Autonics

LASER DISPLACEMENT SENSOR [AMPLIFIER UNIT] BD SERIES

INSTRUCTION MANUAL

Thank you for choosing our Autonics product.
Please read the following safety considerations before use.

■ Safety Considerations

※Please observe all safety considerations for safe and proper product operation to avoid hazards.
※⚠ symbol represents caution due to special circumstances in which hazards may occur.

⚠ **Warning** Failure to follow these instructions may result in serious injury or death.
⚠ **Caution** Failure to follow these instructions may result in personal injury or product damage.

⚠ Warning

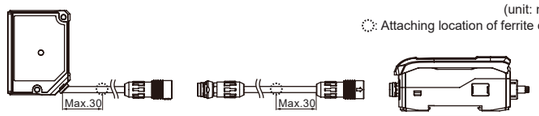
1. **Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime/disaster prevention devices, etc.)**
   Failure to follow this instruction may result in personal injury, economic loss or fire.
2. **Do not use the unit in the place where flammable/explosive/corrosive gas, 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.

■ Model

(unit: mm)
◌: Attaching location of ferrite core



Sensor head | Extension cable (sold separately) | **Amplifier unit**

◎Sensor head

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

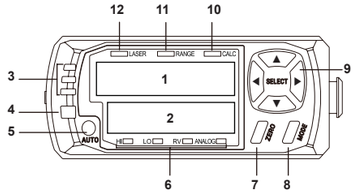
◎Amplifier unit

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

◎Extension cable (sold separately)

Model	Length
CID6P-1-SI-BD	1m
CID6P-2-SI-BD	2m
CID6P-5-SI-BD	5m
CID6P-10-SI-BD	10m

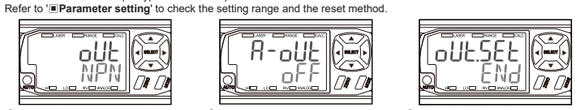
■ Unit Description



1 **Present value (PV) display:** Red
2 **Setting value (SV) display:** Green
3 **Judgment indicator**: Red (HI/LO), Green (GO)
4 **Alarm indicator**: Red
5 **Optimization setting key [AUTO]**
6 **Setting value (SV) indicator recognition lamp**: Green
HI/LOW: HIGH/LOW judgment value
RV: Real distance value
ANALOG: Analog output
7 **Zero adjustment setting key [ZERO]**
8 **Mode setting key [MODE]**
9 **Direction key [◀/▶/▲/▼]**
10 **Calculation indicator (CALC)**: Green
11 **Measurement range indicator (RANGE)**: Green
12 **Laser emission indicator (LASER):** Green

■ 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 '■**Parameter setting**' to check the setting range and the reset method.



① When 'oUt' is displayed on the present value (PV) display, select control output type through the [▲/▼] keys and push the [MODE] key.
② When '$A-oUt$' is displayed on the present value (PV) display, select analog output type through the [▲/▼] keys and push the [MODE] key.
③ After '$oUtSEt$' is flashed three times and it returns to the run mode.

※The above 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).

■ Specifications

Amplifier unit		
Model		BD-A1
Power supply		10-30VDC⎓ ±10% (When connecting BD-C Series communication converter, 12-30VDC⎓)
Power consumption※1		Max. 2800mW (30VDC⎓)
Control input※2	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※3		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, 5 ms (5-step adjustment)
Min. display unit		1㎛
Display method		Dual display by 6-digit, 11-segment LED
Display range※4		±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: 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 temperature	-10 to 50℃, storage: -15 to 60℃
	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 c UL us
Weight※5		Approx. 228g (approx. 126g)

※1: Power to the load is not included.
※2: Use after assigning to external input line. For the details, refer to the item in '■ Parameter group'.
※3: It is possible to use among -5-5V, 0-5V, 1-5V, 4-20mA by parameter setting.
※4: Setting range is assigned automatically when connecting sensor head.
※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.

■ Dimensions

(unit: mm)

◎BD-A1

● **Bracket**

● **Extension cable (sold separately)**

■ Installations

◎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.

◎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 Side amplifier unit to ⓐ direction.
② Pull the assembly part to ⓑ direction to detach.

