Connector
Used to connect the console connector or RS-232C cable connector.
(Page 7-4, 7-5, Section 7 RS-232C)

Terminal Block
Used for signal I/O
(Page 6-2, Section 6 I/O Terminals)

Controller (Bottom)

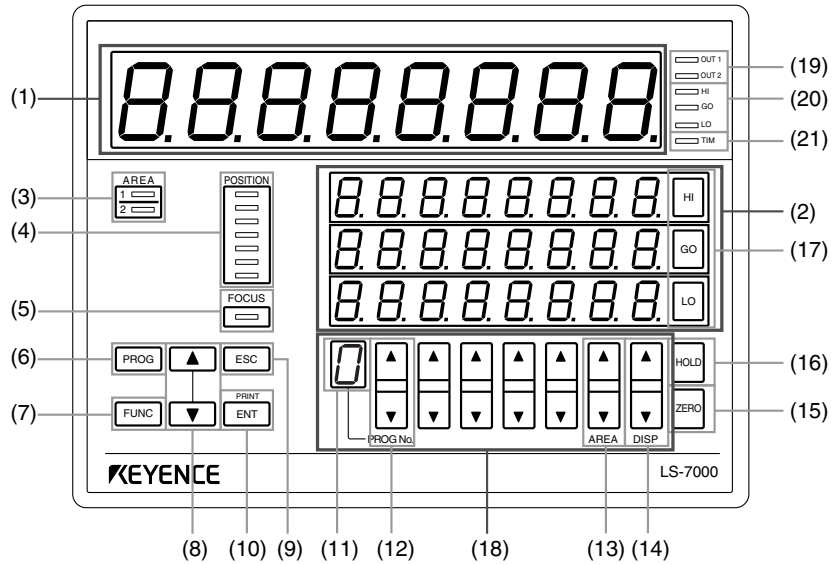


Extension Cable
Connect the cable between the controller and the measuring head.

Power Input Pins (24 VDC)
Provide 24 VDC power supply.

DC IN
Connect the LS-S11 AC Power Supply Cable.

■ Control Panel



(1) Main display: The measured value is displayed. Refer to Selection of Measured Value Display on page 3-2.

(2) Sub display: Used to display tolerance or measured values while the LS-7000 Series is in measuring operation. The set value is displayed while in value setting. Refer to Selection of Measured Value Display on page 3-2.

(3) Area monitor display: The number of the selected area is displayed. Refer to Area Monitor on page 3-4.

(4) Position display: The position of the target in the selected area is displayed. Refer to Area Monitor on page 3-4.

(5) Focus display: The focus status of the selected area is displayed. Refer to Area Monitor on page 3-4.

(6) [PROG] (Setting) key: Press this key to set program details. Refer to Program Changes on page 3-8.

(7) [FUNC] (Function) key: Press this key to set the setting item. Refer to Section 4 Function Settings.

(8) [▲] / [▼] key: Press the Up or Down key to select the set item.

(9) [ESC] key: Press this key to finish the present setting.

(10) [ENT] key: Press this key to enter the set item or print the measured value from the printers.

(11) Program number display: The selected program number is displayed.

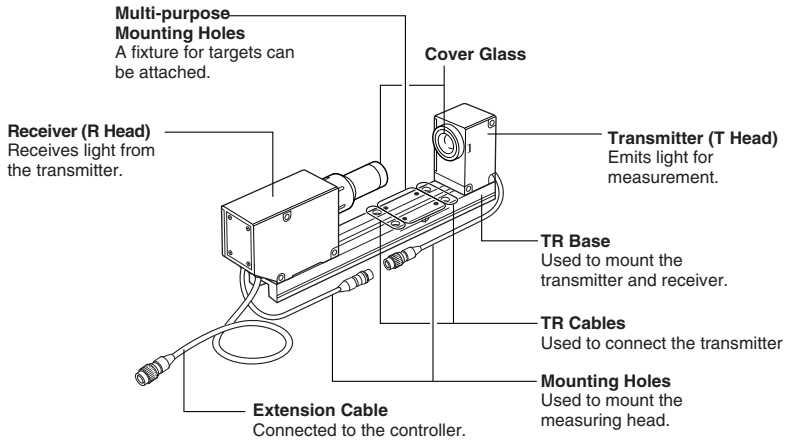
(12) Program selection key: Press this key to select the program number when measuring. (Page 3-8, Program Change)

(13) Area monitor selection key: Press this key to select the area number when measuring. (Page 3-4, Area Monitor)

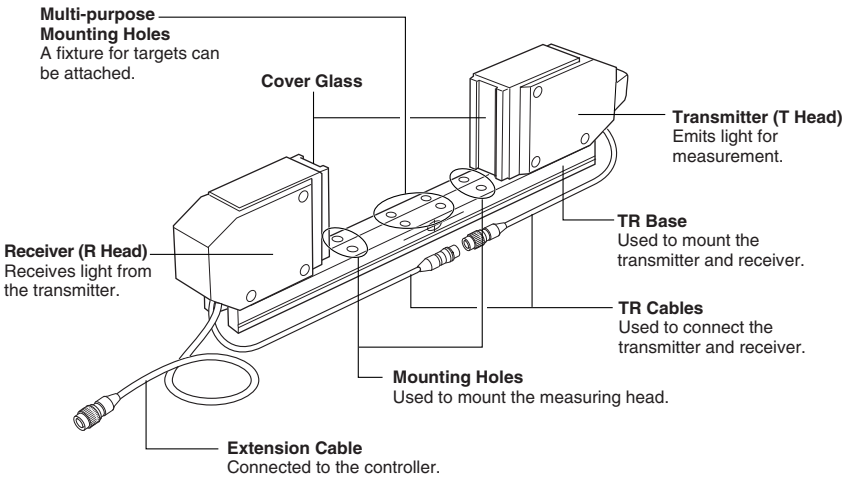
(14) Display selection key:	Press this key to select the main display or sub display when measuring. (Page 3-2, Switching Display Screen)
(15) ZERO key:	Press this key to select the auto zero function. (Page 3-6, Automatic Zero Function)
(16) HOLD key:	Press this key to select the hold function. (Page 3-5, Hold Function)
(17) HI, GO, and LO keys:	Press these keys to make tolerance settings. (Page 4-50, Limit Setting)
(18) ▲ and ▼ keys:	Press these keys to select the set value or item.
(19) Output selection display:	Indicates whether the measured value on the main display is OUT1 or OUT2.
(20) Comparator result display:	Displays the comparator result of the main display.
(21) Timing display:	Lit when timing input into the main display turns ON.

Measuring Head

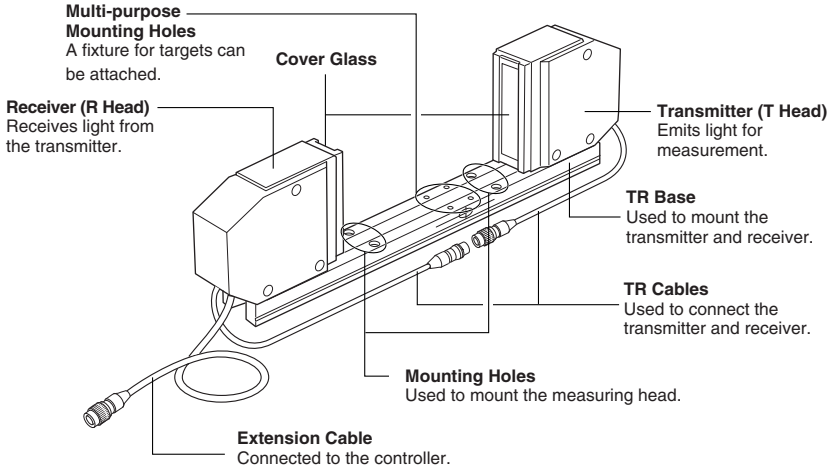
LS-7010



LS-7030



LS-7070



Mounting and Connection

Mount the measuring head and the controller, and connect them with the cables.

■ Mounting the Measuring Head

The measuring head can be mounted with or without the TR base employed, according to the type of targets and operating environment.
The following section provides information on how to mount the measuring head with or without the TR base employed, along with mounting conditions required.

■ Mounting the Controller

Mount the controller to panels, such as control or operation panels, or to the LS-S11 AC Power Supply Stand. The LS-S11 Power Supply Stand is sold separately.

■ Connection

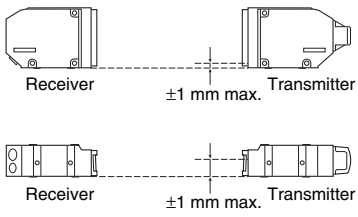
After the measuring head and the controller are mounted, connect them with the cables.

Mounting the Measuring Head

■ Mounting Restrictions

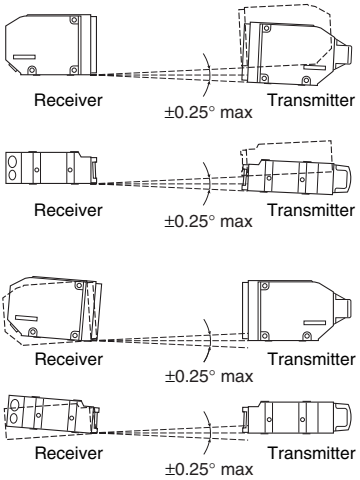
The transmitter and receiver must abide by the following restrictions when the measuring head is mounted.

Vertical Position Mismatching



The values are the same for LS-7010, LS-7030, and LS-7070.

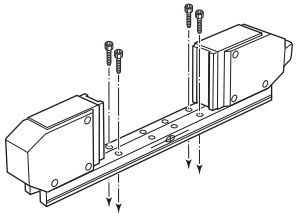
Angle Mismatching



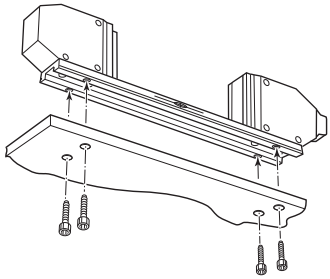
■ With TR Base

The transmitter and receiver are mounted to the TR base at the time of shipment. This section provides how to install the transmitter and receiver (LS-7030 in this case) that are mounted on the TR base.LS-7010 and LS-7070 can also be installed in the same way.

Use the four, M4x20 Allen-head bolts, which are provided with the package, to mount the TR base. To mount the TR base with the bolts on the surface of the TR base, use the mounting holes on the surface.



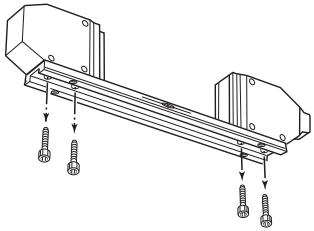
To mount the TR base with the bolts on the back of the TR base, use the 10-mm-deep M4 (10-mm-deep M5 for LS-7070) mounting holes on the back.



■ Without TR Base

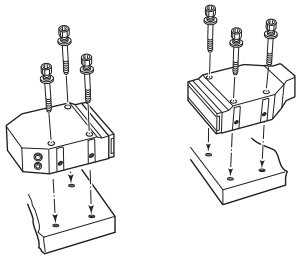
Take the following steps to use the transmitter and receiver (LS-7030 in this case) after dismounting them from the TR base. LS-7010 and LS-7070 can also be used in the same way.

1 Loosen the bolts on the back of the TR base and remove the measuring head.

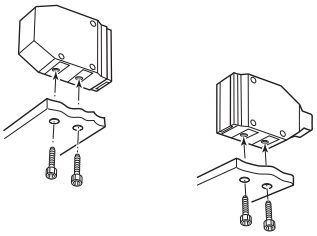


2 Mount the measuring head.

Use the side mounting holes on the transmitter and receiver as shown in the illustration. Mount them with the Allen-head bolts provided with the package.



Use the 5-mm-deep M4 bottom mounting holes of the transmitter and receiver as shown in the illustration.



Mounting the Controller

■ Mounting Restrictions

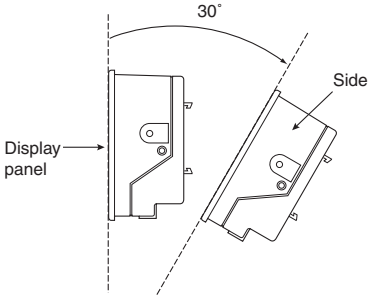
Be aware of the following items when mounting the controller.

⚠ CAUTION

- Do not install the controller upside down.
- Do not block the ventilation louver. Otherwise, the interior heat may cause the controller to malfunction.

Note:

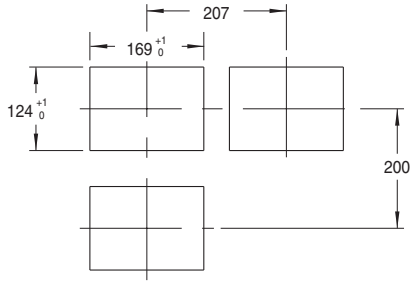
- For the maintenance, operability, and ventilation of the LS-7000 Series, separate the controller as far as possible from peripheral structures or parts.
- The mounting angle must abide by the following restrictions.



- Check that the controller will not be exposed to the heat radiation of peripheral devices.
- Separate the controller as much as possible from devices with arc generation, such as electromagnetic switches or non-fuse breakers.

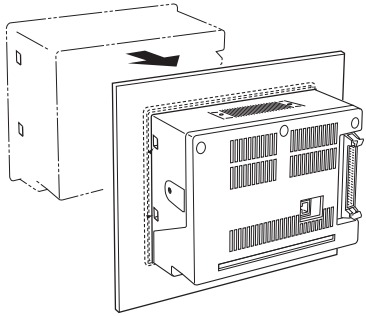
■ Mounting to Panel

The controller can be mounted to control panels with the mounting brackets provided with the package. Arrange the following panel mounting dimensions.

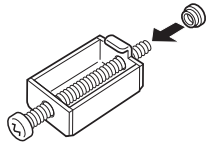


Unit: mm

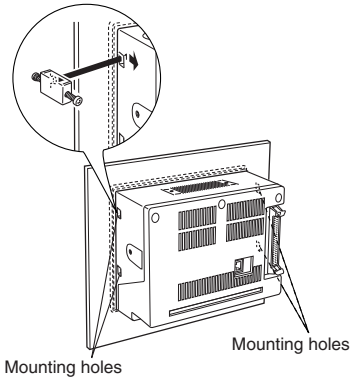
1 Mount the controller from the front side of the panel.



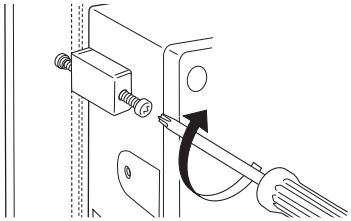
2 Attach resin caps to the mounting brackets.



3 Insert the mounting brackets to the four mounting holes on the side of the controller respectively.



4 Secure the mounting brackets with a Phillips screwdriver.



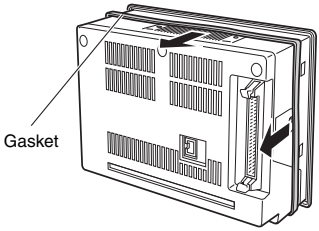
CAUTION

- Tighten the mounting screws to a maximum torque of 0.4 Nm. Do not tighten up the mounting screws excessively, otherwise the panel or controller casing may be deformed.
- Do not remove the gasket, otherwise the controller will not satisfy IP64 conditions.

■ Mounting to AC Power Supply Stand

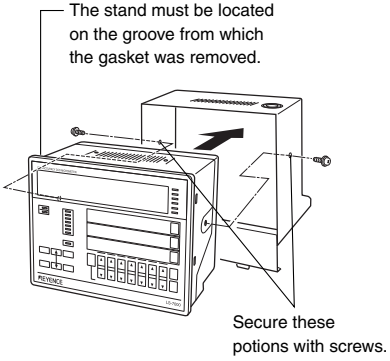
The following section provides information on how to mount the controller to the AC power supply stand (sold separately). The AC power supply stand consists of a stand unit and base unit. Mount the controller to the stand unit first. Connect the power supply cable and extension cable (i.e., the cable between the controller and measuring head). Then mount them to the base unit.

1 Remove the gasket around the controller.



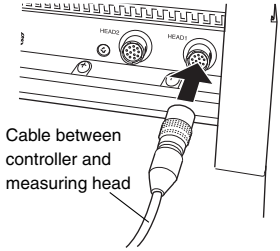
2 Mount the controller to the stand.

Use the two screws provided with the package and secure the controller on the side.

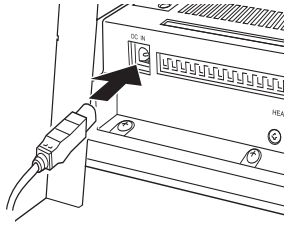


3 Connect the cable between the controller and measuring head.

If only a single measuring head is used, connect the cable to the HEAD1 connector.

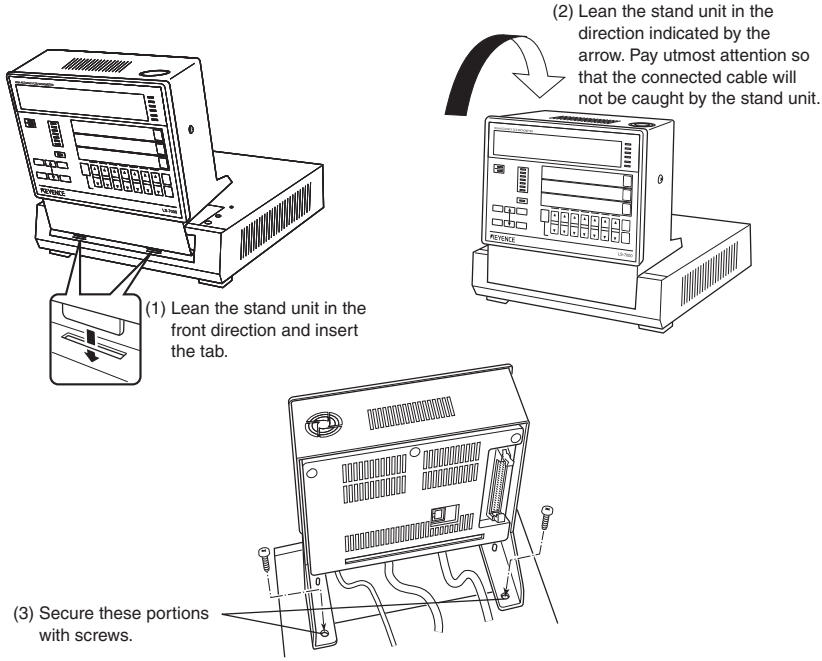


4 Connect the power supply cable of the AC power supply stand to the controller.

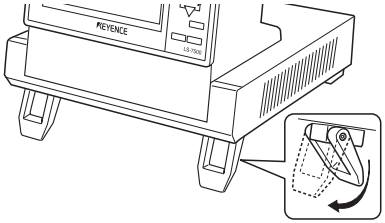


5 Mount the stand unit to the base unit.

Mount the stand unit with the two screws provided with the package.



Tips The back of the AC power supply stand has legs. Erect the legs and use the AC power supply stand if required.



Connection

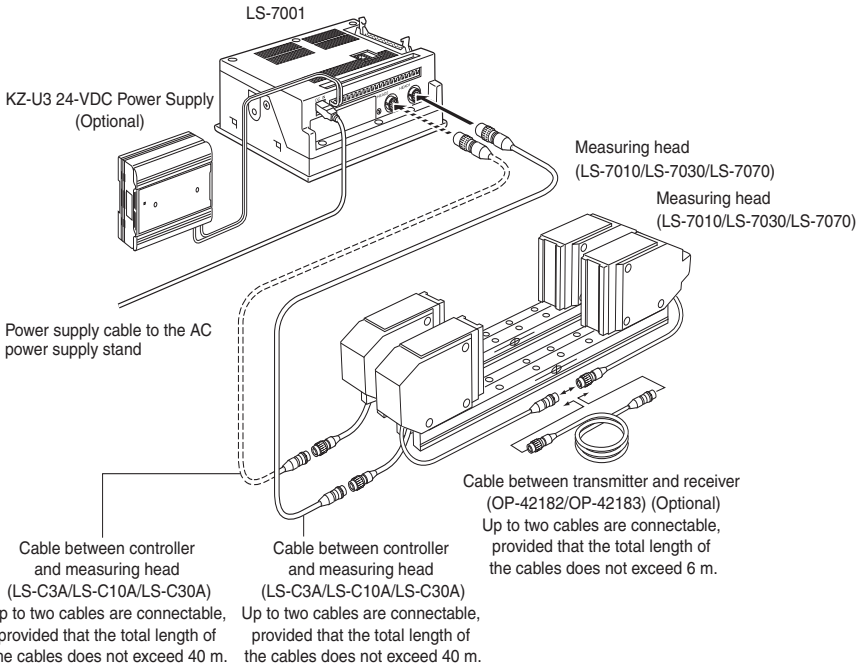
Connect the measuring head, controller, and power supply with the cables.

⚠ CAUTION

Do not supply power to the controller while connecting the cables. If the AC power supply stand is used, turn off the AC power supply stand while connecting the cables. The measuring head, controller, or peripheral devices may be damaged if power is supplied while connecting the cables.

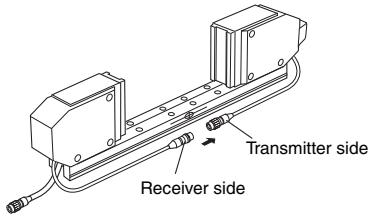
Make the following three connections.

- Transmitter and Receiver: Connect the cables from the transmitter and receiver respectively.
- Measuring head and controller: Connect the cable between the controller and measuring head.
- Power supply cable: Supply 24 VDC to the controller directly or through the AC power supply stand.



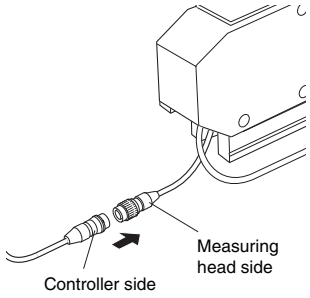
■ Transmitter and Receiver

Connect the cables of the transmitter and receiver respectively.
Connect both connectors so that the notched part of each connector will coincide with each other in position.



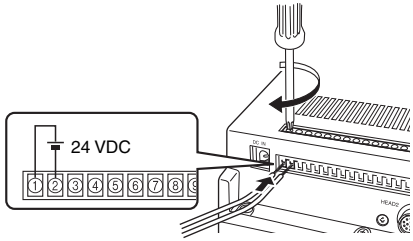
■ Measuring Head and Controller

Connect the cables of the controller and the measuring head.
Connect both connectors so that the notched part of each connector will coincide with each other in position.

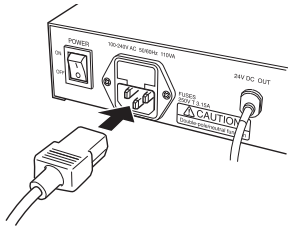


■ Power Supply Cable

Supply 24 VDC to the controller through I/O terminals 1 and 2 on the rear panel of the controller. Secure the wires to the terminals with a Phillips screwdriver.



- **Using AC Power Supply Stand (Sold Separately):**
  Connect the output cable of the AC power supply stand to the DC IN connector of the controller. Then connect the AC cord provided with the AC power supply stand to the electric outlet.

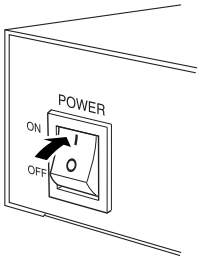


Supply Stand On and Off

This section provides information on how to turn the AC power supply stand on and off.

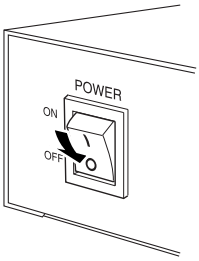
■ Turning Power On

1 Turn on the POWER switch on the rear panel of the AC power supply stand.



■ Turning Power Off

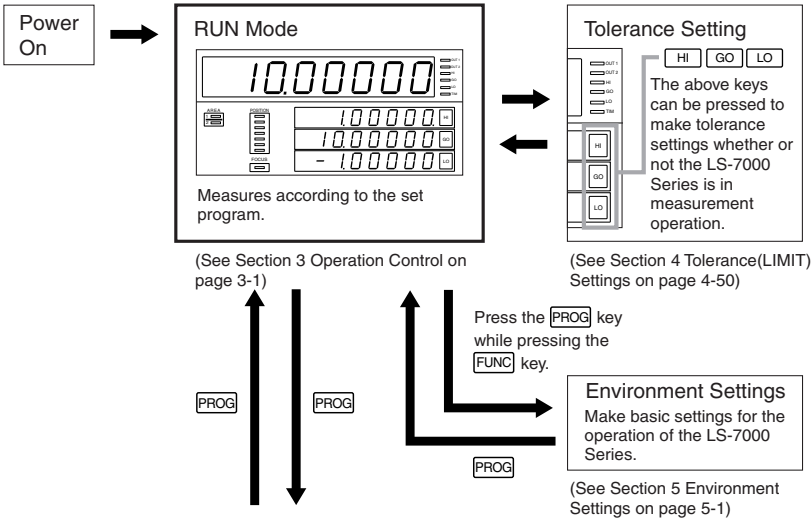
1 Turn off the POWER switch on the rear panel of the AC power supply stand.



Setting Overview

1

The LS-7000 Series is in measurement operation according to a variety of settings. The following section provides information on each mode in detail and how to switch between modes.



(See Section 3 Operation Control on page 3-1)

(See Section 4 Tolerance(LIMIT) Settings on page 4-50)

(See Section 5 Environment Settings on page 5-1)

Program Settings

Settings for measurement are registered as programs. The following settings are possible.

- Area Setting
  Set the measuring part.
- Compensation Setting
  Set the compensation detail of errors in measurement.
- Output Setting
  Set the processing and output details of the measuring value.
- Option Setting
  Set the display unit and other items.

See Section 4 Function Settings on page 4-1.

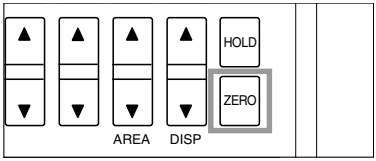
The LS-7000 Series will be reset to the initial status by turning the LS-7000 Series ON with the ZERO key pressed. (Page 1-21)

Resetting to Initial Status

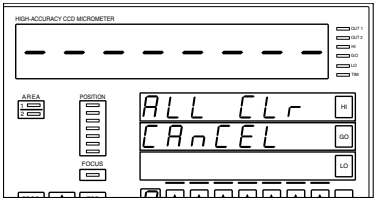
The following section provides information on how to reset all the programs and environment settings to factory-set values.

Tips Refer to 5-2 Resetting All Programs on page 5-5 if the resetting of only the programs to factory-set values is required.

1 Turn on the LS-7000 Series with the ZERO key pressed.

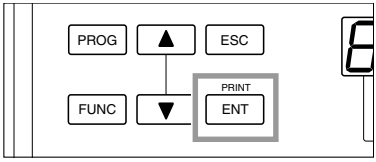


This display will appear when the LS-7000 Series is turned ON.



2 Press the ▲ or ▼ key and select Yes.

3 Press the ENT key after the initialization of the LS-7001 is confirmed.



MEMO

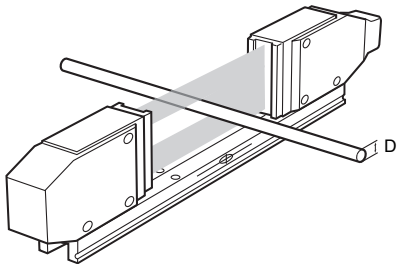
Chapter 2

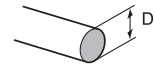
Easy Setting Guide

The LS-7000 Series is used for a variety of measurement applications if the LS-7000 Series is set properly. This section provides information on targets and settings for typical applications respectively.

Measurement of Outer Diameter and Width (with Single Measuring Head)

In the following example, a single measuring head is used to measure the outer diameter of an object in one direction. The result of measurement is displayed as OUT1.





Measures the outer diameter in one direction.

■ Set Values

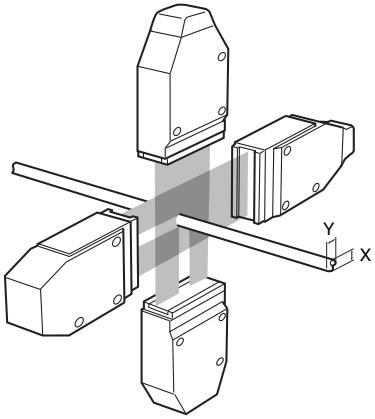
Set item		Set value	
Area setting		AREA 1	AREA 2
	AREA	Head 1 DIA	No settings are required.
Calibration		Make settings if required.	
Output setting		OUT 1	OUT 2
	Operation	A1: 1.0 A2: OFF	No settings are required.
	Averaging	Select the value according to the line speed.	
	Measuring mode	Normal	
	Offset	No settings are required.	
Tolerance setting		Set the upper and lower limit values.	

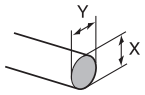
■ Reference

Area Settings (Page 4-7)
Calibration Settings (Page 4-20)
Output Settings (Page 4-28)
Tolerance Settings (Page 4-50)

Measurement of Outer Diameter and Width (with Two Measuring Heads)

In the following example, two measuring heads are used to measure the average outer diameter of an object in two directions. The measurement of the object in two directions ensures high accuracy. The result of measurement is displayed as OUT1.





$$D=\frac{X+Y}{2}$$

Measures the outer diameter in two directions.

■ Set Values

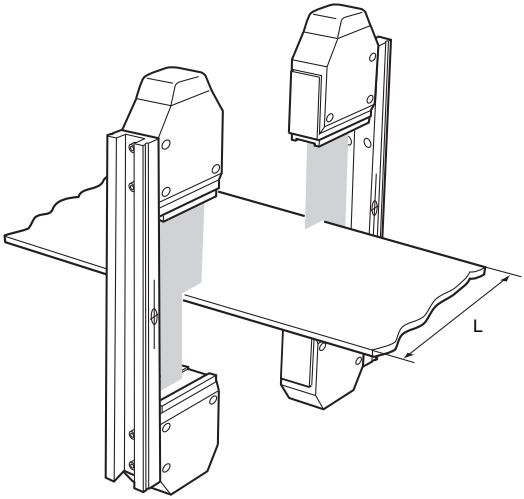
Set item		Set value	
Area setting		AREA 1	AREA 2
	AREA	Head 1 DIA	Head 2 DIA
Calibration		Make settings if required.	
Output setting		OUT 1	OUT 2
	Operation	A1: 0.5 A2: 0.5	No settings are required.
	Averaging	Select the value according to the line speed.	
	Measuring mode	Normal	
	Offset	No settings are required.	
Tolerance setting		Set the upper and lower limit values.	

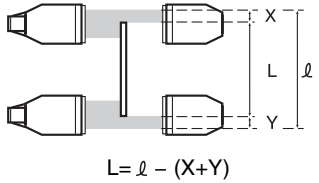
■ Reference

Area Settings (Page 4-7)
Calibration Settings (Page 4-20)
Output Settings (Page 4-28)
Tolerance Settings (Page 4-50)

Measurement of Outer Diameter and Width (with Two Measuring Heads for Larger Objects)

A sheet cannot be located in the measuring area of a single measuring head if the width or diameter of the sheet is excessively large. In that case, the sheet can be measured with two measuring heads as shown below with the automatic zero function and the master workpiece used. The result of output is displayed as OUT1.





■ Set Values

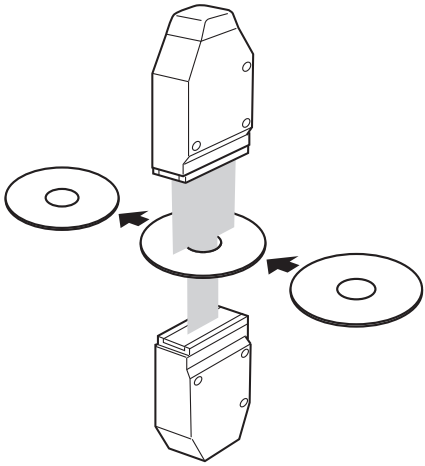
Set item		Set value	
Area setting		AREA 1	AREA 2
	AREA	Head 1 B-EDGE	Head 2 B-EDGE
Calibration		Make settings if required.	
Output setting		OUT 1	OUT 2
	Operation	A1: –1.0 A2: –1.0	No settings are required.
	Averaging	Select the value according to the line speed.	
	Measuring mode	Normal	
	Offset	Input the size of master workpiece.	
Tolerance setting		Set the upper and lower limit values.	

■ Reference

Automatic Zero Function: Measure the master workpiece and make automatic zero settings. (Page 3-6)
Area Settings (Page 4-7)
Calibration Settings (Page 4-20)
Output Settings (Page 4-28)
Tolerance Settings (Page 4-50)

Measurement of Inner Diameter and Clearance

In the following example, the inner diameter of the workpiece is measured while the workpiece moves. The maximum value measured is taken as the inner diameter of the workpiece. The result of output is displayed as OUT1.



■ Set Values

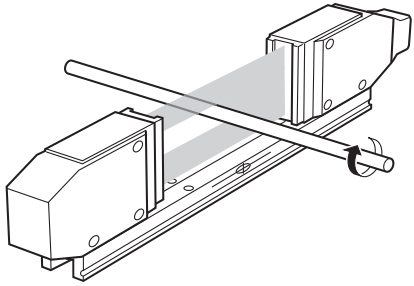
Set item		Set value	
Area setting		AREA 1	AREA 2
	AREA	Head 1 SEG (001-E, 002-E)	No settings are required.
Calibration		Make settings if required.	
Output setting		OUT 1	OUT 2
	Operation	A1: 1.0 A2: OFF	No settings are required.
	Averaging	Select the value according to the line speed.	
	Measuring mode	Peak hold	
	Offset	No settings are required.	
Tolerance setting		Set the upper and lower limit values.	

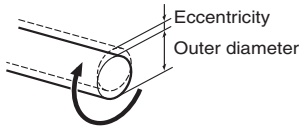
■ Reference

Area Settings (Page 4-7)
Calibration Settings (Page 4-20)
Output Settings (Page 4-28)
Tolerance Settings (Page 4-50)

Measurement of Outer Diameter and Eccentricity

In the following example, the outer diameter and eccentricity of the roller is measured while the roller moves. The outer diameter is displayed as OUT1, and the eccentricity is displayed as OUT2.





■ Set Values

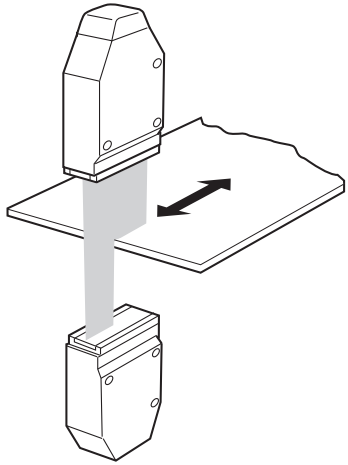
Set item		Set value	
Area setting		AREA 1	AREA 2
	AREA	Head 1 DIA	Head 1 T-EDGE
Calibration		Make settings if required.	
Output setting		OUT 1	OUT 2
	Operation	A1: 1.0 A2: OFF	A1: OFF A2: 1.0
	Averaging	1	Select the value according to the rpm.
	Measuring mode	Average hold	Peak-to-peak hold
	Offset	No settings are required	No settings are required
Tolerance setting		Set the upper and lower limit values.	

■ Reference

Area Settings (Page 4-7)
Calibration Settings (Page 4-20)
Output Settings (Page 4-28)
Tolerance Settings (Page 4-50)

Measurement of Movement and Positioning

In the following example, the movement or position of the workpiece is measured. The result of output is displayed as OUT1.



■ Set Values

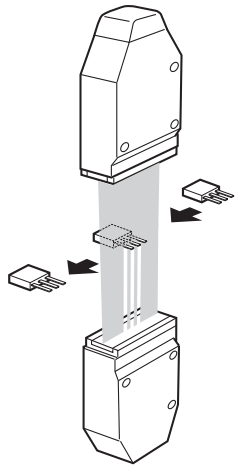
Set item		Set value	
Area setting		AREA 1	AREA 2
	AREA	Head 1 SEG. (000-E, 002-E)	No settings are required
Calibration		Make settings if required.	
Output setting		OUT 1	OUT 2
	Operation	A1: 1.0 A2: OFF	No settings are required
	Averaging	Select the value according to the line speed	
	Measuring mode	Normal	
	Offset	No settings are required	
Tolerance setting		Set the upper and lower limit values.	

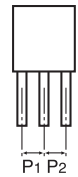
■ Reference

Area Settings (Page 4-7)
Calibration Settings (Page 4-20)
Output Settings (Page 4-28)
Tolerance Settings (Page 4-50)

Measurement of Pitch

The single pitch of connectors pins or IC pins is measured by the LS-7000 Series. Furthermore, multiple pitch of pins is measured with the program function or RS-232C interface used.





