

# **APPENDIX D**

---

## **SUNX** **FIBER OPTIC LIQUID LEVEL SENSORS**





PHOTOELECTRIC SENSOR

## DIGITAL FIBER SENSOR

FX-300 SERIES



Conforming to  
EMC Directive



UL Recognition

Constant advances achieving the highest  
level of performance in its class



APPENDIX D

# 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)

APPENDIX D

High-function

To high-speed

High-function type  
FX-305

Standard type  
FX-301

Ultra high-speed type  
FX-301-HS

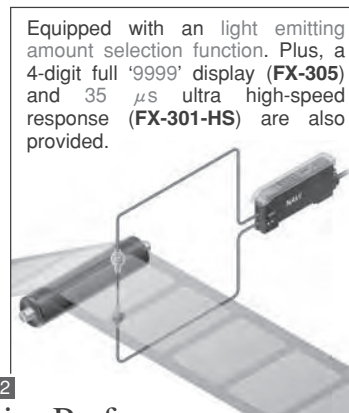
35  $\mu$ s



APC circuit has been added, in addition to the four-chemical emitting element.

Concept 1

High Stability



Equipped with an light emitting amount selection function. Plus, a 4-digit full '9999' display (FX-305) and 35  $\mu$ S ultra high-speed response (FX-301-HS) are also provided.

Concept 2

Superior Performance



Concept 5

Eco-friendly

Lead-free solder used is gentle on the environment.

Concept 3

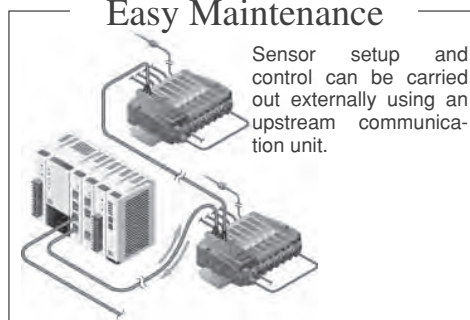
Easy operation

Only two switches, the large MODE key and the large jog switch, are required for operation.

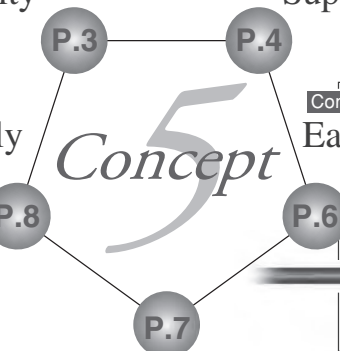


Concept 4

Easy Maintenance



Sensor setup and control can be carried out externally using an upstream communication unit.



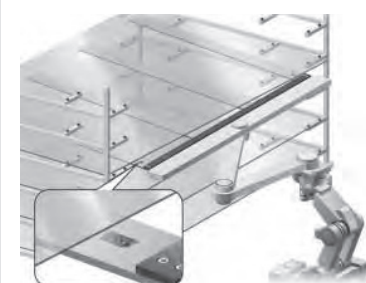
## Full range of fibers

Wide lineup

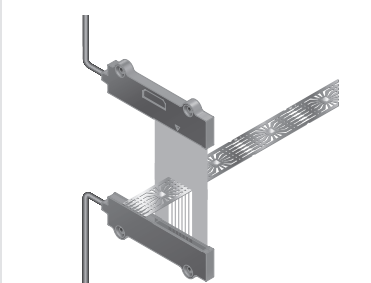
### P.9 Guide for each industry

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

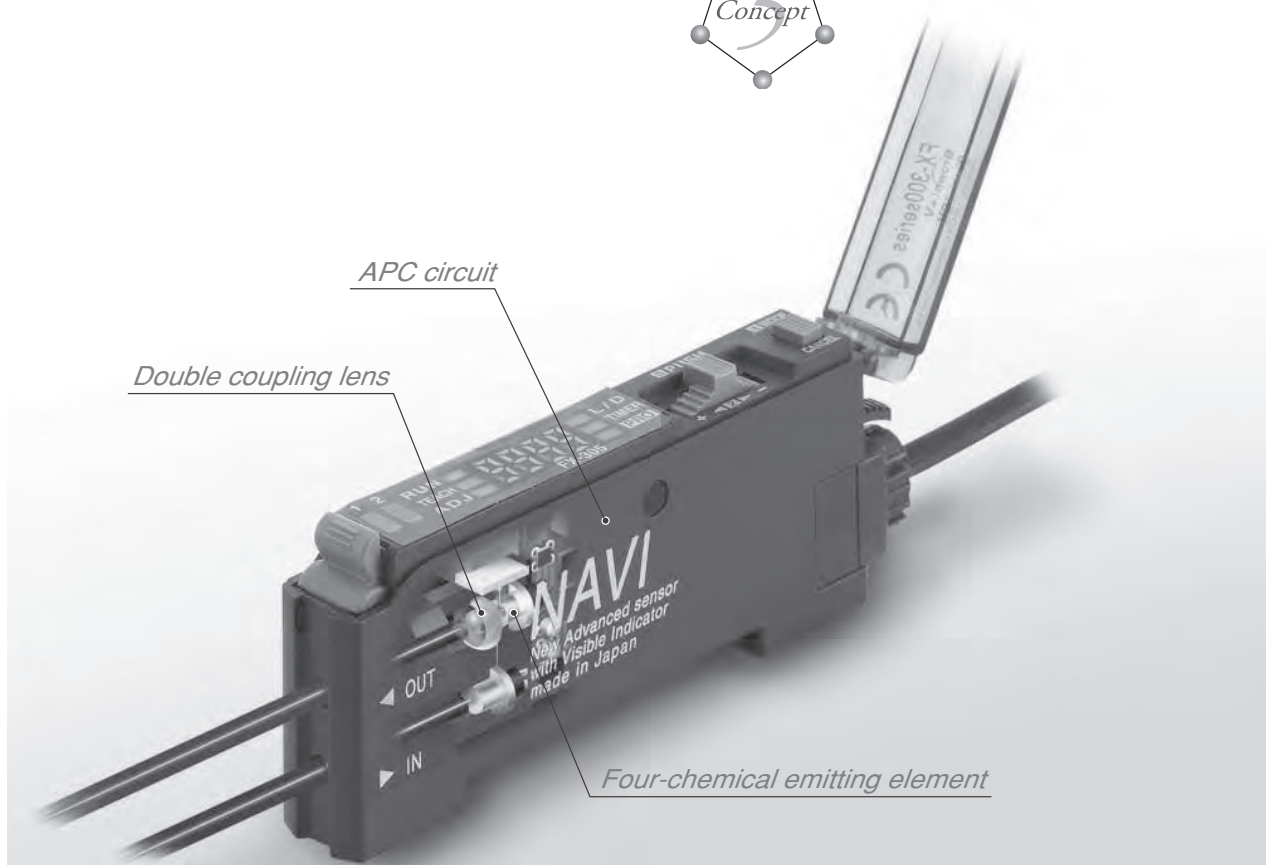
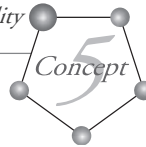


Pharmaceutical • Packaging / P.15



# High Stability

Concept 1  
High Stability



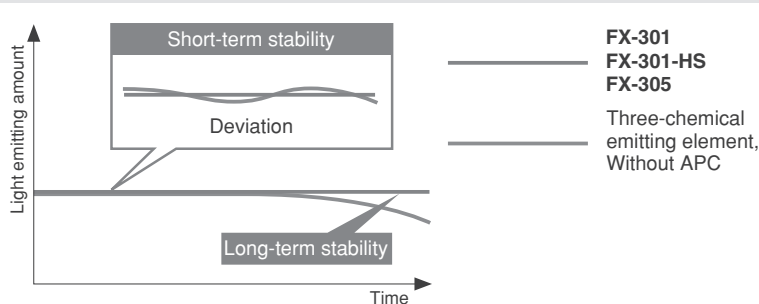
## Stable sensing over long and short periods

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

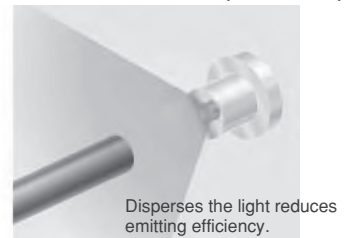


## Even greater sensing range

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)

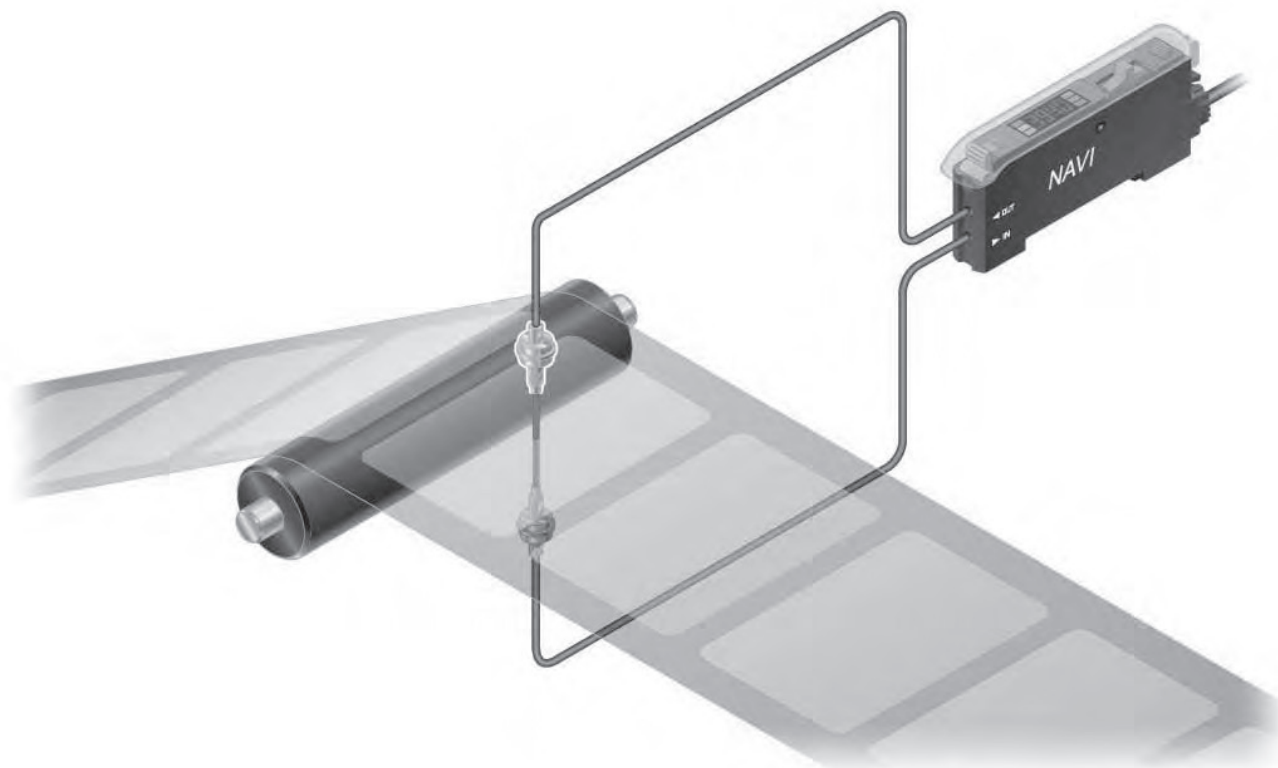
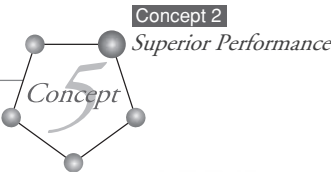


### Double coupling lens



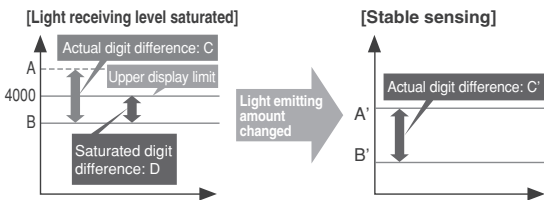


# Superior Performance

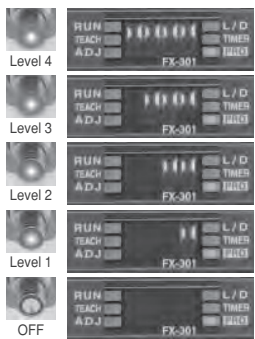


## Light-emitting amount selection

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

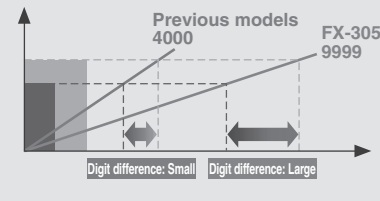
Large display with 4 digits (9999). With a greater difference in digit value than previous models, threshold values can be set in units of 1 digit up to maximum 9999. Threshold setting can now be done more easily and accurately.



(During STDF, LONG and U-LG modes)

### Digit difference comparison

Example Digit difference between object A and object B

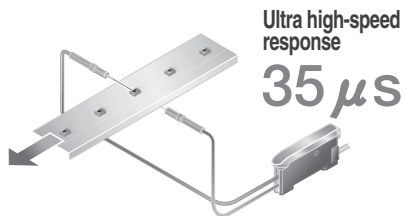


## Ultra high-speed 35 $\mu$ s response

4 times as fast as before

FX-301-HS

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



Ultra high-speed response  
35  $\mu$ s

### Ultra high-speed type FX-301-HS

(H-SP mode)

35  $\mu$ s

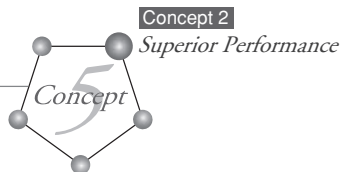
### Standard type FX-301, High-function type FX-305

(H-SP mode)

65  $\mu$ s

### Previous model

150  $\mu$ s



## 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>



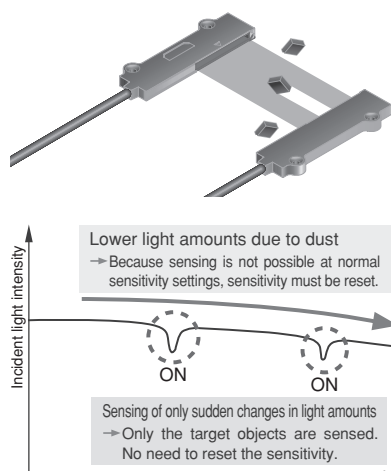
Tray absent	IC present	Tray present
OFF	ON	OFF

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>

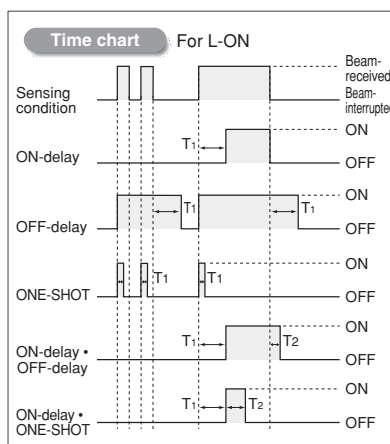


## Equipped with 5 types timers

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)

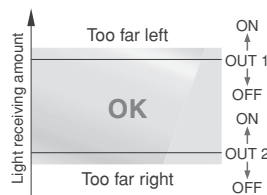


## Multi-purpose 2-output

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.



### • Comparison with previous models Example Sensing meandering of sheets

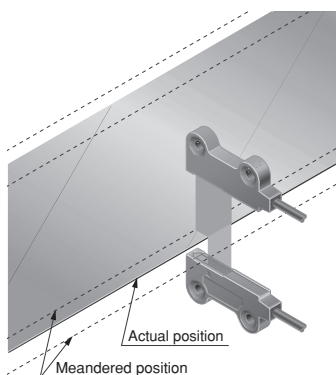


[Previous models]

2 sensors needed

[FX-305]

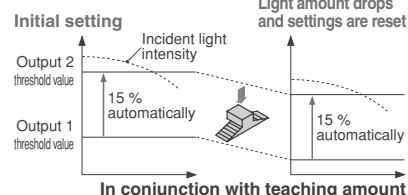
1 sensor is enough!



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

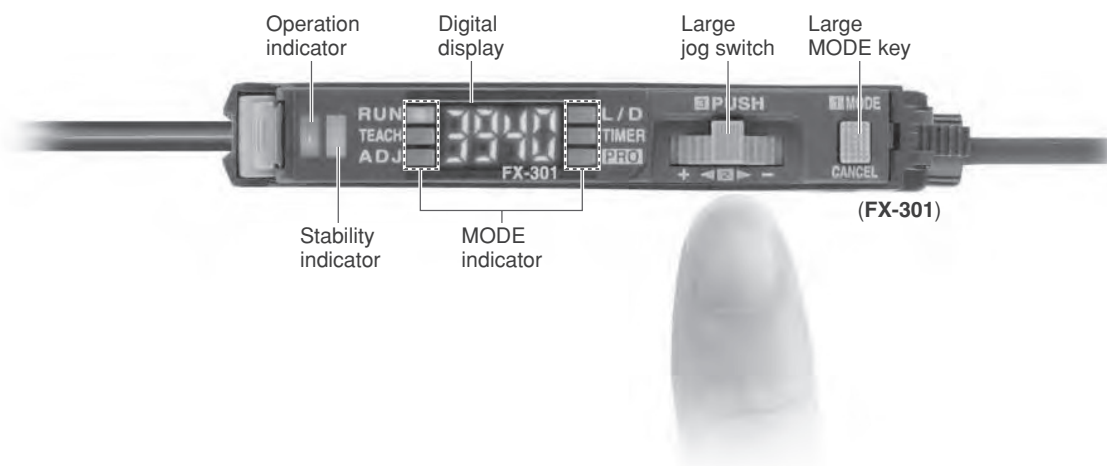
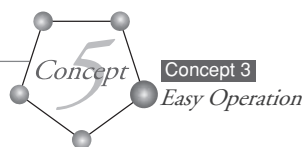
Drops in light amounts due to problems such as broken fibers or dirty tips are detected and output. When output 1 threshold value teaching is carried out with the **FX-305**, output 2 is set concurrently with the setting shifted by the amount of surplus.

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





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

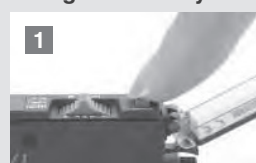


L/D	TIMER	PRO	<b>L/D ON→</b>	This mode allows the selection of output operation as either Light-ON or Dark-ON.
L/D	TIMER	PRO	<b>TIMER→</b>	This mode permits the choice of using or not using the timer.
L/D	TIMER	PRO	<b>PRO→</b>	This mode allows the selection of further advanced functions, such as the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

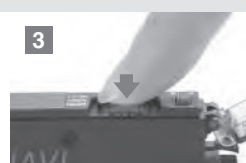


Pressing the switch selects or cancels the operating mode

### • Large jog switch



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



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.



Left: FX-301(-HS) Output 1 for FX-305 Right: Output 2 for FX-305



The threshold value is displayed

## 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.

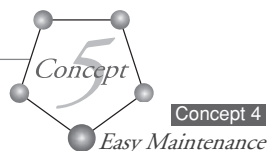


## Key lock function prevents accidental setting changes



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

# Easy Maintenance

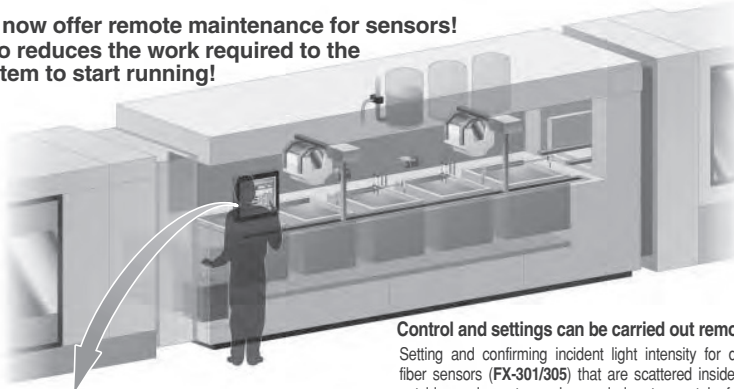


## Communication unit improves equipment starting up and maintenance upstream communication unit SC-GU1-485

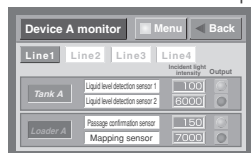
FX-301 FX-305

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!**



<Touch screen monitor example>



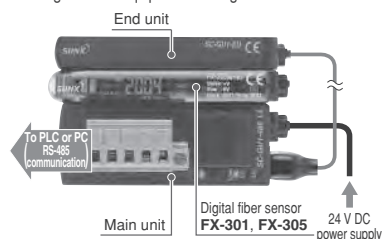
[Communicable commands]  
• Sensor incident light intensity  
• Sensor settings verification  
• Sensor output status  
• Threshold value settings, etc.

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

**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.



## 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.

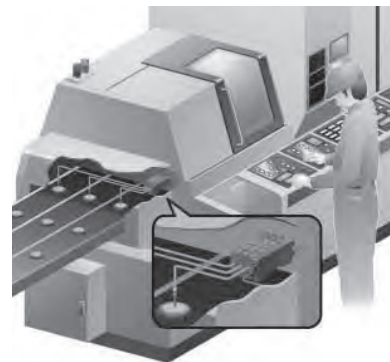
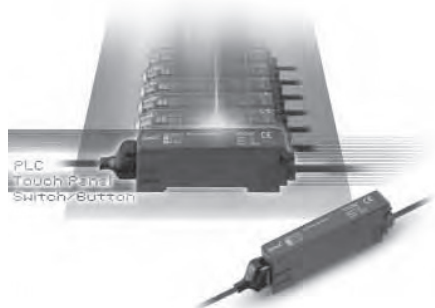
- Full-auto teaching
- Limit teaching '—'
- Limit teaching '+'
- 2-level teaching

#### 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)]

External input unit FX-CH2(-P)

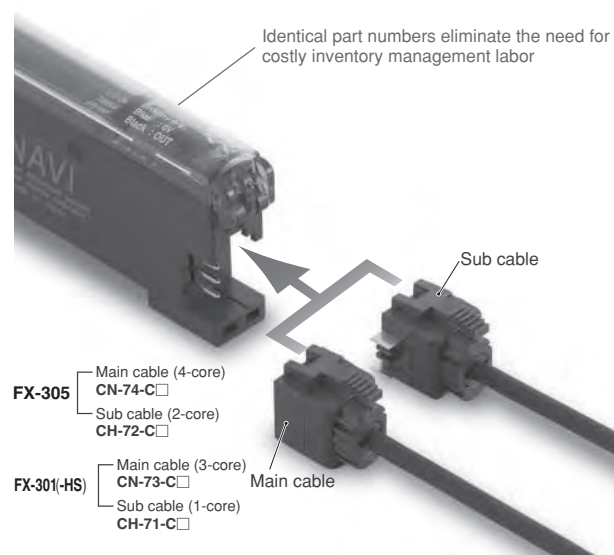


## Wiring- and labor-saving design allows side-by-side configuration for up to sixteen units

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

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

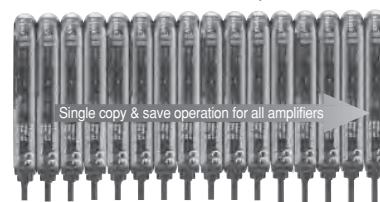
The amplifier unit can be used as either a main unit or a sub unit. This feature allows for easy mounting in the side-by-side configuration. The main and sub unit functions are distinguished only by the proper use of the main cable and the sub cable. Moreover, inventory management and maintenance is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



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

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

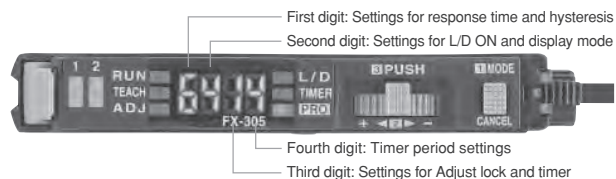
The optical communication function allows the data that is currently set to be copied and saved all at once for all amplifiers connected together from the right side. This greatly reduces troublesome setup tasks and makes setup much smoother. In addition, troublesome adjustment operations at times such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



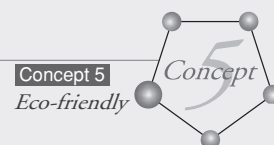
※ Use the optical communication function for only the same types of sensors. Furthermore, the FX-301-HS is not equipped with optical communication function capability. Refer to p. 30 for details.

## 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

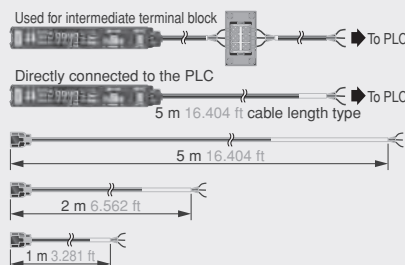


### Lead-free solder used is gentle on the environment ECO

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 ECO

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) ECO

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 ECO

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.

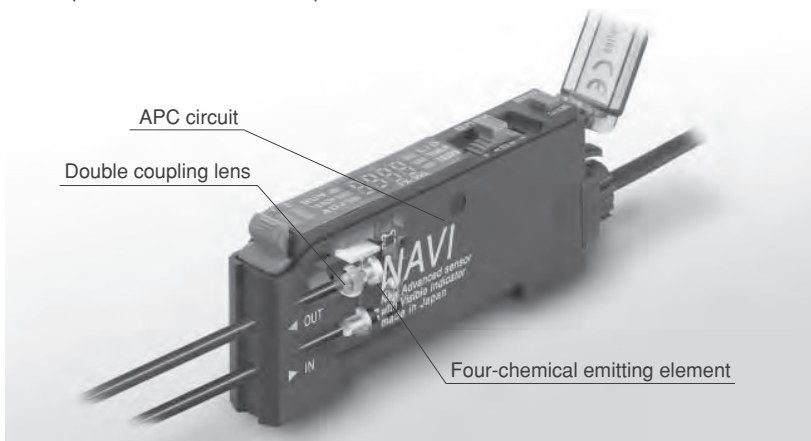
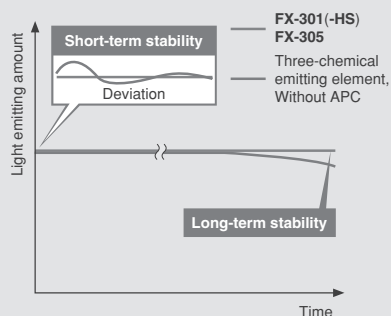


## Improved stability over long and short periods

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



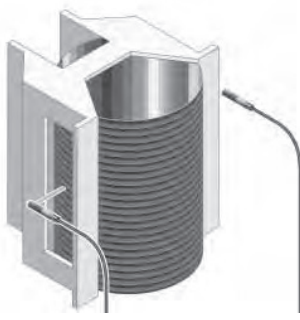
### Mapping fiber

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**  
 $W2 \times H1.5 \times D20 \text{ mm}$   $W0.079 \times H0.059 \times D0.787$  in ultra-compact size allows this sensor to be installed even in thin 200 mm 7.874 in wafer handlers.



**Aperture angle 2° FT-WKV8, 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

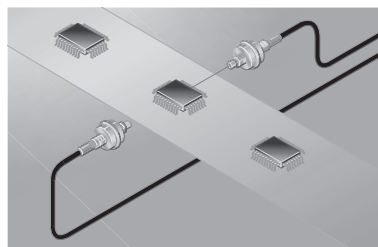
With a thickness of 2.3 mm 0.091 in, this fiber can be installed almost anywhere, and it is a retroreflective type so optical beam axis alignment is simple.

### 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.

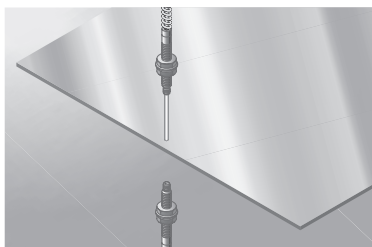
#### IC detection within a high temperature handler



### Flexible type FT-H20W-M2

Withstands temperatures of  $+200\text{ }^{\circ}\text{C}$   $+392\text{ }^{\circ}\text{F}$  and has a bending radius of 10 mm 0.394 in, this fiber can be installed almost anywhere.

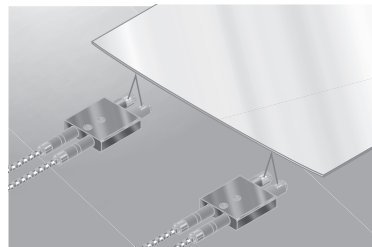
#### Glass substrate detection



### Heat-resistant 350 °C + 662 °F FD-H35-M2

Can be used in temperatures ranging from  $-60$  to  $+350\text{ }^{\circ}\text{C}$   $-76$  to  $+662\text{ }^{\circ}\text{F}$ . Stable sensing is obtained even at temperatures exceeding  $+300\text{ }^{\circ}\text{C}$   $+572\text{ }^{\circ}\text{F}$ .

#### Glass substrate detection



### Convergent reflective type FD-H30-L32, FD-H18-L31

Accurately senses glass substrates at high temperatures of  $+300\text{ }^{\circ}\text{C}$   $+572\text{ }^{\circ}\text{F}$ .



