Good Thinking, Good Future

FASTUS

Ultra High-Accuracy Laser Displacement Sensor

CDX series

New models added

World's No. 1 Linearity

OPTEX FA CO., LTD.

A fusion of ultra high-accuracy and ease-of-use

We have accumulated decades of know-how since our first laser displacement sensor was introduced to market,
all which have been utilized to achieve the World's No. 1 measurement accuracy.
We arrived at a simple configuration by examining various user needs and are able to provide operability by way of a built-in Web server, a new concept for displacement sensors.
Featuring a fusion of ultra high-accuracy and ease-of-use, these laser displacement sensors feature an extremely high level of perfection.

Advanced Opto-technology & High-rigidity design

Featuring unprecedented linearity thanks to an advanced optical system and highly-rigid body

In order to enable ultra high-accuracy measurements to be performed, a specially-designed optical system and rigid body with an independent base unit structure have been adopted. Featuring advanced levels of both accuracy and high speed, causes of errors have been successfully shut out.

Highly-rigid body structure
High rigidity is ensured by providing an independent base unit only to the optical system

Light receiving element
ATMOS

Emitting part
Cylindrical lens
Employed for wide spot type.

Receiving part
Neo LD lens
A CDX specially-designed lens featuring a 4-group-4-element structure. High linearity has been realized thanks to a new optical design with low-aberration.

*Example with the diffuse-reflective type

New algorithm

Linearity has been successfully restrained through use of a newly-developed original measurement algorithm. By performing a thorough review of our algorithm, ultra high-accuracy measurements have been achieved.

Ultra High-Accuracy Laser Displacement Sensor

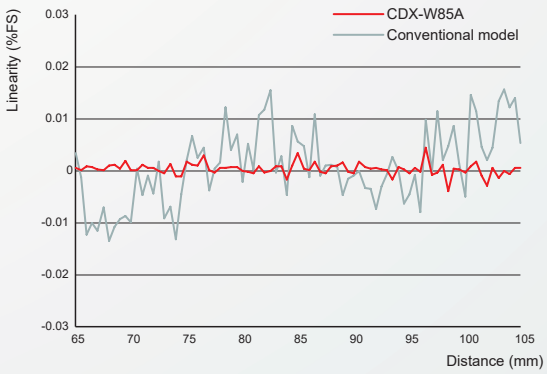
CDX Series

World's No. 1 Linearity

+/-0.015%F.S.

* For triangulation method diffuse-reflective type displacement sensors. OPTEX FA examination performed November 2016.

Linearity comparison



Featuring the World's No. 1 linearity that easily satisfies the [+/-0.015% F.S.] catalog specification, CDX series models realize measurements with significantly higher levels of accuracy than the conventional model.
* Workpiece angle: +/-0°, diffuse mode.
Refer to P. 10 for measurement conditions.

Neo LD lens

The light receiving lens has been customized to enable light reflected from the measurement target to be focused with high accuracy on the light receiving element. Error-causing spot distortions that arise due to lens aberration have been decreased significantly.
Neo LD: Neo Low Dispersion

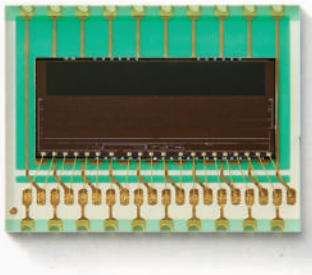
Newly Developed Image Sensor for Highly Accurate, High-speed, and Stable Measurements

NEW

Newly developed image sensor: ATMOS

In order to achieve the World's No. 1 Linearity, ATMOS image sensors were newly developed with a light receiving element featuring a CDX specialized design. By applying the latest technology, accuracy has been increased by 3.3 times* that of the conventional model.

ATMOS: Auto Tuning cMOS
*Comparison between the CDX-W85 and conventional equivalent model

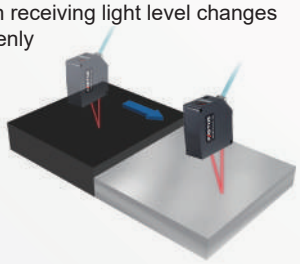


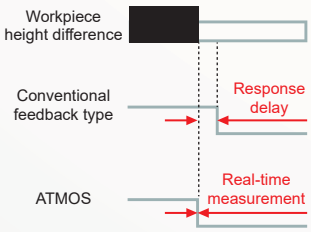
Industry first

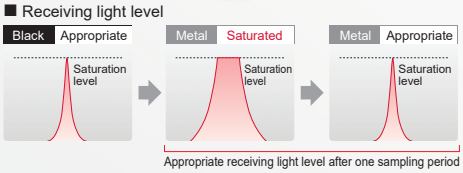
Feedback-free high-speed shutter

With conventional image sensors, feedback control to the shutter could not keep up with sudden changes in receiving light levels caused by changes in workpiece colors, momentary inabilities to perform measurements would be caused, resulting in response delays. With newly developed ATMOS image sensors, measurements can be performed without the need for feedback control thanks to an industry-first algorithm. Because momentary inabilities to perform measurements and response delays have been eliminated, real-time measurements are now possible.

When receiving light level changes suddenly



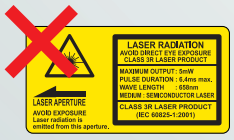




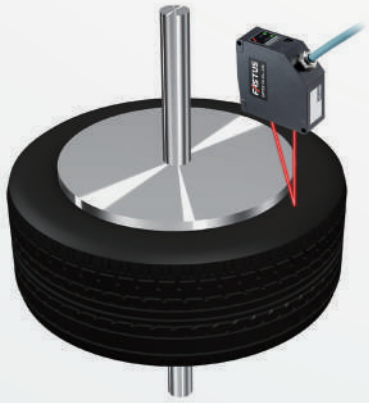
Automatic shutter release (light reception ends) when receiving light level saturation occurs means no feedback time

Stable measurements even with Class 1 lasers

With ATMOS image sensors, stable measurements are possible even with a Class 1 laser thanks to their high level of sensitivity.
Even when measuring black workpieces such as tires, highly accurate measurements can be performed without using a high output laser.
Stable measurement of black workpieces is possible while ensuring the safety of worker's eyes.

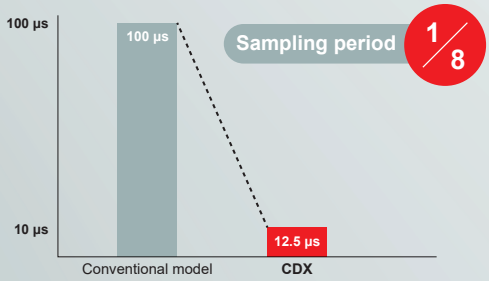


Laser class 1:
Designed to be inherently safe.
Light is collected optically, ensuring a safe level even when the laser is emitted to the human body (eyes and skin).

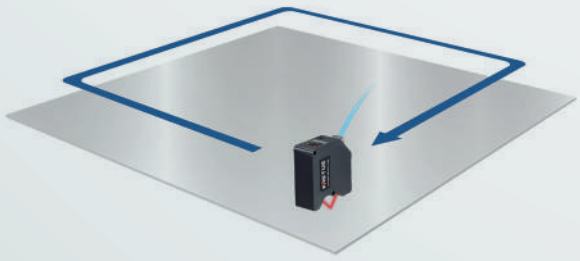


High-speed measurement: Max. sampling period of 12.5 µs (Measuring frequency: 80 kHz)

With highly sensitive ATMOS image sensors, ultra high-speed shutter speeds are possible as the required exposure time is minimized. Because sampling periods have been reduced to 12.5 µs, 1/8th of the conventional model, these sensors can be utilized for application that require ultra high-speed measurements.



