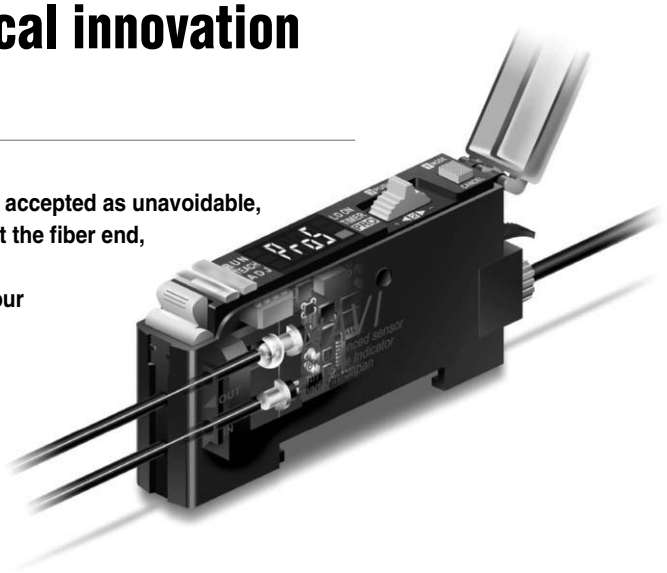
FX-301 SERIES

'FX-301' - born from technological innovation



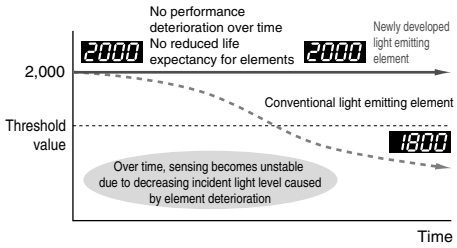
Fiber sensor have again taken one more step forward.
The deterioration of the light emitting elements over time, previously accepted as unavoidable, as well as the conventional idea that lenses could only be attached at the fiber end, have now finally been conquered with SUNX technology.
By utilizing a newly developed light emitting element composed of four chemical elements, which effectively eliminates deterioration, and by incorporating a lens within the fiber sensor itself, stable long-range sensing over long time periods - which has never before been possible - can now be easily implemented.
'FX-301' begins the first page in a new chapter of fiber sensors.

INNOVATION

Crystallizing the Evolution of SUNX Technology to Conquer Conventional Ideas

Specially Developed Light Emitting Element Extends Life Expectancy - No Need to Ever Adjust Incident Light Level

Newly developed



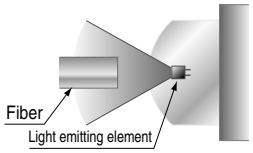
The quantity of light emitted from the light-emitting element in conventional fiber sensor tends to decrease due to the effects of temperature, as well as with element deterioration over time. In order to address this problem, APC (Auto Power Control) circuit is used to sense light reductions and compensate by increasing the amount of current to the light-emitting element, thereby stabilizing sensing operation. Although the incorporation of APC circuit is an effective means of correcting light levels, the element life expectancy is decreased due to the continual increases in electric current levels required for brightness compensation. On the contrary, our newly developed 'LED using four chemical elements' used in **FX-301**, has been specially formulated to reduce performance deterioration of the light-emitting element to the absolute minimum, thus producing stable incident light levels without the use of APC circuit. Furthermore, accurate and stable sensing operation can be maintained over very long periods, because reductions to element life expectancy from excessive electric current do not occur.

Long-range Sensing Made Possible with Built-in Optical Lens

Innovative feafure

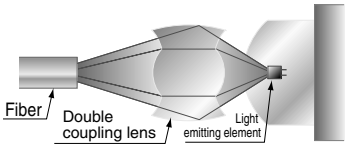
For the first time in the industry, an optical 'double coupling lens' has been incorporated directly into the fiber sensor itself. This lens maximizes the light emission efficiency, resulting in a tremendous improvement in the sensing range. Sensing ranges with small diameter fiber and ultra-small diameter fiber, which have become very popular in recent years due to the miniaturization of chip components, have been increased by 50% over previous values achieved with other amplifiers.

■Conventional fiber sensor system (without lens)



Low efficiency due to the diffusion and loss of emitted light.

■**FX-301 (built-in double coupling lens)**



The light emission efficiency is increased tremendously, as light is now collected and focused into the fiber by the lens.

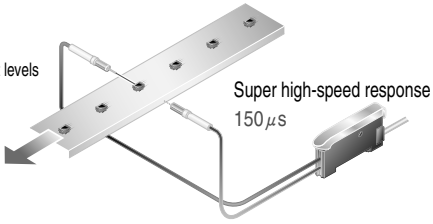
The Fastest Response Time Has Been Achieved

The fastest response time, 150 μs, is now available. Sensing range has also been greatly increased. As a result, high-speed detection utilizing ultra-small diameter fiber, previously unachievable due to problems with response time and range limitation, is now possible.

Response time

Switchable between three different levels

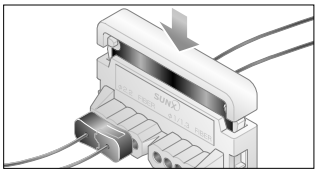
- High-speed mode: 150 μs
- Standard mode: 250 μs
- Long-range mode: 2 ms

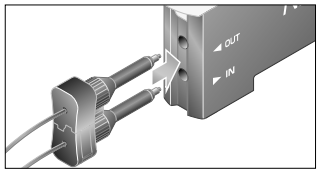


Now It's Possible to Simultaneously Cut Two Fibers to the Same Length

Newly developed

Our new fiber cutter utilizes a specially developed two-in-one fiber attachment that now makes it possible to cut two fibers simultaneously to exactly the same length. Also, since the fibers can be attached to the amplifier while being fixed in position in the two-in-one fiber attachment, sensitivity changes due to variation in the amount of fiber insertion do not occur.



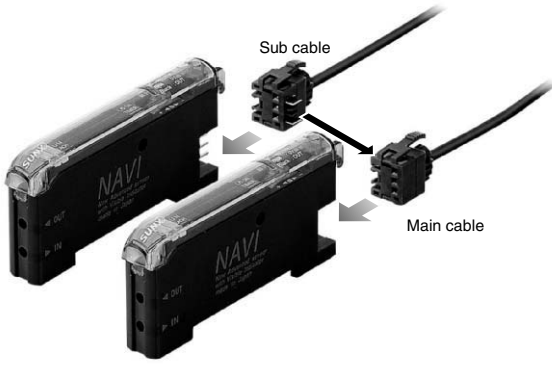


APPLICATION

The Flexible Design Addresses All User Concerns

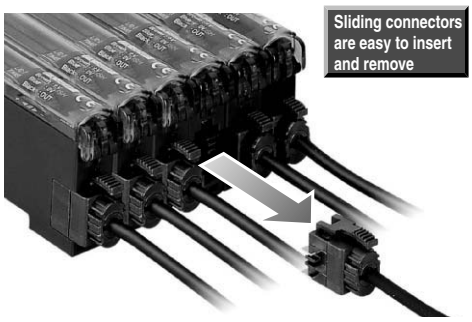
Easy Maintenance, as Main and Sub Units Are Identical

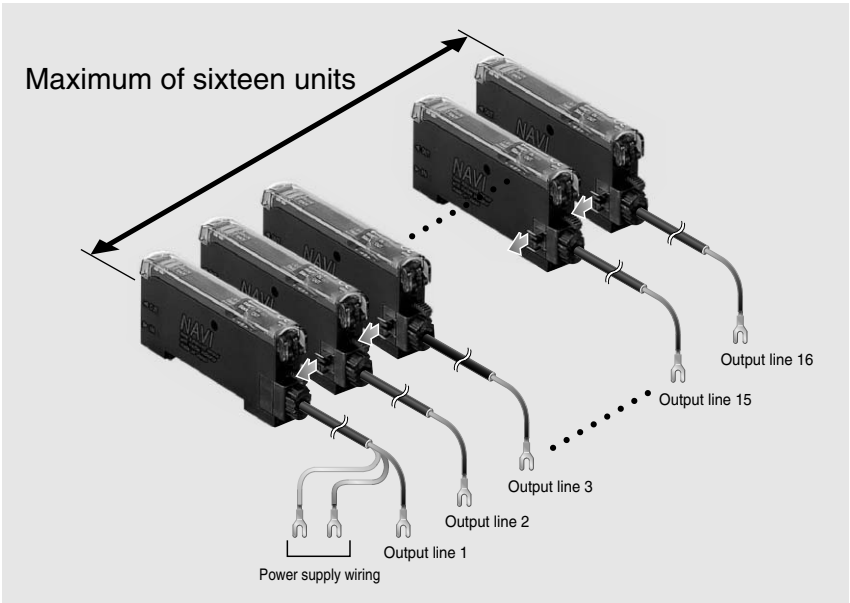
Both main and sub units utilize the same amplifier body. This feature allows for easy mounting in the side-by-side configuration, because main and sub unit functions are distinguished only by the proper use of 3-core main cable for the main unit and 1-core sub cable for each sub unit. Moreover, due to the utilization of the same main body for both main and sub units, inventory management and maintenance, is simplified.



Wiring- and Labor-saving Design Allows Side-by-side Configuration for up to Sixteen Units

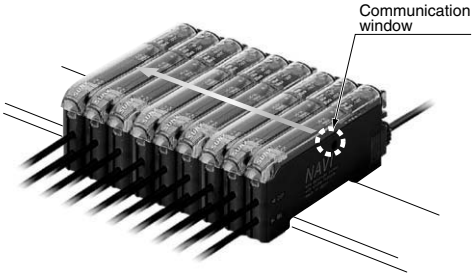
Up to sixteen amplifiers can be connected in a side-by-side configuration. As the sub cable contains only one output line, a great amount of wiring and space can be saved. Also, special 'sliding' connectors have been provided for all main and sub cables, which can be detached merely by releasing the lock and pulling directly back, without having to slide the main amplifier body to the side. Using this connector system, only a minimal amount of space is required for regular maintenance.





Optical Communications Function Enables Data Copying and Saving

By utilizing the optical communications feature, existing setting data can be copied from one amplifier and saved directly to all other amplifiers that are connected to its right hand side in the side-by-side configuration. Therefore, even cumbersome operations during set-up reconfiguration, etc., can be performed smoothly and efficiently.



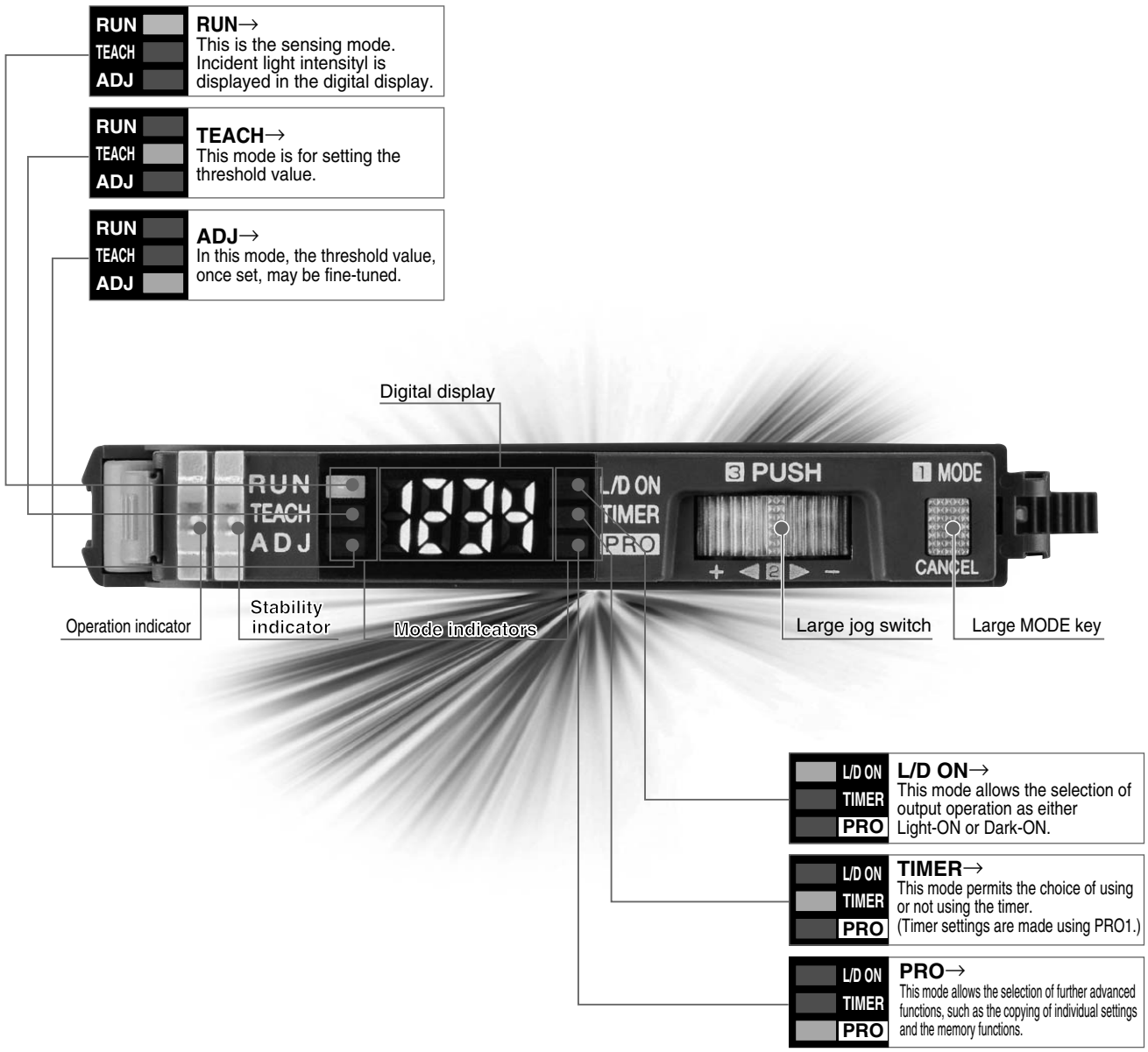
Close Mounting Is Possible for up to Four Fiber Heads

By employing the optical communications feature, mutual interference prevention is enabled for up to four closely mounted fiber heads.
(Automatically set at time of power activation.)

FX-301

Continuous pursuit of ease-of-use.
You will be amazed by its impressive operability.

When considering fiber sensor design from the customer's viewpoint, we must consider the variety of useful features - and even more importantly - their ease-of-use.
'FX-301' integrates numerous technological innovations to make these ideals a reality.
Its amazing usability is made possible by the utilization of MODE NAVI and two large switches.
MODE NAVI contains an easy-to-understand display system and is very simple to operate.
Just two large switches are used to control all MODE NAVI functions.
You will be an expert from the moment you pick up an FX-301!



New Advanced sensor with Visible Indicator

MODE NAVI

Advanced fiber sensor with high performance detection features, navigated using superior display technology.

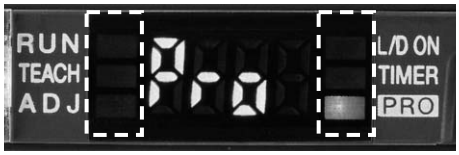
FX-301

INSTRUCTION

Easy to Understand, Even for Beginners
Simple and Confusion-free Operation

Easy Operation with MODE NAVI

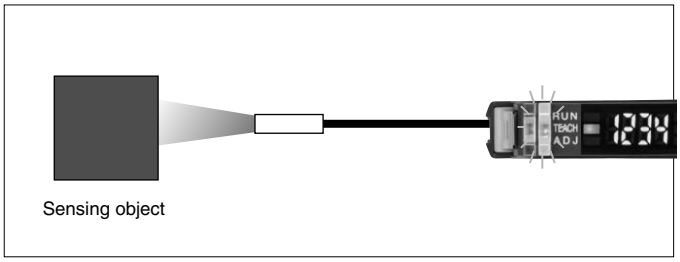
MODE NAVI uses six indicators to display the amplifier's basic operations. The current operating mode can be confirmed at a glance, so even a first time user can easily operate the amplifier without becoming confused.



MODE NAVI (MODE indicators)

Blinking Indicator Displays the Margin in Sensitivity

When setting the threshold value, the margin in sensitivity can be confirmed by the number of times the stability indicator blinks.



* Blinking five times indicates the highest level of sensitivity.

OPERATION

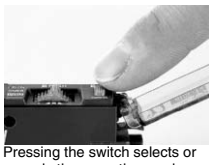
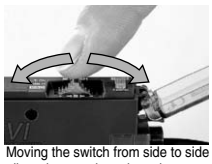
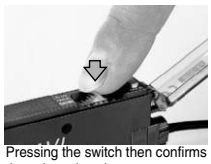
Very easy operation, even with multiple functions. Provides amazing usability.

Simple Operation with Easy Access to Advanced Functions

Each mode can be selected using the large MODE key. Detailed functions and settings can be chosen using the large jog switch. Each setting mode can be easily confirmed by viewing the MODE indicator display. The advanced features available in each mode can be easily viewed and smoothly selected from the digital display.
Further, by utilizing the various functions incorporated in the five 'PRO modes', even more sensitive detection and fine settings may be performed.

Two Switches with Distinct Functions

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. The use of only two switches makes for very simple operations and easy maintenance.

Large MODE key	Large jog switch	
		
Pressing the switch selects or cancels the operating mode	Moving the switch from side to side allows items to be selected	Pressing the switch then confirms the selected setting

FX-301

IMAGINATION

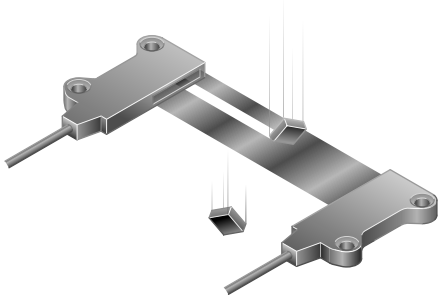
Multifeatured PRO Mode, Supports Efficient Operation

What PRO mode is...

PRO1 to PRO5 incorporate various functions, such as settings required for fine detection operations inaccessible through basic operation settings, as well as features that further improve usability.

PRO mode application example	High-speed sensing of extremely minute chip components during drop sorting

For example, by utilizing the PRO mode, extremely small objects passing the sensor at very high speeds, can now be reliably detected where detection had previously been difficult.



Hysteresis function/ HYS PRO1

Hysteresis is set to H-01, a small hysteresis value, for sensing of extremely minute objects.

Three different levels are available

H-01 (small)
H-02 (standard)
H-03 (large)

Response time change function/ SPEd PRO1

High-speed mode, having a response time of 150 μs, is selected.

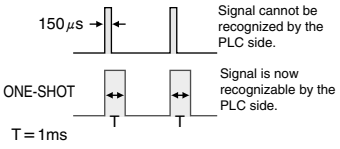
Three different levels are available

FAST <150 μs (high-speed mode)>
STD <250 μs (standard mode)>
LONG <2ms (long-range mode)>

Timer setting function/ dELY PRO1

Signal pulse width is set to 1ms with the ONE-SHOT timer.

As the PLC cannot recognize a signal with a pulse width of only about 150 μs, the ONE-SHOT timer is selected, with a setting of 1ms, thus ensuring adequate pulse width for correct signal detection by the PLC.



Digital display setting function/ diSP PRO2

Bottom hold is utilized.

During sensing operation (RUN), the following data can be selected for viewing on the digital display: incident light level (numerical value), peak value (peak hold), bottom value (bottom hold) and percentage. Selecting 'bottom hold' displays the minimum incident light level when light is blocked from the sensor by the high-speed passage of an extremely small object. This feature allows confirmation of the difference between incident light levels at times when the light is not blocked and when the light is being blocked. The bottom hold value is a guideline for determining threshold value at the time of installation.

