CITIZEN

Controller for Contact-type Displacement Sensors

SA-SD

Operation Manual 2nd Edition

CITIZEN FINEDEVICE CO., LTD.

Notes

- Although great care has been taken in the preparation of this manual, there is nevertheless the possibility of it containing errors in explanations, or typographical errors.

  Please contact us if the meaning of any part of this manual is unclear, or if you notice any errors or omissions.

- Please read this instruction manual before use, and use this unit in the correct manner.

  After reading this instruction manual, keep it where you will be able to refer to it again whenever necessary.

- The content of this manual is subject to change without notice.

  The information contained in this manual is subject to periodic change, details of which are given in the latest edition of the manual.

  CITIZEN FINEDEVICE Co., Ltd. retains the right to change specifications without notice.

- The illustrations shown in this manual may differ from the actual device.

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1. Instructions for Safe Use

This product can be used safely if handled in the correct manner. Improper use may cause fire or electric shock, resulting in possible injury or death. To prevent such accidents, be sure to read, fully understand, and strictly observe the following precautions, together with the other content of this operation manual.

1-1 Warning

Warnings indicate that failure to observe the instructions may result in death or serious injury.

⚠ Warning

- Use a power supply that falls within the specified ratings.
  Use a power supply of 24 VDC.
  Using any other power voltage may cause fire or electric shock.
- Keep the power OFF during wiring work.
  Be sure to keep the power OFF during wiring work, such as when connecting the power supply or interface. Failure to do so may cause electric shock or failure.
- Do not damage the power cord.
  A damaged power cord may cause fire or electric shock.
  Observe the following instructions:
  - Do not forcibly bend, twist, or pull the power cord.
  - Do not place any heavy objects on the power cord.
  - Keep the power cord away from heaters and chemicals that could melt it.
- Do not open the case.
  Opening the case may cause electric shock or failure.
- Do not allow any foreign objects, water, or oil to get into the product.
  If any foreign object, water, or oil gets into the product, this may result in electric shock, fire, or failure.

1-2 Cautions

Cautions indicate that failure to observe the instructions may cause injury, or result in damage to the device or its surroundings.

⚠ Caution

- Do not place any heavy objects on this device, or subject it to any excessive force. Doing so may damage the device, which could result in injury.
- Do not subject this device to any strong impacts. This is a precision instrument which may fail if subjected to strong impacts.

1-3 General Precautions

- Before using this product, be sure to check that its functions are operating normally and at the correct level of performance, and make sure that it has not been damaged during transportation.
- Use this product in a manner that safeguards—even in the event of product failure—against the occurrence any type of damage.
- Please note that use of this product outside the standards or usages specified in this operation manual, or modification of the product, voids any warranty regarding the product's functions and performance.
- Depending on usage conditions and environment, use in conjunction with another device may impair the functions of this product, and prevent it from performing at full capability. Please take this into full account before use.
- Never modify, disassemble, or repair any parts other than those specified in this operation manual. Any damage caused by improper operation, handling, or usage environment will void the product warranty.

1-4 Cautions regarding Usage Environment

Do not use the product in the following places.

Usage in the following places may result in an accident or failure.

- Places where the ambient temperature falls outside the range of −10°C to 50°C
- Places where the ambient humidity falls outside the range of 35 to 85% RH
- Places where there is a large amount of water vapor or dust, or where the product could be splashed by water, oil, chemicals, or welding spatter
- Places where magnetic fields, electrostatic charges, or vibrations are generated
- Places exposed to direct sunlight
- Places subject to sudden changes in temperature resulting in condensation
- Places where there are corrosive or flammable gases
- Places subject to the risk of electrical or water leakage
- Places near which fire is used or where heat accumulates

1-5 Maintenance

- Never disassemble this product.
  Disassembly may result in an accident or failure.
- To remove dirt, wipe it off with a clean dry cloth.
  Do not use alcohol, thinner, benzene, or other volatile solvents, as this could result in an accident or failure.
- To remove persistent dirt, wipe it off with a cloth moistened with a thin neutral detergent solution, wipe the affected part with a water moistened cloth from which the water has been thoroughly wrung out, and finally wipe it with a dry cloth.

2. Product Overview

2-1 Outline

When connected to a detector, the SA-SD controller can be used to measure size and perform pass/fail judgments.

Controller

Model	Characteristics	Power supply	Pass/ fail output	Input/output
SA-SD1AP	Master/high performance	Power cable	Yes	NPN
SA-SD1AP-P	Master/high performance	Connected master	Yes	PNP
SA-SD1AC	Slave/high performance	Connected master	Yes	NPN
SA-SD1AC-P	Slave/high performance	Connected master	Yes	PNP
SA-SD1C	Slave/standard type	Connected master	Yes	NPN
SA-SD1C-P	Slave/standard type	Connected master	Yes	PNP
SA-SDNC	Slave/wire-saving type	Connected master	No	–

Connectable detectors (sold separately)

⚠ Caution

- Do not connect this device to any product other than those listed below. Connection to other products may result in an accident or failure.

Model	Characteristics	Measurement range	Resolution	Indication accuracy
SA-S110	High precision/slim type	10 mm	0.1 µm	1.0 µm
SA-S110/03N	High precision/slim type/low performance	10 mm	0.1 µm	1.0 µm
SA-S510	Universal slim type	10 mm	0.5 µm	2.0 µm
SA-S510/03N	Universal slim type/low performance	10 mm	0.5 µm	2.0 µm

Resolution settings and detector replacement

Resolution varies depending on the detector that is connected. Connection of the detector is detected automatically. As a result, there is no need to perform the parameter setting procedure required with previous products.

Be sure to turn off the power before replacing with a different detector, and adjust the new detector and master prior to use.

Optional parts (sold separately)

Model	Name	Description
SA-SD-SH2M	Detector connection cable	Straight connector: 2 m
SA-SD-SH5M	Detector connection cable	Straight connector: 5 m
SA-SD-SH10M	Detector connection cable	Straight connector: 10 m
SA-SD-SHL2M	Detector connection cable	L-type connector: 2 m
SA-SD-SHL5M	Detector connection cable	L-type connector: 5 m
SA-SD-SHL10M	Detector connection cable	L-type connector: 10 m

Composition

The SA Series consists of a controller, detector connection cables, and detectors.

As the controller, two types of master controller and five types of slave controller are available, and up to 15 slave units can be connected to one master unit.

Four types of sensor heads are available.

⚠ Caution

- When connecting a slave unit to a master unit, these must be of the same output type, i.e., both NPN-type or both PNP-type. Different output types cannot be connected together.

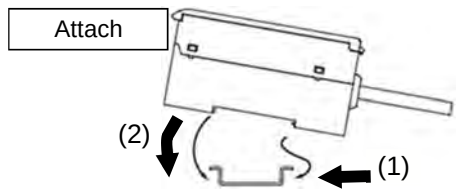
3. Connection and Installation

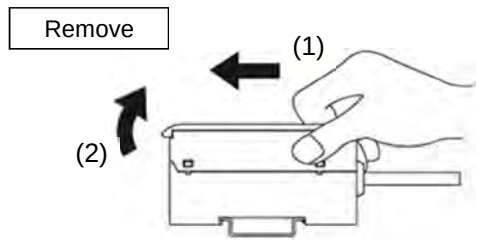
3-1 Installation of Controller

Installation on the 35-mm wide DIN rail

Fit the hook on the spring side into the DIN rail, and while pushing it forward, fit the hook on the fixing side into the DIN rail.

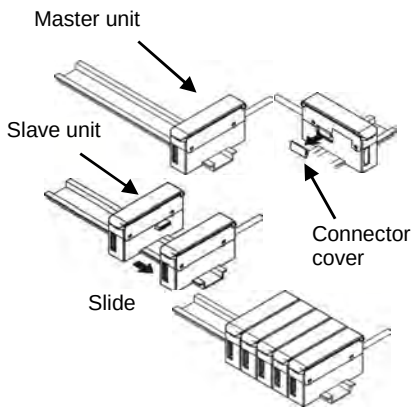
To remove, lift and disengage the hook on the fixing side whilst pushing in the (fixing side) hook direction (toward the side on which the top of the case curves).





Connecting controllers

1) Attach the master unit onto the DIN rail.
2) Remove the connector cover.
3) Attach each slave unit onto the DIN rail individually.
   Remove the connector cover of the slave unit, except for the unit at the end.
4) Connect the female connector to the male connector by sliding the slave unit.



⚠ Caution

- Be sure to turn off the power before connecting slave units to or removing them from the master unit. Connecting them with the power on may cause damage to the controller.
- When connecting a male connector into a female connector, press it in firmly as far as it will go.
  Imperfect connection may cause damage to the controller.
- If connecting two or more units, be sure to attach them onto the DIN rail.
  When doing so, attach commercially available end plates at both ends so as to sandwich the units between them.
- Up to 15 slave units can be connected to one master unit.
- When connecting a slave unit to a master unit, these must be of the same output type, i.e., both NPN-type or both PNP-type. Different output types cannot be connected together.

End plate

When attaching multiple connected units onto the DIN rail, or when units are not held stable on the DIN rail, be sure to use commercially available end plates.

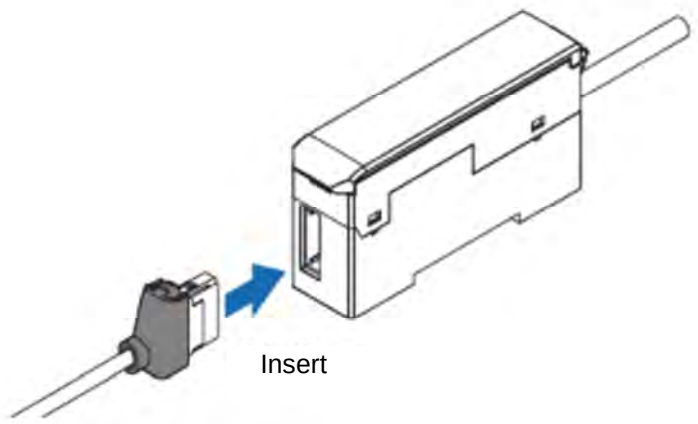
3-2 Connecting to Detector

⚠ Caution

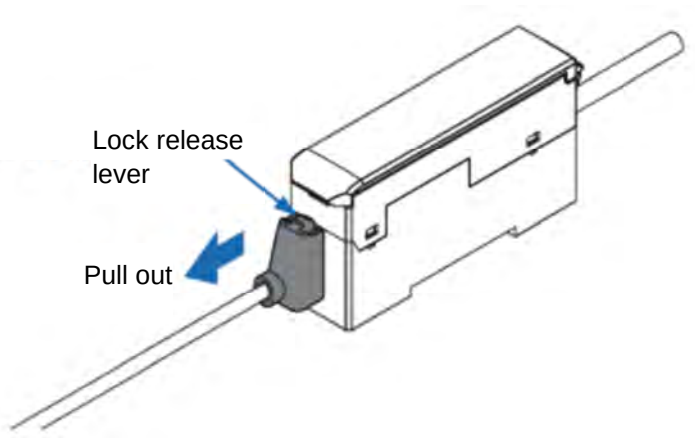
- Keep the power OFF during wiring work.
  Be sure to keep the power OFF when inserting a cable into or removing it from a detector. Performing these operations with the power ON may result in electric shock or failure.

Insert the controller connector of the detector cable into the detector cable connector of the controller.

After checking the orientation of the connector, push it in firmly as far as it will go.



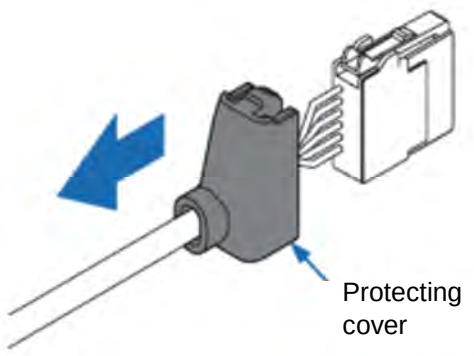
To remove, press the lock release lever on the detector cable controller connector, hold the body of the controller, and—whilst keeping the lever pressed—pull out the connector.



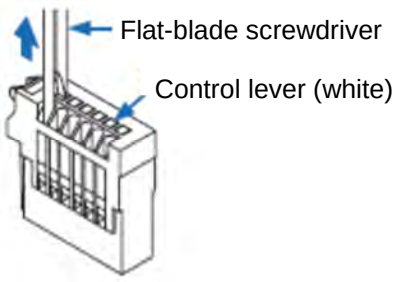
Please note that, when removing the connector, pulling the cable without pressing the lock release lever may result in the cable breaking off or the connector being damaged.

3-3 Changing the Length of the Detector Cable

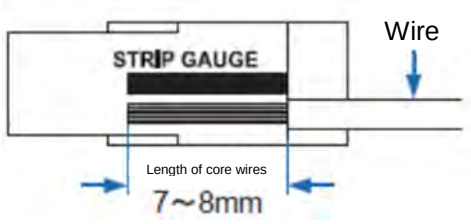
Move the protecting cover in the direction of the arrow.



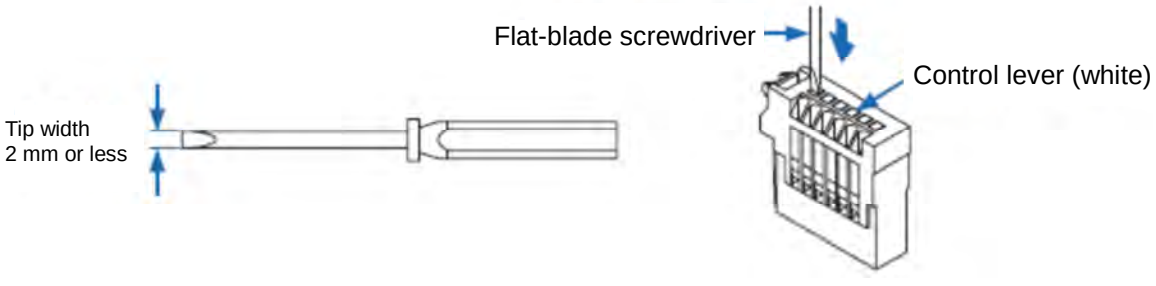
With a flat-blade screwdriver (tip width of 2 mm or less), push in the control lever (white) located at the wire insertion port, and remove the wire.



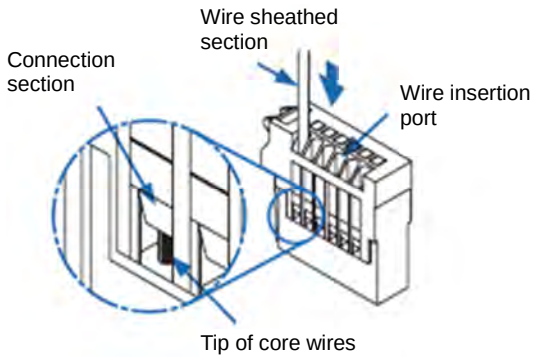
Using the STRIP GAUGE shown on the side of the body, strip the cable sheath so as to expose 7 to 8 mm of core wire, and twist the core wires several times.



Using a flat-blade screwdriver of tip width of 2 mm or less, push in the control lever (white) of the control section until it locks.



Insert the wire into the wire insertion port as far as it will go. As in the figure below, check that the sheathed section of the wire reaches inside the wire insertion port, and that the tip of the core wires passes through the connection section.

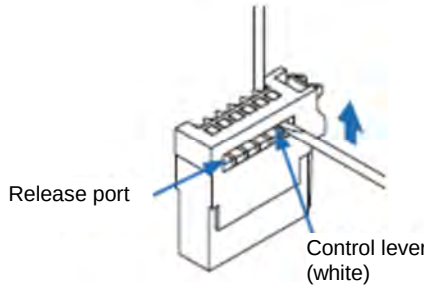


Terminal No.	Connecting wire
1	Red
2	—
3	White
4	Green
5	—
6	Black

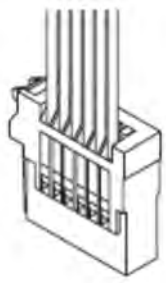
⚠ Caution

- Be careful to ensure that wiring is performed correctly, as wiring errors may result in failure.

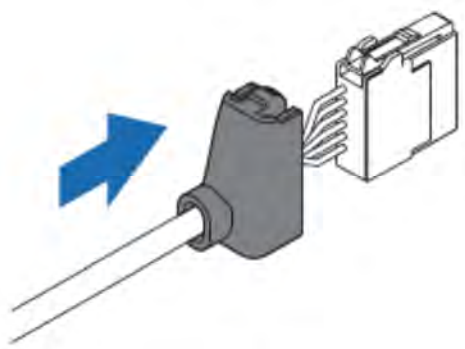
Through the release port, apply the tip of a flat-blade screwdriver to the lower part of the control lever (white), and move the tip of the screwdriver upwards. A snapping noise indicates that the control lever (white) has returned to its original position, thereby fixing the wire.



Pull lightly on the wires to check that they are not loose.



Move the protecting cover in the direction of the arrow to return its original position.

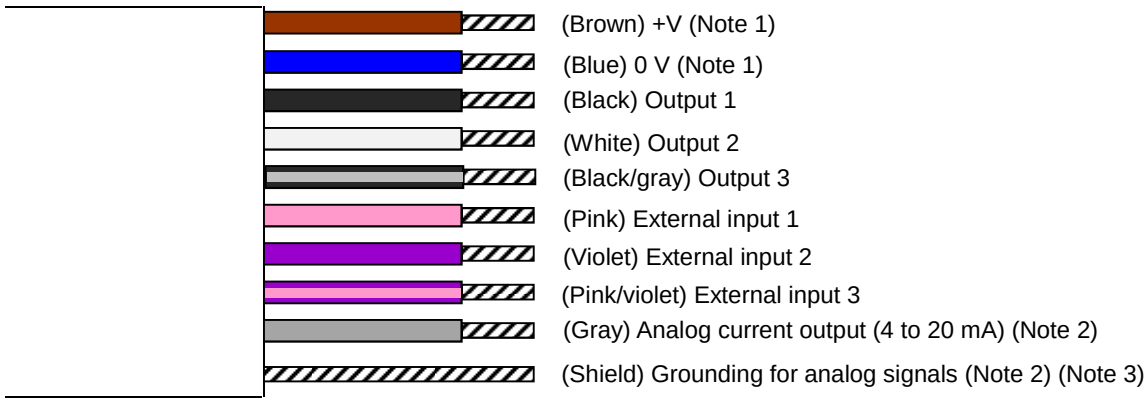


3-4 Wiring of Power Supply

⚠ Warning

- Use a power supply that falls within the specified ratings.
  Use a power supply of 24 VDC.
  Using any other power voltage may cause fire or electric shock.
- Keep the power OFF during wiring work.
  Be sure to keep the power OFF during wiring work. Failure to do so may cause electric shock or failure.
  Before turning the power ON, check that all devices are correctly connected.

Wires



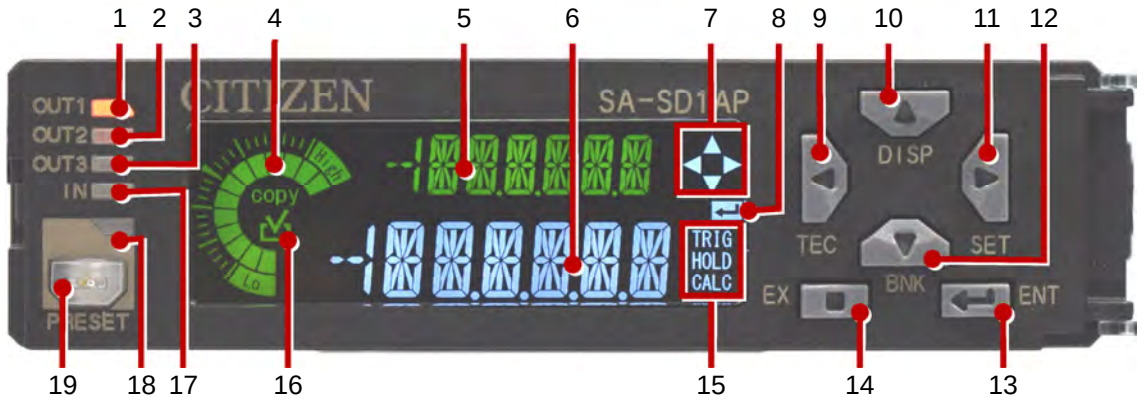
Note 1: Only master units are equipped with +V and 0 V. Power is supplied to slave units through connectors.

Note 2: Only SA-SD1A model is equipped with an analog current output terminal and a grounding terminal for analog signals.

Note 3: Use shielded wires for analog outputs.

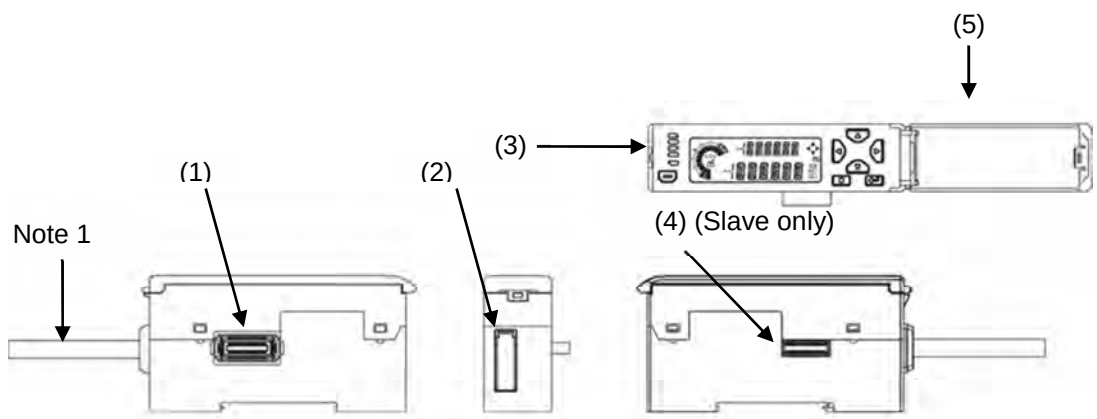
4. Part Names and Functions

4-1 Display and Control Keys



No.	Key	Description
1	Output 1 indicator lamp (orange)	Lights when Output 1 is ON.
2	Output 2 indicator lamp (orange)	Lights when Output 2 is ON.
3	Output 3 indicator lamp (orange)	Lights when Output 3 is ON.
4	Circle meter (orange/green)	• Meter indicating increase/decrease of judgment value. • The two lowest blocks show a LOW judgment, and the two highest show a HIGH judgment. • When the judgment is GO, the lamps turn green, and when it is LOW/HIGH, they turn orange. • When the HIGH setting value is equal to or lower than the LOW setting value, all lamps turn off. • On the basic screen, this meter will display the count when the LEFT/RIGHT/UP/DOWN keys are held down for two seconds. • Lamps turn on to indicate the number of setting items for each layer, and blink to indicate the order.
5	Digital display SUB (green)	Displays setting items. Displays the items set in display switching mode.
6	Digital display MAIN (white)	Displays judgment values or settings.
7	Arrow key guide marks (white)	Lamps turn on to indicate which of the LEFT/RIGHT/UP/DOWN keys can be used.
8	ENT guide mark (white)	Lights when the ENTER key is enabled.
9	LEFT key	• Used to switch setting items and settings, and to move the cursor between the digits of setting values. • On the basic screen, holding this key down for two seconds switches over to teaching mode.
10	UP key	• Used to switch setting items and to change setting values. • On the basic screen, holding this key down for two seconds switches over to the display switching mode. • On the basic screen, pressing this key for a short time switches over to the mode for fine tuning HIGH setting values.
11	RIGHT key	• Used to switch setting items and settings, and to move the cursor between the digits of setting values. • On the basic screen, holding this down key for two seconds switches over to setting mode.
12	DOWN key	• Used to switch setting items and to change setting values. • On the basic screen, holding this key down for two seconds switches over to bank mode. • On the basic screen, pressing this key for a short time switches over to the mode for fine tuning LOW setting values.
13	ENTER key	• Commits the setting items and settings. • On the basic screen, holding this key and the EXIT key down simultaneously for two seconds executes the key lock setting/release.
14	EXIT key	• Cancels the setting items and settings. • On the basic screen, holding this key and the ENTER key down simultaneously for two seconds executes the key lock setting/release.
15	Status mark TRIG (white)	Lights while the trigger input (external input) is ON. Lights during the sampling period in self hold setting.
	Status mark HOLD (white)	Lights while the judgment value is held.
	Status mark CALC (white)	Lights when connected to slave units and set to calculation mode.
16	Copy check mark (orange)	COPY lights if a slave unit is enabled for copying while setting the master unit. If selected for copying, the check mark lights, and the relevant data is copied on execution.
17	Input indicator lamp (white)	Lights when one of the external inputs 1/2/3 is ON.
18	Preset indicator lamp (green)	Lights when the preset function is being used.
19	Preset key	On the basic screen, pressing this key for a short time turns the preset function ON. On the basic screen, holding this key down for two seconds turns the preset function OFF.

4-2 Main Body



No.	Name	Description
(1)	Female connector	Connects to a slave unit. Remove the connector cover before connecting to a slave unit.
(2)	Sensor head cable connector	Connects to a sensor head cable (sold separately).
(3)	Digital display/control section	For details, refer to next page.
(4)	Male connector (Slave unit only)	Connects to a master or slave unit.
(5)	Digital display/control cover	Closed except during control procedures.

Note 1: This section is not present in SA-SDNC.

5. Modes of Use

5-1 Overall Flow Chart

Basic screen

The basic screen appears when the power is turned on.

On this screen, key operations can be used to switch to various modes and execute various functions.

Long press for 2 s

SUB display switching mode
Switches the display on digital display SUB (green).

Long press for 2 s

Bank mode
Designates Banks (1 to 3), to/from which HIGH and LOW setting values can be written and read.

Short press

Fine tuning of HIGH setting values
Automatically sets HIGH and LOW setting values for pass/fail judgment.

Short press

Fine tuning of LOW setting values
Switches the display on digital display SUB (green).

Long press for 2 s

Setting mode
Changes basic settings and sets detailed functions.
In addition, through the use of convenient functions such as calculation, connected unit data copying, and maintenance information, the system can be used for a wide variety of applications.

Long press for 2 s

Teaching mode
Automatically sets HIGH and LOW setting values for pass/fail judgment.

+
Long press for 3 s

Key lock
Disables keys in order to prevent user operation errors during measurement.

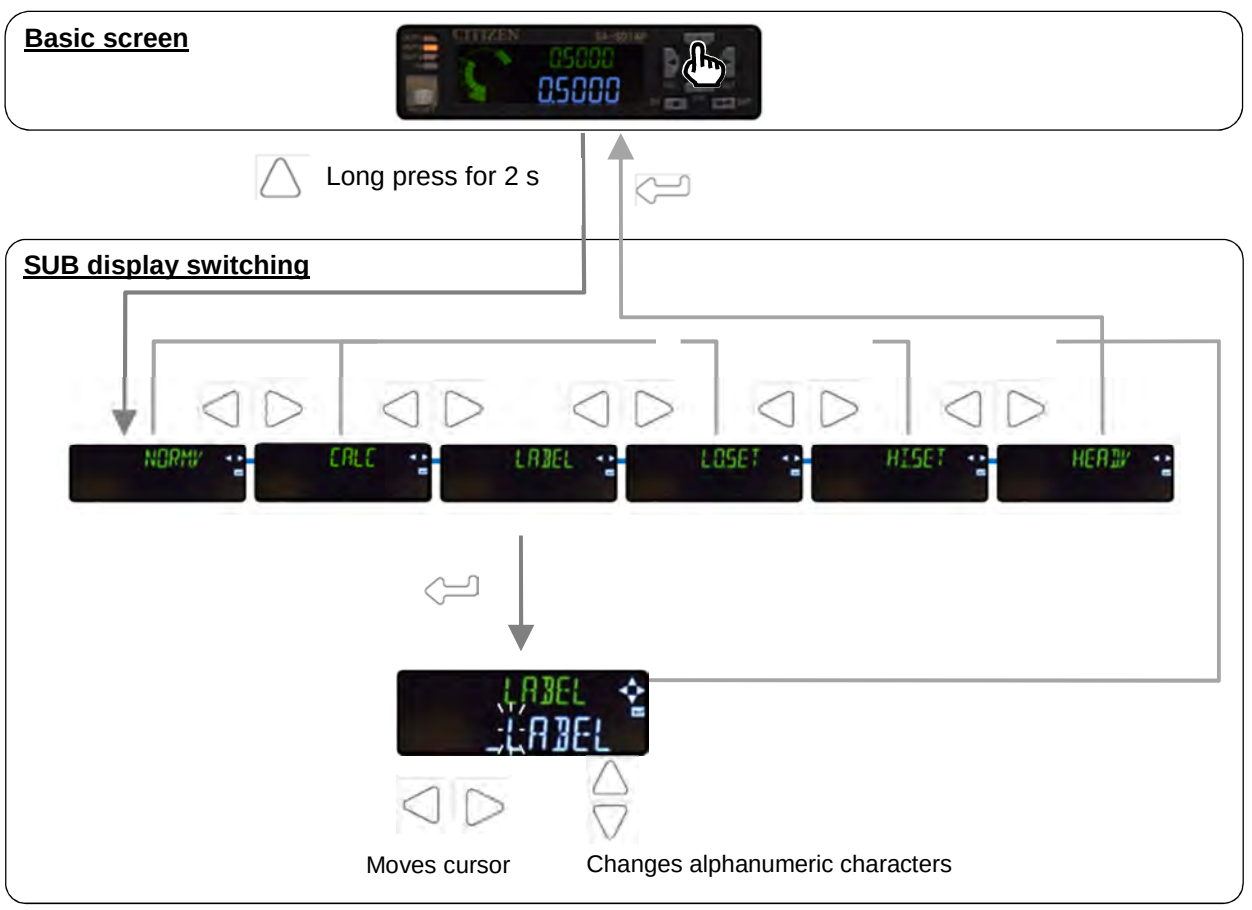
Long press for 2 s

Sensor head measurement values
Clears the preset and displays sensor head measurement values.