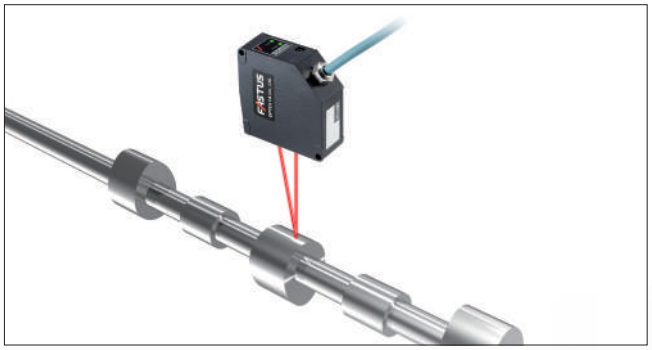
Large glass height measurement

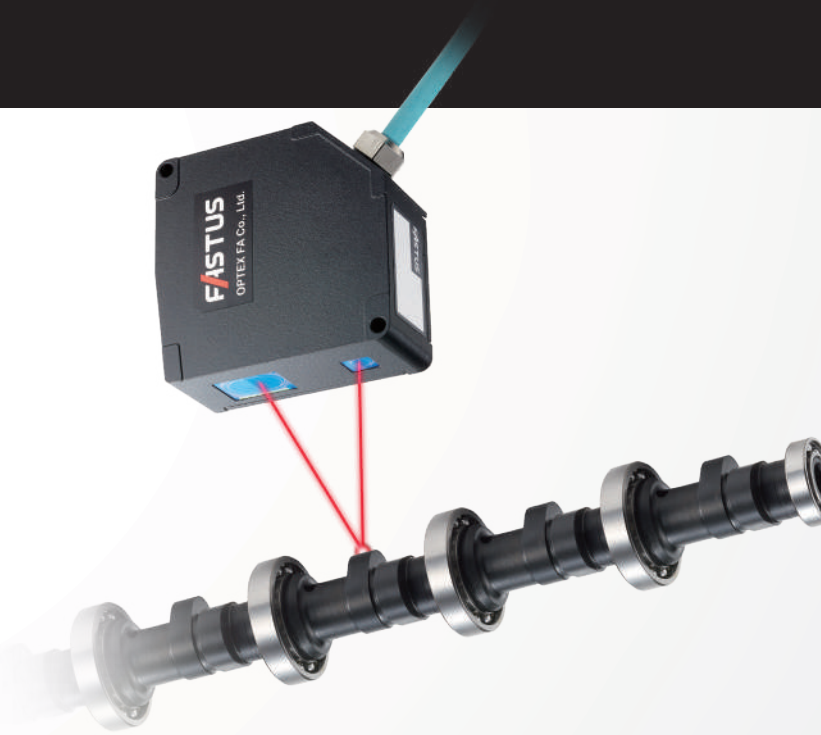


*With a sampling period of 12.5 µs, the measurement range will be limited. For details, refer to P. 10.

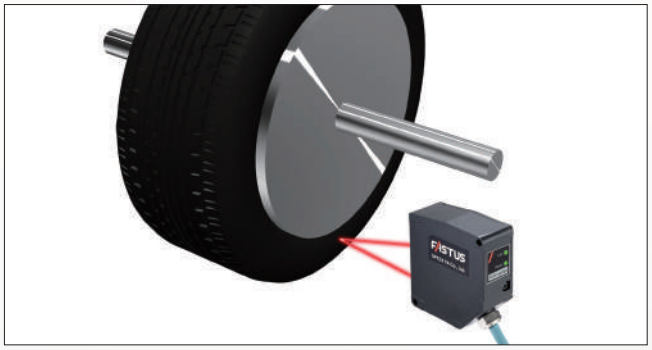
Applications

Shape measurement of cam shafts

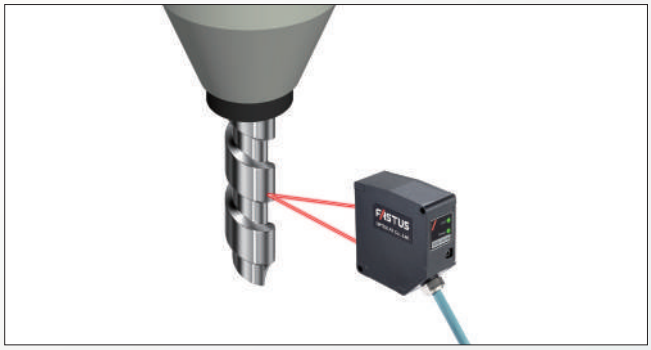




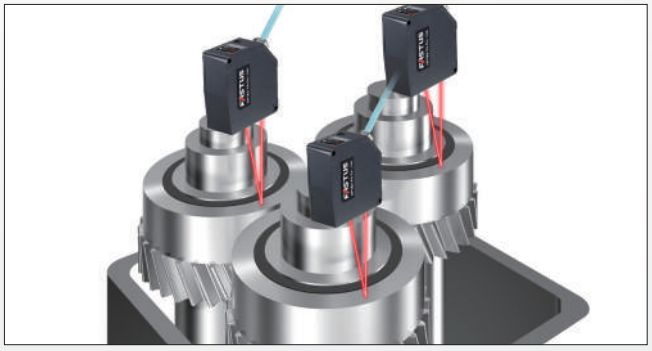
Shape measurement of tires



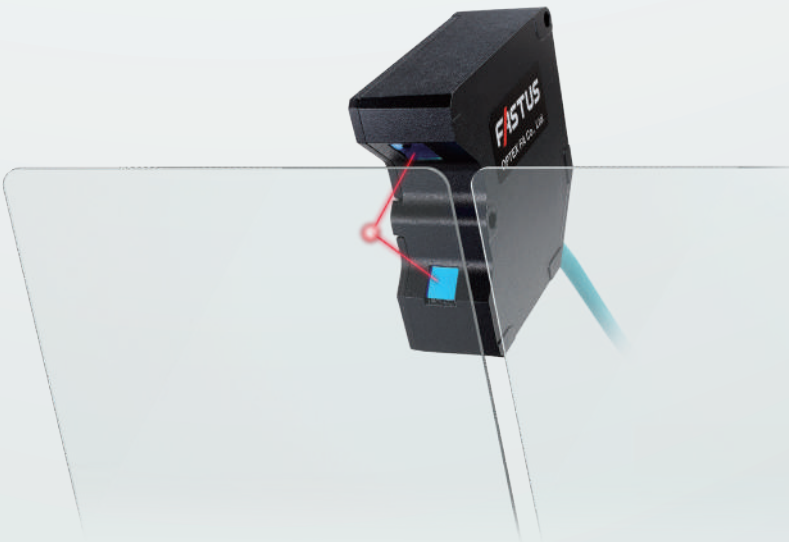
Deflection measurement of large diameter drills



