OPTEX FA

Displacement Sensor

CD33 SERIES Laser type

CD33-30□□　CD33-120□□
CD33-50□□　CD33-250□□

INSTRUCTION MANUAL

- Confirm if the item meets your needs.
- Before the use, you should first thoroughly read this manual and operate correctly as mentioned.
- You should keep this manual at hand for proper use.

Carefully read and understand the safety precautions before operation. The important information is provided to protect your health and property. Do not apply any other installing or operating procedure other than that

Meanings of Safety Symbol

⚠ WARNING	Indicates a possible hazard that may result in death, serious injury, WARNINGS or serious property damage if the product is used without observing the stated instructions.

⚠ WARNING　Mandatory Requirements

- The light source of this product applies the visible light semiconductor laser. Do not allow the laser beam to enter an eye, either directly or reflected from reflective object. If the laser beam enters an eye, it may cause blindness.
- Do not disassemble or modify the product since it is not designed to automatically stop the laser emission when open. Disassembling or modifying at customer's end it may cause personal injury, fire or electric shock.
- This product is not an explosion proof construction. Do not use the product under flammable , explosive gas or liquid environment.
- Use of controls or adjustments or performance of procedures other

⚠ WARNING　Safety Precautions

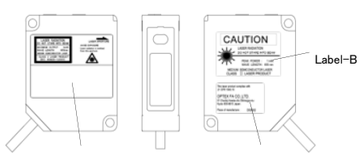
- It is dangerous to wire or attach/remove the connector with the power on. Make sure to turn off the power before operation.
- Installing in the following places may result in malfunction:
  1. A dusty or steamy place
  2. A place generating corrosive gas
  3. A place directly receiving scattering water or oil.
  4. A place suffered from heavy vibration or impact.
- The product is not designed for outdoor use.
- Do not use the sensor in a transient state at power on (Approx. 15min. Warm up period)
- Do not wire with the high voltage cable or the power lines. Failure to do this will cause malfunction by induction or damage.
- Do not use the product in water.
- Operate within the rated range.
- Wipe off dirt on the emitting/receiving parts to maintain correct detection. Also, avoid direct impact on the product.

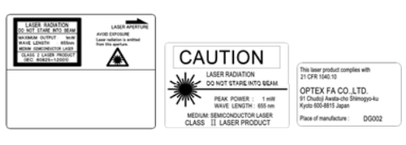
●This product cannot be used as a safety device to protect human body.

Precautions for using laser

■Laser label
This product is classified as Class 2 (Ⅱ) Laser Product by JIS C6802/IEC/FDA Laser Safety Standard.

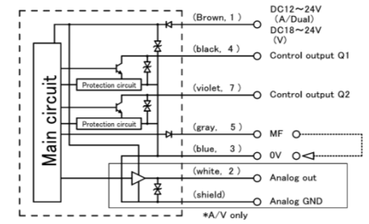
●Regulations in the USA
When exporting laser devices to the USA, the USA laser control, FDA (Food and Drug Administration) is applied. This product has been already reported to CDRH (Center for Devices and Radiological Health). For details, contact our customer service.



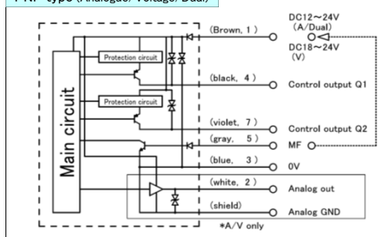


Connection diagram

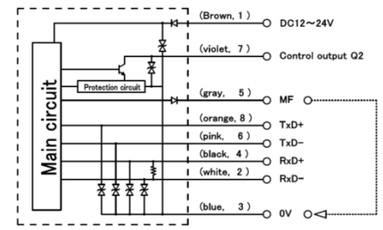
NPN type (Analogue/Voltage/Dual)



