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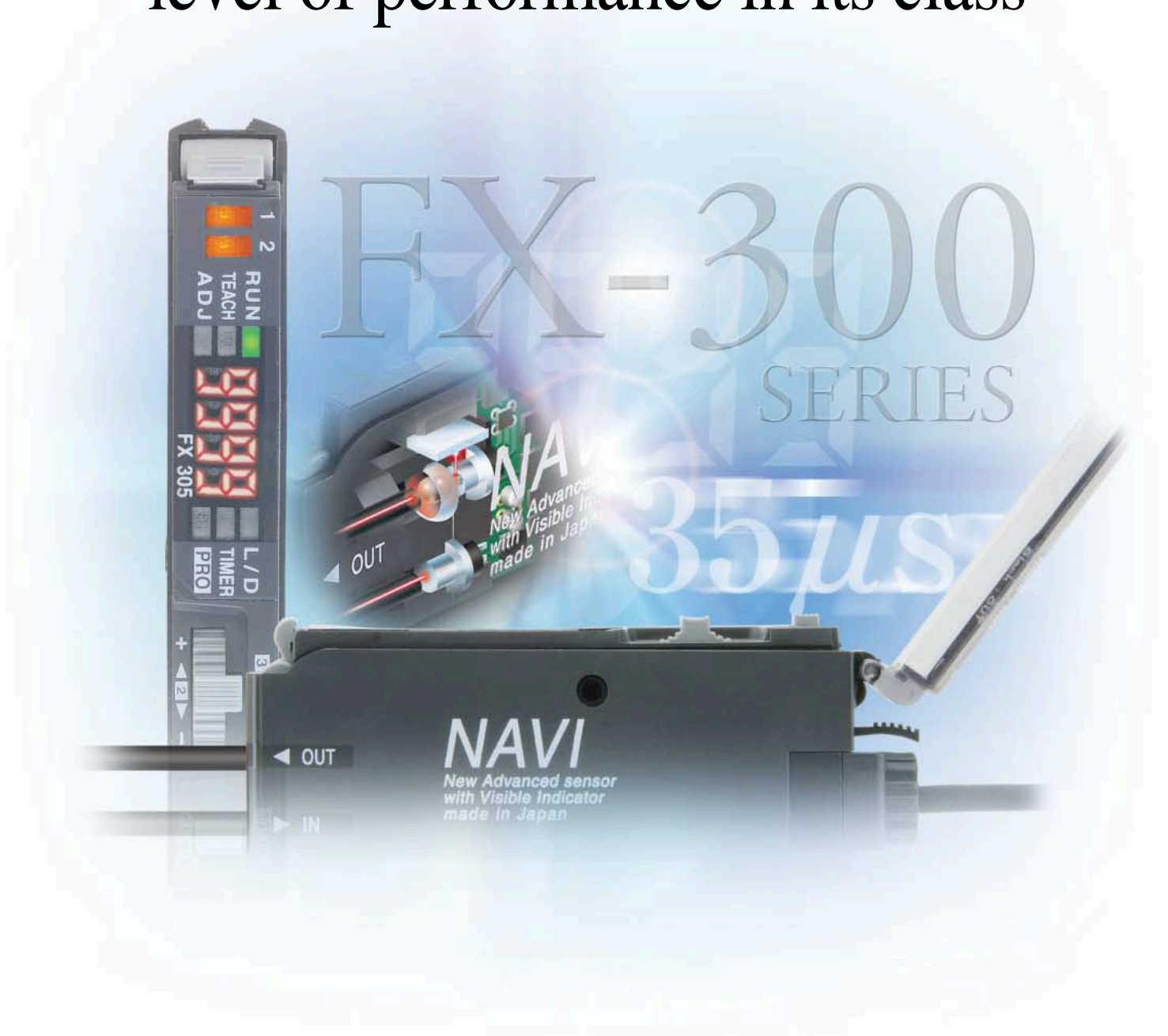


DIGITAL FIBER SENSOR

FX-300 SERIES



Constant advances achieving the highest level of performance in its class



The FX-300 series of next-generation fiber sensors provides the highest level of sensing performance in its class

'Stable sensing', 'high sensing performance', 'easy operation', 'improved ease of maintenance' and 'preservation of the environment' are the five concepts underlying the new FX-300 series!

June 2004
FX-301 advances
even further
(Refer to p.34 for details)



High-function

To high-speed

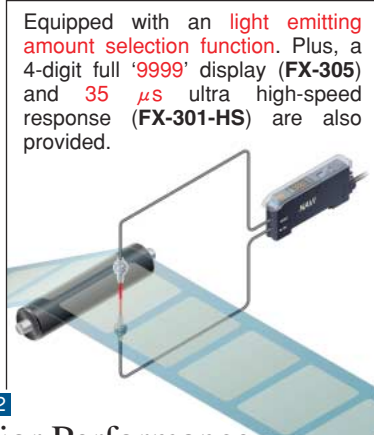
High-function type
FX-305

Standard type
FX-301

Ultra high-speed type
FX-301-HS



Concept 1
High Stability

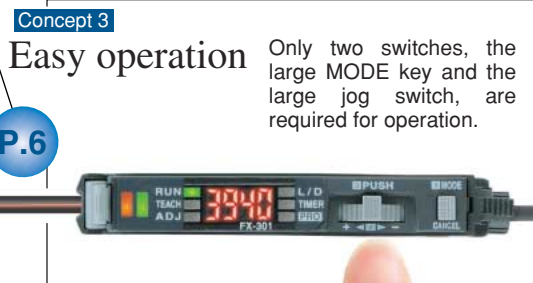
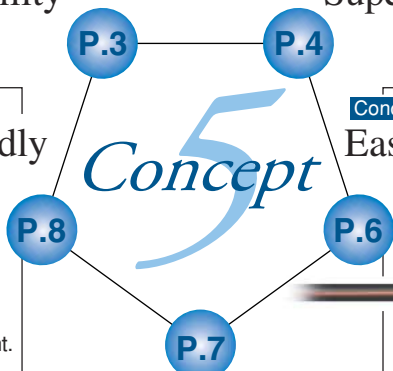


Concept 2
Superior Performance

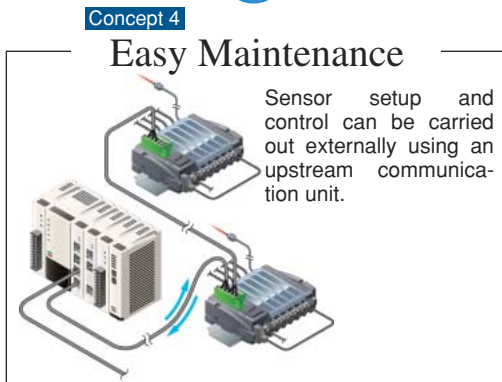
FX-300 SERIES



Concept 5
Eco-friendly



Concept 3
Easy operation



Concept 4
Easy Maintenance

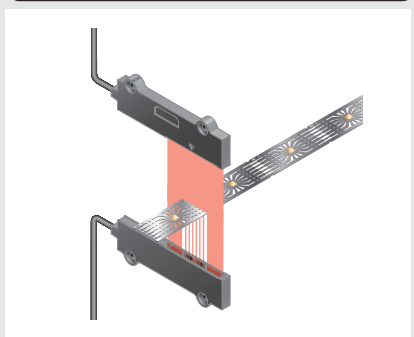
Full range of fibers _____ Wide lineup

P.9 Guide for each industry Description of different fibers and performance for each industry

LCD • Semiconductor / P.9 to P.12



Electronic component • Automatic assembly / P.13 to P.14



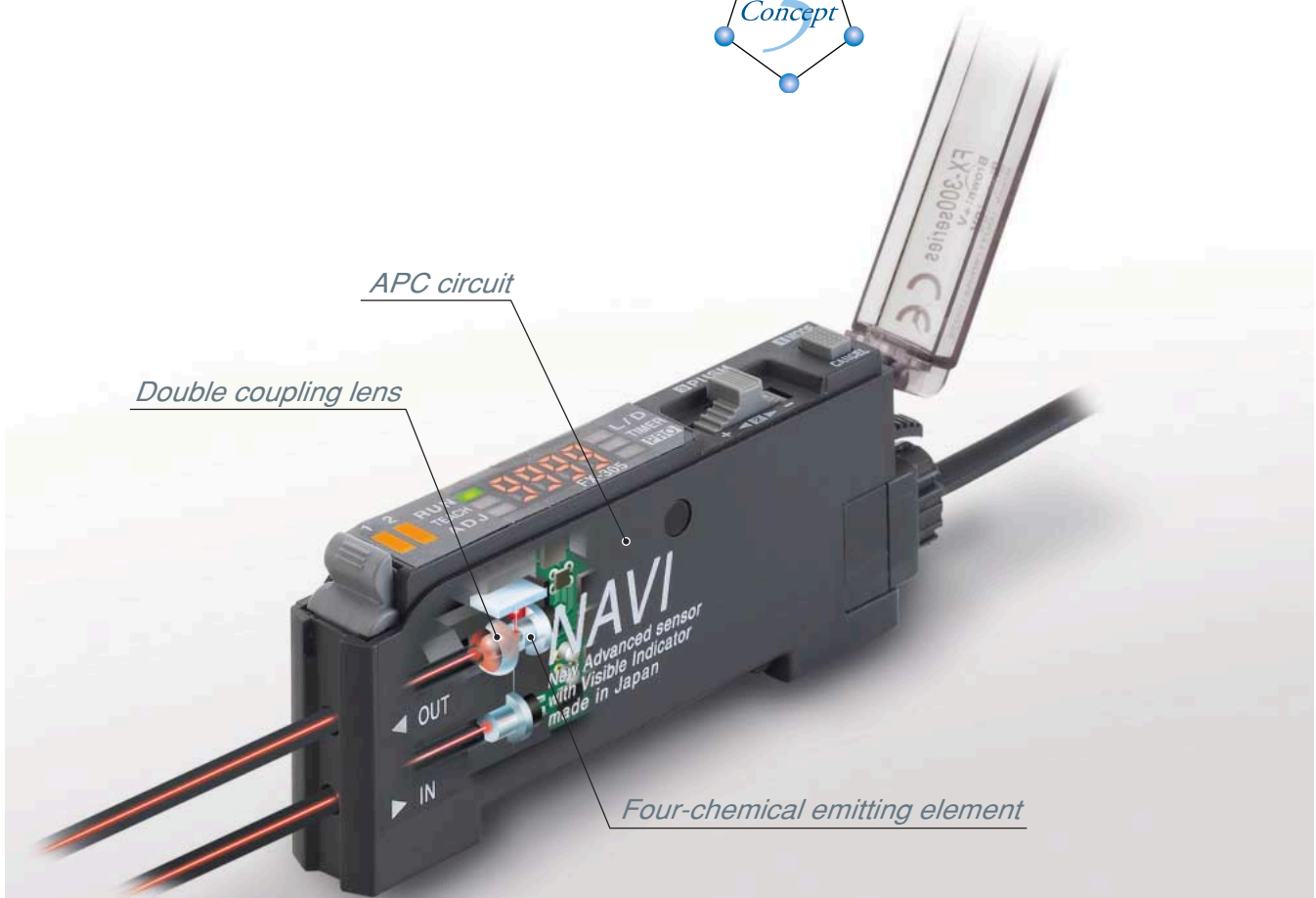
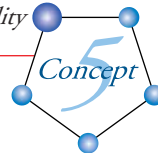
Pharmaceutical • Packaging / P.15



High Stability

Concept 1

High Stability



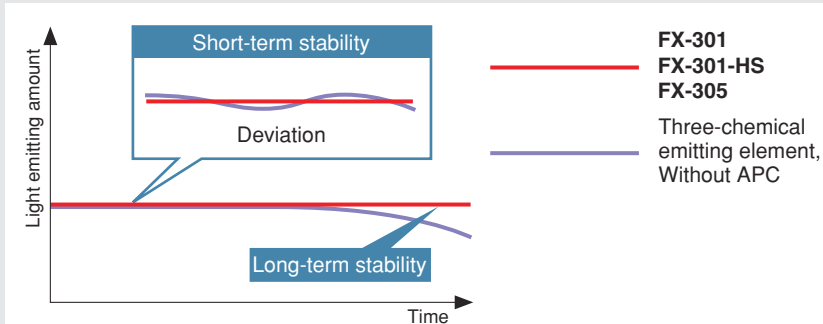
Stable sensing over long and short periods

Stability enhancement

FX-301 FX-301-HS FX-305

In addition to a 'four-chemical emitting element' which suppresses changes in the light emitting element over time so that a stable level of light emission can be maintained over long periods, a 'APC (Auto Power Control) circuit' has also been adopted afreshly. The light emitting amount can be controlled in minute degrees so that even changes occurring over very short periods can be handled, allowing stable sensing performance by suppressing deviations in light emitting amounts caused by changes in the ambient environment that could not previously be suppressed.

Stable sensing comparison

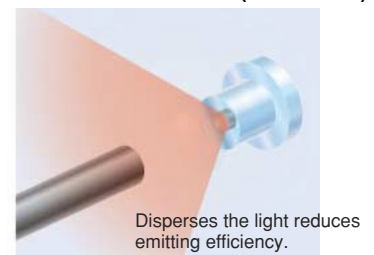


Even greater sensing range

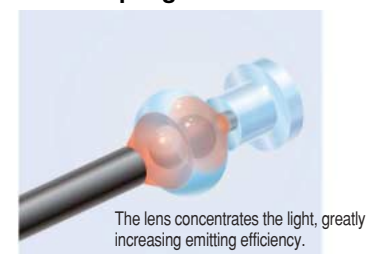
FX-301/B/G/H FX-301-HS FX-305

Adoption of a 'double coupling lens' that increases emission efficiency to its maximum limits and greatly increases sensing range. Sensing ranges with small diameter fibers and ultra-small diameter fibers, which have become very popular due to the miniaturization of chip components, have been increased by 50 % over previous values achieved with other amplifiers.