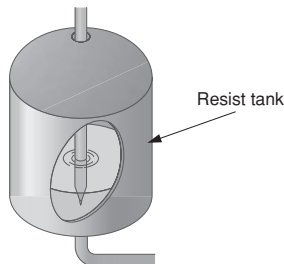
## Large display 9999

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)]

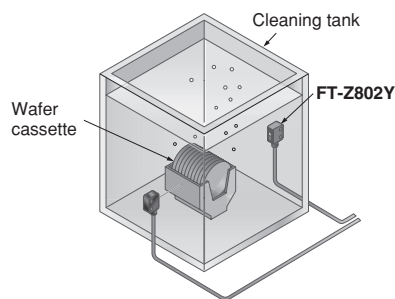
Previous display		FX-305	
<digit value> <Extra width>		<digit value> <Extra width>	
Liquid absent	500	Liquid absent	2000
Liquid present	40	Liquid present	160
460		1840	

**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.

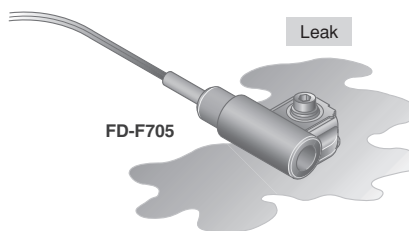
**Detecting wafer cassette in cleaning tank**



**Chemical-resistant fiber FT-Z802Y**

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

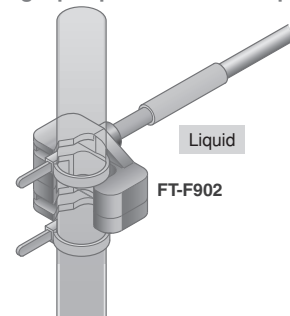
**Detecting leak liquid in cleaning tank (Note)**



**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**

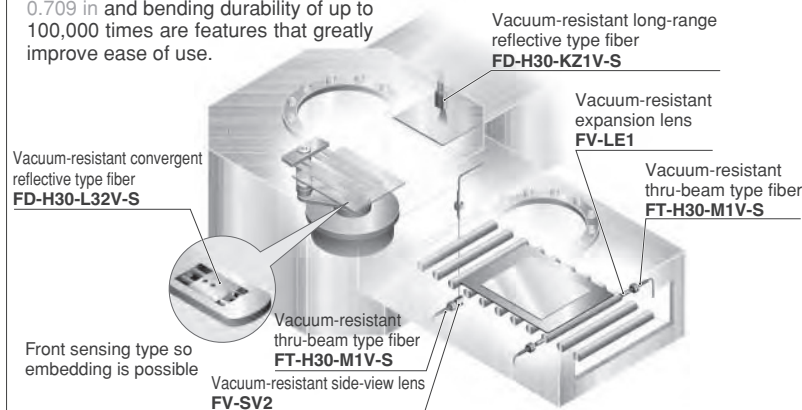
Even if pipe diameters and thicknesses vary, the center of the beam axis always follows a straight line along the pipe, so that the setup environment has almost no effect on sensing.

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

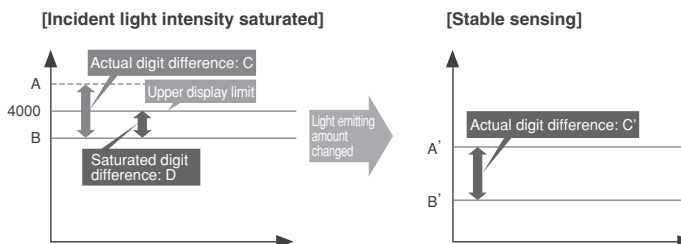
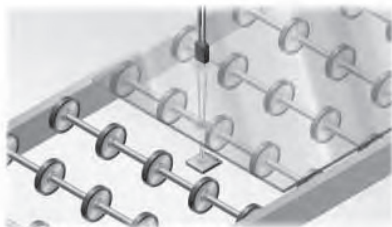
• Sensing range increased by 4 times or more

## 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



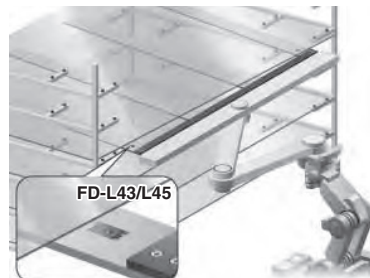
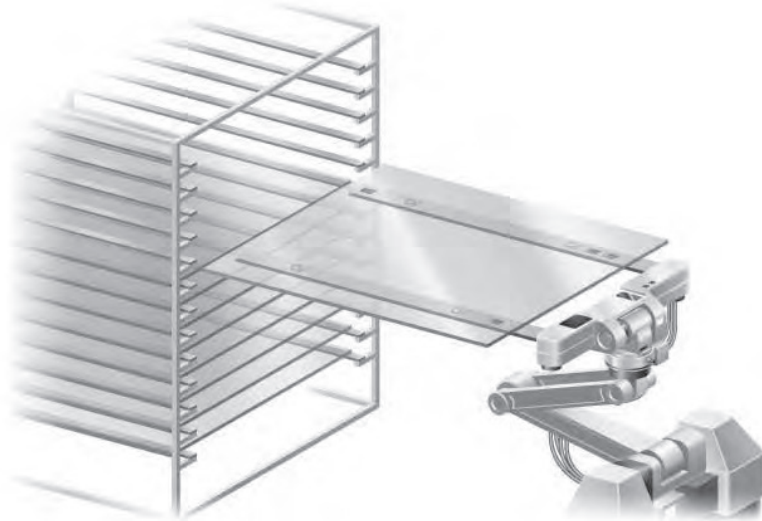
### Comparison of saturation remedies

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

### Fiber for glass substrate conveyor

### FD-L40 series, FR-WKZ11

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

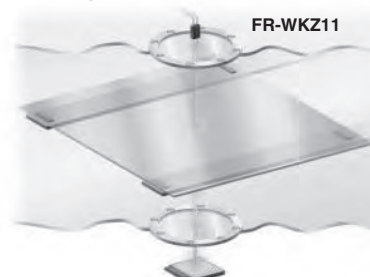


#### Alignment / Convergent reflective type FD-L43, FD-L45

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)

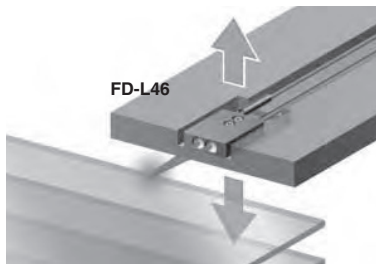
#### Sensing glass substrate through a view port



#### 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

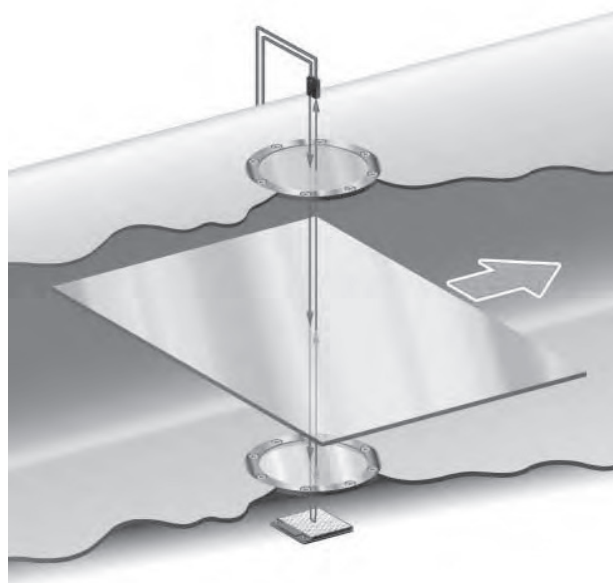
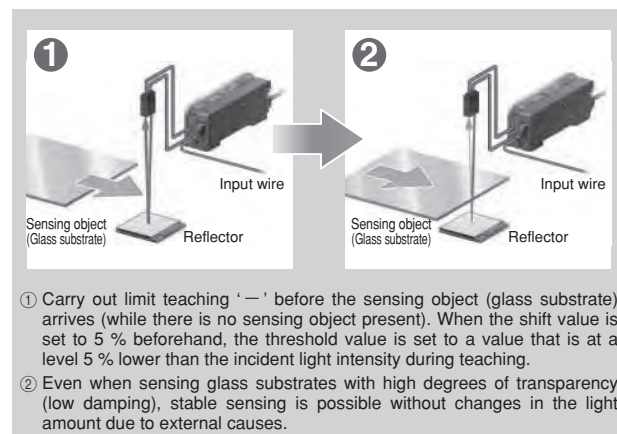
The **FX-CH2** external input unit (optional) can be used to carry out teaching and data bank switching operations externally without needing to operate the digital fiber sensors directly. This is ideal for locations such as clean rooms where entry and exit of personnel are restricted.

### ■ 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.



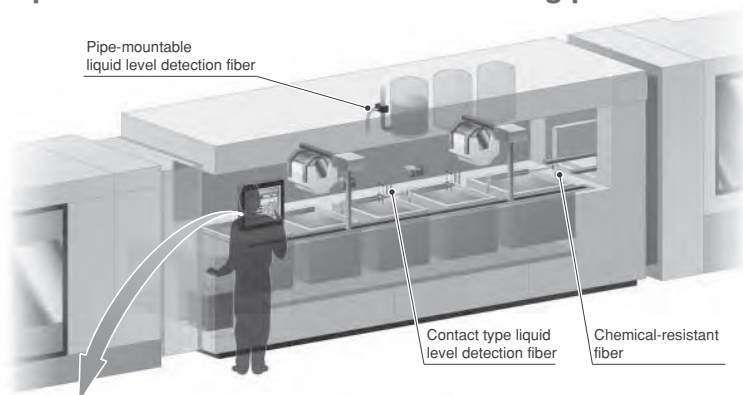
## Upstream communication for reading data and teaching are also possible

Upstream communication unit SC-GU1-485

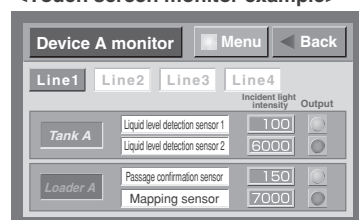
FX-301 FX-305

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



#### <Touch screen monitor example>



#### <Communicable commands>

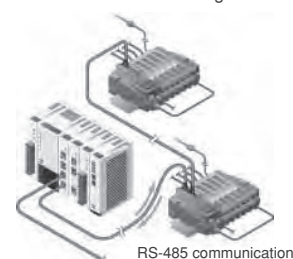
- Sensor incident light intensity
- Sensor settings verification
- Sensor output status
- Threshold value settings, etc.

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

### 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.

## High-speed response 35 $\mu$ s

FX-301-HS

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



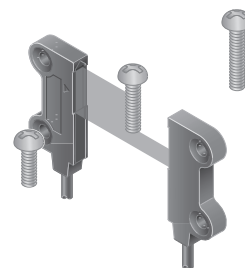
## Independent dual outputs

FX-305

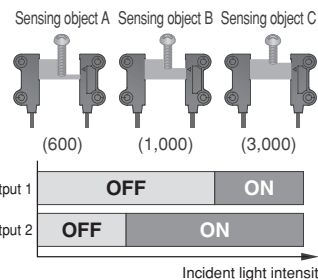
Two independent output channels are provided, so that one sensor can be used for control tasks that previously required two sensors. In addition, the second output channel can be used for alarm output and error output, so that ease of maintenance is improved.

### 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

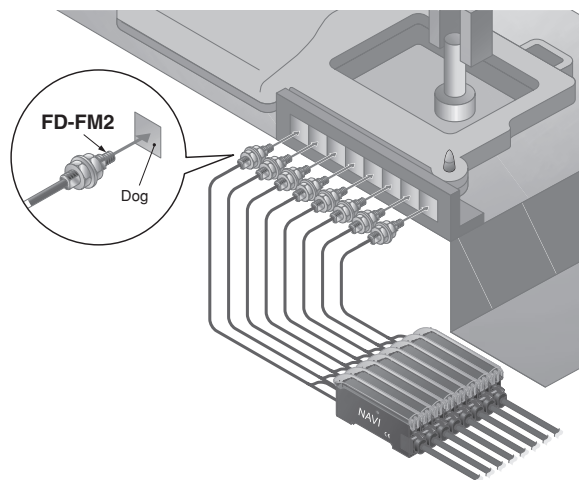
FX-305

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  $\mu$ 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 $\mu$ s	4 units	130 $\mu$ s
FAST	4 units	150 $\mu$ s	8 units	300 $\mu$ s
STD	4 units	250 $\mu$ s	8 units	500 $\mu$ s
STDF	4 units	700 $\mu$ 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.

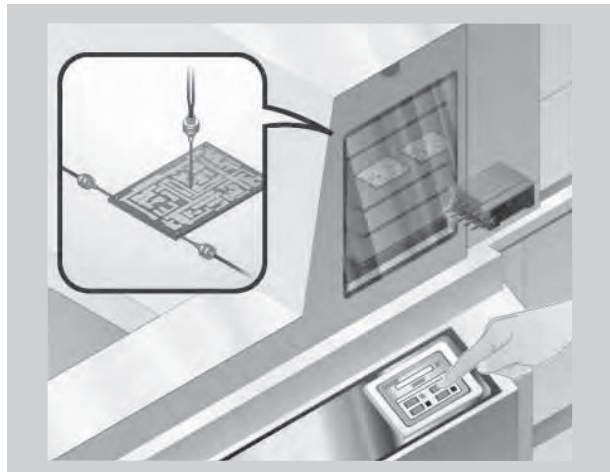
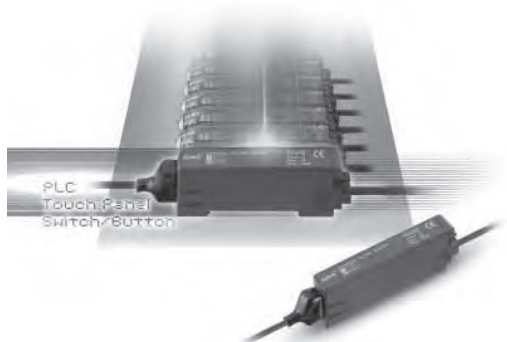
The FX-301-HS is not equipped with an interference prevention function.



## Improved ease of working! External data bank switching and teaching

FX-301 FX-305

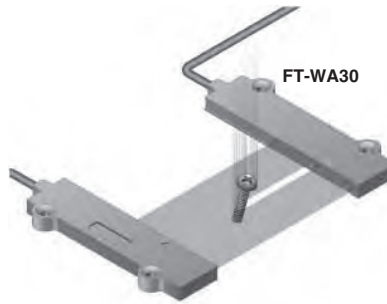
The FX-CH2 external input unit (optional) can be used to carry out teaching and data bank switching operations externally without needing to operate the digital fiber sensors directly. This is very convenient for equipment which requires frequent setup changes.



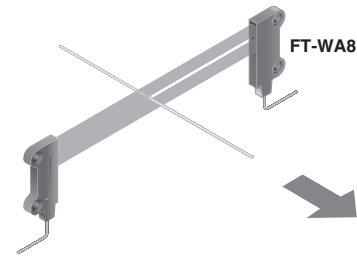
## Wide beam fiber

## 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

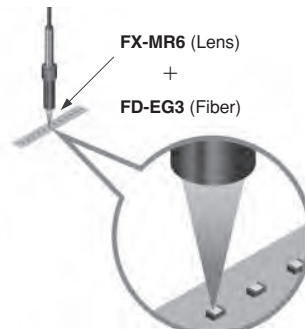
An ultra-small  $\phi 0.1$  mm  $\phi 0.004$  in spot size has now been made possible by combining our precision fiber with our finest spot lens. The orientation of 0603 chips can also be discriminated stably.

## Finest spot lens FX-MR6

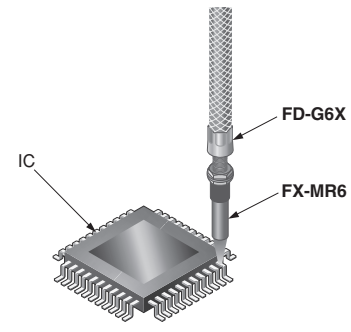
Fiber model No.	Distance to focal point	Spot diameter
FD-EG3	$7 \pm 0.5$ mm $0.276 \pm 0.020$ in	$\phi 0.1$ mm $\phi 0.004$ in approx.
FD-EG2	$7 \pm 0.5$ mm $0.276 \pm 0.020$ in	$\phi 0.15$ mm $\phi 0.006$ in approx.
FD-EG1	$7 \pm 0.5$ mm $0.276 \pm 0.020$ in	$\phi 0.2$ mm $\phi 0.008$ in approx.
FD-WG4/G4/G6X/G6	$7 \pm 0.5$ mm $0.276 \pm 0.020$ 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	$7.5 \pm 0.5$ mm $0.295 \pm 0.020$ in	$\phi 0.15$ mm $\phi 0.006$ in approx.
FD-EG2	$7.5 \pm 0.5$ mm $0.295 \pm 0.020$ in	$\phi 0.2$ mm $\phi 0.008$ in approx.
FD-EG1	$7.5 \pm 0.5$ mm $0.295 \pm 0.020$ in	$\phi 0.3$ mm $\phi 0.012$ in approx.
FD-WG4/G4/G6X/G6	$7.5 \pm 0.5$ mm $0.295 \pm 0.020$ in	$\phi 0.5$ mm $\phi 0.020$ in approx.



0603 chip orientation discrimination

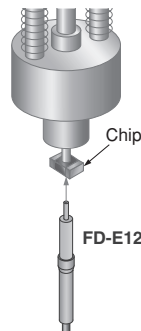


IC pin sensing

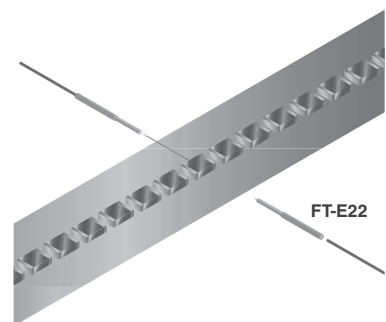
## Ultra small diameter fiber

## 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.



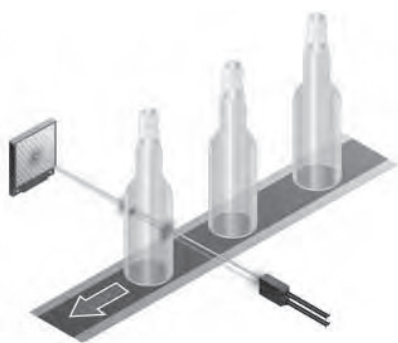
Detecting ICs in transparent stick



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.

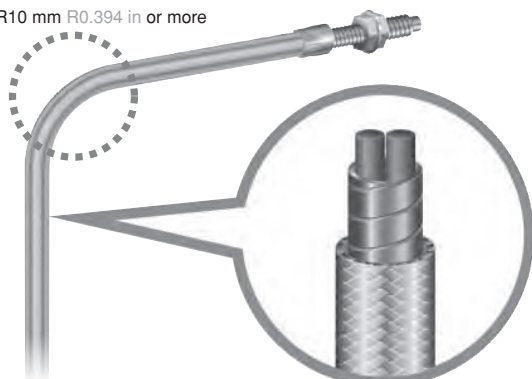
**Chemical-resistant fiber****FT-Z802Y**

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				
		FX-301B	Blue LED	NPN open-collector transistor		CN-73-C2	2 m 6.562 ft	
		FX-301BP		PNP open-collector transistor				
		FX-301G	Green LED	NPN open-collector transistor		CN-73-C5	5 m 16.404 ft	
		FX-301GP		PNP open-collector transistor				
		FX-301H	Infrared LED	NPN open-collector transistor	Sub cable (1-core)	CN-71-C1	1 m 3.281 ft	
		FX-301HP		PNP open-collector transistor		CN-71-C2	2 m 6.562 ft	
		High-speed type	FX-301-HS	Red LED		NPN open-collector transistor	CN-71-C5	5 m 16.404 ft
			FX-301P-HS			PNP open-collector transistor		
High-function type		FX-305	Red LED	NPN open-collector transistor	Main cable (4-core)	CN-74-C1	1 m 3.281 ft	
				CN-74-C2		2 m 6.562 ft		
				CN-74-C5		5 m 16.404 ft		
		FX-305P		PNP open-collector transistor	Sub cable (2-core)	CN-72-C1	1 m 3.281 ft	
						CN-72-C2	2 m 6.562 ft	
						CN-72-C5	5 m 16.404 ft	



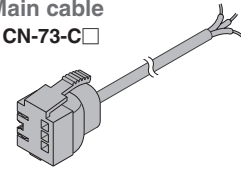
## ORDER GUIDE

### Quick-connection cables

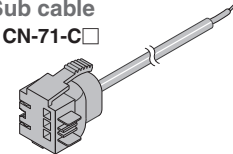
**For FX-301(-HS)/B/G/H** Quick-connection cable is not supplied with the amplifier. Please order it separately.

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

**Main cable**  
• **CN-73-C**



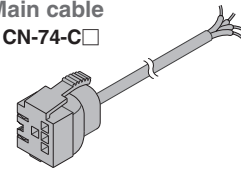
**Sub cable**  
• **CN-71-C**



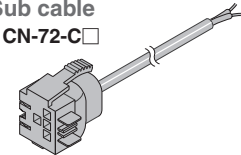
**For FX-305** Quick-connection cable is not supplied with the amplifier. Please order it separately.

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

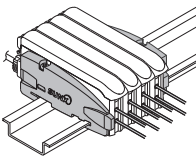
**Main cable**  
• **CN-74-C**



**Sub cable**  
• **CN-72-C**



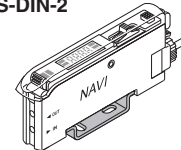
**End plates** End plates are not supplied with the amplifier. Please order them separately when the amplifiers are mounted in cascade.

Appearance	Model No.	Description
	<b>MS-DIN-E</b>	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. <b>Two pcs. per set</b>

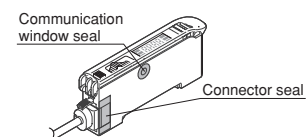
## OPTIONS

Designation	Model No.	Description
Amplifier mounting bracket	<b>MS-DIN-2</b>	Mounting bracket for amplifier
Fiber amplifier protective seal	<b>FX-MB1</b>	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)	Min. sensing object (Note 3)	Fiber cable length	Bending radius	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	φ0.04 mm φ0.0016 in opaque object	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	φ0.03 mm φ0.0012 in opaque object	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	φ0.03 mm φ0.0012 in opaque object	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	φ0.04 mm φ0.0016 in opaque object	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	φ0.05 mm φ0.0020 in opaque object	FT-P81X
		Tough flexible				
		Lens mountable	1,550 21.654 400 15.748 250 9.843 190 7.480	140 5.512 70 2.756 80 3.150	φ0.04 mm φ0.0016 in opaque object	FT-P60
		Lens mountable	750 29.528 570 22.441 350 13.780 290 11.417	200 7.874 90 3.543 100 3.937	φ0.06 mm φ0.0024 in opaque object	FT-WR80
	Nut type	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	φ0.04 mm φ0.0016 in opaque object	FT-WR80L
		Elbow	740 29.134 530 20.866 320 12.598 230 9.055	150 5.906 75 2.953 80 3.150	φ0.04 mm φ0.0016 in opaque object	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	φ0.03 mm φ0.0012 in opaque object	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	φ0.025 mm φ0.0010 in opaque object	FT-NFM2S
		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	φ0.02 mm φ0.0008 in opaque object	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	φ0.04 mm φ0.0016 in opaque object	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	φ0.4 mm φ0.016 in opaque object	FT-FM10L
		Long sensing range				

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)	<div> <div> <div>U-LG</div> <div>LONG</div> <div>STDF</div> <div>STD</div> </div> <div> <div>FAST</div> <div>H-SP</div> <div>S-D</div> </div> </div>	Min. sensing object (Note 3)	Fiber cable length Free-cut	Bending radius	Model No.
Cylindrical type	$\phi 3 \phi 0.118$ With lens · Long sensing range 	1,500 59.055	420 16.535	$\phi 0.02$ mm	 2 m 6.562 ft	R1 mm R0.039 in	FT-WS8L
		1,200 47.244	200 7.874	$\phi 0.0008$ in			FT-WS3
		750 29.528	210 8.268	$\phi 0.05$ mm			
		600 23.622	90 3.543	$\phi 0.0020$ in			
	$\phi 3 \phi 0.118$ With lens · Long sensing range 	1,500 59.055	420 16.535	$\phi 0.02$ mm	 2 m 6.562 ft	R1 mm R0.039 in	FT-WS8L
		1,200 47.244	200 7.874	$\phi 0.0008$ in			FT-WS3
		750 29.528	210 8.268	$\phi 0.05$ mm			
		600 23.622	90 3.543	$\phi 0.0020$ in			
	$\phi 2.5 \phi 0.098$ With lens · Long sensing range 	2,000 78.740	580 22.835	$\phi 0.02$ mm	 2 m 6.562 ft	R25 mm R0.984 in	FT-SFM2L
		1,600 62.992	170 6.693	$\phi 0.0008$ in			FT-SFM2
		800 31.496	280 11.024	$\phi 0.03$ mm			
		1,000 39.370	150 5.906	$\phi 0.0012$ in			
	$\phi 2.5 \phi 0.098$ With lens · Long sensing range 	1,500 59.055	420 16.535	$\phi 0.02$ mm	 2 m 6.562 ft	R1 mm R0.039 in	FT-WS8L
		1,200 47.244	200 7.874	$\phi 0.0008$ in			FT-WS3
		750 29.528	210 8.268	$\phi 0.05$ mm			
		600 23.622	90 3.543	$\phi 0.0020$ in			
	$\phi 1.5 \phi 0.059$ With lens · Long sensing range 	400 15.748	100 3.937	$\phi 0.025$ mm	 2 m 6.562 ft	R25 mm R0.984 in	FT-SNFM2
		270 10.630	155 2.165	$\phi 0.0010$ in			FT-WS4
		200 7.874	49 1.929	$\phi 0.02$ mm			
		140 5.512	55 2.165	$\phi 0.0008$ in			
	$\phi 1.5 \phi 0.059$ With lens · Long sensing range 	220 8.661	25 0.984	$\phi 0.02$ mm	 1 m 3.281 ft	R4 mm R0.157 in	FT-P2
		160 6.299	28 1.102	$\phi 0.0008$ in			FT-PS1
		100 3.937	30 1.181	$\phi 0.0008$ in			
		80 3.150	13 0.512	$\phi 0.0008$ in			
	$\phi 1 \phi 0.039$ With lens · Long sensing range 	100 3.937	30 1.181	$\phi 0.02$ mm	 500 mm 19.685 in	Flexible	FT-PS1
		80 3.150	13 0.512	$\phi 0.0008$ in			
		50 1.969	17 0.669	$\phi 0.0008$ in			
		40 1.575	13 0.512	$\phi 0.0008$ in			
	Ultra-small diameter Beam diameter $\phi 0.25 \phi 3$ $\phi 0.125$ mm $\phi 0.005$ in $\phi 0.010 \phi 0.118$ Sleeve part cannot be bent.	20 0.787	8 0.315	$\phi 0.02$ mm	 500 mm 19.685 in	R5 mm R0.197 in	FT-E12
		18 0.709	13 0.118	$\phi 0.0008$ in			FT-E22
		13 0.512	13 0.118	$\phi 0.0008$ in			
		10 0.394	36 1.417	$\phi 0.0008$ in			
	Ultra-small diameter Beam diameter $\phi 0.4 \phi 3$ $\phi 0.25$ mm $\phi 0.010$ in $\phi 0.016 \phi 0.118$ Sleeve part cannot be bent.	130 5.118	36 1.417	$\phi 0.02$ mm	 1 m 3.281 ft	R5 mm R0.197 in	FT-E12
		80 3.150	18 0.709	$\phi 0.0008$ in			FT-E22
		60 2.362	15 0.591	$\phi 0.0008$ in			
		50 1.969	15 0.591	$\phi 0.0008$ in			
Side-view	$\phi 4 \phi 0.157$ 	2,350 92.520	800 31.496	$\phi 0.05$ mm	 2 m 6.562 ft	R25 mm R0.984 in	FT-V10
		2,000 78.740	340 13.386	$\phi 0.0020$ in			FT-SFM2SV2
		1,400 55.118	350 13.780	$\phi 0.0020$ in			
		1,000 39.370	140 5.512	$\phi 0.02$ mm			
	$\phi 1.5 \phi 0.059$ $\phi 2.5 \phi 0.098$ 	550 21.654	140 5.512	$\phi 0.02$ mm	 1 m 3.281 ft	R25 mm R0.984 in	FT-V10
		400 15.748	65 2.559	$\phi 0.0008$ in			FT-SFM2SV2
		240 9.449	70 2.756	$\phi 0.0008$ in			
		200 7.874	125 4.921	$\phi 0.0008$ in			
	$\phi 1 \phi 0.039$ $\phi 2 \phi 0.079$ 	410 16.142	60 2.362	$\phi 0.02$ mm	 2 m 6.562 ft	R1 mm R0.039 in	FT-V22
		390 15.354	63 2.480	$\phi 0.0008$ in			FT-V41
		220 8.661	60 2.362	$\phi 0.0008$ in			
		180 7.087	25 0.984	$\phi 0.0008$ in			
	$\phi 1 \phi 0.039$ $\phi 2.5 \phi 0.098$ 	220 8.661	60 2.362	$\phi 0.02$ mm	 2 m 6.562 ft	R1 mm R0.039 in	FT-V22
		175 6.890	25 0.984	$\phi 0.0008$ in			FT-V41
		100 3.937	27 1.063	$\phi 0.0008$ in			
		80 3.150	30 1.181	$\phi 0.0008$ in			
	$\phi 1 \phi 0.039$ $\phi 2 \phi 0.079$ 	120 4.724	30 1.181	$\phi 0.02$ mm	 2 m 6.562 ft	R1 mm R0.039 in	FT-WV42
		90 3.543	13 0.512	$\phi 0.0008$ in			
		55 2.165	15 0.591	$\phi 0.0008$ in			
		40 1.575	15 0.591	$\phi 0.0008$ 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 ■ : LONG ■ : STDF ■ : STD	■ : FAST ■ : H-SP ■ : S-D	Min. sensing object (Note 3)	Fiber cable length ✂ : Free-cut	Bending radius	Model No.
Rectangular	Easy mounting · Top sensing W3×H8×D12 W0.118×H0.315×D0.472	3,500 137.795		850 33.465	φ0.08 mm		R1 mm R0.039 in	FT-WZ8H
		2,500 98.425		400 15.748				
		1,600 62.992		410 16.142	opaque object			
		1,200 47.244						
	Easy mounting · Side sensing W3×H12×D8 W0.118×H0.472×D0.315	3,100 122.047		1,000 39.370	φ0.03 mm		R4 mm R0.157 in	FT-Z8H
		2,700 106.299		420 16.535				
		1,550 61.024		490 19.291	opaque object			
		1,400 55.118						
	Easy mounting · Front sensing W8.5×H12×D3 W0.335×H0.472×D0.118	2,100 82.677		500 19.685	φ0.05 mm		R1 mm R0.039 in	FT-WZ8E
		1,500 59.055		200 7.874				
		950 37.402		210 8.268	opaque object			
		700 27.559						
	Easy mounting · Front sensing W8.5×H12×D3 W0.335×H0.472×D0.118	1,850 72.835		600 23.622	φ0.03 mm		R4 mm R0.157 in	FT-Z8E
		1,600 62.992		250 9.843				
		950 37.402		280 11.024	opaque object			
		800 31.496						
	Front sensing W10×H7×D2 W0.394×H0.276×D0.079	950 37.402		240 9.449	φ0.04 mm		R1 mm R0.039 in	FT-WZ8
		700 27.559		100 3.937				
		420 16.535		120 4.724	opaque object			
		330 12.992						
	Fiber bending type W2×H10×D10 W0.079×H0.394×D0.394	1,100 43.307		300 11.811	φ0.03 mm		R4 mm R0.157 in	FT-Z8
		800 31.496		120 4.724				
		500 19.685		140 5.512	opaque object			
		400 15.748						
Special	Front sensing W10×H7×D2 W0.394×H0.276×D0.079	300 11.811		70 2.756	φ0.08 mm			FT-WZ4
		200 7.874		40 1.575				
		140 5.512		40 1.575	opaque object			
		100 3.937						
	Fiber bending type W2×H10×D10 W0.079×H0.394×D0.394	220 8.661		50 1.969	φ0.08 mm			FT-WZ4HB
		150 5.906		30 1.181				
		105 4.134		30 1.181	opaque object			
		75 2.953						
	Front sensing W14×H7×D3.5 W0.551×H0.276×D0.138	660 25.984		150 5.906	φ0.08 mm		R1 mm R0.039 in	FT-WZ7
		440 17.323		80 3.150				
		308 12.126		80 3.150	opaque object			
		220 8.661						
	Fiber bending type W3.5×H14×D11 W0.138×H0.551×D0.433	870 34.252		210 8.268	φ0.03 mm			FT-WZ7HB
		580 22.835		110 4.331				
		406 15.984		110 4.331	opaque object			
		290 11.417						
Narrow beam	Side-view type with small light dispersion φ3.5 φ0.138 φ3.7 φ0.146	3,000 118.110		800 31.496			R25 mm R0.984 in	FT-K8
		2,000 78.740		300 11.811				
		1,500 59.055		350 13.780				
		1,000 39.370						
	Side-view type with small light dispersion φ4 φ0.157 0.118	2,200 86.614		600 23.622	φ0.06 mm		R1 mm R0.039 in	FT-WKV8
		1,700 66.929		280 11.024				
		1,000 39.370		300 11.811	opaque object			
		700 27.559						
	Wide area sensing W2×H1.5×D20 W0.079×H0.059×D0.787	3,000 118.110		800 31.496			R25 mm R0.984 in	FT-KV8
		2,000 78.740		300 11.811				
		1,500 59.055		350 13.780				
		1,000 39.370						
Wide beam	Wide area sensing Sensing width 32 mm W5×H69×D20 W0.197×H2.717×D0.787	600 23.622		180 7.087	φ0.02 mm		R10 mm R0.394 in	FT-KV1
		500 19.685		90 3.543				
		300 11.811		100 3.937	opaque object			
		250 9.843						
	Wide area sensing Sensing width 11 mm W4.2×H31×D13.5 W0.165×H1.220×D0.531	3,500 137.795		3,500 137.795	φ0.3 mm		R1 mm R0.039 in	FT-WA30
		3,500 137.795		3,000 118.110				
		3,500 137.795		3,500 137.795	opaque object			
		3,500 137.795						
	Wide area sensing Sensing width 11 mm W4.2×H31×D13.5 W0.165×H1.220×D0.531	3,500 137.795		1,100 43.307	φ0.25 mm		R1 mm R0.039 in	FT-WA8
		3,500 137.795		1,080 42.520				
		3,500 137.795		750 29.528	opaque object			
		1,500 59.055						
Array	Top sensing W5×H15×D15 W0.197×H0.591×D0.591	850 33.465		220 8.661	Horizontal: φ0.025 mm		R25 mm R0.984 in	FT-AFM2
		650 25.591		100 3.937	φ0.0010 in			
	Side sensing W5×H15×D15 W0.197×H0.591×D0.591	380 14.961		115 4.528	Vertical: φ0.45 mm			FT-AFM2E
		330 12.992			φ0.018 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.

