

# BD Series

## Laser Displacement Sensors - Amplifier unit

Operations Reference Manual MSO-BDU1-V1.8-EN

Thank you for purchasing an Autonics product.

This user manual contains information about the product and its proper use, and should be kept in a place where it will be easy to access.

**Autonics**



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# Thank You for Purchasing The Product

Thank you for purchasing Autonics products.

Please familiarize yourself with the information contained in the **Safety Considerations** section before using this product.

This manual contains information about the product and its proper use, and should be kept in a place where it will be easy to access.



# Manual Guide

- Please familiarize yourself with the information in this manual before using the product.
- This manual provides detailed information on the product's features. It does not offer any guarantee concerning matters beyond the scope of this manual.
- This manual may not be edited or reproduced in either part or whole without permission.
- This manual is not provided as part of the product package. Please visit our website ([www.autonics.com](http://www.autonics.com)) to download a copy.
- The manual's content may vary depending on changes to the product's software and other unforeseen developments within Autonics, and is subject to change without prior notice. Upgrade notice is provided through our homepage.
- We contrived to describe this manual more easily and correctly. However, if there are any corrections or questions, please notify us these on our website.





# Manual Symbols



Failure to follow instructions can result in serious injury or death.



Failure to follow instructions can lead to a minor injury or product damage.



Supplementary information for a particular feature.



An example of the concerned feature's use.



Important information of the concerned feature's use.



# Precautions for Safety

Be sure to follow the 'Safety Precautions' to prevent accidents or dangers in advance by using the product safely and correctly.

## **Warning**

1. Fail-safe device should be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime/disaster prevention devices, etc.) Failure to follow this instruction may result in personal injury, economic loss or fire.
2. Do not use the unit in the place where flammable/explosive/corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact, or salinity may be present.  
Failure to follow this instruction may result in explosion or fire.
3. Do not disassemble or modify the unit.  
Failure to follow this instruction may result in fire.
4. Do not connect, repair, or inspect the unit while connected to a power source.  
Failure to follow this instruction may result in fire.
5. Check 'Connections' before wiring. [Amplifier unit]  
Failure to follow this instruction may result in fire.

## **Caution**

1. Do not stare at the laser emitter. [Sensor head]  
Failure to follow this instruction may result in eye damage.
2. Use the unit within the rated specifications.  
Failure to follow this instruction may result in fire or product damage.
3. Use dry cloth to clean the unit, and do not use water or organic solvent.  
Failure to follow this instruction may result in fire.
4. Mount the ferrite core to specified position before using. [Sensor head, Extension cable]  
Failure to follow this instruction may result in output with noise.
5. If the product is handled arbitrarily without following the instructions, it may cause laser injury.

## Cautions during Use

1. Follow instructions in 'Cautions during Use'. Otherwise, it may cause unexpected accidents.
2. The power supply should be insulated and limited voltage/current or Class 2, SELV power supply device.
3. Do not install where strong magnetic or electric field exist. Otherwise, the resolution may be adversely affected.
4. Mutual optical interference between laser sensors and photoelectric sensors may result in malfunction.
5. Mutual optical interference between laser sensors may result in malfunction.
6. When connecting DC relay or other inductive load to the output, remove surge by using diode or varistor.
7. Wire as short as possible and keep away from high voltage lines or power lines, to prevent surge and inductive noise. [Amplifier unit]
8. For the optimized performance, it is recommended to measure after 30 minute from supplying power. [Amplifier unit]
9. Since external disturbance light (sunlight, fluorescent lighting, etc.) can cause product malfunction, use the product with a light shield or slit. [Sensor head]
10. When detecting with the maximum sensitivity, an error may occur depending on each characteristic deviation.
11. This unit may be used in the following environments.
  - Indoors/Outdoors (in the environment condition rated in 'Specifications')
  - Altitude max. 2,000 m
  - Pollution degree 2
  - Installation category II

Specifications and dimensions described in this user's manual are subject to change without notice for product improvement.

Be sure to observe the precautions in the instruction manual, manual, and technical explanation (catalog, website).

# 1. Function

## 1.1. Display When Power is ON

When the sensor head is connected and power is applied to the amplifier for the first time or the sensor head is replaced, the control output type setting screen is displayed. Follow the steps below to set the output type.

The version information displays right after supplying the power.

Parameter	Display	Default	Description
Version information	V E R	Version	Displays firmware version
Control output type	o U t	N P N	Select the control output type with the ▲ / ▼ key, and enter the <b>MODE</b> key. Select the analog output type with ▲ / ▼ keys and then press <b>MODE</b> key.
Analog control output type	R - o U t	o F F	OFF, 4 - 20 mA, 0 - 5 V, 1 - 5 V, -5 - 5 V After o U t . 5 E t flashed 3 times and it returns to the run mode



For the setting range and reset method for each item, refer to 1.2, “Mode Setting”.

# 1.2. Mode Setting

## 1.2.1. Entering Each Mode

Operation mode → Enter → Mode setting → Return → Operation mode

Emission optimization	AUTO key over 5 seconds
Zero-point adjustment	ZERO key over 2 seconds
HIGH/LOW sensitivity setting	<ul style="list-style-type: none"><li>HIGH sensitivity setting: MODE + ▲ key for over 2 seconds</li><li>LOW sensitivity setting: MODE + ▼ key for over 2 seconds</li></ul>
Teaching (Auto Sensitivity)	MODE key for less than 2 seconds
Control output type	MODE + AUTO key for over 2 seconds
Maximum/minimum value (HIGH/LOW PEAK) monitoring	<ul style="list-style-type: none"><li>Maximum value monitoring: ▲ key</li><li>Minimum value monitoring: ▼ key</li></ul>
Parameter group	MODE key over 2 seconds



Refer to 2.2, “Setting Range and Initial Value” for parameter related defaults and setting ranges related to each mode.

### 1.2.2. RUN Mode

#### PV (present value) display

- For individual use: Displays the present value (PV).
- When using arithmetic function: The arithmetic function indicator (CALC) of the master amplifier turns on and the calculation result is displayed, and the judgment output is executed based on the corresponding value.

#### SV (setting value) display

When ◀ / ▶ key is input in RUN mode, the contents of the setting value (SV) display part are switched and the setting value (SV) indicator indicator of the corresponding item is turned on.

Display	Description	SV display part indicator
HIGH setting value	Displays set HIGH judgment value	Turns on 'HI'
LOW setting value	Displays set LOW judgment value	Turns on 'LO'
RV measurement value	Outputs the actual distance to the target before applying zero adjustment, hold, and scaling	Turns on 'RV'
Analog output value	Analog output voltage value (unit: V) or current value (unit: mA) display	Turns on 'ANALOG'
Bank value	Displays the bank number in use	All indicators are off

### 1.2.3. Emission Optimization

In order to measure a moving object of the same reflectivity, the laser intensity is automatically set according to the object. Perform while the measurement target is stopped.



If this function is used when measuring an object that does not move or whose reflectance changes, be aware that the measurement may be inaccurate.

#### Enter

**AUTO** key over 5 seconds

#### Execution

It is executed automatically when entering the emission optimization mode.

