

472

C-MOS laser displacement sensor

**CD33** series



# Half-palm size. Ideal for built-in use with smaller machines.

- Specular reflection types have been added to the line up
- Control units for Mitsubishi Electric PLC are available

<b>Related products</b>	Ultra-high accuracy <b>CDX</b> ● P.438	Connecting to MELSEC-Q <b>UQ1-02</b> ● P.520	Compact type <b>CD22</b> ● P.464

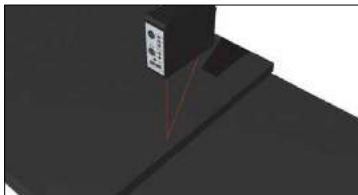
### Substrate warpage measurement



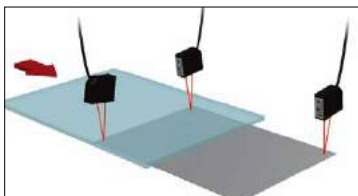
### Height measurement of mounted parts



### Seam detection on rubber sheeting



### Mask height control and glass substrate thickness measurement (Specular reflection type)

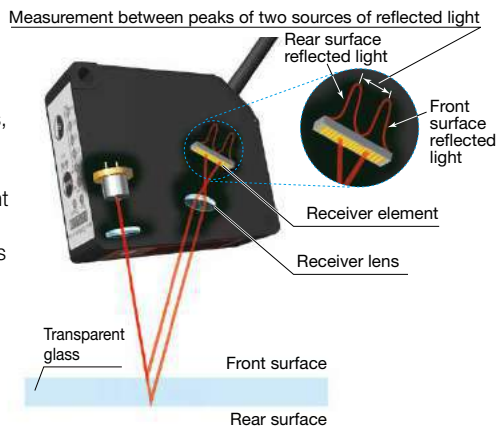


### Specular reflection types for measurements of specular and transparent objects.

Specular reflection types have been added to the line up to enable the measurement of transparent objects such as glass workpiece, as well as specular objects such as wafers, etc. This means that transparent and specular objects that were difficult to measure using diffuse-reflective types can now be measured with stability.

### Thickness measurements also possible

When using a specular reflection type to measure transparent objects, not only surface displacement, but also thickness can be measured. As shown below, when the laser light is emitted at an angle, light reflected from both the front and rear surfaces of the glass are received by receiver element. Thickness measurements are possible by measuring between the peaks of these reflected light forms.

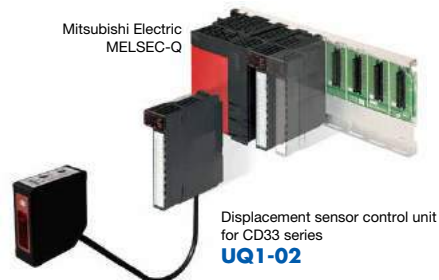


### Direct connection to Mitsubishi Electric PLCs

The UQ1-02 displacement sensor control unit that can be connected to the Mitsubishi Electric MELSEC-Q series!

In addition to the fact that absolutely no communications settings are necessary, by using the specialized UQ1 Navigator software it is possible for any one to perform set up easily in a short period of time.

\*Can be used with the RS-422 type of the CD33 series **UQ1-02** description ● P.520



Photoelectric Sensors

Specialized Photoelectric Sensors

Laser Displacement Sensors

C-MOS Built-in Amplifiers

CDX

CDA

LS


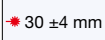


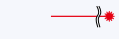
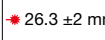
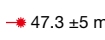

CD22

CD33

UQ1-01

UQ1-02

Selection table

Type	Measurement range	Repeat accuracy	Analog output/serial interface	Control output	Model (Models in parentheses are connector types)	
					NPN type	PNP type
 Diffuse-reflective type (Laser Class 2)	 30 ±4 mm	2 μm (4 μm*)	4 to 20 mA	2ch	<b>CD33-30NA</b> (CD33-30CNA)	<b>CD33-30PA</b> (CD33-30CPA)
			0 to 10 V		<b>CD33-30NV</b> (CD33-30CNV)	<b>CD33-30PV</b> (CD33-30CPV)
			RS-422	1ch	<b>CD33-30N-422</b> (CD33-30CN-422)	<b>CD33-30P-422</b> (CD33-30CP-422)
	 50 ±10 mm	5 μm (8 μm*)	4 to 20 mA	2ch	<b>CD33-50NA</b> (CD33-50CNA)	<b>CD33-50PA</b> (CD33-50CPA)
			0 to 10 V		<b>CD33-50NV</b> (CD33-50CNV)	<b>CD33-50PV</b> (CD33-50CPV)
			RS-422	1ch	<b>CD33-50N-422</b> (CD33-50CN-422)	<b>CD33-50P-422</b> (CD33-50CP-422)
	 85 ±20 mm	10 μm (15 μm*)	4 to 20 mA	2ch	<b>CD33-85NA</b> (CD33-85CNA)	<b>CD33-85PA</b> (CD33-85CPA)
			0 to 10 V		<b>CD33-85NV</b> (CD33-85CNV)	<b>CD33-85PV</b> (CD33-85CPV)
			RS-422	1ch	<b>CD33-85N-422</b> (CD33-85CN-422)	<b>CD33-85P-422</b> (CD33-85CP-422)
	 120 ±60 mm	30 μm (45 μm*)	4 to 20 mA	2ch	<b>CD33-120NA</b> (CD33-120CNA)	<b>CD33-120PA</b> (CD33-120CPA)
			0 to 10 V		<b>CD33-120NV</b> (CD33-120CNV)	<b>CD33-120PV</b> (CD33-120CPV)
			RS-422	1ch	<b>CD33-120N-422</b> (CD33-120CN-422)	<b>CD33-120P-422</b> (CD33-120CP-422)
 250 ±150 mm	75 μm (100 μm*)	4 to 20 mA	2ch	<b>CD33-250NA</b> (CD33-250CNA)	<b>CD33-250PA</b> (CD33-250CPA)	
		0 to 10 V		<b>CD33-250NV</b> (CD33-250CNV)	<b>CD33-250PV</b> (CD33-250CPV)	
		RS-422	1ch	<b>CD33-250N-422</b> (CD33-250CN-422)	<b>CD33-250P-422</b> (CD33-250CP-422)	
 Specular reflection type (Laser Class 1)	 26.3 ±2 mm	1 μm	RS-422	1ch	<b>CD33-L30N-422</b> (CD33-L30CN-422)	<b>CD33-L30P-422</b> (CD33-L30CP-422)
	 47.3 ±5 mm	2.5 μm			<b>CD33-L50N-422</b> (CD33-L50CN-422)	<b>CD33-L50P-422</b> (CD33-L50CP-422)
	 82.9 ±10 mm	5 μm			<b>CD33-L85N-422</b> (CD33-L85CN-422)	<b>CD33-L85P-422</b> (CD33-L85CP-422)

