Panasonic
INDUSTRY

NEW

With Organic EL Display

Digital Fiber Sensor

FX-250 SERIES

CE

“Ease of use” evolves to the next generation.

2025.8

Overwhelmingly easy to understand,

Organic EL display

The clear, high-visibility flat panel ensures easy operation to reduce setting time and minimize setting errors. It contributes to improved efficiency on the production site.

Character display

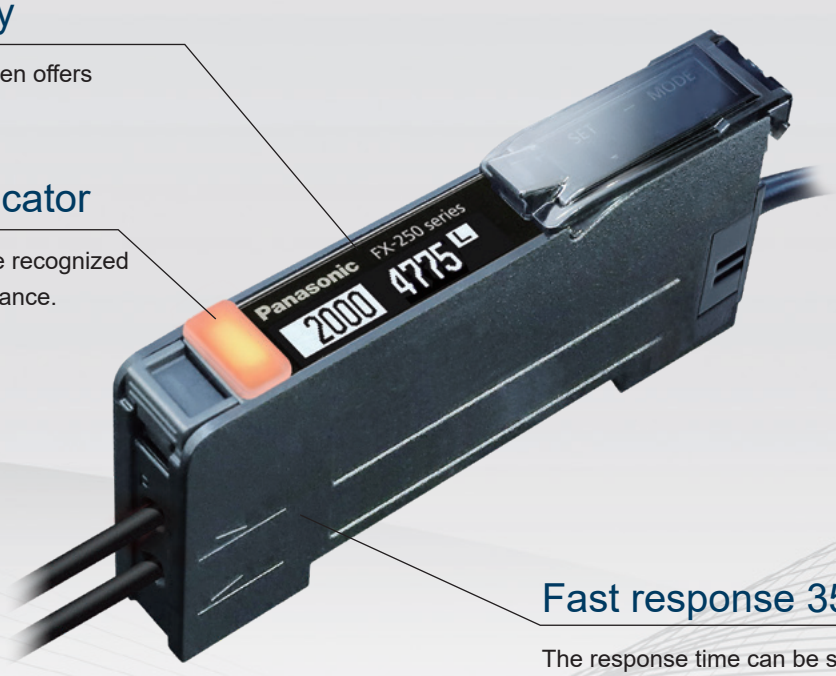
The “Readable” setting screen offers improved ease of use.

Large output indicator

The ON / OFF status can be recognized at a glance even from a distance.

Conventional model

NEW **FX-250** series



Fast response 35 µs

The response time can be selected from five patterns to enable flexible use in a wide range of applications.

Enables intuitive operation without referring to the manual

Reduces setting time **Minimizes setting errors**

7-segment display

NEW **FX-250** series

Improved digital display area

Sufficient incident light intensity is ensured even when a small-diameter fiber is used, thus contributing to stable sensing.

Dual display

The display shows threshold value and incident light intensity simultaneously.

Clear character display for at-a-glance understanding

Information is displayed in the language even first-time users can understand.

Compact body

The compact body can be easily mounted to small equipment and robotic hands with limited installation spaces.

Main unit size

W 10.0 × H 32.0 × D67.5 mm W 0.394 × H 1.260 × D 2.657 in

NEW
FX-250 series

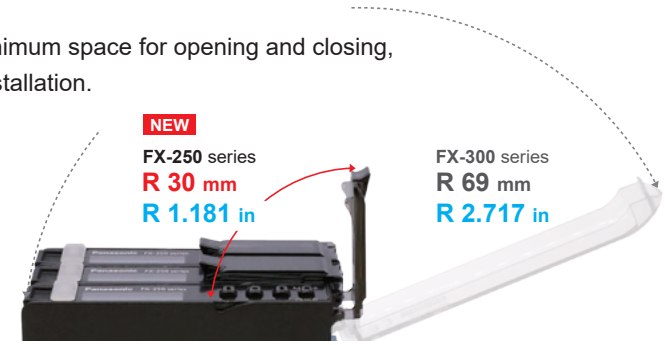
NEW
FX-250 series

Conventional model

Conventional model

Space required for opening and closing the cover

The small cover requires a minimum space for opening and closing, thus enabling space-saving installation.



New function

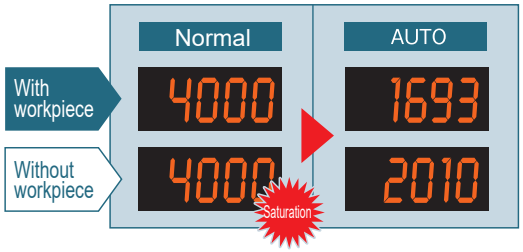
Smart limit teaching
Simultaneous execution of teaching and circumvention of saturation

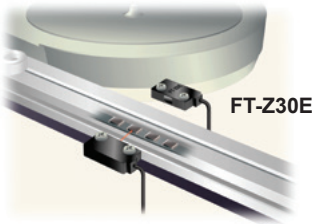
* Only when limit teaching is used

Teaching is executed only with two pushes of a button, and this also achieves circumvention of saturation simultaneously. There is no need for separate adjustment of the light emission amount, thus contributing to reduction of setting man-hours.

Before

In the event the emitted light was too strong and caused incident light saturation, the light emitting amount had to be adjusted before teaching is performed.





After

When limit teaching is executed under incident light saturation, circumvention of light saturation and setting of the threshold value is performed simultaneously. This adds extra convenience when using the thru-beam type to detect a very small object or transparent item.

* Only when limit teaching is used

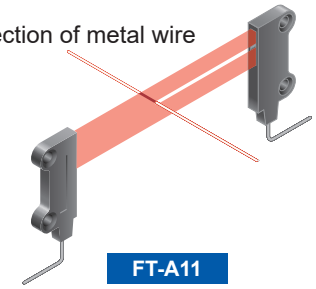
Recommended to use as an amplifier of **FD-F71** as well for liquid leak detection in semiconductor manufacturing machine.

* **FD-F71** receives the beam when there is no liquid present.

Incident light intensity adjustable in 100 increments

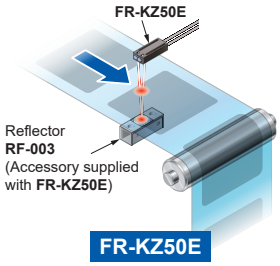
The incident light intensity can be varied in 100 steps to allow flexible and precise adjustment of incident light intensity even when the incident light becomes saturated due to installation in a close distance or during detection of a transparent or very small workpiece, thus realizing stable detection.

Detection of metal wire



FT-A11

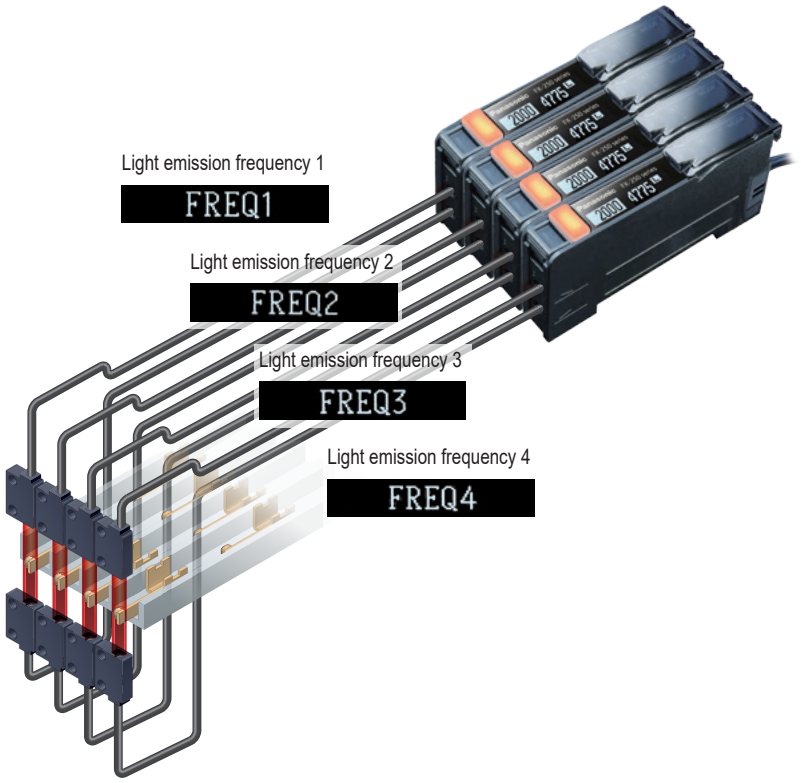
Detection of transparent sticker on transparent sheet



FR-KZ50E

Alternate frequency interference prevention function

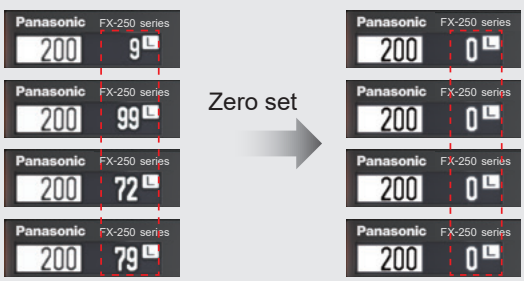
In the case the fibers are arranged side by side, mutual interference can be prevented by setting different light emission frequencies (4 settings).



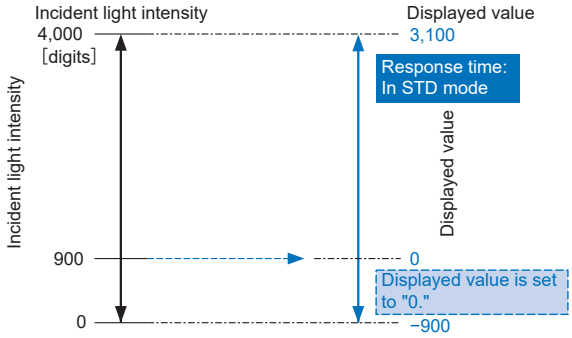
* Response time varies depending on light emission frequencies.
* When the alternate frequency interference prevention function is used, up to four fiber head units can be mounted in contact with each other.

Zero-set function

When a reflective type fiber is used, offsetting the incident light intensity to "0" with no workpiece present enables confirmation of only the change caused by the detected object.
When multiple amplifiers are mounted side by side, all displayed values can be set to "0."

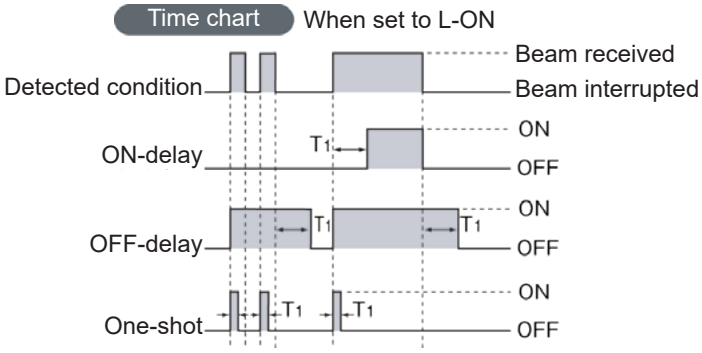


Example 1: Using the zero-set function when displayed incident light intensity is "900"



Equipped with three types of timer function

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



Timer period setting range: 1 to 9,999 ms, in 1-ms increments
(default setting: 1 ms)

Display and indicator can be set to OFF.

Since the digital display and large output indicator can stay turned off during use, the **FX-250** series is suitable for use with equipment that can be affected by light or heat.

Eco OFF (default setting)
The digital display dims when the unit is not operated for about 20 seconds.

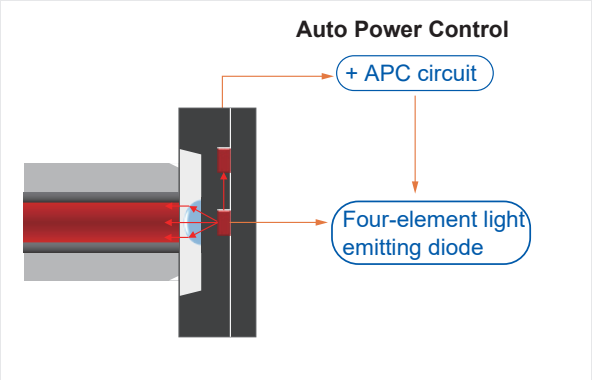
Eco ON
The digital display dims when the unit is not operated for about 20 seconds. The digital display turns off when the unit is not operated for about 2 minutes.

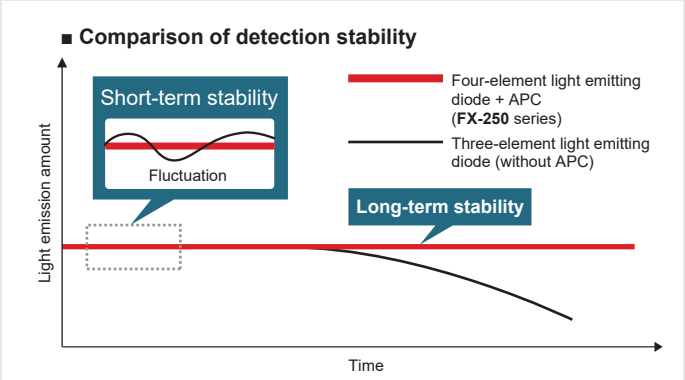
Eco FULL
The digital display dims when the unit is not operated for about 20 seconds. The digital display and output indicator turn off when the unit is not operated for about 2 minutes.

Stable detection over long periods and short periods

Stabilization of light emission amount

The built-in APC circuit stabilizes the short-time fluctuation of the light emission amount at the time of power on and the four-element light emitting diode ensures stable emission over long periods.





■APC circuit

When power is turned on or when the temperature changes, the sensor's light emission amount fluctuates and causes instability of output. To solve this problem, the APC circuit controls the light emission amount to ensure short-term emission stability.

■Four-element light emitting diode

When a conventional LED operates for a long period of time, the LED becomes damaged due to heat or the light intensity decreases due to oxidation. The four-element light emitting diode suppresses degradation of the light emitting element to the maximum extent and ensures long-term emission stability.

