Digital Fiber Sensor

FX-500 SERIES Ver.2

Related Information
■ General terms and conditions..... F-7
■ Fiber selection..... P.5~
■ General precautions ..... P.1458~
■ Sensor selection guide..... P.3~
■ Glossary of terms..... P.1455~

Ver.2

* There is no change in Model No. and price due to version upgrade.
* Cover opened state is shown.

panasonic.net/id/pidsx/global

Conforming to EMC Directive
cULus Listing
Certified

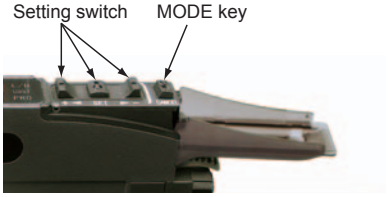
PNP output type available
Timer
Interference prevention
Light intensity monitor
Automatic sensitivity setting
Test input
External sync.

At the industry's leading edge

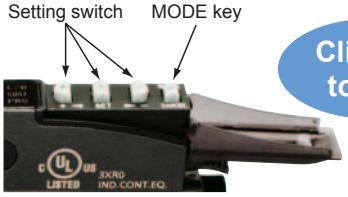
Improved the operability and visibility of the operation keys

Operation keys (setting switch and MODE key) have been renewed to be easy to operate. Also, the color of the keys has been changed from black to light gray to achieve good visibility in dim light.

Previous



Upgraded (Ver. 2)

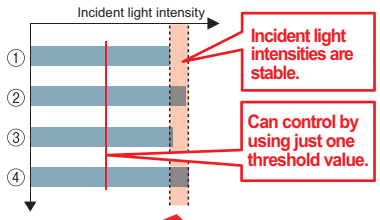


High stability!

When the **FX-500** series is used together with our super quality fiber, the incident light intensity variation among units is decreased to only 1/4 of that of conventional models.
By being close to absolute values instead of modified digital values, changes in detection that could not be found in the past can now be monitored.

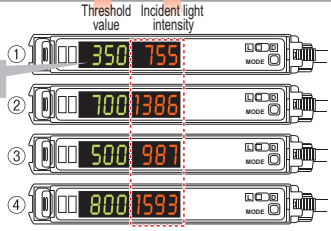
Super quality fiber + **FX-500** series

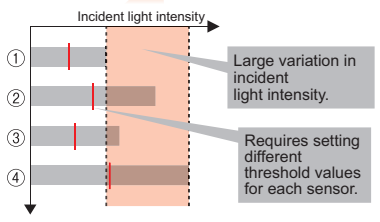
1/4 incident light intensity variation [from previous]



Previous amplifier

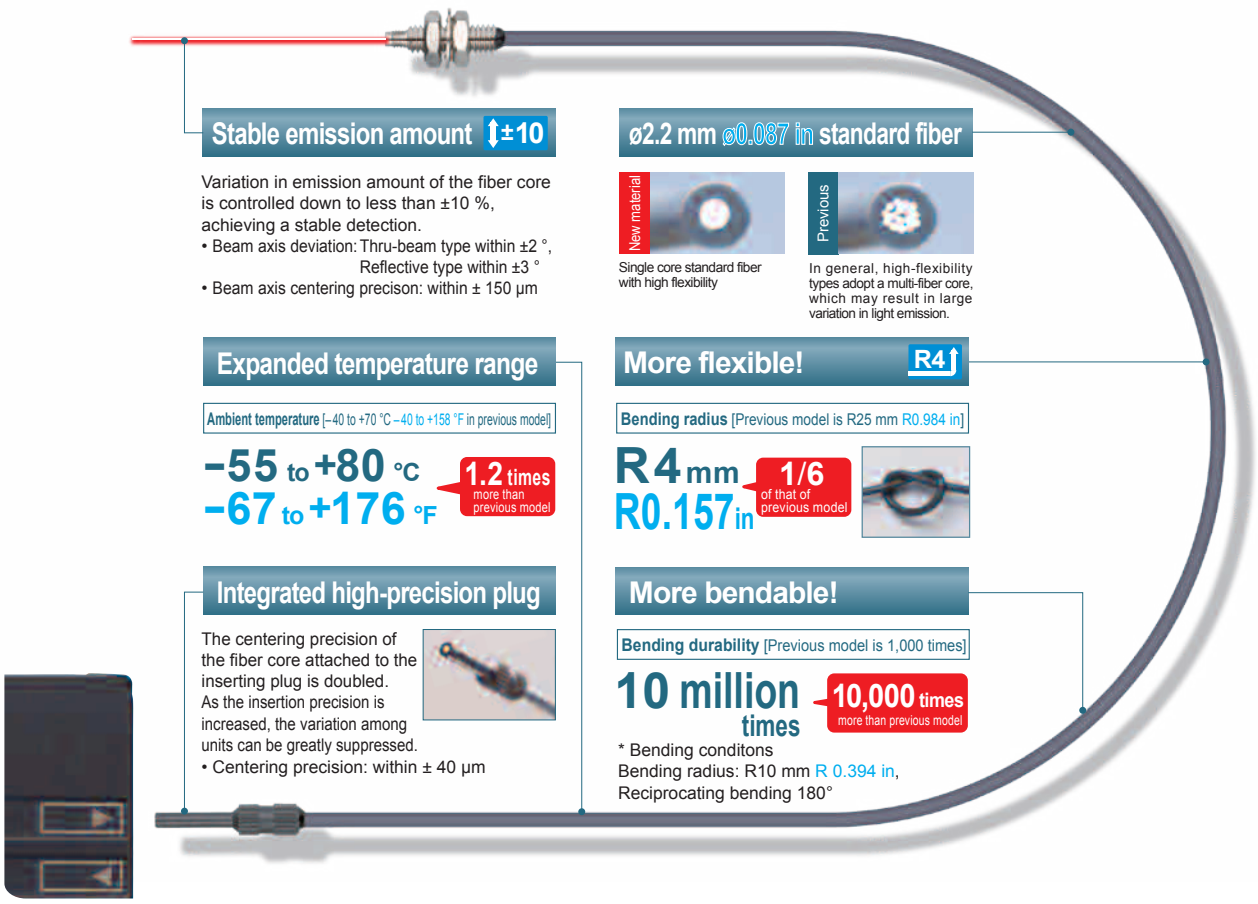
Variation in the threshold value





A quality that surpassed that of standard fibers!

New fibers developed using a new manufacturing method adopted by our own factory along with a persistent quality control system.
The basic performance of a standard fiber is greatly enhanced!



Stable emission amount ↕±10

Variation in emission amount of the fiber core is controlled down to less than ±10 %, achieving a stable detection.
- Beam axis deviation: Thru-beam type within ±2 °, Reflective type within ±3 °
- Beam axis centering precison: within ± 150 µm

ø2.2 mm ø0.087 in standard fiber

New material

Single core standard fiber with high flexibility

Previous

In general, high-flexibility types adopt a multi-fiber core, which may result in large variation in light emission.

Expanded temperature range

Ambient temperature [–40 to +70 °C –40 to +158 °F in previous model]

–55 to +80 °C
–67 to +176 °F

1.2 times more than previous model

More flexible! R4↕

Bending radius [Previous model is R25 mm R0.984 in]

R4 mm
R0.157 in

1/6 of that of previous model

Integrated high-precision plug

The centering precision of the fiber core attached to the inserting plug is doubled. As the insertion precision is increased, the variation among units can be greatly suppressed.
- Centering precision: within ± 40 µm

More bendable!

Bending durability [Previous model is 1,000 times]

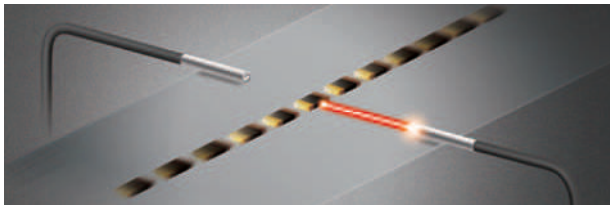
10 million times

10,000 times more than previous model

* Bending conditons
Bending radius: R10 mm R 0.394 in,
Reciprocating bending 180°

Max. 25 µs response time

FX-500 with its high response time contributes to improve productivity.



Performing minute object detection when using a small diameter fiber is now possible with a high response time and longer sensing range.

Hyper HYPR mode incorporated

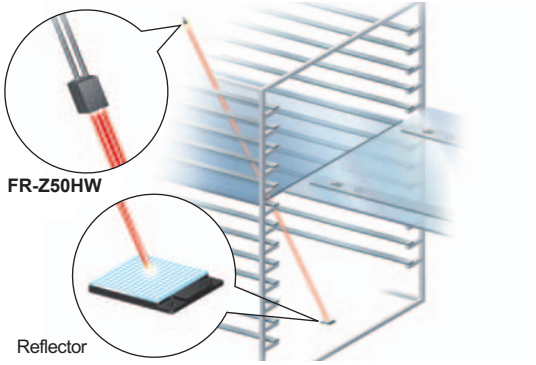
FX-500 in combination with small diameter fibers which can handle challenging detections, allows long sensing range.

Note: When using **FD-NFM2**.

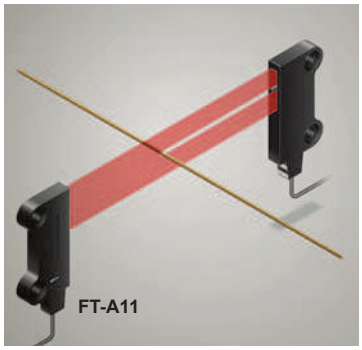
So accurate! Sharp detection with suppressed hysteresis

FX-500 with its accurate detection catches fractional differences in light intensity, achieving high precision and solving low-hysteresis applications.

- Long range detection of small objects with small difference in light intensity **H-02 mode**

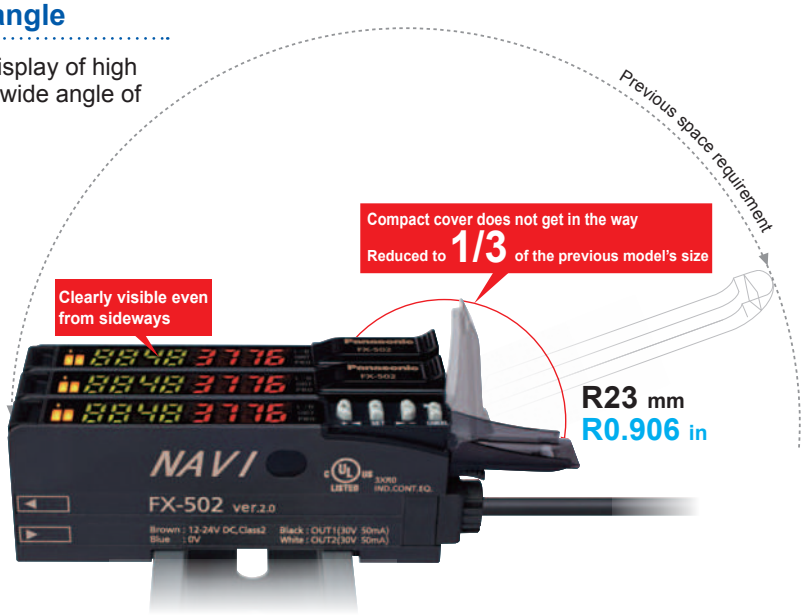


- Highly accurate detection while avoiding saturation **H-01 mode**



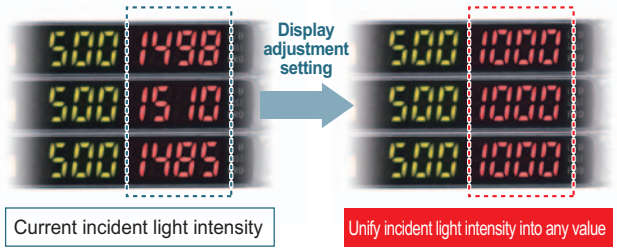
Flat display with wide viewing angle

The large and high-contrast 7-segment display of high luminance provides clear visibility from a wide angle of view.



Resolves variation in displayed incident light intensity
Display adjustment setting

The variation in display can be adjusted to random values. This helps to define proper instruction in a work order.



Stable detection over long and short periods
Stabilized emission amount

The “four-chemical emitting element”, which we are the first to incorporate to maintain a stable level of light emission, has now become an industry standard. **FX-500** series continues to adopt the same emitting element as well as the “APC (Auto Power Control) circuit” which improves stability in short periods such as when the power is turned on.

Saves maintenance time
Threshold tracking function

This function performs automatic setting to threshold value by checking the incident light intensity at desired intervals in order to follow the changes in the light amount resulting from changes in the environment over long periods (such as dust). This contributes to reduction in maintenance hours.

Suitable for preventative maintenance
Self-diagnosis output

FX-502(P)
FX-505(P)-C2

FX-502(**P**) **/ 505**(**P**)**-C2** can set Output 2 as a self-diagnosis output. When the teaching of Output 1’s threshold value is carried out, Output 2 is set concurrently with the setting randomly shifted by the amount of surplus of threshold value. Light intensity deterioration due to fiber breakage or dust accumulation can be notified as an alarm output.

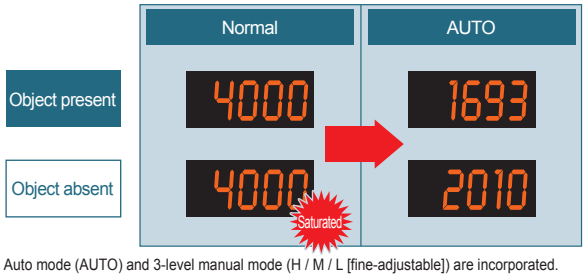
■ Detect deterioration in light intensity
(e.g. Useful in dusty environment)

Self-diagnosis can be used with the threshold tracking function for added effectiveness.

Stable detection while being eco-friendly
Emission power & gain setting

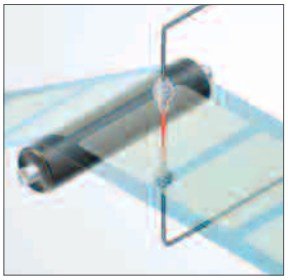
ECO

In cases when the incident light intensity is saturated, the light emitting amount can be adjusted to the optimal level by AUTO without changing the response time. This allows stable detection with an optimal S/N ratio and saves energy by controlling the emitting electric current.



Auto mode (AUTO) and 3-level manual mode (H / M / L [fine-adjustable]) are incorporated.

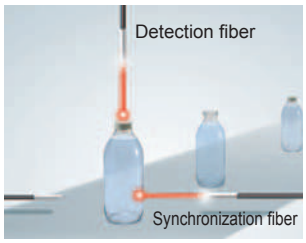
■ Detecting a transparent sheet



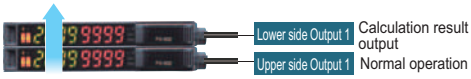
Built-in logic functions
No PLC necessary, saving material and programming costs

Logical calculation functions

3 logical calculations (AND, OR, XOR) are available with fiber sensor only. 3 logical operations can be selected against Output 1. Additional controller is not required so both wire-saving and cost reduction can be achieved.

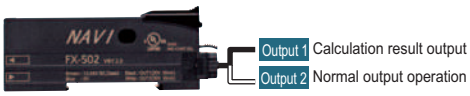


Calculation of two neighboring amplifiers

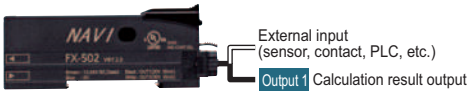


Communication direction (Up to 12 units)

Calculation of two outputs in one amplifier FX-502(P) / 505(P)-C2

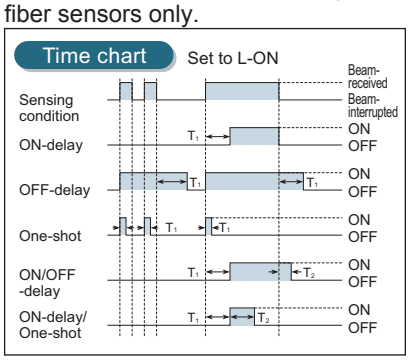


Calculation of one amplifier and external input FX-502(P) / 505(P)-C2



Equipped with 5 timer types

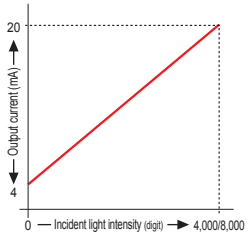
A wide variety of timer control operations can be carried out by fiber sensors only.



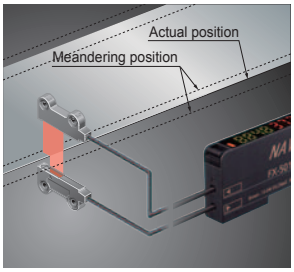
Timer period: 0.05 ms to 32 s
Output 1 has ON / OFF-delay and ON-delay / One-shot timers are available.

Analog output cable type FX-505(P)-C2

To monitor the sensing of objects, a 4 to 20 mA analog current is output in respond to the digital value of the incident light intensity.



■ Edge tracking of film or sheet



The meandering path can be monitored as the light intensity changes.

Smooth setup changes by 8 data banks

The number of data banks used for saving the setup conditions of the amplifirer is increased to eight. Setup conditions can be saved and loaded to make setup changes easy at a worksite where multiple models are manufactured.

Remote control improves work efficiency by external input FX-502(P) FX-505(P)-C2

Work efficiency can be improved by operating via PLC output or other external signal.
(**FX-502**(**P**) can operate via external signal when switching from Output 2 to external input.)

■ Functions operable by external input

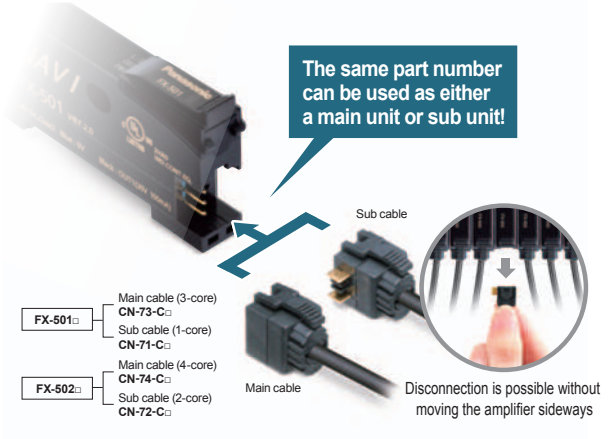
Full-auto / Limit / 2-point teaching	Display adjustment setting
Data bank load / save	Logical calculation (self-unit only)
Emission halt	Copying function lock (self-unit only)

An optical communication function allows sensors to be adjusted simultaneously

The data that is currently set can be copied and saved all at once for all amplifiers connected together from the right side thanks to the optical communication function. This greatly reduces troublesome setup tasks and makes setup much smoother.

No need to specify a main unit or sub unit

All **FX-500** amplifiers can be used as either a main unit or a sub unit. Just use a main cable or a sub cable to distinguish the two. This reduces the costs of inventory management.



ORDER GUIDE

Amplifiers

Quick-connection cable is not supplied with **FX-501**(**P**) and **FX-502**(**P**). Please order it separately.

Type	Appearance	Model No.	Emitting element	Output	External input
Standard type		**FX-501**	Red LED	NPN open-collector transistor	———
		FX-501P		PNP open-collector transistor	
2-output type		**FX-502**		NPN open-collector transistor 2 outputs	Incorporated (Switchable with Output 2)
		FX-502P		PNP open-collector transistor 2 outputs	
Cable type		**FX-505-C2**		NPN open-collector transistor 2 outputs analog output	Incorporated
		FX-505P-C2		PNP open-collector transistor 2 outputs analog output	

Quick-connection cables

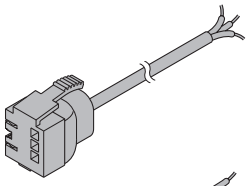
For FX-501(P)

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

Type	Model No.		Description
Main cable (3-core)	**CN-73-C1**	Length: 1 m 3.281 ft	0.2 mm² 3-core cabtyre cable, with connector on one end Cable outer diameter: ø3.3 mm ø0.130 in
	CN-73-C2	Length: 2 m 6.562 ft	
	CN-73-C5	Length: 5 m 16.404 ft	
Sub cable (1-core)	**CN-71-C1**	Length: 1 m 3.281 ft	0.2 mm² 1-core cabtyre cable, with connector on one end Cable outer diameter: ø3.3 mm ø0.130 in Connectable to a main cable up to 15 cables.
	CN-71-C2	Length: 2 m 6.562 ft	
	CN-71-C5	Length: 5 m 16.404 ft	

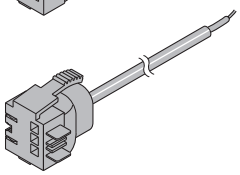
Main cable

• **CN-73-C□**



Sub cable

• **CN-71-C□**



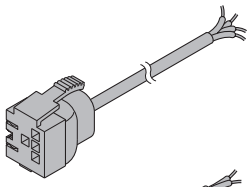
For FX-502(P)

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

Type	Model No.		Description
Main cable (4-core)	**CN-74-C1**	Length: 1 m 3.281 ft	0.2 mm² 4-core cabtyre cable, with connector on one end Cable outer diameter: ø3.3 mm ø0.130 in
	CN-74-C2	Length: 2 m 6.562 ft	
	CN-74-C5	Length: 5 m 16.404 ft	
Sub cable (2-core)	**CN-72-C1**	Length: 1 m 3.281 ft	0.2 mm² 2-core cabtyre cable, with connector on one end Cable outer diameter: ø3.3 mm ø0.130 in Connectable to a main cable up to 15 cables.
	CN-72-C2	Length: 2 m 6.562 ft	
	CN-72-C5	Length: 5 m 16.404 ft	

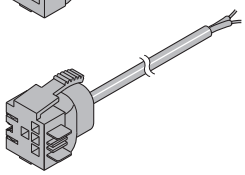
Main cable

• **CN-74-C□**



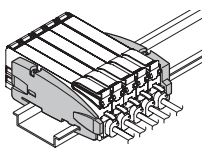
Sub cable

• **CN-72-C□**



End plates

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

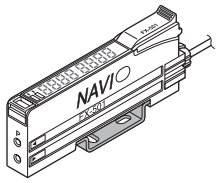
Appearance	Model No.	Description
	**MS-DIN-E**	When amplifiers are mounted in cascade, or when an amplifier moves depending on the way it is installed on a DIN rail, these end plates clamp amplifiers into place on both sides. Make sure to use end plates when cascading multiple amplifiers together. Two pcs. per set

OPTIONS

Designation	Model No.	Description
Amplifier mounting bracket	**MS-DIN-2**	Mounting bracket for amplifier

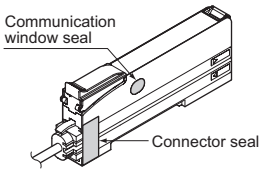
Amplifier mounting bracket

• **MS-DIN-2**



Accessory

• **FX-MB1** (Amplifier protection seal)
10 sets of 2 communication window seals and 1 connector seal



LIST OF FIBERS

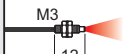
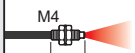
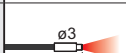
Super quality

Thru-beam type (one pair set)

Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length	Sensing range (mm in) FX-500 series	Sensing range (mm in) U-LG LONG FAST H-SP	Beam axis dia. (mm)	Beam axis position / Inclination of beam axis	Optical transmission loss	Protection	Ambient temp.	Dimensions
Threaded	M3		Tough **FT-30**	R2 Bending durability	2 m	STD 400 15.748 HYPR 1,350 53.150	810 31.890 650 25.591 210 8.268 75 2.953	ø0.5	150 µm / ±2°	±10 %	IP67	−55 to +80 °C	P.51
	M4		Tough **FT-40**	R4 Bending durability		STD 1,200 47.244 HYPR (Note) 3,600 141.732	2,200 86.614 1,700 66.929 530 20.866 190 7.480	ø1					
Cylindrical	ø1.5		Tough **FT-S20**	R2 Bending durability		STD 400 15.748 HYPR 1,350 53.150	810 31.890 650 25.591 210 8.268 75 2.953	ø0.5					P.55
	ø3		Tough **FT-S30**	R4 Bending durability		STD 1,200 47.244 HYPR (Note) 3,600 141.732	2,200 86.614 1,700 66.929 530 20.866 190 7.480	ø1					

Note: The fiber cable length practically limits the sensing range.

Reflective type

Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length	Sensing range (mm in) (Note) FX-500 series	Sensing range (mm in) (Note) U-LG LONG FAST H-SP	Beam axis position / Inclination of beam axis	Optical transmission loss	Protection	Ambient temp.	Dimensions
Threaded	M3		Tough **FD-30**	R2 Bending durability	2 m	STD 160 6.299 HYPR 600 23.622	330 12.992 250 9.843 80 3.150 25 0.984	150 µm / ±3°	±10 %	IP67	−55 to +80 °C	P.59
	M4		Tough **FD-40**									
	M6		Tough **FD-60**	R4 Bending durability		STD 520 20.472 HYPR 1,550 61.024	900 35.433 740 29.134 260 10.236 90 3.543					P.60
Cylindrical	ø3		Tough **FD-S30**			STD 160 6.299 HYPR 600 23.622	330 12.992 250 9.843 80 3.150 25 0.984					P.67

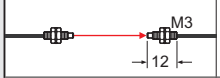
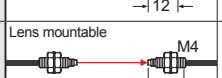
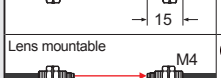
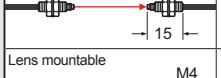
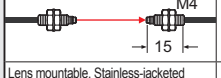
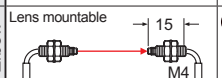
Note: The sensing range is specified for white non-glossy paper.

Tough : Refers to a fiber which possesses both unbreakable (bending radius: R10 mm R0.394 in, reciprocating bending: 180°) and more flexible (bending radius: R4 mm R0.157 in or less) features.

LIST OF FIBERS

Threaded type

Thru-beam type (one pair set)

Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1) FX-500 series	Sensing range (mm in) (Note 1) U-LG LONG FAST H-SP	Beam axis dia. (mm)	Beam axis position / Inclination of beam axis	Protection	Ambient temp.	Dimensions
Threaded	M3		Tough FT-31	R2 Bending durability	✂ 2 m	STD 315 12.402 HYPR 1,350 53.150	770 30.315 550 21.654 210 8.268 70 2.756	ø0.5	150 µm / ±2°	IP67	−55 to +80 °C	P.51
			FT-31W	R1		STD 260 10.236 HYPR 990 38.976	590 23.228 440 17.323 150 5.906 53 2.087		150 µm / ±3°		−40 to +60 °C	
	M4	Lens mountable 	FT-43	R4 Bending durability		STD 1,400 55.118 HYPR (Note 2) 3,600 141.732	2,800 110.236 2,100 82.677 770 30.315 240 9.449	ø1.5	150 µm / ±2°		−55 to +80 °C	
		Lens mountable 	Tough FT-42			STD 1,130 44.488 HYPR (Note 2) 3,600 141.732	2,050 80.709 1,600 62.992 530 20.866 190 7.480	ø1				
		Lens mountable 	FT-42W	R1		STD 800 31.496 HYPR 3,300 129.921	1,900 74.803 1,400 55.118 490 19.291 160 6.299		150 µm / ±3°		−40 to +60 °C	
		Lens mountable, Stainless-jacketed 	FT-45X	R4	1 m	STD 1,200 47.244 HYPR (Note 2) 1,600 62.992	1,600 62.992 (Note 2) 1,600 62.992 (Note 2) 630 24.803 200 7.874		150 µm / ±2°		−55 to +80 °C	P.52
	Elbow	Lens mountable 	Tough FT-R40	R4	✂ 2 m	STD 930 36.614 HYPR (Note 2) 3,600 141.732	1,750 68.898 1,500 59.055 500 19.685 160 6.299					P.54
	M14 Long range	With expansion lens 	Tough FT-140	Bending durability	✂ 10 m	STD (Note 2) 19,600 771.654 HYPR (Note 2) 19,600 771.654	19,600 771.654 (Note 2) 19,600 771.654 (Note 2) 16,000 629.921 6,300 248.031	ø10	—		−40 to +70 °C	P.51

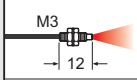
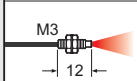
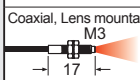
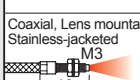
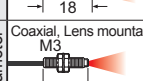
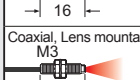
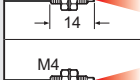
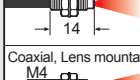
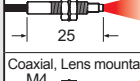
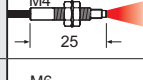
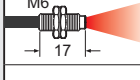
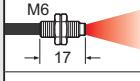
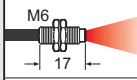
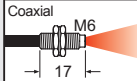
Notes: 1) Note that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
2) The fiber cable length practically limits the sensing range.