\*The repeat accuracy when response time is set to FAST is shown in parentheses.  
 ● For the connector type, please purchase an optional **DOL-1208-G05MF** connector cable.  
 ● When using a UQ1-02 control unit, select the RS-422 communication type.

Options/Accessories

Connector cable

**DOL-1208-G05MF**  
 M12, 8-pin connector cable  
 Cable length: 5 m



Displacement sensor control unit

**UQ1-02**

For connecting to the Mitsubishi Electric MELSEC-Q series  
 \* Can be used with the RS-422 type of the CD33 series



C-MOS laser displacement sensor **CD33** series

**Original built-in technology**  
**Lightweight with a built-in amplifier!**

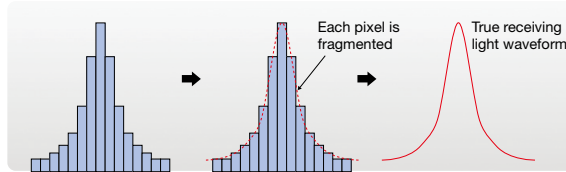
An amplifier and all control functions are integrated into the sensor head. You don't have to worry about space for installing to control panels.  
 It also features a light weight of approx. 65 g, enabling it to be installed to movable parts such as chip mounters or robot arms.



**Uses sub-pixel processing and automatic sensitivity switching function**  
**Pursuit of the limits in terms of accuracy and measurement stability!**

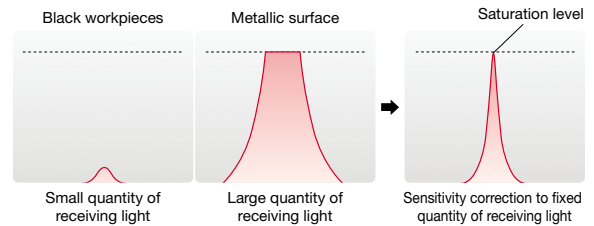
**Sub-pixel processing that recognizes true waveforms**

Sub-pixel processing is employed that performs recognition by fragmenting each C-MOS element pixel. By accurately detecting the true receiving light waveform, it is possible to correctly measure the distance to a workpiece. Repeat accuracy is also  $2 \mu\text{m}^*$  and support is provided for high-accuracy displacement measurement.  
 \*Values with CD33-30N□



**High-accuracy sensitivity switching function effective against influence caused by workpiece material and color**

The opening degree of the shutter is switched automatically in accordance with the reflection rate of the workpiece. By controlling the receiving light quantity and constantly correcting to the optimal sensitivity, we have succeeded in keeping errors caused by color and materials to an absolute minimum.

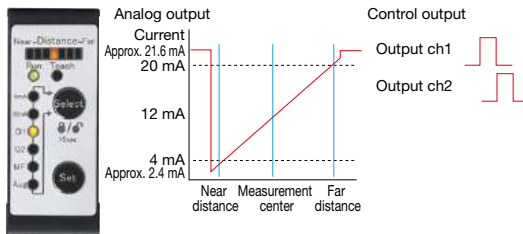


**Low cost version that eliminates unnecessary circuits**

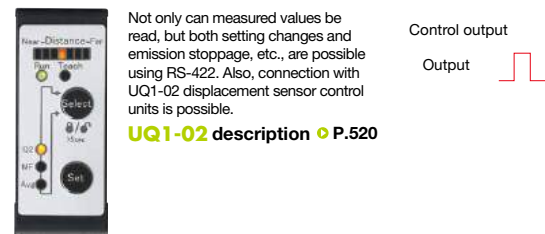
**Realizing a high level of cost performance with a wide output-based lineup**

While many of our competitors' displacement sensors have multiple types of measured value outputs, customers can make selections from "analog current + 2ch control output type", "analog voltage + 2ch control output type", "RS-422 + control output type", based on the input device used. Also, by eliminating unnecessary circuits, a highest-in-class level of cost performance has been realized. These laser displacement sensors are highly-accurate, low in cost, and easy to introduce.