Individual Configuration and Setting Data Can be Displayed and Saved!

Data Bank Load & Save Setting Function/ ch1O & ch5A PRO3

Configuration and setting data, which has been previously saved in the data bank, can be displayed and used to replace the current configuration settings. Also, current configuration settings can be saved in the selected data bank. The data bank contains channels 1 to 3, reducing setting time required during reconfiguration.

With the Optical Communications Feature, Only One Single Step Is Required to Perform Data Copy, Read-out and Save Functions for All Amplifiers Connected in Side-by-side Configuration!

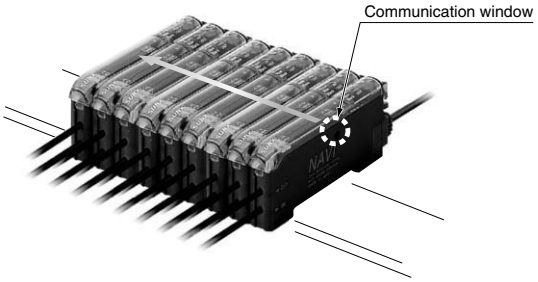
The optical communications feature
FX-301 incorporates an optical communications feature. When several amplifiers are connected in the side-by-side configuration, this function allows the setting status to be altered for units connected on the right side of the operating amplifier.

Setting Condition Copy Function/ CoPY PRO4

The configuration data for an operating amplifier can be copied to all other amplifiers that are connected to it on the right side. (Except for data bank contents.)

Remote Data Bank Load & Save Setting Function/ ch1O & ch5A PRO4

When a group of amplifiers are connected in the side-by-side configuration, this function allows all setting data, previously saved in the data banks, of the amplifiers on the right hand side of the operating amplifier to be read out simultaneously and become the new configuration setting. Further, the current setting can also be simultaneously stored in the data bank of each amplifier.



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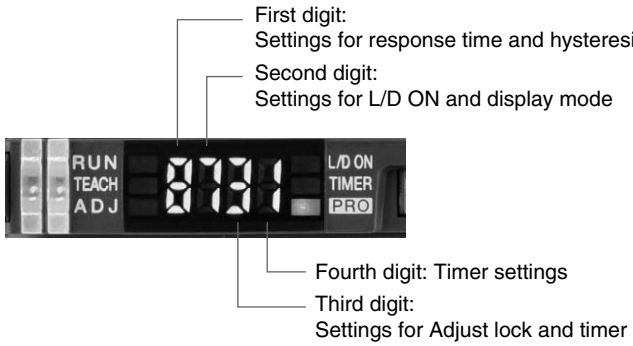
Direct Setting Is Made Possible Through Numerical Inputs!

Code Setting Function/ CodE PRO5

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.
Also, when setting is done by any means other than direct code input, the existing code will be automatically changed (However, if the selected settings is not contained within the code table, then the code will be displayed as ' ---- '.)
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.



[Code setting table]

Direct code	First digit		Second digit		Third digit		Fourth digit
	Response time	Hysteresis	L/D ON	Display mode	Adjust lock	Timer	Timer setting
0	STD	H-02 (standard)	L-ON	digit	ON	OFF	OFF
1	STD	H-03 (large)	L-ON	%	ON	OFF-delay	1ms
2	STD	H-01 (small)	L-ON	Peak hold	ON	ON-delay	3ms
3	LONG	H-02 (standard)	L-ON	Bottom hold	ON	ONE-SHOT	5ms
4	LONG	H-03 (large)	D-ON	digit	OFF	OFF	10ms
5	LONG	H-01 (small)	D-ON	%	OFF	OFF-delay	30ms
6	FAST	H-02 (standard)	D-ON	Peak hold	OFF	ON-delay	50ms
7	FAST	H-03 (large)	D-ON	Bottom hold	OFF	ONE-SHOT	100ms
8	FAST	H-01 (small)					300ms
9							500ms

[Setting example]

In case 'high-speed sensing for extremely minute chip components during drop sorting', described on P. 46, is set by entering a direct code. (Code 8731)

	Code
Response time : FAST (150 μs) Hysteresis : H-01(small)	8
Operating mode : D-ON Display mode : Bottom hold	7
Adjust lock : ON Timer : ONE-SHOT	3
Timer setting : 1ms	1

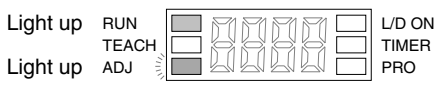
Incident Light Intensity and Sensitivity can be Adjusted!

0-ADJ Setting Function/ 0AdJ PRO5

The digital display allows for automatic zeroing of the incident light intensity. When incident intensity is always at the same level, the difference in incident intensities between normal status and sensing status can be verified. This function is also useful for eliminating any differences between the displayed incident light intensity values for each connected amplifier.

Adjust Lock Setting Function/ ALc PRO5

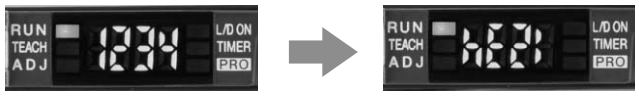
If adjust lock is set to OFF, then fine-tuning for sensitivity can be performed by using the jog switch, even during sensing operation (RUN). This feature is very convenient when delicate adjustments are required. When adjust lock is set to OFF, besides the RUN indicator (green), which displays sensing status, the ADJ indicator (yellow) will also light up. The initial status of adjust lock is ON.



Digital Display Orientation can be Changed!

Digital Display Inversion Function/ turn PRO2

The orientation of the digital display can be flipped and reversed. The initial status for display orientation is 'turn OFF'.



Power Saving Feature Available!

ECO Mode Setting Function/ Eco PRO2

When ECO mode is selected, the digital display will turn off in order to reduce power consumption. The initial status for ECO mode is 'ECO OFF'.

FX-301

PRO MODE FLOW CHART

PRO mode - can be used for a variety of different purposes.
'How should I configure the fiber sensor amplifier for this particular application?'
- are you confused by all the different sensing methods?
PRO mode will solve your problems and accommodate your needs.
Please refer to the '**FX-301** Operation Guide', P.71 and on, for detailed information on the available functions and operating procedures.

Applications	PRO mode	Selected function	Setting items
Objects moving at high speed must be detected.	PRO1	SPEd **Response time change function** Switchable among 3 levels (high-speed/standard/long-range modes)	FASt High-speed mode, having a response time of 150 μs
Insufficient sensing range available.	PRO1		Lon9 Long-range mode, it is convenient when long sensing range is required.
A vibrating object must be reliably detected.	PRO1	HYS **Hysteresis function** Selectable the hysteresis from among 3 different levels (small/standard/large)	H-03 Hysteresis is large value, having a capability of detecting objects having a vibratory motion.
Extremely minute differences must be detected.	PRO1		H-01 Hysteresis is small value, so it can detect extremely minute objects.
Optimum sensitivity must be set without the presence of any sensing object (when a thru-beam type fiber is utilized and light is completely interrupted.)	PRO1	SHFt **Limit teaching function** Shifts the threshold value by a certain percentage increment during limit teaching	50P In the event that the shift increment is 50%. Since the maximum sensitivity is 100% when no object is present, the threshold value is set as 50% of the shift increment (50% of the value).
The display is difficult to read because the amplifier has been installed in the reverse orientation.	PRO2	tUrn **Digital display inversion function**	tron When set to turn ON, the orientation of the digital display can be fipped and reversed.
In order to utilize multiple sensors, current consumption must be minimized.	PRO2	Eco **ECO mode setting function**	Econ If ECO ON has been selected, then the digital display will be turned off, allowing current consumption to be reduced to 25mA or less (at 24V supply voltage).
The timer operation must be set to ON-delay or ONE-SHOT. The timer settings require precise adjustment.	PRO1	dELY **Timer setting function** Selectable timer from 4 different timer (without timer/OFF-delay/ ON-delay/ONE-SHOT) The range of available timer is 0.5 to 500ms.	ond ON-delay timer neglects short output signals. → n.20 The setting is 20ms ON-delay timer.
	PRO1		oSd ONE-SHOT timer outputs a fixed width signal open sensing. → o.05 The setting is 0.5ms ONE-SHOT timer.
The settings configuration must be reset back to factory settings.	PRO5	rSEt **Setting reset function** Causes all configuration settings to revert to factory settings. However, any settings that have been saved within the data bank will not be changed.	
The threshold value must be adjusted during RUN mode.	PRO5	A.Lc **Adjust lock setting function**	LcoF If 'Adjust Lock' has been set to OFF, then the threshold value adjustment can be performed in RUN mode.

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Applications	PRO mode	Selected function	Setting items
The stability indicator must be illuminated, especially if sensing a minute object at high speed.	PRO1	**Stability function** Selectable from among 3 different stability indicator response levels	S-03 The stability indicator will not light up when values are within ±5% of the threshold value.
A stable incident light source must be available. The presence of a stable incident light source is required, in order that the fiber maintenance time may be correctly ascertained.	PRO1		S-01 The stability indicator will not light up when values are within ±15% of the threshold value. If the stability indicator does not light up, then fiber maintenance must be performed.
The threshold value must be set according to the amount of light that is interrupted by the passage of the object, when sensing an object at high speed using a thru-beam type fiber.	PRO2	**Digital display setting function** Selectable from among 4 different numerical values (incident light intensity display/percentage display/peak hold display/bottom hold display)	150P This function sets the numeric display to show percentage values (the above represents 150%). This function displays the incident light intensity on a percentage scale within the range of 1% to 999%, based on the threshold value as a standard.
			bHLd This function sets the numeric display to bottom hold display. This function allows the minimum incident light intensity to be displayed when light is interrupted the passage of an object at high speed. Thus, the difference between incident light intensities can be determined for the two states; when light is interrupted and when light is not interrupted.
The threshold value must be set according to the amount of light in the object present condition, when sensing an object at high speed using a reflective type fiber. The beam axis must be positioned at the optimum location.	PRO2		PHLd This function sets the numeric display to peak hold display. This function allows the maximum incident light intensity to be displayed when the object is present by the passage of an object at high speed. Thus, the difference between incident light intensities can be determined for the two states; when light is interrupted and when light is not interrupted. This makes it convenient to perform fine adjustments of the beam axis during RUN mode, after confirming the peak value of the incident light intensity.
All amplifiers connected together in a side-by-side configuration must contain the same settings information.	PRO4	**Setting condition copy function** The configuration data can be copied to other connected amplifiers.	
Basic configuration information must be directly input without having to make individual adjustments for each setting. The basic configuration procedure must be managed by utilizing numeric codes.	PRO5	**Code setting function** Due to the coding function, all basic configuration information for an amplifier may be set merely by the input of a 4-digit code based on the code setting table. Maintenance is easy since the amplifier settings configuration can be managed by using a 4-digit code. If any settings are changed by accident at the work site, causing a malfunction, then the problem can be easily solved by having the manager input a 4-digit code.	
While existing settings data must be saved, new settings information must be reconfigured. The configuration settings must be capable of being changed for test trials.	PRO3	**Data bank save setting function** Up to 3 sets of configuration settings information can be saved.	
	PRO3	**Data bank load setting function** Configuration setting data, which has been previously saved can be displayed.	
Settings configuration data, for all amplifiers connected together in the side-by-side configuration, must be easily modified.	PRO4	**Remote data bank save setting function** It is possible to save the settings configuration data for multiple connected amplifiers, in a single step.	
	PRO4	**Remote data bank load setting function** It is possible to load saved settings configuration data for multiple connected amplifiers, in a single step.	
The incident light intensity must be confirmed when the sensor amplifier is in the non-sensing state, as well as when in the sensing state. The presence of any displacement in the beam axis must be determined.	PRO5	**0-ADJ setting function** The digital display allows for automatic zeroing of the incident light intensity.	

FX-301

AMPLIFIERS SPECIFICATIONS

Amplifiers

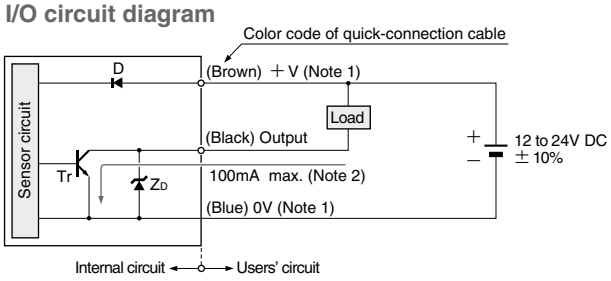
Item \ Type		NPN output	PNP output
Model No.		**FX-301**	**FX-301P**
Supply voltage		12 to 24V DC ± 10% Ripple P-P 10% or less	
Power consumption		Normal operation: 960mW or less (Current consumption 40mA or less at 24V supply voltage) ECO mode: 600mW or less (Current consumption 25mA or less at 24V supply voltage)	
Output		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]	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]
	Utilization category	DC-12 or DC-13	
	Output operation	Selectable either Light-ON or Dark-ON, with jog switch	
	Short-circuit protection	Incorporated	
Response time		150 μs or less (FAST), 250 μs or less (STD), 2ms or less (LONG) selectable with jog switch	
Sensitivity setting		2-level teaching / Limit teaching / 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 7 segment 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: 0.5 to 500ms approx.)	
Automatic interference prevention function		Incorporated (for up to four amplifier connected in cascade) (Note 2)	
Environmental resistance	Pollution degree	3 (Industrial environment)	
	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	
	Ambient illuminance	Sunlight: 10,000 ℓx at the light-receiving face, Incandescent light: 3,000 ℓx at the light-receiving face	
	EMC	Emission: EN50081-2, Immunity: EN50082-2	
	Voltage withstandability	1,000V AC for one min. between all supply terminals connected together and enclosure (Note 3)	
	Insulation resistance	20MΩ, or more, with 250V DC megger between all supply terminals connected together and enclosure (Note 3)	
	Vibration resistance	10 to 150Hz frequency, 0.75mm amplitude in X, Y and Z directions for two hours each	
	Shock resistance	98m/s^2 acceleration (10G approx.) in X, Y and Z directions for five times each	
Emitting element		Red LED (modulated)	
Material		Enclosure: Heat-resistant ABS, Case cover: Polycarbonate, Switch: Acrylic	
Connecting method		Connector connection	
Cable extension		Extension up to total 100m is possible with 0.3mm^2, or more, cable	
Weight		25g approx.	

Notes: 1) 50mA, if five, or more, amplifiers are connected in cascade.
2) When the power supply is switched on, the emission timing are automatically set for interference prevention.
3) The voltage withstandability and the insulation resistance values given in the above table are for the amplifier only.
4) The cable for amplifier connection is not supplied as an accessory. Make sure to use the optional quick-connection cable 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)

I/O CIRCUIT AND WIRING DIAGRAMS

FX-301 NPN output

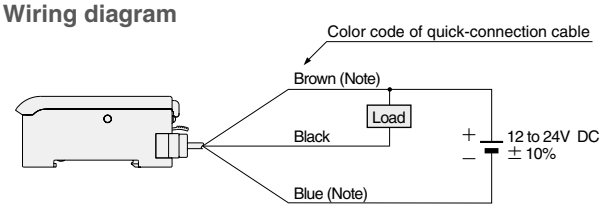
I/O circuit diagram



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

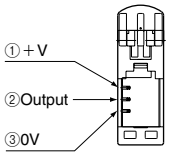
Symbols ... D : Reverse supply polarity protection diode
ZD: Surge absorption zener diode
Tr : NPN output transistor

Wiring diagram



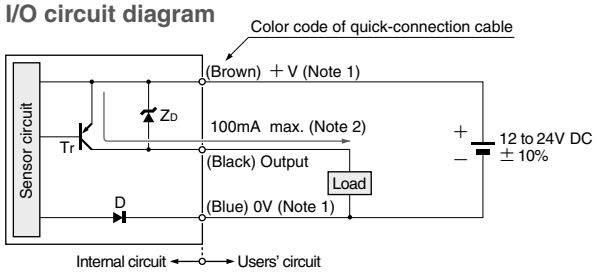
Note: The quick-connection sub cable does not have brown cable and blue cable.

Terminal arrangement diagram



FX-301P PNP output

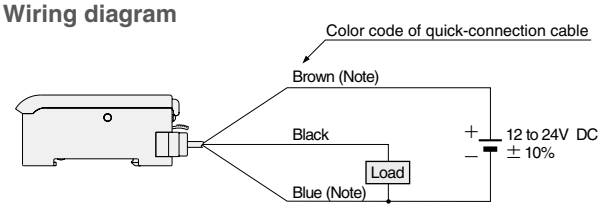
I/O circuit diagram



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

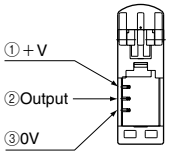
Symbols ... D : Reverse supply polarity protection diode
ZD: Surge absorption zener diode
Tr : PNP output transistor

Wiring diagram



Note: The quick-connection sub cable does not have brown cable and blue cable.

Terminal arrangement diagram



FX-301

Amplifier, quick-connection cables and end plates

Amplifiers

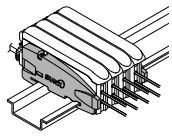
Appearance	Model No.	Emitting element	Output
	**FX-301**	Red LED	NPN open-collector transistor
	FX-301P		PNP open-collector transistor

Quick-connection cables

Type	Model No.	Description	
Main cable	**CN-73-C1**	Length: 1m	0.2mm^2 3-core cabtyre cable, with connector on one end Cable outer diameter: ϕ3.8mm
	CN-73-C2	Length: 2m	0.2mm^2 3-core cabtyre cable, with connector on one end Cable outer diameter: ϕ3.8mm
	CN-73-C5	Length: 5m	0.2mm^2 3-core cabtyre cable, with connector on one end Cable outer diameter: ϕ3.8mm
Sub cable	**CN-71-C1**	Length: 1m	0.2mm^2 1-core cabtyre cable, with connector on one end Cable outer diameter: ϕ3.8mm
	CN-71-C2	Length: 2m	0.2mm^2 1-core cabtyre cable, with connector on one end Cable outer diameter: ϕ3.8mm
	CN-71-C5	Length: 5m	0.2mm^2 1-core cabtyre cable, with connector on one end Cable outer diameter: ϕ3.8mm

Quick-connection cable is not supplied with the amplifier. Please order it separately.

End plates

Appearance	Model No.	Description
	**MS-DIN-E**	When connecting multiple amplifiers, these end plates must be used. It ensure that all amplifiers are mounted together in a secure and fully connected manner. Two Nos. per set

End plates are not supplied with the amplifier. Please order it separately.

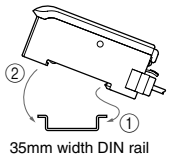
PRECAUTIONS FOR PROPER USE

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.

Mounting

How to mount the amplifier

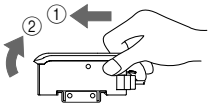
① Fit the rear part of the mounting section of the amplifier on a 35mm width DIN rail.
② Press down the front part of the mounting section of the amplifier on the 35mm width DIN rail.



How to remove the amplifier

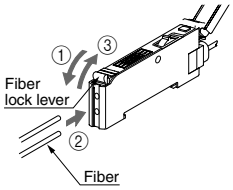
① Push the amplifier forward.
② Lift up the front part of the amplifier to remove it.

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

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.



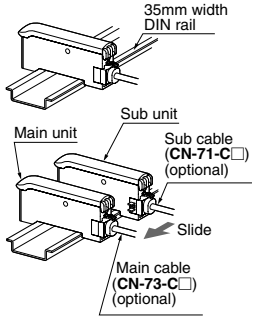
Notes: 1) In case the fiber cables are not inserted to a position where they stop, the sensing range reduces.
2) With the coaxial reflective type fiber, such as, **FD-G4** or **FD-FM2**, insert the single-core fiber cable into the beam-emitting inlet and the multi-core fiber cable into the beam-receiving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

Cascading amplifiers

- Make sure to add or remove the amplifiers in the power supply off condition.
- Make sure to check the allowable ambient temperature, as it dependes 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 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-C**□) as the quick-connection cable for the second amplifier onwards.