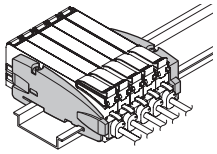
ORDER GUIDE

Amplifier

Appearance	Model No.	Emitting element	Output
	**FX-251-C2**	Red LED	NPN open-collector transistor
	FX-251P-C2		PNP open-collector transistor

End plates

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

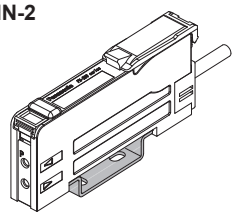
Appearance	Model No.	Description
	**MS-DIN-E**	When an amplifier moves depending on the way it is installed on a DIN rail, these end plates clamp amplifiers into place on both sides. Make sure to use end plates when connecting multiple amplifiers together. Two pcs. per set

OPTIONS

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

Amplifier mounting bracket

· **MS-DIN-2**



SPECIFICATIONS

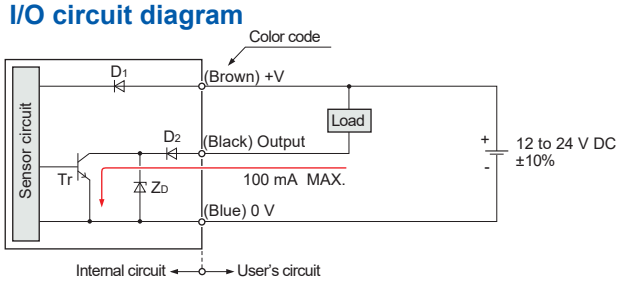
Item \ Type		NPN output type	PNP output type
Model No.		**FX-251-C2**	**FX-251P-C2**
Applicable regulations		CE Marking (EMC Directive, RoHS Directive)	
Supply voltage		12 to 24 V DC ±10% Ripple P-P 10% or less	
Power consumption		960 mW or less (current consumption 40 mA or less at 24 V supply voltage)	
Output		NPN open-collector transistor • Maximum sink current: 100 mA • Applied voltage: 30 V DC or less (between output and 0 V) • Residual voltage: 2 V or less (at maximum sink current)	PNP open-collector transistor • Maximum source current: 100 mA • Applied voltage: 30 V DC or less (between output and +V) • Residual voltage: 2 V or less (at maximum source current)
	Output operation	Switchable either Light-ON or Dark-ON	
	Short-circuit protection	Incorporated	
Response time		H-SPD: 35 µs or less, FAST: 60 µs or less, STD: 250 µs or less, LONG: 2 ms or less, H-PWR: 24 ms or less, selectable	
Output indicator		Orange LED turns on when output is ON.	
Sensitivity setting		2-point teaching / Limit teaching / Full-auto teaching / Manual adjustment	
Threshold value adjustment function		Incorporated	
Incident light intensity adjustment function		Incorporated, max. 100 steps	
Incident light intensity display range		H-SPD / FAST / STD: 0 to 4,000, LONG / H-PWR: 0 to 9,999	
Digital display		White organic EL display	
Various settings		Shift amount setting (percentage, fixed value), display style setting, display inversion setting, ECO setting, zero-set function	
Timer function		OFF-delay timer / ON-delay timer / One-shot timer, switchable either effective or ineffective (setting range: 1 to 9,999 ms in 1-ms increments)	
Interference prevention function		Incorporated (4 selectable frequencies) (Note 2)	
Environmental resistance	Protection	IP40 (IEC)	
	Ambient temperature	-10 to +55 °C +14 to +131 °F (If 4 to 7 units close mounting: -10 to +50 °C +14 to +122 °F or if 8 to 16 units close mounting: -10 to +45 °C +14 to +113 °F) (No dew condensation or icing allowed), Storage: -20 to +70 °C -4 to +158 °F	
	Ambient humidity	35 to 85% RH, Storage: 35 to 85% RH	
	Ambient illuminance	Incandescent light: 10,000 ℓx or less at the light-receiving face	
	Voltage withstandability	1,000 V AC for one min. between all supply terminals connected together and enclosure (Note 3)	
	Insulation resistance	20 MΩ or more, with 250 V DC megger between all supply terminals connected together and enclosure (Note 3)	
	Vibration resistance	10 to 150 Hz frequency, 0.75 mm 0.030 in double amplitude (100 m/s^2 max.) in X, Y and Z directions for two hours each (without power supply)	
	Shock resistance	98 m/s^2 acceleration (10 G approx.) in X, Y and Z directions five times each (without power supply)	
Emitting element (modulation type)		Red LED (Peak emission wavelength: 660 nm 0.026 mil)	
Material		Enclosure, cover, switch: Polycarbonate	
Cable		0.2 mm^2 3-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 mm^2, or more, cable. (however, supply voltage 24 V DC or more)	
Weight		Net weight: 55 g approx., Gross weight: 80 g approx.	

Notes: 1) Where measurement conditions have not been specified precisely, the conditions used were an ambient temperature of +23 °C +73.4 °F.
2) When the interference prevention function is used, set different light emission frequencies in the amplifiers for interference prevention.
3) The indicated voltage withstandability and insulation resistance values apply to the amplifier unit.

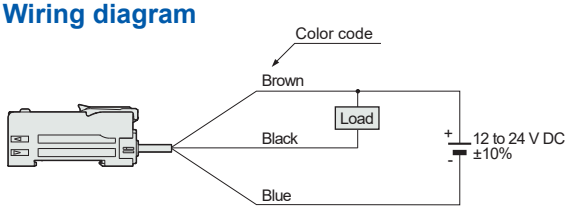
I/O CIRCUIT AND WIRING DIAGRAMS

FX-251-C2

I/O circuit diagram



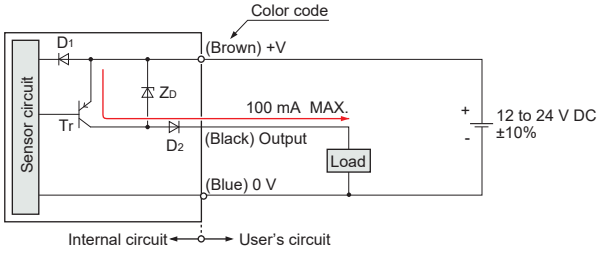
Wiring diagram



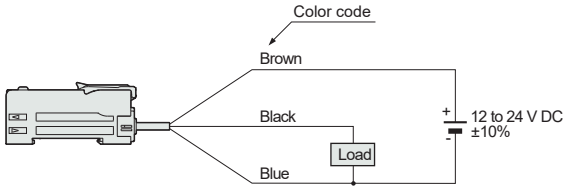
Symbols...D_1: Reverse supply polarity protection diode
D_2: Reverse output polarity protection diode
Z_0: Surge absorption zener diode
T_r: NPN output transistor

FX-251P-C2

I/O circuit diagram



Wiring diagram



Symbols...D_1: Reverse supply polarity protection diode
D_2: Reverse output polarity protection diode
Z_0: Surge absorption zener diode
T_r: PNP output transistor

PRECAUTIONS FOR PROPER USE

Refer to the instruction manual for details.
The instruction manual data can be downloaded from our website.

- This catalog is a guide to select a suitable product. Be sure to read instruction manual of the product prior to its use.

- 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 rated 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.

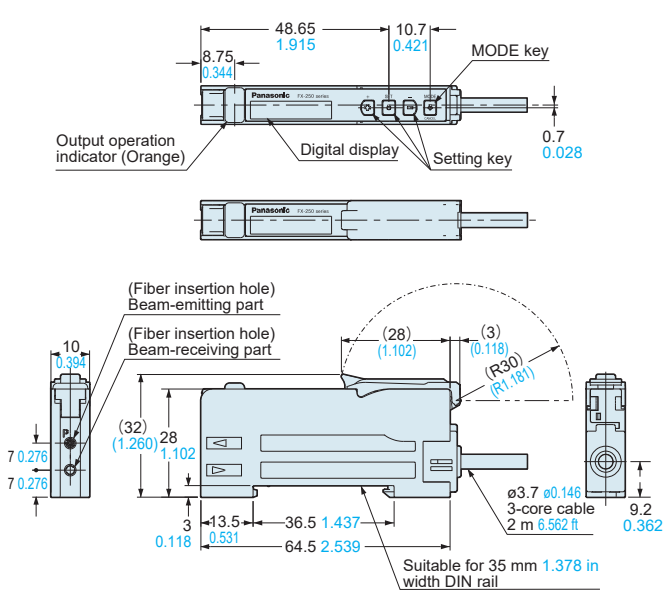
Others

- This product has been developed / produced for industrial use only.
- The specification may not be satisfied in a strong magnetic field.
- Do not use during the initial transient time (the following time) after the power supply is switched ON.
  H-SPD, FAST, STD: 0.5 sec., LONG, H-PWR: 1 sec.
- 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.
- The power input must meet the following requirements:
  1. Be certified for its region of use
  2. Have an output hold time of at least 20 ms
  3. Have a rated output voltage of 12 to 24 V DC ±10% ripple P-P 10% or less and a current capacity of 0.5 A or more
  4. If CE marking compliance is required, have SELV (Safety Extra Low Voltage)/PELV (Protective Extra Low Voltage) in accordance with the EMC Directive

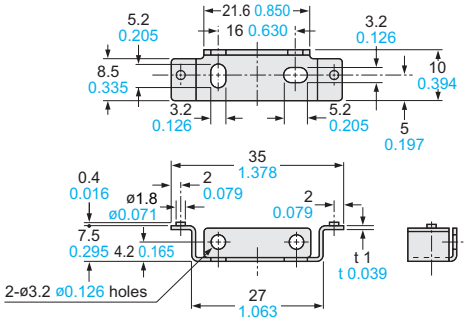
DIMENSIONS (Unit: mm in)

For the external dimensions of the fibers and fiber options, refer to our website.
The CAD data can be downloaded from our website.

FX-251-C2 FX-251P-C2 — Amplifier

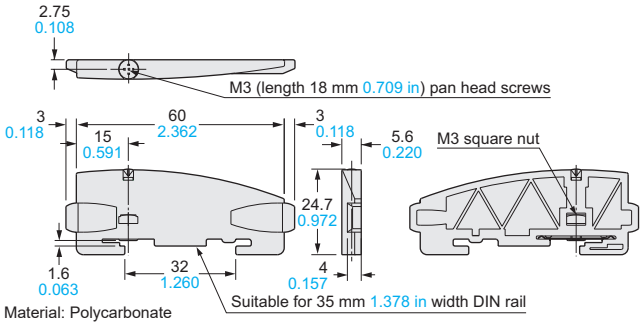


MS-DIN-2 — Amplifier mounting bracket (Optional)



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

MS-DIN-E — End plate (Optional)



Material: Polycarbonate

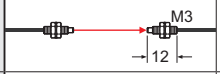
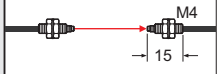
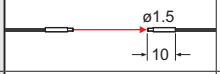
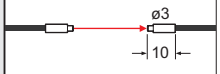
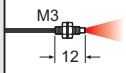
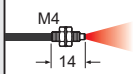
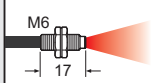
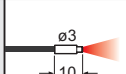
FX-250

LIST OF FIBERS

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

Super quality type

*Thru-beam type sensors are available as two pieces per set.

Type			Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length	Sensing range (mm in) (Note 2) FX-250 series	Sensing range (mm in) (Note 2) Other modes LONG FAST H-SPD	Beam axis dia. (mm)	Beam axis position / Inclination of beam axis	Optical transmission loss	Protection	Ambient temp.
Thru-beam	Threaded	M3		Tough Bending durability FT-30	R2	2 m (Note 3)	STD 400 15.748 H-PWR 1,350 53.150	650 25.591 210 8.268 75 2.953	ø0.5	150 µm / ±2°	±10 %	IP67	−55 to +80 °C
		M4		Tough Bending durability FT-40	R4		STD 1,200 47.244 H-PWR (Note 1) 3,600 141.732	1,700 66.929 530 20.866 190 7.480	ø1				
	Cylindrical	ø1.5		Tough Bending durability FT-S20	R2		STD 400 15.748 H-PWR 1,350 53.150	650 25.591 210 8.268 75 2.953	ø0.5				
		ø3		Tough Bending durability FT-S30	R4		STD 1,200 47.244 H-PWR (Note 1) 3,600 141.732	1,700 66.929 530 20.866 190 7.480	ø1				
Reflective	Threaded	M3		Tough Bending durability FD-30	R2	2 m (Note 3)	STD 160 6.299 H-PWR 600 23.622	250 9.843 80 3.150 25 0.984	—	150 µm / ±3°	±10 %	IP67	−55 to +80 °C
		M4		Tough Bending durability FD-40									
		M6		Tough Bending durability FD-60	R4		STD 520 20.472 H-PWR 1,550 61.024	740 29.134 260 10.236 90 3.543					
	Cylindrical	ø3		Tough Bending durability FD-S30			STD 160 6.299 H-PWR 600 23.622	250 9.843 80 3.150 25 0.984					

Notes: 1) The fiber cable length practically limits the sensing range.
2) The sensing range of reflective type is specified for white non-glossy paper.
3) It is not a free-cut type.

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

LIST OF FIBERS

Threaded type

*Thru-beam type sensors are available as two pieces per set.