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)	<div> <div> <div>U-LG</div> <div>LONG</div> <div>STDF</div> <div>STD</div> </div> <div> <div>FAST</div> <div>H-SP</div> <div>S-D</div> </div> </div>	Min. sensing object (Note 3)	Fiber cable length Free-cut	Bending radius	Model No.
Heat-resistant	350 °C 662 °F Lens mountable	<div> <div>750 29.528</div> <div>550 21.654</div> <div>330 12.992</div> <div>280 11.024</div> </div>	<div> <div>200 7.874</div> <div>85 3.346</div> <div>90 3.543</div> </div>	φ0.04 mm φ0.0016 in opaque object	2 m 6.562 ft	R25 mm R0.984 in	FT-H35-M2
	350 °C 662 °F Sleeve 60 mm 2.362 in M4 φ2.1 φ0.083	<div> <div>420 16.535</div> <div>310 12.205</div> <div>180 7.087</div> <div>140 5.512</div> </div>	<div> <div>100 3.937</div> <div>40 1.575</div> <div>50 1.969</div> </div>	φ0.02mm φ0.0008 in opaque object	1 m 3.281 ft	Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in	FT-H35-M2S6
	Allows flexible wiring 200 °C 392 °F Lens mountable	<div> <div>750 29.528</div> <div>550 21.654</div> <div>320 12.598</div> <div>280 11.024</div> </div>	<div> <div>200 7.874</div> <div>85 3.346</div> <div>90 3.543</div> </div>	φ0.04 mm φ0.0016 in opaque object	1 m 3.281 ft	R25 mm R0.984 in	FT-H20W-M1
	200 °C 392 °F Lens mountable	<div> <div>750 29.528</div> <div>550 21.654</div> <div>320 12.598</div> <div>280 11.024</div> </div>	<div> <div>200 7.874</div> <div>85 3.346</div> <div>90 3.543</div> </div>	φ0.04 mm φ0.0016 in opaque object	1 m 3.281 ft	R25 mm R0.984 in	FT-H20-M1
	130 °C 266 °F Lens mountable (FX-LE2 only)	<div> <div>1,200 47.244</div> <div>880 34.646</div> <div>550 21.654</div> <div>440 17.323</div> </div>	<div> <div>300 11.811</div> <div>150 5.906</div> <div>155 6.102</div> </div>	φ0.06 mm φ0.0024 in opaque object	2 m 6.562 ft		FT-H13-FM2
	Lens mountable (FX-LE1)	<div> <div>530 20.866</div> <div>390 15.354</div> <div>225 8.858</div> <div>200 7.874</div> </div>	<div> <div>140 5.512</div> <div>60 2.362</div> <div>60 2.362</div> </div>	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)	<div>NEW</div> <div>FT-H20-J20-S</div> <div>(Note 6)</div> <div>NEW</div> <div>FT-H20-J30-S</div> <div>(Note 6)</div> <div>NEW</div> <div>FT-H20-J50-S</div> <div>(Note 6)</div> <div>NEW</div> <div>FT-H20-VJ50-S</div> <div>(Note 6)</div> <div>NEW</div> <div>FT-H20-VJ80-S</div> <div>(Note 6)</div>
	Side-view	<div> <div>840 33.071</div> <div>550 21.654</div> <div>370 14.567</div> <div>280 11.024</div> </div>	<div> <div>200 7.874</div> <div>90 3.543</div> <div>90 3.543</div> </div>	φ0.16 mm φ0.006 in opaque object	500 mm 19.685 in (Note 4) 800 mm 31.496 in (Note 4)		
	Easy mounting · Rectangular head SEMI S2 compliant W7 × H15 × D13 W0.276 × H0.591 × D0.512	<div> <div>1,300 137.795</div> <div>1,300 137.795</div> <div>1,300 118.110</div> <div>1,500 59.055</div> </div>	<div> <div>1,000 39.370</div> <div>500 19.685</div> <div>530 20.866</div> </div>	φ4 mm φ0.157 in opaque object	2 m 6.562 ft	R25 mm R0.984 in	FT-Z802Y
	φ5.5 φ0.217	<div> <div>1,300 137.795</div> <div>1,300 137.795</div> <div>2,000 78.740</div> <div>1,500 59.055</div> </div>	<div> <div>1,000 39.370</div> <div>500 19.685</div> <div>530 20.866</div> </div>	φ0.2 mm φ0.008 in opaque object	2 m 6.562 ft (Note 7)	R30 mm R1.181 in	<div>FT-L80Y</div> <div>FT-V80Y</div>
	Side-view	<div> <div>1,000 39.370</div> <div>800 31.496</div> <div>500 19.685</div> <div>400 15.748</div> </div>	<div> <div>280 11.024</div> <div>120 4.724</div> <div>140 5.512</div> </div>				
Vacuum-resistant	300 °C 572 °F Lens mountable (FV-LE1/SV2 only)	<div> <div>350 13.780</div> <div>250 9.843</div> <div>150 5.906</div> <div>125 4.921</div> </div>	<div> <div>90 3.543</div> <div>50 1.969</div> <div>40 1.575</div> </div>	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)	■ : U-LG ■ : LONG ■ : STDF ■ : STD	■ : FAST ■ : H-SP ■ : S-D	Min. sensing object (Note 4)	Fiber cable length ✂ : Free-cut	Bending radius	Model No.
Sharp bending	W9.5 X H5.2 X D15 W10.374 X H0.205 X D0.591 W9.0 X H3.0 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	Cannot use Cannot use	100 to 460 3.937 to 18.110	φ0.3 mm φ0.012 in opaque object	✂ 2 m 6.562 ft	R1 mm R0.039 in	FR-WKZ11
Narrow beam	W6.5 X H2.2 X D21 W10.374 X H0.205 X D0.591 W10.6 X H2.8 X D10.1 W10.417 X H1.102 X D0.398	200 7.874 200 7.874 200 7.874 200 7.874	200 7.874 200 7.874 200 7.874 200 7.874		Horizontal: φ5.5 mm φ0.217 in opaque object Vertical: φ0.06 mm φ0.0024 in opaque object	✂ 2 m 6.562 ft	R10 mm R0.394 in	FR-KZ21 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	15 to 170 0.591 to 6.693 15 to 80 0.591 to 3.150 15 to 90 0.591 to 3.543		φ0.12 mm φ0.005 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)	■ : U-LG ■ : LONG ■ : STDF ■ : STD	■ : FAST ■ : H-SP ■ : S-D	Min. sensing object (Note 4)	Fiber cable length ✂ : Free-cut	Bending radius	Model No.
Threaded type	M6	600 23.622 480 18.898 280 11.024 220 8.661	160 6.299 85 3.346 75 2.953				R25 mm R0.984 in	FD-B8
	Coaxial M6	410 16.142 310 12.205 200 7.874 140 5.512	100 3.937 55 2.165 47 1.850					FD-FM2
	Sleeve 90 mm 3.543 in M6 φ2.5 φ0.098	370 14.567 270 10.630	85 3.346 45 1.772				Fiber R25 mm R0.984 in	FD-FM2S
	Sleeve 40 mm 1.575 in M6 φ2.5 φ0.098	170 6.693 110 4.331	39 1.535		φ0.02 mm φ0.0008 in gold wire	✂ 2 m 6.562 ft	Sleeve R10 mm R0.394 in	FD-FM2S4
	M6	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-W8
	M6	300 11.811 220 8.661 130 5.118 100 3.937	70 2.756 30 1.181 35 1.378				R4 mm R0.157 in Flexible	FD-P80
	M6	270 10.630 185 7.283 100 3.937 80 3.150	60 2.362 30 1.181 35 1.378			1 m 3.281 ft	R10 mm R0.394 in	FD-P81X
	Tough flexible							
	Elbow	240 9.449 185 7.283 110 4.331 85 3.346	60 2.362 25 0.984 30 1.181		φ0.02 mm φ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	FD-R80

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)	<div> <div> <div>U-LG</div> <div>LONG</div> <div>STDF</div> <div>STD</div> </div> <div> <div>FAST</div> <div>H-SP</div> <div>S-D</div> </div> </div>	Min. sensing object (Note 4)	Fiber cable length ✂: Free-cut	Bending radius	Model No.
Threaded type	M4	<div>370 14.567</div> <div>270 10.630</div> <div>170 6.693</div> <div>110 4.331</div>	<div>85 3.346</div> <div>45 1.772</div> <div>39 1.535</div>			R25 mm R0.984 in	FD-T80
	M4						FD-NFM2
	Sleeve 90 mm 3.543 in M4 φ1.48 φ0.058	<div>140 5.512</div> <div>90 3.543</div> <div>60 2.362</div> <div>45 1.772</div>	<div>35 1.378</div> <div>16 0.630</div> <div>16 0.630</div>			Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in	FD-NFM2S
	Sleeve 40 mm 1.575 in M4 φ1.48 φ0.058					R10 mm R0.394 in	FD-NFM2S4
	Sleeve 40 mm 1.575 in M4 φ1.48 φ0.058	<div>40 1.575</div> <div>30 1.181</div> <div>18 0.709</div> <div>15 0.591</div>	<div>12 0.472</div> <div>4.5 0.177</div> <div>5 0.197</div>	φ0.02 mm φ0.0008 in gold wire	✂ 2 m 6.562 ft	Fiber R1 mm R0.039 in Sleeve R10 mm R0.394 in	FD-W44
	M4	<div>250 9.843</div> <div>190 7.480</div> <div>110 4.331</div> <div>90 3.543</div>	<div>60 2.362</div> <div>25 0.984</div> <div>32 1.260</div>			R1 mm R0.039 in	FD-WT8
	Coaxial · Lens mountable M4	<div>85 3.346</div> <div>65 2.559</div> <div>37 1.457</div> <div>32 1.260</div>	<div>25 0.984</div> <div>10 0.394</div> <div>11 0.433</div>			R2 mm R0.079 in	FD-WG4
	M4	<div>150 5.906</div> <div>110 4.331</div> <div>65 2.559</div> <div>55 2.165</div>	<div>42 1.654</div> <div>15 0.591</div> <div>19 0.748</div>			R25 mm R0.984 in	FD-G4
	M4	<div>130 5.118</div> <div>90 3.543</div> <div>55 2.165</div> <div>45 1.772</div>	<div>30 1.181</div> <div>13 0.512</div> <div>16 0.630</div>			R4 mm R0.157 in Flexible	FD-P60
	Small diameter M3	<div>140 5.512</div> <div>90 3.543</div> <div>60 2.362</div> <div>45 1.772</div>	<div>35 1.378</div> <div>16 0.630</div> <div>16 0.630</div>			R25 mm R0.984 in	FD-T40
	M3	<div>40 1.575</div> <div>30 1.181</div> <div>18 0.709</div> <div>15 0.591</div>	<div>12 0.472</div> <div>4.5 0.177</div> <div>5 0.197</div>			R1 mm R0.039 in	FD-WT4
	M3	<div>50 1.969</div> <div>36 1.417</div> <div>20 0.787</div> <div>18 0.709</div>	<div>14 0.551</div> <div>5.5 0.217</div> <div>6 0.236</div>	φ0.02 mm φ0.0008 in gold wire	✂ 2 m 6.562 ft	R4 mm R0.157 in Flexible	FD-P40
	M3	<div>150 5.906</div> <div>110 4.331</div> <div>65 2.559</div> <div>55 2.165</div>	<div>42 1.654</div> <div>15 0.591</div> <div>19 0.748</div>			R25 mm R0.984 in	FD-G6
M3	Coaxial						
	Lens mountable (FX-MR3, FX-MR6) M3	<div>150 5.906</div> <div>90 3.543</div> <div>48 1.890</div> <div>45 1.772</div>	<div>35 1.378</div> <div>12 0.472</div> <div>20 0.787</div>		✂ 1 m 3.281 ft (Note 5)	R10 mm R0.394 in	FD-G6X
	Coaxial · Tough flexible M3						
	Coaxial · Lens mountable (FX-MR3, FX-MR6) M3	<div>50 1.969</div> <div>38 1.496</div> <div>25 0.984</div> <div>18 0.709</div>	<div>14 0.551</div> <div>5 0.197</div> <div>6 0.236</div>			R25 mm R0.984 in	FD-EG1
	High precision M3	<div>40 1.575</div> <div>25 0.984</div> <div>14 0.551</div> <div>12 0.472</div>	<div>9 0.354</div> <div>3 0.118</div> <div>5 0.197</div>	φ0.04 mm φ0.0016 in gold wire	500 mm 19.685 in	R10 mm R0.394 in	FD-EG2
	Coaxial · Lens mountable (FX-MR3, FX-MR6) M3	<div>20 0.787</div> <div>15 0.591</div> <div>9 0.354</div> <div>8 0.315</div>	<div>5 0.197</div> <div>2.5 0.098</div> <div>3 0.118</div>				FD-EG3
	High precision M3	<div>6.5 0.256</div> <div>5 0.197</div> <div>3 0.118</div> <div>3 0.118</div>	<div>2 0.079</div> <div>Cannot use</div> <div>Cannot use</div>	φ0.02 mm φ0.0008 in gold wire	1 m 3.281 ft		FD-EN500S1
	Sleeve part cannot be bent. M3						
	Coaxial M3	<div>50 1.969</div> <div>38 1.496</div> <div>20 0.787</div> <div>18 0.709</div>	<div>14 0.551</div> <div>5 0.197</div> <div>6 0.236</div>			R25 mm R0.984 in	FD-ENM1S1
	Sleeve part cannot be bent. M3						

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)	<div> <div> <div>U-LG</div> <div>LONG</div> <div>STDF</div> <div>STD</div> </div> <div> <div>FAST</div> <div>H-SP</div> <div>S-D</div> </div> </div>	Min. sensing object (Note 4)	Fiber cable length ✂: Free-cut	Bending radius	Model No.
Cylindrical type	 φ3 φ0.118	<div> <div>370 14.567</div> <div>270 10.630</div> <div>170 6.693</div> <div>110 4.331</div> </div>	<div> <div>85 3.346</div> <div>45 1.772</div> <div>39 1.535</div> </div>			R25 mm R0.984 in	FD-S80
	 φ3 φ0.118	<div> <div>250 9.843</div> <div>190 7.480</div> <div>110 4.331</div> <div>90 3.543</div> </div>	<div> <div>60 2.362</div> <div>25 0.984</div> <div>32 1.260</div> </div>			R1 mm R0.039 in	FD-WS8
	Coaxial	<div> <div>85 3.346</div> <div>65 2.559</div> <div>37 1.457</div> <div>32 1.260</div> </div>	<div> <div>25 0.984</div> <div>10 0.394</div> <div>11 0.433</div> </div>			R2 mm R0.079 in	FD-WSG4
	 φ3 φ0.118	<div> <div>130 5.118</div> <div>90 3.543</div> <div>55 2.165</div> <div>45 1.772</div> </div>	<div> <div>30 1.181</div> <div>13 0.512</div> <div>16 0.630</div> </div>			R4 mm R0.157 in	FD-P50
	 φ2.5 φ0.098	<div> <div>140 5.512</div> <div>90 3.543</div> <div>60 2.362</div> <div>45 1.772</div> </div>	<div> <div>35 1.378</div> <div>16 0.630</div> <div>16 0.630</div> </div>	φ0.02 mm φ0.0008 in gold wire	 2 m 6.562 ft	R25 mm R0.984 in	FD-SNFM2
	 φ1.5 φ0.059	<div> <div>80 3.150</div> <div>50 1.969</div> <div>30 1.181</div> <div>25 0.984</div> </div>	<div> <div>19 0.748</div> <div>7.5 0.295</div> <div>9 0.354</div> </div>	φ0.02 mm φ0.0008 in gold wire	 1 m 3.281 ft	R4 mm R0.157 in	FD-P2
	 φ1.5 φ0.059	<div> <div>15 0.591</div> <div>11 0.433</div> <div>8 0.315</div> <div>6 0.236</div> </div>	<div> <div>4 0.157</div> <div>2 0.079</div> <div>1 0.039</div> </div>	φ0.02 mm φ0.0008 in gold wire		R10 mm R0.394 in	FD-E12
	 φ1.5 φ0.059	<div> <div>65 2.559</div> <div>45 1.772</div> <div>28 1.102</div> <div>23 0.906</div> </div>	<div> <div>17 0.669</div> <div>8 0.315</div> <div>7 0.276</div> </div>	φ0.02 mm φ0.0008 in gold wire		R25 mm R0.984 in	FD-E22
	 φ1.5 φ0.059	<div> <div>80 3.150</div> <div>55 2.165</div> <div>30 1.181</div> <div>25 0.984</div> </div>	<div> <div>17 0.669</div> <div>8 0.315</div> <div>9 0.354</div> </div>			R25 mm R0.984 in	FD-V41
	 φ1.5 φ0.059	<div> <div>20 0.787</div> <div>15 0.591</div> <div>8.5 0.335</div> <div>7 0.276</div> </div>	<div> <div>5 0.197</div> <div>Cannot use</div> <div>Cannot use</div> </div>	φ0.02 mm φ0.0008 in gold wire	 2 m 6.562 ft	R1 mm R0.039 in	FD-WV42
	 φ1.5 φ0.059	<div> <div>170 6.693</div> <div>100 3.937</div> <div>55 2.165</div> <div>45 1.772</div> </div>	<div> <div>32 1.260</div> <div>15 0.591</div> <div>16 0.630</div> </div>			R25 mm R0.984 in	FD-SFM2SV2
Rectangular type	 Glass substrate detection · Mapping	<div> <div>12 to 50 0.472 to 1.969</div> <div>12.5 to 37.5 0.492 to 1.476</div> <div>15 to 36 0.591 to 1.417</div> <div>15 to 35 0.591 to 1.378</div> </div>	<div> <div>16 to 29 0.630 to 1.142</div> <div>Cannot use</div> <div>Cannot use</div> </div>	φ0.3 mm φ0.012 in gold wire	 4 m 13.123 ft	R25 mm R0.984 in	FD-L46
	 Glass substrate detection · Alignment	<div> <div>0 to 50 0 to 1.969</div> <div>0 to 36 0 to 1.417</div> <div>0 to 33 0 to 1.299</div> <div>0 to 30 0 to 1.181</div> </div>	<div> <div>0 to 30 0 to 1.181</div> <div>0 to 15 0 to 0.591</div> <div>0 to 21 0 to 0.827</div> </div>		 3 m 9.843 ft	R4 mm R0.157 in	FD-L45
	 Glass substrate detection · Alignment	<div> <div>0 to 23 0 to 0.906</div> </div>		(LCD glass)	 2 m 6.562 ft		FD-L43
	 Glass substrate detection · Seating	<div> <div>0 to 8.2 0 to 0.323</div> <div>0 to 7 0 to 0.276</div> <div>0 to 6.5 0 to 0.256</div> <div>0 to 6 0 to 0.236</div> </div>	<div> <div>0 to 5.7 0 to 0.224</div> <div>0 to 5 0 to 0.197</div> <div>0 to 5.2 0 to 0.205</div> </div>	φ0.03 mm φ0.0012 in gold wire	 2 m 6.562 ft	R10 mm R0.394 in	FD-L44
	 Glass substrate detection · Seating	<div> <div>0 to 4.7 0 to 0.185</div> <div>0 to 4.5 0 to 0.177</div> <div>0 to 4 0 to 0.157</div> <div>0 to 4 0 to 0.157</div> </div>	<div> <div>0 to 3.8 0 to 0.150</div> <div>0 to 3 0 to 0.118</div> <div>0 to 3.5 0 to 0.138</div> </div>				FD-L44S
	 Glass substrate detection	<div> <div>6.5 to 14.5 0.256 to 0.571 (Convergent point 8 0.315)</div> <div>6.5 to 14 0.256 to 0.551 (Convergent point 8 0.315)</div> <div>7 to 14 0.276 to 0.551 (Convergent point 8 0.315)</div> <div>7 to 12 0.276 to 0.472 (Convergent point 8 0.315)</div> </div>	<div> <div>7.5 to 12 0.295 to 0.472 (Convergent point 8 0.315)</div> <div>Cannot use</div> <div>Cannot use</div> </div>	φ1.9 mm φ0.075 in metal pipe (gray)		R1 mm R0.039 in	FD-WL41
	 Glass substrate detection	<div> <div>2 to 19 0.079 to 0.748 (Convergent point 8 0.315)</div> <div>2.5 to 18 0.098 to 0.709 (Convergent point 8 0.315)</div> <div>3 to 16 0.118 to 0.630 (Convergent point 8 0.315)</div> <div>3 to 16 0.118 to 0.630 (Convergent point 8 0.315)</div> </div>	<div> <div>3.5 to 15 0.138 to 0.591 (Convergent point 8 0.315)</div> <div>Cannot use</div> <div>Cannot use</div> </div>	φ0.06 mm φ0.024 in gold wire	 2 m 6.562 ft	R10 mm R0.394 in	FD-L41
	 Glass substrate detection	<div> <div>2 to 20 0.079 to 0.787 (Convergent point 6 0.236)</div> <div>2.5 to 18 0.098 to 0.709 (Convergent point 6 0.236)</div> <div>4 to 12 0.157 to 0.472 (Convergent point 6 0.236)</div> <div>4 to 12 0.157 to 0.472 (Convergent point 6 0.236)</div> </div>	<div> <div>4.5 to 11 0.177 to 0.433 (Convergent point 6 0.236)</div> <div>5 to 8.5 0.197 to 0.335 (Convergent point 6 0.236)</div> <div>4.8 to 9.5 0.189 to 0.374 (Convergent point 6 0.236)</div> </div>	φ0.02 mm φ0.0008 in gold wire			FD-L4
	 Glass substrate detection	<div> <div>0.5 to 8.5 0.020 to 0.335</div> <div>0.5 to 7.5 0.020 to 0.295</div> <div>1 to 6.5 0.039 to 0.256</div> <div>1 to 5.5 0.039 to 0.217</div> </div>	<div> <div>1 to 5 0.039 to 0.197</div> <div>Cannot use</div> <div>Cannot use</div> </div>	φ0.3 mm φ0.012 in copper wire	 1 m 3.281 ft	R1 mm R0.039 in	FD-WL48

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.

## 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	Bending radius	Model No.
Rectangular	Front sensing  W10.394 x H0.276 x D0.079	1 to 50 0.039 to 1.969 1.5 to 34 0.059 to 1.339 2 to 24 0.079 to 0.945 3 to 17 0.098 to 0.906	3 to 10 0.118 to 0.394 Cannot use Cannot use	φ0.16 mm φ0.006 in copper wire	1 m 3.281 ft	NEW FD-WZ4
		1 to 70 0.039 to 2.756 1 to 46 0.039 to 1.811 1 to 32.2 0.039 to 1.268 2.5 to 23 0.098 to 0.906	2.5 to 15 0.098 to 0.591 3 to 7 0.118 to 0.276 3 to 7 0.118 to 0.276			NEW FD-WZ4HB
	Fiber bending type  W2.019 x H0.394 x D0.034	200 7.874 120 4.724 1 to 84 0.039 to 3.307 1 to 60 0.039 to 2.362	1.5 to 35 0.059 to 1.378 2.5 to 18 0.098 to 0.709 2.5 to 18 0.098 to 0.709	φ0.03 mm φ0.0012 in gold wire	2 m 6.562 ft	NEW FD-WZ7
		0.5 to 270 0.002 to 10.630 0.5 to 180 0.002 to 7.087 1 to 126 0.039 to 4.961 1 to 90 0.039 to 3.543	1 to 70 0.039 to 2.756 1 to 35 0.039 to 1.378 1 to 35 0.039 to 1.378			NEW FD-WZ7HB
	Long sensing range - Rectangular head  W5.2 x H5.5 x D15 W0.205 x H0.374 x D0.591	120 to 660 0.787 to 25.984 20 to 480 0.787 to 18.898 20 to 300 0.787 to 11.811 20 to 230 0.787 to 9.055	20 to 170 0.787 to 6.693 25 to 90 0.984 to 3.543 25 to 100 0.984 to 3.937	φ0.3 mm φ0.012 in copper wire	2 m 6.562 ft	FD-WKZ1
		230 9.055 200 7.874 150 5.906 150 5.906	100 3.937 45 1.772 50 1.969	φ0.02 mm φ0.0008 in gold wire	2 m 6.562 ft	FD-A15
	Wide beam  W7 x H15 x D30 W0.276 x H0.591 x D1.181	290 11.417 220 8.661 135 5.315 110 4.331	78 3.071 35 1.378 39 1.535	φ0.02 mm φ0.0008 in gold wire	2 m 6.562 ft	FD-AFM2 FD-AFM2E
Special	Top sensing  W5 x H20 x D20 W0.197 x H0.787 x D0.787					
	Side sensing  W5 x H20 x D20 W0.197 x H0.787 x D0.787					
Liquid level sensing	Contact type  φ6 φ0.236					
	Mountable on pipe - Standard  W25 x H13 x D20 W0.984 x H0.512 x D0.787	Applicable pipe diameter: Outer dia. φ6 to φ26 mm φ0.236 to φ1.024 in transparent pipe [PVC (vinyl chloride), fluorine resin, polycarbonate, acrylic, glass, wall thickness 1 to 3 mm 0.039 to 0.118 in]	(Liquid)	2 m 6.562 ft (Note 5)	Protective tube R40 mm R1.575 in Fiber R15 mm R0.591 in	FD-F8Y
		Applicable pipe diameter: Outer dia. φ6 to φ26 mm φ0.236 to φ1.024 in transparent pipe [PFA (fluorine resin) or equivalently transparent pipe, wall thickness 1 mm 0.039 in]		2 m 6.562 ft	R10 mm R0.394 in	FD-F41 FD-F4

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-WKZ1, FD-AFM2, FD-AFM2E: 400 × 400 mm 15.478 × 15.478 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 1,000 mm 39.370 in from the end that the amplifier inserted.