Tough : Refers to a fiber which possesses both unbreakable (bending radius: R10 mm R0.394 in, reciprocating bending: 180°) and more flexible (bending radius: R4 mm R0.157 in or less) features.

LIST OF FIBERS

Threaded type

Reflective type

Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1, 2) FX-500 series	Sensing range (mm in) (Note 1, 2) U-LG LONG FAST H-SP	Beam axis position / Inclination of beam axis	Protection	Ambient temp.	Dimensions
Threaded	M3		Tough FD-31	R2 Bending durability	2 m	STD 125 4.921 HYPR 515 20.276	290 11.417 220 8.661 80 3.150 25 0.984	150 µm / ±3°	IP67	−55 to +80 °C	P.59
			FD-31W	R1		STD 80 3.150 HYPR 330 12.992	180 7.087 140 5.512 45 1.772 12 0.472	—		−40 to +60 °C	
			Tough FD-32G	R2 Bending durability		STD 200 7.874 HYPR 650 25.591	380 14.961 270 10.630 95 3.740 27 1.063	—	IP40	−55 to +80 °C	
			FD-32GX	R2	1 m (Note 3)	STD 200 7.874 HYPR 630 24.803	410 16.142 360 14.173 100 3.937 30 1.181	—			
	Ultra-small diameter		FD-EG30	R4	500 mm	STD 48 1.890 HYPR 170 6.693	130 5.118 110 4.331 30 1.181 9 0.354	—		−40 to +70 °C	P.61
			FD-EG31			STD 20 0.787 HYPR 85 3.346	45 1.772 35 1.378 12 0.472 3.5 0.138	—		−20 to +60 °C	P.62
	M4		Tough FD-41	R2 Bending durability	2 m	STD 125 4.921 HYPR 515 20.276	290 11.417 220 8.661 80 3.150 25 0.984	150 µm / ±3°	IP67	−55 to +80 °C	P.59
			FD-41W	R1		STD 270 10.630 HYPR 900 35.433	630 24.803 430 16.929 150 5.906 45 1.772	—		−40 to +60 °C	
			Tough FD-42G	R2 Bending durability		STD 200 7.874 HYPR 650 25.591	380 14.961 270 10.630 95 3.740 27 1.063	—	IP40	−55 to +80 °C	P.60
			FD-42GW	R1		STD 150 5.906 HYPR 670 26.378	340 13.386 280 11.024 90 3.543 25 0.984	—		−40 to +60 °C	
	M6		FD-62	R4 Bending durability		STD 520 20.472 HYPR 1,500 59.055	1,000 39.370 940 37.008 340 13.386 110 4.331	150 µm / ±3°	IP67	−55 to +80 °C	
			Tough FD-61			STD 450 17.717 HYPR 1,400 55.118	840 33.071 670 26.378 200 7.874 70 2.756				
			FD-61W	R1		STD 270 10.630 HYPR 900 35.433	630 24.803 430 16.929 150 5.906 45 1.772	—		−40 to +60 °C	
			Tough FD-61G	R4 Bending durability		STD 420 16.535 HYPR 1,100 43.307	800 31.496 650 25.591 200 7.874 60 2.362	—	IP40	−55 to +80 °C	
			FD-64X	R4	1 m	STD 280 11.024 HYPR 670 26.378	500 19.685 410 16.142 160 6.299 50 1.969	—			P.61
	Elbow		Tough FD-R60	R4 Bending durability	2 m	STD 290 11.417 HYPR 1,100 43.307	600 23.622 550 21.654 190 7.480 65 2.559	150 µm / ±3°	IP67		P.66

Notes: 1) Note 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 sensing range is specified for white non-glossy paper.
3) The allowable cutting range is 700 mm 27.559 in from the end that the amplifier inserted.

Tough : Refers to a fiber which possesses both unbreakable (bending radius: R10 mm R0.394 in, reciprocating bending: 180°) and more flexible (bending radius: R4 mm R0.157 in or less) features.

LIST OF FIBERS

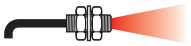
Square head type

Thru-beam type (one pair set)

Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1) FX-500 series	Sensing range (mm in) (Note 1) U-LG LONG FAST H-SP	Beam axis dia. (Fiber Core) (mm)	Protection	Ambient temp.	Dimensions
Square head	M3	M3 W5.5×H8×D16	Tough FT-R31	R2 Bending durability	2m	STD 270 10.630 HYPR 1,000 39.370	580 22.835 440 17.323 160 6.299 55 2.165	ø0.5	IP67	−55 to +80 °C	P.54
	M4	Lens mountable M4 W7×H9×D13.5	Tough FT-R43	R4 Bending durability		STD 720 28.346 HYPR 3,000 118.110	1,600 62.992 1,100 43.307 430 16.929 130 5.118	ø1			
		M4 W7×H9×D13.9	FT-R41W	R1		STD 800 31.496 HYPR 3,200 125.984	1,800 70.866 1,400 55.118 460 18.110 150 5.906		IP40	−40 to +60 °C	
		With expansion lens M4 W7×H9×D14.4	FT-R42W			STD 2,200 86.614 HYPR (Note2) 3,600 141.732	3,600 141.732 (Note 2) 3,500 137.795 1,300 51.181 460 18.110	ø2.2			
		Cable-protection type Compatible with lens M4 W7×H9.5×D15.5	Tough NEW FT-R44Y	R4 Bending durability		STD 720 28.346 HYPR 3,000 118.110	1,600 62.992 1,100 43.307 430 16.929 130 5.118	ø1	IP67 (Note 3)	−55 to +80 °C	P.55
	M6	Full-protection type M6 W10×H11×D21.2	Tough NEW FT-R60Y			STD 2,100 82.677 HYPR (Note2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 1,260 49.606 400 15.748	ø3.5	IP68G		

Notes: 1) Note 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 fiber cable length practically limits the sensing range.
3) The fiber part is oil-resistant.

Reflective type



Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1, 2) FX-500 series	Sensing range (mm in) (Note 1, 2) U-LG LONG FAST H-SP	Beam axis dia. (Fiber Core) (mm)	Protection	Ambient temp.	Dimensions
Square head	M3	Coaxial, Lens mountable M3 W5.5×H8×D16	Tough FD-R31G	R2 Bending durability	2m	STD 170 6.693 HYPR 530 20.866	310 12.205 260 10.236 85 3.346 27 1.063	Emitter ø0.5	IP40	−55 to +80 °C	P.66
		Coaxial, Lens mountable M3 W5.5×H8×D16	FD-R32EG	R4	500mm	STD 45 1.772 HYPR 170 6.693	110 4.331 92 3.622 30 1.181 9 0.354	Emitter ø0.25		−40 to +70 °C	
		Coaxial, Lens mountable M3 W5.5×H8×D16	FD-R34EG			STD 38 1.496 HYPR 130 5.118	90 3.543 70 2.756 23 0.906 7 0.276	Emitter ø0.175			
		Coaxial, Lens mountable M3 W5.5×H8×D16	FD-R33EG			STD 19 0.748 HYPR 84 3.307	44 1.732 33 1.299 11 0.433 3 0.118	Emitter ø0.125		−20 to +60 °C	
	M4	M4 W7×H9×D13.5	Tough FD-R41	R2 Bending durability	2m	STD 210 8.268 HYPR 710 27.953	430 16.929 320 12.598 100 3.937 34 1.339	ø0.75	IP67	−55 to +80 °C	
	M6	Cable-protection type M6 W10×H11×D15.5	Tough NEW FD-R61Y	R4 Bending durability		STD 280 11.024 HYPR 990 38.976	610 24.016 435 17.126 160 6.299 50 1.969	—	IP67 (Note 3)		

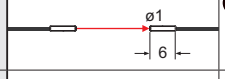
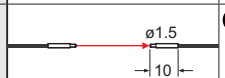
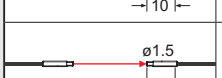
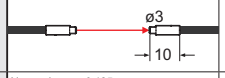
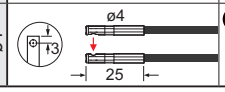
Notes: 1) Note that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
2) The sensing range is specified for white non-glossy paper.
3) The fiber part is oil-resistant.

Tough : Refers to a fiber which possesses both unbreakable (bending radius: R10 mm R0.394 in, reciprocating bending: 180°) and more flexible (bending radius: R4 mm R0.157 in or less) features.

LIST OF FIBERS

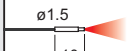
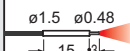
Cylindrical type

Thru-beam type (one pair set)

Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1) FX-500 series	Sensing range (mm in) (Note 1) U-LG FAST LONG H-SP	Beam axis dia. (mm)	Beam axis position / Inclination of beam axis	Protection	Ambient temp.	Dimensions
Cylindrical	ø1		Tough FT-S11	R2 Bending durability	500 mm	STD 90 3.543 HYPR 350 13.780	210 8.268 160 6.299 60 2.362 19 0.748	ø0.25	—	IP67	−55 to +80 °C	P.55
	ø1·5		Tough FT-S21		2 m	STD 315 12.402 HYPR 1,350 53.150	770 30.315 550 21.654 210 8.268 70 2.756	ø0.5	150 µm / ±2°			
			FT-S21W	R1		STD 260 10.236 HYPR 990 38.976	590 23.228 440 17.323 150 5.906 53 2.087		150 µm / ±3°		−40 to +60 °C	
	ø2·5	With lens, Long sensing range ø2.5 8	FT-S32	R10 Bending durability		STD 3,100 122.047 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 1,800 70.866 600 23.622	ø2	—	IP40	−40 to +70 °C	
	ø3		FT-S31W	R1		STD 800 31.496 HYPR 3,300 129.921	1,900 74.803 1,400 55.118 490 19.291 160 6.299	ø1	150 µm / ±3°	IP67	−40 to +60 °C	
	Ultra-small diameter ø3	Narrow beam ø0.125mm ø0.25 ø3 Sleeve part cannot be bent. 5 15	Tough FT-E13	R2 Bending durability	1 m	STD 15 0.591 HYPR 52 2.047	30 1.181 24 0.945 8 0.315 2 0.079	ø0.125	—		−40 to +70 °C	P.52
		Narrow beam ø0.25mm ø0.4 ø3 Sleeve part cannot be bent. 5 15	Tough FT-E23			STD 75 2.953 HYPR 270 10.630	160 6.299 125 4.921 42 1.654 13 0.512	ø0.25	—			
	Side-view ø4		Tough FT-V40	R4 Bending durability	2 m	STD 3,500 137.795 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 2,400 94.488 850 33.465	ø2.5	—	IP50	−40 to +60 °C	P.56

Notes: 1) Note 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 fiber cable length practically limits the sensing range.

Reflective type

Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1, 2) FX-500 series	Sensing range (mm in) (Note 1, 2) U-LG FAST LONG H-SP	Beam axis position / Inclination of beam axis	Protection	Ambient temp.	Dimensions
Cylindrical	ø1·5		Tough FD-S21	R2 Bending durability	1 m	STD 80 3.150 HYPR 190 7.480	130 5.118 110 4.331 37 1.457 11 0.433	—	IP40	−55 to +80 °C	P.66
	ø3		Tough FD-S32	R4 Bending durability	2 m	STD 420 16.535 HYPR 1,200 47.244	790 31.102 660 25.984 220 8.661 75 2.953	150 µm / ±3°	IP67		P.67
			FD-S32W	R1		STD 270 10.630 HYPR 900 35.433	630 24.803 430 16.929 150 5.906 45 1.772	—		−40 to +60 °C	
			Tough FD-S31	R2 Bending durability		STD 125 4.921 HYPR 515 20.276	290 11.417 220 8.661 80 3.150 25 0.984	150 µm / ±3°		−55 to +80 °C	
		Coaxial ø3 15	FD-S33GW	R1		STD 150 5.906 HYPR 670 26.378	340 13.386 280 11.024 90 3.543 25 0.984	—	IP40	−40 to +60 °C	
	ø5.5	Metal-free ø5.5 (16)	Tough NEW FD-S60Y	Protective tube R30 mm Fiber R4 Bending durability	2 m (Note 4)	STD 320 12.598 HYPR 600 23.622	590 23.228 420 16.535 200 7.874 75 2.953	—	IP68G	−40 to +70 °C	
	Ultra-small diameter ø1·5	 Sleeve part cannot be bent.	FD-E13	R4	1 m	STD 12 0.472 HYPR 50 1.969	29 1.142 25 0.984 7 0.276 2 0.079	—	IP40	−40 to +60 °C	P.61
	ø3	ø3 ø0.63 15 5 Sleeve part cannot be bent.	FD-E23			STD 55 2.165 HYPR 170 6.693	120 4.724 80 3.150 30 1.181 9 0.354	—		−40 to +70 °C	

Notes: 1) Note 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 sensing range is specified for white non-glossy paper.
3) The allowable cutting range is 500 mm 19.685 in from the end that is inserted to the amplifier.

Tough : Refers to a fiber which possesses both unbreakable (bending radius: R10 mm R0.394 in, reciprocating bending: 180°) and more flexible (bending radius: R4 mm R0.157 in or less) features.

LIST OF FIBERS

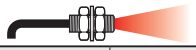
Sleeve

Thru-beam type (one pair set)

Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂ : Free-cut	Sensing range (mm in) (Note 1, 2) FX-500 series	Sensing range (mm in) (Note 1, 2) U-LG LONG FAST H-SP	Beam axis dia. (mm)	Protection	Ambient temp.	Dimensions
Threaded	M3	Sleeve 40mm, M3, ø0.88, 10	Tough FT-31S	R2 Bending durability (Note 3)	✂ 2 m	STD 315 12.402 HYPR 1,220 48.031	740 29.134 550 21.654 195 7.677 63 2.480	ø0.5	IP67	−55 to +80 °C	P.51
	M4	Sleeve 40mm, M4, ø1.48, 12	Tough FT-42S	R4 Bending durability (Note 3)		STD 1,130 44.488 HYPR (Note2) 3,600 141.732	2,050 80.709 1,600 62.992 530 20.866 190 7.480	ø1			
Cylindrical	Ultra-small diameter ø3	Narrow beam ø0.125mm, ø0.25, ø3, Sleeve part cannot be bent., 5, 15	Tough FT-E13	R2 Bending durability	✂ 1 m	STD 15 0.591 HYPR 52 2.047	30 1.181 24 0.945 8 0.315 2 0.079	ø0.125		−40 to +70 °C	P.52
		Narrow beam ø0.25mm, ø0.4, ø3, Sleeve part cannot be bent., 5, 15	Tough FT-E23			STD 75 2.953 HYPR 270 10.630	160 6.299 125 4.921 42 1.654 13 0.512	ø0.25			
	Side-view ø2	ø1, ø2, Sleeve part cannot be bent., 20, 15	Tough FT-V23	R4 Bending durability	✂ 2 m	STD 450 17.717 HYPR 1,800 70.866	1,000 39.370 880 34.646 280 11.024 90 3.543	ø0.75	IP30	−55 to +80 °C	P.55
		ø1, ø2, Sleeve part cannot be bent., 15, 15	Tough FT-V25	R2 Bending durability		STD 240 9.449 HYPR 900 35.433	550 21.654 480 18.898 140 5.512 45 1.772	ø0.5		−55 to +80 °C	P.56
		ø1, ø2, Sleeve part cannot be bent., 15, 15	FT-V24W	R1		STD 110 4.331 HYPR 380 14.961	230 9.055 200 7.874 60 2.362 20 0.787			−40 to +60 °C	
	ø2.5	ø1.5, ø2.5, Sleeve part cannot be bent., 20, 15	Tough FT-V30	R4 Bending durability		STD 680 26.772 HYPR 2,200 86.614	1,200 47.244 1,000 39.370 340 13.386 100 3.937	ø1.0		−55 to +80 °C	

Notes: 1) Note 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 fiber cable length practically limits the sensing range. 3) Bending radius of sleeve part is R10 mm R0.394 in or more.

Reflective type



Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂ : Free-cut	Sensing range (mm in) (Note 1, 2) FX-500 series	Sensing range (mm in) (Note 1, 2) U-LG LONG FAST H-SP	Protection	Ambient temp.	Dimensions
Threaded	Ultra-small diameter M3	Sleeve 15 mm, M3, ø0.8, 15, Sleeve part cannot be bent.	FD-EG30S	R4	1 m	STD 50 1.969 HYPR 170 6.693	110 4.331 80 3.150 30 1.181 9 0.354	IP40	−40 to +70 °C	P.62
	M4	Sleeve 40 mm, M4, ø1.48, 12	Tough FD-41S	R2 Bending durability (Note 3)	✂ 2 m	STD 125 4.921 HYPR 515 20.276	290 11.417 220 8.661 80 3.150 25 0.984	IP67	−55 to +80 °C	P.59
		Sleeve 40 mm, M4, ø1.48, 12	FD-41SW	R1 (Note 3)		STD 80 3.150 HYPR 330 12.992	180 7.087 140 5.512 45 1.772 12 0.472		−40 to +60 °C	
	M6	Sleeve 40 mm, M6, ø2.5, 15	Tough FD-61S	R4 Bending durability (Note 3)		STD 420 16.535 HYPR 1,200 47.244	790 31.102 660 25.984 220 8.661 75 2.953		−55 to +80 °C	P.60
Cylindrical	Ultra-small diameter ø1.5	ø1.5, ø0.48, 15, 3, Sleeve part cannot be bent.	FD-E13	R4	1 m	STD 12 0.472 HYPR 50 1.969	29 1.142 25 0.984 7 0.276 2 0.079	IP40	−40 to +60 °C	P.61
	ø3	ø3, ø0.63, 15, 5, Sleeve part cannot be bent.	FD-E23			STD 55 2.165 HYPR 170 6.693	120 4.724 80 3.150 30 1.181 9 0.354		−40 to +70 °C	
	Side-view ø3	Small diameter, 15, 15, ø3, ø1.5, Sleeve part cannot be bent.	Tough FD-V30	R2 Bending durability	✂ 2 m	STD 65 2.559 HYPR 240 9.449	130 5.118 120 4.724 35 1.378 14 0.551	IP30	−55 to +80 °C	P.67
		15, 15, ø3, ø1.5, Sleeve part cannot be bent.	FD-V30W	R1		STD 20 0.787 HYPR 80 3.150	40 1.575 30 1.181 10 0.394 2 0.079		−40 to +60 °C	
	ø5	15, 20, ø5, ø2, Sleeve part cannot be bent.	Tough FD-V50	R4 Bending durability		STD 120 4.724 HYPR 370 14.567	220 8.661 210 8.268 75 2.953 25 0.984		−55 to +80 °C	P.68

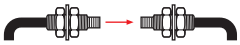
Notes: 1) Note that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
2) The sensing range is specified for white non-glossy paper. 3) Bending radius of sleeve part is R10 mm R0.394 in or more.

Tough : Refers to a fiber which possesses both unbreakable (bending radius: R10 mm R0.394 in, reciprocating bending: 180°) and more flexible (bending radius: R4 mm R0.157 in or less) features.

LIST OF FIBERS

Flat type

Thru-beam type (one pair set)



Type	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1) FX-500 series	Sensing range (mm in) (Note 1) U-LG LONG FAST H-SP	Beam axis dia. (mm)	Protection	Ambient temp.	Dimensions
Flat	Top sensing W3 × H8 × D12	Tough FT-Z30H	R2 Bending durability	2 m	STD 3,500 137.795 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 2,600 102.362 810 31.890	2 × 3	IP40	−40 to +60 °C	P.57
	Top sensing W3 × H8 × D12	FT-Z30HW	R1							
	Side sensing W3 × H12 × D8	Tough FT-Z30E	R2 Bending durability		STD 3,500 137.795 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 2,400 94.488 740 29.134				P.56
	Side sensing W3 × H12 × D8	FT-Z30EW	R1		STD 3,400 133.858 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 2,000 78.740 630 24.803				P.57
	Front sensing W8.5 × H12 × D3	Tough FT-Z30	R2 Bending durability		STD 2,100 82.677 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 1,200 47.244 410 16.142	ø2			P.56
	Front sensing W8.5 × H12 × D3	FT-Z30W	R1		STD 1,500 59.055 HYPR (Note 2) 3,600 141.732	3,300 129.921 3,200 125.984 1,000 39.370 280 11.024				P.57
With boss	Front sensing W10 × H7 × D2	FT-Z20W		1 m	STD 620 24.409 HYPR (Note 2) 1,600 62.992	1,500 59.055 1,100 43.307 420 16.535 130 5.118	ø1.5			P.56
	Fiber bending type W2 × H10 × D10	FT-Z20HBW	R1		STD 260 10.236 HYPR 1,100 43.307	670 26.378 570 22.441 180 7.087 55 2.165	ø0.5	IP67		
	Front sensing W14 × H7 × D3.5	FT-Z40W		2 m	STD 1,500 59.055 HYPR (Note 2) 3,600 141.732	3,300 129.921 2,300 90.551 900 35.433 290 11.417	ø1.5	IP40		P.57
	Fiber bending type W3.5 × H14 × D11	FT-Z40HBW			STD 800 31.496 HYPR 3,300 129.921	1,900 74.803 1,400 55.118 490 19.291 160 6.299	ø1	IP67		

Notes: 1) Note 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 fiber cable length practically limits the sensing range.

Reflective type

Type	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1, 2) FX-500 series	Sensing range (mm in) (Note 1, 2) U-LG LONG FAST H-SP	Protection	Ambient temp.	Dimensions
Flat With boss	Front sensing W10 × H7 × D2	FD-Z20W	R1	1 m	STD 1 to 65 0.039 to 2.559 HYPR 260 10.236	150 5.906 130 5.118 2 to 45 0.079 to 1.772 5 to 13 0.197 to 0.512	IP40	−40 to +60 °C	P.68
	Fiber bending type W2 × H10 × D10	FD-Z20HBW			STD 2 to 85 0.079 to 3.346 HYPR 1 to 340 0.039 to 13.386	1 to 210 0.039 to 8.268 1 to 180 0.039 to 7.087 2 to 55 0.079 to 2.165 3 to 15 0.118 to 0.591	IP67		
	Front sensing W14 × H7 × D3.5	FD-Z40W		2 m	STD 190 7.480 HYPR 790 31.102	440 17.323 390 15.354 1 to 120 0.039 to 4.724 2 to 35 0.079 to 1.378	IP40		
	Fiber bending type W3.5 × H14 × D11	FD-Z40HBW			STD 260 10.236 HYPR 760 29.921	540 21.260 470 18.504 1 to 160 0.039 to 6.299 2 to 50 0.079 to 1.969	IP67		

Notes: 1) Note 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 sensing range is specified for white non-glossy paper.

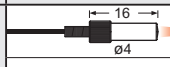
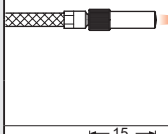
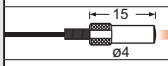
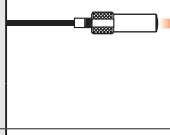
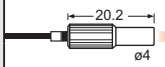
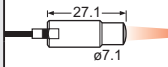
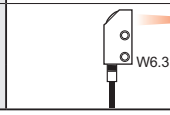
Selection Guide
Fibers
Fiber Amplifiers
FX-500
FX-100
FX-300
FX-410
FX-311
FX-301-F7/ FX-301-F

Tough : Refers to a fiber which possesses both unbreakable (bending radius: R10 mm R0.394 in, reciprocating bending: 180°) and more flexible (bending radius: R4 mm R0.157 in or less) features.

LIST OF FIBERS

Small spot

High precision fiber & spot lens

Designation	Shape of head (mm) Dimensions	Spot diameter (mm in) (Note)	Distance to focal point (mm in) (Note)	Lens		Applicable fibers					
				Model No.	Ambient temp.	Model No.	Fiber cable length ✂: Free-cut	Bending radius (mm)	Protection	Ambient temp.	Dimensions
Finest spot lens	 P.71	ø0.1 ø0.004	7 ±0.5 0.276 ±0.020	FX-MR6	−20 to +60 °C	FD-EG31	500 mm	R4	IP40	−20 to +60 °C	P.62
	 P.71	ø0.2 ø0.008				FD-EG30				−40 to +70 °C	P.61
	 P.71	ø0.4 ø0.016				Tough FD-42G	✂ 2 m	R2 Bending durability		−55 to +80 °C	P.60
						FD-42GW		R1		−40 to +60 °C	
						Tough FD-32G		R2 Bending durability		−55 to +80 °C	P.59
						FD-32GX	✂ 1 m	R2			
	 P.71	ø0.15 ø0.006	7.5 ±0.5 0.295 ±0.020	FX-MR3	−40 to +70 °C	FD-EG31	500 mm	R4		−20 to +60 °C	P.62
	 P.71	ø0.3 ø0.012				FD-EG30				−40 to +70 °C	P.61
	 P.71	ø0.5 ø0.020				Tough FD-42G	✂ 2 m	R2 Bending durability		−55 to +80 °C	P.60
						FD-42GW		R1		−40 to +60 °C	
						Tough FD-32G		R2 Bending durability		−55 to +80 °C	P.59
						FD-32GX	✂ 1 m	R2			
Pinpoint spot lens	 P.70	ø0.5 ø0.020	6 ±1 0.236 ±0.039	FX-MR1	−40 to +70 °C	Tough FD-42G	✂ 2 m	R2 Bending durability		−55 to +80 °C	P.60
						FD-42GW		R1		−40 to +60 °C	
Zoom lens	 P.70	ø0.7 to ø2.0 ø0.028 to ø0.079	18.5 to 43 approx. 0.728 to 1.693 approx.	FX-MR2	−40 to +70 °C	Tough FD-42G		R2 Bending durability		−55 to +80 °C	
						FD-42GW		R1		−40 to +60 °C	
Zoom lens (Side-view type)	 P.71	ø0.5 to ø3.0 ø0.020 to ø0.118	13 to 30 approx. 0.512 to 1.181 approx.	FX-MR5	−40 to +70 °C	Tough FD-42G		R2 Bending durability		−55 to +80 °C	
						FD-42GW		R1		−40 to +60 °C	

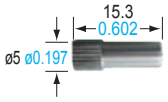
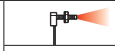
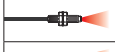
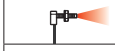
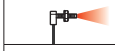
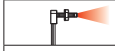
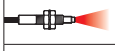
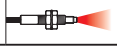
Note: Spot diameter, distance to focal point and sensing range are specified for **FX-500** series.

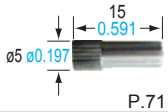
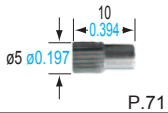
Tough : Refers to a fiber which possesses both unbreakable (bending radius: R10 mm R0.394 in, reciprocating bending: 180°) and more flexible (bending radius: R4 mm R0.157 in or less) features.

LIST OF FIBERS

Small spot

Square head type M3, reflective type fiber & spot lens

Type	Spot diameter (mm in) (Note)	Distance to focal point (mm in) (Note)	Lens: Shape (mm in) Dimensions	Lens: Model No.	Fiber: Shape	Fiber: Emitting fiber core (mm in)	Fiber: Model No.
Finest spot lens	ø0.1 ø0.004 approx.	7 ±0.5 0.276 ±0.020	 P.71	FX-MR7		ø0.125 ø0.005	**FD-R33EG**
						ø0.125 ø0.005	**FD-EG31**
	ø0.15 ø0.006 approx.					ø0.175 ø0.007	**FD-R34EG**
	ø0.2 ø0.008 approx.					ø0.25 ø0.010	**FD-R32EG**
						ø0.25 ø0.010	**FD-EG30**
	ø0.4 ø0.016 approx.					ø0.5 ø0.020	**FD-R31G**
						ø0.5 ø0.020	**FD-32G**
						ø0.5 ø0.020	**FD-32GX**
						ø0.5 ø0.020	**FD-42G**
						ø0.5 ø0.020	**FD-42GW**

Type	Spot diameter (mm in) (Note)	Sensing range (mm in) (Note)	Lens: Shape (mm in)	Lens: Model No.	Applicable fibers: Emitting fiber core (mm in)	Applicable fibers: Model No.
Zoom lens	ø0.4 to ø2.0 ø0.016 to ø0.079 approx.	10 to 30 0.394 to1.181	 P.71	FX-MR8	ø0.125 ø0.005	**FD-R33EG, FD-EG31**
	ø0.4 to ø2.2 ø0.016 to ø0.087 approx.				ø0.175 ø0.007	**FD-R34EG**
	ø0.5 to ø2.5 ø0.020 to ø0.098 approx.				ø0.25 ø0.010	**FD-R32EG, FD-EG30**
	ø0.8 to ø3.5 ø0.031 to ø0.138 approx.				ø0.5 ø0.020	**FD-R31G, FD-32G, FD-32GX, FD-42G, FD-42GW**
Parallel light lens	ø4.0 ø0.157 approx.	0 to 30 0 to 1.181	 P.71	FX-MR9	ø0.125 ø0.005	**FD-R33EG, FD-EG31**
					ø0.175 ø0.007	**FD-R34EG**
					ø0.25 ø0.010	**FD-R32EG, FD-EG30**
					ø0.5 ø0.020	**FD-R31G, FD-32G, FD-32GX, FD-42G, FD-42GW**

Note: Spot diameter, distance to focal point and sensing range are specified for **FX-500** series.