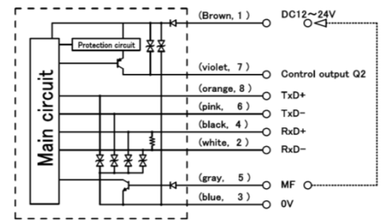
PNP type (Analogue/Voltage/Dual)



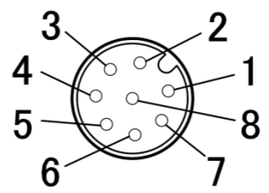
NPN type (RS422)



PNP type (RS422)



Pins configuration



Caution for connection

Analog ground wire is not equipped for connector type. Therefore connect the analog ground terminal of analog input equipment and the 0V terminal of power supply.

MF (multi functional) input

MF (multi functional) input activates when connected to GND(−) for NPN type, and when connected to (+) for PNP type.

1) Connect the lead wires correctly. The analog output wire must not be in contact with any other wire. Do not turn on the power while wiring.
2) The blue wire (0V) and shield wire (analog GND) are internally connected. Use the blue wire (0V) for the power supply and use the shield wire (analog GND) for analog output.

Specifications

●Specifications of Measuring Range

Type	Cable type	①	CD33-30N(P)	CD33-50N(P)	CD33-85N(P)	CD33-120N(P)	CD33-250N(P)
		②	CD33-30N(P)A	CD33-50N(P)A	CD33-85N(P)A	CD33-120N(P)A	CD33-250N(P)A
		③	CD33-30N(P)V	CD33-50N(P)V	CD33-85N(P)V	CD33-120N(P)V	CD33-250N(P)V
		④	CD33-30N(P)-422	CD33-50N(P)-422	CD33-85N(P)-422	CD33-120N(P)-422	CD33-250N(P)-422
	Connector type	①	CD33-30CN(P)	CD33-50CN(P)	CD33-85CN(P)	CD33-120CN(P)	CD33-250CN(P)
		②	CD33-30CN(P)A	CD33-50CN(P)A	CD33-85CN(P)A	CD33-120CN(P)A	CD33-250CN(P)A
		③	CD33-30CN(P)V	CD33-50CN(P)V	CD33-85CN(P)V	CD33-120CN(P)V	CD33-250CN(P)V
		④	CD33-30CN(P)-422	CD33-50CN(P)-422	CD33-85CN(P)-422	CD33-120CN(P)-422	CD33-250CN(P)-422
Center			30mm	50mm	85mm	120mm	250mm
Measuring range			±4mm	±10mm	±20mm	±60mm	±150mm
Light source			Red laser Diode (wave length 655nm)				
Peak power			Max. output 1mW				
Laser Class	IEC/JIS		CLASS2				
	FDA		CLASS Ⅱ				
Spot size (approx. volume) *1	Near		0.15×0.15mm	0.6×1.2mm	0.9×1.5mm	1.2×1.8mm	1.5×2.5mm
	Middle		0.1×0.1mm	0.5×1.0mm	0.75×1.25mm	1.0×1.5mm	1.75×3.5mm
	Far		0.15×0.15mm	0.4×0.9mm	0.6×1.0mm	0.5×0.8mm	2.0×4.5mm
Linearity *2			±0.1% F.S. (F.S.=8mm)	±0.1% F.S. (F.S.=20mm)	±0.1% F.S. (F.S.=40mm)	±0.1% F.S. (F.S.=120mm)	±0.3% F.S. (F.S.=300mm)
Resolution *3			2μm (Fast:4μm)	5μm (Fast:8μm)	10μm (Fast:15μm)	30μm (Fast:45μm)	75μm (Fast:150μm)
Response time	Fast		averaging: 1 time　5ms max.				7.5ms max.
	Standard		averaging: 16 times　12.5ms max.				18ms max.
	High resolution		averaging: 64 times　36.5ms max.				54ms max.
Sampling period			500 ,750(250mm type) /1000 /1500 /2000μs				
Temperature Drift			±0.08% F.S./℃				
Indicators	Distance Indicator		Bar graph LED				
	Output Indicator		ON status : Orange				
MF (multi functional) input			Laser off, Remote teaching, Sample Hold (choose one function) Response time : 3ms max.				
Circuit protection			Reverse polarity, Over current				
Protection Category			IP67				
Operating temp./humidity			−10～+45℃/35～85%RH (No condensation or freezing)				
Storage temp./humidity			−20～+60℃/35～95%RH (No condensation or freezing)				
Ambient Light			Sun light: 10,000 lx max. / Incandescent lamp: 3,000 lx max.				
Vibration resistance			10 to 55 Hz, Double amplitude 1.5 mm, 2 h for XYZ axes				
Shock resistance			50G (500m/s²)				
Warm up period			15min max.				
Material			PBT (Case) PMMA (Front window)				
Weight	Cable type		Approx. 65g (without cable)				
	Connector type		Approx. 70g				