- When the function is completed, the word **OK** appears on the SV display and it automatically returns to RUN mode.
- If the setting fails, **FAIL** appears on the SV display and then automatically returns to RUN mode. Try again by pressing the **AUTO** key for at least 5 seconds.
- You can check whether the feature is enabled by pressing the **AUTO** key briefly. (Enable: On / Disable: Off)



If the setting fails 2 times in a row, it means that emission optimization cannot be performed at the currently set response time. Change the response time setting and try the above process again.



- If you have tried to apply the emission optimization function more than once, but finally it is not possible to apply the function, and you decide not to use the function, change the response time or the Gain setting value to an arbitrary value for normal operation and then change it back to the actual value. Otherwise, the displacement sensor may malfunction. (Emission optimization function initialization condition: response time setting value change, Gain setting value change)
- The measurement may be inaccurate if this function is used when measuring an object that does not move or whose reflectance changes.

#### Return

Automatic after executing the emission optimization function



### 1.2.4. Zero-point Adjustment

When the zero adjustment function is executed, sets the present value (PV) to the offset setting value, and displays the amount of displacement based on this.

The amount of displacement is displayed based on the reference distance determined for each sensor head model, but after the zero adjustment function is executed, it is displayed based on reference distance minus offset value.

#### Enter

**ZERO** key over 2 seconds

#### Settings

- Execution: Press the **ZERO** key on the front of the amplifier unit for more than 2 seconds. After 'ZERO' appears on the present value (PV) display, the present value is set as the offset setting value.
- Off: Initializes the reference distance changed by the zero adjustment function. Press the **ZERO** + **MODE** keys on the front of the amplifier unit at the same time for at least 2 seconds.

#### Return

Auto after activating or disabling the zeroing function



Even if the present value is changed by executing the zero adjustment function, the existing setting value is maintained.



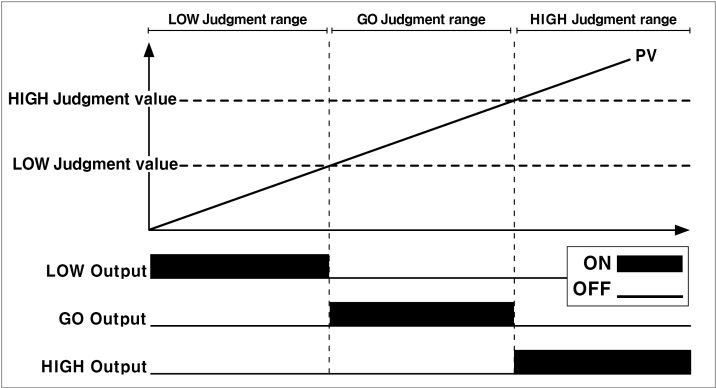
- Offset setting supports only over 5.0 firmware version of the amplifier unit (BD-A1) and the communication converter (BD-C). In previous versions, offset setting value is fixed to Zero.
- For details of selecting the offset settings, refer to 2.3.12, "Offset [offset]".
- PV display  
Calculating result > Display range: H H H H  
Calculating result < Display range: L L L L

### 1.2.5. Sensitivity Setting

Judgment output (HIGH/GO/LOW) range is set and the judgment signal is output when the corresponding standard is satisfied.

HIGH judgment value and LOW judgment value can be set. HIGH judgment signal is output above HIGH judgment value and LOW judgment signal is output below LOW judgment value.

The range between the HIGH judgment value and the LOW judgment value is automatically designated as the GO judgment range, and the GO judgment signal is output in that range.



Present value, HIGH/GO/LOW judgment value and output relation



The HIGH judgment value should be set larger than the LOW judgment value. (HIGH judgment value > LOW judgment value)

#### 1.2.5.1. High/LOW Sensitivity Setting

Set the judgment output (HIGH/GO/LOW) range manually.

##### Enter

- HIGH manual sensitivity: **MODE** + ▲ key for over 2 seconds
- LOW manual sensitivity: **MODE** + ▼ key for over 2 seconds

##### Settings

- Move digit: ◀ / ▶ key
- Change the corresponding digit number: ▲ / ▼ key

##### Return

**MODE** key for less than 2 seconds

### 1.2.5.2. Teaching (Auto Sensitivity)

Set the judgment output (HIGH/GO/LOW) range automatically. Parameter 1 group teaching mode After setting the teaching mode to be used in the  $SE\ N\ 5$  parameter, enter the teaching mode.



For details of selecting the teaching mode, refer to 2.3.2, “Teaching (Auto Sensitivity) [SE N 5]”.

#### One point teaching

Set the judgment output range using the height measurement value of the reference object.

- HIGH setpoint = Height Measurement  $\times$  1.5
- LOW setpoint = Height Measurement  $\div$  2

##### Enter

**MODE** key 2 for less than seconds

##### Settings

1. When  $IP$  is displayed on the SV display, press the **AUTO** key for less than 2 seconds.
2. After teaching the measurement object for 2 seconds, the result is applied and the judgment output range is automatically set.

##### Return

Automatic after executing the 1-point teaching function

#### Two-point teaching

The judgment output range is set using the standard step measurement value.

- HIGH setting value = (step Difference  $\times$  1.5) + Bottom Height
- LOW setting value = (step Difference  $\div$  2) + Bottom Height

##### Enter

**MODE** key for less than 2 seconds

##### Settings

1. When  $IP$  is displayed on the SV display, press the **AUTO** key for less than 2 seconds without a measuring object.
2. After 2 seconds of teaching time, if  $2P$  is displayed on the SV display, place the object to be measured and press the **AUTO** key for less than 2 seconds.
3. After teaching the measurement object for 2 seconds, the result is applied and the judgment output range is automatically set.

**Return**

Auto after executing the 2-point teaching function

## 1.2.6. Control Output Type

Set the control/analog output type.

This setting mode appears when the sensor head is connected to the amplifier and power is applied for the first time. After that, you can reset it by entering the mode below.



Refer to 1.1, “Display When Power is ON” for information on applying power for the first time.

### Enter

**MODE** + **AUTO** key for over 2 seconds

### Settings

1. When  $\square U E$  is lit on the present value (PV) display, select the output type with  $\blacktriangle$  /  $\blacktriangledown$  keys and press **MODE**.
  - Setting range  
 $NPN$ : NPN output (default)  
 $PNP$ : PNP output
2. When  $R - \square U E$  is lit on the present value (PV) display, select the analog output type with  $\blacktriangle$  /  $\blacktriangledown$  keys and input the **MODE** key.
  - Setting range  
 $\square F F$ : Off (default)  
 $4 - 20 m A$ : 4-20mA current output  
 $0 - 5 V$ : 0-5v voltage output  
 $1 - 5 V$ : 1-5v voltage output  
 $- 5 - 5 V$ : -5-5v voltage output
3. When the setting is completed,  $\square U E . S E E$  on the present value (PV) display and  $E N d$  on the setting value (SV) display flash 3 times.

### Return

Auto after setting the output type

### 1.2.7. Maximum/minimum value (HIGH/LOW PEAK) monitoring

#### Enter

- Maximum value monitoring: ▲ key
- Minimum value monitoring: ▼ key

#### Settings

1. HIGH PEAK value check in progress, if you press ▲ for more than 3 seconds, the present value is initialized and the present value is displayed. Display 'HHHH' if no present value exists.
2. If ▼ key is pressed for more than 3 seconds, the present value is initialized and the present value is displayed. Display 'LLLL' if no present value exists.