Short press

Preset
Shifts settings to zero or arbitrary preset values.

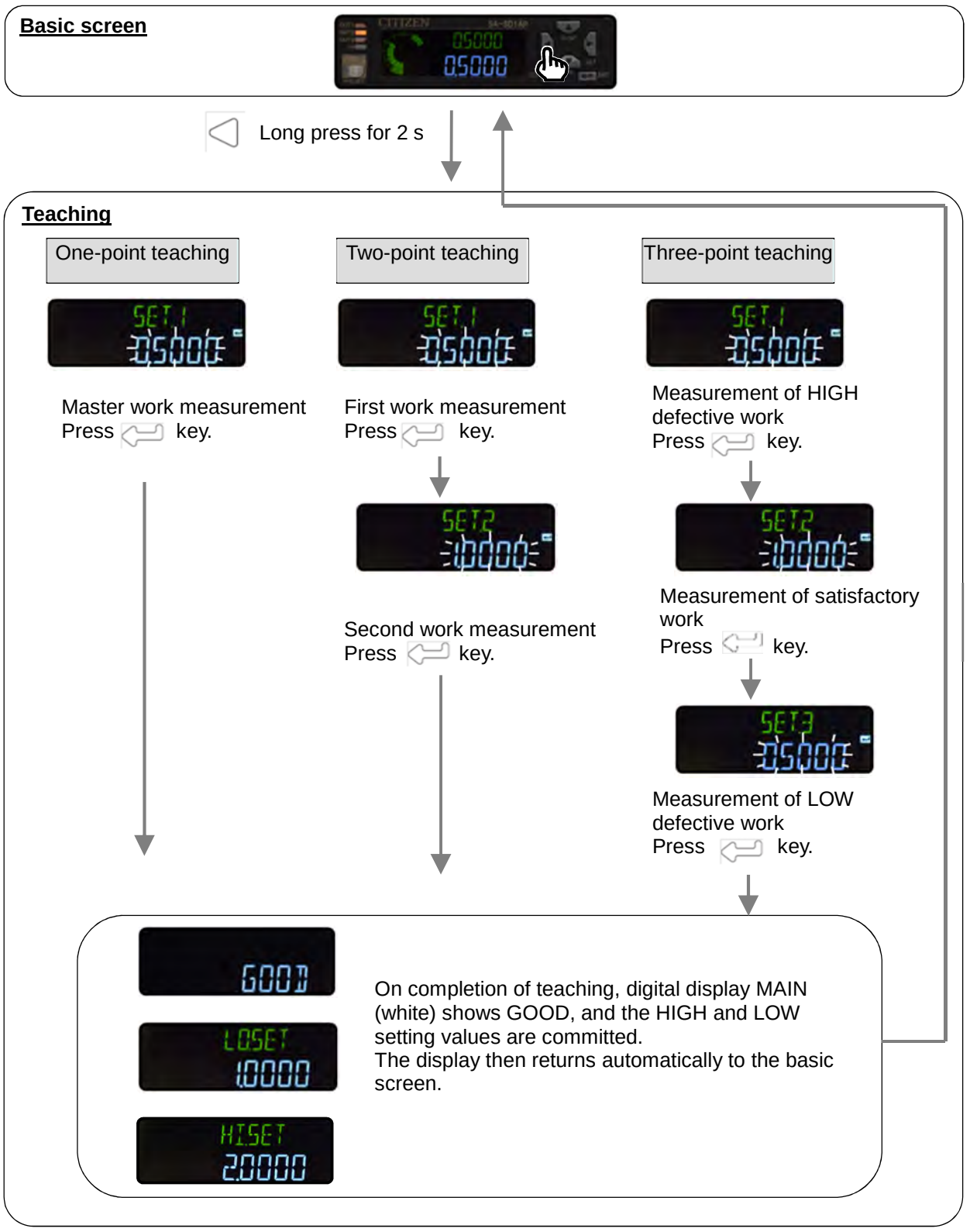
5-2 SUB Display Switching Mode



Normal measurement value	NORMV	Displays a normal measurement value. The displayed value indicates the preset, measurement direction, lever ratio, or calibration function. • While the holding function is being used, this display allows checking of internal measurement values that are not being held.
Calculation value (Note 1)	CALC	Displays a calculation value. • While the calculation and holding functions are being used, this display allows checking of calculation results that are not being held.
Label	LABEL	Displays and sets arbitrary values and characters decided by the user. • This removes the need to attach physical labels (showing sensor numbers, etc.) to controllers.
LOW setting	LO.SET	Displays a LOW setting value. • This allows simultaneous checking of the judgment value and lower limit value.
HIGH setting	HI.SET	Displays a HIGH setting value. • This allows simultaneous checking of the judgment value and upper limit value.
Sensor head measurement value	HEADV	Displays a measurement value from the sensor head (absolute position of the spindle). • While the preset or calibration function is being used, this display allows checking of the absolute position of the spindle.

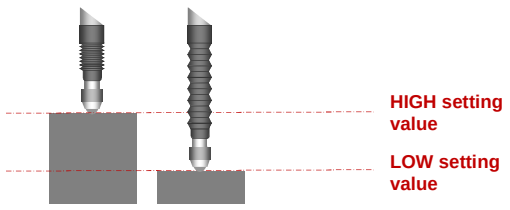
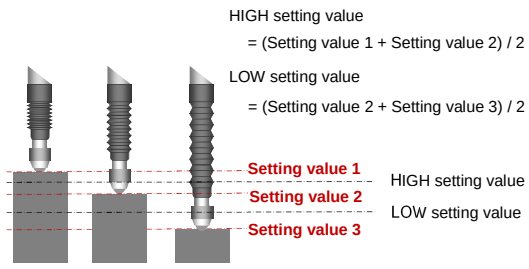
Note 1: The calculation function is set on a master unit. If the calculation function is set to anything other than STAND (Difference from standard), CALC is displayed on the master unit only. If the calculation function is set to STAND (Difference from standard), CALC is displayed on the slave units, but not on the master unit. If the calculation function is not used, neither the master nor slave units display CALC.

5-3 Teaching Mode



For reference

- ✓ The two-point teaching and three-point teaching sort the work judgment values into descending order, and set them accordingly to the HIGH and LOW setting values.
- ✓ For details of switching teaching methods, refer to "6-1-4 Teaching (TEACH)."

Teaching method	Setting
One-point teaching [Initial status]	This sets the HIGH and LOW setting values automatically using one reference work. This is used to judge work with a ±tolerance. 
Two-point teaching	This sets the HIGH and LOW setting values automatically using two reference works. This is used to judge work according to whether it falls between an upper and lower limit. 
Three-point teaching	This sets the HIGH and LOW setting values automatically using a satisfactory work, HIGH defective work, and LOW defective work. It assumes the upper limit to be the median of the satisfactory and HIGH defective work values, and the lower limit to be the median of the satisfactory and LOW defective work values. This type of teaching is used to judge work according to whether it falls between these upper and lower limits. 

Related information

- ✓ The initial status of the tolerance setting for the one-point teaching is 0.1000 (±0.1).
- ✓ For setting of the tolerance in the one-point teaching, refer to "6-1-5 Tolerance <±>."
- ✓ The judgment results are displayed as shown in the following table.

Digital display MAIN (white)	Description
	For a stable measurement
	For a measurement that is not stable
	When teaching did not execute correctly

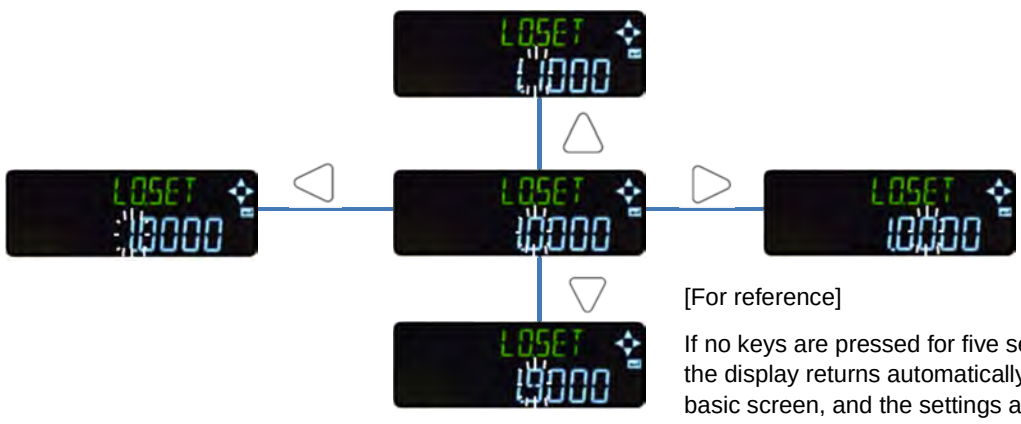
- ✓ Teaching cannot execute correctly in the following cases:
  - Immediately after the power has been turned on, or immediately after input of a reset
  - When the data is outside the display's upper or lower limit.
  - While an alarm is being output
  - While an error is being output

5-4 Fine Tuning of LOW Setting Values

Basic screen

Short press

Fine tuning of LOW setting values



[For reference]

If no keys are pressed for five seconds, the display returns automatically to the basic screen, and the settings are established.

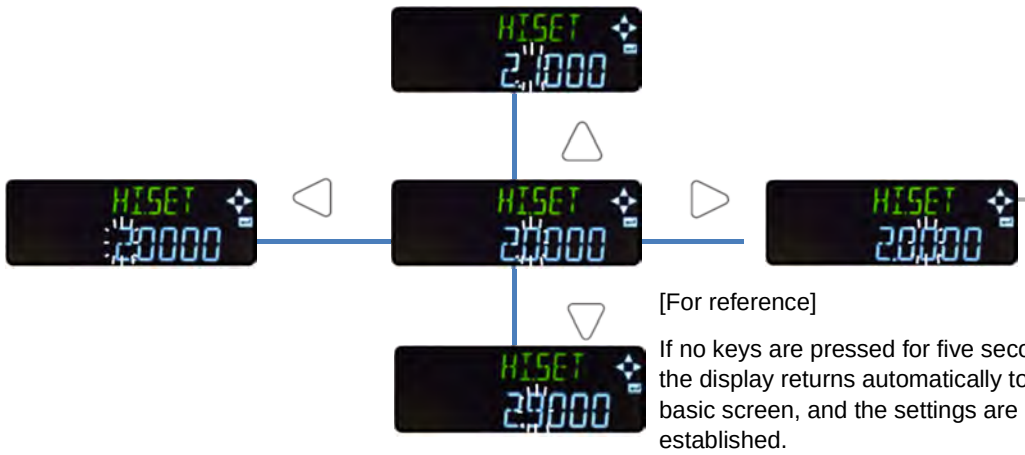
Pressing the LEFT/RIGHT key moves the cursor between digits and pressing the UP/DOWN key increases/decreases the value. Pressing the ENTER key establishes the setting.

5-5 Fine Tuning of HIGH Setting Values

Basic screen

Short press

Fine tuning of HIGH setting values



[For reference]

If no keys are pressed for five seconds, the display returns automatically to the basic screen, and the settings are established.

Pressing the LEFT/RIGHT key moves the cursor between digits and pressing the UP/DOWN key increases/decreases the value. Pressing the ENTER key establishes the setting.

5-6 Bank Mode

In this mode, HIGH and LOW setting values can be written into designated banks (1 to 3) and read out from those banks.

By using the bank function, settings for items to be measured can be stored in the bank in advance, and these settings can then be read out easily when required.

Setting items written into and read out from banks

- ✓ All setting items
- ✓ HIGH and LOW setting values [Initial state]
- ✓ HIGH and LOW setting values, and presets

Methods of writing into/reading from banks

- ✓ Using keys
- ✓ Through external input (for reading out only)

If Bank A or Bank B input is set to external input, the external input can be used to read out the settings stored in the banks.

Each bank is read out by selecting a particular combination of ON/OFF inputs into Bank A and Bank B inputs.

- Ensure that the bank input is of 20 ms duration or longer.
- The combinations of Bank A and B inputs are shown in the following table.

	Bank A	Bank B
Bank 1	ON	OFF
Bank 2	OFF	ON
Bank 3	ON	ON

For reference

- ✓ Because the setting values written into and read out from the banks are stored in internal memory, they are retained after the power is turned off. (Values can be re-written approximately one million times.)

Related information

- ✓ The setting items written into and read out from the banks can be changed in setting mode. For details of how to set them, refer to "6-5 Bank Settings."
- ✓ For details of how to set Bank A or B input to external input, refer to "6-2-3 External Input."

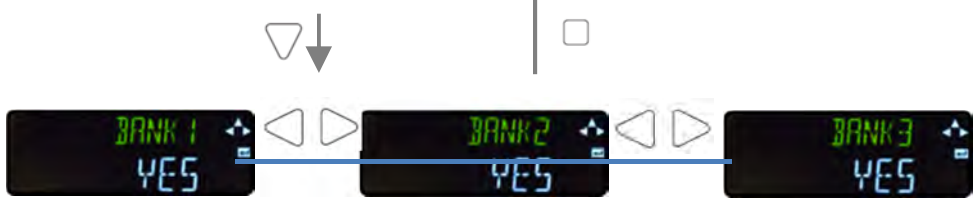
Basic screen

Long press for 2 s

Bank mode

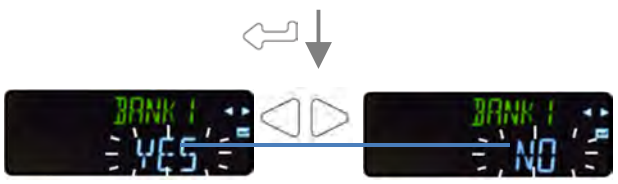
Select SAVE (write) or LOAD (read out).

After selecting, press the DOWN key.



Select the bank to be written into or read from.

After selecting, press the ENTER key.



Select YES (execute).

After selecting, press the ENTER key.

If SAVE (write) is selected, the current setting values will be stored in the bank.

If LOAD (read out) is selected, the settings stored in the bank will be read out.

Press the EXIT key twice to return the display to the basic screen.

5-7 Preset

Preset is a function that determines a reference for measurement values using a master work, etc.

When the preset operation is performed, the current value becomes the preset value.

If 0 is set as the preset value, the current value becomes 0.

Press the Preset key while a master work is being measured.

The preset function comes ON, and the preset indicator lamp (green) lights up.

To quit the preset function, hold the Preset key down for two seconds.

<Preset>

<Quit preset>

For reference

- ✓ If preset is performed using keys, the preset data is retained after the power is turned off because it is written into internal memory. (Values can be overwritten approximately one million times.)
- ✓ Preset cannot execute correctly in the following cases:
  - Immediately after the power is turned on, or immediately after input of a reset
  - When the data is outside the display's upper or lower limit.
  - When an alarm is being output
  - When an error is being output

Related information

- ✓ For details of how to set preset values, refer to "6-1-6 Preset (PR.VAL)."
- ✓ If the preset input is set to external input, the external input can be used to perform the preset. For details of preset input from external input, refer to "6-2-3 External Input."

5-8 Key Lock

Hold down the ENTER and EXIT keys simultaneously for three seconds.

The display will show LOCK ON, and display will then return automatically to the basic screen.

For reference

- ✓ LOCK ACT will be displayed when any key is pressed.

- ✓ The external input function will still be in effect.

5-9 Releasing Key Lock

Hold down the ENTER and EXIT keys simultaneously

LOCK ACT will be displayed. Continue pressing the keys.

When LOCK OFF is displayed, release the keys.

6. Parameter Settings

6-1 Setting the SET No. Parameters

Parameter name	Setting values	Remarks
Basic settings (BASIC)		
HIGH setting value (HI.SET)	Sets a HIGH setting value for pass/fail judgment. −199.9999 to 199.9999 (mm) [Default: 5.0000]	
LOW setting value (LO.SET)	Sets a LOW setting value for pass/fail judgment. −199.9999 to 199.9999 (mm) [Default: 1.0000]	
Hysteresis (HYSTER)	Judgment may be unstable due to measurements fluctuating around the HIGH or LOW setting value. A large hysteresis value can prevent this chattering effect. 0.0000 to 199.9999 (mm) [Default: 0.0030]	
Teaching mode (TEACH)	Sets the method for automatic teaching of tolerance. TCH.1 (One-point) / TCH.2 (Two-point) / TCH.3 (Three-point) [Default: TCH.1]	
Tolerance <±> (TOL <±>)	When executing the one-point teaching, this parameter is set in order to provide a tolerance from which the HIGH and LOW setting values are derived, with the master work measurement taken as the center value. 0.0000 to 199.9999 (mm) [Default: 0.1000]	
Preset value (PR.VAL)	Sets the reference value when the preset function is turned ON. −199.9999 to 199.9999 (mm) [Default: 0.0000]	
Select preset data (PR.OBJ)	When the preset function is turned ON, this parameter selects the type of current value (NORM.V or JUDGE.V) to which the offset value is applied. NORM.V (normal measurement value) / JUDGE.V (judgment value) [Default: NORM.V]	
Preset save (PR.SAVE)	If Preset save is set to ON, the preset and offset values are written to an EEPROM so that they are retained after the power is turned OFF. ON / OFF [Default: OFF]	
Measurement direction (DIRECT)	Selects between normal and reversed display of the measurement value when the spindle of the sensor head is pushed in during measurement. NORMAL (Normal) / REVERS (Reverse) [Default: NORMAL]	
Lever ratio (LEVER)	If a measurement point is on a lever, the measurement value can be displayed as detected value × lever ratio. 0.1 to 100.0 [Default: 1.0]	
Response time (SPEED)	Sets the period between the time the sensor head starts measurement and that at which the measurement value is determined. 3 / 5 / 10 / 100 / 500 / 1,000 (ms) [Default: 100]	
Output behavior (OUTPUT)	Selects behavior of judgment output. N.O. (Normally open) / N.C. (Normally closed) [Default: N.O.]	

Detailed settings (ADVANC)			
HOLD settings (HOLD)			
Measurement mode (MEAS)		Selects a hold mode. S-H (Sample hold) / P-H (Peak hold) / B-H (Bottom hold) / P-P (Peak-to-peak hold) / P-P/2 (Peak-to-peak hold/2) / NG-H (NG hold) / SLF.S-H (Self sample hold) / SLF.P-H (Self peak hold) / SLF.B-H (Self bottom hold) [Default: S-H]	
	Trigger mode (TRG)	Selects the external trigger input behavior. 1SHOT (One shot) / HOLD (Hold) [Default: HOLD]	
	Self trigger level (SLF.LV)	Sets the reference level for the hold function using the self (internal) trigger. −199.9999 to 199.9999 [Default: 0.500]	
	Self trigger edge direction (SLF.EDG)	Sets the edge direction for measurement of the hold value using the self trigger level. UP (Rise) / DOWN (Fall) [Default: UP]	
	Self trigger delay (SLF.DLY)	Sets the self trigger delay type and its reference value when the self sample hold function is used. DLY.WD (Static width) / DLY.TIM (Delay timer) [Default: DLY.WD]	
		Static width (DLY.WD)	Sets a stable fluctuation width until start of hold. 0 to 199.9999 (mm) [Default: 0.0100]
		Delay timer (DLY.TIM)	Sets a delay time until start of hold. 0 to 199.9999 (mm) [Default: 1000]
All input (ALL IN)		When a trigger is input to a master unit, the signal can be input to all connected slave units simultaneously. ONE (Single) / ALL (All) [Default: ONE]	
External input (EXT.IN)		For input 1/input 2/input 3 of external inputs, selects one of four input signal types. P/R/T (Preset/Reset/Trigger) / BANK/P (Bank A/B/Preset) / BANK/R (Bank A/B/Reset) / BANK/T (Bank A/B/Trigger) [Default: P/R/T]	
External output (EXT.OUT)		For output 1/output 2/output 3 of external outputs, selects one of four output signal types. 3VAL (HI, GO, LO) / 2VAL (HIorLO, INRANGE, ALARM) / LOGIC (LOGIC, ALARM) / LOGIC2 [Default: 3VAL]	
Display digits (DIGIT)		Changes the number of digits shown after the decimal point on the digital display. 0.1 / 0.01 / 0.001 / 0.0001 [Default: 0.0001]	
Analog scaling (ANALOG)		For analog output, sets the upper and lower limits corresponding to judgment value (JUDGE.V) converted to current (4 to 20 mA). DEFALT (Default) / FREE (Free) [Default: DEFALT]	
Scaling upper limit (ANA.HI)		Sets the scaling upper limit when analog scaling is set to FREE. −199.9999 to 199.9999 (mm) [Default: 10.0000]	
Scaling lower limit (ANA.LO)		Sets the scaling lower limit when analog scaling is set to FREE. −199.9999 to 199.9999 (mm) [Default: 0.0000]	
Eco mode (ECO)		Saves energy by turning off the backlight of the controller display when the screen is not being used. ON / OFF [Default: OFF]	

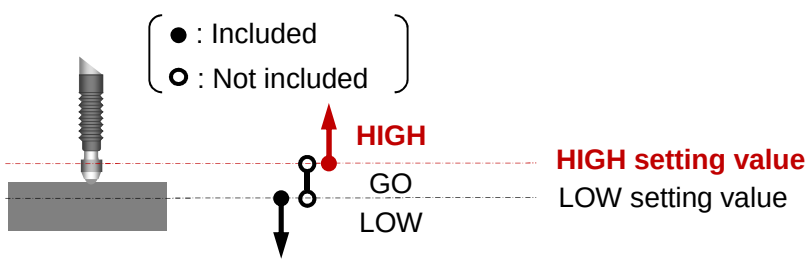
Detailed settings (continued from the preceding page)			
Alarm settings (ALARM)			
	Alarm delay time (DELAY)	Sets the delay time (changeable in 1 ms increments) from the time the sensor head comes into upthrust position to the time the alarm activates. 1 to 1,000 [Default: 1,000]	
	Upthrust check (PRS.CHK)	Sets the upthrust check ON/OFF. ON / OFF [Default: ON]	
	Upthrust check setting value (PRS.SET)	Sets the upthrust check setting value when the upthrust check is set to ON. −199.9999 to 199.9999 (mm) [Default: 10.0000]	
	Catching check (CAT.CHK)	Sets the catching check ON/OFF. ON / OFF [Default: OFF]	
	Number of connected units check (PRS.CHK)	If controllers are connected, this performs a check when the power is turned ON confirming that the number of connected units has not changed. ON / OFF [Default: OFF]	
Calculation mode (CALC)			
	Calculation mode (MODE)	This mode carries out calculations using measurements from each connected controller, and outputs the judgment results on the master unit display and from the master unit. CALC (Calculates) / NOCALC (Does not calculate) [Default: NOCALC]	
	Select calculation app (APPLI)	The Select calculation app can be set when calculation mode is set to CALC. This selects the application used for the calculation. MAX (Maximum) / MIN (Minimum) / FLAT (Flatness) / AVERAG (Average) / STAND (Difference from standard) / TORSIN (Torsion) / CURVEA (Curvature) / THICK (Thickness) [Default: MAX]	
Connected unit copy settings (COPY)			
	Select individual items to be copied (CPY.SEL) (Master unit only)	Items to be copied are selected individually.	
	Select all items to be copied (CHK.ALL) (Master unit only)	Selects all items for copying. YES / NO [Default: YES]	
	Execute copy (CPY.EXE) (Master unit only)	The master unit copies the items selected for copying (individually selected or all items) to the slave units. YES / NO [Default: YES]	
	Copy lock (LOCK) (Slave units only)	Prevents copying from the master unit. ON / OFF [Default: OFF]	
Bank settings (BANK)			
	Select bank storage (BNK.DAT)	Selects the settings to be read out from those stored in a bank. THRS (HIGH setting value, LOW setting value) / THRS.PR (HIGH setting value, LOW setting value, Preset value) / ALL (All) [Default: THRS]	

Calibration settings (CALIB)			
	Calibration select (CAL.SEL)	When a sensor head is replaced, carrying out zero and span adjustment reduces the errors existing at installation time. DEFAUL (Default) / USER (Set by user) [Default: DEFAUL]	
	∗ When calibration select is set to USER (setting by user)		
	Captured measurement value 1 (CL.SET1)	The controller moves the spindle to the zero point (which constitutes the calibration reference), and captures the measurement value.	
	Captured measurement value 2 (CL.SET2)	The controller moves the spindle to the target point for span adjustment, and captures the measurement value.	
	Adjustment value 2 (AJ.VAL2)	Inputs a target value. −199.9999 to 199.9999 (mm) [Default: 10.000]	
Resetting (RESET)			
	Reset (RESET)	This resets the controller settings (excluding calibration settings) to the factory defaults. YES / NO	
Maintenance			
	Total stroke work history (SUM.REC)	Displays information such as sensor head operational history.	
	Maximum peak value (MAX.VAL)		
	Maximum peak value history (MAX.REC)		
	Overstroke history (OVR.NUM)		

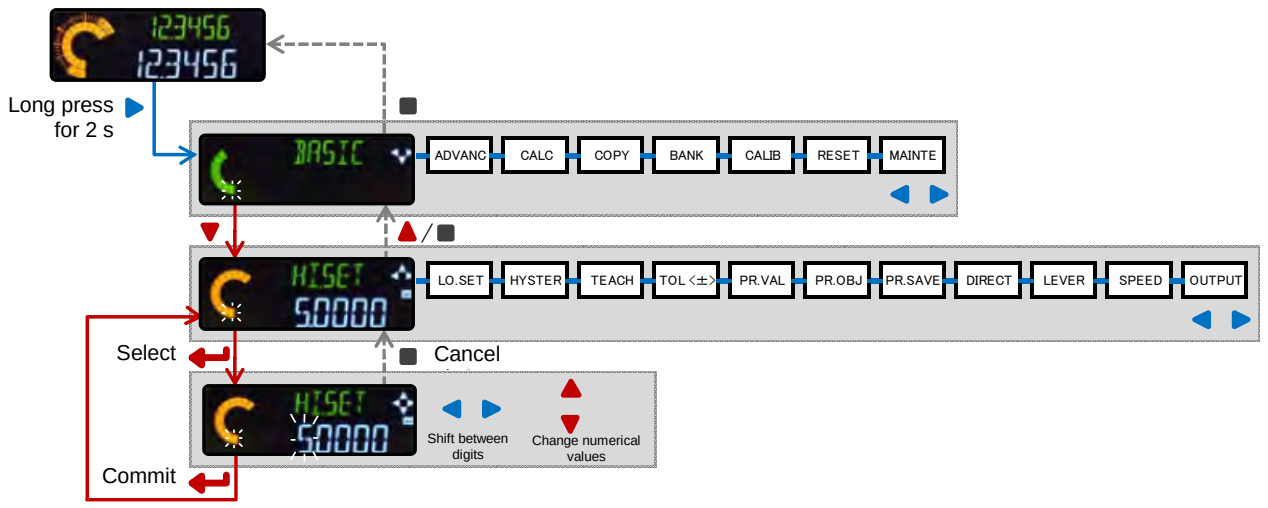
6-1 Basic Settings (BASIC)

6-1-1 HIGH Setting Value (HI.SET)

Parameter name	Setting value	Remarks
HIGH setting value (HI.SET)	Sets a HIGH setting value for pass/fail judgment. −199.9999 to 199.9999 (mm) [Default: 5.0000]	



■ Operation procedure



■ Note

✓ Configure the settings such that HIGH setting value > LOW setting value.
Although it is possible to set HIGH setting value < LOW setting value, the GO judgment will not be output.

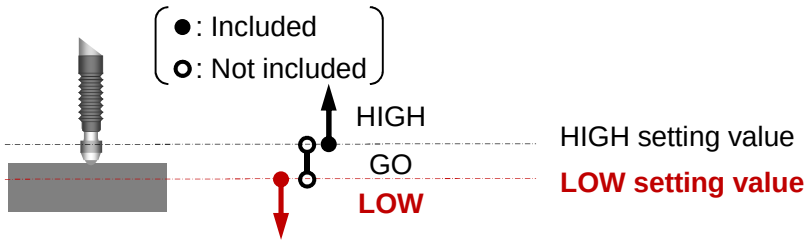
■ Related information

✓ The HIGH setting value can always be displayed on digital display SUB (green).
For details, refer to "5-2 SUB Display Switching Mode."