## LIST OF FIBERS

## 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)	<div> <div> : U-LG : LONG : STDF : STD </div> <div> : FAST : H-SP : S-D </div> </div>	Min. sensing object (Note 4)	Fiber cable length ✂: Free-cut	Bending radius	Model No.
Special	350 °C 662 °F • Coaxial M6				2 m 6.562 ft	R25 mm R0.984 in	FD-H35-M2
	350 °C 662 °F • Sleeve 60 mm 2.362 in M6 φ2.8 φ0.110	300 11.811 270 10.630 150 5.906 140 5.512	100 3.937 35 1.378 47 1.850			Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in	FD-H35-M2S6
	200 °C 392 °F • Coaxial M6					R25 mm R0.984 in	FD-H20-M1
	350 °C 662 °F • Sleeve 90 mm 3.543 in M4 φ2.1 φ0.083	190 7.480 160 6.299 80 3.150 80 3.150	57 2.244 20 0.787 126 1.024		1 m 3.281 ft	Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in	FD-H35-20S
	200 °C 392 °F • Coaxial M4	300 11.811 270 10.630 150 5.906 140 5.512	100 3.937 35 1.378 47 1.850				FD-H20-21
	300 °C 572 °F • Glass substrate detection Convergent reflective type W19 X H27 X D5 W0.748 X H1.063 X D0.197	0 to 20 0 to 0.787 0 to 15 0 to 0.591 0 to 10 0 to 0.394 0 to 10 0 to 0.394	1 to 8 0.039 to 0.315 Cannot use 12 to 6 0.079 to 0.236		2 m 6.562 ft	R25 mm R0.984 in	FD-H30-L32
	180 °C 356 °F • Glass substrate detection Convergent reflective type W19 X H27 X D5 W0.748 X H1.063 X D0.197	0 to 20 0 to 0.787 0 to 15 0 to 0.591 0 to 10 0 to 0.394 0 to 10 0 to 0.394	1 to 8 0.039 to 0.315 Cannot use 12 to 6 0.079 to 0.236		2 m 6.562 ft		FD-H18-L31
	130 °C 266 °F M6	410 16.142 310 12.205 200 7.874 140 5.512	100 3.937 55 2.165 47 1.850				FD-H13-FM2
	300 °C 572 °F • Rectangular head W9.5 X H5.2 X D15 W0.374 X H0.205 X D0.591	20 to 300 0.787 to 11.811 20 to 200 0.787 to 7.874 20 to 150 0.787 to 5.906 25 to 130 0.984 to 5.118	Cannot use Cannot use 30 to 100 1.181 to 3.937		1 m 3.281 ft	R18 mm R0.709 in	FD-H30-KZ1V-S (Note 5)
	300 °C 572 °F • Glass substrate detection Convergent reflective type W19 X H5 X D27 W0.748 X H0.197 X D1.063	0 to 11 0 to 0.433 0 to 8 0 to 0.315 1.5 to 6 0.059 to 0.236 1.5 to 5 0.059 to 0.197	2 to 4 0.079 to 0.157 Cannot use Cannot use		3 m 9.843 ft		FD-H30-L32V-S (Note 5)

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 (FD-H30-L32, FD-H18-L31: 50 × 50 mm 1.969 × 1.969 in glass substrate, FD-H30-KZ1V-S, FD-H30-L32V-S: 100 × 100 × t 0.7 mm 3.937 × 3.937 × t 0.028 in transparent glass)] 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.

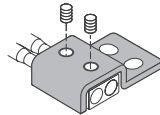
4) The minimum sensing object size is the value for red LED type at maximum sensitivity. Note that the corresponding setting distance is different from the rated sensing distance.

5) 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 vacuum-resistant fibers individually as replacement parts

• Vacuum-resistant fiber  
 FD-H30-KZ1V  
 FD-H30-L32V

• Mounting bracket for FD-H30-KZ1V  
 MS-FD-2



• Photo-terminal  
 FV-BR1 (one pair set)

• Fiber at atmospheric side  
 FT-J8 (one pair set)

## Accessories (attached with fibers)

RF-003 (FR-KZ21/KZ21E exclusive mirror)

RF-13 (Reflective tape)

FX-CT1 (Fiber cutter)

FX-CT2 (Fiber cutter)

FX-AT2 (Attachment for fixed-length fiber, Orange)

FX-AT3 (Attachment for φ2.2 mm φ0.087 in fiber, Clear orange)

FX-AT4 (Attachment for φ1 mm φ0.039 in fiber, Black)

FX-AT5 (Attachment for φ1.3 mm φ0.051 in fiber, Gray)

FX-AT6 (Attachment for φ1 mm φ0.039 in / φ1.3 mm φ0.051 in mixed fiber, Black / Gray)

If connecting to a fiber amplifier other than the FX-300 series

Applicable fiber amplifiers: FX2 / FX3 series

FX-AT10 (Attachment for φ1 mm φ0.039 in fiber)

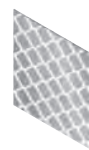
FX-AT13 (Attachment for φ1.3 mm φ0.051 in fiber)

FX-AT15 (Attachment for φ1 mm φ0.039 in / φ1.3 mm φ0.051 in mixed fiber)

• RF-003



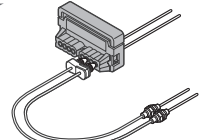
• RF-13



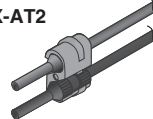
• FX-CT1



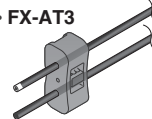
• FX-CT2



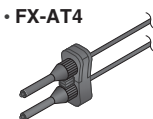
• FX-AT2



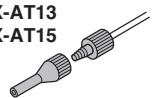
• FX-AT3



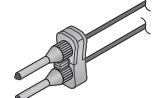
• FX-AT4



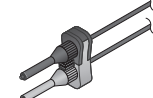
• FX-AT10  
 • FX-AT13  
 • FX-AT15



• FX-AT5



• FX-AT6



SUNX

## LIST OF SENSING RANGE FOR FX-301(P)-HS・FX-301B/G/H

Sensing range for ultra high-speed type FX-301(P)-HS in H-SP mode (35  $\mu$ s)(Typical model)

	Fiber model No.	Sensing range (mm in) (Note)		Fiber model No.	Sensing range (mm in) (Note)
Thru-beam type	FT-B8	160 6.299	Reflective type	FD-B8	60 2.362
	FT-FM2	120 4.724		FD-FM2	35 1.378
	FT-NFM2	40 1.575		FD-NFM2	14 0.551
	FT-E12	2 0.079		FD-E12	1 0.039
	FT-E22	10 0.394		FD-E22	5 0.197

Note: The sensing ranges are in H-SP mode. The sensing ranges in FAST, STD, S-D and LONG modes are the same as for the FX-301. (Refer to p.18~)

## Sensing range for FX-301B/G/H (Typical model)

(mm in)

		Thru-beam type										
		FT-B8	FT-FM2	FT-NFM2	FT-V10	FT-W8	FT-Z8	FT-P80	FT-A30	FT-A8	FT-E12	FT-E22
FX-301B	LONG	220 8.661	150 5.906	50 1.969	400 15.748	90 3.543	120 4.724	130 5.118	2,400 94.488	600 23.622	3 0.118	14 0.551
	STD	110 4.331	75 2.953	25 0.984	200 7.874	45 1.772	60 2.362	65 2.559	1,200 47.244	300 11.811	2 0.079	7 0.276
	FAST	75 2.953	40 1.575	16 0.630	130 5.118	30 1.181	40 1.575	45 1.772	700 27.559	220 8.661	1 0.039	4 0.157
FX-301G	LONG	110 4.331	70 2.756	24 0.945	200 7.874	56 2.205	60 2.362	70 2.756	1,200 47.244	300 11.811	1 0.039	6 0.236
	STD	55 2.165	35 1.378	12 0.472	100 3.937	28 1.102	30 1.181	35 1.378	600 23.622	150 5.906	—	3 0.118
	FAST	40 1.575	24 0.945	8 0.315	65 2.559	20 0.787	22 0.866	25 0.984	350 13.780	110 4.331	—	2 0.079
FX-301H (Note)	LONG	100 3.937	50 1.969	16 0.630	150 5.906	42 1.654	46 1.811	56 2.205	800 31.496	220 8.661	4 0.157	10 0.394
	STD	50 1.969	25 0.984	8 0.315	75 2.953	21 0.827	23 0.906	28 1.102	400 15.748	110 4.331	2 0.079	5 0.197
	FAST	30 1.181	18 0.709	5 0.197	40 1.575	15 0.591	16 0.630	20 0.787	240 9.449	80 3.150	1.5 0.059	3 0.118

Note: Infrared types are easily affected by humidity, so if using them in environments with high humidity or where the humidity fluctuates, please contact our office.

(mm in)

		Reflective type										
		FD-B8	FD-FM2	FD-NFM2	FD-W8	FD-P80	FD-AFM2	FD-G4	FD-EG1	FD-E12	FD-E22	FD-G6X
FX-301B	LONG	80 3.150	46 1.811	16 0.630	23 0.906	40 1.575	40 1.575	22 0.866	6 0.236	2 0.079	6 0.236	22 0.866
	STD	40 1.575	23 0.906	8 0.315	11 0.433	20 0.787	20 0.787	11 0.433	3 0.118	1 0.039	3 0.118	11 0.433
	FAST	26 1.024	15 0.591	5 0.197	8 0.315	13 0.512	13 0.512	8 0.315	2 0.079	—	2 0.079	6 0.236
FX-301G	LONG	42 1.654	24 0.945	8 0.315	14 0.551	20 0.787	18 0.709	12 0.472	3 0.118	1 0.039	3 0.118	12 0.472
	STD	21 0.827	12 0.472	4 0.157	7 0.276	10 0.394	9 0.354	6 0.236	1.5 0.059	—	1.5 0.059	6 0.236
	FAST	14 0.551	8 0.315	2 0.079	4 0.157	7 0.276	5 0.197	4 0.157	1 0.039	—	1 0.039	4 0.157
FX-301H (Note)	LONG	26 1.024	20 0.787	6 0.236	11 0.433	18 0.709	12 0.472	7 0.276	10 0.394	1 0.039	6 0.236	18 0.709
	STD	13 0.512	10 0.394	3 0.118	5.5 0.217	9 0.354	6 0.236	3.5 0.138	5 0.197	—	3 0.118	9 0.354
	FAST	9 0.354	7 0.276	2 0.079	3 0.118	6 0.236	4 0.157	2 0.079	3 0.118	—	2 0.079	5 0.197

Note: Infrared types are easily affected by humidity, so if using them in environments with high humidity or where the humidity fluctuates, please contact our office.

## Sensing range when using in combination with FR-WKZ11 reflector (optional)

The sensing ranges are the values for FX-305 / FX-301 infrared types.


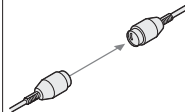


(mm in)

RF-230	100 to 3,200 3.937 to 125.984 (LONG), 100 to 2,000 3.937 to 78.740 (STD), 100 to 1,600 3.937 to 62.992 (FAST), 100 to 1,000 3.937 to 39.370 (S-D)
RF-220	100 to 2,400 3.937 to 94.488 (LONG), 100 to 1,300 3.937 to 51.181 (STD), 100 to 1,000 3.937 to 39.370 (FAST), 100 to 600 3.937 to 23.622 (S-D)
RF-210	100 to 1,100 3.937 to 43.307 (LONG), 100 to 700 3.937 to 27.559 (STD), 100 to 550 3.937 to 21.654 (FAST), 100 to 300 3.937 to 11.811 (S-D)

Note: The sensing range indicates the allowable setting range for the reflector. The fiber head can detect objects at distances of 100 mm 3.937 in or less.  
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 before use.

## FIBER OPTIONS


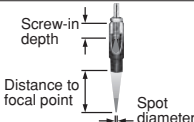
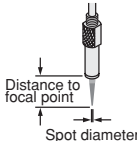
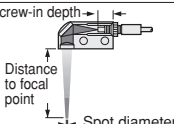
## Lens (For thru-beam type fiber)

Designation	Model No.	Description																																																																																																											
Expansion lens (Note 1)	FX-LE1		Increases the sensing range by 5 times or more.  • Ambient temperature: — 60 to + 350 °C — 76 to + 662 °F																																																																																																										
		<b>Sensing range for red LED type (mm) [Lens on both sides] (Note 3)</b> <table><tr><th>Fiber</th><th>Mode</th><th>U-LG</th><th>LONG</th><th>STDF</th><th>STD</th><th>FAST</th><th>S-D</th><th>H-SP</th></tr><tr><td>FT-B8</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,000</td><td>2,500</td><td>2,000</td><td>1,000</td><td>1,000</td></tr><tr><td>FT-FM2</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>2,500</td><td>1,300</td><td>1,000</td></tr><tr><td>FT-T80</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>2,500</td><td>1,300</td><td>1,000</td></tr><tr><td>FT-R80</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>2,300</td><td>1,600</td><td>800</td><td>750</td></tr><tr><td>FT-W8</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>2,900</td><td>2,000</td><td>1,000</td><td>900</td></tr><tr><td>FT-P80</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>2,500</td><td>1,100</td><td>1,000</td></tr><tr><td>FT-P60</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>1,500</td><td>900</td><td>800</td></tr><tr><td>FT-P81X</td><td></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,100</td><td>950</td></tr><tr><td>FT-H35-M2</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>2,500</td><td>2,000</td><td>1,500</td><td>750</td><td>700</td></tr><tr><td>FT-H20W-M1</td><td></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,300</td><td>900</td><td>500</td><td>400</td></tr><tr><td>FT-H20-M1</td><td></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,100</td><td>900</td><td>600</td></tr></table>		Fiber	Mode	U-LG	LONG	STDF	STD	FAST	S-D	H-SP	FT-B8		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,000	2,500	2,000	1,000	1,000	FT-FM2		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	2,500	1,300	1,000	FT-T80		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	2,500	1,300	1,000	FT-R80		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	2,300	1,600	800	750	FT-W8		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	2,900	2,000	1,000	900	FT-P80		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	2,500	1,100	1,000	FT-P60		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	1,500	900	800	FT-P81X		1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,100	950	FT-H35-M2		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	2,500	2,000	1,500	750	700	FT-H20W-M1		1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,300	900	500	400	FT-H20-M1		1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,100
Fiber	Mode	U-LG	LONG	STDF	STD	FAST	S-D	H-SP																																																																																																					
FT-B8		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,000	2,500	2,000	1,000	1,000																																																																																																					
FT-FM2		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	2,500	1,300	1,000																																																																																																					
FT-T80		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	2,500	1,300	1,000																																																																																																					
FT-R80		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	2,300	1,600	800	750																																																																																																					
FT-W8		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	2,900	2,000	1,000	900																																																																																																					
FT-P80		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	2,500	1,100	1,000																																																																																																					
FT-P60		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	1,500	900	800																																																																																																					
FT-P81X		1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,100	950																																																																																																					
FT-H35-M2		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	2,500	2,000	1,500	750	700																																																																																																					
FT-H20W-M1		1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,300	900	500	400																																																																																																					
FT-H20-M1		1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,100	900	600																																																																																																					
Super-expansion lens (Note 1)	FX-LE2		Tremendously increases the sensing range with large diameter lenses.  • Ambient temperature: — 60 to + 350 °C — 76 to + 662 °F																																																																																																										
		<b>Sensing range for red LED type (mm) [Lens on both sides] (Note 3)</b> <table><tr><th>Fiber</th><th>Mode</th><th>U-LG</th><th>LONG</th><th>STDF</th><th>STD</th><th>FAST</th><th>S-D</th><th>H-SP</th></tr><tr><td>FT-B8</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td></tr><tr><td>FT-FM2</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td></tr><tr><td>FT-R80</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td></tr><tr><td>FT-W8</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td></tr><tr><td>FT-P80</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td></tr><tr><td>FT-P60</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td></tr><tr><td>FT-P81X</td><td></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td></tr><tr><td>FT-H35-M2</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td></tr><tr><td>FT-H20W-M1</td><td></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,500</td><td>1,600 <small>Note 2</small></td></tr><tr><td>FT-H20-M1</td><td></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td><td>1,600 <small>Note 2</small></td></tr><tr><td>FT-H13-FM2</td><td></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td><td>3,500 <small>Note 2</small></td></tr></table>		Fiber	Mode	U-LG	LONG	STDF	STD	FAST	S-D	H-SP	FT-B8		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	FT-FM2		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	FT-R80		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	FT-W8		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	FT-P80		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	FT-P60		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	FT-P81X		1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	FT-H35-M2		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	FT-H20W-M1		1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,500	1,600 <small>Note 2</small>	FT-H20-M1		1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	FT-H13-FM2		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>
Fiber	Mode	U-LG	LONG	STDF	STD	FAST	S-D	H-SP																																																																																																					
FT-B8		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>																																																																																																					
FT-FM2		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>																																																																																																					
FT-R80		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>																																																																																																					
FT-W8		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>																																																																																																					
FT-P80		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>																																																																																																					
FT-P60		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>																																																																																																					
FT-P81X		1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>																																																																																																					
FT-H35-M2		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>																																																																																																					
FT-H20W-M1		1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,500	1,600 <small>Note 2</small>																																																																																																					
FT-H20-M1		1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>	1,600 <small>Note 2</small>																																																																																																					
FT-H13-FM2		3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>	3,500 <small>Note 2</small>																																																																																																					
Side-view lens	FX-SV1		Beam axis is bent by 90 °.  • Ambient temperature: — 60 to + 300 °C — 76 to + 572 °F																																																																																																										
		<b>Sensing range for red LED type (mm) [Lens on both sides] (Note 3)</b> <table><tr><th>Fiber</th><th>Mode</th><th>LONG</th><th>STD</th><th>FAST</th><th>S-D</th></tr><tr><td>FT-B8</td><td></td><td>1,100</td><td>530</td><td>400</td><td>186</td></tr><tr><td>FT-FM2</td><td></td><td>1,200</td><td>600</td><td>440</td><td>210</td></tr><tr><td>FT-T80</td><td></td><td>1,200</td><td>600</td><td>440</td><td>210</td></tr><tr><td>FT-W8</td><td></td><td>900</td><td>450</td><td>330</td><td>160</td></tr><tr><td>FT-P80</td><td></td><td>1,200</td><td>600</td><td>440</td><td>210</td></tr><tr><td>FT-P60</td><td></td><td>650</td><td>300</td><td>200</td><td>130</td></tr><tr><td>FT-P81X</td><td></td><td>1,200</td><td>600</td><td>440</td><td>200</td></tr><tr><td>FT-H35-M2</td><td></td><td>550</td><td>280</td><td>200</td><td>90</td></tr><tr><td>FT-H20W-M1</td><td></td><td>310</td><td>140</td><td>100</td><td>50</td></tr><tr><td>FT-H20-M1</td><td></td><td>550</td><td>280</td><td>200</td><td>90</td></tr></table>		Fiber	Mode	LONG	STD	FAST	S-D	FT-B8		1,100	530	400	186	FT-FM2		1,200	600	440	210	FT-T80		1,200	600	440	210	FT-W8		900	450	330	160	FT-P80		1,200	600	440	210	FT-P60		650	300	200	130	FT-P81X		1,200	600	440	200	FT-H35-M2		550	280	200	90	FT-H20W-M1		310	140	100	50	FT-H20-M1		550	280	200	90																																								
Fiber	Mode	LONG	STD	FAST	S-D																																																																																																								
FT-B8		1,100	530	400	186																																																																																																								
FT-FM2		1,200	600	440	210																																																																																																								
FT-T80		1,200	600	440	210																																																																																																								
FT-W8		900	450	330	160																																																																																																								
FT-P80		1,200	600	440	210																																																																																																								
FT-P60		650	300	200	130																																																																																																								
FT-P81X		1,200	600	440	200																																																																																																								
FT-H35-M2		550	280	200	90																																																																																																								
FT-H20W-M1		310	140	100	50																																																																																																								
FT-H20-M1		550	280	200	90																																																																																																								
Expansion lens for vacuum fiber (Note 1)	FV-LE1		Sensing range increases by 10 times or more. • Ambient temperature: — 40 to + 120 °C — 40 to + 248 °F																																																																																																										
		<b>Sensing range for red LED type (mm) [Lens on both sides] (Note 3, 4)</b> <table><tr><th>Fiber</th><th>Mode</th><th>U-LG</th><th>LONG</th><th>STDF</th><th>STD</th><th>FAST</th><th>S-D</th><th>H-SP</th></tr><tr><td>FT-H30-M1V</td><td></td><td>1,600</td><td>1,200</td><td>650</td><td>450</td><td>300</td><td>150</td><td>200</td></tr></table>		Fiber	Mode	U-LG	LONG	STDF	STD	FAST	S-D	H-SP	FT-H30-M1V		1,600	1,200	650	450	300	150	200																																																																																								
Fiber	Mode	U-LG	LONG	STDF	STD	FAST	S-D	H-SP																																																																																																					
FT-H30-M1V		1,600	1,200	650	450	300	150	200																																																																																																					

Notes: 1) Be careful when installing the thru-beam type fiber equipped with the expansion lens, as the beam envelope becomes narrow and alignment is difficult. Especially when installing a fiber with many cores (sharp bending fibers and heat-resistant glass fiber), please be sure to use it only after you have adjusted it sufficiently.  
2) The fiber cable length practically limits the sensing range to 3,500 mm 137.795 in long (FT-H20W-M1, FT-P81X and FT-H20-M1: 1,600 mm 62.992 in).  
3) The sensing ranges are the values for red LED type amplifier. Please contact our office for details on sensing ranges for other types of amplifiers.  
4) The fiber cable length for the FT-H30-M1V is 1 m 3.281 ft. The sensing ranges in U-LG and LONG modes take into account the length of the FT-J8 atmospheric side fiber.

## Lens (For reflective type fiber)

For reflective type fiber

Designation	Model No.	Description																
Pinpoint spot lens	FX-MR1		Pinpoint spot of $\phi 0.5$ mm $\phi 0.020$ in. Enables detection of minute objects or small marks. <ul style="list-style-type: none"><li>Distance to focal point: <math>6 \pm 1</math> mm <math>0.236 \pm 0.039</math> in</li><li>Applicable fibers: <b>FD-WG4, FD-G4</b></li><li>Ambient temperature: <math>-40</math> to <math>+70</math> °C <math>-40</math> to <math>+158</math> °F</li></ul>															
Zoom lens	FX-MR2		The spot diameter is adjustable from $\phi 0.7$ mm to $\phi 2$ mm $\phi 0.028$ in to $\phi 0.079$ in according to how much the fiber is screwed in. <ul style="list-style-type: none"><li>Applicable fibers: <b>FD-WG4, FD-G4</b></li><li>Ambient temperature: <math>-40</math> to <math>+70</math> °C <math>-40</math> to <math>+158</math> °F</li><li>Accessory: <b>MS-EX-3</b> (mounting bracket)</li></ul> <b>Sensing range for red LED type (Note)</b> <table><tr><th>Screw-in depth</th><th>Distance to focal point</th><th>Spot diameter</th></tr><tr><td>7 mm</td><td>18.5 mm approx.</td><td><math>\phi 0.7</math> mm</td></tr><tr><td>12 mm</td><td>27 mm approx.</td><td><math>\phi 1.2</math> mm</td></tr><tr><td>14 mm</td><td>43 mm approx.</td><td><math>\phi 2.0</math> mm</td></tr></table>	Screw-in depth	Distance to focal point	Spot diameter	7 mm	18.5 mm approx.	$\phi 0.7$ mm	12 mm	27 mm approx.	$\phi 1.2$ mm	14 mm	43 mm approx.	$\phi 2.0$ mm			
Screw-in depth	Distance to focal point	Spot diameter																
7 mm	18.5 mm approx.	$\phi 0.7$ mm																
12 mm	27 mm approx.	$\phi 1.2$ mm																
14 mm	43 mm approx.	$\phi 2.0$ mm																
Finest spot lens	FX-MR3		Extremely fine spot of $\phi 0.3$ mm $\phi 0.012$ in approx. achieved. <ul style="list-style-type: none"><li>Applicable fibers: <b>FD-WG4, FD-G4, FD-EG1, FD-EG2, FD-EG3, FD-G6X, FD-G6</b></li><li>Ambient temperature: <math>-40</math> to <math>+70</math> °C <math>-40</math> to <math>+158</math> °F</li></ul> <b>Sensing range for red LED type (Note)</b> <table><tr><th>Fiber model No.</th><th>Distance to focal point</th><th>Spot diameter</th></tr><tr><td>FD-EG3</td><td><math>7.5 \pm 0.5</math> mm</td><td><math>\phi 0.15</math> mm approx.</td></tr><tr><td>FD-EG2</td><td><math>7.5 \pm 0.5</math> mm</td><td><math>\phi 0.2</math> mm approx.</td></tr><tr><td>FD-EG1</td><td><math>7.5 \pm 0.5</math> mm</td><td><math>\phi 0.3</math> mm approx.</td></tr><tr><td>FD-WG4/G4/G6X/G6</td><td><math>7.5 \pm 0.5</math> mm</td><td><math>\phi 0.5</math> mm approx.</td></tr></table>	Fiber model No.	Distance to focal point	Spot diameter	FD-EG3	$7.5 \pm 0.5$ mm	$\phi 0.15$ mm approx.	FD-EG2	$7.5 \pm 0.5$ mm	$\phi 0.2$ mm approx.	FD-EG1	$7.5 \pm 0.5$ mm	$\phi 0.3$ mm approx.	FD-WG4/G4/G6X/G6	$7.5 \pm 0.5$ mm	$\phi 0.5$ mm approx.
Fiber model No.	Distance to focal point		Spot diameter															
FD-EG3	$7.5 \pm 0.5$ mm	$\phi 0.15$ mm approx.																
FD-EG2	$7.5 \pm 0.5$ mm	$\phi 0.2$ mm approx.																
FD-EG1	$7.5 \pm 0.5$ mm	$\phi 0.3$ mm approx.																
FD-WG4/G4/G6X/G6	$7.5 \pm 0.5$ mm	$\phi 0.5$ mm approx.																
Finest spot lens	FX-MR6	Extremely fine spot of $\phi 0.1$ mm $\phi 0.004$ in approx. achieved. <ul style="list-style-type: none"><li>Applicable fibers: <b>FD-WG4, FD-G4, FD-EG1, FD-EG2, FD-EG3, FD-G6X, FD-G6</b></li><li>Ambient temperature: <math>-20</math> to <math>+60</math> °C <math>-4</math> to <math>+140</math> °F</li></ul> <b>Sensing range for red LED type (Note)</b> <table><tr><th>Fiber model No.</th><th>Distance to focal point</th><th>Spot diameter</th></tr><tr><td>FD-EG3</td><td><math>7 \pm 0.5</math> mm</td><td><math>\phi 0.1</math> mm approx.</td></tr><tr><td>FD-EG2</td><td><math>7 \pm 0.5</math> mm</td><td><math>\phi 0.15</math> mm approx.</td></tr><tr><td>FD-EG1</td><td><math>7 \pm 0.5</math> mm</td><td><math>\phi 0.2</math> mm approx.</td></tr><tr><td>FD-WG4/G4/G6X/G6</td><td><math>7 \pm 0.5</math> mm</td><td><math>\phi 0.4</math> mm approx.</td></tr></table>	Fiber model No.	Distance to focal point	Spot diameter	FD-EG3	$7 \pm 0.5$ mm	$\phi 0.1$ mm approx.	FD-EG2	$7 \pm 0.5$ mm	$\phi 0.15$ mm approx.	FD-EG1	$7 \pm 0.5$ mm	$\phi 0.2$ mm approx.	FD-WG4/G4/G6X/G6	$7 \pm 0.5$ mm	$\phi 0.4$ mm approx.	
Fiber model No.	Distance to focal point	Spot diameter																
FD-EG3	$7 \pm 0.5$ mm	$\phi 0.1$ mm approx.																
FD-EG2	$7 \pm 0.5$ mm	$\phi 0.15$ mm approx.																
FD-EG1	$7 \pm 0.5$ mm	$\phi 0.2$ mm approx.																
FD-WG4/G4/G6X/G6	$7 \pm 0.5$ mm	$\phi 0.4$ mm approx.																
Zoom lens (Side-view) type	FX-MR5		<b>FX-MR2</b> is converted into a side-view type and can be mounted in a very small space. <ul style="list-style-type: none"><li>Applicable fibers: <b>FD-WG4, FD-G4</b></li><li>Ambient temperature: <math>-40</math> to <math>+70</math> °C <math>-40</math> to <math>+158</math> °F</li></ul> <b>Sensing range for red LED type (Note)</b> <table><tr><th>Screw-in depth</th><th>Distance to focal point</th><th>Spot diameter</th></tr><tr><td>8 mm</td><td>13 mm approx.</td><td><math>\phi 0.5</math> mm</td></tr><tr><td>10 mm</td><td>15 mm approx.</td><td><math>\phi 0.8</math> mm</td></tr><tr><td>14 mm</td><td>30 mm approx.</td><td><math>\phi 3.0</math> mm</td></tr></table>	Screw-in depth	Distance to focal point	Spot diameter	8 mm	13 mm approx.	$\phi 0.5$ mm	10 mm	15 mm approx.	$\phi 0.8$ mm	14 mm	30 mm approx.	$\phi 3.0$ mm			
Screw-in depth	Distance to focal point	Spot diameter																
8 mm	13 mm approx.	$\phi 0.5$ mm																
10 mm	15 mm approx.	$\phi 0.8$ mm																
14 mm	30 mm approx.	$\phi 3.0$ mm																

Note: The sensing ranges are the values when used in combination with red LED type amplifier. Please contact our office for details on sensing ranges for other types of amplifier.