◎Connecting to sensor head

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.

※Do not supply the power when connecting or disconnecting sensor head to amplifier unit.

◎Ferrite core (accessory for sensor head, extension cable)

● **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.

◎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.

● **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 increases sequentially to the right.

※Max. 8 units

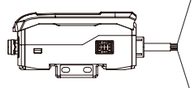
● **Precautions when connecting amplifier unit**

• 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.

■ Manuals

For the detail information and instructions, please refer to user manual, and be sure to follow cautions written in the technical descriptions (catalog, website).
Visit our website (www.autonics.com) to download manuals.

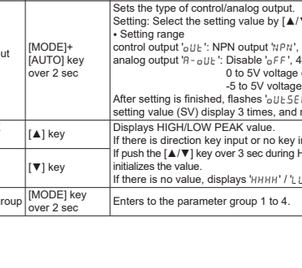
■ Connections



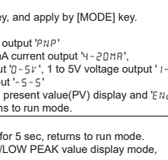
Item	Code color	Description	
Power	Brown	Power: 10-30VDC	
	Blue	Common GND (input, output, power)	
Output	Black	HIGH Judgment	
	Orange	LOW Judgment	
	Gray	GO Judgment	
	Green	Alarm	
	White	Analog: Following parameter value (-5-5V, 0-5V, 1-5V, 4-20mA)	
	Shield	GND (Analog output) ※It is needed to distinguish 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	

■ Control Output Diagram

◎Judgment (High, Go, Low) and alarm output

Item	Inner circuit	Connection
NPN open collector output		(brown)+V (black) OUT0 (orange) OUT1 (gray) OUT2 (green) OUT3 (blue)GND Load Max.100mA 30VDC
PNP open collector output		(brown)+V (black) OUT0 (orange) OUT1 (gray) OUT2 (green) OUT3 (blue)GND Load Max.100mA 30VDC

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



White Shield

■ 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 Can change the type of value by the [◀/▶] keys, and each recognition lamp turns on. Setting range: HIGH setting value, LOW setting value, real distance value (RV), analog output, bank (Displays [$bANK-□$] and all the recognition lamps turn off.)
Sensing optimization	[AUTO] key over 2 sec	Optimizes the level of laser emission and receiving sensitivity regarding the object color and environment. Execution: Execute automatically when entering the mode.
Zero adjustment	[ZERO] key over 2 sec	Sets the present value (PV) to the reference distance forcibly. Execution: After entering the mode, push the [ZERO] key within 1 sec, or apply the signal to external input wire for zero adjustment over 3 sec. Dismiss: Push the [ZERO]+[MODE] keys over 2 sec, or apply the signal to external input wire of zero adjustment over 3 sec. ※If the present value is changed by zero adjustment, the setting values (HIGH SV, LOW SV etc.) are not changed.
HIGH sensitivity adjustment	[MODE]+[▲] key over 2 sec	Sets the judgment output (HIGH/GO/LOW) range by manual input. Can change the number of digit by the [◀/▶] keys, and setting value by the [▲/▼] keys. The recognition lamps display the type of sensitivity adjustment.
LOW sensitivity adjustment	[MODE]+[▼] key over 2 sec	
Auto sensitivity adjustment (Teaching)	[MODE] key within 2 sec	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. • 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 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, 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 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.
Control output type	[MODE]+[AUTO] key over 2 sec	Sets the type of control/analog output. Setting: Select the setting value by [▲/▼] key, and apply by [MODE] key. • Setting range control output 'oUt': NPN output 'NPN', PNP output 'PNP' analog output '$A-oUt$': Disable 'oFF', 4-20mA current output '$4-20mA$', 0 to 5V voltage output '$0-5V$', 1 to 5V voltage output '$1-5V$', -5 to 5V voltage output '$-5-5$' After setting is finished, flashes '$oUtSEt$' on present value(PV) display and 'End' on setting value (SV) display 3 times, and returns to run mode.
HIGH PEAK value	[▲] key	Displays HIGH/LOW PEAK value. If there is direction key input or no key input for 5 sec, returns to run mode. If push the [▲/▼] key over 3 sec during HIGH/LOW PEAK value display mode, initializes the value. If there is no value, displays '$HHHH$' / '$LLLL$'.
LOW PEAK value	[▼] key	
Parameter group	[MODE] key over 2 sec	Enters to the parameter group 1 to 4.