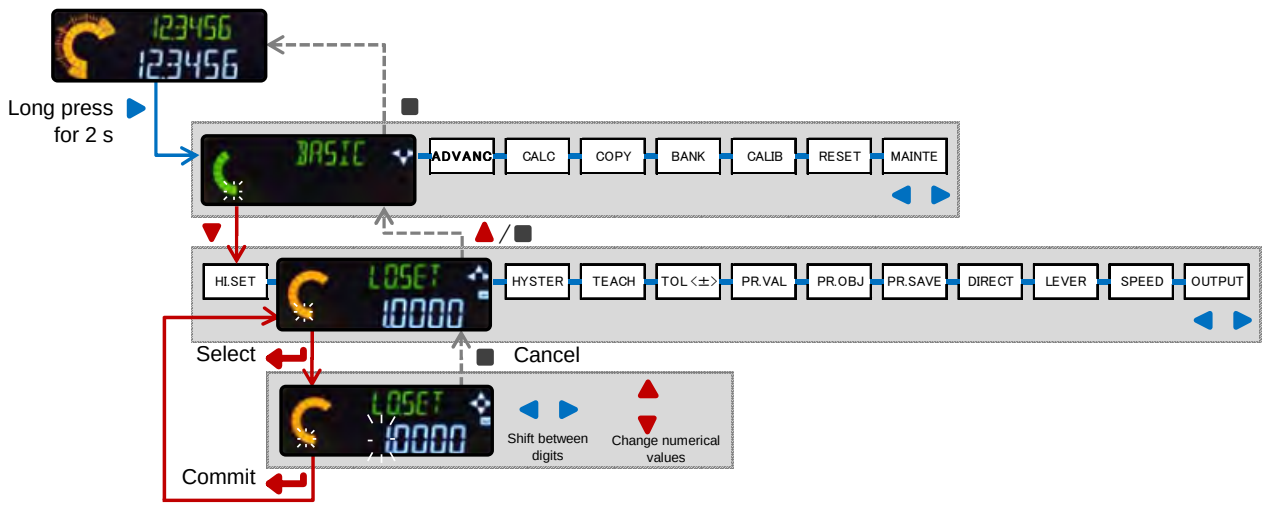
✓ The HIGH and LOW setting values can be set by teaching using a master work, upper limit work, and lower limit work.
For details, refer to "5-3 Teaching Mode."

6-1-2 LOW Setting Value (LO.SET)

Parameter name	Setting value	Remarks
LOW setting value (LO.SET)	Sets a LOW setting value for pass/fail judgment. −199.9999 to 199.9999 (mm) [Default: 1.0000]	



Operation procedure



Note

- ✓ Configure settings such that HIGH setting value > LOW setting value.
  Although it is possible to set HIGH setting value < LOW setting value, the GO judgment will not be output.

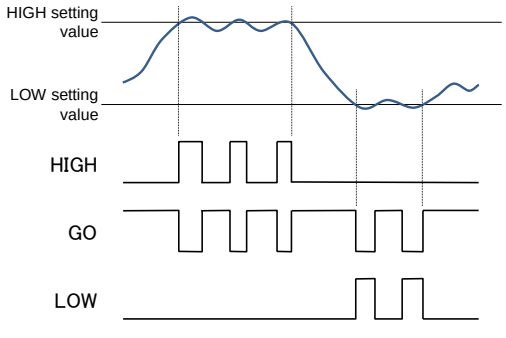
Related information

- ✓ The LOW setting value can always be displayed on digital display SUB (green).
  For details, refer to "5-2 SUB Display Switching Mode."
- ✓ HIGH and LOW setting values can be set by teaching using a master work, upper limit work, and lower limit work.
  For details, refer to "5-3 Teaching Mode."

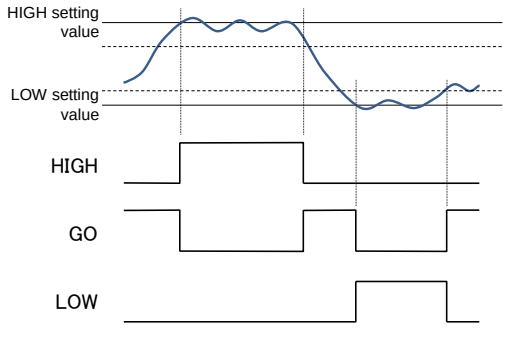
6-1-3 Hysteresis (HYSTER)

Parameter name	Setting value	Remarks
Hysteresis (HYSTER)	Judgment may be unstable due to measurements fluctuating around the HIGH or LOW setting value. A large hysteresis value can prevent this chattering effect. 0.0000 to 199.9999 (mm) [Default: 0.0030]	

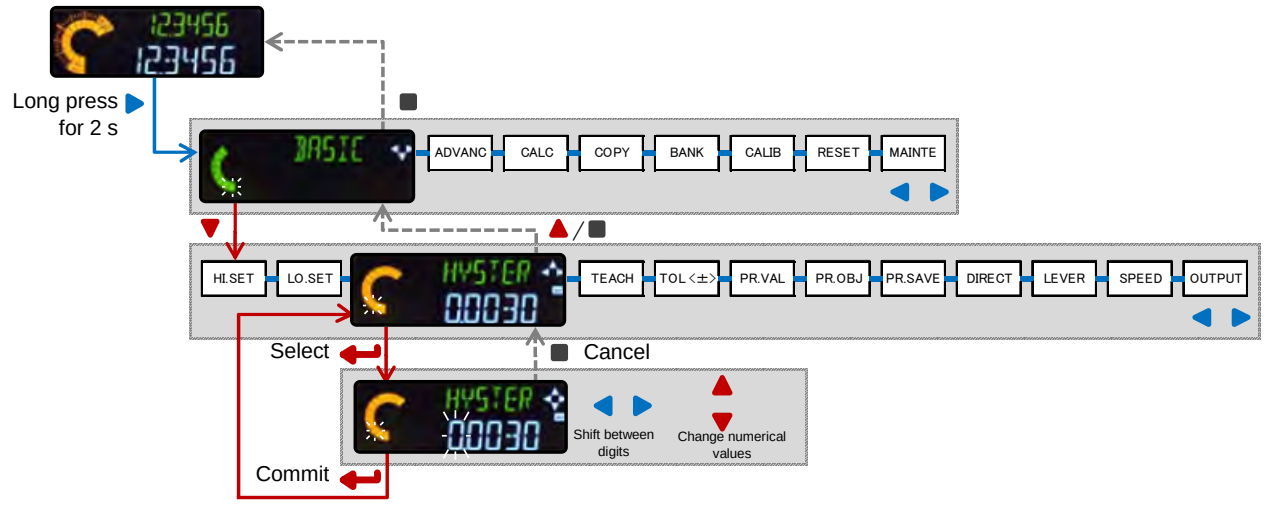
With HYSTER set to 0:
Chattering makes judgment output unstable.



With HYSTER set to non 0:
Judgment output becomes stable.



Operation procedure

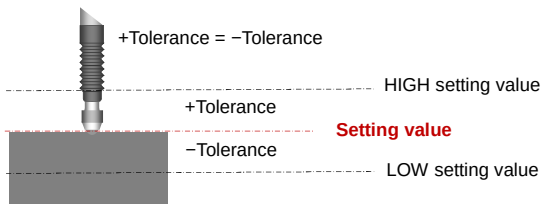
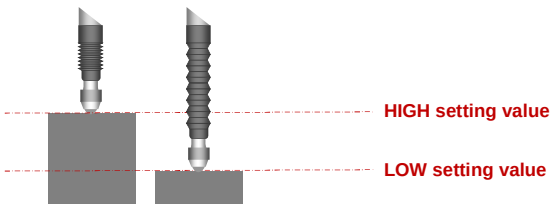
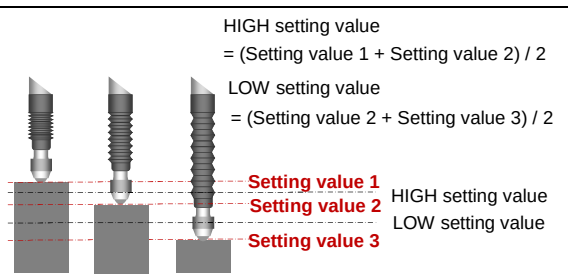


Note

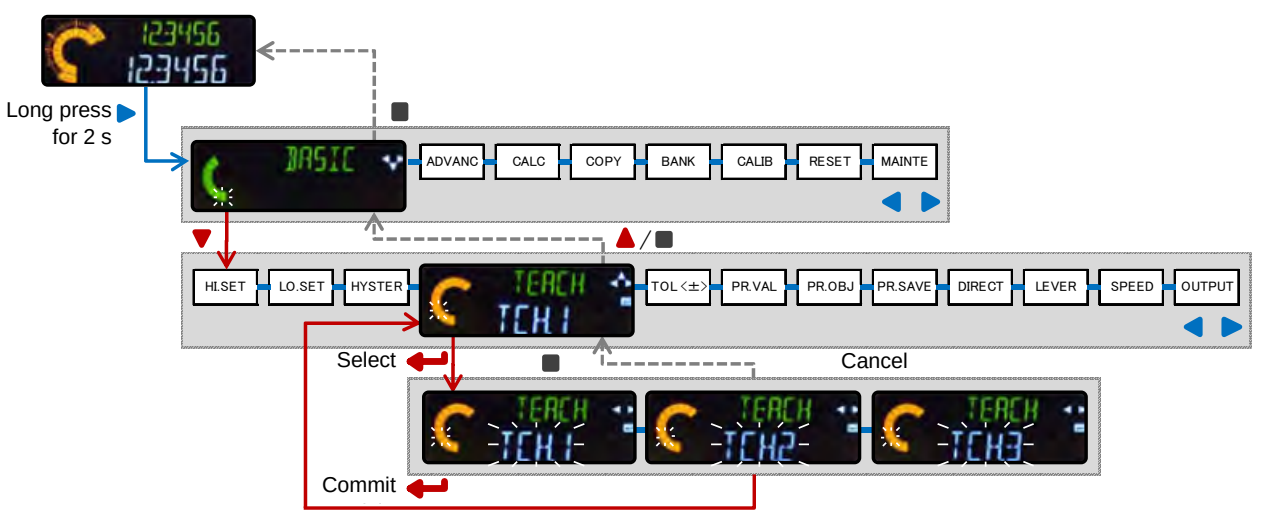
- ✓ HIGH and LOW share the same hysteresis value.
- ✓ Set hysteresis to a value smaller than the difference between the HIGH and LOW setting values. If hysteresis is set to a value equal to or exceeding the difference between the HIGH and LOW setting values, the GO judgment will not be output.

6-1-4 Teaching (TEACH)

Parameter name	Setting value	Remarks
Teaching mode (TEACH)	Sets the method for automatic teaching of tolerance. TCH.1 (One-point) / TCH.2 (Two-point) / TCH.3 (Three-point) [Default: TCH.1]	

Teaching method	Setting
One-point teaching ∗ Initial status	This sets the HIGH and LOW setting values automatically using one reference work. This is used to judge work with a ±tolerance. 
Two-point teaching	This sets the HIGH and LOW setting values automatically using two reference works. This is used to judge work according to whether it falls between an upper and lower limit. 
Three-point teaching	This sets the HIGH and LOW setting values automatically using a satisfactory work, HIGH defective work, and LOW defective work. It assumes the upper limit to be the median of the satisfactory and HIGH defective work values, and the lower limit to be the median of the satisfactory and LOW defective work values. This type of teaching is used to judge work according to whether it falls between these upper and lower limits. 

Operation procedure



Related information

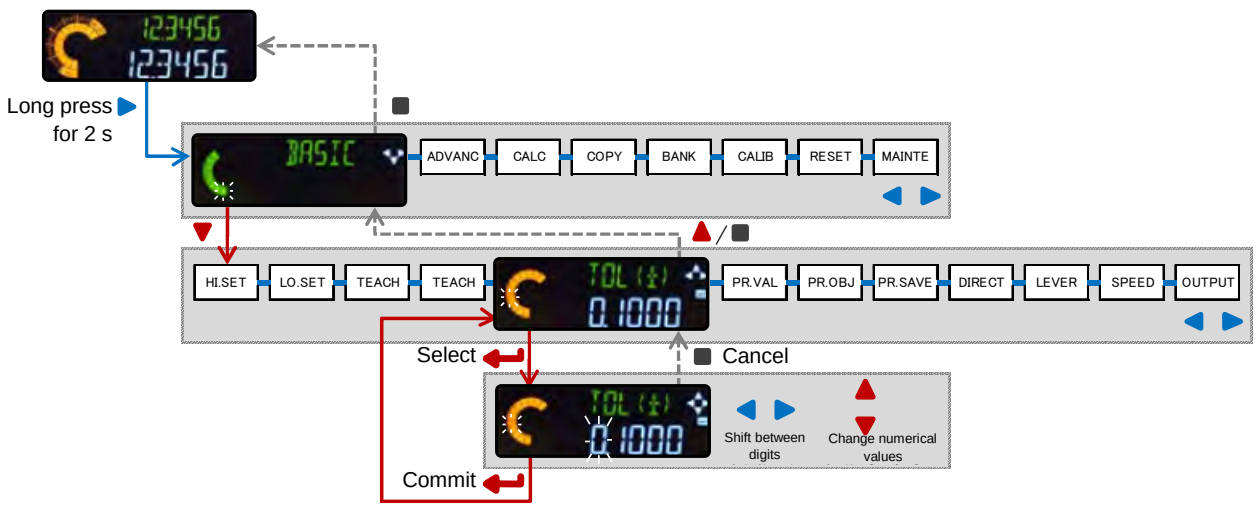
- ✓ For details of how to set tolerance for the one-point teaching, refer to the following page.
- ✓ For details of the teaching methods, refer to "5-3 Teaching Mode."

6-1-5 Tolerance <±> (TOL <±>)

Parameter name	Setting value	Remarks
Tolerance <±> (TOL <±>)	When executing the one-point teaching, this parameter is set in order to provide a tolerance from which the HIGH and LOW setting values are derived, with the master work measurement taken as the center value. 0.0000 to 199.9999 (mm) [Default: 0.1000]	

Teaching method	Setting
One-point teaching	This sets the HIGH and LOW setting values automatically using one reference work. This is used to judge work with a ±tolerance. 

Operation procedure



Related information

✓ Setting Tolerance <±> only has an effect when the one-point teaching is selected.
For details of how to set the teaching method, refer to the preceding section.

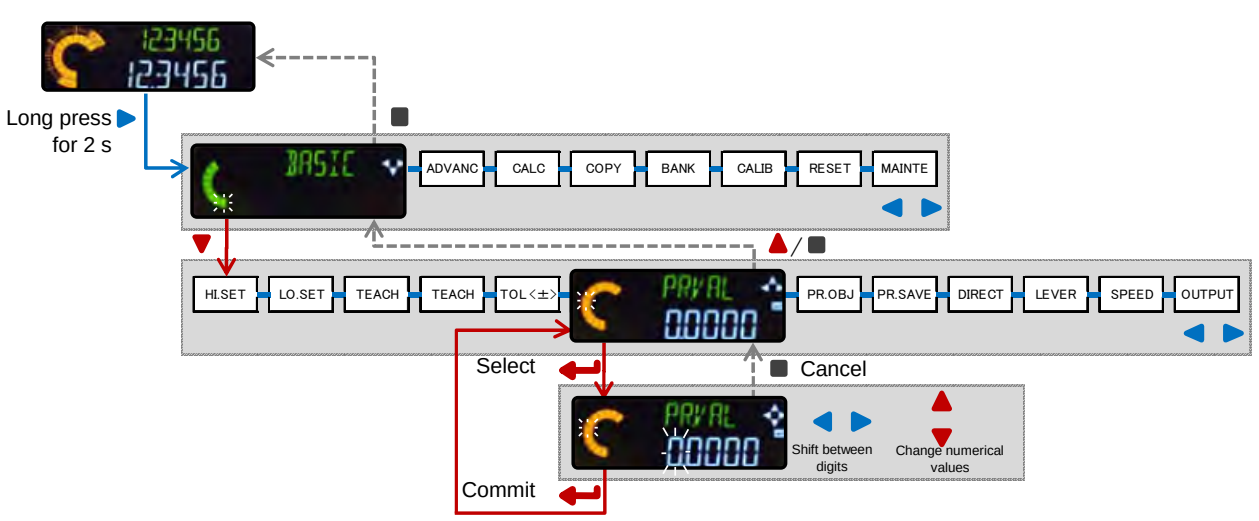
6-1-6 Preset (PR.VAL)

Parameter name	Setting value	Remarks
Preset value (PR.VAL)	Sets the reference value when the preset function is turned ON. −199.9999 to 199.9999 (mm) [Default: 0.0000]	

Preset is a function that adds the set value to a measured value. If a preset value is set, the current value becomes the preset value when the controller executes the preset.

For example, when configuring the preset for a master work, set the preset value to 3.5 mm in order for its position to be displayed as 3.5 mm.

Operation procedure



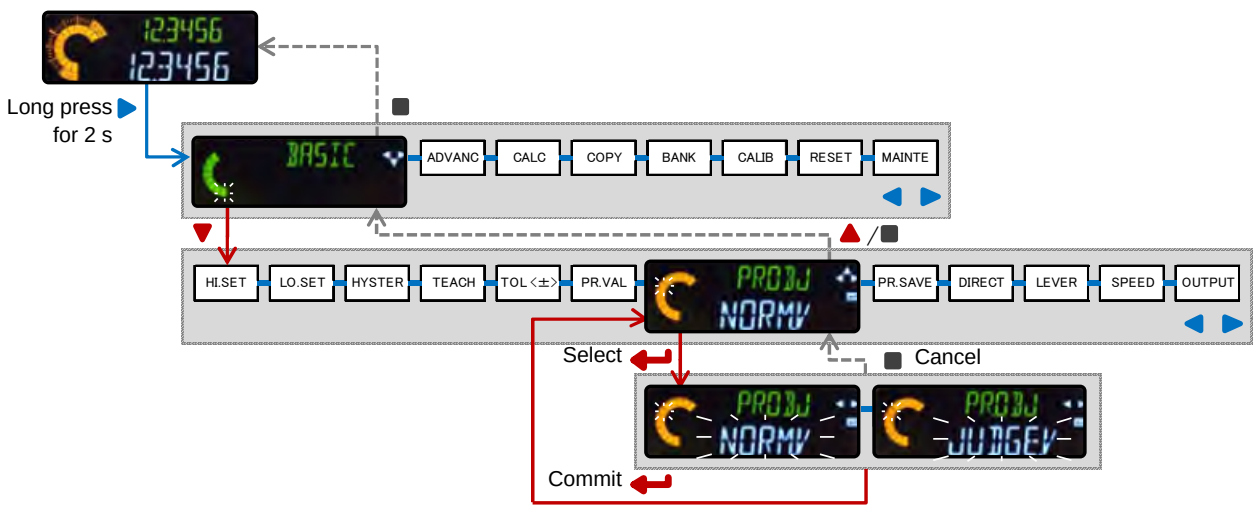
Related information

- ✓ For details of how to operate the preset function, refer to "5-7 Preset."
- ✓ Normal measurement or judgment value can be selected as the value to which the preset function applies. For details of setting method, refer to the next section.

6-1-7 Select Preset Data (PR.OBJ)

Parameter name	Setting value	Remarks
Select preset data (PR.OBJ)	When the preset function is turned ON, this parameter selects the type of current value (NORM.V or JUDGE.V) to which the offset value is applied. NORM.V (normal measurement value) / JUDGE.V (judgment value) [Default: NORM.V]	

Operation procedure



Note

- ✓ The setting value cannot be changed when the calculation function is used (where Difference from standard is used for the master unit/other than the Difference from standard mode is used for slave units).
- ✓ If, after setting PR.OBJ to judgment value (JUDGE.V), the calculation function is set (where Difference from standard is used for the master unit/other than the Difference from standard mode is used for slave units), then the offset value will be applied to the normal measurement value (NORM.V).

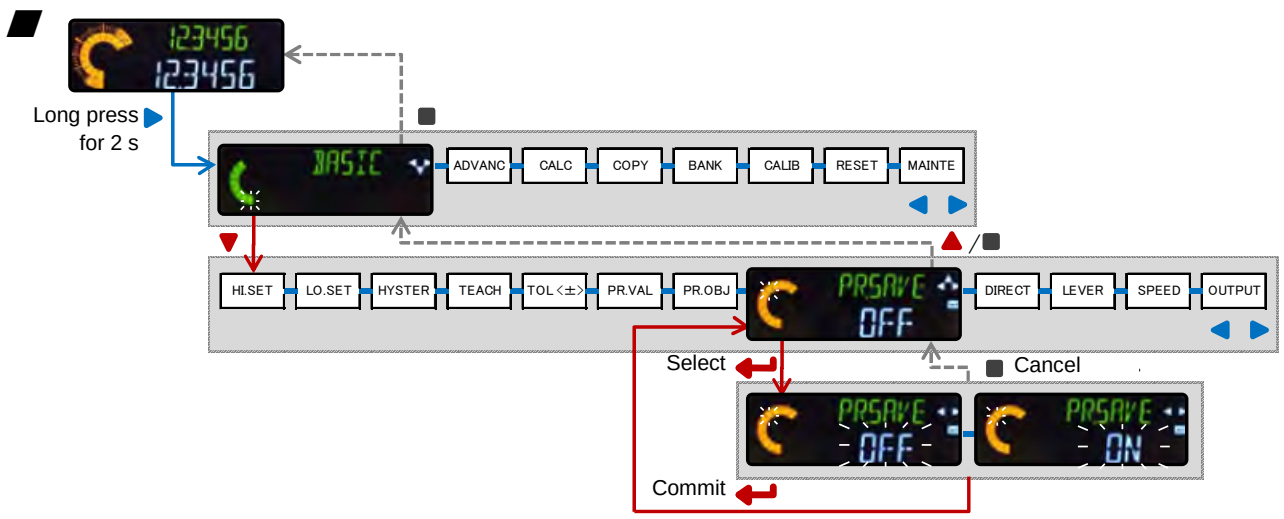
Related information

- ✓ For details of how to operate the preset function, refer to "5-7 Preset."
- ✓ For details of how to set the preset value, refer to the preceding section.

6-1-8 Preset Save (PR.SAVE)

Parameter name	Setting value	Remarks
Preset save (PR.SAVE)	If Preset save is set to ON, the preset and offset values are written to an EEPROM so that they are retained after the power is turned OFF. ON / OFF [Default: OFF]	

Operation procedure



Note

- ✓ The memory (EEPROM) used for saving preset values can be overwritten up to approximately one million times.
  If there is no need to save preset values, set Preset save to OFF.
- ✓ If preset is performed using keys, the preset data is maintained after the power is turned off because it is written into internal memory.

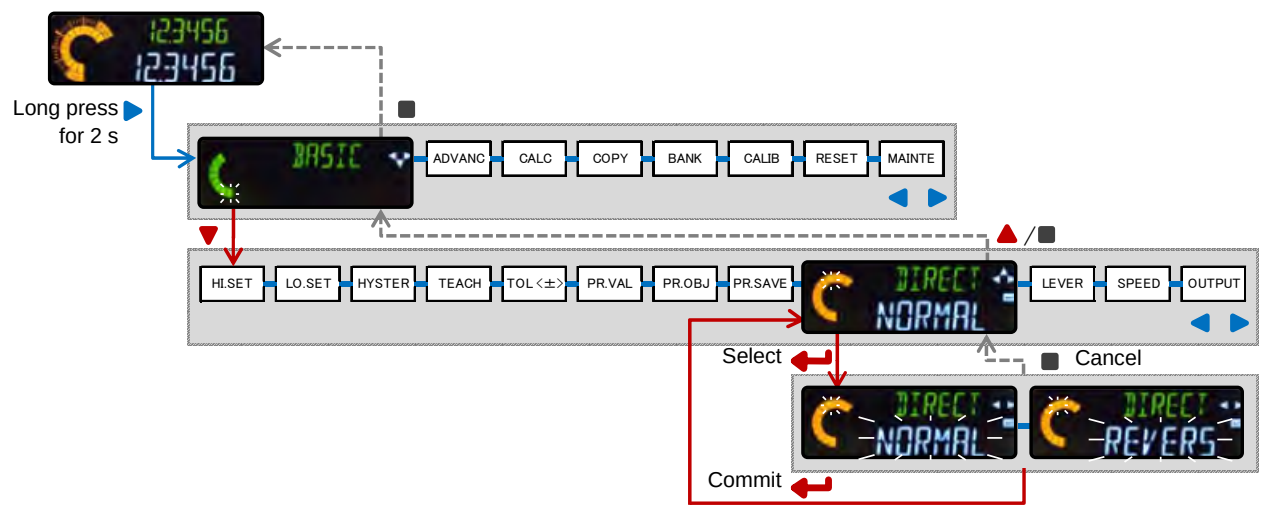
Related information

- ✓ If the preset input is set to external input, the external input can be used to perform the preset.
- ✓ For details of preset input from external input, refer to "6-2-3 External Input."

6-1-9 Measurement Direction (DIRECT)

Parameter name	Setting value	Remarks
Measurement direction (DIRECT)	Selects between normal and reversed display of the measurement value when the spindle of the sensor head is pushed in during measurement. NORMAL (Normal) / REVERS (Reverse) [Default: NORMAL]	

Operation procedure



Note

✓ When the measurement direction is changed, the following items must also be changed to correspond:

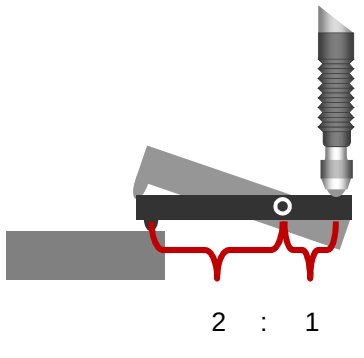
- HIGH setting value
- LOW setting value
- Self trigger edge direction for hold setting

6-1-10 Lever Ratio (LEVER)

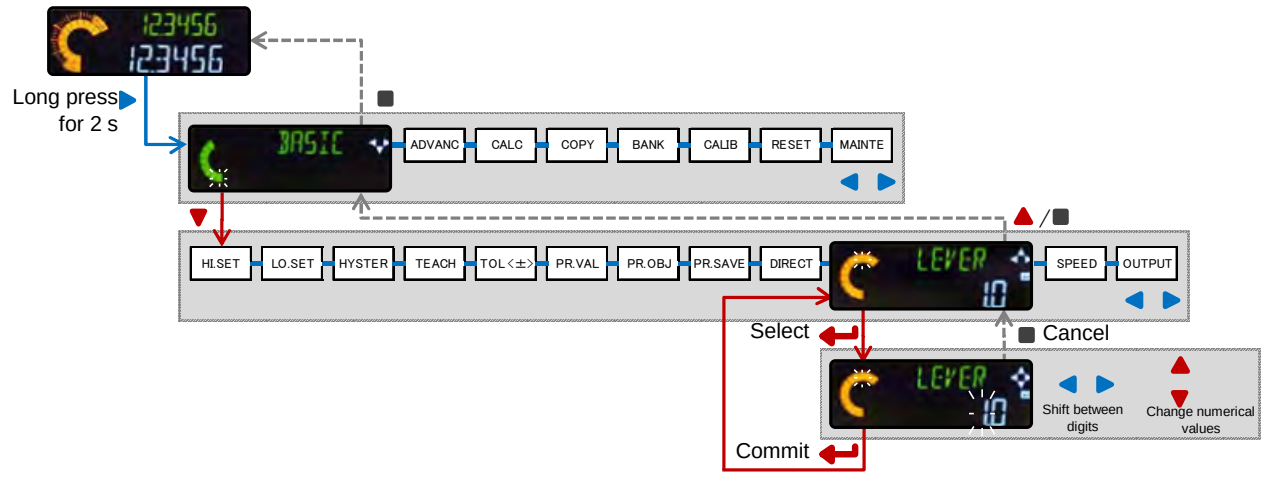
Parameter name	Setting value	Remarks
Lever ratio (LEVER)	If a measurement point is on a lever, the measurement value can be displayed as detected value × lever ratio. 0.1 to 100.0 [Default: 1.0]	

The figure below shows a lever ratio of 2:1.

When the lever ratio is set to "2," the judgment value will be twice a normal measurement value.



Operation procedure



Note

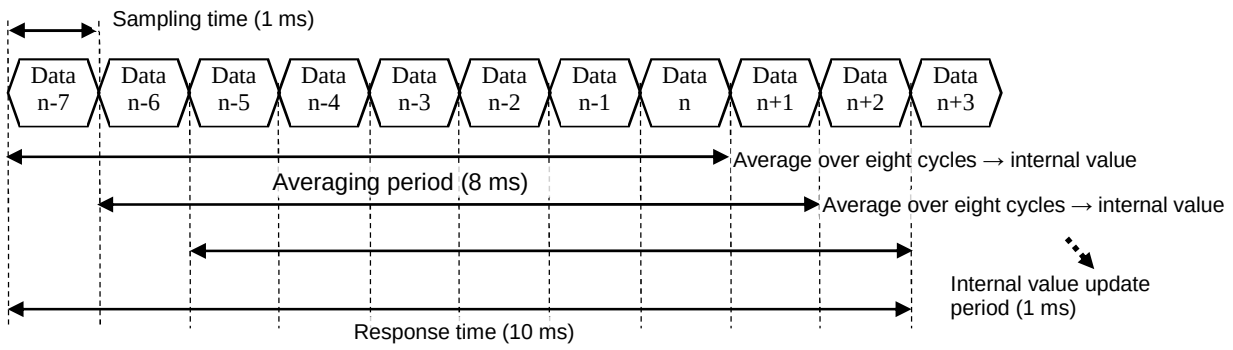
✓ If the lever ratio is set to a value that is out of range, digital display MAIN (white) shows ######. The display then returns to the lever ratio setting screen, allowing the lever ratio to be set again.