Type	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂ : Free-cut	Sensing range (mm in) (Note 1) FX-250 series	Sensing range (mm in) (Note 1) Other modes: LONG FAST H-SPD	Beam axis dia. (mm)	Beam axis position / Inclination of beam axis	Protection	Ambient temp.
Thru-beam, Threaded, M3	M3, 12	Tough Bending durability **FT-31**	R2	✂ 2 m	STD 315 12.402 H-PWR 1,350 53.150	550 21.654 210 8.268 70 2.756	ø0.5	150 µm / ±2°	IP67	−55 to +80 °C
Thru-beam, Threaded, M3	M3, 12	**FT-31W**	R1	✂ 2 m	STD 260 10.236 H-PWR 990 38.976	440 17.323 150 5.906 53 2.087	ø0.5	150 µm / ±3°	IP67	−40 to +60 °C
Thru-beam, Threaded, M3	With lens, M3, 12	Tough Bending durability **FT-32**	R2	✂ 2 m	STD 3,000 118.110 H-PWR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 1,600 62.992 580 22.835	ø1.6	—	IP40	−40 to +70 °C
Thru-beam, Threaded, M4	Lens mountable, M4, 15	Bending durability **FT-43**	R4	✂ 2 m	STD 1,400 55.118 H-PWR (Note 2) 3,600 141.732	2,100 82.677 770 30.315 240 9.449	ø1.5	150 µm / ±2°	IP67	−55 to +80 °C
Thru-beam, Threaded, M4	Lens mountable, M4, 15	Tough Bending durability **FT-42**	R4	✂ 2 m	STD 1,130 44.488 H-PWR (Note 2) 3,600 141.732	1,600 62.992 530 20.866 190 7.480	ø1	150 µm / ±2°	IP67	−55 to +80 °C
Thru-beam, Threaded, M4	Lens mountable, M4, 15	**FT-42W**	R1	✂ 2 m	STD 800 31.496 H-PWR 3,300 129.921	1,400 55.118 490 19.291 160 6.299	ø1	150 µm / ±3°	IP67	−40 to +60 °C
Thru-beam, Threaded, M4	Lens mountable, Stainless-jacketed, M4, 20	**FT-45X**	R4	1 m	STD 1,200 47.244 H-PWR (Note 2) 1,600 62.992	1,600 62.992 (Note 2) 630 24.803 200 7.874	ø1	150 µm / ±2°	IP67	−55 to +80 °C
Thru-beam, Threaded, M4, Elbow	Lens mountable, 15, M4	Tough Bending durability **FT-R40**	R4	✂ 2 m	STD 930 36.614 H-PWR (Note 2) 3,600 141.732	1,500 59.055 500 19.685 160 6.299	ø1	150 µm / ±2°	IP67	−55 to +80 °C
Thru-beam, Threaded, M14, Long range	With expansion lens, M14, 40	Tough Bending durability **FT-140**	R4	✂ 10 m	STD (Note 2) 19,600 771.654 H-PWR (Note 2) 19,600 771.654	19,600 771.654 (Note 2) 16,000 629.921 6,300 248.031	ø10	—	IP67	−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 fiber cable length practically limits the sensing range.

LIST OF FIBERS

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

Threaded 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-250 series	Sensing range (mm in) (Note 1, 2) Other modes: LONG FAST H-SPD	Beam axis position / Inclination of beam axis	Protection	Ambient temp.
Reflective	Threaded	M3	M3 12	Tough Bending durability FD-31	R2	✂ 2 m	STD 125 4.921 H-PWR 515 20.276	220 8.661 80 3.150 25 0.984	150 µm / ±3°	IP67	−55 to +80 °C
			M3 12	FD-31W	R1		STD 80 3.150 H-PWR 330 12.992	140 5.512 45 1.772 12 0.472			−40 to +60 °C
			Coaxial, Lens mountable M3 17	Tough Bending durability FD-32G	R2		STD 200 7.874 H-PWR 650 25.591	270 10.630 95 3.740 27 1.063		IP40	−55 to +80 °C
			Coaxial, Lens mountable, Stainless-jacketed M3 18	FD-32GX	R2	✂ 1 m (Note 3)	STD 200 7.874 H-PWR 630 24.803	360 14.173 100 3.937 30 1.181	—		
			Coaxial, With lens M3 15	Tough Bending durability FD-34G	R2	✂ 2 m	STD 90 3.543 H-PWR 330 12.992	135 5.305 49 1.929 15 0.591			−40 to +70 °C
		Ultra-small diameter	Coaxial, Lens mountable M3 16	FD-EG30	R4	500 mm	STD 48 1.890 H-PWR 170 6.693	110 4.331 30 1.181 9 0.354			
			Coaxial, Lens mountable M3 16	FD-EG31			STD 20 0.787 H-PWR 85 3.346	35 1.378 12 0.472 3.5 0.138			−20 to +60 °C
		M4	M4 14	Tough Bending durability FD-41	R2	✂ 2 m	STD 125 4.921 H-PWR 515 20.276	220 8.661 80 3.150 25 0.984	150 µm / ±3°	IP67	−55 to +80 °C
			M4 14	FD-41W	R1		STD 270 10.630 H-PWR 900 35.433	430 16.929 150 5.906 45 1.772			−40 to +60 °C
			Coaxial, Lens mountable M4 25	Tough Bending durability FD-42G	R2		STD 200 7.874 H-PWR 650 25.591	270 10.630 95 3.740 27 1.063	—	IP40	−55 to +80 °C
			Coaxial, Lens mountable M4 25	FD-42GW	R1		STD 150 5.906 H-PWR 670 26.378	280 11.024 90 3.543 25 0.984			−40 to +60 °C
		M6	M6 17	Bending durability FD-62	R4		STD 520 20.472 H-PWR 1,500 59.055	940 37.008 340 13.386 110 4.331	150 µm / ±3°	IP67	−55 to +80 °C
			M6 17	Tough Bending durability FD-61			STD 450 17.717 H-PWR 1,400 55.118	670 26.378 200 7.874 70 2.756			
			M6 17	FD-61W	R1		STD 270 10.630 H-PWR 900 35.433	430 16.929 150 5.906 45 1.772	—		−40 to +60 °C
			Stainless-jacketed M6 22	FD-64X	R4	1 m	STD 280 11.024 H-PWR 670 26.378	410 16.142 160 6.299 50 1.969		IP40	−55 to +80 °C
		Elbow	15 M6	Tough Bending durability FD-R60	R4	✂ 2 m	STD 290 11.417 H-PWR 1,100 43.307	550 21.654 190 7.480 65 2.559	150 µm / ±3°	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.
3) The allowable cutting range is 700 mm 27.559 in from the end that the amplifier inserted.

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

LIST OF FIBERS

Square head type

*Thru-beam type sensors are available as two pieces per set.

Type			Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1, 3) FX-250 series	Sensing range (mm in) (Note 1, 3) Other modes: LONG FAST H-SPD	Beam axis dia. (Fiber Core) (mm)	Protection	Ambient temp.
Thru-beam	Square head	M3	W5.5 × H8 × D16	Tough Bending durability FT-R31	R2	2 m	STD 270 10.630 H-PWR 1,000 39.370	440 17.323 160 6.299 55 2.165	ø0.5	IP67	−55 to +80 °C
		M4	Lens mountable W7 × H9 × D13.5	Tough Bending durability FT-R43	R4		STD 720 28.346 H-PWR 3,000 118.110	1,100 43.307 430 16.929 130 5.118	ø1		
			Lens mountable (FX-LE2) W7 × H9 × D13.9	FT-R41W	R1		STD 800 31.496 H-PWR 3,200 125.984	1,400 55.118 460 18.110 150 5.906		IP40	−40 to +60 °C
			With expansion lens W7 × H9 × D14.4	FT-R42W			STD 2,200 86.614 H-PWR (Note2) 3,600 141.732	3,500 137.795 1,300 51.181 460 18.110	ø2.2		
		M4 Oil-resistant	Cable-protection type Lens mountable W7 × H9.5 × D15.5	Tough Bending durability FT-R44Y	R4		STD 720 28.346 H-PWR 3,000 118.110	1,100 43.307 430 16.929 130 5.118	ø1	IP67 (Note 4)	−55 to +80 °C
		M6 Oil-resistant	Full-protection type W10 × H11 × D21.2	Tough Bending durability FT-R60Y	R4		STD 2,100 82.677 H-PWR (Note2) 3,600 141.732	3,600 141.732 (Note 2) 1,260 49.606 400 15.748	ø3.5	IP68G	
Reflective	Square head	M3	Coaxial, Lens mountable W5.5 × H8 × D16	Tough Bending durability FD-R31G	R2	2 m	STD 170 6.693 H-PWR 530 20.866	260 10.236 85 3.346 27 1.063	Emitter ø0.5	IP40	−55 to +80 °C
			Coaxial, Lens mountable W5.5 × H8 × D16	FD-R32EG	R4	500 mm	STD 45 1.772 H-PWR 170 6.693	92 3.622 30 1.181 9 0.354	Emitter ø0.25		−40 to +70 °C
			Coaxial, Lens mountable W5.5 × H8 × D16	FD-R34EG			STD 38 1.496 H-PWR 130 5.118	70 2.756 23 0.906 7 0.276	Emitter ø0.175		−20 to +60 °C
			Coaxial, Lens mountable W5.5 × H8 × D16	FD-R33EG			STD 19 0.748 H-PWR 84 3.307	33 1.299 11 0.433 3 0.118	Emitter ø0.125		
		M4	W7 × H9 × D13.5	Tough Bending durability FD-R41	R2	2 m	STD 210 8.268 H-PWR 710 27.953	320 12.598 100 3.937 34 1.339	ø0.75	IP67	−55 to +80 °C
		M6 Oil-resistant	Cable-protection type W10 × H11 × D15.5	Tough Bending durability FD-R61Y	R4		STD 280 11.024 H-PWR 990 38.976	435 17.126 160 6.299 50 1.969	—	IP67 (Note 4)	

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 sensing range of reflective type is specified for white non-glossy paper.
4) The fiber part is oil-resistant.

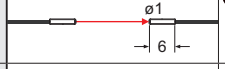
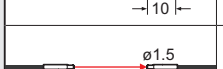
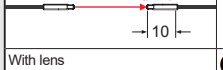
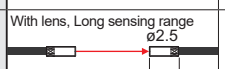
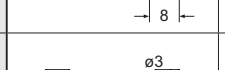
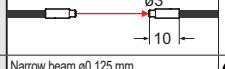
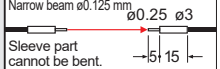
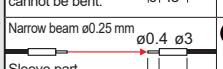
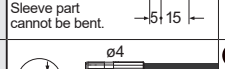
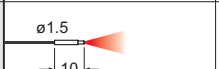
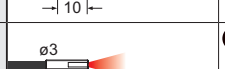
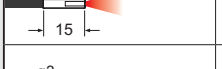
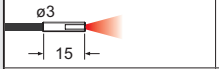
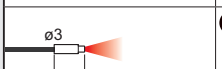
FX-250

LIST OF FIBERS

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

Cylindrical type

*Thru-beam type sensors are available as two pieces per set.

Type			Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂ : Free-cut	Sensing range (mm in) (Note 1 ,3) FX-250 series	Sensing range (mm in) (Note 1 ,3) Other modes: LONG FAST H-SPD	Beam axis dia. (mm)	Beam axis position / Inclination of beam axis	Protection	Ambient temp.
Thru-beam	Cylindrical	ø1		Tough Bending durability FT-S11	R2	500 mm	STD 90 3.543 H-PWR 350 13.780	160 6.299 60 2.362 19 0.748	ø0.25	—	IP67	−55 to +80 °C
		ø1·5		Tough Bending durability FT-S21			STD 315 12.402 H-PWR 1,350 53.150	550 21.654 210 8.268 70 2.756	ø0.5	150 µm / ±2°		
				FT-S21W	R1	2 m	STD 260 10.236 H-PWR 990 38.976	440 17.323 150 5.906 53 2.087		150 µm / ±3°		−40 to +60 °C
			With lens 	Tough Bending durability FT-S22			STD 450 17.717 H-PWR 1,500 59.055	730 28.740 250 9.843 90 3.543	ø0.7	—	IP40	−40 to +70 °C
		ø2·5	With lens, Long sensing range 	Bending durability FT-S32	R10		STD 3,100 122.047 H-PWR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 1,800 70.866 600 23.622	ø2			
		ø3		FT-S31W	R1		STD 800 31.496 H-PWR 3,300 129.921	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 ø0.125 mm  Sleeve part cannot be bent.	Tough Bending durability FT-E13	R2	1 m	STD 15 0.591 H-PWR 52 2.047	24 0.945 8 0.315 2 0.079	ø0.125	—		−40 to +70 °C
			Narrow beam ø0.25 mm  Sleeve part cannot be bent.	Tough Bending durability FT-E23			STD 75 2.953 H-PWR 270 10.630	125 4.921 42 1.654 13 0.512	ø0.25			
	Side-view	ø4		Tough Bending durability FT-V40	R4	2 m	STD 3,500 137.795 H-PWR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 2,400 94.488 850 33.465	ø2.5		IP50	−40 to +60 °C
Reflective	Cylindrical	ø1·5		Tough Bending durability FD-S23 NEW	R2	1 m	STD 46 1.811 H-PWR 130 5.118	65 2.559 20 0.787 7 0.276	—	—	IP40	−55 to +80 °C
		ø3		Tough Bending durability FD-S32	R4	2 m	STD 420 16.535 H-PWR 1,200 47.244	660 25.984 220 8.661 75 2.953	—	150 µm / ±3°	IP67	−40 to +60 °C
				FD-S32W	R1		STD 270 10.630 H-PWR 900 35.433	430 16.929 150 5.906 45 1.772		—		
				Tough Bending durability FD-S31	R2		STD 125 4.921 H-PWR 515 20.276	220 8.661 80 3.150 25 0.984		150 µm / ±3°		−55 to +80 °C
			Coaxial 	FD-S33GW	R1		STD 150 5.906 H-PWR 670 26.378	280 11.024 90 3.543 25 0.984	—		IP40	−40 to +60 °C
			Coaxial, With lens 	Tough Bending durability FD-S34G	R2		STD 90 3.543 H-PWR 330 12.992	135 5.305 49 1.929 15 0.591				−40 to +70 °C
	Ultra-small diameter	ø1·5	ø1.5 ø0.48  Sleeve part cannot be bent.	FD-E13	R4	1 m	STD 12 0.472 H-PWR 50 1.969	25 0.984 7 0.276 2 0.079				−40 to +60 °C
		ø3	Coaxial ø3 ø0.63  Sleeve part cannot be bent.	FD-E23			STD 55 2.165 H-PWR 170 6.693	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 fiber cable length practically limits the sensing range.
3) The sensing range of reflective type is specified for white non-glossy paper.