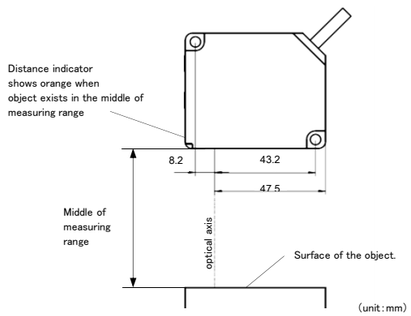
●Specifications of Output

Type		Dual output	Analogue	Voltage	RS422
		CD33- ①	CD33- ②	CD33- ③	CD33- ④
Supply Voltage		DC12～24V (+10%/−5%)		DC18～24V (+10%/−5%)	DC12～24V (+10%/−5%)
Current Consumption		55mA max. (DC24V)	85mA max. (DC24V) including analog output value	55mA max. (DC24V)	
Outputs	Control output Q1	NPN/PNP Open collector 100mA max. /30V DC (Residual voltage 1.8 V max.)			−
	Control output Q2	NPN/PNP Open collector 100mA max. /30V DC (Residual voltage 1.8 V max.)			
	Analog output	−	4～20mA	0～10V	−
Interface		−			RS422
Connection	Cable type *4	φ5 5core 2m cable(PVC) AWG24		φ5 6core 2m cable(PVC) AWG24	φ5 5core 2m cable(PVC) AWG24
	Connector type	M12 8pin			

*1 Defined with center strength 1/e2(13.5%). There may be leak light other than the specified spot size. The sensor may be damaged when there is a highly reflective object around the targets.
*2 Averaging: 64(High resolution), Sampling period:500μs, Object: white ceramic.
*3 Middle of measuring range, Object: white ceramic.
*4 Diameter of min bend cable is 40mm.

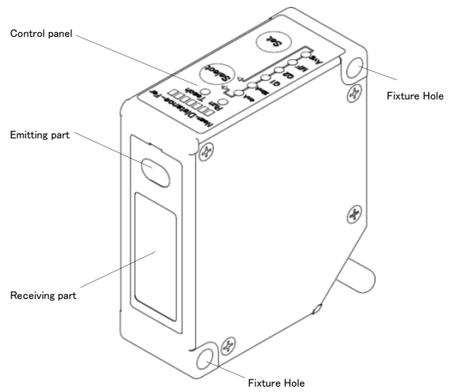
Installation

Install the sensor and adjust the light spot onto the measuring point so that the distance indicator turns ON (orange) at the middle of measuring range.
Use M4 screw (tightening torque need to be under 0.8N･m).