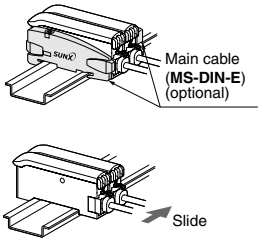
Cascading method

① Mount the amplifiers, one by one, on the 35mm width DIN rail. (For details, refer to '**Mounting**'.)
② Slide the sub units next to the main unit, and connect the quick-connection cables.
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 Loosen the screws of the end plates (**MS-DIN-E**).
② Remove the end plates (**MS-DIN-E**).
③ Slide the sub units and remove them one by one. (For details, refer to '**Mounting**'.)

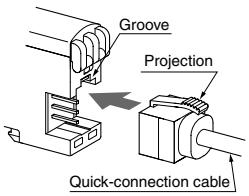


Connection

Make sure to connect or disconnect the quick-connection cable in the power supply off condition.

Connection method

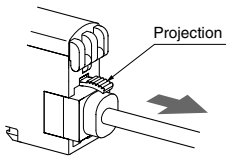
① Holding the connector of the quick-connection cable, align its projection with the groove at the top portion of the amplifier connector.
② Insert the connector till a click is felt.



Disconnection method

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

Note: Take care that it 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.



Wiring

- Make sure to carry out the wiring in the power supply off condition.
- 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 autotransformer 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. Extension up to total 100m is possible with 0.3mm^2, 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 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.

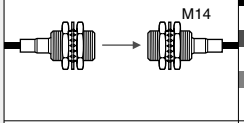
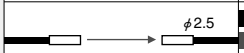
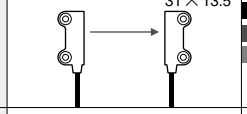
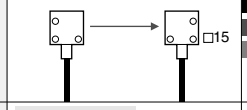
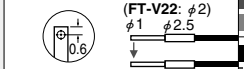
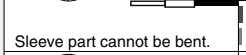
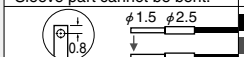
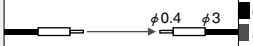
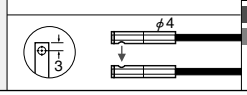
FX-301

General use fibers [Thru-beam type (one pair set)]

Type	Shape of fiber head (mm)	Sensing range (Note 1) ■: LONG ■: STD ■: FAST	Min. sensing object [under the optimum condition (Note 2)]	Features	Fiber cable length ✂: Free-cut	Allowble bending radius	Model No.
Long sensing range	Lens mountable M4	1,100mm 530mm 400mm	ϕ0.04mm opaque object	• 1.5 times approx. the sensing range as standard type	✂ 2m	R25mm or more	**FT-B8**
Standard	Lens mountable M4	780mm 400mm 280mm	ϕ0.03mm opaque object	• Free-cut type	✂ 2m	R25mm or more	**FT-FM2**
Standard	With sleeve M4 ϕ1.48	780mm 400mm 280mm	ϕ0.03mm opaque object	• Free-cut type	✂ 2m	R25mm or more	**FT-FM2S** With sleeve 90mm
Standard	With sleeve M4 ϕ1.48	780mm 400mm 280mm	ϕ0.03mm opaque object	• Free-cut type	✂ 2m	R25mm or more	**FT-FM2S4** With sleeve 40mm
Standard	ϕ2.5	780mm 400mm 280mm	ϕ0.03mm opaque object	• Free-cut type	✂ 2m	R25mm or more	**FT-SFM2**
Economy Long sensing range	M4	1,000mm 480mm 360mm	ϕ0.03mm opaque object	• Low price & free-cut	✂ 2m (Note 3)	R25mm or more	**FT-NB8**
Economy	M4	700mm 360mm 250mm	ϕ0.03mm opaque object	• Low price & free-cut	✂ 2m (Note 3)	R25mm or more	**FT-N8**
Small fiber head	Lens mountable M3	780mm 400mm 280mm	ϕ0.03mm opaque object	• Miniature head but having the same sensing range as the standard type fiber	✂ 2m	R25mm or more	**FT-T80**
Small diameter	M3	270mm 140mm 100mm	ϕ0.025mm opaque object	• Suitable for detection in a congested equipment • Free-cut type	✂ 2m	R25mm or more	**FT-NFM2**
Small diameter	With sleeve M3 ϕ0.88	270mm 140mm 100mm	ϕ0.025mm opaque object	• Suitable for detection in a congested equipment • Free-cut type	✂ 2m	R25mm or more	**FT-NFM2S** With sleeve 90mm
Small diameter	With sleeve M3 ϕ0.88	270mm 140mm 100mm	ϕ0.025mm opaque object	• Suitable for detection in a congested equipment • Free-cut type	✂ 2m	R25mm or more	**FT-NFM2S4** With sleeve 40mm
Small diameter	ϕ1.5	270mm 140mm 100mm	ϕ0.025mm opaque object	• Suitable for detection in a congested equipment • Free-cut type	✂ 2m	R25mm or more	**FT-SNFM2**
Sharp bend Standard	Lens mountable M4	570mm 290mm 200mm	ϕ0.03mm opaque object	• The fiber can be bent sharply, like an electric wire, to avoid space wastage in installation because of its small allowable bending radius of R1mm or more.	✂ 2m	R1mm or more	**FT-W8**
Sharp bend Standard	ϕ2.5	570mm 290mm 200mm	ϕ0.03mm opaque object	• The fiber can be bent sharply, like an electric wire, to avoid space wastage in installation because of its small allowable bending radius of R1mm or more.	✂ 2m	R1mm or more	**FT-WS8**
Sharp bend Small diameter	M3	160mm 80mm 55mm	ϕ0.02mm opaque object	• The fiber can be bent sharply, like an electric wire, to avoid space wastage in installation because of its small allowable bending radius of R1mm or more.	✂ 2m	R1mm or more	**FT-W4**
Sharp bend Small diameter	ϕ1.5	160mm 80mm 55mm	ϕ0.02mm opaque object	• The fiber can be bent sharply, like an electric wire, to avoid space wastage in installation because of its small allowable bending radius of R1mm or more.	✂ 2m	R1mm or more	**FT-WS4**
Flexible	Front sensing 12×3	800mm 400mm 300mm	ϕ0.03mm opaque object	• Installs with M2 screws, allowing easy beam axis alignment • Allowable bending radius: R4mm or more • Bending durability: one million times or more (at R10mm)	✂ 2m	R4mm or more	*New* **FT-Z8**
Flexible	Side sensing 12×8	1,600mm 800mm 600mm	ϕ0.03mm opaque object	• Installs with M2 screws, allowing easy beam axis alignment • Allowable bending radius: R4mm or more • Bending durability: one million times or more (at R10mm)	✂ 2m	R4mm or more	*New* **FT-Z8E**
Flexible	Top sensing 8×12	2,700mm 1,400mm 1,000mm	ϕ0.03mm opaque object	• Installs with M2 screws, allowing easy beam axis alignment • Allowable bending radius: R4mm or more • Bending durability: one million times or more (at R10mm)	✂ 2m	R4mm or more	*New* **FT-Z8H**
Flexible	Lens mountable M4	650mm 320mm 230mm	ϕ0.04mm opaque object	• Allowable bending radius: R4mm or more • Bending durability: one million times or more (at R4mm, **FT-P80**: at R10mm)	✂ 2m	R4mm or more	**FT-P80**
Flexible	Small diameter M3	250mm 100mm 75mm	ϕ0.02mm opaque object	• Allowable bending radius: R4mm or more • Bending durability: one million times or more (at R4mm, **FT-P80**: at R10mm)	✂ 2m	R4mm or more	**FT-P40**
Flexible	Small diameter ϕ1.5	280mm 120mm 90mm	ϕ0.02mm opaque object	• Allowable bending radius: R4mm or more • Bending durability: one million times or more (at R4mm, **FT-P80**: at R10mm)	1m	R4mm or more	**FT-P2**

Notes: 1) 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.
2) 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.
3) Fiber cutter is not supplied as accessory along with standard (economy) fibers. Please order it separately.

Special use fibers [Thru-beam type (one pair set)]

Type	Shape of fiber head (mm)	Sensing range (Note 1) [■: LONG ■: STD ■: FAST]	Min. sensing object [under the optimum condition (Note 2)]	Features	Fiber cable length ✂: Free-cut	Allowble bending radius	Model No.
Long sensing range with lens		10,000mm 10,000mm 10,000mm	φ0.4mm opaque object	• Large lenses on the fiber heads increase the sensing range significantly. • Fiber cable length 10m each	✂10m	R25mm or more	**FT-FM10L**
		1,600mm 800mm 580mm	φ0.02mm opaque object	• Long sensing range with small fiber heads of φ2.5mm	✂2m		**FT-SFM2L**
Wide beam		3,000mm 1,500mm 1,100mm	φ0.02mm opaque object	• The wide beam detects an object at any place within the range.	✂2m	R25mm or more	**FT-A8**
Array	Top sensing 	650mm 330mm 220mm	Horizontal: φ0.025mm opaque object Vertical: φ0.45mm opaque object	• The wide beam detects an object at any place within the range.	✂2m	R25mm or more	**FT-AFM2**
	Side sensing 	590mm 290mm 230mm	Horizontal: φ0.025mm opaque object Vertical: φ0.45mm opaque object				**FT-AFM2E**
Elbow	Lens mountable 	530mm 230mm 150mm	φ0.04mm opaque object	• The fiber head is bent at a right angle with 5mm bending radius.	✂2m	R25mm or more	**FT-R80**
Side-view	Small diameter (**FT-V22**: φ2)  Sleeve part cannot be bent.	390mm 180mm 125mm	φ0.02mm opaque object	• The side-view sensing enables it to be used in a small space.	1m	R25mm or more	**FT-V22**
	 Sleeve part cannot be bent.	175mm 80mm 60mm	φ0.02mm opaque object		✂2m		**FT-V41**
	 Sleeve part cannot be bent.	400mm 200mm 140mm	φ0.02mm opaque object				**FT-SFM2SV2**
Ultra-small diameter	 Sleeve part cannot be bent.	18mm 10mm 8mm	φ0.02mm opaque object	• Ultra-small diameter heads, very narrow beam φ0.125mm	500mm	R5mm or more	***New*** **FT-E12**
	 Sleeve part cannot be bent.	80mm 50mm 36mm	φ0.02mm opaque object	• Ultra-small diameter heads, very narrow beam φ0.25mm	1m		***New*** **FT-E22**
Narrow beam		2,000mm 1,000mm 800mm	φ0.06mm opaque object	• Aperture angle 2° • Laser beam equivalent detection	✂2m	R25mm or more	**FT-K8**
				• Aperture angle 2° • Side-view type			**FT-KV8**

Notes: 1) 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.
2) 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.

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Environment resistant fibers [Thru-beam type (one pair set)]

Type	Shape of fiber head (mm)	Sensing range (Note 1) ■: LONG ■: STD ■: FAST	Min. sensing object [under the optimum condition (Note 2)]	Features	Fiber cable length ✂: Free-cut	Allowble bending radius	Model No.
Heat-resistant	Lens mountable M4 / With sleeve M4 ϕ2.1	550mm 280mm 200mm	ϕ0.04mm opaque object	• Heat-resistant temp.: 350°C Cold-resistant temp.: −60°C	2m	R25mm or more	**FT-H35-M2** **FT-H35-M2S6** With sleeve 60mm
	Lens mountable M4	310mm 140mm 100mm	ϕ0.02mm opaque object	• Heat-resistant temp.: 200°C Cold-resistant temp.: −60°C	1m 2m	R10mm or more	New **FT-H20W-M1** New **FT-H20W-M2**
	Lens mountable M4	550mm 280mm 200mm	ϕ0.04mm opaque object	• Flexible cable with silicone jacket • Heat-resistant temp.: 200°C Cold-resistant temp.: −60°C	1m	R25mm or more	**FT-H20-M1**
	Lens mountable M4	880mm 440mm 300mm	ϕ0.06mm opaque object	• Heat-resistant temp.: 130°C Cold-resistant temp.: −60°C • Free-cut type	✂ 2m		**FT-H13-FM2**
Chemical-resistant	ϕ5.5	3,500mm 1,500mm 1,000mm	ϕ0.08mm opaque object	• Usable in chemical solvents • Heat-resistant specification (115°C) • Long sensing range with lens	2m	R30mm or more	**FT-L8Y**
	ϕ5.5	800mm 400mm 280mm	ϕ0.08mm opaque object	• Usable in chemical solvents • Heat-resistant specification (115°C) • Side-view type			**FT-V8Y**
	13 × 15	3,500mm 1,500mm 1,000mm	ϕ4mm opaque object	• Usable in chemical solvents • Rectangular head with no beam misalighment	✂ 2m ✂ 5m ✂ 7m	R25mm or more	New **FT-Z802Y** New **FT-Z805Y** New **FT-Z807Y**
Vacuum	Lens mountable M4	470mm 230mm 165mm	ϕ0.02mm opaque object	• Usable in vacuum chamber • Heat-resistant temp.: 120°C	1m	R200mm or more	**FT-6V**
		220mm 100mm 75mm	ϕ0.02mm opaque object		1m	R30mm or more	**FT-60V**

Notes: 1) 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.
2) 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.

The vacuum type fiber must be used with the following products as a set.
FT-J6: Fiber at atmospheric side (one pair set)
FV-BR1: Photo-terminal (one pair set)

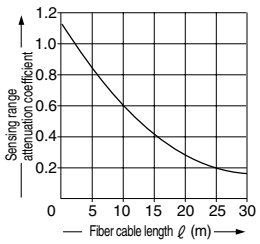
Semi-standard fibers (Custom-order made)
The fiber cable length or sleeve length of the standard fibers can be modified at your request. Select the fiber cable length (symbol ☆) or the sleeve length (symbol △) from the table below.

Type	Basic model No.	☆ Fiber cable length (Unit: m)	△ Sleeve length (Unit: cm)
Standard threaded head (free-cut)	**FT-FM** ☆	3, 4, 5, 10, 15, 20, 25, 30	————
With sleeve	**FT-FM** ☆ **-S** △	2(Note), 3, 4, 5, 10, 15, 20, 25, 30	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
With large diameter lens	**FT-FM** ☆ **L**	20, 30	————
Small diameter threaded head with sleeve (free-cut)	**FT-NFM2-S** △	————	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
200°C heat-resistant	**FT-H20-M** ☆	2, 3	————
350°C heat-resistant	**FT-H35-M** ☆	3	————

Note: The standard fiber has a 2m fiber cable length and a 4cm or 9cm sleeve length.

• **Correlation between sensing range attenuation coefficient and fiber cable length**

Longer the fiber cable, shorter is the sensing range.



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General use fibers [Reflective type]

Type	Shape of fiber head (mm)	Sensing range (Note 1,2) ■: LONG ■: STD ■: FAST	Min. sensing object (under the optimum condition (Note 3))	Features	Fiber cable length ✂: Free-cut	Allowble bending radius	Model No.
Standard (Long sensing range)	M6	480mm 220mm 160mm	ϕ0.02mm gold wire	• Long sensing range • Free-cut type	✂ 2m	R25mm or more	**FD-B8**
Standard	Coaxial M6	310mm 140mm 100mm	ϕ0.02mm gold wire	• As fiber cutting is not required, sensing range will not be reduced.	500mm		**FD-5**
Standard	Coaxial M6			• Free-cut type	✂ 2m		**FD-FM2**
Standard	With sleeve M6 ϕ2.5	270mm 110mm 85mm	ϕ0.02mm gold wire	• Free-cut type	✂ 2m		**FD-FM2S** With sleeve 90mm **FD-FM2S4** With sleeve 40mm
Economy	M6	260mm 120mm 85mm	ϕ0.02mm gold wire	• Low price & free-cut	✂ 2m (Note 4)		**FD-N8**
Economy	Small diameter M4	75mm 38mm 28mm	ϕ0.02mm gold wire				**FD-N4**
Small fiber head	M4	270mm 110mm 85mm	ϕ0.02mm gold wire	• Miniature head but having the same sensing range as the standard type fiber	✂ 2m	R25mm or more	**FD-T80**
Small fiber head	Small diameter M3	90mm 45mm 35mm	ϕ0.02mm gold wire				**FD-T40**
Small fiber head	ϕ3	270mm 110mm 85mm	ϕ0.02mm gold wire				**FD-S80**
Small diameter	M4	90mm 45mm 35mm	ϕ0.02mm gold wire	• Suitable for detection in a congested equipment • Free-cut type	✂ 2m	R25mm or more	**FD-NFM2**
Small diameter	With sleeve M4 ϕ1.48						**FD-NFM2S** With sleeve 90mm **FD-NFM2S4** With sleeve 40mm
Small diameter	ϕ2.5						**FD-SNFM2**
Sharp bend Standard	M6	190mm 90mm 60mm	ϕ0.02mm gold wire	• The fiber can be bent sharply, like an electric wire, to avoid space wastage in installation because of its small allowable bending radius of R1mm or more (**FD-WG4**, **FD-WSG4**: R2mm or more, sleeve part of **FD-W44**: R10mm or more).	✂ 2m	R1mm or more	**FD-W8**
Sharp bend Small diameter with sleeve	With sleeve M4 ϕ1.48	30mm 15mm 12mm	ϕ0.02mm gold wire				**FD-W44**
Sharp bend Small head	M4 ϕ3	190mm 90mm 60mm	ϕ0.02mm gold wire				**FD-WT8** **FD-WS8**
Sharp bend Small diameter	M3	30mm 15mm 12mm	ϕ0.02mm gold wire				**FD-WT4**
Sharp bend High precision	Lens mountable Coaxial M4	65mm 32mm 25mm	ϕ0.02mm gold wire			R2mm or more	**FD-WG4**
Sharp bend High precision	Coaxial ϕ3						**FD-WSG4**
Flexible	M6	220mm 100mm 70mm	ϕ0.02mm gold wire	• Allowable bending radius: R4mm or more • Bending durability: one million times or more (at R10mm, **FD-P40** or **FD-P2**: at R4mm)	✂ 2m	R4mm or more	**FD-P80**
Flexible	M4	90mm 45mm 30mm	ϕ0.02mm gold wire				*New* **FD-P60**
Flexible	ϕ3						*New* **FD-P50**
Flexible	Small diameter M3	36mm 18mm 14mm	ϕ0.02mm gold wire				**FD-P40**
Flexible	Small diameter ϕ1.5	50mm 25mm 19mm	ϕ0.02mm gold wire		1m		**FD-P2**

Notes: 1) The sensing range is specified for white non-glossy paper [100 × 100mm (**FD-B8**, **FD-5**, **FD-FM2**, **FD-FM2S**, **FD-FM2S4**, **FD-N8**, **FD-T80** and **FD-S80**: 400 × 400mm, **FD-N4**, **FD-T40**, **FD-NFM2**, **FD-NFM2S**, **FD-NFM2S4**, **FD-SNFM2**, **FD-W8**, **FD-WT8**, **FD-WS8**, **FD-P80**, **FD-P60** and **FD-P50**: 200 × 200mm)] as the object.
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 is specified for maximum sensitivity. Also, note that the corresponding setting distance is different from the rated sensing distance.
4) Fiber cutter is not supplied as accessory along with standard (economy) fibers. Please order it separately.