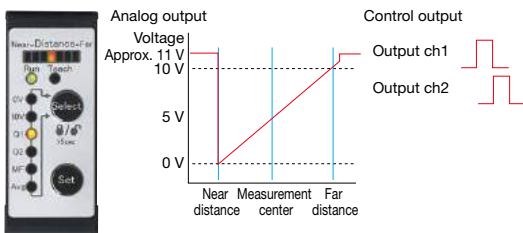
**Analog current + 2ch control output type**



**RS-422 + control output type**



**Analog voltage + 2ch control output type**



Photoelectric Sensors

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Laser Displacement Sensors

C-MOS Built-in Amplifiers

CDX

CDA

LS

CD22

CD33

CD4

CD5

UQ1-01

UQ1-02



## Specifications

### ■ Diffuse-reflective type Measurement distance based specifications

Model	CD33-30□□□	CD33-50□□□	CD33-85□□□	CD33-120□□□	CD33-250□□□
Center of measurement range	30 mm	50 mm	85 mm	120 mm	250 mm
Measurement range	±4 mm	±10 mm	±20 mm	±60 mm	±150 mm
F.S. (full scale)	8 mm	20 mm	40 mm	120 mm	300 mm
Light source	Red semiconductor laser, wavelength: 655 nm, Maximum output: 1 mW				
Laser class	IEC/JIS: CLASS 2 FDA: CLASS II				
Spot size <sup>1</sup>	0.1 × 0.1 mm	0.5 × 1.0 mm	0.75 × 1.25 mm	1.0 × 1.5 mm	1.75 × 3.5 mm
Linearity	±0.1% F.S.				
Repeat accuracy	2 μm (4 μm when response time is set to FAST)	5 μm (8 μm when response time is set to FAST)	10 μm (15 μm when response time is set to FAST)	30 μm (45 μm when response time is set to FAST)	75 μm (100 μm when response time is set to FAST)
Sampling period	0.5 ms/1 ms/1.5 ms/2 ms				0.75 ms/1 ms/1.5 ms/2 ms
Response time <sup>2</sup> Averaging	Fast	5 ms or less: Averaging 1 time (1 ms) + sensitivity switching time (Max. 4 ms)			7.5 ms or less: Averaging 1 time (1.5 ms) + sensitivity switching time (Max. 6 ms)
	Standard	12.5 ms or less: Averaging 16 times (8.5 ms) + sensitivity switching time (Max. 4 ms)			19 ms or less: Averaging 16 times (13 ms) + sensitivity switching time (Max. 6 ms)
	High-resolution	36.5 ms or less: Averaging 64 times (32.5 ms) + sensitivity switching time (Max. 4 ms)			55 ms or less: Averaging 64 times (49 ms) + sensitivity switching time (Max. 6 ms)
Temperature drift	±0.08%/°C F.S.				
Indicators	Distance indicator	LED bar display on operation surface (25-step)			
	Output indicator	Q1 and Q2 LED lights up during output (orange)			
	Input indicator	MF LED lights up during input (orange)			
MF (multi-function) input	Choose from laser OFF, teaching <sup>3</sup> , sample & hold Response time: 3 ms or less				
Connection type	Cable type: Cable length: 2 m (ø5) Connector type: M12, 8-pin				
Protection circuit	Reverse connection protection, overcurrent protection function				
Degree of protection	IP67				
Ambient temperature/humidity	-10 to +45°C / 35 to 85% RH (no freezing or condensation)				
Ambient illuminance	Sunlight: 10,000 lx Incandescent lamp: 3,000 lx				
Vibration resistance	10 to 55 Hz; double amplitude 1.5 mm; 2 hours in each of the X, Y, and Z directions				
Shock resistance	Approx. 50 G (500 m/s <sup>2</sup> ), 3 times in each of the X, Y, and Z directions				
Warm-up time	Approx. 15 minutes				
Material	Housing: PBT, Front cover: PMMA, Cable: PVC				
Weight without cable	Approx. 65 g				

### ■ Diffuse-reflective type Output based specifications

Type	Analog current output type	Analog voltage output type	RS-422 type
Model	NPN type	CD33-□□NA	CD33-□□NV
	PNP type	CD33-□□PA	CD33-□□PV
Supply voltage	12 to 24 VDC, ±10/-5%		12 to 24 VDC, ±10/-5%
Current consumption	Max. 85 mA (including analog output)		Max. 55 mA
Control output	Output channel No.	2ch: Q1, Q2 (default setting of self-diagnosis output for Q2)	
	Output method	1ch: Q2 (default setting of self-diagnosis output)	
Analog output/serial interface	NPN/PNP open collector output, Max. 100 mA / 30 VDC, residual voltage 1.8 V		
Applicable regulations	4 to 20 mA, load impedance: 300 Ω or less 0 to 10 V, output impedance: 100 Ω RS-422 9.6 k to 256 kbps		
Applicable standards	EMC directive (2004/108/EC) / FDA regulations (21 CFR 1040.10)		
	EN 60947-5-7		EN 60947-5-2

<Measurement conditions> The measurement conditions are as follows unless otherwise designated: Ambient temperature of +23°C (normal temperature), Supply voltage 24 VDC, Response time: High-resolution, Center of measurement range, Measurement target: 50 × 50 mm white ceramic.

\*1 Defined with center strength 1/e<sup>2</sup> (13.5%) at the center of measurement range. There may be leak light other than the specified spot size. The sensor may be affected when there is a highly reflective object in the range of the light axis.