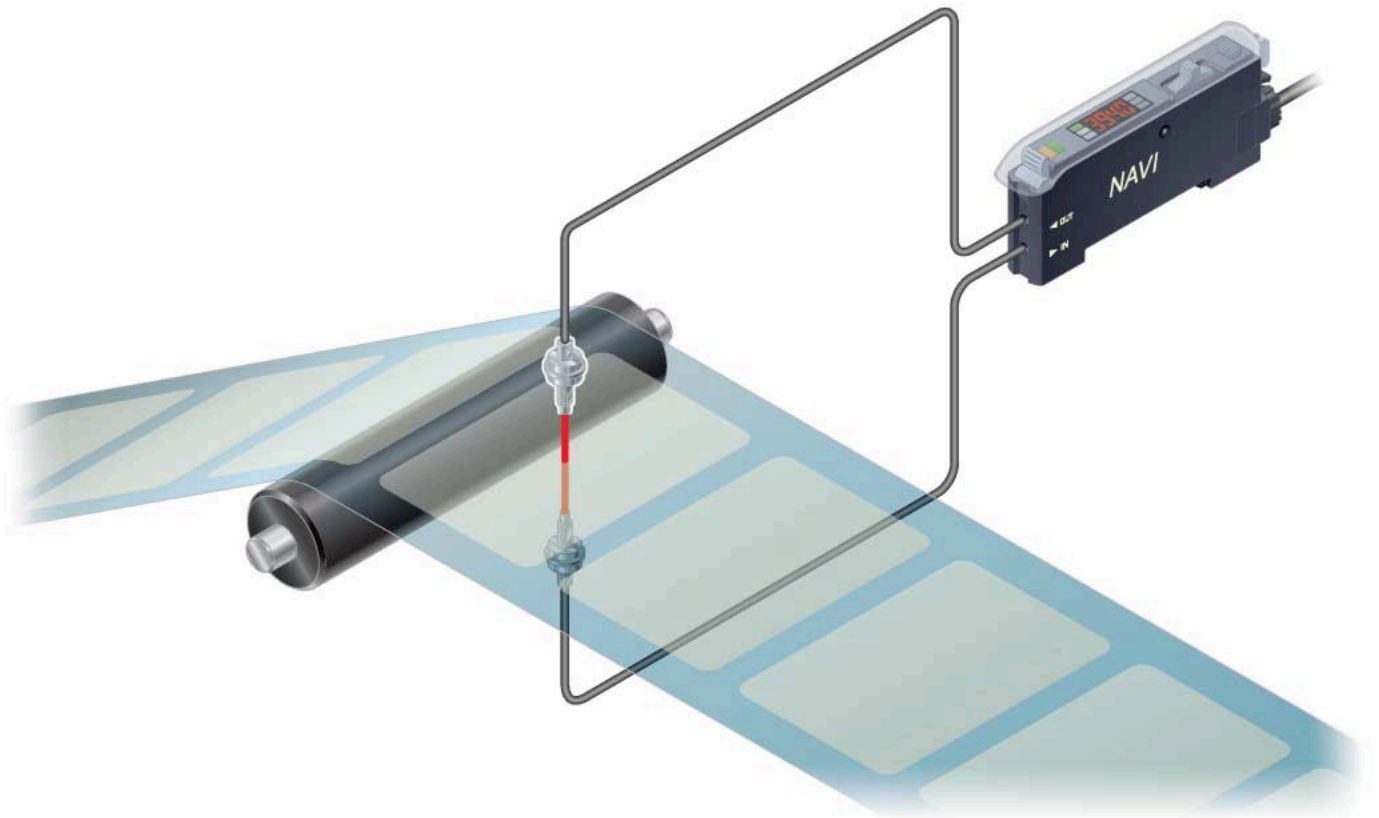
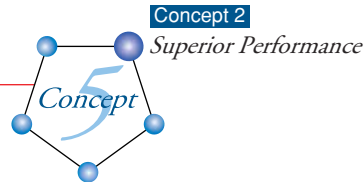
Conventional fiber sensors (Without lens)



Double coupling lens

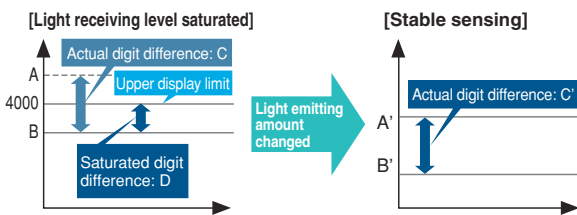


Superior Performance



Light-emitting amount selection

If the light receiving level becomes saturated during close-range sensing or when sensing transparent or minute objects, you can adjust the light emitting amount of the sensor to stabilize sensing **without needing to change the response time**. Sensing that previously required the response time or fibers to be changed can now be set much more easily using this function.



FX-301 FX-301-HS FX-305



Light emitting amount can be changed without changing response time

Large display 9999

2.5 times previous models

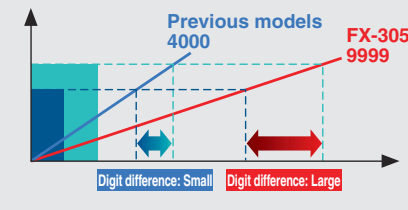
Large display with 4 digits (9999). With a greater difference in digit value than previous models, threshold values can be set in units of 1 digit up to maximum 9999. Threshold setting can now be done more easily and accurately.



(During STDF, LONG and U-LG modes)

Digit difference comparison

Example Digit difference between object A and object B

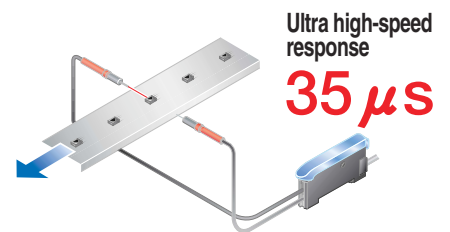


Ultra high-speed 35 μs response

4 times as fast as before

FX-301-HS

Ultra high-speed 35 μs response. Even small objects moving at high speeds can be sensed. In addition, at 65 μs the FX-301 standard type is also twice as fast as previous models.



Ultra high-speed type FX-301-HS

(H-SP mode)

35 μs

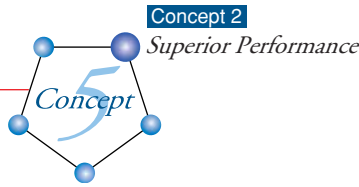
Standard type FX-301, High-function type FX-305

(H-SP mode)

65 μs

Previous model

150 μs



Simplified systems using new operating modes

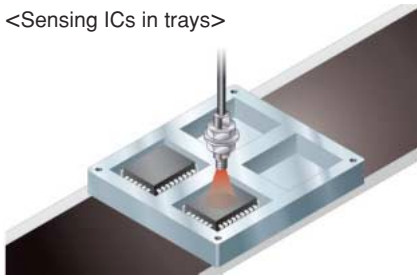
FX-305

A window comparator mode and differential sensing mode have been added. These modes make it easy to carry out sensing tasks that previously required multiple sensors or involved complex threshold settings.

Window comparator mode



<Sensing ICs in trays>



Tray absent	IC present	Tray present
OFF	ON	OFF

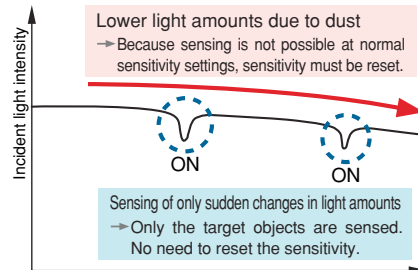
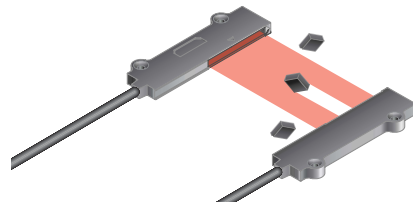
Incident light intensity

Upper and lower limits for threshold values can be set so that the incident light intensity can turn on and off within those ranges. Single output is used, so that only one cable is required, and no PLC processing is required either.

Differential sensing mode



<Sensing of tiny moving objects>

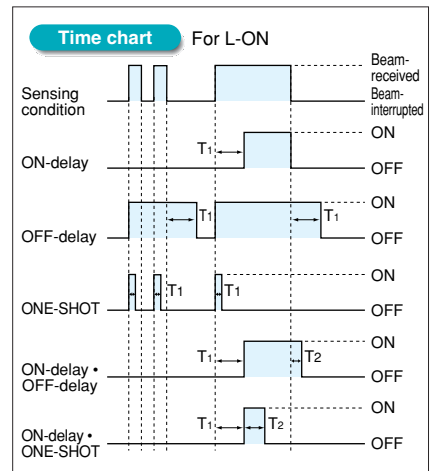


Equipped with 5 types timers

FX-305

The FX-305 includes the same ON-delay / OFF-delay / ONE-SHOT timer as the FX-301(-HS), as well as an ON-delay•OFF-delay timer and an ON-delay•ONE-SHOT timer. A wide variety of timer control operations can be carried out by these fiber sensors alone.

Timer period: Output 1 0.5 to 9,999 ms (variable)
Output 2 0.5 to 500 ms (variable)



Multi-purpose 2-output

Two independent output channels are provided, so that one sensor can be used for control tasks that previously required two sensors. In addition, the second output channel can be used for simple self-diagnosis and alarm output, so that ease of maintenance is improved.

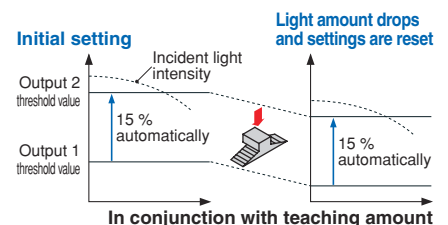


FX-305

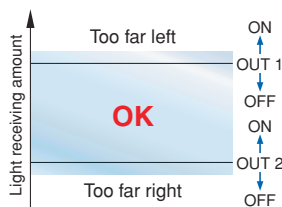
New Alarm output: Output 2 is set concurrently with output 1

Drops in light amounts due to problems such as broken fibers or dirty tips are detected and output. When output 1 threshold value teaching is carried out with the FX-305, output 2 is set concurrently with the setting shifted by the amount of surplus.

Drops in surplus amounts of light intensity due to dust or other particles can therefore be detected and output.



Comparison with previous models Example Sensing meandering of sheets

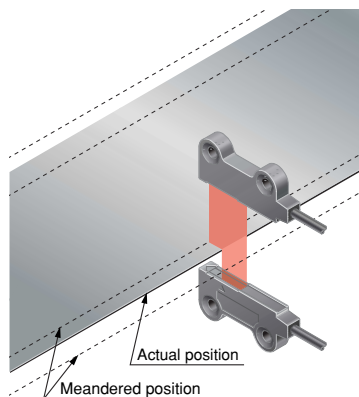


[Previous models]

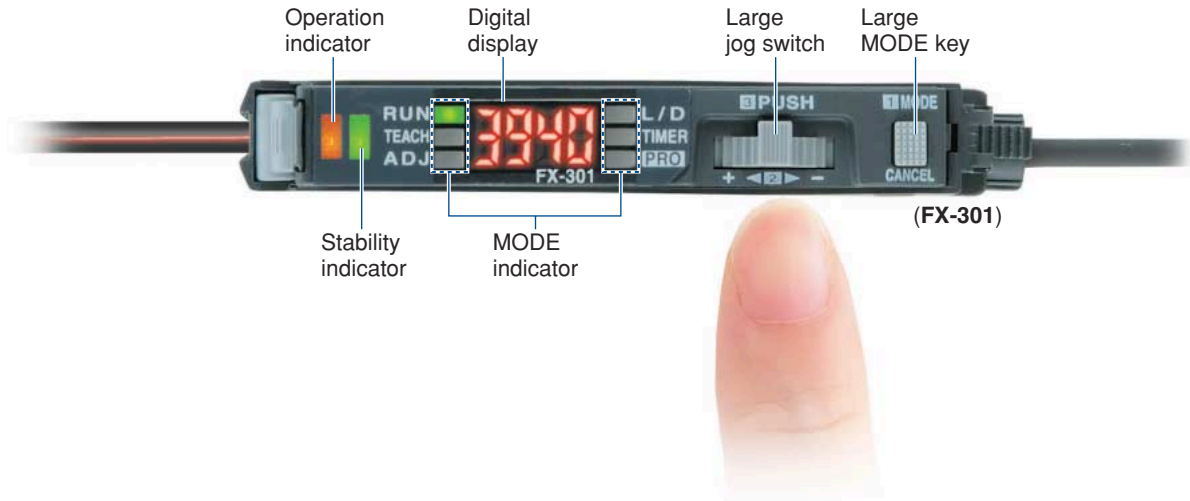
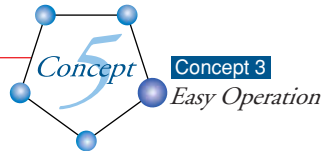
2 sensors needed

[FX-305]

1 sensor is enough!



Easy operation



Even beginners can quickly learn how to use the MODE NAVI

MODE NAVI uses six indicators to display the amplifier's basic operations. The current operating mode can be confirmed at a glance, so even a first time user can easily operate the amplifier without becoming confused.

RUN	TEACH	ADJ	RUN→	This is the sensing mode. Incident light level is displayed in the digital display.
RUN	TEACH	ADJ	TEACH→	This mode is for setting the threshold value.
RUN	TEACH	ADJ	ADJ→	In this mode, the threshold value, once set, may be fine-tuned.



L/D	TIMER	PRO	L/D ON→	This mode allows the selection of output operation as either Light-ON or Dark-ON.
L/D	TIMER	PRO	TIMER→	This mode permits the choice of using or not using the timer.
L/D	TIMER	PRO	PRO→	This mode allows the selection of further advanced functions, such as the copying of individual settings and the memory functions.

The use of only two switches makes for very simple operations

Only two switches, the large jog switch and the large MODE key, are required for operation. Depressing the large MODE key sets the 'mode selection' and 'mode cancel' functions. The large jog switch is used to select from the detailed functions available within each mode, as well as to change numerical values after the mode has been chosen.

● Large MODE key

1 Pressing the switch selects or cancels the operating mode

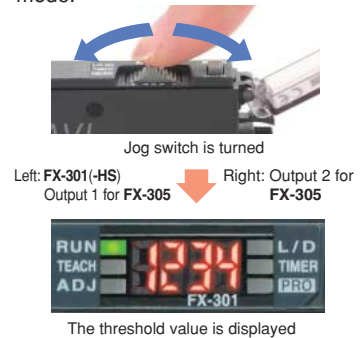
● Large jog switch

2 Moving the switch from side to side allows items to be selected

3 Pressing the switch then confirms the selected setting

Easy confirming of threshold value settings

The threshold value can be confirmed by turning the jog switch even during RUN mode.



Improved workability! Data bank switching and teaching can be carried out externally

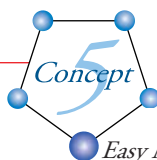
The FX-CH2 external input unit (optional) can be used to carry out teaching and data bank switching operations externally without needing to operate the digital fiber sensors directly. This greatly improves ease of workability during setup.



Key lock function prevents accidental setting changes

This disables input from the jog switch and MODE key, thus preventing operators from accidentally changing settings.

Easy Maintenance



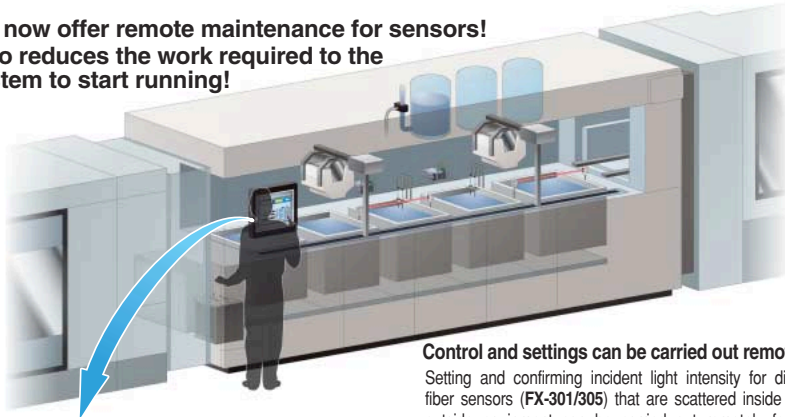
Concept 4
Easy Maintenance

Communication unit improves equipment starting up and maintenance upstream communication unit SC-GU1-485

FX-301 FX-305

The communication unit enables inputs to the digital fiber sensors (such as teaching and data bank switching) to be carried out via a PLC, and also allows confirming of the incident light intensity an output status for the fiber sensors. This greatly improves workability during equipment starting up and maintenance.

**We now offer remote maintenance for sensors!
Also reduces the work required to the system to start running!**



Control and settings can be carried out remotely

Setting and confirming incident light intensity for digital fiber sensors (FX-301/305) that are scattered inside and outside equipment can be carried out remotely for all sensors by using the SC-GU1-485, which greatly improves ease of operations such as monitoring equipment that is running and also equipment starting and maintenance.