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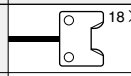
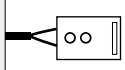
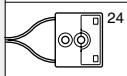
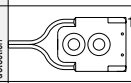
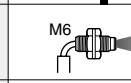
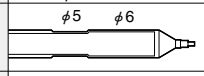
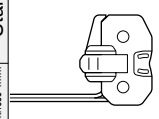
Special use fibers [Reflective type]

Type	Shape of fiber head (mm)	Sensing range (Note 1,2) ■: LONG ■: STD ■: FAST	Min. sensing object [at the maximum sensitivity (Note 3)]	Features	Fiber cable length ✂: Free-cut	Allowble bending radius	Model No.
Fixed-focus reflective	 18×14	■ 2 to18mm ■ 4.5 to12mm (Convergent point: 6mm) ■ 5 to11mm	ϕ0.02mm gold wire	• Detection is not affected by object color.	✂ 2m	R10mm or more	**FD-L4**
Glass substrate detection	 17×29	■ 0 to 20mm	(LCD glass)	• Just 3.8mm thick • Glass substrate is railably detected.		R4mm or more	**FD-L43**
Glass substrate detection	 24×21	■ 2 to16mm ■ 3 to14mm (Convergent point: 8mm) ■ 3.5 to13mm	ϕ0.02mm gold wire	• Just 4mm thick • Glass substrate is reliably detected.		R10mm or more	**FD-L41**
Specular object detection	 15×13	■ 0.5 to4mm ■ 1 to 3mm ■ 1.3to 2.8mm (Convergent point: 2mm)		• Just 3mm thick • Wafer is reliably detected.			**FD-L42**
High precision	Lens mountable M4 Coaxial	■ 110mm ■ 55mm ■ 42mm	ϕ0.02mm gold wire	• Precise position sensing with coaxial fiber	✂ 2m	R25mm or more	**FD-G4**
High precision	Lens mountable M3 Coaxial-small diameter	■ 38mm ■ 18mm ■ 14mm	ϕ0.02mm gold wire	• Combination with the **FX-MR3** lens gives an extremely small spot diameter of ϕ0.3mm approx.	500mm		**FD-EG1**
Array	Top sensing □20	■ 220mm ■ 110mm ■ 78mm	ϕ0.02mm gold wire	• Its wide beam meets various needs.	✂ 2m		**FD-AFM2**
Array	Side sensing □20						**FD-AFM2E**
Elbow	 M6	■ 185mm ■ 85mm ■ 60mm	ϕ0.02mm gold wire	• The fiber head is bent at a right angle with 5mm bending radius at the neck.	✂ 2m		**FD-R80**
Side-view	Small diameter ϕ1.5 ϕ3 Sleeve part cannot be bent.	■ 55mm ■ 25mm ■ 17mm	ϕ0.02mm gold wire	• The side view sensing enables it to be used in a small space.	✂ 2m		**FD-V41**
Side-view	ϕ5 ϕ2 Sleeve part cannot be bent.	■ 100mm ■ 45mm ■ 32mm	ϕ0.02mm gold wire				**FD-SFM2SV2**
Ultra-small diameter	ϕ1.5 ϕ0.5 Sleeve part cannot be bent.	■ 11mm ■ 6mm ■ 4mm	ϕ0.02mm gold wire	• Easy fine adjustment of the installation position.	1m	R10mm or more	New **FD-E12**
Ultra-small diameter	Coaxial ϕ3 ϕ0.65 Sleeve part cannot be bent.	■ 45mm ■ 23mm ■ 17mm	ϕ0.02mm gold wire	• Precise position sensing with coaxial fiber		R25mm or more	New **FD-E22**
Ultra-small diameter	M3 ϕ0.5 Sleeve part cannot be bent.	■ 5mm ■ 3mm ■ 2mm	ϕ0.02mm gold wire	• Suitable for detection in a very congested equipment	500mm	R25mm or more	**FD-EN500S1**
Ultra-small diameter	Coaxial M3 ϕ0.8 Sleeve part cannot be bent.	■ 38mm ■ 18mm ■ 14mm	ϕ0.02mm gold wire	• Precise position sensing with coaxial fiber	1m	R25mm or more	**FD-ENM1S1**
Liquid level sensing	 ϕ5 ϕ6	———	(Liquid)	• Reduces malfunction due to liquid drop at the tip.	✂ 2m	R25mm or more	**FD-F8Y**
Mountable on pipe Standard	 25×20	Applicable pipe diameter: Outer dia. ϕ6 to ϕ26mm transparent pipe (PVC, fluorine resin, PC, acrylic, glass, wall thickness 1 to 3mm)	(Liquid)	• Liquid level is reliably detected from outside the pipe.	✂ 2m	R10mm or more	**FD-F41**
Mountable on pipe Standard					✂ 5m		**FD-F91**
Mountable on pipe For PFA, wall thickness 1mm		Applicable pipe diameter: Outer dia. ϕ6 to ϕ26mm transparent pipe (PFA (fluorine resin), wall thickness 1mm)			✂ 2m		**FD-F4**
Mountable on pipe For PFA, wall thickness 1mm					✂ 5m		**FD-F9**

Notes: 1) The sensing range is specified for white non-glossy paper [100×100mm (**FD-G4**, **FD-AFM2**, **FD-AFM2E**, **FD-R80** and **FD-SFM2SV2**: 200×200mm, **FD-L43**: glass substrate 76×52×t1.1mm, **FD-L41**: glass substrate 100×100×t2mm)] as the object.
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 is specified for maximum sensitivity. Also, note that the corresponding setting distance is different from the rated sensing distance. However, in the case of fixed-focus reflective type, when the sensitivity is at MAX., it is only possible to detect the minimum size of sensing object at a distance of convergent point.

Environment resistant fibers [Reflective type]

Type	Shape of fiber head (mm)	Sensing range (Note 1,2) [■: LONG ■: STD ■: FAST]	Min. sensing object [at the maximum sensitivity (Note 3)]	Features	Fiber cable length ✂: Free-cut	Allowble bending rudius	Model No.
Heat-resistant	Coaxial M6	■ 310mm ■ 140mm ■ 100mm	ϕ0.02mm gold wire	• Heat-resistant temp.: 350°C Cold-resistant temp.: −60°C	2m	R25mm or more	**FD-H35-M2**
	With sleeve M6 ϕ2.8						**FD-H35-M2S6** With sleeve 60mm
	Coaxial M6	■ 310mm ■ 140mm ■ 100mm	ϕ0.02mm gold wire	• Flexible cable with silicone jacket • Heat-resistant temp.: 200°C Cold-resistant temp.: −60°C	1m		**FD-H20-M1**
	M6	■ 310mm ■ 140mm ■ 100mm	ϕ0.02mm gold wire	• Heat-resistant temp.: 130°C Cold-resistant temp.: −60°C • Free-cut type	✂ 2m		**FD-H13-FM2**
Vacuum	M6	■ 165mm ■ 75mm ■ 52mm	ϕ0.02mm gold wire	• Usable in vacuum chamber • Heat-resistant temp.: 120°C	1m	R200mm or more	**FD-6V**

Notes: 1) The sensing range is specified for white non-glossy paper [400 × 400mm (**FD-6V**: 200 × 200mm)] as the object.
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 is specified for maximum sensitivity. Also, note that the corresponding setting distance is different from the rated sensing distance.

The vacuum type fiber must be used with the following products as a set.
FT-J6: Fiber at atmospheric side (one pair set)
FV-BR1: Photo-terminal (one pair set)

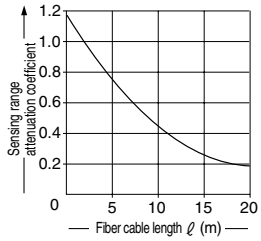
Semi-standard fibers (Custom-order made)
The fiber cable length or sleeve length of the standard fibers can be modified at your request. Select the fiber cable length (symbol ☆) or the sleeve length (symbol △) from the table below.

Type	Basic model No.	☆ Fiber cable length (Unit: m)	△ Sleeve length (Unit: cm)
Standard threaded head (free-cut)	**FD-FM**☆	3, 4, 5, 10, 15, 20	————
With sleeve	**FD-FM**☆**-S**△	2(Note), 3, 4, 5, 10, 15, 20	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Small diameter threaded head with sleeve (free-cut)	**FD-NFM2-S**△	————	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
200°C heat-resistant	**FD-H20-M**☆	2, 3	————
350°C heat-resistant	**FD-H35-M**☆	3	————

Note: The standard fiber has a 2m fiber cable length and a 4cm or 9cm sleeve length.

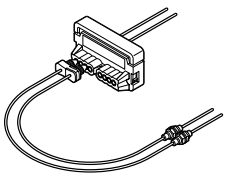
• Correlation between sensing range attenuation coefficient and fiber cable length

Longer the fiber cable, shorter is the sensing range.

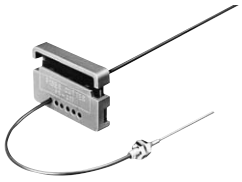


Accessary (attached with fibers)

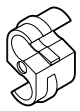
Fiber cutter
• **FX-CT2**



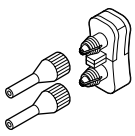
• **FX-CT1**



Fiber attachment
• **FX-AT2** (for fixed-length fiber)



• **FX-AT4** (for ϕ1mm fiber)
• **FX-AT5** (for ϕ1.3mm fiber)
• **FX-AT6** (for ϕ1mm and ϕ1.3mm fiber)



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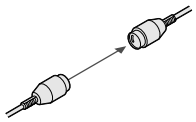
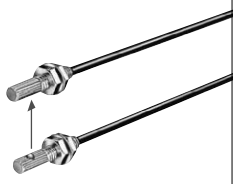
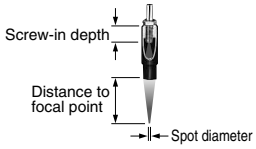
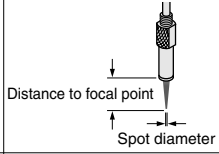
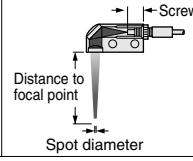
OPTIONS

<table>
<tr><th colspan="2">Designation</th><th>Model No.</th><th colspan="2">Description</th></tr>
<tr><td rowspan="4">For thru-beam type fiber</td><td>Expansion lens</td><td>FX-LE1</td><td>  </td><td>Increases the sensing range by 5 times or more.
• Ambient temperature:
−60 to +350°C
Sensing range (mm)[Lens on both sides]<table><tr><th>Fiber \ Mode</th><th>LONG</th><th>STD</th><th>FAST</th></tr><tr><td>FT-B8</td><td>3,500 (Note)</td><td>2,400</td><td>1,800</td></tr><tr><td>FT-FM2</td><td>3,500 (Note)</td><td>3,500 (Note)</td><td>2,500</td></tr><tr><td>FT-T80</td><td>3,500 (Note)</td><td>3,500 (Note)</td><td>2,500</td></tr><tr><td>FT-W8</td><td>3,500 (Note)</td><td>2,900</td><td>2,000</td></tr><tr><td>FT-P80</td><td>3,500 (Note)</td><td>3,500 (Note)</td><td>2,500</td></tr><tr><td>FT-R80</td><td>3,500 (Note)</td><td>1,500</td><td>1,000</td></tr><tr><td>FT-H35-M2</td><td>3,000</td><td>1,600</td><td>1,100</td></tr><tr><td>FT-H20W-M1</td><td>1,600 (Note)</td><td>1,300</td><td>900</td></tr><tr><td>FT-H20W-M2</td><td>2,600</td><td>1,300</td><td>900</td></tr><tr><td>FT-H20-M1</td><td>1,600 (Note)</td><td>1,600 (Note)</td><td>1,100</td></tr></table></td></tr>
<tr><td>Super-expansion lens</td><td>FX-LE2</td><td>  </td><td>Tremendously increases the sensing range with large aperture lenses.
• Ambient temperature:
−60 to +350°C
Sensing range (mm)[Lens on both sides]<table><tr><th>Fiber \ Mode</th><th>LONG</th><th>STD</th><th>FAST</th></tr><tr><td>FT-B8</td><td>3,500 (Note)</td><td>2,800</td><td>2,100</td></tr><tr><td>FT-FM2</td><td>3,500 (Note)</td><td>3,500 (Note)</td><td>3,500 (Note)</td></tr><tr><td>FT-W8</td><td>3,500 (Note)</td><td>3,500 (Note)</td><td>3,500 (Note)</td></tr><tr><td>FT-P80</td><td>3,500 (Note)</td><td>3,500 (Note)</td><td>3,500 (Note)</td></tr><tr><td>FT-R80</td><td>3,500 (Note)</td><td>3,500 (Note)</td><td>2,500</td></tr><tr><td>FT-H35-M2</td><td>3,500 (Note)</td><td>3,500 (Note)</td><td>3,500 (Note)</td></tr><tr><td>FT-H20W-M1</td><td>1,600 (Note)</td><td>1,600 (Note)</td><td>1,600 (Note)</td></tr><tr><td>FT-H20W-M2</td><td>3,500 (Note)</td><td>2,500</td><td>2,000</td></tr><tr><td>FT-H20-M1</td><td>1,600 (Note)</td><td>1,600 (Note)</td><td>1,600 (Note)</td></tr><tr><td>FT-H13-FM2</td><td>3,500 (Note)</td><td>3,500 (Note)</td><td>2,500</td></tr></table></td></tr>
<tr><td>Side-view lens</td><td>FX-SV1</td><td>  </td><td>Beam axis is bent by 90°
• Ambient temperature:
−60 to +300°C
Sensing range (mm)[Lens on both sides]<table><tr><th>Fiber \ Mode</th><th>LONG</th><th>STD</th><th>FAST</th></tr><tr><td>FT-B8</td><td>1,100</td><td>530</td><td>400</td></tr><tr><td>FT-FM2</td><td>1,200</td><td>600</td><td>440</td></tr><tr><td>FT-T80</td><td>1,200</td><td>600</td><td>440</td></tr><tr><td>FT-W8</td><td>900</td><td>450</td><td>330</td></tr><tr><td>FT-P80</td><td>1,200</td><td>600</td><td>440</td></tr><tr><td>FT-H35-M2</td><td>550</td><td>280</td><td>200</td></tr><tr><td>FT-H20W-M1</td><td>280</td><td>140</td><td>100</td></tr><tr><td>FT-H20W-M2</td><td>280</td><td>140</td><td>100</td></tr><tr><td>FT-H20-M1</td><td>550</td><td>280</td><td>200</td></tr></table></td></tr>
<tr><td>Expansion lens for vacuum fiber</td><td>FV-LE1</td><td>  </td><td>Sensing range increases by 15 times or more.
• Ambient temperature:
−40 to +120°C
Sensing range (mm)[Lens on both sides]<table><tr><th>Fiber \ Mode</th><th>LONG</th><th>STD</th><th>FAST</th></tr><tr><td>FT-6V</td><td>3,500 (Note)</td><td>2,700</td><td>1,800</td></tr><tr><td>FT-60V</td><td>3,500 (Note)</td><td>1,450</td><td>1,000</td></tr></table></td></tr>
<tr><td rowspan="4">For reflective type fiber</td><td>Pinpoint spot lens</td><td>FX-MR1</td><td>  </td><td colspan="2">Pinpoint spot of ϕ0.5mm. Enables detection of minute objects or small marks.
• Applicable fibers: FD-WG4, FD-G4 • Ambient temperature: −40 to +70°C
• Distance to focal point: 6±1mm</td></tr>
<tr><td>Zoom lens</td><td>FX-MR2</td><td>  </td><td>The spot diameter is adjustable from ϕ0.7 to ϕ2mm according to how much the fiber is screwed in.
• Applicable fibers: FD-WG4, FD-G4
• Ambient temperature: −40 to +70°C<table><tr><th>Screw-in depth</th><th>Distance to focal point</th><th>Spot diameter</th></tr><tr><td>7mm</td><td>18.5mm apprpx.</td><td>ϕ 0.7mm</td></tr><tr><td>12mm</td><td>27mm apprpx.</td><td>ϕ 1.2mm</td></tr><tr><td>14mm</td><td>43mm apprpx.</td><td>ϕ 2.0mm</td></tr></table></td></tr>
<tr><td>Finest spot lens</td><td>FX-MR3</td><td>  </td><td>Extremely fine spot of ϕ0.3mm achieved.
• Applicable fibers: FD-WG4, FD-G4, FD-EG1
• Ambient temperature: −40 to +70°C<table><tr><th>Fiber</th><th>Distance to focal point</th><th>Spot diameter</th></tr><tr><td>FD-WG4</td><td>7.5±0.5mm</td><td>ϕ 0.5mm apprpx.</td></tr><tr><td>FD-G4</td><td>7.5±0.5mm</td><td>ϕ 0.5mm apprpx.</td></tr><tr><td>FD-EG1</td><td>7.5±0.5mm</td><td>ϕ 0.3mm apprpx.</td></tr></table></td></tr>
<tr><td>Zoom lens (Side-view type)</td><td>FX-MR5</td><td>  </td><td>FX-MR2 is converted into a side-view type and can be mounted in a very small space.
• Applicable fibers: FD-WG4, FD-G4
• Ambient temperature: −40 to +70°C<table><tr><th>Screw-in depth</th><th>Distance to focal point</th><th>Spot diameter</th></tr><tr><td>8mm</td><td>13mm apprpx.</td><td>ϕ 0.5mm</td></tr><tr><td>10mm</td><td>15mm apprpx.</td><td>ϕ 0.8mm</td></tr><tr><td>14mm</td><td>30mm apprpx.</td><td>ϕ 3.0mm</td></tr></table></td></tr>
</table>

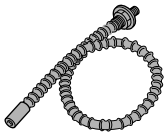
Note: The fiber cable length practically limits the sensing range to 3,500mm long (**FT-H20W-M1** and **FT-H20-M1**: 1,600mm).

OPTIONS

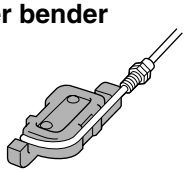
<table>
<tr><th>Designation</th><th>Model No.</th><th colspan="4">Description</th></tr>
<tr><td rowspan="6">Protective tube
(For thru-beam type fiber)</td><td>FTP-500(0.5m)</td><td rowspan="3">For M4 thread</td><td rowspan="12">Applicable fibers</td><td rowspan="3">FT-B8 FT-P80
FT-FM2 FT-H13-FM2
FT-FM2S
FT-FM2S4</td><td rowspan="12">The protective tube, made of non-corrosive stainless steel, protects the inner fiber cable from any external forces.</td></tr>
<tr><td>FTP-1000(1m)</td></tr>
<tr><td>FTP-1500(1.5m)</td></tr>
<tr><td>FTP-N500(0.5m)</td><td rowspan="3">For M3 thread</td><td rowspan="3">FT-T80 FT-P40
FT-NFM2 FD-T40
FT-NFM2S FD-P40
FT-NFM2S4</td></tr>
<tr><td>FTP-N1000(1m)</td></tr>
<tr><td>FTP-N1500(1.5m)</td></tr>
<tr><td rowspan="6">Protective tube
(For reflective type fiber)</td><td>FDP-500(0.5m)</td><td rowspan="3">For M6 thread</td><td rowspan="3">FD-B8 FD-P80
FD-FM2 FD-H13-FM2
FD-FM2S
FD-FM2S4</td></tr>
<tr><td>FDP-1000(1m)</td></tr>
<tr><td>FDP-1500(1.5m)</td></tr>
<tr><td>FDP-N500(0.5m)</td><td rowspan="3">For M4 thread</td><td rowspan="3">FD-T80
FD-NFM2
FD-NFM2S
FD-NFM2S4</td></tr>
<tr><td>FDP-N1000(1m)</td></tr>
<tr><td>FDP-N1500(1.5m)</td></tr>
<tr><td>Fiber bender</td><td>FB-1</td><td colspan="4">The fiber bender bends the sleeve part of the fiber head at the proper radius. (Note 1)</td></tr>
<tr><td>Universal sensor mounting stand (Note 2)</td><td>MS-AJ-F</td><td colspan="4">Mounting stand assembly for fiber
(For M3, M4 or M6 threaded head fibers)</td></tr>
<tr><td>Amplifier mounting bracket</td><td>MS-DIN-2</td><td colspan="4">Mounting bracket for amplifier</td></tr>
<tr><td rowspan="2">Fiber cutter</td><td>FX-CT2</td><td colspan="4" rowspan="2">The free-cut type fiber can be easily cut.
(However, they are attached with free-cut type fiver but economy fiber.)</td></tr>
<tr><td>FX-CT1</td></tr>
<tr><td>ϕ1mm fiber attachment</td><td>FX-AT4</td><td colspan="4">Fiber attachment for ϕ1mm fiber cables
(It is needed for FD-N4 economy fiber.)</td></tr>
</table>

Notes: 1) Do not bend the sleeve part of any side-view type fiber or ultra-small diameter head type fiber.
2) Refer to **MS-AJ** series catalog or sensor general catalog for the universal sensor mounting stand.