\*2 The response time is a time in which the sensitivity switching time has been added. The sensitivity switching time fluctuates within a max. range of 4 ms (6 ms for CD33-250□□) depending on measurement conditions. Also, if the sampling period is long, the response time will also increase proportionately.

Ex.: Sampling period 500 μs → 1000 μs: Response time 12.5 ms → Approx. 25 ms

\*3 If external teaching is selected, setting items can be changed as shown in the table below depending on the input time thereof.

Setting items	Input time	Setting items	Input time
1st point for span adjustment	70 to 130 ms	1-point teaching of control output Q2	470 to 530 ms
2nd point for span adjustment	170 to 230 ms	Please input the same time for the 2nd point of 2-point teaching within one minute.	
1-point teaching of control output Q1	270 to 330 ms	Inverted 1-point teaching of control output Q2	570 to 630 ms
Please input the same time for the 2nd point of 2-point teaching within one minute.		Offset (zero reset)	670 to 5000 ms
Inverted 1-point teaching of control output Q1	370 to 430 ms	Clearing offset	5000 ms or more

C-MOS laser displacement sensor **CD33** series

## Specifications

## ■ Specular reflection type

Model	NPN type	CD33-L30□N-422	CD33-L50□N-422	CD33-L85□N-422
	PNP type	CD33-L30□P-422	CD33-L50□P-422	CD33-L85□P-422
Measurement target object	Specular object, glass			
Center of measurement range	26.3 mm		47.3 mm	
Measurement range	±2 mm		±5 mm	
F.S. (full scale)	4 mm		10 mm	
Light source	Red semiconductor laser, wavelength: 655 nm, Maximum output: 390 μW			
Laser class	IEC/JIS: CLASS 1 FDA: CLASS II			
Spot size <sup>1</sup>	0.1 × 0.1 mm			
Linearity	±0.2% F.S.			
Repeat accuracy	1 μm		2.5 μm	
Sampling period	0.5 (default setting), 4-stage switching is possible between 1 ms, 1.5 ms, 2 ms			
Response time <sup>2</sup>	Fast	5 ms or less: Averaging 1 time (1 ms) + sensitivity switching time (Max. 4 ms)		
	Standard	12.5 ms or less: Averaging 16 times (8.5 ms) + sensitivity switching time (Max. 4 ms)		
	High-resolution	36.5 ms or less: Averaging 64 times (32.5 ms) + sensitivity switching time (Max. 4 ms)		
Averaging	Output channel No.	1ch: Q2 (default setting of self-diagnosis output)		
	Output method	NPN/PNP open collector output, Max. 100 mA / 30 VDC, residual voltage 1.8 V		
Control output				
Analog output	Not equipped			
Serial interface	RS-422 9.6 k to 256 kbps			
Temperature drift	±0.08%/°C F.S.			
Indicators	Distance indicator	LED bar display on operation surface (25-step)		
	Output indicator	Q2 LED lights up during output (orange)		
	Input indicator	MF LED lights up during input (orange)		
MF (multi-function) input	Choose from laser OFF, teaching <sup>3</sup> , sample & hold Response time: 3 ms or less			
Supply voltage	12 to 24 VDC, ±10/-5%			
Current consumption	Max. 55 mA			
Connection type	Cable type: Cable length: 2 m (ø5) Connector type: M12, 8-pin			
Protection circuit	Reverse connection protection, overcurrent protection function			
Degree of protection	IP67			
Ambient temperature/humidity	-10 to +45°C / 35 to 85% RH (no freezing or condensation)			
Ambient illuminance	Sunlight: 10,000 lx Incandescent lamp: 3,000 lx			
Vibration resistance	10 to 55 Hz; double amplitude 1.5 mm; 2 hours in each of the X, Y, and Z directions			
Shock resistance	Approx. 50 G (500 m/s <sup>2</sup> ), 3 times in each of the X, Y, and Z directions			
Applicable regulations	EMC directive (2004/108/EC) / FDA regulations (21 CFR 1040.10)			
Applicable standards	EN 60947-5-2			
Warm-up time	Approx. 15 minutes			
Material	Housing: PBT, Front cover: PMMA, Cable: PVC			
Weight without cable	Approx. 65 g			

<Measurement conditions>

The measurement conditions are as follows unless otherwise designated: Ambient temperature of +23°C (normal temperature), Supply voltage 24 VDC, Response time: High-resolution, Center of measurement range, Measurement target: aluminum deposition mirror.

\*1 Defined with center strength 1/e<sup>2</sup> (13.5%) at the center of measurement range. There may be leak light other than the specified spot size. The sensor may be affected when there is a highly reflective object in the range of the light axis.

