Displacement Sensor

# CD33-L SERIES

Specular
Laser type

CD33-L30□□
CD33-L50□□

## 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 than those specified herein may result in hazardous radiation exposure.

### ⚠ WARNING Safety Precautions

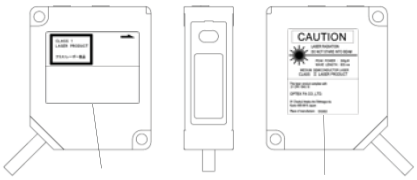
- It is dangerous to wire or attach/remove the connector with the power on. Make sure to turn off the power before operation.
- Installing in the following places may result in malfunction:
  1. A dusty or steamy place
  2. A place generating corrosive gas
  3. A place directly receiving scattering water 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.**

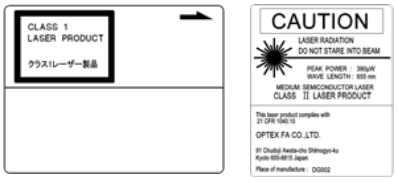
## Precautions for using laser

■Laser label
This product is classified as Class 1 by JIS C6802/IEC and Class Ⅱ by FDA Laser Product 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.




Label-A Label-B




Label-A Label-B

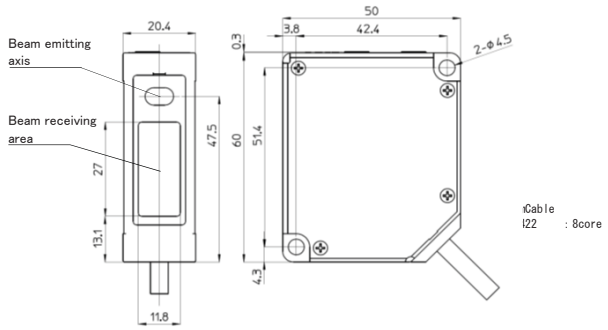
## Specifications

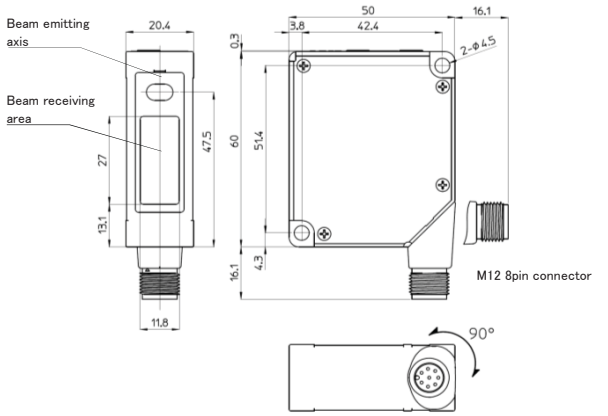
●Specifications of Measuring Range

| | | | | |
|---|---|---|---|---|
| Type | Cable type | CD33-L30N(P) | CD33-L50N(P) | CD33-L85N(P) |
| | Connector type | CD33-L30CN(P) | CD33-L50CN(P) | CD33-L85CN(P) |
| Center | | 26.3mm | 47.3mm | 82.9mm |
| Measuring range | | ±2mm | ±5mm | ±10mm |
| Light source | | Red laser Diode (wave length 655nm) | | |
| Peak power | | Max. output 390μW | | |
| Laser Class | IEC/JIS | CLASS1 | | |
| | FDA | CLASS Ⅱ | | |
| Spot size (approx. volume) *1 | Near | 0.15×0.15mm | 0.15×0.15mm | 0.15×0.15mm |
| | Middle | 0.1×0.1mm | 0.1×0.1mm | 0.1×0.1mm |
| | Far | 0.15×0.15mm | 0.15×0.15mm | 0.15×0.15mm |
| Linearity *2 | | ±0.2% F.S. (F.S.=4mm) | ±0.2% F.S. (F.S.=10mm) | ±0.2% F.S. (F.S.=20mm) |
| Resolution *3 | | 1μm | 2.5μm | 5μm |
| Response time | Fast | averaging: 1 time 5ms max. | | |
| | Standard | averaging: 16 times 12.5ms max. | | |
| | High resolution | averaging: 64 times 36.5ms max. | | |
| Sampling period | | 500 /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 | | |

*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.