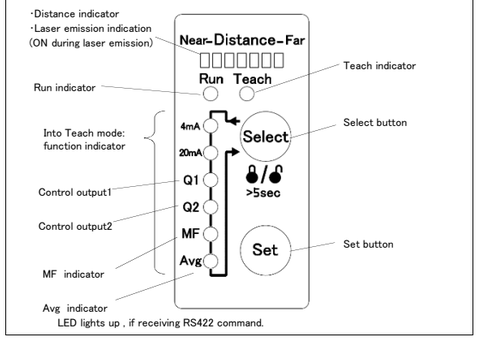
・Adjust the sensor position so that it is set parallel to the surface of object obtain reliable measurement (see above).
・If there is any foreign object around the spot that is glossier than the measuring object, it may cause incorrect measurement.

Functions of components

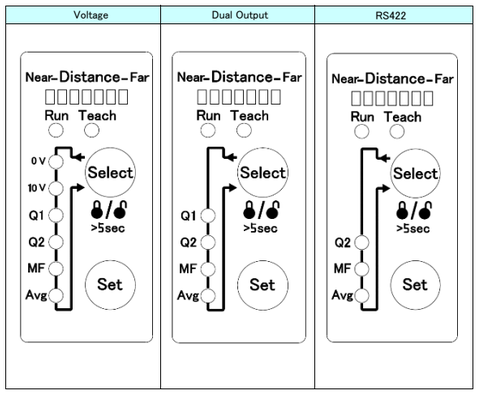


●Control panel

Analogue



Voltage　Dual Output　RS422



Distance indicator

Distance indicator has seven LEDs. LED indicate distance by moving at near to far side.

Status of LED	Status of measurement	Indicator
Near-Distance-Far	Out of range. *This LED indicate when due to too high/low reflection	Both side of red LED lights up
	Object is near of range.	Near side of red LED lights up
	Object is far of range.	Far side of red LED lights up
	Object is some far of range.	Far side of green LED lights up
	Object is middle of range.	Middle of orange LED lights up

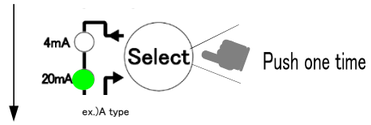
Select Function

●Teach mode
①Press the Select button more than 5 seconds.

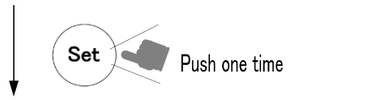
②Teach indicator lights up showing that Run status changes to Teach status.

③Function indicator lights up.

④Select function by pressing Select button.



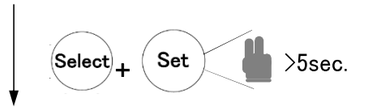
⑤Adjust or select value of function you need by pressing Set button.



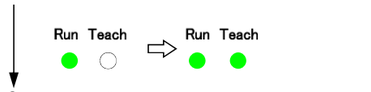
⑥Then return to RUN by pressing by pressing Select button continuously 5 seconds.

●Special Setting mode

①Press simultaneously both the Select button and Set button for 5 seconds.

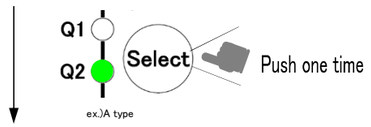


②Both Run and Teach indicators come up.

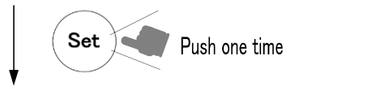


③Function indicator Q1 lights up.
※Q2 lights up when it's RS422 type.

④Select a function by pressing Select button.



⑤Adjust or select the function by pressing Set button.



⑥Then return to RUN by pressing by pressing Select button and Set button continuously 5 seconds.