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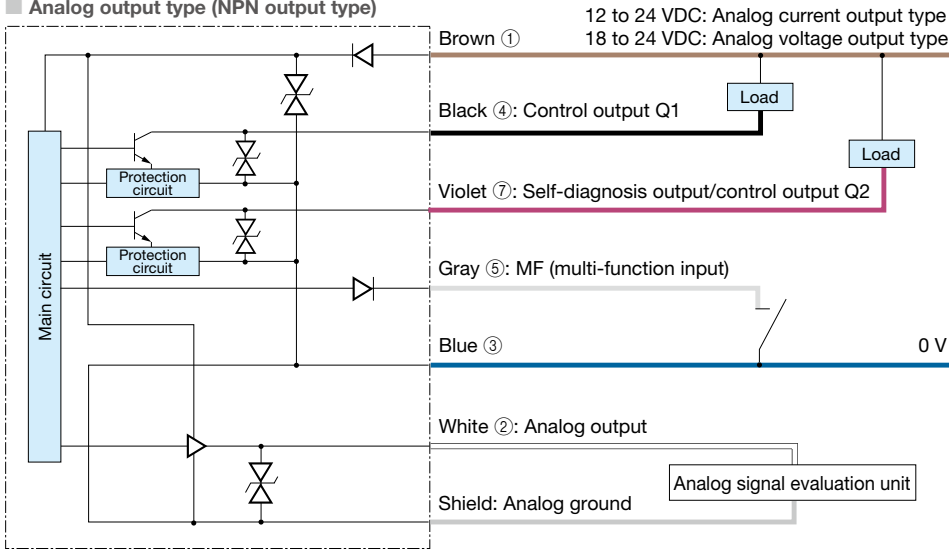
Ex.: Sampling period 500 μs → 1000 μs: Response time 12.5 ms → Approx. 25 ms

\*3 If external teaching is selected, setting items can be changed as shown in the table below depending on the input time thereof.

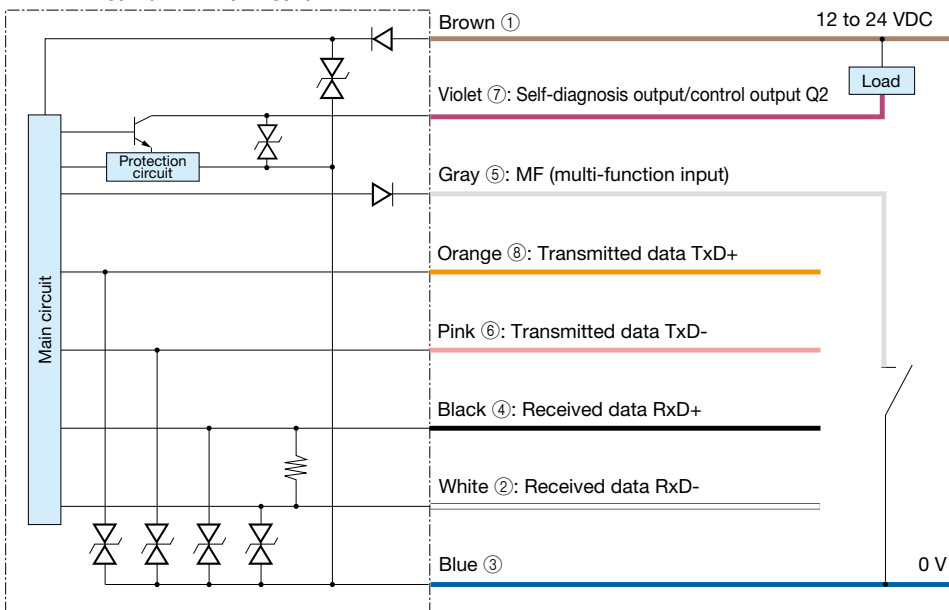
Setting items	Input time
1-point teaching of control output Q2 Please input the same time for the 2nd point of 2-point teaching within one minute.	470 to 530 ms
Inverted 1-point teaching of control output Q2	570 to 630 ms
Offset (zero reset)	670 to 5000 ms
Clearing offset	5000 ms or more

I/O circuit diagram

■ Analog output type (NPN output type)



■ RS-422 type (NPN output type)



■ Connector type

(Pin configuration)

Sensor side



Connector cable side



- ① Supply voltage
- ② Analog output/Received data RxD-
- ③ 0 V
- ④ Control output Q1/Received data RxD+

- ⑤ Multi-function input
- ⑥ Transmitted data TxD-
- ⑦ Self-diagnosis output/control output Q2
- ⑧ Transmitted data TxD+

Connecting

- ① to ⑧ are connector pin No.
- Because the connector type is not equipped with an analog ground wire, please use by connecting the analog ground terminal of the analog input device and 0 V of the sensor power supply.

Notes

- When using a switching regulator for the power supply, be sure to ground the frame ground terminal.
- Avoid wiring in parallel with or in the same piping as high-voltage wires or power lines. Doing so may lead to malfunctions caused by noise. Also, shorten the power supply and signal wires as much as possible.
- Avoid using the transient state while the power is on (approx. 1.5 s).

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Specialized Photoelectric Sensors