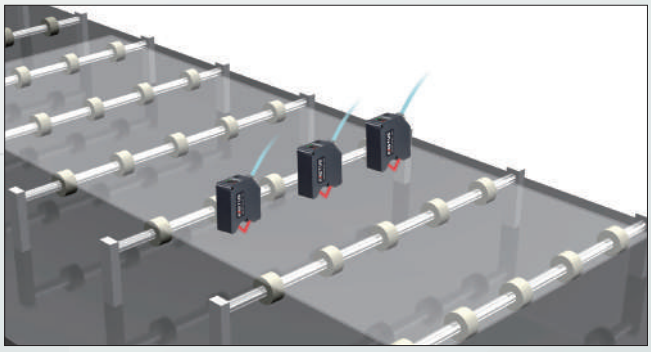
Flatness measurement of transmission parts



Height inspection of smartphone frames (specular reflection type)



Warpage measurement of glass substrates (specular reflection type)

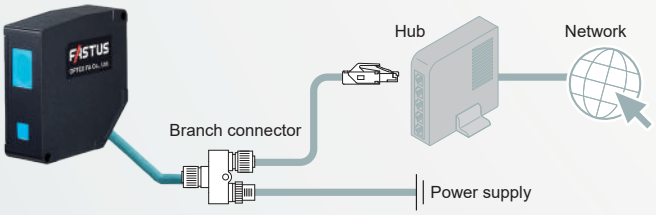


Direct Network Connections are Possible without Use of a Controller

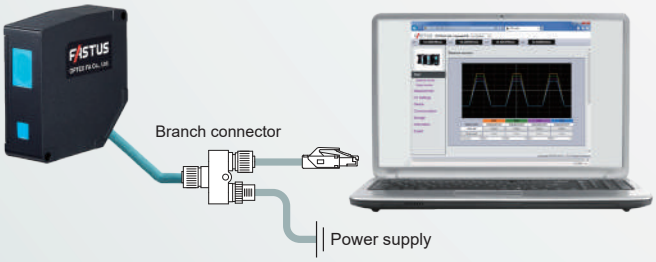
NEW Direct Ethernet connection

Because an Ethernet serial interface is built-in to the sensor head, connection to a network is possible without use of a controller. Not only can the cost of a controller be eliminated, but any worries about securing space for controller installation can also be forgotten.

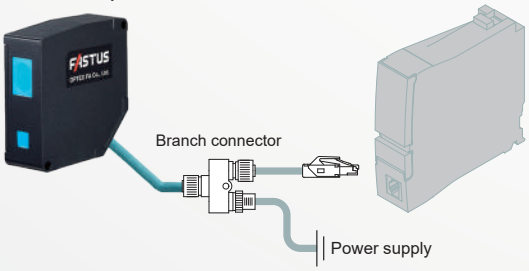
■ No controller required. Simply add new sensors to the hub.



■ Operation is possible by connecting directly to a PC LAN port



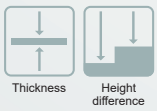
■ Of course, connection to a PLC Ethernet port is also possible



When Analog/Control Output is Necessary

Displacement sensor amplifier unit CDA-M

The CDA-M amplifier unit is equipped with an organic EL display on which both Japanese characters and English lettering can be viewed with clarity. Control can be performed using either analog or control outputs, while thickness and height difference measurements can be performed using two sensor heads.



Model		CDA-M
Sensor head (CDX series)	No. of connectable units	Max. 2 units
	Connection type	Amplifier side: M8, 4-pin connector
Rating	Supply voltage	12 to 24 VDC +/-10%, including 10% ripple (p-p)
	Current consumption	100 mA or less (at 12 V)
Display	Dot matrix display	Organic EL panel 128 × 96 pixels
	Indicators	Power display: Red/Green, Output 1 to 3 display: Orange (Only output 1 display available)
Analog current output		4 to 20 mA/F.S. Load impedance 300 Ω or less
Control output		NPN/PNP open collector (selectable by setting) 3 outputs (Only output 1 available) max. 100 mA / 30 VDC, Residual voltage: 1.8 V or less
External input		2 inputs (Only 1 input available)
Connection type		Cable type: Cable length: 2 m (ø5.8 mm)
Environmental resistance	Ambient temperature/humidity	-20 to +50°C / 35 to 85% RH (no freezing or condensation)
	Storage temperature/humidity	-20 to +60°C / 35 to 85% RH (no freezing or condensation)
	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/s²), 3 times in each of the X, Y, and Z directions
	Protection circuit	Reverse connection protection
	Degree of protection	IP50 (IEC 60529)
Material		Polycarbonate
Weight		170 g

○ If using an amplifier unit, some settings for the CDX series cannot be confirmed or changed. For details, see the CDX series user's manual.
○ On the CDX series, CH1 is the only output that can be set and used with an amplifier unit.
○ The CDX series does not support CC-Link communication.
○ The resolution of the analog outputs (shown below) will be lower than that when using Ethernet communication.
CDX-L15A/-LW15A: 1 µm, CDX-30A/-W30A: 1 µm, CDX-85A/-W85A: 10 µm, CDX-150A/-W150A: 10 µm

Equipped with a Web Server

NEW Setup software is unnecessary

The CDX series features a new Web server. Using a web browser on the computer connected to the same network, browsing and controlling measured values and setup contents are possible. Use is possible without need for a dedicated computer software.

Supported browsers Internet Explorer Ver.11 and above, Google Chrome 49 and above

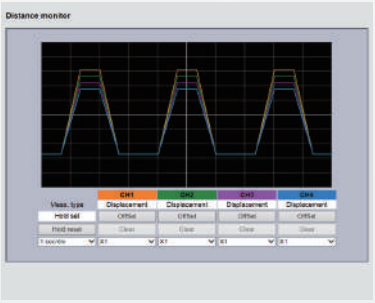
Internet Explorer®

Google Chrome™

Main functions

■ Distance monitor

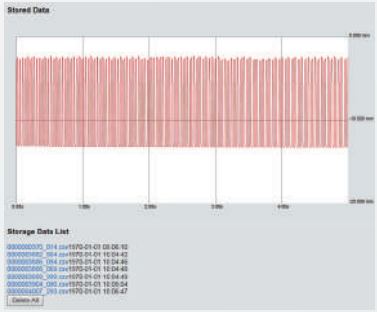
Simultaneous display for 4 CHs



With the CDX series, judgment settings can be configured for channels 1 to 4. The measured values for each channel can be displayed at once on a graph, allowing for simple comparison of measurement data. Moreover, monitoring of speed and thickness of transparent objects in addition to displacement is possible simultaneously.

■ Storage

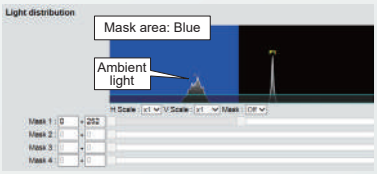
No data logger required



Measured values for up to 100,000 points can be stored. By operating using a browser, data can be viewed and CSV files can be downloaded.

■ Light distribution

Masking of unnecessary areas



By monitoring receiving light waveforms, receiving light levels and mounting angle can be confirmed. Thanks to a newly developed mask function, even if there are unnecessary objects or ambient light in the measurement range, those can be masked to enable measurements to be performed free of influence.

Other functions

■ Measurement setting ■ I/O setting ■ Device setting ■ Communication setting ■ Product information etc.

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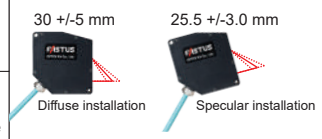
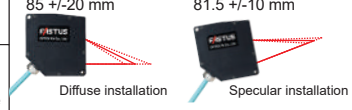
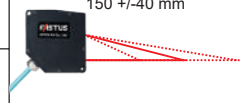
• Google Chrome and the Google Chrome logo are trademarks or registered trademarks of Google Inc. in the United States and other countries.