## FIBER OPTIONS

### Others

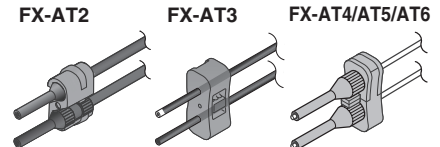
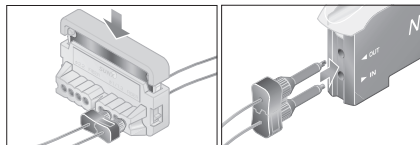
Designation	Model No.	Description			
Protective tube (For thru-beam) type fiber	FTP-500 (0.5 m 1.640 ft)	For M4 thread	Applicable fibers	FT-B8      FT-P80 FT-FM2    FT-P60 FT-FM2S   FT-FM2S4 FT-H13-FM2	The protective tube, made of non-corrosive stainless steel, protects the inner fiber cable from any external forces.
	FTP-1000 (1 m 3.281 ft)				
	FTP-1500 (1.5 m 4.921 ft)				
	FTP-N500 (0.5 m 1.640 ft)	FT-T80      FT-P40 FT-NFM2    FD-T40 FT-NFM2S   FD-P40 FT-NFM2S4			
	FTP-N1000 (1 m 3.281 ft)				
	FTP-N1500 (1.5 m 4.921 ft)				
Protective tube (For reflective) type fiber	FDP-500 (0.5 m 1.640 ft)	For M6 thread		FD-B8      FD-P80 FD-FM2    FT-H13-FM2 FD-FM2S FD-FM2S4	
	FDP-1000 (1 m 3.281 ft)				
	FDP-1500 (1.5 m 4.921 ft)				
	FDP-N500 (0.5 m 1.640 ft)	FD-T80 FD-NFM2 FD-NFM2S FD-NFM2S4			
	FDP-N1000 (1 m 3.281 ft)				
	FDP-N1500 (1.5 m 4.921 ft)				
Fiber bender	FB-1	The fiber bender bends the sleeve part of the fiber head at the proper radius. (Note)			
Universal sensor mounting stand	MS-AJ1-F	Horizontal mounting type		Mounting stand assembly for fiber (For M3, M4 or M6 threaded head fiber)	
	MS-AJ2-F	Vertical mounting type			
Fiber cutter	FX-CT2	The free-cut type fiber can be easily cut. [Accessory. <b>FX-CT1</b> is attached with the <b>FT-P80</b> or the <b>FD-P80</b> . The <b>FX-CT2</b> is provided with fibers other than this.]			
	FX-CT1				
Attachment for fixed-length fiber	FX-AT2	This is the attachment for the fixed length fiber. (Accessory)			
Attachment for $\phi 2.2$ mm $\phi 0.087$ in fiber	FX-AT3	This is the attachment for the $\phi 2.2$ mm $\phi 0.087$ in fiber. (Accessory. Does not attach with the <b>FT-P80</b> or the <b>FD-P80</b> .)			
Attachment for $\phi 1$ mm $\phi 0.039$ in fiber	FX-AT4	This is the attachment for the $\phi 1$ mm $\phi 0.039$ in fiber. (Accessory)			
Attachment for $\phi 1.3$ mm $\phi 0.051$ in fiber	FX-AT5	This is the attachment for the $\phi 1.3$ mm $\phi 0.051$ in fiber. (Accessory)			
Attachment for $\phi 1$ mm $\phi 0.039$ in / $\phi 1.3$ mm $\phi 0.051$ in mixed fiber	FX-AT6	This is the attachment for the $\phi 1$ mm $\phi 0.039$ in / $\phi 1.3$ mm $\phi 0.051$ in mixed fiber. (Accessory)			

Note: Do not bend the sleeve part of any side-view type fiber or ultra-small diameter head type fiber.

### Fiber attachment

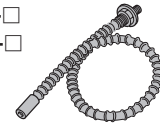
#### It's possible to simultaneously cut two fibers to the same length

Each fiber (with some exceptions) has a newly developed two-in-one fiber attachment (**FX-AT3/AT4/AT5/AT6**) which enables two fibers to be cut simultaneously to the same length with the new fiber cutter (**FX-CT2**). Also, since the fibers can be attached to the amplifier while being fixed in position in the two-in-one fiber attachment, sensitivity changes resulting from variation in the amount of fiber insertion do not occur.



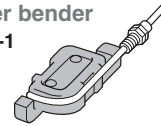
### Protective tube

- **FTP-**☐
- **FDP-**☐



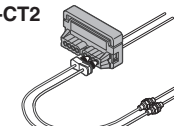
### Fiber bender

- **FB-1**

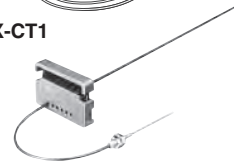


### Fiber cutter

- **FX-CT2**



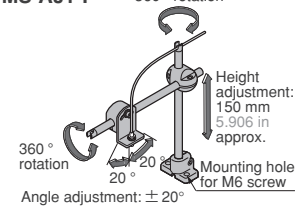
- **FX-CT1**



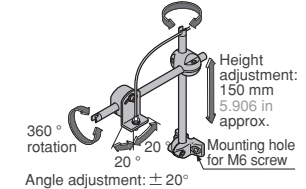
### Universal sensor mounting stand

Using the arm which enables adjustment in the horizontal direction, sensing can also be done from above an assembly line.

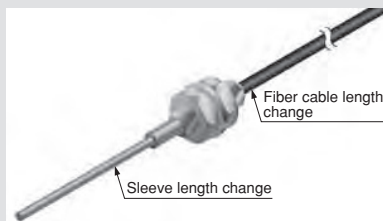
- **MS-AJ1-F**    360° rotation



- **MS-AJ2-F**    360° rotation



## Guide to interchanging fiber length and sleeve length



Custom-ordered products are available with different fiber lengths and sleeve lengths in order to respond quickly to different requirements.

### Custom-ordered product (Typical)

- Fiber length can be set up to 30 m 98.425 ft in units of 1 m 3.281 ft ..... **FT-B8**, **FT-AFM2** etc.
- Sleeve length can be set up to 12 cm 4.724 in in units of 1 cm 0.394 in ..... **FT-FM2S4**, **FD-NFM2S4** etc.

Please contact us.



## SPECIFICATIONS

Refer to the 'Sensor general catalog 2003-2004' for fiber specifications.

		Type	Standard type				High-speed type	High-function type		
			Red LED	Blue LED	Green LED	Infrared LED				
Item	Model No.	NPN output	FX-301	FX-301B	FX-301G	FX-301H	FX-301-HS	FX-305		
		PNP output	FX-301P	FX-301BP	FX-301GP	FX-301HP	FX-301P-HS	FX-305P		
Supply voltage			12 to 24 V DC $\pm$ 10 % Ripple P-P 10 % or less							
Power consumption			<Red LED / Infrared LED type> Normal operation: 960 mW or less (Current consumption 40 mA or less at 24 V supply voltage) ECO mode: 600 mW or less (Current consumption 25 mA or less at 24 V supply voltage)				<Blue LED / Green LED type> Normal operation: 720 mW or less (Current consumption 30 mA or less at 24 V supply voltage) ECO mode: 430 mW or less (Current consumption 18 mA or less at 24 V supply voltage)			
Output			<NPN output type> NPN open-collector transistor • Maximum sink current: 100 mA (50 mA, if five, or more, amplifiers are connected in cascade.) • Applied voltage: 30 V DC or less (between output and 0 V) • Residual voltage: 1.5 V or less [at 100 mA (at 50 mA, if five, or more, amplifiers are connected in cascade) sink current.]  <PNP output type> PNP open-collector transistor • Maximum source current: 100 mA (50 mA, if five, or more, amplifiers are connected in cascade.) • Applied voltage: 30 V DC or less (between output and + V) • Residual voltage: 1.5 V or less [at 100 mA (at 50 mA, if five, or more, amplifiers are connected in cascade) source current.]				<NPN output type> NPN open-collector transistor 2 outputs • Maximum sink current: 50 mA each (Note 1) • Applied voltage: 30 V DC or less (between output and 0 V) • Residual voltage: 1.5 V or less [at 50 mA (Note 1)]  <PNP output type> PNP open-collector transistor 2 outputs • Maximum source current: 50 mA each (Note 1) • Applied voltage: 30 V DC or less (between output and + V) • Residual voltage: 1.5 V or less [at 50 mA (Note 1)]			
	Output operation		Selectable either Light-ON or Dark-ON, with jog switch							
	Short-circuit protection		Incorporated							
Response time			65 $\mu$ s or less [H-SP (Red LED type only)], 150 $\mu$ s or less (FAST), 250 $\mu$ s or less [STD / S-D (Red LED type only)], 2 ms or less (LONG), selectable with jog switch				35 $\mu$ s or less (H-SP), 150 $\mu$ s or less (FAST), 250 $\mu$ s or less (STD / S-D), 2 ms or less (LONG), selectable with jog switch	65 $\mu$ s or less (H-SP), 150 $\mu$ s or less (FAST), 250 $\mu$ s or less (STD), 700 $\mu$ s or less (STDF), 2.5 ms or less (LONG), 4.5 ms or less (U-LG), selectable with jog switch		
Sensitivity setting			2-level teaching / Limit teaching / Manual adjustment / Full-auto teaching / Max. sensitivity teaching				Normal mode: 2-level teaching / Limit teaching / Full-auto teaching / Max. sensitivity teaching / Manual adjustment Window comparator mode: Teaching (1-level / 2-level / 3-level) / Manual adjustment			
Operation indicator			Orange LED (lights up when the output is ON)							
Stability indicator			Green LED (lights up under stable light received condition or stable dark condition)				—————			
MODE indicator			RUN: Green LED, TEACH · ADJ · L/D ON · TIMER · PRO: Yellow LED							
Digital display			4 digit red LED display							
Fine sensitivity adjustment function			Incorporated							
Timer function			Incorporated with variable ON-delay / OFF-delay / ONE-SHOT timer, switchable either effective or ineffective. [Timer period: Red LED type; 0.5 ms approx., 1 ms to 9999 ms (Blue LED, Green LED, Infrared LED type; approx. 0.5 ms to 500 ms)]				Incorporated with variable ON-delay / OFF-delay / ONE-SHOT / ON-delay · OFF-delay / ON-delay · ONE-SHOT timer, switchable either effective or ineffective. (Timer period: Output 1; 0.5 ms, 1 ms to 9999 ms, Output 2; 0.5 ms, 1 ms to 500 ms)			
Light emitting amount selection function			Incorporated (Red LED type only)(Note 2) FAST, STD, LONG: 4 level, H-SP: 3 level, S-D: 2 level				Incorporated (Note 2) FAST, STD, LONG: 4 level H-SP, S-D: 2 level	Incorporated (Note 2) FAST, STD, STDF, LONG, U-LG: 4 level H-SP: 3 level		
Automatic interference prevention function			Incorporated (Up to four sets of fiber heads can be mounted close together. However, H-SP mode is 2 fiber heads.)(Note 3)				Incorporated [Up to four sets of fiber heads can be mounted close together. (However, U-LG mode is 8 fiber heads, H-SP mode is 2 fiber heads.)(Note 4)]			
Environmental resistance	Ambient temperature		- 10 to + 55 °C + 14 to + 131 °F (If 4 to 7 units are connected in cascade: - 10 to + 50 °C + 14 to + 122 °F, if 8 to 16 units are connected in cascade: - 10 to + 45 °C + 14 to + 113 °F (No dew condensation or icing allowed), Storage: - 20 to + 70 °C - 4 to + 158 °F							
	Ambient humidity		35 to 85 % RH, Storage: 35 to 85 % RH							
	Ambient illuminance		Sunlight: 10,000 lx at the light-receiving face, Incandescent light: 3,000 lx at the light-receiving face							
	Voltage withstandability		1,000 V AC for one min. between all supply terminals connected together and enclosure (Note 5)							
	Insulation resistance		20 M $\Omega$ , or more, with 250 V DC megger between all supply terminals connected together and enclosure (Note 5)							
	Vibration resistance		10 to 150 Hz frequency, 0.75 mm 0.030 in amplitude in X, Y and Z directions for two hours each							
	Shock resistance		98 m/s <sup>2</sup> acceleration (10 G approx.) in X, Y and Z directions for five times each							
Emitting element (modulated)			Red LED	Blue LED	Green LED	Infrared LED	Red LED	Red LED		
Material			Enclosure: Heat-resistant ABS, Case cover: Polycarbonate, MODE key: Acrylic, Jog switch: Heat-resistant ABS (FX-301B/G/H: Acrylic)							
Connecting method			Connector (Note 6)							
Cable extension			Extension up to total 100 m 328.084 ft (50 m 164.042 ft for 5 to 8 units, 20 m 65.617 ft for 9 to 16 units) is possible with 0.3 mm <sup>2</sup> , or more, cable.							
Weight			Net weight: 20 g approx., Gross weight: 25 g approx.							

Notes: 1) 50 mA per output. 25 mA if five, or more, amplifiers are connected in cascade.

2) The light emitting amount can be zero (emission halt) in all modes.

3) When the power supply is switched on, the light emission timing is automatically set for interference prevention.

4) When the interference prevention function 'IP-2' is set, the number of mountable fiber heads becomes double. Furthermore, take care that the response time also becomes double.

5) The voltage withstandability and the insulation resistance values given in the above table are for the amplifier only.

6) The cable for amplifier connection is not supplied as an accessory. Make sure to use the optional quick-connection cables given below.

Main cable (3-core) for FX-301(P)-(HS): CN-73-C1 (Cable length 1 m 3.281 ft), CN-73-C2 (Cable length 2 m 6.562 ft), CN-73-C5 (Cable length 5 m 16.404 ft)

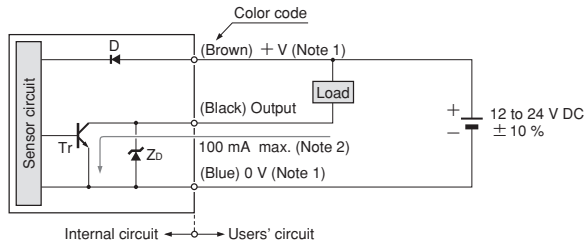
Sub cable (1-core) for FX-301(P)-(HS): CN-71-C1 (Cable length 1 m 3.281 ft), CN-71-C2 (Cable length 2 m 6.562 ft), CN-71-C5 (Cable length 5 m 16.404 ft)

Main cable (4-core) for FX-305(P): CN-74-C1 (Cable length 1 m 3.281 ft), CN-74-C2 (Cable length 2 m 6.562 ft), CN-74-C5 (Cable length 5 m 16.404 ft)

Sub cable (2-core) for FX-305(P): CN-72-C1 (Cable length 1 m 3.281 ft), CN-72-C2 (Cable length 2 m 6.562 ft), CN-72-C5 (Cable length 5 m 16.404 ft)

## I/O CIRCUIT DIAGRAMS

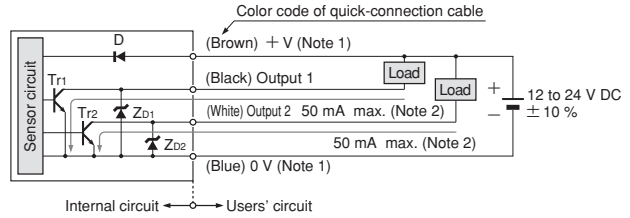
### FX-301(-HS) NPN output type



Notes: 1) The quick-connection sub cable does not have + V (brown) and 0 V (blue). The power is supplied from the connector of the main cable.  
2) 50 mA max., if five amplifiers, or more, are connected together.

Symbols ... D : Reverse supply polarity protection diode  
Zd: Surge absorption zener diode  
Tr: NPN output transistor

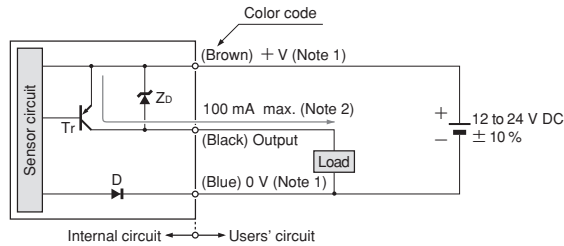
### FX-305 NPN output type



Notes: 1) The quick-connection sub cable does not have + V (brown) and 0 V (blue). The power is supplied from the connector of the main cable.  
2) 25 mA max., if five amplifiers, or more, are connected together.

Symbols ... D: Reverse supply polarity protection diode  
Zd1, Zd2: Surge absorption zener diode  
Tr1, Tr2 : NPN output transistor

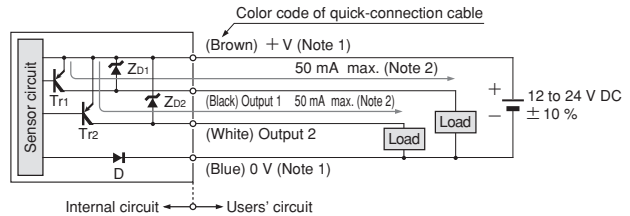
### FX-301P(-HS) PNP output type



Notes: 1) The quick-connection sub cable does not have + V (brown) and 0 V (blue). The power is supplied from the connector of the main cable.  
2) 50 mA max., if five amplifiers, or more, are connected together.

Symbols ... D : Reverse supply polarity protection diode  
Zd: Surge absorption zener diode  
Tr: PNP output transistor

### FX-305P PNP output type



Notes: 1) The quick-connection sub cable does not have + V (brown) and 0 V (blue). The power is supplied from the connector of the main cable.  
2) 25 mA max., if five amplifiers, or more, are connected together.

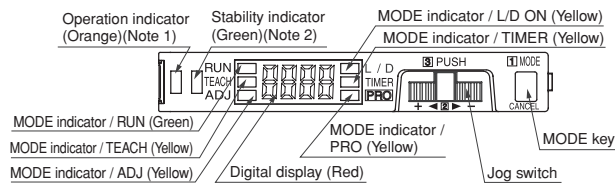
Symbols ... D: Reverse supply polarity protection diode  
Zd1, Zd2: Surge absorption zener diode  
Tr1, Tr2 : PNP output transistor

## PRECAUTIONS FOR PROPER USE



This product is not a safety sensor. Its use is not intended or designed to protect life and prevent body injury or property damage from dangerous parts of machinery. It is a normal object detection sensor.

### Part description

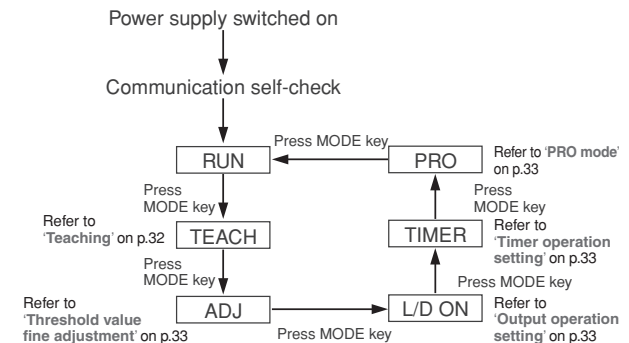


Notes: 1) **FX-305(P)**; Output 1 operation indicator (Orange)  
2) **FX-305(P)**; Output 2 operation indicator (Orange)

Refer to the 'Sensor general catalog 2003-2004' for fiber precautions.

### Operation procedure

- When the power supply is switched on, communication self-check is carried out and normal condition is displayed [MODE indicator / RUN (green) lights up and the digital display shows incident light intensity].
- When MODE key is pressed, the mode changes as per the diagram below.



When jog switch is pressed, the setting is confirmed.  
When MODE key is pressed for 2 sec., or more, the sensor returns to the RUN mode.  
Cancellation is possible by pressing MODE key during setting.

### For FX-305(P)

The **FX-305** is equipped with two independent outputs, but the items that can be set in output 1 and output 2 respectively are only the following.  
The items other than those are common.  
① Threshold value ② Output operation  
③ Timer operation and Timer period ④ Sensing mode

## PRECAUTIONS FOR PROPER USE

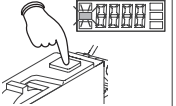
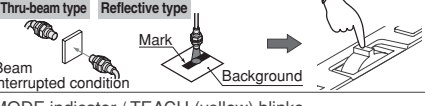
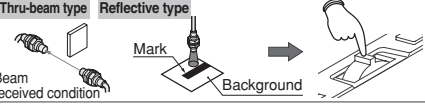
Refer to the 'Sensor general catalog 2003-2004' for fiber precautions.

## Teaching

- The threshold values can be set by normal mode (2-level teaching, limit teaching or full-auto teaching) or window comparator mode (1-level / 2-level / 3-level teaching) [FX-305(P) only], when the MODE indicator / TEACH (yellow) lights up.

## In case of 2-level teaching

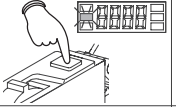
- This is the method of setting the threshold value by teaching two levels, corresponding to the object present and object absent conditions. Normally, setting is done by this method.

Step	Description	Display
①	Set the fiber within the sensing range. Press the MODE key to light up MODE indicator / TEACH (yellow). 	1234
②	For the FX-305(P), select '0001' or '0002' beforehand. Press jog switch in the object present condition. If the teaching is accepted, the read incident light intensity blinks in the digital display. 	567
③	MODE indicator / TEACH (yellow) blinks. Press the jog switch in the object absent condition. 	1234
④	If the teaching is accepted, the read incident light intensity blinks in the digital display and the threshold value is set at the mid-value between the incident light intensities in the object present and the object absent conditions. After this, the judgment on the stability of sensing is displayed. • In case stable sensing is possible: '9000' is displayed. • In case stable sensing is not possible: 'Hrrd' blinks.	9000 Hrrd
⑤	The threshold value is displayed.	900
⑥	'....' blinks in the digital display. (FX-301B/G/H only)	....
⑦	The incident light intensity in the digital display and the setting is complete.	1234

Notes: 1) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.  
2) In case of using the reflective type fibers, if Jog switch is pressed in the object absent condition at ② and ③, the sensitivity is set to the maximum.

## In case of full-auto teaching

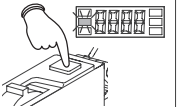
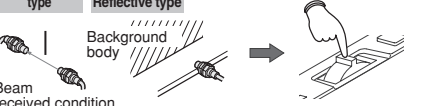
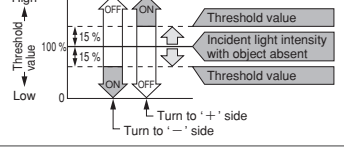
- Full-auto teaching is used when it is desired to set the threshold value without stopping the assembly line, with the object in the moving condition.

Step	Description	Display
①	Set the fiber within the sensing range. Press MODE key to light up MODE indicator / TEACH (yellow). 	1234
②	For the FX-305(P), select '0001' or '0002' beforehand. Press the jog switch continuously for 0.5 sec. or more with the object moving on the assembly line. (The incident light intensity is displayed during sampling.)	1234
③	'Auto' is displayed on the digital display. Release the jog switch when the object has passed.	Auto
④	If the teaching is accepted, the read incident light intensity blinks in the digital display and the threshold value is set at the mid-value between the incident light intensities in the object present and the object absent conditions. After this, the judgment on the stability of sensing is displayed. • In case stable sensing is possible: '9000' is displayed. • In case stable sensing is not possible: 'Hrrd' blinks.	9000 Hrrd
⑤	The threshold value is displayed.	900
⑥	'....' blinks in the digital display. (FX-301B/G/H only)	....
⑦	The incident light intensity in the digital display and the setting is complete.	1234

Notes: 1) The threshold value's shift amount can be selected in PRO mode. (Increments of 5 % between -45 and 45 % for setting possible. 0 % default.)  
2) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

## In case of limit teaching

- This is the method of setting the threshold value by teaching only the object absent condition (stable incident light condition). This is used for detection in the presence of a background body or for detection of minute objects.

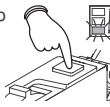
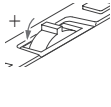
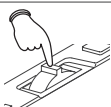
Step	Description	Display
①	Set the fiber within the sensing range. Press the MODE key to light up MODE indicator / TEACH (yellow). 	1234
②	For the FX-305(P), select '0001' or '0002' beforehand. Press the jog switch in the object absent condition. If the teaching is accepted, the read incident light intensity blinks in the digital display. 	1234
③	MODE indicator / TEACH (yellow) blinks. Turn jog switch to the '+' side or '-' side.	1234
④	If the jog switch is turned to the '+' side, ' ' scrolls (twice) (Note 2) the display from right to left, and the threshold level is shifted to a value approx. 15 % higher (lower sensitivity) + than that set at ②. (Note 1) This is used in case of reflective type fibers. If the jog switch is turned to the '-' side, ' ' scrolls (twice) (Note 2) the display from left to right, and the threshold level is shifted to a value approx. 15 % lower (higher sensitivity) than that set at ②. (Note 1) This is used in case of thru-beam type fibers. 	1234 [Blank]
⑤	After this, the judgment on whether the setting shift amount can be shifted or not is displayed. • In case shifting is possible: '9000' blinks. • In case shifting is not possible: 'Hrrd' blinks.	9000 Hrrd
⑥	The threshold value is displayed.	900
⑦	'....' blinks in the digital display. (FX-301B/G/H only)	....
⑧	The incident light intensity appears in the digital display and the setting is complete.	1234

Notes: 1) The FX-301B/G/H has no scroll display.  
2) The approx. 15 % amount of shift is the initial value. The amount of shift can be changed in the PRO mode from approx. 5 to 80 % (5 % step).  
3) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

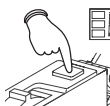
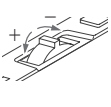
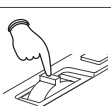
Please refer to the 'Sensor general catalog 2003-2004' or website (<http://www.sunx.jp>) for setting of threshold value when used in combination with contact type liquid level detection fiber **FD-F8Y**, and for setting of threshold value when used in combination with pipe-mountable liquid level detection fiber **FD-F4**.

## PRECAUTIONS FOR PROPER USE

## Threshold value fine adjustment

Step	Description	Display
①	Press the MODE key to light up MODE indicator / ADJ (yellow). 	—
②	For the <b>FX-305(P)</b> , select '0ut 1' or '0ut 2' beforehand. In case the threshold value is to be increased (sensitivity to be reduced), turn the jog switch to the '+' side to increase the threshold value slowly. If the jog switch is turned continuously to the '+' side, the threshold value increases rapidly. In case the threshold value is to be decreased (sensitivity to be increased), turn the jog switch to the '-' side to decrease the threshold value slowly. If the jog switch is turned continuously to the '-' side, the threshold value decreases rapidly. 	1234 ↓ 1235 or 1234 ↓ 1233
③	When the jog switch is pressed, the threshold value is confirmed. 	—

## Output operation setting

Step	Description	Display
①	Press the MODE key to light up MODE indicator / L/D ON (yellow). 	L-on Displays present setting
②	For the <b>FX-305(P)</b> , select '0ut 1' or '0ut 2' beforehand. If the jog switch is turn to the '+' or '-' direction, the output operation setting will change. 	L-on ↑ Light state ↓ Dark state d-on
③	When the jog switch is pressed, the threshold value is confirmed. 	d-on Displays selected setting

## Timer operation setting

- When the MODE indicator / TIMER (yellow) lights up, you can set the type of timer and whether the timer is to be used or not. For the **FX-301B/G/H**, the type of timer is set in PRO mode.
- Further, an OFF-delay which is useful when the response of the connected device is slow, etc., an ON-delay which is useful to detect only objects taking a long time to travel, and ONE-SHOT, which is useful when the input specifications of the connected device require a signal of a fixed width, are possible with the **FX-301(-HS)**. [Furthermore, ON-delay • OFF-delay and ON-delay • ONE-SHOT timer are incorporated for **FX-305(P)**.]

## Cascading amplifiers

- The **FX-301(P)**, **FX-301B/G/H(P)** and **FX-305(P)** cannot use communication for any settings other than the automatic interference prevention function. When using these amplifiers as well, use only the same type of amplifiers all together. However, the **FX-301-HS(P)** is not equipped with an optical communication function for setting the automatic interference prevention function, so be aware of this when using these amplifiers with other amplifiers.
- If the **FX-301(P)** updated version unit or the **FX-305(P)** is mounted with the **FX-301(P)** previous version unit or the **FX-301B/G/H(P)** in cascade, place the **FX-301(P)** updated version units and the **FX-305** units to the right side (seen from the connector side) of the previous version units. For a difference between the updated version unit and the previous version unit, refer to 'A difference between the updated version unit and the previous version unit' (P.34).

## PRO mode

- PRO settings can be done when MODE indicator / PRO (yellow) lights up.