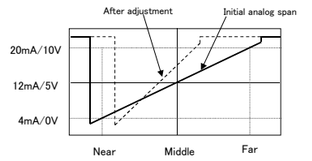
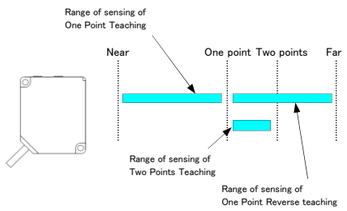
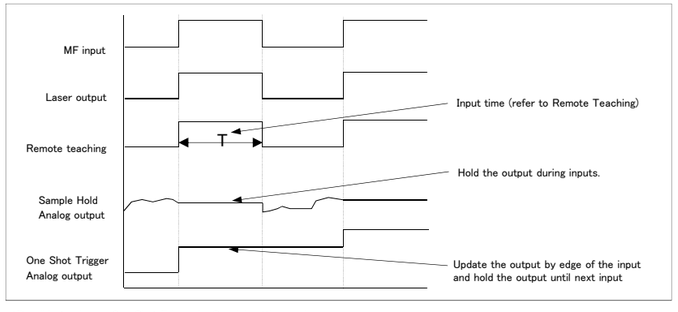
・Control output stops during teaching and setting period while Analog output works.

Reset the presettings

Turn on the power by pressing Select button and Set button at the same time and keeping them pushed continuously 5 seconds. Then make sure if all the indicator blinks 3 times to confirm cancel of all presettings.

Functions

●Teach mode

Functions	Functions indicated	Details	Settings and Adjustments	Factory Setting
Span	4mA 0 V 20mA 10 V	Possible to coordinate analog output 4–20mA (0–10V) at an arbitrary position in the rated range of measurement. 	①Push the Select button more than five seconds to get in Teach mode. ② Push the Select button and let 4mA (0V) indication turn on. ③ Set up the object at the first point that you want to span, and push Set button. ④ 4mA (0V) indication flashes one time. In the case of adjustment failure, the indication flashes for five seconds. Try again getting back to ② of above. ⑤ Push the Select button and let 20mA (10V) indication turn on ⑥ Set up the object at the second point that you want to span, and push the Set button. ⑦20mA (0V) indication flashes one time. In the case of adjustment failure, indication flashes for five seconds. Try again getting back to ⑤ of above. ⑦ Push the Select button more than five seconds to return to Run mode	Of the measurement range Near side: 4mA(0V) Far side: 20mA(10V)
Output setting	Q1	set the range of Control Output. One point teaching :From the position of the teaching – 0.15%(FS) to the Near side of the sensing range. Two points teaching :Between the position of the first point teaching +0.15%(FS) and the position of the second point teaching –0.15%(FS). One point reverse teaching: From the position of the teaching +0.15%(FS) to the Far side of the sensing range.	●One point teaching ①Push the Select button more than five seconds to enter Teach mode. ②Push the Select button and let Q1(Q2) indication turn on. ③Set the object in the position that you want to measure and push the Set button ④ Q1(Q2) indication flashes one time. In the case of adjustment failure, indication flashes for five seconds. Try again getting back to ② of above. ⑤Push the Select button more than five seconds to return to Run mode. ●Two points teaching ①Push the Select button more than five seconds to enter Teach mode. ②Push the Select button and let Q1(Q2) indication turn on ③Set up the object at the first point of the range that you want to measure and push the Set button ④ Q1(Q2) indication flashes one time. In the case of adjustment failure, the indication flashes for five seconds. Try again getting back to ② of above. ⑤Q1(Q2)) which you Set up the object to the second point you want to measure, and push the Set button. Q1(Q2) indication flashes two times. In the case of the adjustment failure that the indication flashes for five seconds. Try again getting back to ② of above. ⑥Push the Select button more than five seconds to return to Run mode.	The output in the measurement range
	Q2		●One point Reverse teaching ①Push the Select button more than five seconds to enter Teach mode. ②Push the Select button and let Q1(Q2) indication turn on ③Set the object in the position that you want to measure and push the Set button more than five seconds . ④ Q1(Q2) indication flashes one time. In the case of adjustment failure, the indication flashes five seconds. Try again getting back to ② of above. ⑤Push the Select button more than five seconds to return to Run mode.	The output in the measurement range & Self-diagnosis *1
External input	MF	Select the function of the external input. Blink Once : Laser OFF Blink twice : Remote teaching Blink three times : Sample Hold  *Possible to choose One Shot Trigger by Special setting mode.	①Push the Select button more than five seconds to enter Teach mode. ②Push the Select button and let MF indication turn on. ③Choose the function you need by pushing Set button. ④Push the Select button more than five seconds to return to Run mode.	Laser OFF
Averaging	Avg	Average count setting Blink Once : Fast (averaging 1 time) Blink twice : Standard (averaging 16 times) Blink three times : High Res. (averaging 64 times)	①Push the Select button more than five seconds to enter Teach mode. ②Push the Select button and let Avg. indication turn on. ③Choose the function by pushing Set button. ④Push the Select button more than five seconds to return to Run mode.	averaging: 16