Lineup

■ Sensor heads

Type		Measurement range	Spot size	Resolution	Linearity		Model
					Diffuse mode	Specular mode	
NEW Specular reflection	Spot		ø30 µm	0.25 µm	—	+/-0.05% of F.S. (+/-1 µm)	**CDX-L15A**
	Wide		30 × 1000 µm				**CDX-LW15A**
NEW Short range	Spot		ø30 µm		+/-0.03% of F.S. (+/-3 µm)	+/-0.04% of F.S. (+/-2.4 µm)	**CDX-30A**
	Wide		30 × 1000 µm		+/-0.015% of F.S. (+/-1.5 µm)		**CDX-W30A**
Middle range	Spot		ø70 µm		Meas. range 65 to 85 mm: +/-0.018% of F.S.(+/-7.2 µm) Meas. range 85 to 105 mm: +/-0.03% of F.S.(+/-12.0 µm)	+/-0.03% of F.S. (+/-6.0 µm)	**CDX-85A**
	Wide		70 × 2000 µm		+/-0.015% of F.S. (+/-6.0 µm)		**CDX-W85A**
Long range	Spot		ø120 µm		Meas. range 110 to 150 mm: +/-0.03% of F.S.(+/-24 µm) Meas. range 150 to 190 mm: +/-0.04% of F.S.(+/-32 µm)	—	**CDX-150A**
	Wide		120 × 4000 µm		+/-0.015% of F.S. (+/-12 µm)		**CDX-W150A**

Regarding applicability of Export Trade Control Order enacted by Japanese government for the CDX series

Caution CDX series sensor heads are products that are subject to “Export Trade Control Order Appended Table 1 2-(12) Measurement devices (including machine tools with a measurement function)”. Please inquire for details.

Model	Measurement mode	Resolution	
		Sensor head only	With amplifier unit
CDX-L15	Specular mode	0.01 µm	1 µm
CDX-LW15			
CDX-30	Diffuse mode	0.05 µm	
	Specular mode		
CDX-W30	Diffuse mode	0.05 µm	
	Specular mode		
CDX-85	Diffuse mode	0.1 µm	10 µm
	Specular mode		
CDX-W85	Diffuse mode	0.1 µm	
	Specular mode		
CDX-150	Diffuse mode	0.2 µm	
CDX-W150			

Additional information

There is no differentiation for the applicability of CDA series amplifier units and the resolution outputted from amplifiers connected to sensor heads is regulated as shown in the table to the left even if the average number of cycles is increased.

Options/Accessories

■ Connectors/Connector Cables

Type	Specifications	Cable length	Model
Sensor head extension cable	Dedicated cable for extension between the sensor head and branch connector. Up to two extention cables can be connected and extended. Robot cable specifications. • Sensor side: M12, 8-pin socket • Branch connector side: M12, 8-pin plug	2 m	**DSC-1208-G02MA**
		5 m	**DSC-1208-G05MA**
		10 m	**DSC-1208-G10MA**
Ethernet cable	Dedicated cable for connecting from the branch connectors to the Ethernet port. Robot cable specifications. • Branch connector side: M12, 4-pin socket • Host side: RJ45 plug	2 m	**SSL-2J04-G02ME-R**
		5 m	**SSL-2J04-G05ME-R**
		10 m	**SSL-2J04-G10ME-R**
Power supply/ external input cable	Power supply/external input cable for connecting to branch connector. • Branch connector side: M12, 4-pin socket • Power supply/external device side: discrete wire	2 m	**DOL-1204-G02M**
		5 m	**DOL-1204-G05M**
Branch connector	Branch connector for connecting sensor heads and various cables. Included with sensor head.	-	**SYL-1208-G0M**

■ Amplifier unit, connector cables for amplifier unit

Type	Specifications	Cable length	Model
Amplifier unit	An amplifier unit to which up to two sensor heads can be connected. Control can be performed using either analog or control outputs, while thickness and height difference measurements can be performed using two sensor heads.	2 m	**CDA-M**
Sensor/amplifier connection cable	Connector cable for connecting branch connectors and amplifier units. Robot cable specifications. • Branch connector side: M12, 5-pin socket • Amplifier unit side: M8, 4-pin plug	2 m	**DSL-1204-G02M**
Sensor-to-amplifier extension cable	Extension cable for connection to DSL-1204-G02M. Robot cable specifications. • Sensor/amplifier connection cable side: M8, 4-pin socket • Amplifier unit side: M8, 4-pin plug	2 m	**DSL-0804-G02M**
		5 m	**DSL-0804-G05M**

○ Please ensure that the overall cable length when an amplifier unit is used is within 10 m (sensor head extension cable + sensor/amplifier connection cable + sensor-to-amplifier extension cable).
○ If using an amplifier unit, some settings for the CDX series cannot be confirmed or changed. For details, see the CDX series user's manual.
○ On the CDX series, CH1 is the only output that can be set and used with an amplifier unit.
○ The CDX series does not support CC-Link communication.
○ The resolution of the analog outputs (shown below) will be lower than that when using Ethernet communication.
CDX-L15A/-LW15A: 1 µm, CDX-30A/-W30A: 1 µm, CDX-85A/-W85A: 10 µm, CDX-150A/-W150A: 10 µm

Specifications

■ Sensor head (model based specifications)

Model		CDX-L15A	CDX-LW15A	CDX-30A		CDX-W30A	
Optical method		Specular reflection		Diffuse installation	Specular installation	Diffuse installation	Specular installation
Measurement range*1		15 +/-1 mm		30 +/-5 mm	25.5 +/-3.0 mm	30 +/-5 mm	25.5 +/-3.0 mm
Light source	Medium	Red semiconductor laser					
	Wavelength	655 nm					
	Maximum output	0.39 mW					
Laser class	JIS/IEC	CLASS 1					
	FDA*2	Class I					
Spot size*3		ø30 µm	30 × 1000 µm	ø30 µm		30 × 1000 µm	
Linearity		+/-0.05% of F.S. (+/-1 µm)		+/-0.03% of F.S. (+/-3 µm)	+/-0.04% of F.S. (+/-2.4 µm)	+/-0.015% of F.S. (+/-1.5 µm)	+/-0.04% of F.S. (+/-2.4 µm)
Resolution*4		0.25 µm					
Repeat accuracy*5		0.25 µm					
Sampling period		12.5 µs / 25 µs / 50 µs / 100 µs / 200 µs / 500 µs / 1 ms / Auto					
Temperature drift	-10 to +40°C	+/-0.02% F.S./°C	+/-0.03% F.S./°C	+/-0.01% F.S./°C		+/-0.02% F.S./°C	
	+40 to +50°C	+/-0.03% F.S./°C	+/-0.1% F.S./°C	+/-0.03% F.S./°C		+/-0.04% F.S./°C	
Weight		Approx. 300 g (including 500 mm connector cable)		Approx. 280 g (including 500 mm connector cable)		Approx. 280 g (including 500 mm connector cable)	