## PRO mode table

	Display	Description
PRO1	Pro1	① Response time change function 'SPEd' ② Timer setting function 'delS' ③ Hysteresis function 'HYS' ④ Stability function 'StbS' ⑤ Shift function 'SHfS' ⑥ Emitting power selection function 'Pccl' (Note 1)
PRO2	Pro2	① Digital display setting function 'dISp' ② Digital display inversion function 'Invern' ③ ECO mode setting function 'ECO'
PRO3	Pro3	① Data bank load setting function 'chld' ② Data bank save setting function 'chSR'
PRO4	Pro4	① Setting condition copy function 'COPY' ② Remote data bank load setting function 'chld' ③ Remote data bank save setting function 'chSR' ④ Communication condition confirmation function 'LcSt' (Note 2) ⑤ Communication lock function 'LcLc' ⑥ Back-up function 'b-uP' (Note 3)
PRO5	Pro5	① Code setting function 'CODE' ② Adjust lock setting function 'R.Lc' ③ Setting reset function 'rStt' ④ Interference prevention function 'InPr' (Note 4)
PRO6 (Note 4)	Pro6	① Output setting function '0ut 1', '0ut 2'

Notes: 1) **FX-301(P)** updated version unit, **FX-301(P)-HS**, **FX-305(P)** only  
 2) **FX-301B(P)/G(P)/H(P)** only  
 3) **FX-301(P)** updated version unit, **FX-305(P)** only  
 4) **FX-305(P)** only

## Key-lock function

- If the jog switch and the MODE key are pressed for more than 3 sec. at the same time in RUN mode condition, the key operations are locked, and only the threshold value confirmation function or the adjust function (valid only when the adjust lock function is canceled) is valid.

## Wiring

- When the emission halt of the emitting power switching function is set from 'OFF' to 'ON', the output may be unstable. Do not use the output control for 0.5 sec. after starting emission.
- Make sure that the power supply is off while wiring.
- Verify that the supply voltage variation is within the rating.
- Take care that if a voltage exceeding the rated range is applied, or if an AC power supply is directly connected, the sensor may get burnt or damaged.
- If power is supplied from a commercial switching regulator, ensure that the frame ground (F.G.) terminal of the power supply is connected to an actual ground.
- In case noise generating equipment (switching regulator, inverter motor, etc.) is used in the vicinity of this product, connect the frame ground (F.G.) terminal of the equipment to an actual ground.
- Take care that short-circuit or wrong wiring of the load may burn or damage the sensor.
- Do not run the wires together with high-voltage lines or power lines or put them in the same raceway. This can cause malfunction due to induction.
- Ensure that an isolation transformer is utilized for the DC power supply. If an auto transformer is utilized, the main amplifier or power supply may be damaged.
- Make sure to use the optional quick-connection cable for the connection of the amplifier [**FX-301(P)-HS** / **FX-305(P)**]. Extension up to total 100 m 328.084 ft (50 m 164.042 ft for 5 to 8 units, 20 m 65.617 ft for 9 to 16 units), is possible with 0.3 mm<sup>2</sup>, or more, cable. However, in order to reduce noise, make the wiring as short as possible.

## Others

- Do not use during the initial transient time (0.5 sec. approx.) after the power supply is switched on.
- Take care that the sensor is not directly exposed to fluorescent light from a rapid-starter lamp or a high frequency lighting device, as it may affect the sensing performance.
- This sensor is suitable for indoor use only.
- Avoid dust, dirt, and steam.  
Take care that the product does not come in direct contact with water, oil, grease, or organic solvents, such as, thinner, etc.
- This sensor cannot be used in an environment containing inflammable or explosive gasses.
- Never disassemble or modify the sensor.



## PRECAUTIONS FOR PROPER USE

Refer to the 'Sensor general catalog 2003-2004' for fiber precautions.

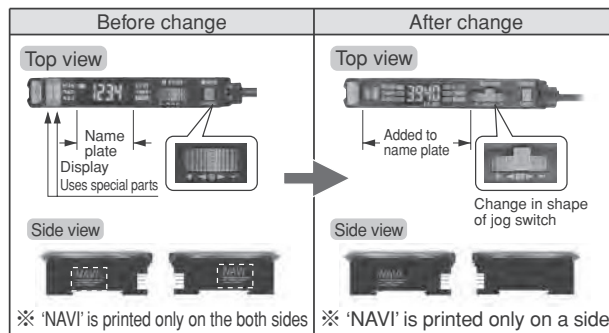
Function table for FX-300 series

	Previous models			New models		
	FX-301(P) (Previous version unit)	FX-302(P)	FX-303(P)	FX-301(P) (Updated version unit)	FX-301(P)-HS	FX-305(P)
Four-chemical emitting element + APC circuit	×	×	×	○	○	○
Four-chemical emitting element only	○ (Note 1)	○	○	—	—	—
Light emitting amount selection function	×	×	×	○	○	○
Reduced intensity mode (S-D)	○ (Note 1)	○	×	○	○	—
9,999 digit display	×	×	×	×	×	○
Response time (Max. speed)	150 $\mu$ s	300 $\mu$ s	90 $\mu$ s	65 $\mu$ s	35 $\mu$ s	65 $\mu$ s
Interference prevention function (Effective no. of units)	Incorporated (4)	Incorporated (8)	Not incorporated (0)	Incorporated (4)	Not incorporated (0)	Incorporated (16)
Independent 2 outputs	×	×	×	×	×	○
Alarm output function	×	×	×	×	×	○
Error output function	×	×	×	×	×	○
Differential sensing	×	×	×	×	×	○
Window comparator mode	×	○	×	×	×	○
<b>Peripheral units that can be combined</b>						
FX-CH(-P)	○	○	×	×	×	×
FX-CH2(-P)	×	×	×	○	×	○
SC-GU1-485	×	×	×	○	×	○

Note: Except FX-301B/G/H.

## A difference between the updated version unit and the previous version unit for FX-301 (Red LED type)

## Changes in appearance



Checking minor changes between previous and new models can be done by checking whether the printing is on both sides or only one side.

## Upgraded functions

## 1. Response times added

An ultra high-speed mode (H-SP) has been added to the existing 4 response time modes [high-speed (FAST), reduced intensity (S-D), standard (STD) and long range (LONG)]. This is changed using 'PRO1' in 'SPED'.

Before change	After change
4 steps	5 steps
FAST 150 $\mu$ s (FAST)	H-SP 65 $\mu$ s (added)(H-SP)
S-D 250 $\mu$ s (S-D)	FAST 150 $\mu$ s (FAST)
STD 250 $\mu$ s (STD)	S-D 250 $\mu$ s (S-D)
LONG 2 ms (LONG)	STD 250 $\mu$ s (STD)
	LONG 2 ms (LONG)

## 2. Extension of timer period

The setting range for the timer period was previously 500 ms, but this has been extended to a new range of 9999 ms.

## 3. Light emitting amount selection function

The light emitting amount can be changed to one of 4 levels (5 levels when emission halt is included).

## 4. Backup, copy lock and key lock functions added

Backup: This selects whether or not threshold values set by teaching are written to (stored in) an EEPROM.

Copy lock: This selects whether copy function and data bank function communication are possible or not.

Key lock: This disables input using switches to prevent accidental changing of settings.

## Changes in operation

## 1. Timer selection method

Previous version unit: Timer type was changed using PRO1 mode. The 'TIMER' setting in NAVI mode could only be turned on or off.

After change: The type of timer can be changed using the 'TIMER' function in NAVI mode.

## 2. Checking threshold value in RUN mode

The threshold values can be checked by turning the jog switch.

## Display changes

## 1. Checking blinking of sensitivity surplus

The stable surplus display method after teaching has been changed.

Previous version unit: Sensitivity surplus is indicated by the number of blinks of the stability indicator.

After change

Digital display only

## 2. Initial direct code value changed

The factory default settings for the direct codes have been changed.

Previous version unit 0000 → After change 0004

※ The default setting for the timer period is 10 ms, and the direct code for 10 ms is '4', so this has been changed.

## Internal circuit changes

## 1. Addition of an APC circuit

A four-chemical emitting element which provides stable sensing over long periods has been added, as well as an APC (Auto Power Control) circuit that improves stability during short periods.

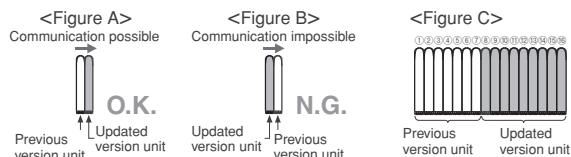
## Points to note when combining sensor types

When using the newer sensors together with previous version units (including the FX-301B/G/H), note the following.

- Communication is possible when the previous version units and the updated version units are used in an arrangement such as that shown in Figure A below.

- If the previous version units and the updated version units are used in an arrangement such as that shown in Figure B below, the interference prevention function and the PRO4 function cannot be used.

- In order to use the interference prevention function and the PRO4 function when using previous version units and the updated version units together, it is recommended that you use an arrangement such as that shown in Figure C below.





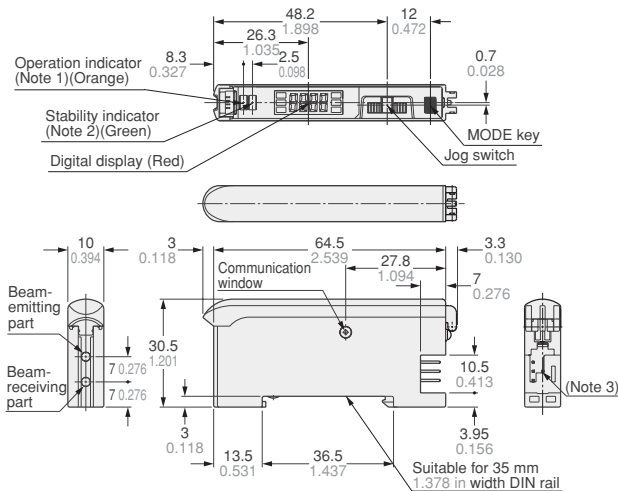
# FX-300

## DIMENSIONS (Unit: mm in)

Refer to the 'Sensor general catalog 2003-2004' for fiber dimensions.  
The CAD data in the dimensions can be downloaded from the website: <http://www.sunx.jp/>

**FX-301**□  
**FX-305**□

Amplifier



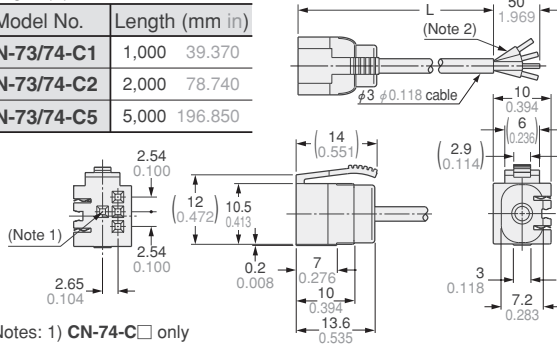
- Notes: 1) **FX-305**□; Output 1 operation indicator (Orange)  
2) **FX-305**□; Output 2 operation indicator (Orange)  
3) **FX-301**□; 3-pin, **FX-305**□; 4-pin

**CN-73-C**□  
**CN-74-C**□

Main cable (Optional)

• Length (L)

Model No.	Length (mm in)
<b>CN-73/74-C1</b>	1,000 39.370
<b>CN-73/74-C2</b>	2,000 78.740
<b>CN-73/74-C5</b>	5,000 196.850



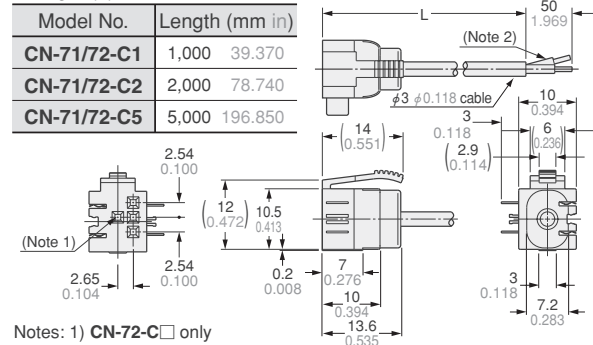
- Notes: 1) **CN-74-C**□ only  
2) **CN-74-C**□; 4-core

**CN-71-C**□  
**CN-72-C**□

Sub cable (Optional)

• Length (L)

Model No.	Length (mm in)
<b>CN-71/72-C1</b>	1,000 39.370
<b>CN-71/72-C2</b>	2,000 78.740
<b>CN-71/72-C5</b>	5,000 196.850



- Notes: 1) **CN-72-C**□ only  
2) **CN-72-C**□; 2-core

## Introducing digital laser sensor LS series

**Making high precision laser sensing more intuitive and easier to use**

- Minute objects can be sensed even at removed distances.
- 3 types of laser sensor head available.
- Side-by-side placement together with fiber sensors is also possible.



<IC pin check>

<Sensing remaining sheet roll amounts>

For further details, please refer to the SUNX home page (<http://www.sunx.co.jp/>) or contact our office.

# External Input Unit for Digital Sensor / FX-CH2



## Support for stable sensing and smooth setup changes!

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.



## Applications involving smooth setup operations

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

Digital fiber 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

### Key lock setting input

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

### Data bank switching input

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

## Product lineup

Connector for input device

**CN-EP1** [1 pc. included with **FX-CH2(-P)**]

#### • Input signal

The types of input operations are determined by S1 and S2, and the input timing is determined by S3.

S1  
S2  
S3  
COM.

※ **FX-CH2(-P)** does not include a cable for connecting to the input device.

External input unit **FX-CH2(-P)**

Quick-connection cable  
**CN-73-C** (Optional)

#### • Mode selection

The MODE wire can be switched between high and low to select the input mode from either 'external teaching and key lock' or 'data bank switching'.

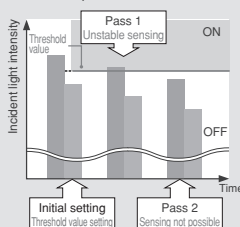
## Explanation of limit teaching

### ● Limit teaching '—'

Limit teaching '—' shifts the threshold value setting to make it less than the incident light intensity during teaching.

#### When limit teaching is not used

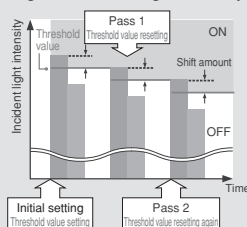
If the incident light intensity changes with respect to the initial threshold setting value because of reasons such as beam axis slippage, sensing can become unstable and incorrect operations can occur.



Incident light intensity when sensing object is not present

#### When limit teaching '—' is used

The threshold value is reset each time before the sensing object arrives, (limit teaching '—'). As a result, sensing is not affected by changes in incident light intensity.



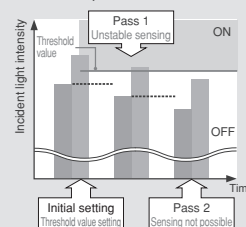
Incident light intensity when sensing object is present

### ● Limit teaching '+'

Limit teaching '+' is the opposite of limit teaching '—', so that the threshold value setting is shifted toward a higher setting to make it more than the incident light intensity during teaching.

#### When limit teaching is not used

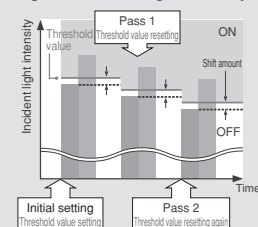
If dust or other particles cause changes in the incident light intensity with respect to the initial threshold setting value, sensing can become unstable and incorrect operations can occur.



※ When limit teaching is used, use the SHIFT function in PRO mode of the amplifier to set the shift amount beforehand.

#### When limit teaching '+' is used

The threshold value is reset each time before the sensing object arrives, (limit teaching '+'). As a result, sensing is not affected by changes in incident light intensity.



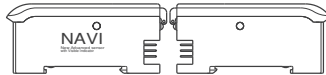
## ORDER GUIDE

Designation		Model No.
External input unit	NPN input type	<b>FX-CH2</b>
	PNP input type	<b>FX-CH2-P</b>
Connector for input device (1 pc. included as standard with external input unit)		<b>CN-EP1</b> 5 pcs. per set
Quick-connection cable (Main cable)	Length: 1 m 3.281 ft	<b>CN-73-C1</b>
	Length: 2 m 6.562 ft	<b>CN-73-C2</b>
	Length: 5 m 16.404 ft	<b>CN-73-C5</b>
End plate		<b>MS-DIN-E</b> 2 pcs. per set

## SPECIFICATIONS

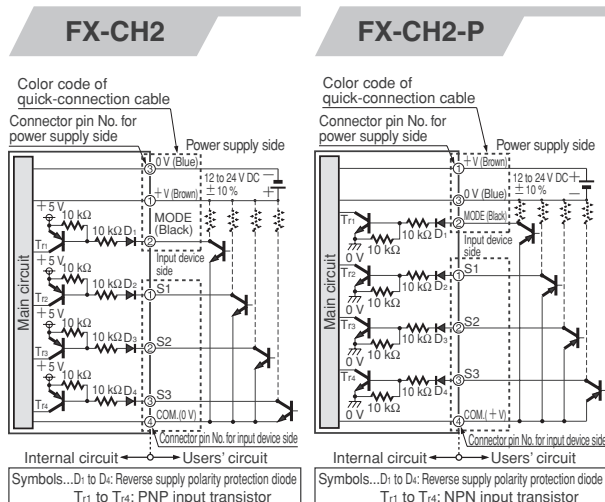
Type	NPN input type	PNP input type
Item	Model No.	Model No.
Applicable sensor	<b>FX-301(P)</b> (Note 1), <b>FX-305(P)</b>	
Supply voltage	12 to 24 V DC $\pm 10\%$ Ripple P-P 10 % or less	
Power consumption	600 mW or less (when all indicators light up)	
Input	Low: 0 to +2 V DC Source current 0.5 mA Input impedance 10 k $\Omega$ approx. High: +5 V to +V DC, or open	Low: +4 V to +V DC Sink current 0.5 to 3 mA Input impedance 10 k $\Omega$ approx. High: 0 to +0.6 V DC, or open
Power indicator	Green LED (Lights up when the power is ON)	
Transmission operation indicator	Green LED (Lights up when loaded, and 2-level / Limit teaching, blinks→lights up when saved, and Full-auto teaching)	
Ambient temperature	-10 to +55 °C +14 to +131 °F (if 4 to 7 sensors are connected in cascade: -10 to +50 °C +14 to +122 °F, if 8 to 16 sensors are connected in cascade: -10 to +45 °C +14 to +113 °F)(No dew condensation or icing allowed), Storage: -20 to +70 °C -4 to +158 °F	
Material	Enclosure: Heat-resistant ABS	
Cable extension	Extension up to total 10 m 32.808 ft is possible with 0.3 mm <sup>2</sup> , or more, cable.	
Weight	Net weight: 20 g approx., Gross weight: 40 g approx.	
Accessory	<b>CN-EP1</b> (Connector for input device)(Note 2): 1 pc.	

Notes: 1) Only updated version of **FX-301(P)** can be used. Do not use the previous version of **FX-301(P)**.  
The updated version of **FX-301(P)** have 'NAVI' printed on one side.  
(See the right figure.)



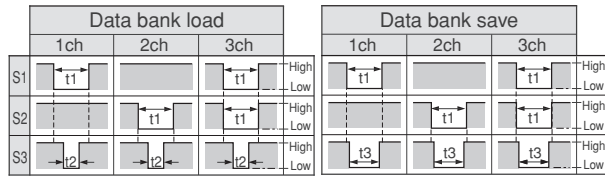
2) The applicable wire is 0.08 mm<sup>2</sup> (AWG 28) to 0.5 mm<sup>2</sup> (AWG 20) and the wire sheath diameter should be  $\phi 1.5$  mm  $\phi 0.059$  in or less.

## I/O CIRCUIT DIAGRAMS



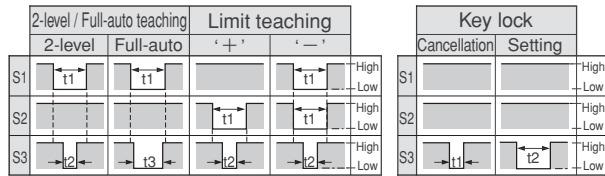
## OPERATION TIMING CHART

When **MODE** is set to High (Low for **FX-CH2-P**) or open



t1 : t1 > t2, t1 > t3 t2 : 20 ms to less than 2 sec. t3 : 2 sec. or more

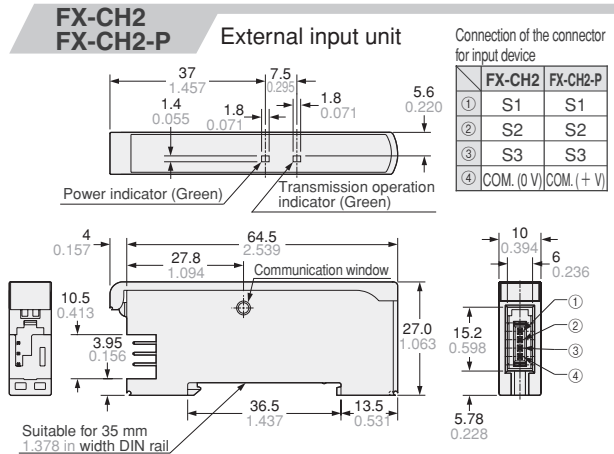
When **MODE** is set to Low (High for **FX-CH2-P**)



t1 : t1 > t2, t1 > t3 t2 : 20 ms to less than 2 sec. (This is the timing period for 1 level. 2 levels are required.) t3 : 0.5 sec. or more (Sampling starts after 0.5 sec.)

Notes: 1) The above diagrams show the **FX-CH2** (NPN input type).  
For the **FX-CH2-P** (PNP input type), High and Low are reversed.  
2) After each operation has been confirmed, the fiber sensor cannot be reset for a period of approximately 50 ms.

## DIMENSIONS (Unit: mm in)



# Upper Communication Unit for Digital Sensors / SC-GU1-485

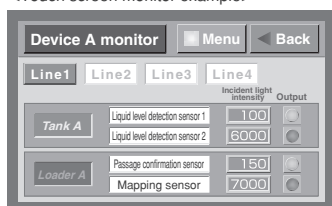


**We now offer remote maintenance for sensors!  
Also reduces the work required to the system  
to start running!**

**Centralized control and setting of scattered digital sensors  
(FX-301/305) is possible using a PLC or personal computer**



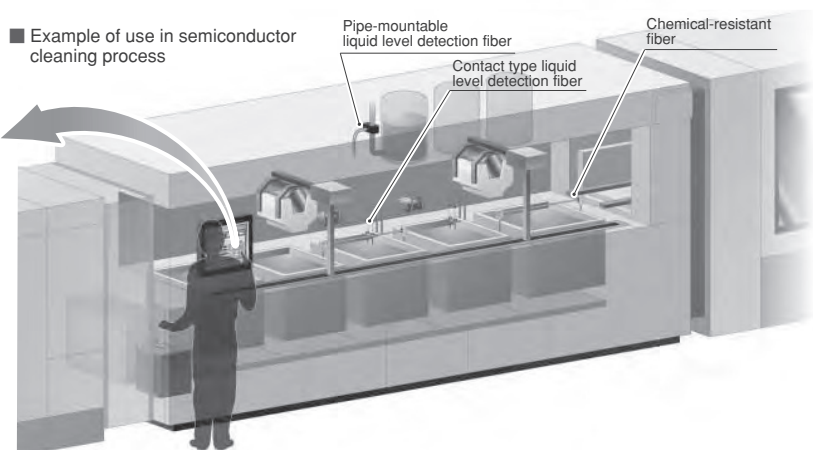
<Touch screen monitor example>



[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!

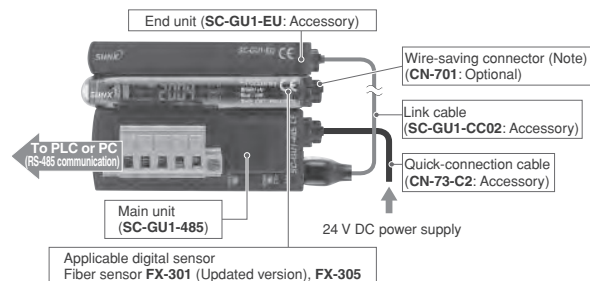
Ideal for workplaces such as semiconductor and LCD manufacturing lines where there are restrictions on operators entering and exiting

■ Example of use in semiconductor cleaning process



## Control and settings can be carried out remotely

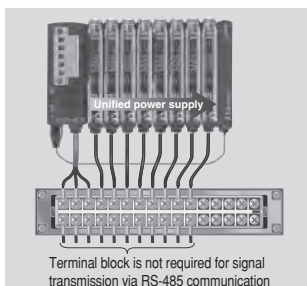
Setting and checking incident light intensity for digital sensors (FX-301/305) that are scattered inside and outside equipment can be carried out remotely for all sensors by using the **SC-GU1-485**, which greatly improves ease of operations such as monitoring equipment that is running and also equipment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



Note: Used when the output signal is sent via a **SC-GU1-485** to the PLC. If the output signal is sent directly to the PLC, a quick-connection cable (CN-72-C□, CN-71-C□) should be used.

## 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.

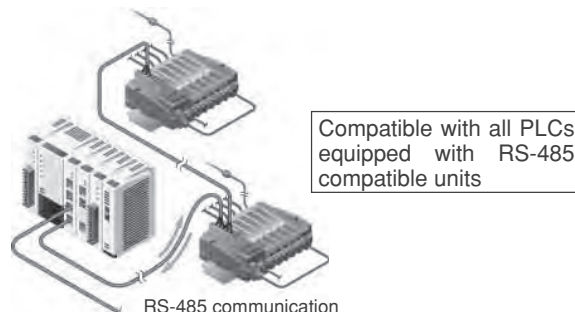


## Communication speed 57.6 kbps

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

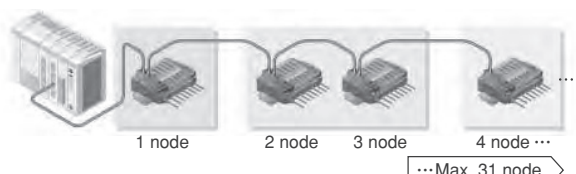
## High general applicability so that any type of PLC can be used

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.



## 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.



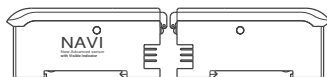


## SPECIFICATIONS

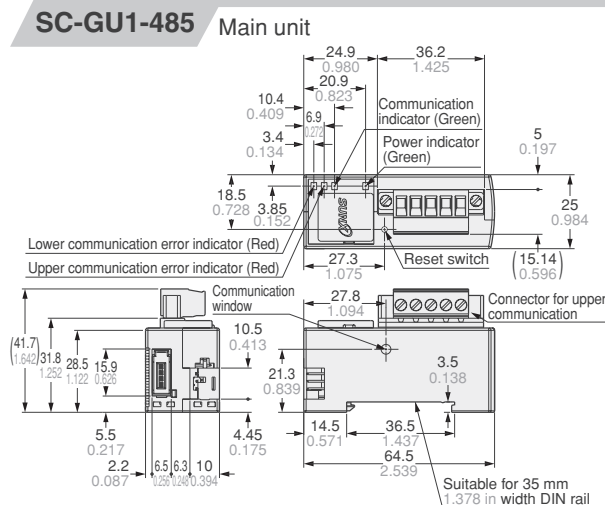
Type	Main unit
Item Model No.	SC-GU1-485
Applicable sensor	FX-301(P)(Note), FX-305(P)
Connectable units	Max. 16 units of sensor per SC-GU1-485
Connectable nodes	Max. 31 nodes
Supply voltage	24 V DC $\pm$ 10 % Ripple P-P10 % or less
Current consumption	45 mA or less (10 mA or less for SC-GU1-EU)
Communication method	2 wire half duplex method
Communication speed	57,600 bps / 38,400 bps / 19,200 bps / 9,600 bps Selectable by DIP switch
Synchronization method	Asynchronous communication method
Electrical characteristic	Conforming to EIA RS-485
Total extension length	Communication cable: 100 m 328.084 ft or less [SC-GU1-485 (termination) to PLC] Power supply cable: Less than 10 m 32.808 ft
Ambient temperature	-10 to +55 °C +14 to +131 °F (If 4 to 7 sensors are connected in cascade: -10 to +50 °C +14 to +122 °F, if 8 to 16 sensors are connected in cascade: -10 to +45 °C +14 to +113 °F)(No dew condensation or icing allowed), Storage: -20 to +70 °C -4 to +158 °F
Material	Enclosure: Heat-resistant ABS
Weight	35 g approx. (10 g approx. for SC-GU1-EU)
Accessories	SC-GU1-EU (End unit): 1 pc. CN-73-C2 [Quick-connection cable (cable length 2 m 6.562 ft)]: 1 pc. SC-GU1-CC02 [Link cable (cable length 0.2 m 0.656 ft)]: 1 pc.

Note: Applicable units are for the FX-301(P) after version update. Do not use the previous version of FX-301(P).

The updated version of FX-301(P) has the 'NAVI' printed only on single side. (See the right figure.)



## DIMENSIONS (Unit: mm in)



All information is subject to change without prior notice.



<http://www.sunx.jp/>

### SUNX Limited

2431-1 Ushiyama-cho, Kasugai-shi, Aichi,  
486-0901, Japan  
Phone: +81-(0)568-33-7211  
FAX: +81-(0)568-33-2631

### Overseas Sales Dept.

Phone: +81-(0)568-33-7861  
FAX: +81-(0)568-33-8591

## OPERATION VERIFICATION PROGRAM DOWNLOAD SERVICE

The SUNX website download data service lets you download operation verification programs to a personal computer. (<http://www.sunx.co.jp/>)

### Monitoring example



### Operating environment

OS: Windows 98 Second Edition  
(standard English language installation only) or later  
CPU: Pentium II 400 MHz processor or higher  
(Pentium III 450 MHz or higher recommended)  
Memory: 64 MB or more  
(128 MB or more recommended)  
Free hard disk space: 10 MB or more  
Serial port: RS-232C compatible

### Details that can be checked:

Sensor threshold values, output statuses, configuration settings, teaching and timer period setting changes, etc.