LIST OF FIBERS

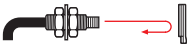
Narrow beam

Thru-beam type (one pair set)

Type	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1) **FX-500** series	Sensing range (mm in) (Note 1) U-LG LONG FAST H-SP	Beam axis dia. (mm)	Inclination of beam axis	Protection	Ambient temp.	Dimensions
Narrow beam, Side-view	Aperture angle 2° ø3.5 ø3.7 20	Tough FT-KS40	R2 Bending durability	2 m	STD (Note 2) 3,600 141.732 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 1,200 47.244	ø2.2	—	IP40	−40 to +60 °C	P.54
	Aperture angle 2° ø4 25	Tough FT-KV40			STD (Note 2) 3,600 141.732 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 1,200 47.244	ø2.5	±0.8°	IP30		
	Aperture angle 2° ø4 25	FT-KV40W	R1		STD (Note 2) 3,600 141.732 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 3,100 122.047 940 37.008					
	Aperture angle 3° 1.5 × 2 20	Tough FT-KV26	R2 Bending durability		STD 710 27.953 HYPR 2,500 98.425	1,600 62.992 1,200 47.244 440 17.323 160 6.299	ø1	X ±1° Z ±0.5°			

Notes: 1) Note 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 fiber cable length practically limits the sensing range.

Retroreflective type



Type	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1, 2) **FX-500** series	Sensing range (mm in) (Note 1, 2) U-LG LONG FAST H-SP	Protection	Ambient temp.	Dimensions
With polarizing filter	W5.2 × H9.5 × D16 W30 × H30 × D0.5	FR-Z50HW	R1	2 m	STD 100 to 990 3.937 to 38.976 HYPR 100 to 1,900 3.937 to 74.803	100 to 1,400 3.937 to 55.118 100 to 1,200 3.937 to 47.244 100 to 780 3.937 to 30.709 100 to 490 3.937 to 19.291	IP40	−25 to +55 °C	P.58
Wafer mapping	W7.5 × H2.2 × D11.2 Aperture angle 3° (emitter) W4 × H2 × D21.5	Tough FR-KZ22E	R2 Bending durability		STD 15 to 310 0.591 to 12.205 HYPR 15 to 570 0.591 to 22.441	15 to 460 0.591 to 18.110 15 to 410 0.591 to 16.142 15 to 220 0.591 to 8.661 15 to 100 0.591 to 3.937	IP30	−40 to +60 °C	
Narrow beam, Top sensing	W5.2 × H9.5 × D21 W10.6 × H28 × D10.1	Tough FR-KZ50H			STD 20 to 300 0.787 to 11.811 HYPR 20 to 1,000 0.787 to 39.370	20 to 800 0.787 to 31.496 20 to 400 0.787 to 15.748 20 to 200 0.787 to 7.874 20 to 200 0.787 to 7.874			
Side sensing	W9.5 × H25 × D5.2 W28 × H10.6 × D10.1	Tough FR-KZ50E							

Notes: 1) Note 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 sensing range is the possible setting range for the attached reflector. The fiber can detect an object less than setting range for the reflector. Refer to p.90 for the sensing range when **FR-Z50HW** is used in combination with a reflector (optional).

Reflective type

Type	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1, 2) **FX-500** series	Sensing range (mm in) (Note 1, 2) U-LG LONG FAST H-SP	Protection	Ambient temp.	Dimensions
Long range	W5.2 × H9.5 × D16	FD-Z50HW	R1	2 m	STD 10 to 650 0.394 to 25.591 HYPR 10 to 2,500 0.394 to 98.425	10 to 1,100 0.394 to 43.307 10 to 1,000 0.394 to 39.370 10 to 410 0.394 to 16.142 15 to 130 0.591 to 5.118	IP40	−40 to +60 °C	P.68

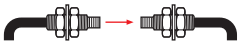
Notes: 1) Note that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
2) The sensing range is specified for white non-glossy paper.

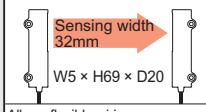
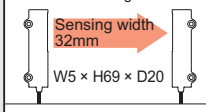
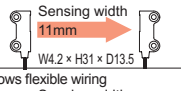
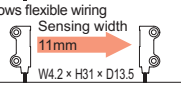
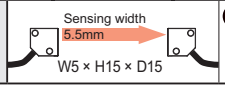
Tough : Refers to a fiber which possesses both unbreakable (bending radius: R10 mm R0.394 in, reciprocating bending: 180°) and more flexible (bending radius: R4 mm R0.157 in or less) features.

LIST OF FIBERS

Wide beam

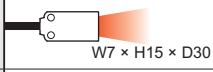
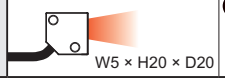
Thru-beam type (one pair set)



Type	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1) FX-500 series	Sensing range (mm in) (Note 1) U-LG LONG FAST H-SP	Beam axis dia. (mm)	Protection	Ambient temp.	Dimensions
Wide beam	 Sensing width 32mm W5 × H69 × D20	Tough **FT-A32**	R2 Bending durability	2 m	STD (Note 2) 3,600 141.732 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 2,100 82.677	3.2 × 32	IP40	−40 to +60 °C	P.52
	Allows flexible wiring  Sensing width 32mm W5 × H69 × D20	**FT-A32W**	R1		STD (Note 2) 3,600 141.732 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 3,000 118.110			−40 to +55 °C	
	 Sensing width 11mm W4.2 × H31 × D13.5	Tough **FT-A11**	R2 Bending durability		STD (Note 2) 3,600 141.732 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 1,100 43.307	2.2 × 11		−40 to +70 °C	
	Allows flexible wiring  Sensing width 11mm W4.2 × H31 × D13.5	**FT-A11W**	R1		STD (Note 2) 3,600 141.732 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 1,300 51.181			−40 to +55 °C	
Array	 Sensing width 5.5mm W5 × H15 × D15	Tough **FT-AL05**	R2 Bending durability		STD 860 33.858 HYPR 2,300 90.551	1,550 61.024 1,500 59.055 500 19.685 170 6.693	0.25 × 5.5		−55 to +80 °C	

Notes: 1) Note 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 fiber cable length practically limits the sensing range.

Reflective type

Type	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1, 2) FX-500 series	Sensing range (mm in) (Note 1, 2) U-LG LONG FAST H-SP	Protection	Ambient temp.	Dimensions
Wide beam	 W7 × H15 × D30	Tough **FD-A16**	R4 Bending durability	2 m	STD 200 7.874 HYPR Cannot use	200 7.874 200 7.874 140 5.512 75 2.953	IP40	−40 to +60 °C	P.61
Array	 W5 × H20 × D20	Tough **FD-AL11**	R2 Bending durability		STD 320 12.598 HYPR 670 26.378	530 20.866 510 20.079 180 7.087 50 1.969		−55 to +80 °C	

Notes: 1) Note 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 sensing range is specified for white non-glossy paper.

Tough : Refers to a fiber which possesses both unbreakable (bending radius: R10 mm R0.394 in, reciprocating bending: 180°) and more flexible (bending radius: R4 mm R0.157 in or less) features.

LIST OF FIBERS

Convergent reflective type

Reflective type

Type	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1, 2) **FX-500** series	Sensing range (mm in) (Note 1, 2) U-LG LONG FAST H-SP	Protection	Ambient temp.	Dimensions
Glass substrate detection	Mapping W25 × H7.3 × D30	**FD-L32H**	R4 Bending durability	✂ 4 m	STD 0 to 56 0 to 2.205 HYPR 0 to 110 0 to 4.331	0 to 87 0 to 3.425 0 to 74 0 to 2.913 1 to 38 0.039 to 1.496 Cannot use	IP40	−40 to +60 °C	P.66
	Alignment W20 × H29 × D3.8	Tough **FD-L30A**	R2 Bending durability	✂ 3 m	STD 0 to 43 0 to 1.693 HYPR 0 to 43 0 to 1.693	0 to 43 0 to 1.693 0 to 43 0 to 1.693 0 to 42 0 to 1.654 0 to 29 0 to 1.142		0 to +70 °C	P.65
	Alignment W23.5 × H29 × D4.5	Tough **FD-L31A**	R4 Bending durability		STD 4 to 33 0.157 to 1.299 HYPR 3 to 35 0.118 to 1.378	4 to 33 0.157 to 1.299 4 to 33 0.157 to 1.299 4 to 32 0.157 to 1.260 5 to 25 0.197 to 0.984			
	Alignment W17 × H29 × D3.8	Tough **FD-L22A**	R2 Bending durability	✂ 2 m	STD 0 to 24 0 to 0.945 HYPR 0 to 31 0 to 1.220	0 to 28 0 to 1.102 0 to 27 0 to 1.063 0 to 24 0 to 0.945 0 to 18 0 to 0.709			
	Seating confirmation W18 × H29 × D3.8	Tough **FD-L23**		✂ 3 m	STD 0 to 29 0 to 1.142 HYPR 0 to 30 0 to 1.181	0 to 30 0 to 1.181 0 to 30 0 to 1.181 0 to 28 0 to 1.102 1.5 to 24 0.059 to 0.945		−20 to +70 °C	
	Seating confirmation W12 × H19 × D3	Tough **FD-L11**	R4 Bending durability		STD 0 to 9.5 0 to 0.374 HYPR 0 to 11.5 0 to 0.453	0 to 10.5 0 to 0.413 0 to 10 0 to 0.394 0 to 9 0 to 0.354 0 to 8 0 to 0.315		−40 to +60 °C	
	Seating confirmation W12 × H19 × D3	Tough **FD-L10**			STD 0 to 5 0 to 0.197 HYPR 0 to 6 0 to 0.236	0 to 5.5 0 to 0.217 0 to 5.5 0 to 0.217 0 to 4.5 0 to 0.177 0 to 4 0 to 0.157			
	W24 × H21 × D4	Tough **FD-L21**	R2 Bending durability	✂ 2 m	STD 1.5 to 16 0.059 to 0.630 HYPR 1 to 19 0.039 to 0.748	1 to 18 0.039 to 0.709 1 to 18 0.039 to 0.709 2 to 15 0.079 to 0.591 3 to 12 0.118 to 0.472			
	W24 × H21 × D4	**FD-L21W**	R1		STD 3 to 14 0.118 to 0.551 HYPR 1.5 to 15 0.059 to 0.591	2 to 15 0.079 to 0.591 2 to 15 0.079 to 0.591 4 to 14 0.157 to 0.551 6.5 to 10 0.256 to 0.394			
General purpose	W6 × H18 × D14	Tough **FD-L20H**	R2 Bending durability		STD 23 0.906 HYPR 45 1.772	35 1.378 32 1.260 2 to 15 0.079 to 0.591 5 to 9 0.197 to 0.354		−40 to +70 °C	
Ultra-small	W7.2 × H7.5 × D2	**FD-L12W**	R1	✂ 1 m	STD 8 0.315 HYPR 14 0.551	12.5 0.492 12 0.472 0.5 to 7 0.020 to 0.276 0.5 to 4 0.020 to 0.157	IP30	−40 to +60 °C	

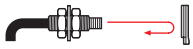
Notes: 1) Note that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
2) The sensing range is specified for transparent glass 100 × 100 × t0.7 mm 3.937 × 3.937 × t0.028 in (**FD-L32H**: R edge, **FD-L21** and **FD-L21W**: t2 mm t0.079 in) (**FD-L20H**: white non-glossy paper, **FD-L10**: silicon wafers 100 × 100 mm 3.937 × 3.937 in).

Tough : Refers to a fiber which possesses both unbreakable (bending radius: R10 mm R0.394 in, reciprocating bending: 180°) and more flexible (bending radius: R4 mm R0.157 in or less) features.

LIST OF FIBERS

Retroreflective type

Retroreflective type



Type	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂ : Free-cut	Sensing range (mm in) (Note 1, 2) **FX-500** series	Sensing range (mm in) (Note 1, 2) U-LG LONG FAST H-SP	Protection	Ambient temp.	Dimensions
With polarizing filters	W5.2 × H9.5 × D16 W30 × H30 × D0.5	**FR-Z50HW**	R1	✂ 2 m	STD 100 to 990 3.937 to 38.976 HYPR 100 to 1,900 3.937 to 74.803	100 to 1,400 3.937 to 55.118 100 to 1,200 3.937 to 47.244 100 to 780 3.937 to 30.709 100 to 490 3.937 to 19.291	IP40	−25 to +55 °C	P.58
Wafer mapping	W7.5 × H2.2 × D11.2 Aperture angle 3° (emitter) W4 × H2 × D21.5	Tough **FR-KZ22E**	R2 Bending durability	✂ 2 m	STD 15 to 310 0.591 to 12.205 HYPR 15 to 570 0.591 to 22.441	15 to 460 0.591 to 18.110 15 to 410 0.591 to 16.142 15 to 220 0.591 to 8.661 15 to 100 0.591 to 3.937	IP30	−40 to +60 °C	
Narrow beam Top sensing	W5.2 × H9.5 × D21 W10.6 × H28 × D10.1	Tough **FR-KZ50H**			STD 20 to 300 0.787 to 11.811 HYPR 20 to 1,000 0.787 to 39.370	20 to 800 0.787 to 31.496 20 to 400 0.787 to 15.748 20 to 200 0.787 to 7.874 20 to 200 0.787 to 7.874			
Narrow beam Side sensing	W9.5 × H25 × D5.2 W28 × H10.6 × D10.1	Tough **FR-KZ50E**							

Notes: 1) Note that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
The sensing range of **FR-KZ22E** is specified for the attached reflector.
The sensing range of **FR-KZ50E** and **FR-KZ50H** is specified for the attached reflector **RF-003**.
The sensing range of **FR-Z50HW** is specified for the **RF-13**.
2) The sensing range is the possible setting range for the attached reflector.
The fiber can detect an object less than setting range for the reflector.
However, note that if there are any white or highly-reflective surfaces near the fiber head, reflected incident light may affect the fiber head.
If this occurs, adjust the threshold value of the amplifier unit before use.

Sensing range when FR-Z50HW is used in combination with a reflector (optional)

Reflector model No.	Sensing range (mm in) **FX-500** series HYPR	U-LG	LONG	STD	FAST	H-SP
RF-230	100 to 19,000 3.937 to 748.030	100 to 8,000 3.937 to 314.960	100 to 5,000 3.937 to 196.850	100 to 3,600 3.937 to 141.732	100 to 2,900 3.937 to 114.173	100 to 1,400 3.937 to 55.118
RF-220	100 to 8,000 3.937 to 314.960	100 to 4,700 3.937 to 185.039	100 to 3,500 3.937 to 137.795	100 to 3,000 3.937 to 118.110	100 to 1,800 3.937 to 70.866	100 to 830 3.937 to 32.677
RF-210	100 to 5,500 3.937 to 216.535	100 to 2,700 3.937 to 106.299	100 to 2,400 3.937 to 94.488	100 to 1,500 3.937 to 59.055	100 to 1,200 3.937 to 47.244	100 to 530 3.937 to 20.866

Note: The sensing range is the possible setting range for the reflector. The fiber can detect an object less than 100 mm 3.937 in. However, note that if there are any white or highly-reflective surfaces near the fiber head, reflected incident light may affect the fiber head. If this occurs, adjust the threshold value of the amplifier unit before use.

Tough : Refers to a fiber which possesses both unbreakable (bending radius: R10 mm R0.394 in, reciprocating bending: 180°) and more flexible (bending radius: R4 mm R0.157 in or less) features.

LIST OF FIBERS

Chemical / oil-resistant

Thru-beam type (one pair set)

Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1) FX-500 series	Sensing range (mm in) (Note 1) U-LG LONG FAST H-SP	Beam axis dia. (mm)	Protection	Ambient temp.	Dimensions
Oil-resistant	Square head type M4	Cable-protection type Compatible with lens W7 × H9.5 × D15.5	Tough NEW FT-R44Y	R4 Bending durability	2 m	STD 720 28.346 HYPR 3,000 118.110	1,600 62.992 1,100 43.307 430 16.929 130 5.118	ø1	IP67 (Note 4)	−55 to +80 °C	P.55
	Square head type M6	Full-protection type W10 × H11 × D21.2	Tough NEW FT-R60Y			STD 2,100 82.677 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 1,260 49.606 400 15.748	ø3.5		−55 to +80 °C	
Chemical-resistant	Flat type	Easy mounting • Rectangular head SEMI S2 compliant W7 × H15 × D13 Metal-free	Tough FT-Z802Y	R4 Bending durability	2 m	STD 3,100 122.047 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 1,900 74.803 470 18.504	ø3.7	IP68G	0 to +60 °C	P.57
	Cylindrical type	Heat-resistant 115 °C Metal-free ø5.5 (25)	FT-HL80Y	R30	2 m (Note 3)	STD (Note 2) 3,600 141.732 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 2,300 90.551 740 29.134			−40 to +115 °C	P.53
		Metal-free ø5.5 (25)	FT-L80Y			STD (Note 2) 3,600 141.732 HYPR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 2,800 110.236 920 36.220			−40 to +70 °C	P.54
		Side-view Metal-free ø5.5 (25)	FT-V80Y			STD 1,300 51.181 HYPR (Note 2) 3,600 141.732	2,800 110.236 2,200 86.614 800 31.496 240 9.449	ø2.8			P.56

Notes: 1) Note 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 fiber cable length practically limits the sensing range.
3) The allowable cutting range is 500 mm 19.685 in from the end that the amplifier inserted.
4) The fiber part is oil-resistant.

Reflective type

Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1, 2) FX-500 series	Sensing range (mm in) (Note 1, 2) U-LG LONG FAST H-SP	Beam axis dia. (mm)	Protection	Ambient temp.	Dimensions
Oil-resistant	Square head type M6	Cable-protection type W10 × H11 × D15.5	Tough NEW FD-R61Y	R4 Bending durability	2 m	STD 280 11.024 HYPR 990 38.976	610 24.016 435 17.126 160 6.299 50 1.969	—	IP67 (Note 3)	−55 to +80 °C	P.66
Chemical-resistant	Cylindrical type	Metal-free ø5.5 (16)	Tough NEW FD-S60Y	Protective tube R30 mm Fiber R4 Bending durability	2 m (Note 4)	STD 320 12.598 HYPR 600 23.622	590 23.228 420 16.535 200 7.874 75 2.953	—	IP68G	−40 to +70 °C	P.67

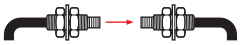
Notes: 1) Note that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending on how the fiber is cut.
2) The sensing range is specified for white, non-glossy paper.
3) The fiber part is oil-resistant.
4) The allowable cutting range is 500 mm 19.685 in from the end that is inserted to the amplifier.

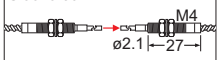
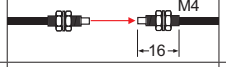
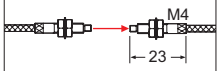
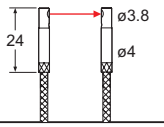
Tough : Refers to a fiber which possesses both unbreakable (bending radius: R10 mm R0.394 in, reciprocating bending: 180°) and more flexible (bending radius: R4 mm R0.157 in or less) features.

LIST OF FIBERS

Heat-resistant

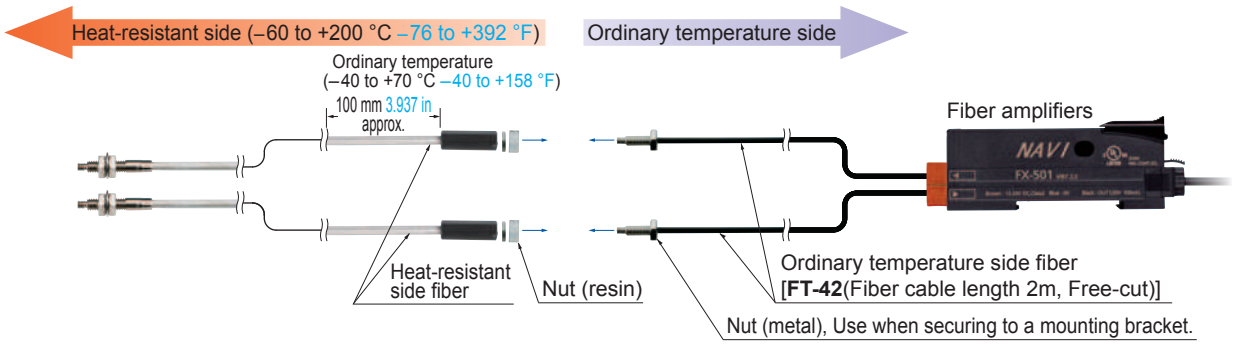
Thru-beam type (one pair set)



Type	Heat-resistant temp.	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1) FX-500 series	Sensing range (mm in) (Note 1) U-LG LONG FAST H-SP	Beam axis dia. (mm)	Ambient temp.	Dimensions
Heat-resistant	350 °C	Lens mountable (**FX-LE1/LE2/SV1**) 	**FT-H35-M2**	R25	2 m	STD 430 16.929 HYPR 1,200 47.244	880 34.646 670 26.378 250 9.843 80 3.150	ø1.2	−60 to +350 °C	P.53
		Sleeve 60 mm 	**FT-H35-M2S6**	Fiber R25 Sleeve R10						
	200 °C	Allows flexible wiring Lens mountable (**FX-LE1/LE2/SV1**) 	**FT-H20W-M1**	R10	1 m	STD 470 18.504 HYPR (Note2) 1,600 62.992	1,000 39.370 840 33.071 300 11.811 90 3.543	ø0.8	−60 to +200 °C	
		Lens mountable (**FX-LE1/LE2/SV1**) 	**FT-H20-M1**	R25		STD 540 21.260 HYPR (Note2) 1,600 62.992	1,300 51.181 960 37.795 330 12.992 110 4.331	ø1.2		
	130 °C	Lens mountable (**FX-LE2** only) 	**FT-H13-FM2**		✂ 2 m	STD 700 27.559 HYPR 3,300 129.921	1,900 74.803 1,300 51.181 410 16.142 140 5.512	ø1.5	−60 to +130 °C	P.52
Heat-resistant (joint)	200 °C	Lens mountable (**FX-LE1/LE2/SV1**) 	**FT-H20-J20-S** (Note 5)	Heat-resistant side R18 (Note 4)	✂ 200 mm (Note 3)	STD 470 18.504 HYPR 1,600 62.992	1,000 39.370 790 31.102 300 11.811 90 3.543	ø1.2	−60 to +200 °C	P.53
			FT-H20-J30-S (Note 5)		✂ 300 mm (Note 3)					
			FT-H20-J50-S (Note 5)		✂ 500 mm (Note 3)					
		Side-view 	**FT-H20-VJ50-S** (Note 5)			STD 600 23.622 HYPR 2,100 82.677	1,300 51.181 980 38.583 390 15.354 120 4.724			
			FT-H20-VJ80-S (Note 5)		✂ 800 mm (Note 3)					

Notes: 1) Note 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 fiber cable length practically limits the sensing range.
3) Fiber length (fixed-length) for heat-resistant fiber side. Fiber length for ordinary temperature side is 2 m 6.562 ft (free-cut).
4) Bending durable fiber R4 mm R0.157 in or more for ordinary temperature side.
5) Heat-resistant joint fibers and ordinary-temperature fibers (**FT-42**) are sold as a set.

Heat-resistant joint fiber set contents



Model No. when ordering individually as spare parts

- Heat-resistant side fiber one pair set
  FT-H20-J20, **FT-H20-J30**, **FT-H20-J50**, **FT-H20-VJ50**, **FT-H20-VJ80**
- Ordinary temperature side fiber one pair set
  FT-42

LIST OF FIBERS

Heat-resistant

Reflective type

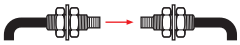
Type		Heat-resistant temp.	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1, 2) FX-500 series	Sensing range (mm in) (Note 1, 2) U-LG LONG FAST H-SP	Ambient temp.	Dimensions
Heat-resistant	Threaded	350 °C	Coaxial M6, 25	FD-H35-M2	R25	2 m	STD 260 10.236 HYPR 720 28.346	540 21.260 460 18.110 150 5.906 45 1.772	−60 to +350 °C	P.64
			Sleeve 60 mm M6, ø2.8, 22	FD-H35-M2S6	Fiber R25 Sleeve R10					
			Sleeve 90 mm M4, ø2.1, 27	FD-H35-20S		1 m	STD 260 10.236 HYPR 840 33.071	550 21.654 440 17.323 140 5.512 45 1.772		
		200 °C	Coaxial M6, 28	FD-H20-M1	R25		STD 330 12.992 HYPR 840 33.071	550 21.654 500 19.685 200 7.874 55 2.165	−60 to +200 °C	P.63
			Coaxial M4, 27	FD-H20-21			STD 230 9.055 HYPR 770 30.315	500 19.685 380 14.961 130 5.118 45 1.772		
		130 °C	M6, 21	FD-H13-FM2		✂ 2 m	STD 350 13.780 HYPR 880 34.646	640 25.197 600 23.622 200 7.874 65 2.559	−60 to +130 °C	
	Glass substrate detection convergent reflective	300 °C	W19 × H27 × D5	FD-H30-L32		2 m	STD 17 0.669 HYPR 40 1.575	30 1.181 25 0.984 12 0.472 1.5 to 6 0.059 to 0.236	−60 to +300 °C	P.64
		250 °C	W21 × H33.2 × D5	FD-H25-L43		3 m	STD 1.5 to 26 0.059 to 1.024 HYPR 1 to 31 0.039 to 1.220	1 to 30 0.039 to 1.181 1 to 28 0.039 to 1.102 1.5 to 24 0.059 to 0.945 2 to 18 0.079 to 0.709	−20 to +250 °C (Ordinary temp. side: −20 to +70 °C)	P.63
			W21 × H34.5 × D5	FD-H25-L45			STD 5 to 42 0.197 to 1.654 HYPR 4 to 43.5 0.157 to 1.713	4 to 43 0.157 to 1.693 4.5 to 43 0.177 to 1.693 5 to 40 0.197 to 1.575 6.5 to 34 0.256 to 1.339		
		180 °C	W19 × H27 × D5	FD-H18-L31		✂ 2 m	STD 16 0.630 HYPR 60 2.362	32 1.260 24 0.945 13 0.512 2 to 6.5 0.079 to 0.256	−60 to +180 °C	

Notes: 1) Note 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 sensing range of reflective type is the value for white non-glossy paper (50 × 50 mm 1.969 × 1.969 in glass substrate for **FD-H30-L32** and **FD-H18-L31**, transparent glass 100 × 100 × t0.7 mm 3.937 × 3.937 × t0.028 in for **FD-H25-L43** and **FD-H25-L45**).

LIST OF FIBERS

Vacuum-resistant

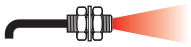
Thru-beam type (one pair set)



Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length	Sensing range (mm in) **FX-500** series	Sensing range (mm in) U-LG LONG FAST H-SP	Beam axis dia. (mm)	Ambient temp.	Dimensions
Vacuum-resistant	Thru-beam	300 °C Lens mountable (**FV-LE1/SV2**) M4 30	**FT-H30-M1V-S** (Note)	R18	1 m	STD 270 10.630 HYPR 1,000 39.370	590 23.228 470 18.504 160 6.299 55 2.165	ø1.2	−30 to +300 °C	P.53

Note: Sold as a set comprising vacuum type fiber + photo-terminal (**FV-BR1**) + fiber at atmospheric side (**FT-J8**).