Model		CDX-85A		CDX-W85A		CDX-150A	CDX-W150A
Optical method		Diffuse installation	Specular installation	Diffuse installation	Specular installation	Diffuse installation	
Measurement range*1		85 +/-20 mm	81.5 +/-10.0 mm	85 +/-20 mm	81.5 +/-10.0 mm	150 +/-40 mm	
Light source	Medium	Red semiconductor laser					
	Wavelength	655 nm					
	Maximum output	0.39 mW					
Laser class	JIS/IEC	Class 1					
	FDA*2	Class I					
Spot size*3		ø70 µm		70 × 2000 µm		ø120 µm	120 × 4000 µm
Linearity		Meas. range 65 to 85 mm: +/-0.018% of F.S. (+/-7.2 µm) Meas. range 85 to 105 mm: +/-0.03% of F.S. (+/-12.0 µm)	+/-0.03% of F.S. (+/-6.0 µm)	+/-0.015% of F.S. (+/-6.0 µm)	+/-0.03% of F.S. (+/-6.0 µm)	Meas. range 110 to 150 mm: +/-0.03% of F.S. (+/-24 µm) Meas. range 150 to 190 mm: +/-0.04% of F.S. (+/-32 µm)	+/-0.015% of F.S. (±12 µm)
Resolution*4		0.3 µm					
Repeat accuracy*5		0.3 µm					
Sampling period		12.5 µs / 25 µs / 50 µs / 100 µs / 200 µs / 500 µs / 1 ms / Auto					
Temperature drift	-10 to +40°C	+/-0.01% F.S./°C					
	+40 to +50°C	+/-0.03% F.S./°C					
Weight		Approx. 280 g (including 500 mm connector cable)					

○ The CDX series sensor heads mentioned above are products to which limits on resolution have been added to enable their non-applicability to “Export Trade Control Order Appended Table 1 2-(12) Measurement devices.” For applicable products with no limited resolution, refer to P.8.

Measurement conditions

The measurement conditions are as follows unless otherwise designated:
Ambient temperature: 25°C (normal temperature), Supply voltage: 24 VDC, Sampling period: 50 µs, Moving average performed: 256, Median filter: 31, Center of measurement range, Measurement target ([specular reflection: glass] for the 15 mm/30 mm type, [specular reflection: aluminum vapor deposition mirror] and [diffuse reflection: visible light shielding ceramic] for the 85 mm type) Furthermore, the sensor head is fixed in place with an aluminum jig when measurements are performed.

*1. The measurement range will become narrower when the sampling period is set to the maximum speed of 12.5 µs. Please use by selecting from Near/Center/Far below.

Model		Measurement range		
		Near	Center	Far
CDX-L15A/-LW15A		14.0 to 14.6 mm	14.4 to 15.4 mm	15.3 to 16.0 mm
CDX-30A/-W30A	Diffuse installation	25.0 to 28.1 mm	27.8 to 31.9 mm	31.1 to 35.0 mm
	Specular installation	22.5 to 24.0 mm	22.8 to 27.9 mm	26.7 to 28.5 mm
CDX-85A/-W85A	Diffuse installation	65.0 to 77.7 mm	73.5 to 90.8 mm	84.8 to 105.0 mm
	Specular installation	71.5 to 74.3 mm	70.6 to 86.9 mm	81.0 to 91.5 mm
CDX-150A/-W150A		110.0 to 134.4 mm	124.8 to 166.3 mm	150.2 to 190.0 mm

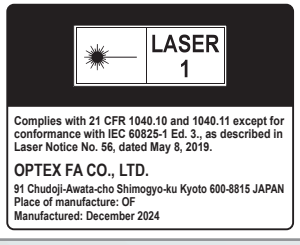
*2. In accordance with the FDA provisions of Laser Notice No. 56, the laser is classified as Class 1 per the IEC 60825-1:2014 standard.
*3. Defined with center strength $1/e^2$ (13.5%) at the center of measurement range. There may be leak light other than the specified spot size. The sensor may be affected when there is a highly reflective object close to the detection area.
*4. The minimum step that can be identified when the distance between the sensor and target changes one step at a time (when performing moving average 65,536 times)
*5. Peak-to-peak value of measured value when measuring in stationary state (when performing moving average 65,536 times)

Notes for sensor usage

This product emits a Class 1 (I) visible laser beam that is compliant with JIS C 6802/IEC 60825- 1/FDA laser safety standards. Warning and explanation labels are affixed to the sides of the sensor.

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

CDX-□□A



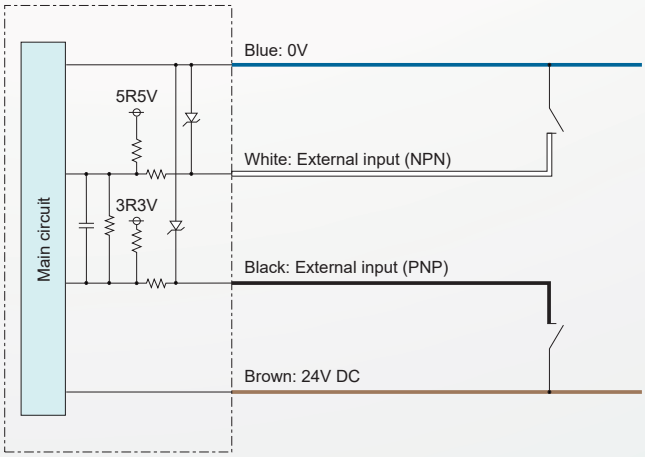
■ Sensor head (common specifications)

Supply voltage		12 to 24 VDC (+/-10%, including ripple)
Current consumption		340 mA (at 12 VDC), 180 mA (at 24 VDC)
Communication interface		Ethernet (100BASE-TX) / Corresponding to IEEE1588
External input		Selectable from laser OFF, hold/reset, start storage, and offset
Indicators		Link indicator (green) / power indicator (orange/green/blue/red)
Degree of protection		IP67 (IEC 60529) (including connector part)
Ambient temperature/humidity		-10 to +50°C / 35 to 85% RH (no condensation or freezing)
Storage temperature/humidity		-20 to +60°C / 35 to 85% RH (no condensation or freezing)
Ambient illuminance		Incandescent lamp: 3,000 lx or less, fluorescent lamp: 10,000 lx or less
Vibration resistance		10 to 55 Hz; double amplitude 1.5 mm; 2 hours in each of the X, Y, and Z directions
Shock resistance		50 G (500 m/s^2), 3 times in each of the X, Y, and Z directions
Applicable regulations	EMC	EMC directive (2014/30/EU)
	Environment	RoHS directive (2011/65/EU), Battery regulation ((EU)/2023/1542), China RoHS (MIIT Order No. 32)
	Safety	FDA regulations (21 CFR 1040.10 and 1040.11)*6
Applicable standards		EN IEC 60947-5-2, IEC 60825-1
Warm-up time		Approx. 30 minutes
Material		Housing: Aluminum die-cast, Optical window: Glass

*6. Except for deviations pursuant to Laser Notice No.56.

