Make Life Easy :

User Manual

Displacement Sensor

BD Series

MSO-BDU1-V1.1-2002US

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.

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Preface

Thank you for purchasing Autonics product.

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

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

User 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) 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.

User Manual Symbols

Symbol	Description
 Note	Supplementary information for a particular feature.
 Warning	Failure to follow instructions can result in serious injury or death.
 Caution	Failure to follow instructions can lead to a minor injury or product damage.
 Ex.	An example of the concerned feature's use.
※	Annotation mark.

Safety Considerations

- Following these safety considerations will ensure the safe and proper use of the product and help prevent accidents, as well as minimizing possible hazards.
- Safety considerations are categorized as Warnings and Cautions, as defined below:

Warning	**Warning**	Failure to follow the instructions may lead to a serious injury or accident.
Caution	**Caution**	Failure to follow the instructions may lead to a minor injury or accident.

Warning

- Fail-safe device must 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.
- 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.
- Do not disassemble or modify the unit.
  Failure to follow this instruction may result in fire.
- Do not connect, repair, or inspect the unit while connected to a power source.
  Failure to follow this instruction may result in fire.
- Check 'Connections' before wiring. [Amplifier unit]
  Failure to follow this instruction may result in fire.

Caution

- Do not stare at the laser emitter. [Sensor head]
  Failure to follow this instruction may result in eye damage.
- Use the unit within the rated specifications.
  Failure to follow this instruction may result in fire or product damage.
- Use dry cloth to clean the unit, and do not use water or organic solvent.
  Failure to follow this instruction may result in fire.
- Mount the ferrite core to specified position before using. [Sensor head, Extension cable]
  Failure to follow this instruction may result in output with noise.

Cautions during Use

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

The specifications are subject to change and some models may be discontinued without notice.

Be sure to follow cautions written in the instruction manual, user manual and the technical descriptions (catalog, website).

Table of Contents

1 Overview

1.1 Features

Displacement sensor BD Series can accurately measure displacement precisely by high resolution (max. 1㎛, BD-030) and wide measurement range (max. 120mm, BD-100).

And consists of a connector type sensor head, an amplifier unit which can be connected up to 8 units, and a communication converter which supports RS-232C, RS-485 communication, to configure the measuring system efficiently.

1.1.1 Sensor head/Amplifier unit

- Easy maintenance with separable structure of sensor head/amplifier unit
- Maximum resolution: 1μm (different by models)
- Stable measurement regardless of color or material of the object
- Mutual connection up to 8 amplifier units
  : Interference prevention and channel alignment are automatically applied
- Various calculation function (add, subtraction, average)
- Various filter function for stable measurement (average, differential, median)
- Teaching modes configuration (1-point, 2-point) for user environment
- Mounting on DIN-Rail or wall (accessory bracket is needed) is available
- Sensor head IP67 protection structure (patented)
  : Korea patent application number 2017-0043925

1.1.2 Communication converter

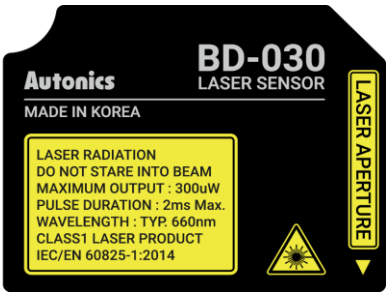
- Supports RS232C and RS485 communications in one device
  : Separated ports of RS232C/RS485 for user convenience
- Maximum connection up to 8 amplifier units
- Power supply without extra wiring via amplifier unit
- Dedicated Device Management Program (atDisplacement)
  : Batch parameter setting via save/load function
  : Real-time monitoring of measured values and output status
- Communication speed and station number can be set by side DIP switch without connecting host device

1.2 Warning Label

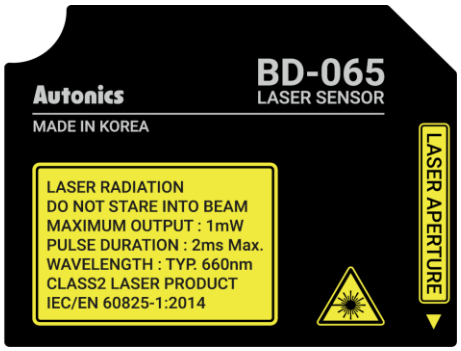
The description on the warning labels attached to the device and the label locations are described below.

1.2.1 Label description

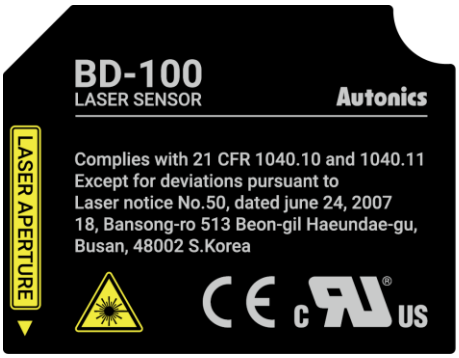
- **BD-030**

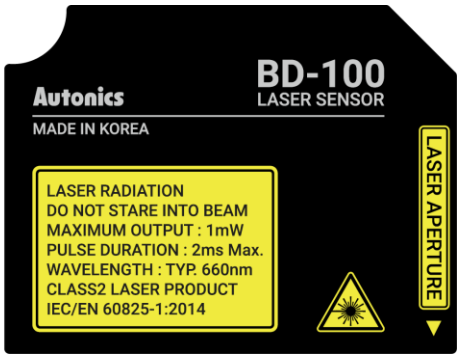


- **BD-065**



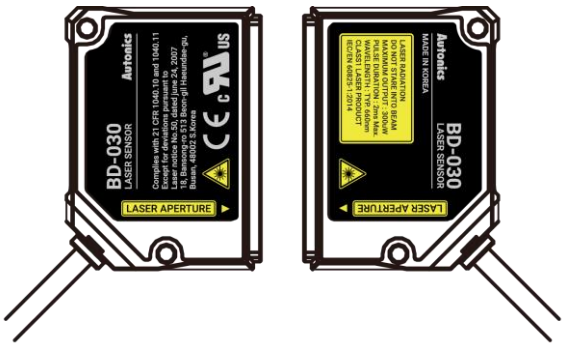
- **BD-100**





1.2.2 Label attachment locations

- **BD-030**



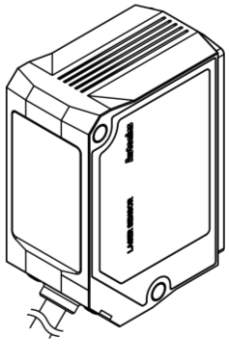
- **BD-065**

- **BD-100**

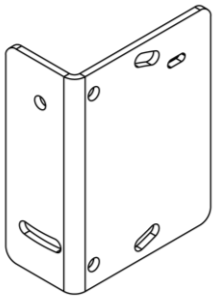
1.3 Components and Sold separately

1.3.1 Sensor head

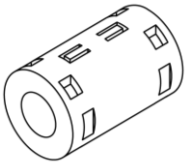
(1) Components



- BD series sensor head

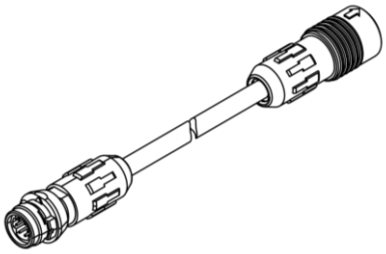


- Bracket for sensor head



- Ferrite core
- Bolt, Nut 2 sets
- Instruction manual

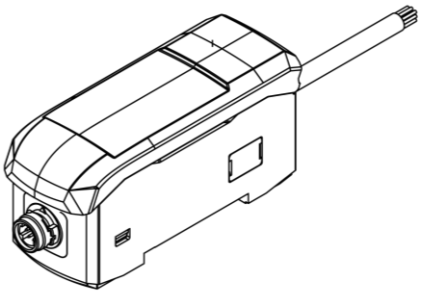
(2) Sold separately



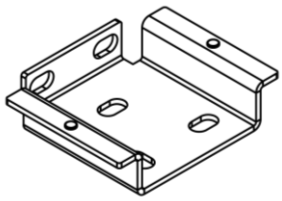
- External cable for sensor head and amplifier unit

1.3.2 Amplifier unit

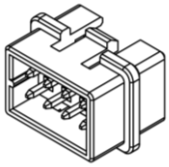
(1) Components



- BD series amplifier unit

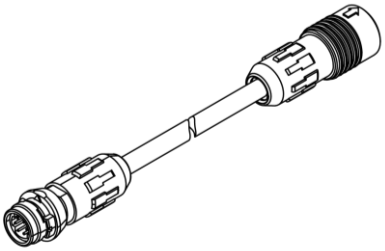


- Bracket for amplifier unit



- Side connector
- Instruction manual

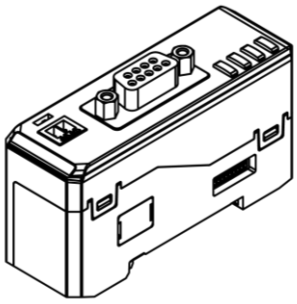
(2) Sold separately



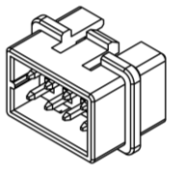
- External cable for sensor head and amplifier unit

1.3.3 Communication converter

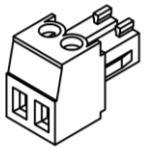
(1) Components



- BD-C series communication converter

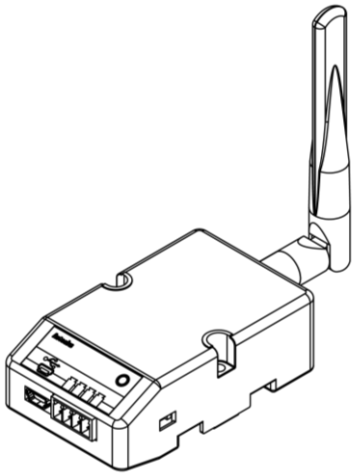


- Side connector

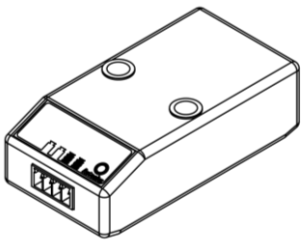


- RS485 connector
- Instruction manual

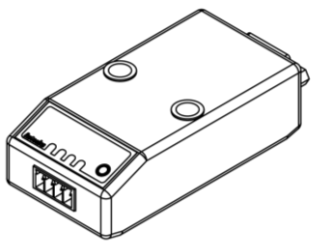
(2) Sold separately



- SCM-WF48 (Wi-Fi, USB - RS485)



- SCM-US48I (USB – RS485)

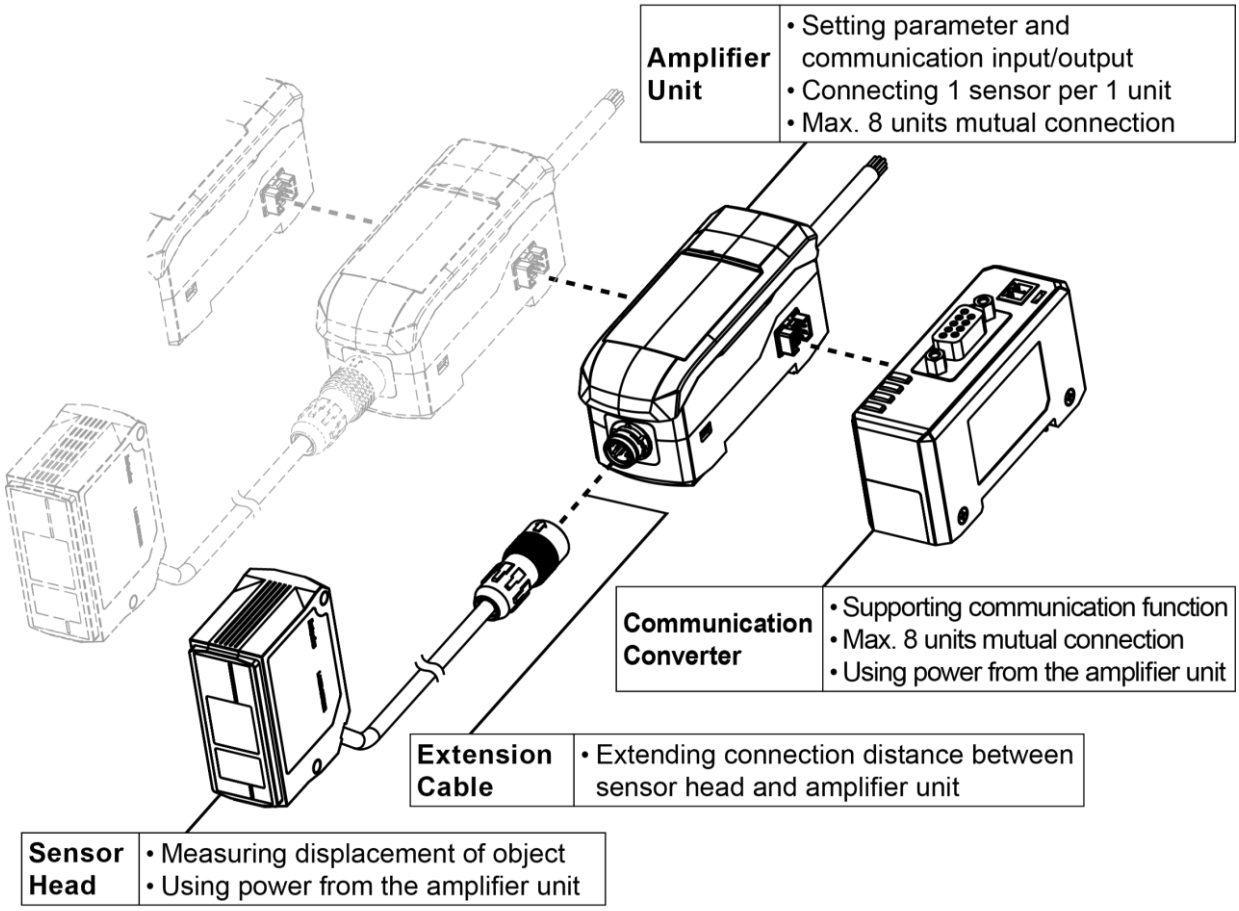


- SCM-38I (RS232C - RS485)

Note

- Please make sure that all of the components are included before using the product.
  If either component is damaged or missing, please contact our sales office.
- Components and sold separately image may be slightly different.

1.4 Product configuration



1.5 Model configuration

1.5.1 Sensor head

Model	Beam shape	Reference distance (Maximum measurement range)	Spot diameter		
			Near	Reference	Far
BD-030	Standard	30mm (20-40mm)	Apporx. 290×790㎛ (at 25mm)	Apporx. 240×660㎛ (at 30mm)	Apporx. 190×450㎛ (at 35mm)
BD-065	Standard	65mm (50-80mm)	Apporx. 360×1590㎛ (at 55mm)	Apporx. 290×1180㎛ (at 65mm)	Apporx. 210×830㎛ (at 75mm)
BD-100	Standard	100mm (70-130mm)	Apporx. 480×1870㎛ (at 80mm)	Apporx. 410×1330㎛ (at 100mm)	Apporx. 330×950㎛ (at 120mm)

1.5.2 Amplifier unit

Model	Compatible sensor head
BD-A1	BD series sensor head: 1

1.5.3 Communication converter

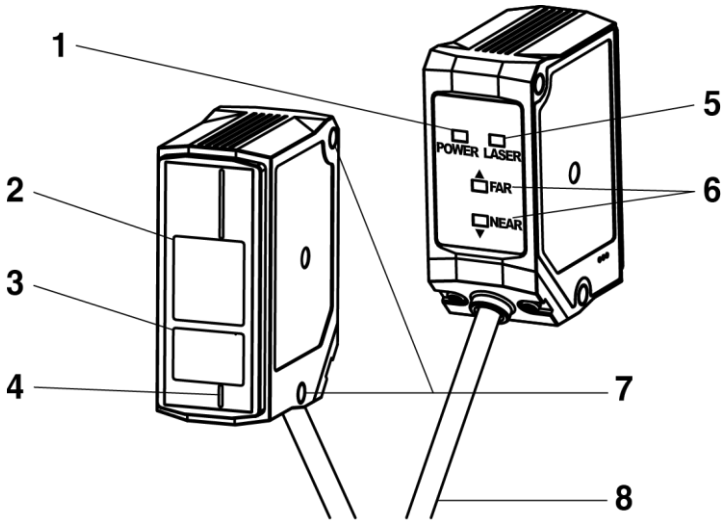
Model	Supported communication function
BD-CRS	RS-232C, RS-485

1.5.4 External cable

Model	Cable length
CID6P-1-SI-BD	1m
CID6P-2-SI-BD	2m
CID6P-5-SI-BD	5m
CID6P-10-SI-BD	10m

1.6 Unit Description

1.6.1 Sensor head



1. Power indicator (red)

Indicates whether power supply the sensor head.

2. Receiver

Receives reflected laster from the object.

3. Emitter

Emits laser to the object to measure the displacement.

4. Emission center line

The line and the object should be aligned because the laser is emitted along the line.