The center pitches of the two portions are measured at a time.

■ Set Values

Set item		Set value	
Area setting		AREA 1	AREA 2
	AREA	Head 1 SEG (002-P, 004-P)	Head 1 SEG (004-P, 006-P)
Calibration		Make settings if required.	
Output setting		OUT 1	OUT 2
	Operation	A1: 1.0 A2: OFF	A1: OFF A2: 1.0
	Averaging	Select the value according to the line speed	Select the value according to the line speed
	Measuring mode	Sample hold 1/2	Sample hold 1/2
	Offset	No settings are required	No settings are required
Tolerance setting		Set the upper and lower limit values.	

■ Reference

RS-232C (Page 7-1)
Area Settings (Page 4-7)
Calibration Settings (Page 4-20)
Output Settings (Page 4-28)
Tolerance Settings (Page 4-50)

Chapter 3

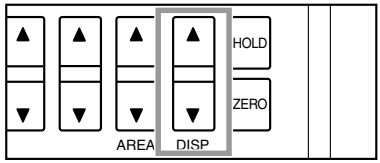
Operation Control

This section provides information on setting control items on the control panel while the LS-7000 Series is in measurement operation.

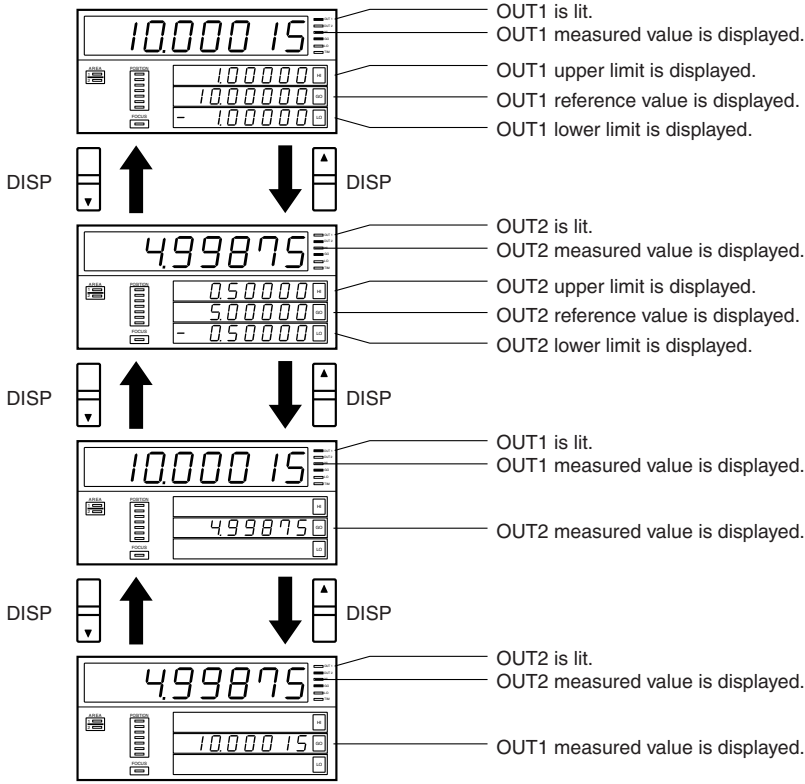
Selection of Measured Value Display

Displayed values on the main and sub displays can be switched. The main display can display the measured results of OUT1 (or OUT2) and the sub display can display tolerance comparator set values or measured values simultaneously. Four display types can be selected in two tolerance modes (i.e., the reference value mode and threshold mode). Refer to Option settings on page 4-54 for the selection of the reference value mode or threshold mode.

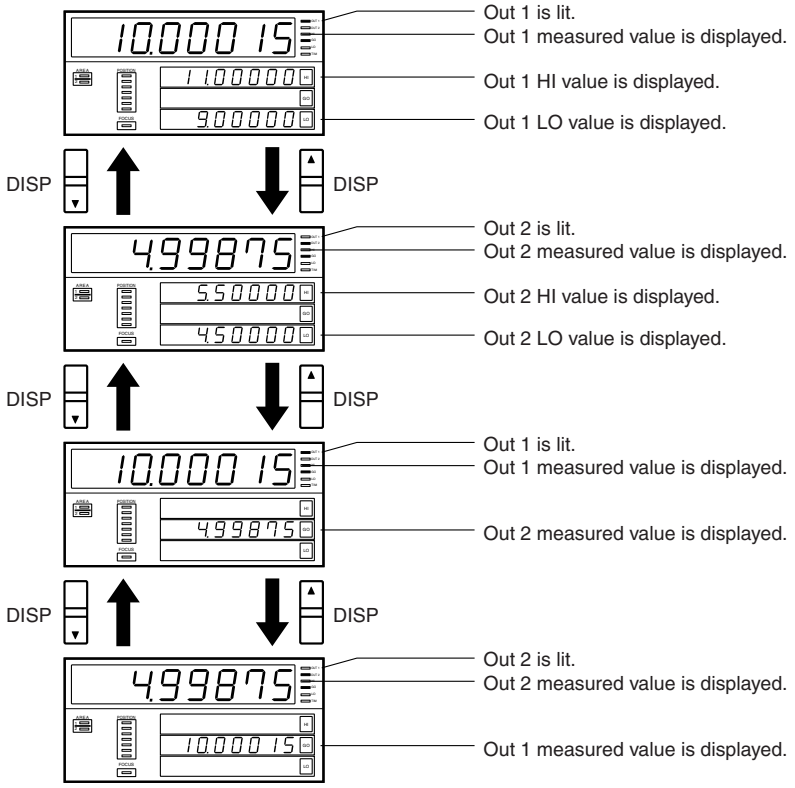
Press the DISP (display) key and select the value or item.
The following displayed values can be selected.



■ Tolerance Mode with Reference Value



■ Tolerance Mode with Threshold



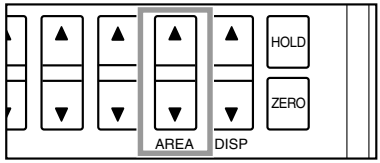
Tips The displayed settings are saved in the program settings.

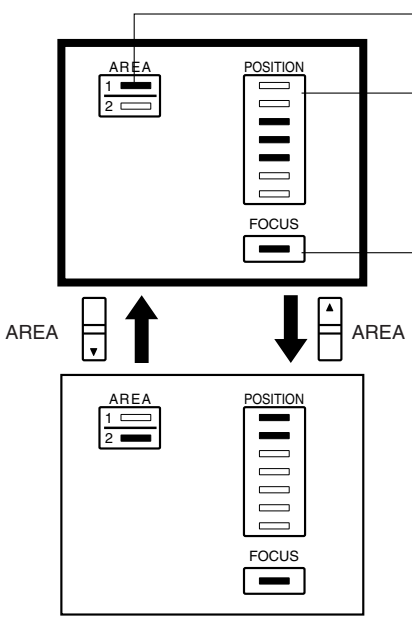
Area Monitor

The area monitor display can be used to confirm the insertion positions of the targets in AREA1 or AREA2 to be selected.

Press the AREA key on the control panel and select the area.

The following items will be displayed when the area is selected.





The selected area number is lit.

POSITION Monitor
The POSITION monitor is lit according to the position and size of the target in the CCD scanning range.

FOCUS monitor
The FOCUS monitor is lit according to the distance between the receiver and target.

Tips The displayed settings are saved in the program settings.

Hold Function

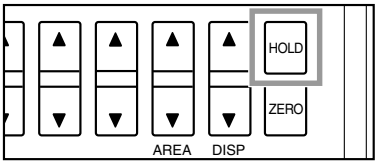
Measured values can be held and displayed. Furthermore, measuring mode combinations allow the measurement of a variety of values, such as maximum and minimum values. The types of measured values held vary with the measuring mode.
Refer to Measuring Mode on page 4-33 for details.

Measured values are held and displayed through the following functional components.
- Control panel
- External I/O terminals
- RS-232C interface

■ Control Panel

If either the OUT1 or OUT2 measured value is displayed, the displayed value will be held. If both OUT1 and OUT2 measured values are displayed, both values will be held.

Press the HOLD key on the control panel.
When the measured value is held, the TIM indicator on the right-hand side of the main display will be lit. To cancel the hold status, press the HOLD key again.



Tips By pressing the ESC key, the measured value kept on hold will be reset.

■ External I/O Terminals

Measured values will be held by short-circuiting the timing input terminal and COM terminal together on the rear panel of the controller.
Refer to Section 6 I/O Terminals on page 6-1 for the external input terminals to be used.

■ RS-232C Interface

Commands sent by external devices through the RS-232C interface make it possible to put measured values on hold.
Refer to Section 7 RS-232C on page 7-1 for the commands in detail.

Automatic Zero Function

The automatic zero function sets measured values to zero (0.00000) instantly. This function is convenient for zero-point calibration for a variety of targets. Furthermore, master calibration is possible by using this function in combination with the offset function.

Note: This function will not be available while the controller is awaiting the result of measurement, during which the monitor will display "– – –. – – – –.")

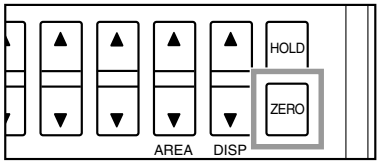
Tips The automatic zero value will not be lost after the LS-7000 Series is turned off. The automatic zero value for each program will be stored.

Automatic zero settings are made through the following functional components.
- Control panel
- External terminal
- RS-232C interface

■ Control Panel

When only the OUT1 or OUT2 measured value is displayed, auto zero setting is made for the displayed value. If both OUT1 and OUT2 values are displayed, auto zero setting is made for both values.

Press the ZERO key on the control panel.
Press the ZERO key again to cancel the auto zero setting.



■ External I/O Terminal

Auto zero setting is made by short-circuiting the ZERO and COM terminals on the rear panel of the controller. Refer to Section 6 I/O Terminals on page 6-1 for details.

Note: Automatic zero cannot be canceled through the external I/O terminals.

■ RS-232C Interface

Commands sent by external devices through the RS-232C interface make it possible to set or cancel the automatic zero function. Refer to Automatic Zero ON/OFF on page 7-10 for details.

Tips **Master Calibration with Offset Function (Automatic Offset Function)**
Set the size of a master workpiece to an offset value and make an automatic zero setting while measuring the master workpiece. Then the size of the master workpiece will be displayed as an offset value. Refer to Measurement of Outer Diameter and Width (with Two Measuring Heads) on page 2-4 for an application example. Refer to Offset on page 4-43 for the offset function in detail.

Panel Lock Function

The panel lock function is used to lock the control panel so that no key input will be enabled. As a result, there will be no risk of making setting changes with careless key input.

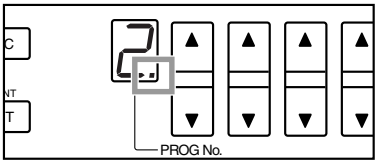
Panel Lock Types

The following types of panel locks are possible with the PAN-LOC settings as environment settings. Refer to Panel Lock on page 5-13 for details.

- Set the panel lock type to ALL: All keys will be locked.
- Set the panel lock type to PART: All keys excluding the DISP and AREA keys for the display change function and [HI], [GO], and [LO] keys for the tolerance setting function and [HOLD] key will be locked. Select this type if you make tolerance changes frequently without changing any other setting.

Panel Lock Display

The decimal in the PROG No. display will flash while the panel is locked.



Tips The panel lock status will not be lost after the LS-7000 Series is turned off or program number changes are made.

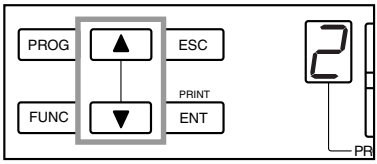
Panel lock settings are made through the following functional components.

- Control panel
- RS-232C interface

■ Control Panel

Press the [▲] and [▼] keys on the control panel together for 2 seconds.

To cancel the panel lock status, repeat the above.



■ RS-232C Interface

Commands sent by external devices through the RS-232C interface make it possible to set or cancel the panel lock function. Refer to Panel Lock ON/OFF on page 7-11.

Program Changes

The following section provides information on how to call 16 programs saved in the LS-7000 Series.

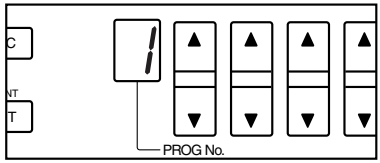
Names and Number of Programs

The selected program is displayed on the display monitor next to the [PROGRAM No.] key.

It is possible to register 16 alphanumeric characters (i.e., 0 through 9 and A through F) for program numbers.

Programs are selected through the following functional components.

- Control panel
- External I/O terminals
- RS-232C interface



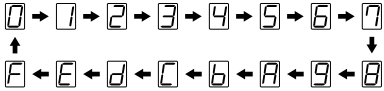
Note: The operation method varies with the P-SELECT setting as an environmental setting. Refer to Program on page 5-5 for environment settings in detail.

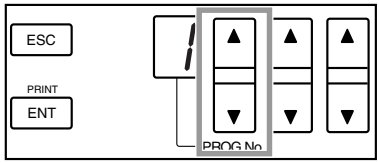
P-SELECT setting	Operation method
PANEL	Control panel/RS-232C interface
TERMINAL	I/O terminals (P1 through P4)

■ Control Panel

Press the [PROGRAM No.] key (▲ or ▼ key) on the control panel.

The program numbers will be displayed in sequence by pressing the key repeatedly.





■ External I/O Terminals

External I/O terminals P1 through P4 on the rear panel of the controller can be used for program selection. Refer to Section 6 I/O Terminals on page 6-1 for external I/O terminals to be used and program numbers in detail.

■ RS-232C Interface

Commands sent by external devices through the RS-232C interface make it possible to select programs. Refer to PROGRAM No. on page 7-11 for the RS-232C interface in detail.

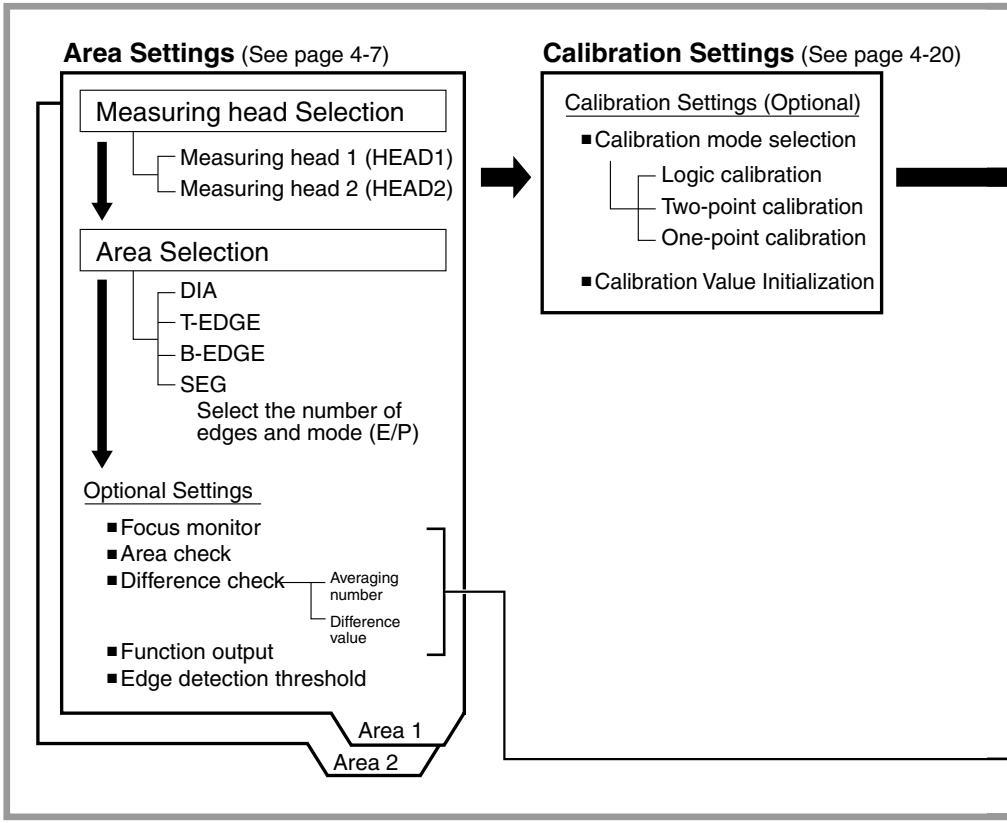
Chapter 4

Function Settings

The LS-7000 Series is available to the measurement of a variety of items by making setting changes. These settings can be registered as programs that can be used whenever required. This section provides information on the overview of program settings and setting methods.

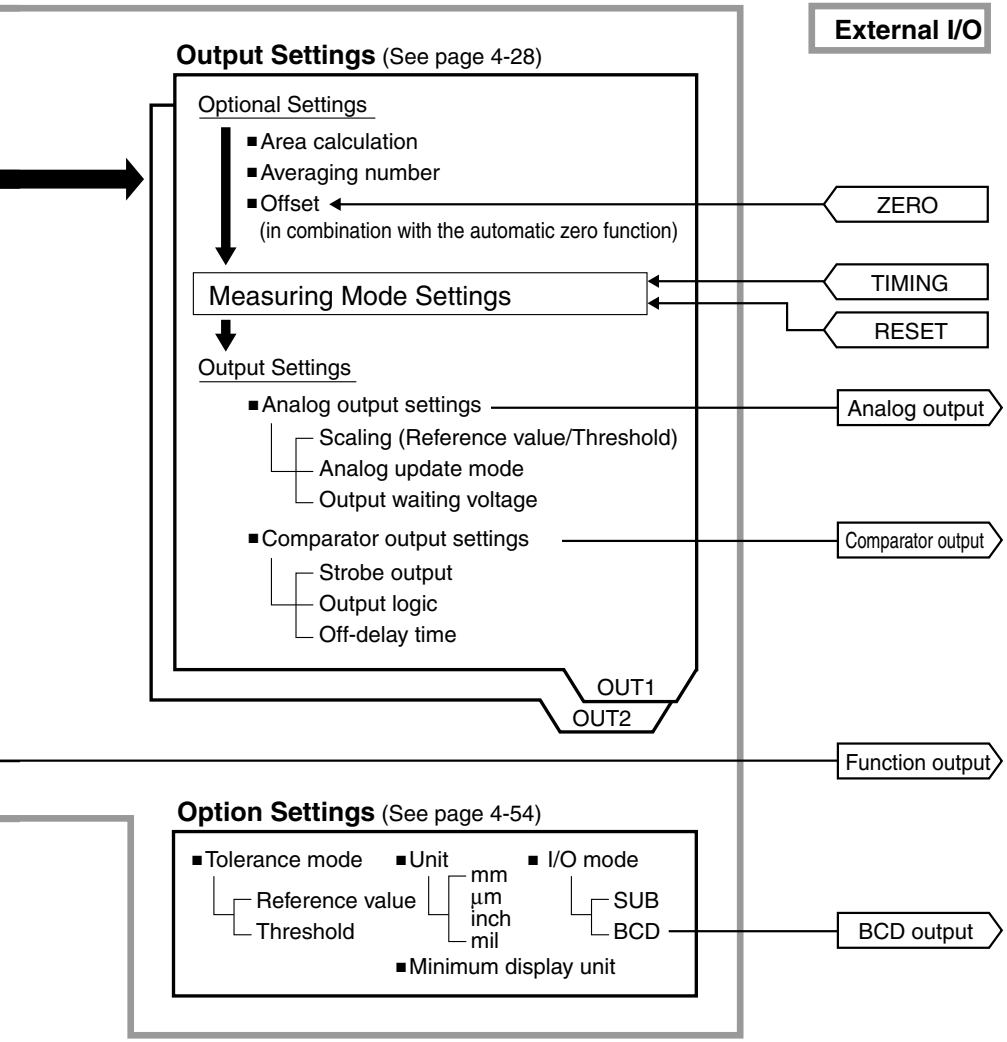
Flow of Program Settings

The following section provides information on the types and flows of program settings available to the LS-7000 Series along with the relationship between the program settings and external I/O.



Environment Settings (See page 5-1)

- ■Program
- ■RS-232C
- ■Head
- ■Buzzer
- ■Panel lock


External I/O
Output Settings (See page 4-28)
Optional Settings
■Area calculation
■Averaging number
■Offset
(in combination with the automatic zero function)
ZERO
Measuring Mode Settings
TIMING
RESET
Output Settings
■Analog output settings
Analog output
Scaling (Reference value/Threshold)
Analog update mode
Output waiting voltage
■Comparator output settings
Comparator output
Strobe output
Output logic
Off-delay time
OUT1
OUT2
Function output
Option Settings (See page 4-54)
■Tolerance mode
Reference value
Threshold
■Unit
mm
µm
inch
mil
■ I/O mode
SUB
BCD
BCD output
■Minimum display unit

Default Values and Possible Setting Ranges

The following programs settings are made by default.
Items in parentheses indicate what is displayed on the monitor.

■ Area Settings (AREA) (Page 4-7)

Item		Default	Possible setting range
Measuring head selection (HEAD No.)		1	1, 2
Area (AREA)		DIA	Diameter (DIA) Top edge (T-EDGE) Bottom edge (B-EDGE) Segment (SEG) Specified SEG edge number: -127 to +127 SEG mode: Edge (E) or Pitch (P)
Focus monitor (FOCUS)		5	0 to 9
Area check (A-TEST)		OFF	OFF (No area check), 2 to 127
Difference check (DIFF)	Averaging number (AVE)	1	1, 2, 4, 8, 16
	Difference value	1000	1 to 9999 (in μm, mm, inch, or mil)
Function output setting (FUNCTION)		FOCUS	Focus monitor (FOCUS), Area check (A-TEST), Difference check (DIFF)
Edge detection threshold (LEVEL)		50	10 to 99

■ Calibration Settings (CALIB) (Page 4-20)

Item	Default	Possible setting range
Calibration mode (CAL-MODE)	THEORY	Logic calibration (THEORY), 2-point calibration (2-TARGET), or 1-point calibration (1-TARGET)
T1-A/T1-B/T2-A/T2-B		–99.99995 to +99.99995mm ❊

■ Tolerance Settings (LIMIT) (Page 4-50)

Item		Default	Possible setting range
Threshold mode (TOL)	HH output range (HH)	+40.00000	-99.99995 to +99.99995mm ❊
	HI output range (HI)	+30.00000	
	LO output range (LO)	0.00000	
	LL output range (LL)	-10.00000	
	HOLD-H	OFF	OFF, -99.99995 to +99.99995mm ❊
	HOLD-L	OFF	
Reference value mode (DEV)	STANDARD	+10.00000	-99.99995 to +99.99995mm ❊
	UPPER	+1.00000	
	LOWER	-1.00000	
	HOLD-H	OFF	OFF, -99.99995 to +99.99995mm ❊
	HOLD-L	OFF	

■ Output Settings (OUTPUT) (Page 4-28)

Item		Default	Possible setting range
Area calculation (CALC)		OUT1: A1 1.0 A2 OFF OUT2: A1 OFF A2 1.0	OFF, 1.0, 0.5, –1.0, –0.5
Averaging number (AVERAGE)		512	1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096
Measuring mode (MEA-MODE)		Normal	Normal (NORMAL) Peak hold (P-HOLD) Bottom hold (B-HOLD) Peak-to-peak hold (D-HOLD) Average hold (AV-HOLD) Automatic peak hold (A-P-HOLD) Automatic bottom hold (A-B-HOLD) Automatic peak-to-peak hold (A-D-HOLD) Sample hold 1 (S-HOLD1) Sample hold 2 (S-HOLD2) Self-timing hold (SELF-T) Self-timing period: 1 to 9999 ms (By default set to 100 ms)
Offset (OFFSET)		0.00000	-99.99995 to +99.99995mm ❊
Threshold (TOL)	Scaling at +10 V (A-OUT +10)	+30.00000	
	Scaling at –10 V (A-OUT –10)	0.00000	
Reference value (DEV)	Scaling (A-UNIT)	1000 μm/V	1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000 μm/V
Analog output setting: Analog update mode (A-SET)		OFF	OFF, ON
Analog output setting: Output waiting voltage (A-CONT)		+10.5V	+10.5V, Hold, 0V
Comparator output setting: Strobe output time (STOBE-T)		0.4ms	0.4, 0.8, 1.6, 3.3, 6.6, 13.3, 26.6ms
Comparator output setting: Output logic (OUT-SET)		N.O.	Normally open (N.O.) Normally closed (N.C.)
Comparator output setting: Off-delay time (OFF-DLY)		0ms	0, 0.4, 0.8, 1.6, 3.3, 6.6, 13.3, 26.6ms

■ Option Settings (OPTION) (Page 4-54)

Item	Default	Possible setting range
Tolerance mode (LIMITS)	DEV	Reference value (DEV) or threshold (TOL)
Timing mode (T-MODE)	ASYNC	Synchronous (SYNC) or asynchronous (ASYNC)
Unit (D-UNIT)	mm (UNIT1)	mm (UNIT1), μm (UNIT2), inch (UNIT3), mil (UNIT4)
Minimum display unit (D-RES)	0.00005	mm: 0.00001, 0.00002, 0.00005, 0.0001, 0.0002, 0.001, 0.01, 0.1
I/O mode (C-OUT)	SUB	SUB mode (SUB), BCD mode (BCD)

❊ Displayed values are based on a minimum display unit of 0.00005 millimeters. Refer to page 4-60 for other types of minimum display units.

Copying Program Setting Details and Initialization

The LS-7000 Series can be initialized so that the details of programs will return to ones set by default. Furthermore, the LS-7000 Series has a function making it possible to copy the details of any program to different programs.

Copying Program Setting Details

The details of any program can be copied to different programs by using the P-COPY item as an environment setting. Refer to Copying Programs on page 5-5 for details.

Types of Initialization

The following three types of initialization are available.

- Initialization of a single program
- Initialization of all programs
- Total initialization of all programs and environment settings.

■ Initialization of Single Program

The details of a single program can be initialized by using the P-COPY item as an environment setting. Refer to Copying Programs on page 5-5 for details.

■ Initialization of All Programs

The details of all programs can be initialized by using the P-CLEAR item as an environment setting menu. Refer to Resetting All Programs on page 5-6.

■ Program Initialization

The LS-7000 Series can be initialized so that the details of programs and environment settings will return to ones set by default. Refer to Resetting to Initial Status for details on page 1-21.

Area Settings

Area settings are used to determine the measurements taken from a variety of objects placed in the beam. The LS-7000 Series can use up to two measuring heads to set two measurements (AREA1 and AREA2) for simultaneous measurements.

Area Settings

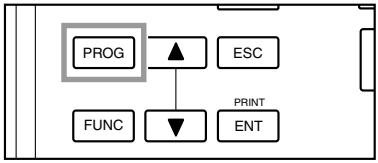
Area settings include the following items.

- Area: Select the measuring head number together with the DIA, T-EDGE, B-EDGE, or SEG mode.
- Focus monitor: A function to check whether the target is within the measuring range. Set the best measuring range (i.e., the distance between the target and transmitter) with this function.
- Area check: Set the total number of edges to be measured. If the number of edges detected does not coincide with the set value, the measured value will be invalidated.
- Difference check: If there is a radical change between measured values, the change will be detected and output. Set the value for the change to be detected.
- Function output selection: Set the items to be output from the output terminal on the rear panel.
- Edge detection threshold change: Set the threshold to be detected when measuring highly transparent objects.

Area Setting Procedure

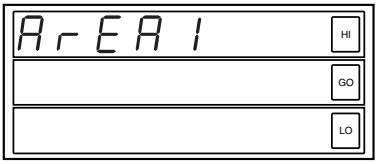
Make settings while monitoring the sub display.
The following procedure is for area settings for measuring head 1.

1 Press the PROG key.



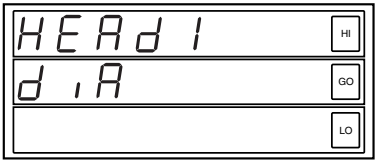
2 Check that the area to be set will appear. Press the ENT key.

To set AREA2, press the FUNC key. Then press the ENT key.

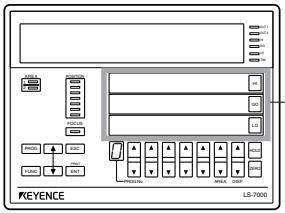


3 The area setting screen will appear.

Press the FUNC key to select another set area item.

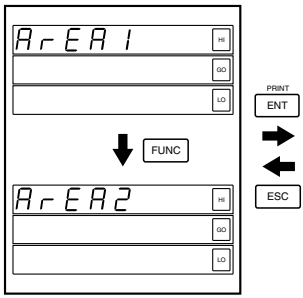


Flow of Area Setting Display

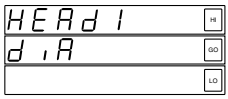


4

Area Setting

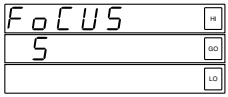


PRINT
ENT
ESC



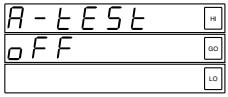
Area Setting
(See page 4-9)

FUNC



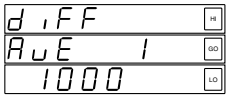
Focus Monitor
(See page 4-14)

FUNC



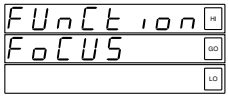
Area Check
(See page 4-15)

FUNC



Difference Check
(See page 4-16)

FUNC



Function Output Selection
(See page 4-17)

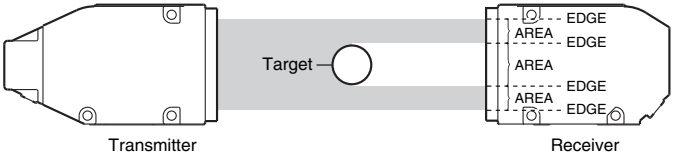
FUNC

Change of Edge Detection Threshold
(See page 4-18)

Area Selection

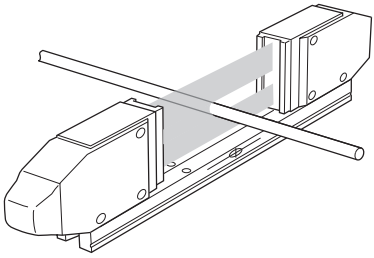
Area

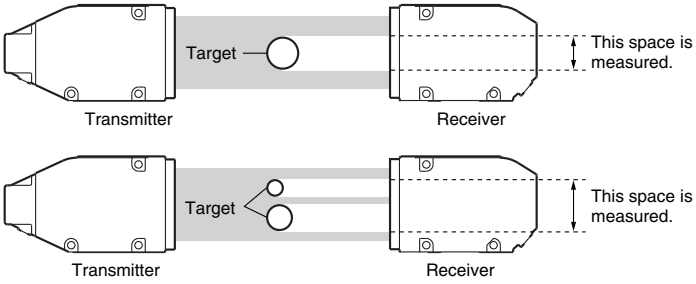
When a target is located in the measuring area as shown below, the light into the receiver is partly obstructed, thus creating a shadow.
The contour of the shadow is called “edge.” The area is surrounded by the edge line.
The LS-7000 Series can measure objects with area designation or edge designation.
Area designation is possible in DIA, T-EDGE, or B-EDGE mode. Edge designation is possible in SEG mode.



■ DIA (Diameter)

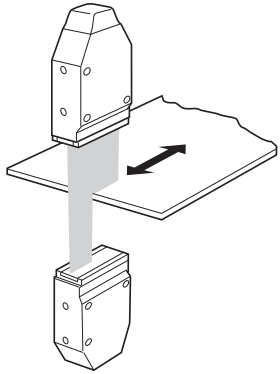
When the LS-7000 Series is in DIA measurement operation, it measures the outer diameters of round bars or transparent objects. The area between the top of the first shadow and the bottom of the last shadow is measured as shown in the illustrations.





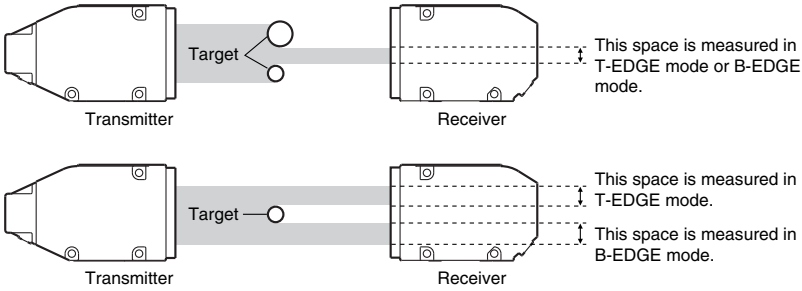
■ T-EDGE (Top Edge)/B-EDGE (Bottom Edge)

Select either of these settings for the gap measurement or positioning of rollers.



When the LS-7000 Series is in T-EDGE measurement operation, it measures the width of the bright portion between the top of the measuring head and the first shadow in the measuring area.

When the LS-7000 Series is in B-EDGE measurement operation, it measures the width of the bright portion between the bottom of the measuring area and the bottom of the last object in the beam.



Tips Setting the reference edge within the measuring area enables measurements in higher repeat accuracy.

■ SEG (Segment)

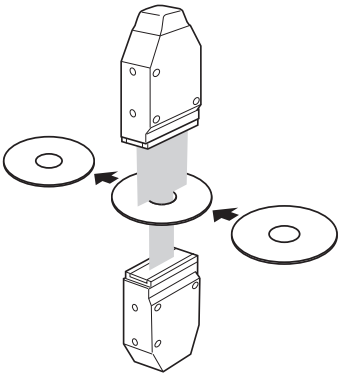
Select this setting for the measurement of the inner diameters of discs or the measurement of pitches.
The edge where the measurement of the object in the measuring area starts is called “start edge” and the edge where the measurement terminates is called “end edge.” The space between these edges specified is measured.
Segment measurement is performed in E mode or P mode. If objects are measured with the virtual center of the light axis set, use edge 0.

Setting Range

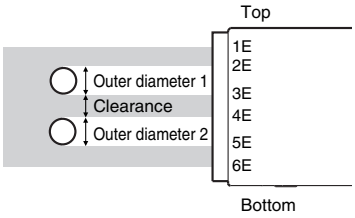
- Edge or pitch numbers can be designated between –127 and 127.
- The duplicated designation of an edge or pitch number will set the measured value to 0.
- If edges or pitches are designated in reverse order, negative measured values will be obtained.

E (Edge) Mode

The LS-7000 Series measures objects based on the edges in this mode.

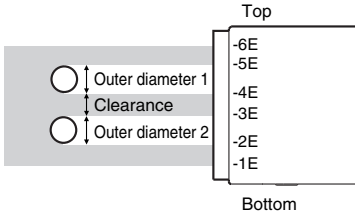


Set the edge numbers to positive values beginning with the top of the measuring head. The following example shows positive edge numbers and measuring portions.



Outer diameter 1: Space between 2E and 3E (+2E to +3E)
Outer diameter 2: Space between 4E and 5E (+4E to +5E)
Clearance: Space between 3E and 4E (+3E to +4E)

Set the edge numbers to negative values beginning with the bottom of the measuring head. The following example shows negative edge numbers and measuring portions.

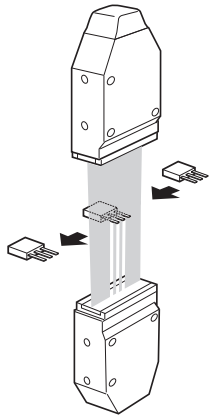


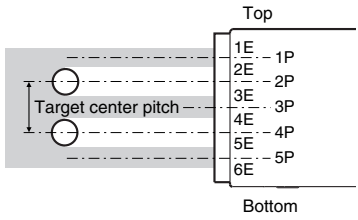
Outer diameter 1: Space between –5E and –4E (–5E to –4E)
Outer diameter 2: Space between –3E and –2E (–3E to –2E)
Clearance: Space between –4E and –3E (–4E to –3E)

P (Pitch) Mode

The LS-7000 Series measures objects based on the middle point between the edges of the objects in this mode.

In this example as shown, five P-mode edges exist, based on which the LS-7000 measures the center pitch of the target in the measuring area.
Center pitch: The space between 2P and 4P

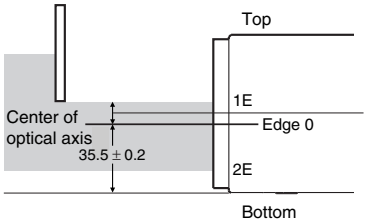




Edge 0

Edge 0 refers to a method of measurement, in which the center of the optical axis is used as an origin. In this case, set the edge number to 0.

Use this method to position the objects or measure the movement or deviation of objects.



Edge position of workpiece
: Space between+1E and 0 (+1E to 0E)

In the edge 0 method, the E and P modes will not make any difference.