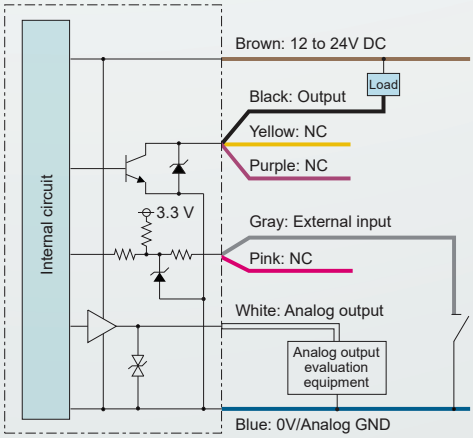
I/O Circuit Diagram

■ Connection and Circuit Diagram of Power Supply/External Input Cable DOL-1204-G0xM

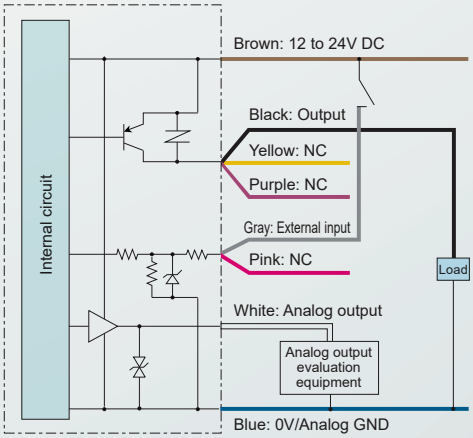


■ Connection and Circuit Diagram of Amplifier Unit CDA-M

With the NPN setting



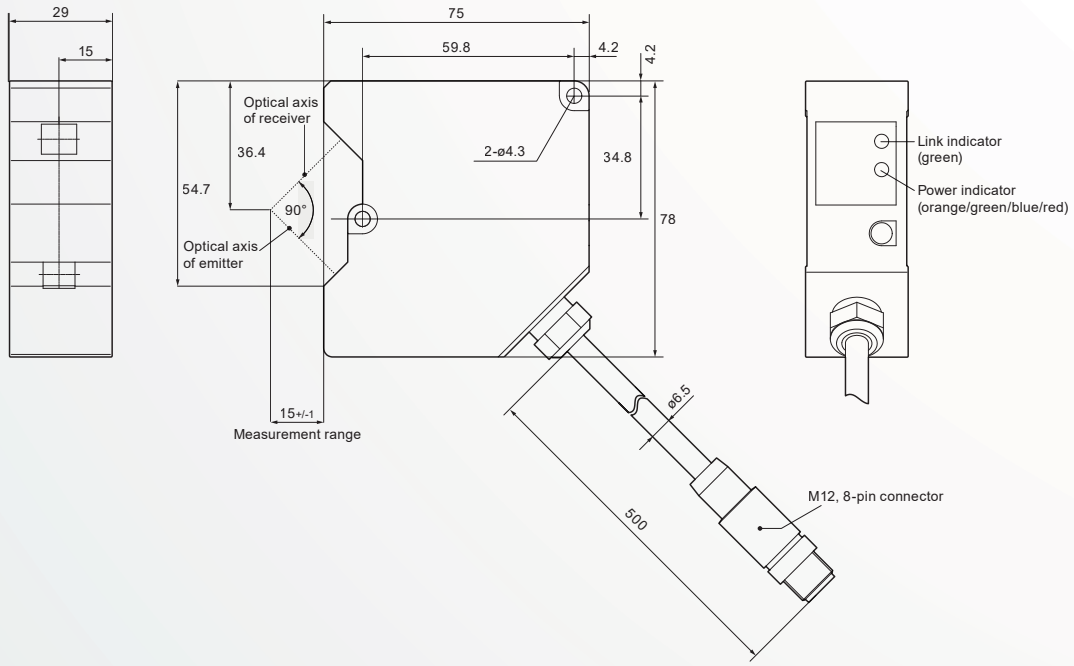
With the PNP setting



Dimensions

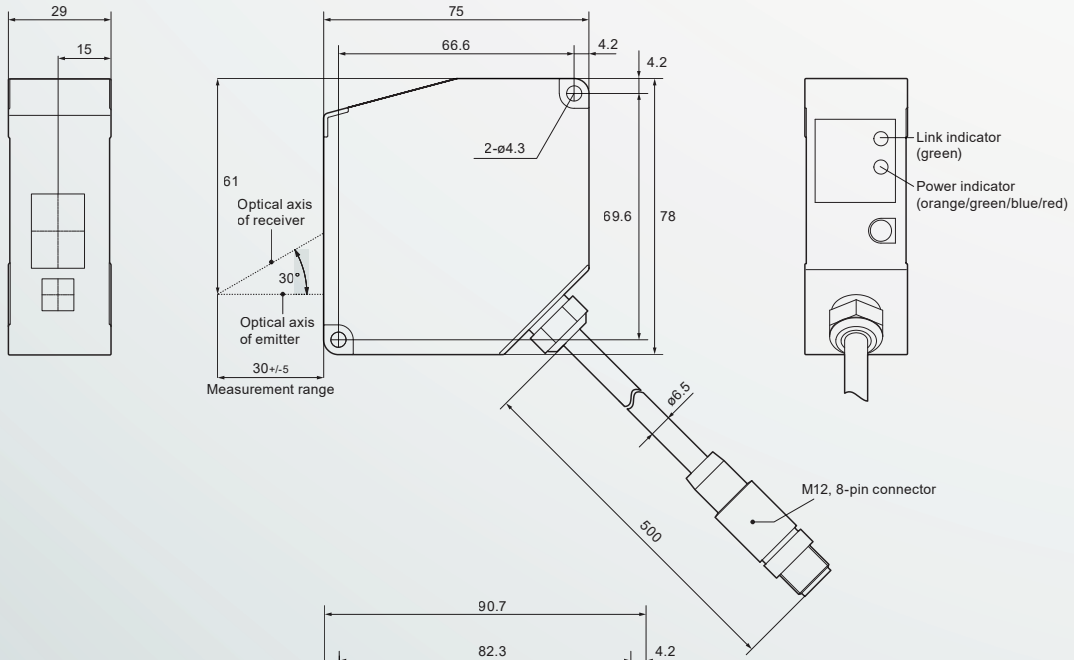
(Unit: mm)

■ CDX-L15A/-LW15A

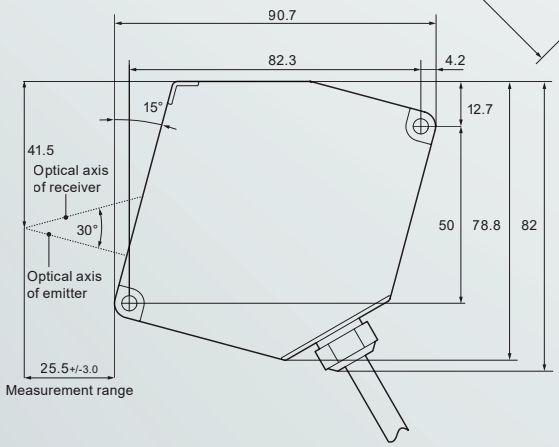


■ CDX-30A/-W30A

(Diffuse installation)