#### Return

◀ / ▶ / ▼ / ▲ or automatically when there is no key input for 5 seconds

### 1.2.8. Parameter Group

For parameter setting method, check the item 2.1, “Setting”.

## 1.3. Error Display and Trouble Shooting

In the error state,  $ERR$  appears on the present value (PV) display.

Take action according to the processing method for each setting value (SV) display part below.

### [SV display error message] (Alarm output)

#### Cause

#### Solution

### [HEAD] (O)

#### Disconnection of sensor head / amplifier unit / cable or sensor head malfunction

1. Make sure the sensor head is connected to the amplifier unit.
2. Check if the sensor head cable is disconnected.
3. After performing the above items, re-apply the power.
4. If the problem is not resolved after taking the above measures, it is judged that the sensor head is malfunctioning and the product needs to be replaced.

### [LEADER] (O)

#### Sensor head error

1. Check if the sensor head is connected to the amplifier.
2. Check if the sensor head cable is disconnected.
3. After performing the above items, re-apply the power.
4. If the problem is not resolved after taking the above measures, it is judged that the sensor head is malfunctioning and the product needs to be replaced.

### [DARK] / [RANGE] (X)

#### Not existing the object or background in maximum measurement range

Adjust the distance between the sensor head and the sensing object within the maximum measurement range.

### [BRIGHT] (X)

#### Excessive light reception

Adjust the distance between the sensor head and the sensing object within the maximum measurement range.

### [-----] (X)

#### Present value cannot be displayed due to function setting and use

Return to the state where the present value can be displayed.

[R - MEM] (O)

**Amplifier unit memory error (unable to update due to EEPROM write count exceeding 1 million)**

1. Turn off the power and check that the sensor head is properly connected before applying power.
2. Execute the initialization / INIT function.
3. If the problem is not resolved after taking the above measures, it is judged that the amplifier is malfunctioning and the product needs to be replaced.

[H - MEM] (O)

**Sensor head memory error**

1. Turn off the power and check that the sensor head is properly connected before applying power.
2. If the problem is not resolved after taking the above measures, it is judged that the sensor head is malfunctioning and the product needs to be replaced.

[AMP - C] (O)

**Poor connection between amplifier unit**

Turn off the power, check the connection between the amplifier units, and then re-apply the power.

[VER] (O)

**Firmware version incompatible**

Check the firmware version and needs to update to compatible version.

[OUT] (O)

**Judgment output short circuit**

Turn off the power and check whether the HIGH (black) / GO (gray) / LOW (orange) output lines are short-circuited, then re-apply the power.

[AMP] (O)

**Amplifier unit error**

1. Turn off the power, check that the sensor head is properly connected, and then re-apply the power.
2. If the problem is not resolved after taking the above measures, it is judged that the amplifier is malfunctioning and the product needs to be replaced.

[OUT] (O)

**Output stage overcurrent**

1. Check that the load on the output stage is within the rated range.
2. Check if the output terminal is in contact with another wire or frame.

[RIF] (O)

**Poor connection between amplifier unit or communication module**



Turn off the power, check the connection between the amplifier unit or the communication module, and then re-apply the power.



If you connect an incompatible firmware version of the product, it will not work properly.

Check the firmware version and needs to update to compatible version.



# 2. Parameter

## 2.1. Setting

- In RUN mode, enter **MODE** key for more than 2 seconds.
- In parameter setting mode, use the arrow keys ◀ / ▶ to change the parameter group and press the **MODE** key to enter the parameter group.
- In the parameter group, use the arrow keys ◀ / ▶ to change the parameter, press the **MODE** key to select it, and then use the arrow keys ▲ / ▼ to change the setting value. .
- In each step, if you press the **MODE** key for more than 3 seconds, the changed setting values are saved and the screen returns to the upper level.

## 2.2. Setting Range and Initial Value

A brief description of the parameters and the setting range and defaults are provided.  
The amplifier unit recognizes the model of the connected sensor head and automatically changes the setting range and default.



Sensor head model BD-300/600 supports only over 5.0 firmware version of the amplifier unit (BD-A1) and communication converter (BD-C).

**Parameter 1 group [PARAM1]: Output type, Displacement, Display method, Setting related to operation when measurement is not possible**

Parameter name	Setting range	Default
Response time [RESPd]	330 μs, 500 μs, 1 ms, 2 ms, 5 ms	BD-030/065/100: 1 ms BD-300/600: 2 ms
Teaching mode [SEN5]	1PNT: 1 point teaching, 2PNT: 2 point teaching	1PNT
Output type [NANC]	NO: Normally open, NC: Normally closed	NO
PV display [dISP]	STNd: Standard, SCALE: Scale	STNd
Display digits [dote]	BD-030/065/100: 0.000, 0.00, 0.0, 0 BD-300/600: 0.00, 0.0, 0	BD-030/065/100: 0.000 BD-300/600: 0.00

Parameter name	Setting range	Default
High limit display scale [H - S C]	BD-030/065/100: -99.999 to 99.999 BD-300/600: -999.99 to 999.99	BD-030: 5.000 BD-065: 10.000 BD-100: 20.000 BD-300: 140.00 BD-600: 350.00
Low limit display scale [L - S C]	BD-030/065/100: -99.999 to 99.999 BD-300/600: -999.99 to 999.99	BD-030: -5.000 BD-065: -10.000 BD-100: -20.000 BD-300: -150.00 BD-600: -400.00
Hysteresis [H Y S]	BD-030/065/100: 0.001to99.999 BD-300/600: 0.01 to 999.99	BD-030/065/100: 0.001 BD-300/600: 0.01
High limit analog output scale [H - A N]	BD-030/065/100: -99.999 to 99.999 BD-300/600: -999.99 to 999.99	BD-030: 5.000 BD-065: 10.000 BD-100: 20.000 BD-300: 140.00 BD-600: 350.00
Low limit analog output scale [L - A N]	BD-030/065/100: -99.999 to 99.999 BD-300/600: -999.99 to 999.99	BD-030: -5.000 BD-065: -10.000 BD-100: -20.000 BD-300: -150.00 BD-600: -400.00
Error output displacement [E R R. O U T]	KEEP: Maintain measurement value, F i x: fixed error output	KEEP
Fixed error output_Analog [F i x. O U T]	Set analog output range	Maximum value in range
Fixed error output_Judgment [F i x. O U T] <sup>01)</sup>	H i G H, G O, L O W	G O
Offset [O F F S E T] <sup>01)</sup>	BD-030/065/100: -99.999 to 99.999 BD-300/600: -999.99 to 999.99	BD-030/065/100: 0.000 BD-300/600: 0.00

<sup>01)</sup> Supports only over 5.0 firmware version of the amplifier unit (BD-A1) and communication converter (BD-C)