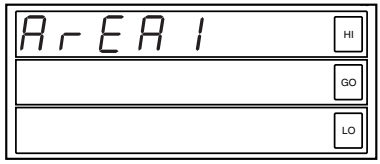
Tips Use edge 0 method if higher repetitive accuracy is required from the measurement of objects.

■ Setting Procedure

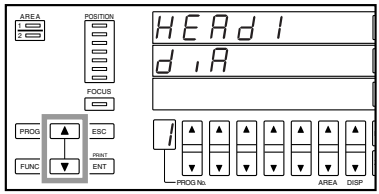
1 Select the area to be set and press the [ENT] key.

2 Press the [▲] or [▼] key and select the measuring method.

Set the following items that appear on the



screen.

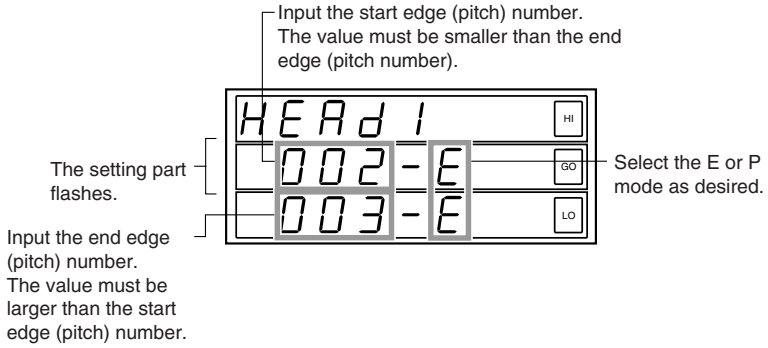


HEAd 1	Measuring head No. 1
HEAd2	Measuring head No. 2

d iA	DIA (Diameter)
t-EdGE	T-EDGE (Top edge)
b-EdGE	B-EDGE (Bottom edge)
002-E / 003-E	SEG (Segment)

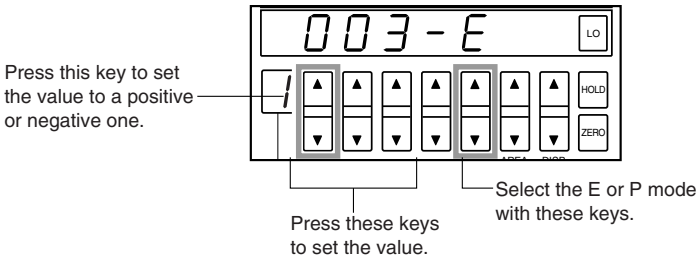
4

SEG (Segment) Setting



Note:
- The duplicated designation of an edge or pitch number will set the measured value to 0.
- If edges or pitches are designated in reverse order, negative measured values will be obtained.

(1) Input the start edge (pitch) number.



(2) Press the ENT key.

The input value is entered and the value in the next line flashes.

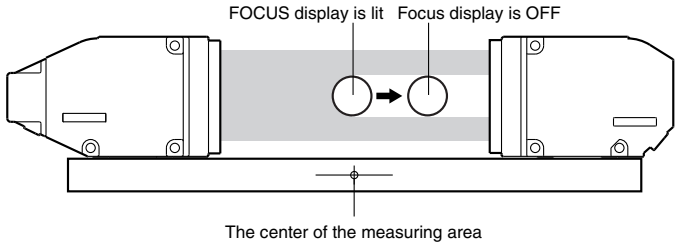
(3) Input the end edge (pitch) number.

4 Press the [ENT] key.

The input value is entered and the area display appears again.

Focus Monitor

The focus monitor is a function that makes it possible to check whether the target is located within the range where the highest precision measurement of the target is ensured. The focus monitor range is the distance between the receiver and target in the measuring area. When the target is within the range specified, the FOCUS indicator will light.



Setting Range

The value is set at 10 levels between 0 and 9. Set the value to 0 if the focus monitor function is not used. Refer to Focus Characteristics on page 8-6 for the set values and focus range in detail.

Tips The result of focus monitoring can be externally output as function output. Refer to Selection of Function Output on page 4-17 for details.

■ Setting Method

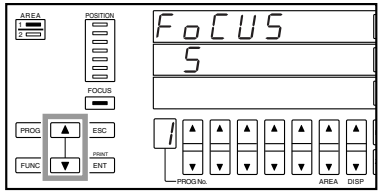
1 Select the area to be set and press the [ENT] key.

2 Press the [FUNC] key.

3 Press the [▲] or [▼] key and set the value.

4 Press the [ENT] key after the value is set.

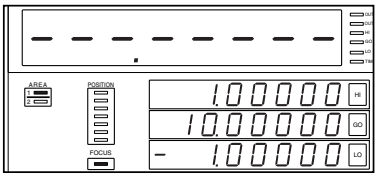
The input value is entered and the area display appears again.



Area Check

Set the total number of edges to be measured. If the number of edges detected does not coincide with the set value, the measured value will be invalidated.
This function makes it possible to prevent the measurement of abnormal values that may result if dust or oil is stuck on the measuring head.

The monitor will display the following data if the measured value is invalidated.



Setting Range

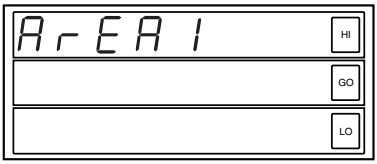
The setting range is between 2 and 127. Set the value to OFF if no area check is made.

Tips The result of area checking can be external output as function output. Refer to Selection of Function Output on page 4-17 for details.

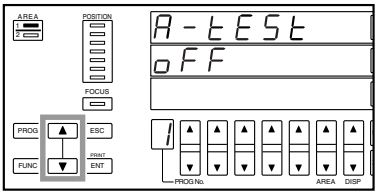
■ Setting Method

1 Select the area to be set and press the [ENT] key.

2 Press the [FUNC] key twice.

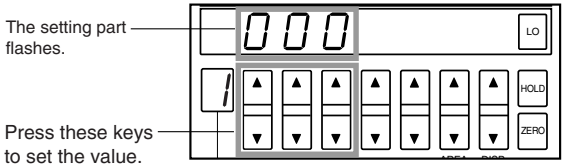


3 Press the [▲] or [▼] key and make ON/OFF settings.



ON Setting

(1) Input the number of edges to be measured.



4 Press the [ENT] key after the value is set.

The input value is entered and the area display appears again.

Difference Check

If there is a radical change between measured values, the change will be detected and output.

Setting Range

- Difference average: 1 to 16 times
- Difference value: 1 to 9999 μm

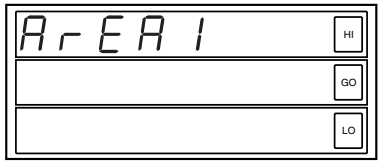
Note: The results of difference checks will be output externally, provided that DIFF function output settings are made properly in advance. Refer to Function Output Selection on page 4-19 for details.
The result output of a difference check is a 26.6-ms-long single output signal, which is not displayed on the control panel.

4

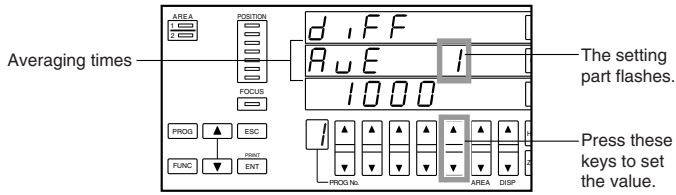
■ Setting Method

1 Select the area to be set and press the ENT key.

2 Press the FUNC key three times.

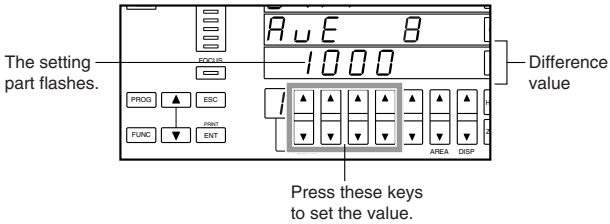


3 Press the ▲ or ▼ key and set the averaging number.



4 Press the ENT key.
The input value is entered and the difference value display flashes.

5 Press the ▲ or ▼ key and set the difference value.



6 Press the [ENT] key after the value is set.

The input value is entered and the area display appears again.

Function Output Selection

Select either Focus, Area, or Difference to be output from the output terminal block on the rear panel.

Setting Range

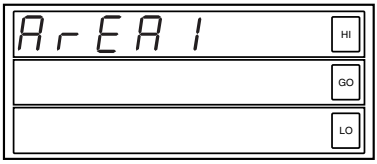
Any one of the following items is selectable for output. Refer to Section 6 I/O Terminals on page 6-1 for the FUNCTION output terminals in details.

- Focus monitor
- Area check
- Difference check

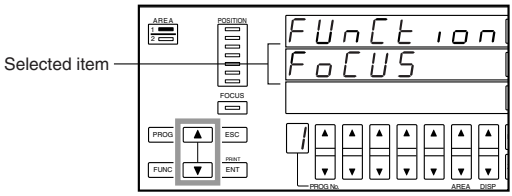
■ Setting Method

1 Select the area to be set and press the [ENT] key.

2 Press the [FUNC] key four times.



3 Press the [▲] or [▼] key and set the output item.



The following items are displayed for setting.

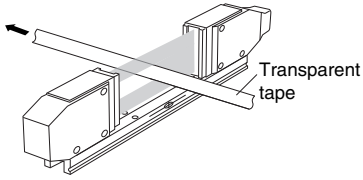
FoCUS	Focus monitor
A-tESt	Area check
diFF	Difference check

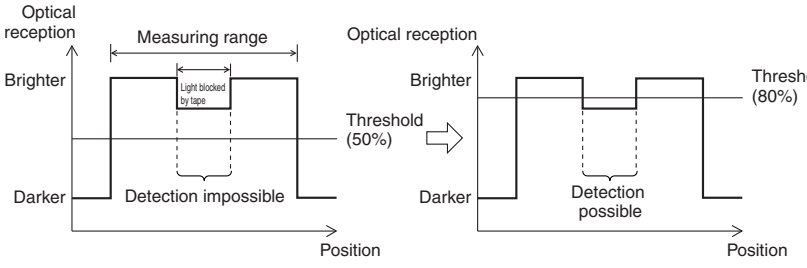
4 Press the [ENT] key.

The input value is entered and the area display appears again.

Change of Edge Detection Threshold

The following section provides information on how to make threshold changes for the measurement of highly transparent objects.





50% threshold

When measuring a highly transparent target, such as a plastic tape, the amount of light blocked by the tape is minimal. Therefore, the tape may not be detected if the threshold is low.

80% threshold

In that case, increase the threshold level so that the tape will be detected

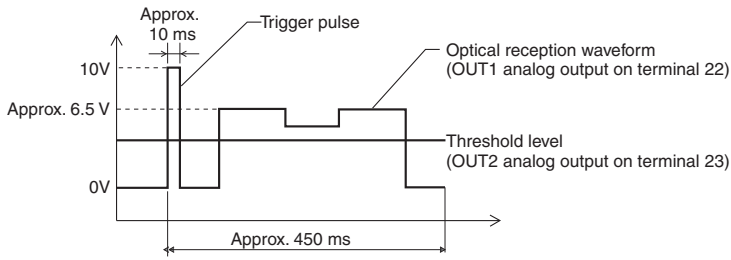
Setting Range

The threshold can be set between 10% and 99% in 1% increments.

Note:
- Only a single threshold can be set for each measuring head.
- In the measurement using the window edge such as T-EDGE or B-EDGE, the measurement may become unstable with a higher threshold. In such a case, use the reference edge or edge 0.

■ Optical Reception Waveform Output

While making a threshold setting for the target in the measuring area, an oscilloscope can be used to output the optical reception waveform of the target so that the threshold can be adjusted while monitoring the waveform.

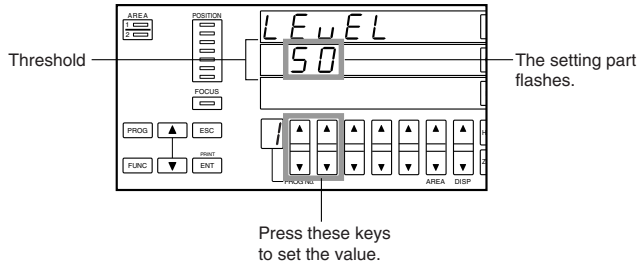


■ Setting method

1 **Select the area to be set and press the [ENT] key.**

2 **Press the [FUNC] key five times.**

3 **Press the ▲ or ▼ key and set the threshold.**



4 **Press the [ENT] key.**

The input value is entered and the area display appears again.

Calibration Settings

The measured value of a target may have a subtle error due to the surface condition and angle of the target. Calibration settings correct for this error. It is possible to make calibration settings for each area independently.

■ Types of Calibration Settings

Select the type of calibration from the following ones in advance. Refer to Calibration Type Selection on page 4-23.

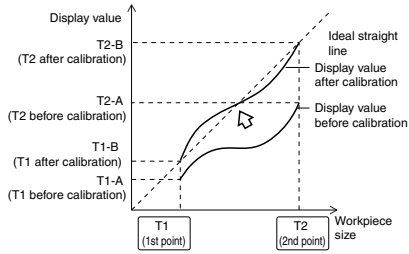
Logic calibration: Logic calibration requires two types of master workpieces that are different to each other in size. Calibration is performed according to pre-calibration and post-calibration values that are input by the user. This type of calibration is used for the measurement of the distance between two workpieces, for example.

Two-point calibration: Two-point calibration requires two types of master workpieces that are different to each other in size.

One-point calibration: One-point calibration requires a single master workpiece. This calibration is used for the size measurement of a single type of workpiece.

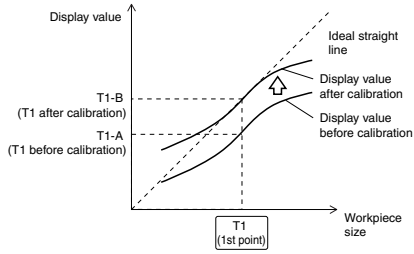
Logic Calibration/Two-point Calibration

Prepare target 1 (T1) and target 2 (T2) as two measuring points. The LS-7000 Series performs calibration on these points based on the T1-A and T2-A display values, which are obtained before calibration, and the T2-B and T2-B display values, which are obtained after calibration. In this case, the non-calibrated display values are converted into the calibrated display values with the span value (inclination) and shift value of the workpiece determined by the LS-7000 Series internally.



One-point Calibration

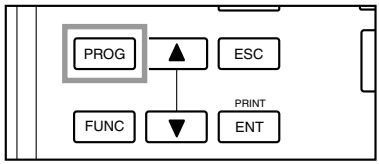
Prepare target 1 (T1) as a single measuring point. The LS-7000 Series performs calibration on this point based on the display value before calibration and that after calibration. In this case, the non-calibrated display value is converted into the calibrated display value with the span (inclination) and shift value of the workpiece determined by the LS-7000 Series internally. The span value is always set to 1.



■ Procedure for Calibration Settings

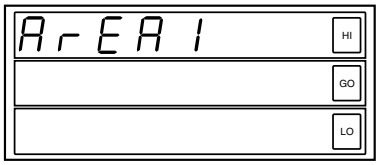
Make calibration settings while monitoring the sub display.

1 Press the PROG key.



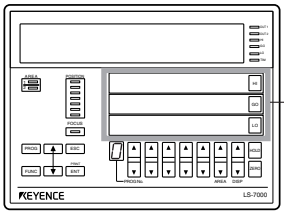
2 Press the FUNC key four times.

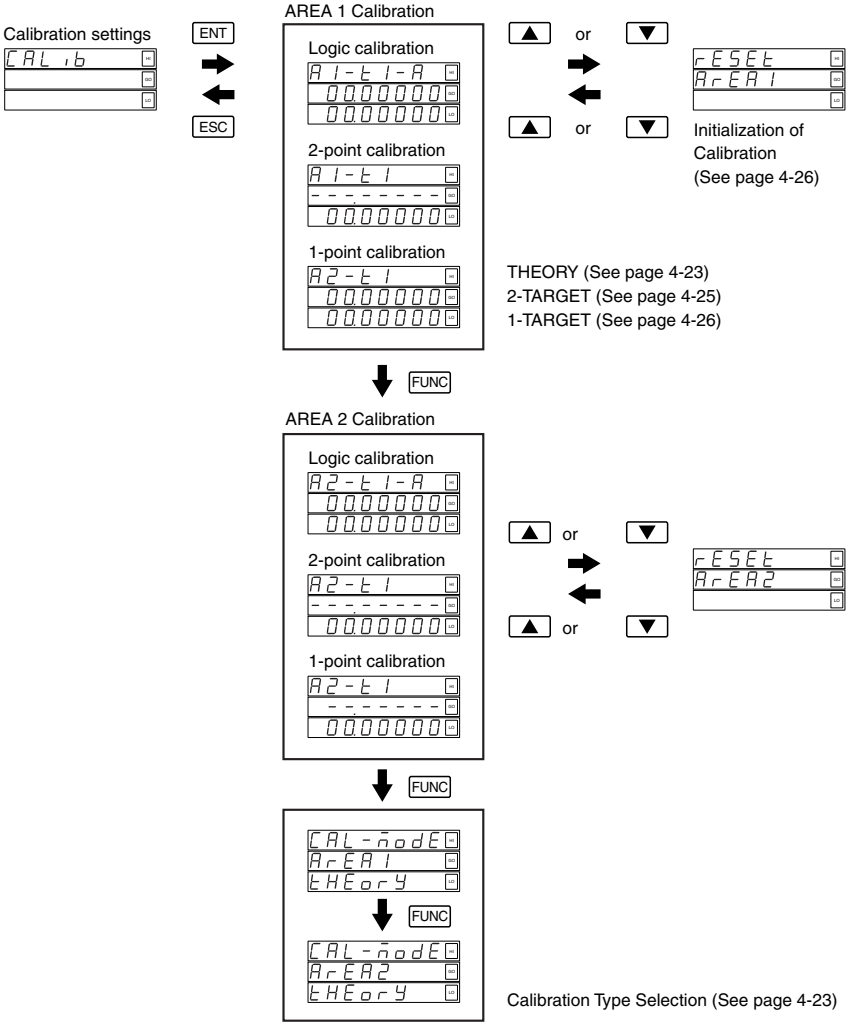
The “Calib” display appears.



4

Flow of Calibration Setting Display





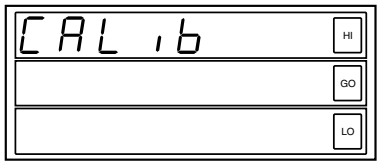
Calibration Type Selection

The following section provides information on how to set the calibration type for each area.

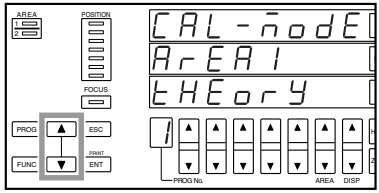
1 Press the [ENT] key for calibration setting.

2 Press the [FUNC] key twice.

Press the [FUNC] key three times to set the AREA2 calibration type.



3 Press the [▲] or [▼] key and select the AREA1 calibration type.



The following items are displayed for setting.

tHEorY	Logic calibration
2-tArGEt	Two-point calibration
1-tArGEt	One-point calibration

4 Press the [ENT] key.

The input item is entered and the calibration setting display appears again.

Logic Calibration Settings

Make logic calibration settings as explained below.

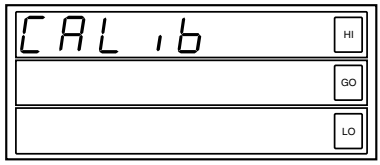
Setting Range

Logic calibration does not require master workpieces. Input the non-calibrated values and calibrated values of two measuring points (target 1 and target 2). Logic calibration uses the following values

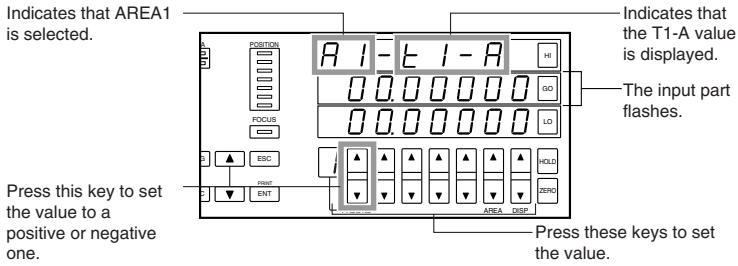
T1-A: Target 1 display value before calibration
T1-B: Target 1 display value after calibration
T2-A: Target 2 display value before calibration
T2-B: Target 2 display value after calibration

Make settings so that the following conditions will be satisfied.
T1-A < T2-A and T1-B < T2-B
Furthermore, set the calibration span between 0.5 and 2.0.

1 Press the [ENT] key for calibration setting.
The AREA1 calibration display appears. Press the [FUNC] key to make AREA2 settings.

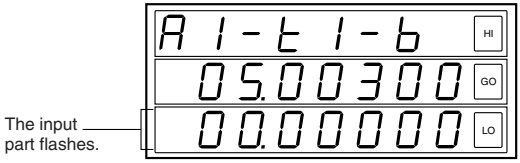


2 Input T1-A Value.



3 Press the [ENT] key.
The input value is entered and the value in the next line flashes.

4 Input T1-B Value.



5 Press the [ENT] key.

6 Input T2-A Value.

7 Press the [ENT] key.
The input value is entered and the value in the next line flashes.

8 Input T2-B Value.

9 Press the [ENT] key.
The input item is entered and the calibration setting display appears again.

Note: If the calibration conditions are not satisfied, “Error-1” will appear on the main display. Reset the error status by pressing the [ENT] key or [ESC] key and make the calibration settings again.

Two-point Calibration Settings

Make two-point calibration settings as explained below.

Setting Range

Two-point calibration requires two types of master workpieces that are different to each other in size. If the master workpieces are target 1 (T1) and target 2 (T2) respectively, make settings so that the following conditions will be satisfied.

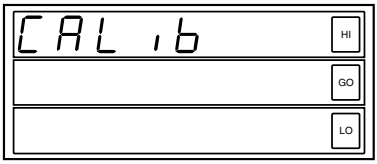
T1 < T2

Furthermore, set the calibration span between 0.5 and 2.0.

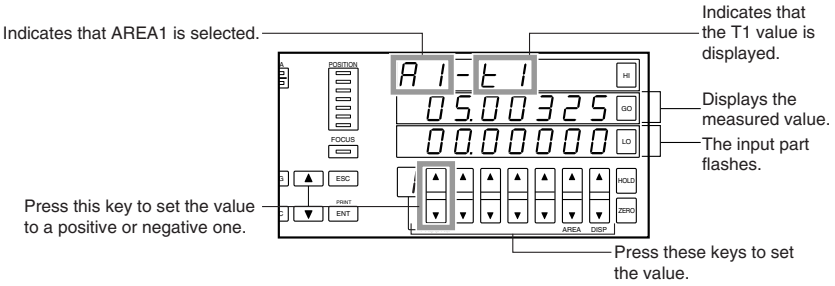
Note: In the case of two-point calibration, the number of averaging measurements is fixed at 4,096 times.

1 Press the [ENT] key for calibration setting.

The AREA1 calibration display appears.



2 Set the master workpiece, monitor the measured value, and input the T1 value.



3 Press the [ENT] key.

4 Set the other master workpiece, monitor the measured value, and input the T2 value.

5 Press the [ENT] key.

The input item is entered and the calibration setting display appears again.

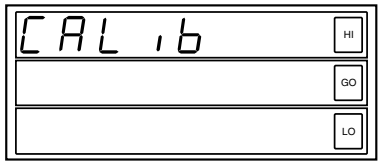
Note: If the calibration conditions are not satisfied, “Error-1” will appear on the main display. Reset the error status by pressing the [ENT] key or [ESC] key and make the calibration settings again.

One-point Calibration Settings

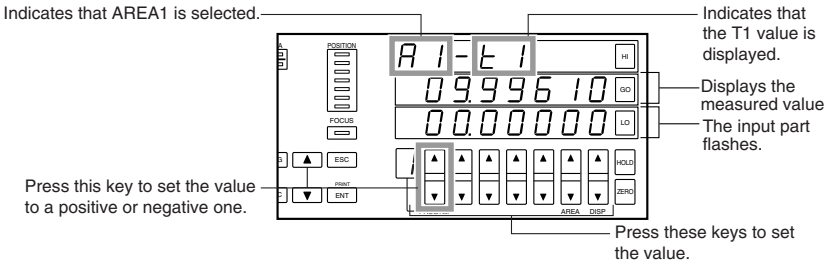
Make one-point calibration settings as explained below.

Note: In the case of one-point calibration, the number of averaging measurements is fixed at 4,096 times.

1 Press the [ENT] key for calibration setting.
The AREA1 calibration display appears.



2 Set the master workpiece, monitor the measured value, and input the T1 value.
Indicates that AREA1 is selected.



3 Press the [ENT] key.
The input item is entered and the calibration setting display appears again.

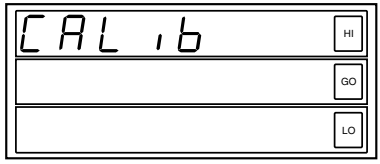
Note: If the calibration conditions are not satisfied, “Error-1” will appear on the main display.
Reset the error status by pressing the [ENT] key or [ESC] key and make the calibration settings again.

Initialization of Calibration

Take the following procedure to initialize the calibration values you are setting or you have already set (i.e., to return the values to the ones set by default).
In this case, the span value is by default set to 1 and the shift value is by default set to 0.

Note: It is possible to initialize the calibration value of each area independently.

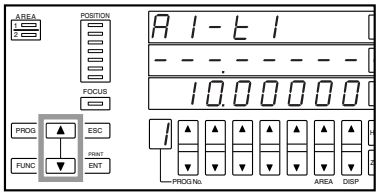
1 Press the [ENT] key for calibration setting.
The AREA1 calibration display appears.



Initializing AREA1 Calibration Value

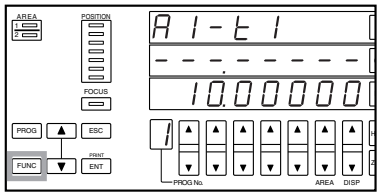
(1) Press the ▲ or ▼ key.
"Reset" appears on the screen.

(2) Confirm the area to be initialized and press the ENT key.



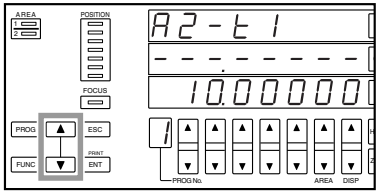
Initialization of AREA2 Calibration Value

(1) Press the FUNC key.
The AREA2 settings appear.



(2) Press the ▲ or ▼ key.
"Reset" appears on the screen.

(3) Confirm the area to be initialized and press the ENT key.



Output Settings

Values measured in AREA1 and AREA2 can be processed in a variety of ways and output as OUT1 and OUT2 signals. This section provides information on the details and methods of output settings.

Possible Output Settings

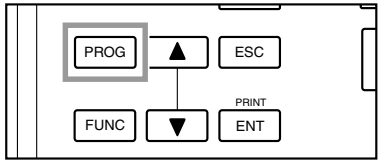
The following output settings are possible.

- Area calculation: The measured values of two-area points specified by area settings are used for calculation processing.
- Number of averaging measurements: Set the number of measuring times.
- Measuring mode: Measured values are output “as is” or processed as maximum and minimum timing output values.
- Offset: An offset value is a desired value that can be added to or subtracted from measured values.
- Analog output: Analog voltages are output according to the measured values.
- Comparator output: Set the details of output that turns ON according to the judgment results of measured values.

Output Settings

Make output settings while monitoring the sub display.

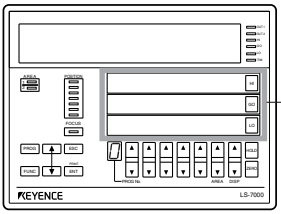
1 Press the PROG key.



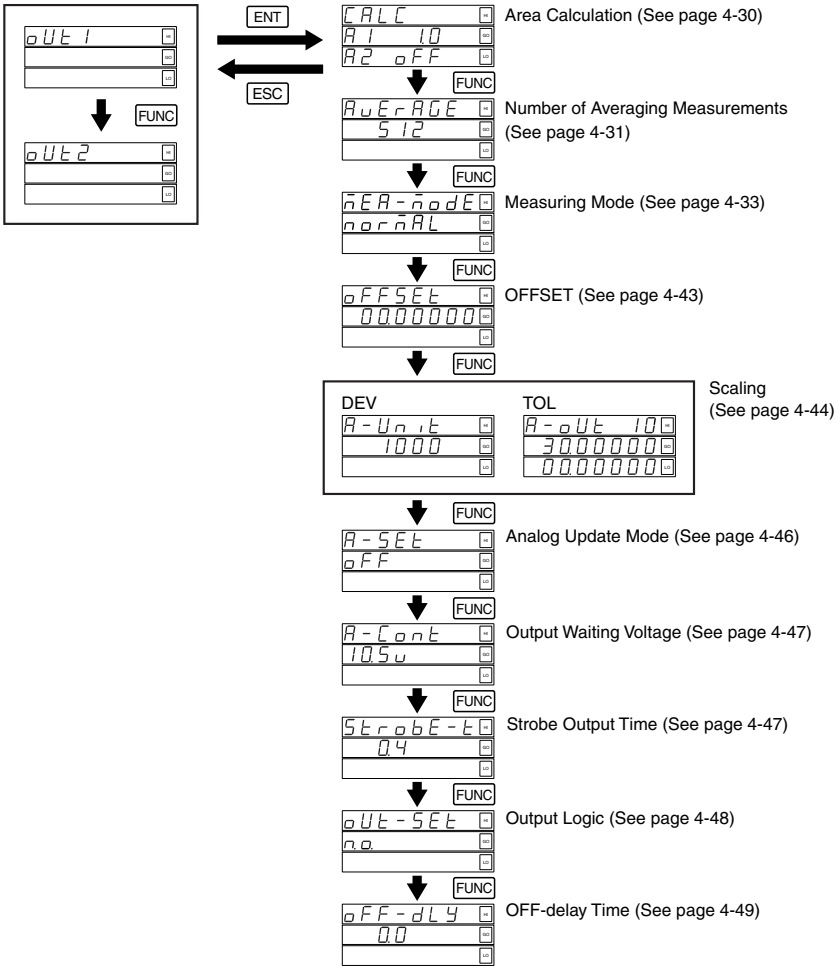
2 Press the FUNC key twice.

To make OUT2 settings, press the FUNC key again.

Flow of Output Setting Display



Output Settings



Area Calculation

The measured values from the two memory areas are used for calculation processing.

Setting Range

Select the coefficient from the following.
OFF (No coefficient will be multiplied and the value will be 0), 1.0, 0.5, -1.0, or -0.5

■ Examples of Area Calculation

By multiplying the measured values with the coefficient selected, automatic size calculation will be obtained. Set the coefficient as explained below to obtain the desired output value.

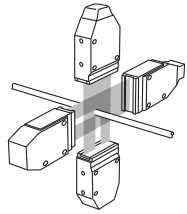
No Calculation is Performed

A1	1.0
A2	OFF

Obtaining the Outer Diameter from Two Measuring Heads

Set AREA1 for DIA of measuring head 1 and AREA2 for DIA in measuring head 2.

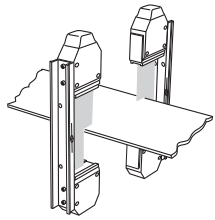
A1	0.5
A2	0.5



Obtaining the object width from Two Measuring Heads

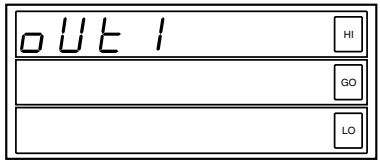
Set AREA1 for B-EDGE in measuring head 1 and AREA2 for B-EDGE in measuring head 2.

A1	–1.0
A2	–1.0

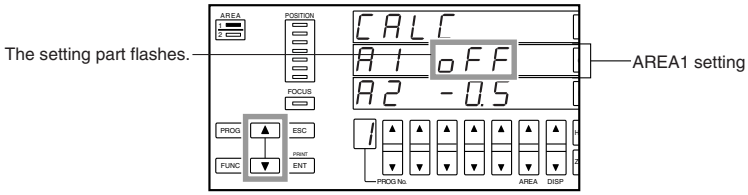


■ Setting Method

1 Press the ENT key when the output setting is displayed.



2 Press the ▲ or ▼ key and set the coefficient for AREA1.



3 Press the ENT key.

The input value is entered and the AREA2 value flashes.

4 Press the ▲ or ▼ key and set the coefficient for AREA2.

5 Press the ENT key.

The input item is entered and the output setting display appears again.

4

Number of Averaging Measurements

Take the following procedure to determine the number of times to average measured values.

Setting Range

Select the number of averaging measurements from the following.
1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, and 4096
If you want to average the fluctuation of measured values and obtain stable results, select a comparatively large number. For high-speed measurement, the number selected should be comparatively small.

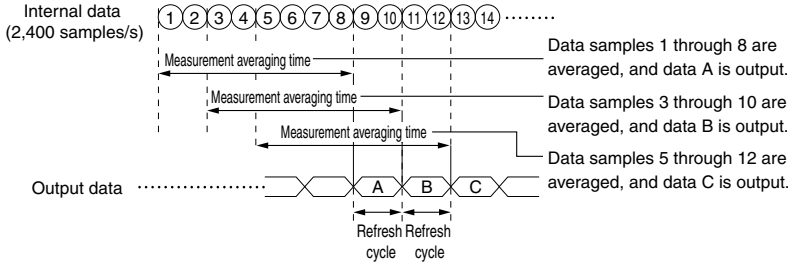
■ Averaging Time and Refresh Cycle

The LS-7000 Series averages measured values in a moving averaging method, thus making it possible to output the measured values within a short time.
The following table lists the averaging time, the number of moving averaging data items, and the refresh cycle of a target according to the number of averaging measurements.

Number of averaging measurements	Averaging time (ms)	Number of moving data samples	Refresh cycle (ms)
1	0.42	1	0.42
2	0.83	2	0.83
4	1.67	2	0.83
8	3.33	2	0.83
16	6.67	2	0.83
32	13.33	2	0.83
64	26.67	2	0.83
128	53.33	2	0.83
256	106.67	4	1.67
512	213.33	8	3.33
1024	426.67	16	6.67
2048	853.33	32	13.33
4096	1706.67	64	26.67

✻Measurement averaging time does not indicate the measuring response time of the LS-7000 Series. Refer to Measuring Response Time on page 8-6 for details.

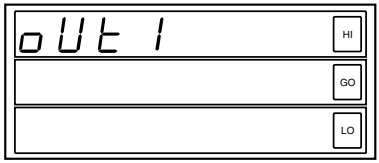
Example: If the averaging number is eight, the LS-7000 Series will output the data as shown below.



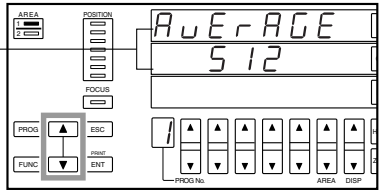
■ Setting Method

1 Press the [ENT] key when the output setting is displayed.

2 Press the [FUNC] key.



3 Press the [▲] or [▼] key and set the averaging number.



4 Press the [ENT] key.

The input item is entered and the output setting display appears again.

Note: When the measurement mode is set to Average Hold, set the averaging number to 1.

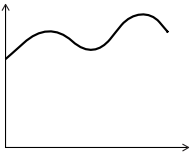
Measuring mode

The Measuring mode allows the LS-7000 Series to capture and hold measured values.

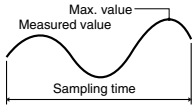
Setting Range

The LS-7000 Series has 11 types of Measuring modes. Refer to the following information for the outline of each mode.

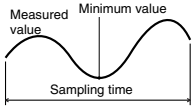
Normal
The measured value is displayed and output as it occurs.



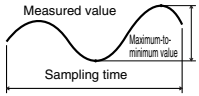
Peak Hold
The maximum value during the period specified is displayed and output.



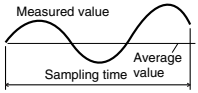
Bottom Hold
The minimum value during the period specified is displayed and output.



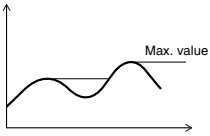
Peak-to-peak Hold
The maximum-to-minimum value during the period specified is displayed and output.



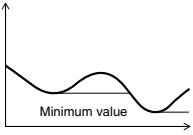
Average Hold
The average value during the period specified is displayed and output.



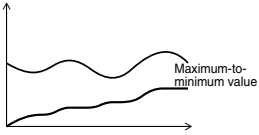
Auto Peak Hold
The maximum value measured is displayed and output as it occurs.



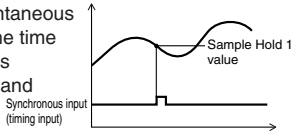
Auto Bottom Hold
The minimum value measured in displayed and output as it occurs.