6-1-11 Response Time (SPEED)

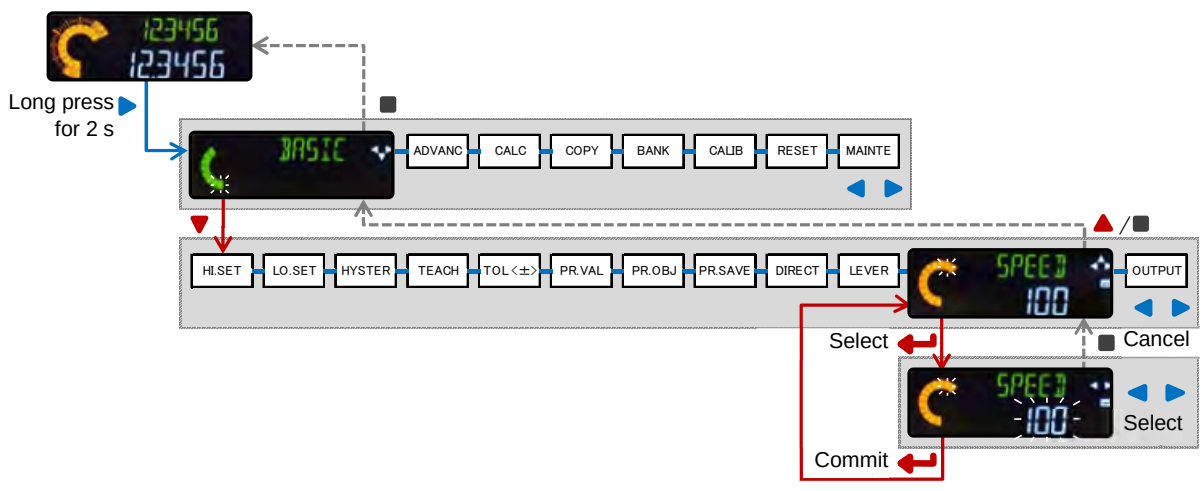
Parameter name	Setting value	Remarks
Response time (SPEED)	Sets the period between the time the sensor head starts measurement and that at which the measurement value is determined. This parameter is effective for stabilizing measurement values. 3 / 5 / 10 / 100 / 500 / 1,000 (ms) [Default: 100]	

Response time (ms)	No. of cycles per average	Averaging time (ms)	Internal value update period (ms)
3	1	1	1
5	3	3	1
10	8	8	1
100	96	96	4
500	480	480	16
1,000	960	960	32

When response time is set to 10 ms:



Operation procedure

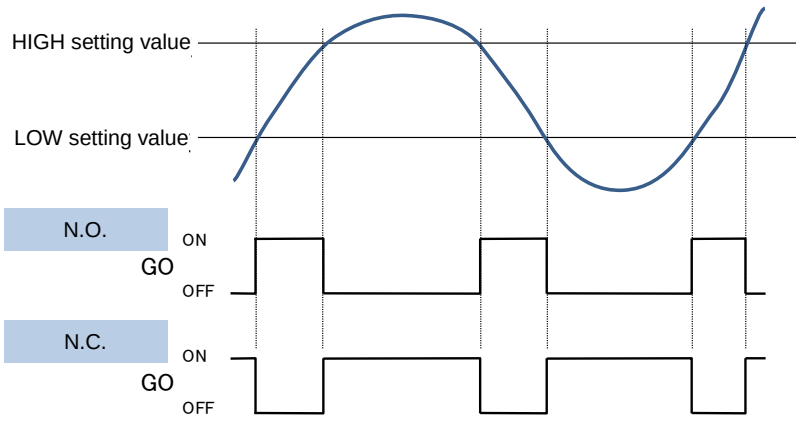


Note

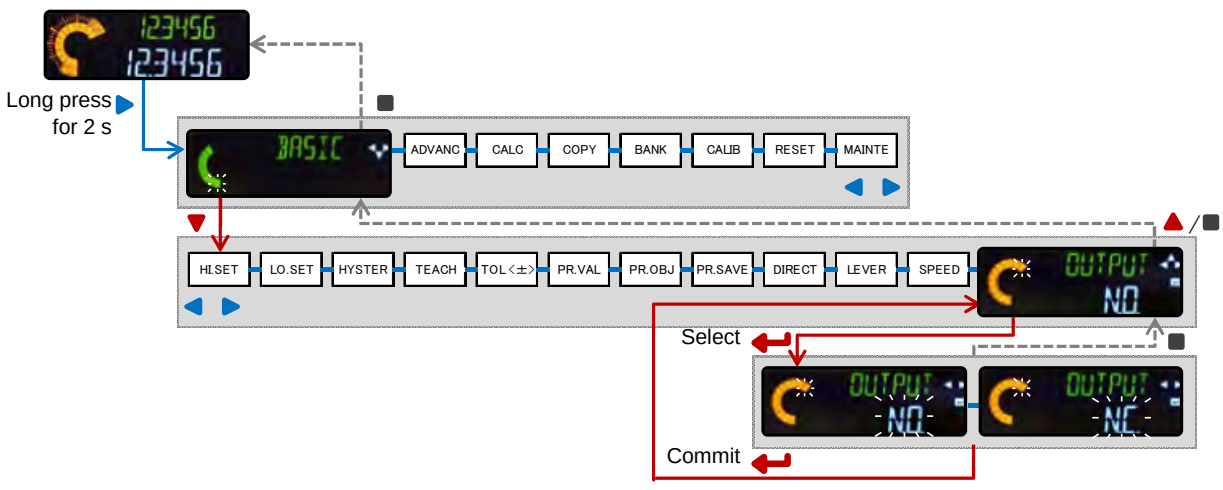
- ✓ When the reset input is turned ON, the display shows an indefinite value "------" until the device reaches the number of cycles per average.

6-1-12 Output Behavior (OUTPUT)

Parameter name	Setting value	Remarks
Output behavior (OUTPUT)	Selects behavior of judgment output. N.O. (Normally open) / N.C. (Normally closed) [Default: N.O.]	



Operation procedure



6-2 Detailed Settings (ADVANC)

6-2-1 Hold Settings

Measurement mode (MEAS)	Function		Refer to
Sample hold (S-H)	When (and only when) the external input is ON, the controller holds and outputs the judgment value (JUDGE.V). When the external input is OFF, the judgment value (JUDGE.V) is updated and output (real-time output).		6-2-1-1 Sample Hold Settings
Peak hold (P-H)	Holds and outputs the maximum value as the judgment value (JUDGE.V).		6-2-1-2 Peak Hold Settings
Bottom hold (B-H)	Holds and outputs the minimum value as the judgment value (JUDGE.V).		
Peak-to-peak hold (P-P)	Holds and outputs the difference between the maximum and minimum values as the judgment value (JUDGE.V).		
Peak-to-peak hold/2 (P-P/2)	Holds and outputs half the difference between the maximum and minimum values as the judgment value (JUDGE.V).		
NG hold (NG-H)	Holds and outputs the LOW and HIGH judgments.		6-2-1-3 NG Hold Settings
Self sample hold (SLF.S-H)	Static width	After measurement fluctuations have settled, automatically self-triggers holding and output of the judgment value (JUDGE.V).	6-2-1-4 Self Sample Hold (Static Width)
	Delay timer	After a delay, automatically self-triggers holding and output of the judgment value (JUDGE.V).	6-2-1-5 Self Sample Hold (Delay Timer)
Self peak hold (SLF.P-H)	Automatically self-triggers holding and output of the maximum value as the judgment value (JUDGE.V).		6-2-1-6 Self Peak Hold/ Self Bottom Hold
Self bottom hold (SLF.B-H)	Automatically self-triggers holding and output of the minimum value as the judgment value (JUDGE.V).		

Note

- ✓ If the calculation app selection function is set to STAND (Difference from standard), the hold setting of the master unit will be invalid.
- ✓ Setting the calculation app selection function will invalidate the hold setting of the slave unit used for the calculation.

6-2-1-1 Sample Hold Settings

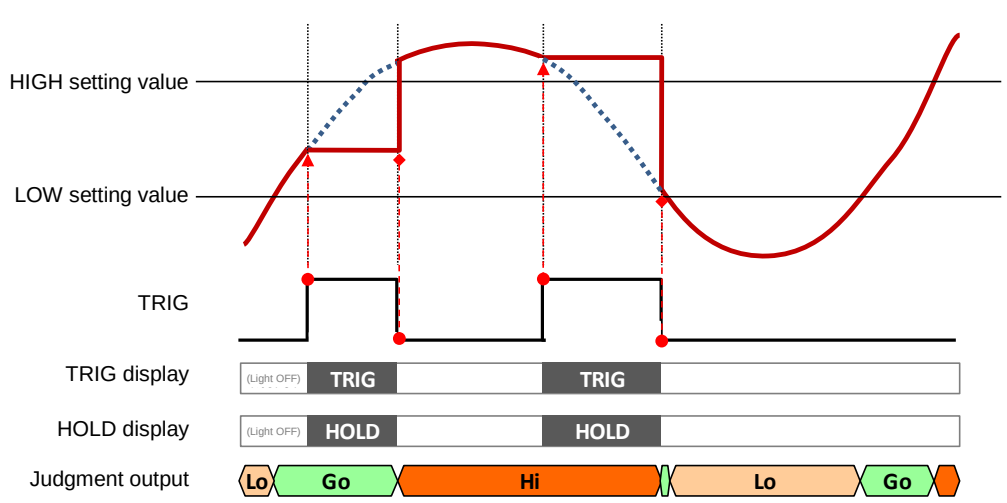
Parameter name	Setting value	Remarks
Measurement mode (MEAS)	Selects a hold mode. **S-H (Sample hold)** P-H / B-H / P-P / P-P/2 NG-H SLF.S-H / SLF.P-H / SLF.B-H [Default: S-H]	
Trigger mode (TRG)	Selects the external trigger input behavior. HOLD (Hold) / 1SHOT(One shot) [Default: HOLD]	

An external trigger input holds a normal measurement value as the judgment value.

The hold behavior can be set using the trigger mode.

Sample hold (Trigger mode: Hold)

While the external trigger input is ON, the sample is held; while it is OFF, the sample hold is released.



Note

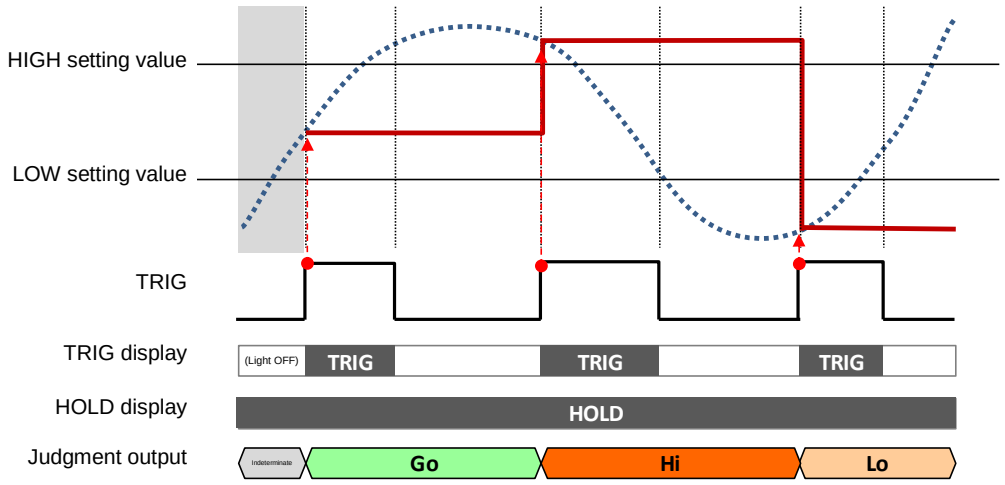
- ✓ When the reset input is turned ON with the external trigger input ON, an indefinite state will be held.
- ✓ In this type of sample hold, the judgment output is the same as the judgment value.
  (However, please note that there are some measurement modes for which this is not the case.)

Related information

- ✓ For details of trigger input as external input, refer to "6-2-3 External Input."

Sample hold (Trigger mode: One shot)

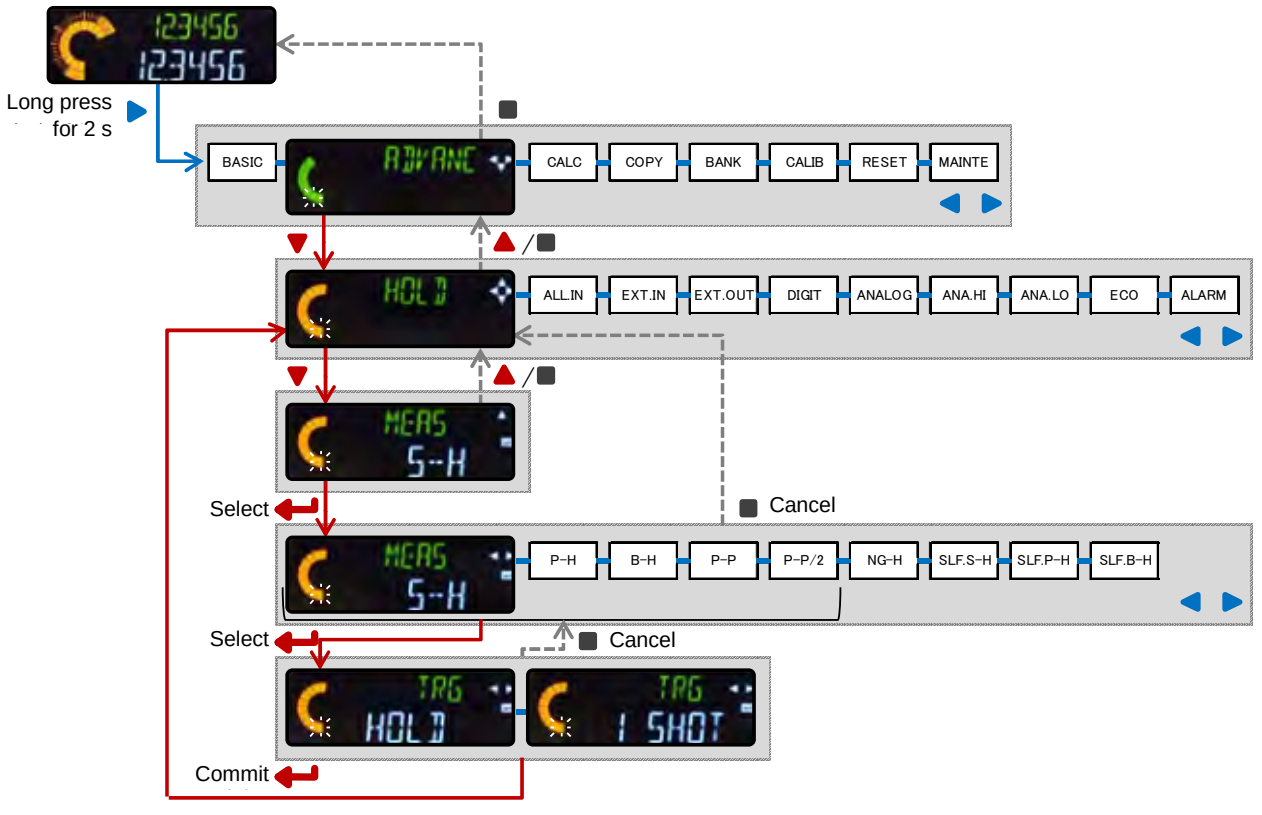
The held data is updated when the external trigger input is turned ON (at a rising edge).



Note

- ✓ An indefinite state is held during the following intervals:
  - From the time immediately after the power is turned ON until the external trigger is turned ON.
  - From the time the reset input is turned ON until the external trigger is turned ON.
- ✓ In this type of sample hold, the judgment output is the same as the judgment value.
  (However, please note that there are some measurement modes for which this is not the case.)

Operation procedure



6-2-1-2 Peak Hold Settings

Parameter name	Setting value	Remarks
Measurement mode (MEAS)	Selects a hold mode. S-H **P-H (Peak hold)** **B-H (Bottom hold)** **P-P (Peak-to-peak hold)** **P-P/2 (Peak-to-peak hold/2)** NG-H (NG hold) SLF.S-H / SLF.P-H / SLF.B-H [Default: S-H]	
Trigger mode (TRG)	Selects the external trigger input behavior. HOLD (Hold) / 1SHOT (One shot) [Default: HOLD]	

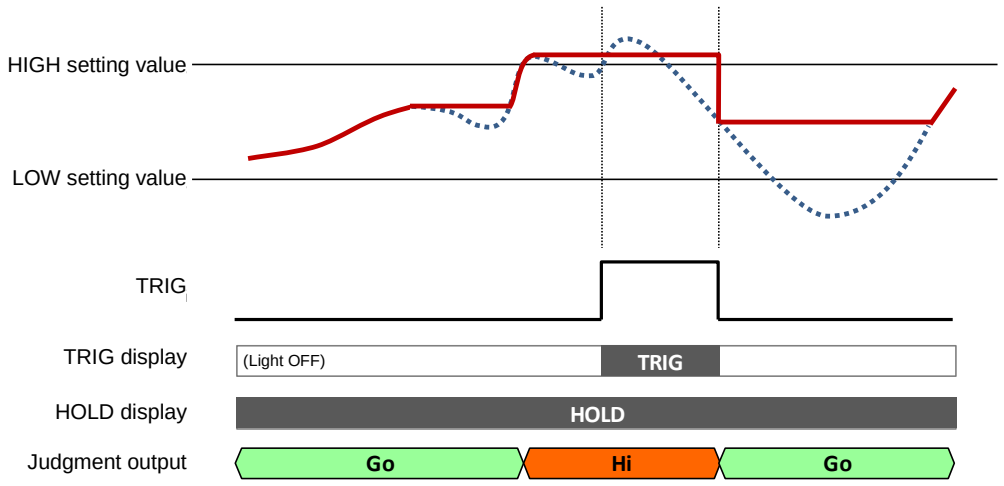
An external trigger input holds a normal measurement value as the judgment value in accordance with a specified condition.

The hold behavior can be set using the trigger mode.

Peak hold (Trigger mode: Hold)

While the external trigger input is OFF, the peak value is constantly updated.

While the external trigger input is ON, the peak value is held, and when it is turned OFF, the peak value is cleared and the device returns to its state of performing constant updates.



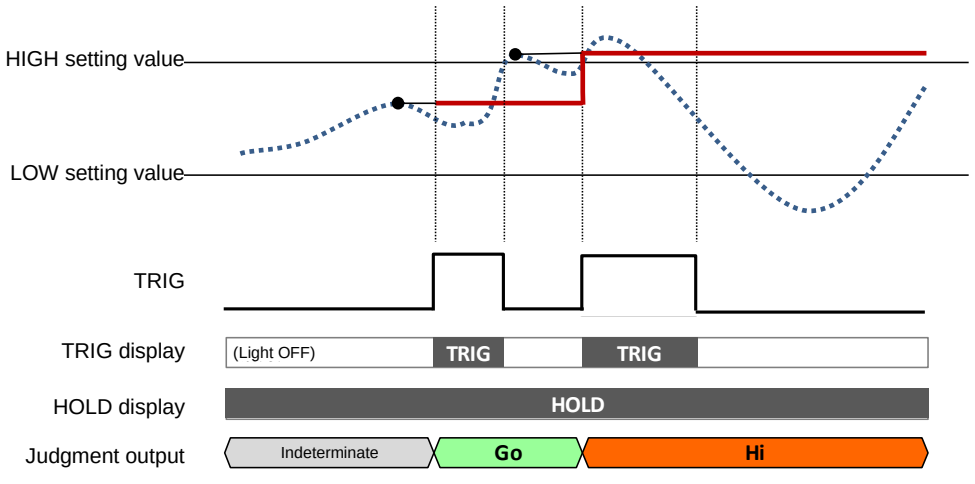
Note

- ✓ When the reset input is turned ON with the external trigger input ON, an indefinite state will be held.
- ✓ When the reset input is turned ON with the external trigger input OFF, an indefinite state will be held for the duration of the specified response time.
- ✓ In this type of sample hold, the judgment output is the same as the judgment value.
  (However, please note that there are some measurement modes for which this is not the case.)

Peak hold (Trigger mode: One shot)

While the external trigger input is OFF, the peak value is constantly updated, but this is an internal process and it does not appear on the display or as the judgment output.

When the external trigger input is turned ON (at a rising edge), the internally updated peak value becomes the new hold value.

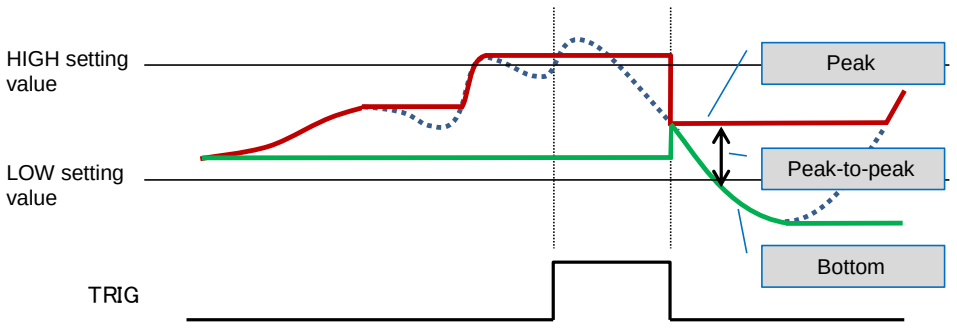


Note

- ✓ An indefinite state is held during the following intervals:
  - From the time immediately after the power is turned ON until the external trigger is turned ON.
  - From the time the reset input is turned ON until the external trigger is turned ON.
- ✓ In this type of sample hold, the judgment output is the same as the judgment value.
  (However, please note that there are some measurement modes for which this is not the case.)

Related information

- ✓ The relationship between Peak, Bottom, and Peak-to-peak (Peak-to-peak/2) is shown below.



Operation procedure

- ✓ Operation is the same as for the sample hold type in the preceding section.
  Select the appropriate measurement mode (MEAS) from P-H, B-H, P-P, and P-P/2.

6-2-1-3 NG Hold Settings

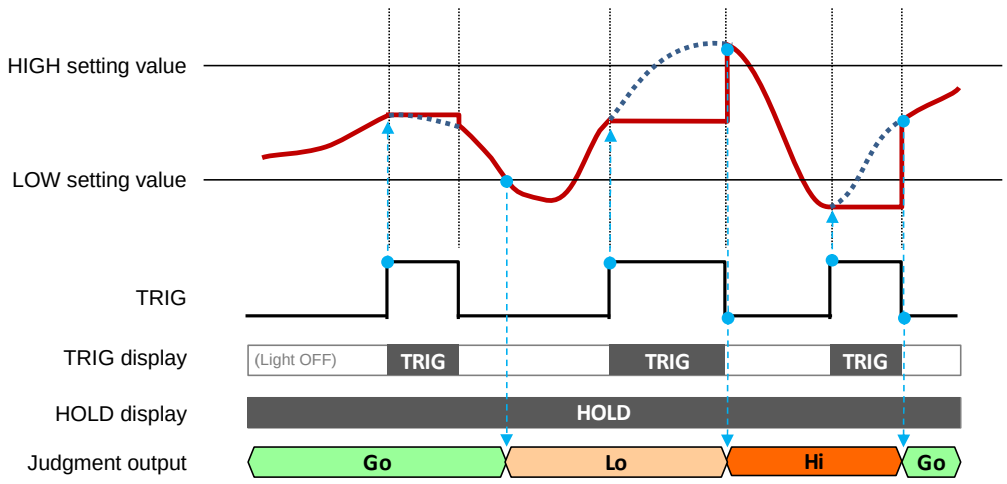
Parameter name	Setting value	Remarks
Measurement mode (MEAS)	Selects a hold mode. S-H (Sample hold) P-H / B-H / P-P / P-P/2 **NG-H (NG hold)** SLF.S-H / SLF.P-H / SLF.B-H [Default: S-H]	

NG hold

The judgment output is held when the judgment value becomes HIGH or LOW whilst the external trigger input is OFF.

The hold is released when the external trigger input is turned OFF after being turned ON.

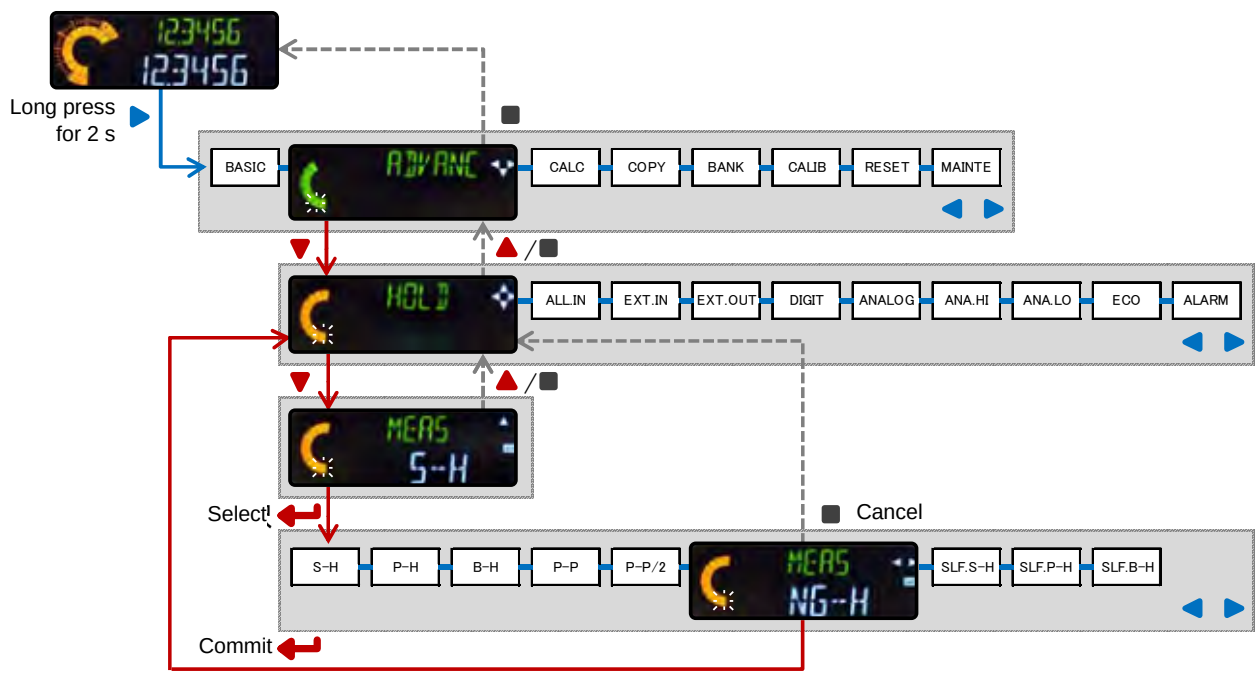
The judgment value is held only while the external trigger input is ON.



Note

- ✓ When the reset input is turned ON with the external trigger input ON, an indefinite state will be held.
- ✓ When the reset input is turned ON with the external trigger input OFF, an indefinite state will be held for the duration of the specified response time. In addition, when a setting is configured such that the judgment value changes, a reset will occur, also resulting in an indefinite state for the duration of the specified response time.
- ✓ Note that, with NG hold, the judgment output is not the same as the judgment value.
- ✓ Once a HIGH judgment has been output during an output judgment period, a LOW judgment will not be output.
  When a LOW judgment has been output, a HIGH judgment will not be output.