5. Laser emission indicator (green)

Lights ON during sensor head emits laser.

6. NEAR/FAR indicator (green)

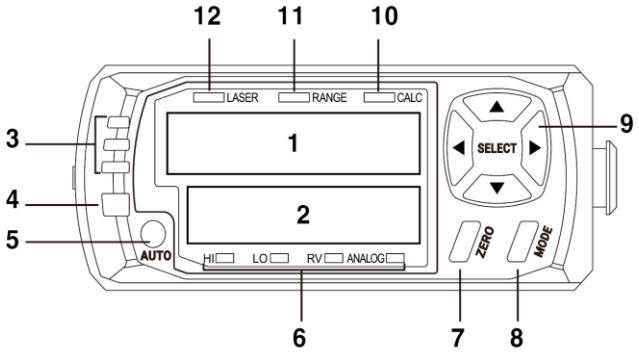
- Out of the rated measurement range: Flashing
- Near the reference distance: Turns on

  ※ For the details, refer to '5.2.2 Mounting Location - Indicator display'.

7. Mounting hole

8. Connector cable

1.6.2 Amplifier unit



1. Present value (PV) display

Displays PV, calculating result (when using calculation), parameter name (when setting parameter).

2. Setting value (SV) display

Displays SV (HIGH, LOW, RV, Analog output, Bank), parameter setting value (when setting parameter). The type of displaying SV can be recognized by 'Setting value (SV) indicator recognition'.

3. Judgment indicator (Red: HI / LO, Green: GO)

Lights ON when outputting judgment value following to SV.

4. Alarm indicator (Red)

Lights ON when outputting alarm.

5. Optimization setting key [AUTO]

Executes 'Sensing optimization'.

6. Setting value (SV) indicator recognition lamp (Green)

Displays the value type of 'Setting value (SV) display'

- HI/LOW: HIGH/LOW judgment value
- RV: Real distance value
- ANALOG: Analog output

7. Zero adjustment setting key [ZERO]

Executes 'Zero adjustment'.

8. Mode setting key [MODE]

Enters modes and sets the parameter value.

9. Direction key [◀] / [▶] / [▲] / [▼]

Sets the value of mode and parameter.

10. Calculation indicator (CALC, Green)

Lights ON when using calculation.

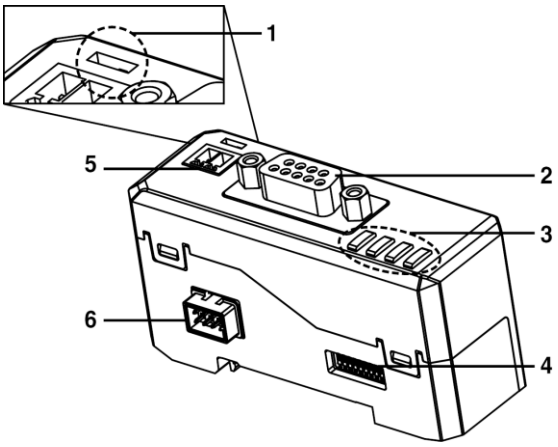
11. Measurement range indicator (RANGE, Green)

Lights ON when PV is in the measurement range, lights OFF when PV is out of the measurement range or emitting laser is stopped.

12. Laser emission indicator (LASER, Green)

Lights ON when emitting laser.

1.6.3 Communication converter



1. RS485 terminating switch

Set the switch to 'RT' when the communication converter is connected to the terminal of RS485 communication connection.

2. RS232C connector

A connector for RS232C communication.

3. Status indicator

Displays power, communication input/output/error.

- Power indicator (POWER, Green): Displays power supply.
- Communication output indicator (TX, Green): Displays communication output status from communication converter to external device.
- Communication input indicator (RX, Green): Displays communication input status from communication converter to external device.
- Communication error indicator (ERROR, Red): Displays the communication status of communication converter.

4. Communication Setting Switch

Sets communication speed, address, parity bit and stop bit.

5. RS485 connector

A connector for RS485 communication.

6. Side connector

A connector for connecting between communication converter and amplifier unit.

2 Specification

2.1 Sensor Head

Model		BD-030			BD-065			BD-100		
Spot diameter (Unit: ㎛)		Near (25mm)	Reference (30mm)	Far (35mm)	Near (55mm)	Reference (65mm)	Far (75mm)	Near (80mm)	Reference (100mm)	Far (120mm)
		Approx. 290×790	Approx. 240×660	Approx. 190×450	Approx. 360×1590	Approx. 290×1180	Approx. 210×830	Approx. 480×1870	Approx. 410×1330	Approx. 330×950
Resolution※1		1㎛			2㎛			4㎛		
Reference distance		30mm			65mm			100mm		
Maximum measurement range		20 to 40mm			50 to 80mm			70 to 130mm		
Linearity※1※2		0.1% F.S. (in 25 to 35mm)			0.1% F.S. (in 55 to 75mm)			0.15% F.S. (in 80 to 120mm)		
Temperature Characteristics※3		0.05% F.S.			0.06% F.S.					
Power supply※4		-								
Light Source		Red semiconductor laser (wavelength: 660nm, IEC 60825-1:2014)								
	Optical method	Diffuse reflection								
	Laser class	Class 1 (IEC/EN), Class I (FDA(CDRH) CFR Part 1002)			Class 2 (IEC/EN), Class II (FDA(CDRH) CFR Part 1002)					
	Output	Max. 300㎼			Max. 1㎽					
Operation indicators		Power indicator: red LED, Laser emission indicator: green LED, NEAR/FAR indicator: green LED								
Connection		Connector type								
Insulation resistance		Over 20MΩ (at 500VDC⎓ megger)								
Noise immunity		Square shaped noise by noise simulator (pulse width: 1㎲) ±500V								
Dielectric strength		1,000VAC 50/60Hz for 1 minute								
Vibration		1.5mm amplitude at frequency of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 2 hours								

Shock		300m/s² (Approx. 30G) in each X, Y, Z direction for 3 times		
Environment	Ambient Illumina-tion	Max. incandescent lamp 10,000lx		
	Ambient tempera-ture	-10 to 50°C, Storage: -15 to 60°C		
	Ambient humidity	Under 85%RH, Storage: Under 85%RH		
Protection structure		IP67 (IEC Standards, except connector of extension cable)		
Material		Case: Polycarbonate, Sensing part: Glass, Cable: Polyvinyl chloride		
Amplifier unit compatibility		BD Series amplifier unit: 1		
Accessory		Ferrite core (made by TDK co. ZCAT2132-1130), Mounting bracket, Bolt, Nut		
Approval		CE cULus		
Weight※5		Approx. 209g (approx. 56g)	Approx. 233g (approx. 68g)	Approx. 233g (approx. 68g)

※1: When measuring fixed non-glossy white paper (reference temperature: 25°C, reference distance, response time: 1ms, average 128 times).

※2: Value indicates the error with respect to the ideal straight line and the numbers in parentheses are the rated measurement ranges guarantee linearity.

※3: Value measured by using an aluminum jig fix the sensor head and non-glossy white paper.

※4: Using power from the amplifier unit.

※5: The weight is with packaging and the weight in parenthesis is only unit weight.

※ The temperature or humidity mentioned in Environment indicates a non freezing or condensation environment.

2.2 Amplifier Unit

Model		BD-A1
Power supply		10-30VDC⎓ ±10% (When connecting BD-C Series communication converter, 12-30VDC⎓)
Power consumption		Max. 2800mW (30VDC⎓, except connected)
Control input※1	Timing	No-voltage input
	Output reset	
	Laser OFF	
	Zero adjustment	
	Bank change	
Judgment output (HIGH/GO/LOW)		NPN or PNP open collector output (Load current: Max. 100mA)
Alarm output		NPN or PNP open collector output (Load current: Max. 100mA)
Analog output※2	Voltage	-5-5V, 0-5V, 1-5V (Resistance: 100Ω, ± 0.05% F.S., at 10V)
	Current	4-20mA (Max load resistance: 350Ω, ± 0.2% F.S., at 16mA)
Residual voltage		NPN: Max. 1.5V, PNP: Max. 2.5V
Protection circuit		Reverse polarity protection circuit, output overcurrent (short-circuit) protection circuit
Response time		0.33, 0.5, 1, 2, 5ms (5-step adjustment)
Min. display unit		1㎛
Display method		Dual display by 6-digit, 11-segment LED
Display range※3		±99.999mm to ±99mm (4-step adjustment)
Display period		Approx. 100ms
Insulation resistance		Over 20MΩ (at 500VDC⎓ megger)
Noise immunity		Square shaped noise by noise simulator (pulse width: 1μs) ±500V
Dielectric strength		1,000VAC 50/60Hz for 1 minute
Vibration		1.5mm amplitude at frequency of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 2 hours
Shock		300m/s2 (Approx. 30G) in each X, Y, Z direction for 3 times
Environment	Ambient temperature	-10 to 50°C, storage: -15 to 60°C
	Ambient humidity	Under 85%RH, Storage: Under 85%RH
Protection structure		IP40 (IEC Standards)
Material		Case: Polycarbonate, Cover: Polycarbonate, Cable: Polyvinyl chloride
Connection		Connector type

Sensor head compatibility	BD Series sensor head: 1
Accessory	Mounting bracket, Side connector
Approval	CE cULus
Weight※4	Approx. 228g (approx. 126g)

※1: Use after assigning to external input line.

※2: It is possible to use among -5-5V, 0-5V, 1-5V, 4-20mA by parameter setting.

※3: Setting range is assigned automatically when connecting sensor head.

※4: The weight is with packaging and the weight in parenthesis is only unit weight.

※ The temperature or humidity mentioned in Environment indicates a non freezing or condensation environment.

2.3 Communication Converter

Model		BD-CRS
Power supply※1		-
Power consumption		Max. 2.3W
Communication function		RS-232C, RS-485
Communication speed		9600, 19200, 38400, 115200bps (default)
Indication		4 LED status indicators
Function		• Real-time monitoring • Executes every BD-Series feature and sets parameter by external device (Master)
Environ -ment	Ambient temperature	-10 to 50°C, Storage: -15 to 60°C
	Ambient humidity	35 to 85%RH, Storage: 35 to 85%RH
Vibration		1.5mm amplitude at frequency of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 2 hours
Shock		300m/s2 (approx. 50G) in each X, Y, Z direction for 3 times
Protection structure		IP40 (IEC Standards)
Material		Case: Polycarbonate
Accessory		Side connector, Connector for RS485
Sold separately		Communication converter (SCM-38I, SCM-US48I, SCM-WF48)
Approval		CE cULus KC
Weight※2		Approx. 91g (approx. 49g)

※1: Using power from the amplifier unit. To use BD-C Series communication converter, the amplifier unit needs 12-30VDC⎓ power supply.

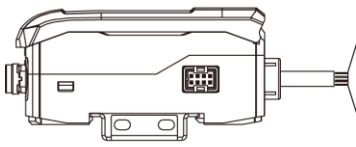
※2: The weight is with packaging and the weight in parenthesis is only unit weight.

※ The temperature or humidity mentioned in Environment indicates a non freezing or condensation environment.

3 Product Connection

3.1 Amplifier Unit

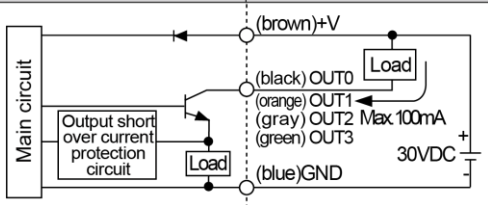
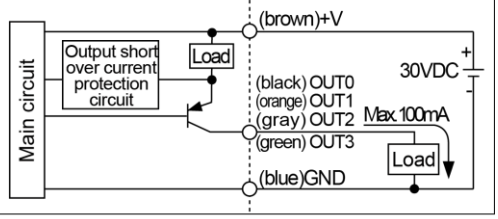
3.1.1 Connection



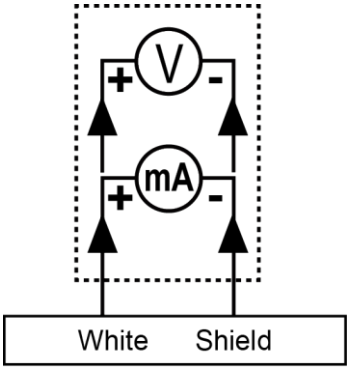
Item	Code color	Description	
Power	Brown	Power: 10-30VDC	
	Blue	Common GND (input, output, power)	
Output	Black	HIGH Judgment	
	Orange	LOW Judgment	
	Gray	GO Judgment	
	Green	Alarm	
	White	Analog: Following parameter value (-5-5V, 0-5V, 1-5V, 4-20mA)	
	Shield	GND (Analog output) ※It is needed to distinguish from common GND.	
External input	Pink	External input 1	Select parameters as below and input a signal to execution. (Timing, Output reset, Laser OFF, Zero adjustment, BankA, BankB, OFF)
	Yellow	External input 2	
	Red	External input 3	
	Purple	External input 4	

3.1.2 Control output diagram

- **Judgment (High, Go, Low) and alarm output**

Item	Inner circuit	Connection
NPN open collector output		
PNP open collector output		

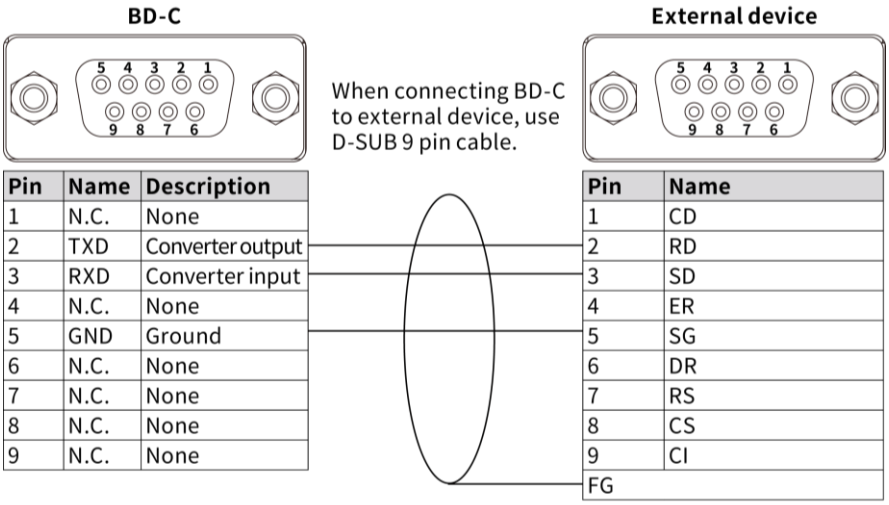
- **Analog output (-5-5V, 0-5V, 1-5V, 4-20mA)**



3.2 Communication Converter

3.2.1 Connection

(1) RS232C communication

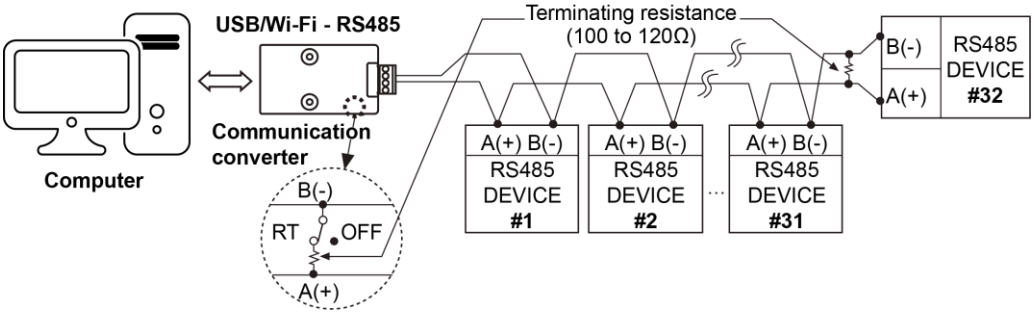


Pin	Name	Description
1	N.C.	None
2	TXD	Converter output
3	RXD	Converter input
4	N.C.	None
5	GND	Ground
6	N.C.	None
7	N.C.	None
8	N.C.	None
9	N.C.	None

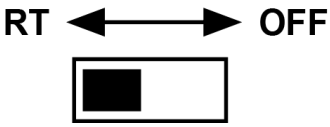
Pin	Name
1	CD
2	RD
3	SD
4	ER
5	SG
6	DR
7	RS
8	CS
9	CI
FG	

(2) RS485 communication

- **Application of system organization**

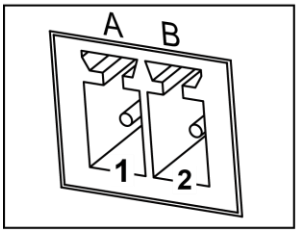


- **Terminating switch**



Set the switch to 'RT' when the communication converter is connected to the terminal of RS485 communication connection, and set to 'OFF' when it is in the middle of the communication connection.