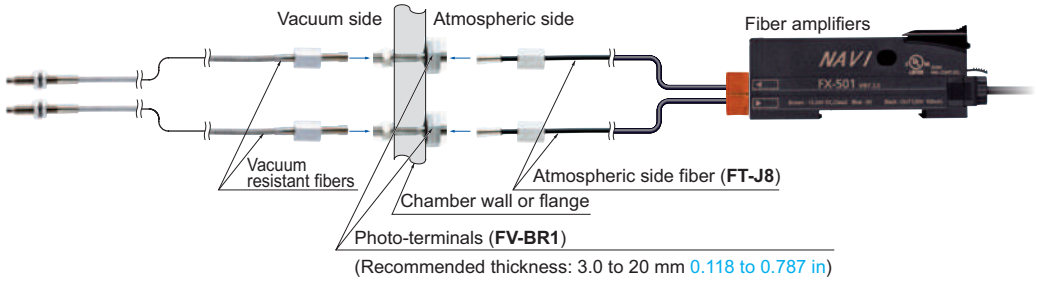
Reflective type



Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length	Sensing range (mm in)(Note 2) **FX-500** series	Sensing range (mm in)(Note 2) U-LG LONG FAST H-SP	Ambient temp.	Dimensions
Vacuum-resistant	Reflective	300 °C, Rectangular head W9.5 × H5.2 × D15	**FD-H30-KZ1V-S** (Note 1)	R18	1 m	STD 20 to 200 0.787 to 7.874 HYPR 5 to 500 0.197 to 19.685	10 to 340 0.394 to 13.386 15 to 270 0.591 to 10.630 20 to 120 0.787 to 4.724 20 to 45 0.787 to 1.772	−30 to +300 °C	P.64
	Convergent reflective	300 °C, Glass substrate detection W19 × H5 × D27	**FD-H30-L32V-S** (Note 1)		3 m	STD 8 0.315 HYPR 18 0.709	12 0.472 10 0.394 5.5 0.217 1.5 to 3 0.059 to 0.118		

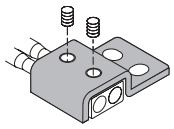
Notes: 1) Sold as a set comprising vacuum type fiber + photo-terminal (**FV-BR1**) + fiber at atmospheric side (**FT-J8**).
2) The sensing range of reflective type is the value for transparent glass 100 × 100 × t0.7 mm 3.937 × 3.937 × t0.028 in.

Vacuum-resistant fiber set contents



Model No. when ordering individually as spare parts

- Vacuum resistant fiber
  FT-H30-M1V (one pair set)
  FD-H30-KZ1V
  FD-H30-L32V
- Photo-terminal
  FV-BR1 (one pair set)
- Atmospheric side fiber
  FT-J8 (one pair set)
- Mounting bracket for **FD-H30-KZ1V**(**-S**)
  MS-FD-2



LIST OF FIBERS

Liquid leak / Liquid detection

Reflective type / Thru-beam type

Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Description **FX-500** series (STD mode)	Protection	Ambient temp.	Dimensions
Contact type	Liquid level sensing	Heat resistant 125 °C Fluorine resin coating ø6	**FD-F8Y**	Protective tube R40 Fiber R15	✂ 2 m (Note 1)	ø6 mm ø0.236 in Protective tube: Fluorine resin, length 1,000 mm 39.370 in (not cuttable) Liquid surface not contacted: Beam received, Liquid surface contacted: Beam not received	IP68	−40 to +125 °C	P.62
		Heat resistant 105 °C Fluorine resin coating Metal-free ø4	**FD-HF40Y** (Note 2)	Protective tube R20 Fiber R10	✂ 2 m	ø4 mm ø0.157 in Protective tube: Fluorine resin, length 500 mm 19.685 in (cuttable) Liquid surface not contacted: Beam received, Liquid surface contacted: Beam not received	IP68G	−40 to +105 °C	P.64
		Heat resistant 70 °C Fluorine resin coating throughout the fiber Metal-free ø4	**FD-F41Y** (Note 2)			ø4 mm ø0.157 in Protective tube: Fluorine resin, length 500 mm 19.685 in (cuttable) Liquid surface not contacted: Beam received, Liquid surface contacted: Beam not received		−40 to +70 °C	P.62
	Liquid leak detection	SEMI S2 compliant W20 × H30 × D10	Tough **FD-F71**	R4 Bending durability	✂ 5 m	Liquid leak detection Leak absent: Beam received, Leak present: Beam interrupted Compatible amplifire: **FX500** series only	IP67	−20 to +60 °C	
Pipe-mountable type	Liquid level sensing	Standard W25 × H13 × D20	**FD-F41**	R10	✂ 2 m	Applicable pipe diameter: Outer dia. ø6 to ø26 mm ø0.236 to ø1.024 in transparent pipe [PVC (vinyl chloride), fluorine resin, polycarbonate, acrylic, glass, wall thickness 1 to 3 mm 0.039 to 0.118 in] Liquid absent: Beam received, Liquid present: Beam not received	—	−40 to +100 °C	P.62
		For 1 mm thick PFA pipe W25 × H13 × D20	**FD-F4**			Applicable pipe diameter: Outer dia. ø6 to ø26 mm ø0.236 to ø1.024 in transparent pipe [PFA (fluorine resin) or equivalently transparent pipe, wall thickness 1 mm 0.039 in] Liquid absent: Beam received, Liquid present: Beam not received			
	Liquid sensing	Mountable on pipe-array fiber W6.5 × H28.3 × D17	Tough **FD-FA93**	R4 Bending durability		Applicable pipe diameter: Outer dia. ø8 mm ø0.315 in or more transparent pipe (When used with the tying bands: ø8 to ø80 mm ø0.315 to ø3.150 in) [PFA (fluorine resin), including translucent] Liquid absent: Beam received, Liquid present: Beam not received	IP40	−40 to +70 °C	
		SEMI S2 compliant W23 × H20 × D17	Tough **FT-F93**	Protective tube R20 Fiber R2 Bending durability		Applicable pipe diameter: Outer dia. ø3 to ø10 mm ø0.118 to ø0.394 in transparent pipe [PFA (fluorine resin) or equivalently transparent pipe, wall thickness 0.3 to 1 mm 0.012 to 0.039 in] Liquid absent: Beam not received, Liquid present: Beam received Compatible amplifire: **FX500** series only		−40 to +60 °C	P.52

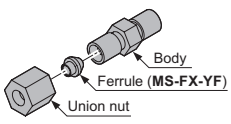
Notes: 1) The allowable cutting range is 1,000 mm 39.370 in from the end that the amplifier inserted.
2) Liquid inflow prevention joint, protective tube extension joint, fiber mounting joint is available.

Designation	Model No.	Applicable fibers	Description
Liquid inflow prevention joint (Note)	**MS-FX-01Y**	**FD-HF40Y** **FD-F41Y**	This joint suppresses false operations due to liquid slip-in from the top of the protective tube.
Protective tube extension joint (Note)	**MS-FX-02Y**		The protective tube can be extended.
Fiber mounting joint (Note)	**MS-FX-03Y**		The joint is used for mounting fibers on a tank.

Note: The joint internal ferrule (**MS-FX-YF**) is available as a spare part. A distorted ferrule may result in leakage.

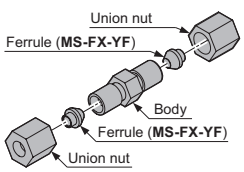
Liquid inflow prevention joint

• **MS-FX-01Y**



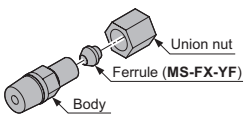
Protective tube extension joint

• **MS-FX-02Y**



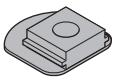
Fiber mounting joint

• **MS-FX-03Y**

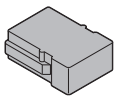


Accessories for additional supply

- **MS-FD-F7-1**
(SUS mounting bracket for **FD-F71**)



- **MS-FD-F7-2**
(PVC mounting bracket for **FD-F71**)

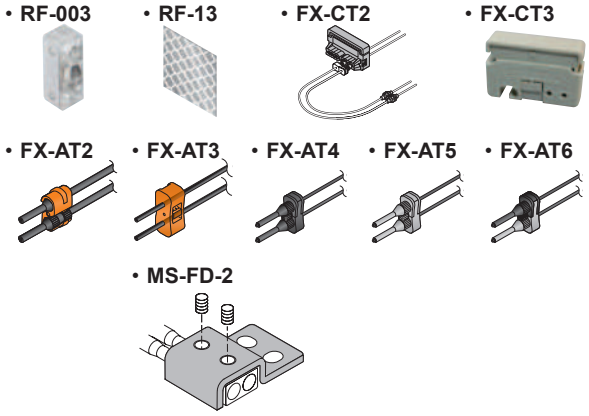


Tough : Refers to a fiber which possesses both unbreakable (bending radius: R10 mm R0.394 in, reciprocating bending: 180°) and more flexible (bending radius: R4 mm R0.157 in or less) features.

LIST OF FIBERS

Model No. when ordering accessories additionally

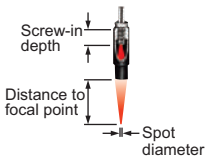
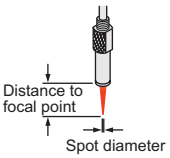
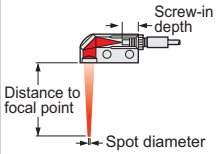
- **RF-003** (Reflector for **FR-KZ50E/KZ50H**)
- **RF-13** (Reflective tape for **FR-Z50HW**)
- **FX-CT2** (Fiber cutter)
- **FX-CT3** (Fiber cutter for **FD-H40Y/F41Y**)
- **FX-AT2** (Attachment for fixed-length fiber, Orange)
- **FX-AT3** (Attachment for ø2.2 mm ø0.087 in fiber, Clear orange)
- **FX-AT4** (Attachment for ø1 mm ø0.039 in fiber, Black)
- **FX-AT5** (Attachment for ø1.3 mm ø0.051 in fiber, Gray)
- **FX-AT6** (Attachment for ø1 mm ø0.039 in / ø1.3 mm ø0.051 in mixed fiber, Black / Gray)
- **MS-FD-2** (Fiber mounting bracket)



FIBER OPTIONS

Refer to p.69~ for details of lens dimensions.

Lens (For reflective type fiber)

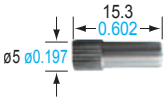
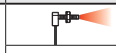
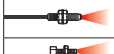
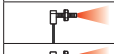
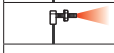
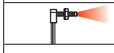
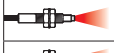
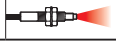
Designation		Model No.		Description
For reflective type fiber	Pinpoint spot lens	**FX-MR1**		Pinpoint spot of ø0.5 mm ø0.020 in. Enables detection of minute objects or small marks. • Distance to focal point: 6 ± 1 mm 0.236 ± 0.039 in • Applicable fibers: **FD-42G**, **FD-42GW** • Ambient temperature: −40 to +70 °C −40 to +158 °F (Note)
	Zoom lens	**FX-MR2**		The spot diameter is adjustable from ø0.7 to ø2 mm ø0.028 to ø0.079 in according to how much the fiber is screwed in. • Applicable fibers: **FD-42G**, **FD-42GW** • Ambient temperature: −40 to +70 °C −40 to +158 °F (Note) • Accessory: **MS-EX3** (mounting bracket) **Sensing range for FX-500 series** Screw-in depth / Distance to focal point / Spot diameter 7 mm / 18.5 mm approx. / ø0.7 mm 12 mm / 27 mm approx. / ø1.2 mm 14 mm / 43 mm approx. / ø2.0 mm
	Finest spot lens	**FX-MR3**		Extremely fine spot of ø0.15 mm ø0.006 in approx. achieved. • Applicable fibers: **FD-EG31**, **FD-EG30**, **FD-42G**, **FD-42GW**, **FD-32G**, **FD-32GX** • Ambient temperature: −40 to +70 °C −40 to +158 °F (Note) **Sensing range for FX-500 series** Fiber model No. / Distance to focal point / Spot diameter **FD-EG31** / 7.5 ±0.5 mm / ø0.15 mm approx. **FD-EG30** / 7.5 ±0.5 mm / ø0.3 mm approx. **FD-42G/42GW FD-32G/32GX** / 7.5 ±0.5 mm / ø0.5 mm approx.
	Finest spot lens	**FX-MR6**		Extremely fine spot of ø0.1 mm ø0.004 in approx. achieved. • Applicable fibers: **FD-EG31**, **FD-EG30**, **FD-42G**, **FD-42GW**, **FD-32G**, **FD-32GX** • Ambient temperature: −20 to +60 °C −4 to +140 °F (Note) **Sensing range for FX-500 series** Fiber model No. / Distance to focal point / Spot diameter **FD-EG31** / 7 ±0.5 mm / ø0.1 mm approx. **FD-EG30** / 7 ±0.5 mm / ø0.2 mm approx. **FD-42G/42GW FD-32G/32GX** / 7 ±0.5 mm / ø0.4 mm approx.
	Zoom lens (side-view type)	**FX-MR5**		**FX-MR2** is converted into a side-view type and can be mounted in a very small space. • Applicable fibers: **FD-42G**, **FD-42GW** • Ambient temperature: −40 to +70 °C −40 to +158 °F (Note) **Sensing range for FX-500 series** Screw-in depth / Distance to focal point / Spot diameter 8 mm / 13 mm approx. / ø0.5 mm 10 mm / 15 mm approx. / ø0.8 mm 14 mm / 30 mm approx. / ø3.0 mm

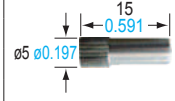
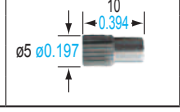
Note: Refer to p.80 or p.85 for the ambient temperature of fibers to be used in combination.

FIBER OPTIONS

Refer to p.69~ for details of lens dimensions.

Lens (For square head M3 reflective fiber)

Type		Spot diameter (mm in)(Note)	Distance to focal point (mm in)(Note)	Lens		Fiber		
				Shape (mm in)	Model No.	Shape	Emitting fiber core (mm in)	Model No.
For Square head M3 reflective fiber	Finest spot lens	ø0.1 ø0.004 approx.	7 ± 0.5 0.276 ± 0.020		FX-MR7		ø0.125 ø0.005	FD-R33EG
							ø0.125 ø0.005	FD-EG31
		ø0.15 ø0.006 approx.					ø0.175 ø0.007	FD-R34EG
		ø0.2 ø0.008 approx.					ø0.25 ø0.010	FD-R32EG
							ø0.25 ø0.010	FD-EG30
		ø0.4 ø0.016 approx.					ø0.5 ø0.020	FD-R31G
							ø0.5 ø0.020	FD-32G
							ø0.5 ø0.020	FD-32GX
							ø0.5 ø0.020	FD-42G
							ø0.5 ø0.020	FD-42GW

Type		Spot diameter (mm in)(Note)	Sensing range (mm in)(Note)	Lens		Applicable fibers	
				Shape (mm in)	Model No.	Emitting fiber core (mm in)	Model No.
For Square head M3 reflective fiber	Zoom lens	ø0.4 to ø2.0 ø0.016 to ø0.079 approx.	10 to 30 0.394 to1.181		FX-MR8	ø0.125 ø0.005	FD-R33EG, FD-EG31
		ø0.4 to ø2.2 ø0.016 to ø0.087 approx.				ø0.175 ø0.007	FD-R34EG
		ø0.5 to ø2.5 ø0.020 to ø0.098 approx.				ø0.25 ø0.010	FD-R32EG, FD-EG30
		ø0.8 to ø3.5 ø0.031 to ø0.138 approx.				ø0.5 ø0.020	FD-R31G, FD-32G, FD-32GX, FD-42G, FD-42GW
	Parallel light lens	ø4.0 ø0.157 approx.	0 to 30 0 to 1.181		FX-MR9	ø0.125 ø0.005	FD-R33EG, FD-EG31
						ø0.175 ø0.007	FD-R34EG
						ø0.25 ø0.010	FD-R32EG, FD-EG30
						ø0.5 ø0.020	FD-R31G, FD-32G, FD-32GX, FD-42G, FD-42GW

Note: Spot diameter, distance to focal point and sensing range are specified for **FX-500** series.

FIBER OPTIONS

Refer to p.69~ for details of lens dimensions.

Lens (For thru-beam type fiber)

Expansion lens (Note 1) — FX-LE1

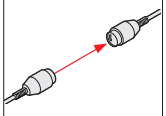
Increases the sensing range by 5 times or more.

- Ambient temperature: −60 to +350 °C −76 to +662 °F (Note 4)
- Beam dia: ø3.6 mm ø0.142 in

Sensing range (mm in) [Lens on both sides]

Fiber \ Mode	HYPR	U-LG	LONG	STD	FAST	H-SP
FT-43	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	1,600 62.992
FT-42 FT-42W	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	2,200 86.614
FT-45X	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,500 59.055
FT-R40	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	1,900 74.803
FT-R43	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	1,900 74.803	670 26.378
FT-H35-M2	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,300 129.921	1,400 55.118
FT-H20W-M1	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	850 33.465
FT-H20-M1	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,200 47.244
FT-H20-J50-S FT-H20-J30-S FT-H20-J20-S	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,500 137.795	2,000 78.740	1,600 62.992	500 19.685

Super-expansion lens (Note 1) — FX-LE2



Tremendously increases the sensing range with large diameter lenses.

- Ambient temperature: −60 to +350 °C −76 to +662 °F (Note 4)
- Beam dia: ø9.8 mm ø0.386 in

Sensing range (mm in) [Lens on both sides]

Fiber \ Mode	HYPR	U-LG	LONG	STD	FAST	H-SP
FT-43 FT-42 FT-42W	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)
FT-45X	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)
FT-R40	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)
FT-R43	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)
FT-H35-M2	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)
FT-H20W-M1 FT-H20-M1	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)
FT-H13-FM2	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)
FT-H20-J50-S FT-H20-J30-S FT-H20-J20-S	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)

Side-view lens — FX-SV1

Beam axis is bent by 90°.

- Ambient temperature: −60 to +300 °C −76 to +572 °F (Note 4)
- Beam dia: ø2.8 mm ø0.110 in

Sensing range (mm in) [Lens on both sides]

Fiber \ Mode	HYPR	U-LG	LONG	STD	FAST	H-SP
FT-43	3,600 141.732 (Note 2)	3,400 133.858	2,600 102.362	1,700 66.929	970 38.189	310 12.205
FT-42	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	2,100 82.677	1,150 45.276	370 14.567
FT-42W	3,600 141.732 (Note 2)	3,500 137.795	2,700 106.299	1,800 70.866	990 38.976	320 12.598
FT-45X	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,400 55.118	800 31.496	210 8.268
FT-R43	3,200 125.984	1,800 70.866	1,300 51.181	950 37.402	510 20.079	160 6.299
FT-H35-M2	3,500 137.795	1,600 62.992	1,200 47.244	780 30.709	500 19.685	150 5.906
FT-H20W-M1	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,500 59.055	950 37.402	560 22.047	190 7.480
FT-H20-M1	1,600 62.992 (Note 2)	1,600 62.992 (Note 2)	1,300 51.181	780 30.709	500 19.685	150 5.906
FT-H20-J50-S FT-H20-J30-S FT-H20-J20-S	1,600 62.992 (Note 2)	960 37.795	740 29.134	450 17.717	290 11.417	80 3.150

Expansion lens for vacuum fiber (Note 1) — FV-LE1

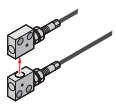
Sensing range increases by 4 times or more.

- Ambient temperature: −60 to +350 °C −76 to +662 °F (Note 4)
- Beam dia: ø3.6 mm ø0.142 in

Sensing range (mm in) [Lens on both sides] (Note 3)

Fiber \ Mode	HYPR	U-LG	LONG	STD	FAST	H-SP
FT-H30-M1V-S	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,400 133.858	1,500 59.055	900 35.433	370 14.567

Vacuum-resistant side-view lens (Note 1) — FV-SV2



Beam axis is bent by 90°.

- Ambient temperature: −60 to +300 °C −76 to +572 °F (Note 4)
- Beam dia: ø3.7 mm ø0.146 in

Sensing range (mm in) [Lens on both sides] (Note 3)

Fiber \ Mode	HYPR	U-LG	LONG	STD	FAST	H-SP
FT-H30-M1V-S	3,600 141.732 (Note 2)	3,600 141.732 (Note 2)	3,400 133.858	1,500 59.055	900 35.433	370 14.567

Notes: 1) Be careful sure to use it only after you have adjusted it sufficiently when installing the thru-beam type fiber equipped with the expansion lens, as the beam envelope becomes narrow and alignment is difficult.
2) The fiber cable length practically limits the sensing range.
3) The fiber cable length for the **FT-H30-M1V-S** is 1 m 3.28 ft. The sensing ranges in HYPR, U-LG and LONG of **FX-500** series are specified considering the length of the **FT-J8** atmospheric side fiber.
4) Refer to p.79, p.81, p.92, and p.94 for the ambient temperature of fibers to be used in combination.

FIBER OPTIONS

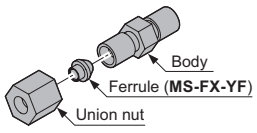
Others

Designation	Model No.	Description				
Protective tube for thru-beam type fiber	**FTP-500** (0.5 m 1.640 ft)	For M4 thread	Applicable fibers	**FT-42** **FT-42S** **FT-42W**	**FT-43** **FT-H13-FM2**	The protective tube, made of non-corrosive stainless steel, protects the inner fiber cable from any external forces.
	FTP-1000 (1 m 3.281 ft)					
	FTP-1500 (1.5 m 4.921 ft)					
	FTP-N500 (0.5 m 1.640 ft)	For M3 thread		**FT-31** **FT-31S** **FT-31W**	**FD-31** **FD-31W**	
	FTP-N1000 (1 m 3.281 ft)					
	FTP-N1500 (1.5 m 4.921 ft)					
Protective tube for reflective type fiber	**FDP-500** (0.5 m 1.640 ft)	For M6 thread		**FD-61** **FD-61G** **FD-61S** **FD-61W**	**FD-62** **FD-H13-FM2**	
	FDP-1000 (1 m 3.281 ft)					
	FDP-1500 (1.5 m 4.921 ft)					
	FDP-N500 (0.5 m 1.640 ft)	For M4 thread		**FD-41** **FD-41W**	**FD-41S** **FD-41SW**	
	FDP-N1000 (1 m 3.281 ft)					
	FDP-N1500 (1.5 m 4.921 ft)					
Fiber bender	**FB-1**	The fiber bender bends the sleeve part of the fiber head at the proper radius. (Note 1)				
Universal sensor mounting stand (Note 2)	**MS-AJ1-F**	Horizontal mounting type			Mounting stand assembly for fiber (For M3, M4 or M6 threaded head fiber)	
	MS-AJ2-F	Vertical mounting type				
Liquid inflow prevention joint (Note 2)	**MS-FX-01Y**	Applicable fibers	**FD-HF40Y** **FD-F41Y**		This joint suppresses false operations due to liquid slip-in from the top of the protective tube.	
Protective tube extension joint (Note 2)	**MS-FX-02Y**				The protective tube can be extended.	
Fiber mounting joint (Note 2)	**MS-FX-03Y**				The joint is used for mounting fibers on a tank.	
Single core holder	**FX-AT15A**	The incident light intensity may vary when using a multi-core fiber or a thin type sharp bending fiber. This holder suppresses the variation in the incident light intensity. (Brown)				
Reflector	**RF-210**	Used with **FR-Z50HW**. Refer to p.90 for the sensing range when **FR-Z50HW** is used in combination with a reflector.				
	RF-220					
	RF-230					

Notes: 1) Do not bend the sleeve part of any side-view type fiber or ultra-small diameter head type fiber.
2) The joint internal ferrule (**MS-FX-YF**) is available as a spare part. A distorted ferrule may result in leakage.

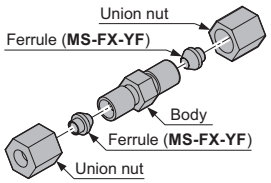
Liquid inflow prevention joint

- **MS-FX-01Y**



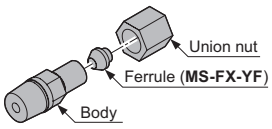
Protective tube extension joint

- **MS-FX-02Y**



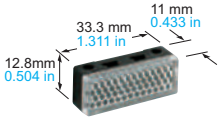
Fiber mounting joint

- **MS-FX-03Y**

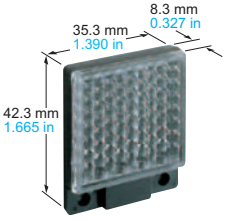


Reflector

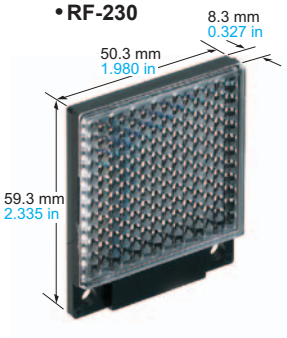
- **RF-210**



- **RF-220**

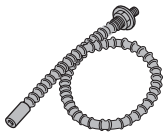


- **RF-230**



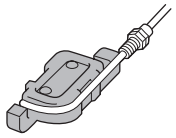
Protective tube

- **FTP-□**
- **FDP-□**



Fiber bender

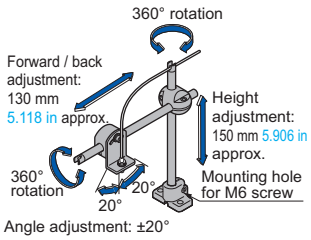
- **FB-1**



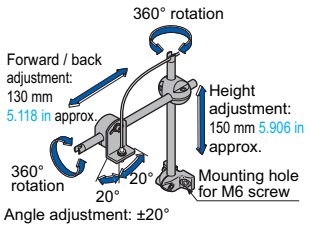
Universal sensor mounting stand

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

- **MS-AJ1-F**



- **MS-AJ2-F**



Single core holder

- **FX-AT15A**

SPECIFICATIONS

Item \ Type		Standard type	2-output type	Cable type (Analog output type)
Model No.	NPN output	**FX-501**	**FX-502**	**FX-505-C2**
	PNP output	**FX-501P**	**FX-502P**	**FX-505P-C2**
Supply voltage		12 to 24 V DC$^{+10}_{-15}$ % Ripple P-P 10 % or less		
Power consumption		Normal operation: 960 mW or less (current consumption 40 mA or less at 24 V supply voltage, excluding analog output of cable type) ECO mode: 680 mW or less (current consumption 28 mA or less at 24 V supply voltage, excluding analog output of cable type)		
Output (2-output type and cable type: Output 1, Output 2)		<NPN output type> NPN open-collector transistor • Maximum sink current: 100 mA (2-output type and cable type are 50 mA) (Note 2) • Applied voltage: 30 V DC or less (between output and 0 V) • Residual voltage: 2 V or less (Note 3) (at maximum sink current)		<PNP output type> PNP open-collector transistor • Maximum source current: 100 mA (2-output type and cable type are 50 mA) (Note 2) • Applied voltage: 30 V DC or less (between output and +V) • Residual voltage: 2 V or less (Note 3) (at maximum source current)
	Output points	1 point	2 points	
	Output operation	Switchable either Light-ON or Dark-ON by L/D mode		
	Short-circuit protection	Incorporated		
Response time		H-SP: 25 µs or less, FAST: 60 µs or less, STD: 250 µs or less, LONG: 2 ms or less, U-LG: 4 ms or less, HYPR: 24 ms or less, selectable		
Analog output (Cable type only)		Output current: 4 to 20 mA approx. [H-SP, FAST, STD: At 0 to 4,000 digits, LONG: At 0 to 8,000 digits (Note 4)], Response time: 2 ms or less, Zero point: Within 4 mA ±1 % F.S., Span: Within 16 mA ±5 % F.S., Linearity: Within ±3 % F.S., Load resistance: 0 to 250 Ω		
External input (2-output type only, switchable with Output 2)		———	<NPN output type> NPN non-contact input • Signal condition High: +8 V to +V DC or Open Low: 0 to +1.2 V DC (at 0.5 mA source current) • Input impedance: 10 kΩ approx.	<PNP output type> PNP non-contact input • Signal condition High: +4 V to +V DC (at 3 mA sink current) Low: 0 to +0.6 V DC or Open • Input impedance: 10 kΩ approx.
Possible external input function		———	Emission halt / Teaching (Full-auto, Limit, 2-point) / Logic operation setting / Copy lock / Display adjustment / Data bank load / Data bank save, selectable	
Sensitivity setting		2-point teaching / Limit teaching / Full-auto teaching / Manual adjustment		
Incident light intensity display range		H-SP / FAST / STD: 0 to 4,000, LONG: 0 to 8,000, U-LG / HYPR: 0 to 9,999		
Timer function		Incorporated with variable OFF-delay / ON-delay /One-shot / ON OFF-delay / ON-delay • One-shot timer, switchable either effective or ineffective	<Output 1> Incorporated with variable OFF-delay / ON-delay /One-shot / ON OFF-delay / ON-delay • One-shot timer, switchable either effective or ineffective <Output 2> Incorporated with variable OFF-delay / ON-delay /One-shot timer, switchable either effective or ineffective	
	Timer period	Timer range "ms": 0.5 ms approx., 1 to 9,999 ms approx., 1 ms approx., Timer range "sec.": 0.5 s approx., 1 to 32 s approx., 1 s approx., Timer range "1/10 ms": 0.05 ms approx., 0.1 to 999.9 ms approx., 0.1 ms approx., each output is set individually		
Light emitting amount selection function		Incorporated, 3 levels (each level 25 to 100 %) + Auto setting [1 level (25 to 100 %) when using H-SP mode]		
Interference prevention function		Incorporated (Note 5), selectable either automatic interference prevention or different frequency		
Various settings		Hysteresis setting / Shift amount setting / Emission power setting / Display turning setting / ECO setting / Data bank loading saving setting / Copying setting / Code setting / Reset setting / Logical calculation setting / Threshold tracking setting, etc.		
Protection		IP40 (IEC)		
Ambient temperature		−10 to +55 °C +14 to +131 °F [If 4 to 7 units are mounted in cascade: −10 to +50 °C +14 to +122 °F or if 8 to 16 units (cable type: 8 to 12 units) are mounted in cascade: −10 to +45 °C +14 to +113 °F] (No dew condensation or icing allowed), Storage: −20 to +70 °C −4 to +158 °F		
Emitting element (modulated)		Red LED (Peak emission wavelength: 643 nm 0.025 mil)		
Material		Enclosure, Case cover: Polycarbonate, Switch: TPEE		
Cable		———		0.2 mm² 6-core cabtyre cable, 2 m 6.562 ft long
Cable extension		———		Extension up to total 100 m 328.084 ft is possible with 0.3 mm², or more, cable. (however, supply voltage 12 V DC)
Weight		Net weight: 15 g approx., Gross weight: 70 g approx.		Net weight: 60 g approx., Gross weight: 100 g approx.
Accessory		**FX-MB1** (Amplifier protection seal): 1 set		

Notes: 1) Where measurement conditions have not been specified precisely, the conditions used were an ambient temperature of +23 °C +73.4 °F.
2) 50 mA max. if 5 or more standard types are connected together. (25 mA in case of 2-output type and cable type)
3) In case of using the quick-connection cable (cable length 5 m 16.404 ft) (optional).
4) If display adjustment was conducted, it is not in this range.
5) Number of sensor heads which is possible to be mounted closely in auto interference prevention function depends on response time as shown in table below.
Number of sensor heads which is possible to be mounted closely in different frequency Interference prevention function is up to 3 units.