●Special setting mode function

Functions	Functions indicated	Details	Settings and Adjustments	Initial value
Analog output when reflection is too high/low	Q1	Set Analog output when impossible to measure due to too high/low reflection.. Blink Once : Analog output is fixed at about 22mA(about 11V). Blink twice : The last value is fixed and maintained.	①Push the Select and set button at same time for more than five seconds to enter Special setting mode ②Push the Select button and let Q1 indication turn on. ③Choose the function by pushing Set button. ④Push the Select and set button more than five seconds and to return to Run mode.	Analog output is fixed at about 22mA(about 11V).
One shot trigger	MF	One shot trigger is possible to select through external input. On :One shot trigger Blink Once : Laser OFF Blink twice : Remote teaching Blink three times : Sample Hold	①Push the Select and set button at same time for more than five seconds to enter Special setting mode ②Push the Select button and let MF indication turn on. ③Choose the function by pushing Set button. ④Push the Select and set button more than five seconds to return to Run mode.	Laser OFF
Sampling period	Avg	Sampling period setting Blink Once : 500 μ s Blink twice : 1000 μ s Blink three times : 1500 μ s On : 2000 μ s High response High sensitivity Shorter sampling period increases the response and longer sampling period enhances the sensitivity.	①Push the Select button more than five seconds to enter Teach mode. ②Push the Select button and let Avg. indication turn on. ③Choose the function by pushing Set button. ④Push the Select and set button more than five seconds to return to Run mode.	500 μ s 750 μ s(CD33-250)

(Remarks)

When the Teach mode / special setting mode it returns to RUN if no operation in given for 60 seconds.

*1 Self-diagnosis output comes at the time of (1) laser stop (2) saturation by mirror-like object or (3) low sensitivity. This function does not work when you set the output of Q2. Reset the product when you want to use Self-diagnosis again.

Remote teaching

Remote Teaching is possible through External Input. Input time of Remote Teaching means change of settings.

Input time	Item
70 – 130ms	The first point of span
170 – 230ms	The second point of span
270 – 330ms	Q1: One point teaching The second point of two points teaching must be completed in one minute with same value as the first point.
370 – 430ms	Q1:One point Reverse Teaching
470 – 530 ms	Q2: One point teaching The second point of two points teaching must be completed in one minute with same value as the first point.
570 – 630 ms	Q2:One Point Reverse Teaching
670 – 5000ms	Offset*
5000ms and more	Offset cancel

*The current measurement value will be the central position of the measured analog value by making offset. (A: 12mA / V: 5V)

Communication

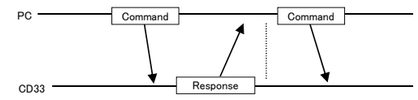
●Specification

Communication method	RS422
Synchro system	Asynchronous
Baud rate	9600/19200/38400/76800 bps *
Transmission code	ASCII
Data length	8 bit
Stop bit length	1 bit
Parity check	Nil
Data classification	STX・ETX

* Baud rate :9600bps at factory set

●Communication Procedure

When PC sends a command to CD33 it sends back a response to the PC.
In principle one response is given to one command. When sending a command, make sure if you receive the response to the previous command.



* Avg indication will turn on whenever a command response comes.