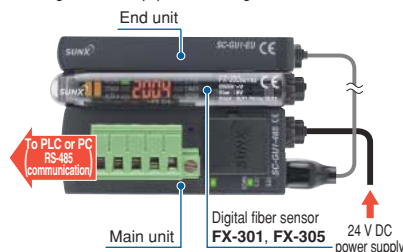
<Touch screen monitor example>

Device A monitor	Menu	Back			
Line1	Line2	Line3	Line4	Incident light intensity	Output
Tank A	Liquid level detection sensor 1	100	6000		
Loader A	Liquid level detection sensor 2	150	2000		
	Passage confirmation sensor	150			
	Mapping sensor	2000			

- [Communicable commands]
- Sensor incident light intensity
 - Sensor settings verification
 - Sensor output status
 - Threshold value settings, etc.

The sensor settings and operation can be checked on the touch screen, greatly improving ease of operation!

Ideal for workplaces such as semiconductor and LCD manufacturing lines where there are restrictions on operators entering and exiting



External input unit FX-CH2

FX-301 FX-305

Teaching and data bank switching for up to a maximum of 16 digital fiber sensors (FX-301 and FX-305) can be carried out all at once using an external device such as a PLC, touch screen or switch.

Support for stable sensing and smooth setup changes!

■ Setup changes (external automatic teaching / data bank switching)

Digital fiber sensor settings can be changed using input from a touch screen or switch, so that production line setup changes can be carried out more easily.

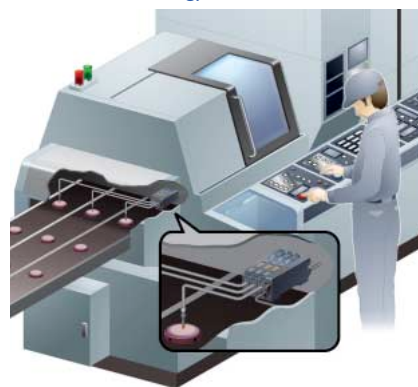
● External teaching

Full-auto teaching is recommended for teaching when the sensing object is changed without stopping the line.

● Data bank switching

Settings such as output operations (L-ON / D-ON) and timer operations can be recorded in the digital fiber sensor's data bank and switching can be carried out externally.

※ Up to 3 files can be stored.



■ FX-CH2 function list

Teaching input

The following types of external teaching can be carried out.

- Full-auto teaching
- Limit teaching ' - '
- Limit teaching ' + '
- 2-level teaching

Data bank switching input

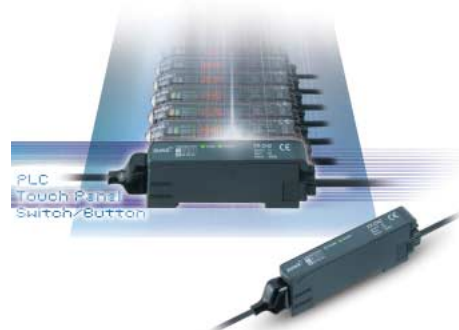
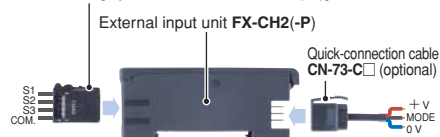
Switching between 3 channels of data banks and loading and saving of all channels at once can be carried out.

Key lock setting input

The key lock function that prevents incorrect operations by operators can be set on and off.

■ Product lineup

Connector for input device
CN-EP1 [1 pc. included with FX-CH2(-P)]

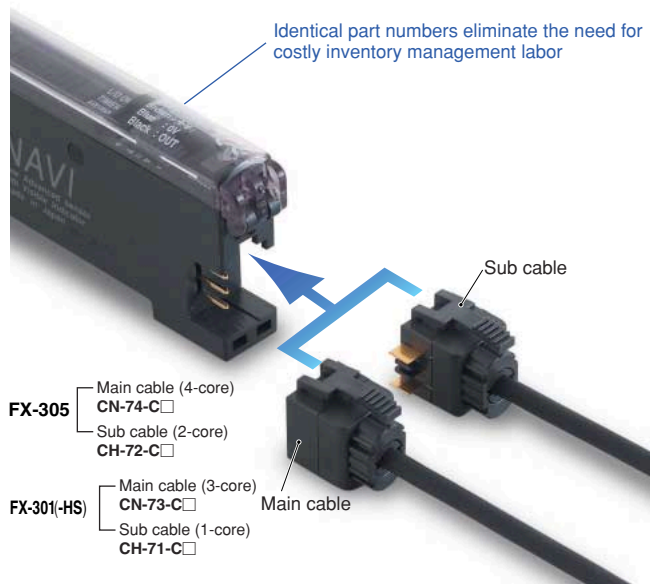


Wiring- and labor-saving design allows side-by-side configuration for up to sixteen units

FX-301/B/G/H FX-301-HS FX-305

One unit can be used as either a main unit or sub unit

The amplifier unit can be used as either a main unit or a sub unit. This feature allows for easy mounting in the side-by-side configuration. The main and sub unit functions are distinguished only by the proper use of the main cable and the sub cable. Moreover, inventory management and maintenance is simplified.



An optical communication function allows up to 16 sensors to be adjusted simultaneously

FX-301/B/G/H FX-305

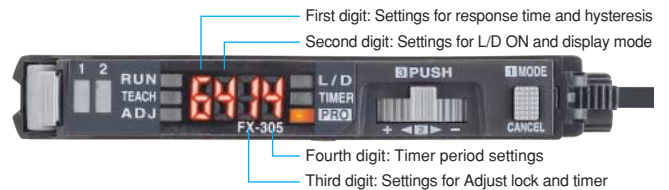
The optical communication function allows the data that is currently set to be copied and saved all at once for all amplifiers connected together from the right side. This greatly reduces troublesome setup tasks and makes setup much smoother. In addition, troublesome adjustment operations at times such as when replacing sensors can also be carried out easily and data can also be copied and stored using the optical communication function.



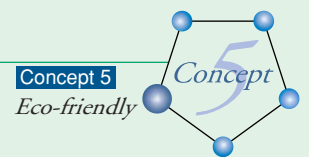
※ Use the optical communication function for only the same types of sensors. Furthermore, the FX-301-HS is not equipped with optical communication function capability. Refer to p. 30 for details.

Settings can be entered directly using numerical input

Every function can be directly set merely by the input of a four digit code (numbers) from the code table. This convenient feature is easy to set up. In the event that settings are accidentally changed at the operating site, merely entering the correct code can restore the original settings. This results in easy and quick maintenance.



Eco-friendly

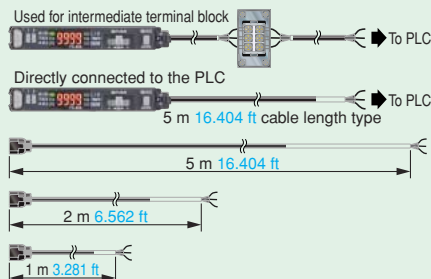


Lead-free solder used is gentle on the environment

SUNX promotes the use of lead-free materials in all of its sensor manufacturing processes including those used for the FX-300 series of digital fiber sensors.

Selectable cable length

Made available are 3 lengths, 1 m 3.281 ft, 2 m 6.562 ft, and 5 m 16.404 ft, to suit your application requirements. This helps reduce the waste caused by cutting cables and lightens the installation workload.



Reduced power consumption possible (ECO mode)

This turns off the digital display to reduce power consumption to approximately 600 W or less. (960 W is consumed when the display is on.)

Environmentally friendly packaging

With regard to effects on the environment, we only utilize the simplest of packaging methods greatly contributing to the reduction in wastes generated by your worksite. Also, the bags are made of polyethylene, a substance that doesn't give off polluting gases when burned.

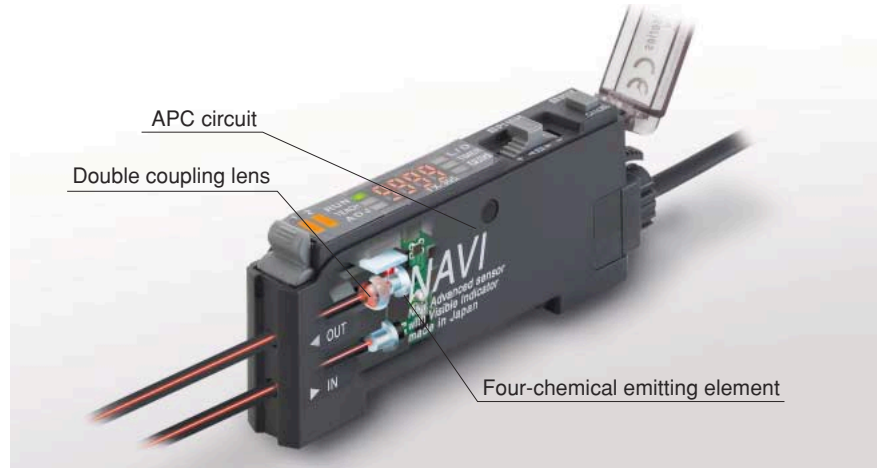
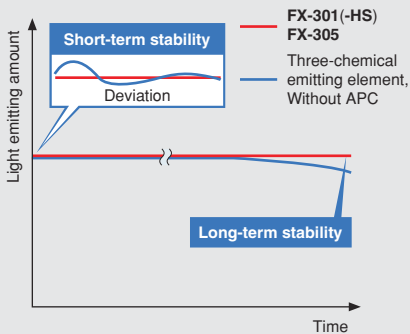


Improved stability over long and short periods

FX-301 FX-301-HS FX-305

A **four-chemical emitting element** for stable sensing over long periods has been added, in addition to an **APC** (Auto Power Control) circuit that suppresses fluctuations in light amount over short periods. The light amount becomes stable a short period after the power is turned on, so setup time can be reduced.

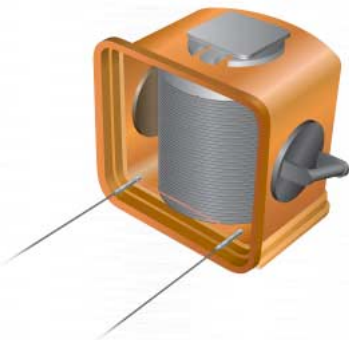
Stable sensing comparison



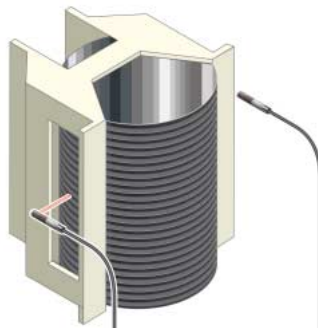
Mapping fiber

FT-KV1, FT-KV8, FR-KV1

This ultra-narrow optical beam fiber is ideal for mapping wafers.



1.5 mm 0.059 in thickness FT-KV1
 W2 × H1.5 × D20 mm **W0.079 × H0.059 × D0.787 in** ultra-compact size allows this sensor to be installed even in thin 200 mm **7.874 in** wafer handlers.



Aperture angle 2° FT-KV8, FT-KV8
 Aperture angle for the ultra-narrow optical beam is 2° or less. The light does not spread much at all, so that stable sensing can be obtained.



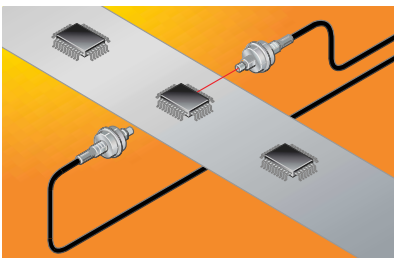
Retroreflective type FR-KV1
 With a thickness of 2.3 mm **0.091 in**, this fiber can be installed almost anywhere, and it is a retroreflective type so optical beam axis alignment is simple.

Heat-resistant fiber

FT-H□, FD-H□

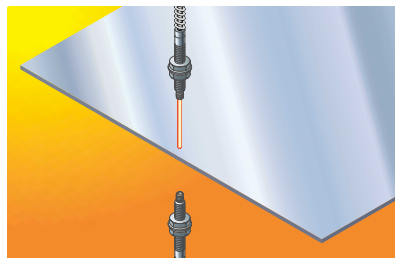
A variety of types are available, including a convergent reflective type for accurately sensing glass substrates, and a type with a bending radius of 10 mm **0.394 in** that hardly takes up any space.

IC detection within a high temperature handler



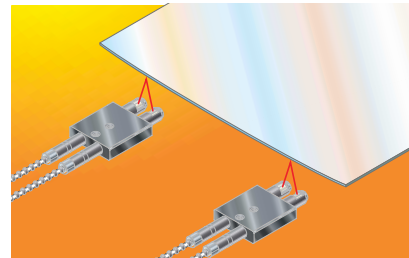
Flexible type FT-H20W-M2
 Withstands temperatures of +200 °C **+392 °F** and has a bending radius of 10 mm **0.394 in**, this fiber can be installed almost anywhere.

Glass substrate detection



Heat-resistant 350 °C +662 °F FD-H35-M2
 Can be used in temperatures ranging from -60 to +350 °C **-76 to +662 °F**. Stable sensing is obtained even at temperatures exceeding +300 °C **+572 °F**.

Glass substrate detection



Convergent reflective type FD-H30-L32, FD-H18-L31
 Accurately senses glass substrates at high temperatures of +300 °C **+572 °F**.

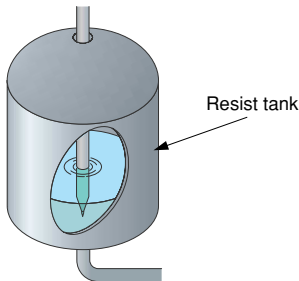
Large display 9999

FX-305

Large display with 4 digits (9999).

Extremely fine settings for detecting minute changes can be made to provide more stable sensing for items such as transparent objects.

Contact type liquid level detection fiber FD-F8Y



[Example of using liquid level detection fiber sensor (LONG mode)]

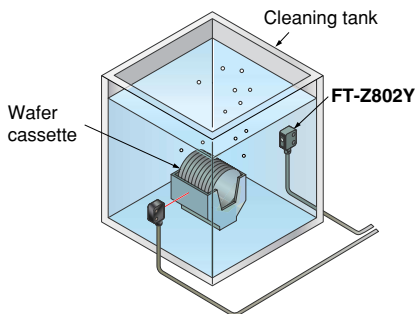
Previous display		FX-305	
Liquid absent	500	Liquid absent	2000
Liquid present	40	Liquid present	160
} 460		} 1840	

Extra display width has been increased!

Around liquids • Chemical-resistant fiber FT-Z802Y, FD-F705, FT-F902

Chemical-resistant fiber with fluorine resin coatings over the whole of the fiber, leak detection fiber that quickly sense leaks such as from detergents, and liquid detection fiber that accurately sense liquid levels are among the lineup of fibers that are ideal for liquid sensing.

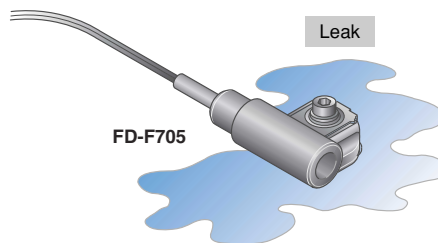
Detecting wafer cassette in cleaning tank



Chemical-resistant fiber FT-Z802Y

Fluorine resin coating allows fiber to be used with confidence even where contact with chemicals may occur.