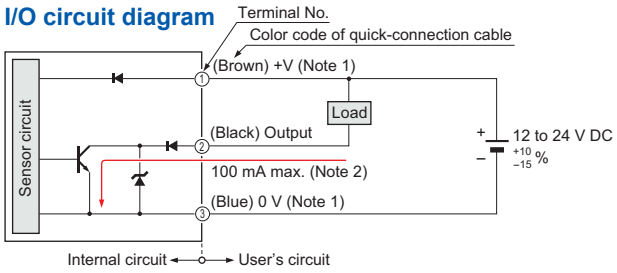
• Number of sensor heads mountable closely (Unit: set)

Response time	H-SP	FAST	STD	LONG	U-LG	HYPR
IP-1	0	2	4	8	8	12

I/O CIRCUIT AND WIRING DIAGRAMS

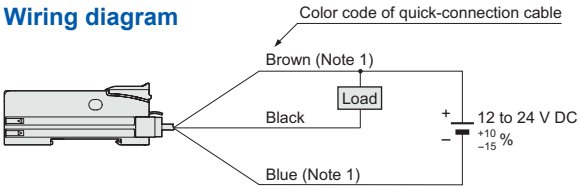
FX-501 — NPN output type

I/O circuit diagram



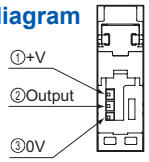
Notes: 1) The quick-connection sub cable does not have +V (brown) and 0 V (blue). The power is supplied from the connector of the main cable.
2) 50 mA max., if five amplifiers or more, are connected together.

Wiring diagram



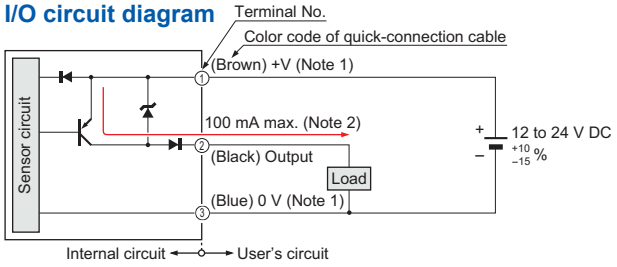
Note: The quick-connection sub cable does not have a brown and a blue lead wire.

Terminal arrangement diagram



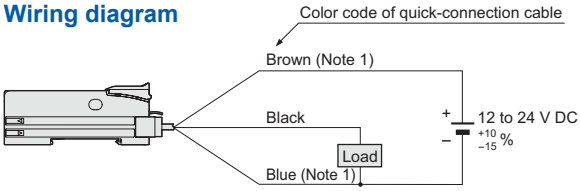
FX-501P — PNP output type

I/O circuit diagram



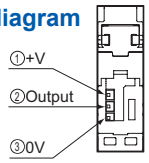
Notes: 1) The quick-connection sub cable does not have +V (brown) and 0 V (blue). The power is supplied from the connector of the main cable.
2) 50 mA max., if five amplifiers or more, are connected together.

Wiring diagram



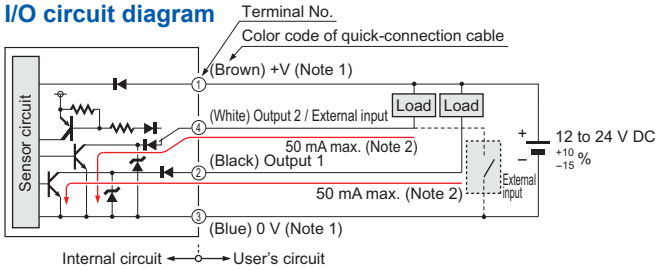
Note: The quick-connection sub cable does not have a brown and a blue lead wire.

Terminal arrangement diagram



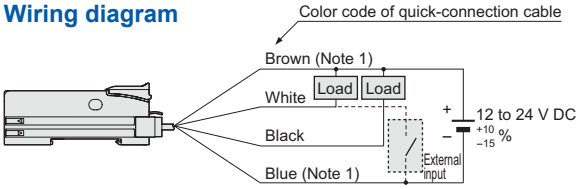
FX-502 — NPN output type

I/O circuit diagram



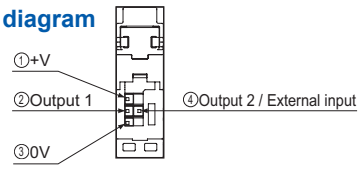
Notes: 1) The quick-connection sub cable does not have +V (brown) and 0 V (blue). The power is supplied from the connector of the main cable.
2) 25 mA max., if five amplifiers or more, are connected together.

Wiring diagram



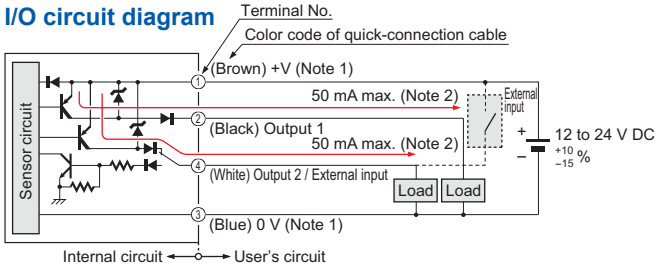
Note: The quick-connection sub cable does not have a brown and a blue lead wire.

Terminal arrangement diagram



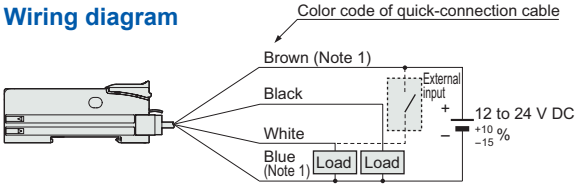
FX-502P — PNP output type

I/O circuit diagram



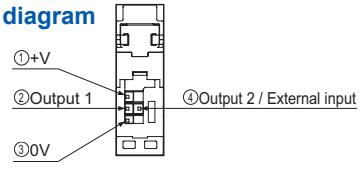
Notes: 1) The quick-connection sub cable does not have +V (brown) and 0 V (blue). The power is supplied from the connector of the main cable.
2) 25 mA max., if five amplifiers or more, are connected together.

Wiring diagram



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

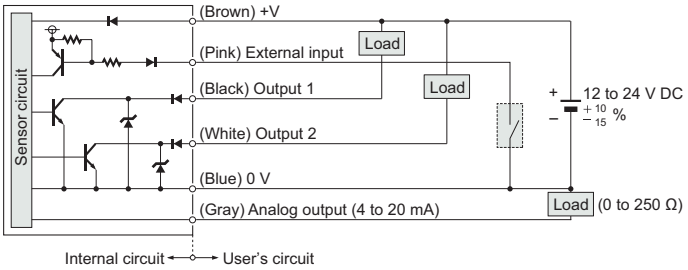
Terminal arrangement diagram



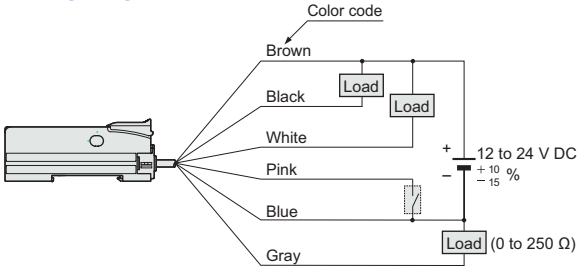
I/O CIRCUIT AND WIRING DIAGRAMS

FX-505-C2 NPN output type

I/O circuit diagram

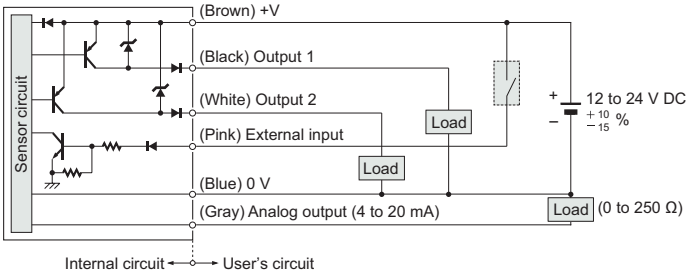


Wiring diagram

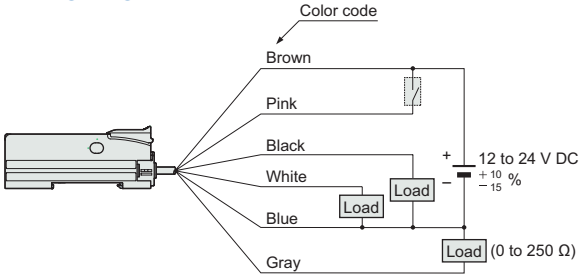


FX-505P-C2 PNP output type

I/O circuit diagram



Wiring diagram

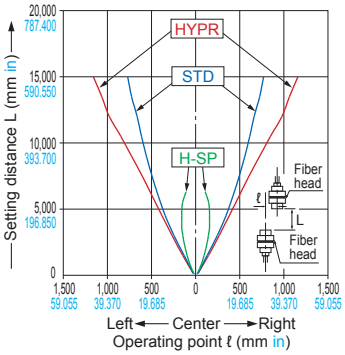


SENSING CHARACTERISTICS (TYPICAL)

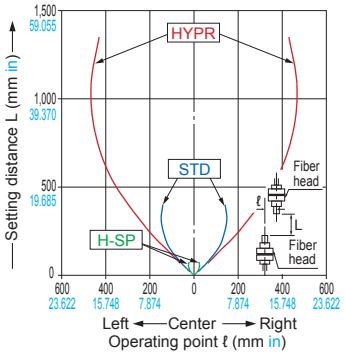
Thru-beam type Parallel deviation

Sensing characteristics are listed in the alphabetic order of Model No.

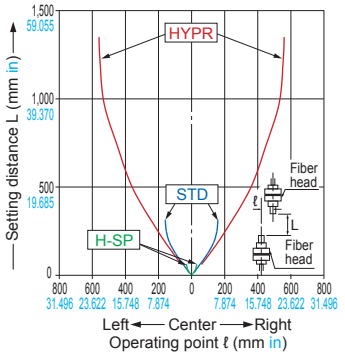
FT-140 — Thru-beam type



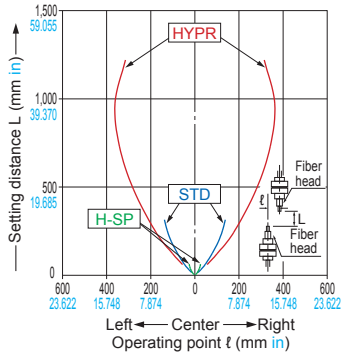
FT-30 — Thru-beam type



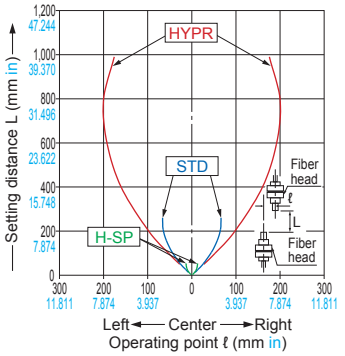
FT-31 — Thru-beam type



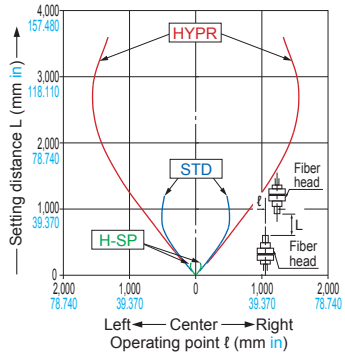
FT-31S — Thru-beam type



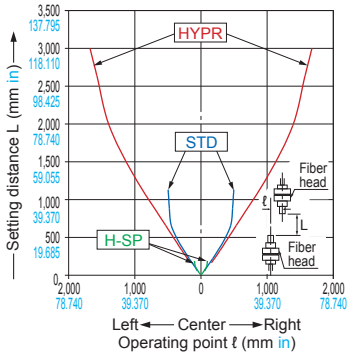
FT-31W — Thru-beam type



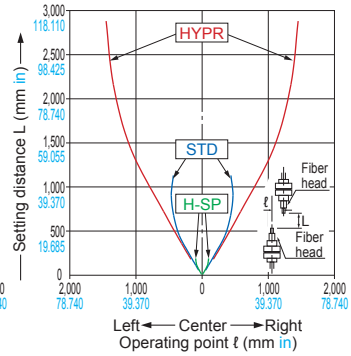
FT-40 — Thru-beam type



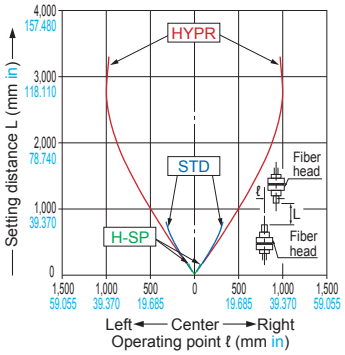
FT-42 — Thru-beam type



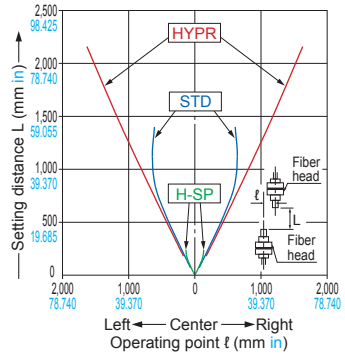
FT-42S — Thru-beam type



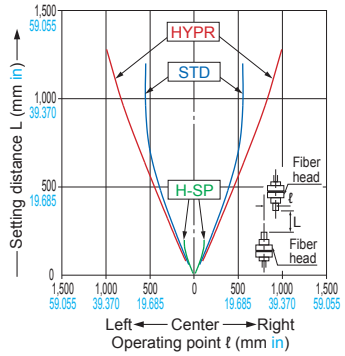
FT-42W — Thru-beam type



FT-43 — Thru-beam type

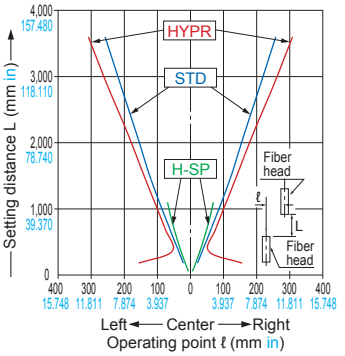


FT-45X — Thru-beam type

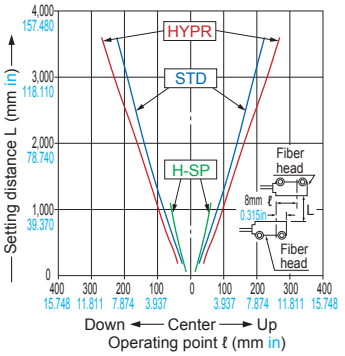


FT-A11 — Thru-beam type

Horizontal direction

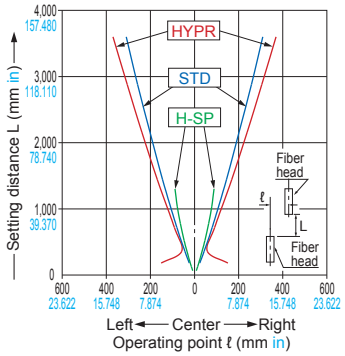


Vertical direction

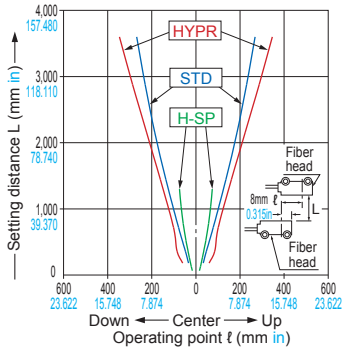


FT-A11W — Thru-beam type

Horizontal direction



Vertical direction

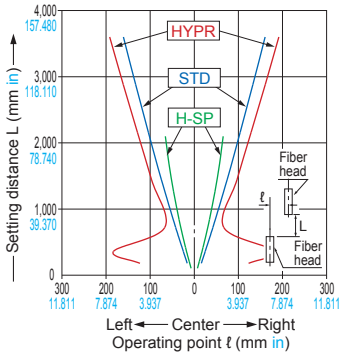


SENSING CHARACTERISTICS (TYPICAL)

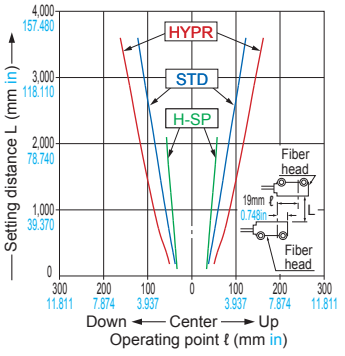
Thru-beam type Parallel deviation Sensing characteristics are listed in the alphabetic order of Model No. (Models with same sensing characteristics are grouped together.)

FT-A32 — Thru-beam type

Horizontal direction

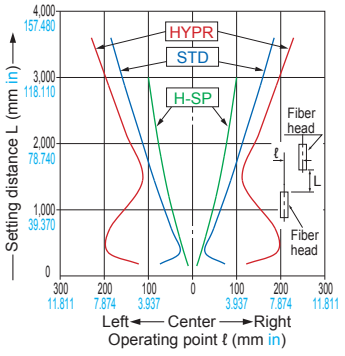


Vertical direction

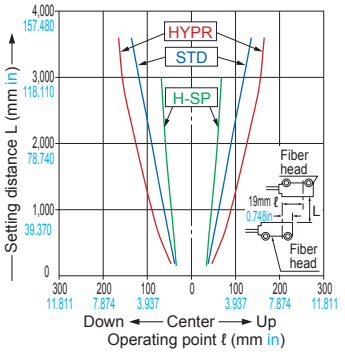


FT-A32W — Thru-beam type

Horizontal direction

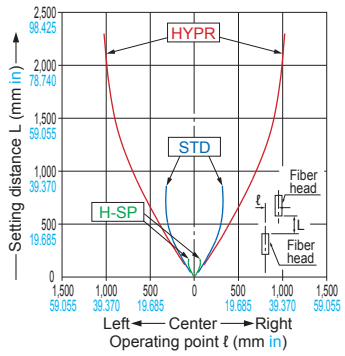


Vertical direction

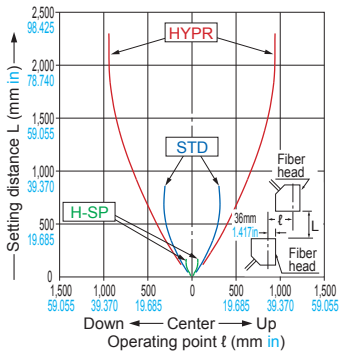


FT-AL05 — Thru-beam type

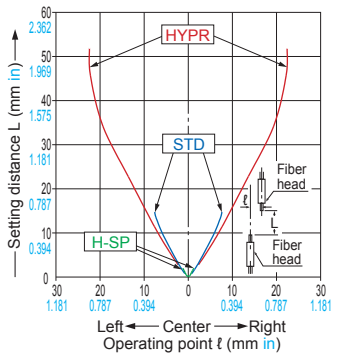
Horizontal direction



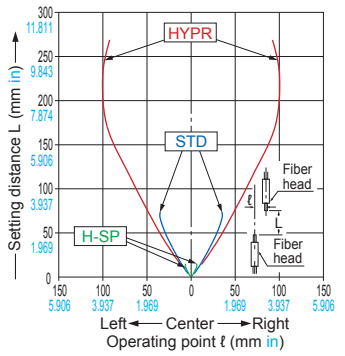
Vertical direction



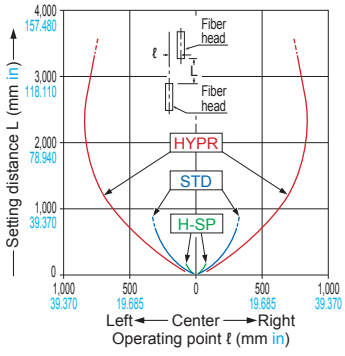
FT-E13 — Thru-beam type



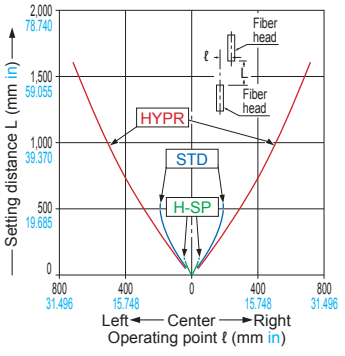
FT-E23 — Thru-beam type



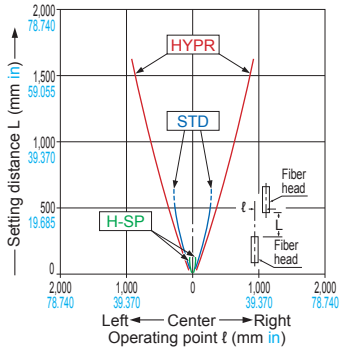
FT-H13-FM2 — Thru-beam type



FT-H20-J20-S FT-H20-J30-S FT-H20-J50-S — Thru-beam type

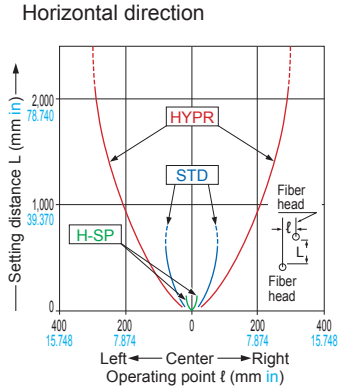


FT-H20-M1 — Thru-beam type

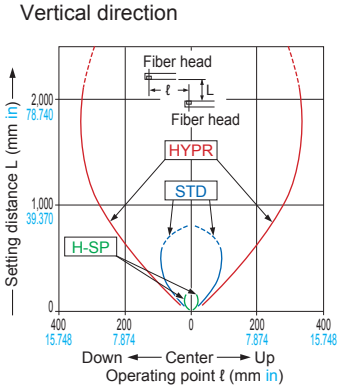


FT-H20-VJ50-S FT-H20-VJ80-S — Thru-beam type

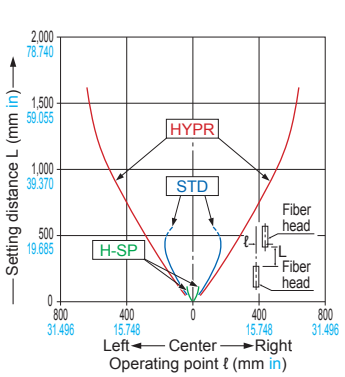
Horizontal direction



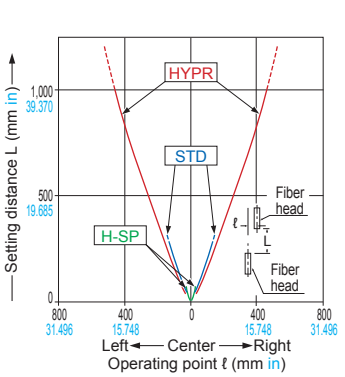
Vertical direction



FT-H20W-M1 — Thru-beam type



FT-H30-M1V-S — Thru-beam type

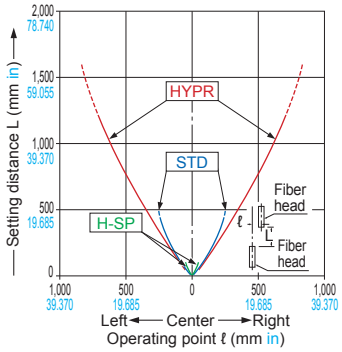


SENSING CHARACTERISTICS (TYPICAL)

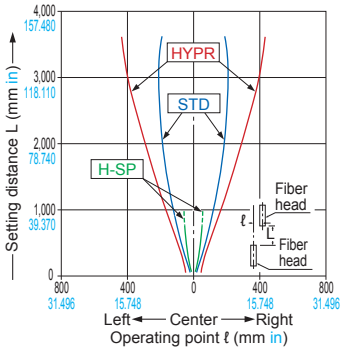
Thru-beam type Parallel deviation

Sensing characteristics are listed in the alphabetic order of Model No. (Models with same sensing characteristics are grouped together.)