**Parameter 2 group [PARAM2]: setting related to measurement value processing**

Parameter name	Setting range	Default
Calculation [CALC]	OFF: Off, Add - Ab: Add, Sub - Ab: Subtract, AVG: Average	OFF
Gain [GAIN]	1, 2, 3	1
Filter [FILTER]	MAF: Moving average filter, dFF: Differential filter	MAF
Number of moving average samples [MAFS]	1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096	16
Number of median samples [MEDIAN]	OFF, 3, 5, 7, 15, 31	OFF
Hold [HOLD]	OFF: Off PEAK: Maximum value BOEOM: Minimum value PP: Difference value SAMPLE: Starting value AVG: Average value	OFF
Hold timing input [HOLDt]	EN: Use external input AULP: Over auto trigger level AULW: Under auto trigger level	EN
Auto trigger level [AULV]	BD-030/065/100: -99.999 to 99.999 BD-300/600: -999.99 to 999.99	0
Auto trigger hysteresis [AULYS]	BD-030/065/100: 0.001 to 99.999 BD-300/600: 0.01 to 999.99	BD-030/065/100: 0.001 BD-300/600: 0.01
Timer [TMD]	OFF: Off, ONd: On delay, OFd: Off delay	OFF
Timer time [TIME]	0 to 9999	0

### Parameter 3 group [PARAM3]: External input related settings

Parameter name	Setting range	Default
External input 1 [d-I N1]	OFF: Off t-IN: Hold trigger OULCLR: Output reset L-OFF: Stop laser emission ZERO: Zero-point adjustment BANK-A: Bank input-A BANK-b: Bank input-B	OFF
External input 2 [d-I N2]	Same as external input 1 [d-I N1]	OFF
External input 3 [d-I N3]	Same as external input 1 [d-I N1]	OFF
External input 4 [d-I N4]	Same as external input 1 [d-I N1]	OFF

### Parameter 4 group [PARAM4]: User-friendly function related settings

Parameter name	Setting range	Default
Display direction [d-I R]	Normal display, reverse display	Normal display
Bank [BANK]	BANK-0, BANK-1, BANK-2, BANK-3	BANK-0
Saving mode [SAVE]	OFF: Off, SAVE 1: Digital display, SAVE 2: All displays	OFF
Lock mode [LOCK]	OFF: Off LOCK 1: <b>AUTO</b> / <b>ZERO</b> key lock LOCK 2: <b>AUTO</b> / <b>ZERO</b> key + Lock parameter group item LOCK 3: Lock all keys (except unlock key)	OFF
Initialization [INI t]	OFF: Off CLR-b0: Initialize bank 0 CLR-b1: Initialize bank 1 CLR-b2: Initialize bank 2 CLR-b3: Initialize bank 3 CLR-A: Initialize all banks	OFF



Parameter 4 groups are not saved for each bank and are used in common.

## 2.3. Parameter 1 Group [P A R A 1]

Describes the items in parameter 1 group consisting of output type, displacement, display method, and operation setting related functions when measurement is not possible.



For the setting range and default of each item in the group, refer to 2.2, “Setting Range and Initial Value”.

### 2.3.1. Response Time [R S P d]

Set the sampling response time for the measured data from the sensor head.

When measuring an object with extremely low light reflection, such as black rubber, it is necessary to set the response time to be long so that it can receive a sufficient amount of light. Conversely, when high-speed sampling is required, set a shorter response time.

**Set the response time according to the light reflectance of the target**

Light reflectance: High  
330  $\mu$ s [330US]



Light reflectance: Low  
5 ms [5MS]

### 2.3.2. Teaching (Auto Sensitivity) [S E N S]

One-point teaching and two-point teaching, two modes to be used can be set.

It performs auto sensitivity operation of 1.2.5, “Sensitivity Setting” in the mode selected in this parameter.

#### 1-point teaching [1 P N T]

Measure the value in the presence of a sensing object and apply it to calculate the HIGH/LOW setting value.

This function is useful when determining the presence or absence of a sensing object when there is a sensing object as a reference.

#### 2-point teaching [2 P N T]

The HIGH/LOW setting values are calculated by measuring the values with and without the sensing object, respectively, and applying them.

This is a useful function when measuring the level difference between sensing objects when there is a level difference as a reference.



For calculation equation and detailed setting method, refer to 1.2.5, “Sensitivity Setting”.

2.3.3. Output Type [No.NC]

Select the output type (Normally open, Normally closed) for the judgment output (HIGH/GO/LOW).  
As the output type selected in this parameter, the judgment signal is output according to the judgment output range set in the 1.2.5, “Sensitivity Setting” item.

2.3.4. PV Display [di SP]

Select the display method for the present value (PV).

Standard [SetNd]

Displays the present value within the measurement range for each sensor head.

Scale [SCALE]

Displays the input within the setting range of parameter 1 group 2.3.6, “High/Low Limit Display Scale [H - SC / L - SC]”.



For details on setting the scale setting value, refer to 2.3.6, “High/Low Limit Display Scale [H - SC / L - SC]”.

2.3.5. Display Digits [dot]

Set the number of displayed digits of the present value (PV) display.

Number of displayed digits for each setting value

Setting value	Number of displayed digits
0.000	Display 3 digit after the decimal point <sup>01)</sup>
0.00	Display 2 digit after the decimal point
0.0	Display 1 digit after the decimal point
0	Display integer

<sup>01)</sup> Sensor head BD-300 / 600 models are not supported.



### 2.3.6. High/Low Limit Display Scale [H - SC / L - SC]

The present value (PV) is converted into an arbitrary linear range (scale) and displayed.

**High limit display scale** [H - SC]      High limit display scale value for maximum input value

**Low limit display scale** [L - SC]      Low limit display scale value for minimum input value



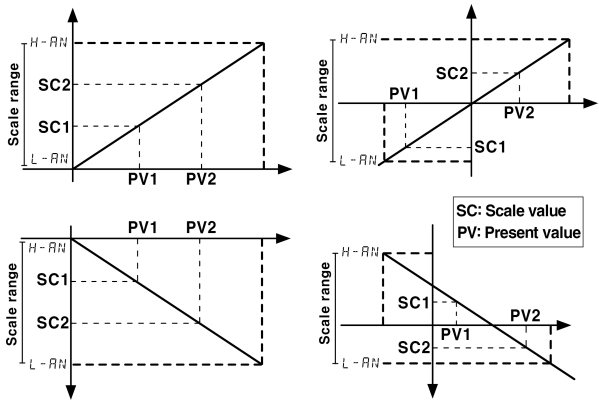
Activated when the 'PV display [d1 SP]' parameter setting value is 'Scale [SC REL E]'.

#### Relationship between present value and display value according to high/low limit display scale setting value

Sensor head BD-030 model  
(reference distance: 30 mm, maximum measurement range: 20 to 40 mm, rated measurement display range: -5 to 5)

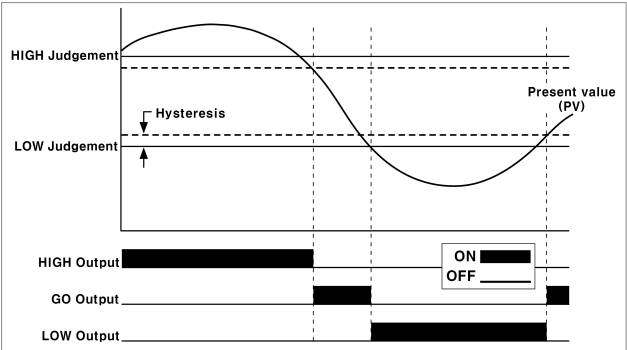
(M: Measure, D: Display)

L-SC	H-SC	M 1	D 1	M 2	D 2	M 3	D 3	M 4	D 4
-50	50	-5	-50	-2.5	-25	2.5	25	5	50
0	40	-5	0	-2.5	10	2.5	30	5	40
40	0	-5	40	-2.5	30	2.5	10	5	0



### 2.3.7. Hysteresis [HYS]

In order to prevent output instability due to fluctuations in the present value (chattering), a specific value is set between the ON/OFF of the output to delay the switching of the output.