Operation procedure

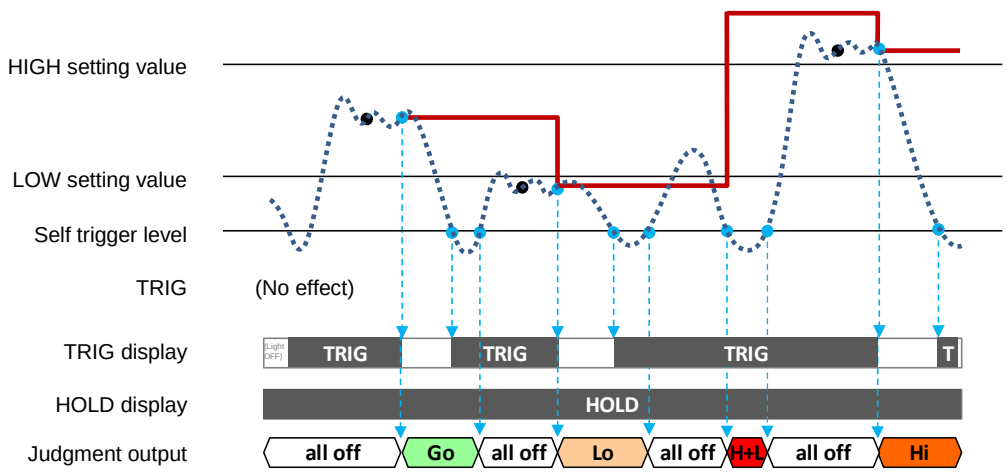


6-2-1-4 Self Sample Hold (Static Width)

Parameter name	Setting value	Remarks
Measurement mode (MEAS)	Selects a hold mode. S-H (Sample hold) P-H / B-H / P-P / P-P/2 NG-H (NG hold) **SLF.S-H (Self sample hold)** SLF.P-H (Self peak hold) SLF.B-H (Self bottom hold) [Default: S-H]	
Self trigger level (SLF.LV)	Sets the reference level for the hold function using the self (internal) trigger. −199.9999 to 199.9999 [Default: 0.500]	
Self trigger edge direction (SLF.EDG)	Sets the edge direction for measurement of the hold value using the self trigger level. UP (Rise) / DOWN (Fall) [Default: UP]	
Self trigger delay (SLF.DLY)	Sets the self trigger delay type and its reference value when the self sample hold function is used. **DLY.WD (Static width)** / DLY.TIM (Delay timer) [Default: DLY.WD]	
Static width (DLY.WD)	0 to 199.9999 (mm) [Default: 0.0100]	

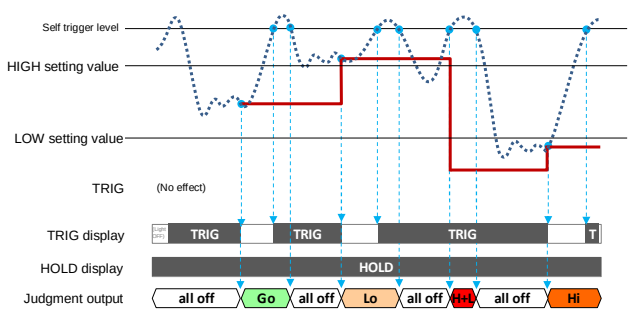
After exceeding or falling below the specified self trigger level (depending on the specified self trigger edge direction), the judgment value is held automatically when the normal measurement value becomes stable within the specified static width.

Fulfillment of the above condition activates self triggering, which updates the judgment value. Until that time, the output continues to be held.



Self trigger level and self trigger edge direction

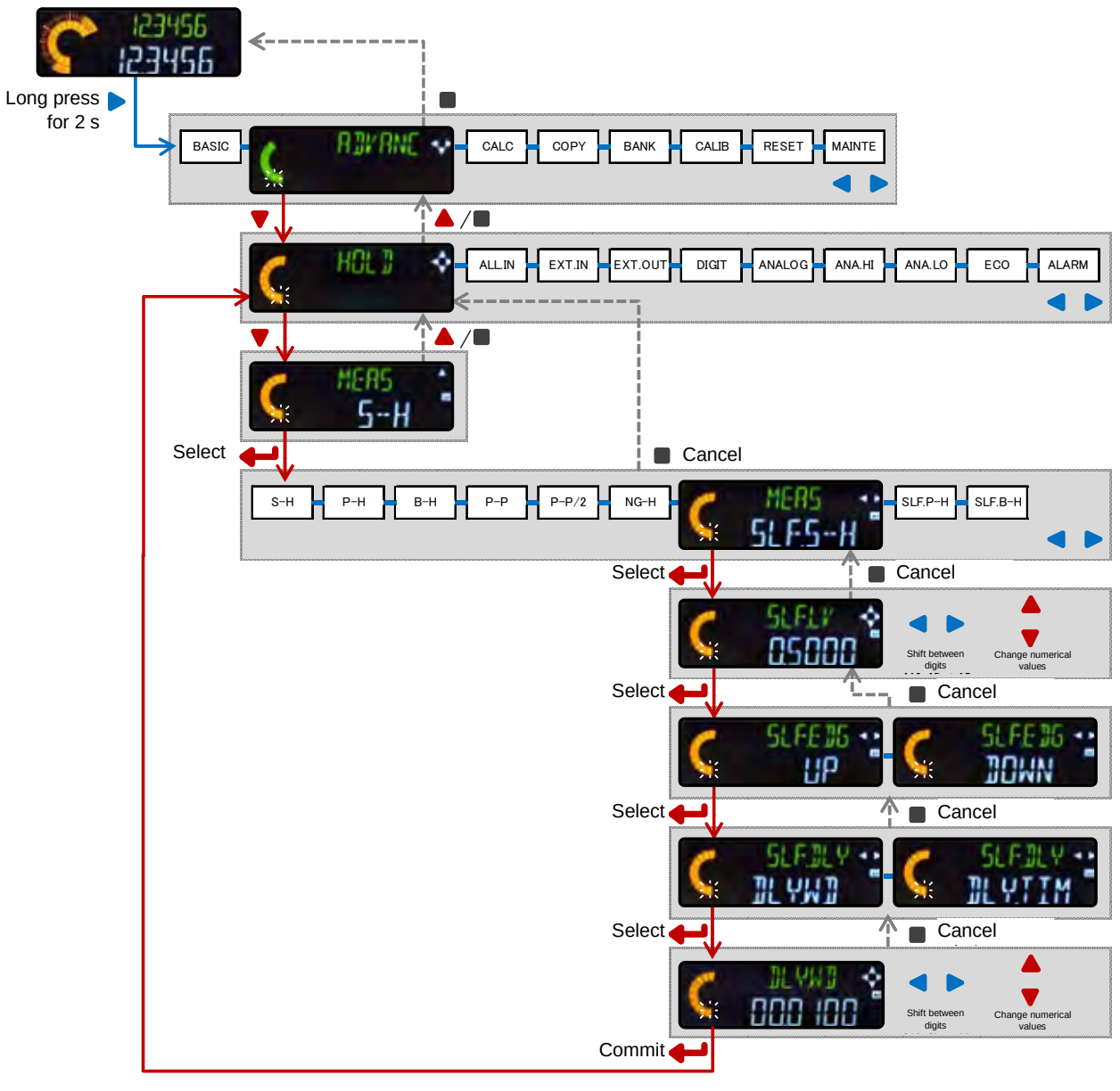
It is recommended that the self trigger direction be set to UP when the self trigger level is lower than the LOW setting value, as shown in the figure above, and that it be set to DOWN when the self trigger level is higher than the HIGH setting value, as shown in the figure on the right.



Note

- ✓ An indefinite state is held on occurrence of any of the following:
  - The power is turned ON
  - The reset input is ON
  - A sensor head disconnection error or upthrust error (alarm) is canceled
- ✓ If the input value falls below the self trigger level before settling within the static width, the controller enters an alarm state. (In the case of the self trigger edge direction being set to UP)
- ✓ Note that, with this type of self sample hold, the judgment output is not the same as the judgment value. After the input value exceeds the specified self trigger level (in the case of the self trigger edge direction being UP), the judgment output is all OFF until the normal measurement value settles within the specified static width.
- ✓ When self sample hold is selected, external trigger input has no effect.

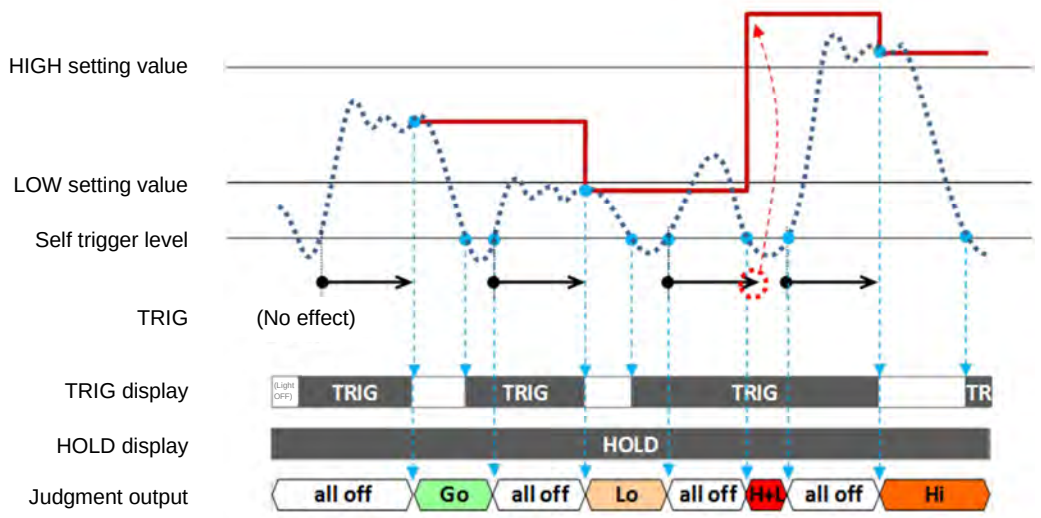
Operation procedure



6-2-1-5 Self Sample Hold (Delay Timer)

Parameter name	Setting value	Remarks
Measurement mode (MEAS)	Selects a hold mode. S-H (Sample hold) P-H / B-H / P-P / P-P/2 NG-H (NG hold) **SLF.S-H (Self sample hold)** SLF.P-H (Self peak hold) SLF.B-H (Self bottom hold) [Default: S-H]	
Self trigger level (SLF.LV)	Sets the reference level for the hold function using the self (internal) trigger. −199.9999 to 199.9999 [Default: 0.500]	
Self trigger edge direction (SLF.EDG)	Sets the edge direction for measurement of the hold value using the self trigger level. UP (Rise) / DOWN (Fall) [Default: UP]	
Self trigger delay (SLF.DLY)	Sets the self trigger delay type and its reference value when the self sample hold function is used. DLY.WD (Static width) / **DLY.TIM (Delay timer)** [Default: DLY.WD]	
Delay timer (DLY.TIM)	0 to 199.9999 (mm) [Default: 1000]	

After exceeding or falling below the specified self trigger level (depending on the specified self trigger edge direction), the judgment value is held automatically on expiry of a period specified by the delay timer.
Fulfillment of the above condition activates self triggering, which updates the judgment value. Until that time, the output continues to be held.

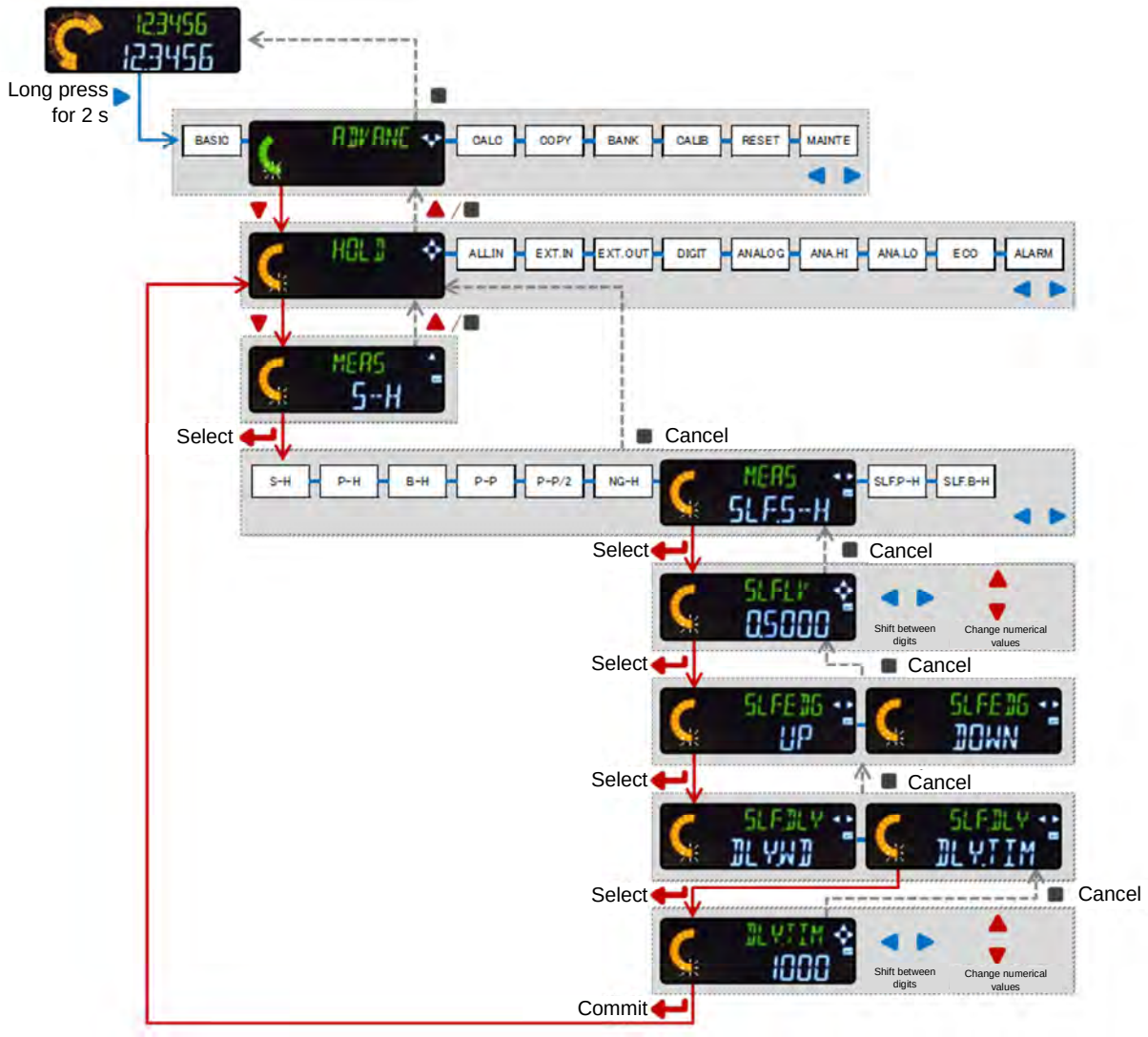


Note

- ✓ An indefinite state is held on occurrence of any of the following:
  - The power is turned ON
  - The reset input is ON
  - A sensor head disconnection error or upthrust error (alarm) is canceled
- ✓ If the input value falls below the self trigger level before the time set by the delay timer has elapsed, the controller enters an alarm state. (In the case of the self trigger edge direction being set to UP)

- ✓ Note that, with this type of self sample hold, the judgment output is not the same as the judgment value. After the input value exceeds the specified self trigger level (in the case of the self trigger edge direction being UP), the judgment output is all OFF during the time set by the delay timer.
- ✓ When self sample hold is selected, external trigger input has no effect.

Operation procedure



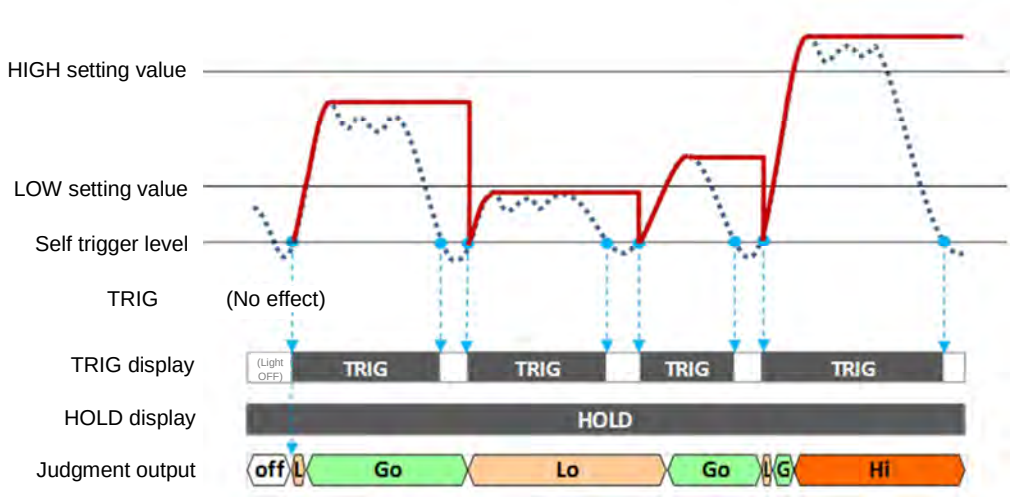
6-2-1-6 Self Peak Hold/Self Bottom Hold

Parameter name	Setting value	Remarks
Measurement mode (MEAS)	Selects a hold mode. S-H (Sample hold) P-H / B-H / P-P / P-P/2 NG-H (NG hold) SLF.S-H (Self sample hold) **SLF.P-H (Self peak hold)** **SLF.B-H (Self bottom hold)** [Default: S-H]	
Trigger mode (TRG)	Selects the external trigger input behavior. HOLD (Hold) / 1SHOT (One shot) [Default: HOLD]	
Self trigger level (SLF.LV)	Sets the reference level for the hold function using the self (internal) trigger. −199.9999 to 199.9999 [Default: 0.500]	
Self trigger edge direction (SLF.EDG)	Sets the edge direction for measurement of the hold value using the self trigger level. UP (Rise) / DOWN (Fall) [Default: UP]	

Self peak hold (Trigger mode: Hold)

After the input value exceeds or falls below the specified self trigger level (depending on the specified self trigger edge direction), constant updating of the peak value is performed automatically.

When the input value exceeds or falls below the specified self trigger level once again (depending on the specified self trigger edge direction), the peak value is cleared, and the device returns to its state of performing constant updates.



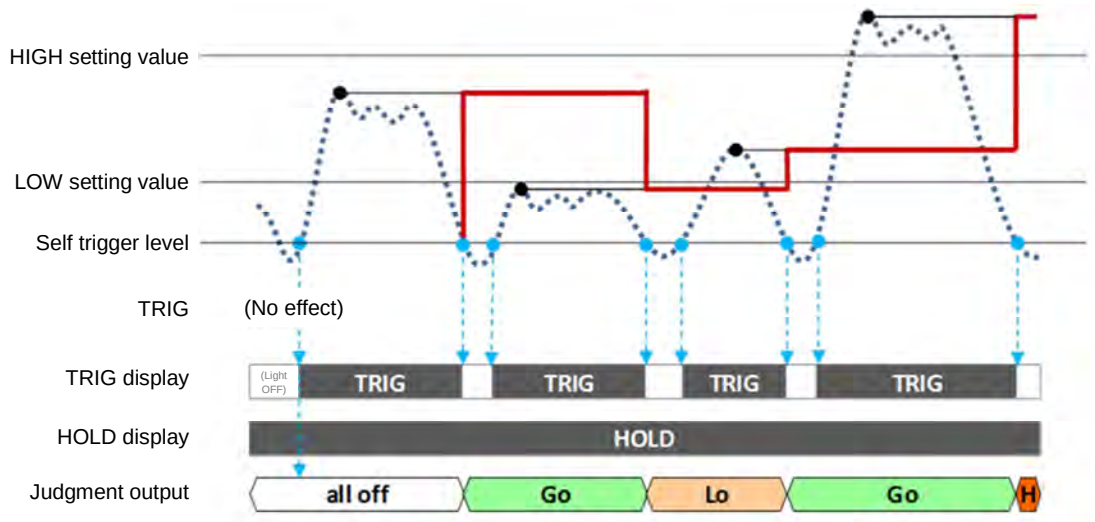
Note

- ✓ An indefinite state is held on occurrence of the following:
  - The power is turned ON
  - The reset input is ON
  - A sensor head disconnection error or upthrust error (alarm) is canceled
- ✓ In this type of self peak hold, the judgment output is the same as the judgment value. (However, please note that there are some measurement modes for which this is not the case.)
- ✓ When self peak hold is selected, external trigger input has no effect.

Self peak hold (Trigger mode: One shot)

After the input value exceeds or falls below the specified self trigger level (depending on the specified self trigger edge direction), constant updating of the peak value is performed automatically. However, this is an internal process, and does not appear on the display or as the judgment output.

After the input value falls below or exceeds the specified self trigger level (in accordance with the opposite of the specified self trigger edge direction), the hold value is updated to the internally updated peak value.



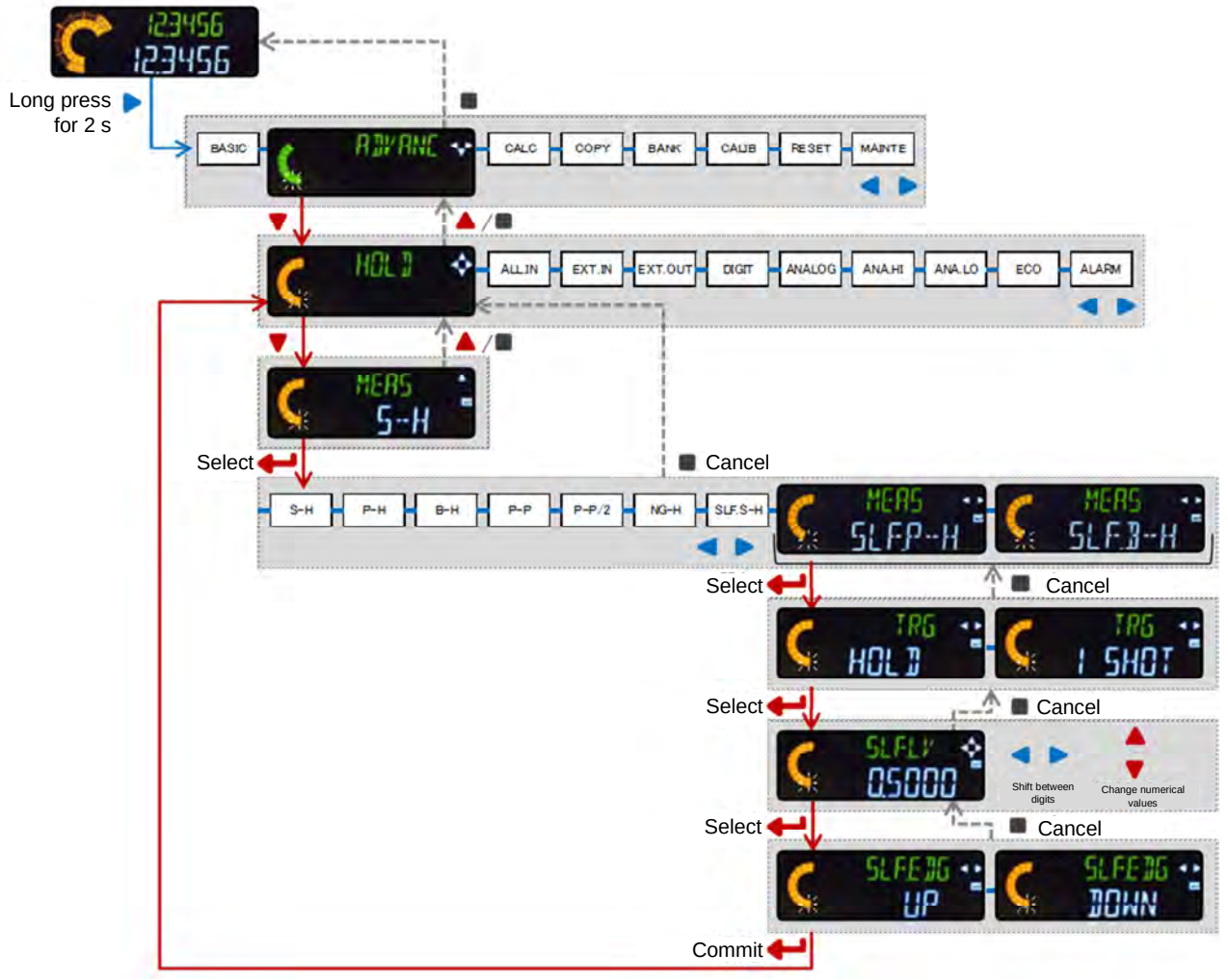
Note

- ✓ An indefinite state is held on occurrence of the following:
  - The power is turned ON
  - The reset input is ON
  - A sensor head disconnection error or upthrust error (alarm) is canceled
- ✓ In this type of self peak hold, the judgment output is the same as the judgment value. (However, please note that there are some measurement modes for which this is not the case.)
- ✓ When self peak hold is selected, external trigger input has no effect.

Related information

- ✓ In self bottom hold, the relevant value is held for each measurement mode in a similar manner.

Operation procedure



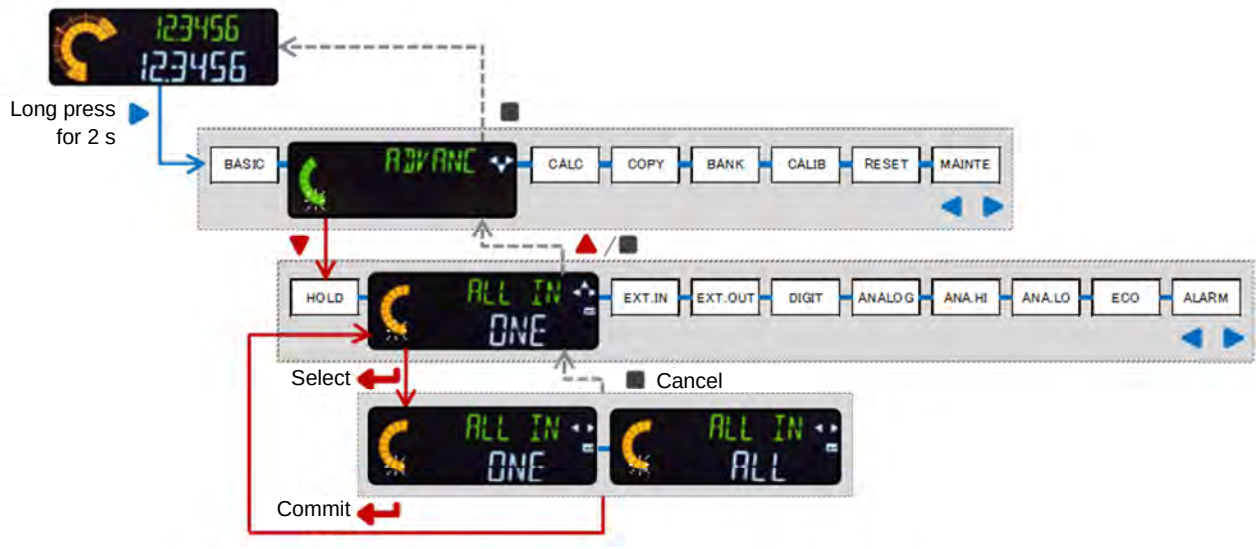
6-2-2 All Input

Parameter name	Setting value	Remarks
All input (ALL IN)	When a trigger is input to a master unit, the signal can be input to all connected slave units simultaneously. ONE (Single) / ALL (All) [Default: ONE]	

When the trigger or preset inputs into all of the master and slave units which are connected together share the same timing, the trigger/preset inputs into the master unit can be set to be input into all of the slave units.

This allows the amount of wiring in the system to be reduced.

Operation procedure



Note

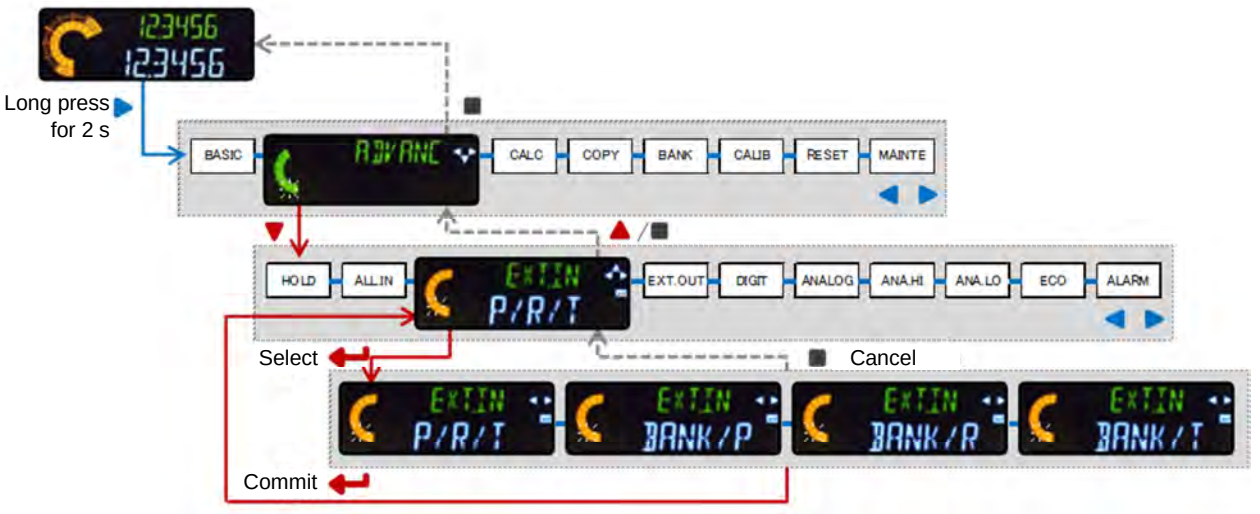
✓ Input all can only be set for a master unit to which slave units are connected.

6-2-3 External Input

Parameter name	Setting value	Remarks
External input (EXT.IN)	For input 1/input 2/input 3 of external inputs, selects one of four input signal types. P/R/T (Preset/Reset/Trigger) BANK/P (Bank A/B/Preset) BANK/R (Bank A/B/Reset) BANK/T (Bank A/B/Trigger) [Default: P/R/T]	

External input	Input 1	Input 2	Input 3
P/R/T [Default]	Preset	Reset	Trigger
BANK/P	Bank A	Bank B	Preset
BANK/R			Reset
BANK/T			Trigger

Operation procedure



Note

- ✓ The ON and OFF times of the preset, reset, and bank inputs must be at least 20 ms.
- ✓ Banks A and B have to be turned ON in order to select Bank 3. The rising delay time for Banks A and B must be 8 ms or shorter.
- ✓ If the Select bank storage parameter is set to ALL, the OFF time of Banks A and B must be at least 50 ms.
- ✓ The ON and OFF times of trigger input must be at least 2 ms.