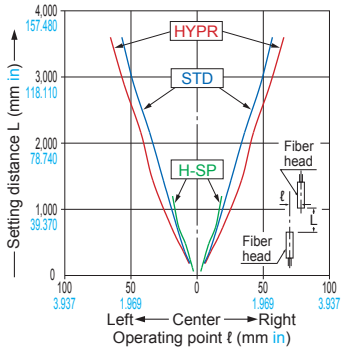
FT-H35-M2 FT-H35-M2S6 — Thru-beam type



FT-HL80Y — Thru-beam type

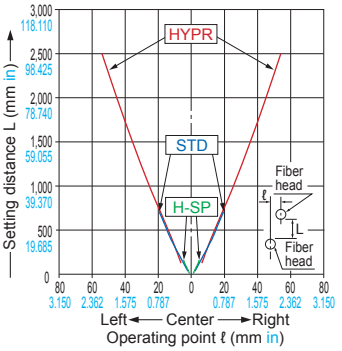


FT-KS40 — Thru-beam type

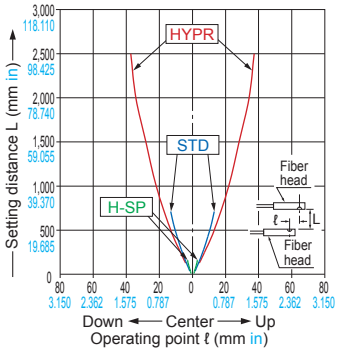


FT-KV26 — Thru-beam type

Horizontal direction

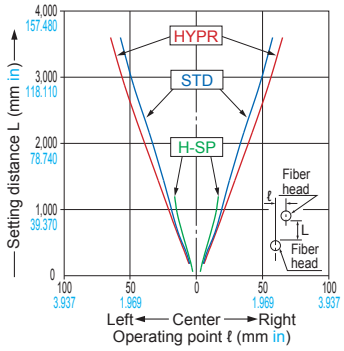


Vertical direction

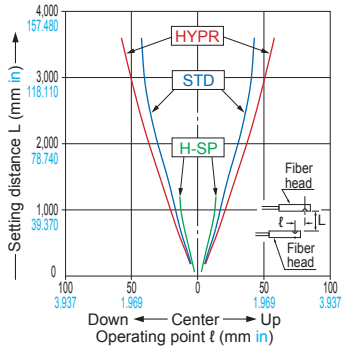


FT-KV40 — Thru-beam type

Horizontal direction

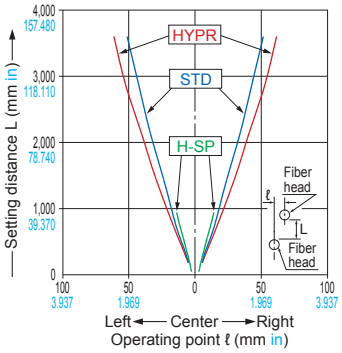


Vertical direction

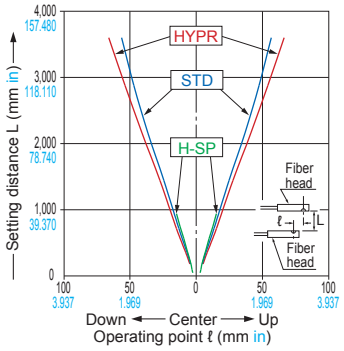


FT-KV40W — Thru-beam type

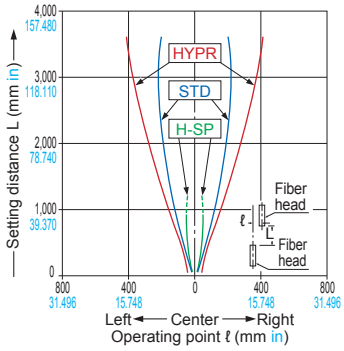
Horizontal direction



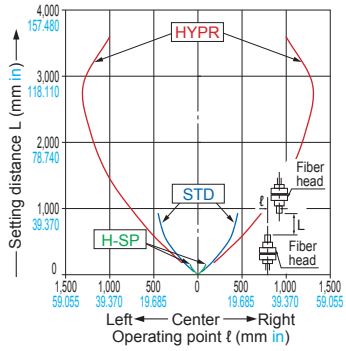
Vertical direction



FT-L80Y — Thru-beam type

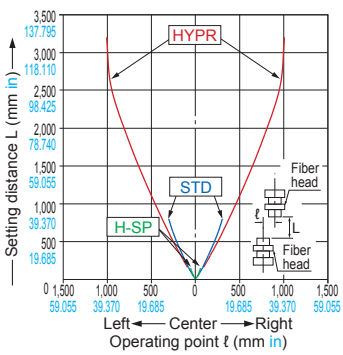


FT-R40 — Thru-beam type

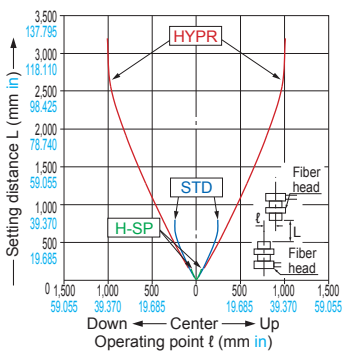


FT-R41W — Thru-beam type

Horizontal direction

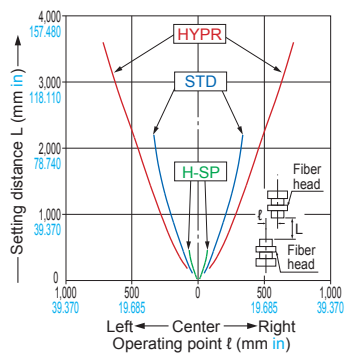


Vertical direction

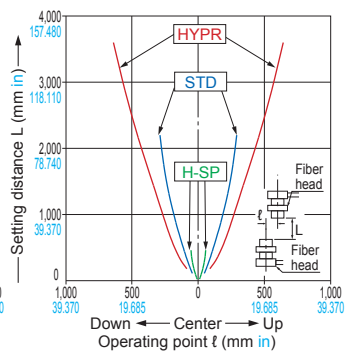


FT-R42W — Thru-beam type

Horizontal direction



Vertical direction

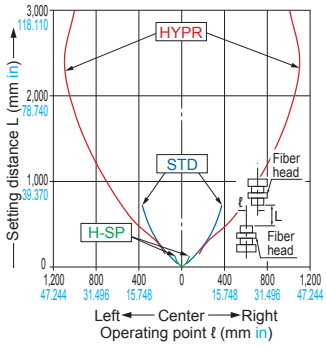


SENSING CHARACTERISTICS (TYPICAL)

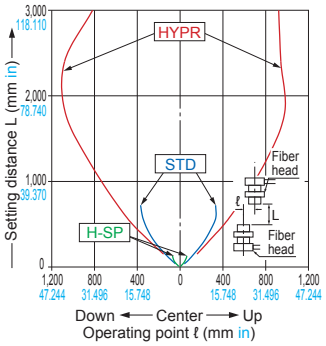
Thru-beam type Parallel deviation Sensing characteristics are listed in the alphabetic order of Model No.

FT-R44Y — Thru-beam type

Horizontal direction

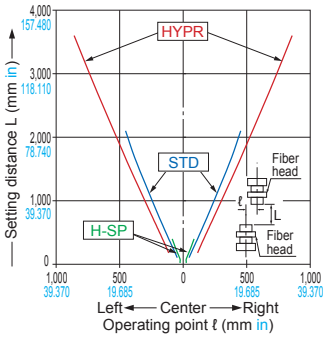


Vertical direction

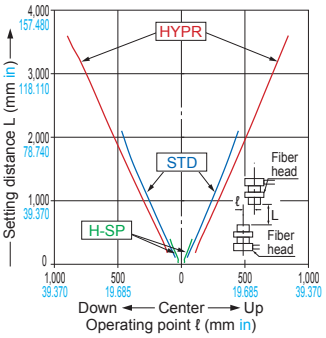


FT-R60Y — Thru-beam type

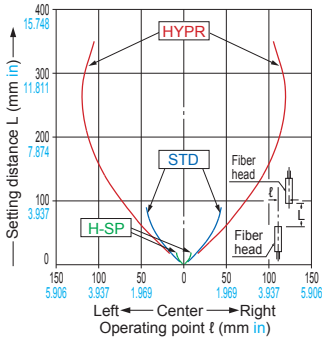
Horizontal direction



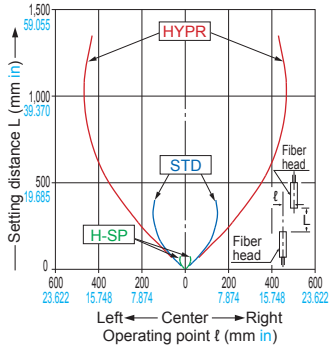
Vertical direction



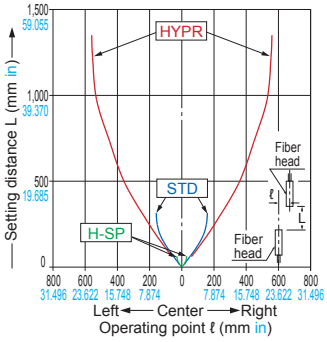
FT-S11 — Thru-beam type



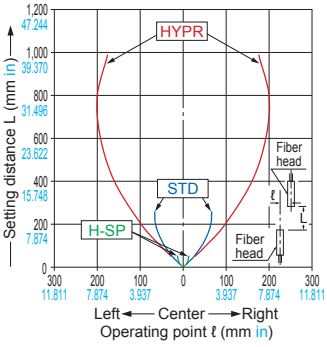
FT-S20 — Thru-beam type



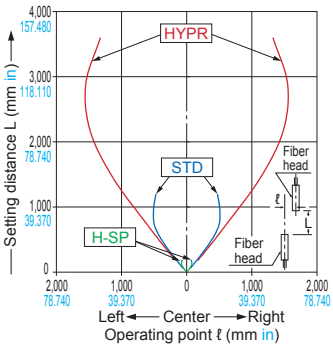
FT-S21 — Thru-beam type



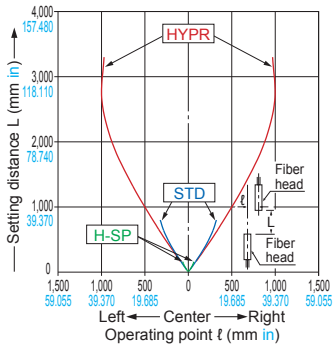
FT-S21W — Thru-beam type



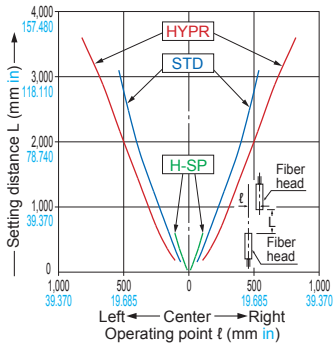
FT-S30 — Thru-beam type



FT-S31W — Thru-beam type

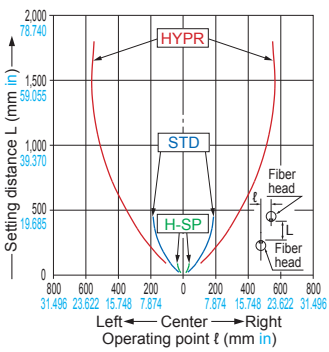


FT-S32 — Thru-beam type

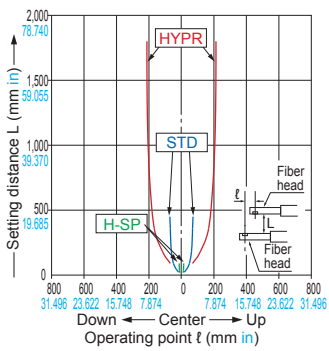


FT-V23 — Thru-beam type

Horizontal direction

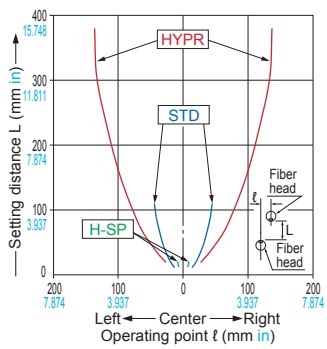


Vertical direction

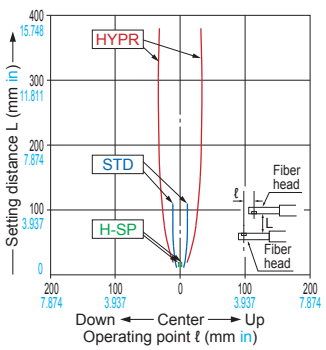


FT-V24W — Thru-beam type

Horizontal direction



Vertical direction



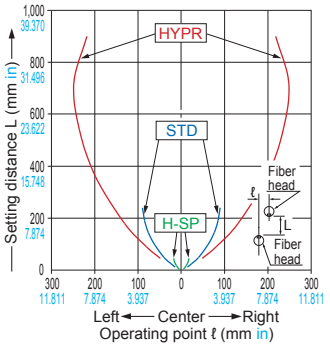
SENSING CHARACTERISTICS (TYPICAL)

Thru-beam type Parallel deviation

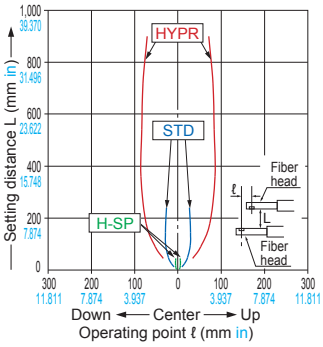
Sensing characteristics are listed in the alphabetic order of Model No.

FT-V25 — Thru-beam type

Horizontal direction

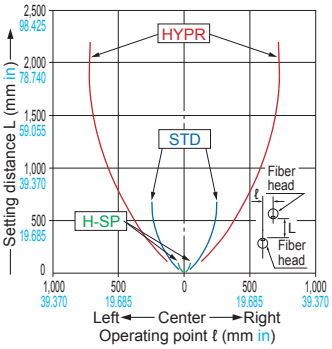


Vertical direction

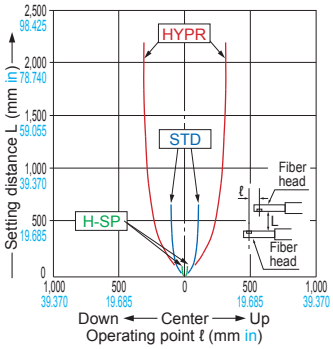


FT-V30 — Thru-beam type

Horizontal direction

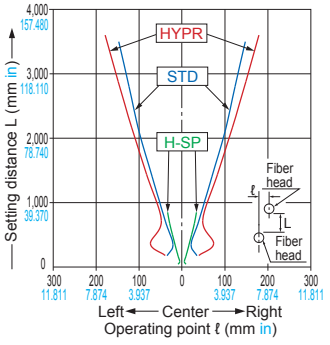


Vertical direction

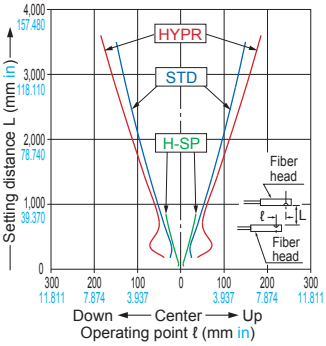


FT-V40 — Thru-beam type

Horizontal direction

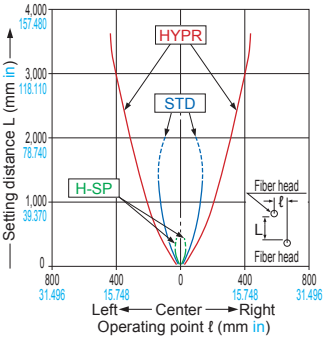


Vertical direction

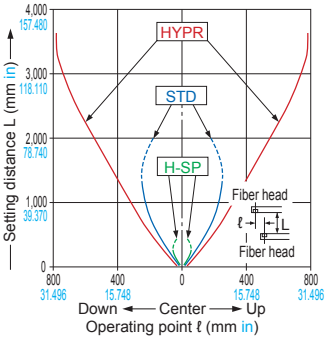


FT-V80Y — Thru-beam type

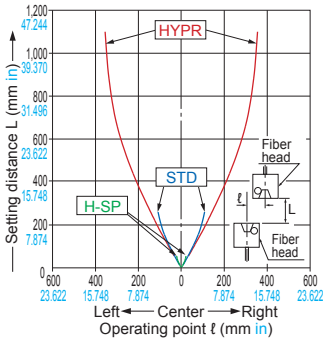
Horizontal direction



Vertical direction

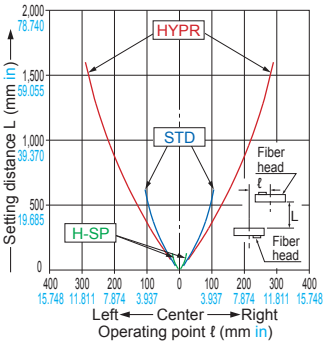


FT-Z20HBW — Thru-beam type

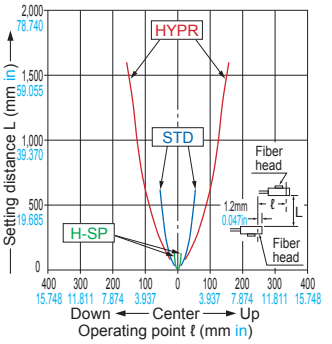


FT-Z20W — Thru-beam type

Horizontal direction

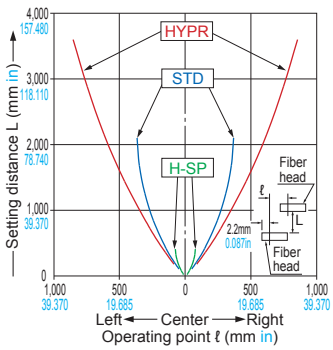


Vertical direction

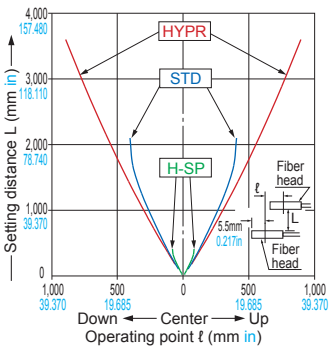


FT-Z30 — Thru-beam type

Horizontal direction

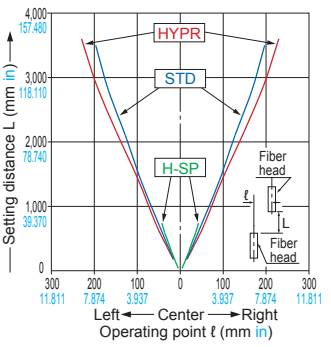


Vertical direction

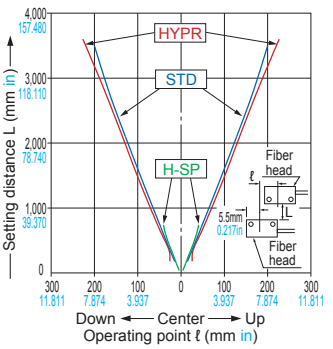


FT-Z30E — Thru-beam type

Horizontal direction



Vertical direction



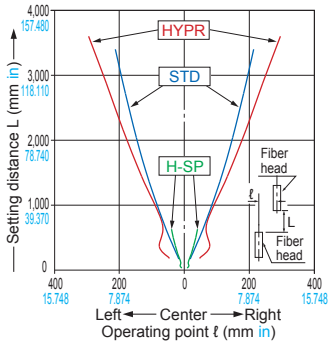
SENSING CHARACTERISTICS (TYPICAL)

Thru-beam type Parallel deviation

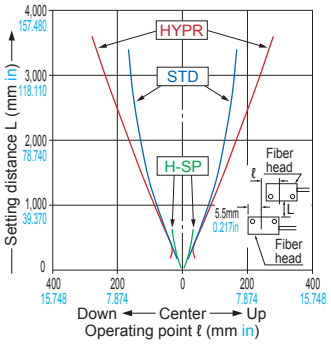
Sensing characteristics are listed in the alphabetic order of Model No.

FT-Z30EW — Thru-beam type

Horizontal direction

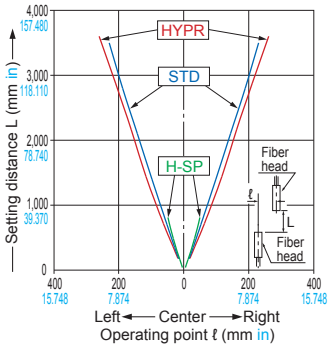


Vertical direction

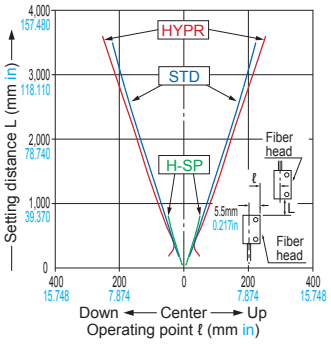


FT-Z30H — Thru-beam type

Horizontal direction

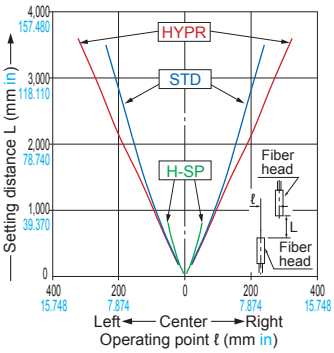


Vertical direction

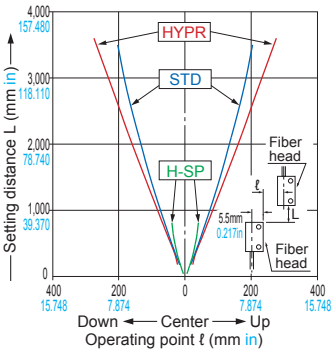


FT-Z30HW — Thru-beam type

Horizontal direction

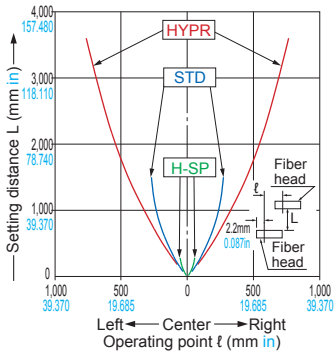


Vertical direction

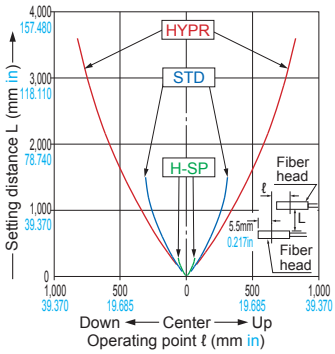


FT-Z30W — Thru-beam type

Horizontal direction

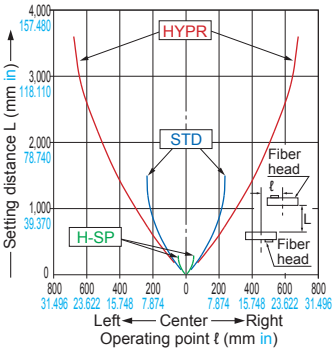


Vertical direction

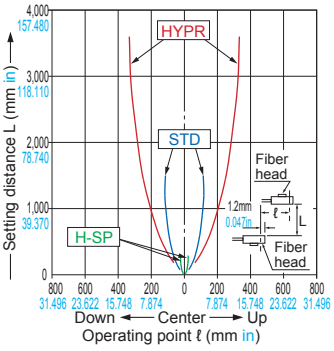


FT-Z40W — Thru-beam type

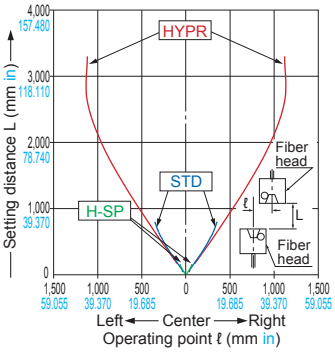
Horizontal direction



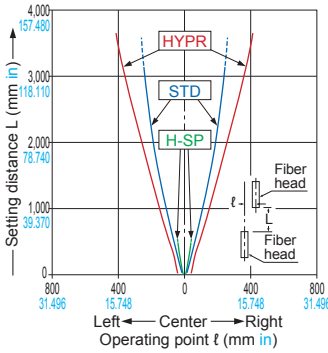
Vertical direction



FT-Z40HBW — Thru-beam type



FT-Z802Y — Thru-beam type

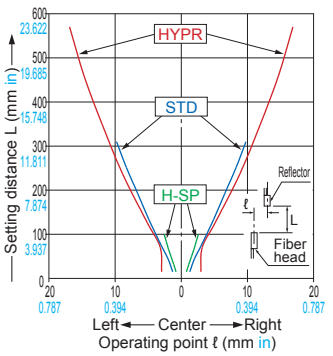


Retroreflective type Parallel deviation

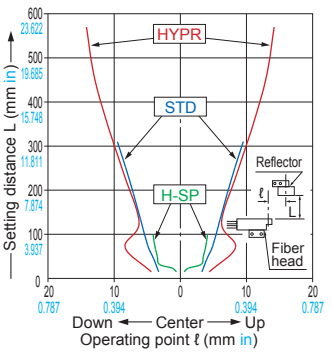
Sensing characteristics are listed in the alphabetic order of the Model No.

FR-KZ22E — Retroreflective type

Horizontal direction

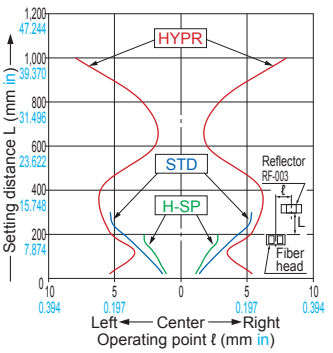


Vertical direction

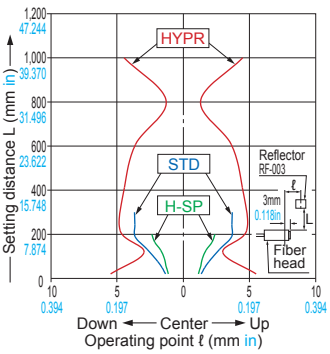


FR-KZ50E — Retroreflective type

Horizontal direction



Vertical direction



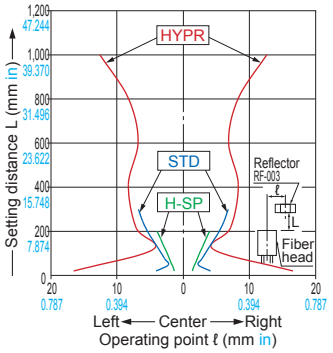
SENSING CHARACTERISTICS (TYPICAL)

Retroreflective type Parallel deviation

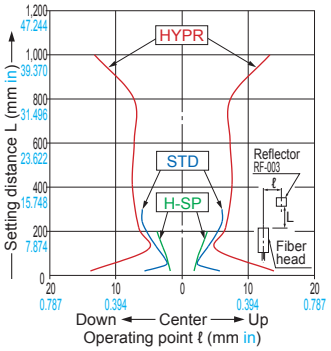
Sensing characteristics are listed in the alphabetic order of the Model No.

FR-KZ50H — Retroreflective type

Horizontal direction



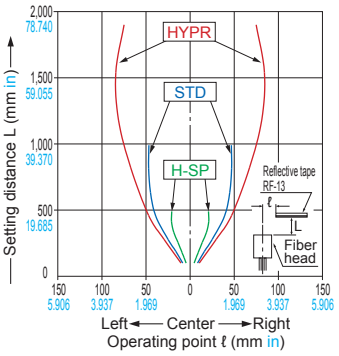
Vertical direction



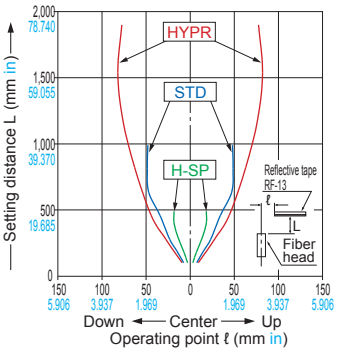
FR-Z50HW — Retroreflective type

With Reflective tape **RF-13** (attached)

Horizontal direction

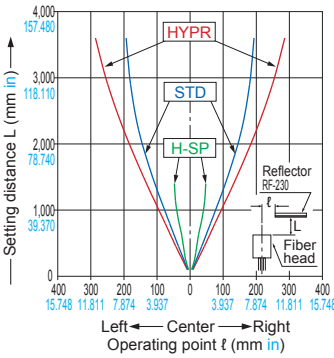


Vertical direction

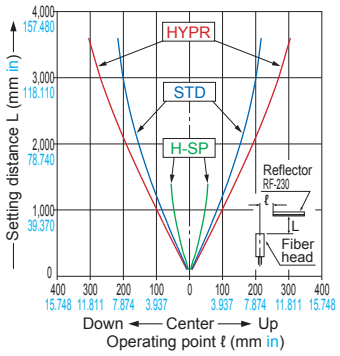


With reflector **RF-230** (optional)

Horizontal direction



Vertical direction

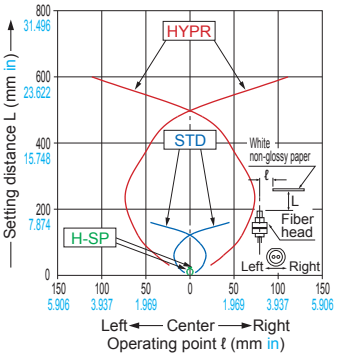


Reflective type Sensing field

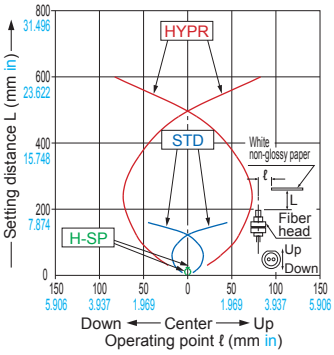
Sensing characteristics are listed in the alphabetic order of the Model No.