Protective tube

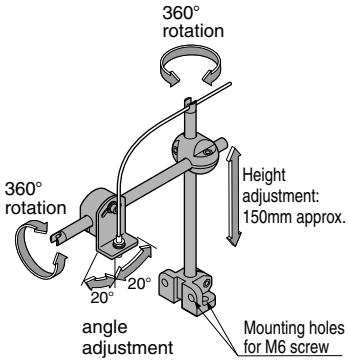


Fiber bender

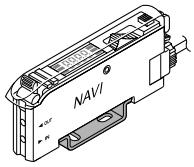


Universal sensor mounting stand

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

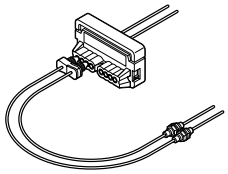


Amplifier mounting bracket

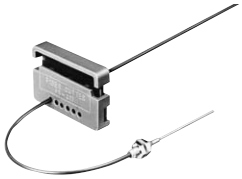


Fiber cutter

• **FX-CT2**



• **FX-CT1**



FX-301

FIBER SPECIFICATIONS

Fibers

Item \ Type	Standard, small fiber head, small diameter, sharp bend, flexible, long sensing range with lens, wide beam, array, elbow, high precision, thru-beam type of ultra-small diameter	Fixed-focus reflective	Side-view, narrow beam, reflective type of ultra-small diameter
Allowable bending radius	R25mm or more (Sharp bend: R1mm or more (**FD-WG4**, **FD-WSG4**: R2mm or more), Flexible: R4mm or more, Thru-beam type of ultra-small diameter: R5mm or more	R10mm or more (**FD-L43**: R4mmor more)	R25mm or more (**FD-E12**: R10mm or more)
Ambient temperature	−40 to +70°C (Sharp bend: −40 to +60°C, **FD-EG1**: −20 to +60°C)	−40 to +70°C (**FD-L41** and **FD-L42**: −40 to +60°C, **FD-L43**: 0 to +70°C)	−20 to +60°C (**FT-V41**, **FD-V41**, **FT-K8** and **FT-KV8**: −40 to +60°C)
Ambient humidity	35 to 85% RH (No dew condensation or icing allowed)		
Material: Fiber core	Acrylic		
Material: Sheath	Polyethylene (**FT-E12**, **FT-E22**, **FD-E12**, **FD-E22**: Polyolefin, Flexible, except for **FD-P2**: Vinyl chloride)		
Material: Fiber head	Brass (Nickel plated) : Threaded part of standard, threaded part of small diameter, threaded type of sharp bend, thru-beam type ultra-small diameter, **FT-P80**, **FD-P80**, high precision, array, threaded part of **FT-R80** Polycarbonate : Lens of **FT-WS8L**, Case of **FT-Z8**□ • **FT-A8** Stainless steel (SUS): **FT-SFM2**, small fiber head, non-threaded type of sharp bend, **FT-SNFM2**, **FD-SNFM2**, **FT-SFM2L**, **FT-P40**, **FT-P2**, **FD-P60**, **FD-P50**, **FD-P40**, **FD-P2**, sleeve part of sleeve-attached fiber Polyolefin : Lens of **FT-A8** ABS : **FT-FM10L** Acrylic : Lens of **FT-FM10L** Die-cast zinc alloy : Threaded part of **FD-R80**	ABS: **FD-L4**, **FD-L41**, **FD-L43** Acrylic: Lens of **FD-L4** and **FD-L43** Aluminum: **FD-L42**	Stainless steel (SUS) Threaded part of reflective type of ultra-small diameter: Brass, Reflector of **FT-KV8**: Acrylic, Holder of **FT-K8** and **FT-KV8**: Polycarbonate, Lens of **FT-K8** and **FT-KV8**: Norbornene resin
Accessories (Note)	Threaded head fiber: 2 Nos. of nuts (thru-beam type: 4 Nos.) and 1 No. of toothed lock washer (thru-beam type: 2 Nos.) Free-cut type fiber (except for economy type) : 1 No. of **FX-CT2** (Fiber cutter)(φ2.2mm fiber cable type: 1 No. of **FX-CT1**) **FD-5**, **FT-P2**, **FD-P2**, **FD-EG1**, **FT-V22**, **FT-E12**, **FT-E22**, **FD-E12** and **FD-E22**: **FX-AT2** (Fixed-length fiber attachment) **FD-T40**, small diameter (except for **FD-N4**), **FT-WS4**, **FD-W44**, **FD-WT4**, **FT-P40**, **FD-P40**, **FD-L41**, **FD-L42**, **FT-V41** and **FD-V41**: **FX-AT4** (φ1mm fiber attachment) **FT-T80**, **FD-T80**, **FD-S80**, **FD-WT8**, **FD-WS8**, **FD-P60**, **FD-P50** and **FD-L43**: **FX-AT5** (φ1.3mm fiber attachment) **FD-WG4**, **FD-WSG4**, **FD-G4**: **FX-AT6** (φ1mm/φ1.3mm fiber attachment) **FT-Z8**□: **FX-AT5** (φ1.3mm fiber attachment), 1 set of mounting screw **FT-A8**: 2 Nos. of 0.5 × 12mm seal type slit mask and 2 Nos. of 1 × 12mm seal type slit mask **FD-L4**: **FX-AT4** (φ1mm fiber attachment), 2 Nos. of M2.6 (length 12mm) screws with washers and 2 Nos. of nuts		

Note: The fiber attachment accessories described in this guide book are for use only with the **FX-301**. Fiber attachment accessories are also available for conventional amplifiers. Please contact our office for more details on these accessories.

Item \ Type	Liquid level sensing		Vacuum	Heat-resistant			Chemical-resistant
		Mountable on pipe		350°C type	200°C type	130°C type	
Allowable bending radius	Protective tube: R40mm or more Fiber cable: R15mm or more	R10mm or more	R200mm or more (**FT-60V**: R30mm or more)	R25mm or more (**FT-H20W-**□: R10mm or more)			R30mm or more (**FT-Z**□**Y**: R25mm or more)
Ambient temperature	−40 to +125°C (Note 1)	−40 to +100°C (Note 1)	−40 to +120°C	−60 to +350°C (Note 2, 3)	−60 to +200°C (Note 3)	−60 to +130°C	−40 to +115°C (**FT-Z**□**Y**: 0 to +60°C)
Ambient humidity	35 to 85% RH (No dew condensation or icing allowed)						
Material: Fiber core	Acrylic		Quartz glass (Note 4)	Multi-component glass (Note 4)		Acrylic	
Material: Sheath	Protective tube: Fluorine resin Sheath: Polypropylene	Polypropylene	Fluorine resin	Stainless steel (SUS)	Silicone (Inside stainless steel (SUS) spiral tube (**FTH20W-**□: PTFE))	Fluorine resin	Protective tube: Fluorine resin Fiber sheath: Polypropylene (**FT-Z**□**Y**: Fluorine resin)
Material: Fiber head		Polyetherimide	Aluminum		Brass (Nickel plated)	Brass (Nickel plated)	
Accessories (Note 5)	Threaded head fiber: 2 Nos. of nuts (thru-beam type: 4 Nos.) and 1 No. of toothed lock washer (thru-beam type: 2 Nos.) Free-cut type fiber: 1 No. of **FX-CT2** (Fiber cutter)(φ2.2mm fiber cable type, chemical-resistant type fiber: 1 No. of **FX-CT1**) **FT-H20W-**□: **FX-AT2** (Fiber-length fiber attachment) **FD-F4**□ and **FD-F9**□: **FX-AT4** (φ1mm fiber attachment), 4 Nos. of tying bands and 2 Nos. of anti-slip tubes						

Notes: 1) With the liquid level sensing fiber, make sure that the temperature of the liquid is also within the ambient temperature range.
2) If the fiber is used under −30°C, its resistable maximum temperature drops to +200°C. If the side-view lens **FX-SV1** is put on the fiber head, the allowable maximum temperature comes down to +300°C. (The ambient temperature range of the **FX-SV1** is from −60 to +300°C.)
3) The ambient temperature of heat-resistant 350°C type and 200°C type fibers is the value in dry condition. In humid environment, the ambient temperature differs. (For a high humidity of 85% RH, the ambient temperature is 0 to 40°C.)
4) If the fiber material is quartz glass or multi-component glass, keep it away from vibration or impact.
5) The fiber attachment accessories described in this guide book are for use only with the **FX-301**. Fiber attachment accessories are also available for conventional amplifiers. Please contact our office for more details on these accessories.

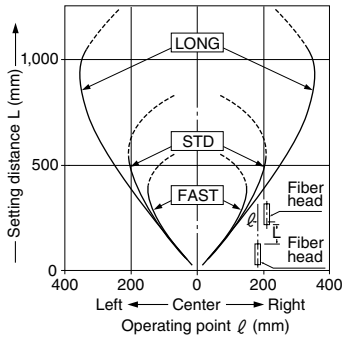
SENSING CHARACTERISTICS (TYPICAL)

Please contact our office for more details on models that are not described below.

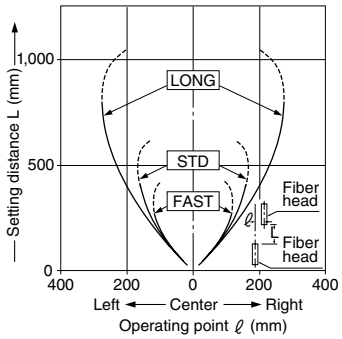
Parallel deviation

Thru-beam type

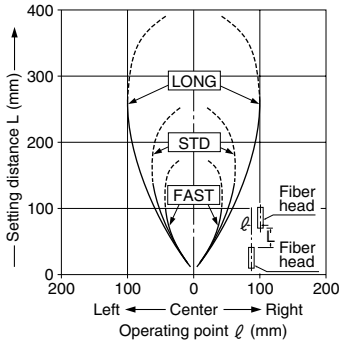
FT-B8



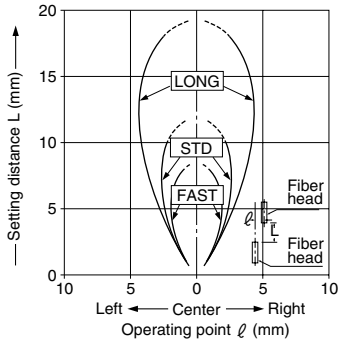
FT-FM2



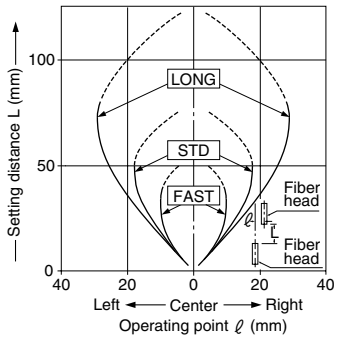
FT-NFM2



FT-E12



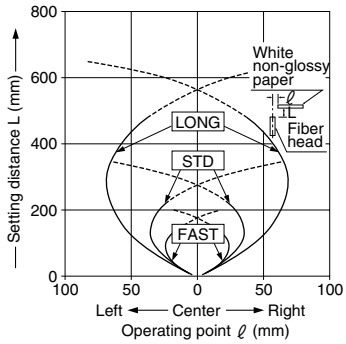
FT-E22



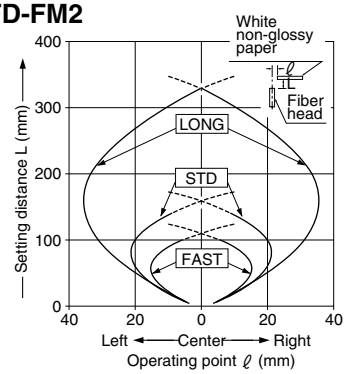
Sensing fields

Reflective type

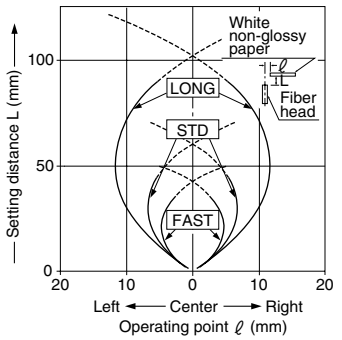
FD-B8



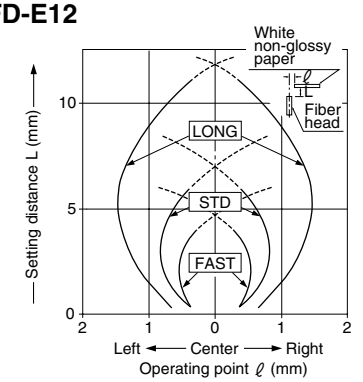
FD-FM2



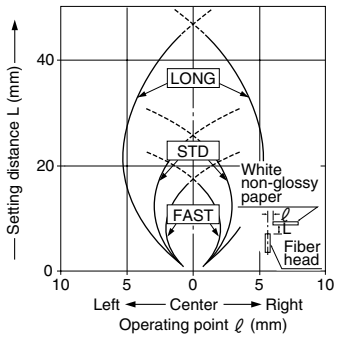
FD-NFM2



FD-E12



FD-E22



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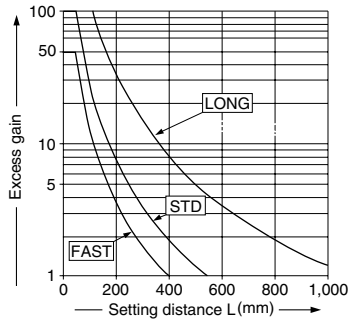
SENSING CHARACTERISTICS (TYPICAL)

Please contact our office for more details on models that are not described below.

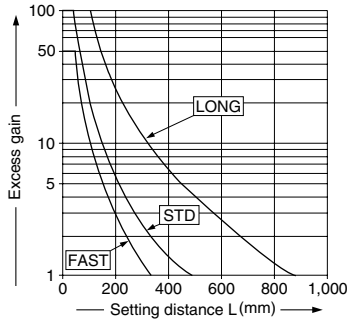
Correlation between setting distance and excess gain

Thru-beam type

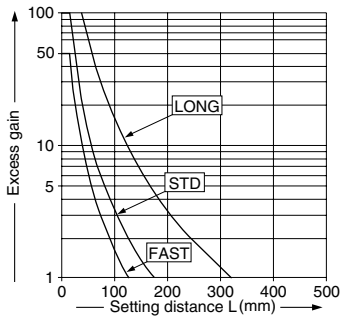
FT-B8



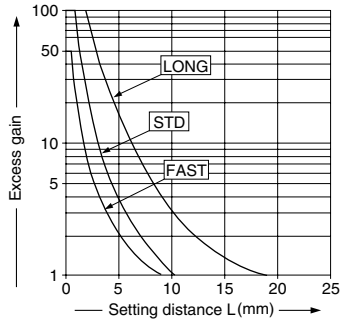
FT-FM2



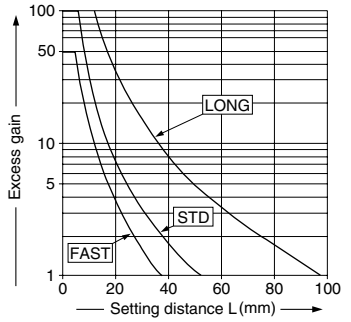
FT-NFM2



FT-E12

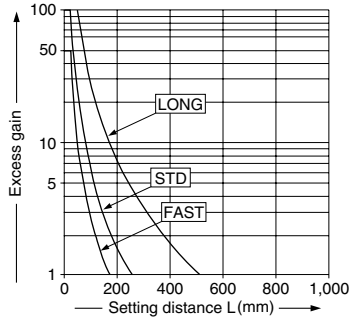


FT-E22

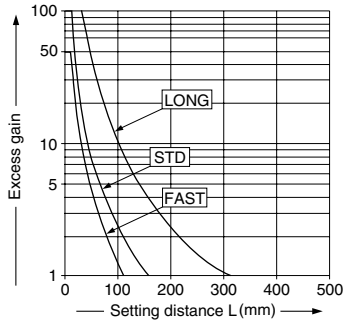


Reflective type

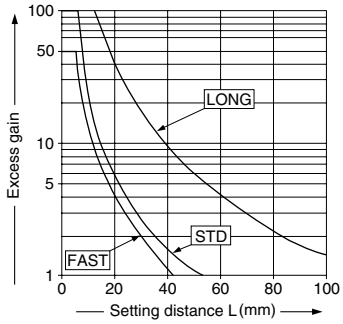
FD-B8



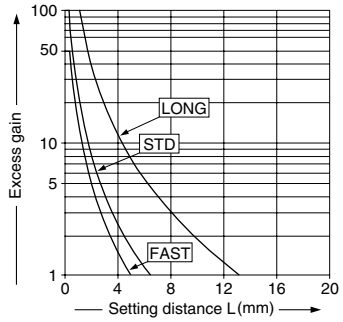
FD-FM2



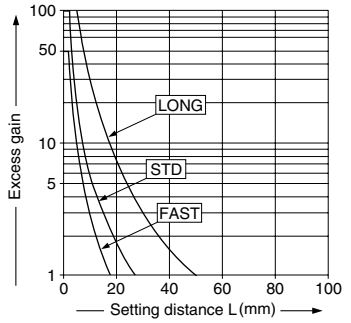
FD-NFM2



FD-E12



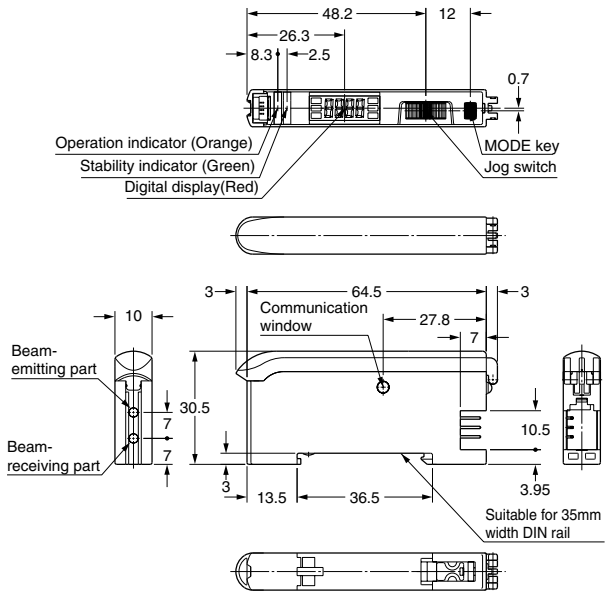
FD-E22



DIMENSIONS (Unit: mm)