Related information

- ✓ For details of the input/output circuit, refer to "7-1-1 Input/Output Circuit."
- ✓ For details of all input, refer to the preceding section.

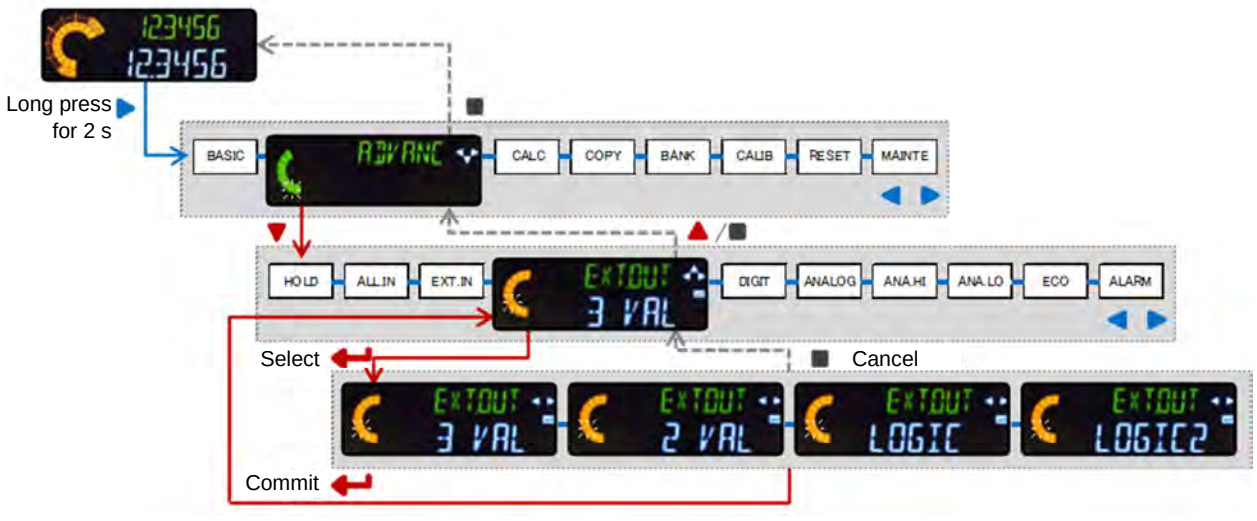
6-2-4 External Output

Parameter name	Setting value	Remarks
External output (EXT.OUT)	For output 1/output 2/output 3 of external outputs, selects one of four output signal types. 3VAL (HI, GO, LO) 2VAL (HIorLO, INRANGE, ALARM) LOGIC (LOGIC, ALARM) LOGIC2 (ALLGO, GO, ALARM) [Default: 3VAL]	

Details of outputs are as follows:

			LOW judgment	GO judgment	HIGH judgment	Alarm
3VAL [Default]	OUT1	HIGH	OFF	OFF	ON	ON
	OUT2	GO	OFF	ON	OFF	OFF
	OUT3	LOW	ON	OFF	OFF	ON
2VAL	OUT1	Out of range	ON	OFF	ON	
	OUT2	GO	OFF	ON	OFF	
	OUT3	Alarm	ON	ON	ON	OFF
LOGIC	OUT1	Judgment 1	ON	OFF	ON	
	OUT2	Judgment 2	OFF	ON	ON	
	OUT3	Alarm	ON	ON	ON	OFF
LOGIC2	OUT1	ALL GO (all connected)	OFF	ON	OFF	
	OUT2	GO (master unit)	OFF	ON	OFF	
	OUT3	Alarm (connected)	ON	ON	ON	OFF

■ Operation procedure



■ Note

✓ When any one of 2VAL/LOGIC/LOGIC2 is set, the alarm output (OUT3) is ON for normal operation, and OFF when an alarm is active.

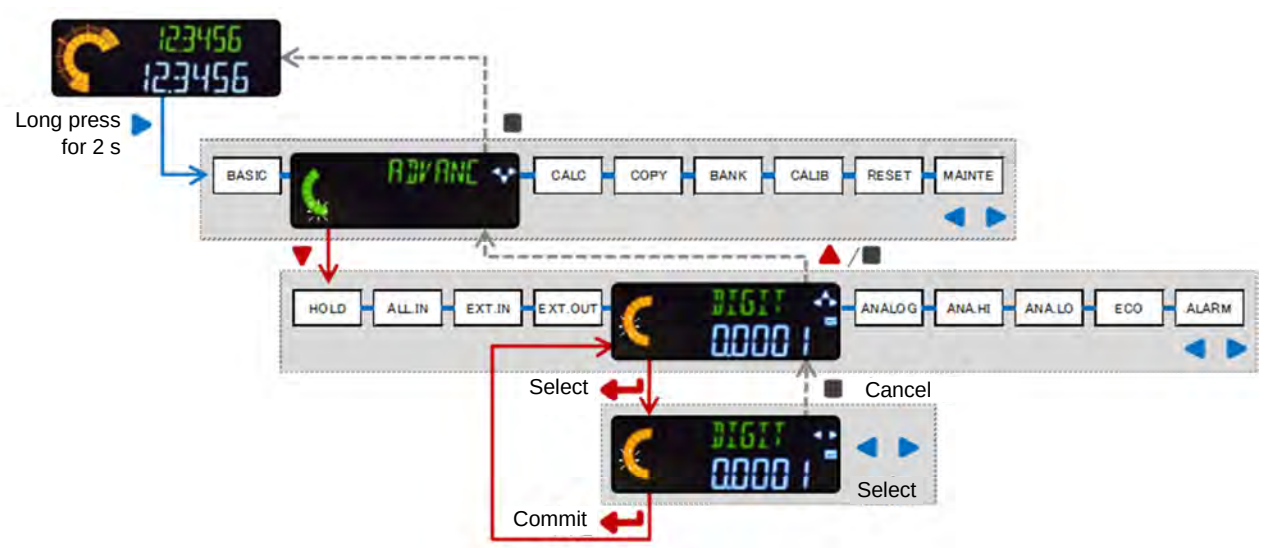
Related information

- ✓ For details of the input/output circuit, refer to "7-1-1 Input/Output Circuit."
- ✓ For details of setting output behavior, refer to "6-1-12 Output Behavior (OUTPUT)."

6-2-5 Display Digits

Parameter name	Setting value	Remarks
Display digits (DIGIT)	Changes the number of digits shown after the decimal point on the digital display. 0.1 / 0.01 / 0.001 / 0.0001 [Default: 0.0001]	

Operation procedure



Note

- ✓ Independent of the number of digits, numbers are displayed right-aligned.
- ✓ Setting the number of digits only affects the display of normal measurement (NORM.V), LOW setting, HIGH setting, sensor head measurement, calculation, and judgment (JUDGE.V) values.
- ✓ Judgment output does not affect changes in the number of displayed digits.

6-2-6 Analog Output Settings

6-2-6-1 Analog Scaling

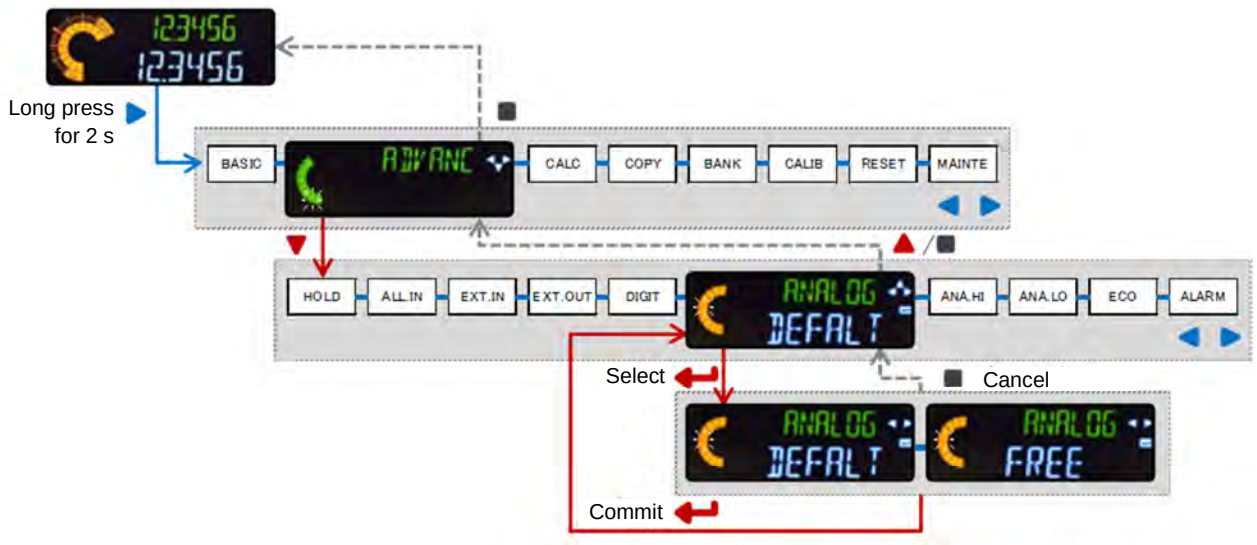
Parameter name	Setting value	Remarks
Analog scaling (ANALOG)	For analog output, sets the upper and lower limits corresponding to judgment value (JUDGE.V) converted to current (4 to 20 mA). DEFALT (Default) / FREE (Free) [Default: DEFALT]	

If set to DEFALT, the lower limit is fixed at 0.0000, and the output is 4 mA.

The upper limit is fixed at a specific value that depends on sensor head type, and the output is 20 mA.

When the judgment value is equal to or less than the lower limit, the output is 4 mA, and when it is equal to or greater than the upper limit, the output is 20 mA.

Operation procedure



Note

✓ The analog output is specified as follows:

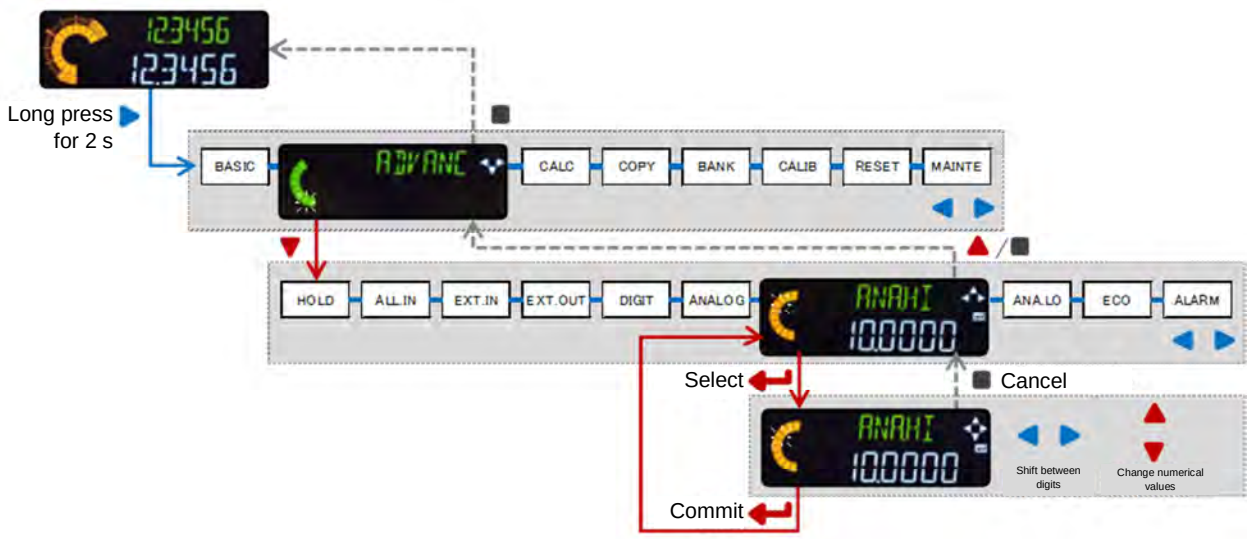
- Resolution: 0.3 µA
- Output during error: 0 mA
- Linearity: ±0.25% F.S.
- Maximum load impedance: 250 Ω MAX

6-2-6-2 Scaling Upper Limit/Scaling Lower Limit

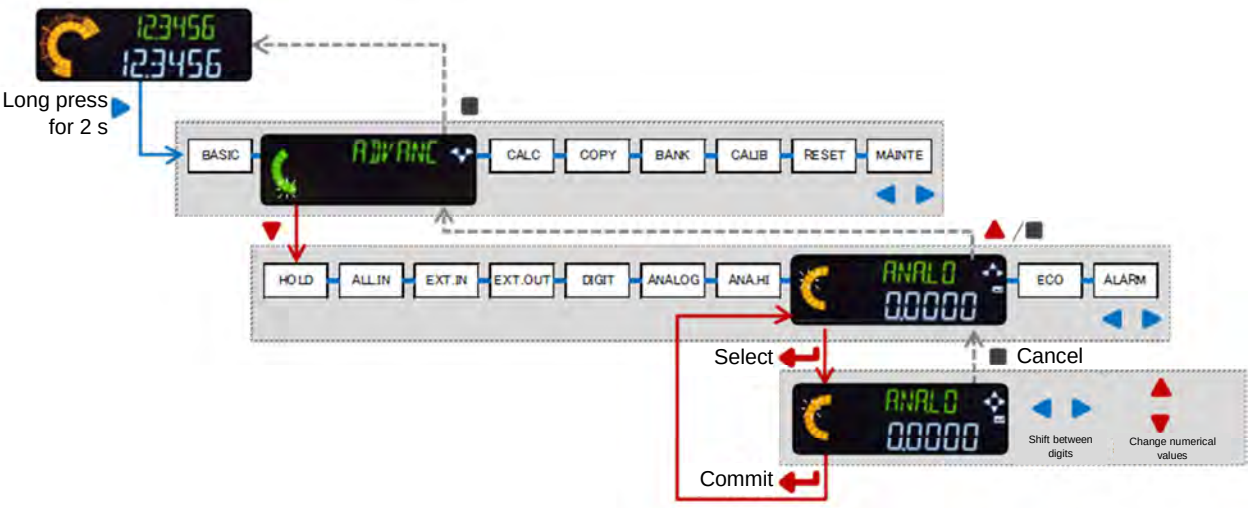
Parameter name	Setting value	Remarks
Scaling upper limit (ANA.HI)	This can be set only when analog scaling is set to FREE. It sets the judgment value that outputs a current of 20 mA −199.9999 to 199.9999 (mm) [Default: 10.0000]	
Scaling lower limit (ANA.LO)	This can be set only when analog scaling is set to FREE. It sets the judgment value that outputs a current of 4 mA. −199.9999 to 199.9999 (mm) [Default: 0.0000]	

Operation procedure

- Setting the scaling upper limit



- Setting the scaling lower limit



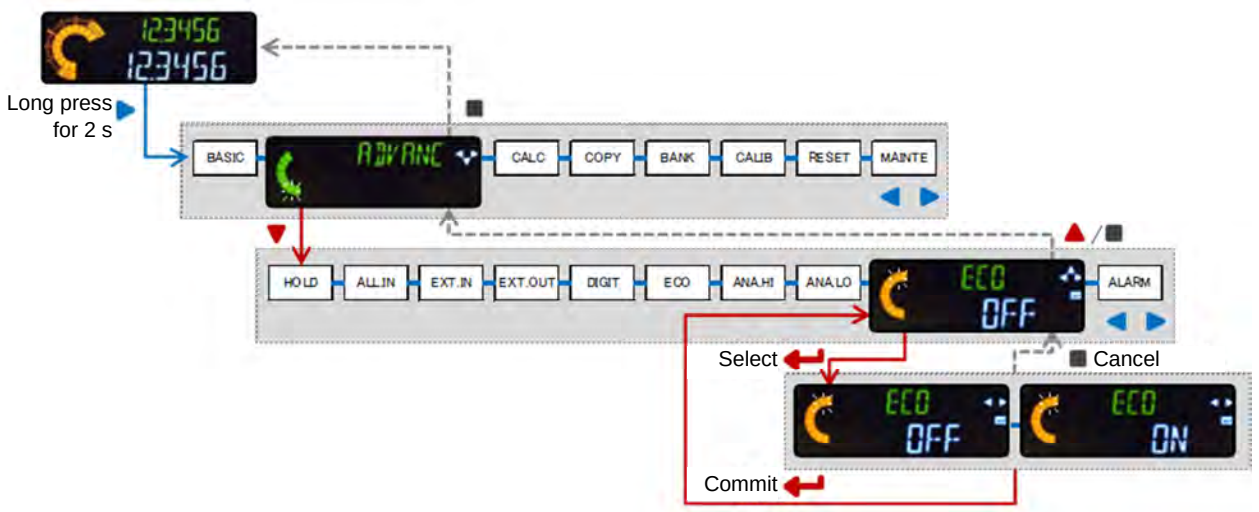
6-2-7 Eco Mode

Parameter name	Setting value	Remarks
Eco mode (ECO)	Saves energy by turning off the backlight of the controller display when the screen is not being used. ON / OFF [Default: OFF]	

If eco mode is set to ON, the screen backlight is turned OFF if no keys operations are performed for 30 seconds.

When the screen backlight is OFF, pressing any key turns it ON again.

Operation procedure



Note

- ✓ If an error occurs while the screen backlight is OFF, it turns back ON.
- ✓ The backlight never turns OFF while an error is being displayed.

6-2-8 Alarm Settings

Parameter name	Setting value	Remarks
Alarm delay time (DELAY)	Sets the delay time (changeable in 1 ms increments) from the time the sensor head comes into upthrust position to the time the alarm activates. 1 to 1,000 [Default: 1,000]	
Upthrust check (PRS.CHK)	Sets the upthrust check ON/OFF. ON / OFF [Default: ON]	
Upthrust check setting value (PRS.SET)	Sets the threshold level of the upthrust check. −199.9999 to 199.9999 (mm) [Default: 10.0000]	
Catching check (CAT.CHK)	Sets the catching check ON/OFF. ON / OFF [Default: OFF]	
Number of connected units check (PRS.CHK)	If controllers are connected, this performs a check when the power is turned ON confirming that the number of connected units has not changed. ON / OFF [Default: OFF]	

Upthrust

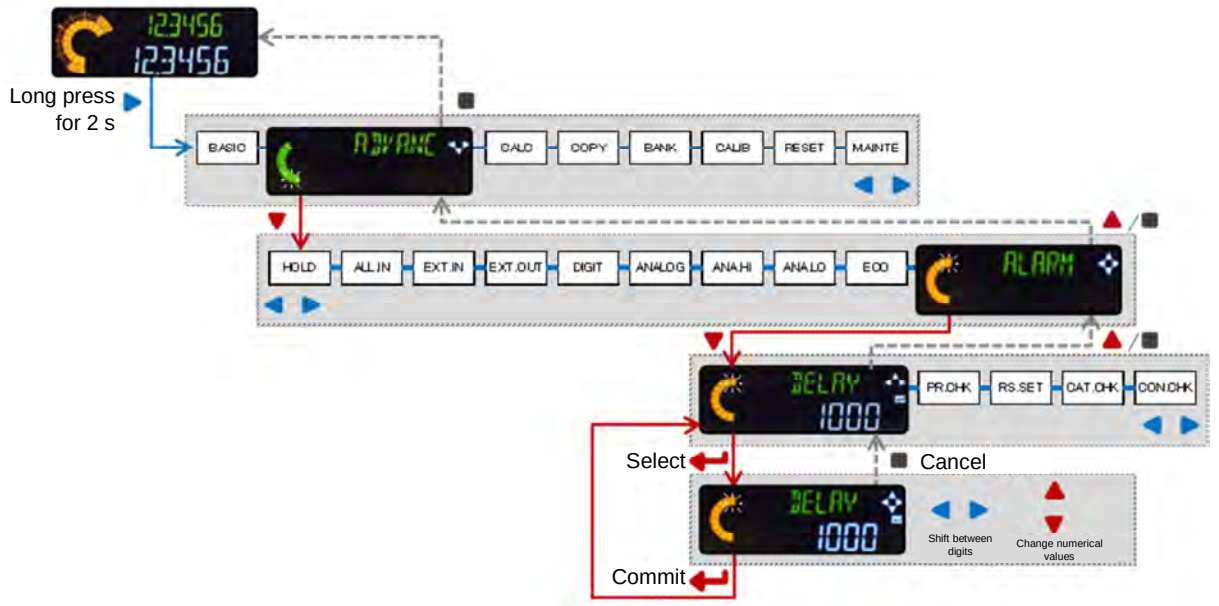
"Upthrust" indicates a state in which the spindle has been pushed in too much. Upthrust can cause damage to the sensor head. If the upthrust check is set to ON, an alarm is output before upthrust occurs, protecting the sensor head from damage.

6-2-8-1 Alarm Delay Time

Parameter name	Setting value	Remarks
Alarm delay time (DELAY)	Sets the delay time (changeable in 1 ms increments) from the time the sensor head comes into upthrust position to the time the alarm activates. 1 to 1,000 [Default: 1,000]	

Can be set such that a momentary upthrust will not activate the alarm.

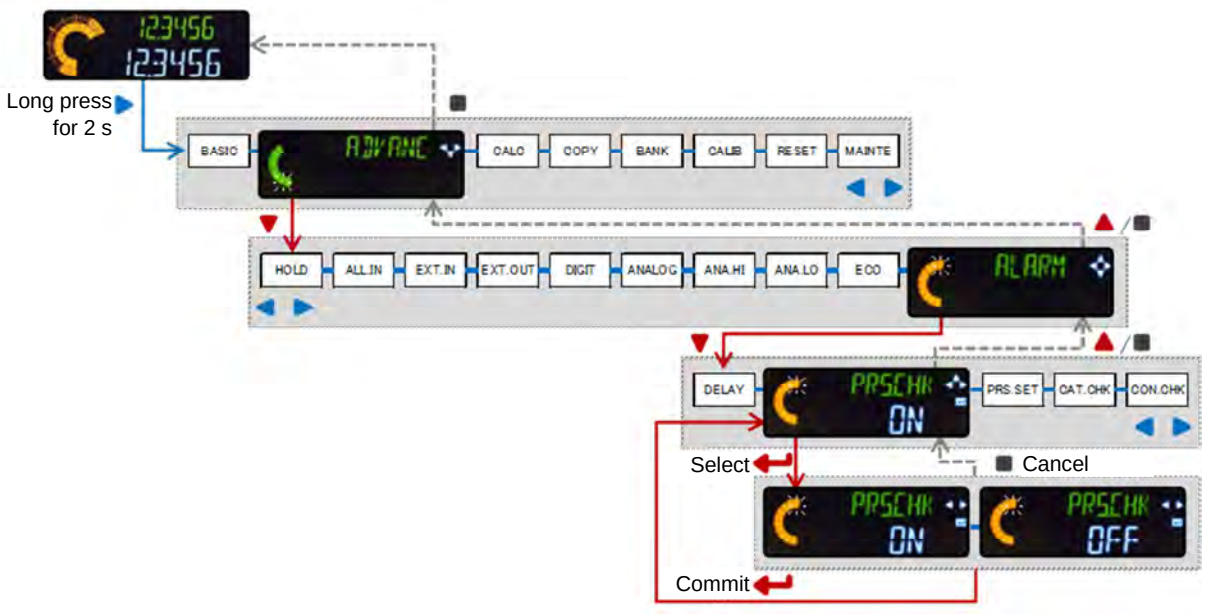
Operation procedure



6-2-8-2 Upthrust Check

Parameter name	Setting value	Remarks
Upthrust check (PRS.CHK)	Sets the upthrust check ON/OFF. ON / OFF [Default: ON]	

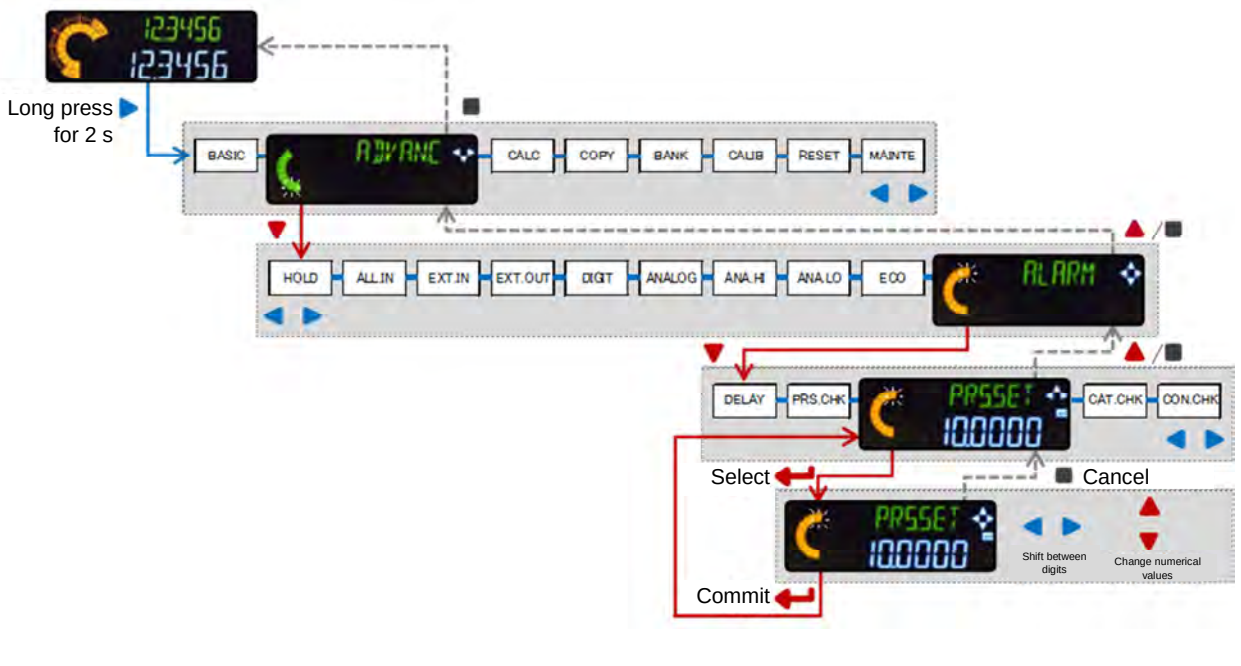
Operation procedure



6-2-8-3 Upthrust Check Setting Value

Parameter name	Setting value	Remarks
Upthrust check setting value (PRS.SET)	Sets the threshold level of the upthrust check. −199.9999 to 199.9999 (mm) [Default: 10.0000]	

Operation procedure



6-2-8-4 Catching Check

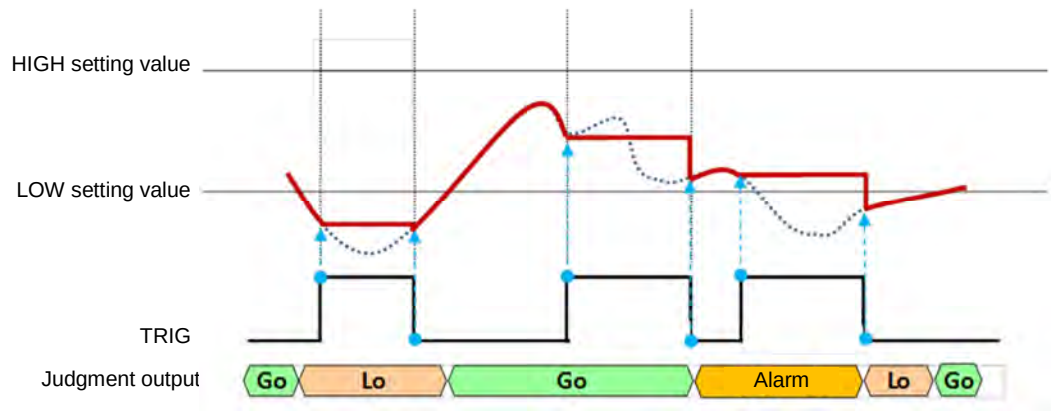
Parameter name	Setting value	Remarks
Catching check (CAT.CHK)	Sets the catching check ON/OFF. ON / OFF [Default: OFF]	

If, due to aging, spindle movement becomes poor and the spindle does not return to the correct position, then accurate measurement cannot be performed. The catching check function detects failure of the spindle to return correctly.