- **Communication pin**



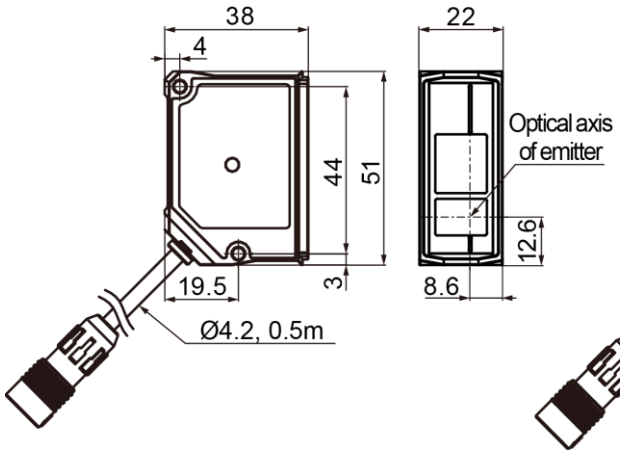
Pin	Name	Description
1	A(+)	RS485 + Signal
2	B(-)	RS485 - Signal

4 Dimension

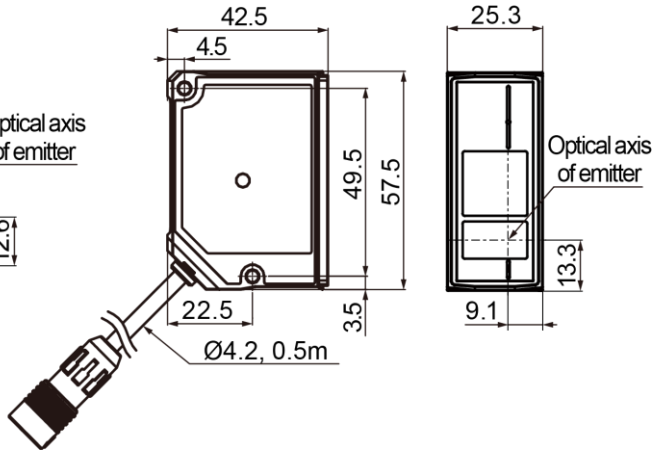
(unit: mm)

4.1 Sensor Head

● BD-030

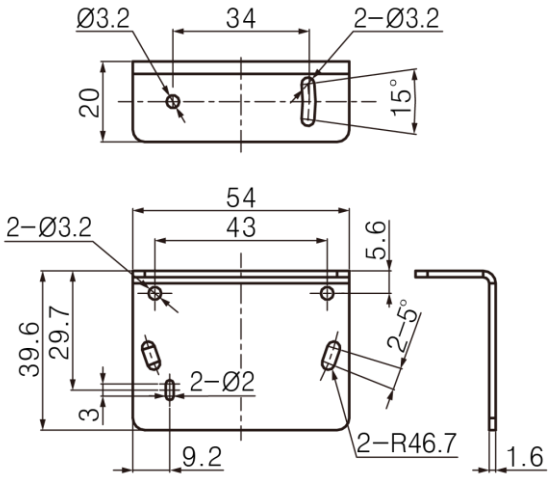


● BD-065/100

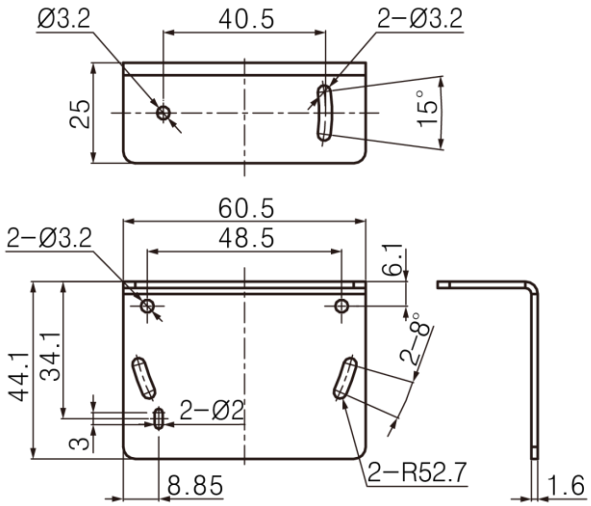


4.1.1 Bracket (accessory)

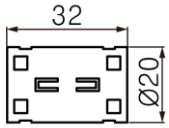
● BD-030



● BD-065/100



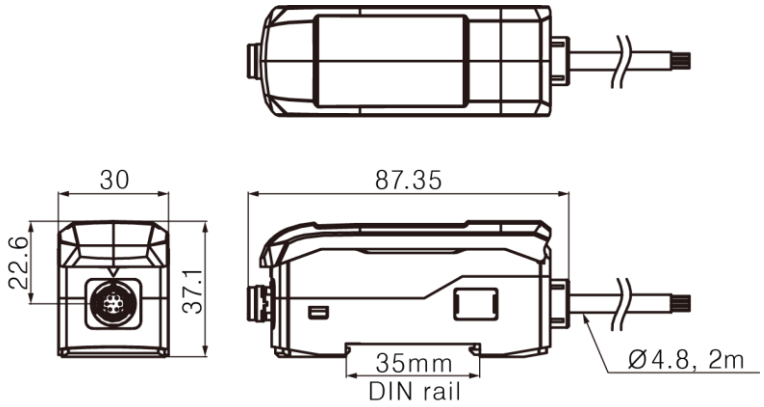
4.1.2 Ferrite core (accessory)



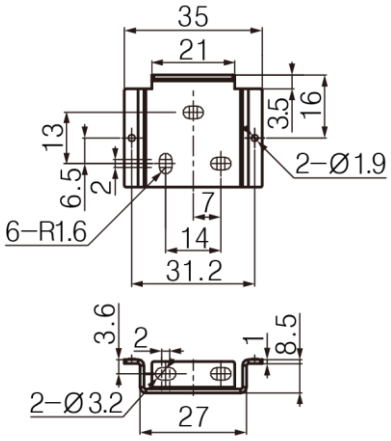
4.1.3 Extension cable (sold separately)

4.2 Amplifier Unit

(unit: mm)



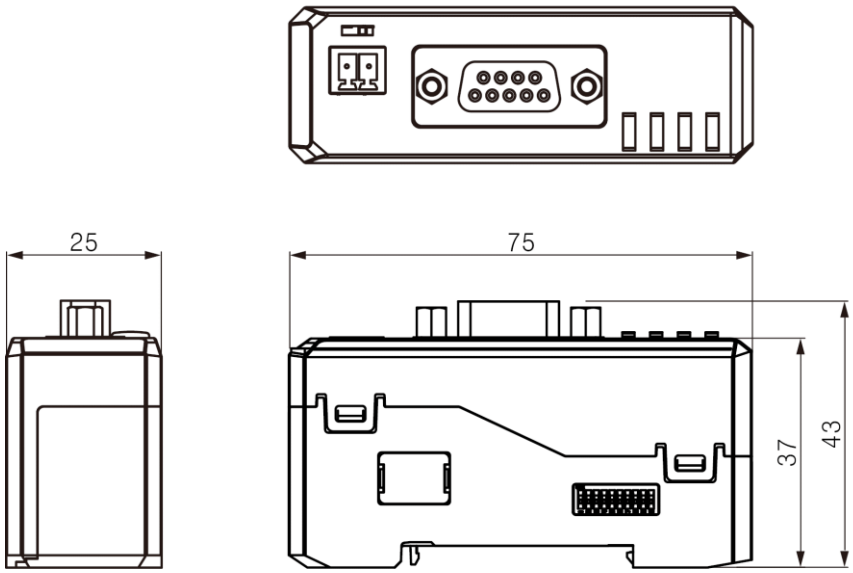
4.2.1 Bracket (accessory)



4.2.2 Extension cable (sold separately)

4.3 Communication Converter

(unit: mm)



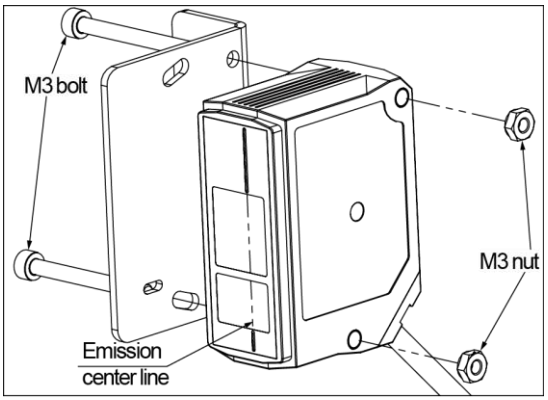
5 Installation

5.1 Installation Procedures

Order	Chapter	Description
1	Check reference distance and	As the distance between the sensor head and the object approaches the reference distance, accurate measurements can be made. Refer to '5.2.2 Mounting Location'.
2	Select mounting location	In case of measuring moving or rotating object, it is needed to install the sensor head to correct direction. When measuring at narrow area or concave object, it is needed to set the position of the sensor head. For the details, refer to '5.2.3 Installation Precautions'.
3	Check the precautions about the measurement	Mount to the panel directly or through the enclosed bracket. Refer to '5.2.1 Mounting' to mount the sensor head.
4	Check mounting method and mount	BD series support various settings and functions such as pitch light optimization, zero adjustment setting, automatic sensitivity setting, calculation through the amplifier unit. Refer to '5 Installation - 5.3 Amplifier Unit', '6 Function – Amplifier Unit'.
5	Check and apply the function of communication converter	It is possible to set parameters, monitor and manage data by connecting between communicate between BD-C Series communication converter and master device. Refer to '5 Installation - 5.5 Communication Converter'.

5.2 Sensor Head

5.2.1 Mounting



- Check the mounting position considering emission center line, vibration and shock.
- Mount to the panel directly or through the bracket by using M3 bolt and nut.
- Tighten the bolt with 0.5N.m torque when mounting.

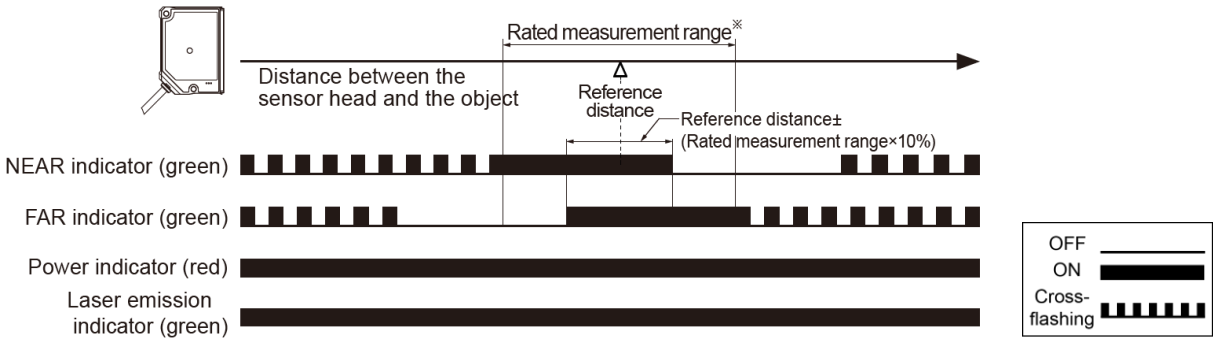
5.2.2 Mounting Location

Select mounting location regarding displacement of the object, reference distance and measurement range.

Mount sensor head where the object is located at the reference distance by checking the operation of indicators and displacement value.

- **Indicator display**

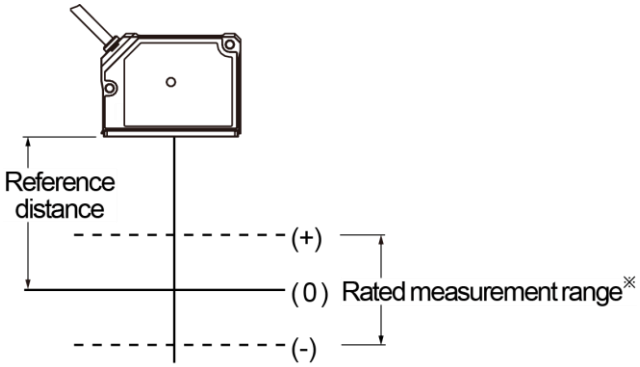
  Check the distance between sensor head and object by indicator display.



  - NEAR/FAR indicators turn on, off and cross-flashing by the distance between the sensor head and the object and the indicator are on both, it means the sensor head is located in optimum area near reference distance.
  - Power indicator is on when power is supplied.
  - Laser emission indicator is on during laser emission.

※ The linearity guaranteed measurement range.

- **Displacement indication**



The value is displaced more positive (+) as the object is closer to sensor head, more negative value (-) as the object is far from sensor head relative to the origin (0).

- **Indication by distance** **(unit: mm)**

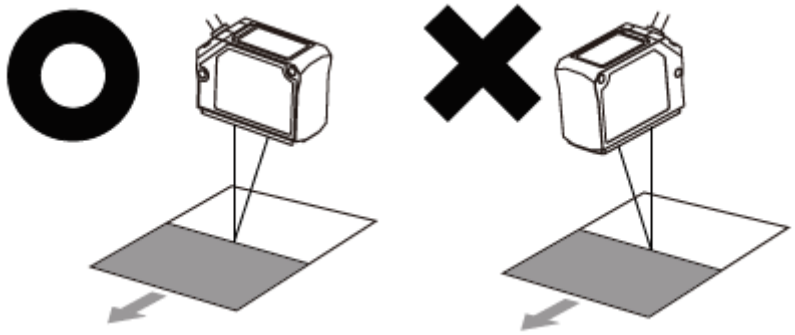
Model	Reference Distance	Rated measurement range※	Indication		
			NEAR ON	NEAR/FAR ON	FAR ON
BD-030	30	25 to 35	25 to 31	29 to 31	29 to 35
BD-065	65	55 to 75	55 to 67	63 to 67	63 to 75
BD-100	100	80 to 120	80 to 104	96 to 104	96 to 120

※ The linearity guaranteed measurement range.

5.2.3 Installation Precautions

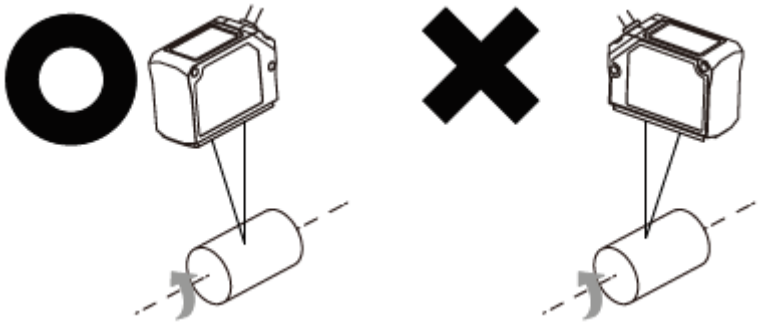
For stable measurement, mount the sensor head by refering to the below items.

- **Moving object measurement**
  - Object with material / color difference



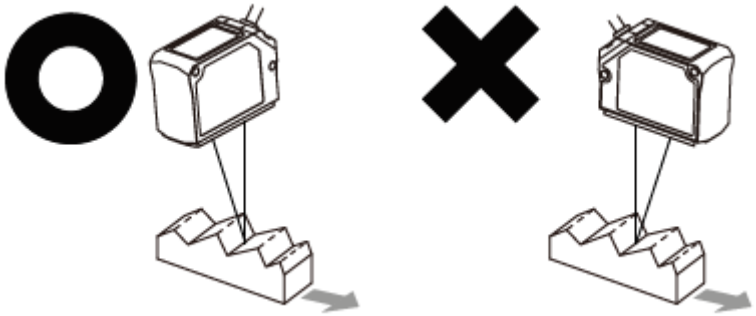
Install the emitter and receiver in parallel to the material or color boundary of the object.

  - Rotating object



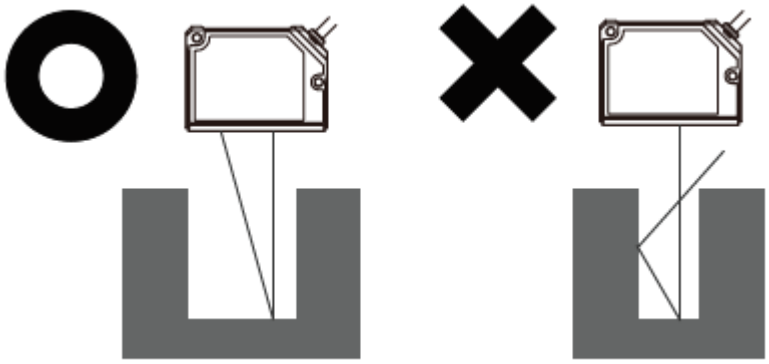
Install the receiver and the rotating shaft in parallel to minimize the influence of fluctuations and position deviations.

  - Object with step



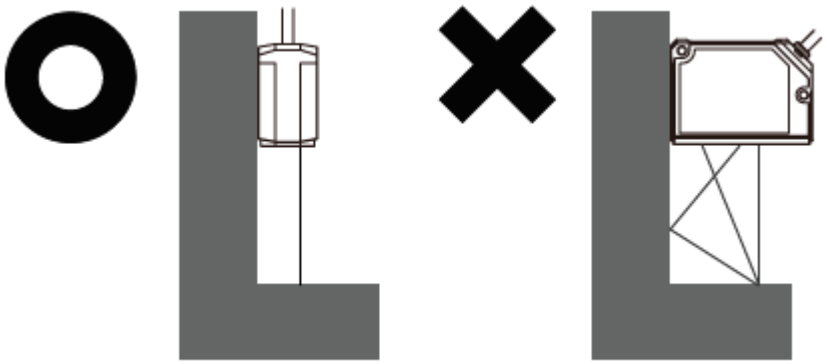
Install the emitter and receiver vertically to the line between crest and valley of the object.