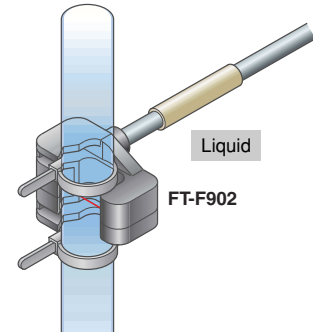
Detecting leak liquid in cleaning tank (Note)



Leak detection fiber FD-F705

The unique effect of capillarity enables reliable detection of small leaks and viscous liquids.

Detecting liquid presence within a pipe (Note)



Liquid detection fiber FT-F902

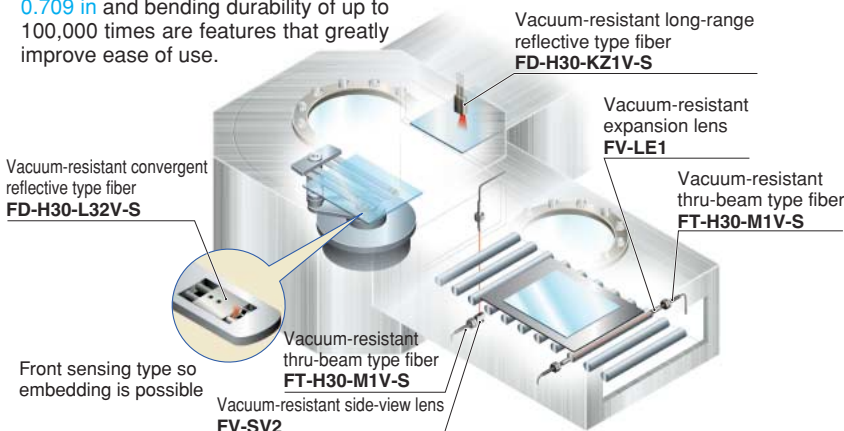
Even if pipe diameters and thicknesses vary, the center of the beam axis always follows a straight line along the pipe, so that the setup environment has almost no effect on sensing.

Note: Use the FX-301-F amplifier that is specially designed for leak / liquid detection. For details, please refer to the 'sensor general catalog 2003-2004' or 'SUNX homepage' (<http://www.sunx.co.jp/>).

Vacuum-resistant fiber

FT/FD-□V

The vacuum-resistant fiber lineup lets you select the best fiber for the application. Withstanding temperatures of up to +300 °C +572 °F, a bending radius of 18 mm 0.709 in and bending durability of up to 100,000 times are features that greatly improve ease of use.



Vacuum-resistant convergent reflective type FD-H30-L32V-S

• Sensing range: 0 to 8 mm 0 to 0.315 in (LONG mode)

Vacuum-resistant long-range reflective type FD-H30-KZ1V-S

• Sensing range: 20 to 200 mm 0.787 to 7.874 in (LONG mode)

Vacuum-resistant thru-beam type FT-H30-M1V-S

• Sensing range: 250 mm 9.843 in (LONG mode)

Vacuum-resistant side-view lens FV-SV2

• Sensing range greatly increased without taking up space

Vacuum-resistant expansion lens FV-LE1

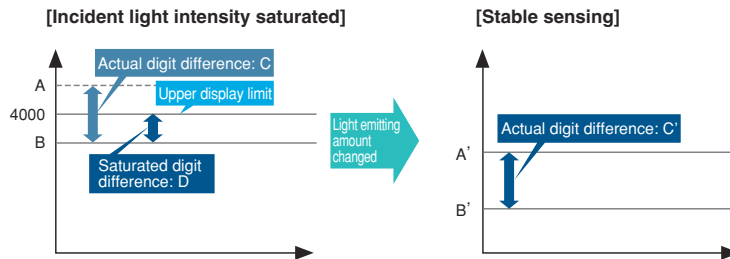
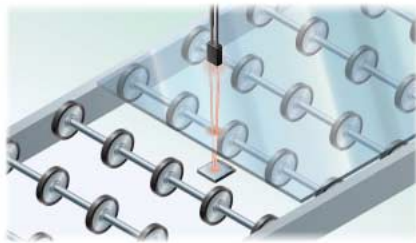
• Sensing range increased by 4 times or more

Light emitting amount selection function

FX-301 FX-301-HS FX-305

When sensing transparent objects and minute objects, the light emitting amount can be changed without changing the response time, even for cases where the incident light intensity is fully saturated, which was not possible with conventional models. This allows stable sensing to be maintained, and there is no longer any need to change the sensing range or change the fiber sensor as used to be required.

Example: Sensing glass substrate



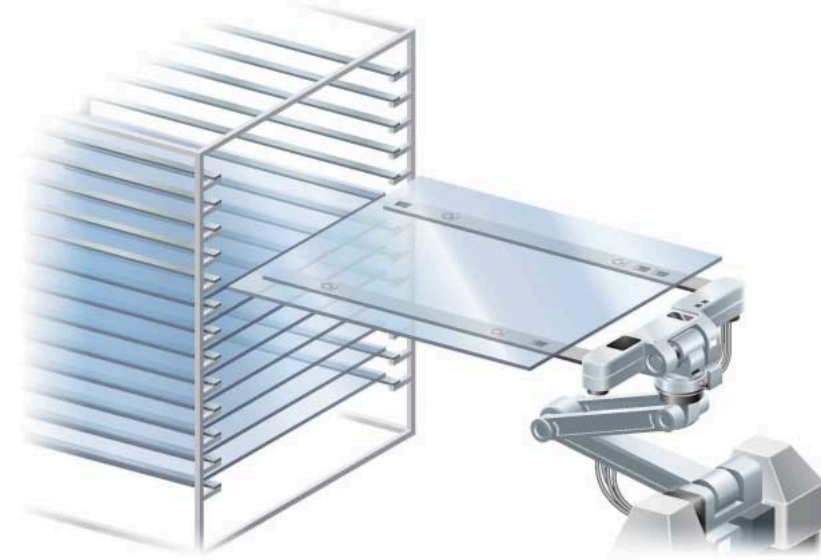
Comparison of saturation remedies

Previous models		FX-301(-HS), FX-305
<p>Remedy</p> <ul style="list-style-type: none"> • Changing response time • Changing fiber • Changing setting position 	<p>Problem</p> <ul style="list-style-type: none"> Mode selection → Affects positioning precision Change to thinner fiber to reduce light amount → Cost and man-hour inefficiencies Increase sensing range → Man-hour and space inefficiencies 	<p>Light emitting amount selection function makes steps such as those at left unnecessary.</p>

Fiber for glass substrate conveyor

FD-L40 series, FR-WKZ11

Fibers are available which are ideal for glass substrate conveyor processes.

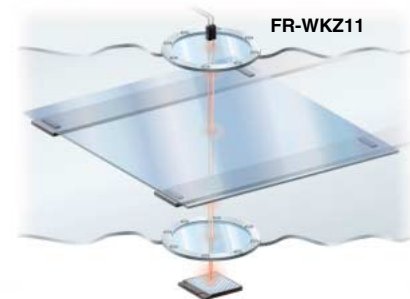


Alignment / Convergent reflective type FD-L43, FD-L45

Even glass substrates with $\pm 8^\circ$ (FD-L45: $\pm 6^\circ$) of flexure can be stably sensed.

- High flexure of $\pm 8^\circ$ (FD-L43)
- Long sensing range 30 mm 1.181 in (FD-L45)

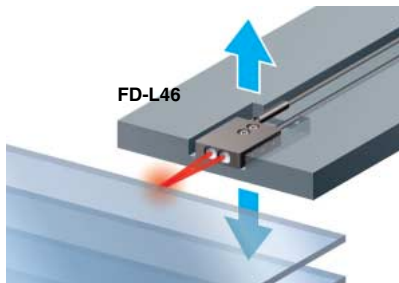
Sensing glass substrate through a view port



Retroreflective type FR-WKZ11

A polarization filter allows accurate sensing of glass substrates that pass by the view port.

- Long sensing range 1.5 m 4.921 ft (when sensing glass substrates)



Mapping / Convergent reflective type FD-L46

Accurate mapping even for 0.5 mm 0.020 in thin glass substrates. A light weight of approximately 39 g means it can even be installed at the ends of handlers.



Seating confirmation / Convergent reflective type FD-L44

Long sensing range 0 to 6 mm 0 to 0.236 in for seating confirmation.

External data bank switching and teaching are possible External input unit FX-CH2

FX-301 FX-305

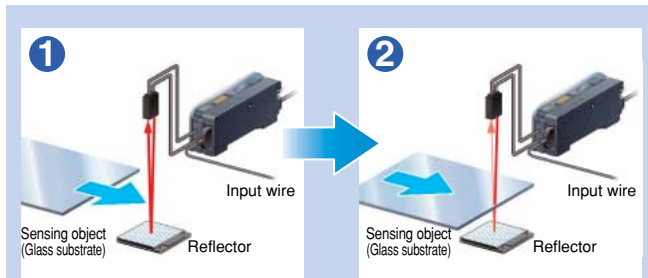
The FX-CH2 external input unit (optional) can be used to carry out teaching and data bank switching operations externally without needing to operate the digital fiber sensors directly. This is ideal for locations such as clean rooms where entry and exit of personnel are restricted.

Sensing glass substrate (stable sensing of minute differences)

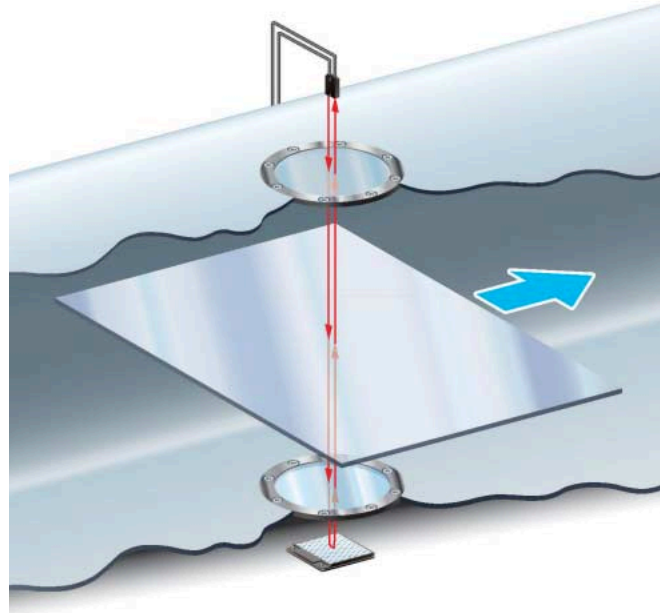
When sensing transparent objects and extremely small objects, variations in the incident light intensity caused by external factors such as slippage of the beam axis due to vibration can result in incorrect operation.

In such cases, periodically setting limit teaching '—' can be used to ensure more stable sensing.

The FX-CH2 can be used to carry out teaching externally, so that teaching can be carried out much more easily in places where entry and exit of personnel are restricted.



- ① Carry out limit teaching '—' before the sensing object (glass substrate) arrives (while there is no sensing object present). When the shift value is set to 5% beforehand, the threshold value is set to a value that is at a level 5% lower than the incident light intensity during teaching.
- ② Even when sensing glass substrates with high degrees of transparency (low damping), stable sensing is possible without changes in the light amount due to external causes.

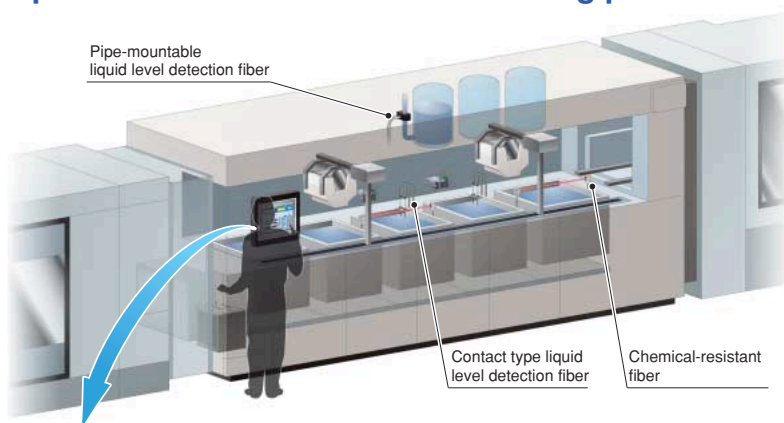


Upstream communication for reading data and teaching are also possible Upstream communication unit SC-GU1-485

FX-301 FX-305

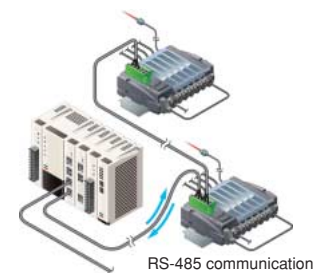
A PLC or computer can be used for sending inputs (teaching or data bank switching) to the digital fiber sensors, and also a communication unit can be used for confirming incident light intensities and output statuses for the digital fiber sensors, which is ideal for equipment such as semiconductor manufacturing equipment in places where entry and exit of personnel are restricted.

Example of use in semiconductor cleaning process



High general compatibility so that any type of PLC can be used

RS-485 communication provides a high level of general compatibility so that any type of PLC can be used. Integration with existing systems is possible without the need to change PLCs.



Compatible with all PLCs equipped with RS-485 compatible units

Communication speed 57.6 kbps

High-speed communication at a maximum speed of 57.6 kbps allows the operator to instantly confirm information such as the incident light intensity and output statuses of the digital sensors.

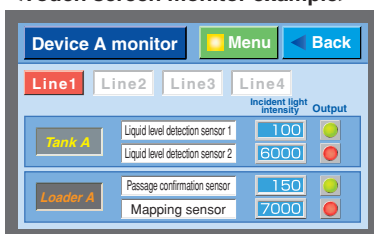
Series connection of a maximum of 31 nodes is possible

A maximum of 31 nodes can be connected in series. This is ideal for flexible handling when the sensors are to be installed in scattered locations or if more sensors are added.

Less wiring and installation work

Up to a maximum of 16 sensors can be connected side-by-side. Power can be supplied to all of them at once, so that less wiring and installation work is required. Wire-saving connectors also makes it possible to send output signals to the PLC in a single batch.

<Touch screen monitor example>



The sensor settings and operation can be confirmed on the touch screen, greatly improving ease of operation!

Ideal for workplaces such as semiconductor and LCD manufacturing lines where there are restrictions on operators entering and exiting

<Communicable commands>

- Sensor incident light intensity
- Sensor settings verification
- Sensor output status
- Threshold value settings, etc.

High-speed response 35 μ s

FX-301-HS

These digital fiber sensors have the fast response time of 35 μ s. They are ideal for sensing minute objects that are moving at high speeds.



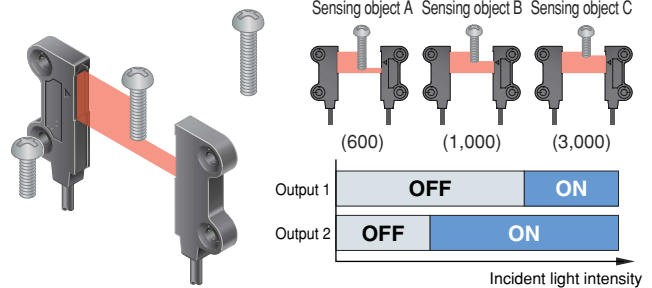
Independent dual outputs

FX-305

Two independent output channels are provided, so that one sensor can be used for control tasks that previously required two sensors. In addition, the second output channel can be used for alarm output and error output, so that ease of maintenance is improved.