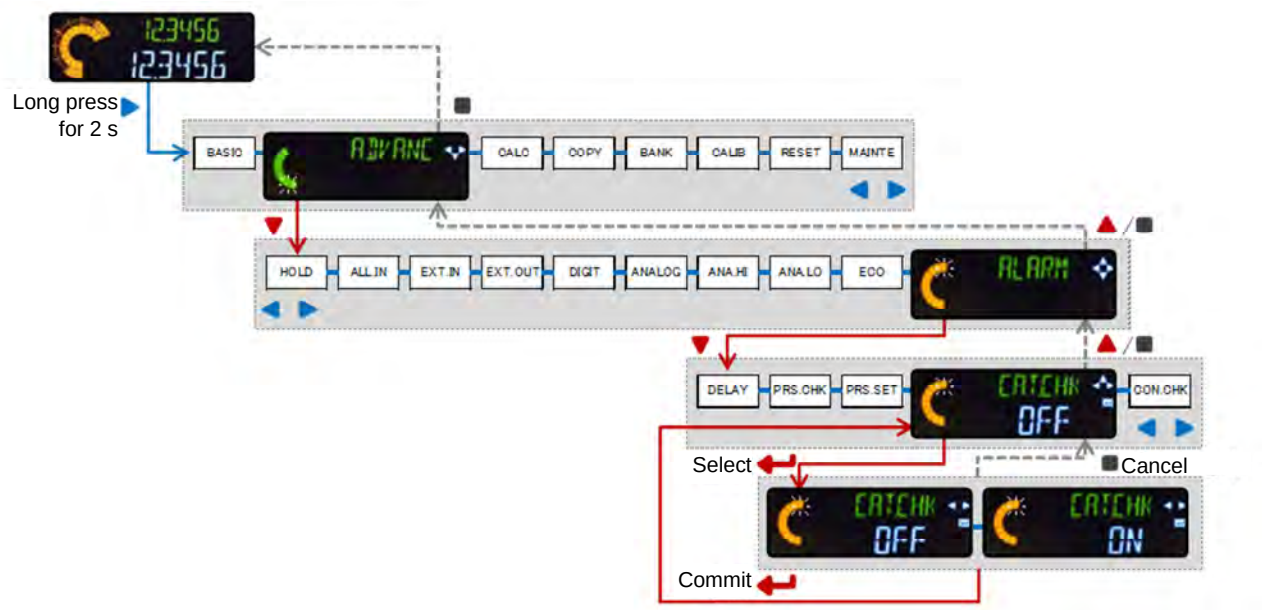
This function checks for complete extension of the spindle while the trigger input is ON by detecting whether the normal measurement value (NORM.V) falls below the LOW setting value.

If the normal measurement value has not fallen below the LOW setting value whilst the trigger input is ON, an alarm is activated.

The alarm can also be set not to activate.



Operation procedure



Note

✓ This function can be used only when the measurement mode is set such that external trigger input has an effect, as described in "6-2-1 Hold Settings."

6-2-8-5 Number of Connected Units Check (Master Unit Only)

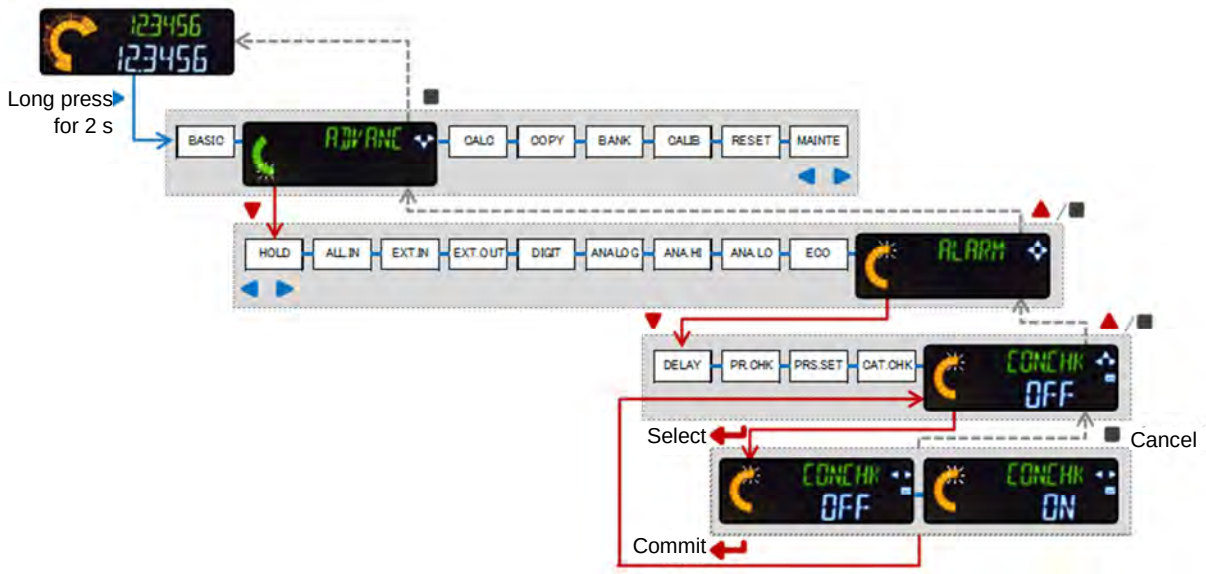
Parameter name	Setting value	Remarks
Number of connected units check (PRS.CHK)	If controllers are connected, this performs a check when the power is turned ON confirming that the number of connected units has not changed. ON / OFF [Default: OFF]	

The number of connected controller units is checked and, if that number has changed, an error is output.

If the number is larger or smaller than that when this parameter was set to ON, an error is output.

When changing the number of connected controller units, set this parameter to OFF, change the number of units, and then set the parameter to ON again.

Operation procedure



Note

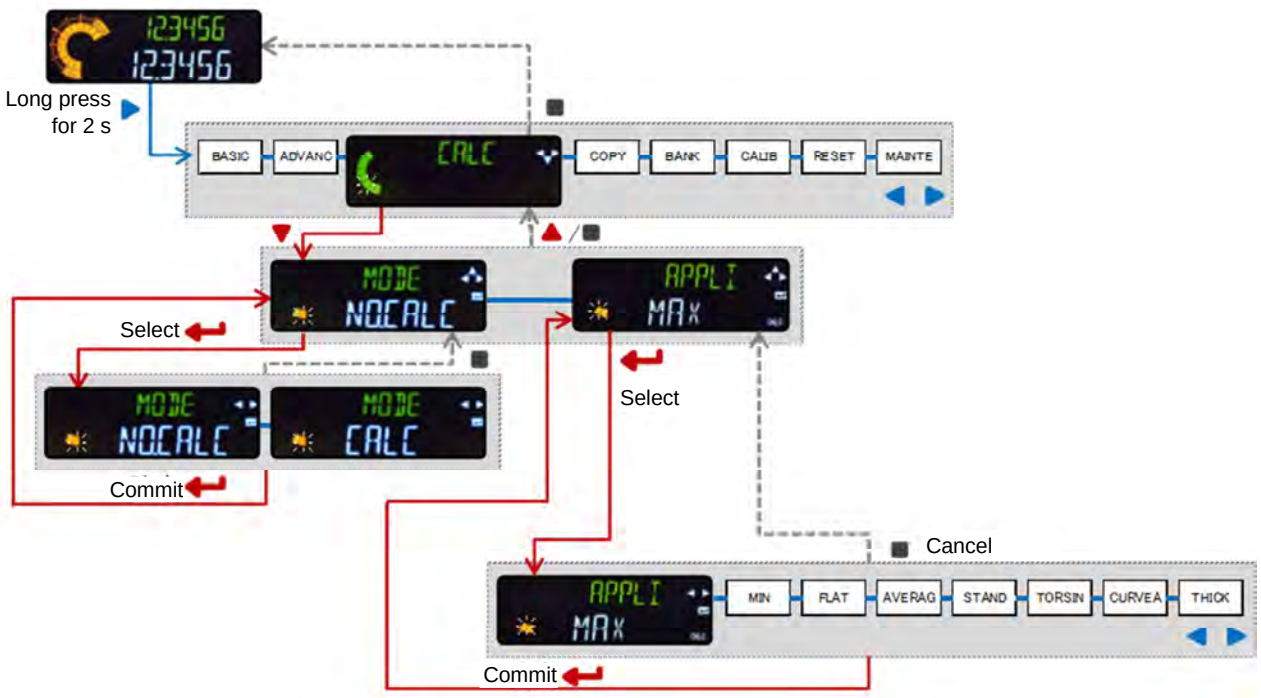
✓ The number of connected units check can only be set on master units.

6-3 Calculation Settings (Master Unit Only)

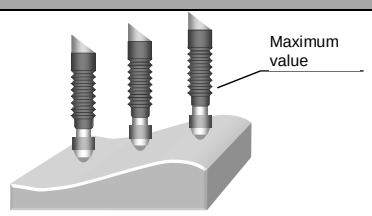
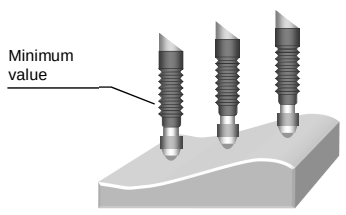
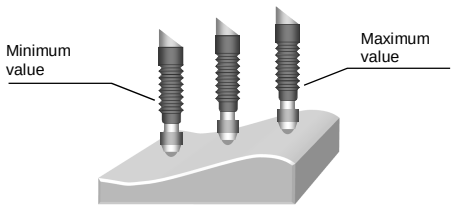
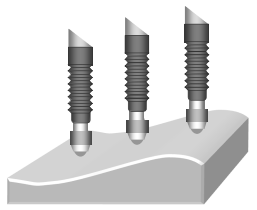
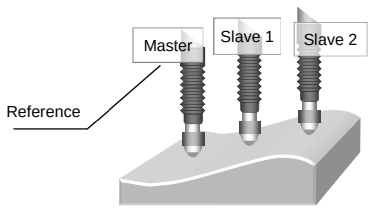
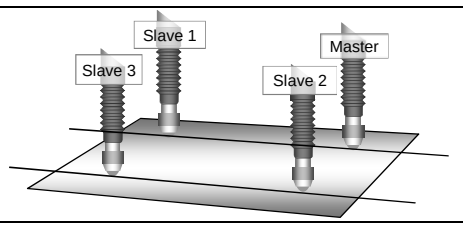
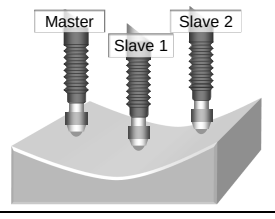
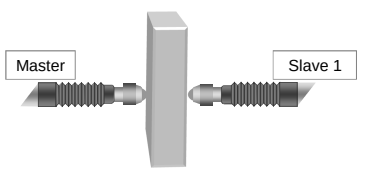
6-3-1 Calculation Mode

Parameter name	Setting value	Remarks
Calculation mode (MODE)	This mode carries out calculations using measurements from each connected controller, and outputs the judgment results on the master unit display and from the master unit. CALC (Calculates) / NOCALC (Does not calculate) [Default: NOCALC]	
Select calculation app (APPLI)	The Select calculation app can be set when calculation mode is set to CALC. This selects the application used for the calculation. MAX (Maximum) MIN (Minimum) FLAT (Flatness) AVERAG (Average) STAND (Difference from standard) TORSIN (Torsion) CURVEA (Curvature) THICK (Thickness) [Default: MAX]	

■ Operation procedure



Calculation app

Application	Function	Remarks
Maximum value (MAX)	The calculation value is the maximum value of the measurements from all the connected controllers. [Calculation value] = [Maximum value] 	One or more units
Minimum value (MIN)	The calculation value is the minimum value of the measurements from all the connected controllers. [Calculation value] = [Minimum value] 	One or more units
Flatness (FLAT)	The calculation value is the difference between the maximum and minimum values of the measurements from all the connected controllers. [Calculation value] = [Maximum value] − [Minimum value] 	One or more units
Average (AVERAG)	The calculation value is obtained by dividing the sum of the measurements from all the connected controllers by the number of units. [Calculation value] = ([Master] + [Slave 1] + ... + [Slave n]) / (1 + n) 	One or more units
Difference from standard (STAND)	Calculations are performed on the measurement value from the master and that from each connected slave. Each calculation value is obtained by subtracting the master unit measurement value from that from each slave unit. Each slave unit outputs a calculation value. [Calculation value] = [Slave n] − [Master] 	One or more units
Torsion (TORSIN)	Measurements from four points are used to calculate level of torsion. The calculation value is the result of this calculation. [Calculation value] = ([Master] − [Slave 1]) − ([Slave 2] − [Slave 3]) 	Three units
Curvature (CURVEA)	Measurements from three points are used to calculate level of curvature. The calculation value is the result of this calculation. [Calculation value] = ([Master] + [Slave 2]) / 2 − [Slave 1] 	Two units
Thickness (THICK)	The object to be measured is placed between the sensor heads of the master and slave units, and the measurements obtained from these are summed to give the calculation value. [Calculation value] = [Master] + [Slave 1] 	One unit

6-4 Copy Settings

6-4-1 Select Individual Items to Be Copied (Master Unit Only)

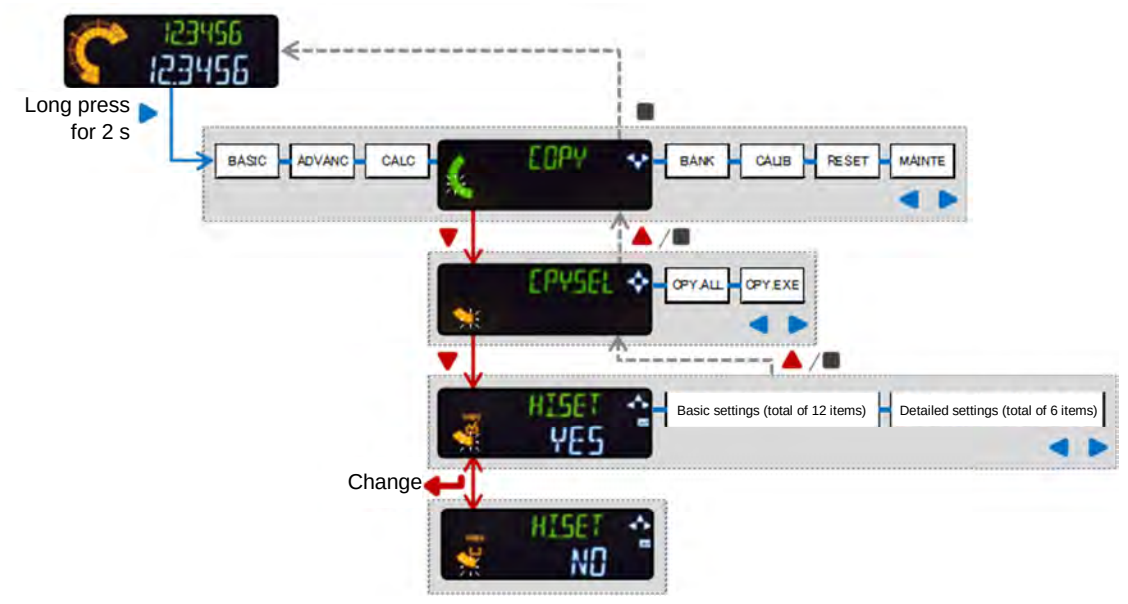
Parameter name	Setting value	Remarks
Copy select (CPY.SEL)	Items to be copied are selected individually. YES / NO [Default: YES]	

The settings on the master unit can be copied to the slave units that are connected to it.
Each item to be copied can be selected individually, or all settings can be selected together.
If the Execute copy parameter CPY.EXE is set to YES, pressing the ENTER key executes copying.
Slave units are provided with a function that prevents copying from a master unit.

■ Items that can be copied

Setting	Item
Basic settings	HIGH setting value (HI.SET)
	LOW setting value (LO.SET)
	Hysteresis (HYSTER)
	Teaching type (TEACH)
	Tolerance <±> (TOL<±>)
	Preset value (PR.VAL)
	Select preset data (PR.OBJ)
	Preset save (PR.SAVE)
	Measurement direction (DIRECT)
	Lever ratio (LEVER)
	Response time (SPEED)
	Output behavior (OUTPUT)
Detailed settings	Hold settings (HOLD)
	External input (EXT.IN)
	External output (EXT.OUT)
	Display digits (DIGIT)
	Eco mode (ECO)
	Alarm settings (ALARM)

■ Operation procedure



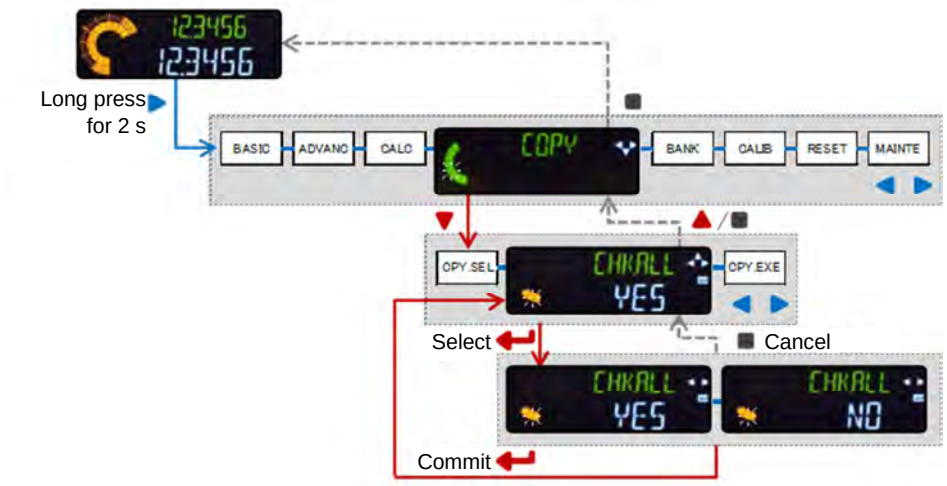
Note

- ✓ The other items are set to YES/NO using the same kind of operation procedure as that for HI.SET.
- ✓ Only the current settings are copied. The settings stored in banks cannot be copied.
- ✓ When setting the basic settings (BASIC) and detailed settings (ADVANC) items, the preset key can be used to select or deselect individual items for copying.

6-4-1 Select All Items to Be Copied (Master Unit Only)

Parameter name	Setting value	Remarks
Select all items to be copied (CHK.ALL)	Selects all items for copying. YES / NO [Default: YES]	

Operation procedure



Note

- ✓ Even with NO (do not execute) selected in Select individual items to be copied, selecting items as being subject to copying will not exclude them from being copied.

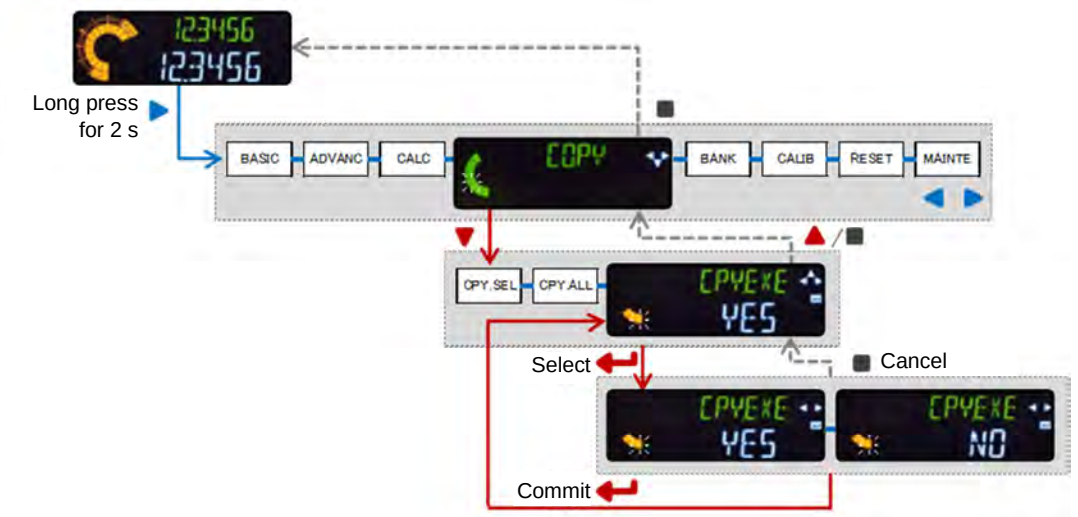
6-4-2 Execute Copy (Master Unit Only)

Parameter name	Setting value	Remarks
Execute copy (CPY.EXE)	The master unit copies the items selected for copying (individually selected or all items) to the slave units. YES / NO [Default: YES]	

When copy is executed, the master and slave units show NOW on digital display SUB (green), and COPY on digital display MAIN (white).

When copying has finished, the master unit (only) displays OK.

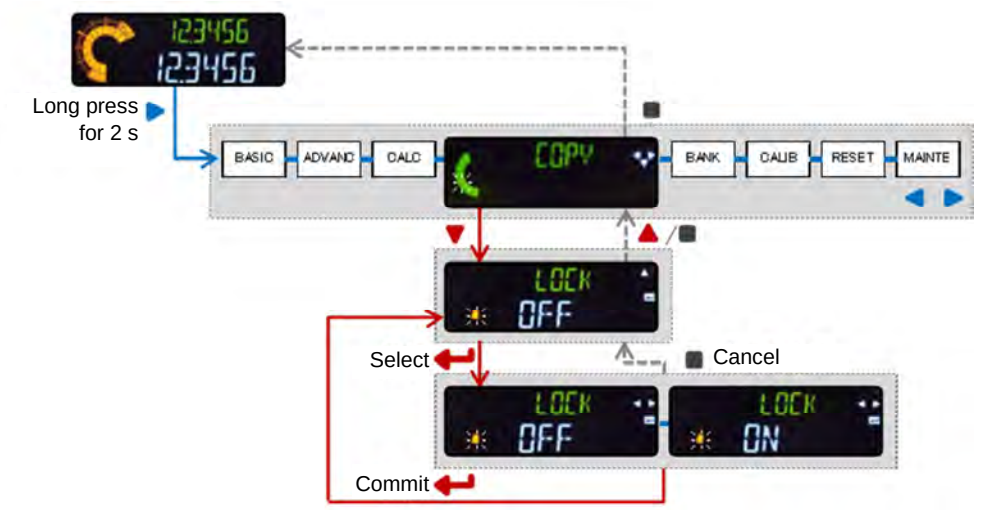
Operation procedure



6-4-3 Copy Lock (Slave Units Only)

Parameter name	Setting value	Remarks
Copy lock (LOCK) (Slave units only)	Prevents copying from the master unit. ON / OFF [Default: OFF]	

Operation procedure



6-5 Bank Settings

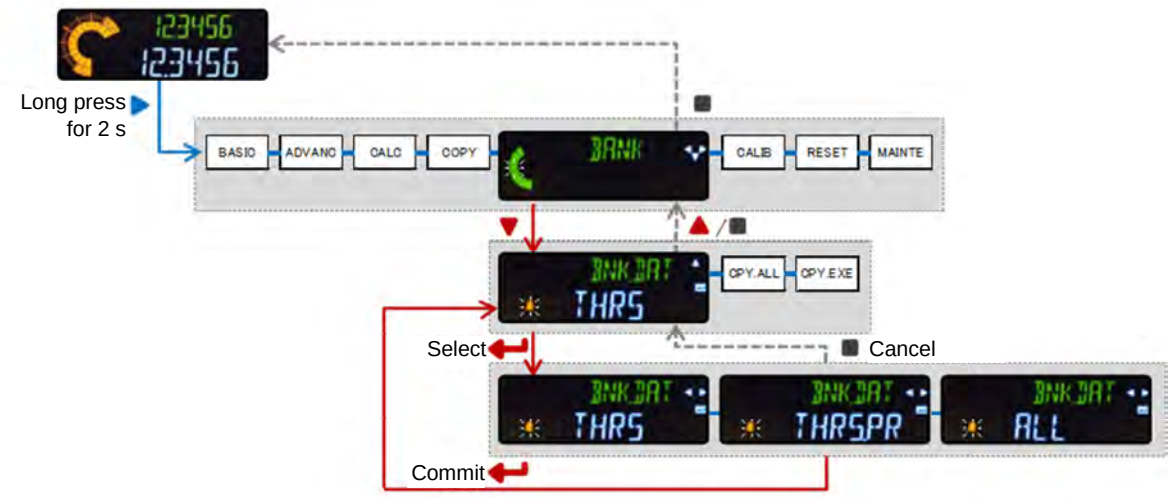
Parameter name	Setting value	Remarks
Select bank storage (BNK.DAT)	Selects the settings to be read out from those stored in a bank. ALL (All) THRS (HIGH setting value, LOW setting value) THRS.PR (HIGH setting value, LOW setting value, Preset value) [Default: ALL]	

Banks are storage areas. The settings in banks are not reflected on displays or in judgment values.

For this to happen, the relevant settings must be read out and placed in the work area.

Banks can only be overwritten by storing current work area settings inside them.

Operation procedure



Note

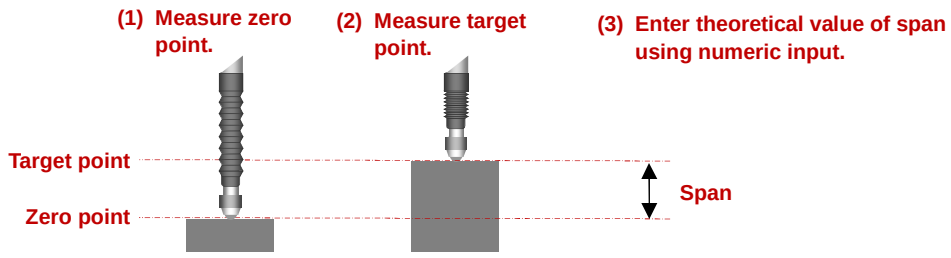
- ✓ The settings read out from banks are retained after the power is turned OFF.

Related information

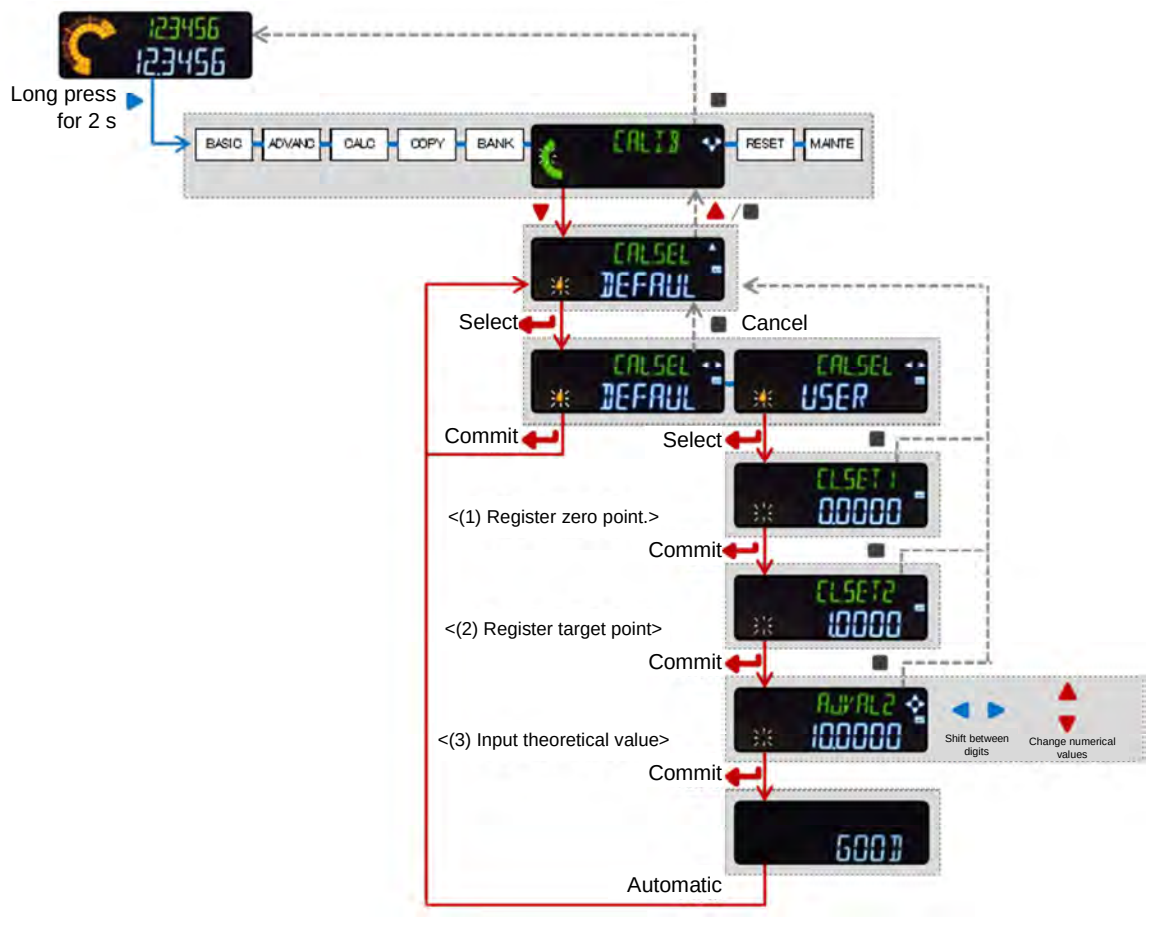
- ✓ For settings relating to writing and reading-out, refer to "5-6 Bank Mode."