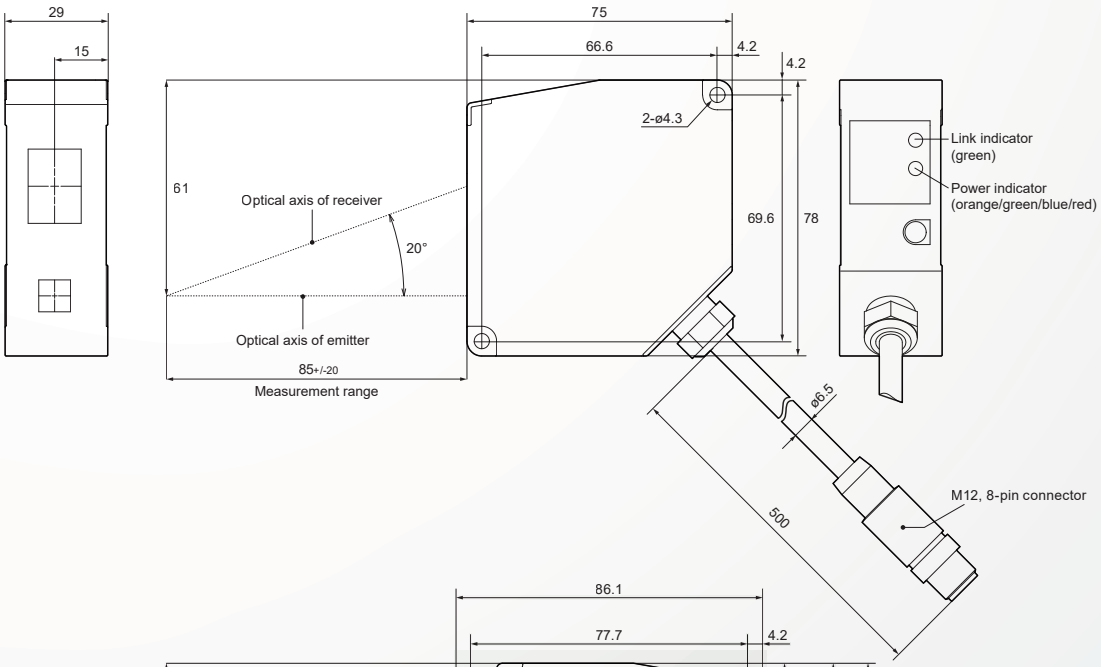
(Specular installation)



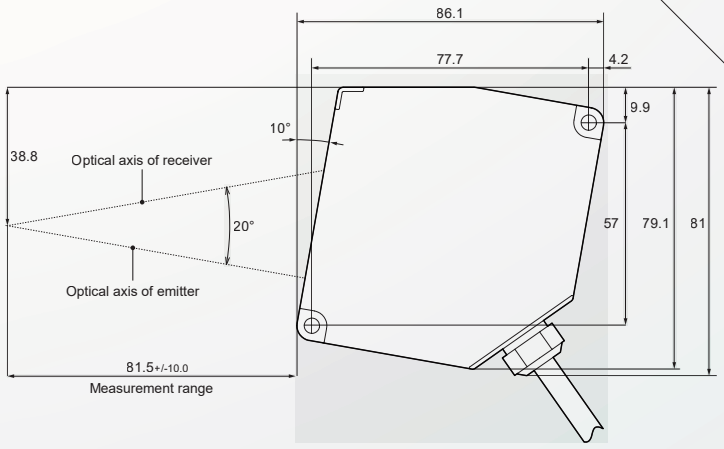
(Unit: mm)

■ CDX-85A/-W85A

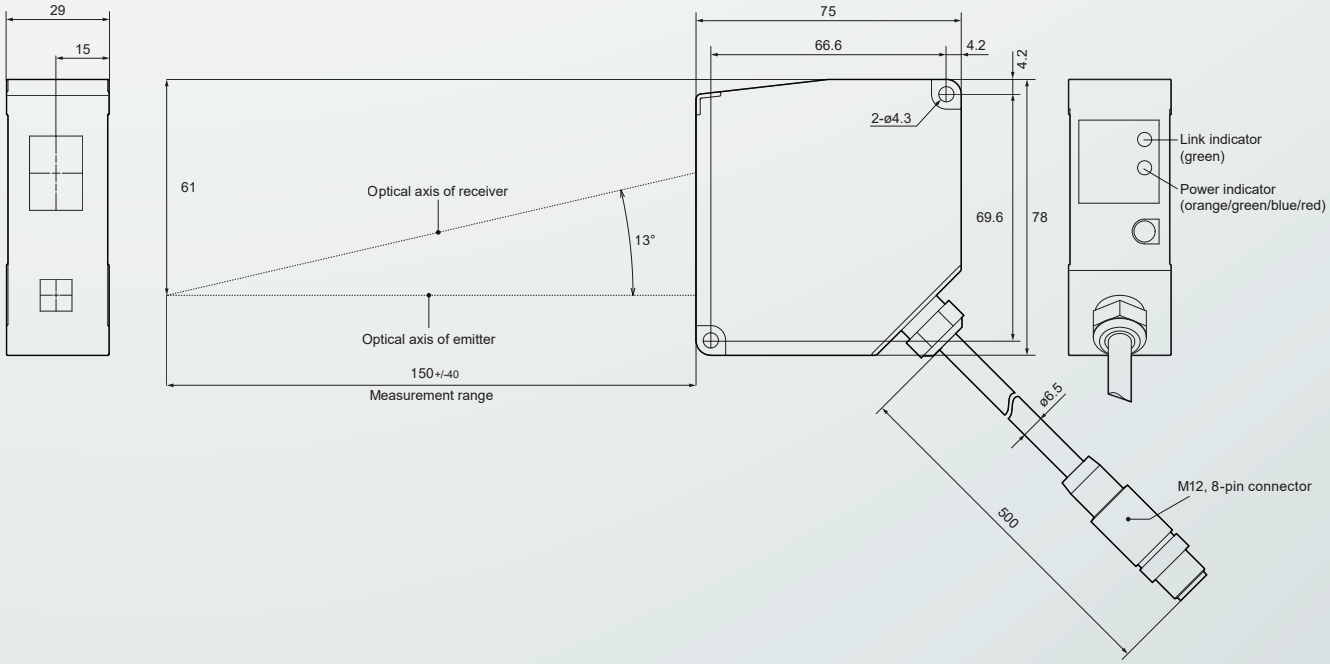
(Diffuse installation)



(Specular installation)



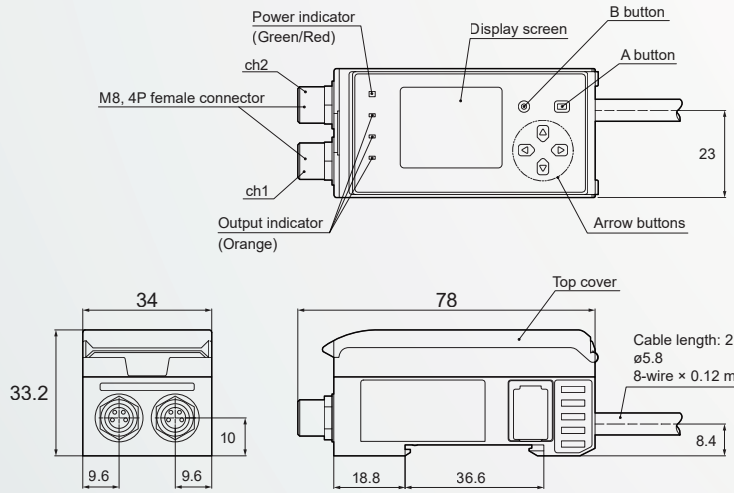
■ CDX-150A/-W150A



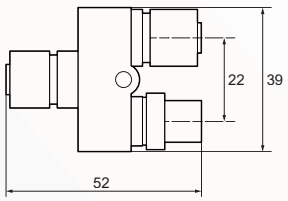
Dimensions

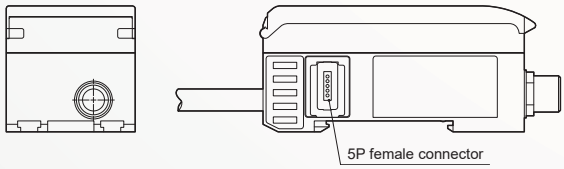
(Unit: mm)