Hysteresis operation timing chart

2.3.8. High/Low Limit Analog Output Scale [H - AN / L - AN]

It converts the present value (PV) into an arbitrary linear range (scale) and outputs it as an analog signal.

High limit analog scale [H - AN]

High limit analog output scale value for maximum input value

Low limit analog scale [L - AN]

Low limit analog output scale value for minimum input value



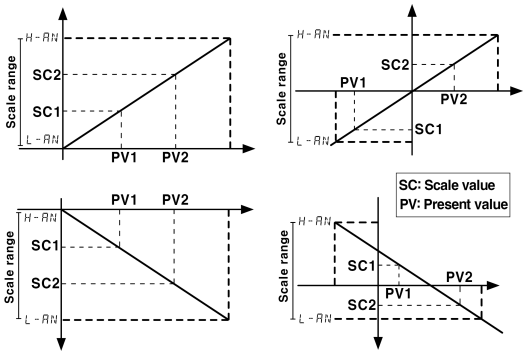
It is activated when the 'Analog output [A - OUT]' parameter setting value is not 'Off [OFF]'.

Relationship between measurement value and display value according to high/low limit analog output scale setting value

Sensor head model BD-030, analog output setting: Based on -5 to 5 V  
(reference distance: 30 mm, maximum measurement range: 20 to 40 mm, rated measurement display range: -5 to 5)

(M: Measure, D: Display)

L-AN	H-AN	M 1	D 1	M 2	D 2	M 3	D 3	M 4	D 4
5	0	5	5 V	3	1 V	2	-1 V	0	-5 V
0	5	0	5 V	2	1 V	3	-1 V	5	-5 V
-5	5	-5	5 V	-2.5	2.5 V	2.5	-2.5 V	5	-5 V



### 2.3.9. Error output displacement [ERR. OUT]

Measurement error (out of measurement range, insufficient reflected light, saturated reflected light), output reset [OUT. CLR] set the output type for external input, filter delay (when the present value is smaller than the setting value of the filter).

#### Present value hold mode [KEEP]

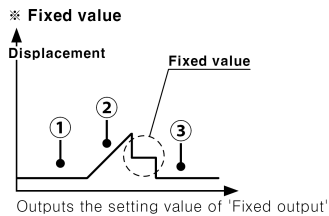
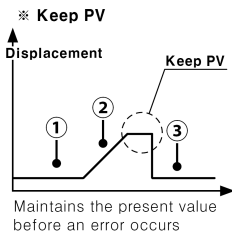
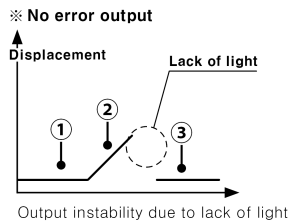
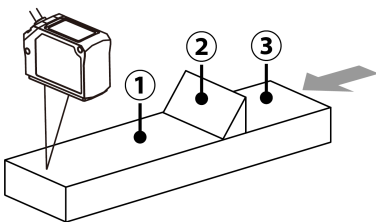
The present value just before the occurrence of a measurement error is maintained and output. (judgment output ON / analog output ON)

#### Fixed value output mode [Fix]

In case of measurement error, the value set in 2.3.10, “Fixed error output\_Analog [Fix. OUT]”, 2.3.11, “Fixed error output\_Judgment [Fix. OUT]” is output. (judgment output OFF / analog output ON)

- Alarm output does not work while error output is occurring.
- Fixed error output\_Judgment [Fix. OUT] supports only over 5.0 firmware version of the amplifier unit (BD-A1) and communication converter (BD-C).

#### Example graph



### 2.3.10. Fixed error output\_Analog [F1 %OUT]

In case of a measurement error, an arbitrarily set analog value is output.



Activated when the value of 'Analog output [R-OUT]' is not 'Off [OFF]' and the value of 'Error output displacement [ERR-OUT]' is 'Fixed value output [F1 %]'.  
[F1 %OUT]

#### Setting range and default for each analog output

Analog output setting value	Setting range	Default
4 - 20 mA	4.00 - 20.00 mA	22.00 mA
0 - 5 V	0.000 - 5.000 V	5.500 V
1 - 5 V	1.000 - 5.000 V	5.500 V
-5 - 5 V	-5.000 - 5.000 V	5.500 V

### 2.3.11. Fixed error output\_Judgment [F1 %JUD]

In case of a measurement error, the set judgment output signal(HIGH/GO/LOW) is output.



- Using "FIXOUT\_Judgment", output by sensitivity setting is ignored.
- This function supports only over 5.0 firmware version of the amplifier unit (BD-A1) and the communication converter (BD-C).



Activated when the value of 'Error output displacement [ERR-OUT]' is 'Fixed value output [F1 %]'.  
[F1 %JUD]

### 2.3.12. Offset [OFFSET]

When the zero adjustment function is executed, sets the present value (PV) to the offset setting value, and displays the amount of displacement based on this.

The amount of displacement is displayed based on the reference distance determined for each sensor head model, but after the zero adjustment function is executed, it is displayed based on reference distance minus offset value.



If the displacement is 1.23, and the offset value is 0.00, the displacement is expressed as 0.00 when performing zero adjustment.

If the displacement is 1.23, and the offset value is 10.00, the displacement is expressed as 10.00 when performing zero adjustment.



This function supports only over 5.0 firmware version of the amplifier unit (BD-A1) and the communication converter (BD-C)

## 2.4. Parameter 2 Group [PARAM2]

Describes the items in parameter 2 group consisting of the sensor head present value processing related functions.



For the setting range and default of each item in the group, refer to 2.2, “Setting Range and Initial Value”.

### 2.4.1. Calculation [CALC]

This function internally calculates and outputs the present values of multiple heads.



- When the calculation function is activated, the response speed setting change is automatically executed according to the mutual interference prevention function and sensors and the number of connected amplifier units. All settings are available only in the master amplifier unit.
- Zero-point adjustment is available for each device.
- This parameter is activated when multiple amplifier units are combined.
- When using the filter function, the same filter setting value should be applied to multiple amplifier units for accurate measurement.



- PV display  
Calculating result > Display range: H H H H  
Calculating result < Display range: L L L L
- Sensor head BD-030/065/100 model and BD-300/600 can calculating together, and display digit change according to master amplifier ‘Display digit’ parameter.  
It is recommended to connect the sensor head BD-300/600 model to the master amplifier for wide range of measurements and to connect the sensor head BD-030/065/100 model to the master amplifier for precision.

#### Off [OFF]

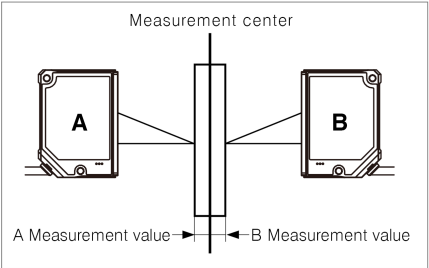
Displays the present values measured by each sensor head. Select this to send/receive data between each amplifier unit and PC through a communication converter.

