FX-311 SERIES

New

Manually Set Fiber Sensor

PNP output type available | Timer | Interference prevention

* UL 61010C-1 compatible, Passed the UL 991 Environment Test based on SEMI S2-0200.
[Category applicable for semiconductor manufacturing: TWW2, Process Equipment]
[Applicable standards: UL 61010C-1]
[Additional test / evaluation standards as per intended use: UL991, SEMI S2-0200]

Highly sensitive manual tuning made easy

*** Passed the UL 991 Environment Test**

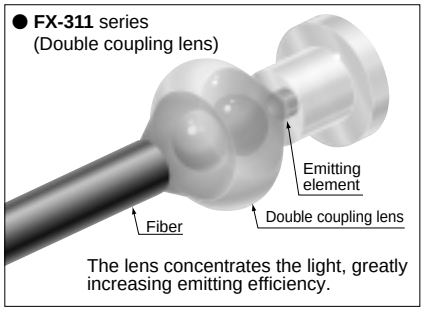
Conforming to EMC Directive

UL Recognition

Long-range sensing made possible with built-in optical lens

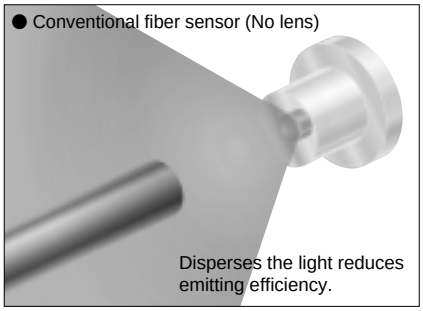
For the first time in the industry, an optical 'double coupling lens' has been incorporated directly into the fiber sensor itself. This lens maximizes the light emission efficiency, resulting in a tremendous improvement in the sensing range. Sensing ranges with small diameter fibers and ultra-small diameter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

● **FX-311** series
(Double coupling lens)



The lens concentrates the light, greatly increasing emitting efficiency.

● Conventional fiber sensor (No lens)



Disperses the light reduces emitting efficiency.

Three light source types are made available for expanding applications

In addition to the red LED (four-chemical emitting element) type, the blue LED and green LED types are also available to conform to an even wider array of applications.

Color combinations that can be discerned during mark sensing

Background color \ Mark color	White	Yellow	Orange	Red	Green	Blue	Black
White		■	■	■▲	●■▲	●■▲	●■▲
Yellow	■		▲	▲	●■▲	●■▲	●■▲
Orange	■	▲		■▲	●■▲	●■▲	●■▲
Red	■▲	▲	■▲		●	●■	●■
Green	●■▲	●■▲	●■▲	●		■	■
Blue	●■▲	●■▲	●■▲	●■	■		■
Black	●■▲	●■▲	●■▲	●■	■	■	

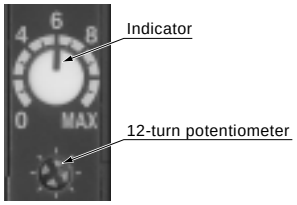
●: Red LED ■: Blue LED ▲: Green LED

Stable long-term sensing

The newly developed four-chemical emitting element that uses the **FX-311** (red LED type) suppresses changes over long periods of time as much as possible, so that a stable light emitting level is maintained. There is very little element deterioration so that stable and accurate sensing can be maintained over long periods.

12-turn potentiometer with visible indicator

12-turn potentiometer has been incorporated for fine adjustments.
It enables very fine differences to be detected.
Moreover, since the pointer of indicator has a red backlight, you can confirm the position at a glance, even in a dark area.

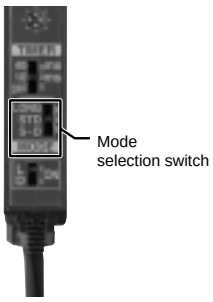


Mode can be selected in three steps to suit the application

The mode select switch can change the mode to one of three modes to suit a variety of sensing applications.

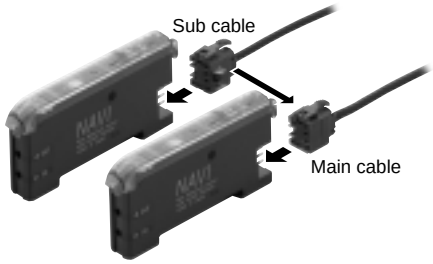
Long-range mode (LONG)	Ideal for cases where long-distance sensing is required (Response time: 2 ms)
Standard mode (STD)	Used for general sensing (Response time: 250 μs)
High-speed mode (FAST) (Note)	Ideal for cases where fast sensing is required (Response time: 150 μs)
Reduced intensity mode (S-D) (Note)	Effective for fine detection (Response time: 250 μs)

Note: High-speed mode is only available for the **FX-311B**(**P**) and **FX-311G**(**P**). S-D (reduced intensity) mode is only available with the **FX-311**(**P**).