Laser Displacement Sensors

C-MOS Built-in Amplifiers

CDX

CDA

LS

CD22

CD33

CD4

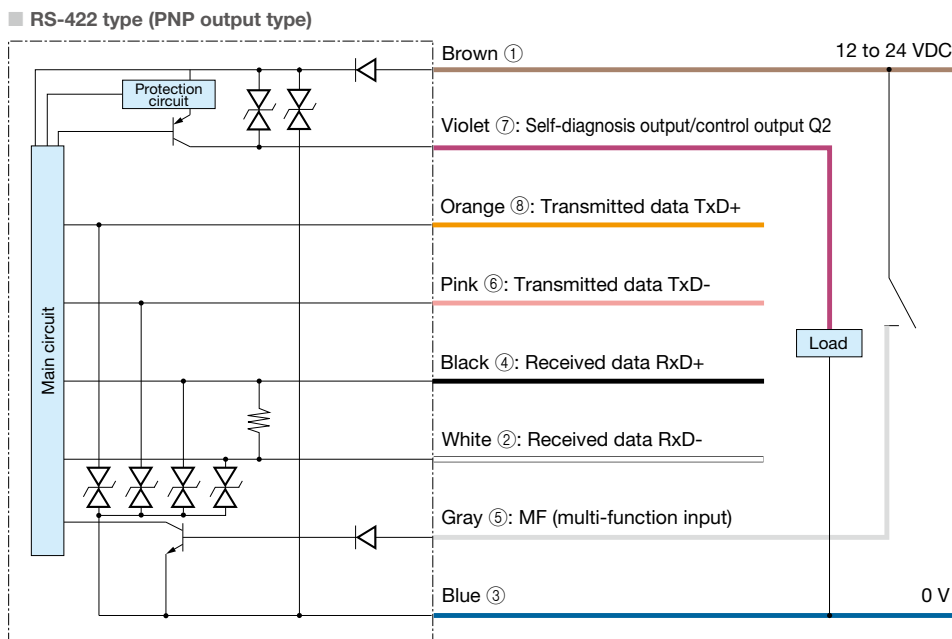
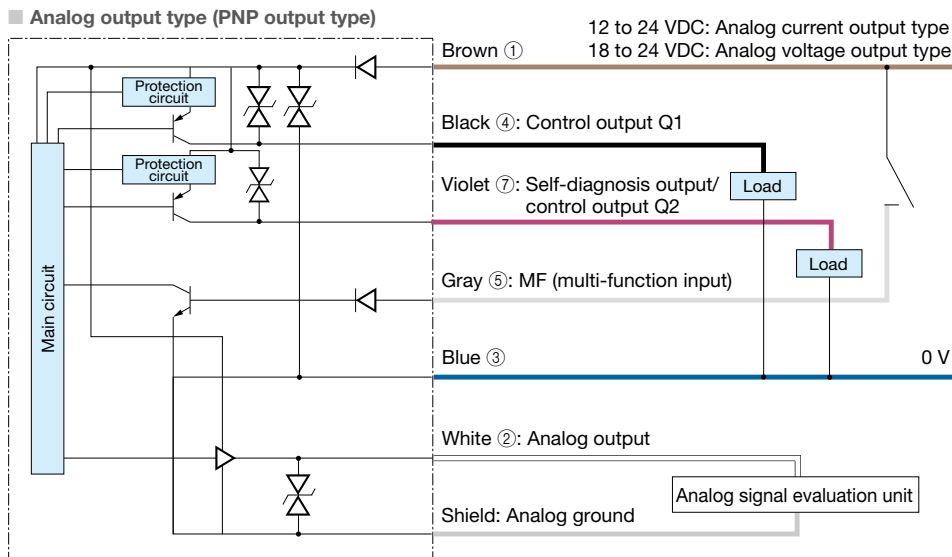
CD5

UQ1-01

UQ1-02

C-MOS laser displacement sensor CD33 series

I/O circuit diagram



■ Connector type

(Pin configuration)

Sensor side



- ① Supply voltage
- ② Analog output/  
Received data RxD-
- ③ 0 V
- ④ Control output Q1/  
Received data RxD+

Connector cable side



- ⑤ Multi-function input
- ⑥ Transmitted data TxD-
- ⑦ Self-diagnosis output/  
control output Q2
- ⑧ Transmitted data TxD+

Connecting

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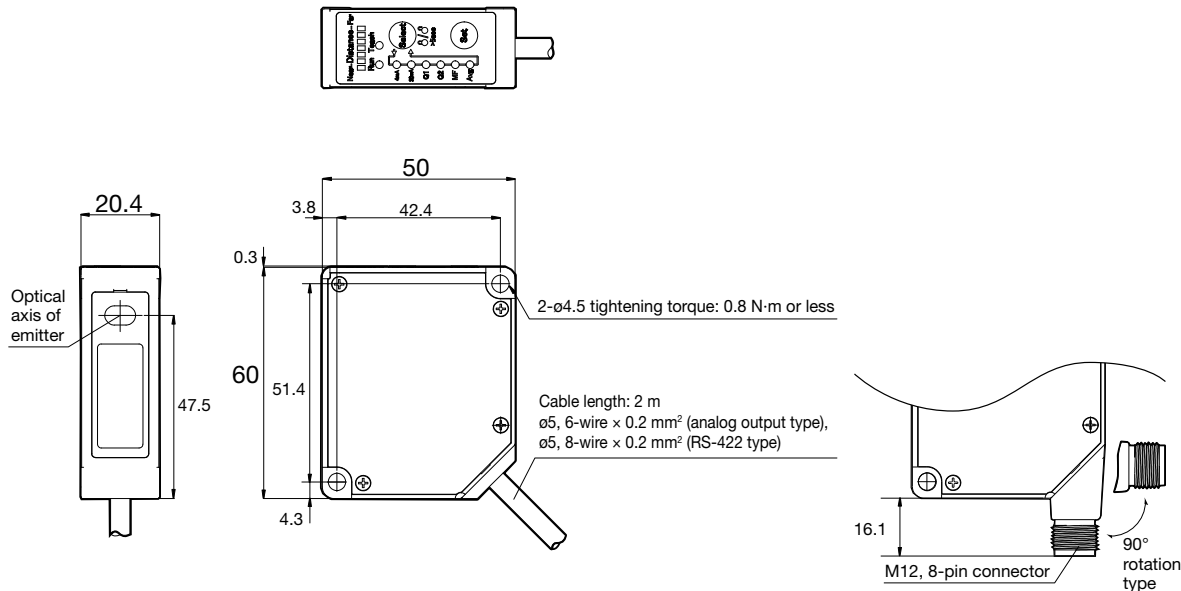
**Dimensions**