- **Narrow area or concave object**



Install the sensor head where the reflected laser beam does not blocked toward the receiver part.

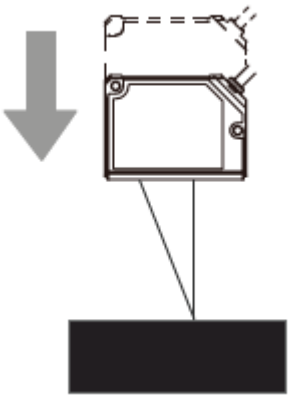
- **Wall mounting**



Install the sensor head where the reflected laser beam from the wall does not enter the receiver part.

If the color of wall is black with low reflectivity and no gloss, the error can be minimized.

- **Black object**



When measuring black object with low reflectance the amount of light received decreases, install the sensor head closely to the object.

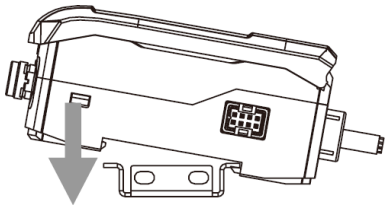
5.3 Amplifier Unit

5.3.1 Mounting with bolt

- Mounting without DIN rail is possible by using bracket.
- The method of mounting and detaching with bracket is as same as DIN rail.

5.3.2 Mounting on DIN rail

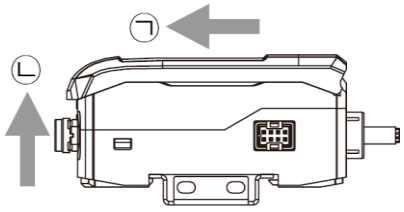
- **Mounting**



① Insert the bottom holder of amplifier unit to 35mm width DIN rail.

② Push the front part of the unit to arrow direction to mount.

- **Detaching**



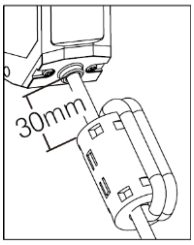
① Connecting: Insert a connector of the sensor head into amplifier unit with aligning '↑' mark and '▲' mark until it sounds click.

② Disconnecting: Pull out the connector cap of sensor head to the opposite direction.

5.4 Check Point for Installing Sensor Head and Amplifier Unit

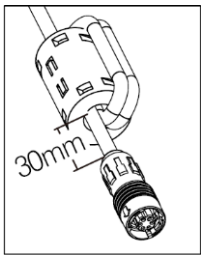
5.4.1 Ferrite core (accessory)

- **Sensor Head**



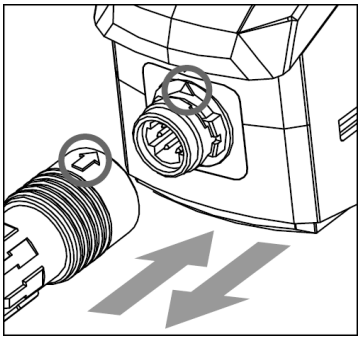
Within 30mm from the sensor head, wind the cable through the inside of the ferrite core three times and mount the ferrite core.

- **Extension cable (sold separately)**



Within 30mm from the connector of amplifier unit, wind the cable through the inside of the ferrite core three times and mount the ferrite core.

5.4.2 Connecting to amplifier unit

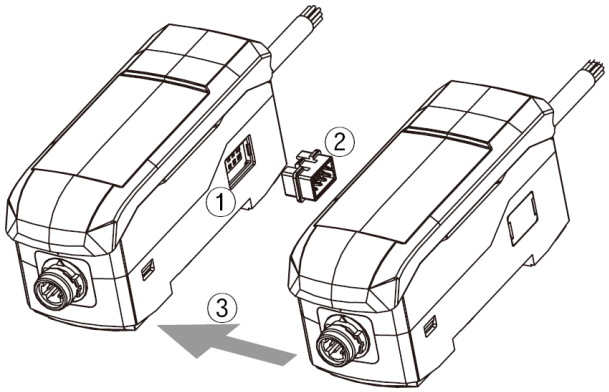


① Connecting: Insert connector of the sensor head into amplifier unit with aligning ↑ mark and ▲ mark until it sounds click.

② Disconnecting: Pull out the connector cap of sensor head to the opposite direction.

※ Do not supply the power when connect / disconnect sensor head to amplifier unit.

5.4.3 Connecting amplifier units mutually



① Remove the side cover at the connecting side.

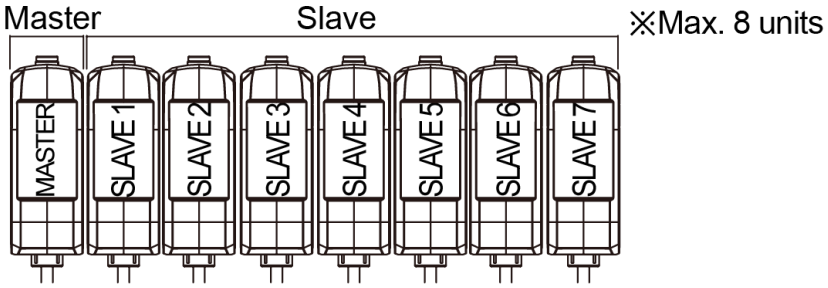
② Connect the side connector to the units.

③ After mounting amplifier unit on DIN rail, push it to arrow direction tightly.

※ In case of disconnecting, follow the upper sequence reversely.

5.4.4 Distinguishing master/slave amplifier units

When the power cable direction is down, the amplifier at the left end is the master unit, and the channel number of slaves increases sequentially to the right.



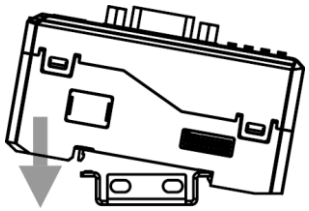
5.4.5 Precautions when connecting amplifier unit

- Mount on DIN rail.
- Do not supply the power when adding amplifier unit.
- Supply power to each connected amplifier unit at the same time.
- Up to 8 amplifier units can be connected, and only 1 calculation function can be performed per 1 group of mutually connected amplifiers.
- When the calculation function is activated, the setting values (SV) of the slave units are disable and the mutual interference prevention function for sensor heads is executed automatically.

5.5 Communication Converter

5.5.1 Mounting on DIN rail

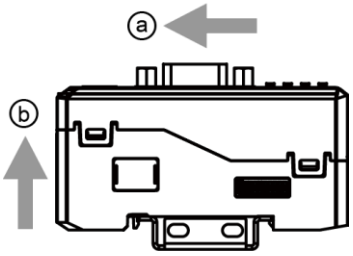
- **Mounting**



① Insert bottom holder of communication converter to 35mm width DIN rail.

② Push the front part of the unit to arrow direction to mount.

- **Detaching**

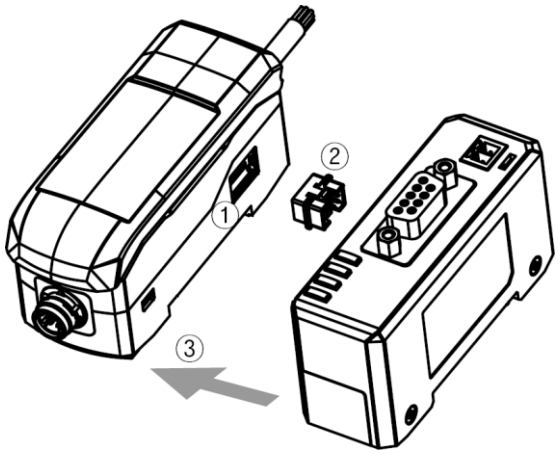


① Side amplifier unit to ⓐ direction.

② Pull the assembly part to ⓑ direction to detach.

5.6 Check Point for Installing Communication Converter

5.6.1 Connecting to amplifier unit



① Remove the side cover at the connecting side.

② Connect the side connector to the units.

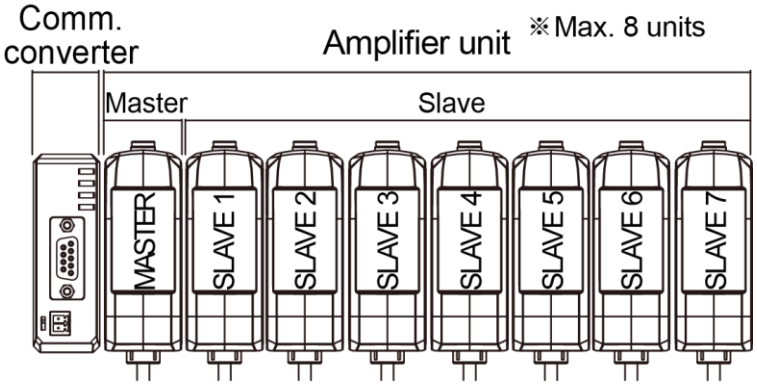
③ After mounting amplifier unit and communication unit on DIN rail, push it to arrow direction tightly.

※ In case of disconnecting, follow the upper sequence reversely.

5.6.2 Distinguishing master/slave amplifier units

When the power cable direction is down, the amplifier at the left end is the master unit, and the channel number of slaves increases sequentially to the right.

Communication converter is connected to the left side of master amplifier unit.



5.6.3 Precautions when connecting amplifier unit

- Mount on DIN rail.
- Do not supply the power when adding amplifier unit.
- Supply power to each connected amplifier unit at the same time.
- Up to 8 amplifier units can be connected, and only 1 calculation function can be performed per 1 group of mutually connected amplifiers.
- When the calculation function is activated, the setting values (SV) of the slave units are disable and the mutual interference prevention function for sensor heads is executed automatically.

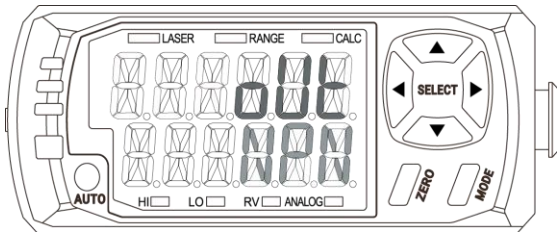
6 Function – Amplifier Unit

6.1 Display When Power is ON

Displays control output setting screen when connecting a sensor head and supplying power at the first time, or replacing a sensor head. Set the output type as below sequence.

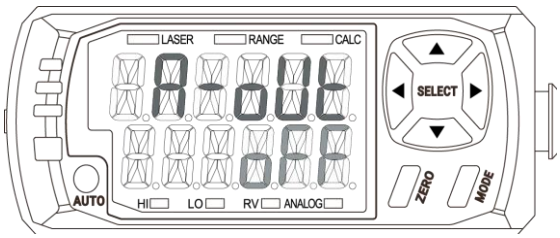
※ Refer to '6.2 Mode Setting' to check the setting range and the reset method.

① When '$_{o}$OUT' is displayed on the present value (PV) display, select control output type through the [▲/▼] keys and push the [MODE] key.



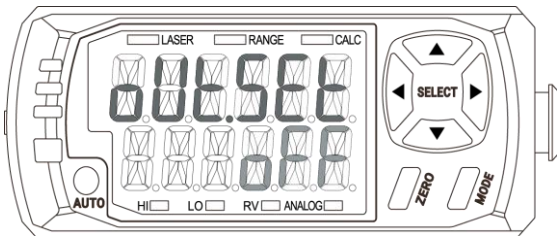
- Setting value
  NPN: NPN output (Default)
  PNP: PNP output

② When 'A-$_{o}$UT' is displayed on the present value (PV) display, select analog output type through the [▲/▼] keys and push the [MODE] key.



- Setting value
  $_{o}$FF: None (default) / 4-20MA: 4-20mA current output /
  0-5V: 0-5v voltage output / 1-5V: 1-5v voltage output / -5-5V: -5-5v voltage output

③ After '$_{o}$UT.SET' is flashed three times and it returns to the run mode.



6.2 Mode Setting

6.2.1 Parameter setting

Mode	Key	Description
Run mode		Present value (PV) display
		• Solo: Displays present value (PV). • When using calculation: Displays the result of calculation, and calculation indicator (CALC) of master amplifier unit turns on.
		Setting value(SV) display
		Displays HIGH setting value, LOW setting value, real distance value (RV), analog output, bank
Sensing optimization	[AUTO] key over 2 sec	Optimizes the level of laser emission and receiving sensitivity regarding the object color and environment.
Zero adjustment	[ZERO] key over 2 sec	Sets the present value (PV) to the reference distance forcibly.
HIGH sensitivity adjustment	[MODE]+[▲] key over 2 sec	Sets the judgment output (HIGH/GO/LOW) range by manual input.
LOW sensitivity adjustment	[MODE]+[▼] key over 2 sec	
Auto sensitivity adjustment (Teaching)	[MODE] key within 2 sec	Sets the judgment output (HIGH/GO/LOW) range automatically.
		• 1-point teaching Sets the judgment output range by using present value (PV) of reference object height.
		• 2-point teaching Sets the judgment output range by using present value (PV) of reference object step.
Control output type	[MODE]+ [AUTO] key over 2 sec	Sets the type of control/analog output.
HIGH PEAK value	[▲] key	Displays HIGH/LOW PEAK value.
LOW PEAK value	[▼] key	
Parameter group	[MODE] key over 2 sec	Enters to the parameter group 1 to 4.

6.2.2 RUN mode setting

6.2.2.1 Present value (PV) display

- **Solo**

  Displays present value (PV).

- **When using calculation**

  Displays the result of calculation, and calculation indicator (CALC) of master amplifier unit turns on.

※ Refer to '7.4.1 Calculation [CALC]' for the details of calculation'.

6.2.2.2 Setting value(SV) display

- **Selection**

  To change the type of value and turns on each recognition lamp, press [◀/▶] keys.

Display	Description	Setting value (SV) indicator recognition lamp
HIGH setting value	Displays high judgment value	Turns on 'HI'
LOW setting value	Displays low judgment value	Turns on 'LO'
Real distance value	Displays real distance value without zero adjustment, hold, and scale.	Turns on 'RV'
Analog output	Displays analog output value of voltage (V) or current (mA).	Turns on 'ANALOG'
Bank	Displays bank number	Turns off all recognition lamp

6.2.2.3 HIGH/LOW PEAK display

- **Execution**
  - Push [▲] key to display 'H-PEAK' on PV display and the value of high peak on SV display.
  - Push [▼] key to display 'L-PEAK' on PV display and the value of low peak on SV display.
- **Setting**
  - Push [▲] key over 3 sec during HIGH PEAK value display mode, initializes the value. If there is no present value, displays 'HHHH'.
  - If push [▼] key over 3 sec during LOW PEAK value display mode, initializes the value. If there is no present value, displays 'LLLL'.

- **Exit**

  If there is direction key input [◀] / [▶] / [▲] / [▼] or no key input for 5 sec, returns to run mode.

6.2.3 Sensing optimization

Optimizes the level of laser emission and receiving sensitivity regarding the object color and environment.

- **Execution**

  Press [AUTO] key over 2 sec to execute the sensing optimization. When the optimization is finished, 'OK' is displayed on SV display and returns to run mode automatically.

6.2.4 Zero adjustment

Sets the present value (PV) to the reference distance forcibly.

After zero adjustment, displacement value is displayed on the basis of PV, not the reference distance.

- **Execution**
  - Push [ZERO] key over 2 sec.
  - Apply the signal to external input wire for zero adjustment over 3 sec.
- **Setting**

  After 'ZERO' on PV display, '0000' is displayed, and PV is set as the reference distance.
- **Dismiss**

  Initializes changed reference distance by zero adjustment.
  - Push the [ZERO]+[MODE] keys over 2 sec.
  - Apply the signal to external input wire of zero adjustment over 3 sec.

Note

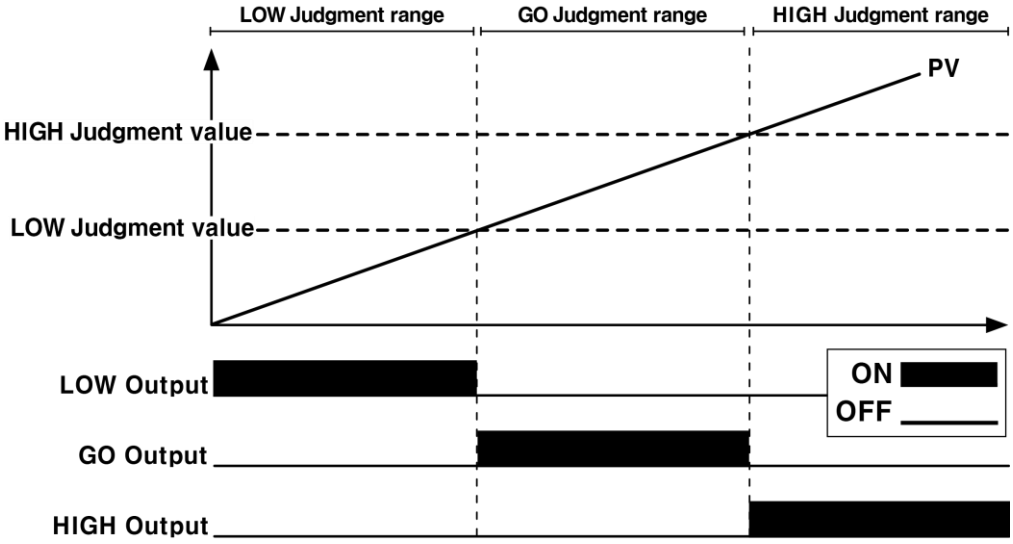
If the present value is changed by zero adjustment, the setting values (HIGH SV, LOW SV etc.) are not changed.