Screw length discrimination
[Distinguishing between sensing objects A, B and C]

Output 1 and output 2 can be used together to distinguish between sensing objects A, B and C.



※ A window comparator mode for distinguishing between sensing objects with single output is also available.

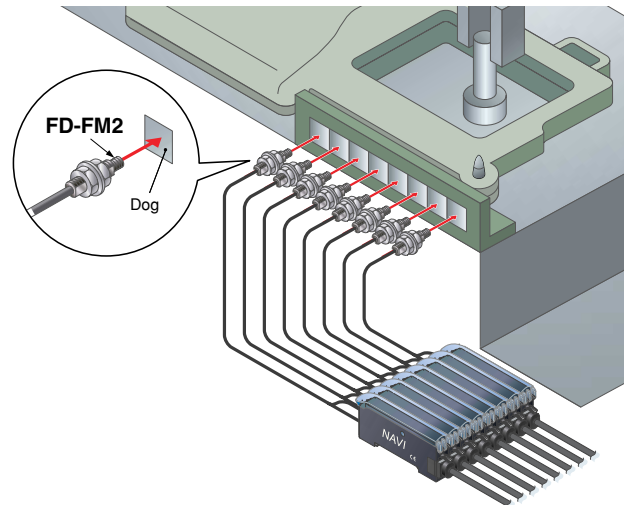
Interference prevention up to maximum of sixteen units

FX-305

Interference prevention can be set for up to a maximum of 16 units, so that they can be used with confidence in locations where the fibers are installed in contact with each other. In addition, interference prevention for two fibers can be set during 65 μ s ultra high-speed mode.

Mode	Interference prevention switching function			
	IP-1		IP-2	
	No. of units	Response time	No. of units	Response time
H-SP	2 units	65 μ s	4 units	130 μ s
FAST	4 units	150 μ s	8 units	300 μ s
STD	4 units	250 μ s	8 units	500 μ s
STDF	4 units	700 μ s	8 units	1.4 ms
LONG	4 units	2.5 ms	8 units	5 ms
U-LG	8 units	4.5 ms	16 units	9 ms

For the FX-301/B/G/H, up to 4 units can be set.
The FX-301-HS is not equipped with an interference prevention function.



Improved ease of working! External data bank switching and teaching

FX-301 FX-305

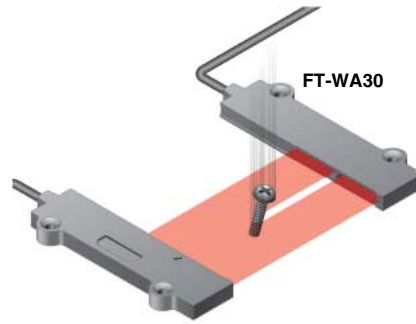
The FX-CH2 external input unit (optional) can be used to carry out teaching and data bank switching operations externally without needing to operate the digital fiber sensors directly. This is very convenient for equipment which requires frequent setup changes.



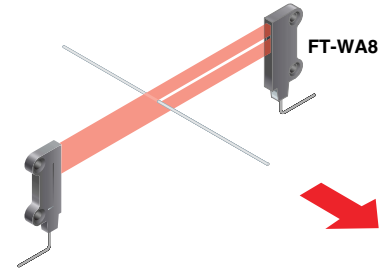
Wide beam fiber

FT-WA30/A30, FT-WA8/A8

It has a wide sensing width of 11 mm 0.433 in for the FT-WA8/A8 and 32 mm 1.260 in for the FT-WA30/A30 enabling long distance sensing of objects as far as 3,500 mm 137.795 in (with the FX-301 in long range mode). Optimal for detecting unsteady works or small objects.



Detecting dropping screws



Wire breakage detection

Finest spot fiber

FX-MR6 + FD-EG3

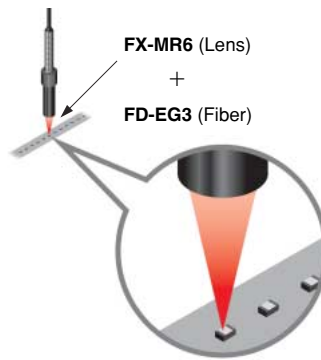
An ultra-small $\phi 0.1$ mm $\phi 0.004$ in spot size has now been made possible by combining our precision fiber with our finest spot lens. The orientation of 0603 chips can also be discriminated stably.

Finest spot lens FX-MR6

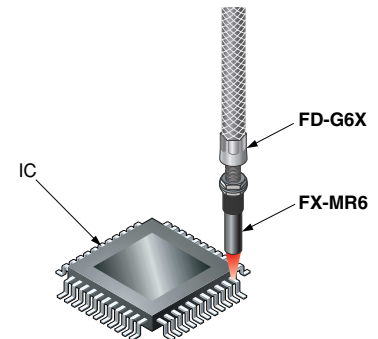
Fiber model No.	Distance to focal point	Spot diameter
FD-EG3	7 ± 0.5 mm 0.276 ± 0.020 in	$\phi 0.1$ mm $\phi 0.004$ in approx.
FD-EG2	7 ± 0.5 mm 0.276 ± 0.020 in	$\phi 0.15$ mm $\phi 0.006$ in approx.
FD-EG1	7 ± 0.5 mm 0.276 ± 0.020 in	$\phi 0.2$ mm $\phi 0.008$ in approx.
FD-WG4/G4/G6X/G6	7 ± 0.5 mm 0.276 ± 0.020 in	$\phi 0.4$ mm $\phi 0.016$ in approx.

Finest spot lens FX-MR3

Fiber model No.	Distance to focal point	Spot diameter
FD-EG3	7.5 ± 0.5 mm 0.295 ± 0.020 in	$\phi 0.15$ mm $\phi 0.006$ in approx.
FD-EG2	7.5 ± 0.5 mm 0.295 ± 0.020 in	$\phi 0.2$ mm $\phi 0.008$ in approx.
FD-EG1	7.5 ± 0.5 mm 0.295 ± 0.020 in	$\phi 0.3$ mm $\phi 0.012$ in approx.
FD-WG4/G4/G6X/G6	7.5 ± 0.5 mm 0.295 ± 0.020 in	$\phi 0.5$ mm $\phi 0.020$ in approx.



0603 chip orientation discrimination

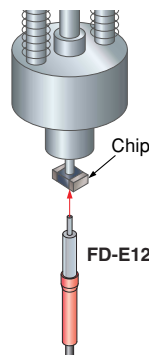


IC pin sensing

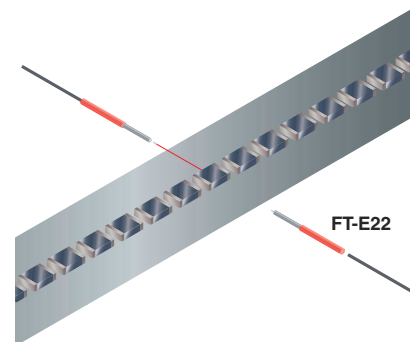
Ultra small diameter fiber

FT-E12/E22, FD-E12/E22

Sleeve head diameter of 0.25 mm 0.010 in has been realized (FT-E12). This has improved the sensing capability for minute objects such as the 0603 chip.



Sensing of chip components during suction transport



Confirming passage of chip components

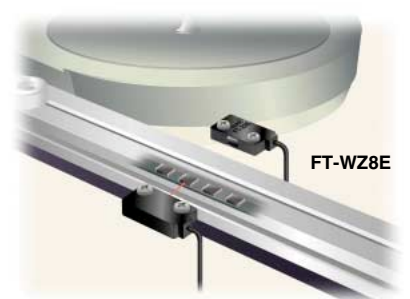
Rectangular head fiber

FT-Z8□/WZ8□

The allowable bending radius is 4 mm 0.157 in (1 mm 0.039 in for the FT-WZ8□). This allows the fibers to be routed with great freedom and uses less space. Because it is installed with only two M2 screws, light beam axis alignment is easy. A front sensing type, side sensing type and top sensing type are provided.



Detecting ICs in transparent stick

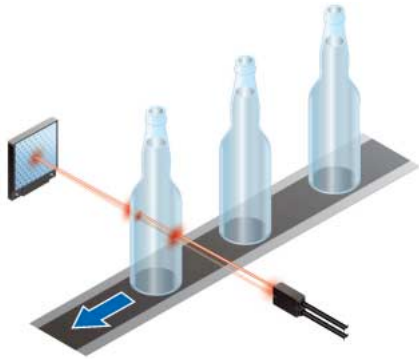


Parts feeder surplus detection

Retroreflective type fiber

FR-WKZ11, FR-KZ21/22

The lineup includes retroreflective type fibers which are ideal for sensing transparent objects.



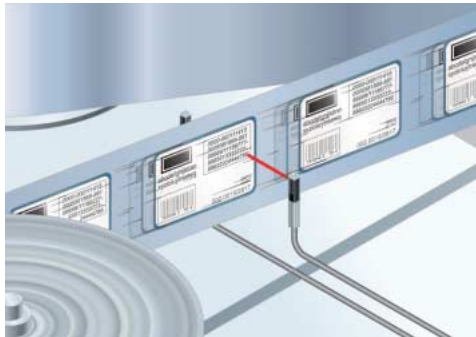
With polarizing filters FR-WKZ11

This fiber has a compact head of $W9.5 \times H5.2 \times D15$ mm $W0.374 \times H0.205 \times D0.591$ in. Equipped with allowable bending radius: R1 mm $R0.039$ in making it space efficient.

Side-view fiber

FT-V10

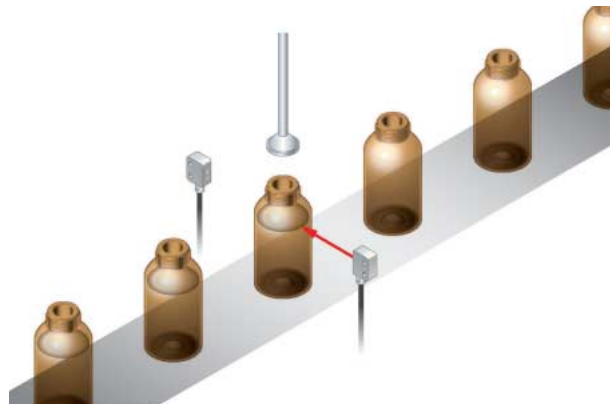
Because this is a side-view fiber, it is ideal for sensing in locations where space is scarce. Has a 4-side beveled shape and beam axis alignment with respect to the beveled surface is done when installing the product, so that the fiber can be installed easily just by aligning its surface.



Chemical-resistant fiber

FT-Z802Y

With the case made of PFA (fluorine resin) and fiber sheath with PFA (fluorine resin), the fiber can be used with various types of chemical liquids.

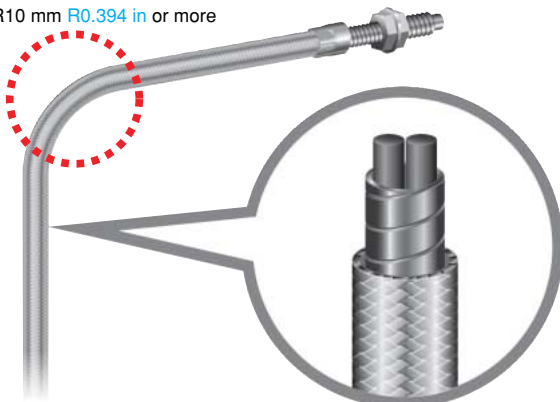


Tough flexible fiber

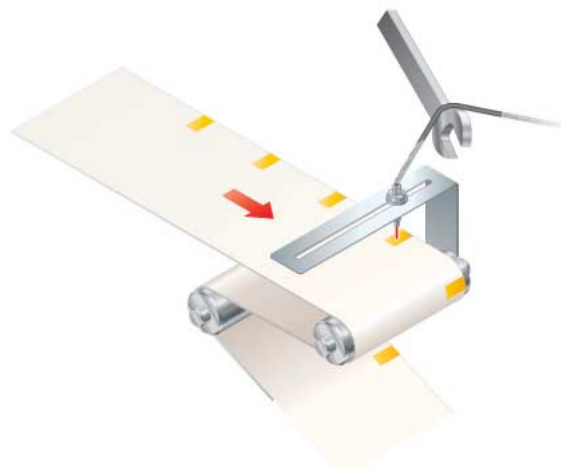
FT-P81X, FD-P81X, FD-G6X

Stainless steel braiding protects the fiber cable and prevents fiber breakage due to snagging.

R10 mm $R0.394$ in or more



Strong stainless steel mesh protects fiber cables from breakage



ORDER GUIDE

Connector type amplifiers **Quick-connection cable is not supplied with the amplifier. Please order it separately.**

Type	Appearance	Model No.	Emitting element	Output	Quick-connection cables					
					Type	Model No.	Length			
Standard type		FX-301	Red LED	NPN open-collector transistor	Main cable (3-core)	CN-73-C1	1 m 3.281 ft			
		FX-301P		PNP open-collector transistor		CN-73-C2	2 m 6.562 ft			
		FX-301B	Blue LED	NPN open-collector transistor		Sub cable (1-core)	CN-73-C5	5 m 16.404 ft		
		FX-301BP		PNP open-collector transistor			CN-71-C1	1 m 3.281 ft		
		FX-301G	Green LED	NPN open-collector transistor			CN-71-C2	2 m 6.562 ft		
		FX-301GP		PNP open-collector transistor		CN-71-C5	5 m 16.404 ft			
		High-speed type		FX-301-HS		Red LED	NPN open-collector transistor	Sub cable (2-core)	CN-72-C1	1 m 3.281 ft
				FX-301P-HS			PNP open-collector transistor		CN-72-C2	2 m 6.562 ft
High-function type		FX-305	Red LED	NPN open-collector transistor	Main cable (4-core)	CN-74-C1	1 m 3.281 ft			
				PNP open-collector transistor		CN-74-C2	2 m 6.562 ft			
				PNP open-collector transistor		CN-74-C5	5 m 16.404 ft			
		FX-305P		NPN open-collector transistor	Sub cable (2-core)	CN-72-C1	1 m 3.281 ft			
				PNP open-collector transistor		CN-72-C2	2 m 6.562 ft			
				PNP open-collector transistor		CN-72-C5	5 m 16.404 ft			

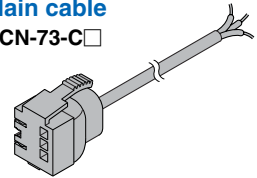
ORDER GUIDE

Quick-connection cables

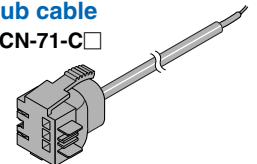
For FX-301(-HS)/B/G/H **Quick-connection cable is not supplied with the amplifier. Please order it separately.**

Type	Model No.	Description	
Main cable (3-core)	CN-73-C1	Length: 1 m 3.281 ft	0.15 mm ² 3-core cabtyre cable, with connector on one end Cable outer diameter: ϕ 3.0 mm ϕ 0.118 in
	CN-73-C2	Length: 2 m 6.562 ft	
	CN-73-C5	Length: 5 m 16.404 ft	
Sub cable (1-core)	CN-71-C1	Length: 1 m 3.281 ft	0.15 mm ² 1-core cabtyre cable, with connector on one end Cable outer diameter: ϕ 3.0 mm ϕ 0.118 in
	CN-71-C2	Length: 2 m 6.562 ft	
	CN-71-C5	Length: 5 m 16.404 ft	