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

LIST OF FIBERS

Sleeve type

*Thru-beam type sensors are available as two pieces per set.

Type			Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1, 4) FX-250 series	Other modes: LONG FAST H-SPD	Beam axis dia. (mm)	Protection	Ambient temp.
Thru-beam	Cylindrical	Threaded M3	Sleeve 40 mm, M3, ø0.88, 10	Tough Bending durability FT-31S	R2 (Note 2)	✂ 2 m	STD 315 12.402; H-PWR 1,220 48.031	550 21.654; 195 7.677; 63 2.480	ø0.5	IP67	−55 to +80 °C
		Threaded M4	Sleeve 40 mm, M4, ø1.48, 12	Tough Bending durability FT-42S	R4 (Note 2)	✂ 2 m	STD 1,130 44.488; H-PWR (Note 3) 3,600 141.732	1,600 62.992; 530 20.866; 190 7.480	ø1	IP67	−55 to +80 °C
		Ultra-small diameter ø3	Narrow beam ø0.125 mm, ø0.25, ø3, Sleeve part cannot be bent., 5, 15	Tough Bending durability FT-E13	R2	✂ 1 m	STD 15 0.591; H-PWR 52 2.047	24 0.945; 8 0.315; 2 0.079	ø0.125	IP67	−40 to +70 °C
		Ultra-small diameter ø3	Narrow beam ø0.25 mm, ø0.4, ø3, Sleeve part cannot be bent., 5, 15	Tough Bending durability FT-E23	R2	✂ 1 m	STD 75 2.953; H-PWR 270 10.630	125 4.921; 42 1.654; 13 0.512	ø0.25	IP67	−40 to +70 °C
		Side-view ø2	ø1, ø2, Sleeve part cannot be bent., 20, 15	Tough Bending durability FT-V23	R4	✂ 2 m	STD 450 17.717; H-PWR 1,800 70.866	880 34.646; 280 11.024; 90 3.543	ø0.75	IP30	−55 to +80 °C
		Side-view ø2	ø1, ø2, Sleeve part cannot be bent., 15, 15	Tough Bending durability FT-V25	R2	✂ 2 m	STD 240 9.449; H-PWR 900 35.433	480 18.898; 140 5.512; 45 1.772	ø0.5	IP30	−55 to +80 °C
		Side-view ø2	ø1, ø2, Sleeve part cannot be bent., 15, 15	FT-V24W	R1	✂ 2 m	STD 110 4.331; H-PWR 380 14.961	200 7.874; 60 2.362; 20 0.787	ø0.5	IP30	−40 to +60 °C
		Side-view ø2.5	ø1.5, ø2.5, Sleeve part cannot be bent., 20, 15	Tough Bending durability FT-V30	R4	✂ 2 m	STD 680 26.772; H-PWR 2,200 86.614	1,000 39.370; 340 13.386; 100 3.937	ø1.0	IP30	−55 to +80 °C
Reflective	Cylindrical	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; H-PWR 170 6.693	80 3.150; 30 1.181; 9 0.354	—	IP40	−40 to +70 °C
		Threaded M4	Sleeve 40 mm, M4, ø1.48, 12	Tough Bending durability FD-41S	R2 (Note 2)	✂ 2 m	STD 125 4.921; H-PWR 515 20.276	220 8.661; 80 3.150; 25 0.984		IP67	−55 to +80 °C
		Threaded M4	Sleeve 40 mm, M4, ø1.48, 12	FD-41SW	R1 (Note 2)	✂ 2 m	STD 80 3.150; H-PWR 330 12.992	140 5.512; 45 1.772; 12 0.472		IP67	−40 to +60 °C
		Threaded M6	Sleeve 40 mm, M6, ø2.5, 15	Tough Bending durability FD-61S	R4 (Note 2)	✂ 2 m	STD 420 16.535; H-PWR 1,200 47.244	660 25.984; 220 8.661; 75 2.953		IP67	−55 to +80 °C
		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; H-PWR 50 1.969	25 0.984; 7 0.276; 2 0.079		IP40	−40 to +60 °C
		Ultra-small diameter ø3	Coaxial, ø3, ø0.63, 15, 5, Sleeve part cannot be bent.	FD-E23	R4	1 m	STD 55 2.165; H-PWR 170 6.693	80 3.150; 30 1.181; 9 0.354		IP40	−40 to +70 °C
		Side-view ø3	Small diameter, 15, 15, ø3, ø1.5, 2, Sleeve part cannot be bent.	Tough Bending durability FD-V30	R2	✂ 2 m	STD 65 2.559; H-PWR 240 9.449	120 4.724; 35 1.378; 14 0.551		IP30	−55 to +80 °C
		Side-view ø3	15, 15, ø3, ø1.5, 2, Sleeve part cannot be bent.	FD-V30W	R1	✂ 2 m	STD 20 0.787; H-PWR 80 3.150	30 1.181; 10 0.394; 2 0.079		IP30	−40 to +60 °C
		Side-view ø5	15, 20, ø5, ø2, 4.3, Sleeve part cannot be bent.	Tough Bending durability FD-V50	R4	✂ 2 m	STD 120 4.724; H-PWR 370 14.567	210 8.268; 75 2.953; 25 0.984		IP30	−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) Bending radius of sleeve part is R10 mm R0.394 in or more.
3) The fiber cable length practically limits the sensing range.
4) The sensing range of reflective type is specified for white non-glossy paper.

FX-250

LIST OF FIBERS

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

Flat type

*Thru-beam type sensors are available as two pieces per set.

Type	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂ : Free-cut	Sensing range (mm in) (Note 1, 3) FX-250 series	Sensing range (mm in) (Note 1, 3) Other models LONG FAST H-SPD	Beam axis dia. (mm)	Protection	Ambient temp.
Thru-beam Flat	Top sensing W3 × H8 × D12	Tough Bending durability FT-Z30H	R2	2 m	STD 3,500 137.795 H-PWR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 2,600 102.362 810 31.890	2 × 3	IP40	−40 to +60 °C
	Top sensing W3 × H8 × D12	FT-Z30HW	R1						
	Side sensing W3 × H12 × D8	Tough Bending durability FT-Z30E	R2		STD 3,500 137.795 H-PWR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 2,400 94.488 740 29.134			
	Side sensing W3 × H12 × D8	FT-Z30EW	R1		STD 3,400 133.858 H-PWR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 2,000 78.740 630 24.803			
	Front sensing W8.5 × H12 × D3	Tough Bending durability FT-Z30	R2		STD 2,100 82.677 H-PWR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 1,200 47.244 410 16.142	ø2		
	Front sensing W8.5 × H12 × D3	FT-Z30W	R1		STD 1,500 59.055 H-PWR (Note 2) 3,600 141.732	3,200 125.984 1,000 39.370 280 11.024			
With boss	Front sensing W10 × H7 × D2	FT-Z20W		1 m	STD 620 24.409 H-PWR (Note 2) 1,600 62.992	1,100 43.307 420 16.535 130 5.118	ø1.5		
	Fiber guide type W2 × H10 × D10	FT-Z20HBW			STD 260 10.236 H-PWR 1,100 43.307	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 H-PWR (Note 2) 3,600 141.732	2,300 90.551 900 35.433 290 11.417	ø1.5	IP40	
	Fiber guide type W3.5 × H14 × D11	FT-Z40HBW			STD 800 31.496 H-PWR 3,300 129.921	1,400 55.118 490 19.291 160 6.299	ø1	IP67	
Chemical-resistant	Easy mounting, Rectangular head SEMI S2 compliant (Note 4) Metal-free W7 × H15 × D13	Tough Bending durability FT-Z802Y	R4		STD 3,100 122.047 H-PWR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 1,900 74.803 470 18.504	ø3.7	IP68G	0 to +60 °C
Reflective Flat	Front sensing W10 × H7 × D2	FD-Z20W	R1	1 m	STD 1 to 65 0.039 to 2.559 H-PWR 260 10.236	130 5.118 2 to 45 0.079 to 1.772 5 to 13 0.197 to 0.512	—	IP40	−40 to +60 °C
With boss	Fiber guide type W2 × H10 × D10	FD-Z20HBW			STD 2 to 85 0.079 to 3.346 H-PWR 1 to 340 0.039 to 13.386	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 H-PWR 790 31.102	390 15.354 1 to 120 0.039 to 4.724 2 to 35 0.079 to 1.378		IP40	
	Fiber guide type W3.5 × H14 × D11	FD-Z40HBW			STD 260 10.236 H-PWR 760 29.921	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 fiber cable length practically limits the sensing range.
3) The sensing range of reflective type is specified for white non-glossy paper.
4) The design takes into account the environmental testing required by SEMI S2. To ensure that the final system complies with the standards, you must design and use it in accordance with relevant standards, laws, and regulations.

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

LIST OF FIBERS

Convergent 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-250 series	Sensing range (mm in) (Note 1, 2) Other modes: LONG / FAST / H-SPD	Protection	Ambient temp.
Convergent reflective	Glass substrate detection	Mapping W25 × H7.3 × D30	Bending durability **FD-L32H**	R4	✂ 4 m	STD 0 to 56 0 to 2.205 H-PWR 0 to 110 0 to 4.331	0 to 74 0 to 2.913 1 to 38 0.039 to 1.496 Cannot use	IP40	−40 to +60 °C
		Alignment W20 × H29 × D3.8	Tough Bending durability **FD-L30A**	R2	✂ 3 m	STD 0 to 43 0 to 1.693 H-PWR 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
		Alignment W23.5 × H29 × D4.5	Tough Bending durability **FD-L31A**	R4		STD 4 to 33 0.157 to 1.299 H-PWR 3 to 35 0.118 to 1.378	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 Bending durability **FD-L24A** NEW	R2	✂ 2 m	STD 0 to 23 0 to 0.906 H-PWR 0 to 31 0 to 1.220	0 to 26 0 to 1.024 0 to 22 0 to 0.866 0 to 18 0 to 0.709		
		Seating confirmation W18 × H29 × D3.8	Tough Bending durability **FD-L25** NEW		✂ 3 m	STD 0 to 29 0 to 1.142 H-PWR 0 to 30 0 to 1.181	0 to 30 0 to 1.181 0 to 28 0 to 1.102 2 to 23 0.079 to 0.906		−20 to +70 °C
		Seating confirmation W12 × H19 × D3	Tough Bending durability **FD-L11**	R4	✂ 2 m	STD 0 to 9.5 0 to 0.374 H-PWR 0 to 11.5 0 to 0.453	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 Bending durability **FD-L10**			STD 0 to 5 0 to 0.197 H-PWR 0 to 6 0 to 0.236	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 Bending durability **FD-L21**	R2		STD 1.5 to 16 0.059 to 0.630 H-PWR 1 to 19 0.039 to 0.748	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 H-PWR 1.5 to 15 0.059 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 Bending durability **FD-L20H**	R2		STD 0 to 23 0 to 0.906 H-PWR 0 to 45 0 to 1.772	0 to 32 0 to 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 0 to 8 0 to 0.315 H-PWR 0 to 14 0 to 0.551	0 to 12 0 to 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

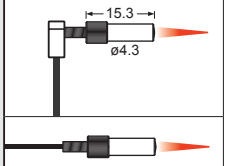
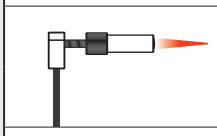
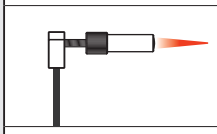
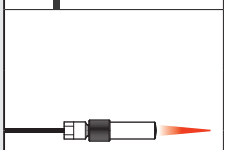
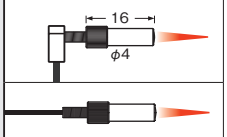
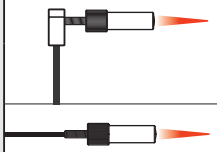
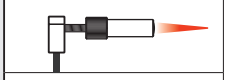
Notes: 1) Note that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
2) The sensing range is specified for transparent glass 100 × 100 × t0.7 mm 3.937 × 3.937 × t0.028 in (**FD-L32H**: R edge, **FD-L21** and **FD-L21W**: t2 mm t0.079 in) (**FD-L20H**: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

LIST OF FIBERS

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

Small spot

Reflective type fiber & spot lens

Designation	Shape of head (mm)	Spot diameter (mm in) (Note 1)	Sensing range (mm in) (Note 1)	Lens		Applicable fibers				
				Model No.	Ambient temp.	Model No.	Fiber cable length ✂: Free-cut (Note 2)	Bending radius (mm)	Protection	Ambient temp.
Finest spot lens		ø0.1 ø0.004 approx.	Distance to focal point 7 ±0.5 0.276 ±0.020	FX-MR7	−55 to +70 °C	FD-R33EG	500 mm	R4	IP40	−20 to +60 °C
						FD-EG31				
		ø0.15 ø0.006 approx.				FD-R34EG				
		ø0.2 ø0.008 approx.				FD-R32EG				−40 to +70 °C
						FD-EG30				
		ø0.4 ø0.016 approx.				Tough Bending durability FD-R31G		R2		−55 to +80 °C
						Tough Bending durability FD-42G	2 m			
						FD-42GW		R1		−40 to +60 °C
						Tough Bending durability FD-32G		R2		−55 to +80 °C
						FD-32GX	✂1 m (Note 3)			
		ø0.1 ø0.004 approx.	Distance to focal point 7 ±0.5 0.276 ±0.020	FX-MR6	−20 to +60°C	FD-R33EG	500 mm	R4		−20 to +60°C
						FD-EG31				
		ø0.15 ø0.006 approx.				FD-R34EG				
		ø0.2 ø0.008 approx.				FD-R32EG				−40 to +70°C
						FD-EG30				
		ø0.4 ø0.016 approx.				Tough Bending durability FD-R31G		R2		−55 to +80°C
						Tough Bending durability FD-42G	2 m			
						FD-42GW		R1		−40 to +60°C
						Tough Bending durability FD-32G		R2		−55 to +80°C
						FD-32GX	✂1 m (Note 3)			

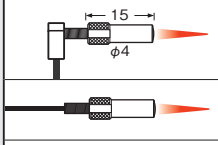
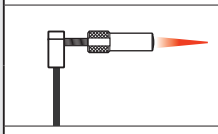
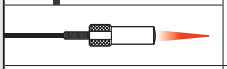
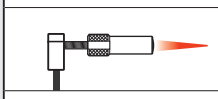
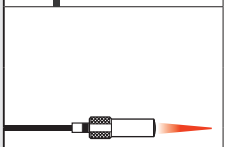
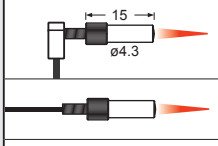
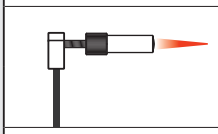
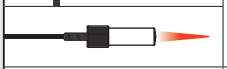
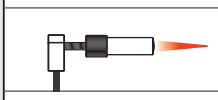
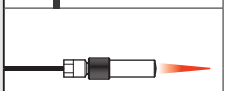
Notes: 1) Spot diameter, sensing range and distance to focal point are specified for **FX-250** series.
2) Note that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
3) The allowable cutting range is 700 mm 27.559 in from the end that the amplifier inserted.