FD-30 — Reflective type

Horizontal direction

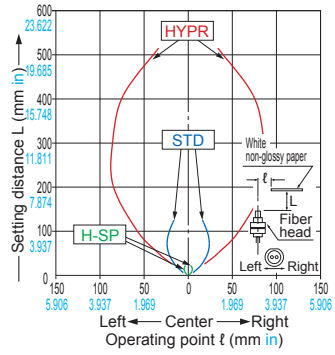


Vertical direction

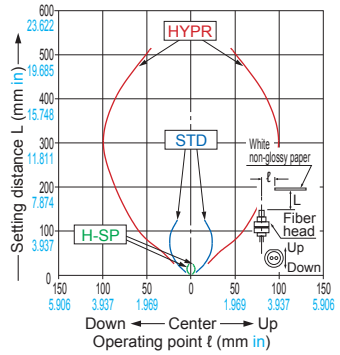


FD-31 — Reflective type

Horizontal direction

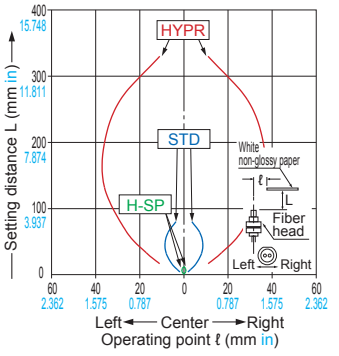


Vertical direction

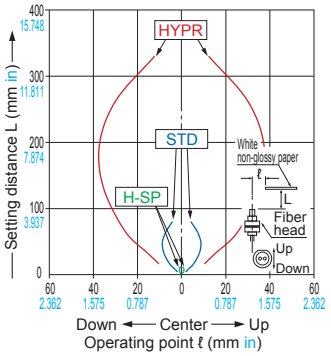


FD-31W — Reflective type

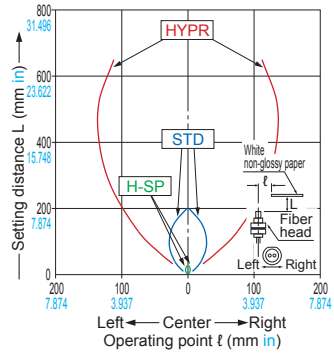
Horizontal direction



Vertical direction



FD-32G — Reflective type

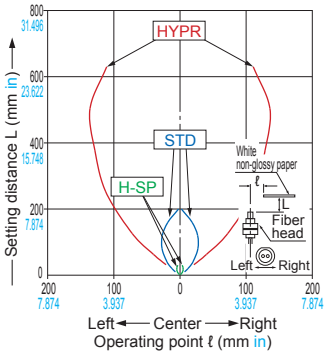


SENSING CHARACTERISTICS (TYPICAL)

Reflective type Sensing field

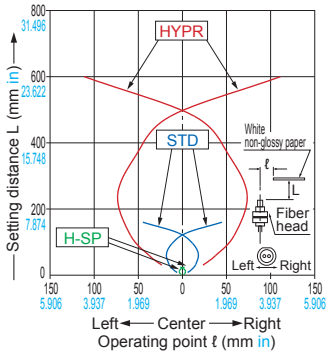
Sensing characteristics are listed in the alphabetic order of the Model No.

FD-32GX Reflective type

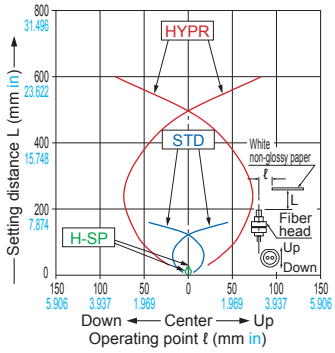


FD-40 Reflective type

Horizontal direction

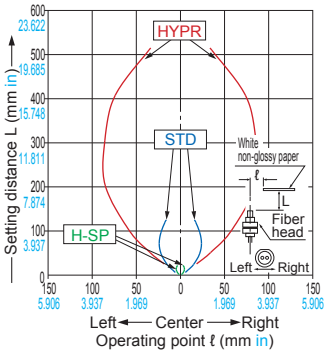


Vertical direction

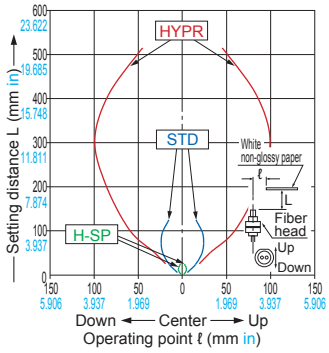


FD-41 Reflective type

Horizontal direction

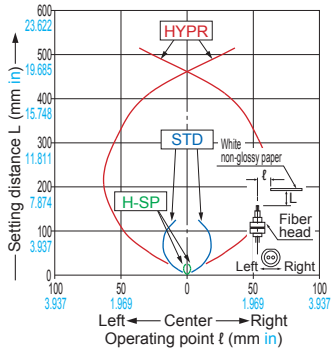


Vertical direction

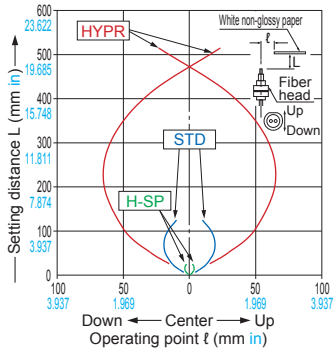


FD-41S Reflective type

Horizontal direction

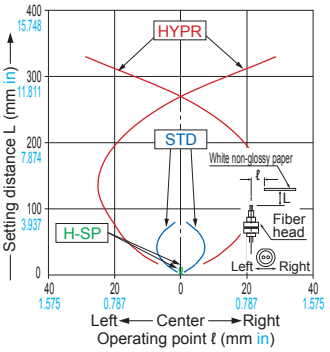


Vertical direction

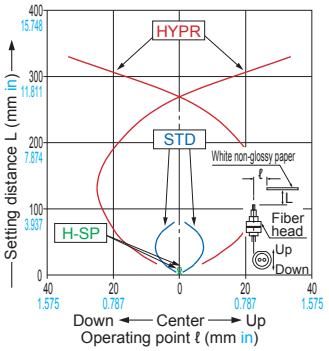


FD-41SW Reflective type

Horizontal direction

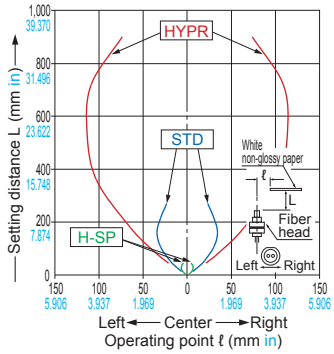


Vertical direction

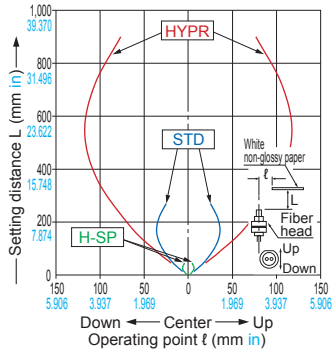


FD-41W Reflective type

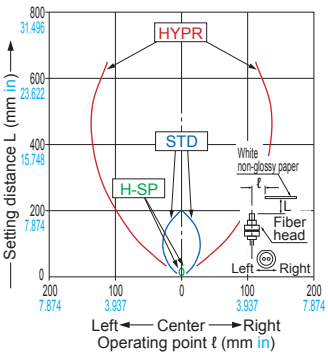
Horizontal direction



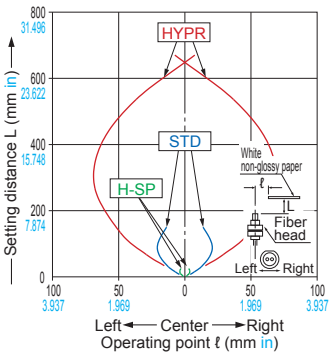
Vertical direction



FD-42G Reflective type

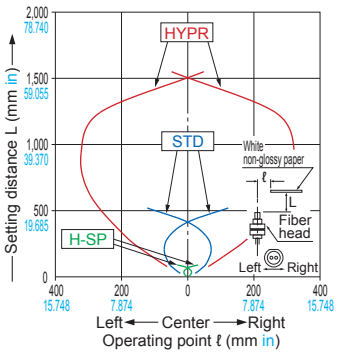


FD-42GW Reflective type

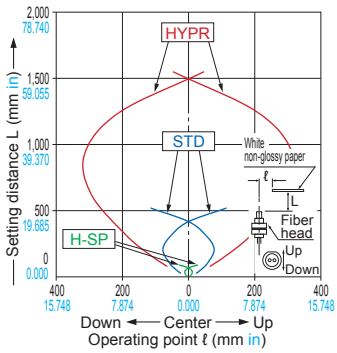


FD-60 Reflective type

Horizontal direction



Vertical direction



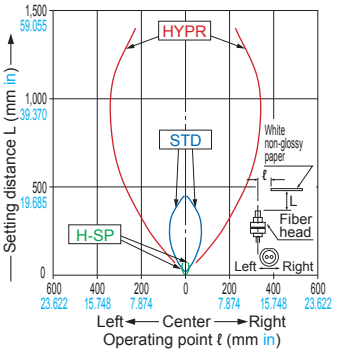
SENSING CHARACTERISTICS (TYPICAL)

Reflective type Sensing field

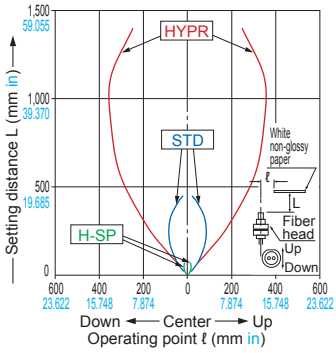
Sensing characteristics are listed in the alphabetic order of the Model No.

FD-61 — Reflective type

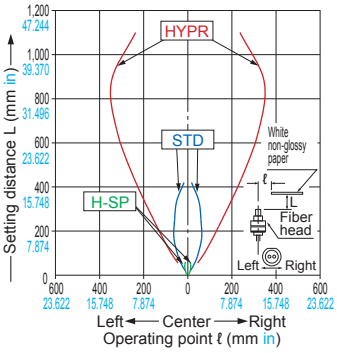
Horizontal direction



Vertical direction

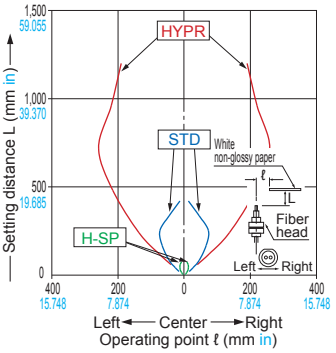


FD-61G — Reflective type

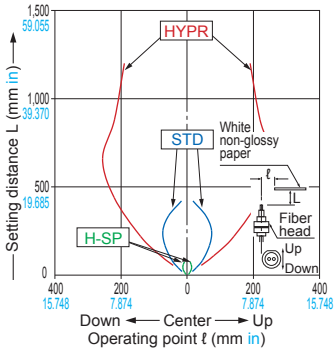


FD-61S — Reflective type

Horizontal direction

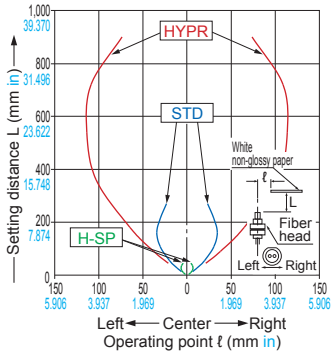


Vertical direction

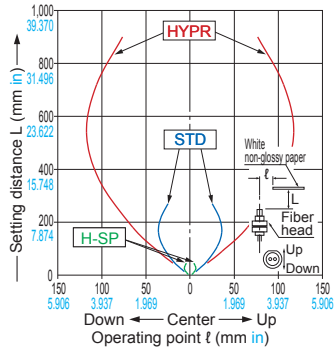


FD-61W — Reflective type

Horizontal direction

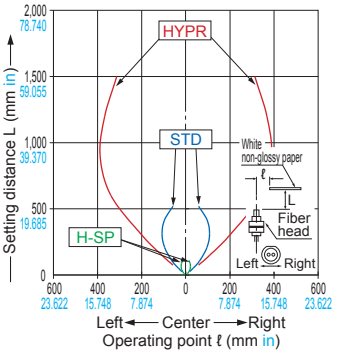


Vertical direction

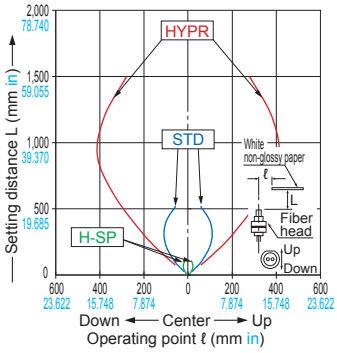


FD-62 — Reflective type

Horizontal direction

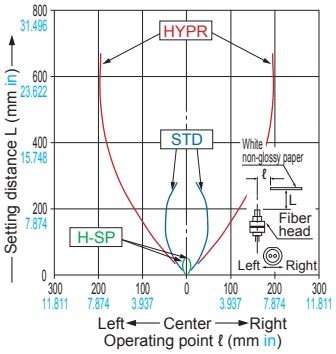


Vertical direction

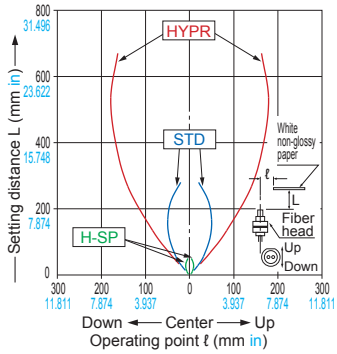


FD-64X — Reflective type

Horizontal direction

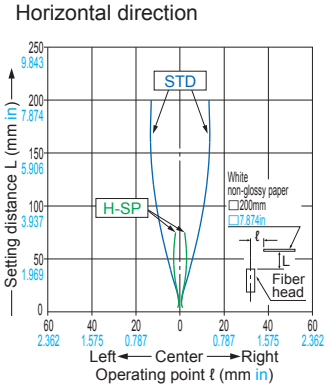


Vertical direction

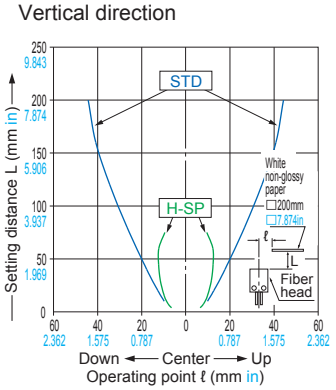


FD-A16 — Reflective type

Horizontal direction

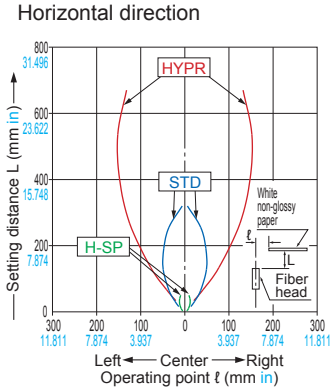


Vertical direction

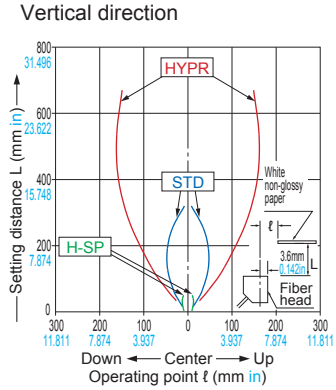


FD-AL11 — Reflective type

Horizontal direction



Vertical direction

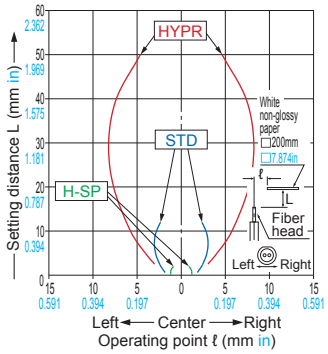


SENSING CHARACTERISTICS (TYPICAL)

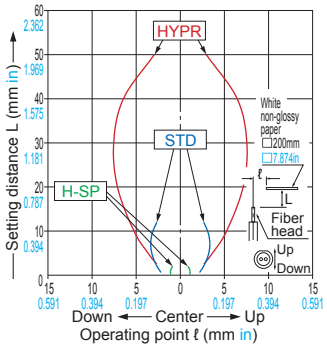
Reflective type Sensing field Sensing characteristics are listed in the alphabetic order of the Model No.

FD-E13 Reflective type

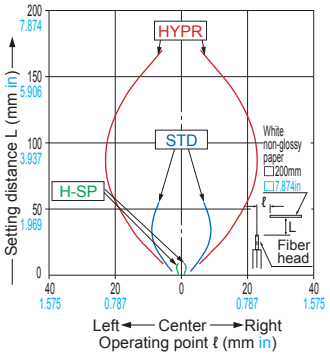
Horizontal direction



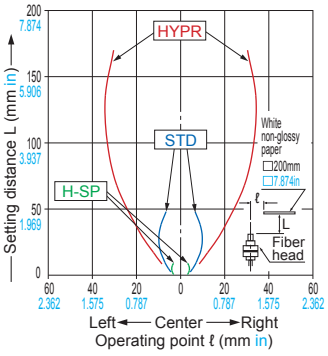
Vertical direction



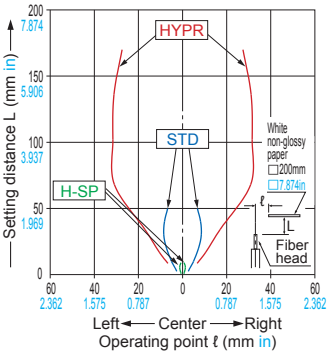
FD-E23 Reflective type



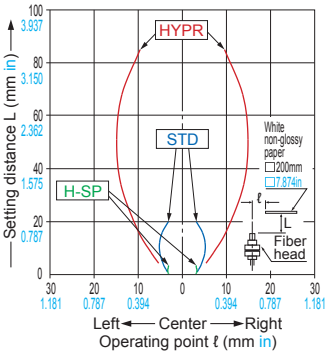
FD-EG30 Reflective type



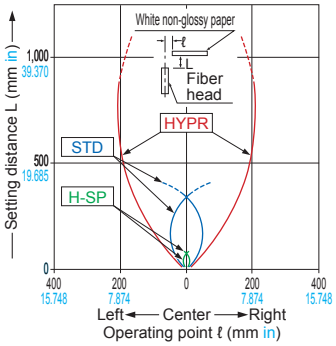
FD-EG30S Reflective type



FD-EG31 Reflective type

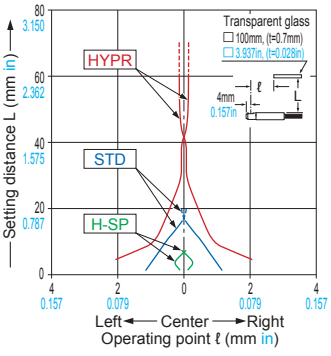


FD-H13-FM2 Reflective type

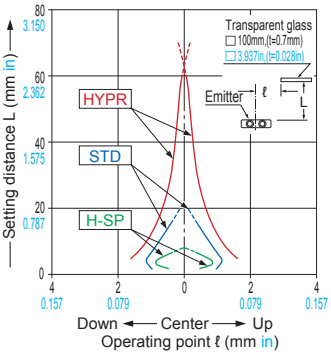


FD-H18-L31 Reflective type

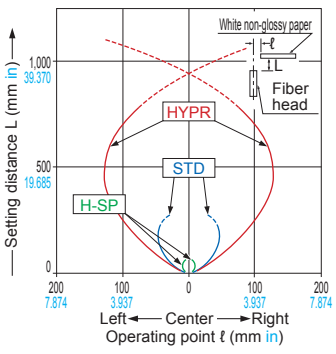
Horizontal direction



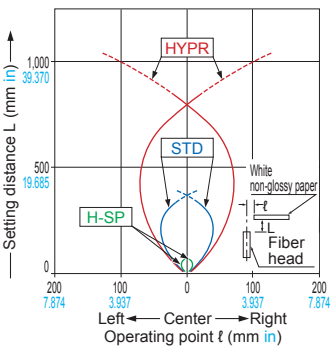
Vertical direction



FD-H20-21 Reflective type

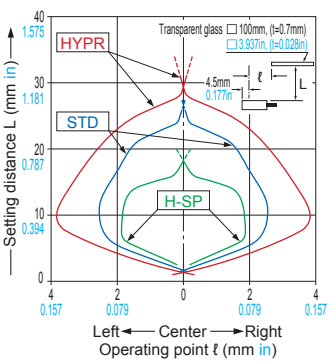


FD-H20-M1 Reflective type

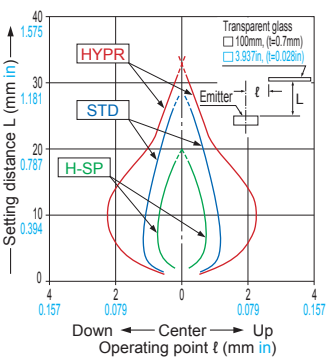


FD-H25-L43 Reflective type

Horizontal direction



Vertical direction

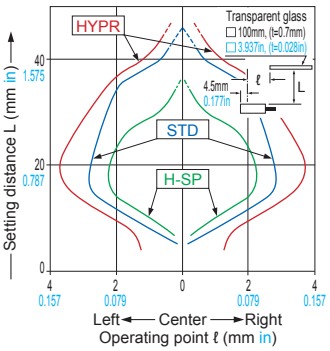


SENSING CHARACTERISTICS (TYPICAL)

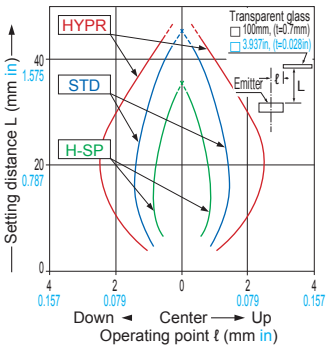
Reflective type Sensing field Sensing characteristics are listed in the alphabetic order of the Model No. (Models with same sensing characteristics are grouped together.)

FD-H25-L45 Reflective type

Horizontal direction

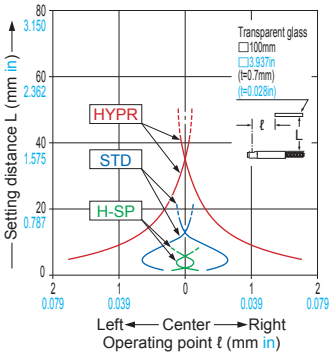


Vertical direction

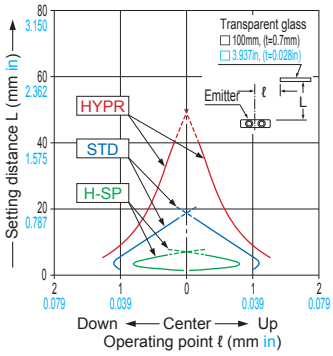


FD-H30-L32 Reflective type

Horizontal direction

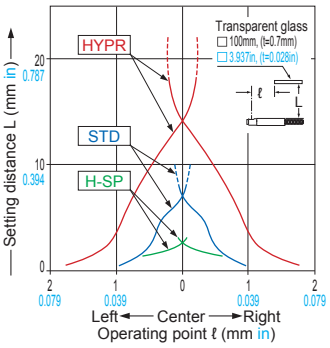


Vertical direction

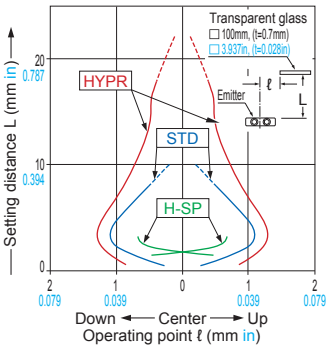


FD-H30-L32V-S Reflective type

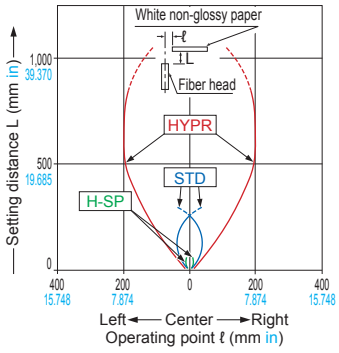
Horizontal direction



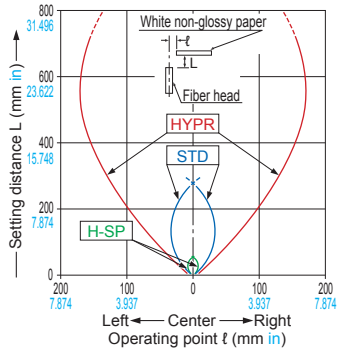
Vertical direction



FD-H35-20S Reflective type

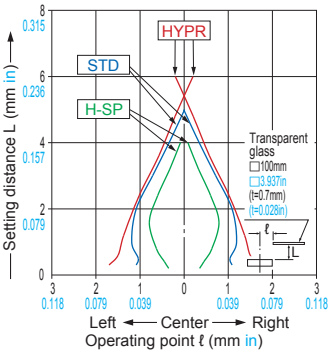


FD-H35-M2 FD-H35-M2S6 Reflective type

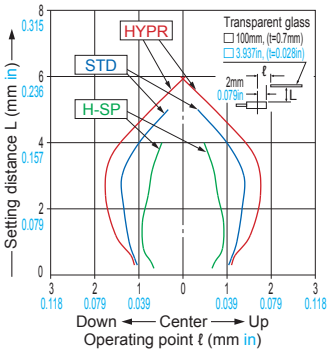


FD-L10 Reflective type

Horizontal direction

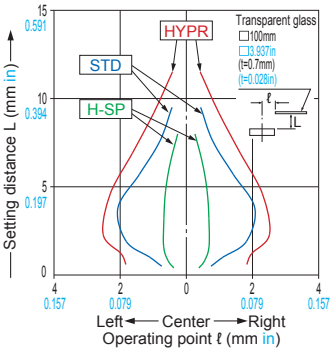


Vertical direction

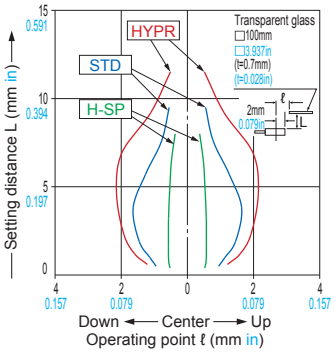


FD-L11 Reflective type

Horizontal direction

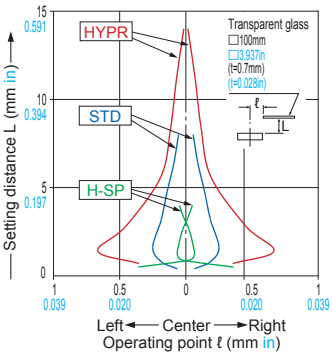


Vertical direction

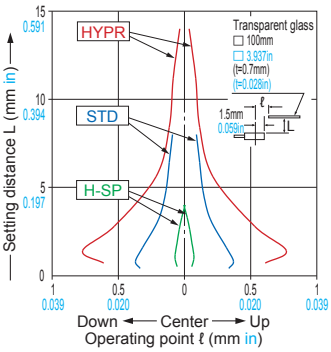


FD-L12W Reflective type

Horizontal direction

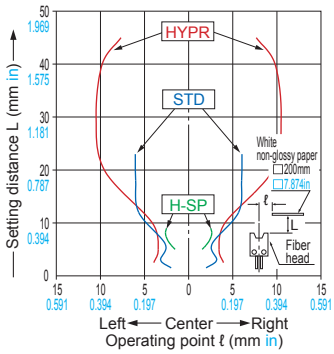


Vertical direction

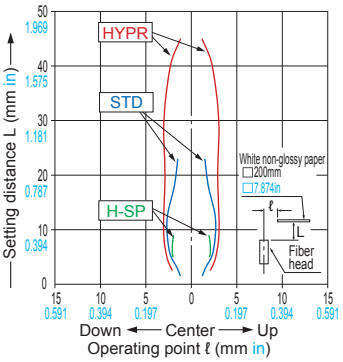


FD-L20H Reflective type

Horizontal direction



Vertical direction

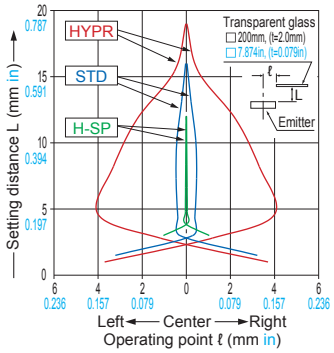


SENSING CHARACTERISTICS (TYPICAL)

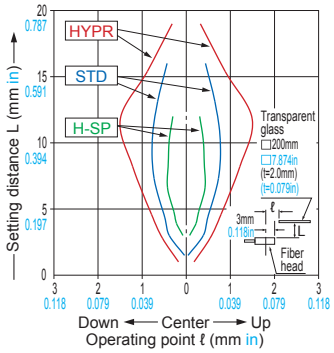
Reflective type Sensing field Sensing characteristics are listed in the alphabetic order of the Model No.