Sensor

■ Cable type

(Unit: mm)

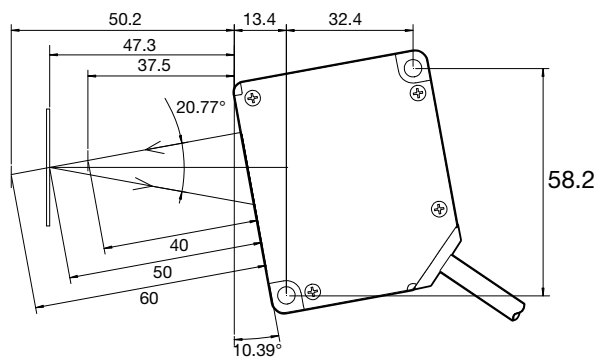
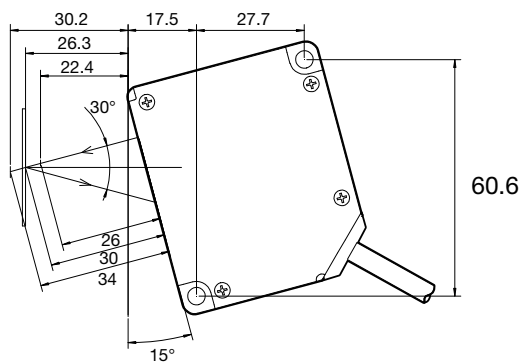
■ Connector type



**Specular reflection type (side view)**

**CD33-L30□-422**

**CD33-L50□-422**



Photoelectric Sensors

Specialized Photoelectric Sensors

Laser Displacement Sensors

C-MOS Built-in Amplifiers

CDX

CDA

LS

CD22

CD33

CD4

CD5

UQ1-01

UQ1-02



480

Laser Displacement Sensors

Photoelectric Sensors

Specialized Photoelectric Sensors

Laser Displacement Sensors

C-MOS Built-in Amplifiers

CDX

CDA

LS

CD22

CD33

CD4

CD5

UQ1-01

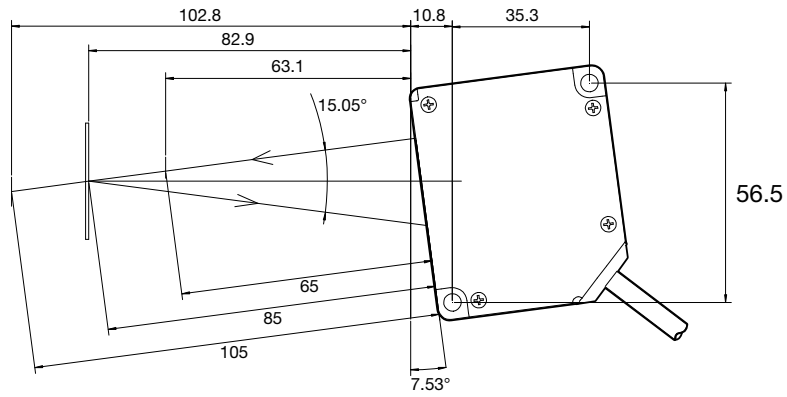
UQ1-02

C-MOS laser displacement sensor CD33 series

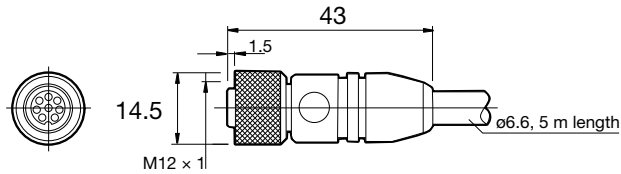
Dimensions

CD33-L85□-422

(Unit: mm)