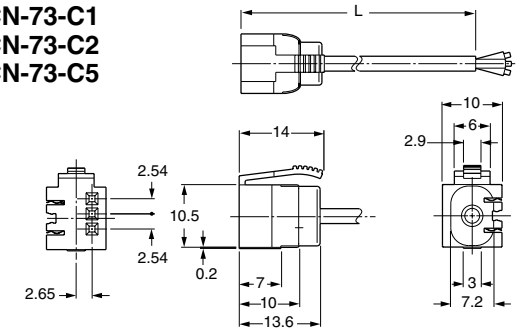
Amplifier

FX-301(P)



Main cable (Optional)

CN-73-C1
CN-73-C2
CN-73-C5

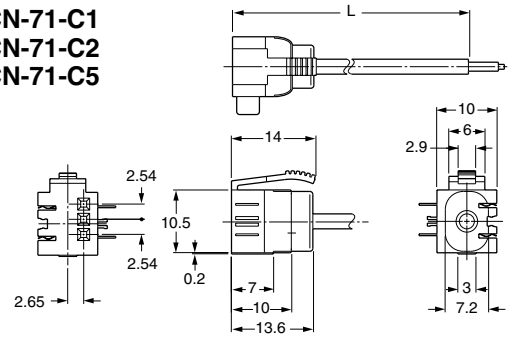


• Length

Model No.	Length (mm)
CN-73-C1	1,000
CN-73-C2	2,000
CN-73-C5	5,000

Sub cable (Optional)

CN-71-C1
CN-71-C2
CN-71-C5

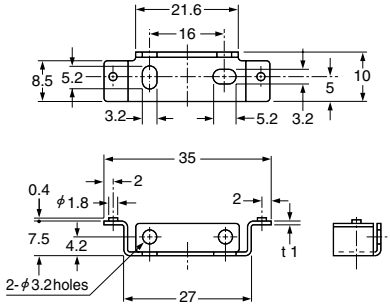


• Length

Model No.	Length (mm)
CN-71-C1	1,000
CN-71-C2	2,000
CN-71-C5	5,000

Amplifier mounting bracket (Optional)

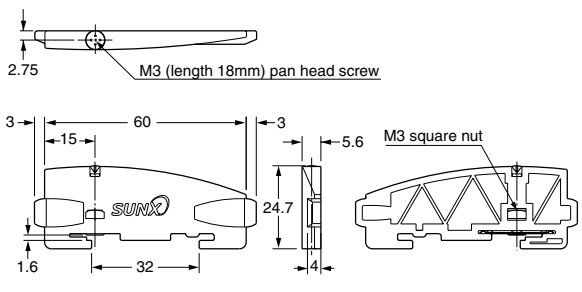
MS-DIN-2



Material: Cold rolled carbon steel (SPCC)
(Uni-chrome plated)

End plates (Optional)

MS-DIN-E

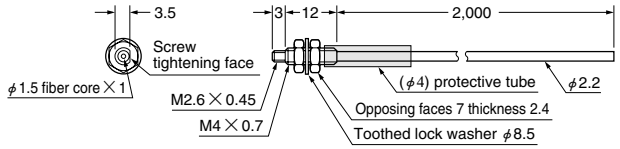


FX-301

DIMENSIONS (Unit: mm)

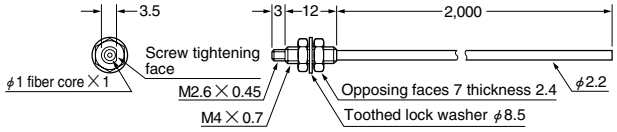
Thru-beam type fiber

FT-B8 Free-cut



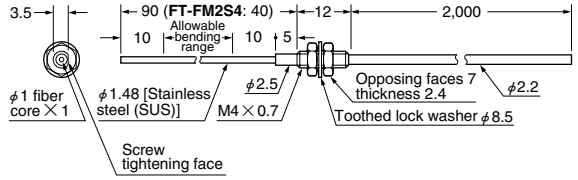
Thru-beam type fiber

FT-FM2 Free-cut



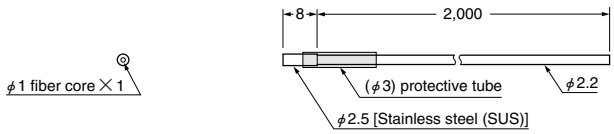
Thru-beam type fiber

FT-FM2S
FT-FM2S4 Free-cut



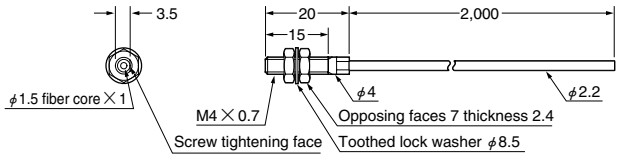
Thru-beam type fiber

FT-SFM2 Free-cut



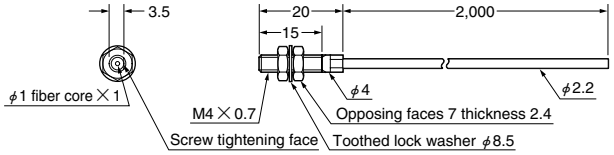
Thru-beam type fiber

FT-NB8 Free-cut



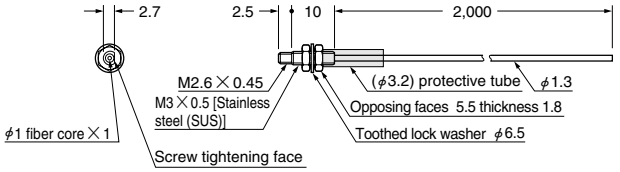
Thru-beam type fiber

FT-N8 Free-cut



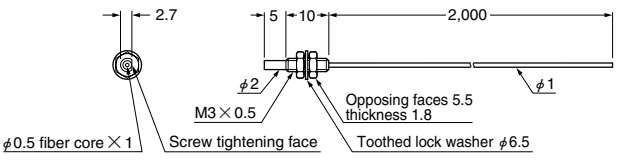
Thru-beam type fiber

FT-T80 Free-cut With attachment



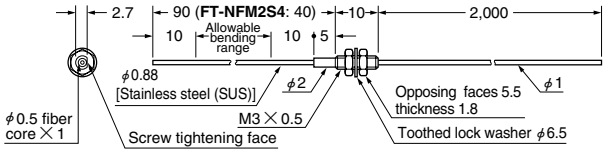
Thru-beam type fiber

FT-NFM2 Free-cut With attachment



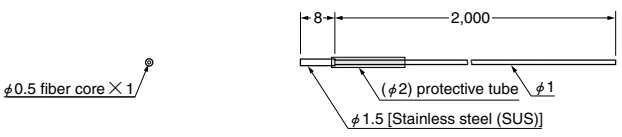
Thru-beam type fiber

FT-NFM2S
FT-NFM2S4 Free-cut With attachment



Thru-beam type fiber

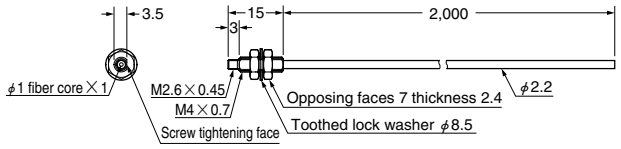
FT-SNFM2 Free-cut With attachment



DIMENSIONS (Unit: mm)

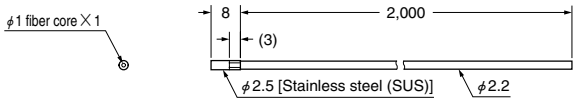
Thru-beam type fiber

FT-W8 ✂ Free-cut



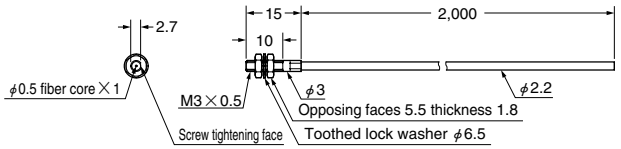
Thru-beam type fiber

FT-WS8 ✂ Free-cut



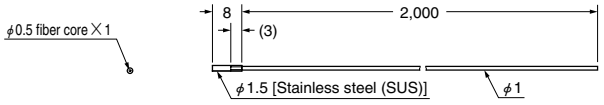
Thru-beam type fiber

FT-W4 ✂ Free-cut



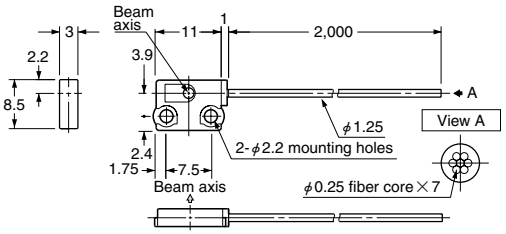
Thru-beam type fiber

FT-WS4 ✂ Free-cut With attachment



Thru-beam type fiber

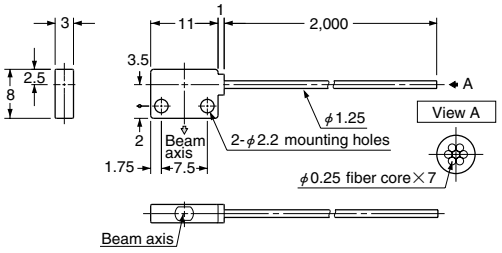
FT-Z8 ✂ Free-cut With attachment



Note: Beam emitting fiber and beam receiving fiber are symmetrical.

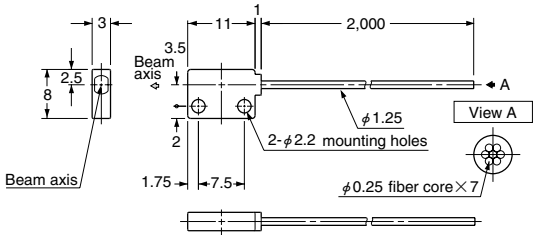
Thru-beam type fiber

FT-Z8E ✂ Free-cut With attachment



Thru-beam type fiber

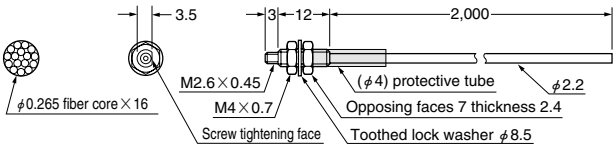
FT-Z8H ✂ Free-cut With attachment



Thru-beam type fiber

FT-P80 ✂ Free-cut

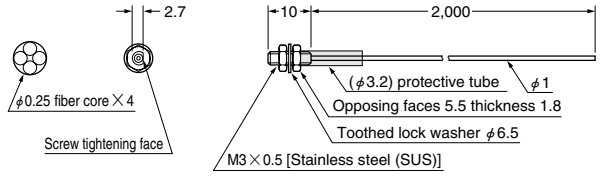
Details of sensing part



Thru-beam type fiber

FT-P40 ✂ Free-cut With attachment

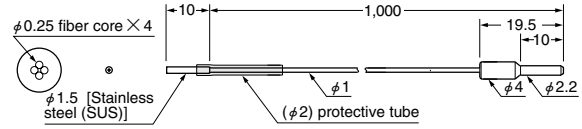
Details of sensing part



Thru-beam type fiber

FT-P2 With attachment

Details of sensing part



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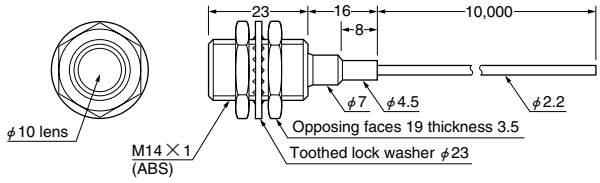
DIMENSIONS (Unit: mm)

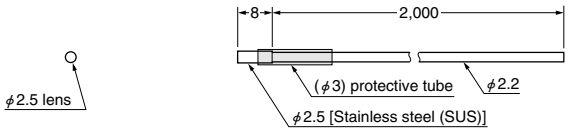
Thru-beam type fiber

FT-FM10L ✂ Free-cut



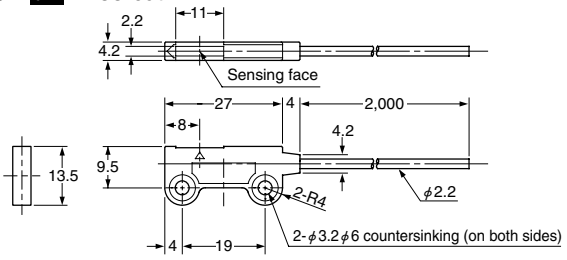
Thru-beam type fiber

FT-SFM2L ✂ Free-cut



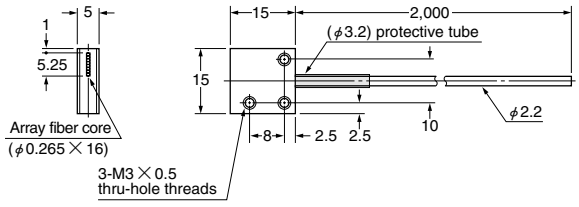
Thru-beam type fiber

FT-A8 ✂ Free-cut



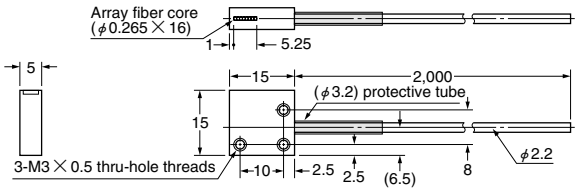
Thru-beam type fiber

FT-AFM2 ✂ Free-cut



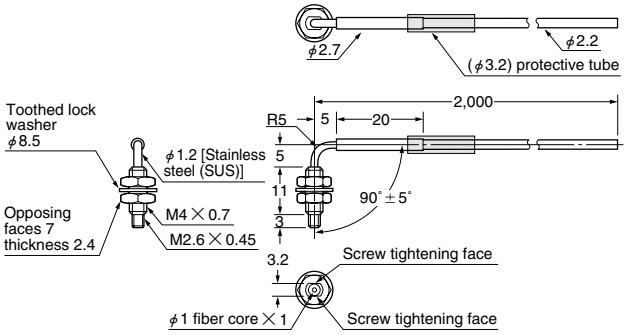
Thru-beam type fiber

FT-AFM2E ✂ Free-cut



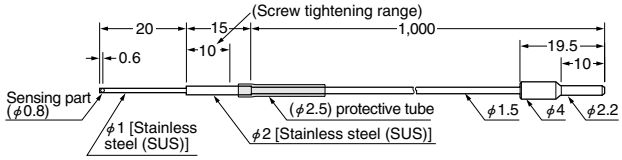
Thru-beam type fiber

FT-R80 ✂ Free-cut



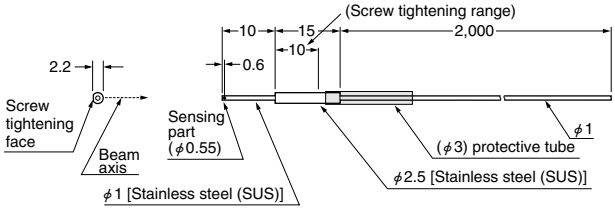
Thru-beam type fiber

FT-V22 With attachment



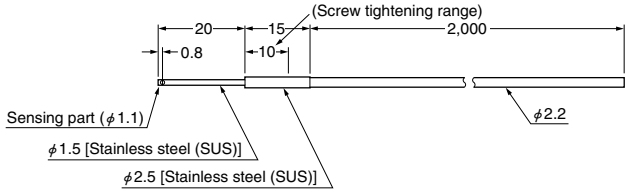
Thru-beam type fiber

FT-V41 ✂ Free-cut With attachment



Thru-beam type fiber

FT-SFM2SV2 ✂ Free-cut

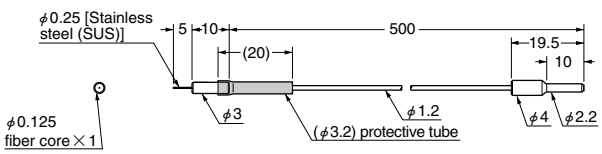


FX-301

DIMENSIONS (Unit: mm)

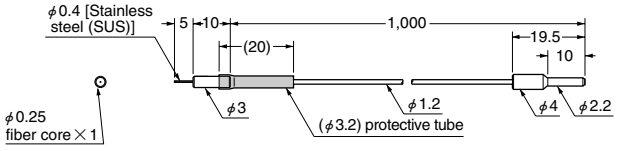
Thru-beam type fiber

FT-E12 With attachment



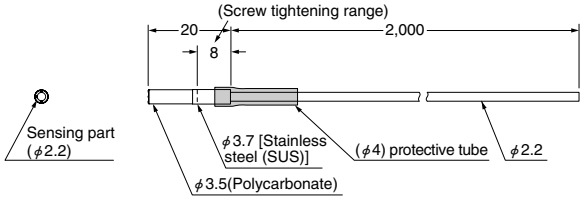
Thru-beam type fiber

FT-E22 With attachment



Thru-beam type fiber

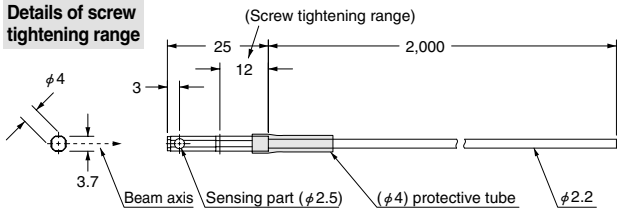
FT-K8 ✂ Free-cut



Thru-beam type fiber

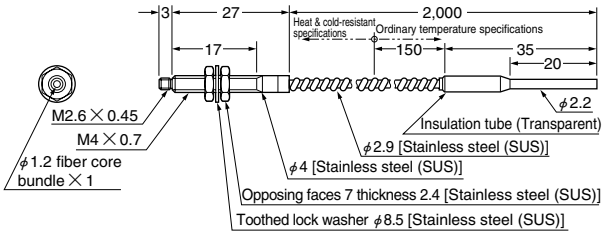
FT-KV8 ✂ Free-cut

Details of screw tightening range



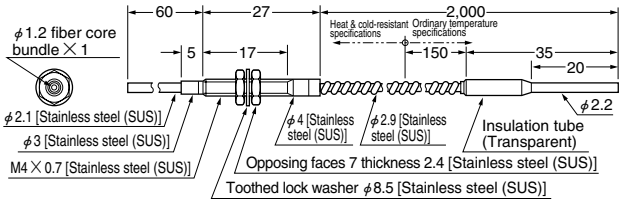
Thru-beam type fiber

FT-H35-M2



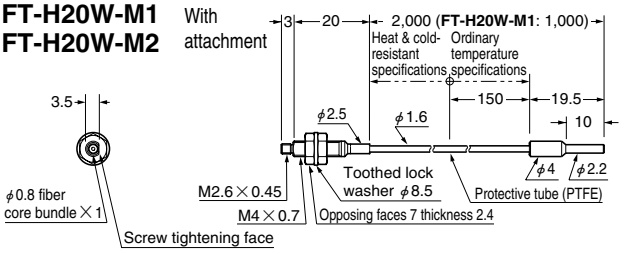
Thru-beam type fiber

FT-H35-M2S6



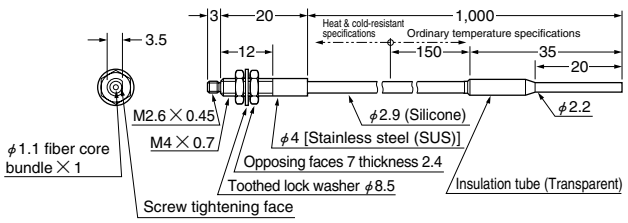
Thru-beam type fiber

FT-H20W-M1
FT-H20W-M2 With attachment



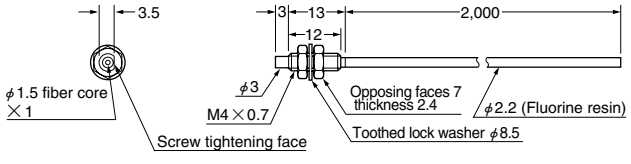
Thru-beam type fiber

FT-H20-M1



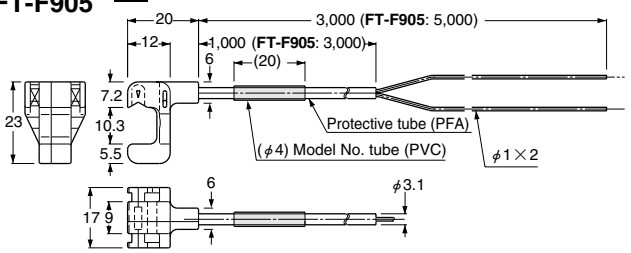
Thru-beam type fiber

FT-H13-FM2 ✂ Free-cut



Thru-beam type fiber

FT-F902
FT-F905 ✂ Free-cut With attachment

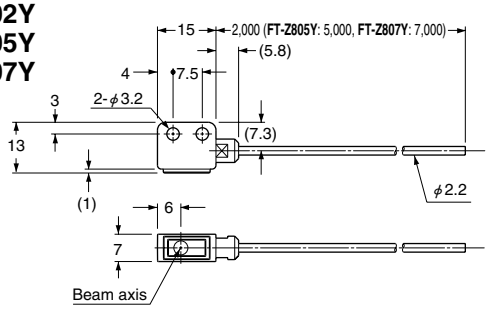


FX-301

DIMENSIONS (Unit: mm)