FD-L21 Reflective type

Horizontal direction

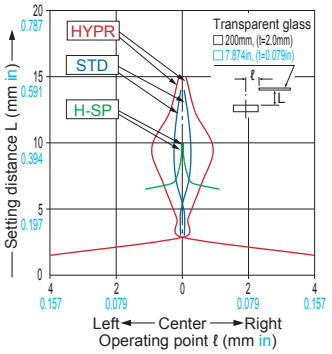


Vertical direction

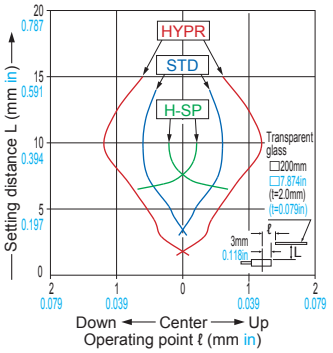


FD-L21W Reflective type

Horizontal direction

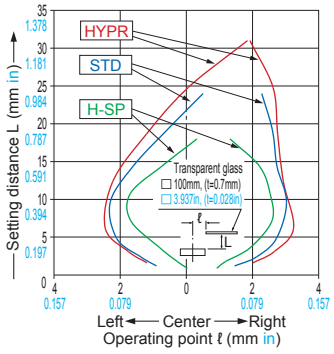


Vertical direction

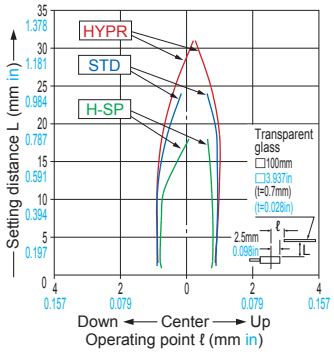


FD-L22A Reflective type

Horizontal direction

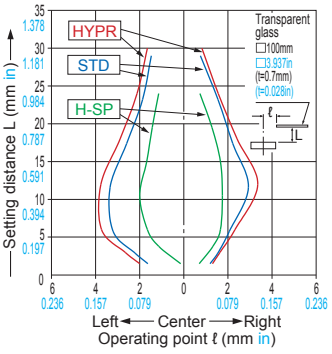


Vertical direction

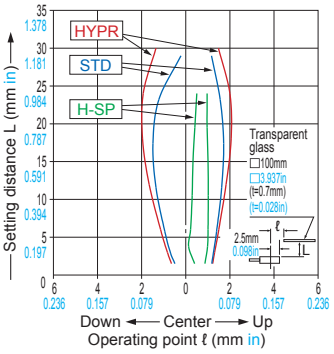


FD-L23 Reflective type

Horizontal direction

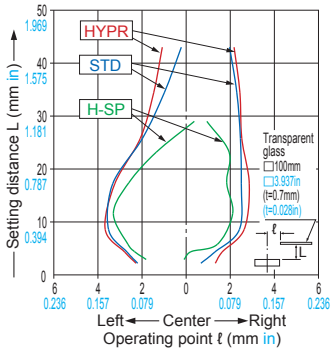


Vertical direction

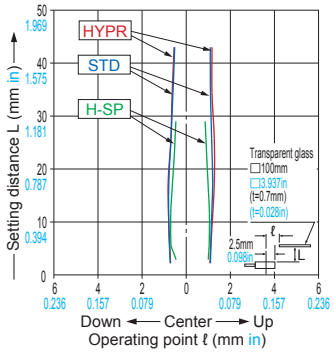


FD-L30A Reflective type

Horizontal direction

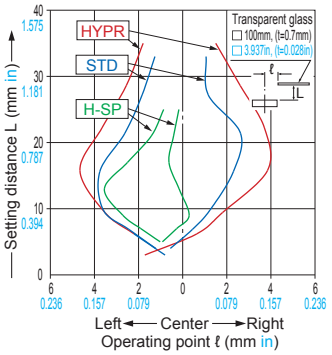


Vertical direction

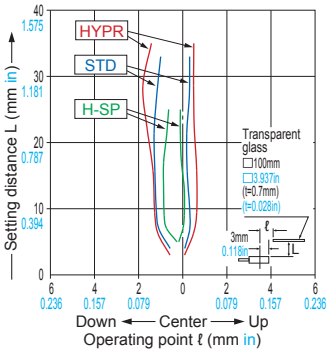


FD-L31A Reflective type

Horizontal direction

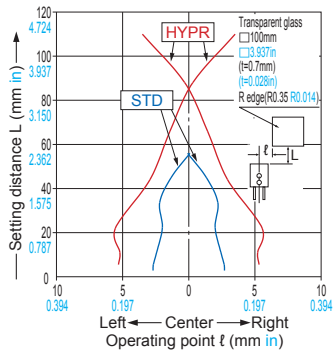


Vertical direction

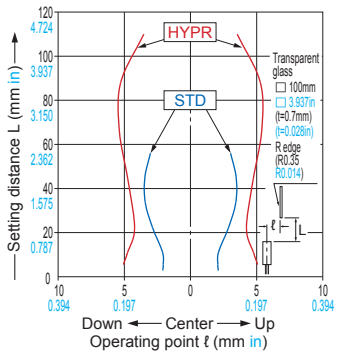


FD-L32H Reflective type

Horizontal direction

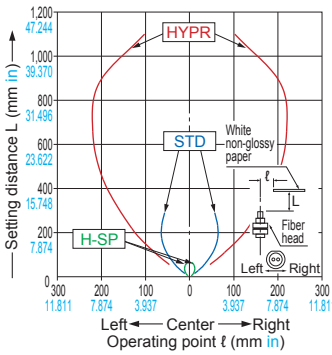


Vertical direction

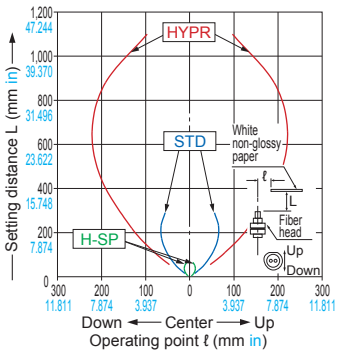


FD-R60 Reflective type

Horizontal direction



Vertical direction



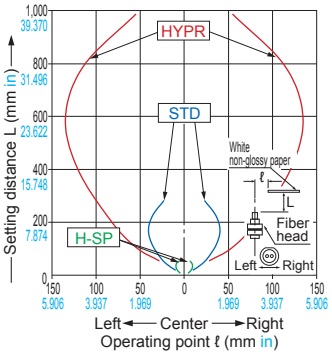
SENSING CHARACTERISTICS (TYPICAL)

Reflective type Sensing field

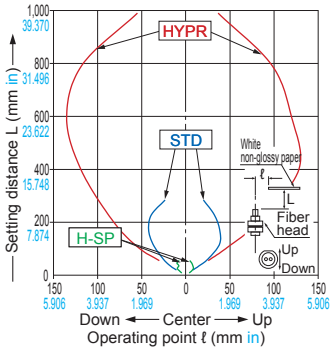
Sensing characteristics are listed in the alphabetic order of the Model No.

FD-R61Y — Reflective type

Horizontal direction

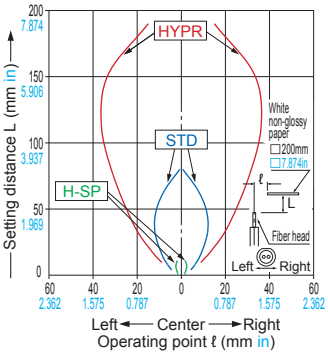


Vertical direction

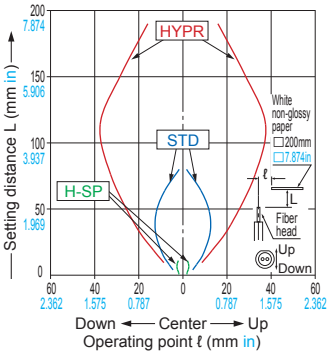


FD-S21 — Reflective type

Horizontal direction

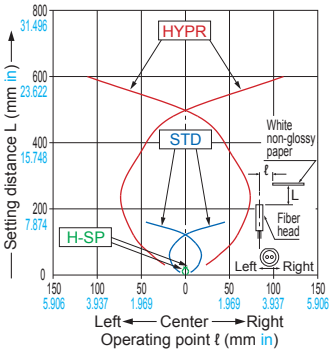


Vertical direction

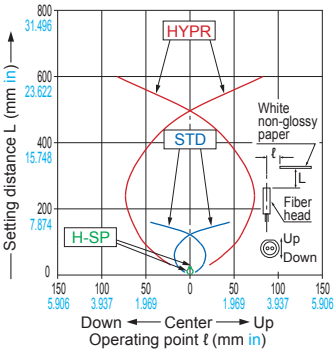


FD-S30 — Reflective type

Horizontal direction

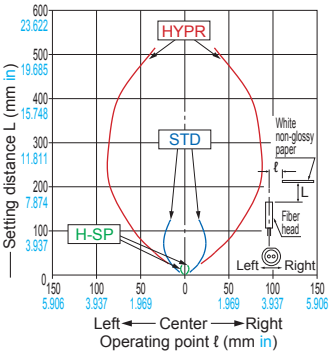


Vertical direction

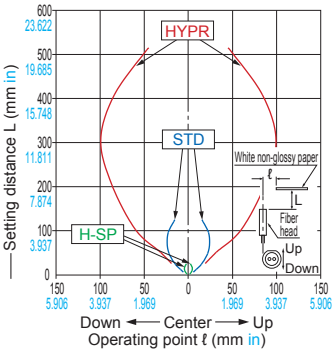


FD-S31 — Reflective type

Horizontal direction

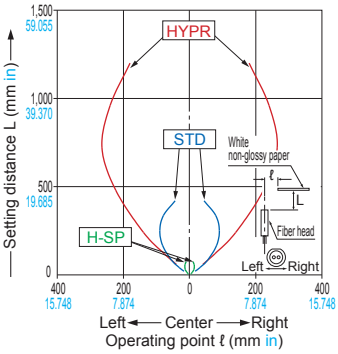


Vertical direction

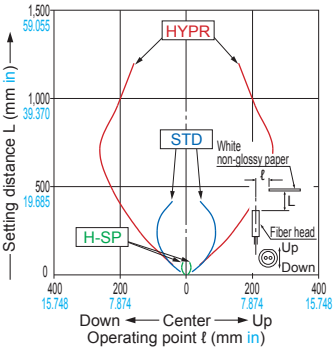


FD-S32 — Reflective type

Horizontal direction

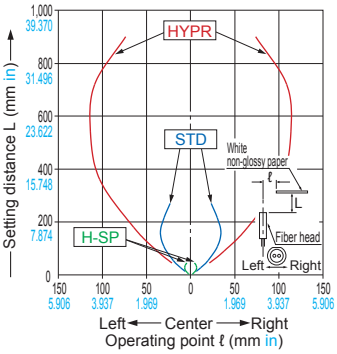


Vertical direction

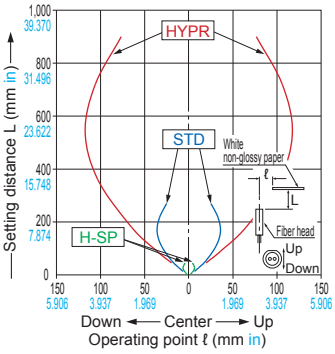


FD-S32W — Reflective type

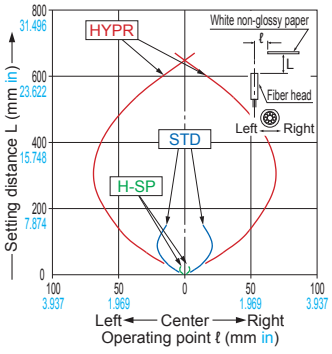
Horizontal direction



Vertical direction

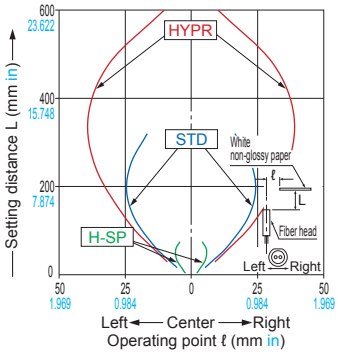


FD-S33GW — Reflective type

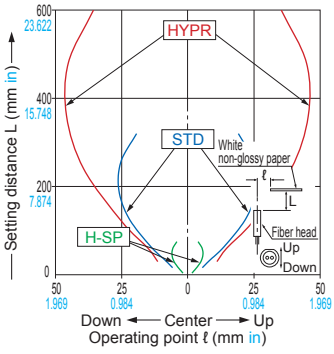


FD-S60Y — Reflective type

Horizontal direction



Vertical direction

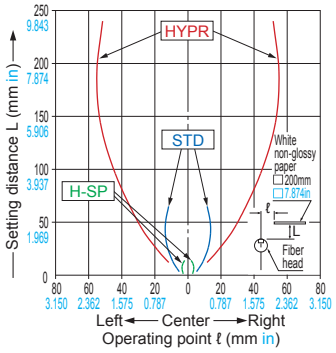


SENSING CHARACTERISTICS (TYPICAL)

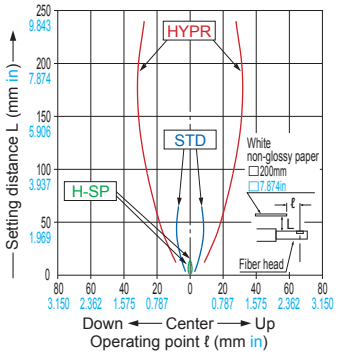
Reflective type Sensing field Sensing characteristics are listed in the alphabetic order of the Model No.

FD-V30 — Reflective type

Horizontal direction

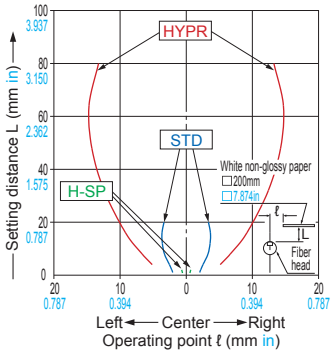


Vertical direction

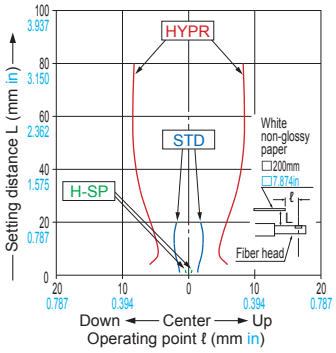


FD-V30W — Reflective type

Horizontal direction

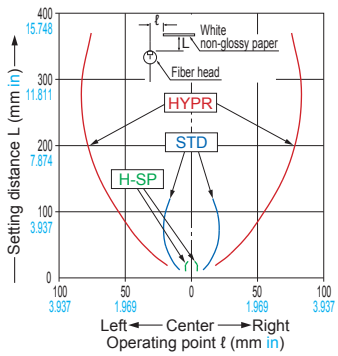


Vertical direction

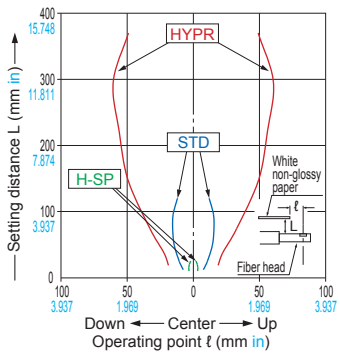


FD-V50 — Reflective type

Horizontal direction

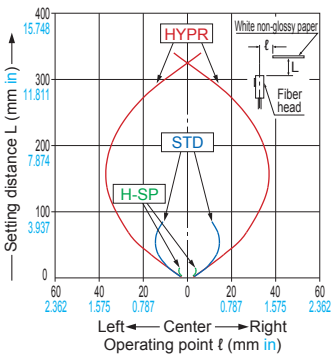


Vertical direction

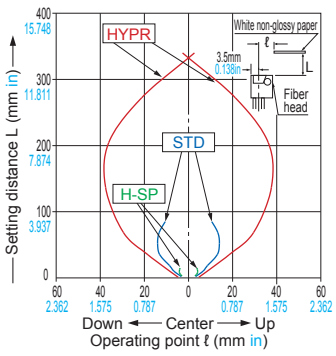


FD-Z20HBW — Reflective type

Horizontal direction

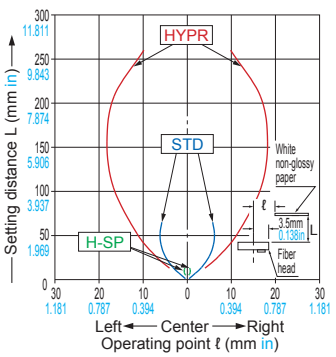


Vertical direction

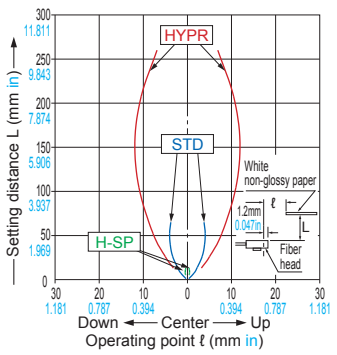


FD-Z20W — Reflective type

Horizontal direction

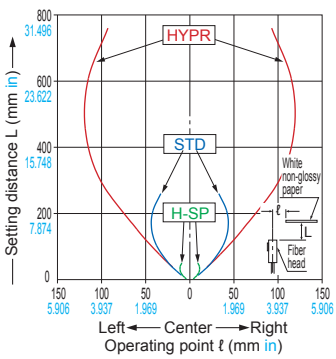


Vertical direction

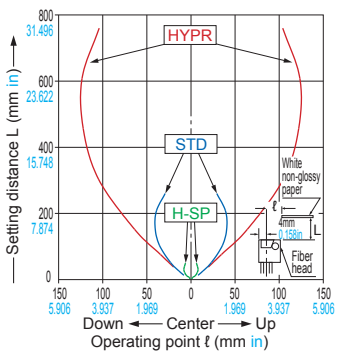


FD-Z40HBW — Reflective type

Horizontal direction

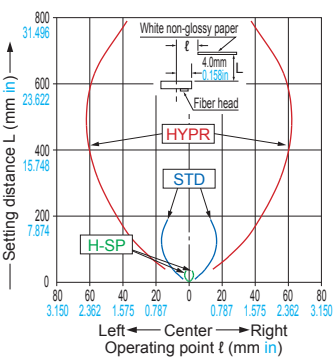


Vertical direction

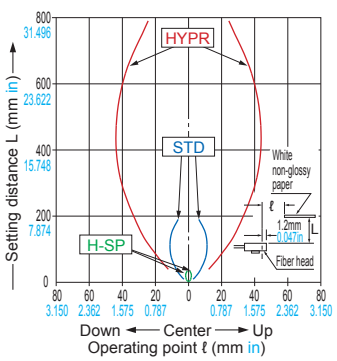


FD-Z40W — Reflective type

Horizontal direction

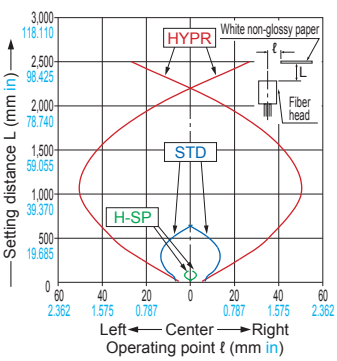


Vertical direction

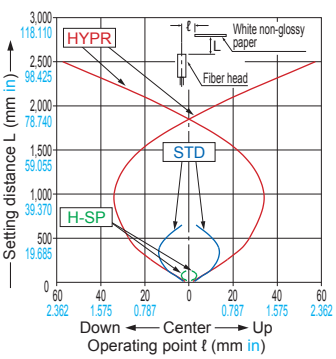


FD-Z50HW — Reflective type

Horizontal direction



Vertical direction



PRECAUTIONS FOR PROPER USE

Refer to the “PRO mode operation manual” on our website for details.

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

Wiring

- Make sure that the power supply is OFF while adding or removing the amplifiers.
- Note that if a voltage exceeding the reted range is applied, or if an AC power supply is directly connected, the product may get burnt or damaged.
- Note that short-circuit of the load or wrong wiring may burn or damage the product.
- 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.
- Verify that the supply voltage variation is within the rating.
- 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.
- Make sure to use the quick-connection cable (optional) for the connection of the controller. Extension up to total 100 m 328.084 ft is possible with 0.3 mm^2 or more, cable. However, in order to reduce noise, make the wiring as short as possible.
- Make sure that stress by forcible bending or pulling is not applied to the sensor cable joint and fiber cable.

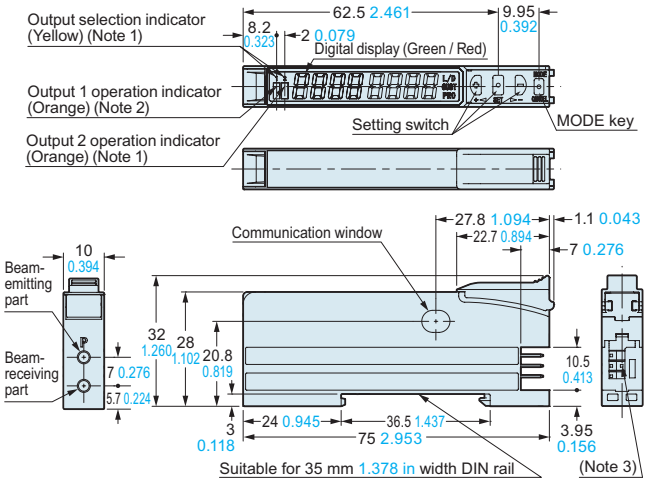
Others

- Our products have been developed / produced for industrial use only.
- The specification may not be satisfied in a strong magnetic field.
- The ultra long distance (U-LG, HYPR) mode is more likely to be affected by extraneous noise since the sensitivity of that is higher than the other modes. Make sure to check the environment before use.
- Do not use during the initial transient time (H-SP, FAST, STD: 0.5 sec., LONG, U-LG, HYPR: 1 sec.) after the power supply is switched ON.
- These sensors are only for indoor use.
- Avoid dust, dirt, and steam.
- Make sure that the product does not come in contact with oil, grease, organic solvents such as thinner, etc., strong acid or alkaline.
- This product cannot be used in an environment containing inflammable or explosive gases.
- Never disassemble or modify this product.
- This product adopts EEPROM. Settings cannot be done a million times or more because of the EEPROM's lifetime.

DIMENSIONS (Unit: mm in)

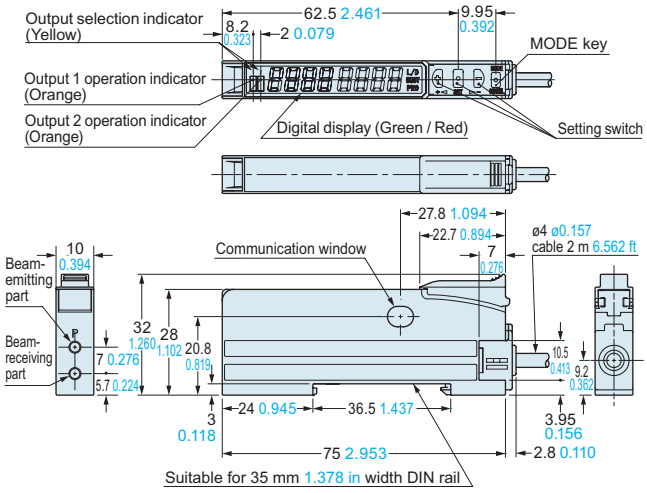
The CAD data in the dimensions can be downloaded from our website.

FX-501(P) FX-502(P) — Amplifier



Notes: 1) **FX-502(P)** only
2) **FX-501(P)**: Operation indicator
3) **FX-501(P)**: 3-pin, **FX-502(P)**: 4-pin

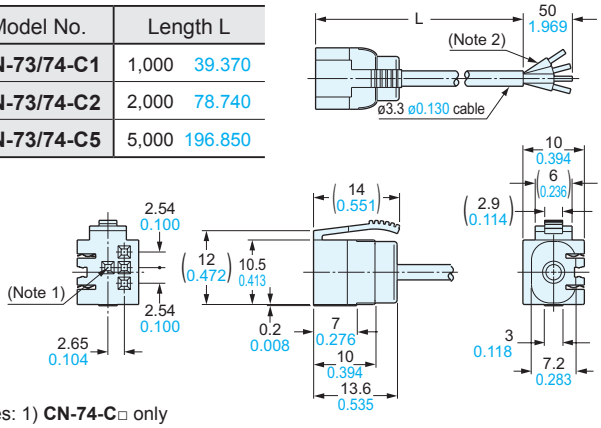
FX-505-C2 FX-505P-C2 — Amplifier



CN-73-C□ CN-74-C□ — Main cable (Optional)

• Length L

Model No.	Length L
CN-73/74-C1	1,000 39.370
CN-73/74-C2	2,000 78.740
CN-73/74-C5	5,000 196.850

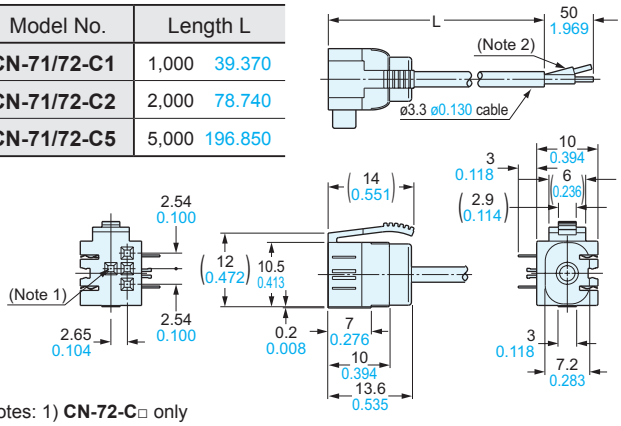


Notes: 1) **CN-74-C□** only
2) **CN-73-C□**: 3-core

CN-71-C□ CN-72-C□ — Sub cable (Optional)

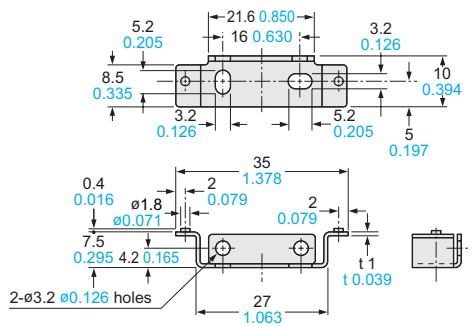
• Length L

Model No.	Length L
CN-71/72-C1	1,000 39.370
CN-71/72-C2	2,000 78.740
CN-71/72-C5	5,000 196.850



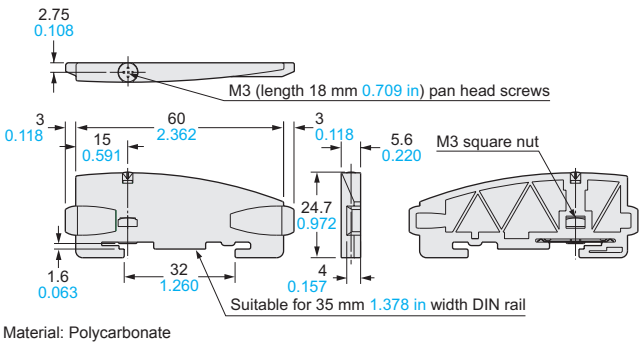
Notes: 1) **CN-72-C□** only
2) **CN-71-C□**: 1-core

MS-DIN-2 — Amplifier mounting bracket (Optional)



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

MS-DIN-E — End plate (Optional)



Material: Polycarbonate