6.2.5 Sensitivity adjustment

The device outputs judgment output by setting the range (HIGH/GO/LOW) and satisfying it.

It is possible to set HIGH judgment value and LOW judgment value. HIGH judgment signal is outputted when PV is over HIGH judgment value and LOW judgment signal is outputted when PV is under LOW judgment value.

The range between HIGH judgment value and LOW judgment value is set as GO judgment range automatically and output GO judgment signal.



※ HIGH judgment value should be set greater than LOW judgment value. (HIGH judgment value > LOW judgment value)

6.2.5.1 Factory default

Model	Setting range	Factory default	
		LOW judgment value	HIGH judgment value
BD-030	-99.999 to 99.999	-5,000	5,000
BD-065		-10,000	10,000
BD-100		-20,000	20,000

※ Factory default is automatically set when connecting the sensor head to the amplifier unit.

6.2.5.2 Manual sensitivity adjustment

Sets the judgment output (HIGH/GO/LOW) range by manual input.

- **Execution**
  - Press [MODE] + [▲] over 2 sec to enter HIGH sensitivity adjustment.
  - Press [MODE] + [▼] over 2 sec to enter LOW sensitivity adjustment.
- **Setting**
  - Change the number of digit by the [◀] / [▶] keys.
  - Change the setting value by the [▲] / [▼] keys.
- **Exit**
  - Press [MODE] key within 2 sec to return to run mode.

6.2.5.3 Auto sensitivity adjustment (Teaching)

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

Enter the auto sensitivity adjustment setting mode after set the type of teaching mode in parameter 1 group.

※ Refer to '7.3.2 Teaching mode [SENS]' to check the selecting method of teaching type.

- **1-point teaching**

  Sets the judgment output range by using present value (PV) of reference object height.

  - HIGH setting value=height present value×1.5

  - LOW setting value=height present value÷2

  - **Execution**

    Press key [MODE] key within 2 sec.

  - **Setting**

    ① 'IP' is displayed on setting value (SV) display, push the [AUTO] key within 2 sec.

    ② After teaching the object for 2 sec, set the judgment output range automatically by applying the result.

- **2-point teaching**

  Sets the judgment output range by using present value (PV) of reference object step.

  - HIGH setting value=(step×1.5)+bottom height

  - LOW setting value=(step÷2)+bottom height

  - **Execution**

    Press key [MODE] key within 2 sec.

- **Setting**
  ① '1P' is displayed on setting value (SV) display, push the [AUTO] key within 2 sec.
  ② After teaching the object for 2 sec, '2P' is displayed on setting value (SV) display, push the [AUTO] key within 2 sec.
  ③ After teaching the object for 2 sec, set the judgment output range automatically by applying the result.

6.2.6 Control output type

Sets the type of control/analog output.

Control output setting screen is displayed when connecting a sensor head and supplying power at the first time. It is possible to re-enter by below execution method.

※ Refer to '6.1 Display When Power is ON' to check about first power supply.

▪ **Execution**

Press [MODE] + [AUTO] keys over 2 sec.

▪ **Setting**

① 'oUt' is displayed on present value (PV) display, select the setting value by [▲] / [▼] key, and apply by [MODE] key.

- Setting value
  NPN: NPN output (Factory default)
  PNP: PNP output

② 'A-oUt' is displayed on present value (PV) display, select analog output type, and apply by [MODE] key.

- Setting value
  oFF: Disable (Factory default) / 4-20MA: 4-20mA current output /
  0-5V: 0-5V voltage output / 1-5V: 1-5V voltage output /
  -5-5V: -5-5V voltage output

③ After setting is finished, flashes 'oUt.SEt' on present value(PV) display and 'End' on setting value (SV) display 3 times, and returns to run mode.

7 Parameter Group – Amplifier unit

7.1 Setting

- Push the [MODE] key over 2 sec to enter the parameter setting mode.
- In the setting mode, change the parameter group by the [◀/▶] keys and enter the group by pushing the [MODE] key.
- In the group, change the parameter by the [◀/▶] keys, select it by pushing the [MODE] key, and change the setting value by [▲/▼] keys
- In each step, push the [MODE] key over 3 sec to save and return to the upper step.

7.2 Configuration, Setting range and Factory default

This chapter is the guide with a brief description for parameter, setting range and factory default.

The amplifier unit automatically change the setting value by recoginzing connected sensor head model.

※ Refer to the each chapter in '7 Parameter Group – Amplifier unit' for the details.

PARA 1	**Parameter group 1: Settings related to output type, displacement, display and error output.**				
Parameter		**Setting range**		**Description**	**Default**
RSPd	Response time	330μs, 500μs, 1ms, 2ms, 5ms		Sets the data sampling response time.	1ms
SENS	Teaching mode	1PNt	1-point	Sets the type of teaching mode.	1PNt
		2PNt	2-point		
NoNC	Output type	No	Normally open	Sets the control output type.	No
		NC	Normally closed		
dISP	PV display	StNd	Standard	Sets the type of PV display.	StNd
		SCALE	Scale		
dot	Display digit	0.000, 0.00, 0.0, 0		Sets the decimal point of PV display.	0.000

PARA 1	Parameter group 1: Settings related to output type, displacement, display and error output.			
Parameter		**Setting range**	**Description**	**Default**
H-SC L-SC	Display scale	-99.999 to 99.999	Sets the display scale value.	BD-030 L-SC : -5.000 H-SC : 5.000 BD-065 L-SC : -10.000 H-SC : 10.000 BD-100 L-SC : -20.000 H-SC : 20.000
HYS	Hysteresis	0.001 to 99.999	Set the value of hysteresis.	0.001
H-AN L-AN	Analog output scale	-99.999 to 99.999	Changes present value (PV) to linear range (Scale) and output it as analog signal.	BD-030 L-SC : -5.000 H-SC : 5.000 BD-065 L-SC : -10.000 H-SC : 10.000 BD-100 L-SC : -20.000 H-SC : 20.000
ERR.OUT	Error output	KEEP : Keep PV FIX : Fixed value	Select the type of output when an error occurs. ※ The default of fixed value is the maximum value of previously set analog output.	KEEP
FIX.OUT	Fixed output	Set value of analog output	Outputs the fixed analog value when an error occurs.	Max. value within the range

PARA2	Parameter group 2: Settings related to present value				
Parameter		**Setting range**		**Description**	**Default**
CALC	Calculation	oFF	Off	Sets the type of inner-calculation.	oFF
		Add-Ab	Add		
		Sub-Ab	Subtraction		
		AVG	Averge		
GAIN	Gain	1, 2, 3		Sets the level of sensing sensitivity which increases with level.	1
FILTER	Filter	AVF	Averge	Sets the filter which controls deviation of present value (PV).	AVF
		diFF	Differential		
AVF	Samples for averaging	1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096		Sets the number of sampling for average.	16
MEdIAN	Samples for median	OFF, 3, 5, 7, 15, 31		Sets the number of sampling for median.	oFF
Hold	Hold	oFF	Off	Set the output holding type for hold timing input [HoLdt].	oFF
		PEAK	Peak		
		bottoM	Bottom		
		P-P	Difference		
		SAMPLE	Sample		
		AVG	Average		
Holdt	Hold timing input	t-IN	External input	Set the sampling time condition for hold [Hold]. ※ The parameter is activated when the value of hold [Hold] is not OFF.	t-IN
		At.UP	Over auto trigger level		
		At.dW	Under auto trigger level		
ATLV	Auto trigger level	-99.999 to 99.999		Set the auto trigger level of hold timing input [Holdt]. ※ The parameter is activated when the value of hold timing input [Holdt] is over/under auto trigger level [At.UP] or [At.dW].	0

PARA2	Parameter group 2: Settings related to present value			
Parameter		**Setting range**	**Description**	**Default**
AT.HYS	Auto trigger hysteresis	0.001 to 99.999	Set the hysteresis value of Auto trigger level [AT.LV]. ※ The parameter is activated when the value of hold timing input [T-IN] is over/under auto trigger level [AT.UP] or [AT.dW].	0.001
T-Mod	Timer	oFF: Off oNd: On delay oFd: Off delay	Sets the type of judgment output	oFF
TIME	Timer value	0 to 9999	Set the delay or hold time of timer [T-Mod].	0

PARA3	Parameter group 3: Settings related to external input.			
Parameter		**Setting range**	**Description**	**Default**
d-IN1	External input 1	oFF: Off T-IN: Timing input oUT.CLR: Output reset L-oFF: Stop emission ZERo: Zero adjustment bANK-A: Bank input-A bANK-b: Bank input-B	Assigns the function to each external wire.	T-IN
d-IN2	External input 2			oUT.CLR
d-IN3	External input 3			L-oFF
d-IN4	External input 4			ZERo

PARA4	Parameter group 4: Settings related to user convenience functions (This parameter group is common, not saved per bank separately)			
Parameter		**Setting range**	**Description**	**Default**
dIR	Display direction	Change display direction of present value (PV) and setting value (SV).		Normal display
bANK	Bank	bANK-0, bANK-1, bANK-2, bANK-3	Save and load the parameter setting values.	bANK-0
SAVE	Saving mode	oFF: Off SAVE1: Digital display SAVE2: All display	If there is no user input over 1min in run mode, turn off the display to save power.	oFF

PARA4	Parameter group 4: Settings related to user convenience functions (This parameter group is common, not saved per bank separately)			
Parameter		**Setting range**	**Description**	**Default**
LoCK	Lock mode	Set the type of key which lock function is applied.		oFF
		oFF	Off	
		LoCK1	[AUTO], [ZERO] key lock	
		LoCK2	[AUTO], [ZERO] key + entering parameter group lock	
		LoCK3	All key lock (except unlock key)	
INIt	Initialize	oFF, CLR-b0, CLR-b1, CLR-b2, CLR-b3, CLR-A	CLR-b□: Initialize No. □ bank parameter setting value. CLR-A: Initialize all bank parameter setting value.	oFF

7.3 Parameter Group 1 [PARA 1]

Explains items within parameter group 1 related to output type, displacement, display and error output.

※ Refer to '7.2 Configuration, Setting range and Factory default' to check them of each item in group.

7.3.1 Response time [RSPd]

Sets the data sampling response time.

When measuring objects with extremely low reflectance, such as black rubber, the response time should be set as long enough to allow sufficient light to be received. Conversely, if fast sampling is required, set the response time as short.

Frequency	Display	Brightness of object
330μs | 5ms	330US | 5MS	Bright | Dark

7.3.2 Teaching mode [SENS]

Sets the type of teaching mode.

Auto sensitivity adjustment in '7.2 Configuration, Setting range and Factory default' is conducted by the mode selected in this parameter.

- **1-point teaching [1PNt]**

  When the object is present, the value is measured and applied to calculate HIGH/LOW setting.

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

- **2-point teaching [2PNt]**

  The value is measured and applied separately when the object is present and not present.

  This is a useful function for measuring the steps of object when there is a reference step.

※ Refer to '6.2.5 Sensitivity adjustment' to check the equation and setting details.

7.3.3 Output type [NoNC]

Selects output type (Normally open, Normally closed) for judgment output(HIGH/GO/LOW). Judgment signal with the type selected in this parameter is outputted according to the judgment output range which is set in '6.2.5 Sensitivity adjustment'.

7.3.4 PV display [dI SP]

Sets the type of PV display.

- **Standard [StNd]**

  Displays the measured value in rated measurement range per each sensor head.

- **Scale [SCALE]**

  Displays the input within setting range of 'High/Low display scale'.

※ Refer to '7.3.6 Display scale [H-SC /L-SC]' in parameter group 1 to check the details of scale setting.

7.3.5 Display digit [dot]

Sets the decimal point of the present value (PV) and the setting value (SV).

- **Setting range**

Range	Description
0.000	Display 3 digit after the decimal point
0.00	Display 2digit after the decimal point
0.0	Display 1 digit after the decimal point
0	Display integer

7.3.6 Display scale [H-SC /L-SC]

※ Converts the present value (PV) to any linear range (scale) and displays it.

※ Only appears when 'PV display [dI SP]' is set to 'Scale [SCALE]'.

- H-SC

  High display scale value for maximum input

- L-SC

  Low display scale value for minimum input

※ The parameter is activated when the value of PV display [dI SP] is 'Scale [SCALE]'.

Ex.

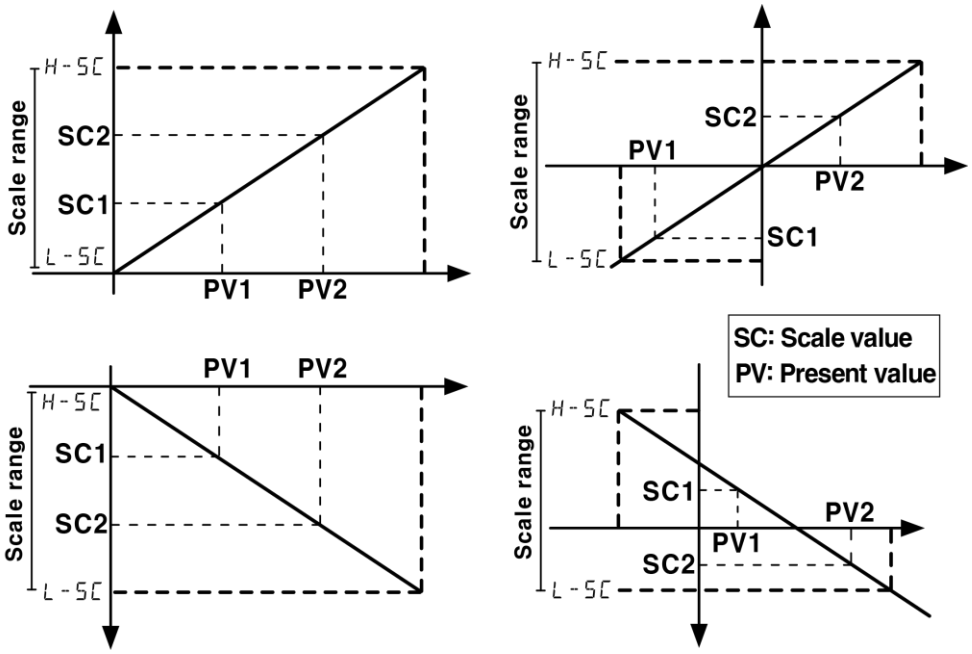
- **Example setting table**

  Based on sensor head BD-030 model

  (Reference distance: 30mm, Maximum measurement range: 20 to 40mm, Rated display range: -5 to 5)

Setting range		Present value (PV) – Scale display (SD)							
H-SC	L-SC	PV1	SD1	PV2	SD2	PV3	SD3	PV4	SD4
-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

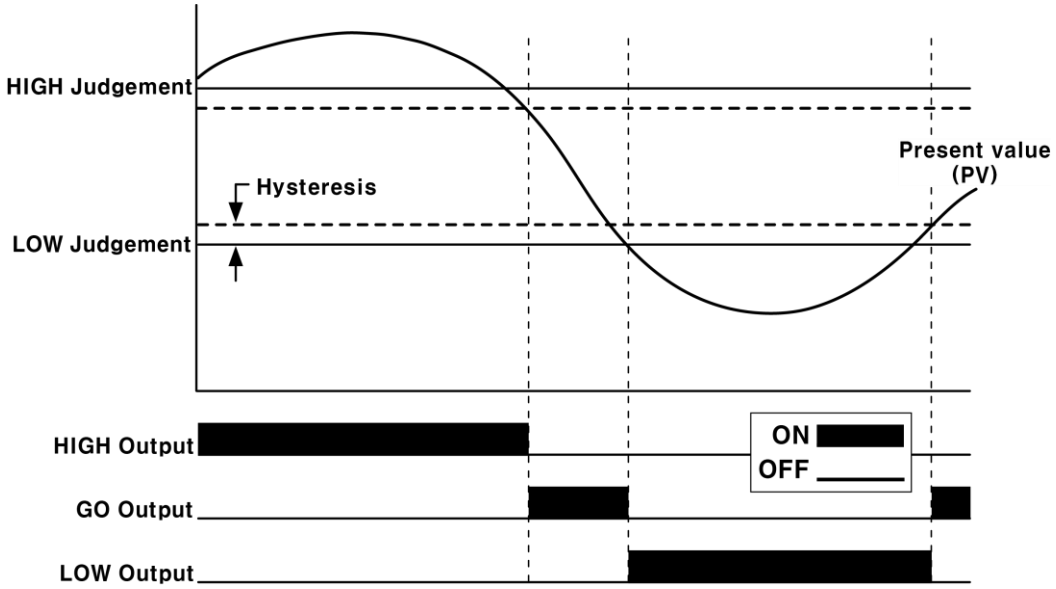
- **Example graph**



7.3.7 Hysteresis [HYS]

Sets specific value between ON/OFF of output and delay transition to prevent output instability due to chattering. Refer to below operation timing chart.