## Dimension

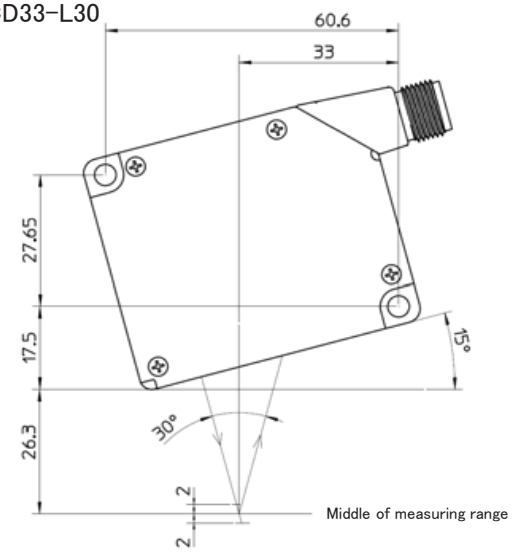


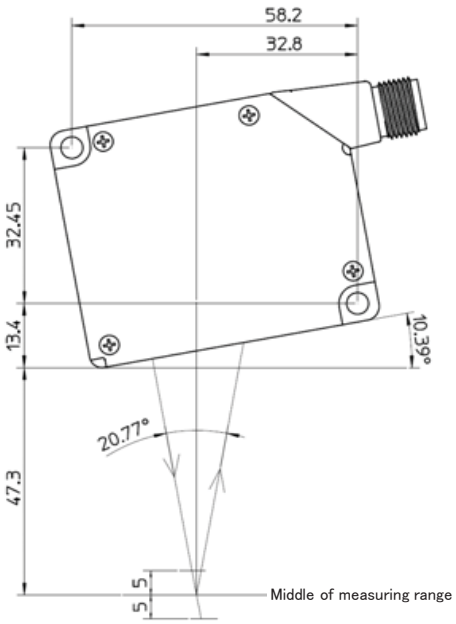
# Installation

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).

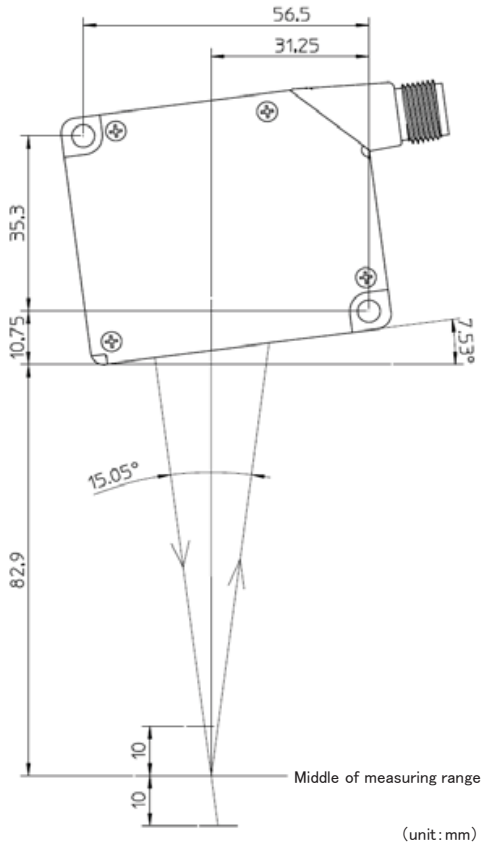
CD33-L30




CD33-L50



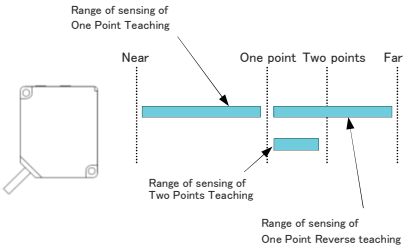
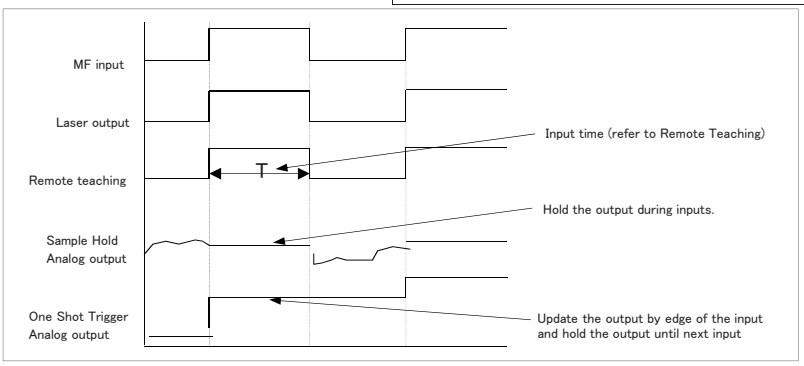

CD33-L85



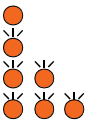
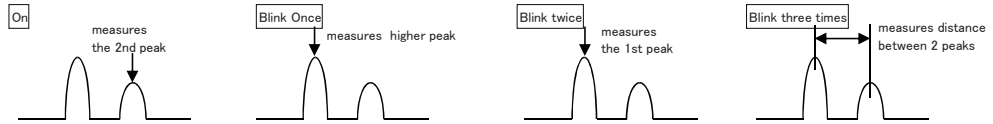
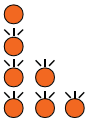
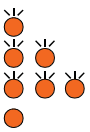