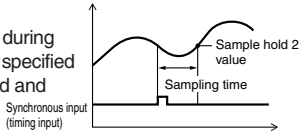
Auto Peak-to-peak Hold
The maximum-to-minimum value measured is displayed and output as it occurs.



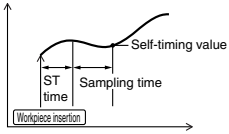
Sample Hold 1
The instantaneous value at the time specified is displayed and output.



Sample Hold 2
The value measured during the period specified is displayed and output.

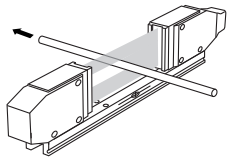
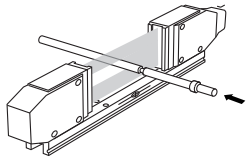
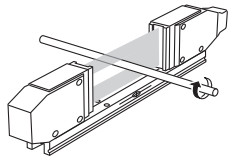
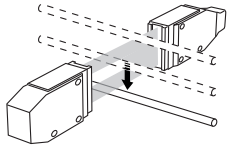


Self-timing Hold
The measured value is displayed and output with no external timing input (i.e., timing input). The self-timing period is adjustable between 1 and 9,999 ms.



Application Example of Measuring modes

Select the measurement mode according to the type of target and measuring condition. The following applications are typical examples of measurement in a variety of Measuring modes.

Application		Applicable RUN mode
	Continuous measurement of wire, tube, or fiber	Normal
	Measurement of maximum value within specified period	Peak Hold Auto Peak Hold
	Measurement of minimum value within specified period	Bottom Hold Auto Bottom Hold
	Measurement of maximum-to-minimum value within specified period	Peak-to-peak Hold Auto Peak-to-peak Hold
	Measurement of average values within specified period	Average Hold
	Measurement of maximum value per rotation	Peak Hold Auto Peak Hold
	Measurement of minimum value per rotation	Bottom Hold Auto Bottom Hold
	Measurement of maximum-to-minimum fluctuation or eccentricity per rotation	Peak-to-peak Hold Auto Peak-to-peak Hold
	Measurement of average value per rotation	Average Hold
	Single workpiece measurement	Sample Hold 1 Sample Hold 2 Self-timing Hold

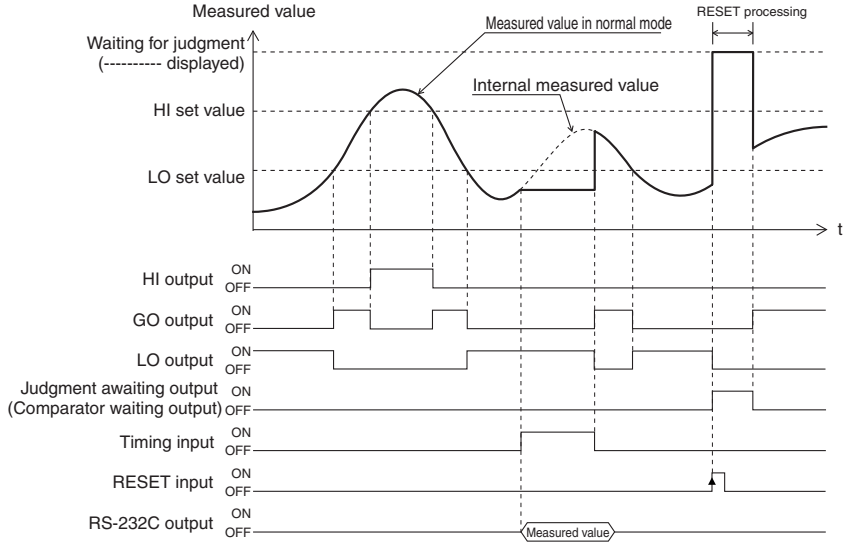
Timing Chart

The following table lists timing charts for respective measuring modes.

RUN mode	Timing chart name	Reference page
Normal	Normal	4-35
Peak Hold/Bottom Hold/ Peak-to-peak Hold/Average Hold	Peak Hold	4-36
Auto Peak Hold/Auto Bottom Hold/ Auto Peak-to-peak Hold	Auto Peak Hold	4-37
Sample Hold 1	Sample Hold 1	4-38
Sample Hold 2	Sample Hold 2	4-39
Self-timing Hold	Self-timing Hold	4-40

■ Normal

The value is continuously measured, displayed, and output in normal mode.



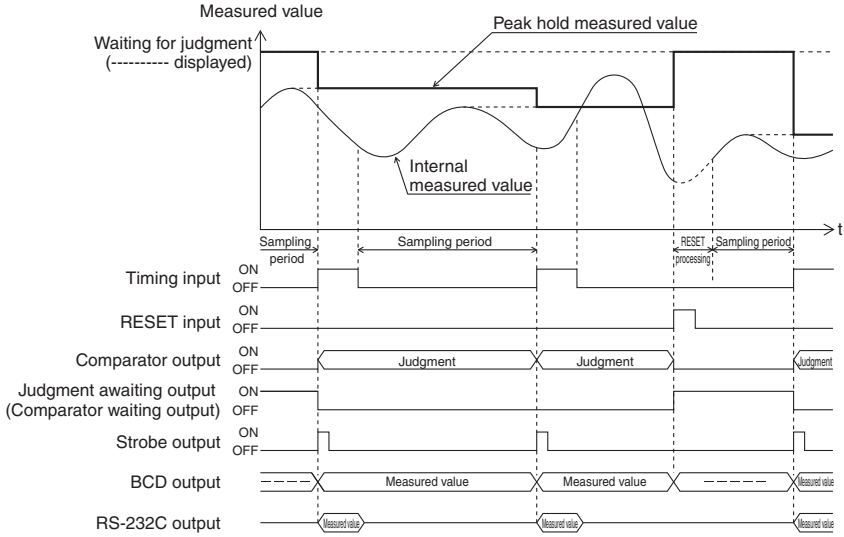
- In addition to the above output signals, HH output and LL output are available though they are omitted from the above chart.
- In the above chart, the ON status of each output means that NPN open collector output is ON, provided that it is normally open type. If it is normally closed type, the signal will be inverted.
- The ON status of each input means that the input is short-circuited to the COM terminal.
- RS-232C output is ON in synchronization with timing input if the D-SEND item as an environment setting is set to S1 or S2 only. Refer to Data Transmission Mode on page 5-9 for environment settings in detail.
- For strobe output in detail, refer to Strobe Output Time on page 4-48.
- For BCD output in detail, refer to BCD Output on pages 6-9 and 6-13.

Tips

- If RESET input is ON while timing input is ON, awaiting the result of measurement, the monitor will display the result waiting status “---.-----” until the timing input is turned OFF.
- Comparator waiting output can be OFF-delayed. Refer to OFF-delay Time on page 4-49 for the details of OFF-delays.
- Timing input and reset input can be sent by RS-232C control. Refer to page 7-8 for details.

■ Peak Hold

- Peak hold: The maximum value during the sampling period specified by external timing input is displayed and output as shown below.
- Bottom hold: The minimum value during the sampling period specified is displayed and output.
- Peak-to-peak hold: The maximum-to-minimum value during the period specified is displayed and output.
- Average hold: The average value during the sampling period specified is displayed and output.



- Timing input is OFF during sampling periods. The maximum value during the sampling period immediately before timing input will be output when the timing input turns ON.
- In the following cases, the monitor will display the result waiting status "---.-----" until the first measured value is determined.
  The LS-7000 is turned on, setting changes are made, program number changes are made, RESET input is ON, or auto zero is input.
- Comparator output turns ON according to the measured value.
- In the above chart, the ON status of each output means that NPN open collector output is ON, provided that it is normally open type. If it is normally closed type, the signal will be inverted.
- The ON status of each input means that the input is short-circuited to the COM terminal.
- RS-232C output turns ON in synchronization with timing input if the D-SEND item as an environment setting is set to S1 or S2 only. Refer to Data Transmission Mode on page 5-9 for environment settings in detail.
- If timing input is ON during reset processing, the monitor will display the result waiting status "---.-----."

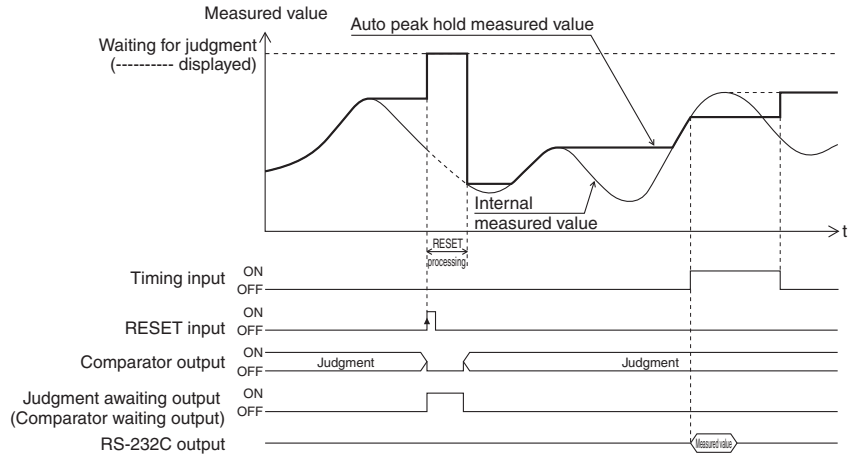
Tips

- If a workpiece is eliminated during a sampling period and it becomes a period without the internal measured value obtained, the maximum value of the rest of the normal measured values will be output.
- Timing input and RESET input can be under RS-232C control. Refer to page 7-8 for details.
- Strobe output time can be changed. Refer to Strobe Output Time on page 4-48 for details.

Note: When the measurement mode is set to Average Hold, set the averaging number to 1.

■ Auto Peak Hold

- Auto peak hold: The maximum value measured by the LS-7000 Series in continuous measurement operation is displayed and output.
- Auto bottom hold: The minimum value measured by the LS-7000 Series in continuous measurement operation is displayed and output.
- Auto peak-to-peak hold: The maximum-to-minimum value measured by the LS-7000 Series in continuous measurement operation is displayed and output .



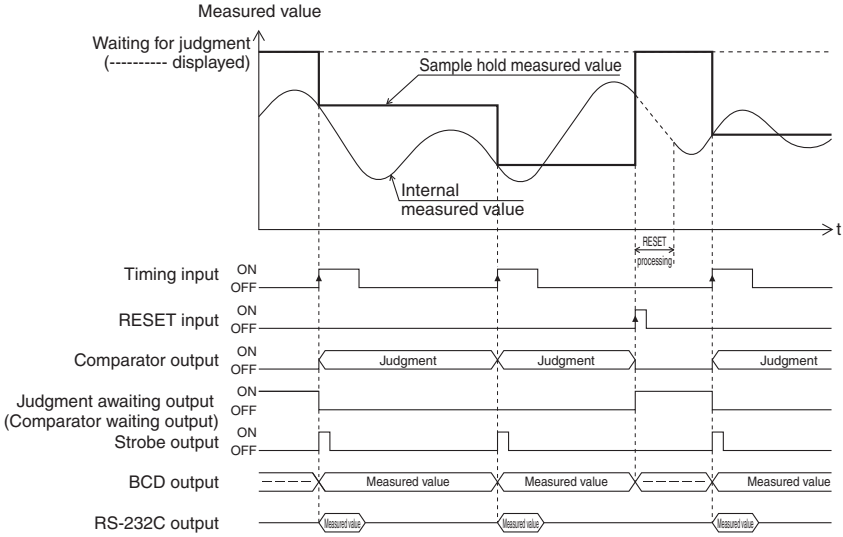
- Comparator output turns ON according to the measured value.
- In the above chart, the ON status of each output means that NPN open collector output is ON, provided that it is normally open type. If it is normally closed type, the signal will be inverted.
- The ON status of each input means that the input is short-circuited to the COM terminal.
- RS-232C output is ON in synchronization with timing input if the D-SEND item as an environment setting is set to S1 or S2 only. Refer to Data Transmission Mode on page 5-9 for environment settings in detail.
- For strobe output in detail, refer to Strobe Output Time on page 4-48.
- For BCD output in detail, refer to BCD Output on pages 6-9 and 6-13.
- If timing input is ON during reset processing, the monitor will display the result waiting status “---.-----.”

Tips

- If RESET input is ON while timing input is ON, awaiting the result of measurement, the monitor will display the result waiting status “---.-----” until the timing input is turned OFF.
- Timing input and reset input can be under RS-232C control. Refer to page 7-8 for details.
- If a workpiece is missing and there is a period without the internal measured value obtained, the monitor will display the result waiting status “---.-----.” The LS-7000 Series will start measurement with the previous auto peak value maintained when the internal measured value is obtained.

■ Sample Hold 1

The instantaneous value at the time specified by external timing input is displayed, and the value is output as shown below.



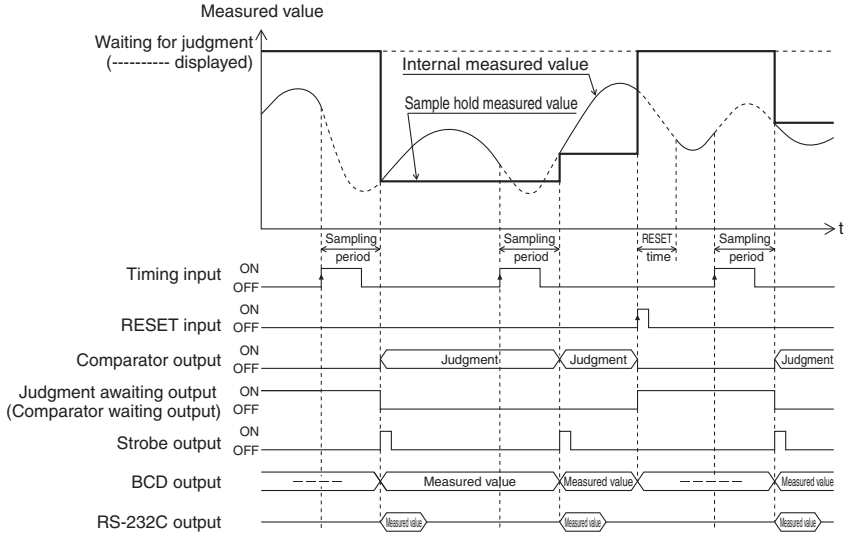
- When timing input turns ON, the internal measured value will be held. Then the value will be output.
- In the following cases, the monitor will display the result waiting status "---.-----" until the first measured value is determined.
  The LS-7000 is turned on, setting changes are made, program number changes are made, RESET input is ON, or auto zero is input.
- Comparator output turns ON according to the measured value.
- In the above chart, the ON status of each output means that NPN open collector output is ON, provided that it is normally open type. If it is normally closed type, the signal will be inverted.
- The ON status of each input means that the input is short-circuited to the COM terminal.
- RS-232C output is ON in synchronization with timing input if the D-SEND item as an environment setting is set to S1 or S2 only. Refer to Data Transmission Mode on page 5-9 for environment settings in detail.
- If timing input is ON during reset processing, the monitor will display the result waiting status "---.-----."

Tips

- Timing input and RESET input can be under RS-232C control. Refer to page 7-8 for details.
- Strobe output time can be changed. Refer to Strobe Output Time on page 4-48 for details.

■ Sample Hold 2

The value measured during the period specified by external timing input is displayed, and the value is output as shown below.



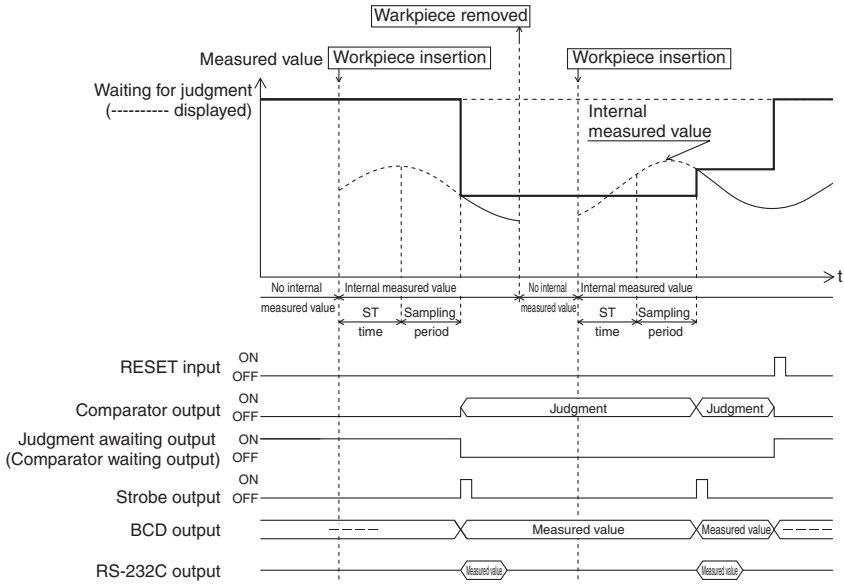
- When timing input is ON, input data is sampled for the averaging number. The determined internal measured value will be held. Then the value will be output.
- In the following cases, the monitor will display the result waiting status "---.-----" until the first measured value is determined.
  The LS-7000 is turned on, setting changes are made, program number changes are made, RESET input is ON, or auto zero is input.
- Comparator output turns ON according to the measured value.
- In the above chart, the ON status of each output means that NPN open collector output is ON, provided that it is normally open type. If it is normally closed type, the signal will be inverted.
- The ON status of each input means that the input is short-circuited to the COM terminal.
- RS-232C output is ON in synchronization with timing input if the D-SEND item as an environment setting is set to S1 or S2 only. Refer to Data Transmission Mode on page 5-9 for environment settings in detail.
- If timing input turns ON while the LS-7000 Series is in process of resetting, the process of resetting will be interrupted and sampling will start.
- If the internal measured value during a sampling period becomes "---.-----," the monitor will display the result waiting status "---.-----."

Tips

- Timing input and RESET input can be under RS-232C control. Refer to page 7-8 for details.
- Strobe output time can be changed. Refer to Strobe Output Time on page 4-48 for details.

■ Self-timing Hold

The LS-7000 Series in self-timing hold operation will detect targets automatically with no external timing input. Then the measured value is displayed and output.



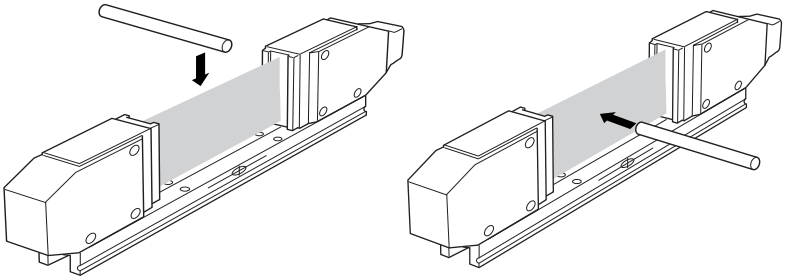
- When a workpiece is within the sensing distance, the emergence of the internal measured value will be used as a trigger. Then data will be sampled for the averaging number after the preset self-timing (ST) period is over. The determined internal measured value will be held. Then the value will be output.
- In the following cases, the monitor will display the result waiting status "---.-----" until the first measured value is determined.
  The LS-7000 is turned on, setting changes are made, program number changes are made, RESET input is ON, or auto zero is input.
- Comparator output turns ON according to the measured value.
- In the above chart, the ON status of each output means that NPN open collector output is ON, provided that it is normally open type. If it is normally closed type, the signal will be inverted.
- The ON status of each input means that the input is short-circuited to the COM terminal.
- RS-232C output is ON in synchronization with timing input if the D-SEND item as an environment setting is set to S1 or S2 only. Refer to Data Transmission Mode on page 5-9 for environment settings in detail.
- Timing input is ignored.
- If the internal measured value during a sampling period becomes "---.-----," the monitor will display the result waiting status "---.-----."

Tips

- RESET input can be under RS-232C control. Refer to page 7-8 for details.
- Strobe output time can be changed. Refer to Strobe Output Time on page 4-48 for details.
- The monitor will display "TIM" until the next workpiece is located in the measuring area after the present measured value is determined.

● Self-timing Hold and Area Settings

The LS-7000 Series in self-timing hold operation will detect a target when the target is within the optical axis. Then the LS-7000 Series will start sampling after a certain period (i.e., a self-timing period) elapses. Therefore, the target may enter the measuring area from any direction as shown below.



The LS-7000 Series will detect the target within the optical axis when the LS-7000 Series confirms a certain number of edges and not at the moment the target enters the optical axis. The confirmation condition varies with the measurement method selected as an area setting. Refer to the following examples.

Diameter (DIA) Measurement

The target will be detected when the number of edges in the optical axis is four or over.

The number of edges in the optical axis is two. The target has not been detected yet.

The number of edges in the optical axis is four or over. The target has been detected.

Segment (SEG) Measurement

The target will be detected when the number of edges in the optical axis coincides with the number of edges specified.
In the following example, settings are made so that the width between edges 002 and 003 will be measured.

The specified edge value (003) has not been detected within the optical axis. The target has not been detected.

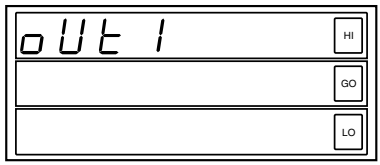
The specified edge value has been detected within the optical axis. The target has been detected.

Note: The LS-7000 Series in self-timing hold mode cannot be used for the following measurement applications, when the LS-7000 Series will be always in measurement operation regardless of whether there is a target or not (because the internal measured value always exists).
Example: • T-EDGE (Top edge) measurement
• B-EDGE (Bottom edge) measurement
• SEG (Segment) measurement of 001 and 002 edge widths

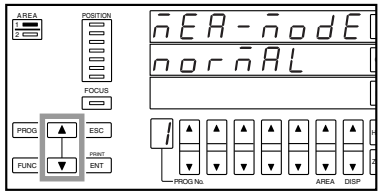
Setting Method

1 **Press the [ENT] key when the output setting is displayed.**

2 **Press the [FUNC] key twice.**



3 **Press the [▲] or [▼] key and set the measuring mode.**



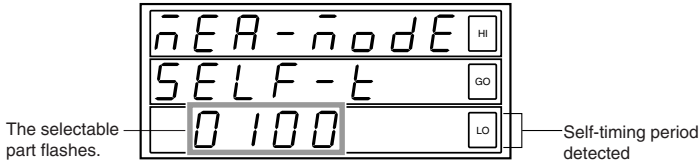
4

The following displayed items can be selected.

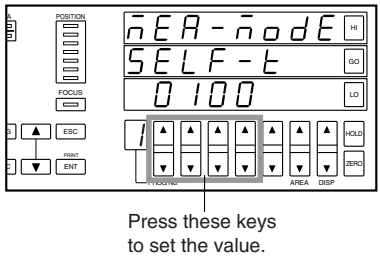
nornAL	Normal	A-b-HoLd	Auto bottom hold
P-HoLd	Peak hold	A-d-HoLd	Auto peak to peak hold
b-HoLd	Bottom hold	S-HoLd 1	Sample hold 1
d-HoLd	Peak to peak hold	S-HoLd2	Sample hold 2
Au-HoLd	Average hold	SELF-t / 0100	Self timing hold
A-P-HoLd	Auto peak hold		

Self-timing Hold Setting

The possible setting range is from 1 to 9999 ms.



(1) Press the ▲ or ▼ key and set the self-timing period.



4 Press the ENT key.

The input item is entered and the output setting display appears again.

Offset

An offset value is a desired value that can be added to or subtracted from measured values. If the offset value is set, it is possible to display the offset value immediately on the screen by using the auto zero function.

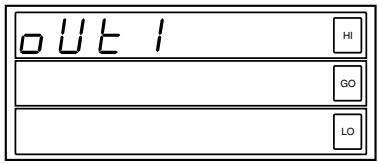
Setting Range

The range can be set between –99.99999 and 99.99999 mm. This range varies with the display unit or minimum display unit setting. Refer to Display Unit on page 4-57 and Minimum Display Unit on page 4-58.

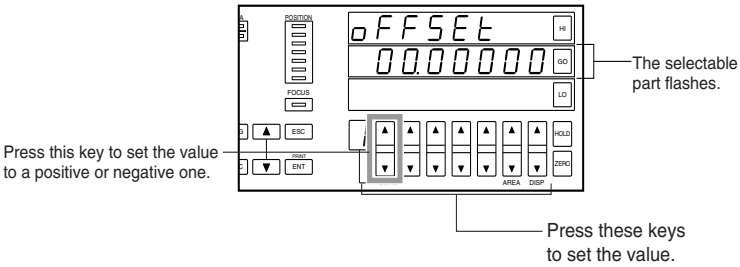
Input positive or negative values to increase or decrease the set value.

1 Press the ENT key when the output setting is displayed.

2 Press the FUNC key three times.



3 Press the ▲ or ▼ key and set the offset value.



4 Press the ENT key.

The input item is entered and the output setting display appears again.

■ Master Calibration with Automatic Zero (Automatic Offset) Function

The automatic zero function sets measured values to the preset size values (i.e., offset values) of master workpieces. Refer to Measurement of Outer Diameter and Width (with Two Measuring Heads for Larger Objects) on page 2-4 for an application example. For the details of the automatic zero function, refer to Automatic Zero Function on page 3-6.

Analog Output Settings

The LS-7000 Series has analog voltage output according to the measured value. The range of analog voltage output is between –10 and +10 V.

Setting Range

The following analog output settings are available.

- Scaling (reference value): In reference value mode (LIMITS), the deviation is output as a positive or negative voltage based on the reference value of 0 V. Select the scaling of deviation from the following: 1, 2, 5, 10, 20, 50, 100, 200, 1000, 2000, 5000, and 10000 μm/V
- Scaling (threshold): In threshold mode, set the measurement values to be output at +10 V and –10 V respectively so that the scaling value will be decided.
  The absolute value of the difference between these values must satisfy the following condition.
  {(Measured value at +10 V) – (Measured value at –10 V)} ≧ X
  Value X varies with the minimum display unit.
  The relationship between value X and minimum display unit is shown below.

Minimum display unit (mm)	X(mm)
0.00001, 0.00002, 0.00005	0.02
0.0001, 0.0002	0.2
0.001, 0.01, 0.1	2

Minimum display unit (μm)	X(μm)
0.01, 0.02, 0.05	20
0.1, 0.2	200
1	2000

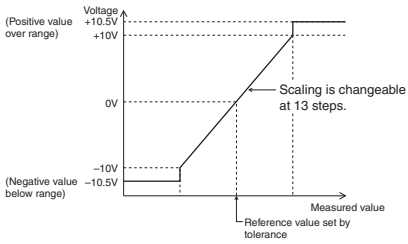
- Analog Update Mode: The measured value after area calculation is output after the analog scaling of the value regardless of whether the display value is held or not. The function is ON/OFF selectable.
- Output Waiting Voltage: Set the output voltage of the LS-7000 Series when the display shows "---.-----." The items selectable are 0 V, 10.5 V, and HOLD (holding the previous voltage before the LS-7000 Series began waiting for the result of the measurement).

■ Scaling

There is a difference in scaling settings between the LS-7000 Series in tolerance mode with reference values used and that with thresholds used. Refer to Tolerance Mode (LIMITS) on page 4-56 for details.

● Tolerance Mode with Reference Value

Based on a reference value of 0 V, the deviation is output as positive or negative voltage. The voltage can be changed while the result waiting status is "---.-----." (See page 4-47)



The following table shows the relationship of scaling values along with their output ranges and resolutions.

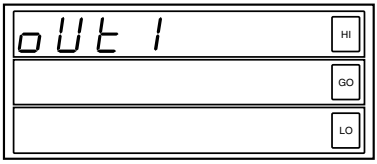
Scaling value [μm/V]	Output range	Resolution (✻)
1	±10μm	0.01μm
2	±20μm	0.01μm
5	±50μm	0.02μm
10	±100μm	0.04μm
20	±200μm	0.08μm
50	±500μm	0.2μm
100	±1mm	0.4μm
200	±2mm	0.8μm
500	±5mm	2μm
1000	±10mm	4μm
2000	±20mm	8μm
5000	±50mm	20μm
10000	±100mm	40μm

✻If the minimum display unit selected is larger than the resolution selected, the minimum display unit will be used as applicable resolution.

■ Setting Method

1 Press the [ENT] key when the output setting is displayed.

2 Press the [FUNC] key four times.



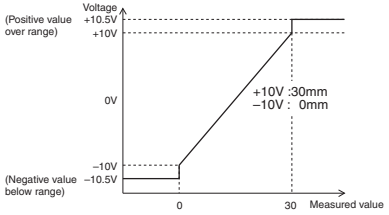
3 Press the [▲] or [▼] key and set the scaling value.

4 Press the [ENT] key.

The input item is entered and the output setting display appears again.

● Tolerance Mode with Threshold

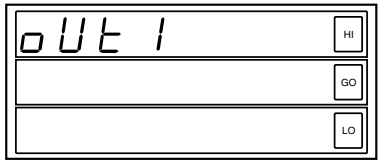
Set the measurement values to be output at 10 V and –10 V respectively so that the scaling value will be decided. The voltage can be changed while the result waiting status is "---.-----." (See Page 4-47)



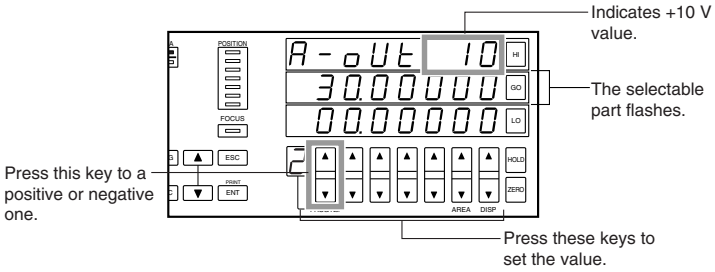
Setting Method

1 Press the [ENT] key when the output setting is displayed.

2 Press the [FUNC] key four times.



3 Press the ▲ or ▼ key and set the +10 V value.



4 Press the [ENT] key.

The input item is entered and the value in the next line flashes.

5 Press the ▲ or ▼ key and set the -10 V value.

6 Press the [ENT] key.

The input item is entered and the output setting display appears again.

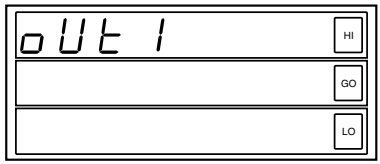
Note: If the input conditions are not satisfied, "Error-4" will appear on the main display. Reset the error status by pressing the [ENT] key or [ESC] key and make the settings again.

■ Analog update mode

If the analog update mode is ON, the measured value after area calculation will be output after analog scaling.

1 Press the [ENT] key when the output setting is displayed.

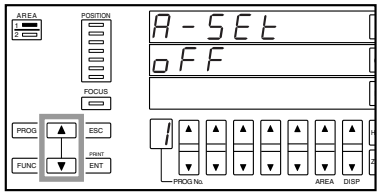
2 Press the [FUNC] key five times.



3 **Press the ▲ or ▼ key and set the analog update mode.**

4 **Press the ENT key.**

The input item is entered and the output setting display appears again.

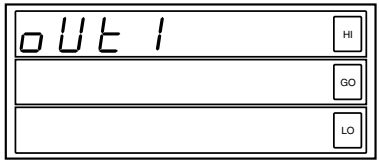


■ Output Waiting Voltage

Take the following steps to set the voltage to be output when the display shows "- - - - - - - - -."

1 **Press the ENT key when the output setting is displayed.**

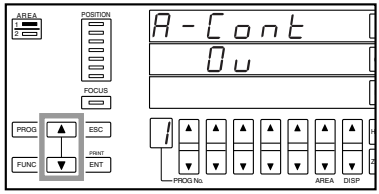
2 **Press the FUNC key six times.**



3 **Press the ▲ or ▼ key and set the voltage.**

4 **Press the ENT key.**

The input item is entered and the output setting display appears again.



Comparator Output Setting

Adjust the comparator output settings.

Setting Range

The following comparator output settings are available.

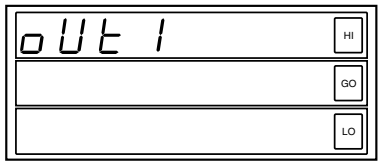
- Strobe output time: Select the ON-time of the strobe output (i.e., one-shot output time) from 0.4, 0.8, 1.6, 3.3, 6.6, 13.3, and 26.6 ms.
- Output logic: Set the logic of the comparator output and WAITING output to NO (normally open) or NC (normally closed).
- OFF-delay time: Select the OFF-delay time of the comparator output from 0.0, 0.4, 0.8, 1.6, 3.3, 6.6, 13.3 and 26.6 ms.

■ Strobe Output Time

Take the following steps to set the ON-time of strobe output.

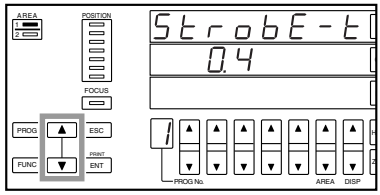
1 **Press the [ENT] key when the output setting is displayed.**

2 **Press the [FUNC] key seven times.**



3 **Press the [▲] or [▼] key and set the output time.**

4 **Press the [ENT] key.**
The input item is entered and the output setting display appears again.

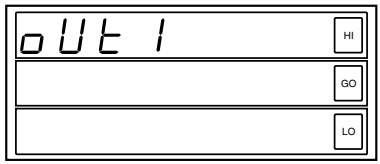


■ Output Logic

The logic of comparator output and WAITING output can be set to NO (normally open) or NC (normally closed).

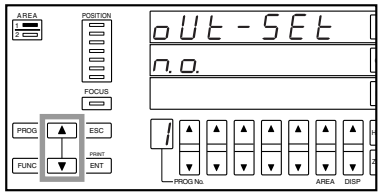
1 **Press the [ENT] key when the output setting is displayed.**

2 **Press the [FUNC] key eight times.**



3 **Press the [▲] or [▼] key and set the output logic.**
The following displayed items can be selected.

n.o.	N.O. (Normally open)
n.C.	N.C. (Normally closed)



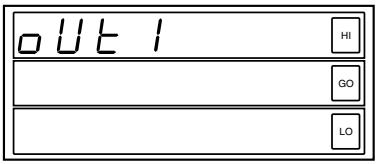
4 **Press the [ENT] key.**
The input item is entered and the output setting display appears again.

■ OFF-delay Time

Take the following steps to set the OFF-delay time for comparator output.

1 **Press the [ENT] key when the output setting is displayed.**

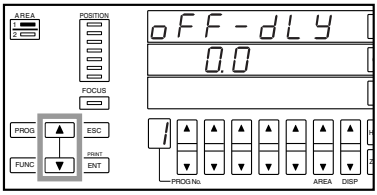
2 **Press the [FUNC] key nine times.**



3 **Press the [▲] or [▼] key and set the OFF-delay time.**

4 **Press the [ENT] key.**

The input item is entered and the output setting display appears again.



Tolerance (LIMIT) Settings

The LS-7000 Series judges whether or not the measured values pass the criteria. The range of values used for judgment is called a tolerance. Tolerances can be set to OUT1 and OUT2 respectively.

Types of Limits

The following tolerance settings are possible.

- Reference value
  Set the reference value and its upper and lower limits as deviation values. Measured values can be compared to three levels (i.e., HI, GO, and LO). Use this mode if the workpiece size changes but the deviations (tolerances) do not change.
- Threshold
  Specify the upper and lower limits in absolute values. Measured values can be compared to five levels (HH, HI, GO, LO, and LL).

Limit Range

The following ranges are used for the limits.

■ Reference Value

HI output range: (Reference value + Upper limit) < Measured value
GO output range: (Reference value + Lower limit) ≦ Measured value ≦ (Reference value + Upper limit)
LO output range: Measured value < (Reference value + Lower limit)

Possible Setting Conditions

A possible set value must be within a range where the following two items can be set.
Reference value + Upper limit value
Reference value + Lower limit value
In addition, the following condition must be satisfied.
Reference value + Upper limit value > Reference value + Lower limit value

Tips Refer to Units, Default Minimum Values, and Setting Ranges on page 4-60 for possible setting ranges in detail.

■ Threshold

HH output range: HH set value < Measured value
HI output range: HI set value < Measured value ≦ HH set value
GO output range: LO set value ≦ Measured value ≦ HI set value
LO output range: LL set value ≦ Measured value < LO set value
LL output range: Measured value < LL set value

Possible Setting Conditions

HH set value > HI set value > LO set value > LL set value

Tips Refer to Units, Default Minimum Values, and Setting Ranges on page 4-60 for possible setting ranges in detail.

Note: If the input conditions are not satisfied, “Error-5” will appear on the main display. Reset the error status by pressing the ENT key or ESC key and make the settings again.