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

LIST OF FIBERS

Small spot

Reflective type fiber & spot lens

Designation	Shape of head (mm)	Spot diameter (mm in) (Note 1)	Sensing range (mm in) (Note 1)	Lens		Applicable fibers				
				Model No.	Ambient temp.	Model No.	Fiber cable length ✂: Free-cut (Note 2)	Bending radius (mm)	Protection	Ambient temp.
Finest spot lens		ø0.15 ø0.006 approx.	Distance to focal point 7.5 ±0.5 0.295 ±0.020	FX-MR3	−40 to +70 °C	FD-R33EG	500 mm	R4	IP40	−20 to +60 °C
						FD-EG31				
		ø0.2 ø0.008 approx.				FD-R34EG				
		ø0.3 ø0.012 approx.				FD-R32EG				−40 to +70 °C
						FD-EG30				
		ø0.5 ø0.020 approx.				Tough Bending durability FD-R31G		R2		−55 to +80 °C
						Tough Bending durability FD-42G	✂ 2 m			
						FD-42GW		R1		−40 to +60 °C
						Tough Bending durability FD-32G		R2		−55 to +80 °C
						FD-32GX	✂ 1 m (Note 3)			
Zoom lens		ø0.4 to ø2.0 ø0.016 to ø0.079 approx.	10 to 30 0.394 to 1.181	FX-MR8	−55 to +70 °C	FD-R33EG	500 mm	R4		−20 to +60 °C
						FD-EG31				
		ø0.4 to ø2.2 ø0.016 to ø0.087 approx.				FD-R34EG				
		ø0.5 to ø2.5 ø0.020 to ø0.098 approx.				FD-R32EG				−40 to +70 °C
						FD-EG30				
		ø0.8 to ø3.5 ø0.031 to ø0.138 approx.				Tough Bending durability FD-R31G	✂ 2 m	R2		−55 to +80 °C
						Tough Bending durability FD-32G				
						FD-32GX	✂ 1 m (Note 3)			

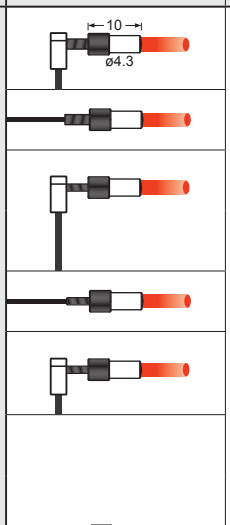
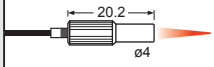
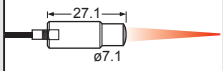
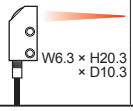
Notes: 1) Spot diameter, sensing range and distance to focal point are specified for **FX-250** series.
2) Note that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
3) The allowable cutting range is 700 mm 27.559 in from the end that the amplifier inserted.

LIST OF FIBERS

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

Small spot

Reflective type fiber & spot lens

Designation	Shape of head (mm)	Spot diameter (mm in) (Note 1)	Sensing range (mm in) (Note 1)	Lens		Applicable fibers				
				Model No.	Ambient temp.	Model No.	Fiber cable length ✂: Free-cut (Note 2)	Bending radius (mm)	Protection	Ambient temp.
Parallel light lens		ø4 ø0.157 approx.	0 to 30 0 to 1.181	FX-MR9	−55 to +70 °C	FD-R33EG	500 mm	R4	IP40	−20 to +60 °C
						FD-EG31				
						FD-R34EG				
						FD-R32EG				−40 to +70 °C
						FD-EG30				
						Tough Bending durability FD-R31G		R2		−55 to +80 °C
						Tough Bending durability FD-42G	✂ 2 m			
						FD-42GW		R1		−40 to +60 °C
						Tough Bending durability FD-32G		R2		−55 to +80 °C
						FD-32GX	✂ 1 m (Note 3)			
Pinpoint spot lens		ø0.5 ø0.020	Distance to focal point 6 ±1 0.236 ±0.039	FX-MR1	−40 to +70 °C	Tough Bending durability FD-42G	✂ 2 m	R2		−55 to +80 °C
						FD-42GW		R1		−40 to +60 °C
Zoom lens		ø0.7 to ø2.0 ø0.028 to ø0.079 approx.	Distance to focal point 18.5 to 43 0.728 to 1.693 approx.	FX-MR2	−40 to +70 °C	Tough Bending durability FD-42G		R2		−55 to +80 °C
						FD-42GW		R1		−40 to +60 °C
Zoom lens (Side-view type)		ø0.5 to ø3.0 ø0.020 to ø0.118 approx.	Distance to focal point 13 to 30 0.512 to 1.181 approx.	FX-MR5	−40 to +60 °C	Tough Bending durability FD-42G		R2		−55 to +80 °C
						FD-42GW		R1		−40 to +60 °C

Notes: 1) Spot diameter, sensing range and distance to focal point are specified for **FX-250** series.
2) Note that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
3) The allowable cutting range is 700 mm 27.559 in from the end that the amplifier inserted.

LIST OF FIBERS

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

Narrow beam

*Thru-beam type sensors are available as two pieces per set.

Type	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1, 3, 4) FX-250 series	Other modes: LONG FAST H-SPD	Beam axis dia. (mm)	Inclination of beam axis	Protection	Ambient temp.
Thru-beam, Narrow beam, Side-view	Aperture angle 2° ø3.5 ø3.7 20	Tough Bending durability FT-KS40	R2	2 m	STD (Note 2) 3,600 141.732 H-PWR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,600 141.732 (Note 2) 1,200 47.244	ø2.2	—	IP40	−40 to +80 °C
	Aperture angle 2° ø4 25	Tough Bending durability FT-KV40			STD (Note 2) 3,600 141.732 H-PWR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,100 122.047 (Note 2) 940 37.008	ø2.5	±0.8°	IP30	
	Aperture angle 2° ø4 25	FT-KV40W	R1		STD (Note 2) 3,600 141.732 H-PWR (Note 2) 3,600 141.732	3,600 141.732 (Note 2) 3,100 122.047 940 37.008				−40 to +60 °C
	Aperture angle 3° 1.5 × 2 20	Tough Bending durability FT-KV26	R2		STD 710 27.953 H-PWR 2,500 98.425	1,200 47.244 440 17.323 160 6.299	ø1	X ±1° Z ±0.5°		−40 to +80 °C
	Aperture angle 3° 1.5 × 2 20	FT-KV26H1	R10		STD 630 24.803 H-PWR 2,200 86.614	1,070 42.126 390 15.354 135 5.315				−40 to +105 °C
Retroreflective, 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 H-PWR 100 to 1,900 3.937 to 74.803	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
Ultra-narrow beam	W7.5 × H2.2 × D11.2 Aperture angle 3° (emitter) W4 × H2 × D21.5	Tough Bending durability FR-KZ22E	R2		STD 15 to 310 0.591 to 12.205 H-PWR 15 to 570 0.591 to 22.441	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 Bending durability FR-KZ50H			STD 20 to 300 0.787 to 11.811 H-PWR 20 to 1,000 0.787 to 39.370	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 Bending durability FR-KZ50E								
Reflective, Long range	W5.2 × H9.5 × D16	FD-Z50HW	R1	2 m	STD 10 to 650 0.394 to 25.591 H-PWR 10 to 2,500 0.394 to 98.425	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

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 sensing range of retroreflective type is the possible setting range for the attached reflector. The fiber can detect an object less than setting range for the reflector. Refer to the next page for the sensing range when **FR-Z50HW** is used in combination with a reflector (optional).
4) The sensing range of reflective type is specified for white non-glossy paper.

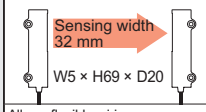
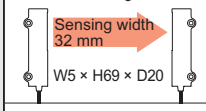
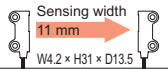
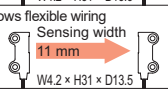
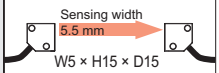
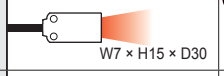
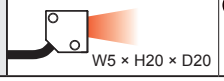
FX-250

LIST OF FIBERS

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

Wide beam

*Thru-beam type sensors are available as two pieces per set.

Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Sensing range (mm in) (Note 1, 4) FX-250 series	Sensing range (mm in) (Note 1, 4) Other modes LONG FAST H-SPD	Beam axis dia. (mm)	Protection	Ambient temp.
Thru-beam	Wide beam		Tough Bending durability **FT-A32** (Note 2)	R2	✂ 2 m	STD (Note 3) 3,600 141.732 H-PWR (Note 3) 3,600 141.732	3,600 141.732 (Note 3) 3,600 141.732 (Note 3) 2,100 82.677	3.2 × 32	IP40	−40 to +60 °C
		Allows flexible wiring 	**FT-A32W** (Note 2)	R1		STD (Note 3) 3,600 141.732 H-PWR (Note 3) 3,600 141.732	3,600 141.732 (Note 3) 3,600 141.732 (Note 3) 3,000 118.110			−40 to +55 °C
			Tough Bending durability **FT-A11** (Note 2)	R2		STD (Note 3) 3,600 141.732 H-PWR (Note 3) 3,600 141.732	3,600 141.732 (Note 3) 3,600 141.732 (Note 3) 1,100 43.307	2.2 × 11		−40 to +70 °C
		Allows flexible wiring 	**FT-A11W** (Note 2)	R1		STD (Note 3) 3,600 141.732 H-PWR (Note 3) 3,600 141.732	3,600 141.732 (Note 3) 3,600 141.732 (Note 3) 1,300 51.181			−40 to +55 °C
	Array		Tough Bending durability **FT-AL05**	R2		STD 860 33.858 H-PWR 2,300 90.551	1,500 59.055 500 19.685 170 6.693	0.25 × 5.5		−55 to +80 °C
Reflective	Wide beam		Tough Bending durability **FD-A16**	R4	✂ 2 m	STD 200 7.874 H-PWR Cannot use	200 7.874 140 5.512 75 2.953	—	IP40	−40 to +60 °C
	Array		Tough Bending durability **FD-AL12** NEW	R2		STD 270 10.630 H-PWR 670 26.378	420 16.535 150 5.906 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 slit mask (accessory) is sold separately. Refer to the last page for more details.
3) The fiber cable length practically limits the sensing range.
4) The sensing range of reflective type is specified for white non-glossy paper.

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

LIST OF FIBERS

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-250 series	Sensing range (mm in) (Note 1, 2) Other modes: LONG FAST H-SPD	Protection	Ambient temp.
Retroreflective	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 H-PWR 100 to 1,900 3.937 to 74.803	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
	Ultra-narrow beam	W7.5 × H2.2 × D11.2 / Aperture angle 3° (emitter) / W4 × H2 × D21.5	Tough Bending durability FR-KZ22E			STD 15 to 310 0.591 to 12.205 H-PWR 15 to 570 0.591 to 22.441	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 Bending durability FR-KZ50H	R2		STD 20 to 300 0.787 to 11.811 H-PWR 20 to 1,000 0.787 to 39.370	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 Bending durability 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.

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

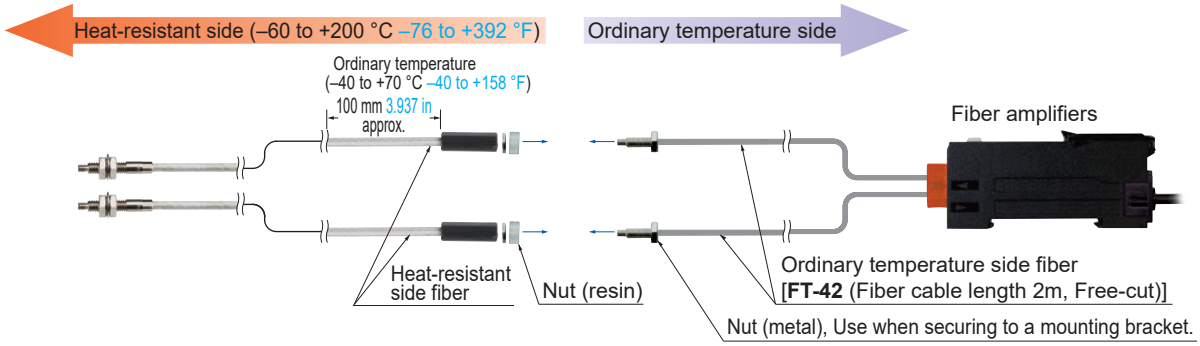
Reflector model No.	Sensing range (mm in) FX-250 series H-PWR	LONG	STD	FAST	H-SPD
RF-230	100 to 19,000 3.937 to 748.030	100 to 5,000 3.937 to 196.850	100 to 3,600 3.937 to 141.732	100 to 2,900 3.937 to 114.173	100 to 1,400 3.937 to 55.118
RF-220	100 to 8,000 3.937 to 314.960	100 to 3,500 3.937 to 137.795	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 2,400 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.