Main cable
• **CN-73-C**



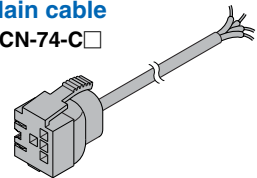
Sub cable
• **CN-71-C**



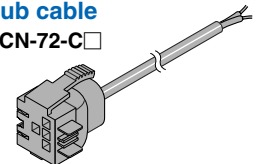
For FX-305 **Quick-connection cable is not supplied with the amplifier. Please order it separately.**

Type	Model No.	Description	
Main cable (4-core)	CN-74-C1	Length: 1 m 3.281 ft	0.15 mm ² 4-core cabtyre cable, with connector on one end Cable outer diameter: ϕ 3.0 mm ϕ 0.118 in
	CN-74-C2	Length: 2 m 6.562 ft	
	CN-74-C5	Length: 5 m 16.404 ft	
Sub cable (2-core)	CN-72-C1	Length: 1 m 3.281 ft	0.15 mm ² 2-core cabtyre cable, with connector on one end Cable outer diameter: ϕ 3.0 mm ϕ 0.118 in
	CN-72-C2	Length: 2 m 6.562 ft	
	CN-72-C5	Length: 5 m 16.404 ft	

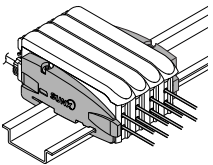
Main cable
• **CN-74-C**



Sub cable
• **CN-72-C**



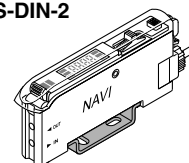
End plates **End plates are not supplied with the amplifier. Please order them separately when the amplifiers are mounted in cascade.**

Appearance	Model No.	Description
	MS-DIN-E	When cascading multiple amplifiers, or when it moves depending on the way it is installed on a DIN rail, these end plates ensure that all amplifiers are mounted together in a secure and fully connected manner. Two pcs. per set

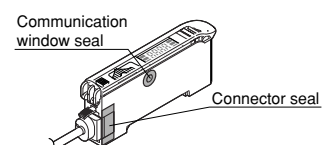
OPTIONS

Designation	Model No.	Description
Amplifier mounting bracket	MS-DIN-2	Mounting bracket for amplifier
Fiber amplifier protective seal	FX-MB1	10 sets of 2 communication window seals and 1 connector seal Communication window seal: It prevents malfunction due to transmission signal from another amplifier, as well as, prevents effect on another amplifier. Connector seal: It prevents contact of any metal, etc., with the pins of the quick-connection cable.

Amplifier mounting bracket
• **MS-DIN-2**



Fiber amplifier protective seal
• **FX-MB1**



LIST OF FIBERS

Pliable fibers (flexible and sharp bending fibers) are marked with light blue in the table.

FX-305 / FX-301 (Red LED type) sensing range (Note 1)

Thru-beam type (one pair set)



The FX-305 and FX-301(-HS) have different sensing modes.
 FX-305: H-SP, FAST, STD, STDF, LONG, U-LG (no S-D mode)
 FX-301(-HS): S-D, H-SP, FAST, STD, LONG (no STDF or U-LG mode)

Type	Shape of fiber head (mm in)	Sensing range (mm in)(Note 2)	■ U-LG ■ FAST ■ LONG ■ H-SP ■ STDF ■ S-D ■ STD	Min. sensing object (Note 3)	Fiber cable length Free-cut 2 m 6.562 ft 10 m 32.808 ft	Bending radius R25 mm R0.984 in Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in R1 mm R0.039 in R4 mm R0.157 in Flexible	Model No.	
Thru-beam type	M4	Lens mountable	1,600 62.992 1,100 43.307 700 27.559 530 20.866	400 15.748 200 7.874 180 7.087	φ 0.04 mm φ 0.0016 in opaque object	R25 mm R0.984 in	FT-B8	
		Lens mountable					FT-FM2	
		Sleeve 90 mm 3.543 in	1,000 39.370 780 30.709 500 19.685 400 15.748	280 11.024 150 5.906 130 5.118	φ 0.03 mm φ 0.0012 in opaque object		Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in	FT-FM2S
		Sleeve 40 mm 1.575 in					FT-FM2S4	
		Lens mountable	750 29.528 570 22.441 350 13.780 290 11.417	200 7.874 90 3.543 100 3.937	φ 0.03 mm φ 0.0012 in opaque object		R1 mm R0.039 in	FT-W8
		Lens mountable	900 35.433 650 25.591 400 15.748 320 12.598	230 9.055 100 3.937 110 4.331	φ 0.04 mm φ 0.0016 in opaque object		R4 mm R0.157 in Flexible	FT-P80
		Lens mountable	900 35.433 650 25.591 380 14.961 320 12.598	230 9.055 100 3.937 110 4.331	φ 0.05 mm φ 0.0020 in opaque object		1 m 3.281 ft R10 mm R0.394 in	FT-P81X
		Lens mountable Tough flexible	550 21.654 400 15.748 250 9.843 190 7.480	140 5.512 70 2.756 80 3.150	φ 0.04 mm φ 0.0016 in opaque object		2 m 6.562 ft Flexible	FT-P60
	Nut type	Lens mountable	750 29.528 570 22.441 350 13.780 290 11.417	200 7.874 90 3.543 100 3.937	φ 0.06 mm φ 0.0024 in opaque object	2 m 6.562 ft	R1 mm R0.039 in	FT-WR80 NEW
		With lens	1,500 59.055 1,200 47.244 750 29.528 600 23.622	420 16.535 200 7.874 210 8.268	φ 0.04 mm φ 0.0016 in opaque object	2 m 6.562 ft	R1 mm R0.039 in	FT-WR80L NEW
	Elbow	Lens mountable	740 29.134 530 20.866 320 12.598 230 9.055	150 5.906 75 2.953 80 3.150	φ 0.04 mm φ 0.0016 in opaque object	2 m 6.562 ft	R25 mm R0.984 in	FT-R80
	M3	Lens mountable (except FX-LE2)	1,000 39.370 780 30.709 500 19.685 400 15.748	280 11.024 150 5.906 130 5.118	φ 0.03 mm φ 0.0012 in opaque object	2 m 6.562 ft	R25 mm R0.984 in	FT-T80
		Lens mountable						FT-NFM2
		Sleeve 90 mm 3.543 in	400 15.748 270 10.630 200 7.874 140 5.512	100 3.937 55 2.165 49 1.929	φ 0.025 mm φ 0.0010 in opaque object			Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in
Sleeve 40 mm 1.575 in					FT-NFM2S4			
Lens mountable		220 8.661 160 6.299 100 3.937 80 3.150	55 2.165 25 0.984 28 1.102	φ 0.02 mm φ 0.0008 in opaque object	R1 mm R0.039 in			FT-W4
Lens mountable		350 13.780 250 9.843 150 5.906 100 3.937	75 2.953 30 1.181 35 1.378		R4 mm R0.157 in Flexible			FT-P40
With lens		19,500 767.715 19,500 767.715 19,500 767.715 14,000 551.180	10,000 393.700 3,500 137.795 3,800 149.606	φ 0.4 mm φ 0.016 in opaque object	10 m 32.808 ft			R25 mm R0.984 in

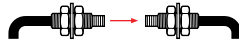
Notes: 1) Refer to p.27 for the sensing ranges for the FX-301(-HS) in H-SP mode and for the FX-301B/G/H.
 2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
 3) The minimum sensing object size is the value for red LED type. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type.
 The optimum condition is the condition when the sensitivity is set so that the sensing output just changes to light incident operation in the object absent condition.

LIST OF FIBERS

Pliable fibers (flexible and sharp bending fibers) are marked with light blue in the table.

FX-305 / FX-301 (Red LED type) sensing range (Note 1)

Thru-beam type (one pair set)



The FX-305 and FX-301(-HS) have different sensing modes.
 FX-305: H-SP, FAST, STD, STDF, LONG, U-LG (no S-D mode)
 FX-301(-HS): S-D, H-SP, FAST, STD, LONG (no STDF or U-LG mode)

Type	Shape of fiber head (mm in)	Sensing range (mm in)(Note 2)	■ : U-LG ■ : FAST ■ : LONG ■ : H-SP ■ : STDF ■ : S-D ■ : STD	Min. sensing object (Note 3)	Fiber cable length ✂ Free-cut	Bending radius	Model No.		
Cylindrical type	φ3 φ0.118	With lens · Long sensing range	1,500 59.055	420 16.535	φ0.02 mm φ0.0008 in opaque object	✂ 2 m 6.562 ft	R1 mm R0.039 in	FT-WS8L	
			1,200 47.244	200 7.874					
			750 29.528	210 8.268					
			600 23.622						
			780 30.709	200 7.874					
			340 13.386	90 3.543					
	φ2.5 φ0.098	With lens · Long sensing range	φ2.5 φ0.098	2,000 78.740	580 22.835	φ0.02 mm φ0.0008 in opaque object	✂ 2 m 6.562 ft	R25 mm R0.984 in	FT-SFM2L
				1,600 62.992	170 6.693				
				600 23.622	280 11.024				
				800 31.496					
				1,000 39.370	280 11.024				
				780 30.709	150 5.906				
φ1.5 φ0.059	With lens · Long sensing range	φ1.5 φ0.059	400 15.748	100 3.937	φ0.025 mm φ0.0010 in opaque object	✂ 2 m 6.562 ft	R25 mm R0.984 in	FT-SNFM2	
			270 10.630	55 2.165					
			200 7.874	49 1.929					
			140 5.512						
			220 8.661	55 2.165					
			160 6.299	25 0.984					
φ1 φ0.039	With lens · Long sensing range	φ1 φ0.039	350 13.780	90 3.543	φ0.02 mm φ0.0008 in opaque object	✂ 1 m 3.281 ft	R1 mm R0.039 in	FT-WS4	
			280 11.024	40 1.575					
			160 6.299	42 1.654					
			120 4.724						
			100 3.937	30 1.181					
			80 3.150	13 0.512					
Ultra-small diameter	Beam diameter φ0.125 mm φ0.005 in	φ0.25 φ3	20 0.787	8 0.315	φ0.02 mm φ0.0008 in opaque object	✂ 500 mm 19.685 in	R5 mm R0.197 in	FT-E12	
		φ0.10 φ0.118	18 0.709	13 0.512					
			13 0.512	3 0.118					
			10 0.394						
			130 5.118	36 1.417					
			80 3.150	18 0.709					
Side-view	φ4 φ0.157	φ1 φ0.039	2,350 92.520	800 31.496	φ0.05 mm φ0.0020 in opaque object	✂ 2 m 6.562 ft	R25 mm R0.984 in	FT-V10	
		φ2 φ0.079	2,000 78.740	340 13.386					
			1,400 55.118	350 13.780					
			1,000 39.370						
			550 21.654	140 5.512					
			400 15.748	65 2.559					
	φ1.5 φ0.059	φ1.5 φ0.059	φ1.5 φ0.059	400 15.748	140 5.512	φ0.02 mm φ0.0008 in opaque object	✂ 1 m 3.281 ft	R25 mm R0.984 in	FT-SFM2SV2
			φ2.5 φ0.098	240 9.449	70 2.756				
				200 7.874					
				410 16.142	125 4.921				
				390 15.354	60 2.362				
				220 8.661	63 2.480				
φ1 φ0.039	φ1 φ0.039	φ1 φ0.039	220 8.661	60 2.362	φ0.02 mm φ0.0008 in opaque object	✂ 2 m 6.562 ft	R1 mm R0.039 in	FT-V41	
		φ2 φ0.079	175 6.890	25 0.984					
			100 3.937	27 1.063					
			80 3.150						
			120 4.724	30 1.181					
			90 3.543	13 0.512					

- Notes: 1) Refer to p.27 for the sensing ranges for the FX-301(-HS) in H-SP mode and for the FX-301B/G/H.
 2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
 3) The minimum sensing object size is the value for red LED type. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type.
 The optimum condition is the condition when the sensitivity is set so that the sensing output just changes to light incident operation in the object absent condition.

LIST OF FIBERS

Pliable fibers (flexible and sharp bending fibers) are marked with light blue in the table.

FX-305 / FX-301 (Red LED type) sensing range (Note 1)

Thru-beam type (one pair set)



The FX-305 and FX-301 (-HS) have different sensing modes.
 FX-305: H-SP, FAST, STD, STDF, LONG, U-LG (no S-D mode)
 FX-301 (-HS): S-D, H-SP, FAST, STD, LONG (no STDF or U-LG mode)

Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 2)	■ U-LG ■ FAST ■ LONG ■ H-SP ■ STDF ■ S-D ■ STD	Min. sensing object (Note 3)	Fiber cable length ✂ Free-cut	Bending radius	Model No.			
Rectangular	Compact	Easy mounting · Top sensing W3 × H8 × D12 W0.118 × H0.315 × D0.472	3,500 137.795	850 33.465	φ 0.08 mm φ 0.0032 in opaque object	2 m 6.562 ft	R1 mm R0.039 in	FT-WZ8H		
			2,500 98.425	400 15.748						
		Easy mounting · Side sensing W3 × H12 × D8 W0.118 × H0.472 × D0.315	1,600 62.992	410 16.142	φ 0.03 mm φ 0.0012 in opaque object		R4 mm R0.157 in	Flexible	FT-Z8H	
			3,100 122.047	1,000 39.370						
		Easy mounting · Front sensing W8.5 × H12 × D3 W0.335 × H0.472 × D0.118	2,700 106.299	420 16.535	φ 0.05 mm φ 0.0020 in opaque object		R1 mm R0.039 in	Flexible	FT-WZ8E	
	1,550 61.024		490 19.291							
	Special	Narrow beam	Front sensing W10 × H7 × D2 W0.394 × H0.276 × D0.079	1,850 72.835	600 23.622	φ 0.03 mm φ 0.0012 in opaque object	2 m 6.562 ft	R4 mm R0.157 in	FT-Z8E	
				1,600 62.992	250 9.843					
			Fiber bending type W2 × H10 × D10 W0.079 × H0.394 × D0.394	950 37.402	280 11.024	φ 0.04 mm φ 0.0016 in opaque object		R1 mm R0.039 in	Flexible	FT-WZ8
				700 27.559	100 3.937					
Front sensing W14 × H7 × D3.5 W0.551 × H0.276 × D0.138			950 37.402	240 9.449	φ 0.03 mm φ 0.0012 in opaque object	R4 mm R0.157 in		Flexible	FT-Z8	
		700 27.559	120 4.724							
Wide beam		Front sensing W10 × H7 × D2 W0.394 × H0.276 × D0.079	1,100 43.307	300 11.811	φ 0.08 mm φ 0.0032 in opaque object	1 m 3.281 ft	R1 mm R0.039 in	FT-WZ4		
			800 31.496	120 4.724						
		Fiber bending type W2 × H10 × D10 W0.079 × H0.394 × D0.394	500 19.685	140 5.512	φ 0.03 mm φ 0.0012 in opaque object		R4 mm R0.157 in	Flexible	FT-Z8	
			400 15.748	70 2.756						
	Front sensing W14 × H7 × D3.5 W0.551 × H0.276 × D0.138	300 11.811	40 1.575	φ 0.08 mm φ 0.0032 in opaque object	2 m 6.562 ft		R1 mm R0.039 in	FT-WZ4		
200 7.874		40 1.575								
Fiber bending type W2 × H10 × D10 W0.079 × H0.394 × D0.394	140 5.512	30 1.181	φ 0.03 mm φ 0.0012 in opaque object	R4 mm R0.157 in		Flexible	FT-WZ4HB			
	100 3.937	30 1.181								
Wide area sensing	Front sensing W14 × H7 × D3.5 W0.551 × H0.276 × D0.138	660 25.984	150 5.906	φ 0.08 mm φ 0.0032 in opaque object		2 m 6.562 ft	R1 mm R0.039 in	FT-WZ7		
		440 17.323	80 3.150							
	Fiber bending type W3.5 × H14 × D11 W0.138 × H0.551 × D0.433	308 12.126	80 3.150	φ 0.03 mm φ 0.0012 in opaque object	R4 mm R0.157 in		Flexible	FT-WZ7HB		
		220 8.661	110 4.331							
	Array	Top sensing W5 × H15 × D15 W0.197 × H0.591 × D0.591	870 34.252	210 8.268	φ 0.06 mm φ 0.0024 in opaque object		2 m 6.562 ft	R25 mm R0.984 in	FT-K8	
580 22.835			110 4.331							
Side-view type with small light dispersion W2 × H1.5 × D20 W0.079 × H0.059 × D0.787		406 15.984	110 4.331	φ 0.02 mm φ 0.0008 in opaque object	2 m 6.562 ft	R1 mm R0.039 in		FT-WKV8		
		290 11.417	110 4.331							
Wide area sensing Sensing width 32 mm 1.260 in W5 × H69 × D20 W0.197 × H2.717 × D0.787		3,000 118.110	800 31.496	φ 0.06 mm φ 0.0024 in opaque object		2 m 6.562 ft		R25 mm R0.984 in	FT-KV8	
	2,000 78.740	300 11.811								
Wide area sensing Sensing width 11 mm 0.433 in W4.2 × H31 × D13.5 W0.165 × H1.220 × D0.531	1,500 59.055	350 13.780	φ 0.02 mm φ 0.0008 in opaque object	2 m 6.562 ft			R10 mm R0.394 in	FT-KV1		
	1,000 39.370	100 3.937								
Top sensing W5 × H15 × D15 W0.197 × H0.591 × D0.591	3,000 118.110	800 31.496	φ 0.3 mm φ 0.012 in opaque object		2 m 6.562 ft		R1 mm R0.039 in	FT-WA30		
	2,000 78.740	300 11.811								
Wide area sensing Sensing width 11 mm 0.433 in W4.2 × H31 × D13.5 W0.165 × H1.220 × D0.531	1,500 59.055	180 7.087	φ 0.25 mm φ 0.010 in opaque object			2 m 6.562 ft	R1 mm R0.039 in	FT-WA8		
	300 11.811	90 3.543								
Side sensing W5 × H15 × D15 W0.197 × H0.591 × D0.591	3,000 118.110	350 13.780	Horizontal: φ 0.025 mm φ 0.0010 in opaque object Vertical: φ 0.45 mm φ 0.018 in opaque object	2 m 6.562 ft			R10 mm R0.394 in	FT-A8		
	2,000 78.740	100 3.937								
Side sensing W5 × H15 × D15 W0.197 × H0.591 × D0.591	850 33.465	220 8.661	R25 mm R0.984 in		2 m 6.562 ft		R25 mm R0.984 in	FT-AFM2		
	650 25.591	100 3.937								
Side sensing W5 × H15 × D15 W0.197 × H0.591 × D0.591	380 14.961	115 4.528	R25 mm R0.984 in			2 m 6.562 ft	R25 mm R0.984 in	FT-AFM2E		
	330 12.992	115 4.528								

- Notes: 1) Refer to p.27 for the sensing ranges for the FX-301-HS in H-SP mode and for the FX-301B/G/H.
 2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
 3) The minimum sensing object size is the value for red LED type. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type.
 The optimum condition is the condition when the sensitivity is set so that the sensing output just changes to light incident operation in the object absent condition.
 4) The fiber cable length practically limits the sensing range to 3,500 mm 137.795 in long.

LIST OF FIBERS

FX-305 / FX-301 (Red LED type) sensing range (Note 1)

Thru-beam type (one pair set)



The FX-305 and FX-301(-HS) have different sensing modes.
 FX-305: H-SP, FAST, STD, STDF, LONG, U-LG (no S-D mode)
 FX-301(-HS): S-D, H-SP, FAST, STD, LONG (no STDF or U-LG mode)

Type	Shape of fiber head (mm in)	Sensing range (mm in)(Note 2)	■ : U-LG ■ : LONG ■ : STDF ■ : STD ■ : FAST ■ : H-SP ■ : S-D	Min. sensing object (Note 3)	Fiber cable length Free-cut	Bending radius	Model No.		
Heat-resistant	350 °C 662 °F Lens mountable 		■ 750 29.528 ■ 550 21.654 ■ 330 12.992 ■ 280 11.024	■ 200 7.874 ■ 85 3.346 ■ 90 3.543	φ0.04 mm φ0.0016 in opaque object	2 m 6.562 ft	R25 mm R0.984 in	FT-H35-M2	
			■ 420 16.535 ■ 310 12.205 ■ 180 7.087 ■ 140 5.512	■ 100 3.937 ■ 40 1.575 ■ 50 1.969	φ0.02mm φ0.0008 in opaque object	1 m 3.281 ft	R10 mm R0.394 in	FT-H35-M2S6	
	200 °C 392 °F Lens mountable 		■ 750 29.528 ■ 550 21.654 ■ 320 12.598 ■ 280 11.024	■ 200 7.874 ■ 85 3.346 ■ 90 3.543	φ0.04 mm φ0.0016 in opaque object	1 m 3.281 ft	R25 mm R0.984 in	FT-H20-M1	
			■ 1,200 47.244 ■ 880 34.646 ■ 550 21.654 ■ 440 17.323	■ 300 11.811 ■ 150 5.906 ■ 155 6.102	φ0.06 mm φ0.0024 in opaque object	2 m 6.562 ft		FT-H13-FM2	
	Special	Lens mountable (FX-LE1) 		■ 530 20.866 ■ 390 15.354 ■ 225 8.858 ■ 200 7.874	■ 140 5.512 ■ 60 2.362 ■ 60 2.362	φ0.12 mm φ0.005 in opaque object	200 mm 7.874 in (Note 4) 300 mm 11.811 in (Note 4) 500 mm 19.685 in (Note 4)	Heat-resistant fiber R18 mm R0.709 in (Note 5)	FT-H20-J20-S (Note 6)
				■ 840 33.071 ■ 550 21.654 ■ 370 14.567 ■ 280 11.024	■ 200 7.874 ■ 90 3.543 ■ 90 3.543	φ0.16 mm φ0.006 in opaque object	500 mm 19.685 in (Note 4) 800 mm 31.496 in (Note 4)		FT-H20-J30-S (Note 6)
			■ 3,500 137.795 ■ 3,500 137.795 ■ 3,000 118.110 ■ 1,500 59.055	■ 1,000 39.370 ■ 500 19.685 ■ 530 20.866	φ4 mm φ0.157 in opaque object	2 m 6.562 ft	FT-H20-J50-S (Note 6)		
Side-view 			■ 1,000 39.370 ■ 800 31.496 ■ 500 19.685 ■ 400 15.748	■ 280 11.024 ■ 120 4.724 ■ 140 5.512	φ0.2 mm φ0.008 in opaque object	2 m 6.562 ft (Note 7)		FT-H20-VJ50-S (Note 6)	
			■ 3,500 137.795 ■ 3,500 137.795 ■ 2,000 78.740 ■ 1,500 59.055	■ 1,000 39.370 ■ 500 19.685 ■ 530 20.866	φ0.2 mm φ0.008 in opaque object	2 m 6.562 ft (Note 7)		FT-H20-VJ80-S (Note 6)	
Chemical-resistant	Easy mounting - Rectangular head SEMI S2 compliant W7 × H15 × D13 W0.276 × H0.591 × D0.512 		■ 3,500 137.795 ■ 3,500 137.795 ■ 3,000 118.110 ■ 1,500 59.055	■ 1,000 39.370 ■ 500 19.685 ■ 530 20.866	φ4 mm φ0.157 in opaque object	2 m 6.562 ft	R25 mm R0.984 in	FT-Z802Y	
			■ 3,500 137.795 ■ 3,500 137.795 ■ 2,000 78.740 ■ 1,500 59.055	■ 1,000 39.370 ■ 500 19.685 ■ 530 20.866	φ0.2 mm φ0.008 in opaque object	2 m 6.562 ft (Note 7)	R30 mm R1.181 in	FT-L80Y	
	Side-view 		■ 1,000 39.370 ■ 800 31.496 ■ 500 19.685 ■ 400 15.748	■ 280 11.024 ■ 120 4.724 ■ 140 5.512	φ0.2 mm φ0.008 in opaque object	2 m 6.562 ft (Note 7)		FT-V80Y	
Vacuum-resistant	300 °C 572 °F Lens mountable (FV-LE1/SV2 only) 		■ 350 13.780 ■ 250 9.843 ■ 150 5.906 ■ 125 4.921	■ 90 3.543 ■ 50 1.969 ■ 40 1.575	φ0.03 mm φ0.0012 in opaque object	1 m 3.281 ft	R18 mm R0.709 in	FT-H30-M1V-S (Note 8)	

- Notes: 1) Please contact our office for the sensing ranges for the FX-301-HS in H-SP mode and for the FX-301B/G/H.
 2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
 3) The minimum sensing object size is the value for red LED type. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type.
 The optimum condition is the condition when the sensitivity is set so that the sensing output just changes to light incident operation in the object absent condition.
 4) This is the fiber length (fixed length) for heat-resistant fibers. The ordinary-temperature fibers are free-cut to 2 m 6.562 ft.
 5) The ordinary-temperature fiber is R25 mm R0.984 in or more.
 6) Heat-resistant joint fibers and ordinary-temperature fibers (FT-FM2) are sold as a set. Please refer to 'Heat-resistant joint fibers catalog' for details.
 7) The allowable cutting range is 500 mm 19.685 in from the end that the amplifier inserted.
 8) Sold as a set comprising vacuum type fiber + photo-terminal (FV-BR1) + fiber at atmospheric side (FT-J8). Please refer to 'Vacuum resistant fiber catalog' for details.

Model No. when ordering heat-resistant joint fibers individually as replacement parts

- FT-H20-J20 (one pair set)
- FT-H20-J30 (one pair set)
- FT-H20-J50 (one pair set)
- FT-H20-VJ50 (one pair set)
- FT-H20-VJ80 (one pair set)

Model No. when ordering vacuum-resistant fibers individually as replacement parts

- Vacuum-resistant fiber
- Photo-terminal
- Fiber at atmospheric side
- FT-H30-M1V (one pair set)
- FV-BR1 (one pair set)
- FT-J8 (one pair set)

LIST OF FIBERS

Pliable fibers (flexible and sharp bending fibers) are marked with light blue in the table.

FX-305 / FX-301 (Red LED type) sensing range (Note 1)

Retroreflective type



The FX-305 and FX-301 (-HS) have different sensing modes.
 FX-305: H-SP, FAST, STD, STDF, LONG, U-LG (no S-D mode)
 FX-301(-HS): S-D, H-SP, FAST, STD, LONG (no STDF or U-LG mode)

Type	Shape of fiber head (mm in)	Sensing range (mm in)(Note 2, 3)	Legend	Min. sensing object (Note 4)	Fiber cable length	Bending radius	Model No.
Sharp bending With polarizing filters	W9.5 X H5.2 X D15 W0.374 X H0.205 X D0.591 W30 X H30 X D0.5 W1.181 X H1.181 X D0.020	100 to 910 3.937 to 35.827 100 to 730 3.937 to 28.740 100 to 600 3.937 to 23.622 100 to 520 3.937 to 20.472	U-LG, LONG, STDF, STD, FAST, H-SP, S-D	φ 0.3 mm φ 0.012 in opaque object	2 m 6.562 ft	R1 mm R0.039 in	FR-WKZ11
Narrow beam Top sensing	W9.5 X H5.2 X D21 W0.374 X H0.205 X D0.827 W10.6 X H28 X D10.1 W0.417 X H1.102 X D0.398	200 7.874 200 7.874 200 7.874	FAST, H-SP, S-D	Horizontal: φ 5.5 mm φ 0.217 in opaque object Vertical: φ 0.06 mm φ 0.0024 in opaque object	2 m 6.562 ft	R10 mm R0.394 in	FR-KZ21 FR-KZ21E
Narrow beam Side sensing	W9.5 X H25 X D5.2 W0.374 X H0.984 X D0.205 W10.6 X H28 X D10.1 W0.417 X H1.102 X D0.398	200 7.874 200 7.874	FAST, H-SP, S-D	Horizontal: φ 5.5 mm φ 0.217 in opaque object Vertical: φ 0.06 mm φ 0.0024 in opaque object	2 m 6.562 ft	R10 mm R0.394 in	FR-KZ21E
Wafer mapping	W7.5 X H2.2 X D11.2 W0.295 X H0.087 X D0.441 W4 X H2 X D21.5 W0.157 X H0.079 X D0.846	15 to 370 0.591 to 14.567 15 to 330 0.591 to 12.992 15 to 240 0.591 to 9.449 15 to 210 0.591 to 8.268	FAST, H-SP, S-D	φ 0.12 mm φ 0.005 in opaque object	2 m 6.562 ft	R10 mm R0.394 in	FR-KV1

- Notes: 1) Please contact our office for the sensing ranges for the FX-301-HS in H-SP mode and for the FX-301B/G/H.
 2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut. The sensing range of FR-WKZ11 is specified for the RF-13. The sensing range of FR-KZ21, FR-KZ21E and FR-KV1 is specified for the attached reflector.
 3) The sensing range of FR-WKZ11 is the possible setting range for the reflector or reflective tape. The fiber can detect an object less than 100 mm 3.937 in away. However, note that if there are any white or highly-reflective surfaces near the fiber head, reflected incident light may affect the fiber head. If this occurs, adjust the threshold value of the amplifier unit before use. The sensing range of FR-KZ21(E) is the possible setting range for the reflector. However, if setting the fiber to detect objects passing within 0 to 20 mm 0 to 0.787 in from the fiber head, unstable detection may result. The sensing range of FR-KV1 is the possible setting range for the reflector. The fiber can detect an object less than 15 mm 0.591 in away.
 4) The minimum sensing object size is the value for red LED type. The optimum condition is the condition when the sensitivity is set so that the sensing output just changes to light incident operation in the object absent condition.