- **Hysteresis operation timing chart**



7.3.8 Analog output scale [H-AN / L-AN]

Converts present value (PV) into linear range (Scale) and output it to an analog signal.

- H-AN
  High analrog output scale value for maximum input
- L-AN
  Low analog output scale value for minimum input

※ The parameter is activated when the value of analog output [A-OUT] is not OFF.

Ex.

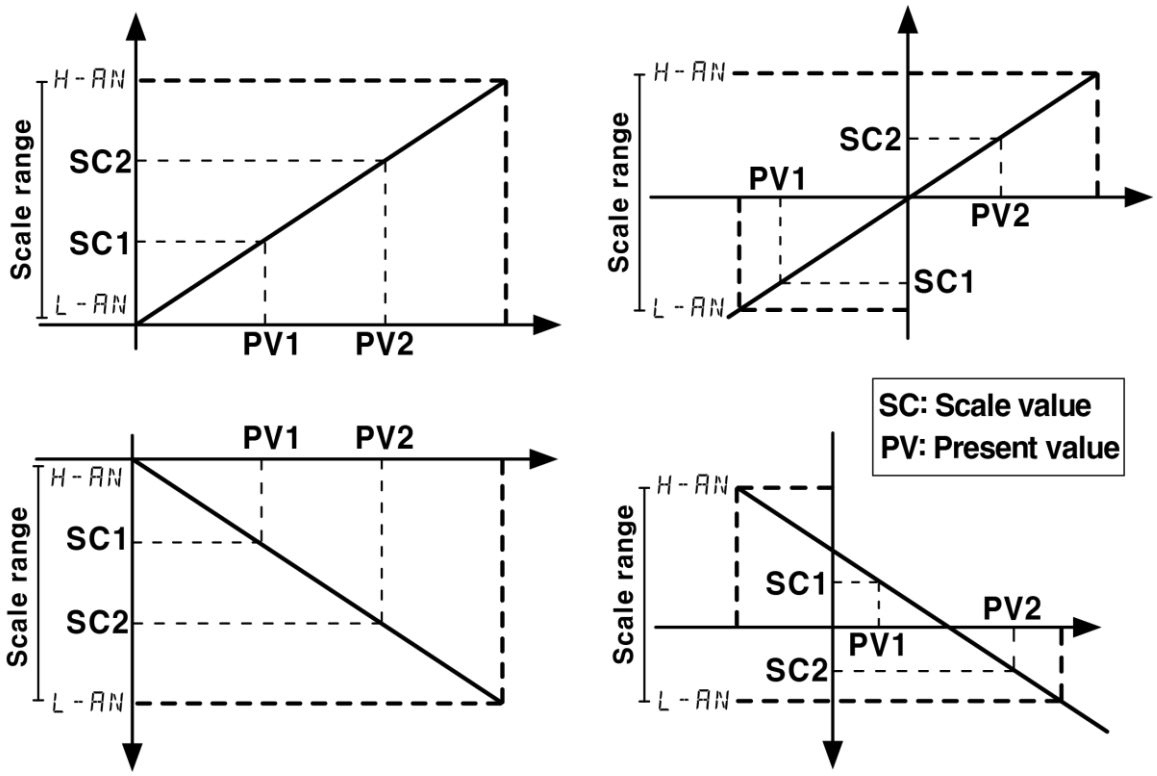
- **Example setting table**

  Based on sensor head BD-030 model, set analog output as '-5 to 5V'.

  (Reference distance: 30mm, Maximum measurement range: 20 to 40mm, Rated display range: -5 to 5)

Setting range		Present value (PV) – Analog output (AO, -5 to 5V)							
H-AN	L-AN	PV1	AO1	PV2	AO2	PV3	AO3	PV4	AO4
5	0	5	5V	3	1V	2	-1V	0	-5V
0	5	0	5V	2	1V	3	-1V	5	-5V
-5	5	-5	5V	-2.5	2.5V	2.5	-2.5V	5	-5V

- **Example graph**



7.3.9 Error output [ERR.oUt]

Select the type of output when an error (out of measurement range, lack or saturation of sensitivity), external input – output [oUt.CLR], filter delay (present value is lower than filter setting value) occurs.

※ Alarm output does not work during error output.

- **Keep PV [KEEP]**

  Maintains and outputs the present value before an error occurs.

  (Judgment output ON / Analog output ON)

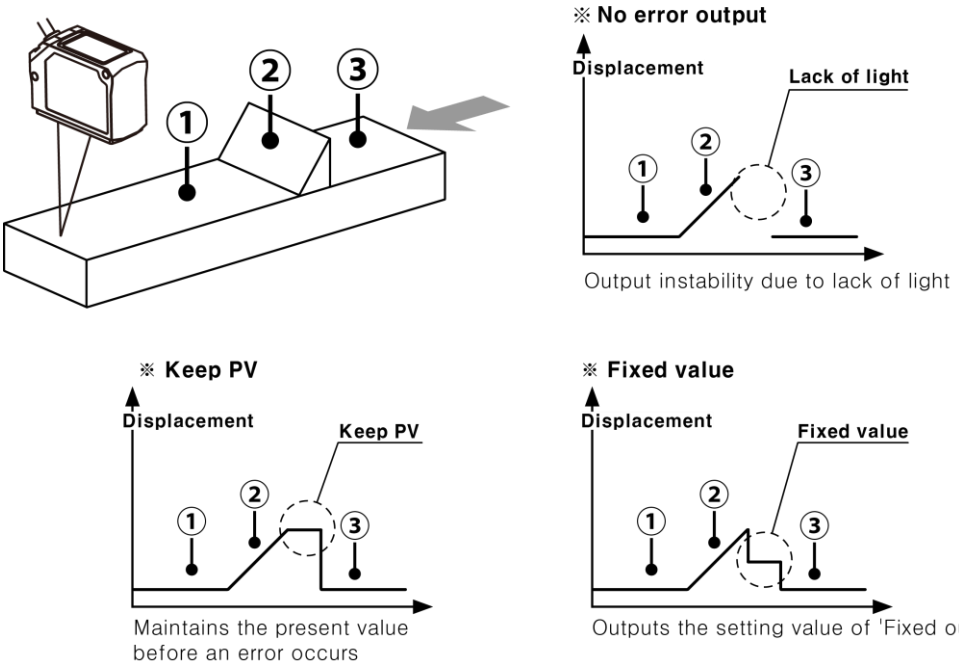
- **Fixed value [FIX]**

  Outputs the previously set value in '7.3.10 Fixed output [FIX.oUt]'.

  (Judgment output OFF / Analog output ON)

Ex.

- **Graph**



7.3.10 Fixed output [F1 %.oUt]

Outputs the fixed analog value when an error occurs.

※ The parameter is activated when the value of analog output [A-oUt] is not OFF and error output [ERR..oUt] is Fixed value [F1 %].

- **Setting range and default by analog output**

Type	Analog output	Setting range	Default
Current	4-20mA	4.00-20.00mA	Maximum value
Voltage	0-5V	0.000-5.000V	
	1-5V	1.000-5.000V	
	-5-5V	-5.000-5.000V	

7.4 Parameter Group 2 [PARA2]

Explains items within parameter group 2 related to present value.

※ Refer to '7.2 Configuration, Setting range and Factory default' to check them of each item in group.

7.4.1 Calculation [CALC]

Inner-calculates the measurement value of multiple sensor head and output it.

When activating calculation, the mutual interference prevention function and the response speed setting change according to the number of connected amplifiers, and all setting is possible on the master amplifier unit.

※ Zero adjustment is possible in each device.

※ Only appears when multiple amplifier units are connected.

- **Off [oFF]**

  Displays the measurement value separately per each sensor head. Set when communicating each amplifier unit and PC via communication converter.

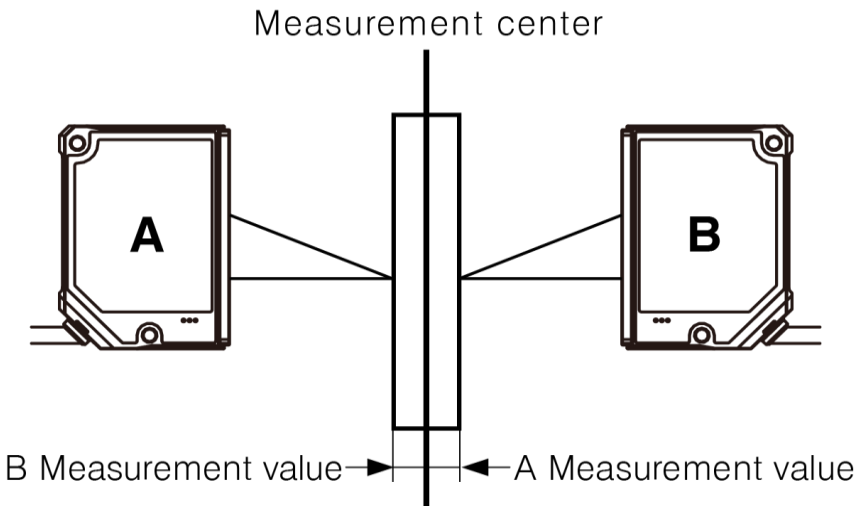
- **Add [Add-Ab]**

  Displays the added measurement value of 2 sensor heads.

  Use when measuring a thickness of the object.

  Place 2 sensor heads facing each other and adjust the object to be center of them.

  - Equation: Sensor head A + Sensor head B

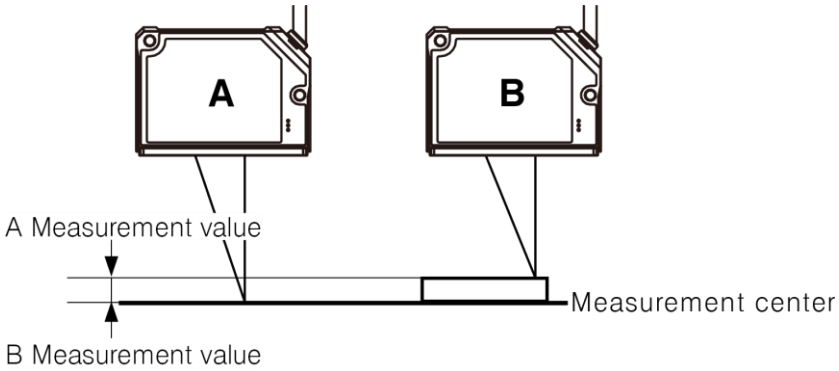


- **Subtraction [SUb-Ab]**

  Displays the difference between measurements of 2 sensor heads.

  Use when measuring step, lifting, bending of the object.

  - Equation: Sensor head A – Sensor head B

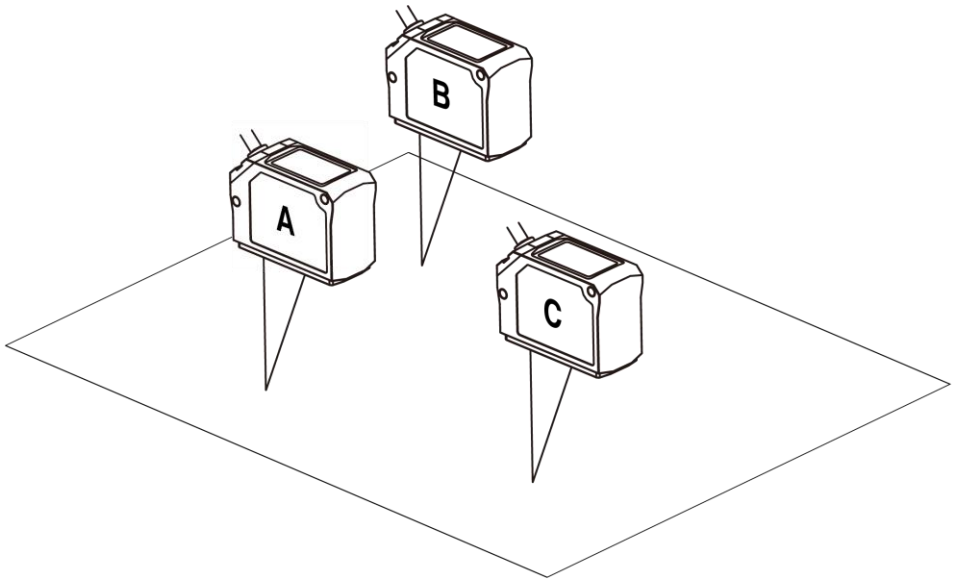


- **Average [AVG]**

  Displays the average of measurements of 2 or more (up to 8) sensor heads.

  Use when measuring a flatness of the object.

  - Equation: (Sensor head A + Sensor head B + Sensor head C + … + Sensor head N) ÷ N



7.4.2 Gain [GAIN]

When measuring target objects with low reflective light or large inclines in the measuring surface, adjust the level of the sensitivity of the sensor head to provide a stable instrument. The higher setting value makes sensitivity greater but it can be easily influenced by external factor and resolution might be lowered.

7.4.3 Filter [FILTER]

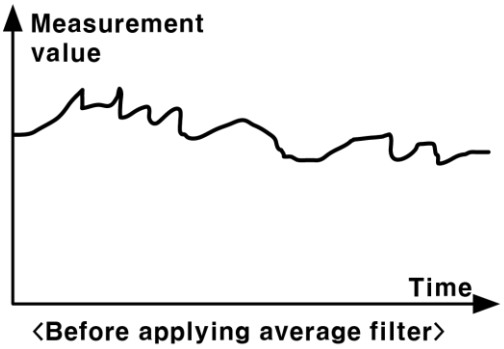
Sets the filter to adjust the deviation of the sensor head measurement value. BD series support 'Average [AVF]', 'Differential [diFF]', 'Median [MEdIAN]' filters.

※ Median filter can be set through a separate parameter. Refer to '7.4.5 Samples for median [MEDIAN]'.

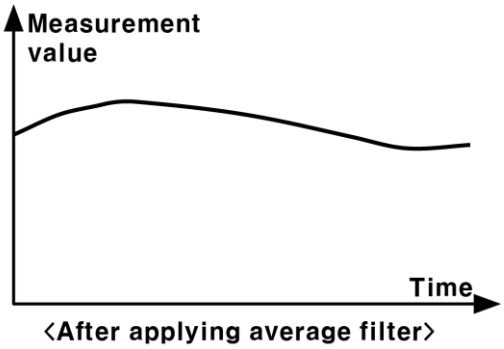
※ It is not possible to use 'Average [AVF]' and 'Differential [diFF]' filters at the same time.

- **Average [AVF]**

  Samples the most recent measurements and calculates the average and outputs them to reduce the rapid changes of the measured values.



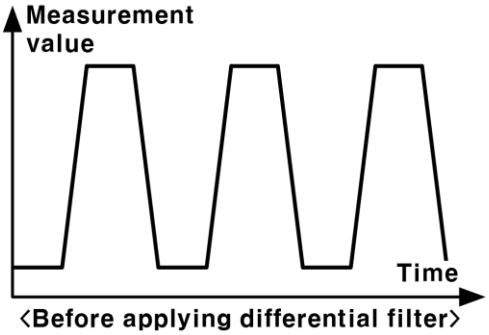
〈Before applying average filter〉



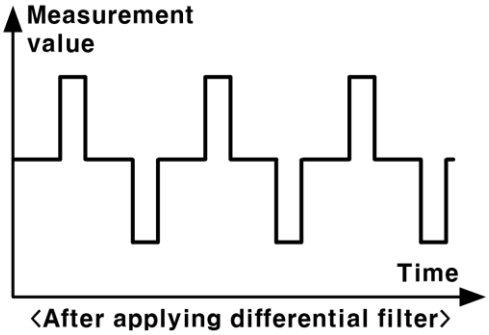
〈After applying average filter〉

- **Differential [HPF]**

  Outputs the difference between the current and the previous measurement. Use when detecting sharp deviations.



〈Before applying differential filter〉



〈After applying differential filter〉

7.4.4 Samples for averaging [AVF]

Sets the number to sample for averaging. The amplifier unit calculates the average and outputs it.

※ Only appears when setting 'Filter [FILTER]' as 'Average [AVF]'.

7.4.5 Samples for median [MEDIAN]

Sets the number to sample for median. The amplifier unit calculates the median and outputs it. It is possible to filter out sudden changes in values (e.g., disturbance, noise, etc.) that cannot be removed by the average filters.

※ The median filter function is disabled by setting the parameter to OFF.

※ BD-series displacement sensor indicates the present value by processing the measurement in the order of the median → average / differential.