LIST OF FIBERS

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

<Heat-resistant joint fiber set contents>



Heat-resistant

*Thru-beam type sensors are available as two pieces per 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-250 series	Sensing range (mm in) (Note 1) Other models: LONG FAST H-SPD	Beam axis dia. (mm)	Ambient temp.
Thru-beam	Heat-resistant	350 °C	Lens mountable (FX-LE1/LE2/SV1) M4 30	FT-H35-M2	R25	2 m	STD 430 16.929 H-PWR 1,200 47.244	670 26.378 250 9.843 80 3.150	ø1.2	−60 to +350 °C
			Sleeve 60 mm M4 ø2.1 27	FT-H35-M2S6	Fiber R25 Sleeve R10					
		200 °C	Allows flexible wiring Lens mountable (FX-LE1/LE2/SV1) M4 23	FT-H20W-M1	R10	1 m	STD 470 18.504 H-PWR (Note2) 1,600 62.992	840 33.071 300 11.811 90 3.543	ø0.8	−60 to +200 °C
			Lens mountable (FX-LE1/LE2/SV1) M4 23	FT-H20-M1	R25		STD 540 21.260 H-PWR (Note2) 1,600 62.992	960 37.795 330 12.992 110 4.331	ø1.2	
		130 °C	Lens mountable (FX-LE2 only) M4 16	FT-H13-FM2		✂ 2 m	STD 700 27.559 H-PWR 3,300 129.921	1,300 51.181 410 16.142 140 5.512	ø1.5	−60 to +130 °C
	Heat-resistant (joint)	200 °C	Lens mountable (FX-LE1/LE2/SV1) M4 23	FT-H20-J20-S (Note 5)	Heat-resistant side R18 (Note 4)	✂ 200 mm (Note 3)	STD 470 18.504 H-PWR 1,600 62.992	790 31.102 300 11.811 90 3.543	ø1.2	−60 to +200 °C
				FT-H20-J30-S (Note 5)		✂ 300 mm (Note 3)				
				FT-H20-J50-S (Note 5)		✂ 500 mm (Note 3)				
			Side-view 24 ø3.8 ø4	FT-H20-VJ50-S (Note 5)			STD 600 23.622 H-PWR 2,100 82.677	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-resistant 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.

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

LIST OF FIBERS

Heat-resistant

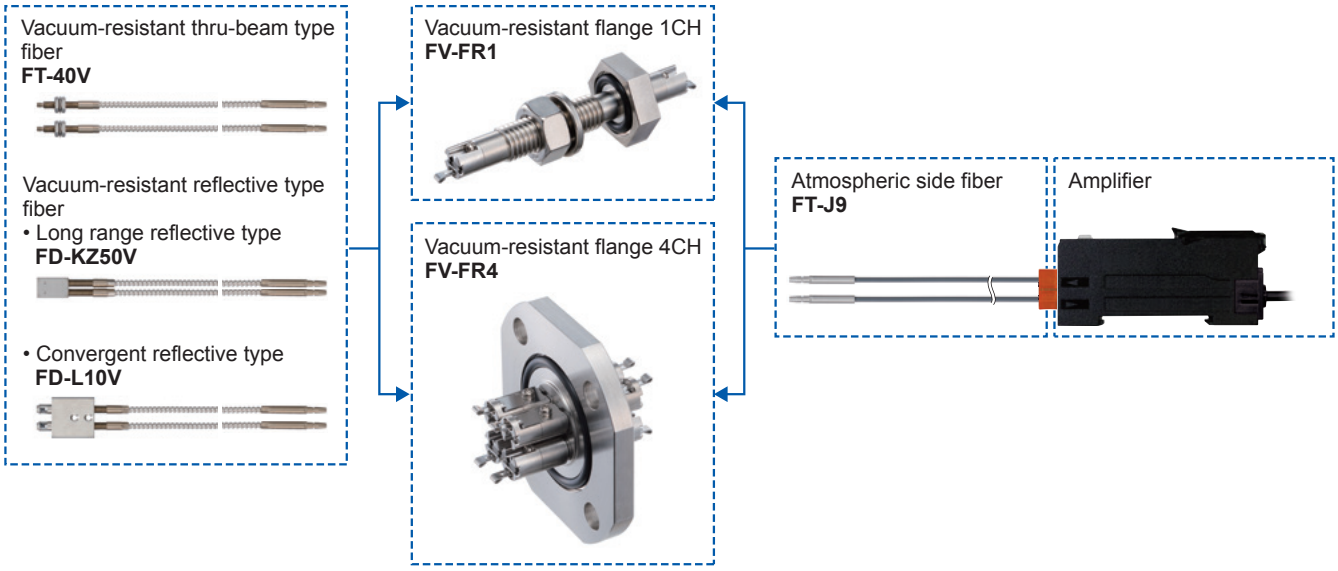
Type	Heat-resistant temp.	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂ : Free-cut	Sensing range (mm in) (Note 1, 2) FX-250 series	Sensing range (mm in) (Note 1, 2) Other modes: LONG FAST H-SPD	Ambient temp.
Reflective / Heat-resistant / Threaded	350 °C	Coaxial M6, 25	**FD-H35-M2**	R25	2 m	STD 260 10.236 H-PWR 720 28.346	460 18.110 150 5.906 45 1.772	−60 to +350 °C
		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 H-PWR 840 33.071	440 17.323 140 5.512 45 1.772	
	200 °C	Coaxial M6, 28	**FD-H20-M1**			STD 330 12.992 H-PWR 840 33.071	500 19.685 200 7.874 55 2.165	−60 to +200 °C
		Coaxial M4, 27	**FD-H20-21**			STD 230 9.055 H-PWR 770 30.315	380 14.961 130 5.118 45 1.772	
	130 °C	M6, 21	**FD-H13-FM2**		✂ 2 m	STD 350 13.780 H-PWR 880 34.646	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**	R25	2 m	STD 0 to 17 0 to 0.669 H-PWR 0 to 40 0 to 1.575	0 to 25 0 to 0.984 0 to 12 0 to 0.472 1.5 to 6 0.059 to 0.236	−60 to +300 °C
	250 °C	W21 × H33.2 × D5	**FD-H25-L43**		3 m	STD 1.5 to 26 0.059 to 1.024 H-PWR 1 to 31 0.039 to 1.220	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)
		W21 × H34.5 × D5	**FD-H25-L45**			STD 5 to 42 0.197 to 1.654 H-PWR 4 to 43.5 0.157 to 1.713	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 0 to 16 0 to 0.630 H-PWR 0 to 60 0 to 2.362	0 to 24 0 to 0.945 0 to 13 0 to 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

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

<One-touch connection system compatible with 4CH / 1CH flange Vacuum-resistant fiber set contents>



Vacuum-resistant (One-touch connection system compatible with 4CH / 1CH flange)

*Thru-beam type sensors are available as two pieces per set.

Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length	Sensing range (mm in) (Note 3) FX-250 series	Sensing range (mm in) (Note 3) Other modes: LONG / FAST / H-SPD	Beam axis dia. (mm)	Ambient temp.
Thru-beam	Vacuum-resistant	300 °C, Lens mountable (FV-LE1/SV1/SV2) M4, ← 30 →	FT-40V	R25	1 m (Note 2)	STD: 270 10.630; H-PWR: 1,000 39.370	470 18.504; 160 6.299; 55 2.165	ø1.3	-30 to +300 °C
Long range reflective	Vacuum-resistant	300 °C, Rectangular head, W9.5 × H5.2 × D15	FD-KZ50V	R25	1 m (Note 2)	STD: 20 to 200 0.787 to 7.874; H-PWR: 5 to 500 0.197 to 19.685	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
Convergent reflective	Vacuum-resistant	300 °C, Glass substrate detection, W19 × H5 × D27	FD-L10V	R25	3 m (Note 2)	STD: 0 to 8 0 to 0.315; H-PWR: 0 to 18 0 to 0.709	0 to 10 0 to 0.394; 0 to 5.5 0 to 0.217; 1.5 to 3 0.059 to 0.118	—	-30 to +300 °C

Notes: 1) Atmospheric side fiber is optional and sold separately.
2) This is not a “free-cut” type. We offer only semi-custom products in which the fiber length can be specified in 100 mm 3.937 in increments. For details, please contact our sales office.
3) The sensing range is the value for transparent glass 100 × 100 × t0.7 mm 3.937 × 3.937 × t0.028 in.
4) Please refer to p.32 for lenses that can be installed on the **FT-40V**.

Atmospheric side (one pair set)

Type	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Ambient temp.
Atmospheric side	ø3.7 × 30	Tough Bending durability FT-J9	R4	✂ 2 m (Note 1, 2)	-30 to +80 °C

Notes: 1) We offer only semi-custom products in which the fiber length can be specified in 1 m 3.280 ft increments. For details, please contact our sales office.
2) Note that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

LIST OF FIBERS

Vacuum-resistant flange

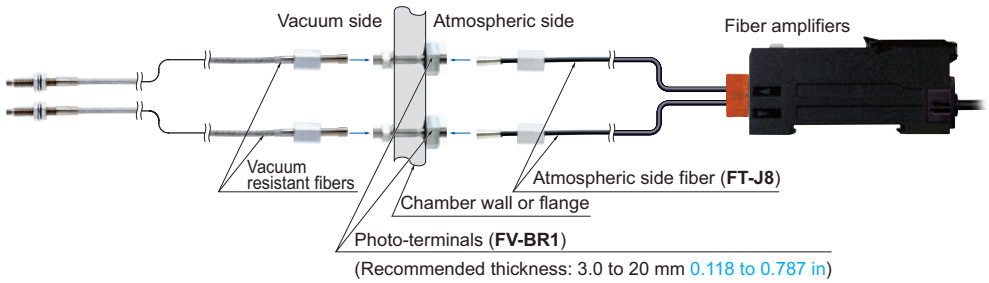
Designation	Model No.	Description
Vacuum-resistant flange 1CH	**FV-FR1**	 Atmospheric side and vacuum side are isolated. Main specifications
Vacuum-resistant flange 4CH	**FV-FR4**	

Model No.	FV-FR1	FV-FR4
Applicable fibers	**FT-40V**, **FD-KZ50V**, **FD-L10V**, **FT-J9**	
Leakage	1.0×10^{-10} Pa·m³/s [He] or less (* Measured with a He detector)	
Ambient temperature	-30 to +120°C -22 to +248°F (Same for storage. Up to +40 °C +104°F when humidity is high. However, no dew condensation or icing allowed.)	
Ambient humidity	35 to 85% RH (Same for storage)	
Tightening torque	Nut: 14.7 N·m or less (M14 nut)	9.8 N·m or less (M8 screw)
Tensile strength	20 N or less (Atmospheric / vacuum side fiber joint)	
O-ring size	V15	V40
Weight	100 g approx.	410 g approx.
Material	Main unit: Stainless steel (SUS303), Holding bracket: Stainless steel (SUS301), Fiber: Quartz glass, O-ring: Fluororubber	

Recommended thickness of vacuum chamber wall
• For **FV-FR1**: 3.0 to 40.0 mm 0.118 to 1.575 in (Note 1)
• For **FV-FR4**: 3.0 mm 0.118 in or more (Note 2)

Notes: 1) Confirm the wall thickness in advance since the **FV-FR1** cannot be installed to a vacuum chamber with a wall thickness outside the recommended thickness range.
2) If the vacuum chamber wall is too thick, the **FV-FR4** may not be able to connect to the vacuum side fiber. In that case, connect the **FV-FR4** to the vacuum side fiber before the installation.

<Vacuum-resistant fiber set contents>



Vacuum-resistant

*Thru-beam type sensors are available as two pieces per set.

Type		Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length	Sensing range (mm in) (Note 3) FX-250 series	Sensing range (mm in) (Note 3) Other modes (LONG FAST H-SPD)	Beam axis dia. (mm)	Ambient temp.
Thru-beam	Vacuum-resistant	300 °C Lens mountable (**FV-LE1/SV2**) M4, 30	**FT-H30-M1V-S** (Note 1)	R18	1 m (Note 2)	STD 270 10.630; H-PWR 1,000 39.370	470 18.504; 160 6.299; 55 2.165	ø1.2	−30 to +300 °C
Reflective	Vacuum-resistant	300 °C, Rectangular head, W9.5 × H5.2 × D15	**FD-H30-KZ1V-S** (Note 1)	R18	1 m (Note 2)	STD 20 to 200 0.787 to 7.874; H-PWR 5 to 500 0.197 to 19.685	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
Convergent reflective	Vacuum-resistant	300 °C, Glass substrate detection, W19 × H5 × D27	**FD-H30-L32V-S** (Note 1)	R18	3 m (Note 2)	STD 0 to 8 0 to 0.315; H-PWR 0 to 18 0 to 0.709	0 to 10 0 to 0.394; 0 to 5.5 0 to 0.217; 1.5 to 3 0.059 to 0.118	—	−30 to +300 °C

Notes: 1) Sold as a set comprising vacuum type fiber + photo-terminal (**FV-BR1**) + fiber at atmospheric side (**FT-J8**).
2) This is not a “free-cut” type.
3) The sensing range is the value for transparent glass 100 × 100 × t0.7 mm 3.937 × 3.937 × t0.028 in.