**Add [ $R_{dd} - R_{bb}$ ]**

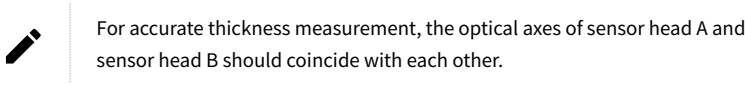
The present values of the two sensor head are added and displayed. Use it when measuring the thickness of the sensing object.

After placing the two sensor head facing each other, adjust and install the sensing object at the center.

- Equation: Sensor head A measurement + sensor head B measurement



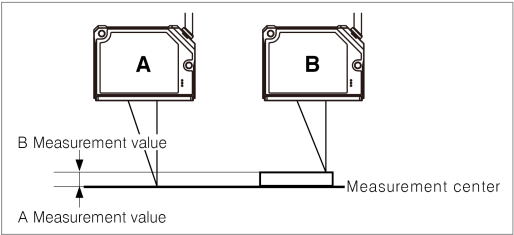
**Add calculation function installation example**



**Subtract [ $S_{bb} - R_{bb}$ ]**

Displays the difference in the present values of the two sensor head. Use it to measure the step, lift, and curvature of the sensing object.

- Equation: Sensor head A measurement – sensor head B measurement



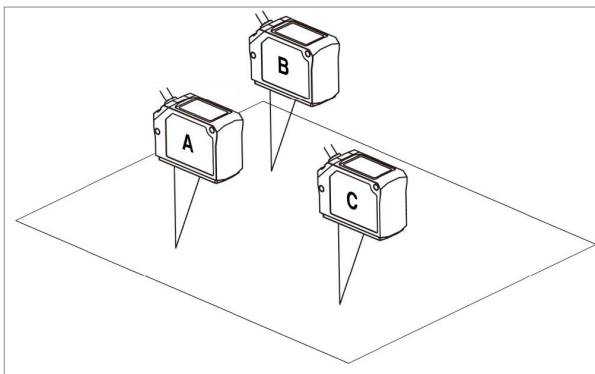
**Subtract calculation function installation example**



### Average [AVG]

Displays the average of measurement values of two or over sensor head (up to 8 units). Use it to measure the flatness of the sensing object.

- Equation: (Present value of sensor head A + present value of sensor head B + ... + present value of sensor head N)  $\div$  N



**Average calculation function installation example**

### 2.4.2. Gain [G A I N]

When measuring a target with a low reflected light quantity or a large inclination of the measuring surface, the sensor enables stable measurement.

Adjusts the light-receiving sensitivity level of the head. The higher the setting value, the higher the sensitivity.

### 2.4.3. Filter [F I L T E R]

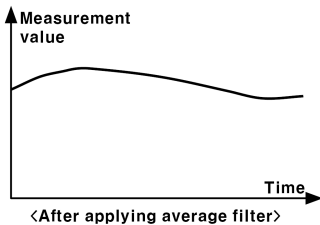
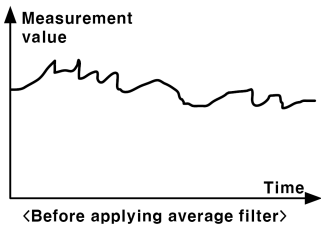
Set up a filter that adjusts the deviation of the sensor head readings. BD series supports 'Moving average filter [M V F]', 'Differential filter [d i F F]', 'Number of median samples [M E d i A N]' functions.



- The median filter function can be set through a separate parameter. Refer to 2.4.5, “Number of Median Samples [M E d i A N]”.
- Moving average filter and differential filter cannot be used at the same time.

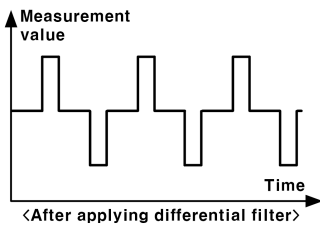
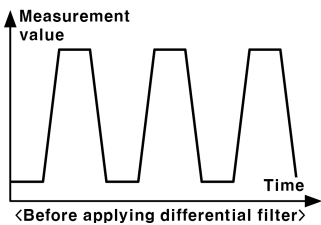
#### Moving average filter [M V F]

After sampling the most recent measurements, the average is calculated and output. Displays abrupt changes in present values by reducing them.



#### Differential filter [d i F F]

Outputs the difference between the current measurement and the previous measurement. It is mainly used for detecting a sudden step difference.



#### 2.4.4. Number of Moving Average Samples [AVER]

Sets the number of measurements to sample to calculate the average. The calculated average value is output by sampling the present value as many as the set number.



This parameter appears when the 'Filter [FILTER]' parameter is set to 'Moving average filter [AVER]'.

#### 2.4.5. Number of Median Samples [MEDIAN]

Sets the number of measurements to sample to calculate the median. After sampling the present value as many as the set number, the size of the value is compared and the value located at the center is output. You can filter out abrupt changes in values (disturbing, noise, etc.) that cannot be removed with a moving average filter.



Setting this parameter to OFF disables the median filter function.



The BD series displacement sensor processes the sensor measurement value in the order of median filter → moving average / differential filter and displays the current value.

### 2.4.6. Hold [HOLD]

It maintains the display and output of the measurement value during the sampling time in the set mode. You can adjust the sampling time by setting the 'Hold timing input [HOLD t.]' parameter. For more information on 'Hold Timing Input [HOLD t.]', refer to 2.4.7, "Hold Timing Input [HOLD t.]".



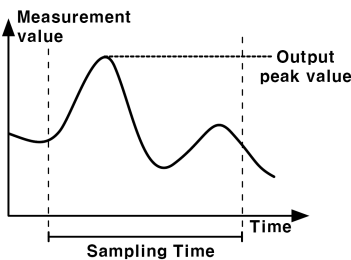
'Timer setting function [t - Mod]' and 'Hold [HOLD]' function cannot be used at the same time. When the timer setting function is activated, the hold function setting is automatically switched to OFF.



The 'Filter [FILTER]' function may cause delays in operation.

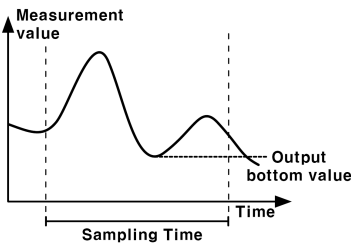
#### Maximum value [PEAK]

Outputs and maintains the maximum value within the sampling time. The output starts after sampling ends, and the output stays on until the next sampling ends.



#### Minimum value [BOTTOM]

Outputs and maintains the minimum value within the sampling time. The output starts after sampling ends, and the output stays on until the next sampling ends.

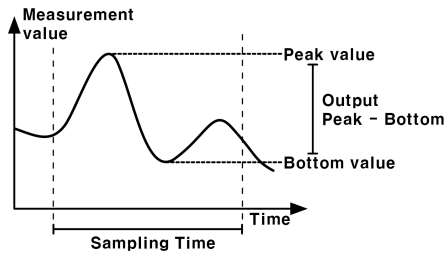


### Difference value [ $P - P$ ]

Outputs and maintains the difference between the maximum and minimum values within the sampling time. The output starts after sampling ends, and the output stays on until the next sampling ends.