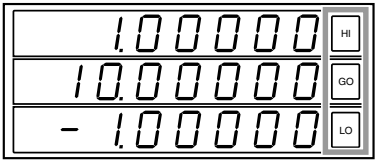
Limit Settings

Take the following steps to make tolerance settings in reference value mode or threshold mode.
Refer to Selection of Measured Value Display on page 3-2 to change OUT1 to OUT2 or vice versa.

■ Reference Value Mode

1 Press the key corresponding to the type of tolerance to be set.

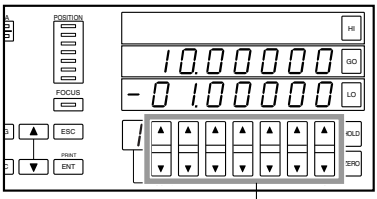
Press the [HI] key to set the upper limit, the [GO] key to set the reference value, and the [LO] key to set the lower limit. The corresponding tolerance item flashes.



2 Press the ▲ or ▼ key and set the tolerance.

3 Press the flashing tolerance key again.

The input item is entered.



Press these keys to set the value.

■ Threshold Mode

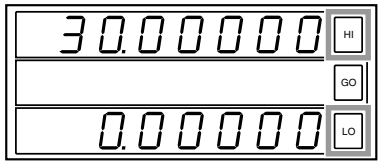
The following values displayed can be set in threshold mode.

HI set value	Press the [HI] key.
HH set value	Press the [HI] key twice.
LO set value	Press the [LO] key.
LL set value	Press the [LO] key twice.

1 Press the key corresponding to the type of tolerance to be set.

The corresponding tolerance item flashes.

The following display flashes.

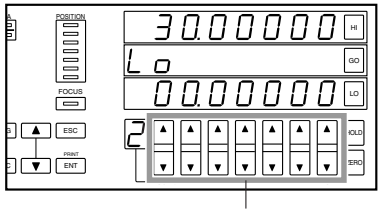


Value	Tolerance display
HI set value	30.000000 HI H I GO
HH set value	40.000000 HI HH HH
LO set value	L o GO 00.000000 LO
LL set value	L L HH - 10.000000 LO

2 Press the ▲ or ▼ key and set the tolerance.

3 Press the flashing tolerance key again.

The input value is entered.



Press these keys to set the value.

Hold Value Elimination

If the target has dirt or dust, the measured value may be wide of the accurate value. The LS-7000 Series automatically detects and eliminates such values.

Hold Value Elimination Conditions

Hold values are eliminated under the following conditions.

● In Tolerance Mode with Reference Value Used

- The measured value is below the reference value + lower limit hold value (i.e., Measured value < (Reference value + Lower limit hold value)
- The measured value is above the reference value + upper limit hold value (i.e., Reference value + Upper limit hold value) < Measured value

● In Tolerance Mode with Threshold Used

- The measured value is below the lower limit hold value (i.e., Measured value < Lower limit hold value)
- The measured value is above the upper limit hold value (i.e., Upper limit hold value < Measured value)

Note:
- Hold values are eliminated before measured values are averaged.
- The previous measured value will be kept on hold and displayed when the present hold value is eliminated.

Possible Setting Conditions

● **Reference Value in Tolerance Mode**

Reference value + Lower limit hold value < Reference value + Upper limit hold value

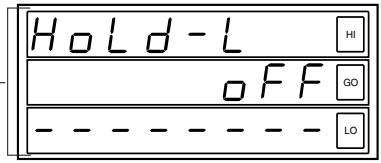
● **Threshold Value in Tolerance Mode**

Lower limit hold value < Upper limit hold value

Note: If the input conditions are not satisfied, "Error-6" will appear on the main display. Reset the error status by pressing the [ENT] key or [ESC] key and make the settings again.

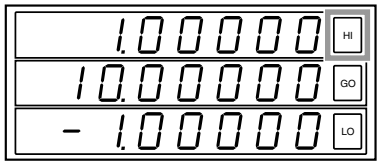
■ Setting Method

Take the following steps to set the upper limit hold value.
Press the [LO] key in steps 1 and 4 to set the lower limit hold value.



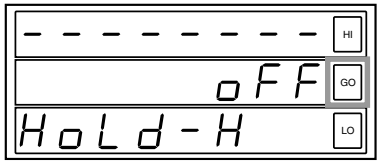
The lower limit hold balue display

1 Continue pressing the [HI] key for 2 seconds.



2 Press the [GO] key to change the display to "on."

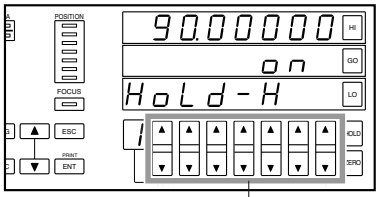
The hold value elimination function turns ON and the value flashes.



3 Press the ▲ or ▼ key to make settings.

4 Press the [HI] key.

The input item is entered and the measuring display appears again.



Press these keys to set the value.

Option Settings

Settings, such as display unit and I/O terminal mode, are available on the LS-7000 Series.

Option Settings

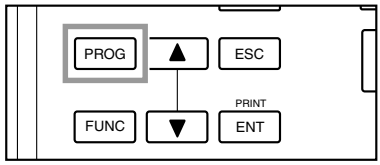
The following option settings are available.

- Tolerance mode: Sets the tolerance mode to use either reference values or thresholds.
- Timing mode: Sets the timing input terminals for OUT1 and OUT2 respectively.
- Unit: Changes the display unit of measured values.
- Minimum display unit: Changes the minimum display unit of measured values.
- I/O mode: Changes the I/O connector mode to SUB from BCD or vice versa.

Option setting

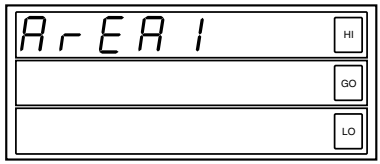
Make method settings while monitoring the sub display.

1 Press the PROG key.

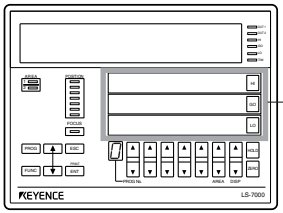


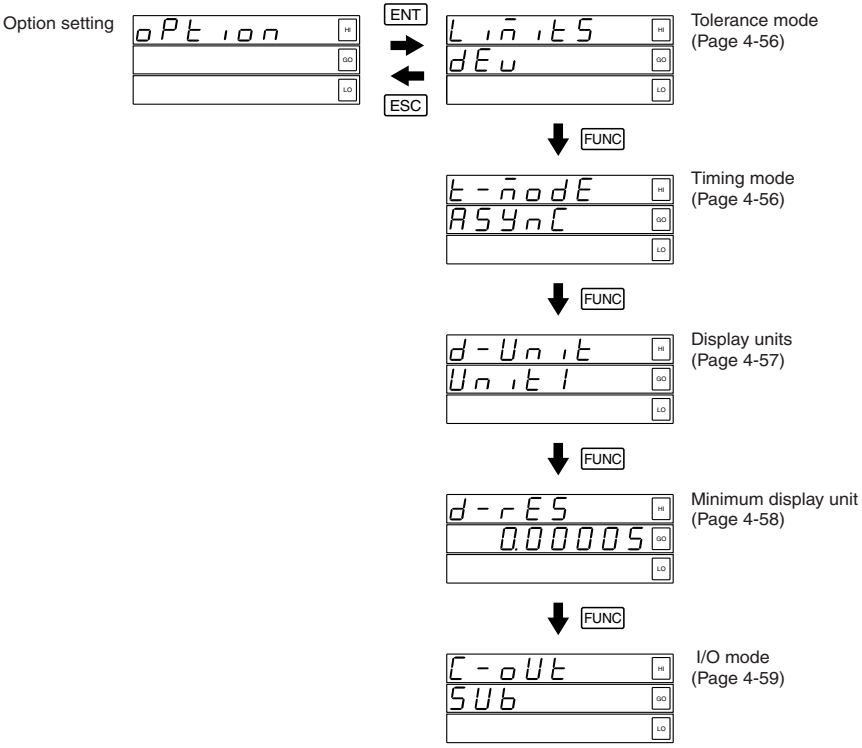
2 Press the FUNC key five times.

"Option" appears on the screen.



Flow of Option setting Display





Tolerance Mode (LIMITS)

Take the following steps to select the appropriate tolerance mode.

Setting Range

The following modes are selectable.

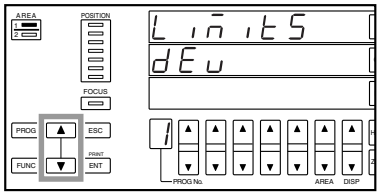
- Reference value mode: Use this mode if there is a workpiece size change with the deviations (tolerances) unchanged.
- Threshold mode: Specify the upper and lower limits in absolute values.

1 Press the [ENT] key when the option setting is displayed.

2 Press the [▲] or [▼] key and set the tolerance mode.

The following displayed items can be selected.

dEv	Reference value mode
tol	Threshold mode



3 Press the [ENT] key.

The input item is entered and the option setting display appears again.

Timing Mode

Take the following steps to set the synchronous (timing) input terminals corresponding to OUT1 and OUT2 respectively.

Setting Range

Select the input terminals from the following ones.

- Asynchronous mode (ASYNC): The LS-7000 Series is in asynchronous control of OUT1 and OUT2. Select the input terminals independently for OUT1 and OUT2 respectively. Terminal number 13 corresponds to OUT1 and connector I/O number 38 corresponds to OUT2.
- Synchronous mode (SYNC): The LS-7000 Series is in synchronous control of OUT1 and OUT2. Terminal number 13 corresponds to them. Connector I/O number 38 is disabled.

Refer to Section 6 I/O Terminals on page 6-1 for details.

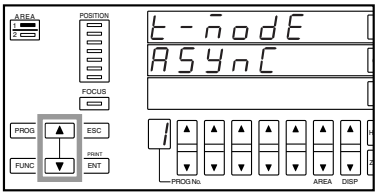
1 **Press the [ENT] key when the option setting is displayed.**

2 **Press the [FUNC] key.**

3 **Press the [▲] or [▼] key and set the timing input.**

The following displayed items can be selected.

ASYnC	Asynchronous mode
SYnC	Synchronous mode



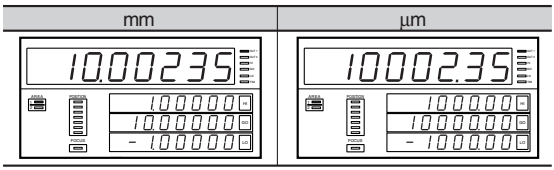
4 **Press the [ENT] key.**
The input item is entered and the option setting display appears again.

Display Unit

The display unit of measured values can be changed.

Select the display unit from the following.
- UNIT 1: Displayed in millimeters.
- UNIT 2: Displayed in micrometers.
- UNIT 3: Displayed in inches.
- UNIT 4: Displayed in mils (0.001 inch = 1 mil).

The displayed decimal position changes as shown below with the display unit changed.



Note: When the display unit is changed, all set values will be reset to default values (e.g., output set values and tolerance set values). Refer to page 4-60 for default values in millimeters and micrometers and available value setting ranges.

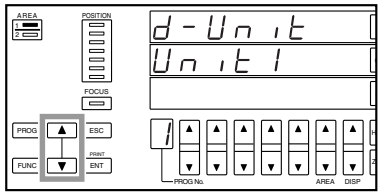
1 **Press the [ENT] key when the option setting is displayed.**

2 **Press the [FUNC] key twice.**

3 Press the ▲ or ▼ key and set the display unit.

The following displayed items can be selected.

Unit 1	mm
Unit 2	µm
Unit 3	inch
Unit 4	mil



To change the unit to UNIT3, press the ▲ key for 2 seconds when the UNIT2 is displayed.
To change the unit to UNIT2, press the ▼ key for 2 seconds when the UNIT3 is displayed.

4 Press the ENT key.

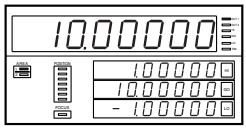
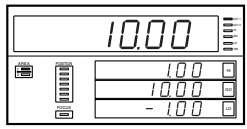
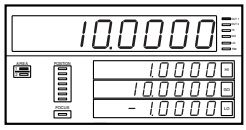
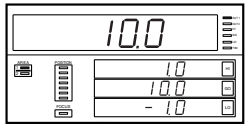
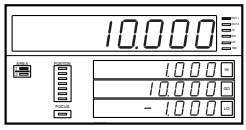
The input item is entered and the option setting display appears again.

Minimum Display Unit

The minimum display unit of measured values can be changed.

Setting Range

Select the minimum display unit from the following. When the minimum display unit is switched, the display changes together with the decimal position as shown below. A µm display unit is changed in the same way.

Minimum display unit	Display	Minimum display unit	Display
0.00001 0.00002 0.00005		0.01	
0.0001 0.0002		0.1	
0.001			

Note: When the minimum display unit is changed, all set values will be reset to default values (e.g., output set values and tolerance set values). Refer to page 4-60 for default values and available value setting ranges.

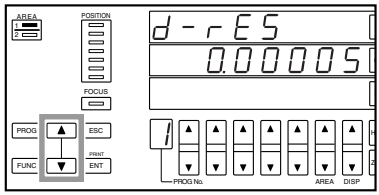
1 **Press the ENT key when the option setting is displayed.**

2 **Press the FUNC key three times.**

3 **Press the ▲ or ▼ key and set the display unit.**

4 **Press the ENT key.**

The input item is entered and the option setting display appears again.



4

I/O Mode

The mode of the I/O connector on the rear panel of the controller can be changed.

Setting Range

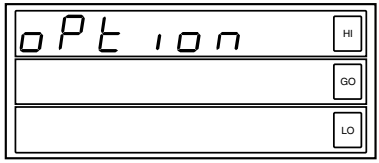
Select the connector mode from the following.

- SUB: Output 2 I/O.
- BCD: BCD output.

Tips For the operation of the connectors in each mode, refer to Connector I/O on page 6-4.

1 **Press the ENT key when the option setting is displayed.**

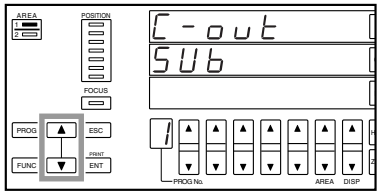
2 **Press the FUNC key four times.**



3 **Press the ▲ or ▼ key and set the mode.**

The following displayed items can be selected.

SUb	SUB mode
bCd	BCD mode



4 **Press the ENT key.**

The input item is entered and the option setting display appears again.

Units, Default Minimum Values, and Setting Ranges

Minimum display unit			0.00001mm 0.01μm		0.00002mm 0.02μm		0.00005mm 0.05μm		0.0001mm 0.1μm	
Setting item			Default value	Setting range	Default value	Setting range	Default value	Setting range	Default value	Setting range
Calibration setting	T1-A/B • T2-A/B									
Output setting	Offset		0.00000mm 0.00μm		0.00000mm 0.00μm		0.00000mm 0.00μm		0.0000mm 0.0μm	
	Threshold	A– +10V	+30.00000mm +30000.00μm		+30.00000mm +30000.00μm		+30.00000mm +30000.00μm		+30.0000mm +30000.0μm	
		A– –10V	0.00000mm 0.00μm		0.00000mm 0.00μm		0.00000mm 0.00μm		0.0000mm 0.0μm	
Tolerance setting	Threshold mode	HH	+40.00000mm +40000.00μm		+40.00000mm +40000.00μm		+40.00000mm +40000.00μm		+40.0000mm +40000.0μm	
		HI	+30.00000mm +30000.00μm		+30.00000mm +30000.00μm		+30.00000mm +30000.00μm		+30.0000mm +30000.0μm	
		LO	0.00000mm 0.00μm		0.00000mm 0.00μm		0.00000mm 0.00μm		0.0000mm 0.0μm	
		LL	+10.00000mm +10000.00μm	–99.99999~ +99.99999mm –99999.99~ +99999.99μm	+10.00000mm +10000.00μm	–99.99998~ +99.99998mm –99999.98~ +99999.98μm	–10.00000mm –10000.00μm	–99.99995~ +99.99995mm –99999.95~ +99999.95μm	–10.0000mm –10000.0μm	–999.9999~ +999.9999mm –999999.9~ +999999.9μm
		H-LMT	OFF		OFF		OFF		OFF	
		L-LMT	OFF		OFF		OFF		OFF	
	Reference value mode	STAN-DARD	+10.00000mm +10000.00μm		+10.00000mm +10000.00μm		+10.00000mm +10000.00μm		+10.0000mm +10000.0μm	
		UPPER	+1.00000mm +1000.00μm		+1.00000mm +1000.00μm		+1.00000mm +1000.00μm		+1.0000mm +1000.0μm	
		LOWER	+1.00000mm +1000.00μm		+1.00000mm +1000.00μm		–1.00000mm –1000.00μm		–1.0000mm –1000.0μm	
		H-LMT	OFF		OFF		OFF		OFF	
		L-LMT	OFF		OFF		OFF		OFF	

Minimum display unit			0.0002mm 0.2μm		0.001mm 1μm		0.01mm		0.1mm	
Setting item			Default value	Setting range	Default value	Setting range	Default value	Setting range	Default value	Setting range
Calibration setting										
Output setting	Offset		0.0000mm 0.0μm		0.000mm 0μm		0.00mm		0.0mm	
	Threshold	A– +10V	+30.0000mm +30000.0μm		+30.000mm +30000μm		+30.00mm		+30.0mm	
		A– –10V	0.0000mm 0.0μm		0.000mm 0μm		0.00mm		0.0mm	
Tolerance setting	Threshold mode	HH	+40.0000mm +40000.0μm		+40.000mm +40000μm		+40.00mm		+40.0mm	
		HI	+30.0000mm +30000.0μm		+30.000mm +30000μm		+30.00mm		+30.0mm	
		LO	0.0000mm 0.0μm		0.000mm 0μm		0.00mm		0.0mm	
		LL	–10.0000mm –10000.0μm	–999.9998~ +999.9998mm –999999.8~ +999999.8μm	–10.000mm –10000μm	–9999.999~ +9999.999mm –9999999~ +9999999μm	–10.00mm	–9999.99~ +9999.99mm	–10.0mm	–9999.9~ +9999.9mm
		H-LMT	OFF		OFF		OFF		OFF	
		L-LMT	OFF		OFF		OFF		OFF	
	Reference value mode	STAN-DARD	+10.0000mm +10000.0μm		+10.000mm +10000μm		+10.00mm		+10.0mm	
		UPPER	+1.0000mm +1000.0μm		+1.000mm +1000μm		+1.00mm		+1.0mm	
		LOWER	–1.0000mm –1000.0μm		–1.000mm –1000μm		–1.00mm		–1.0mm	
		H-LMT	OFF		OFF		OFF		OFF	
		L-LMT	OFF		OFF		OFF		OFF	

- Each cell shows minimum display units in the order of millimeters and micrometers.
- The display unit is set to mm and the minimum display unit is set to 0.00005 (mm) before shipping.
- Set values in the table will be initialized if the change of the minimum display unit is made. Setting items other than those in the table will not be initialized.
- If the display unit of mm is changed to μm, the minimum display unit will change from 0.00005 mm to 0.05 μm, and vice versa. Set values in the table will be initialized.
- If the program is initialized, the display unit will be set to mm and the minimum display unit will be set to 0.00005 mm. The set values will be initialized as well.

Setting item \ Minimum display unit			0.0000005inch 0.01mil		0.000001inch 0.02mil		0.00005inch 0.05mil		0.0001inch 0.1mil	
			Default value	Setting range	Default value	Setting range	Default value	Setting range	Default value	Setting range
Calibration setting	T1-A/B • T2-A/B									
Output setting	Offset		0.0000000inch 0.0000mil	−0.9999995~ +0.9999995inch −999.9995~ +999.9995mil	0.000000inch 0.000mil	−9.999999~ +9.999999~inch −9999.999~ +9999.999mil	0.00000inch 0.00mil	−99.99999~ +99.99999inch −99999.99~ +99999.99mil	0.0000inch 0.0mil	−999.9999~ +999.9999inch −999999.9~ +999999.9mil
	Threshold	A– +10V	+0.3000000inch +300.0000mil		+3.000000inch +3000.000mil		+3.00000inch +3000.00mil		+3.0000inch +3000.0mil	
		A– –10V	0.00000inch 0.0000mil		0.000000inch 0.000mil		0.00000inch 0.00mil		0.0000inch 0.0mil	
Tolerance setting	Threshold mode	HH	+0.4000000inch +400.0000mil		+4.000000inch +4000.000mil		+4.00000inch +4000.00mil		+4.0000inch +4000.0mil	
		HI	+0.3000000inch +30000.00mil		+3.000000inch +3000.000mil		+3.00000inch +3000.00mil		+3.0000inch +3000.0mil	
		LO	0.0000000mm 0.0000mil		0.000000inch 0.000mil		0.00000inch 0.00mil		0.0000inch 0.0mil	
		LL	+0.1000000inch +100.0000mil		+1.000000inch +1000.000mil		−1.00000inch −1000.00mil		−1.0000inch −1000.0mil	
		H-LMT	OFF		OFF		OFF		OFF	
		L-LMT	OFF		OFF		OFF		OFF	
	Reference value mode	STAN-DARD	+0.1000000inch +100.0000mil		+1.000000inch +1000.000mil		+1.00000inch +1000.00mil		+1.0000inch +1000.0mil	
		UPPER	+0.0100000inch +10.0000mil		+0.100000inch +100.000mil		+1.00000inch +100.00mil		+1.0000inch +100.0mil	
		LOWER	−0.0100000inch −10.0000mil		−0.100000inch −100.000mil		−0.10000inch −100.00mil		−0.1000inch −100.0mil	
		H-LMT	OFF		OFF		OFF		OFF	
		L-LMT	OFF		OFF		OFF		OFF	

- Each cell shows minimum display units in the order of inches and mils.
- Each set value in the table will be initialized if the change of the minimum display unit or the change of display unit is made. Items other than those in the table will not be, however, initialized.
- If the program is initialized, the display unit will be set to mil and the minimum display unit will be set to 0.00005 (mil). The set values will be initialized as well.

MEMO

Chapter 5

Environment Settings

This section provides information on environment settings that include RS-232C interface settings along with basic operation settings and changes.

Possible Environment Settings

The following environment settings are possible.

- Program: Program setting changes, program copying, and setting initialization.
- RS-232C: Baud rate, parity, stop bit, data length, data mode, and data transmission mode of the RS-232C interface.
- Head: LED inspection function and mutual interference prevention function.
- Beep: Turn the key buzzer ON or OFF.
- Panel lock: Select which keys are locked.

Default Settings

The LS-7000 Series has the following default settings. Settings in parentheses indicate settings to be displayed on the monitor.

■ Program (See page 5-5)

Item	Default	Setting range
Program setting change (P-SELECT)	PANEL	PANEL, TERMINAL
Program copy (P-COPY)	From: 0 to: 0	Copied from (From): 0 to 9, A to F, – Copied to (to): 0 to 9, A to F
All program resetting (P-CLEAR)	CANCEL	CANCEL, YES

■ RS-232C (See page 5-7)

Item	Default	Setting range
Baud rate (BAUDRATE)	9600	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200bps
Parity (PARITY)	NONE	NONE, EVEN, ODD
Stop bit (STOPBIT)	1	1, 2
Data length (D-LENGTH)	8	7, 8
Data mode (D-MODE)	NORMAL	NORMAL, PLC, PRINTER1, PRINTER2
Data transmission mode (D-SEND)	OFF	OFF, S1, S2, S3

■ **Head** (See page 5-10)

Item	Default	Setting range
LED inspection function (L-INSPCT)	(—)	HEAD1, HEAD2 (Connected head number)
Mutual interference prevention function (H-SYNC)	OFF	OFF, ON

■ **Beep** (See page 5-12)

Item	Default	Setting range
Buzzer ON/OFF switch (BEEP)	ON	OFF, ON

■ **Panel Lock** (See page 5-13)

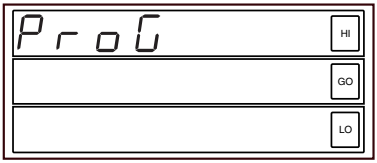
Item	Default	Setting range
Panel lock function (PAN-LOC)	ALL	ALL, PART

Changing Environment Settings

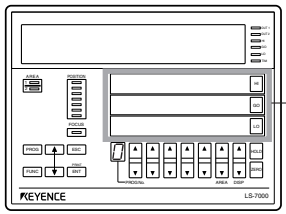
Make changes to the environment settings.

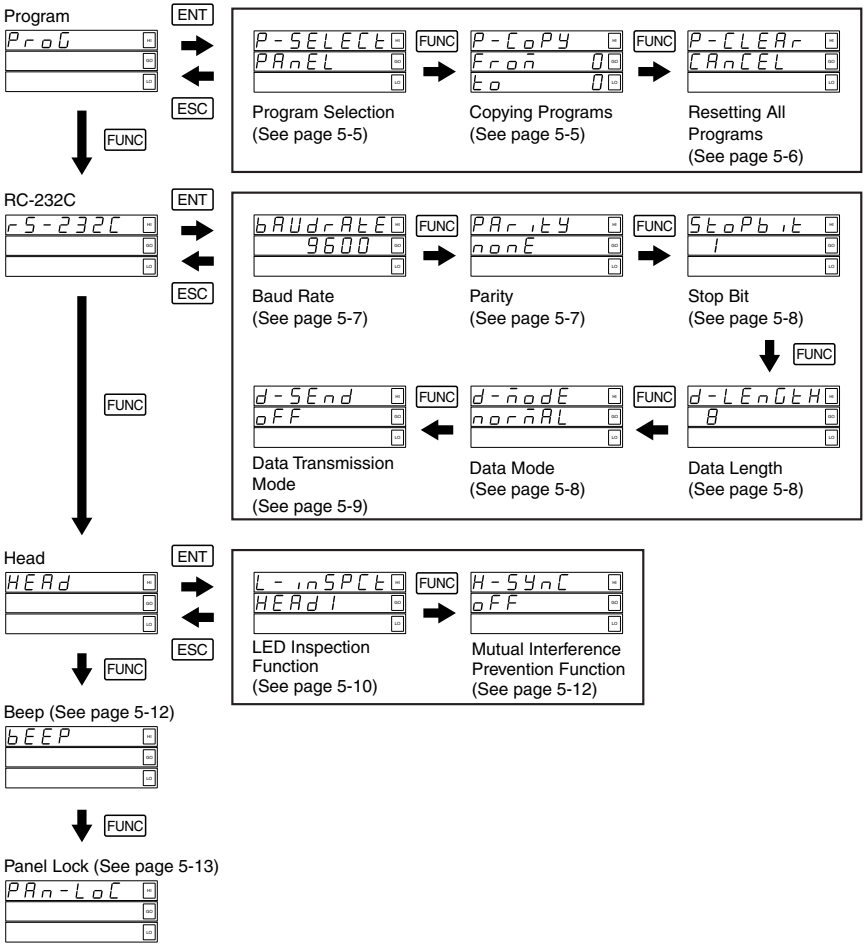
1 Press the PROG key while pressing the FUNC key.

The sub display changes as shown in the illustration.



Flow of Environment Setting Display





Details of Environment Settings

This section provides information on environment setting items and setting methods.

Program

The LS-7000 Series ensures ease of program settings or changes.

Possible Settings

- Program Selection (P-SELECT):
  Select the program from the front panel or the rear terminals.
- Copying Programs (P-COPY):
  Program can be copied to other programs. Furthermore, a selected program can be initialized.
- Resetting all programs (P-CLEAR):
  All programs are initialized and returned to factory-set data.

■ Program Selection

Take the following steps to decide the selection method of the program number.

Setting Items

- Panel (PANEL): The program number is selected through the control panel or RS-232C interface.
- Terminal (TERMINAL): The program number is selected through the external input terminals.

1 Press the [ENT] key when the program display is on the screen.

2 Press the [▲] or [▼] key and select the selection method.
The following displayed items can be selected.

PAnEL	PANEL
tErn inAL	TERMINAL

3 Press the [ENT] key.
The input item is entered and the program display appears again.

■ Copying Programs

The contents of a program can be copied to another program. Furthermore, the selected program can be initialized.

Initializing a Selected Program

A program number can be selected to be initialized. In this case, set "—" for the number of the program to be copied and specify a program number for the destination program number.

1 **Press the [ENT] key when the program display is on the screen.**

2 **Press the [FUNC] key.**

3 **Press the [▲] or [▼] key to select the number of the program to be copied.**
The selectable part flashes.

4 **Press the [ENT] key.**
The input item is entered and the value in the next line flashes.

5 **Press the [▲] or [▼] key to select the destination program number.**
The selectable part flashes.

6 **Press the [ENT] key.**
The input item is entered and the program display appears again.

■ Resetting All Programs

Take the following steps to initialize all programs.

1 **Press the [ENT] key when the program display is on the screen.**

2 **Press the [FUNC] key twice.**

3 **Press the [▲] or [▼] key and select the item.**
The following items displayed can be selected.

CAnCEL	Program initialization will be canceled.
YES	All programs will be initialized.

4 **Press the [ENT] key.**
The input item is entered and the program display appears again.

RS-232C

Take the following steps to make the communication settings for the RS-232C interface and relative settings for peripheral devices.

Tips Communication settings for the RS-232C interface vary with the peripheral device to be connected or the type of output desired. For the details of RS-232C, refer to Chapter 7 RS-232C on page 7-1.

Setting Items

The following items can be set.

- Baud rate: Set the speed of data transmission to 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200 bps.
- Parity: Set the parity to NONE, EVEN, or ODD.
- Stop bit: Set the stop bit length to 1 or 2.
- Data length: Set the length of transmission data to 7 or 8.
- Data mode: Set the data mode to Normal, PLC, Printer 1 or Printer 2 according to the peripheral device to be connected.
- Data transmission mode: Set the data transmission mode to OFF, S1, S2, or S3.

■ RS-232C Settings

1 Press the [FUNC] key when the program display is on the screen.

■ Baud Rate

1 Press the [ENT] key when the RS-232C display is on the screen.

2 Press the [▲] or [▼] key and select the baud rate.

3 Press the [ENT] key.

The input item is entered and the RS-232C display appears again.

■ Parity

1 Press the [ENT] key when the RS-232C display is on the screen.

2 Press the [FUNC] key.

3 Press the ▲ or ▼ key and select the parity.
The following displayed items can be selected.

nonE	None
EuEn	Even
odd	Odd

4 Press the ENT key.
The input item is entered and the RS-232C display appears again.

■ Stop Bit

1 Press the ENT key when the RS-232C display is on the screen.

2 Press the FUNC key twice.

3 Press the ▲ or ▼ key and select the stop bit.

4 Press the ENT key.
The input item is entered and the RS-232C display appears again.

■ Data Length

1 Press the ENT key when the RS-232C display is on the screen.

2 Press the FUNC key three times.

3 Press the ▲ or ▼ key and select the data length.

4 Press the ENT key.
The input item is entered and the RS-232C display appears again.

■ Data Mode

1 Press the ENT key when the RS-232C display is on the screen.

2 Press the FUNC key four times.

3 Press the [▲] or [▼] key and select the data mode.
The following displayed items can be selected.

nor AL	None
PLC	PLC
Printer 1	Printer 1
Printer 2	Printer 2

4 Press the [ENT] key.
The input item is entered and the RS-232C display appears again.

Note: Other set values change as shown below according to the selected data mode.

Setting item	Description
NORMAL	Only the item OFF is selectable in data transmission mode.
PLC	The following environment settings are fixed. Baud rate: 9600 Data length: 8 Stop bit length: 1 Parity: Even
PRINTER1/PRINTER2	The items S1, S2, or S3 is selectable in data transmission mode.

■ Data Transmission Mode

1 Press the [ENT] key when the RS-232C display is on the screen.

2 Press the [FUNC] key five times.

3 Press the [▲] or [▼] key and select the data transmission mode.
The following displayed items can be selected.

oFF	None
S1	S1
S2	S2
S3	S3

4 Press the [ENT] key.
The input item is entered and the RS-232C display appears again.

Head

Take the following steps to set the LED inspection function and mutual interference prevention function.

Setting Item

- LED inspection function: The intensity of the LED light source can be inspected.
- Mutual interference prevention function: Prevents mutual interference that may result when two measuring heads are located at right angles.

Measuring Head Settings

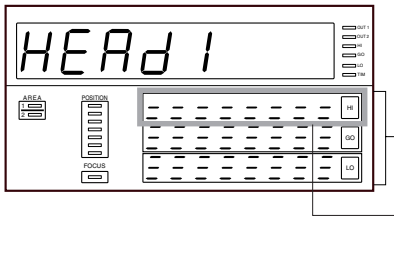
1 Press the FUNC key twice when the program display is on the screen.

■ LED Inspection Function

Use this function to check for change of the LED light source or the fluctuation of light intensity caused by dirt on the cover glass. It is recommended to make a regular check on the change of light intensity after the installation of the LS-7000 Series.

Check on Intensity of LED Light Source

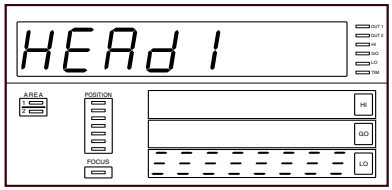
With the LED inspection function, the distribution of light will appear on the monitor as shown below, which makes it possible to check the change of light intensity after the LS-7000 Series is installed.



The distribution of light is uniform.

Indicates that 100% light is distributed.

This bar indicates 5% intensity.

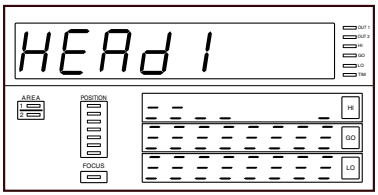


The display indicates that the light intensity drops by 25%.

If the intensity of light does not recover with the cover glass cleaned or the mounting position corrected, contact your Keyence representative.

Check on Fluctuation of Light Intensity Due to Dirt or Dust

To check the dispersion of the amount of light, record the status of the clean cover glass.



The distribution of light has fluctuation.

In the above case, refer to page 3 and clean the cover glass.

Note: **LED Inspection Function**

- The function operates correctly, provided that the position of the measuring head remains the same before, while, and after the intensity of light is checked. The intensity of light fluctuates if the mounting position shifts.
- This function cannot be used to check errors in the mounting position of the measuring head.
- This function is not intended to guarantee the measurement accuracy of the LS-7000 Series. Use master workpieces such as pin gauges to check the measurement accuracy.
- The intensity of light displayed will decrease by approximately 6% if the mutual interference prevention function is used. Furthermore, the intensity of light displayed will decrease by approximately 11% if the cable between the controller and measuring head is extended to 40 m. They are not errors. Check the intensity of LED light source based on the displayed value.

1 **Press the [ENT] key when the head display is on the screen.**

2 **Press the [▲] or [▼] key and select the measuring head.**

The following displayed items can be selected.

HEAd 1	Measuring head 1
HEAd2	Measuring head 2

3 **Press the [ENT] key.**

The distribution of light of the selected measuring head appears.

4 **Press the [ENT] key.**

Returns to the head display.

Tips Optical reception waveform can be output while checking the light intensity. Refer to Optical Reception Waveform Output on page 4-18 for details. The optical reception waveform is output to the OUT1 analog output. The threshold level when the received light intensity is 100% is output to the OUT2 analog output.

■ Mutual Interference Prevention Function

This function prevents mutual interference that may result when two measuring heads are located at right angles. With the function used, the LED light sources are turned sequenced ON and OFF.

Note: If the mutual interference prevention function is used, the following settings will change.

- The sampling cycle of measurement will be set to 1,200 times per second.
- The averaging number preset will be halved by the LS-7000 Series while in operation.
  Example: If it is set to 512 times, the number of actual averaging times will be 256 times.
- The response delay time with the averaging number set to 1 will be the same as that with the averaging number set to 2. If the averaging number preset is 2 or over, there will be no difference in response delay time. (See page 8-6)

1 Press the [ENT] key when the head display is on the screen.

2 Press the [FUNC] key.

3 Press the [▲] or [▼] key and make the setting.

The following displayed items can be selected.

oFF	Not set
on	Set

4 Press the [ENT] key.

The input item is entered and the head display appears again.

Beep

Take the following steps to activate the buzzer when control panel keys are pressed.

1 Press the [FUNC] key three times when the program display is on the screen.

2 Press the [ENT] key.

3 Press the [▲] or [▼] key and set the buzzer sound.

The following displayed items can be selected.

on	The buzzer turns ON.
oFF	The buzzer turns OFF.

4 Press the [ENT] key.

The input item is entered and the BEEP display appears again.

Panel Lock

Take the following steps to specify the panel lock range when the panel lock function is set.

Setting Range

Set the following items.

- All (ALL): All function keys are locked.
- Part (PART): All function keys other than the display selection function keys (DISP and AREA keys), [HOLD] keys, and tolerance setting keys ([HI], [GO], and [LO] keys) are locked.