●Transmission Data Format (Command)

Reading out Setting/Measurement Value/Output Status

02H		03H
STX	COMMAND	ETX
1	2	3

1 The code showing the head of transmit data (02H).
2 Selects the command to transmit.
3 The code showing the completion of transmit data (03H).

Writing the setting

02H		20H		03H
STX	COMMAND	SPACE	COMMAND	ETX
1	2	3	4	5

1 The code showing the head of transmit data (02H).
2 Selects the command to transmit.
3 Shows the separation between Command and Command (20H).
4 Set the Setting/Measurement Value/Output Status.

●Incoming Data Format (Response)

02H		03H
STX	RESPONSE	ETX
1	2	3

1 The code showing the head of incoming data (02H).
2 The response data is set to the transmitted command.
3 The code showing the completion of incoming data (03H).

The following four responses are for the written commands:
> (3EH) :Writings completed
? (3FH) :Writings rejected due to wrong command, etc.
(Numerical value) : Measurements or settings

Continuous readout of measurement value
Readout the measurements continuously at "START_MEASURE" command. The response of this case never has STX, ETX. CR(0DH) is inserted between the measurements.
(ex.)
85.0000<CR>85.0001<CR>85.0…

Sure to use the command "STOP_MEASURE" to stop the continuous reading. Any other command will be valid until the stop command is set. Continuous reading will not be activated simultaneously.