(unit：mm)

## Functions

●Teach mode

| Functions | Functions indicated | Details | Settings and Adjustments | Factory Setting |
|---|---|---|---|---|
| Output setting | Q1 / Q2 | set the range of Control Output.<br>One point teaching : From the position of the teaching − 0.15%(FS) to the Near side of the sensing range.<br>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).<br>One point reverse teaching: From the position of the teaching +0.15%(FS) to the Far side of the sensing range.<br>  | ●One point teaching<br>①Push the Select button more than five seconds to enter Teach mode.<br>②Push the Select button and let Q1(Q2) indication turn on.<br>③Set the object in the position that you want to measure and push the Set button<br>④ Q1(Q2) indication flashes one time.<br>In the case of adjustment failure, indication flashes for five seconds. Try again getting back to ② of above.<br><br>●Two points teaching<br>①Push the Select button more than five seconds to enter Teach mode.<br>②Push the Select button and let Q1(Q2) indication turn on<br>③Set up the object at the first point of the range that you want to measure and push the Set button<br>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.<br>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.<br>⑥Push the Select button more than five seconds to return to Run mode.<br><br>●One point Reverse teaching<br>①Push the Select button more than five seconds to enter Teach mode.<br>②Push the Select button and let Q1(Q2) indication turn on<br>③Set the object in the position that you want to measure and push the Set button more than five seconds .<br>④ Q1(Q2) indication flashes one time.<br>In the case of adjustment failure, the indication flashes five seconds.<br>Try again getting back to ② of above.<br>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.<br>  <br>Blink Once : Laser OFF<br>Blink twice : Remote teaching<br>Blink three times : Sample Hold<br>  <br>*Possible to choose One Shot Trigger by Special setting mode. | ①Push the Select button more than five seconds to enter Teach mode.<br>②Push the Select button and let MF indication turn on.<br>③Choose the function you need by pushing Set button.<br>④Push the Select button more than five seconds to return to Run mode. | Laser OFF |
| Averaging | Avg | Average count setting<br>  <br>Blink Once : Fast (averaging 1 time)<br>Blink twice : Standard (averaging 16 times)<br>Blink three times : High Res. (averaging 64 times) | ①Push the Select button more than five seconds to enter Teach mode.<br>②Push the Select button and let Avg. indication turn on.<br>③Choose the function by pushing Set button.<br>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 | Factory Setting |
|---|---|---|---|---|
| Measurement settings | Q2 | This setting is choice of measurement peak at receiver.<br>  <br>On : measures the 2nd peak<br>Blink Once : measures higher peak<br>Blink twice : measures the 1st peak<br>Blink three times : measures distance between 2 peaks<br>  | ①Push the Select and set button at same time for more than five seconds to enter Special setting mode<br>②Push the Select button and let MF indication turn on.<br>③Choose the function by pushing Set button.<br>④Push the Select and set button more than five seconds to return to Run mode. | measures higher peak |
| One shot trigger | MF | One shot trigger is possible to select through external input.<br>  <br>On : One shot trigger<br>Blink Once : Laser OFF<br>Blink twice : Remote teaching<br>Blink three times : Sample Hold | ①Push the Select and set button at same time for more than five seconds to enter Special setting mode<br>②Push the Select button and let MF indication turn on.<br>③Choose the function by pushing Set button.<br>④Push the Select and set button more than five seconds to return to Run mode. | Laser OFF |
| Sampling period | Avg | Sampling period setting<br>  <br>Blink Once : 500 μ s<br>Blink twice : 1000 μ s<br>Blink three times : 1500 μ s<br>On : 2000 μ s<br>High response<br>High sensitivity<br>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.<br>②Push the Select button and let Avg. indication turn on.<br>③Choose the function by pushing Set button.<br>④Push the Select and set button more than five seconds to return to Run mode. | 500 μ s |

(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.

# Communication

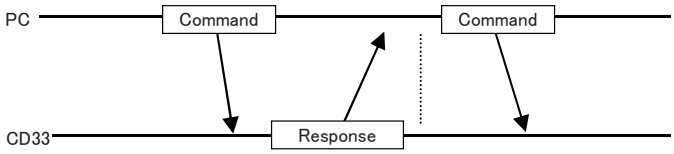
●Specification

| | |
|---|---|
| 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.

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

<For diffuse reflection /specular reflection type>

| 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<br>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 *8 *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]xxxxxxxxxF[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 μs at factory set. Choose sampling period among ( 500/1000/1500/2000 μs)

*8 While Offset is activated, it will output displacement data including minus sign for the data smaller than zero.

*9 Please set MF input as "Remote teaching" when you activate Offset.