Tips Refer to page 3-7 for the panel lock function in detail.

1 Press the [FUNC] key four times when the program display is on the screen.

2 Press the [ENT] key.

3 Press the [▲] or [▼] key and make the setting.

The following displayed items can be selected.

ALL	All function keys are locked.
PArt	All function keys other than the display selection function keys (DISP and AREA keys), [HOLD] keys, and tolerance setting keys ([HI], [GO], and [LO] keys) are locked.

4 Press the [ENT] key.

The input item is entered and the PAN-LOC display appears again.

MEMO

Chapter 6

I/O Terminals

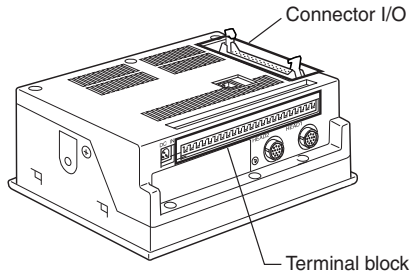
This section provides information on I/O terminal specifications and timing charts.

Nomenclature and Functions of I/O Terminals

This section provides nomenclature and functions of the I/O terminals of the LS-7000 Series.

Types of I/O Terminals

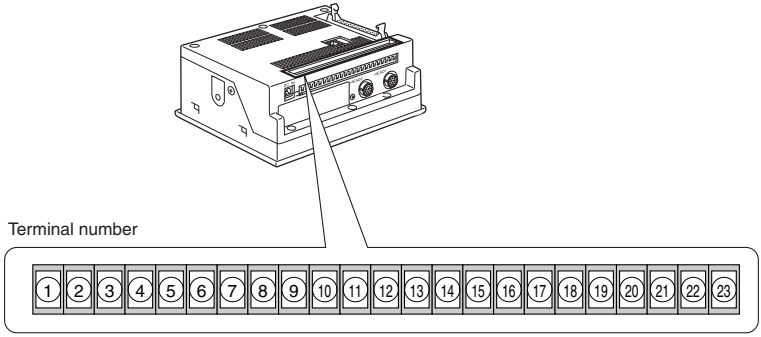
The LS-7000 Series has three types of I/O terminals. Use them according to the function used and the environment.



Terminal Block

Applicable Cable Specifications

AWG14~24



I/O Signal Names and Descriptions

The I/O terminals handle the following signals. Refer to Function on page 6-7 for the functions of the signals in detail. For the electrical specifications of signals, refer to the reference pages indicated in the table.

Terminal number	Signal name	Description	
1	24VDC+	24-VDC power supply	–
2	24VDC–	0-V power supply	
3	COM1	Terminal I/O common	
4	ALARM	Alarm output	NPN open collector output ⇒See page 6-9
5	HH	OUT1 HH output	
6	HI	OUT1 HI output	
7	GO	OUT1 GO output	
8	LO	OUT1 LO output	
9	LL	OUT1 LL output	
10	WAITING	OUT1 waiting output	
11	STROBE	OUT1 strobe output	
12	COM1	Terminal I/O common	–
13	TIMING	OUT1 timing input	Non-voltage input ⇒See page 6-9
14	RESET	OUT1 RESET input	
15	ZERO	OUT1 auto zero input	
16	P1	Program number selection input	
17	P2		
18	P3		
19	P4		
20	(Not used)	–	
21	0V	0-V analog output	–
22	OUT1 MONITOR	OUT1 analog output	Analog voltage output ⇒See page 6-10
23	OUT2 MONITOR	OUT2 analog output	

❊ Terminals 3 and 12 share the COM1 signal in common.
❊ Terminals 21 and 2 are isolated from each other.

⚠ CAUTION

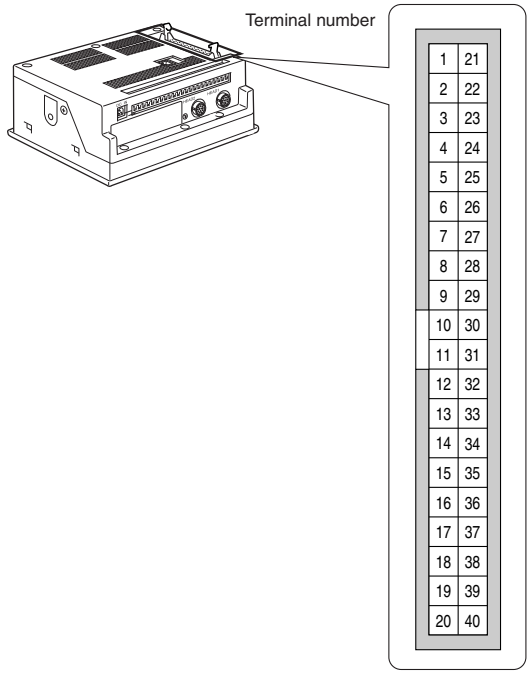
- The 0-V power supply, COM1, and COM2 signals are common in voltage through a choke coil. Check that there is no potential difference between them.
- All unused terminals must be open. Do not connect any wires to them, otherwise the LS-7000 Series may malfunction.

Connector I/O

Connector I/O signals operate in either SUB mode or BCD. Refer to I/O Mode on page 4-59 for details.

Applicable Connector Specifications

HIROSE ELECTRIC's HIF3B Series or equivalent ones



■ I/O Signal Names and Descriptions

The connector I/O terminals handle the following signals. Refer to Function on page 6-7 for the functions of the signals in detail. For the electrical specifications of signals, refer to the reference pages indicated in the table.

SUB Mode

Terminal number		Signal name	Description		Cable color
1		COM2	Connector I/O common		Brown
	21	(Not used)			Red
2		(Not used)			Orange
	22	(Not used)			Yellow
3		(Not used)			Green
	23	(Not used)			Blue
4		(Not used)			Purple
	24	(Not used)			Gray
5		(Not used)			White
	25	(Not used)			Black
6		(Not used)			Brown
	26	(Not used)			Red
7		(Not used)			Orange
	27	(Not used)			Yellow
8		COM2	Connector I/O common		Green
	28	(Not used)			Blue
9		(Not used)			Purple
	29	(Not used)			Gray
10		(Not used)			White
	30	(Not used)			Black
11		(Not used)			Brown
	31	(Not used)			Red
12		(Not used)			Orange
	32	(Not used)			Yellow
13		(Not used)			Green
	33	AREA2 FUNCTION	AREA2 function output	NPN open collector output ⇒See page 6-10	Blue
14		OUT2 HH	OUT2 HH output		Purple
	34	OUT2 HI	OUT2 HI output		Gray
15		OUT2 GO	OUT2 GO output		White
	35	OUT2 LO	OUT2 LO output		Black
16		OUT2 LL	OUT2 LL output		Brown
	36	OUT2 WAITING	OUT2 waiting output		Red
17		OUT2 STROBE	OUT2 strobe output		Orange
	37	COM2	Connector I/O common		Yellow
18		(Not used)			Green
	38	OUT2 TIMING	OUT2 timing input	Non-voltage input ⇒See page 6-9	Blue
19		OUT2 RESET	OUT2 RESET input		Purple
	39	OUT2 ZERO	OUT2 auto zero input		Gray
20		(Not used)			White
	40	AREA1 FUNCTION	AREA1 function output	NPN open collector output ⇒See page 6-10	Black

❉ Terminals 1, 8, and 37 share the COM2 signal in common.
❉ The cable colors correspond to OP-26505.

CAUTION

- The 0-V power supply, COM1, and COM2 signals are common in voltage through a choke coil each. Check that there is no potential difference between them.
- All unused terminals must be open. Do not connect any wires to them, otherwise the LS-7000 Series may malfunction.

BCD Mode

Terminal number		Signal name	Description		Cable color
1		COM2	Connector I/O common		Brown
	21	BCD POLE	BCD output polarity	NPN open collector output ⇒See page 6-10	Red
2		BCD DIGIT 7 (8)	BCD output 7th digit (Leftmost digit)		Orange
	22	BCD DIGIT 7 (4)			Yellow
3		BCD DIGIT 7 (2)			Green
	23	BCD DIGIT 7 (1)			Blue
4		BCD DIGIT 6 (8)	BCD output 6th digit		Purple
	24	BCD DIGIT 6 (4)			Gray
5		BCD DIGIT 6 (2)			White
	25	BCD DIGIT 6 (1)			Black
6		BCD DIGIT 5 (8)	BCD output 5th digit		Brown
	26	BCD DIGIT 5 (4)			Red
7		BCD DIGIT 5 (2)			Orange
	27	BCD DIGIT 5 (1)			Yellow
8		COM2	Connector I/O common		Green
	28	BCD DIGIT 4 (8)	BCD output 4th digit	NPN open collector output ⇒See page 6-10	Blue
9		BCD DIGIT 4 (4)			Purple
	29	BCD DIGIT 4 (2)			Gray
10		BCD DIGIT 4 (1)			White
	30	BCD DIGIT 3 (8)	BCD output 3rd digit		Black
11		BCD DIGIT 3 (4)			Brown
	31	BCD DIGIT 3 (2)			Red
12		BCD DIGIT 3 (1)			Orange
	32	BCD DIGIT 2 (8)	BCD output 2nd digit		Yellow
13		BCD DIGIT 2 (4)			Green
	33	BCD DIGIT 2 (2)			Blue
14		BCD DIGIT 2 (1)			Purple
	34	BCD DIGIT 1 (8)	BCD output 1st digit (Rightmost digit)		Gray
15		BCD DIGIT 1 (4)			White
	35	BCD DIGIT 1 (2)			Black
16		BCD DIGIT 1 (1)			Brown
	36	BCD INDICATE OUT 1/2	BCD output OUT number selection output		Red
17		OUT2 STROBE	OUT2 strobe output		Orange
	37	COM2	Connector I/O common		Yellow
18		BCD SELECT OUT 1/2	BCD output OUT number selection input	Non-voltage input ⇒See page 6-9	Green
	38	OUT2 TIMING	OUT2 timing input		Blue
19		OUT2 RESET	OUT2 RESET input		Purple
	39	OUT2 ZERO	OUT2 auto zero input		Gray
20		(Not used)			White
	40	AREA1 FUNCTION	AREA1 function output	NPN open collector output ⇒See page 6-10	Black

❊ Terminals 1, 8, and 37 share the COM2 signal in common.
❊ The cable colors correspond to OP-26505.

CAUTION

- The 0-V power supply, COM1, and COM2 signals are common in voltage through a choke coil each. Check that there is no potential difference between them.
- All unused terminals must be open. Do not connect any wires to them, otherwise the LS-7000 Series may malfunction.

Functions

The following section provides information on I/O signal functions. For the arrangement of each terminal, refer to pages 6-2 and 6-4.

■ Alarm Output

Name	Description	Reference page
ALARM	Turns ON when an error is detected. (Normally closed)	6-3

■ Comparator Output

Name	Description	Reference page
5-level comparator output (HH, HI, GO, LO, LL)	Turns ON according to the result of the preset tolerances. This output can be set to NO (normally open) or NC (normally closed) type.	6-3
WAITING output	Turns ON when the workpiece is not in the measuring area or the LS-7000 Series is awaiting comparator output. This output can be set to NO (normally open) or NC (normally closed) type.	6-3
STROBE output	Turns ON in synchronization with the determined result of the comparator output. This output is used for STROBE BCD output as well.	6-3

■ Measurement Control I/O

Name	Description	Reference page
TIMING input	Turns external synchronous input ON while the LS-7000 Series is in measuring mode.	6-3, 6-5, 6-6
RESET input	Resets held data.	6-3, 6-5, 6-6

■ Auto Zero Input

Name	Description	Reference page
ZERO Input	Instantaneously set the present measured value to zero.	6-3, 6-5, 6-6

■ Program Number Selection Input

Name	Description	Reference page
P1 through P4 Input	Externally changes program numbers.	6-3

The following table shows a list of program numbers and the status of the P1 terminal through the P4 terminal.

Program number	P4	P3	P2	P1
0	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	ON
2	OFF	OFF	ON	OFF
3	OFF	OFF	ON	ON
4	OFF	ON	OFF	OFF
5	OFF	ON	OFF	ON
6	OFF	ON	ON	OFF
7	OFF	ON	ON	ON
8	ON	OFF	OFF	OFF
9	ON	OFF	OFF	ON
A	ON	OFF	ON	OFF
B	ON	OFF	ON	ON
C	ON	ON	OFF	OFF
D	ON	ON	OFF	ON
E	ON	ON	ON	OFF
F	ON	ON	ON	ON

ON: Indicates the status of short-circuiting to the COM 1 terminal.
OFF: Indicates the open status of each terminal.
To change program numbers through I/O terminals, it is necessary to change the P-SELECT setting as an environment setting to TERMINAL. Refer to Program Setting Change on page 5-5 for environment settings in detail.

■ FUNCTION Output

Name	Description	Reference page
FUNCTION output	One of the following functions (focus, area check, and difference check) is selected and output. FOCUS : Turns ON or OFF in synchronization with the results of focus monitoring. (Normally open) A-TEST : Turns ON when the area check function is operating. (Normally open) DIFF : Turns ON once (for 26.6 ms) at the time of difference detection. (Normally open)	6-5, 6-6

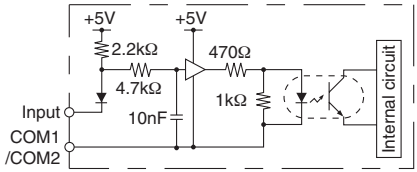
■ BCD Output

Name	Description	Reference page
BCD POLE output	BCD polarity output. OFF: Positive ON: Negative	6-6
BCD DIGIT output	BCD numeric output for each digit. Negative logic (i.e., Turns ON (set to 1) when NPN open connector output is ON). Comparator waiting status (with "–" displayed for each digit): All digits set to B (1011) Overrange (with "F" displayed for each digit): All digits turn ON (1111).	6-6
BCD INDICATE OUT1/2 output	Present OUT number turns ON. OFF : OUT1 ON : OUT2	6-6
BCD SELECT OUT1/2 input	Select and input the OUT number to be output. OFF (Open) : OUT1 ON (Short-circuited to COM2 terminal) : OUT2	6-6
STROBE output	Output in synchronization with determined BCD output.	6-6

Electrical Specifications

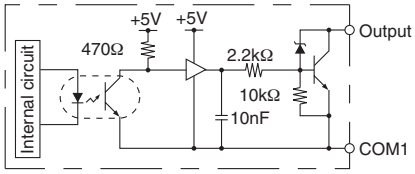
The following section provides information on the I/O electrical specifications and circuitry of the LS-7000 Series.

■ Non-voltage Input



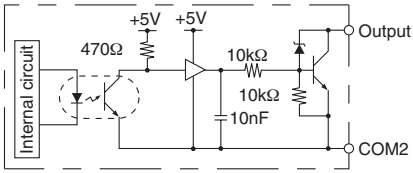
ON voltage	1 V max.
OFF current	0.6 mA max.
Short-circuit current (typical)	2mA

■ NPN Open Collector Output 1



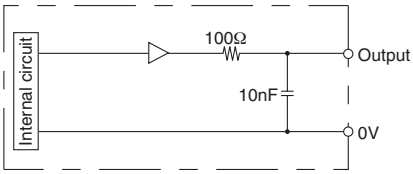
Max. applied voltage	40V
Max. sink current	100mA
Residual voltage	1 V max.
Current leakage	0.1 mA max.

■ NPN Open Collector Output 2



Max. applied voltage	30V
Max. sink current	30mA
Residual voltage	1 V max.
Current leakage	0.1 mA max.

■ Analog Voltage Output



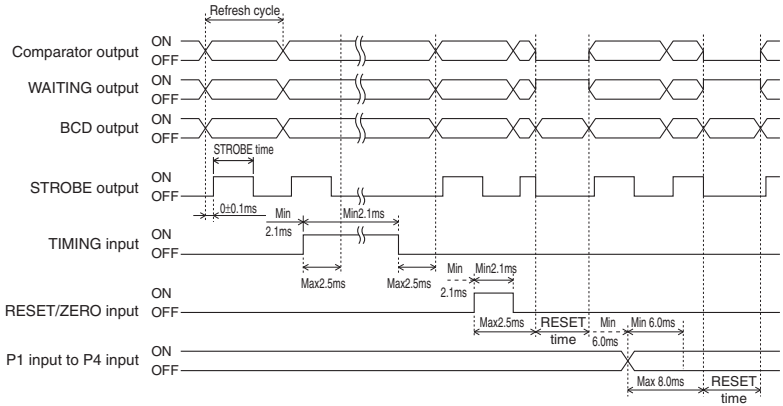
Output range	±10.5V (measured data:±10V)
Resolution	4mV
Accuracy	±0.05% of F.S. (Based on displayed value and FS of 20 V)
Output impedance	100Ω
Response delay time	Approx. 0.4 ms (after measured value refreshment)

6

Timing Chart

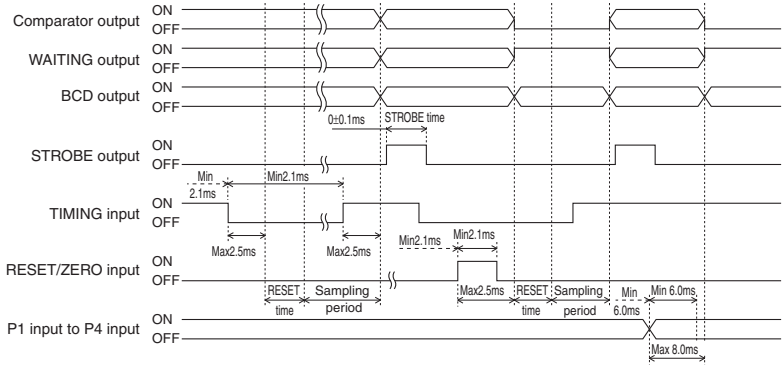
This section provides information on the timing charts of BCD output in a variety of measuring modes.

■ Normal, Auto Peak Hold, Auto Bottom Hold, and Auto Peak-to-peak Hold



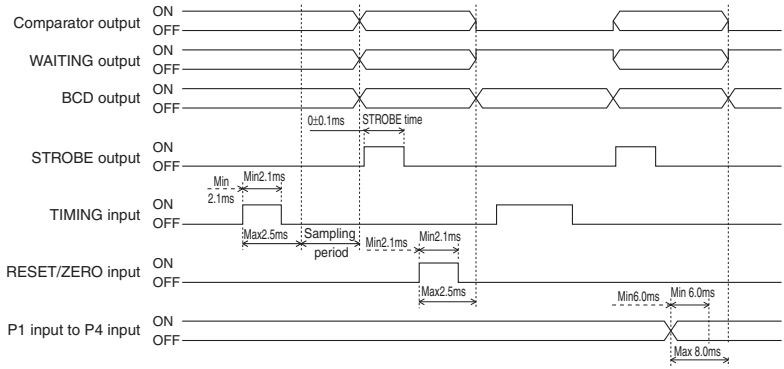
- The refresh cycle and reset time vary with the setting of the averaging number.
  Refer to Reset Time and Refresh Cycle on page 6-13 for detail.
- The strobe output time can be changed. If the time set exceeds the refresh cycle time, the strobe output will be always ON.
  Refer to Strobe Output Time on page 4-48 for detail.

■ Peak Hold, Bottom Hold, Peak-to-peak Hold, Average Hold, and Sample Hold 1



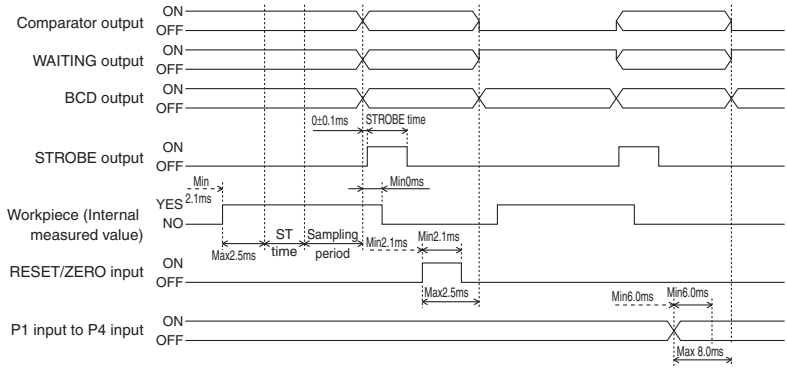
- The strobe output time can be changed.
  Refer to Strobe Output Time on page 4-48 for detail.
- Reset time varies with the setting of the averaging number.
  Refer to Reset Time and Refresh Cycle on page 6-13 for detail.
- When RESET input turns ON, the internal measured value will be determined with an elapse of reset time.

■ Sample Hold 2



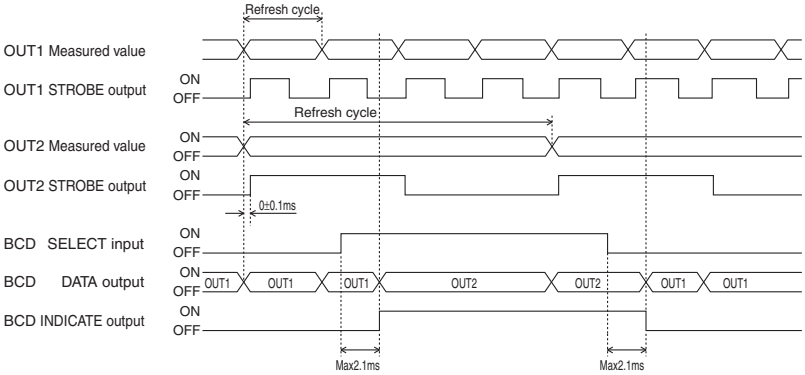
- Triggered by the acknowledgment of timing input, the measured value will be determined with an elapse of the sampling period (i.e., reset time).
- The strobe output time can be changed.
  Refer to Strobe Output Time on page 4-48 for detail.
- The sampling period (i.e., reset time) varies with the averaging number.
  Refer to Reset Time and Refresh Cycle on page 6-13.
- If RESET input or ZERO input is ON during the sampling period, the sampling will be interrupted and the LS-7000 Series will await the result of measurement.

■ Self-timing Hold



- Triggered by the acknowledgment of the workpiece, the measured value will be determined with an elapse of self-timing and sampling periods (i.e., reset time).
- The self-timing period is adjustable between 1 and 9,999 ms.
  Refer to Self-timing Hold Setting on page 4-42 for detail.
- The strobe output time can be changed.
  Refer to Strobe Output Time on page 4-48 for detail.
- The sampling period (i.e., reset time) varies with the averaging number.
  Refer to Reset Time and Refresh Cycle on page 6-13.
- If RESET input or ZERO input is ON during the sampling period, the sampling will be interrupted and the LS-7000 Series will await the result of measurement.

■ BCD Output Switching



- BCD output can be set to OUT1 or OUT2 according to BCD SELECT input.
- OUT1 and OUT2 are refreshed asynchronously according to the user settings for the averaging number and measuring mode. OUT1 or OUT2 can be selected according to BCD SELECT input.
- It is possible to use BCD INDICATE output to check if the present BCD output is OUT1 or OUT2.

■ Reset Period and Refresh Cycle

The following table shows the relationship of the averaging number, reset time, and the periods of refresh cycle. If the measuring mode is set to sample hold 2 or self-timing hold, change the item Reset Time with Sampling Period.

Number of averaging times	Reset time [ms]	Refresh cycle [ms]
1	0.42	0.42
2	0.83	0.83
4	1.67	0.83
8	3.33	0.83
16	6.67	0.83
32	13.33	0.83
64	26.67	0.83
128	53.33	0.83
256	106.67	1.67
512	213.33	3.33
1024	426.67	6.67
2048	853.33	13.33
4096	1706.67	26.67

■ Minimum Input Period

Refer to the relevant timing charts for the delay time (response delay time) in response to input.

Name	Specifications
TIMING/ZERO/RESET	ON : 2.1ms OFF : 2.1ms
P1~P4	ON : 6.0ms OFF : 6.0ms

Chapter 7

RS-232C

This section provides information on how to connect the LS-7000 Series to external devices along with RS-232C communications functions used for the external control of the LS-7000.

Specifications

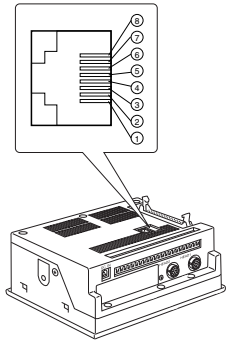
The LS-7000 Series has RS-232C communications functions. The following section provides information on the RS-232C communications specifications of the LS-7000 Series and the outline of communications settings that vary with the connecting device.

■ Applicable Connector Specification

Modular 8-pin plug connector

■ Pin Arrangement

Pin number	Signal name	Description
1	(Not used)	—
2	SD(TXD)	Receives (inputs into itself) data from external devices.
3	RD(RXD)	Transmits (outputs) data to external devices.
4	SG(GND)	GND
5	(Not used)	—
6	(Not used)	—
7	(Not used)	—
8	(Not used)	—



7

- ❊ All unused terminals must be open. Do not connect any wires to them, otherwise the LS-7000 Series may malfunction.
- ❊ The SG terminal is internally connected (common) with the 0-V power supply terminal (terminal block 2) through a choke coil.

■ Communications Specifications

EIA RS-232C Compliance (Modem Definitions)

D-MODE	NORMAL	PRINTER 1/2	PLC (KV mode)
Communications method	Full duplex		
Synchronous method	Start-stop synchronization		
Transmission code	ASCII		
Data length	7/8bit		8bit
Stop bit length	1/2bit		1bit
Parity	None/Even/Odd		Even
Baud rate	1200/2400/4800/9600/ 19200/38400/57600/115200bps		9600bps
Delimiter	CR	CR + LF	STX + ETX
Flow control	None		

Refer to RS-232C on page 5-7 for communications specification settings.

■ RS-232C Connection Settings

Make the following environment settings according to the connecting device. For details, go to the reference pages indicated in the table. Refer to page 5-7 for RS-232C environment setting details.

External device		Environment setting item		Reference page
		D-MODE	D-SEND	
Non-protocol communications with PCs or PLC link units.		NORMAL	OFF	Measured Value Output and Setting Changes with Commands (Page 7-4)
KV-series (KV mode)	KV <=> LS (Command transmission and reception)	PLC		
	KV <= LS (KV for command reception only)		S1/S2	Output of Measured Values under External Synchronous Control (Page 7-23)
Printer		PRINTER1/ PRINTER 2	S1/S2/S3	Connecting to Printers (Page 7-25)

Communication using Serial Commands

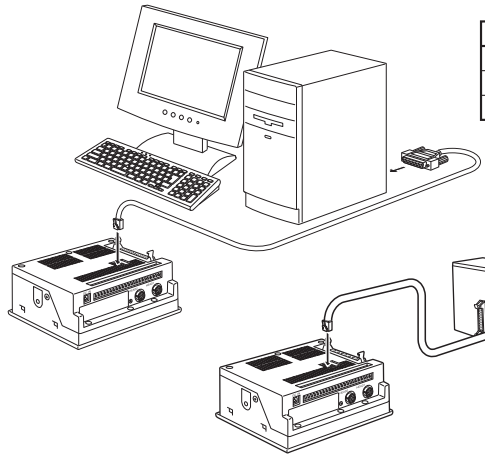
To enable the LS-7000 Series to transmit measured values or allow setting changes, connect a peripheral device, such as a PC or PLC link unit to the LS-7000 Series.

Connecting to a PC/PLC Link Unit

The following section provides information on how to connect PCs or PLC link units to the LS-7000 Series. Use the dedicated OP-35382 cable (with 9-pin D-sub connectors) or the OP-25253 (with 25-pin D-sub connectors) for connection.
When connecting the PLC link unit, refer to the operation manual of the PLC link unit for necessary information.

Note: The output of the LS-7000 Series under external synchronous control cannot be connected to printers.

Connections



LS side	PC side		
	op-25253	op-35382	Signal name
SD(TXD) ②	②	③	SD(TXD)
RD(RXD) ③	③	②	RD(RXD)
SG(GND) ④	⑦	⑤	SG(GND)
	④	⑦	RS(RTS)
	⑤	⑧	CS(CTS)
	⑥	⑥	DR(DSR)
	⑧	①	CD(DCD)
	⑳	④	ER(DTR)

■ Environment Settings

Make the following environment settings according to the PC or PLC link unit to be connected. Refer to RS-232C on page 5-7 for environment settings in detail.

Item	Set value	Remarks
BAUDRATE	1200/2400/4800/9600/19200 /38400/57600/115200bps	Make settings according to the external device.
PARITY	NONE/EVEN/ODD	
STOPBIT	1/2	
D-LENGTH	7/8	
D-MODE	NORMAL	Select the settings specified in this table.
D-SEND	OFF	

- ❊ When the D-MODE item is set to NORMAL, the Cr character will be selected for delimiter insertion.
- ❊ When the D-SEND item is set to OFF, measured value output and setting changes will be possible through RS-232C commands.

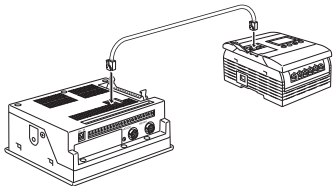
Connecting to KV Series

The following information provides information on how to connect Keyence's KV-series Programmable Logic Controller to the LS-7000 Series. Use the dedicated OP-25254 to connect the KV to the LS-7000.

Note:
- The output of the LS-7000 Series under external synchronous control cannot be connected to printers.
- Only the KV-300/Visual Series can transmit text data. The KV-10/80 series - can not be used with this mode. Refer to page 7-23 for more details.
- Refer to the KV-series Operation Manual before connecting the KV-10/80 series.

Connections

The following section provides information on how to connect the KV-16DT. (for example)



LS side		KV-16DT	
SD(TXD)	②	③	SD(TXD)
RD(RXD)	③	⑤	RD(RXD)
SG(GND)	④	④	SG(GND)

■ Environment Settings

Make the following environment settings when connecting to the KV-10/80 series. Refer to RS-232C on page 5-7 for environment settings in detail.

Item	Set value	Remarks
BAUDRATE	9600bps	The settings specified in this table will be automatically selected when the D-MODE item is set to PLC.
PARITY	EVEN	
STOPBIT	1	
D-LENGTH	8	
D-MODE	PLC	Select the settings specified in this table.
D-SEND	OFF	

- ❊ When the D-MODE item is set to PLC, the STX+ETX characters will be selected for delimiter insertion.
- ❊ When the D-SEND item is set to OFF, measured value output and setting changes will be possible through RS-232C commands.

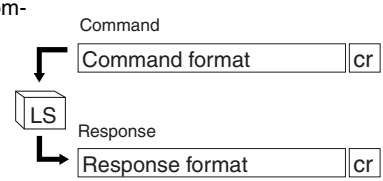
Outline of Command Formats

When LS-7000 Series receives a command from the external device, the LS-7000 Series will respond to the received command and return a response to the external device. The following section provides information on respective command formats.

Note: When you write a control program, check that the program will enable the external device to send the next command after the external device confirms the response from the LS-7000 Series.

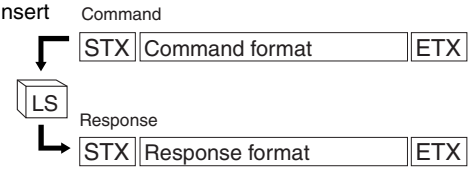
■ Connection to a PC/PLC Link Unit

The Cr character is appended to the commands and responses.



■ Connection to KV-10/80 series

The STX+ETX characters are used to insert a delimiter each to the command and response formats.



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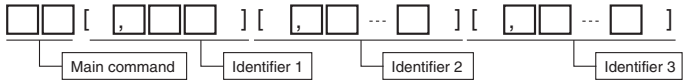
■ Outline of Command Formats

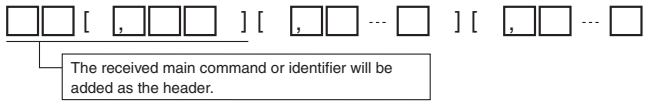
The following typical examples of command formats are explained below.

- Command format
- Response format
- Error response format

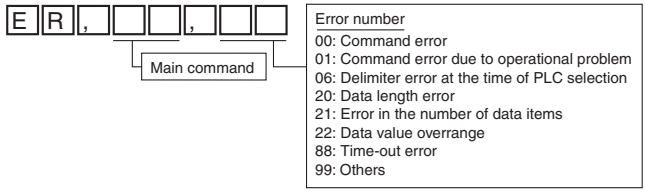
Command Format



Response Format



Error Response Format



Measurement Serial Commands

The following section provides information on serial commands used for measurement control.

List of Commands

	Command	Response
Measured value output (Page 7-8)	M q , r cr	M q , s s s s s s s s s [, t t] [, s s s s s s s s s [, t t]] cr
	M R cr	Re-output
Measured value output under timing control (Page 7-8)	L q , r cr	L q , s s s s s s s s s [, t t] [, s s s s s s s s s [, t t]] cr
Timing ON (Page 7-10)	H q cr	H q cr
Timing OFF (Page 7-10)	U q cr	U q cr
Reset (Page 7-10)	Q q cr	Q q cr
Auto zero ON (Page 7-10)	V q cr	V q cr
Auto zero OFF (Page 7-10)	W q cr	W q cr
Program number selection (Page 7-11)	P W , v cr	P W cr
Program number check (Page 7-11)	P R cr	P R , v cr
Panel lock ON/OFF (Page 7-11)	P L , w cr	P L , w cr
Function output (Page 7-11)	I S , a cr	I S , x , y cr

Code				
a: Area number q: Output number	tt: Comparison result r: Output contents	sssssssss: Measured value v: Program number	w: ON/OFF Confirmation x: FOCUS	y: Area check

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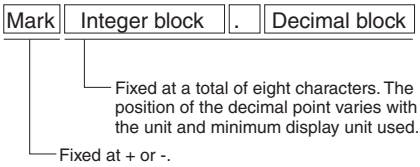
❊ The above formats are examples with the Cr key used for delimiters.
If the KV-10/80 series is used (i.e., PLC is set as a D-MODE environment setting), use the STX+ETX characters instead. (Page 7-6)

■ Measured Value Format (s s s s s s s s Format)



The following table shows format examples.

Display value	Output format
1.23450	+ 0 1 . 2 3 4 5 0
–123.450	– 0 1 2 3 . 4 5 0
–123.4	– 0 1 2 3 . 4 0 0

Commands in Detail

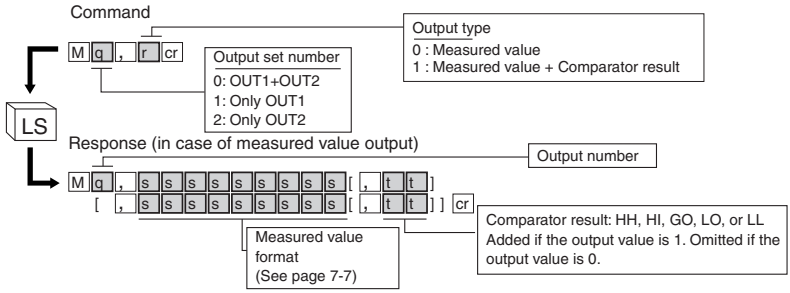
The following section provides information on commands and responses that the LS-7000 Series returns when commands are correctly processed. For error responses, refer to Outline of Command Formats on page 7-6. Refer to Timing Chart on page 7-21 for response delays.

■ Measured Value Output

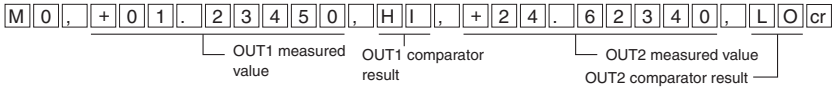
The LS-7000 Series can output a measured value.
The following types of measured value output are possible.

- Measured value output: The measured value is output.
- Measured value re-output: The previous measured value is output again.

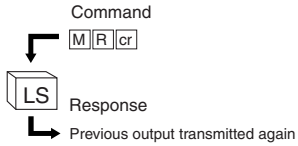
● Measured Value Output



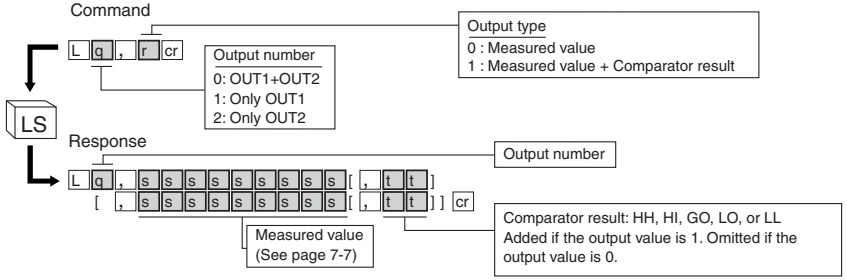
Example: The following data will be output if the output set number is 0 and the output value is 1.