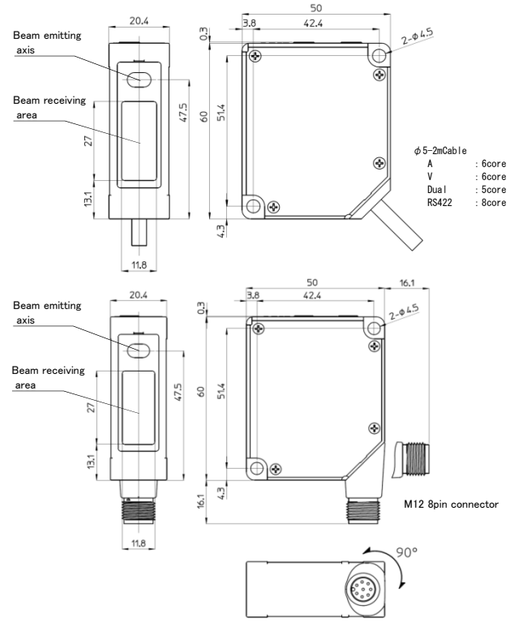
●Command Table

Command		type*	Initial value	Description	Example of Response
Read the measurements	START_MEASURE	CR	–	Start continuous reading of measurements	85.0000[CR]85.0001[CR]85.0…
	STOP_MEASURE	–	–	Stop continuous reading of measurements	[STX] > [ETX]
	MEASURE	R	–	Read the measurements	[STX] 85.0000 [ETX]
	START_MEASURE_S	CR	–	Start continuous reading of measurements and sensitivity *1	85.0000 121[CR]85.0001 121[CR]85.0…
	STOP_MEASURE_S	–	–	Stop continuous reading of measurements and sensitivity *1	[STX] > [ETX]
	MEASURE_S	R	–	Read the measurements and sensitivity	[STX]85.0000 121[ETX]
START_Q2		CR	–	Start continuous Q2 output	ON[CR]ON[CR]OFF[CR]OFF…
STOP_Q2		–	–	Stop continuous Q2 output	[STX] > [ETX]
Q2 setting	Q2	R	–	Read Q2 output	[STX]ON[ETX]
	Q2_HI	R	–	Read actual setting of Q2 Hi	[STX]105.0000[ETX]
	Q2_LO	R	–	Read actual setting of Q2 Lo	[STX]65.0000[ETX]
	Q2_HI()60.000	W	–	Set Q2 Hi for example to 60mm *2	[STX] > [ETX] or [STX]?[ETX]
	Q2_LO()40.000	W	–	Set Q2 Lo for example to 40mm *2	[STX] > [ETX] or [STX]?[ETX]
	Q2 DEFAULT	R	●	Set Q2 to default (Self-diagnosis output)	[STX] > [ETX]
Avg. setting	AVG	R	–	Read setting of the response time	[STX]FAST[ETX]
	AVG()FAST	W	–	Set response time to Fast	[STX] > [ETX]
	AVG()MEDIUM	W	●	Set response time to Standard	[STX] > [ETX]
	AVG()SLOW	W	–	Set response time to High resolution	[STX] > [ETX]
Multi functional input	MF	R	–	Read setting of multi functional inputs	[STX]LSR_OFF[ETX]
	MF()LSR_OFF	W	●	Set to Laser off (default)	[STX] > [ETX]
	MF()SH	W	–	Set to Sample Hold	[STX] > [ETX]
	MF()TEACH	W	–	Set to external Teach	[STX] > [ETX]
	MF()OS	W	–	Set to one shot by trigger or command	[STX] > [ETX]
Alarm setting	ALARM	R	–	Read actual setting for Alarm	[STX]CLAMP[ETX]
	ALARM()CLAMP	W	●	Set Alarm to clamp	[STX] > [ETX]
	ALARM()HOLD	W	–	Set Alarm to Hold	[STX] > [ETX]
RESET		W	–	Reset all settings to default settings	[STX] > [ETX]
ON		W	–	Set MF active	[STX] > [ETX]
OFF		–	–	Set MF inactive	[STX] > [ETX]
External Teach	ON()500	W	–	Q2: One point teaching The second point of two points of teaching ; Complete input of the same command within one minute.	[STX] > [ETX]
	ON()600	W	–	Q2:One Point Reverse teaching	[STX] > [ETX]
	ON()700	W	–	Offset *3 *9	[STX] > [ETX]
	ON()5000	W	–	Offset cancel	[STX] > [ETX]
SAVE		R	–	Save all setting	
	WRITE()xxxx	W	–	Write all setting *3	
	SERIAL_NO	R	–	Read Serial number *4	[STX]xxxxxxxxxxF[ETX]
	USER DATA	R	–	Read user Data	[STX]xxxxxxxxxxxxxxxx[ETX]
	USER_DATA()xxx	W	–	Write user data (max. 16 byte ASCII) *5	[STX] > [ETX]
	BIT_RATE	R	–	Read actual setting for Bit rate	[STX]9.6K[ETX]
	BIT_RATE()9.6	W	9.6	Set baud rate *6	[STX] > [ETX]
	SAMPLE_RATE	R	–	Read actual setting for sampling period	[STX]500US[ETX]
	SAMPLE_RATE()500	W	500	Set sampling period *7	[STX] > [ETX]

Command type = CR: Continuous reading command, R: Reading command, W: writing command
The space (20H) is shown as ( ) for convenience.

*1 Sensitivity is automatically adjusted between the value of 0 and 223. (0 as Low limit, 223 as HIGH limit). Manual setting of sensitivity is not available.
*2 Input the distance to set by mm. Possible to input decimal four columns, but the setting distance over the detection performance becomes invalid.
*3 Write the values in turn as they have been read out in the SAVE.
*4 Reads out the serial numbers (11 digit) that is printed in the product label on the back.
*5 Up to 16byte by ASCII code
*6 Baud rate is 9.6kbps at factory set. Choose baud rate among(9.6/19.2/38.4/57.6/76.8/115.2/128/256kbps
*7 Sampling period is 500 μ s at factory set. Choose sampling period among (500/1000/1500/2000 μ s) (CD33-250 750/1000/1500/2000 μ s 750 μ s at factory set)
*8 While Offset is activated, it will output displacement data including minus sign for the data smaller than zer

Dimension



● Specifications and equipment are subject to change without any notice.
● For more information, questions and comments regarding products, please contact us below.

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