Connector cable DOL-1208-G05MF



Cable material: PVC  
Conductor cross-section: 0.25 mm<sup>2</sup>



Photoelectric Sensors

Specialized Photoelectric Sensors

Laser Displacement Sensors

C-MOS Built-in Amplifiers

CDX

CDA

LS

CD22

CD33

CD4

CD5

UQ1-01

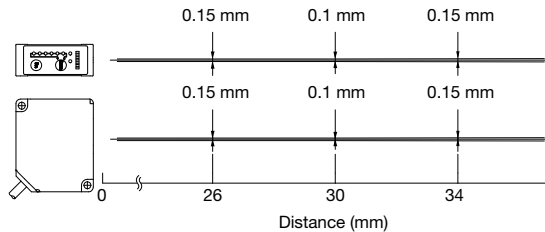
UQ1-02

Typical characteristic data

Spot size

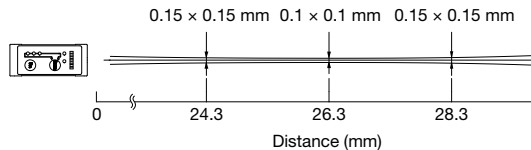
Diffuse-reflective type

CD33-30

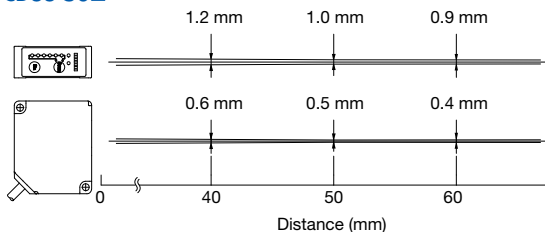


Specular reflection type

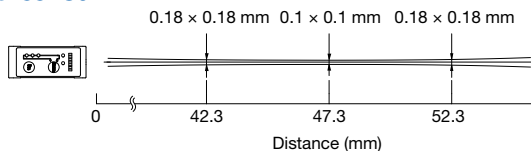
CD33-L30-422



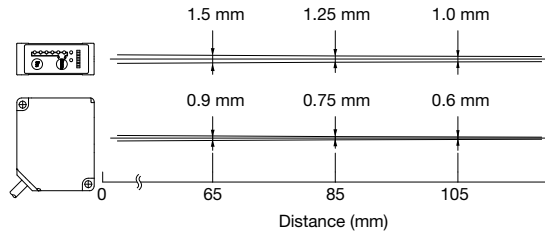
CD33-50



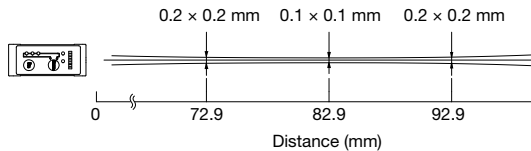
CD33-L50-422



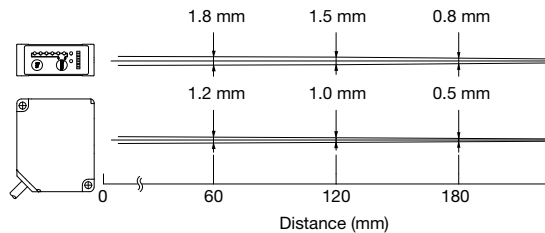
CD33-85



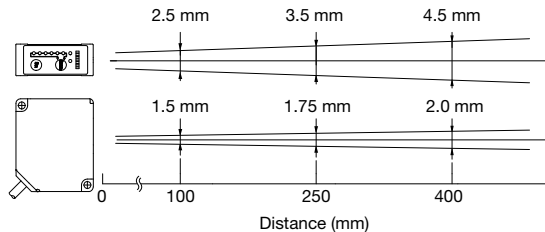
CD33-L85-422



CD33-120



CD33-250



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C-MOS laser displacement sensor CD33 series

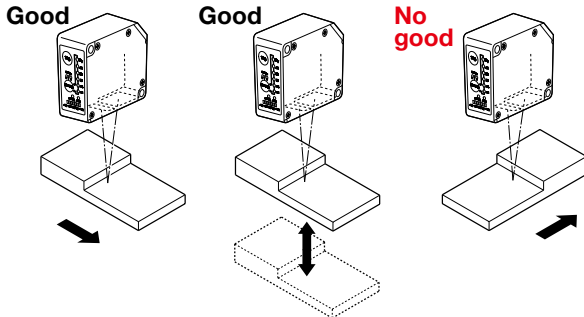
Installation of sensor



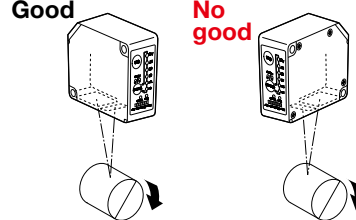
- Install the sensor at a height that is not at worker eye level.
- Make sure to turn the power off before connecting or removing sensors.

Mount the sensor head so that the detection surface (optical plane) is always parallel to the detection target. Adjust the target so that the spot aligns with the detection position, and ensure that the bar graph distance indicator lights up orange at the reference detection surface (center of change).

● Workpieces with large fluctuations in height difference or color

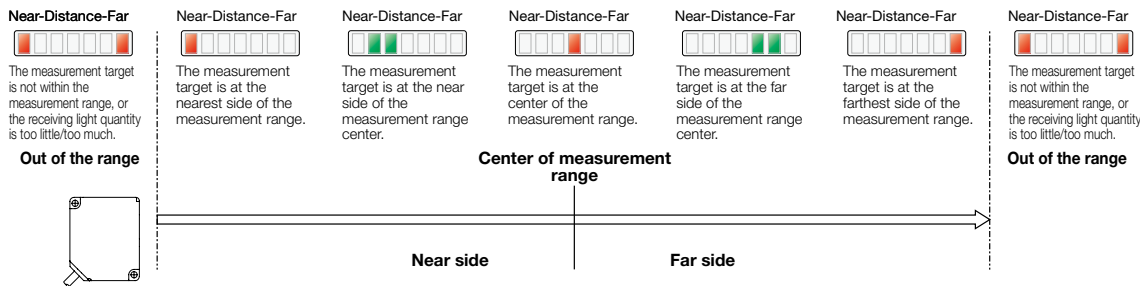


● Rotating workpieces



Bar graph distance indicator

By combining individual lighting/multiple lighting and lighting/flashing patterns, distances will be displayed in 25 steps (the following example shows 5 steps).



Do not look directly at the laser or intentionally aim the laser beam in another person's eyes. Doing so may cause damage to the eyes or health.

**Precautions for laser use**

This product emits a Class 1/Class 2 (II) visible laser beam that is compliant with JIS C 6802/IEC/FDA laser safety standards. Because English language warnings indicating the sensor as Class 1 or Class 2 (II), as well as explanation labels, are located on the side of the sensor, please replace these warnings/explanation labels with the Japanese language warnings/explanation labels included in the box when using in Japan.  
Type of laser used in this product



Type	Red semiconductor laser
Wavelength	655 nm
Output	390 μW/1 mW

If you install this product in a piece of machinery that will then be exported to the United States, it is necessary to follow laser standards as stipulated by the American Food and Drug Administration (FDA). This product has already been submitted to the CDRH (Center for Devices and Radiological Health). (Please inquire for details.)

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