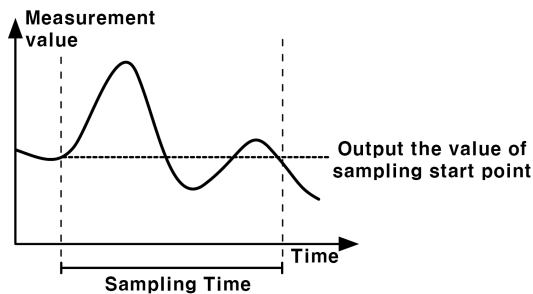


This function can be used for vibration and eccentricity measurements.



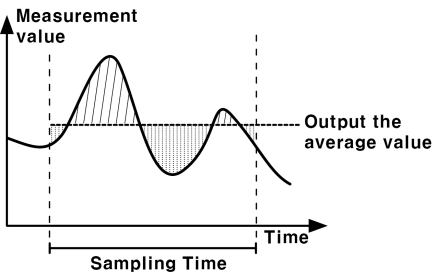
### Starting value [ $SAMPLE$ ]

It outputs and maintains the value at the moment of entering the sampling time. The output starts after sampling ends, and the output stays on until the next sampling ends.



**Average value [AVG]**

Outputs and maintains the average of the present values during the sampling time. The output starts after sampling ends, and the output stays on until the next sampling ends.



### 2.4.7. Hold Timing Input [HOLD.t]

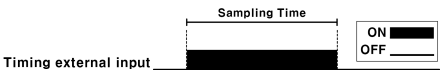
Set the sampling time input method for the hold function.



- It is activated when the hold [HOLD] setting value is not OFF.
- When 'Over/Under auto trigger level [A.L.U.P] / [A.L.d.W]' among setting items is set, it sequentially switches to 'Trigger level [A.L.V]' and 'Hysteresis [A.L.H.Y.S]' setting mode. Enter.

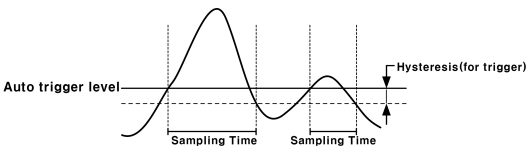
#### Using external input [E.I.N]

Input the trigger of the sampling time as an external input. Sampling is performed while the external input signal is ON.



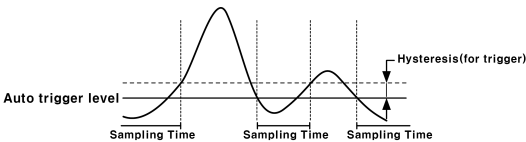
#### Over auto trigger level [A.L.U.P]

Sets the auto trigger level and starts sampling when a value above it is measured. Sampling ends when the present value falls below the set hysteresis value for auto trigger.



#### Below auto trigger level [A.L.d.W]

Sets the auto trigger level and starts sampling when a value below that is measured. Sampling ends when the present value exceeds the set auto trigger hysteresis value.



### 2.4.8. Auto Trigger Level [A.T.L V ]

Among the hold timing input methods, set the trigger level for auto trigger mode.



- Appears when the 'Hold timing input [H o L d t ]' parameter setting value is set to 'Over/Under auto trigger level [A.T.U P ]/[A.T.d W ]'.
- When the 'Display scale [H - 5 C ] / [L - 5 C ]' function is applied, the trigger operates based on the present value (PV) to which the scale is applied.

### 2.4.9. Auto Trigger Hysteresis [A.T.H Y S ]

Set trigger hysteresis for auto trigger mode among hold timing input methods.



Appears when the 'Hold timing input [H o L d t ]' parameter setting value is set to 'Over/Under auto trigger level [A.T.U P ]/[A.T.d W ]'.



### 2.4.10. Timer [t - M o d E]

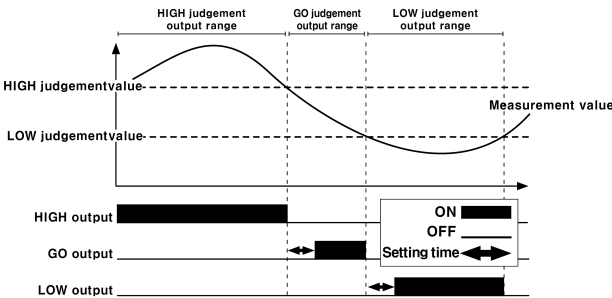
Set the timing of judgment (HI/GO/LOW) output.



'Timer [t - M o d E]' and 'Hold [H o l d]' functions cannot be used at the same time. When the timer setting function is activated, the hold function setting is automatically switched to OFF.

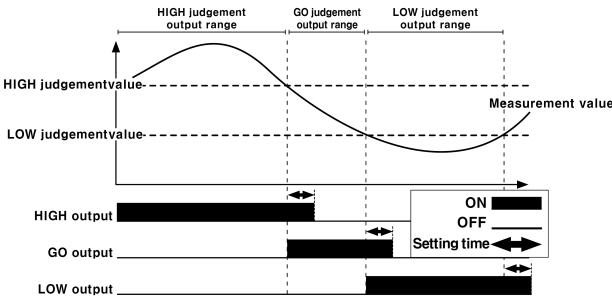
#### On delay [o n d]

After judgment, output is delayed by the set time.



#### Off delay [o f d]

It ends after maintaining the judgment output for the set time.



### 2.4.11. Timer Time [TIME]

Set the time to delay or hold judgment output.



Appears when the 'Timer [MODE]' parameter setting value is set to 'On delay [ONd]', 'Off delay [OFFd]' mode.

## 2.5. Parameter Group 3 [PARAM3]

Describes the items in parameter 3 group consisting of external input related settings.



For the setting range and default of each item in the group, refer to 2.2, “Setting Range and Initial Value”.

### 2.5.1. External Input [d - I N□]

Set the external input function to be assigned to external input 1 to 4 lines. Each function can be set individually or overlapped, but bank A and bank B functions cannot be nested.

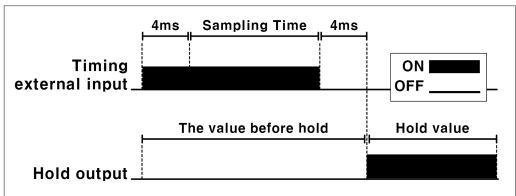
#### Hold trigger input [t - I N]

Assign the hold trigger function used for 'hold timing input [HOLD t]’.



For more information on 'Hold Timing Input [HOLD t]’, refer to 2.4.7, “Hold Timing Input [HOLD t]”.

- Minimum input time: 4 ms
- Output delay time after sampling: 4 ms

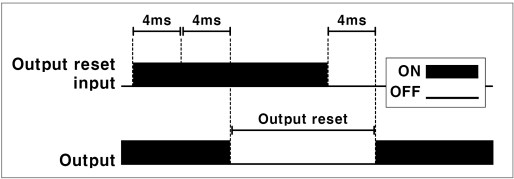


Hold trigger input timing chart

**Output reset [OUT CLR]**

Assign the output reset function.  
The output is stopped during the input time. After input ends and the output resumes after 4 ms.