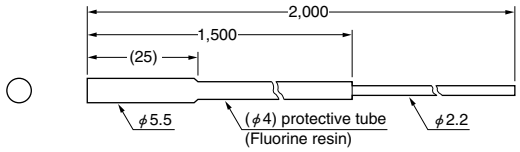
Thru-beam type fiber

FT-Z802Y
FT-Z805Y
FT-Z807Y



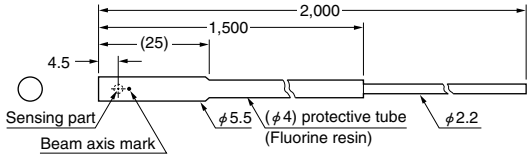
Thru-beam type fiber

FT-L8Y



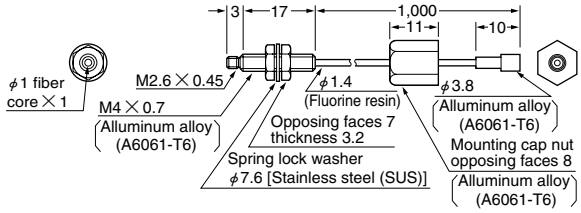
Thru-beam type fiber

FT-V8Y



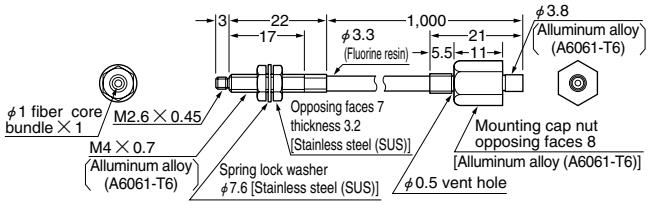
Thru-beam type fiber

FT-6V



Thru-beam type fiber

FT-60V



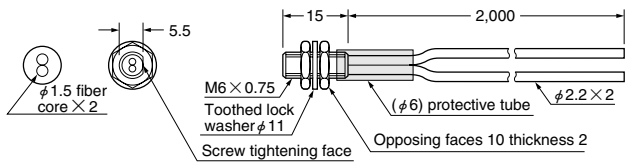
FX-301

DIMENSIONS (Unit: mm)

Reflective type fiber

FD-B8 Free-cut

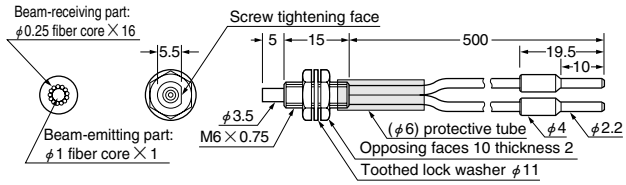
Details of sensing part



Reflective type fiber

FD-5 With attachment

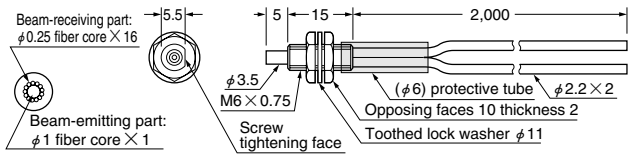
Details of sensing part



Reflective type fiber

FD-FM2 Free-cut

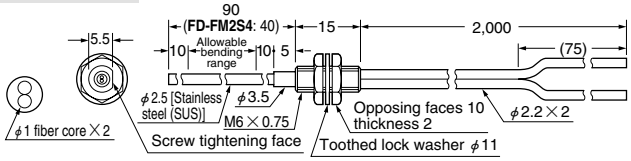
Details of sensing part



Reflective type fiber

FD-FM2S
FD-FM2S4 Free-cut

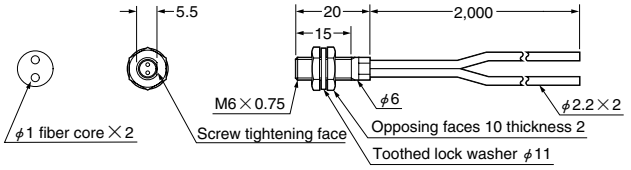
Details of sensing part



Reflective type fiber

FD-N8 Free-cut

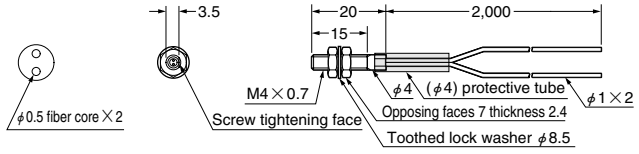
Details of sensing part



Reflective type fiber

FD-N4 Free-cut

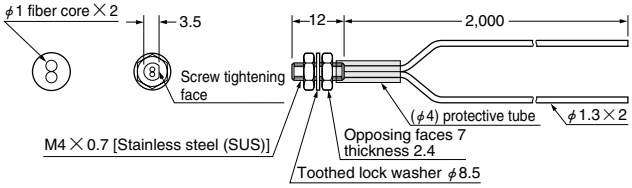
Details of sensing part



Reflective type fiber

FD-T80 Free-cut With attachment

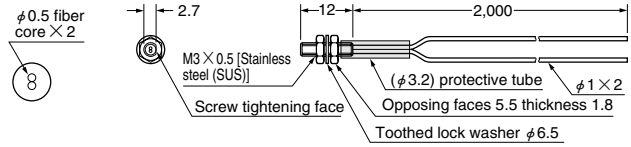
Details of sensing part



Reflective type fiber

FD-T40 Free-cut With attachment

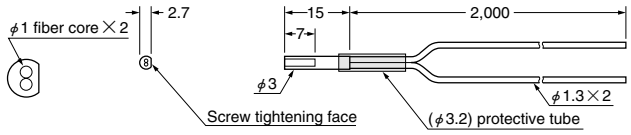
Details of sensing part



Reflective type fiber

FD-S80 Free-cut With attachment

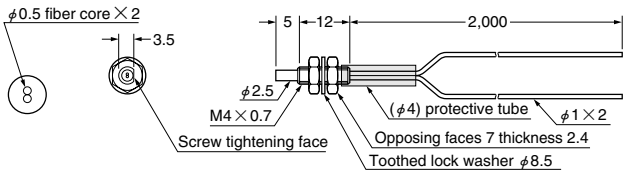
Details of sensing part



Reflective type fiber

FD-NFM2 Free-cut With attachment

Details of sensing part



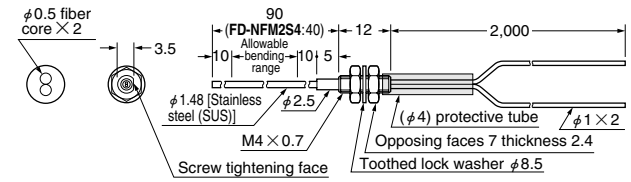
FX-301

DIMENSIONS (Unit: mm)

Reflective type fiber

FD-NFM2S
FD-NFM2S4 Free-cut With attachment

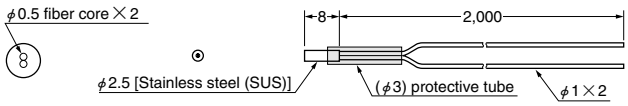
Details of sensing part



Reflective type fiber

FD-SNFM2 Free-cut With attachment

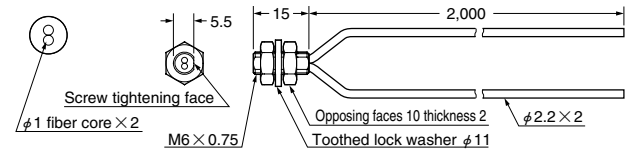
Details of sensing part



Reflective type fiber

FD-W8 Free-cut

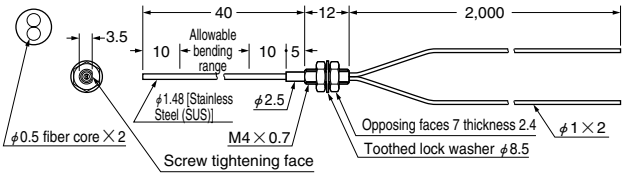
Details of sensing part



Reflective type fiber

FD-W44 Free-cut With attachment

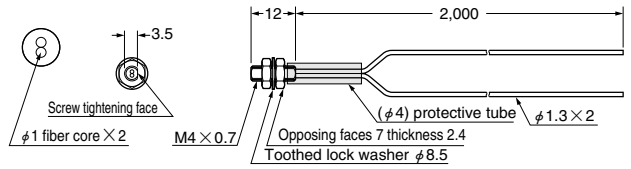
Details of sensing part



Reflective type fiber

FD-WT8 Free-cut With attachment

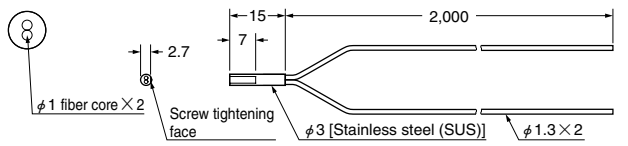
Details of sensing part



Reflective type fiber

FD-WS8 Free-cut With attachment

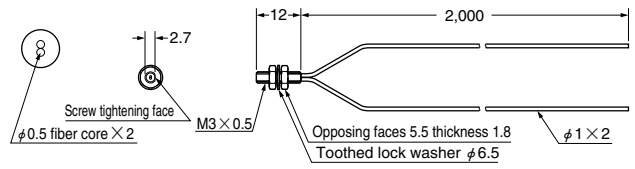
Details of sensing part



Reflective type fiber

FD-WT4 Free-cut With attachment

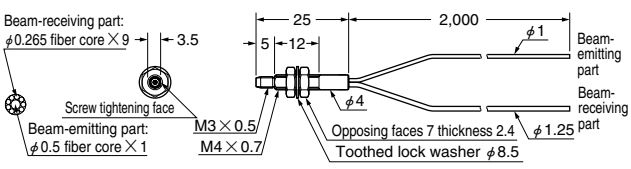
Details of sensing part



Reflective type fiber

FD-WG4 Free-cut With attachment

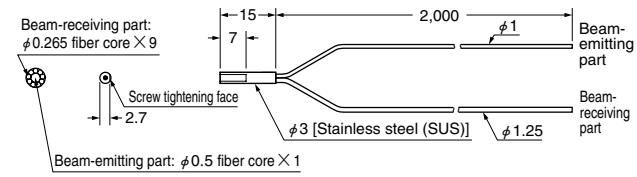
Details of sensing part



Reflective type fiber

FD-WSG4 Free-cut With attachment

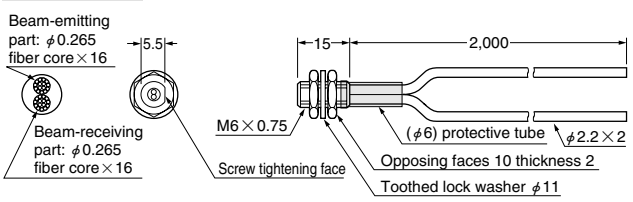
Details of sensing part



Reflective type fiber

FD-P80 Free-cut

Details of sensing part

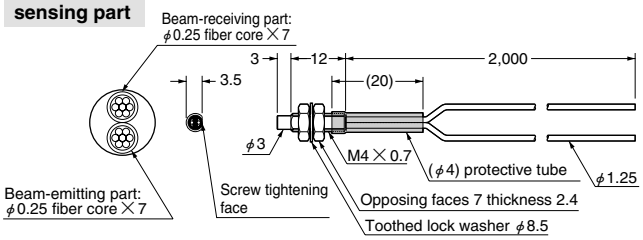


DIMENSIONS (Unit: mm)

Reflective type fiber

FD-P60 With attachment

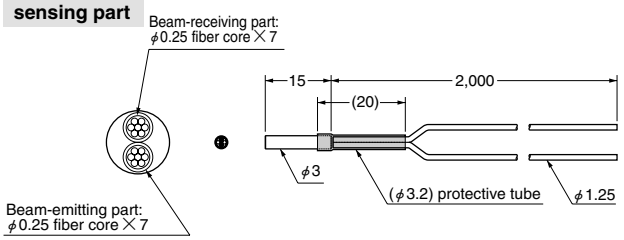
Details of sensing part



Reflective type fiber

FD-P50 With attachment

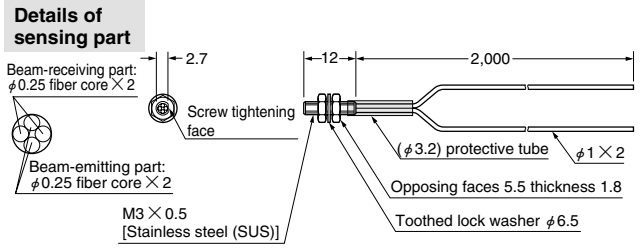
Details of sensing part



Reflective type fiber

FD-P40 ✂ Free-cut With attachment

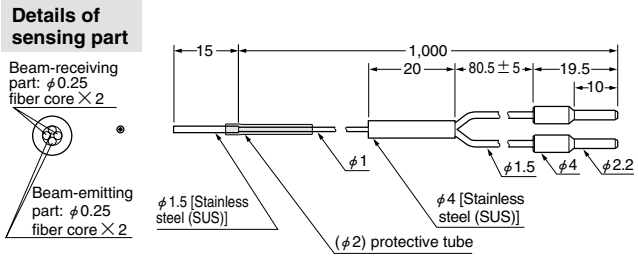
Details of sensing part



Reflective type fiber

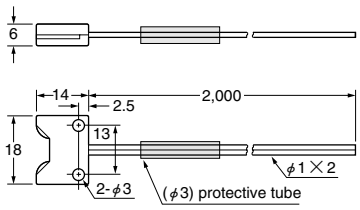
FD-P2 With attachment

Details of sensing part



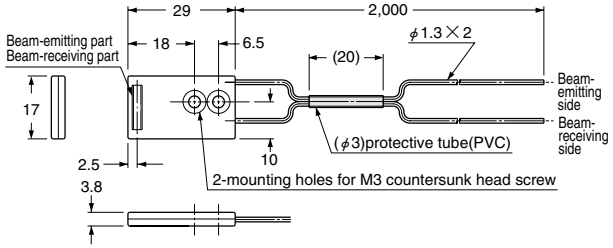
Reflective type fiber

FD-L4 ✂ Free-cut With attachment



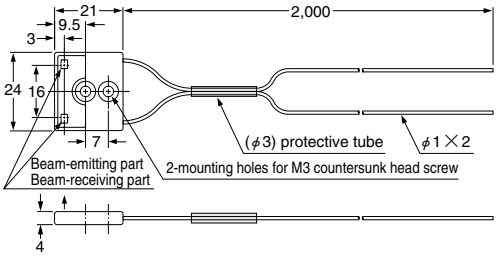
Reflective type fiber

FD-L43 ✂ Free-cut With attachment



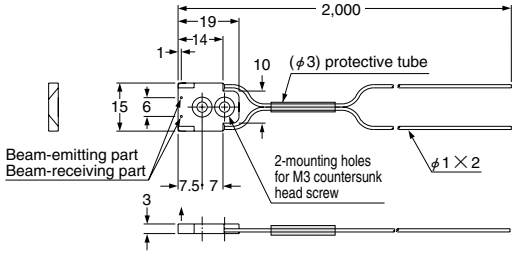
Reflective type fiber

FD-L41 ✂ Free-cut With attachment



Reflective type fiber

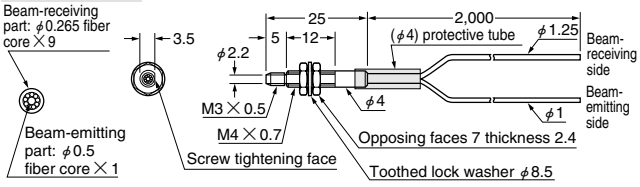
FD-L42 ✂ Free-cut With attachment



Reflective type fiber

FD-G4 ✂ Free-cut With attachment

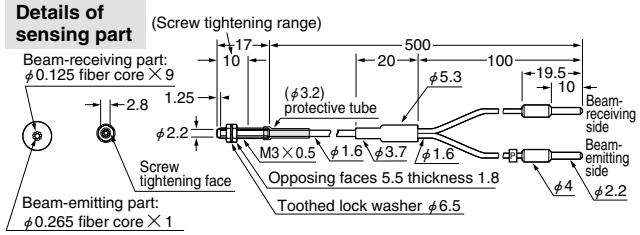
Details of sensing part



Reflective type fiber

FD-EG1 With attachment

Details of sensing part

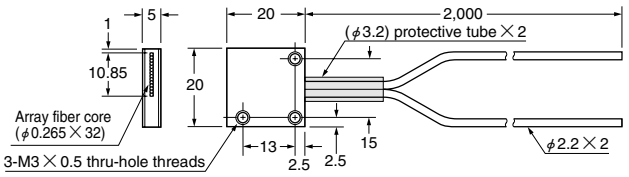


FX-301

DIMENSIONS (Unit: mm)