■ Parameter Group

• 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 the each step, push the [MODE] key over 3 sec to save and return to the upper step.
※Some parameters are enable by related parameter setting.

PARA1 Parameter group 1 — Settings related to output type, displacement, display and error output.

Parameter		Setting range		Default
RSPd	Response time	330㎲, 500㎲, 1ms, 2ms, 5ms		1ms
SENS	Teaching mode	tPnt	1-point	tPnt
		2Pnt	2-point	
NoNC	Output type	No	Normally open	No
		NC	Normally closed	
AvF	Samples for averaging	1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096		16
diSP	PV display	StNd	Standard	StNd
		SCALE	Scale	
dot	Display digit	0.000, 0.000, 0.0, 0		0.000
H-SC	Display scale	-99.999 to 99.999		Different by models
L-SC				
HYS	Hysteresis	0.001 to 99.999		0.001
H-AN	Analog output scale	-99.999 to 99.999		Different by models
L-AN				
ERRoUt	Error output	KEEP	Keep PV	KEEP
		FIX	Fixed value	
FIXoUt	Fixed output	Set analog output range		Max. value

PARA2 Parameter group 2 — Settings related to present value.

Parameter		Setting range		Default
CALC	Calculation	oFF	Off	oFF
		Add-Ab	Add	
		Sub-Ab	Subtraction	
		AvG	Average mode	
GAIN	Gain	1, 2, 3		1
FILTER	Filter	AvF	Average filter	AvF
		diFF	Differential filter	
AvF	Samples for averaging	1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096		16
MEdIAN	Samples for median	oFF, 3, 5, 7, 15, 31		oFF
HoLd	Hold	oFF	Off	oFF
		PEAk	Peak	
		bottom	Bottom	
		P-P	Difference	
		SAMPLE	Sample	
		AvG	Average	
HoLdt	Hold timing input	t-IN	External input	t-IN
		tUP	Over auto trigger level	
		tdN	Under auto trigger level	
tLV	Auto trigger level	-99.999 to 99.999		0
tHYS	Auto trigger hysteresis	0.001 to 99.999		0.001
t-Mod	Timer	oFF	Off	oFF
		oNd	Output delay	
		oFd	Output hold	
tIME	Timer value	0 to 9999		0

PARA3 Parameter group 3 — Settings related to external input.

Parameter		Setting range		Default
d-IN1	External input 1	oFF	Off	t-IN
d-IN2	External input 2	t-IN	Timing input	oUtCLP
d-IN3	External input 3	oUtCLP	Output reset	L-oFF
		L-oFF	Stop emission	ZERo
		ZERo	Zero adjustment	
		bANK-A	Bank input-A	
		bANK-b	Bank input-B	
d-IN4	External input 4			ZERo

PARA4 Parameter group 4 — Settings related to user convenience functions.

Parameter		Setting range		Default
diP	Display direction	[▲/▼] (select direction) → [MODE] (apply)		Normal display
bANK	Bank	bANK-0, bANK-1 bANK-2, bANK-3		bANK-0
SAVE	Saving mode	oFF	Off	oFF
		SAVE1	Digital display	
		SAVE2	All display	
LoCK	Lock mode	oFF	Off	oFF
		LoCK1	[AUTO], [ZERO]	
		LoCK2	[AUTO], [ZERO] +entering parameter group	
		LoCK3	All key (except unlock key)	
INIt	Initialize	oFF, CLR-b0, CLR-b1, CLR-b2, CLR-b3, CLR-A		oFF

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

■ Error Display

In error status, '$ERRoR$' 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.
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.
oCUR	O	Over current of output terminal	Check the load of output is specification range. Check the output is contacted other wire or frame.

■ 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.
    ①Indoors/Outdoors (in the environment condition rated in 'Specifications')
    ②Altitude max. 2,000m
    ③Pollution degree 2
    ④Installation category II

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