7.4.6 Hold [HOLD]

Maintains the display and outputs measurement value during the sampling time in the set type. The sampling time can be adjusted by setting the 'Hold Timing Input [HOLDT]' parameter.

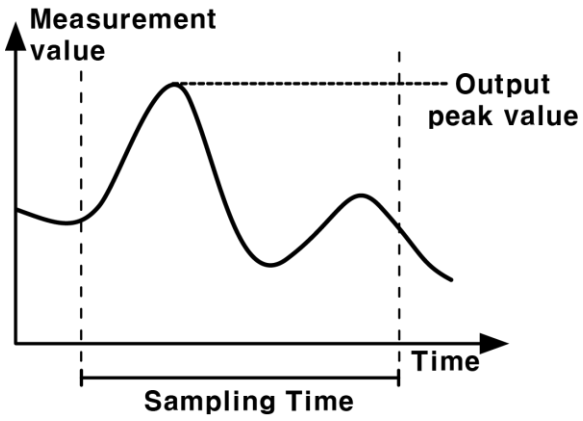
※ Refer to '7.4.7 Hold timing input [HOLdT]' for the details of hold timing input.

※ 'Timer [T-MOD]' and 'Hold [HOLD]' cannot be used at the same time. When the timer function is enabled, the hold function setting automatically switches to OFF.

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

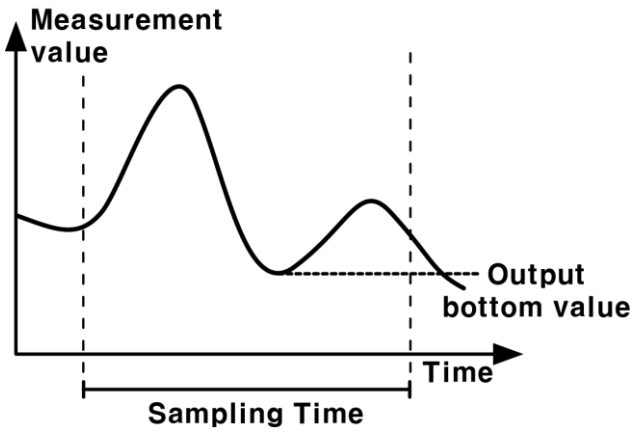
- **Peak [PEAK]**

  Outputs and maintains the maximum value during the sampling time. The output starts after the sampling ends and remains until the end of the next sampling.



- **Bottom [bottoM]**

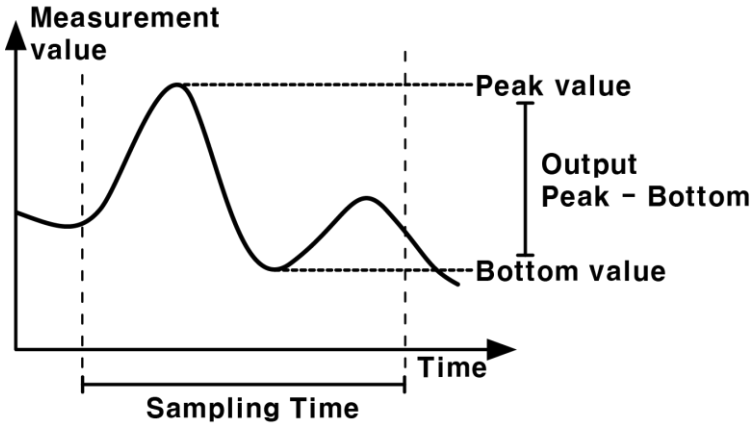
  Outputs and maintains the minimum value during the sampling time. The output starts after the sampling ends and remains until the end of the next sampling.



- **Difference [P-P]**

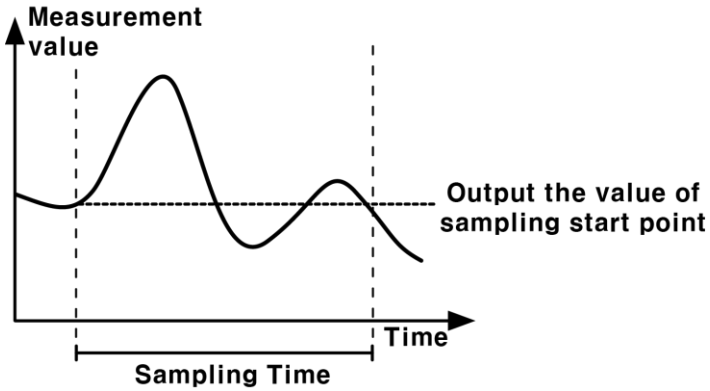
  Outputs and maintains the difference between maximum and minimum value during the sampling time. The output starts after the sampling ends and remains until the end of the next sampling.

※ Use when measuring vibration and eccentricity.



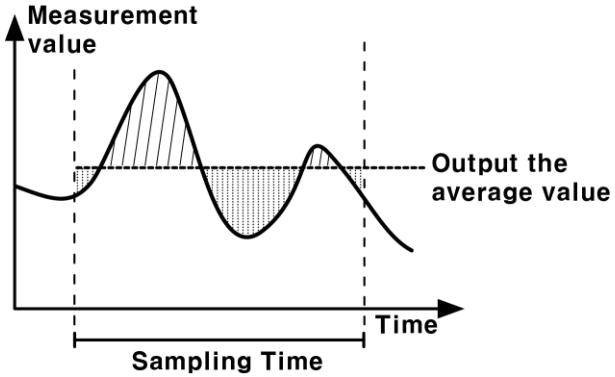
- **Sample [SAMPLE]**

  Outputs and maintains the value of sampling start. The output starts after the sampling ends and remains until the end of the next sampling.



- **Average [AVG]**

  Outputs and maintains the average value during the sampling time. The output starts after the sampling ends and remains until the end of the next sampling.



7.4.7 Hold timing input [HoLdt]

Sets the input type of the sampling time for hold function.

※ Only appears when 'Hold [HOLD]' is not set to OFF.

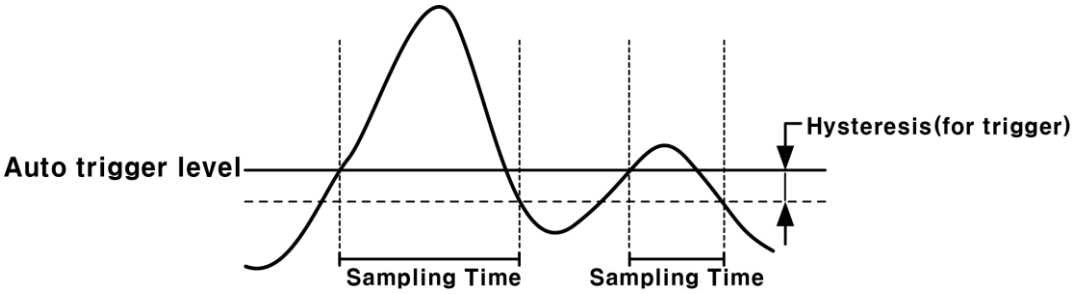
※ When setting 'Over / Under auto trigger mode [AT.UP] / [AT.dW]', enters 'Auto trigger level [AT.LV]', 'Auto trigger level hysteresis [AT.HYS]' sequentially.

- **External input [t-IN]**

  Inputs the trigger for sampling time by external input. Proceed sampling while external input signal is ON.

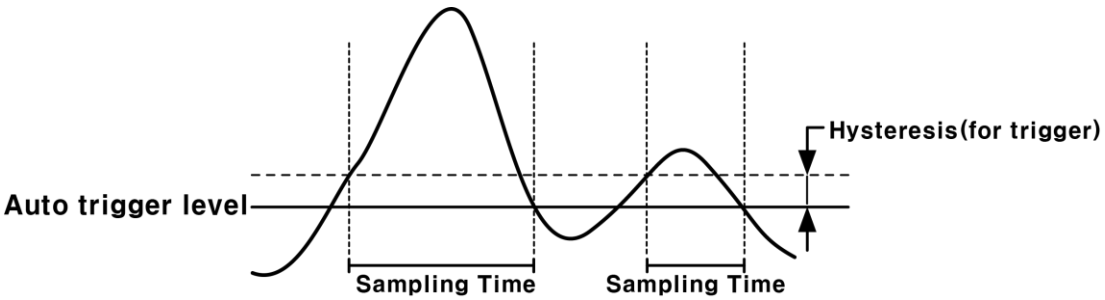
- **Over auto trigger level [AT.UP]**

  Sets auto trigger level and starts the sampling when measuring the value greater than the auto trigger level. When measuring the value lower than the auto trigger level, exit the sampling.



- **Under auto trigger level [AT.dW]**

  Sets auto trigger level and starts the sampling when measuring the value lower than the auto trigger level. When measuring the value greater than the auto trigger level, exit the sampling.



7.4.8 Auto trigger level [AtLV]

Sets the trigger level for auto trigger mode.

※ Only appears when setting 'Hold timing input [HoLdt]' to 'Over / Under auto trigger level [AtUP] / [AtdW]'.

※ When the 'Display scale [H-SC] / [L-SC] function is applied, the trigger will operate based on the present value (PV).

7.4.9 Auto trigger hysteresis [AtHYS]

Sets the trigger hysteresis for the auto trigger mode of hold timing input.

※ Only appears when setting the 'Hold timing input [HoLdt]' parameter to 'Over / Under auto trigger level [AtUP] / [AtdW]'.

7.4.10 Timer [t-ModE]

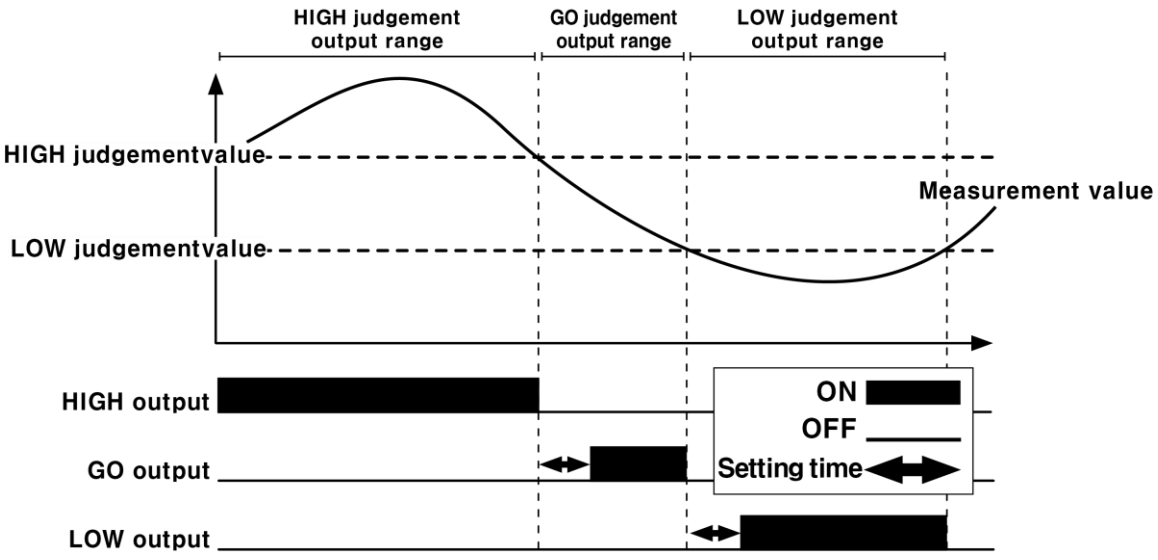
Sets timing of judgement output (HI/GO/LOW).

※ 'Timer [t-Mod]' and 'Hold [HoLd]' functions can not be used at the same time. When activating 'Timer [t-Mod]', 'Hold [HoLd]' is set to OFF automatically.

※ After setting, 'Timer value [tIME]' is set sequentially.

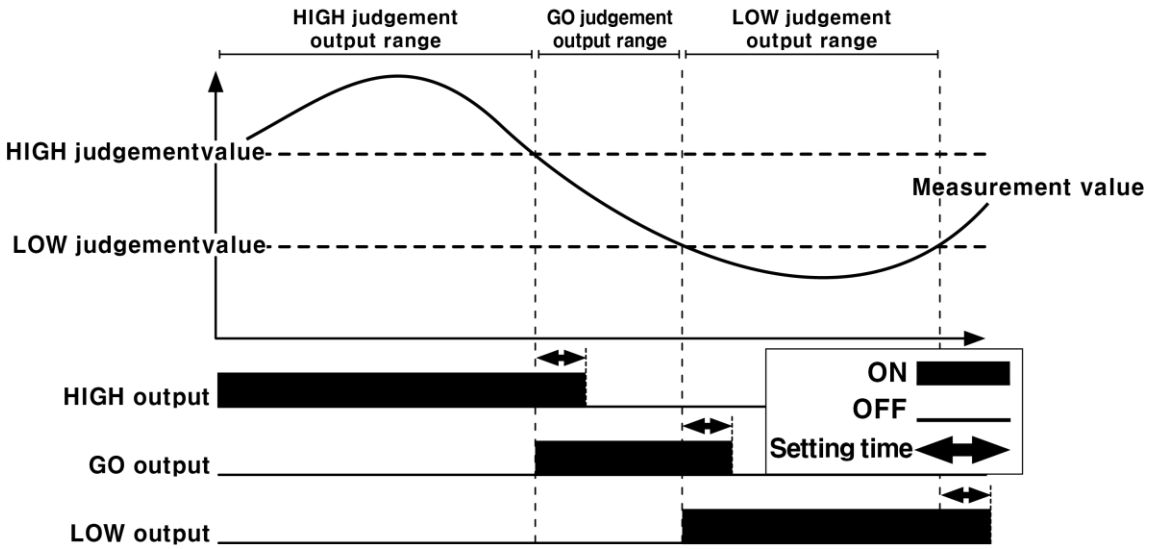
- **On delay [oNd]**

  Delays the output by the set time after the judgment.



- **Off delay [oFd]**

  Holds the judgment output for the set amount of time.



7.4.11 Timer value [tIME]

Set the time to delay or hold the judgment output.

※ Only appears when setting 'Timer [t-ModE]' to 'On delay [oNd]' or Off delay [oFd]'.

7.5 Parameter Group 3 [PARA3]

Explains items within parameter group 2 related to external input.

※ Refer to '7.2 Configuration, Setting range and Factory default' to check them of each item in group.

7.5.1 External input□ [d-IN□]

Assigns the function to each external wire 1 to 4.

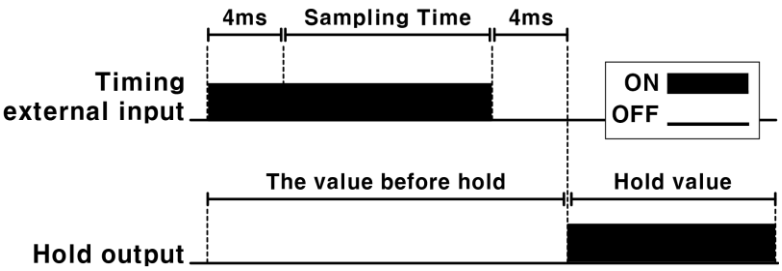
You can set each function individually or overlay it. Bank A and bank B functions cannot be overlaid.

- **Timing input [t-IN]**

  Assigns hold trigger function for 'Hold timing input [HoLdt]'.

※ Refer to '7.4.7 Hold timing input [HoLdt]' for the details of 'Hold timing input [HoLdt]'.

- **Timing chart**



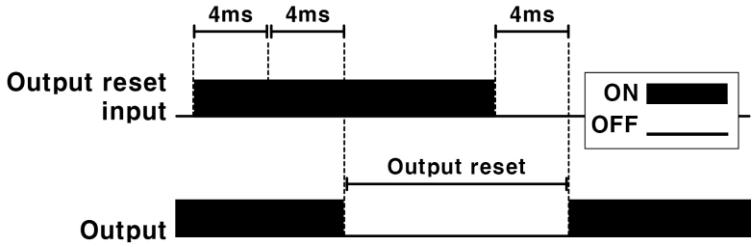
- Minimum input time: 4ms
- Delay time after sampling: 4ms

- **Output reset [oUt.CLR]**

  Assigns output reset function.

  The output is stopped during the input. The input is terminated and the output resumes after 4ms.

- **Timing chart**



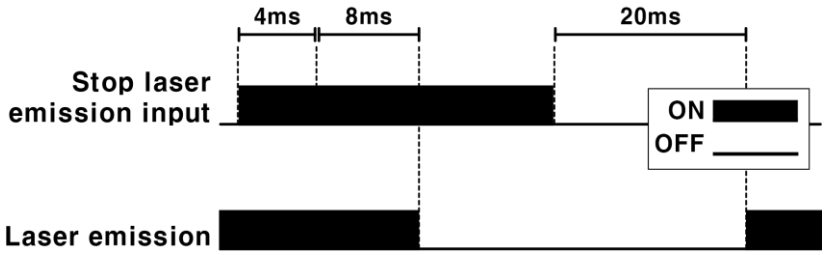
- Minimum input time: 4ms
- Output reset execution time: 8ms
- Reset release input time: 4ms

- **Stop emission [L-oFF]**

  Assigns stop laser emission function.