## <Only for specular reflection type>

| Command | | type* | Initial value | Description | Example of Response |
|---|---|---|---|---|---|
| Measurement settings | MODE | R | HIGHEST | Read out measurement settings | [STX] HIGHEST [ETX] |
| | MODE()HIGHEST | W | ● | measures higher peak | [STX] > [ETX] |
| | MODE()FIRST | W | – | measures the 1st peak | [STX] > [ETX] |
| | MODE()LAST | W | – | measures the 2nd peak | [STX] > [ETX] |
| | MODE()GLASS | W | – | measures distance between 2 peaks | [STX] > [ETX] |
| PIXEL_DATA | | R | – | Read out pixel level (1024byte) and header (16byte) data from receiver | See below. |
| Sensitivity setting | SENSE | R | – | Read out sensitivity value (0–223). The bigger higher sensitivity. | AUTO_XXX / FIX_XXX |
| | SENSE()AUTO | W | AUTO | Change the sensitivity mode to automatic. Use fixed auto sensitivity usually. | [STX] > [ETX] |
| | SENSE()xxx | W | – | Set sensitivity value , if use fixed sensitivity mode. If send the sensitivity value , sensor return response by 4 digit (current receiving level). | [STX] XXXX [ETX] |
| Zero suppress setting | ZSUPPRESS | R | – | Read out the current zero suppress setting. (Zero suppress : Rejecting "0" at the forefront of the data.) | [STX] ON [ETX] / [STX] OFF [ETX] |
| | ZSUPPRESS()ON | W | ON | Use zero suppress (default setting). | [STX] > [ETX] |
| | ZSUPPRESS()OFF | W | – | Does not use zero suppress. | [STX] > [ETX] |
| Multi functional input logic setting | LOGIC | R | – | Read out the current multi function input (MF : gray cable) status. | [STX] NORMAL [ETX] / [STX] INVERTED [ETX] |
| | LOGIC()NORMAL | W | NORMAL | Change the logic of the multi function input to "Normal mode".(NPN: connect 0V to active / PNP: connect +V to active) | [STX] > [ETX] |
| | LOGIC()INVERTED | W | – | Change the logic of the multi function input to " Inverted mode".(NPN: connect +V or open to active / PNP: connect 0V or open to active) | [STX] > [ETX] |
| GLASS_T | | R | – | Read out the refractive index for correction value for measurement of the glass thickness. | [STX] XXX [ETX] |
| GLASS_T xxx | | W | – | Teaching the refractive index using gauge glass. Measure the glass thickness and send its know thickness. | [STX] > [ETX] |

●Reading format of PIXEL_DATA

Response is 1040byte data including header and pixel data (No STX and ETX)

| | |
|---|---|
| Header 16byte | Pixel deta : 512pixcel 1pixel = 2byte 1024byte |

Header data

16byte at the forefront of the data.

| bit data | 0byte | 1byte | 2byte | 3byte | 4byte | 5byte | 6byte | 7byte | 8byte | 9byte | 10byte | 11byte | 12byte | 13byte | 14byte | 15byte |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| lower/higher | L | H | L | H | L | H | L | H | L | H | L | H | L | H | L | H |

| read the measurement settings | | read the first peak pixel | read the second peak pixel | reading threshold | reserve | reserve | reserve | reserve |
|---|---|---|---|---|---|---|---|---|
| 0 | Highest | response by 0–511 (number is pixel position) | response by 0–511 (number is pixel position) | response threshold | | | | |
| 1 | First | | | | | | | |
| 2 | Glass | | | | | | | |
| 3 | Last | | | | | | | |

example

| Hex | 02 | 00 | 42 | 01 | 00 | 00 | 1C | 04 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dec | 2 | | 322 | | 0 | | 1052 | | 0 | | 0 | | 0 | | 0 | |

※One data is 2byte(16bit)

※Part of reserve data is response by 00 00

Pixel data

1024byte data after header data

| bit data | 0byte | 1byte | 2byte | 3byte | 4byte | 5byte | 1018byte | 1019byte | 1020byte | 1021byte | 1022byte | 1023byte |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| lower/higher | L | H | L | H | L | H | L | H | L | H | L | H |

| pixel 0 receiver level | pixel 1 receiver level | pixel 2receiver level | pixel 509 receiver level | pixel 510receiver level | pixel 511receiver level |
|---|---|---|---|---|---|
| response by 0–4095 | response by 0–4095 | response by 0–4095 | response by 0–4095 | response by 0–4095 | response by 0–4095 |

example

| Hex | 20 | 00 | 22 | 00 | 25 | 00 | 40 | 03 | 42 | 03 | 1F | 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dec | 20 | | 22 | | 25 | | 832 | | 834 | | 543 | |

●Specifications and equipment are subject to change without any notice.

●For more information, questions and comments regarding products, please contact us.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