6-6 Calibration Settings

Parameter name	Setting value	Remarks
Calibration select (CAL.SEL)	When a sensor head is replaced, carrying out zero and span adjustment reduces the errors existing at installation time. DEFAUL (Default) / USER (Set by user) [Default: DEFAUL]	



Operation procedure



Note

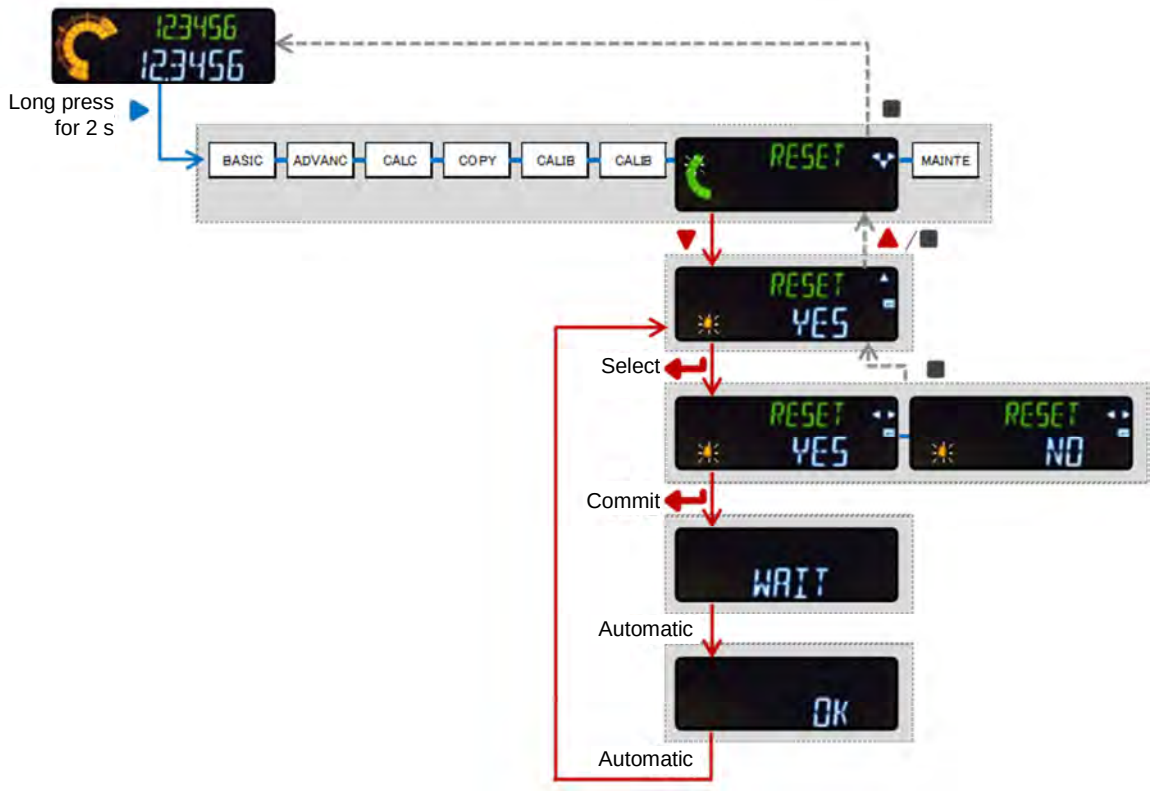
✓ Calibration cannot be executed in the following cases. If they occur, an ERROR is shown on digital display MAIN (white).

- The span and measurement values have different signs. (The target value and detected value are opposite in sign.)
- Relative to the span at time of shipment, span adjustment gives an adjustment ratio greater than two.
- The measurement value is indefinite. ("------" is displayed.)
- The measurement value is out of measurement range. (+OVER or −OVER is displayed.)

6-7 Resetting

Parameter name	Setting value	Remarks
Reset (RESET)	This resets all controller settings to the factory defaults. YES / NO	

Operation procedure



Note

- ✓ Resetting does not alter the settings stored in banks.
- ✓ Calibration settings are not reset.

6-8 Maintenance

Parameter name	Setting value	Remarks
Total stroke work history (SUM .REC)	Displays in meters the accumulated distance that the spindle has moved.	
Maximum peak value (MAX. VAL)	Displays the maximum peak value reached during operation.	
Maximum peak value history (MAX. REC)	Displays in meters the accumulated distance that the spindle had moved when the maximum peak value was reached.	
Overstroke history (OVR. NUM)	Displays a history of the number of strokes exceeding the maximum stroke.	

Displays information such as sensor head operational history.

Operation procedure

7. External Input/Output

7-1 Interface

7-1-1 Input/Output Circuit

■ SA-SD1AP, SA-SD1AP-P

Color	Signal	I/O	Remarks
Brown	+V	−	24 VDC
Black	Output 1	OUT	Refer to "6-2-4 External Output."
White	Output 2	OUT	
Black/gray	Output 3	OUT	
Pink	External input 1	IN	Refer to "6-2-3 External Input."
Violet	External input 2	IN	
Pink/violet	External input 3	IN	
Blue	0 V	−	Ground for power supply
Gray	Analog output	OUT	Current output (4 to 20 mA)
Shield	Analog ground	−	

Note 1: Use shielded wires for analog outputs.

■ SA-SD1AC, SA-SD1AC-P

Color	Signal	I/O	Remarks
Black	Output 1	OUT	Refer to "6-2-4 External Output."
White	Output 2	OUT	
Black/gray	Output 3	OUT	
Pink	External input 1	IN	Refer to "6-2-3 External Input."
Violet	External input 2	IN	
Pink/violet	External input 3	IN	
Gray	Analog output	OUT	Current output (4 to 20 mA)
Shield	Analog ground	−	

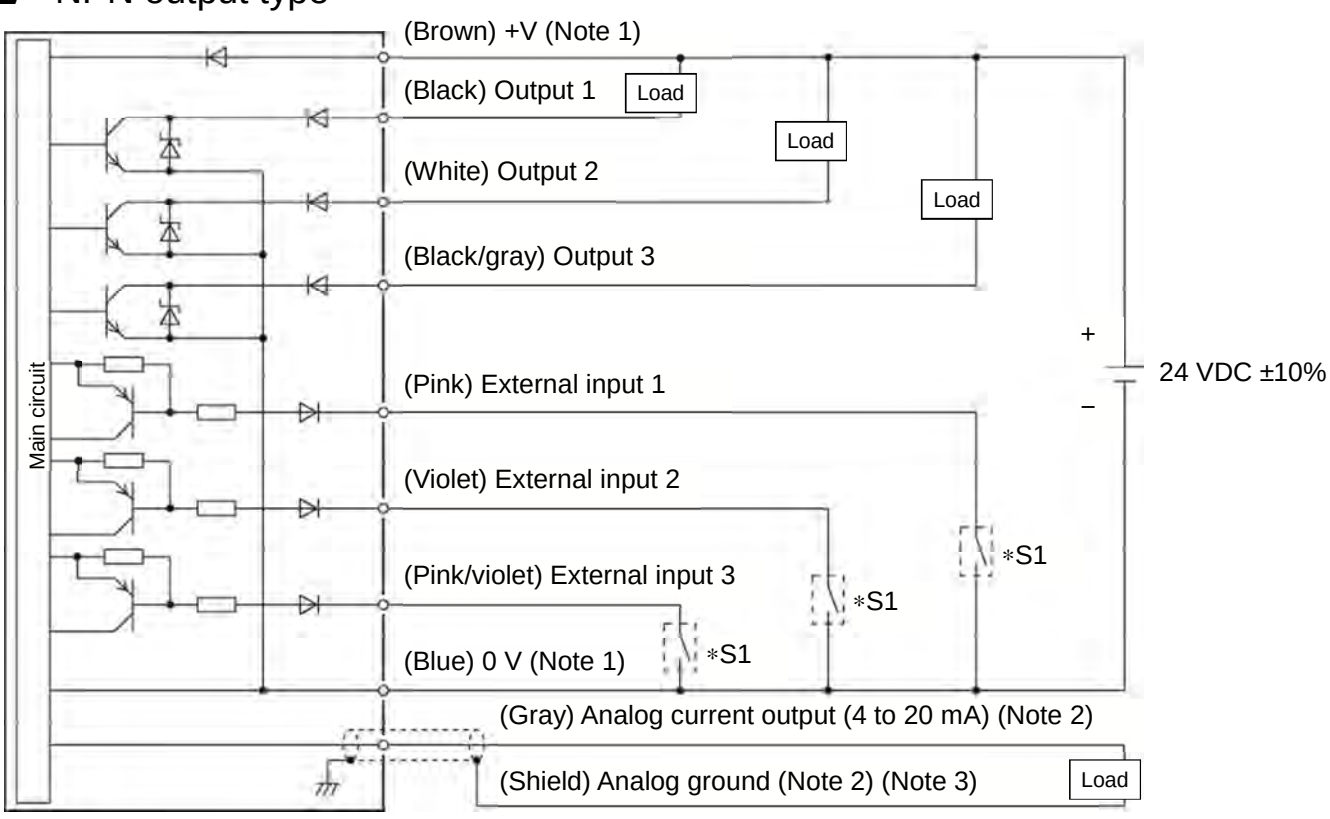
Note 1: Use shielded wires for analog outputs.

■ SA-SD1C, SA-SD1C-P

Color	Signal	I/O	Remarks
Black	Output 1	OUT	Refer to "6-2-4 External Output."
White	Output 2	OUT	
Black/gray	Output 3	OUT	
Pink	External input 1	IN	Refer to "6-2-3 External Input."
Violet	External input 2	IN	
Pink/violet	External input 3	IN	

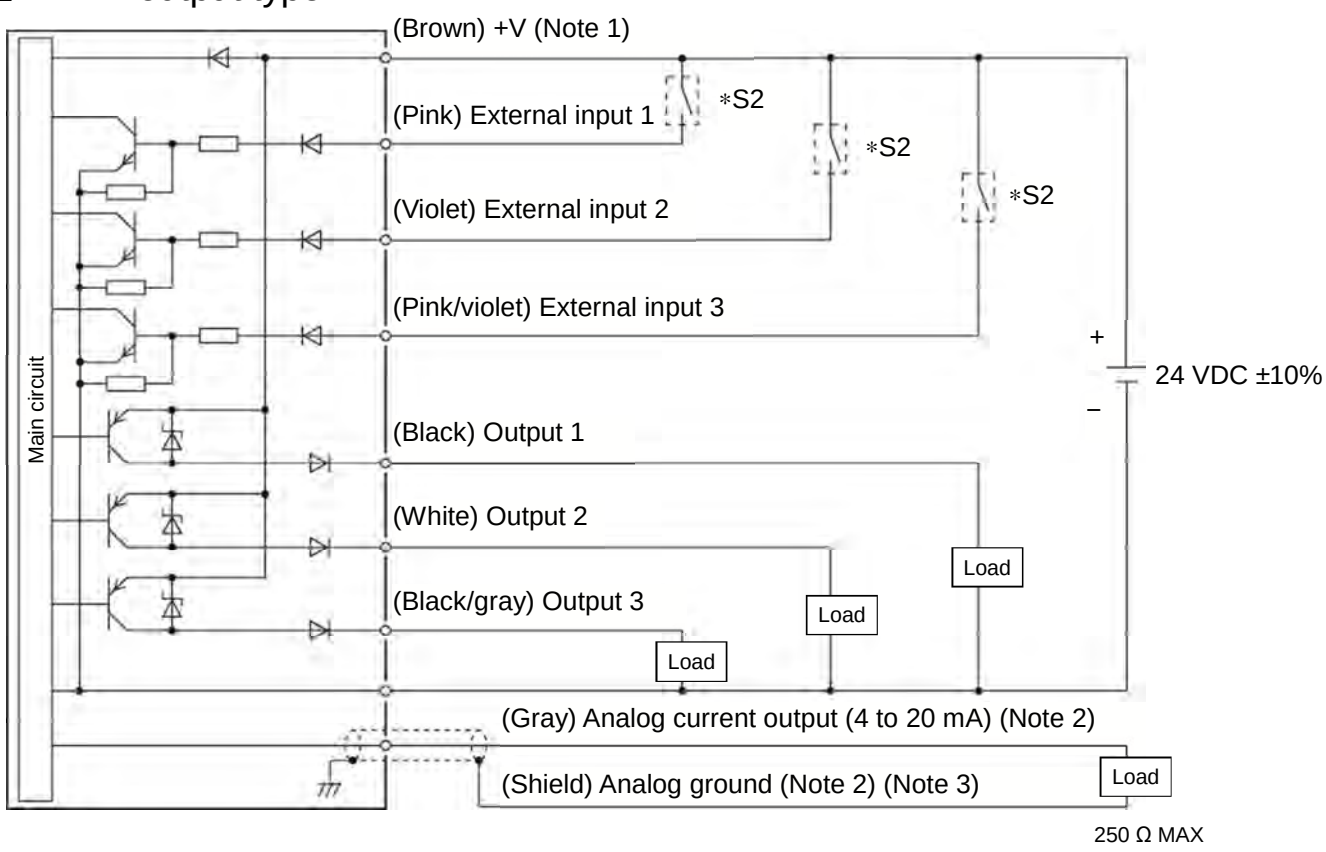
Note 1: Power is supplied through master unit connectors.

NPN output type



∗S1: Non-voltage contact or NPN open-collector transistor

PNP output type



∗S2: Non-voltage contact or PNP open-collector transistor

Note 1: Only master units are equipped with +V and 0 V. Power is supplied to slave units through connectors.

Note 2: Only SA-SD1A model is equipped with an analog current output terminal and a grounding terminal for analog signals.

Note 3: Use shielded wires for analog outputs.

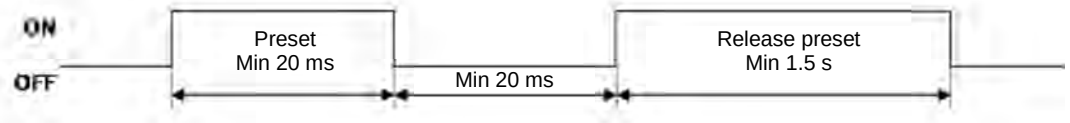
Note

✓ All of the output terminals are equipped with short-circuit protection. If any of Outputs 1 to 3 short-circuit, all output terminals are temporarily turned OFF. If the short-circuit is removed, the circuit recovers automatically.

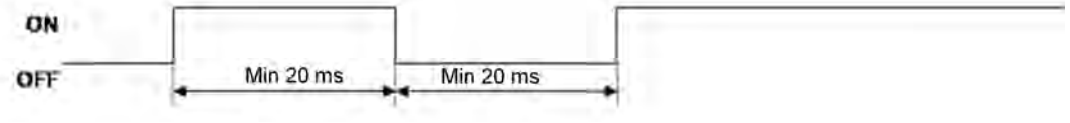
7-2-3 Minimum Input Time

The minimum input time depends on input signal type.

- Preset input

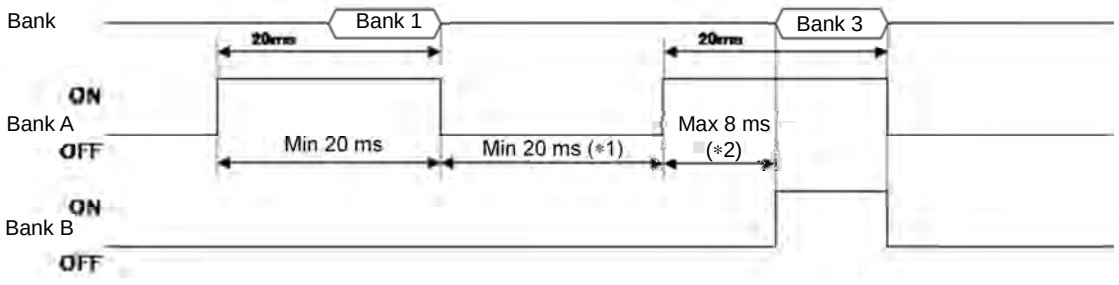


- Reset input



- Trigger input

- Bank A/B input



*1: If the Select bank storage parameter is set to ALL, this is at least 50 ms.

*2: If 8 ms or more has elapsed, Bank 3 may be read out after Bank 1 has been read out.

8. Troubleshooting

8-1 Errors

If an error occurs during operation, an error No. is displayed, as shown in the table below.

No.	Cause	Solution
E100	Both NPN and PNP output types are connected.	Connect only the same output type.
E110	Too many units are connected.	Up to 15 slave units can be connected to one master unit.
E120	Controllers cannot communicate with each other.	Turn the power OFF. Check that the controllers are correctly connected, and then turn the power ON again.
E130		
E140	The calculation function is set to ON with no slave units connected.	Set the calculation mode to OFF.
E150	With the calculation function in effect, not enough slave units are connected.	Set the calculation mode to OFF, or change the calculation app selection setting.
E160	The number of connected units differs from the stored number of connected units.	Set the Number of connected units check function to OFF.
E200	• A sensor head is not connected. • A sensor head cable is broken. • A sensor head has failed.	• Check that all the sensor heads are connected correctly. • Check that none of the sensor head cables are broken. If a sensor head cable is broken, replace it with a new one. • Replace the failed sensor head with a new one.
E210	A sensor head has undergone an upward thrust outside the specified stroke range.	Check the sensor head installation and work positions, and adjust them such that the stroke is within the specified range.
E500	An external input cannot perform a preset.	Check that the preset was not attempted immediately after the power was turned ON or immediately after a reset was input. Check that the display upper or lower limits are not exceeded and that the alarm is not activated.
E600	• Writing or reading of EEPROM has failed. • The number of overwrites of the EEPROM has exceeded its limit of one million.	• Turn the power OFF and ON again, and then reset the controller while in setting mode. • If the above procedure is ineffective, the number of overwrites of the EEPROM may have exceeded one million. Replace the controller with a new one.
E610		
E620		
E700	A short-circuit of the detection output load has caused an overcurrent.	Turn the power OFF, and then check the load.
E900	An internal error has occurred in a controller.	Turn the power OFF and ON again, and then reset the controller while in setting mode.
E910		
E911		
E912		
E920		

8-2 What to Do If a Problem Occurs

Problem	Please perform these checks
Power does not turn ON.	Is the power supply connected correctly? Is power being supplied correctly? Has the power been connected with the polarity (+/−) reversed? Is the power voltage correct? Is the current capacity sufficient?
The measurement remains unchanged.	Is a hold signal being input? When a hold signal is being input, "HOLD" is displayed in the lower right corner of the display. Turn the power OFF, and then disconnect and re-connect the detector.
Measurements are inaccurate.	Is the detector installed securely, with no play? Is the measurement terminal loose? Is the detector being subjected to any excessive vibration or impacts? For example, when a detector is put on a guide rail and moved up and down using an air cylinder, the impact sustained from a strong collision with the mechanical stopper at the upper end (back clearance side) may cause erroneous counting. Install a shock absorber or other means of softening the impact, reduce the air cylinder operation speed, or take other appropriate measures. Is the spindle moving up and down correctly? If the spindle is tightened excessively during installation, spindle operation may be affected.
Pressing keys has no effect.	Is the key lock in operation? To unlock keys, refer to "5-9 Releasing Key Lock."

9. Specifications

9-1 Specifications

Type		Master unit	Slave unit		
		High performance type		Standard type	Wire saving type
Model	NPN	SA-SD1AP	SA-SD1AC	SA-SD1C	SA-SDNC
	PNP	SA-SD1AP-P	SA-SD1AC-P	SA-SD1C-P	
Number of connectable units		Up to 15 slave units to one master unit			
Power voltage		24 VDC ±10% Including ripple of 0.5 V (P-P)			
Current consumption (Note 2)		70 mA or less (when connected to sensor heads)			
Analog current output (Note 3)		• Current output range: 4 to 20 mA F.S. (Default) • Output during error: 0 mA • Linearity: ±0.25% F.S. • Load impedance: 250 Ω MAX.		—	
Control output	Output	[NPN output type] NPN open-collector transistor • Maximum inflow current: 50 mA (Note 4) • Applied voltage: 30 VDC or lower (output – 0 V) • Residual voltage: 1.5 V or lower (at inflow current: 50 mA) • Leakage current: 0.1 mA or less [PNP output type] PNP open-collector transistor • Maximum outflow current: 50 mA (Note 4) • Applied voltage: 30 VDC or lower (output – +V) • Residual voltage: 1.5 V or lower (at outflow current: 50 mA) • Leakage current: 0.1 mA or less			—
	Short-circuit protection	Incorporated (automatic recovery)			
	Judgment output	NO/NC			
	Alarm output	Open when alarm activated			
External output		Output 1/Output 2/Output 3 can be switched between "HI/GO/LO," "HI or LO/IN RANGE/ALARM," and "LO/HI/ALARM."			—
External input	Input	[NPN output type] Non-contact input or NPN open-collector transistor • Input condition: Ineffective (+8 V to +VDC or open) Effective (0 to +1.2 VDC) • Input impedance: Approx. 10 kΩ [PNP output type] Non-contact input or PNP open-collector transistor • Input condition: Ineffective (0 to +0.6 VDC or open) Effective (+4 V to +VDC) • Input impedance: Approx. 10 kΩ			—
	Trigger input	Input duration: 2 ms or longer (ON)			
	Preset input	Input duration: 20 ms or longer (ON)			
	Reset input	Input duration: 20 ms or longer (ON)			
	Bank input A/B	Input duration: 20 ms or longer (ON)			
External input		Input 1/Input 2/Input 3 can be switched between "Preset/Reset/Trigger" and "Bank input A/Bank input B/Selection (Preset, Reset, or Trigger)."			—

Type		Master unit	Slave unit		
		High performance type		Standard type	Wire saving type
Model	NPN	SA-SD1AP	SA-SD1AC	SA-SD1C	SA-SDNC
	PNP	SA-SD1AP-P	SA-SD1AC-P	SA-SD1C-P	
Response time		Switchable between 3 ms, 5 ms, 10 ms, 100 ms, 500 ms, and 1,000 ms			
Output 1 indicator lamp		Orange LED (Lit when Output 1 is ON)			
Output 2 indicator lamp		Orange LED (Lit when Output 2 is ON)			
Output 3 indicator lamp		Orange LED (Lit when Output 3 is ON)			
Input indicator lamp		White LED (Lit when Input is ON)			
Preset indicator lamp		Green LED (Lit during preset)			
Display		Circle meter: Orange/green LCD; Copy check mark: Orange LCD Digital display MAIN: White LCD; Digital display SUB: Green LCD Guide mark arrow keys: White LCD; Guide mark ENT: White LCD Status mark TRIG: White LCD; Status mark HOLD: White LCD Status mark CALC: White LCD			
Display resolution		0.1 μm			
Display range		−199.9999 to 199.9999 mm			
Protection standard		IP40 (IEC)			
Pollution level		2			
Operating ambient temperature		−10 to 50°C (provided there is no condensation or freezing) (Note 4); During storage: −20 to +60°C			
Operating ambient humidity		35 to 85% RH; During storage: 35 to 85% RH			
Operating altitude		2,000 m or less (Note 5)			
Insulation resistance		20 MΩ or higher with 250-VDC megger tester (across whole charged section and case)			
Withstanding voltage		1,000 VAC for one minute (across whole charged section and case)			
Resistance to vibration		10 to 150 Hz, 0.75 mm double amplitude for two hours in each of X, Y, and Z directions			
Resistance to impact		98 m/s^2 (approx. 10 G), five times in each of X, Y, and Z directions			
Materials		Case: polycarbonate; Cover: polycarbonate; Switches: polyacetal			
Cables		Includes 0.2-mm^2 2-core brown and blue lead wires, and 2-m length 0.15-mm^2 7-core composite cable	Includes 2-m length 0.15-mm^2 7-core composite cable	Includes 2-m length 0.15-mm^2 6-core composite cable	—
Mass (main body only)		Approx. 140 g	Approx. 140 g	Approx. 130 g	Approx. 60 g
Standards applied		EMC Directive			

Note 1: If not otherwise specified, measurement conditions are as follows: power supply voltage: +24 VDC; operating ambient temperature: +20°C.

Note 2: Current consumption does not include analog current output.

Note 3: Stated linearity is for digital measurement value, with F.S. = 16 mA.

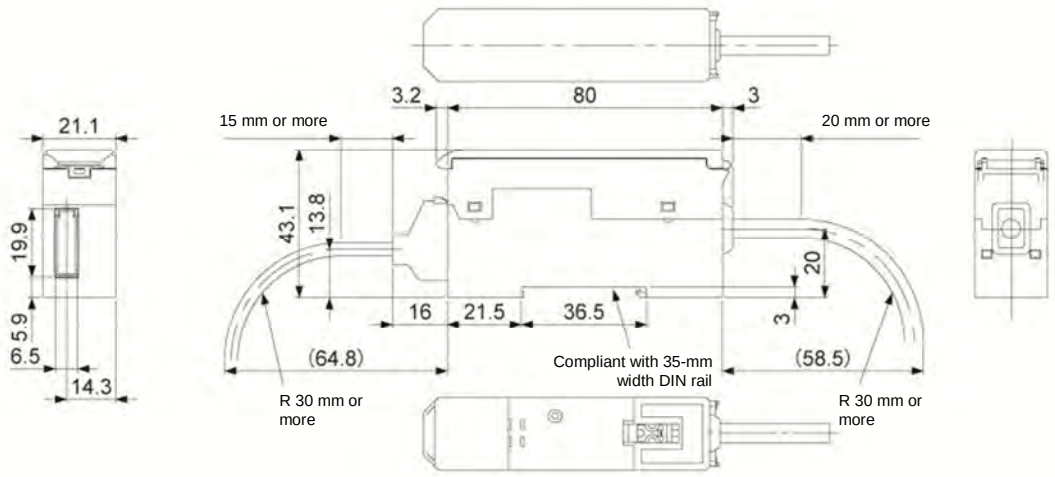
Note 4: When slave units are connected to the master unit, the maximum inflow/outflow current of the control output and the operating ambient temperature depends on the number of slave units connected, as shown in the following table.

Number of slave units connected	Maximum inflow/outflow current of control output	Operating ambient temperature
1 to 7 units	20 mA	−10 to +45°C
8 to 15 units	10 mA	

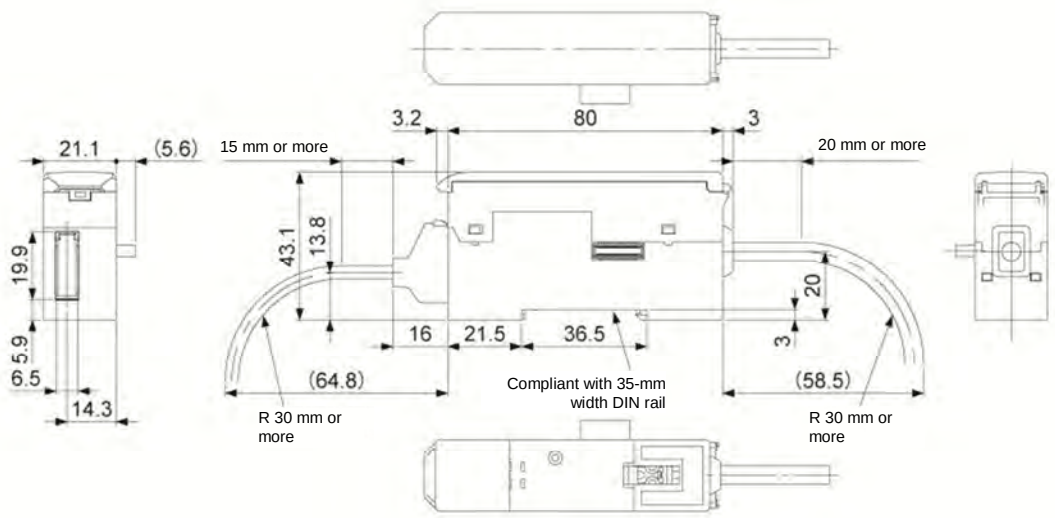
Note 5: Do not use controllers under a pressure higher than atmospheric pressure at altitude 0 m.

9-2 Outline Dimensional Drawings

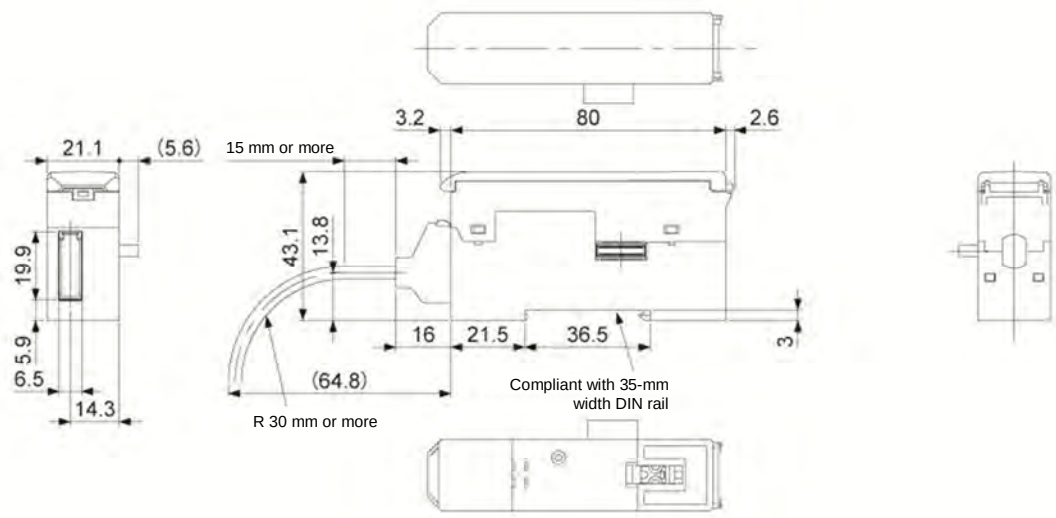
SA-SD1AP and SA-SD1AP-P



SA-SD1AC, SA-SD1AC-P, SA-SD1C, and SA-SD1C-P



SA-SDNC



Certificate of Quality Approval

This product is certified to be in compliance with the company standards of Citizen Finedevice.

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