  After assigning, laser emission can be stopped by sending signal.

  - **Timing chart**



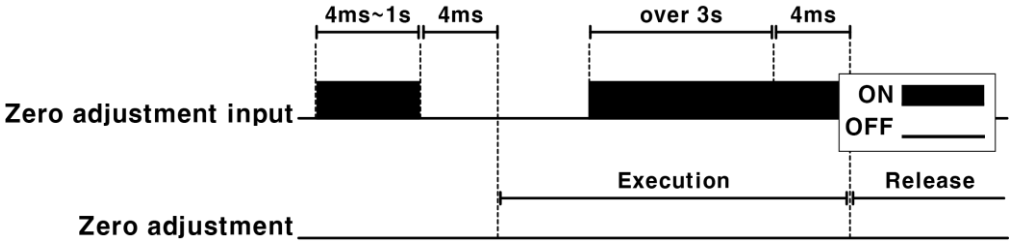
  - Minimum input time: 4ms
  - Laser emission ON – OFF switch time: 12ms
  - Laser emission OFF – ON switch time: 20ms

- **Zero adjustment [ZERo]**

  Assigns zero adjustment function.

  After assigning, present value (PV) can be set to zero point by sending signal.

  - **Timing chart**



  - Minimum input time: 4ms
  - Execution time: Max. 1s
  - Release input time: Min 3s

▪ **Bank input [bANK-A, bANK-b]**

Assigns bank load function.

After assigning, the bank is activated during the input.

- Use single wire

Activation	BANK-A
BANK-0	OFF
BANK-1	ON

- Use double wire

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

※ Overlapping BANK-A, B is impossible.

7.6 Parameter Group 4 [PARA4]

Explains items within parameter group 2 related to user convenience.

※ Refer to '7.2 Configuration, Setting range and Factory default' to check them of each item in group.

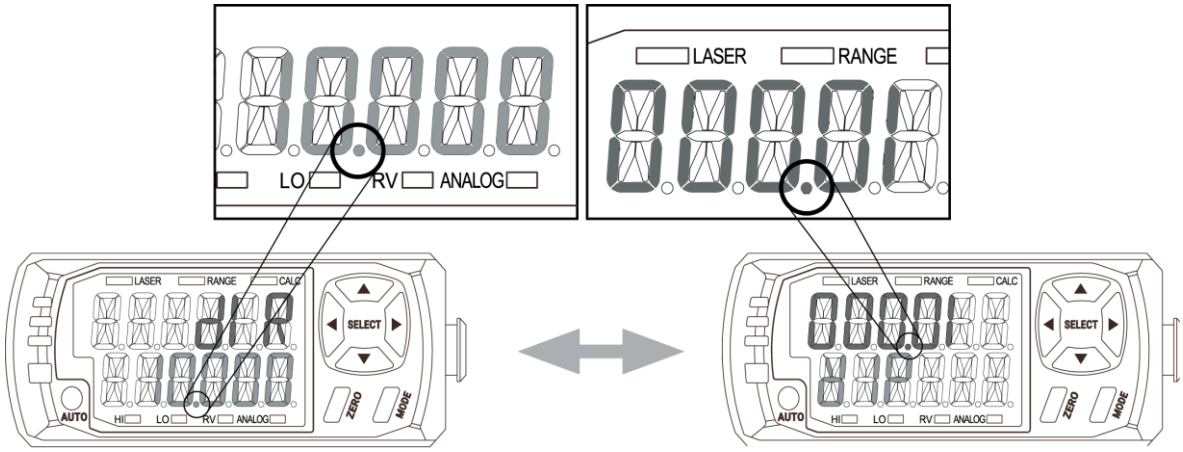
※ Parameter group 4 is not saved per bank separately, but used in common.

7.6.1 Display direction [dIR]

Select display direction (normal, reverse) of amplifier unit to check conveniently regardless of the installation direction.

※ Reverse display changes the direction of number, not decimal point.

▪ **Comparison of normal and reverse**



<Normal> **<Reverse>**

7.6.2 Bank [bANK]

Parameter setting can be saved and loaded to 4 banks.

- **Check the bank number**

  It is possible to check the bank number in use by pressing [◀] / [▶] key in the operation mode.

- **Save the bank**

  After setting parameters, select the bank number in 'Parameter 4 group - Bank [bANK]' parameter. Press [MODE] key more than 3 seconds with the display flashing to save the parameters to the bank.

- **Load the bank**

  Use the external output function, or select the bank number in 'Parameter 4 group - Bank [bANK]' parameter. Press [ZERO] key more than 3 seconds with the display flashing to load the parameters from the bank.

7.6.3 Saving mode [SAVE]

Reduces power consumption by extinguishing the front display lamp when there is no user input for a minute.

※ This fuction is only activated in run mode, all display are on in setting mode.

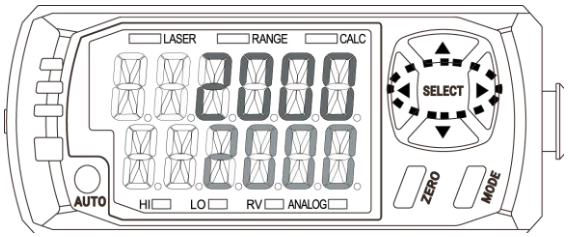
7.6.4 Lock mode [LoCK]

Set the key lock function to prevent operating errors.

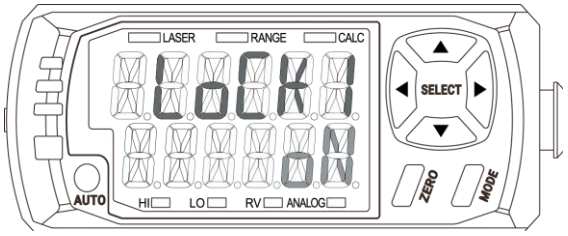
※ Press [◀] / [▶] keys over 3 sec to lock or unlock the key in run mode.

- **Lock**

1st Press [◀] / [▶] keys over 3 sec in run mode.

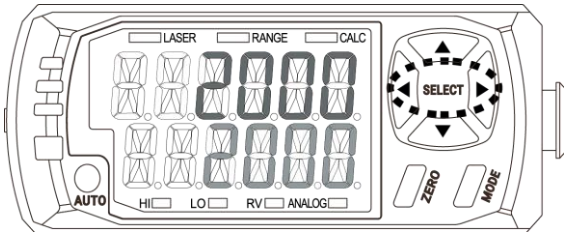


2nd Lock mode is set with 'Lock mode parameter' and 'ON' as below.

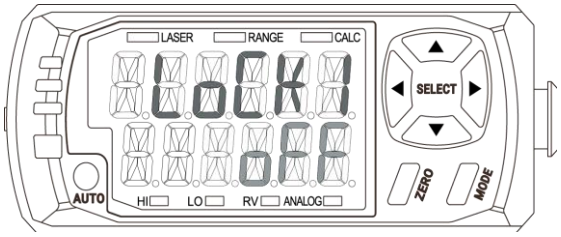


- **Unlock**

1st Press [◀] / [▶] keys over 3 sec in run mode.



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

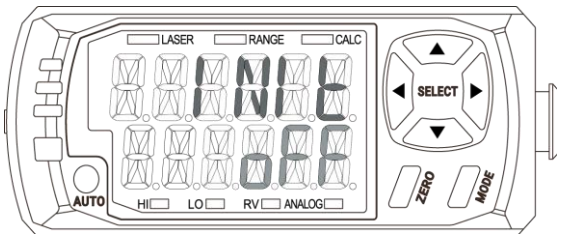


7.6.5 Initialize [INIT]

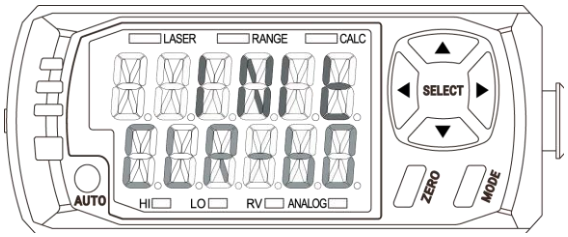
The bank and all settings can be initialized by selecting parameter.

- **Initialize**

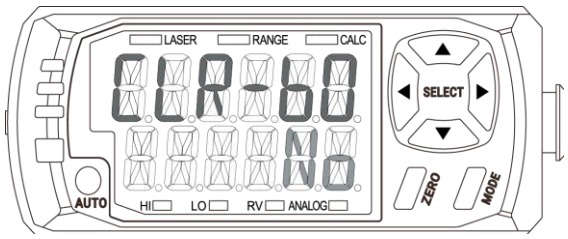
1st Select 'Initialize [INIT]' parameter. When pressing [MODE] key, 'OFF' is flashed in SV display.



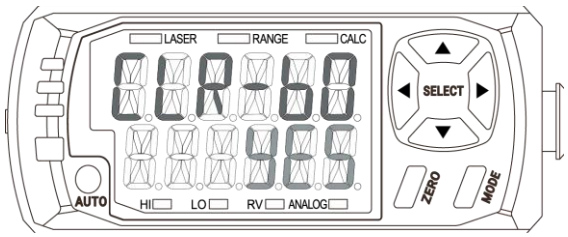
2nd Select the bank to initialize by pressing [▲] / [▼] keys.



3rd After selecting the bank to initialize and pressing [MODE] key, 'NO' is flashed on SV display.



4th Select 'YES' by pressing [▲] / [▼] keys and press [MODE] key. All display are flashed and initialize is complete.



8 Error – Amplifier unit

In error status, 'ERR□R' is displayed on present value (PV) display.

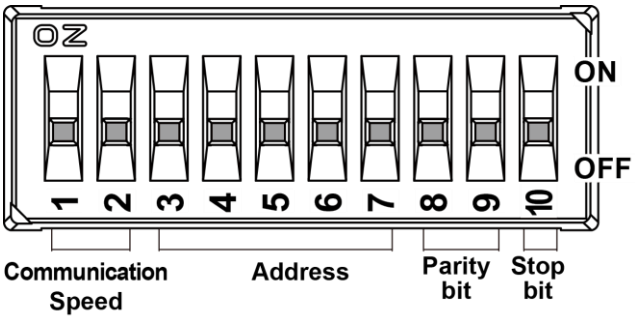
Deal with an error by referring to the below solution of each setting value (SV) display.

Setting value (SV) display	Output	Reason	Solution
HEAd	O	Disconnection of sensor head/amplifier unit/cable Sensor head malfunction	Check the connection between sensor head and amplifier unit. Check the disconnection of sensor head cable. Perform the above items and supply the power again. If the problem is not resolved after the above items are performed, it is judged that the sensor head is defective and needs to be replaced.
LASER	O	Malfunction of emission	
dARK	-	Not existing the object or background in maximum measurement range	Adjust the distance between sensor head and object in the maximum measurement range.
RANGE			
bRIGHt	-	Over receive the light	
------	-	In status of display unavailable	Return to status of present value display available.
A-MEM	O	Amplifier unit memory malfunction (EEPROM cannot be refreshed due to exceeding the number of recording over 1 million times)	Turn off the power, check the connection of sensor head, and supply the power again. Executes the initialize 'INIt' function. If the problem is not resolved after the above items are performed, it is judged that the amplifier unit is defective and needs to be replaced.
H-MEM	O	Sensor head memory malfunction	Turn off the power, check the connection of sensor head, and supply the power again. If the problem is not resolved after the above item is performed, it is judged that the amplifier unit is defective and needs to be replaced.

Setting value (SV) display	Output	Reason	Solution
AMP-C	O	Poor connection between amplifier units.	Check the connection between amplifier units, and supply the power again.
VER	O	Mismatch the version of firmware between sensor head and amplifier unit.	Please contact the Autonics technical advisory center.
oUt	O	Disconnection of the judgement output	After turn off the power, check connection of HIGH (black) / GO (gray) / LOW (orange) wire, and supply the power again.
AUto	-	Teaching failure	After check the object is in the maximum measurement range, execute again.
AMP	O	Amplifier unit error	After turn off the power, check the connection of sensor head, and supply the power again. If the problem is not resolved after the above items are performed, it is judged that the amplifier unit is defective and needs to be replaced.
o.CUR	O	Over current of output terminal	Check the load of output is specification range. Check the output is contacted other wire or frame.

9 Communication Converter

9.1 Communication Setting Switch



Default: All switches are OFF

Communication speed (Switch 1, 2): Sets RS-232C, RS-485 communication speed to external device.		
Communication Speed	**Switch 1**	**Switch 2**
9600bps	ON	ON
19200bps	OFF	ON
38400bps	ON	OFF
115200bps	OFF	OFF

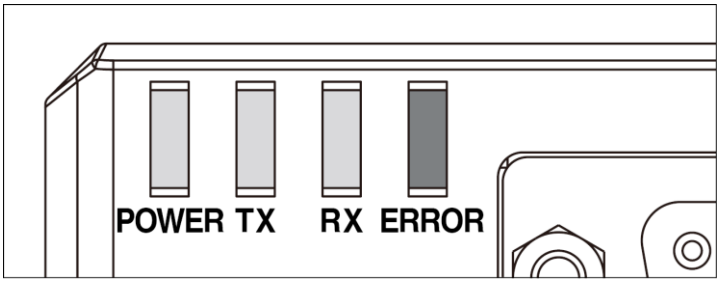
Address (Switch 3 to 7): Sets the address of communication converter.
It is calculated in binary according to the ON/OFF status of each switch.

Switch No.	Switch 3	Switch 4	Switch 5	Switch 6	Switch 7	Address
Binary digit OFF=0 ON=1	2^4	2^3	2^2	2^1	2^0	Address= Switch3×2^4+Switch4×2^3+ Switch5×2^2+Switch6×2^1+ Switch7×2^0+1
Address 1	OFF	OFF	OFF	OFF	OFF	1=0×2^4+0×2^3+0×2^2+0× 2^1+0×2^0+1
Address 2	OFF	OFF	OFF	OFF	ON	2=0×2^4+0×2^3+0×2^2+0× 2^1+1×2^0+1
Address 3	OFF	OFF	OFF	ON	ON	3=0×2^4+0×2^3+0×2^2+1× 2^1+1×2−0+1
...	...	...	...	...	...	...
Address 16	ON	OFF	ON	ON	ON	16=1×2^4+0×2^3+1×2^2+1× 2^1+1×2^0+1
...	...	...	...	...	...	...
Address 31	ON	ON	ON	ON	OFF	31=1×2^4+1×2^3+1×2^2+1× 2^1+0×2^0+1
Address 32	ON	ON	ON	ON	ON	32=1×2^4+1×2^3+1×2^2+1× 2^1+1×2^0+1

Parity bit (switch 8, 9): Sets parity bit for RS-232C, RS-485 communication.		
Parity	**Switch 8**	**Switch 9**
Even	ON	ON
Odd	OFF	ON
None	ON	OFF
None	OFF	OFF

Stop bit (switch 10): Sets stop bit for RS-232C, RS-485 communication.	
Stop bit	**Switch 10**
2bit	ON
1bit	OFF

9.2 Status Indicator – Communication converter



Power indicator (POWER): Green, DIsplays power supply.		
Status	**Reason**	**Solution**
On	Power is supplied	-
Off	Power is not supplied	After checking the connection between communication converter and amplifier unit correctly, reconnect the device.

Communication output indicator (TX): Green, Displays communication output status from communication converter to external device.		
Status	**Reason**	**Solution**
Flashing	Signal is outputting	-
Off	Signal is not outputting	-

Communication input indicator (RX): Green, Displays communication input status from communication converter to external device.		
Status	**Reason**	**Solution**
Flashing	Signal is inputting	-
Off	Signal is not inputting	-

Communication error indicator (ERROR): Red, Displays the communication status of communication converter.		
Status	**Reason**	**Solution**
On	Connection is bad between communication converter and amplifier unit.	After checking the connection between communication converter and amplifier unit correctly, reconnect the device.
Flashing	Communication is bad between communication converter and amplifier unit.	After checking the connection between communication converter and amplifier unit correctly, reconnect the device.
		Apply noise prevention to communication converter and amplifier unit.
Off	Operation is normal.	-

9.3 Dedicated Device Management Program (atDisplacement)

atDisplacement is a comprehensive management program that can be used with Autonics BD-C Series.

atDisplacement provides GUI control for easy and convenient parameter setting and monitoring data management of multiple devices.

Features

- Checking product information
  - It is possible to check information about connected products by status window.
    BD-C series Communication Converter: model, firmware version
    BD series amplifier unit: each channel model, hardware version, firmware version, connected head unit model, status of connection
- Monitoring
  - Live data
    Displays the state and the present value (PV) of amplifier unit numerically.
  - Live Graph
    Displays the present value (PV) graph of the connected amplifier unit in real time.
  - Waveform Graph
    Displays the waveform graph of the connected amplifier unit in real time.
- Setting
  - Parameter setting
    Checks and changes the setting value of the connected amplifier units.
  - Bank management
    Manages parameter bank of connected amplifier units by save and load.

※ For more information, visit our website (www.autonics.com) to download 'atDisplacement user manual'.

Make Life Easy : Autonics

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