Notes: 1) Note the following when using this software.

The software is supplied as freeware. Copyright is retained by SUNX Limited. You must agree to the following conditions before using the software.

### Conditions of use

• SUNX does not guarantee the correct operation of this software. SUNX takes no responsibility for any direct or indirect losses, damage, loss of profit or any other problems arising as a result of using or operating this software.

2) When connecting the SC-GU1-485 to a personal computer, you will need obtain a interface converter (RS-232C  $\leftrightarrow$  RS-485 converter) and cable to connect between the computer and the interface converter.

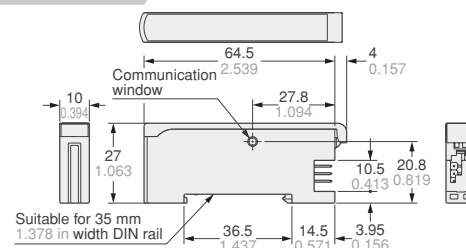
## OPTION

### CN-701 (Wire-saving connector)

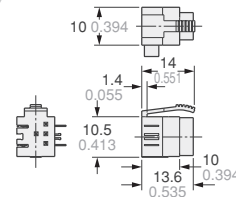
Note: Used when the output signal is sent via a SC-GU1-485 to the PLC.



### SC-GU1-EU End unit (Accessory)



### CN-701 Wire-saving connector (Optional)





Digital fiber sensor FX-301(P) has been modified since production in June, 2004. Hence, this instruction manual has been changed to reflect the modifications.



## INSTRUCTION MANUAL

### Photoelectric Sensor Digital Fiber Sensor FX-301 Series

Thank you very much for using SUNX products. Please read this Instruction Manual carefully and thoroughly for the correct and optimum use of this product. Kindly keep this manual in a convenient place for quick reference.



- Never use this product as a sensing device for personnel protection.
- In case of using sensing devices for personnel protection, use products which meet standards, such as OSHA, ANSI or IEC etc., for personnel protection applicable in each region or country.

For further details on the fiber sensor amplifier, please refer to the SUNX home page (<http://www.sunx.co.jp/>) or contact our office.

## 1 SPECIFICATIONS

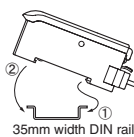
Item	Type	Connector type	Cable type
	Model No.		
	NPN output	FX-301	FX-301-C1
	PNP output	FX-301P	FX-301P-C1
Supply voltage		12 to 24V DC $\pm$ 10% Ripple P-P 10% or less	
Power consumption		Normal operation: 960mW or less (current consumption 40mA or less at 24V supply voltage)	
		ECO mode: 600mW or less (current consumption 25mA or less at 24V supply voltage)	
Output		<b>&lt;NPN output type&gt;</b> NPN open-collector transistor • Maximum sink current: 100mA (Note 1) • Applied voltage: 30V DC or less (between output and 0V) • Residual voltage: 1.5V or less [at 100mA (Note 1) sink current]	<b>&lt;PNP output type&gt;</b> PNP open-collector transistor • Maximum source current: 100mA (Note 1) • Applied voltage: 30V DC or less (between output and +V) • Residual voltage: 1.5V or less [at 100mA (Note 1) source current]
		Light-ON or Dark-ON, selectable with jog switch	
	Output operation	Incorporated	
	Short-circuit protection	Incorporated	
Response time		H-SP: 65 $\mu$ s or less, FAST: 150 $\mu$ s or less, S-D: 250 $\mu$ s or less STD: 250 $\mu$ s or less, LONG: 2ms or less selectable with jog switch	
Display		4 digit red LED display	
Sensitivity setting		2-level teaching / Limit teaching / Full-auto teaching / Max. sensitivity teaching / Manual adjustment	
Fine sensitivity adjustment function		Incorporated	
Timer function		Incorporated with variable ON-delay/OFF-delay/ONE-SHOT timer, switchable either effective or ineffective (Timer: approx. 0.5 to 9999ms)	
Interference prevention function		Incorporated [up to four fibers can be mounted adjacently (However, H-SP mode is two fibers)]	
Ambient temperature		-10 to +55°C (If 4 to 7 units are connected in cascade: -10 to +50°C, if 8 to 16 units are connected in cascade: -10 to +45°C) (No dew condensation or icing allowed), Storage: -20 to +70°C	
Ambient humidity		35 to 85% RH, Storage: 35 to 85% RH	
Emitting element		Red LED (modulated)	
Material		Enclosure: Heat-resistant ABS, Transparent cover: Polycarbonate Press switches: Acrylic, Jog switch: Heat-resistant ABS	
Cable		—	0.3mm $\phi$ 3-core cabtyber cable, 1m long
Weight		20g approx.	60g approx.

- Notes: 1) 50mA, the connector type FX-301(P) five, or more, amplifiers are connected in cascade.  
2) When the power supply is switched on, the light emission timing is automatically set for interference prevention.  
3) The cable for amplifier connection is not supplied as an accessory. Make sure to use the optional quick-connection cables given below.  
Main cable (3-core): **CN-73-C1** (cable length 1m), **CN-73-C2** (cable length 2m)  
**CN-73-C5** (cable length 5m)  
Sub cable (1-core): **CN-71-C1** (cable length 1m), **CN-71-C2** (cable length 2m)  
**CN-71-C5** (cable length 5m)

## 2 MOUNTING

### How to mount the amplifier

- ① Fit the rear part of the mounting section of the amplifier on a 35mm width DIN rail.
- ② Press down the rear part of the mounting section of the unit on the 35mm width DIN rail and fit the front part of the mounting section to the DIN rail.



### How to remove the amplifier

- ① Push the amplifier forward.
- ② Lift up the front part of the amplifier to remove it.

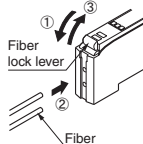
Note: Take care that if the front part is lifted without pushing the amplifier forward, the hook on the rear portion of the mounting section is likely to break.

### How to connect the fiber cables

Be sure to fit the attachment to the fibers first before inserting the fibers to the amplifier. For details, refer to the instruction manual enclosed with the fibers.

- ① Snap the fiber lock lever down.
- ② Insert the fiber cables slowly into the inlets until they stop. (Note 1)
- ③ Return the fiber lock lever to the original position, till it stops.

- Notes: 1) In case the fiber cables are not inserted to a position where they stop, the sensing range reduces. In case of a flexible fiber, take care that it may bend inside the amplifier, during insertion.  
2) With the coaxial reflective type fiber, such as, **FD-G4** or **FD-FM2**, insert the single-core fiber cable into the beam-emitting inlet and the multi-core fiber cable into the beam-receiving inlet. If they are inserted in reverse, the sensing accuracy will deteriorate.

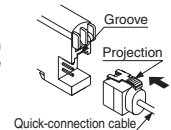


## 3 CONNECTION OF CONNECTOR TYPE FX-301(P)

Make sure that the power supply is off while connecting or disconnecting the quick-connection cable.

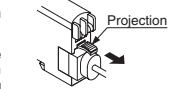
### Connection method

- ① Holding the connector of the quick-connection cable, align its projection with the groove at the top portion of the amplifier connector.
- ② Insert the connector till a click is felt.



### Disconnection method

- ① Pressing the projection at the top of the quick-connection cable, pull out the connector.



Note: Take care that if the connector is pulled out without pressing the projection, the projection may break. Do not use a quick-connection cable whose projection has broken. Further, do not pull by holding the cable, as this can cause a cable-break.

## 4 CAUTIONS

- When the emission halt of the emitting power switching function is set from 'OFF' to 'ON', the output may be unstable. Do not use the output control for 0.5 sec. after starting emission.
- Make sure that the power supply is off while wiring.
- Verify that the supply voltage variation is within the rating.
- Take care that if a voltage exceeding the rated range is applied, or if an AC power supply is directly connected, the sensor may get burnt or damaged.
- In case noise generating equipment (switching regulator, inverter motor, etc.) is used in the vicinity of this product, connect the frame ground (F.G.) terminal of the equipment to an actual ground.
- If power is supplied from a commercial switching regulator, ensure that the frame ground (F.G.) terminal of the power supply is connected to an actual ground.
- Do not use during the initial transient time (0.5 sec.) after the power supply is switched on.
- Take care that short-circuit of the load or wrong wiring may burn or damage the sensor.
- Do not run the wires together with high-voltage lines or power lines or put them in the same raceway. This can cause malfunction due to induction.
- For the cable to connect to the connector type sensor **FX-301(P)**, be sure to use the optional quick-connection cable.
- Extension up to total 100m is possible with 0.3mm $\phi$ , or more, cable. However, in order to reduce noise, make the wiring as short as possible.
- This sensor is suitable for indoor use only.
- Avoid dust, dirt, and steam.
- Take care that the product does not come in direct contact with water, oil, grease, or organic solvents, such as, thinner, etc.
- This sensor cannot be used in an environment containing inflammable or explosive gases.
- Never disassemble or modify the sensor.

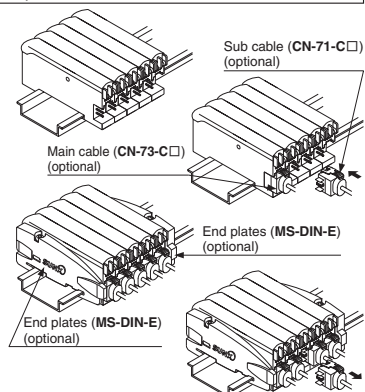
## 5 CASCADING

- Make sure that the power supply is off while adding or removing the amplifiers.
- Make sure to check the allowable ambient temperature, as it depends on the number of amplifiers connected in cascade.
- In case two, or more, amplifiers are connected in cascade, make sure to mount them on a DIN rail.
- When the amplifiers move on the DIN rail depending on the attaching condition, fitting them between the optional end plates (**MS-DIN-E**) mounted at the two ends.
- When connecting in cascade, mount the amplifiers close to each other, fitting them between the optional end plates (**MS-DIN-E**) mounted at the two ends.
- Up to maximum 15 amplifiers can be added (total 16 amplifiers connected in cascade.)
- When connecting more than two amplifiers in cascade, use the sub cable (**CN-71-C1**) as the quick-connection cable for the second amplifier onwards.
- In case of using the connector type **FX-301(P)** with the cable type **FX-301(P)-C1** in cascade, mount the identical models together.
- In case the modified version units are mounted with the conventional version units in cascade, place the modified version units to the right side (see from the connector side) of the conventional version units. For a difference between the modified version unit and the conventional version unit, refer to 'A DIFFERENCE BETWEEN THE MODIFIED VERSION UNIT AND THE CONVENTIONAL VERSION UNIT'.
- The settings other than the interference prevention function cannot be transmitted between this product and other digital fiber amplifiers. Therefore, in case both models of amplifiers are mounted in cascade, be sure to mount identical models together. However, the interference prevention function is not incorporated into the **FX-303(P)**. Take care when the sensors are mounted in cascade.
- Since the communication function of this product and that of the **FX-301(P)-F** is different, if these models are mounted in cascade, do not use the communication function.

For mounting and removing the amplifier, refer to '2 MOUNTING'.

### Cascading method

- ① Mount the amplifiers, one by one, on the 35mm width DIN rail and make them close each other.
- ② Insert the connector of the quick-connection cable to the connector part of the amplifier.
- ③ Mount the optional end plates (**MS-DIN-E**) at both the ends to hold the amplifiers between their flat sides.
- ④ Tighten the screws to fix the end plates (**MS-DIN-E**).

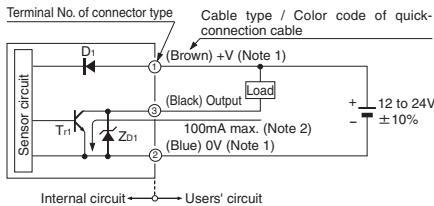


### Dismantling

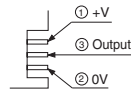
- ① Pressing the projection at the top of the quick-connection cable, pull out the connector.
- ② Remove the amplifier.

## 6 I/O CIRCUIT DIAGRAMS

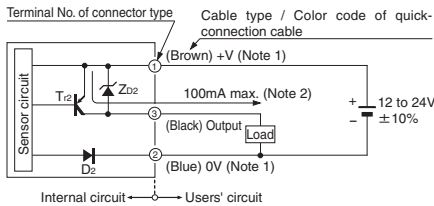
### ● NPN output type



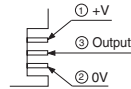
Terminal arrangement diagram of the connector type FX-301



### ● PNP output type



Terminal arrangement diagram of the connector type FX-301P



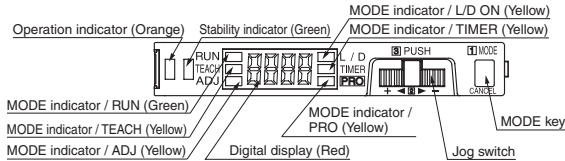
Notes: 1) The quick-connection sub cable does not have +V (brown) and 0V (blue).

The power is supplied from the connector of the main cable.

2) 50mA max., the connector type FX-301(P) five, or more, amplifiers are connected in cascade.

Symbols...D1, D2: Reverse supply polarity protection diode  
Zb1, Zb2: Surge absorption zener diode  
Tr1: NPN output transistor  
Tr2: PNP output transistor

## 7 PART DESCRIPTION



## 8 OPERATION PROCEDURE

- When the power supply is switched on, communication self-check is carried out and normal condition is displayed [MODE indicator / RUN (green)] lights up and the digital display shows the incident light intensity.

MODE key		Jog switch	
Press	Press	Turn '+' side	Turn '-' side

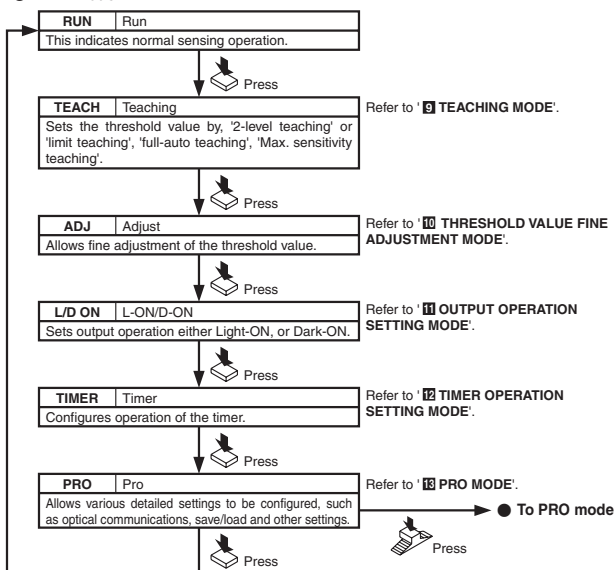
\*1: When Jog switch is pressed, the setting is confirmed.

\*2: When MODE key is pressed for 2 sec., or more, the sensor returns to the 'RUN' mode.

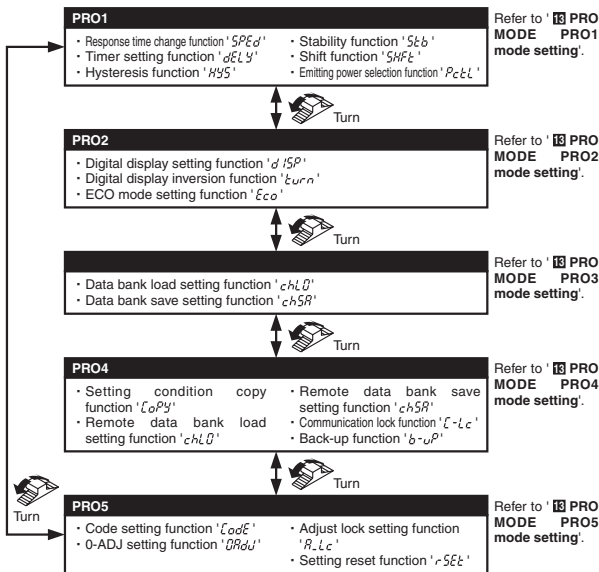
\*3: Cancellation is possible by pressing MODE key during setting.

\*4: When Jog switch is turned in the 'RUN' mode, the current threshold value is displayed. And then, the current incident light intensity display appears again automatically.

### ● NAVI mode



### ● PRO mode



## 9 TEACHING MODE

### In case of 2-level teaching

- This is the method of setting the threshold value by teaching two levels, corresponding to the object present and object absent conditions. Normally, setting is done by this method.

Step	Display	Description
①	1234	• Set the fiber within the sensing range. • Press MODE key to light up MODE indicator / TEACH (yellow).
②	567	• Press Jog switch in the object present condition. • If the teaching is accepted, the read incident light intensity blinks in the digital display.
③	1234	• The MODE indicator / TEACH (yellow) blinks. • Press Jog switch in the object absent condition.
④	Good	• If the teaching is accepted, the read incident light intensity blinks in the digital display and the threshold value is set at the mid-value between the incident light intensities in the object present and the object absent conditions. After this, the judgment on the stability of sensing is displayed. In case stable sensing is possible: 'Good' is displayed. In case stable sensing is not possible: 'HRrd' is displayed.
⑤	900	• The threshold value is displayed.
⑥	1234	• The incident light intensity appears in the digital display and the setting is complete.

Note: In case of using the fibers, if Jog switch is pressed in the object absent condition at ② and ③, the sensitivity is set to the maximum.

### In case of limit teaching

- This is the method of setting the threshold value by teaching only the object absent condition (stable incident light condition). This is used for detection in the presence of a background body or for detection of small objects.

Step	Display	Description
①	1234	• Set the fiber within the sensing range. • Press MODE key to light up MODE indicator / TEACH (yellow).
②	1234	• Press Jog switch in the object absent condition. • If the teaching is accepted, the read incident light intensity blinks in the display.
③	1234	• The MODE indicator / TEACH (yellow) blinks. • Turn Jog switch to the '+' side or the '-' side.
④		• If Jog switch is turned to the '+' side, ' ' scrolls (twice) the display from right to left, and the threshold level is shifted to a value approx. 15% higher (lower sensitivity) than that set at ②. Turn to '+' side (Note) This is used in case of reflective type fibers. • If Jog switch is turned to the '-' side, ' ' scrolls (twice) the display from left to right, and the threshold level is shifted to a value approx. 15% lower (higher sensitivity) than that set at ②. Turn to '-' side (Note) This is used in case of thru-beam type fibers.
⑤	Good	• After this, the judgment on whether the set shift amount is possible or not will be displayed. When the shift is possible: 'Good' is displayed. When the shift is not possible: 'HRrd' is displayed.
⑥	1420	• The threshold value is displayed.
⑦	1234	• The incident light intensity appears in the digital display and the setting is complete.

Note: The approx. 15% amount of shift is the initial value. The amount of shift can be changed in the PRO mode from approx. 5 to 80% (5% step). Refer to '13 PRO MODE / PRO1 mode setting' for the setting method.

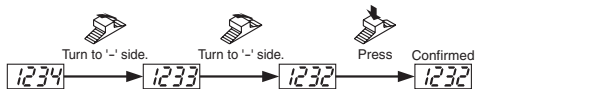
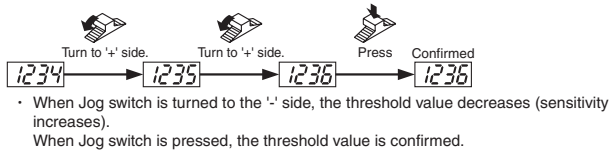
### In case of full-auto teaching

- Full-auto teaching is used when it is desired to set the threshold value without stopping the assembly line, with the object in the moving condition.

Step	Display	Description
①	1234	<ul style="list-style-type: none"> <li>Set the fiber within the sensing range.</li> <li>Press MODE key to light up MODE indicator / TEACH (yellow).</li> </ul>
②	567	<ul style="list-style-type: none"> <li>Press Jog switch continuously for 0.5 sec. or more with the object moving on the assembly line. (The incident light intensity is displayed during sampling.)</li> </ul>
③	Ruto	<ul style="list-style-type: none"> <li>'Ruto' is displayed on the digital display. Release the jog switch when the object has passed.</li> </ul>
④	Good	<ul style="list-style-type: none"> <li>If the teaching is accepted, the read incident light intensity blinks in the digital display and the threshold value is set at the mid-value between the incident light intensities in the object present and the object absent conditions. After this, the judgment on the stability of sensing is displayed. In case stable sensing is possible: 'Good' is displayed. In case stable sensing is not possible: 'Hrd' is displayed.</li> </ul>
⑤	900	<ul style="list-style-type: none"> <li>The threshold value is displayed.</li> </ul>
⑥	1234	<ul style="list-style-type: none"> <li>The incident light intensity appears in the digital display and the setting is complete.</li> </ul>

### 10 THRESHOLD VALUE FINE ADJUSTMENT MODE

- Fine adjustment of the threshold value can be done when MODE indicator / ADJ (yellow) lights up.
- When Jog switch is turned to the '+' side, the threshold value increases (sensitivity decreases).
- When Jog switch is pressed, the threshold value is confirmed.



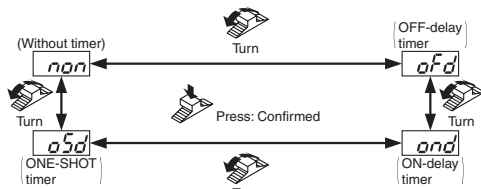
### 11 OUTPUT OPERATION SETTING MODE

- The output operation setting can be done when MODE indicator / L/D ON (yellow) lights up.
- The output operation is changed when Jog switch is turned to the '+' side or the '-' side.
- When Jog switch is pressed, the threshold value is confirmed.



### 12 TIMER OPERATION SETTING MODE

- The setting for whether the timer is used or not can be done when MODE indicator / TIMER (yellow) lights up.
- 10ms OFF-delay (initial value) timer is automatically set when the timer is set to be used.
- Refer to '13 PRO MODE / PRO1 mode setting' for the setting method of the OFF-delay timer, ON-delay timer and ONE-SHOT timer intervals.



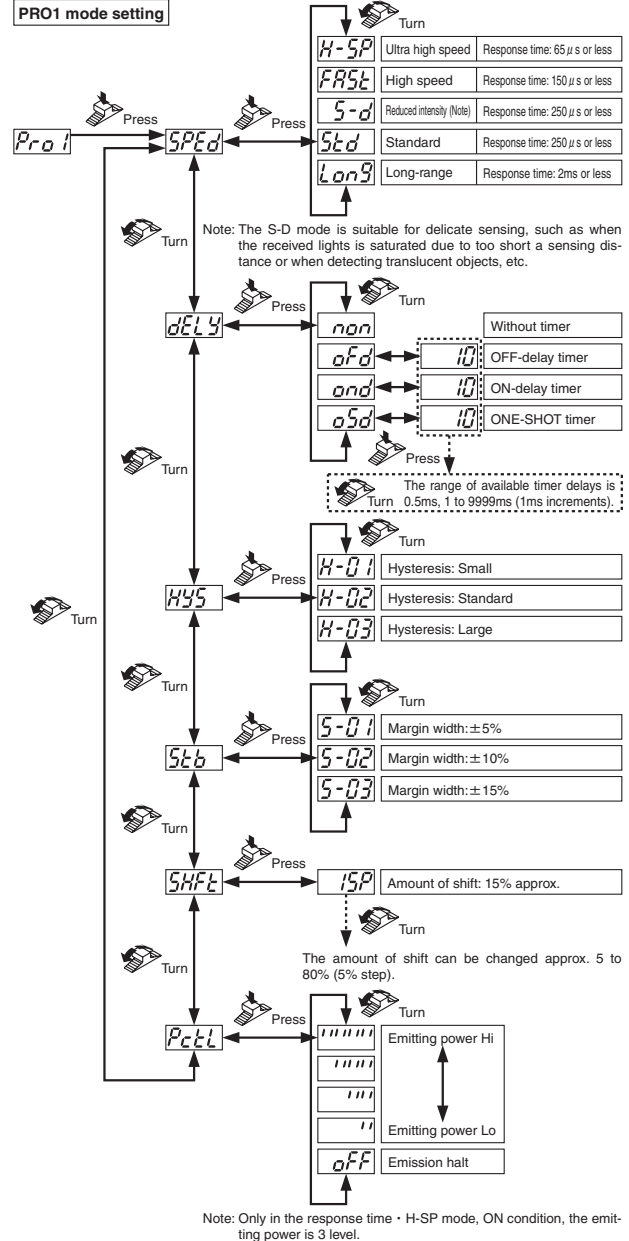
Notes: 1) The timer interval set in the PRO mode is displayed.  
2) The factory setting is without timer 'non'.

### 13 PRO MODE

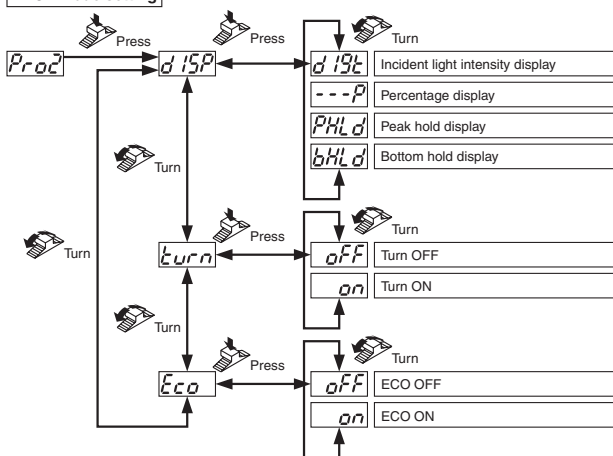
- For details of the settings and the setting procedure of the PRO mode, refer to the SUNX home page (<http://www.sunx.co.jp/>) or contact our office.

- PRO settings can be done when MODE indicator / PRO (yellow) lights up.

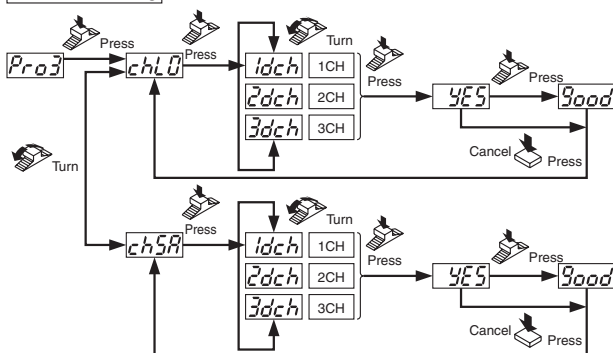
#### PRO1 mode setting



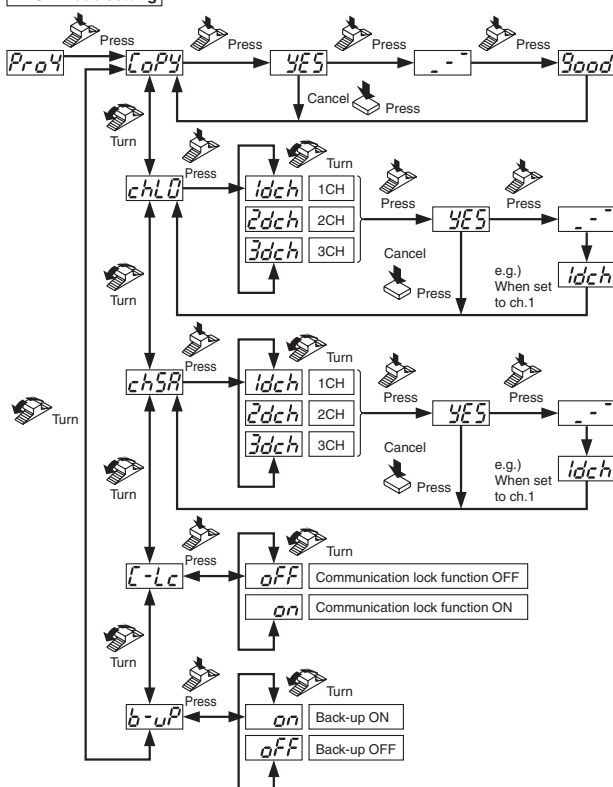
### PRO2 mode setting



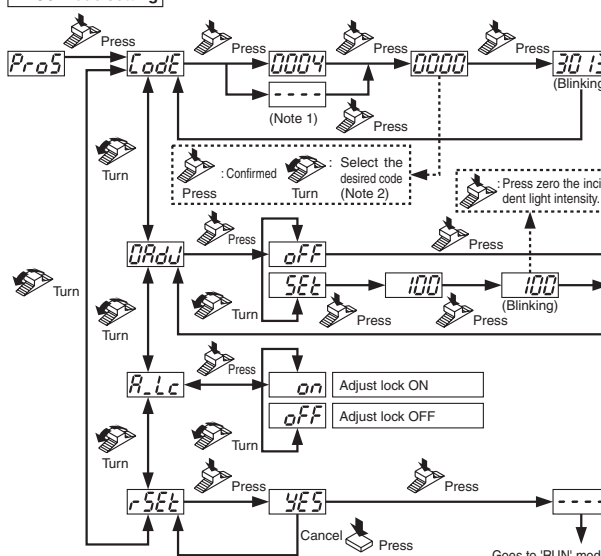
### PRO3 mode setting



### PRO4 mode setting



### PRO5 mode setting



Notes: 1) When any code other than the codes given in the Code setting table below is used, '----' is displayed. The factory setting is '0004'.  
2) When the code setting function is used, refer to the 'Code setting table' given below.