FX-305 / FX-301 (Red LED type) sensing range (Note 1)

Reflective type



The FX-305 and FX-301 (-HS) have different sensing modes.
 FX-305: H-SP, FAST, STD, STDF, LONG, U-LG (no S-D mode)
 FX-301(-HS): S-D, H-SP, FAST, STD, LONG (no STDF or U-LG mode)

Type	Shape of fiber head (mm in)	Sensing range (mm in)(Note 2, 3)	Legend	Min. sensing object (Note 4)	Fiber cable length	Bending radius	Model No.	
Threaded type M6	M6	600 23.622 480 18.898 280 11.024 220 8.661	FAST, H-SP, S-D	φ 0.02 mm φ 0.0008 in gold wire	2 m 6.562 ft	R25 mm R0.984 in	FD-B8	
	Coaxial M6	410 16.142 310 12.205 200 7.874 140 5.512	FAST, H-SP, S-D				FD-FM2	
	Sleeve 90 mm 3.543 in M6 φ 2.5 φ 0.098	370 14.567 270 10.630	FAST, H-SP, S-D				Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in	FD-FM2S
	Sleeve 40 mm 1.575 in M6 φ 2.5 φ 0.098	170 6.693 110 4.331	FAST, H-SP, S-D				FD-FM2S4	
	M6	250 9.843 190 7.480 110 4.331 90 3.543	FAST, H-SP, S-D			R1 mm R0.039 in	FD-W8	
	M6	300 11.811 220 8.661 130 5.118 100 3.937	FAST, H-SP, S-D			R4 mm R0.157 in Flexible	FD-P80	
	M6	270 10.630 185 7.283 100 3.937 80 3.150	FAST, H-SP, S-D			1 m 3.281 ft	FD-P81X	
	Elbow M6	240 9.449 185 7.283 110 4.331 85 3.346	FAST, H-SP, S-D			φ 0.02 mm φ 0.0008 in gold wire	2 m 6.562 ft	R25 mm R0.984 in

- Notes: 1) Refer to p.27 for the sensing ranges for the FX-301-HS in H-SP mode and for the FX-301B/G/H.
 2) The sensing range is specified for white non-glossy paper [400 × 400 mm 15.748 × 15.748 in] as the object.
 3) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
 4) The minimum sensing object size is the value for red LED type at maximum sensitivity. Note that the corresponding setting distance is different from the rated sensing distance.




LIST OF FIBERS

Pliable fibers (flexible and sharp bending fibers) are marked with light blue in the table.

FX-305 / FX-301 (Red LED type) sensing range (Note 1)

Reflective type 

The FX-305 and FX-301(-HS) have different sensing modes.
 FX-305: H-SP, FAST, STD, STDF, LONG, U-LG (no S-D mode)
 FX-301(-HS): S-D, H-SP, FAST, STD, LONG (no STDF or U-LG mode)

Type	Shape of fiber head (mm in)	Sensing range (mm in)(Note 2, 3)	■ : U-LG ■ : FAST ■ : LONG ■ : H-SP ■ : STDF ■ : S-D ■ : STD	Min. sensing object (Note 4)	Fiber cable length  Free-cut	Bending radius	Model No.		
Threaded type	M4	370 14.567 270 10.630 170 6.693 110 4.331	85 3.346 45 1.772 39 1.535	ϕ 0.02 mm ϕ 0.0008 in gold wire	 Free-cut 2 m 6.562 ft	R25 mm R0.984 in	FD-T80		
	M4					R25 mm R0.984 in	FD-NFM2		
	Sleeve 90 mm 3.543 in M4	140 5.512 90 3.543 60 2.362 45 1.772	35 1.378 16 0.630 16 0.630			Fiber R25 mm R0.984 in	FD-NFM2S		
	Sleeve 40 mm 1.575 in M4					Sleeve R10 mm R0.394 in	FD-NFM2S4		
	Sleeve 40 mm 1.575 in M4	40 1.575 30 1.181 18 0.709 15 0.591	12 0.472 4.5 0.177 5 0.197			Fiber R1 mm R0.039 in Sleeve R10 mm R0.394 in	FD-W44		
	M4	250 9.843 190 7.480 110 4.331 90 3.543	60 2.362 25 0.984 32 1.260			R1 mm R0.039 in	FD-WT8		
	Coaxial · Lens mountable M4	85 3.346 65 2.559 37 1.457 32 1.260	25 0.984 10 0.394 11 0.433			R2 mm R0.079 in	FD-WG4		
	M4	150 5.906 110 4.331 65 2.559 55 2.165	42 1.654 15 0.591 19 0.748			R25 mm R0.984 in	FD-G4		
	M4	130 5.118 90 3.543 55 2.165 45 1.772	30 1.181 13 0.512 16 0.630			R4 mm R0.157 in Flexible	FD-P60		
	Threaded type	Small diameter M3	140 5.512 90 3.543 60 2.362 45 1.772			35 1.378 16 0.630 16 0.630	ϕ 0.02 mm ϕ 0.0008 in gold wire	 Free-cut 2 m 6.562 ft	R25 mm R0.984 in
M3		40 1.575 30 1.181 18 0.709 15 0.591	12 0.472 4.5 0.177 5 0.197	R1 mm R0.039 in	FD-WT4				
M3		50 1.969 36 1.417 20 0.787 18 0.709	14 0.551 5.5 0.217 6 0.236	R4 mm R0.157 in Flexible	FD-P40				
Lens mountable (FX-MR3, FX-MR6) M3		150 5.906 110 4.331 65 2.559 55 2.165	42 1.654 15 0.591 19 0.748	R25 mm R0.984 in	FD-G6				
Coaxial									
Lens mountable (FX-MR3, FX-MR6) M3		150 5.906 90 3.543 48 1.890 45 1.772	35 1.378 12 0.472 20 0.787	R10 mm R0.394 in	FD-G6X				
Coaxial Tough flexible									
Coaxial · Lens mountable (FX-MR3, FX-MR6) M3		50 1.969 38 1.496 25 0.984 18 0.709	14 0.551 5 0.197 6 0.236	R25 mm R0.984 in	FD-EG1				
High precision									
Coaxial · Lens mountable (FX-MR3, FX-MR6) M3		40 1.575 Light emitting fiber element 25 0.984 14 0.551 High precision ϕ 0.175 ϕ 0.007 12 0.472	9 0.354 3 0.118 5 0.197	ϕ 0.04 mm ϕ 0.0016 in gold wire	500 mm 19.685 in	FD-EG2			
Coaxial · Lens mountable (FX-MR3, FX-MR6) M3		Light emitting fiber element 15 0.591 9 0.354 High precision ϕ 0.125 ϕ 0.005 8 0.315	5 0.197 2.5 0.098 3 0.118			FD-EG3			
M3		6.5 0.256 5 0.197 3 0.118 Sleeve part cannot be bent.	2 0.079 Cannot use Cannot use	ϕ 0.02 mm ϕ 0.0008 in gold wire		R25 mm R0.984 in			FD-EN500S1
Coaxial M3		50 1.969 38 1.496 20 0.787 18 0.709 Sleeve part cannot be bent.	14 0.551 5 0.197 6 0.236			1 m 3.281 ft			FD-ENM1S1

- Notes: 1) Refer to p.27 for the sensing ranges for the FX-301-HS in H-SP mode and for the FX-301B/G/H.
 2) The sensing range is specified for white non-glossy paper [200×200 mm 7.874×7.874 in (FD-T80, FD-WT8: 400×400 mm 15.748×15.748 in, FD-W44, FD-WT4, FD-P40, FD-G6, FD-EG1, FD-EG2, FD-EG3, FD-EN500S1, FD-ENM1S1: 100×100 mm 3.937×3.937 in)] as the object.
 3) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
 4) The minimum sensing object size is the value for red LED type at maximum sensitivity.
 Note that the corresponding setting distance is different from the rated sensing distance.
 5) The allowable cutting range is 700 mm 27.559 in from the end that the amplifier inserted.

LIST OF FIBERS

Pliable fibers (flexible and sharp bending fibers) are marked with light blue in the table.

FX-305 / FX-301 (Red LED type) sensing range (Note 1)

Reflective type



The FX-305 and FX-301(-HS) have different sensing modes.
 FX-305: H-SP, FAST, STD, STDF, LONG, U-LG (no S-D mode)
 FX-301(-HS): S-D, H-SP, FAST, STD, LONG (no STDF or U-LG mode)

Type	Shape of fiber head (mm in)	Sensing range (mm in)(Note 2, 3)	Min. sensing object (Note 4)	Fiber cable length Free-cut	Bending radius	Model No.		
Cylindrical type	φ3 φ0.118	370 14.567 270 10.630 170 6.693 110 4.331	85 3.346 45 1.772 39 1.535	φ0.02 mm φ0.0008 in gold wire	2 m 6.562 ft	R25 mm R0.984 in	FD-S80	
		250 9.843 190 7.480 110 4.331 90 3.543	60 2.362 25 0.984 32 1.260			R1 mm R0.039 in	FD-WS8	
		85 3.346 65 2.559 37 1.457 32 1.260	25 0.984 10 0.394 11 0.433			R2 mm R0.079 in	FD-WSG4	
		130 5.118 90 3.543 55 2.165 45 1.772	30 1.181 13 0.512 16 0.630			R4 mm R0.157 in	FD-P50	
		Flexible						
	φ2.5 φ0.098	140 5.512 90 3.543 60 2.362 45 1.772	35 1.378 16 0.630 16 0.630	φ0.02 mm φ0.0008 in gold wire	2 m 6.562 ft	R25 mm R0.984 in	FD-SNFM2	
	φ1.5 φ0.059	80 3.150 50 1.969 30 1.181 25 0.984	19 0.748 7.5 0.295 9 0.354	φ0.02 mm φ0.0008 in gold wire	1 m 3.281 ft	R4 mm R0.157 in	FD-P2	
	Ultra-small diameter	φ1.5 φ0.5 φ0.059 φ0.020	15 0.591 11 0.433 8 0.315 6 0.236	4 0.157 2 0.079 1 0.039	φ0.02 mm φ0.0008 in gold wire	1 m 3.281 ft	R10 mm R0.394 in	FD-E12
		Sleeve part cannot be bent.						
		Coaxial φ3 φ0.118	65 2.559 45 1.772 28 1.102 23 0.906	17 0.669 8 0.315 7 0.276			φ0.02 mm φ0.0008 in gold wire	R25 mm R0.984 in
Sleeve part cannot be bent.								
Side-view	Small diameter φ1.5 φ0.059	80 3.150 55 2.165 30 1.181 25 0.984	17 0.669 8 0.315 9 0.354	φ0.02 mm φ0.0008 in gold wire	2 m 6.562 ft	R25 mm R0.984 in	FD-V41	
	φ3 φ0.118	20 0.787 15 0.591 8.5 0.335 7 0.276	5 0.197 Cannot use Cannot use			R1 mm R0.039 in	FD-WV42	
	Sleeve part cannot be bent.							
	φ5 φ2 φ0.197 φ0.079	170 6.693 100 3.937 55 2.165 45 1.772	32 1.260 15 0.591 16 0.630			R25 mm R0.984 in	FD-SFM2SV2	
Rectangular	Glass substrate detection · Mapping W25 × H7.3 × D30 W0.984 × H0.287 × D1.181	12 to 50 0.472 to 1.969 12.5 to 37.5 0.492 to 1.476 15 to 36 0.591 to 1.417 15 to 35 0.591 to 1.378	16 to 29 0.630 to 1.142 Cannot use Cannot use	φ0.3 mm φ0.012 in gold wire	4 m 13.123 ft	R25 mm R0.984 in	FD-L46	
		0 to 50 0 to 1.969 0 to 36 0 to 1.417 0 to 33 0 to 1.299 0 to 30 0 to 1.181	0 to 30 0 to 1.181 0 to 15 0 to 0.591 0 to 21 0 to 0.827			(LCD glass)	R25 mm R0.984 in	FD-L45
	Glass substrate detection · Alignment W20 × H29 × D3.8 W0.787 × H1.142 × D0.157	0 to 23 0 to 0.906			φ0.03 mm φ0.0012 in gold wire	2 m 6.562 ft	R4 mm R0.157 in	FD-L43
		0 to 8.2 0 to 0.323 0 to 7 0 to 0.276 0 to 6.5 0 to 0.256 0 to 6 0 to 0.236	0 to 5.7 0 to 0.224 0 to 5 0 to 0.197 0 to 5.2 0 to 0.205				FD-L44	
	Glass substrate detection · Seating W12 × H19 × D3 W0.472 × H0.748 × D0.118	0 to 4.7 0 to 0.185 0 to 4.5 0 to 0.177 0 to 4 0 to 0.157 0 to 4 0 to 0.157	0 to 3.8 0 to 0.150 0 to 3 0 to 0.118 0 to 3.5 0 to 0.138		φ0.06 mm φ0.024 in gold wire	2 m 6.562 ft	R10 mm R0.394 in	FD-L44S
		6.5 to 14.5 0.256 to 0.571 (Convergent point 8 0.315) 6.5 to 14 0.256 to 0.551 (Convergent point 8 0.315) 7 to 14 0.276 to 0.551 (Convergent point 8 0.315) 7 to 12 0.276 to 0.472 (Convergent point 8 0.315)	Cannot use Cannot use Cannot use	φ1.9 mm φ0.075 in metal pipe (gray)			R1 mm R0.039 in	FD-WL41
	Convergent reflective type	W24 × H21 × D4 W0.945 × H0.827 × D0.157	2 to 19 0.079 to 0.748 (Convergent point 8 0.315) 2.5 to 18 0.098 to 0.709 (Convergent point 8 0.315) 3 to 16 0.118 to 0.630 (Convergent point 8 0.315) 3 to 16 0.118 to 0.630 (Convergent point 8 0.315)	3.5 to 15 0.138 to 0.591 (Convergent point 8 0.315) Cannot use Cannot use	φ0.02 mm φ0.0008 in gold wire	2 m 6.562 ft	R10 mm R0.394 in	FD-L41
			2 to 20 0.079 to 0.787 (Convergent point 6 0.236) 2.5 to 18 0.098 to 0.709 (Convergent point 6 0.236) 4 to 12 0.157 to 0.472 (Convergent point 6 0.236) 4 to 12 0.157 to 0.472 (Convergent point 6 0.236)	4.5 to 11 0.177 to 0.433 (Convergent point 6 0.236) 1.5 to 8.5 0.197 to 0.335 (Convergent point 6 0.236) 1.8 to 9.5 0.189 to 0.374 (Convergent point 6 0.236)				FD-L4
		W7.2 × H7.5 × D2 W0.283 × H0.295 × D0.079	0.5 to 8.5 0.020 to 0.335 0.5 to 7.5 0.020 to 0.295 1 to 6.5 0.039 to 0.256 1 to 5.5 0.039 to 0.217	1 to 5 0.039 to 0.197 Cannot use Cannot use			φ0.3 mm φ0.012 in copper wire	1 m 3.281 ft

- Notes: 1) Refer to p.27 for the sensing ranges for the FX-301-HS in H-SP mode and for the FX-301B/G/H.
 2) The sensing range is specified for white non-glossy paper (FD-S80, FD-WS8: 400 × 400 mm 15.748 × 15.748 in, FD-WSG4, FD-P50, FD-SNFM2, FD-V41, FD-SFM2SV2: 200 × 200 mm 7.874 × 7.874 in, FD-P2, FD-E12, FD-E22, FD-WV42, FD-L4, FD-WL48: 100 × 100 mm 3.937 × 3.937 in, FD-L46: 100 × 100 × t 0.7 mm 3.937 × 3.937 × t 0.028 in R edge of LCD glass substrates, FD-L43, FD-L44 and FD-L45: 100 × 100 × t 0.7 mm 3.937 × 3.937 × t 0.028 in LCD glass substrates, FD-L44S: silicon wafers polished surface, FD-WL41, FD-L41: 100 × 100 × t 2 mm 3.937 × 3.937 × t 0.079 in glass substrates).
 3) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
 4) The minimum sensing object size is the value for red LED type at maximum sensitivity. Note that the corresponding setting distance is different from the rated sensing distance. However, with the convergent reflective type, when the sensitivity is at MAX., it is only possible to detect the minimum size of the sensing object at a distance corresponding to the convergent point.