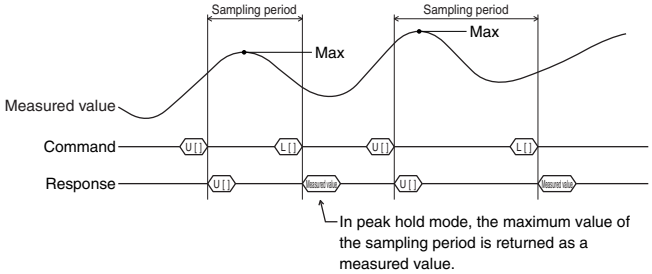
● Measured Value Re-output



■ Measured Value Output under Timing Control

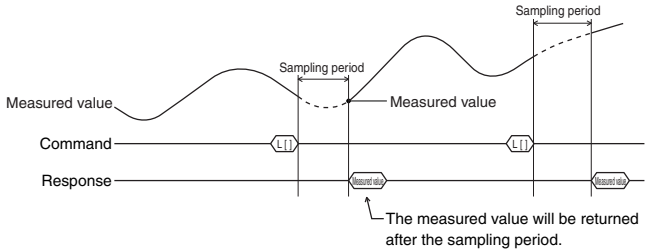


Peak Hold, Bottom Hold, Peak-to-peak Hold, Average Hold, or Sample Hold 1 Measuring mode



When the LS-7000 Series receives command L (measured value output), the internal timing is triggered and the determined measured value will be returned. The timing ON command (command H) is not required. The timing OFF command (command U) is required to start sampling.

Sample Hold 2 Measuring mode



When the LS-7000 Series receives command L (measured value output), the internal timing is triggered. The LS-7000 Series will start sampling and the determined measured value will be returned. The timing OFF command (command U) or timing ON command (command H) is not required.

Note:

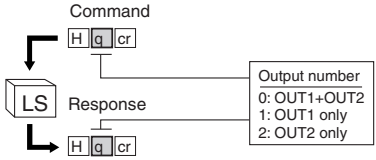
- If the LS-7000 Series receives command L while the LS-7000 Series is receiving timing input or the internal timing is triggered by command H, the LS-7000 Series will return an error response (01).
- If the measuring mode is set to self-timing hold, command L will not be available. Error (99) will be returned if this command is executed.
- If both OUT1 and OUT2 are set to sample hold 2 or either of them is set to sample hold 2, measured values will be determined asynchronously. At that time, if the LS-7000 Series receives command L0, the response will not be returned asynchronously. Instead, both OUT1 and OUT2 measured values with a comma as a delimiter will be returned when the OUT1 and OUT2 measured values are determined.

■ Timing ON

This command turns timing input ON.

With command H0 executed, the operation of the LS-7000 Series will be the same as that with SYNC set as a T-MODE environment setting item.

With command H1 or H2 executed, the operation of the LS-7000 Series will be the same as that with ASYNC set as a T-MODE environment setting item.

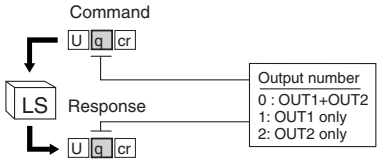


■ Timing OFF

This command turns timing input OFF.

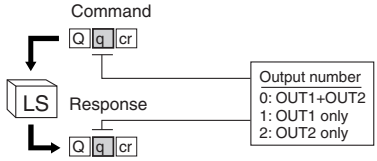
With command U0 executed, the operation of the LS-7000 Series will be the same as that with SYNC set as a T-MODE environment setting item.

With command U1 or U2 executed, the operation of the LS-7000 Series will be the same as that with ASYNC set as a T-MODE environment setting item.



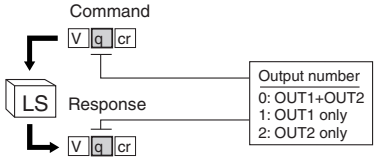
■ Reset

This turns RESET input ON.



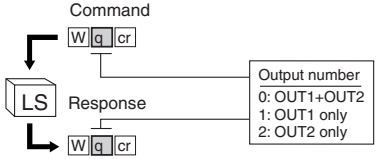
■ Auto Zero ON

This turns auto zero input ON.



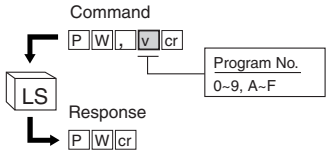
■ Auto Zero OFF

The command cancels the auto zero.



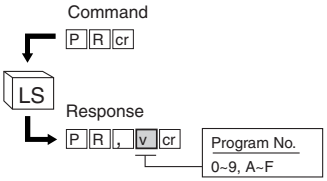
■ Program Number Selection

This command selects program numbers. The command will be enabled if PANEL is set as a P-SELECT environment setting item.



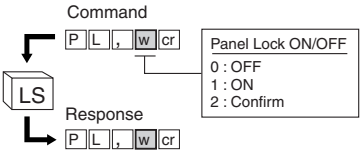
■ Program Number Confirmation

This command is used to confirm the program number that has been currently set. The command will be enabled if PANEL is set as a P-SELECT environment setting item.



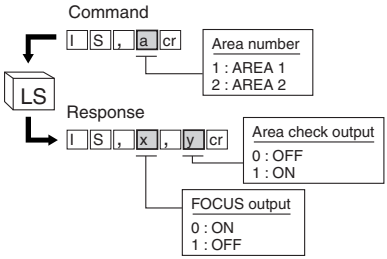
■ Panel Lock ON/OFF

This command sets the panel lock to ON or OFF.



■ Function Output

This command makes it possible to monitor the status of the FOCUS output and the status of the area check output.



Setup Serial Commands

The following section provides information on command formats that are used to make setting changes.

List of Commands

		Command	Response
Area setting	Head (Page 7-13)	SD,HE,a,b cr	SD,HE,a cr
	Area (Page 7-13)	SD,AR,a,c cr	SD,AR,a cr
	SEG edge number (Page 7-13)	SD,SE,a,dddd e,dddd e cr	SD,SE,a cr
	Area check (Page 7-14)	SD,AT,a,fff cr	SD,AT,a cr
	Level (Page 7-14)	SD,LE,a,gg cr	SD,LE,a cr
Output setting	Calculation (Page 7-14)	SD,CA,h,ii cr	SD,CA,h cr
	Average (Page 7-14)	SD,AV,h,jj cr	SD,AV,h cr
	RUN mode (Page 7-15)	SD,ME,h,kk cr	SD,ME,h cr
	Self-timing (Page 7-15)	SD,TM,h,llll cr	SD,TM,h cr
	Offset (Page 7-15)	SD,OF,h,mmmmmmmm cr	SD,OF,h cr
	Analog Reference value (Page 7-15)	SD,AU,h,nn cr	SD,AU,h cr
	Threshold (Page 7-16)	SD,AO,h,mmmmmmmm,mmmmmmmm cr	SD,AO,h cr
Tolerance setting	Reference value UPPER (Page 7-16)	SD,UP,h,mmmmmmmm cr	SD,UP,h cr
	STANDARD	SD,SD,h,mmmmmmmm cr	SD,SD,h cr
	LOWER	SD,LW,h,mmmmmmmm cr	SD,LW,h cr
	Threshold HH (Page 7-17)	SD,HH,h,mmmmmmmm cr	SD,HH,h cr
	HI	SD,HI,h,mmmmmmmm cr	SD,HI,h cr
	LO	SD,LO,h,mmmmmmmm cr	SD,LO,h cr
	LL	SD,LL,h,mmmmmmmm cr	SD,LL,h cr
	Hold ON/OFF (Page 7-18)	SD,JO,h,ww cr	SD,JO,h cr
	HOLD-H	SD,EH,h,mmmmmmmm cr	SD,EH,h cr
	HOLD-L	SD,EL,h,mmmmmmmm cr	SD,EL,h cr
Calibration setting	Logic calibration (Page 7-18)	SD,CL,a,mmmmmmmm,mmmmmmmm,mmmmmmmm,mmmmmmmm cr	SD,CL,a cr

Code				
a : Area setting number	dddd : Edge number	gg : Threshold	jj : Averaging number	mmmmmmmm : Numeric value
b : Head number	e : Edge mode	h : Output setting number	kk : Measuring mode	nn : Analog scale
c : Area	fff : Number of edges	ii : Calculation	llll : Self-timing period	w : ON/OFF

❊ The above formats are examples with the Cr key used for delimiters.
If the KV-10/80 series is used (i.e., PLC is set as a D-MODE environment setting), use the STX+ETX characters instead of Cr. (See page 7-6)

■ Numeric Setting Format (mmmmmmmm Format)

This format is a fixed length format consisting of a single mark character and seven numeric characters with no decimal used.

The following format will be used for the corresponding measured value.

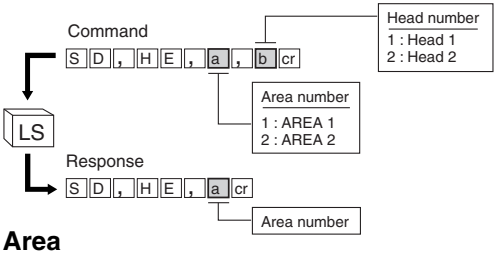
Measured value	Format
1.23450	+ 0 1 2 3 4 5 0

Commands in Detail

The following section provides information on commands and responses that the LS-7000 Series returns when commands are correctly processed. For error responses, refer to Outline of Command Formats on page 7-6. Refer to Timing Chart on page 7-21 for response delays.

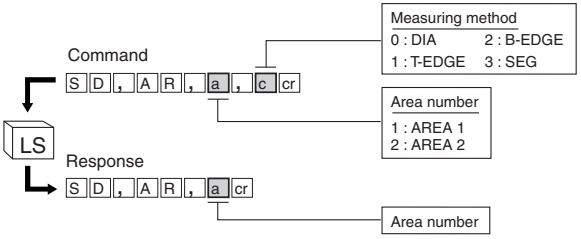
■ Head

This command changes measuring head settings.



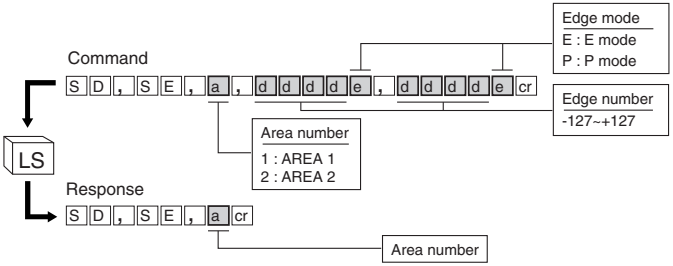
■ Area

This command changes the area measuring method of the LS-7000 Series.



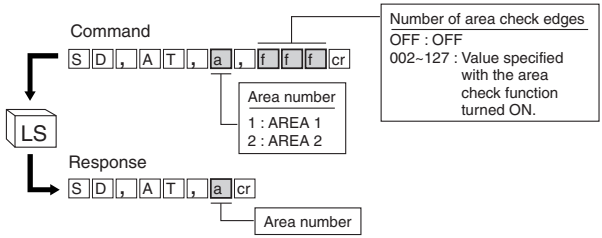
■ Edge Number

This command will change the edge number setting in the LS-7000 Series if the area measurement method is set to SEG.



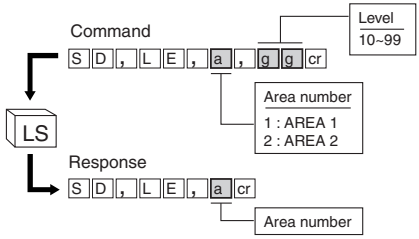
■ Area Check

This command makes area check ON/OFF settings and changes the number of edges.



■ Level

This command changes threshold level settings.



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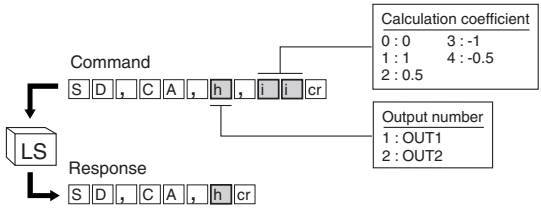
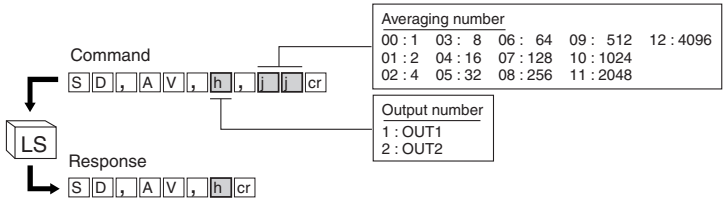
■ Calculation

This command changes area calculation settings.



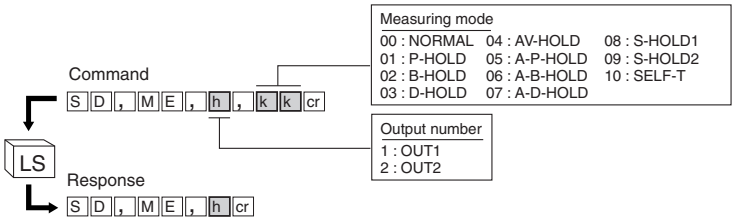
■ Average

This command changes the averaging number



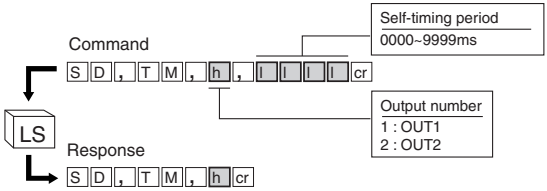
■ Measuring Mode

This command changes measuring mode settings.



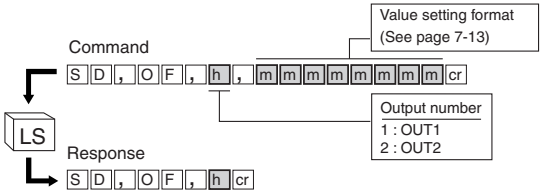
■ Self-timing Period

If the measuring mode is set to self-timing hold, this command will change self-timing period settings.



■ Offset

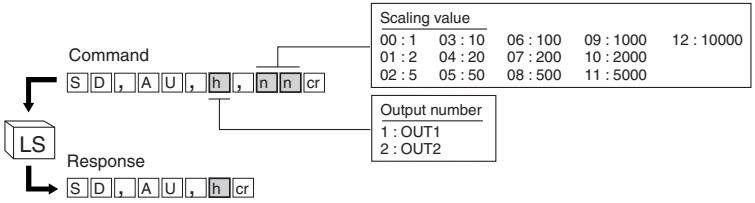
This command makes offset value setting changes.



■ Analog Scaling

This command changes scaling settings for analog output. The LS-7000 Series will return an error response if a command received is different in tolerance mode.

Reference Value Mode



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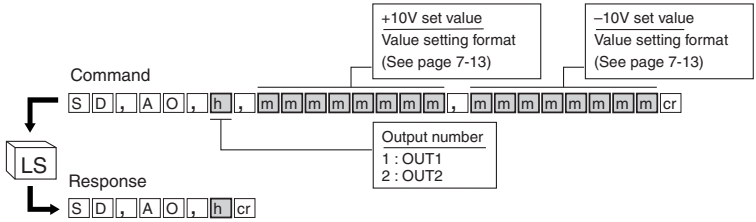
Threshold Mode

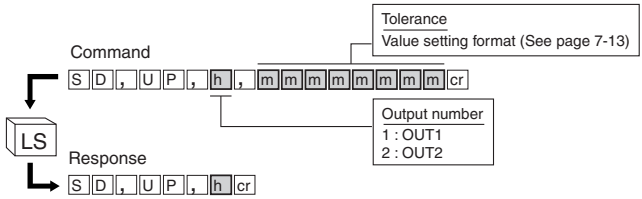


■ Tolerance

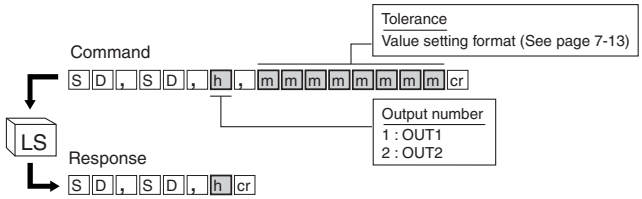
This command changes tolerance settings. The LS-7000 Series will return an error response if a command received is different in tolerance mode.

● Reference Value Mode

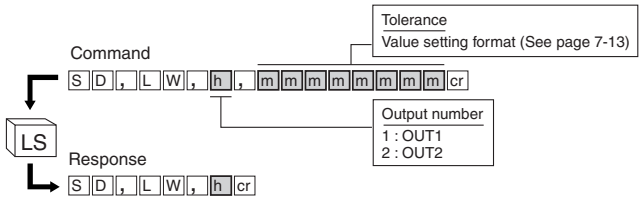
UPPER



STANDARD

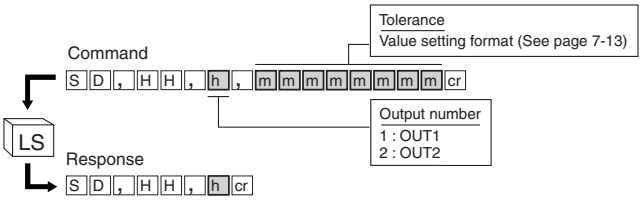


LOWER

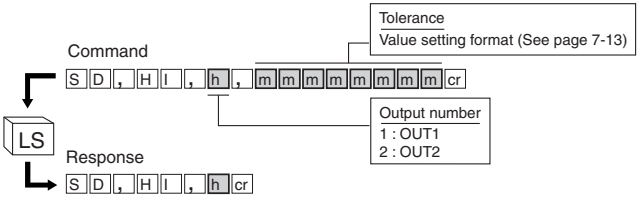


● **Threshold Mode**

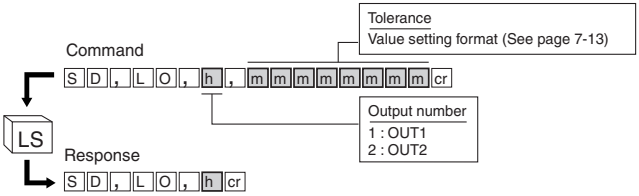
HH



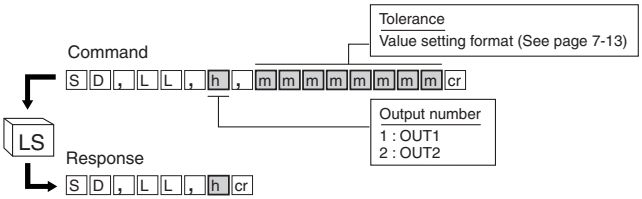
HI



LO

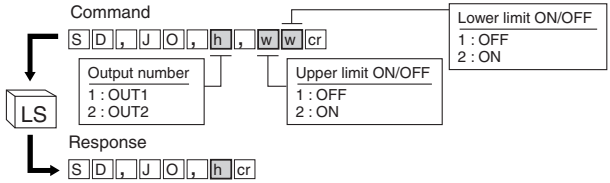


LL



■ Hold Value Elimination ON/OFF

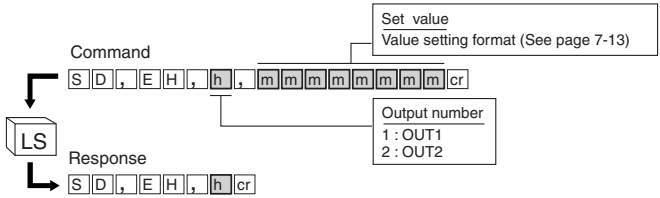
This command turns the function of abnormal value elimination ON and OFF.



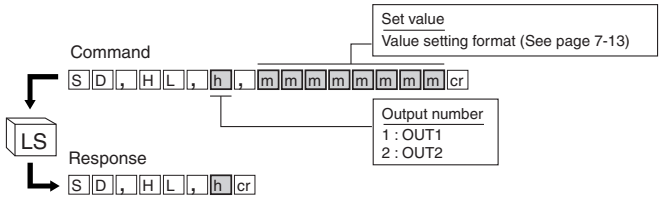
■ Hold Value Elimination Set Value

Change the set value of the function of abnormal value elimination.

HOLD-H

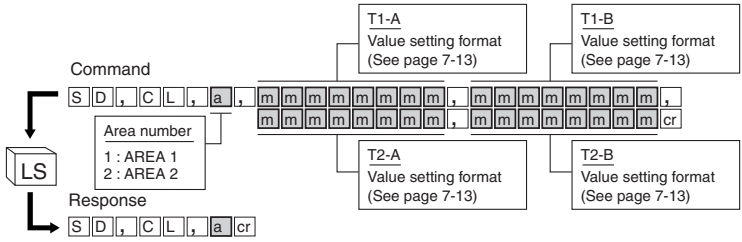


HOLD-L



■ Logic Calibration

This command is used for logic calibration.
The LS-7000 Series will return an error response if the calibration mode is not set to logic calibration.



Serial Commands to check the LS Settings

The following section provides information on command formats used to check setting details.

		Command	Response
Area setting	Head (Page 7-13)	SC,HE,acr	SC,HE,a,bcr
	Area (Page 7-13)	SC,AR,acr	SC,AR,a,ccr
	SEG edge number (Page 7-13)	SC,SE,acr	SC,SE,a,ddddde,ddddecr
	Area check (Page 7-14)	SC,AT,acr	SC,AT,a,fffcr
	Level (Page 7-14)	SC,LE,acr	SC,LE,a,ggcr
Output setting	Calculation (Page 7-14)	SC,CA,hcr	SC,CA,h,iicr
	Average (Page 7-14)	SC,AV,hcr	SC,AV,h,jjcr
	Measuring mode (Page 7-15)	SC,ME,hcr	SC,ME,h,kkcr
	Self-timing (Page 7-15)	SC,TM,hcr	SC,TM,h,llllcr
	Offset (Page 7-15)	SC,OF,hcr	SC,OF,h,mmmmmmmmcr
	Analog Reference value (Page 7-15)	SC,AU,hcr	SC,AU,h,nncr
	Analog Threshold (Page 7-16)	SC,AO,hcr	SC,AO,h,mmmmmmmm,mmmmmmmmcr
Tolerance setting	Reference value UPPER (Page 7-16)	SC,UP,hcr	SC,UP,h,mmmmmmmmcr
	STANDARD	SC,SD,hcr	SC,SD,h,mmmmmmmmcr
	LOWER	SC,LW,hcr	SC,LW,h,mmmmmmmmcr
	Threshold HH (Page 7-17)	SC,HH,hcr	SC,HH,h,mmmmmmmmcr
	HI	SC,HI,hcr	SC,HI,h,mmmmmmmmcr
	LO	SC,LO,hcr	SC,LO,h,mmmmmmmmcr
	LL	SC,LL,hcr	SC,LL,h,mmmmmmmmcr
	Hold ON/OFF (Page 7-18)	SC,JO,hcr	SC,JO,h,wwcr
	HOLD-H	SC,EH,hcr	SC,EH,h,mmmmmmmmcr
	HOLD-L	SC,EL,hcr	SC,EL,h,mmmmmmmmcr
Calibration setting	Logic calibration (Page 7-18)	SC,CL,acr	SC,CL,a,mmmmmmmm,mmmmmmmm,mmmmmmmm,mmmmmmmmcr

Code				
a : Area setting number	dddd : Edge number	gg : Threshold	jj : Averaging number	mmmmmmmm : Numeric value
b : Head number	e : Edge mode	h : Output setting number	kk : Measuring mode	nn : Analog scale
c : Area	fff : Number of edges	ii : Calculation	llll : Self-timing period	w : ON/OFF

- ❊ The above formats are examples with the Cr character used for delimiters. If the KV-10/80 series is used (i.e., PLC is set as a D-MODE environment setting), use the STX+ETX characters instead of Cr. (See page 7-6)
- ❊ Refer to Outline of Command Formats on page 7-6 for commands in detail. When the response for the setting change command is received by the LS-7000 Series, the LS-7000 Series will return detailed data on the current settings in the LS-7000.

Batch Commands

It is possible to read the whole setting data of the LS-7000 Series and save the data on the PC. The saved data on the PC can be written to the controller as well. Use the program read and program write commands.

These commands allow the following operations.

- Reading and writing program settings (auto zero set values are included).
- Reading and writing environment settings.

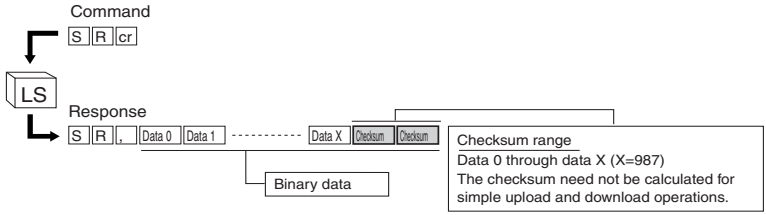
	Command	Response	Page
Read Program Settings	S R cr	S R , Data 0 Data 1 --- Data X Checksum Checksum	7-20
Writing Program Settings	S W , Data 0 Data 1 --- Data X Checksum Checksum	S W cr	7-20
Reading Environment Settings	S A cr	S A , Data 0 Data 1 --- Data X Checksum Checksum	7-21
Writing Environment Settings	S B , Data 0 Data 1 ---- Data X Checksum Checksum	S B cr	7-21

Note:
- The commands are available only when NORMAL is set as a D-MODE environment setting.
- No delimiter (Cr) will be required if the commands use binary data.
- A data length of seven bits is not available.

7

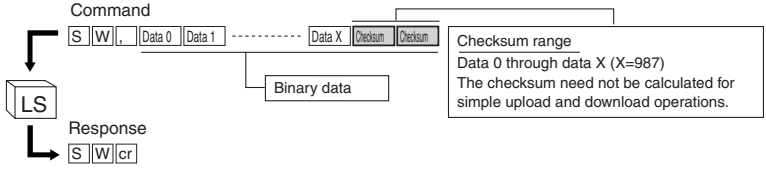
■ Reading Program Settings

All program settings selected are read.



■ Writing Program Settings

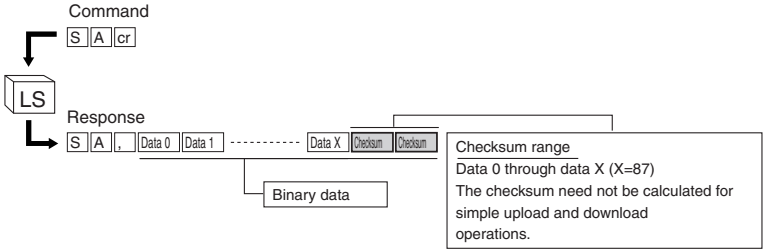
Select the program number and write the saved program that was read with the read command (SR command).



■ Reading Environment Settings

It is possible to read all environment settings in detail.

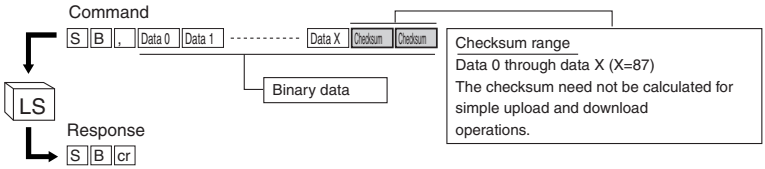
Note: P-COPY, P-CLEAR, or L-INSPCT settings are not read with this command.



■ Writing Environment Settings

Saved environment settings that were read with the read command (SA command) can be written to the LS-7000 Series.

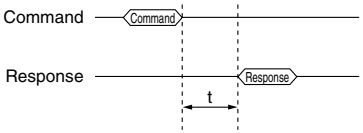
Note: P-COPY, P-CLEAR, or L-INSPCT settings are not read with this command.



7

Timing Chart

The following timing chart is for commands and responses.



Period t varies with the command as shown below.

Measurement control command	(1) Measured value output under timing control (Command L)	t=Sampling period + 3 ms
	(2) Program number selection	t=9ms
	(3) Commands other than (1) or (2)	t=3ms
Setting change command		t=17ms (40 ms for calibration)
Setting confirmation command		t=3ms
Reading and writing whole settings		t=35ms

ASCII Table

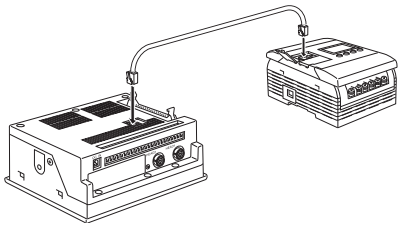
Leftmost 4 bits \ Rightmost 4 bits	0	1	2	3	4	5	6	7
0	$^{N}_{U}$	$^{D}_{L}$	$^{S}_{P}$	0	@	P	`	p
1	$^{S}_{O}$	$^{D}_{C_1}$	!	1	A	Q	a	q
2	$^{S}_{T_X}$	$^{D}_{C_2}$	”	2	B	R	b	r
3	$^{E}_{T_X}$	$^{D}_{C_3}$	#	3	C	S	c	s
4	$^{E}_{O_T}$	$^{D}_{C_4}$	$	4	D	T	d	t
5	$^{E}_{N_Q}$	$^{N}_{A_K}$	%	5	E	U	e	u
6	$^{A}_{C_K}$	$^{S}_{Y_N}$	&	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_T

Communication using an External Synchronous Trigger

The following section provides information on how to obtain output from the RS-232C interface in synchronization with a timing input into the input terminal. This operation does not require ASCII commands. Therefore, use this function if the KV-10/80 Series (or the KV mode) is used only to retrieve measurements. This can also be used when connecting a data logger to the LS-7000 Series.

Note:
- No commands are available for measured value output or setting changes. The printer cannot be connected while the LS-7000 Series is under external synchronous control.
- While the RS-232C interface is transmitting measurements, do not trigger the next measured value, otherwise the next measured value will not be output.

Connections



■ Environment Settings

Make the following environment settings. Refer to RS-232C on page 5-7 for environment settings in detail.

Item	Set value	Remarks
BAUDRATE	9600bps	The settings specified in this table will be automatically selected when the D-MODE item is set to PLC.
PARITY	EVEN	
STOPBIT	1	
D-LENGTH	8	
D-MODE	PLC	Select the settings as specified in this table.
D-SEND	S1/S2	

❊ When the D-MODE item is set to PLC, the STX+ETX characters will be selected for delimiter insertion.

❊ When the D-SEND item is set to S1 or S2, measured value output under external synchronous control will be possible.

■ Output

Output All Measured Values

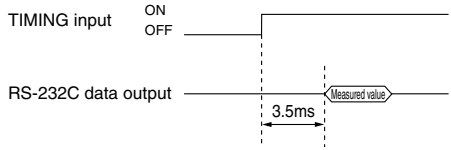
With the D-SEND item set to S1, all measured values will be output.

Output NG (No Good) Measured Values

If the D-SEND item is set to S2, NG measured values will be output.

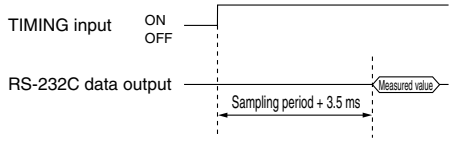
Timing Chart

The following timing chart applies to timing input and RS-232C data output (the measuring mode is not set to sample hold 2 or self-timing hold.)



- If the measuring mode is set to normal, auto peak hold, auto bottom hold, or auto peak-to-peak hold, the measured value will be transmitted at the moment timing input is turned ON.
- The measured value will be output when timing input turns ON if the measuring mode is set to peak hold, bottom hold, peak-to-peak average hold, or sample hold 1.

If the measuring mode is set to sample hold 2, the following timing chart will apply.



- The measured value will be output when sampling period plus 3.5 ms elapses after timing input turns ON. Refer to page 4-39 for the sampling period in detail.

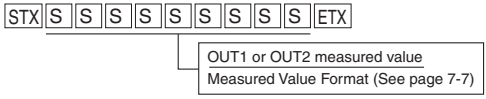
If the measuring mode is set to self-timing hold, the measured value will be transmitted when the measured value is determined.

Note: If both OUT1 and OUT2 are set to sample hold 2 or either of them is set to sample hold 2 while SYNC is set as a T-MODE option setting, measured values will be determined asynchronously. At that time, if timing input turns ON, both OUT1 and OUT2 measured values with a comma and a delimiter will be returned when the OUT1 and OUT2 measured values are determined.

■ Output Format

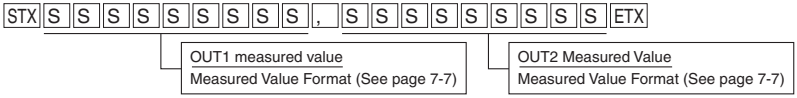
Measured Value

The following command format will be used if ASYNC is set as a T-MODE option setting.



Simultaneous Measured Value

The following command format will be used if SYNC is set as a T-MODE option setting.

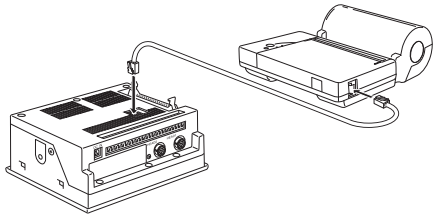


Connecting to Printers

The LS-7000 Series connects to the OP-35350 printer (sold separately) to print measured values and other data. The following section provides information on how to print out with the printer. Use the dedicated OP-42184 cable to connect the RS-232C connector of the printer and the LS-7001.

Note:
- When using the printer, no commands are available for measured value output or setting changes.
- Do not use any cable other than the dedicated one. Turn on the printer after the dedicated cable is connected to the printer, otherwise the printer will not work properly.

Connections



■ Environment Settings

Make the following environment settings. Refer to RS-232C on page 5-7 for environment settings in detail.

Item	Set value	Remarks
BAUDRATE	9600bps	Select the settings as specified in this table if the communications specifications of the printer are set to default values.
PARITY	NONE	
STOPBIT	1	
D-LENGTH	8	
D-MODE	PRINTER1/ PRINTER2	PRINTER1: Only measured values will be printed. PRINTER2: Each measured value will be printed together with a comma as a delimiter and a comparator result.
D-SEND	S1/S2/S3	S1: All measured values determined under external synchronous control will be printed. Press the ENT key to print. S2: Only no good (NG) measured values determined under external synchronous control will be output. Press the ENT key to print. S3: The measured value presently displayed on the monitor is printed. Press the ENT key to print.

- ❊ If D-MODE item is set to PRINTER1 or PRINTER2, the D-SEND item cannot be set to OFF.
- ❊ If the communications specifications of the printer are changed, change the communications specifications of the LS-7000 Series to coincide.

■ Printing

The following two types of printing are available.

- Printing with the ENT key pressed: Displayed measured values will be printed.
- Printing under external synchronization: Measured values will be printed in synchronization with measurement under timing input control. Either all data or only NG (no good) data can be selected and printed.

● Printing with the ENT Key Pressed

Displayed measured values will be printed. If both OUT1 and OUT2 measured values are displayed, they will be continuously printed with commas as delimiters inserted to separate the OUT1 and OUT2 measured values.

● Printing under External Synchronization

The measured value will be printed in synchronization with measurement under timing input control.

If the T-MODE option setting is set to ASYNC (asynchronous): OUT1 and OUT2 measured values will be printed respectively.

If the T-MODE option setting is set to SYNC (synchronous): Printed values will be continuously printed with commas as delimiters inserted to separate the values.

Printing All Measured Values

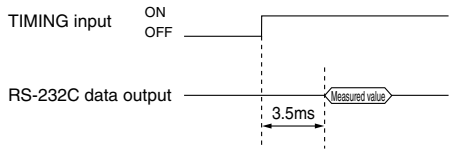
If the D-SEND item is set to S1, all measured values determined under external synchronous control will be output. If the D-MODE item is set to PRINTER1, only measured values will be printed. Measured values and comparator results will be output if the item is set to PRINTER2.

Printing NG (No Good) Measured Values

If the D-SEND item is set to S2, NG measured values determined under external synchronous control will be output.
If the D-MODE item is set to PRINTER1, only measured NG values will be printed. Measured NG values and comparator results will be output if the item is set to PRINTER2.

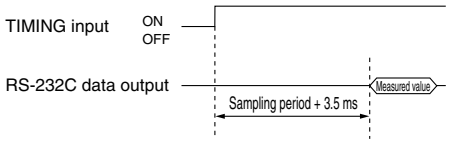
Timing Chart

The following timing chart will apply to timing input and RS-232C data output if the measuring mode is not set to sample hold 2 or self-timing hold.



- If the measuring mode is set to normal, auto peak hold, auto bottom hold, or auto peak-to-peak hold, the measured value will be printed at the moment timing input is turned ON.
- The measured value will be on when timing input turns ON if the measuring mode is set to peak hold, bottom hold, peak-to-peak average hold, or sample hold 1.

If the measuring mode is set to sample hold 2, the following timing chart will apply.