■ CDA-M



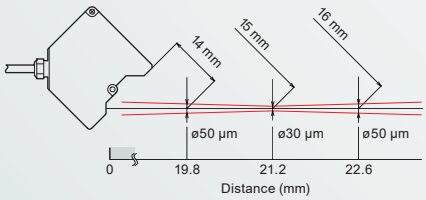
■ SYL-1208-G0M



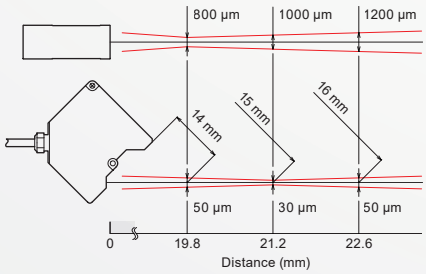


Spot Size (Typical Characteristic Data)

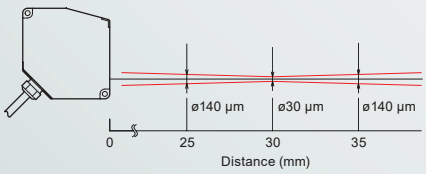
■ CDX-L15A



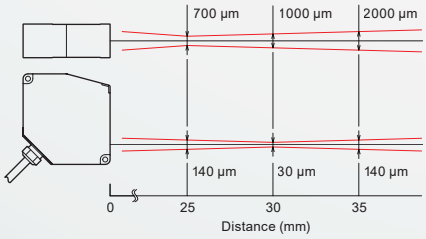
■ CDX-LW15A



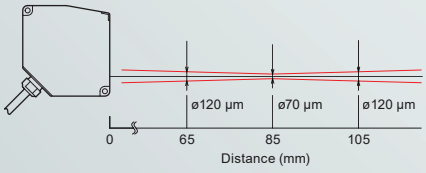
■ CDX-30A



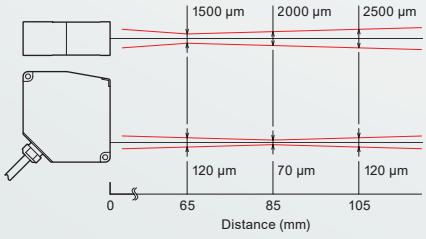
■ CDX-W30A



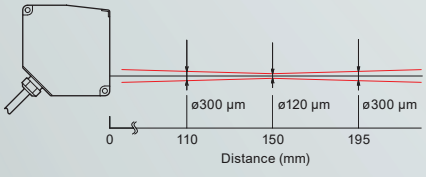
■ CDX-85A



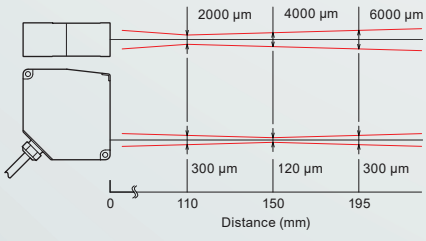
■ CDX-W85A



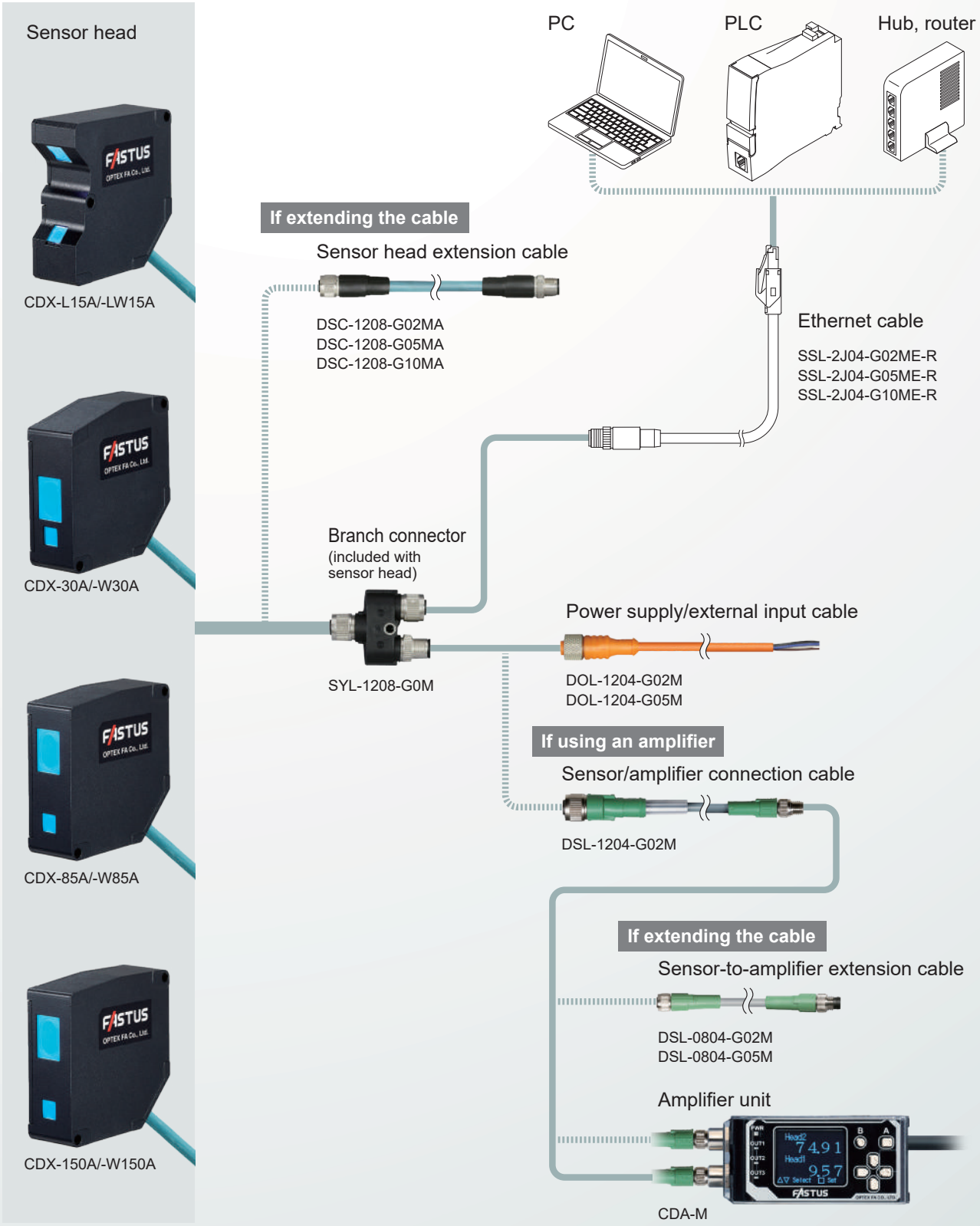
■ CDX-150A



■ CDX-W150A



System Configuration



○ Ensure that the overall cable length from the power supply to the sensor head is within 30 m, and the number of Sensor Head Extension Cables to be connected must be up to two.
Also ensure that the overall cable length when the CDA-M amplifier unit is used is within 10 m.
(This length restriction does not apply to the Ethernet cable.)

Attention: Not to be Used for Personnel Protection.

Never use these products as sensing devices for personnel protection. Doing so could lead to serious injury or death.
These sensors do not include the self-checking redundant circuitry necessary to allow their use in personnel safety applications.
A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.
Please consult our distributors about safety products which meet OSHA, ANSI and IEC standards for personnel protection.

- Specifications are subject to change without prior notice.
- Specifications and technical information not mentioned here are written in Instruction Manual. Or visit our website for details.
- All the warnings and cautions to know prior to use are given in Instruction Manual.

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Catalog content accurate as of November 2024. 78021-02-006-2411