- Minimum input time: 4 ms
- Output reset execution time: 8 ms
- Reset reset input time: 4 ms

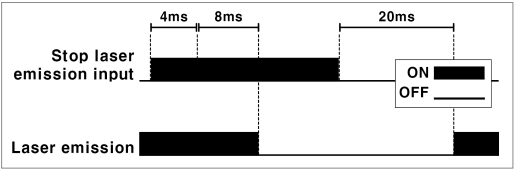


**Output reset input timing chart**

**Stop laser emission [L - OFF]**

Assign the laser emission stop function.  
After assigning the corresponding function, you can apply a signal to stop the laser emission.

- Minimum input time: 4 ms
- Laser emission ON – OFF switching time: 12 ms
- Laser emission OFF – ON switching time: 20 ms

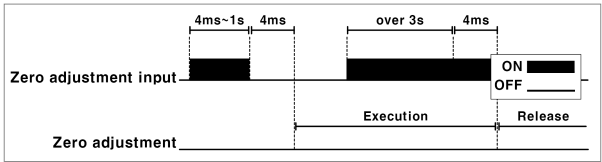


**Laser OFF timing chart**

**Zero-point adjustment [ZER0]**

Assign the zero adjustment function.  
After assigning the relevant function, you can apply a signal to set the present value (PV) as the origin.

- Minimum input time: 4 ms
- Zero calibration execution time: Up to 1 sec
- Zero-adjustment release input time: At least 3 sec



**Zero-point adjustment timing chart**

**Load bank [bANK - A, bANK - b]**

Assigns the bank recall function.  
After assigning the corresponding function, the corresponding bank is activated only when input signal changed.  
For two-wire use, other input signals operate in combination if they change within the minimum input time of the first input signal.

- Minimum input time : After signal change 1 sec

**When using single wire**

Activated bank	BANK-A input
BANK-0	OFF
BANK-1	ON

**When using 2 wires**

Activation bank	BANK-A input	BANK-B input
BANK-0	OFF	OFF
BANK-1	OFF	ON
BANK-2	ON	OFF
BANK-3	ON	ON

## 2.6. Parameter 4 Group [PARR4]

Describes the items in parameter 4 group composed of user convenience related functions.



- Parameter 4 groups are not saved for each bank and are used in common.
- For the setting range and default of each item in the group, refer to 2.2, “Setting Range and Initial Value”.

### 2.6.1. Display Direction [d1 R]

By selecting the display direction of the amplifier unit display (normal display, reverse display), the user can conveniently check the display regardless of the installation direction.

#### Normal display

Present value (PV) display: Red, Setting value (SV) display: Green, and the decimal point is displayed at the bottom of the character.

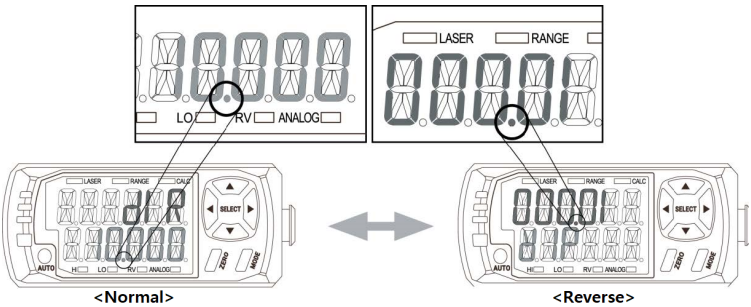
#### Reverse display

Present value (PV) display: Green, Setting value (SV) display: Red, and the decimal point is displayed at the top of the character.

#### Example of normal display and reverse display

Present value (PV) display: d1 R

Setting value (SV) display: 10.000



### 2.6.2. Bank [bANK]

Parameter settings can be stored and recalled in up to 4 banks.

#### Check the bank number

You can check the bank number being used in the setting value check mode by entering the arrow keys ◀ / ▶ during RUN mode.

#### Save Bank

After completing the desired parameter settings, go to parameter 4 Group - Bank [bANK] parameter and select the bank number to save. After that, if the **MODE** key is pressed for more than 3 seconds while the display is blinking, the parameter setting value is saved in the corresponding bank.

#### Load Bank

Use the external input function, or go to parameter 4 group - bank [bANK] parameter and select the bank number to recall. After that, if the **ZERO** key is pressed for more than 3 seconds while the display is blinking, the corresponding bank is called up.

### 2.6.3. Saving Mode [SAVE]

This is a function to reduce power consumption by turning off the front display lamp when there is no user operation for more than 1 minute in RUN mode.



This function is applied only in RUN mode, and all display parts are always ON when entering setting mode.

### 2.6.4. Lock Mode [L O C K]

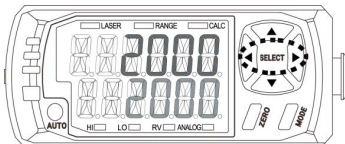
Set the key lock function to prevent operation mistakes.



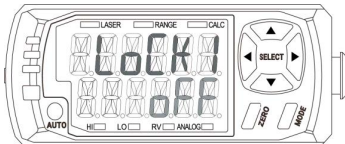
- When sets Lock Mode[L O C K], you can set/release key lock by pressing the arrow keys ◀ / ▶ for more than 3 seconds in RUN mode.
- When the communication converter and amplifier unit are connected, unlocking is not possible.

#### Unlock Settings

1. In RUN mode, press ◀ / ▶ key for more than 3 seconds.

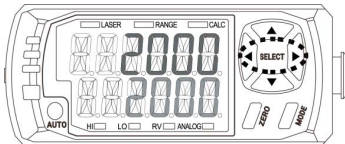


2. As shown below, the key lock parameter setting value and OFF text appear and the lock is released.

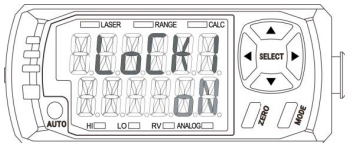


#### Lock Settings

1. In RUN mode, press the arrow keys ◀ / ▶ for more than 3 seconds.



2. Lock mode is set with Lock mode parameter and ON as below.



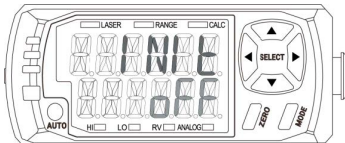


## 2.6.5. Initialization [I N I E]

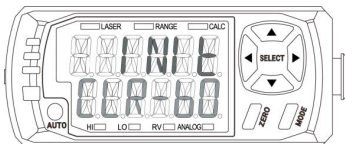
Depending on the parameter selection, the bank and all settings can be initialized.

### Reset Settings

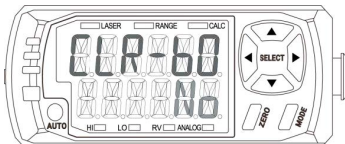
1. Select parameter 4 group 'Initialization [I N I E]' parameter. When the **MODE** key is pressed, the OFF text on the setting value (SV) display part flashes.



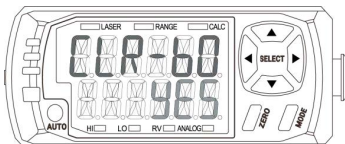
2. Select the bank to initialize with the ▲ / ▼ keys.



3. After selecting the bank to initialize, press the **MODE** key, and the NO text flashes on the setting value (SV) display.



4. Press the ▲ / ▼ key to select YES and then press the **MODE** key to complete the initialization after the entire text flashes.



# Autonics

Dimensions or specifications on this manual are subject to change and some models may be discontinued without notice.

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