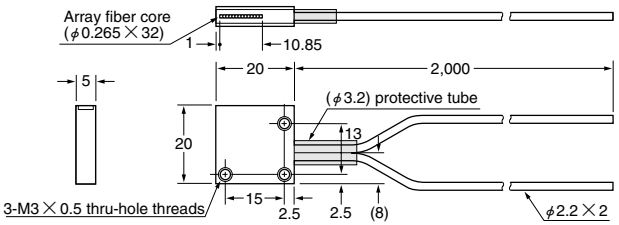
Reflective type fiber

FD-AFM2 ✂ Free-cut



Reflective type fiber

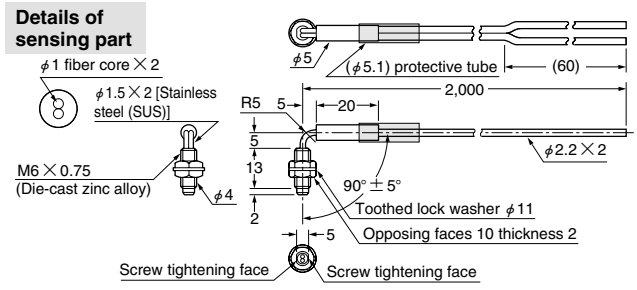
FD-AFM2E ✂ Free-cut



Reflective type fiber

FD-R80 ✂ Free-cut

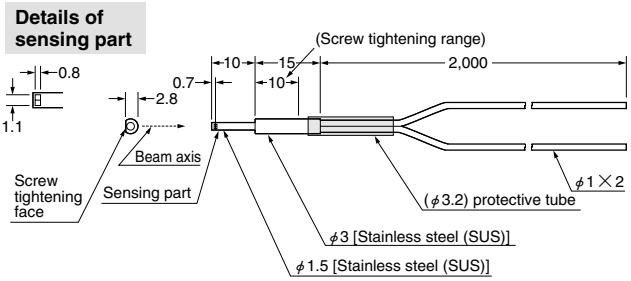
Details of sensing part



Reflective type fiber

FD-V41 ✂ Free-cut With attachment

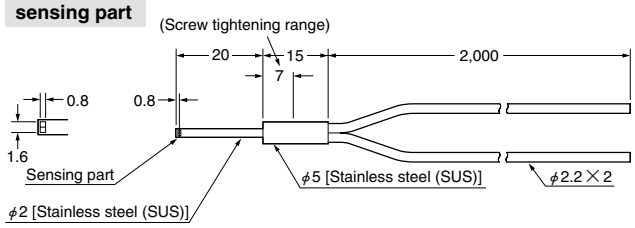
Details of sensing part



Reflective type fiber

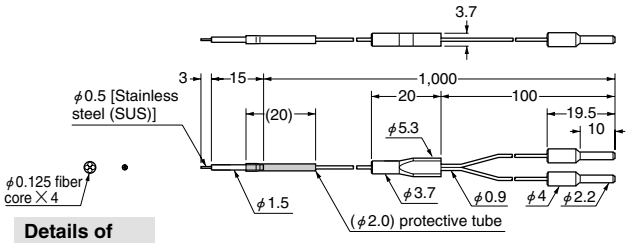
FD-SFM2SV2 ✂ Free-cut

Details of sensing part



Reflective type fiber

FD-E12 With attachment

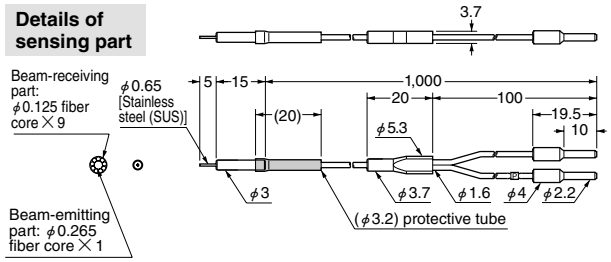


Details of sensing part

Reflective type fiber

FD-E22 With attachment

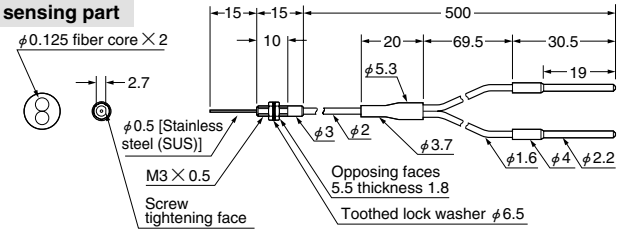
Details of sensing part



Reflective type fiber

FD-EN500S1

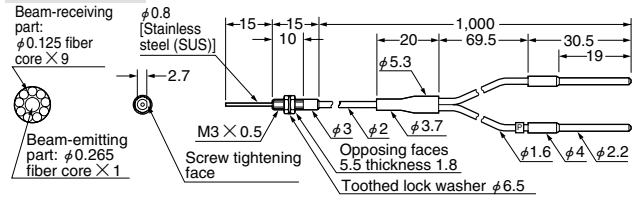
Details of sensing part



Reflective type fiber

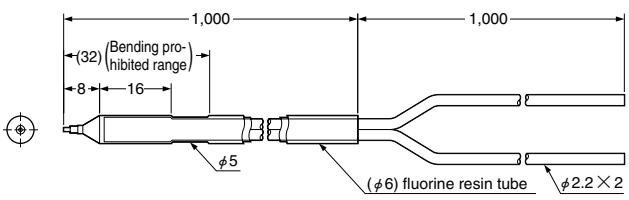
FD-ENM1S1

Details of sensing part



Reflective type fiber

FD-F8Y ✂ Free-cut



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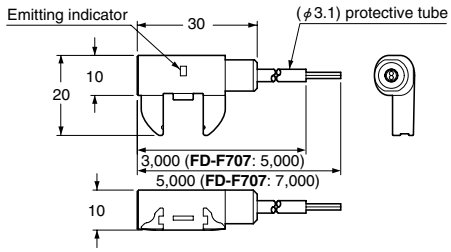
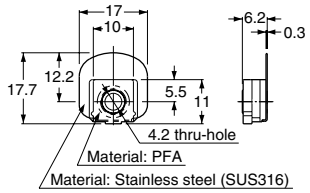
DIMENSIONS (Unit: mm)

Reflective type fiber

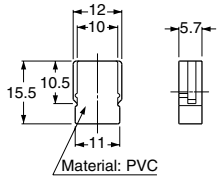
FD-F705
FD-F707 ✂ Free-cut With attachment



PFA mounting bracket

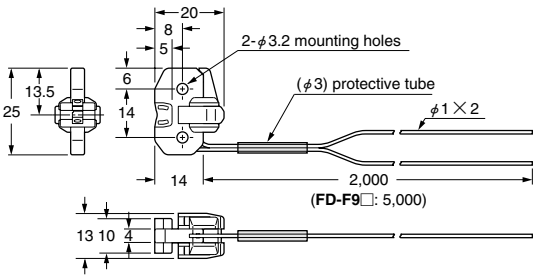


PVC mounting bracket



Reflective type fiber

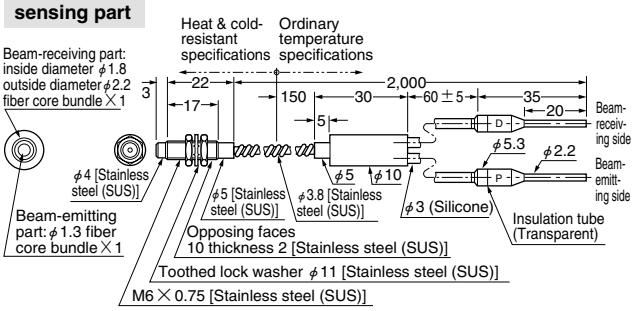
FD-F91 ✂ Free-cut With attachment
FD-F41
FD-F9
FD-F4



Reflective type fiber

FD-H35-M2

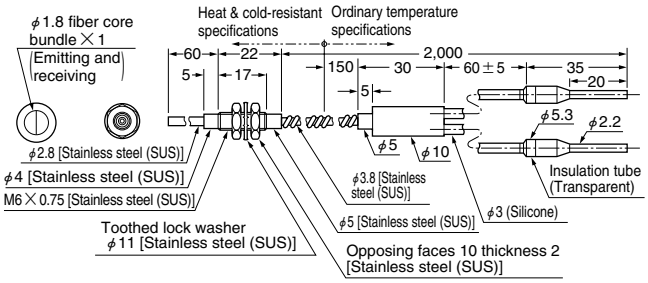
Details of sensing part



Reflective type fiber

FD-H35-M2S6

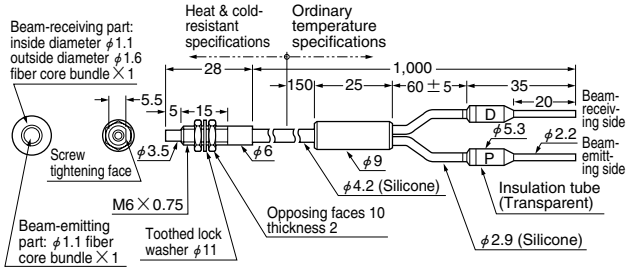
Details of sensing part



Reflective type fiber

FD-H20-M1

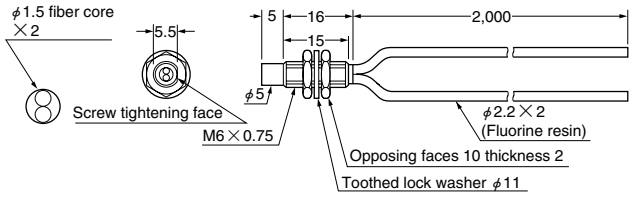
Details of sensing part



Reflective type fiber

FD-H13-FM2 ✂ Free-cut

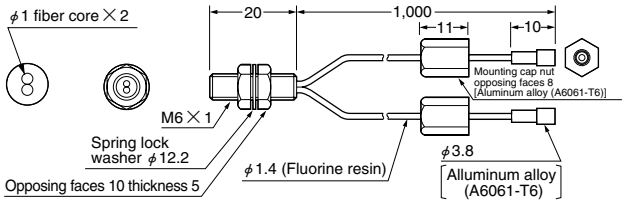
Details of sensing part



Reflective type fiber

FD-6V

Details of sensing part

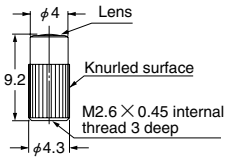


FX-301

DIMENSIONS (Unit: mm)

Expansion lens (Optional)

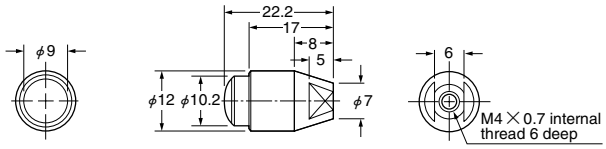
FX-LE1



Material: Enclosure.....Brass (Nickel plated)
Lens.....Glass

Super-expansion lens (Optional)

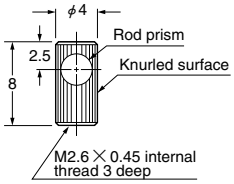
FX-LE2



Material: Enclosure.....Stainless steel (SUS303)
Lens.....Glass

Side-view lens (Optional)

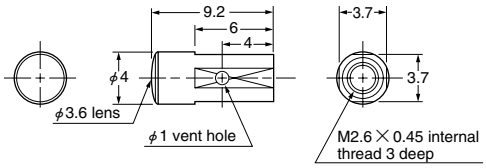
FX-SV1



Material: Enclosure.....Brass (Nickel plated)
Lens.....Glass

Expansion lens (For vacuum type fiber)

FV-LE1

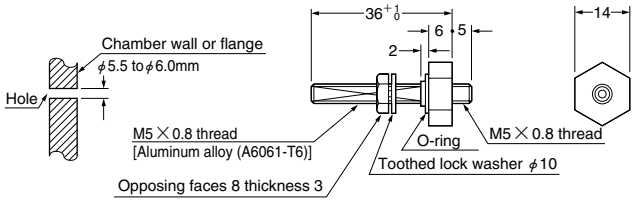


Material: Enclosure.....Aluminum alloy (A6061-T6)
Lens.....BK-7

Photo-terminal (For vacuum type fiber)

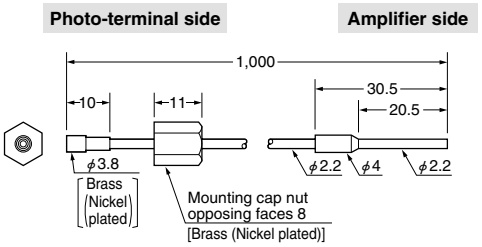
FV-BR1

Mounting hole



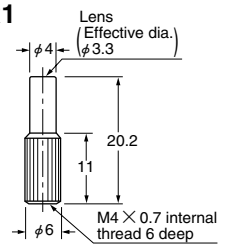
Fiber at atmospheric side (For vacuum type fiber)

FT-J6

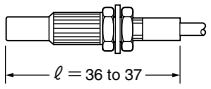


Pinpoint spot lens (Optional)

FX-MR1



Mounting drawing with FD-G4

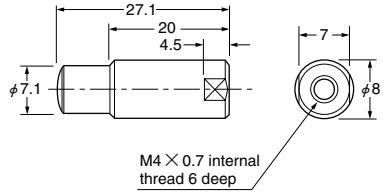


Note: In order to obtain a ϕ0.5mm spot, it is necessary to keep 'ℓ', in the above figure, within the specified range.

Material: Enclosure.....Aluminum (Black ALMITE)
Lens.....Glass

Zoom lens (Optional)

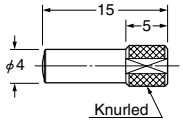
FX-MR2

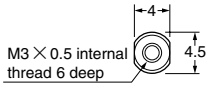


Material: Enclosure.....Aluminum (Black ALMITE)
Lens.....Glass

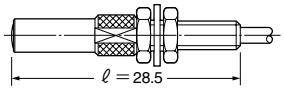
Finest spot lens (Optional)

FX-MR3





Mounting drawing with FD-EG1

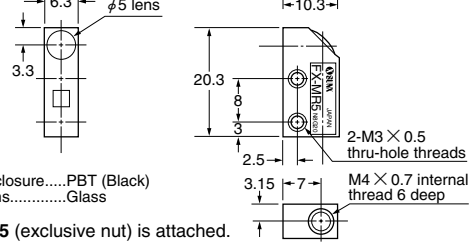


Material: Enclosure.....Aluminum (Black ALMITE)
Lens.....Glass

Notes: 1) In order to obtain a ϕ0.3mm spot, it is necessary for 'ℓ', in the above figure, to be 28.5mm.
2) When inserting the fiber, insert it fully till it stops.

Zoom lens (Optional)

FX-MR5



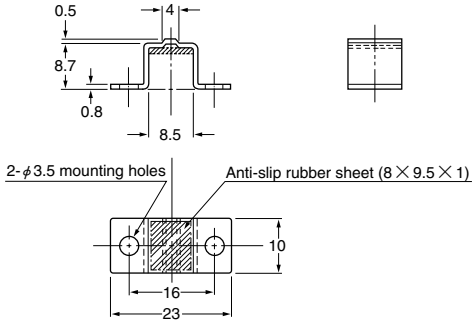
Material: Enclosure.....PBT (Black)
Lens.....Glass

NT-FX-MR5 (exclusive nut) is attached.

DIMENSIONS (Unit: mm)

Mounting bracket for **FX-MR2** (Accessory with **FX-MR2**)

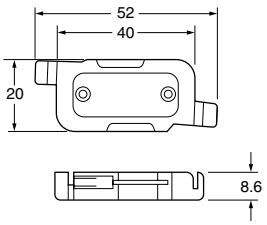
MS-EX-3



Material: Brass (Nickel plated)

Fiber bender (Optional)

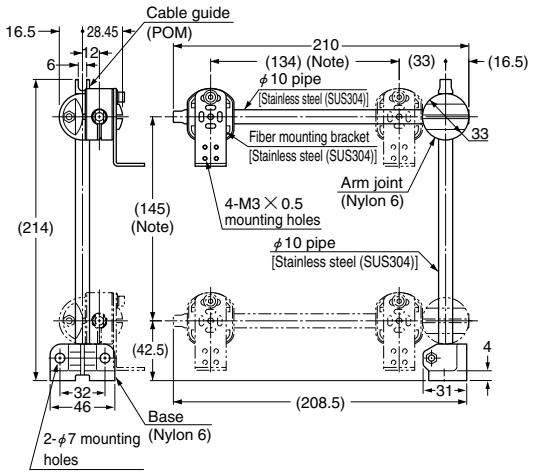
FB-1



Material: PP (containing steel blade)

Universal sensor mounting stand (Optional)

MS-AJ-F

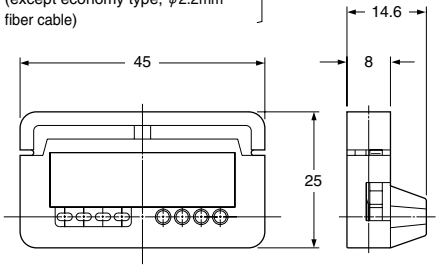


Note: The dimensions in the brackets indicate the adjustable range of the morable part.

Fiber cutter (Optional)

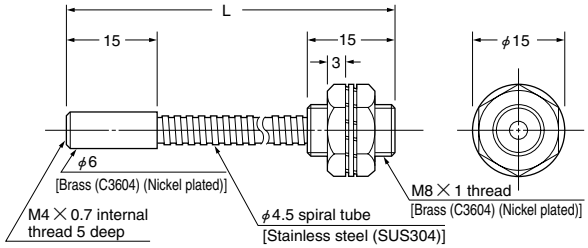
FX-CT2

Accessory with free-cut type fiber (except economy type, ϕ2.2mm fiber cable)

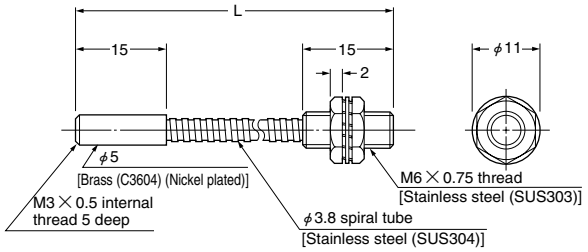


Protective tube (Optional)

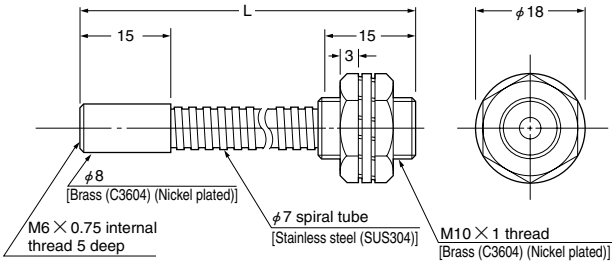
FTP- □
FDP-N □



FTP-N □



FDP- □

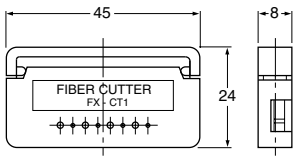


Model No.	Length L (mm)
FTP-500, FTP-N500, FDP-N500, FDP-500	500^{+10}_{0}
FTP-1000, FTP-N1000, FDP-N1000, FDP-1000	$1{,}000^{+10}_{0}$
FTP-1500, FTP-N1500, FDP-N1500, FDP-1500	$1{,}500^{+10}_{0}$

Fiber cutter (Optional)

FX-CT1

Accessory with free-cut type fiber (ϕ2.2mm fiber cable type only, except economy type), chemical-resistant type fiber



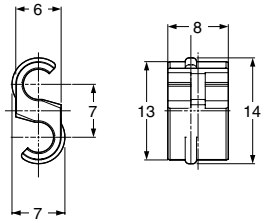
Material: ABS

FX-301

DIMENSIONS (Unit: mm)

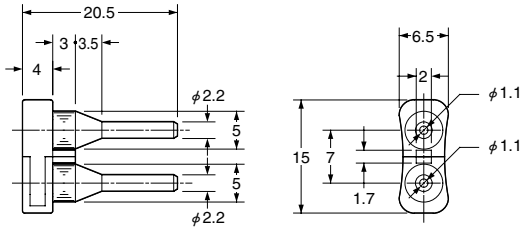
Fixed-length fiber attachment

FX-AT2



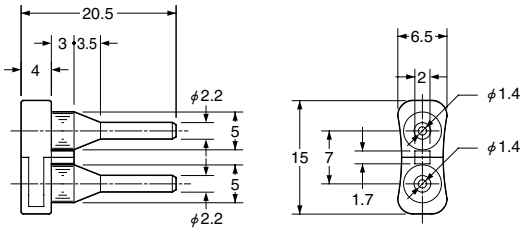
ϕ1mm fiber attachment

FX-AT4



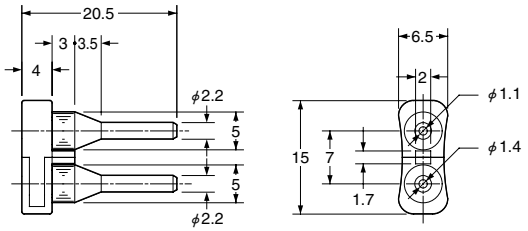
ϕ1.3mm fiber attachment

FX-AT5



ϕ1mm/ ϕ1.3mm fiber attachment

FX-AT6



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