- The measured value will be output when sampling period plus 3.5ms elapses after timing input turns ON. Refer to page 4-39 for the sampling period in detail.
  If the measuring mode is set to self-timing hold, the measured value will be printed when the measured value is determined.

Note: If both OUT1 and OUT2 are set to sample hold 2 or either of them is set to sample hold 2 while SYNC is set as a T-MODE option setting, measured values will be determined asynchronously. At that time, if timing input turns ON, both OUT1 and OUT2 measured values with a comma as a delimiter will be returned when the OUT1 and OUT2 measured values are determined.

■ Print Format

Measured values are printed as shown below.

Measured values only

```
8.57365
8.57385
8.57350
8.58565
8.59285
8.59425
8.58945
8.58465
8.58810
8.59080
```

Measured values and comparison results

```
8.59440,GO
8.59460,GO
8.59435,GO
8.60895,HI
8.61150,HI
8.60255,HI
8.59640,GO
8.59375,GO
8.59345,GO
8.59350,GO
```

Measured values only (Simultaneous measurement)

```
8.59375,    1.50280
8.59360,    1.50300
8.59375,    1.50340
8.59370,    1.50315
8.59135,    1.49145
8.58500,    1.47430
8.58115,    1.47605
8.58645,    1.47510
8.58995,    1.48335
8.59375,    1.50040
```

Measured values and comparison results (Simultaneous measurement)

```
8.58185,GO,   1.47605,GO
8.58175,GO,   1.47600,GO
8.58925,GO,   1.47865,GO
8.59385,GO,   1.50160,HI
8.59420,GO,   1.50270,HI
8.59705,GO,   1.47680,GO
8.50460,HI,   1.43800,GO
8.50435,HI,   1.43795,GO
8.59265,GO,   1.49630,HI
8.59305,GO,   1.49610,HI
```

MEMO

Chapter 8

Specifications

This section provides the specifications, characteristics, and external dimensions of the LS-7000 Series.

Specifications

Controller

Model			LS-7001
Number of connectable measuring heads			2 (interchangeable)
Display	Display type		Main display 7-segment red LED (20.3 mm high) Sub display 7-segment red LED (9.9 mm high) x 3
	Minimum display unit		0.1μm to 100μm (7 selectable levels), 0.0000005 to 0.000 inch (4 selectable levels)
	Display range		±0.9999995 to ±999.9999 inch (varies with the minimum display units, inch/mil selectable), ±99.99999~±9999.9mm (varies with the minimum display units, mm/μm selectable)
	Measuring position monitor		Red LED 7-level display
	Tolerance comparator output display		Green LED (GO), Red LED x 2 (HI, LO)
Terminal block	Alarm output		NPN open collector output (N.C.)
	5-level comparator output Comparator waiting output Strobe output		OUT1 NPN open collector output
	Timing input Reset input Auto zero input		OUT1 non-voltage input
	Program selection input		Non-voltage input x 4
	Analog output		±10 V x 2 outputs
Connector I/O	SUB mode (❊1)	5-level comparator output Comparator waiting output Strobe output	OUT2 NPN open collector output
		Function output	Focus, area check, or difference selectable, NPN open collector output x 2
	BCD mode (❊1)	BCD output	Measuring data output (sign + 7 digit) OUT1/OUT2 selectable, NPN open collector output
		BCD selection output	NPN open collector output
		BCD selection input	Non-voltage input
	Timing input		Out2 non-voltage input
	Reset input		
	Auto zero input		
RS-232C interface			Measurement data output and control I/O for printer (Baud rate selectable up to 15200 bps)
Main functions			Simultaneous measurement, area setting, calculation, averaging, calibration, 16 program memory, measurement, automatic zero, print-out, abnormal value elimination, transparent object measurement and mutual interference prevention
Electrical rating (❊2)	Power supply voltage		24V DC ±10%
	Current consumption		0.7A max
Environment resistance	Enclosure rating		IP64 (panel surface only)
	Ambient temperature		0 to +40°C (32 to 104°F), No freezing
	Relative humidity		35 to 85% RH, No condensation
Weight			Approx. 820 g

❊1: Select either the SUB or BCD mode.
❊2: AC power supply is available through the LS-S11 (AC Power Supply Stand).

The terminal block has a maximum open collector output of 100 mA (at 40 V max.) with a maximum residual voltage of 1 V. The connector I/O has a maximum NPN open collector output of 30 mA (at 30 V max.) with a maximum residual voltage of 1 V. The non-voltage input has a maximum rated ON voltage of 1 V and maximum OFF current of 0.6 mA.

Measuring Head

Model	LS-7010	LS-7030	LS-7070
Measuring range	0.04 to 6mm	0.3 to 30mm	0.5 to 65mm
Minimum detectable object	0.04mm	0.3mm	0.5mm
T-to-R distance	60±5mm	160±40mm	250±50mm
Light source	GaN green LED		
CCD scanning range	Approx. 7mm	Approx. 33 mm	Approx. 69 mm
Measurement position accuracy	±0.5μm (✻1)	±2μm (✻3)	±3μm (✻5)
Repeating accuracy	±0.06μm (✻2)	±0.15μm (✻4)	±0.2μm (✻6)
Sampling times (✻7)	2,400 times/s		
Enclosure rating (✻8)	IP64		
Ambient temperature	0 to +50˚C (32 to 122˚F)		
Relative humidity	35% to 85% RH, No condensation		
Weight	Transmitter: Approx. 140 g Receiver: Approx. 340 g Base: Approx. 220 g	Transmitter: Approx. 420 g Receiver: Approx. 470 g Base: Approx. 430 g	Transmitter: Approx. 540 g Receiver: Approx. 730 g Base: Approx. 660 g

✻1: The measuring accuracy is checked with a 1.0-mm-diameter round bar moved within a measuring area of 2 x 4 mm.
✻2: The repeating accuracy is checked with 1.0-mm-diameter round bar located in the center of the measuring area to check the outer diameter of the round bar with 512 averaging times and ±2σ set.
✻3: The measuring accuracy is checked with a 10-mm-diameter round bar moved within a measuring area of 10 x 20 mm.
✻4: The repeating accuracy is checked with 10-mm-diameter round bar located in the center of the measuring area to check the outer diameter of the round bar with 512 averaging times and ±2σ set.
✻5: The measuring accuracy is checked with a 20-mm-diameter round bar moved within a measuring area of 20 x 40 mm.
✻6: The repeating accuracy is checked with 20-mm-diameter round bar located in the center of the measuring area to check the outer diameter of the round bar with 512 averaging times and ±2σ set.
✻7: The number of sampling times per second will be 1,200 when the mutual interference prevention function is used.
✻8: The Enclosure rating is not applicable to the cable connectors.

Optional Accessories

AC Power Supply Stand

Model		LS-S11
Applicable controller		LS-7001
Electrical rating	Power supply voltage	AC100~240V±10% 50/60Hz
	Power consumption	110VA max
Environment resistance	Operating ambient temperature	0 to +40˚C
	Operating ambient humidity	35% to 85%RH (with no condensation)
Weight		Approx.1.7kg

Extension Cable (Cable between the controller and measuring head)

Model	LS-C3A	LS-C10A	LS-C30A
Cable length	3m	10m	30m
Weight	Approx. 250 g	Approx. 700 g	Approx. 2,000 g

✻ Up to two cables are connectable, provided that the total length is 40 m or less.

TR Cables

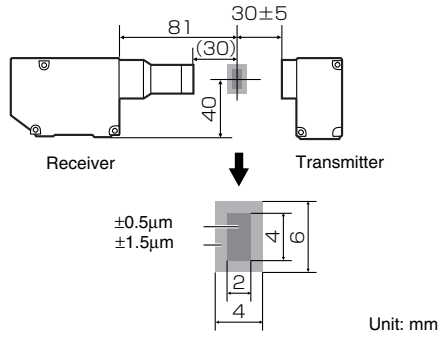
Model	OP-42182	OP-42183
Cable length	1m	3m
Weight	Approx. 50g	Approx. 120g

✻ Up to two cables are connectable, provided that the total length is 6 m or less.

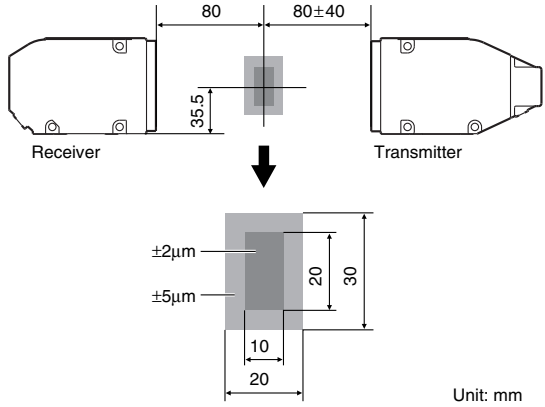
Characteristics

Measurement Range and Accuracy

LS-7010



LS-7030



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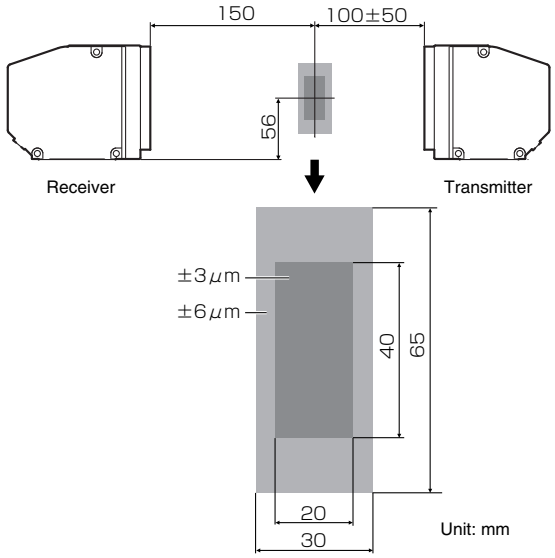
LS-7070



Temperature Characteristics

The following table shows typical examples of the temperature characteristics of the LS-7000 Series.

LS-7010

Temperature	0˚C	10˚C	20˚C	30˚C	40˚C	50˚C
Drift	0.25	0.10	0.00	-0.05	-0.10	-0.15

Unit: μm

❊ The above values are checked with a ø1 round bar located in the center of the measuring range at a reference temperature of 20˚C.

LS-7030

Temperature	0˚C	10˚C	20˚C	30˚C	40˚C	50˚C
Drift	–0.5	–0.1	0.0	0.1	0.1	0.2

Unit: μm

❊ The above values are checked with a ø10 round bar located in the center of the measuring range at a reference temperature of 20˚C.

LS-7070

Temperature	0˚C	10˚C	20˚C	30˚C	40˚C	50˚C
Drift	+1.8	+0.8	0.0	-0.8	-1.8	-3.0

Unit: μm

❊ The above values are checked with a ø20 round bar located in the center of the measuring range at a reference temperature of 20°C.

Response Deley Time

■ Measurement Response Time

The following table lists the response time between the moment the dimensional change of a target is detected and the measured result is obtained.

Averaging times	Measurement response time (ms)	Measurement averaging time (ms)	Refresh cycle (ms)	Internal processing time (ms)
1	3.34	0.42	0.42	2.5
2	4.16	0.83	0.83	2.5
4	5.00	1.67	0.83	2.5
8	6.66	3.33	0.83	2.5
16	10.00	6.67	0.83	2.5
32	16.66	13.33	0.83	2.5
64	30.00	26.67	0.83	2.5
128	56.66	53.33	0.83	2.5
256	110.84	106.67	1.67	2.5
512	219.16	213.33	3.33	2.5
1024	435.84	426.67	6.67	2.5
2048	869.16	853.33	13.33	2.5
4096	1735.84	1706.67	26.67	2.5

The response time is determined by the corresponding measurement averaging time, refresh cycle, and internal processing time (2.5 ms).

- ❊ If the RUN mode is set to normal, auto peak, auto bottom, or auto peak-to-peak, the response time will be the response time of the comparator output (HH, HI, GO, LO, LL, WAITING, or STROBE) and BCD output.
- ❊ The response time of analog output will be the response time of comparator output plus approximately 0.4 ms.
- ❊ If the RUN mode is set to peak, bottom, peak-to-peak, average, or sample hold 1, the response time will be the response time of the internal measured value. Refer to pages 4-36 to 4-40.
- ❊ If the RUN mode is sample hold 2 or self-timing, the measured value will be sampled with a delay of internal processing time.

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■ Function Output Response Time

Focus	110.84ms
Area check	3.34ms
Difference check	3.34ms

Focus Characteristics

The following table shows typical examples of the ranges where the FOCUS display or the FOCUS output turns on, provided that the focal point is at the center of the measurement area.

FOCUS set value	LS-7010	LS-7030	LS-7070
9	Approx. ±0.8mm	Approx. ±12.5mm	Approx. ±40mm
5	Approx. ±0.5mm	Approx. ±10mm	Approx. ±25mm
0	Always set to OFF	Always set to OFF	Always set to OFF

Mode Specifications

■ Measuring Mode

Status		Measured value display		Output							RS-232C	
		Numeric display	Comparator LED	5-level discrimination	WAITING	STROBE	Analog output	BCD	ALARM	FUNCTION	Reception	Response
Measuring	Comparator waiting	– – – – – – –	OFF	OFF	ON	Depends on measuring mode	Comparator waiting voltage	+All digits: B	OFF	Not synchronized with set conditions	O	O
	Positive-side range over	+FFFFFFF	HI	Reference value: HI Threshold: HH	OFF		Voltage according to the measured value. +10.5 V on the positive side and −10.5 V on the negative side if the voltage range is not within ±10 V.	+All digits: F	OFF		O	O
	Value	Measured value	Comparator output	Comparator output	OFF			Value	OFF		O	O
	Negative side range over	–FFFFFFF	LO	Reference value: LO Threshold: LL	OFF			–All digits: F	OFF		O	O
Reset processing		– – – – – – –	OFF	OFF	ON	OFF	Comparator waiting voltage	All digits: B	OFF		O	O
Error		Error-0	OFF	OFF	OFF	OFF	+10.5	+All digits: B	ON	OFF	O	Error response

■ PROGRAM Mode

Status		Measured value display		Output							RS-232C	
		Numeric display	Comparator LED	5-level discrimination	WAITING	STROBE	Analog output	BCD	ALARM	FUNCTION	Reception	Response
Tolerance setting		Same as the condition in measurement operation		Same as the condition in measurement operation							O	Error response
Area setting	Other than level setting	Same as the condition in measurement operation		Same as the condition in measurement operation							O	Error response
	Level setting	Same as the condition in measurement operation		Same as the condition in measurement operation			Optical waveform and threshold	Same as the condition in measurement operation			O	Error response
Output setting		Same as the condition in measurement operation		Same as the condition in measurement operation							O	Error response
Calibration setting		Each area value	OFF	OFF	ON	OFF	Comparator waiting voltage	All digits: B	OFF	OFF	O	Error response
Option setting		None	OFF	Same as the condition in measurement operation							O	Error response
Environment setting	Other than LED inspection	Same as the condition in measurement operation		Same as the condition in measurement operation							O	Error response
	LED inspection	Measuring head number	OFF	OFF	ON	OFF	Optical waveform	All digits: B	OFF	OFF	O	Error response
Error		Error-2 to 6	OFF	Same as the condition in measurement operation							O	Error response

■ Others

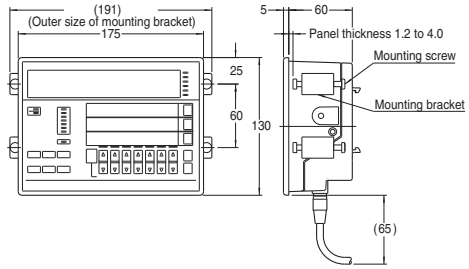
Status	Measured value display		Output							RS-232C	
	Numeric display	Comparator LED	5-level discrimination	WAITING	STROBE	Analog output	BCD	ALARM	FUNCTION	Reception	Response
Power-ON reset processing	- - - - - - -	OFF	OFF	OFF	OFF	0V	+All digits: 0	ON	OFF	O	Error response

- The LS-7000 Series will be reset if the LS-7000 Series is set to RUN mode from PROGRAM mode.
- After a program number change is made, the LS-7000 Series will be reset on completion of auto zero processing.
- The LS-7000 Series will be reset if a set value change is made over RS-232C.
- If an ERROR-0 occurs during power-ON reset processing, the analog output will be set to 0 V and all the digits of the BCD output will be added with 0.

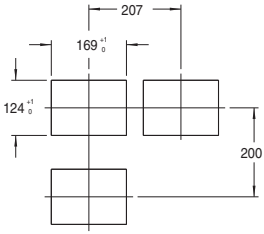
External Dimensions

It is possible to download CAD data on the external dimensions of the LS-7000 Series from KEYENCE's URL (http://www.keyence.com/).

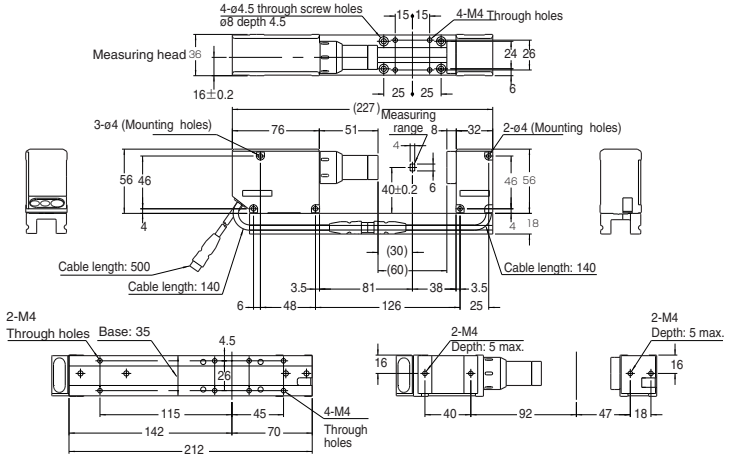
■ LS-7001 Controller



Panel Mounting Dimensions

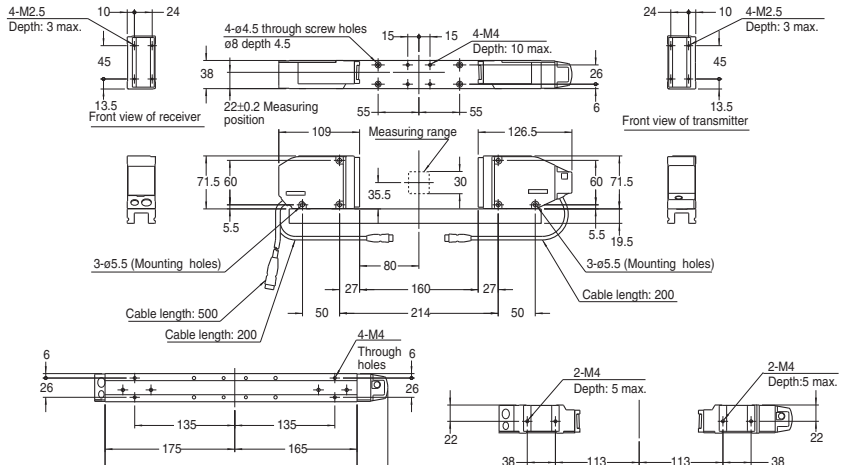


■ LS-7010 Measuring Head



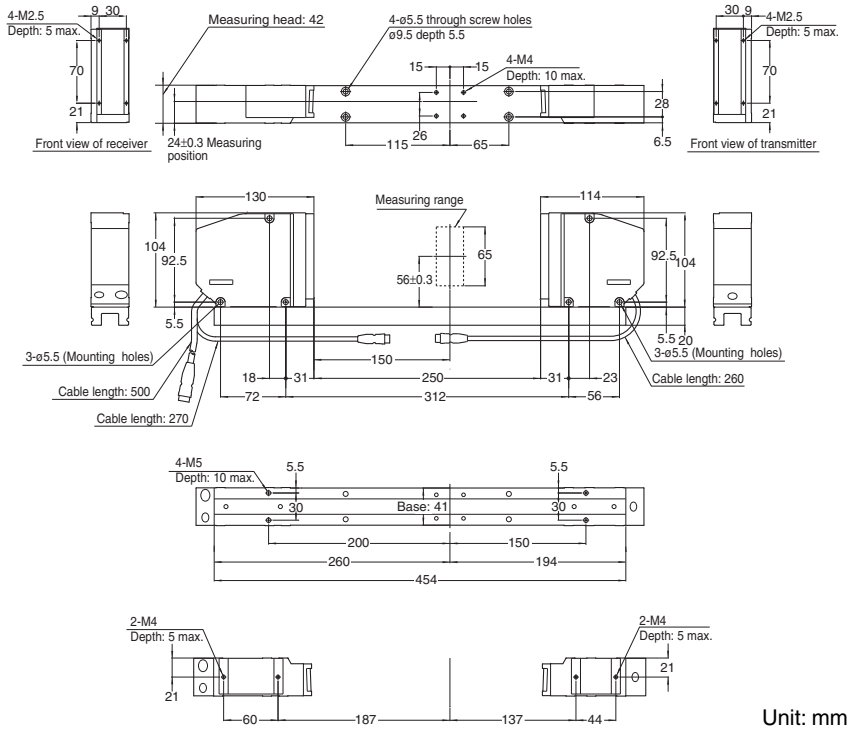
Unit: mm

■ LS-7030 Measuring Head



Unit: mm

■ LS-7070 Measuring Head



Unit: mm

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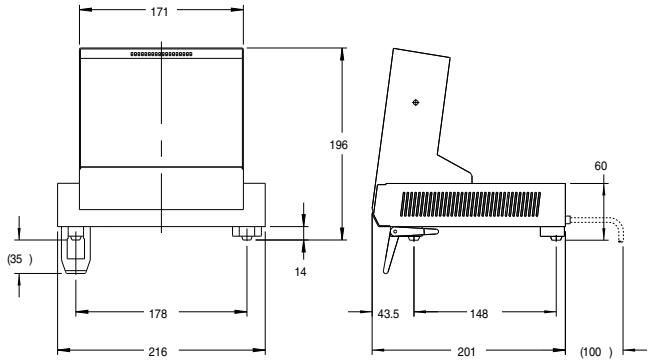
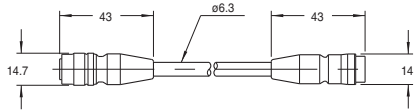
■ LS-S11 AC Power Supply Stand

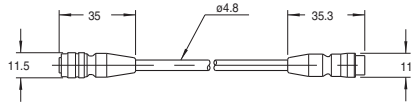


■ Extension Cable

LS-CA Extension Cable (Cable between the controller and measuring head)**



OP-42182/OP-42183 TR Cables



Unit: mm

Chapter 9

Troubleshooting

This section provides information on troubleshooting and the contents of error messages.

Troubleshooting Guide

If the LS-7000 Series fails to operate, follow the inspection steps provided below. If the LS-7000 Series does not operate normally after the inspection, contact your KEYENCE representative.

Problem	Inspection	Remedy
The panel is not lit.	**If 24 VDC is used**	
	Check that the power cable is connected correctly.	Connect the power cable correctly. (See page 1-18)
	Check that the power supply is within the specified range.	Use a power supply within the specified range. (See page 8-2)
	If LS-S11 is used	
	Check that the power cable is connected correctly.	Connect the power cable correctly. (See page 1-18) Connect the DC cable correctly. (See page 1-16)
	Check that the power supply is within the specified range.	Connect the LS-S11 to an AC power supply. (See page 8-3)
	Check that the power switch is turned ON.	Turn the power switch ON. (See page 1-19)
ERROR is displayed.		Process the error according to the displayed error number. (See page 9-6)
The measured value is not displayed.	Check that the target is within the measuring area.	Locate the target correctly in the measuring area. (See page 8-4, 8-5)
	Check that the measuring area is not blocked.	Do not block the beam with any objects other than the target.
	Check that the transmitter and receiver are mounted correctly.	Mount the transmitter and receiver correctly. (See page 1-11)
	Check that the area setting is made correctly.	Make the area setting according to the measuring position. (See page 4-7)
	Check that the cover glass of the transmitter or receiver is free of dust and dirt.	Remove the dirt and dust from the cover glass. (See page 3)
	Check that the cover glass of the transmitter or receiver is free from damage, such as scratches or cracks.	The cover glass needs a replacement if it is damaged. Contact your KEYENCE representative.
	Check that timing control is set according to the measuring mode.	Set the timing control according to the measuring mode.
	Check that the display setting is correct.	Check the display setting. (See page 3-2)
	Check that there is no condensation.	Install the LS-7000 Series in a proper environment. (See page 8-2, 8-3)

Problem	Inspection	Remedy
The measured value is not displayed.	Check that the LED light source of the transmitter is lit.	Check the connection of the cable between the transmitter and receiver. (See page 1-18) If the LED light source is still OFF, the LED light source needs a replacement. Contact your KEYENCE representative.
	Check that the measuring head is connected correctly.	Connect the cable correctly. (See page 1-18)
The measured value displayed fluctuates.	Check the averaging number is set correctly.	Set the averaging number correctly. (See page 4-31)
	Check that the target is within the measuring area.	Locate the target correctly in the measuring area. (See page 8-4, 8-5)
	Check that the reference edge is located within the measuring area.	Set the reference edge within the measuring area if the LS-7000 Series is in T-EDGE or B-EDGE mode. (See page 4-9)
	Check that the cover glass of the transmitter or receiver is free of dust and dirt.	Remove the dirt and dust from the cover glass. (See page 3)
	Check that the cover glass of the transmitter or receiver is free from damage, such as scratches or cracks.	The cover glass needs a replacement if it is damaged. Contact your KEYENCE representative.
	Check that the target is free of dust, dirt, burrs, water drops, and oil drops.	Remove the dust, dirt, burrs, water drops, and oil drops from the target. Use the hold value elimination function (See page 4-52) or area check function (See page 4-15).
	Check that there are no water sprays or oil sprays in the operating environment.	Blow off the sprays with air. Use the hold value elimination function (See page 4-52) or area check function (See page 4-15).
	Check that there is no mutual interference.	• Use the mutual interference prevention function. (See page 5-12) • Change the mounting position of the measuring head.
	Check that there is no intensive external light disturbance.	Block the external light disturbance.
	Check that there is no flow of air.	Use a cover to prevent the flow of air or agitate the air with a fan to shorten the cycle of the flow so that the influence of the flow on the displayed measured value will be suppressed.
	Check that the LED light source is bright enough.	Use the LED inspection function and check the strength of light. (See page 5-10)

Problem	Inspection	Remedy
The measured value displayed drifts.	Check that the cover glass of the transmitter or receiver is free of dust and dirt.	Remove the dirt and dust from the cover glass. (See page 3)
	Check that the target is within the measuring area.	Locate the target correctly in the measuring area. (See page 8-4, 8-5)
	Check that the target is not leaned or shifted.	Locate the target correctly in the measuring area. (See page 8-4, 8-5)
	Check that the transmitter and receiver are mounted correctly.	Mount the transmitter and receiver correctly. (See page 1-11)
	Check that the measured value is correctly calibrated.	Make the right calibration setting. (See page 4-20)
	Check that the operating environment has no radical temperature change.	Maintain a constant operating ambient temperature. (See page 8-2, 8-3)
	Check that the LED light source is intensive enough.	Use the LED inspection function and check the strength of light. (See page 5-10)
The program number cannot be changed.	Check that the P-SELECT setting is correct.	Make the right P-SELECT setting according to the change method. (See page 5-5)
	Check that the panel lock is not ON.	Set the panel lock to OFF. (See page 3-7)
Key input is not possible.	Check that the panel lock is not ON.	Set the panel lock to OFF. (See page 3-7)
Comparator output does not turn ON.	Check that the LS-7000 Series is wired correctly.	Check the output circuit and wiring. Connect the cables correctly.
	Check that the tolerance setting is correct.	Make the right tolerance setting. (See page 4-50)
	Check that the I/O mode for OUT2 is correctly set.	Select the SUB mode. (See page 4-59)
Analog output does not turn ON.	Check that the LS-7000 Series is wired correctly.	Check the output circuit and wiring. Connect the cables correctly.
	The voltage is set to +10.5 V or –10.5 V.	Set the analog scale correctly according to the measured value.

Problem	Inspection	Remedy
BCD output does not turn ON.	Check that the I/O mode is correctly set.	Select the BCD mode. (See page 4-59)
	Check that the LS-7000 Series is wired correctly.	Check the output circuit and wiring. Connect the cables correctly.
	Check that the logic is correctly set.	The LS-7000 Series has negative logic output.
	Check that the retrieval timing is correct.	Use the strobe output and retrieve the input in correct timing. (See page 6-3, 6-5, 6-6)
	Check that the right BCD SELECT signal is input.	Input the signal correctly. (See page 6-9)
RS-232C communications are not possible.	Check that the communications cable is correctly connected.	Connect the communications cable correctly. (See page 7-2)
	Check that the wiring specifications of the communications cable are correct.	Check the wiring of the communications cable. (See page 7-2)
	Check that the communications specifications are set correctly.	Set the LS-7000 Series so that the LS-7000 Series will be the same as the peripheral device in communications specifications. (See page 5-7)
	Check that the communications program is correct.	Check if the commands and delimiters are transmitted and received correctly. (See page 7-1)
	Check that the communications method is correct and that it is set properly according to the peripheral device.	Select the correct D-MODE and D-SEND settings. (See page 5-7)
No printing is possible through the dedicated printer.	Check that the communications cable is correctly connected.	Connect the communications cable correctly. (See page 7-25)
	Check that the dedicated communications cable is used.	Use the OP-42184 communications cable, which is a dedicated communications cable for the LS-7000 Series. (See page 7-25)
	Check that the communications cable is connected before the printer is turned ON.	Turn the printer ON after the communications cable is connected to the printer. (See page 7-25)
	Check that the communications specifications are set correctly.	Set the LS-7000 Series so that it is the same as the peripheral device in communications specifications. (See page 5-7)
	Check that the correct setting is made according to the printing method.	Select the correct D-MODE and D-SEND settings. (See pa 5-7)

Error Messages

The following section explains error messages that will be displayed if the LS-7000 Series has errors while in operation.

Display	Description	Remedy
Error-0	Measuring head error This error message will be displayed if the connector to the measuring head is changed, the measuring head is not connected correctly, or there is a failure in the measuring head or connection cable.	Check the wiring of the connection cable. Refer to the item ERROR-0 in this manual. If the problem is not solved, contact your KEYENCE representative.
Error-1	Calibration setting error	Press the ESC key and reset the error status. Then make the right calibration setting.
Error-2	SEG setting error	Press the ESC key and reset the error status. Then make the right setting.
Error-3	Area check setting error	Press the ESC key and reset the error status. Then make the right setting.
Error-4	Analog setting error	Press the ESC key and reset the error status. Then make the right setting.
Error-5	Tolerance setting error	Press the ESC key and reset the error status. Then make the right setting.
Error-6	Hold value elimination setting error	Press the ESC key and reset the error status. Then make the right setting.

✻ If the error message appearing on the monitor is other than the above ones, contact your KEYENCE representative.

■ ERROR-0

If the connector to the measuring head is changed or Error-0 is displayed for one measuring head while two measuring heads are in use, change the measuring head number. Then the measurement operation of the LS-7000 Series will be continued.

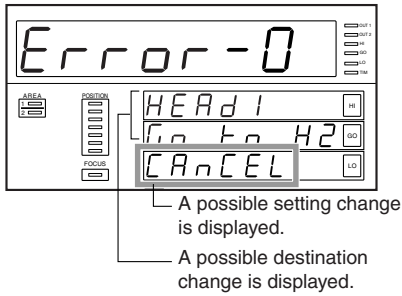
Resetting Error Status

The Error-0 is displayed as shown in the illustration.

1 To make a setting change, Press the ▲ or ▼ key and select "Yes".

2 Continue pressing the ENT key for 2 seconds.

The error status is reset and the LS-7000 Series will return to measurement mode.

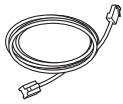
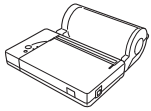
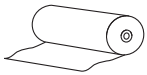
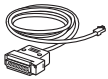


Note:
- Only the measuring head number used for the area setting in the program number in use will be changed. The Error-0 message may be displayed if the program number is changed. In that case, take the same steps to clear the message.
- To change the setting, check that the setting change will not cause problems. Then reset the error status.

Appendix

This section provides information on optional accessories and the index of this manual.

List of Optional Accessories

Item	Type	Appearance	Explanation
TR Cable (1m)	OP-42182		A 1-m extension cable used to connect the transmitter and receiver. Up to two TR cables are connectable, provided that the total length is 6 m or less.
TR Cable (3m)	OP-42183		A 3-m extension cable used to connect the transmitter and receiver. Up to two TR cables are connectable, provided that the total length is 6 m or less.
Printer Cable (1m)	OP-42184		A connection cable for the OP-35350 Printer set.
Printer Set	OP-35350		Printer set Contents: Printer, roll paper folder, battery, AC adapter, and roll paper (one roll) * To connect the LS-7001, the OP-42184 Printer cable is required as well.
Printer Roll Paper (10 rolls)	OP-35354		Printing paper for the OP-35350 Printer set.
I/O Cable (3m)	OP-26505		A 3-m connector I/O cable.
RS-232C Cable (for KV)	OP-25254		A 3-m cross cable for the communications port of the KV-10/80 series.
RS-232C Cable (25-pin D-sub)	OP-25253		A 3-m straight cable for devices with 25-pin D-sub connectors.
RS-232C Cable (9-pin D-sub)	OP-35382		A 3-m straight cable for devices with 9-pin D-sub connectors.

Setting Record Sheet

Use the following tables to record your setting details.

■ Area Settings

Item		Default setting	Setting detail	
			AREA1	AREA2
Measuring head selection (HEAD No.)		1		
Area (AREA)		DIA		
Focus monitor (FOCUS)		5		
Area check (A-TEST)		OFF		
Difference check	Number of averaging times (AVERAGE)	1		
	Difference value (DIFF)	1000		
Function output setting (FUNCTION)		FOCUS		
Edge detection threshold (LEVEL)		50		

■ Calibration Settings

Item	Default setting	Setting detail	
		AREA1	AREA2
Calibration mode (CAL-MODE)	THEORY		
T1-A			
T1-B			
T2-A			
T2-B			

■ Tolerance Settings

Item		Default setting	Setting detail	
			OUT1	OUT2
Threshold mode (TOL)	HH output range (HH)	+40.00000		
	HI output range (HI)	+30.00000		
	LO output range (LO)	0.00000		
	LL output range (LL)	–10.00000		
	HOLD-H	OFF		
	HOLD-L	OFF		
Reference value mode (DEV)	STANDARD	+10.00000		
	UPPER	+1.00000		
	LOWER	–1.00000		
	HOLD-H	OFF		
	HOLD-L	OFF		

■ Output Settings

Item		Default setting	Setting detail	
			OUT1	OUT2
Area calculation (CALC)		OUT1 : A1 1.0		
		A2 OFF		
		OUT2 : A1 OFF		
		A2 1.0		
Number of averaging times (AVE)		512		
Measuring mode (MEA-MODE)		NORMAL		
Offset (OFFSET)		0.00000		
Threshold (TOL)	Scaling at 10 V (A-OUT+10)	+30.00000		
	Scaling at -10 V (A-OUT-10)	0.00000		
Reference value (DEV)	Scaling (A-UNIT)	1000μm/V		
Analog output setting: Analog update mode (A-SET)		OFF		
Analog output setting: Voltage for awaiting result of measurement (A-CONT)		+10.5V		
Comparator output setting: Strobe output time (STOBE-T)		0.4ms		
Comparator output setting: Output logic (OUT-SET)		N.O.		
Comparator output setting: Off-delay time (OFF-DLY)		0ms		

■ Option Settings

Item	Default setting	Setting detail
Tolerance mode (LIMITS)	DEV	
Timing mode (T-MODE)	ASYNC	
Unit (D-UNIT)	mm (UNIT1)	
Minimum display unit (D-RES)	0.00005	
I/O mode (C-OUT)	SUB	

Environment Setting Record Sheet

Use the following tables to record your environment setting details.

■ Program

Item	Default setting	Setting detail
Program setting selection method (P-SELECT)	PANEL	

■ RS-232C

Item	Default setting	Setting detail
Baud rate (BAUDRATE)	9600	
Parity (PARITY)	NONE	
Stop bit (STOPBIT)	1	
Data length (D-LENGTH)	8	
Data mode (D-MODE)	NORMAL	
Data transmission mode (D-SEND)	OFF	

■ Head

Item	Default setting	Setting detail
Mutual interference prevention function (H-SYNC)	OFF	

■ Beep

Item	Default setting	Setting detail
Buzzer ON/OFF selection (BEEP)	ON	

■ Panel Lock

Item	Default setting	Setting detail
Panel Lock Function (PAN-LOC)	ALL	

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