FX-250

LIST OF FIBERS

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

Oil-resistant

*Thru-beam type sensors are available as two pieces per 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-250 series	Sensing range (mm in) (Note 1, 2) Other modes LONG FAST H-SPD	Beam axis dia. (mm)	Protection	Ambient temp.
Thru-beam, Oil-resistant, Square head type, M6	Full-protection type W10 × H11 × D21.2	Tough Bending durability **FT-R60Y**	R4	2 m	STD 2,100 82.677 H-PWR (Note 3) 3,600 141.732	3,600 141.732 (Note 3) 1,260 49.606 400 15.748	ø3.5	IP68G	−55 to +80 °C
Thru-beam, Oil-resistant, Square head type, M4	Cable-protection type Lens mountable W7 × H9.5 × D15.5	Tough Bending durability **FT-R44Y**	R4	2 m	STD 720 28.346 H-PWR 3,000 118.110	1,100 43.307 430 16.929 130 5.118	ø1	IP67 (Note 4)	−55 to +80 °C
Reflective, Oil-resistant, Square head type, M6	Cable-protection type W10 × H11 × D15.5	Tough Bending durability **FD-R61Y**	R4	2 m	STD 280 11.024 H-PWR 990 38.976	435 17.126 160 6.299 50 1.969	—	IP67 (Note 4)	−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 of reflective type is specified for white non-glossy paper.
3) The fiber cable length practically limits the sensing range.
4) The fiber part is oil-resistant.

Chemical-resistant

*Thru-beam type sensors are available as two pieces per set.

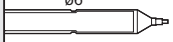
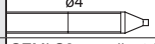
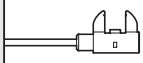
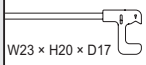
Type	Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂ : Free-cut	Sensing range (mm in) (Note 1, 2) FX-250 series	Sensing range (mm in) (Note 1, 2) Other modes LONG FAST H-SPD	Beam axis dia. (mm)	Protection	Ambient temp.
Thru-beam, Chemical-resistant, Flat type	Easy mounting • Rectangular head SEMI S2 compliant (Note 5) Metal-free W7 × H15 × D13	Tough Bending durability **FT-Z802Y**	R4	2 m	STD 3,100 122.047 H-PWR (Note 3) 3,600 141.732	3,600 141.732 (Note 3) 1,900 74.803 470 18.504	ø3.7	IP68G	0 to +60 °C
Thru-beam, Chemical-resistant, Cylindrical type	Heat-resistant 115 °C Metal-free ø5.5 (25)	**FT-HL80Y** (Note 6)	R30	2 m (Note 4)	STD (Note 3) 3,600 141.732 H-PWR (Note 3) 3,600 141.732	3,600 141.732 (Note 3) 2,300 90.551 740 29.134	ø3.7	IP68G	−40 to +115 °C
Thru-beam, Chemical-resistant, Cylindrical type	Metal-free ø5.5 (25)	**FT-L80Y**	R30	2 m (Note 4)	STD (Note 3) 3,600 141.732 H-PWR (Note 3) 3,600 141.732	3,600 141.732 (Note 3) 2,800 110.236 920 36.220	ø3.7	IP68G	−40 to +70 °C
Thru-beam, Chemical-resistant, Cylindrical type	Side-view Metal-free ø5.5 (25)	**FT-V80Y**	R30	2 m (Note 4)	STD 1,300 51.181 H-PWR (Note 3) 3,600 141.732	2,200 86.614 800 31.496 240 9.449	ø2.8	IP68G	−40 to +70 °C
Reflective, Chemical-resistant, Cylindrical type	Metal-free ø5.5 (16)	Tough Bending durability **FD-S60Y**	Protective tube R30 mm Fiber R4	2 m (Note 4)	STD 320 12.598 H-PWR 600 23.622	420 16.535 200 7.874 75 2.953	—	IP68G	−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 of reflective type is specified for white non-glossy paper.
3) The fiber cable length practically limits the sensing range.
4) The allowable cutting range is 500 mm 19.685 in from the end that the amplifier inserted.
5) The design takes into account the environmental testing required by SEMI S2. To ensure that the final system complies with the standards, you must design and use it in accordance with relevant standards, laws, and regulations.
6) The **FT-HL80Y** will be discontinued at the end of September 2025.

Tough : Refer 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.
Bending durability : Refer to a fiber which possesses unbreakable bending-resistant feature (bending radius: R10 mm R0.394 in, reciprocating bending: 180°).

LIST OF FIBERS

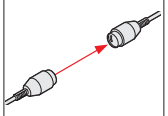
Liquid leak / Liquid detection

Type			Shape of fiber head (mm)	Model No.	Bending radius (mm)	Fiber cable length ✂: Free-cut	Description: FX-250 series (STD mode)	Protection	Ambient temp.
Reflective type	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
			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
		Liquid leak detection	SEMI S2 compliant (Note 3) W20 × H30 × D10 	Tough Bending durability **FD-F71**	Protective tube R20 Fiber R2	✂ 5 m	Liquid leak detection Leak absent: Beam received, Leak present: Beam not received	IP67	−20 to +60 °C
Reflective type	Pipe-mountable type	Liquid level sensing	Standard 	**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
			For 1 mm thick PFA pipe 	**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	Array fiber 	Tough Bending durability **FD-FA93**	R4		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
Thru-beam type			SEMI S2 compliant (Note 3) 	Tough Bending durability **FT-F93**	Protective tube R20 Fiber R2		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		−40 to +60 °C

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.
3) The design takes into account the environmental testing required by SEMI S2. To ensure that the final system complies with the standards, you must design and use it in accordance with relevant standards, laws, and regulations.

FIBER OPTIONS

Lens (For thru-beam type fiber)

<table>
<tr><th colspan="2">Designation</th><th>Model No.</th><th></th><th>Description</th></tr>
<tr><td rowspan="2">For thru-beam type fiber</td><td>Expansion lens (Note 1)</td><td>FX-LE1</td><td>  </td><td>Increases the sensing range by 5 times or more.
• Ambient temperature: -60 to +350 °C -76 to +662 °F (Note 3)
• Beam dia: ø3.6 mm ø0.142 in
Sensing range (mm in) [Lens on both sides]
<table>
<tr><th>Amplifier / Fiber / Mode</th><th>FX-250 series
H-PWR</th><th>LONG</th><th>STD</th><th>FAST</th><th>H-SPD</th></tr>
<tr><td>FT-43</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>1,600
62.992</td></tr>
<tr><td>FT-42
FT-42W</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>2,200
86.614</td></tr>
<tr><td>FT-45X</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>1,500
59.055</td></tr>
<tr><td>FT-R40</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>1,900
74.803</td></tr>
<tr><td>FT-R43
FT-R44Y</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>1,900
74.803</td><td>670
26.378</td></tr>
<tr><td>FT-H35-M2</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,300
129.921</td><td>1,400
55.118</td></tr>
<tr><td>FT-H20W-M1</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>850
33.465</td></tr>
<tr><td>FT-H20-M1</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>1,200
47.244</td></tr>
<tr><td>FT-H20-J50-S
FT-H20-J30-S
FT-H20-J20-S</td><td>3,600
141.732 (Note 2)</td><td>3,500
137.795</td><td>2,000
78.740</td><td>1,600
62.992</td><td>500
19.685</td></tr>
</table></td></tr>
<tr><td>Super-expansion lens (Note 1)</td><td>FX-LE2</td><td>  </td><td>Tremendously increases the sensing range with large diameter lenses.
• Ambient temperature: -60 to +350 °C -76 to +662 °F (Note 3)
• Beam dia: ø9.8 mm ø0.386 in
Sensing range (mm in) [Lens on both sides]
<table>
<tr><th>Amplifier / Fiber / Mode</th><th>FX-250 series
H-PWR</th><th>LONG</th><th>STD</th><th>FAST</th><th>H-SPD</th></tr>
<tr><td>FT-43
FT-42
FT-42W</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td></tr>
<tr><td>FT-45X</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td></tr>
<tr><td>FT-R40</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td></tr>
<tr><td>FT-R41W
FT-R43
FT-R44Y</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td></tr>
<tr><td>FT-H35-M2</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td></tr>
<tr><td>FT-H20W-M1
FT-H20-M1</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td><td>1,600
62.992 (Note 2)</td></tr>
<tr><td>FT-H13-FM2</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td></tr>
<tr><td>FT-H20-J50-S
FT-H20-J30-S
FT-H20-J20-S</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td><td>3,600
141.732 (Note 2)</td></tr>
</table></td></tr>
</table>

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) Refer to **LIST OF FIBERS** (p.10~) for the ambient temperature of fibers to be used in combination.

FIBER OPTIONS

Lens (For thru-beam type fiber)

Designation		Model No.	Description
For thru-beam type fiber	Side-view lens	FX-SV1	

Beam axis is bent by 90°.
• Ambient temperature: -60 to +300 °C -76 to +572 °F (Note 1)
• Beam dia: ø2.8 mm ø0.110 in

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

Fiber \ Amplifier / Mode	FX-250 series H-PWR	LONG	STD	FAST	H-SPD
FT-43	3,600 141.732 (Note 2)	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)	2,100 82.677	1,150 45.276	370 14.567
FT-42W	3,600 141.732 (Note 2)	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)	1,400 55.118	800 31.496	210 8.268
FT-R43	3,200 125.984	1,300 51.181	950 37.402	510 20.079	160 6.299
FT-R44Y	3,200 125.984	1,300 51.181	950 37.402	510 20.079	160 6.299
FT-H35-M2	3,500 137.795	1,200 47.244	780 30.709	500 19.685	150 5.906
FT-H20W-M1	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)	1,300 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)	740 29.134	450 17.717	290 11.417	80 3.150

Notes: 1) Refer to **LIST OF FIBERS** (p.10~) for the ambient temperature of fibers to be used in combination.
2) The fiber cable length practically limits the sensing range.

FIBER OPTIONS

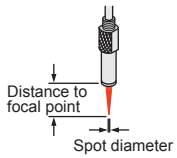
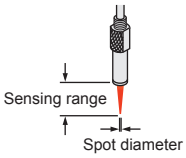
Vacuum-resistant lens (For thru-beam type fiber)

<table>
<tr><th colspan="2">Designation</th><th>Model No.</th><th></th><th>Description</th></tr>
<tr><td rowspan="3">For thru-beam type fiber</td><td>Vacuum-resistant expansion lens (Note 1)</td><td>FV-LE1</td><td>  </td><td>Increases the sensing range 4 times or more.
• Ambient temperature: -60 to +350 °C -76 to +662 °F (Note 5)
• Beam axis dia: ø3.6 mm ø0.142 in
Sensing range (mm in) [Lens on both sides] (Note 3, 4)
<table>
<tr><th>Amplifier / Fiber / Mode</th><th colspan="5">FX-250 series</th></tr>
<tr><th></th><th>H-PWR</th><th>LONG</th><th>STD</th><th>FAST</th><th>H-SPD</th></tr>
<tr><td>FT-40V</td><td>1,800 (Note 2)
70.866</td><td>1,800 (Note 2)
70.866</td><td>1,500
59.055</td><td>900
35.433</td><td>370
14.567</td></tr>
<tr><td>FT-H30-M1V-S</td><td>3,600 (Note 2)
141.732</td><td>3,400
133.858</td><td>1,500
59.055</td><td>900
35.433</td><td>370
14.567</td></tr>
</table></td></tr>
<tr><td>Vacuum-resistant compact side-view lens (Note 1)</td><td>FV-SV1</td><td>  </td><td>Beam axis is bent by 90°.
• Ambient temperature: -30 to +300 °C -22 to +572 °F (Note 5)
• Beam axis dia: ø3 mm ø0.118 in
Sensing range (mm in) [Lens on both sides] (Note 3, 4)
<table>
<tr><th>Amplifier / Fiber / Mode</th><th colspan="5">FX-250 series</th></tr>
<tr><th></th><th>H-PWR</th><th>LONG</th><th>STD</th><th>FAST</th><th>H-SPD</th></tr>
<tr><td>FT-40V</td><td>1,800 (Note 2)
70.866</td><td>700
27.559</td><td>450
17.717</td><td>290
11.417</td><td>90
3.543</td></tr>
<tr><td>FT-H30-M1V-S</td><td>1,800
70.866</td><td>700
27.559</td><td>450
17.717</td><td>290
11.417</td><td>90
3.543</td></tr>
</table></td></tr>
<tr><td>Vacuum-resistant side-view lens (Note 1)</td><td>FV-SV2</td><td>  </td><td>Beam axis is bent by 90°.
• Ambient temperature: -60 to +300 °C -76 to +572 °F (Note 5)
• Beam axis dia: ø3.7 mm ø0.146 in
Sensing range (mm in) [Lens on both sides] (Note 3, 4)
<table>
<tr><th>Amplifier / Fiber / Mode</th><th colspan="5">FX-250 series</th></tr>
<tr><th></th><th>H-PWR</th><th>LONG</th><th>STD</th><th>FAST</th><th>H-SPD</th></tr>
<tr><td>FT-40V</td><td>1,800 (Note 2)
70.866</td><td>1,800 (Note 2)
70.866</td><td>1,500
59.055</td><td>900
35.433</td><td>370
14.567</td></tr>
<tr><td>FT-H30-M1V-S</td><td>3,600
141.732 (Note 2)</td><td>3,400
133.858</td><td>1,500
59.055</td><td>900
35.433</td><td>370
14.567</td></tr>
</table></td></tr>
</table>

Notes: 1) Be careful when installing the thru-beam type fiber equipped with the 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-40V** is 1 m 3.281 ft. The sensing ranges take into account the length of the **FT-J9** atmospheric side fiber.
4) The fiber cable length for the **FT-H30-M1V-S** is 1 m 3.281 ft. The sensing ranges in H-PWR and LONG of **FX-250** series are specified considering the length of the **FT-J8** atmospheric side fiber.
5) Refer to **LIST OF FIBERS** (p.10~) for the ambient temperature of fibers to be used in combination.