### Code setting table

1st figure	2nd figure	3rd figure	4th figure
Direct code	Response time	Display	Timer
0	STD H-02 (standard)	0 L-ON digit	0 OFF
1	STD H-03 (large)	1 L-ON Percent	1 1ms
2	STD H-01 (small)	2 L-ON Peak hold	2 3ms
3	LONG H-02 (standard)	3 L-ON Bottom hold	3 5ms
4	LONG H-03 (large)	4 D-ON digit	4 10ms
5	LONG H-01 (small)	5 D-ON Percent	5 30ms
6	FAST H-02 (standard)	6 D-ON Peak hold	6 50ms
7	FAST H-03 (large)	7 D-ON Bottom hold	7 100ms
8	FAST H-01 (small)	8 D-ON Percent	8 300ms
9	S-D H-02 (standard)	9 D-ON Peak hold	9 500ms
-	-	-	R 1s
-	-	-	b 2s
-	-	-	c 3s
-	-	-	d 4s
-	-	-	e 5s

3) In order to change PRO mode setting to 'RUN' mode, press MODE key for 2 sec. or more.

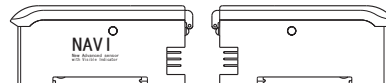
## 14 KEY LOCK FUNCTION

- If the jog switch and MODE key are pressed for more than 2 sec. at the same time in 'RUN' mode condition, the key operations are locked, and only the threshold value confirmation function or the adjust function (valid only when the adjust lock function is canceled) is valid.  
To cancel the lock function, press both the keys for more than 2 sec. once again.

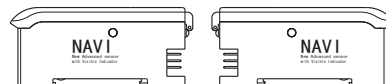
## 15 A DIFFERENCE BETWEEN THE MODIFIED VERSION UNIT AND THE CONVENTIONAL VERSION UNIT

- The unit that 'NAVI' is printed only on a side is the modified version unit. The unit that 'NAVI' is printed on the both sides is the conventional version unit. Make sure to check this when both version units are used together.

<Modified version unit>  
'NAVI' is printed only on a side.



<Conventional version unit>  
'NAVI' is printed on the both sides.



## SUNX Limited

Head Office  
2431-1 Ushiyama-cho, Kasugai-shi, Aichi, 486-0901, Japan  
Phone: +81-(0)568-33-7211 FAX: +81-(0)568-33-2631  
Overseas Sales Dept.  
Phone: +81-(0)568-33-7861 FAX: +81-(0)568-33-8591

http://  
www.sunx.co.jp/

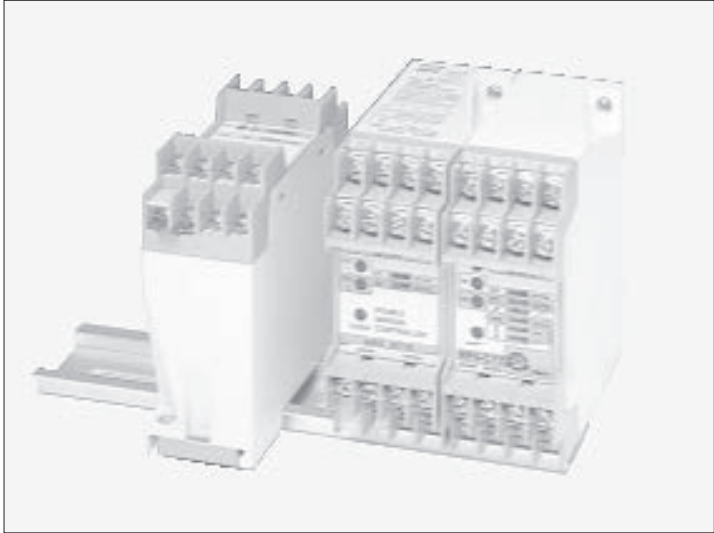
PRINTED IN JAPAN





# NPS SERIES

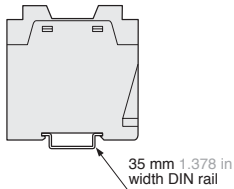
## ON / OFF Input Sensor Controller



### Multi-functional slim sensor controller

#### DIN rail mounting

Mountable on 35 mm 1.378 in DIN rail by one-push. It reduces mounting space and mounting operations.

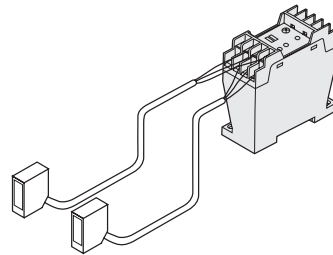


#### Two outputs: contact and non-contact

Useful for various applications because the controller has two outputs, relay contact and NPN open-collector transistor output. (NPS-C7 and NPS-CT7 only)

#### Connects two sensors **NPS-C7W**

Two sensors can be connected, and two independent outputs are generated.

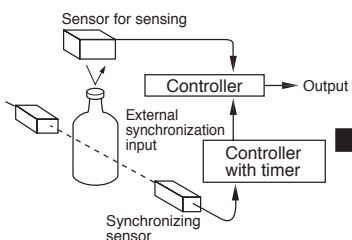


#### Edge trigger **NPS-CT7**

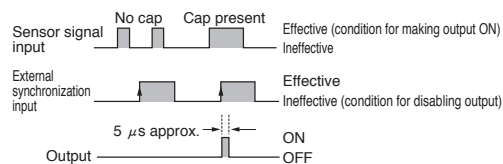
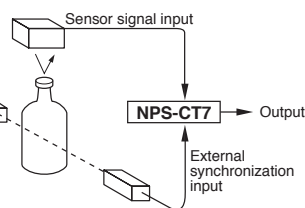
Synchronized input is possible at either the rising or the falling edge of the external synchronization signal. With this, now only one controller suffices where earlier two were required in applications, such as, detecting presence of bottle caps.

#### Example: Detecting presence of cap on bottle

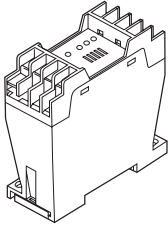
##### • Conventional method



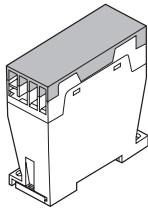
##### • Using NPS-CT7



ORDER GUIDE

Type	Appearance	Model No.	Supply voltage	Power supply for sensor	Output	External synchroni- zation function	Timer function
General use		NPS-C7	100 to 240 V AC ± 10 %	12 V DC ± 10 % 150 mA max.	• Relay contact 1c • NPN open-collector transistor	Gate trigger	_____
High-performance		NPS-CT7		12 V DC ± 10 % 130 mA max.		Gate trigger and edge trigger	Three function selectable timer
Two sensor connection		NPS-C7W		12 V DC ± 10 % 120 mA max.	Relay contact 1c two outputs	_____	_____

**Accessory**  
• NPS-CV (Protection cover)



ON / OFF Input	
NPS	
Analog Input	CA
	CA2
Power Supply	PS-18V-U

## NPS

## SPECIFICATIONS

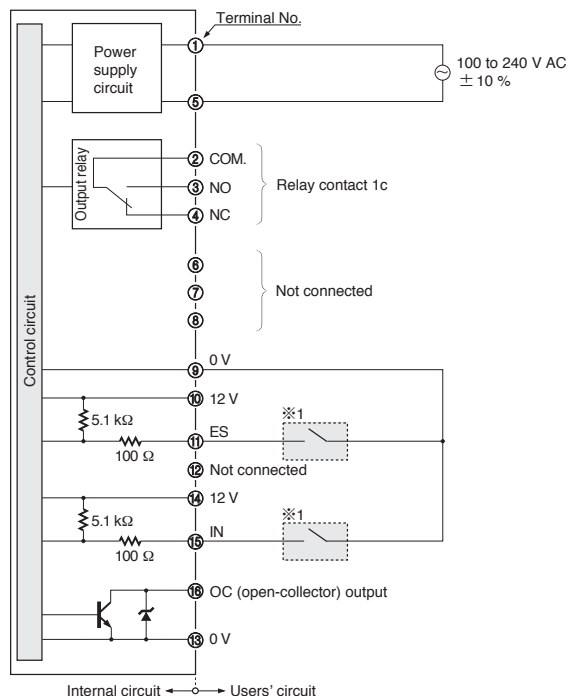
Type		DIN rail mounting		
		General use	High-performance	Two sensor connection
Item	Model No.	NPS-C7	NPS-CT7	NPS-C7W
Applicable sensors		Photoelectric sensor, inductive proximity sensor, etc., with NPN transistor output or relay output		
Supply voltage		100 to 240 V AC $\pm 10\%$		
Power consumption		6 VA or less		
Power supply for sensor	Voltage	12 V DC $\pm 10\%$ (incorporated with short-circuit protection)		
	Current	150 mA	130 mA	120 mA
Output	Relay contact 1c	NPN open-collector transistor • Maximum sink current: 100 mA or less • Applied voltage: 30 V DC or less (between output and 0 V) • Residual voltage: 1 V or less (at 100 mA sink current) 0.4 V or less (at 16 mA sink current)		Relay contact 1c • Switching capacity: 250 V 3 A AC (resistive load) • Electrical life: 100,000 switching operations or more (rated load)(at 1,800 operations/hour) • Mechanical life: 10 million switching operations or more (at 36,000 operations/hour)
	Output operation	Switchable normal operation or inverse operation		
Response time		Relay contact: 10 ms approx., NPN open-collector transistor: 5 $\mu$ s or less		10 ms approx.
Indicators	Power	Red LED (lights up when the power is ON)		
	Output (Note)	Red LED (lights up when the output is ON)		
	Sensor signal input	_____	Red LED (lights up when the sensor signal input is effective)	_____
	External synchronization input	_____	Red LED (lights up when the external synchronization input is effective)	_____
External synchronization function		Gate trigger	Gate trigger and edge trigger	_____
Timer function		_____	Three function selectable timer (Delay time: switchable either 40 ms to 1 sec. or 0.4 sec. to 10 sec.)	_____
Environmental resistance	Ambient temperature	- 10 to + 50 °C + 14 to + 122 °F (No dew condensation or icing allowed), Storage: - 30 to + 70 °C - 22 to + 158 °F		
	Ambient humidity	35 to 85 % RH, Storage: 35 to 85 % RH		
	Noise immunity	Power line: 1,500 Vp, and 0.5 $\mu$ s pulse width (with noise simulator)		
	Voltage withstandability	1,500 V AC for one min. between the power and the output terminals		
	Insulation resistance	10 M $\Omega$ , or more, with 500 V DC megger between the power and the output terminals		
	Vibration resistance	10 to 55 Hz frequency, 0.75 mm 0.030 in amplitude in X, Y and Z directions for two hours each		
Material	Shock resistance	100 m/s <sup>2</sup> acceleration (10 G approx.) in X, Y and Z directions for two times each		
	Material	Enclosure: ABS, Terminal block: PBT (Glass fiber reinforced)		
Connecting method		Terminal block		
Weight		160 g approx.		
Accessories		Short bar: 1 pc., NPS-CV (Protection cover): 1 pc., Short-circuit protection plate: 1 pc. Adjusting screwdriver: 1 pc. (NPS-CT7 only)		

Note: In NPS-C7W, two output indicators, Sensor 1 output indicator and Sensor 2 output indicator, have been incorporated.

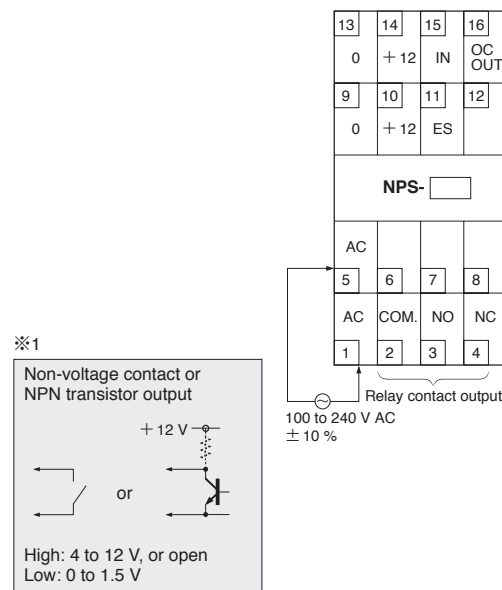
## I/O CIRCUIT AND WIRING DIAGRAMS

NPS-C7  
NPS-CT7

## I/O circuit diagram



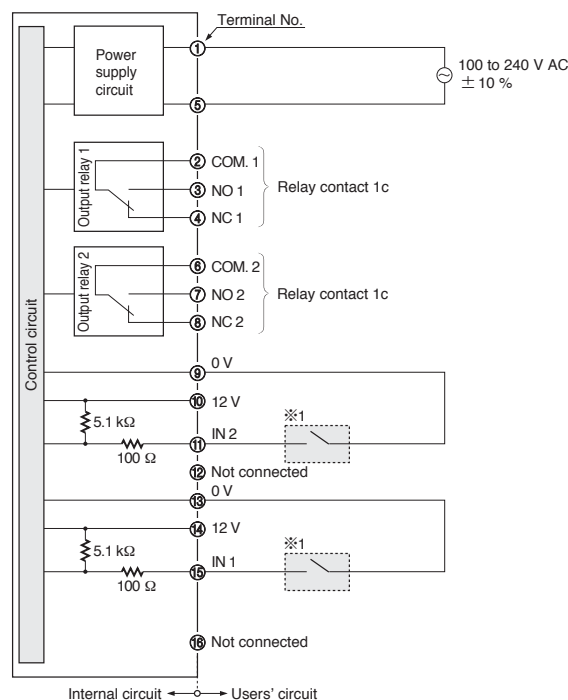
## Terminal arrangement diagram



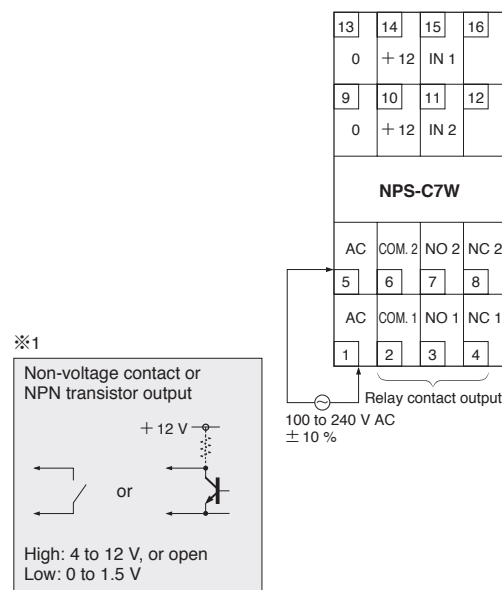
Note: Response time of the NPN open-collector transistor output of **NPS-C7** and **NPS-CT7** is 5  $\mu$ s. If a relay or a micro-switch (mechanical contact) is connected, its bounce may result in output chattering. Take care of this aspect, especially when the timer function is used.

## NPS-C7W

## I/O circuit diagram



## Terminal arrangement diagram



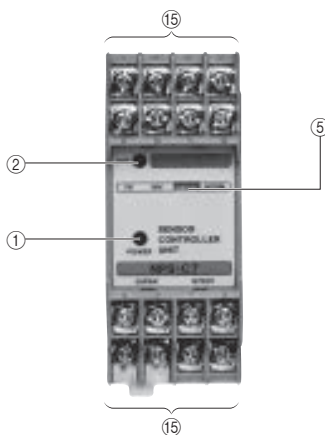
## PRECAUTIONS FOR PROPER USE



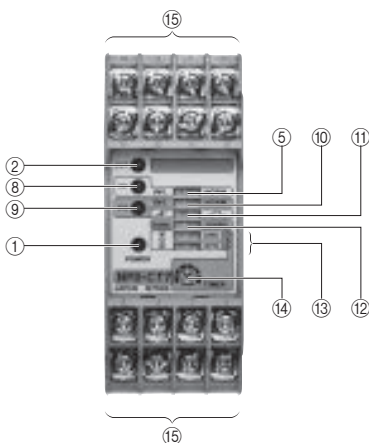
This product is not a safety controller. It does not possess control functions needed for accident prevention or safety maintenance.

### Functional description

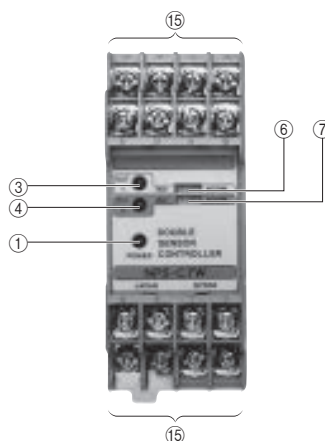
#### NPS-C7



#### NPS-CT7



#### NPS-C7W



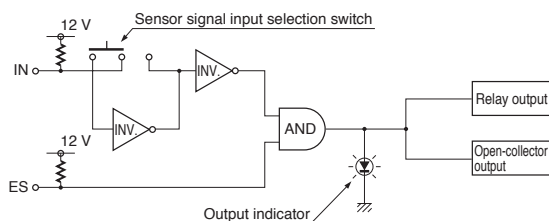
	Description	Function
①	Power indicator (Red LED)	Lights up when the power is ON
②	Output indicator (Red LED)	Lights up when the output is ON.
③	Sensor 1 output indicator (Red LED)	
④	Sensor 2 output indicator (Red LED)	
⑤	Sensor signal input selection switch	<p>Selects the output operation.</p> <p>INV. <input type="checkbox"/> NORM. <input checked="" type="checkbox"/></p> <p>INV.: The output is ON when the sensor signal input is High. NORM.: The output is ON when the sensor signal input is Low.</p>
⑥	Sensor 1 output operation mode switch	<p>Selects the output operation.</p> <p>INV. <input type="checkbox"/> NORM. <input checked="" type="checkbox"/></p>
⑦	Sensor 2 output operation mode switch	<p>INV.: The output is ON when the sensor signal input is High. NORM.: The output is ON when the sensor signal input is Low.</p>
⑧	Sensor signal input indicator (Red LED)	<p>Indicates the state of the sensor signal input. The operation differs according to the mode set with ⑤ Sensor signal input selection switch.</p> <p>INV.: Lights up when the sensor signal input is High. NORM.: Lights up when the sensor signal input is Low.</p>
⑨	External synchronization input indicator (Red LED)	<p>Indicates the state of the external synchronization input. Lights up when the external synchronization input does not disable the output.</p>
⑩	External synchronization operation mode switch	<p>Selects the operation of external synchronization.</p> <p>INV. <input type="checkbox"/> NORM. <input checked="" type="checkbox"/></p> <p>INV.: The output is neglected when the external synchronization input is High. NORM.: The output is neglected when the external synchronization input is Low.</p>
⑪	Gate / Edge trigger operation mode switch	<p>Selects Gate trigger or Edge trigger.</p> <p><input checked="" type="checkbox"/> <input type="checkbox"/></p> <p><input checked="" type="checkbox"/> : Effective at the instant the external synchronization input is applied. <input type="checkbox"/> : Effective over the period for which the external synchronization input is applied.</p>
⑫	Delay time selection switch	<p>Selects the delay time.</p> <p>1 sec. <input type="checkbox"/> 10 sec. <input checked="" type="checkbox"/></p> <p>1 sec.: Variable from 40 ms approx. to 1 sec. approx. 10 sec.: Variable from 0.4 sec. approx. to 10 sec. approx.</p>
⑬	Timer operation mode switch	<p>Selects the timer operation.</p> <p> <input type="checkbox"/> (A) Ineffective    <input checked="" type="checkbox"/> (B) ON-delay    <input type="checkbox"/> (C) OFF-delay    <input type="checkbox"/> (D) ONE SHOT </p>
⑭	Timer adjuster	Set the delay time.
⑮	Terminal block	



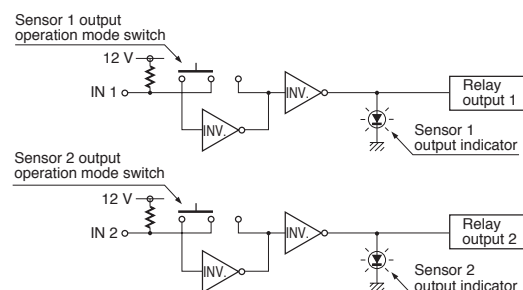
## PRECAUTIONS FOR PROPER USE

**Block diagrams** (The diagrams below explain NPS's operation in a simple manner. The actual circuits may differ slightly.)

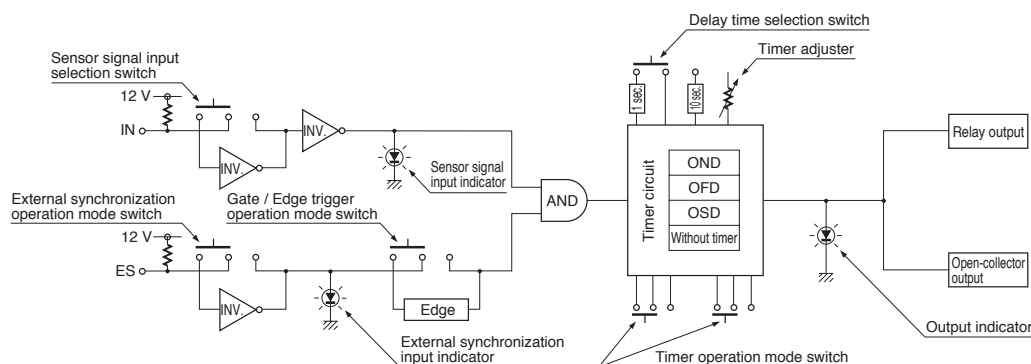
**NPS-C7**



**NPS-C7W**



**NPS-CT7**



### Timer functions (NPS-CT7 only)

- **NPS-CT7** has three types of convenient built-in timer functions.

#### ON-delay (OND)

<Function>: Neglects short output signals.

<Application>: As only long signals are extracted, this function is useful for detecting if a line is choked or for sensing only objects taking a long time to travel.

#### OFF-delay (OFD)

<Function>: Extends the output signal for a fixed period of time.

<Application>: This function is useful if the output signal is so short that the connected device cannot respond.

#### ONE SHOT (OSD)

<Function>: Outputs a fixed width signal upon sensing.

<Application>: This function is useful when the input specifications of the connected device require a signal of fixed width. Of course, it is also useful for extending a short width signal to a desired width.

### Selection switch and timer operation

Switch setting		Sensor signal input	Output operation	High	Low
Sensor signal input selection	Timer operation selection				
N O N	OND	Input not inverted	normal operation	ON	OFF
	OFD	Input not inverted	ON-delay	ON	OFF
	OSD	Input not inverted	OFF-delay	ON	OFF
	Without timer	Input not inverted	ONE SHOT	ON	OFF
I N V.	OND	Input inverted	normal operation	ON	OFF
	OFD	Input inverted	ON-delay	ON	OFF
	OSD	Input inverted	OFF-delay	ON	OFF
	Without timer	Input inverted	ONE SHOT	ON	OFF

Timer period: T = Switchable, either 40 ms approx. to 1 sec. approx., or 0.4 sec. approx. to 10 sec. approx.

Various other applications are possible.

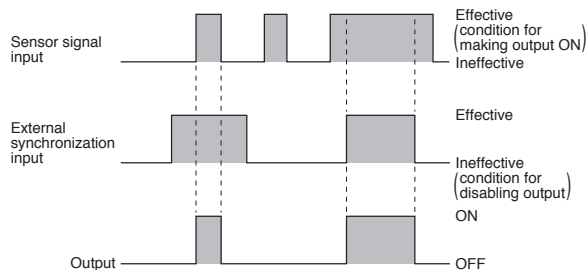
# NPS

## PRECAUTIONS FOR PROPER USE

### External synchronization function (NPS-C7, NPS-CT7 only)

#### • Gate trigger

The output is disabled when the external synchronization input is Low [mode selection switch on NORM. (Note)] or is High [mode selection switch on INV. (Note)] .



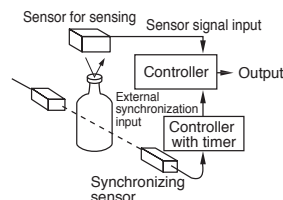
Note: Since **NPS-C7** is not incorporated with the selection switch, the output is disabled only when the external synchronization input is Low.

#### • Edge trigger (NPS-CT7 only)

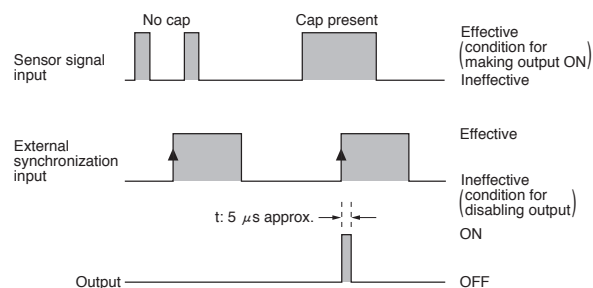
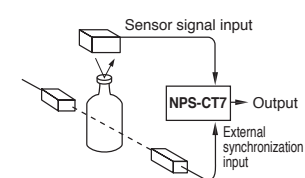
The sensor signal is judged at the instant the external synchronization input rises up or falls down. This sensor is ideal for cap presence detection that would have required two controllers in the past.

Example: Detecting presence of cap on bottle

#### <Conventional>



#### <NPS-CT7>



Note: As the output time 't' is only 5  $\mu$ s approx., extend it by using the OFF-delay timer or the ONE SHOT timer.

### Mounting

- To mount **NPS** with screws, use M4 screws. The tightening torque should be 0.78 N·m or less.

### Wiring

- Make sure that the power supply is off while wiring.
- Verify that the supply voltage variation is within the rating.

#### • Short-circuit protection plate

The short-circuit protection plate is attached to terminal No. 1 to prevent AC short-circuit. Flip the plate up, connect the wire to terminal No. 1, and then flip it down.

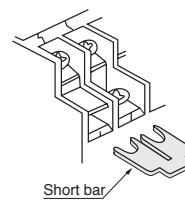
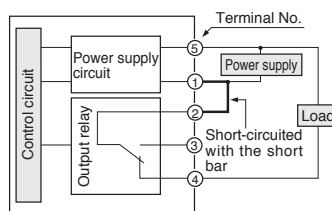


#### • Short bar

The short bar saves wiring when a common power supply is used for the AC supply terminal and the load supply of the relay contact output.

The short bar is attached between the terminal Nos. 1 and 2 at the time of shipment from our factory. To use a separate power supply for the output relay, make sure to remove it.

#### Typical wiring diagram



### • Dimensions of suitable crimp terminals

Unit: mm in

Y-shaped type	Round type

Note: Use crimp terminals having insulation sleeves.

Recommended crimp terminal: Nominal size 1.25-3

- NPS-C7** and **NPS-CT7** do not incorporate a short-circuit protection at the NPN open-collector transistor output. Do not connect them directly to a power supply or a capacitive load.
- The response time of the NPN open-collector transistor output of **NPS-C7** or **NPS-CT7** is 5  $\mu$ s. If a relay or a micro-switch (mechanical contact) is connected, take care since its bounce may result in output chattering.
- Do not run the wires together with high-voltage lines or power lines or put them in the same raceway. This can cause malfunction due to induction.

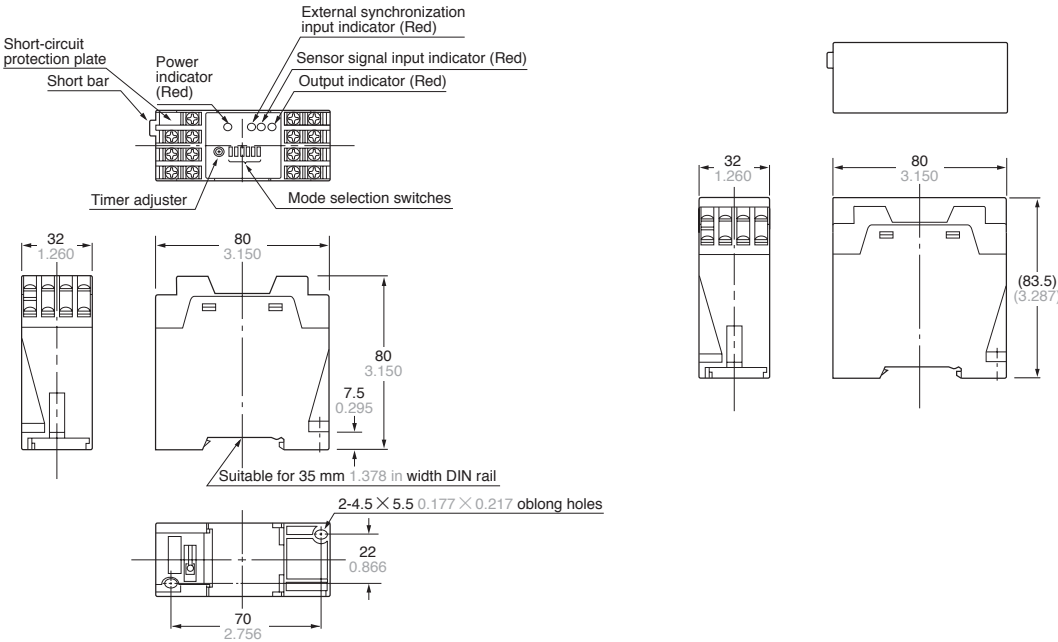
### Others

- Do not use during the initial transient time (0.5 sec.) after the power supply is switched on.
- Avoid dust, dirt, and steam.
- Take care that the controller does not come in direct contact with water, oil, grease, or organic solvents, such as, thinner, etc.

**DIMENSIONS (Unit: mm in)** The CAD data in the dimensions can be downloaded from the SUNX website: <http://www.sunx.co.jp/>

NPS-□

Assembly dimensions with attached protection cover



Notes: 1) The above drawing illustrates the dimensions of **NPS-CT7**.  
The dimensions of **NPS-C7** and **NPS-C7W** are identical to those given above.  
2) The front panel of each model is different.  
Refer to p.850 for more details of the front panels.

Power Supply	Analog Input	ON / OFF Input
PS-18V-U	CA2	NPS