FIBER OPTIONS

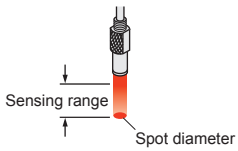
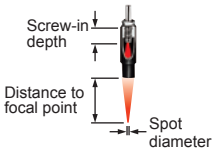
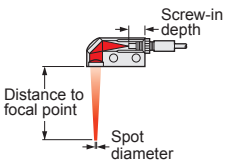
Lens (For reflective type fiber)

<table>
<tr><th colspan="2">Designation</th><th>Model No.</th><th colspan="2">Description</th></tr>
<tr><td rowspan="3">For reflective type fiber</td><td rowspan="3">Finest spot lens</td><td>FX-MR7</td><td rowspan="3"> 
</td><td>Extremely fine spot of ø0.1 mm ø0.004 in approx. achieved.
• Applicable fibers:
FD-R33EG, FD-EG31, FD-R34EG, FD-R32EG, FD-EG30, FD-R31G, FD-42G, FD-42GW, FD-32G, FD-32GX
• Ambient temperature: -55 to +70 °C +67 to +158 °F (Note)</td><td>Sensing range for FX-250 series
<table><tr><th>Fiber model No.</th><th>Distance to focal point</th><th>Spot diameter</th></tr><tr><td>FD-R33EG
FD-EG31</td><td rowspan="4">7 ±0.5 mm
0.276 ±0.020 in</td><td>ø0.1 mm approx.
ø0.004 in approx.</td></tr><tr><td>FD-R34EG</td><td>ø0.15 mm approx.
ø0.006 in approx.</td></tr><tr><td>FD-R32EG
FD-EG30</td><td>ø0.2 mm approx.
ø0.008 in approx.</td></tr><tr><td>FD-R31G
FD-42G/42GW
FD-32G/32GX</td><td>ø0.4 mm approx.
ø0.016 in approx.</td></tr></table></td></tr>
<tr><td>FX-MR6</td><td>Extremely fine spot of ø0.1 mm ø0.004 in approx. achieved.
• Applicable fibers:
FD-R33EG, FD-EG31,
FD-R34EG, FD-R32EG,
FD-EG30, FD-R31G, FD-42G,
FD-42GW, FD-32G, FD-32GX
• Ambient temperature: -20 to +60 °C -4 to +140 °F (Note)</td><td>Sensing range for FX-250 series
<table><tr><th>Fiber model No.</th><th>Distance to focal point</th><th>Spot diameter</th></tr><tr><td>FD-R33EG
FD-EG31</td><td rowspan="4">7 ±0.5 mm
0.276 ±0.020 in</td><td>ø0.1 mm approx.
ø0.004 in approx.</td></tr><tr><td>FD-R34EG</td><td>ø0.15 mm approx.
ø0.006 in approx.</td></tr><tr><td>FD-R32EG
FD-EG30</td><td>ø0.2 mm approx.
ø0.008 in approx.</td></tr><tr><td>FD-R31G
FD-42G/42GW
FD-32G/32GX</td><td>ø0.4 mm approx.
ø0.016 in approx.</td></tr></table></td></tr>
<tr><td>FX-MR3</td><td>Extremely fine spot of ø0.15 mm ø0.006 in approx. achieved.
• Applicable fibers:
FD-R33EG, FD-EG31,
FD-R34EG, FD-R32EG,
FD-EG30, FD-R31G, FD-42G,
FD-42GW, FD-32G, FD-32GX
• Ambient temperature: -40 to +70 °C -40 to +158 °F (Note)</td><td>Sensing range for FX-250 series
<table><tr><th>Fiber model No.</th><th>Distance to focal point</th><th>Spot diameter</th></tr><tr><td>FD-R33EG
FD-EG31</td><td rowspan="4">7.5 ±0.5 mm
0.295 ±0.020 in</td><td>ø0.15 mm approx.
ø0.006 in approx.</td></tr><tr><td>FD-R34EG</td><td>ø0.2 mm approx.
ø0.008 in approx.</td></tr><tr><td>FD-R32EG
FD-EG30</td><td>ø0.3 mm approx.
ø0.012 in approx.</td></tr><tr><td>FD-R31G
FD-42G/42GW
FD-32G/32GX</td><td>ø0.5 mm approx.
ø0.020 in approx.</td></tr></table></td></tr>
<tr><td></td><td>Zoom lens</td><td>FX-MR8</td><td> 
</td><td>The spot diameter is adjustable according to how much the fiber is screwed in.
• Applicable fibers:
FD-R33EG, FD-EG31, FD-R34EG, FD-R32EG, FD-EG30, FD-R31G, FD-32G, FD-32GX
• Ambient temperature: -55 to +70 °C +67 to +158 °F (Note)</td><td>Sensing range for FX-250 series
<table><tr><th>Fiber model No.</th><th>Sensing range</th><th>Spot diameter</th></tr><tr><td>FD-R33EG
FD-EG31</td><td rowspan="4">10 to 30 mm
0.394 to 1.181 in</td><td>ø0.4 to ø2.0 mm approx.
ø0.016 to ø0.079 in approx.</td></tr><tr><td>FD-R34EG</td><td>ø0.4 to ø2.2 mm approx.
ø0.016 to ø0.087 in approx.</td></tr><tr><td>FD-R32EG
FD-EG30</td><td>ø0.5 to ø2.5 mm approx.
ø0.020 to ø0.098 in approx.</td></tr><tr><td>FD-R31G
FD-32G/32GX</td><td>ø0.8 to ø3.5 mm approx.
ø0.031 to ø0.138 in approx.</td></tr></table></td></tr>
</table>

Note: Refer to **LIST OF FIBERS** (p.12~) for the ambient temperature of fibers to be used in combination.

FIBER OPTIONS

Lens (For reflective type fiber)

<table>
<tr><th colspan="2">Designation</th><th>Model No.</th><th colspan="2">Description</th></tr>
<tr><td rowspan="4">For reflective type fiber</td><td>Parallel light lens</td><td>FX-MR9</td><td> 
</td><td>Long-range parallel light
• Applicable fibers:
FD-R33EG, FD-EG31,
FD-R34EG, FD-R32EG,
FD-EG30, FD-R31G, FD-42G,
FD-42GW, FD-32G, FD-32GX
• Ambient temperature: -55 to +70 °C
+67 to +158 °F
(Note)
Sensing range for FX-250 series
<table><tr><th>Fiber model No.</th><th>Sensing range</th><th>Spot diameter</th></tr><tr><td>FD-R33EG
FD-EG31</td><td rowspan="4">0 to 30 mm
0.394 to 1.181 in</td><td rowspan="4">ø4.0 mm approx.
ø0.157 in approx.</td></tr><tr><td>FD-R34EG</td></tr><tr><td>FD-R32EG
FD-EG30</td></tr><tr><td>FD-R31G
FD-42G/42GW
FD-32G/32GX</td></tr></table></td></tr>
<tr><td>Pinpoint spot lens</td><td>FX-MR1</td><td>  </td><td>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)</td></tr>
<tr><td>Zoom lens</td><td>FX-MR2</td><td> 
</td><td>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-250 series
<table><tr><th>Screw-in depth</th><th>Distance to focal point</th><th>Spot diameter</th></tr><tr><td>7 mm 0.276 in</td><td>18.5 mm approx.
0.728 in approx.</td><td>ø0.7 mm approx.
ø0.028 in approx.</td></tr><tr><td>12 mm 0.472 in</td><td>27 mm approx.
1.063 in approx.</td><td>ø1.2 mm approx.
ø0.047 in approx.</td></tr><tr><td>14 mm 0.551 in</td><td>43 mm approx.
1.693 in approx.</td><td>ø2.0 mm approx.
ø0.079 in approx.</td></tr></table></td></tr>
<tr><td>Zoom lens (side-view type)</td><td>FX-MR5</td><td> 
</td><td>FX-MR2 is converted into a side-view type and can be mounted in a very small space.
• Applicable fibers: FD-42G, FD-42GW
• Ambient temperature: -40 to +60 °C
-40 to +140 °F
(Note)
Sensing range for FX-250 series
<table><tr><th>Screw-in depth</th><th>Distance to focal point</th><th>Spot diameter</th></tr><tr><td>8 mm 0.315 in</td><td>13 mm approx.
0.512 in approx.</td><td>ø0.5 mm approx.
ø0.020 in approx.</td></tr><tr><td>10 mm 0.394 in</td><td>15 mm approx.
0.591 in approx.</td><td>ø0.8 mm approx.
ø0.031 in approx.</td></tr><tr><td>14 mm 0.551 in</td><td>30 mm approx.
1.181 in approx</td><td>ø3.0 mm approx.
ø0.118 in approx.</td></tr></table></td></tr>
</table>

Note: Refer to **LIST OF FIBERS** (p.12~) for the ambient temperature of fibers to be used in combination.

FIBER OPTIONS

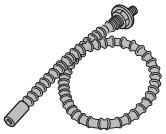
Others

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-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)					
Universal sensor mounting stand	**MS-AJ1-F**	Horizontal mounting type		Mounting stand assembly for fiber (For M3, M4 or M6 threaded head fiber)		
	MS-AJ2-F	Vertical mounting type				
Liquid inflow prevention joint (Note)	**MS-FX-01Y**	Applicable fibers	**FD-HF40Y**	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.		
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.38 for the sensing range of **FR-Z50HW** to be used in combination.				
	RF-220					
	RF-230					

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

Protective tube

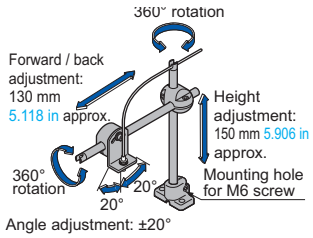
- **FTP-□**
- **FDP-□**



Universal sensor mounting stand

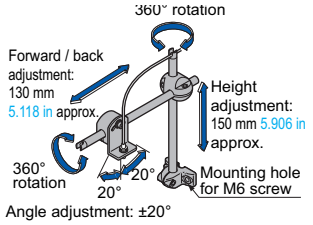
Using the arm which enables adjustment in the horizontal direction, sensing can also be done from above an assembly line.

- **MS-AJ1-F**



Angle adjustment: ±20°

- **MS-AJ2-F**



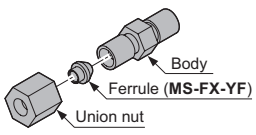
Angle adjustment: ±20°

Single core holder

- **FX-AT15A**

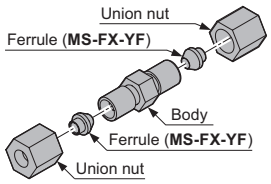
Liquid inflow prevention joint

- **MS-FX-01Y**



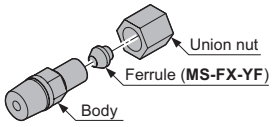
Protective tube extension joint

- **MS-FX-02Y**



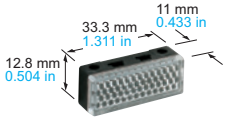
Fiber mounting joint

- **MS-FX-03Y**



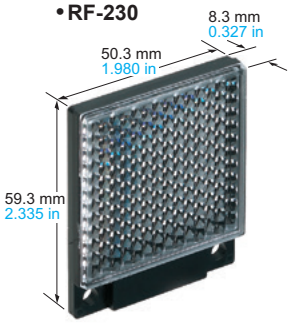
Reflector

- **RF-210**



- **RF-220**

- **RF-230**



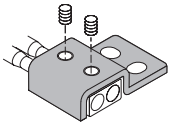
FIBER OPTIONS

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

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

Model No. when ordering vacuum-resistant fibers 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)
- Fiber at atmospheric side
  FT-J8 (one pair set)
- Mouting bracket for **FD-KZ50V / FD-H30-KZ1V**(**-S**)
  MS-FD-2



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 ø1mm ø0.039 in / ø1.3mm ø0.051 in fiber cable / ø4mm ø0.157 in protective tube)
- **FX-CT4** (Fiber cutter for ø2mm ø0.079 in fiber cable / ø4mm ø0.157 in protective tube)
- **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)
- **FX-AT4G1** (Gland single for ø1 mm ø0.039 in fiber, Black)
- **FX-AT5G1** (Gland single for ø1.3 mm ø0.051 in fiber, Gray)
- **FX-AT6G1** (Gland single for ø1 mm ø0.039 in / ø1.3 mm ø0.051 in mixed fiber, Black / Gray)
- **FX-SL1** (Slit mask for **FT-A11** / **FT-A11W** (one pair set), slit size: 0.5 × 12 mm 0.020 × 0.472 in)
- **FX-SL2** (Slit mask for **FT-A11** / **FT-A11W** (one pair set), slit size: 1 × 12 mm 0.039 × 0.472 in)
- **FX-SL3** (Slit mask for **FT-A32** / **FT-A32W** (one pair set), slit size: 0.5 × 33 mm 0.020 × 1.299 in)
- **MS-FD-2** (Fiber mounting bracket)
- **MS-FD-F7-1** (SUS mounting bracket for **FD-F71**)
- **MS-FD-F7-2** (PVC mounting bracket for **FD-F71**)

- **RF-003**

- **RF-13**

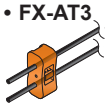
- **FX-CT2**

- **FX-CT3**

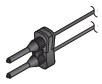
- **FX-CT4**

- **FX-AT2**

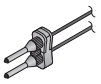
- **FX-AT3**



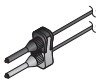
- **FX-AT4**



- **FX-AT5**



- **FX-AT6**

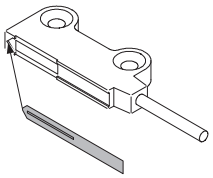


- **FX-AT4G1**

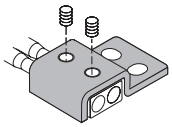
- **FX-AT5G1**

- **FX-AT6G1**

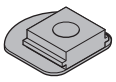
- **FX-SL1**
- **FX-SL2**
- **FX-SL3**



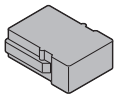
- **MS-FD-2**



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



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



Panasonic INDUSTRY

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