Maintenance made easy with quick-connection cables

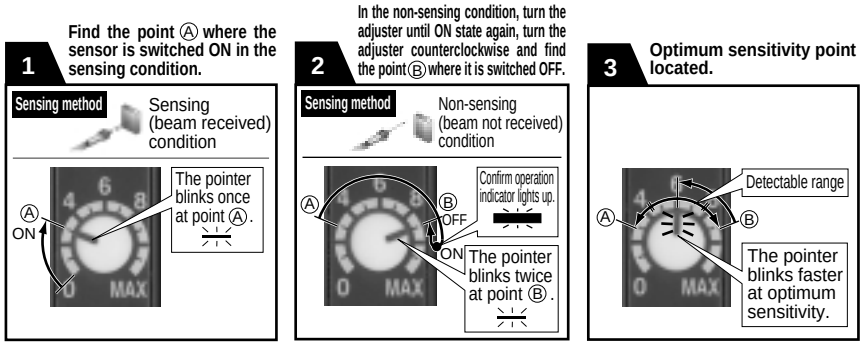
Both main and sub units utilize the same amplifier body. This feature allows for easy mounting in side-by-side configuration. The main and sub unit functions are distinguished only by the proper use of the 3-core main cable and the 1-core sub cable. Moreover, by utilizing the same body for both main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



Rapid blinking 'assist function' eases adjustment for optimum sensitivity

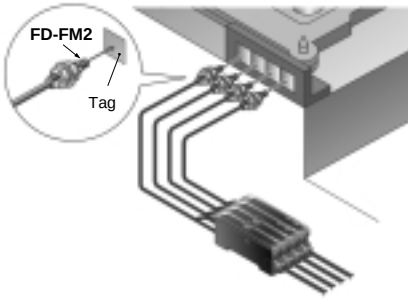
The **FX-311** series has a convenient built-in 'assist function' which indicates the optimum sensitivity position by blinking rapidly when optimum sensitivity is reached. This enables easy and reliable sensitivity adjustment, which is convenient for a narrow sensing range requiring fine tuning.

※In order enable the 'assist function', switch the operation selection switch from L-ON→D-ON→L-ON.



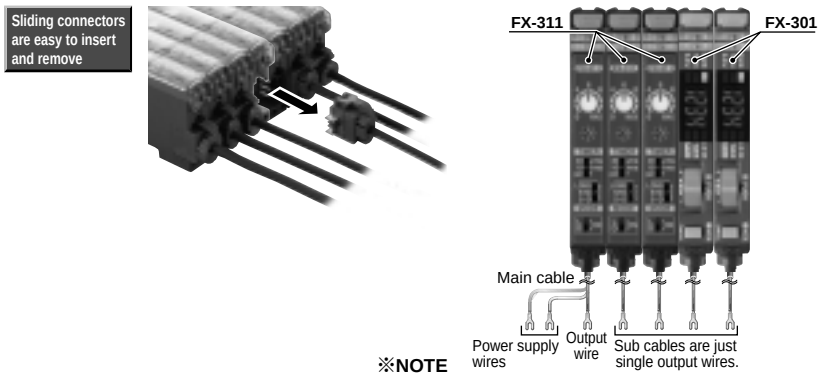
Close mounting is possible for up to four fiber heads

If amplifiers are mounted side-by-side in cascade, the optical communication function automatically sets different emission timing for the amplifiers, when the power supply is switched on. Up to four fiber heads can be mounted close together, without mutual interference.
The **FX-301** series / **FX-302**(**P**) units can also be used in these configurations.



Side-by-side connection with the FX-301 series / FX-302(P) is also possible for wire-saving and quick installation

Each sub cable is a single output wire, reducing wiring and simplifying installation. Quick-connection cables are the same type as used on the **FX-301** series / **FX-302**(**P**), facilitating side-by-side connection. Furthermore, the connectors are sliding type, which allows them to be removed without shifting amplifier positions. This eliminates the need to provide extra maintenance space around the amplifiers.



※NOTE
Only the interference prevention settings can be transmitted between this product and digital fiber sensor **FX-301** series and **FX-302**(**P**).
Therefore, if both models of amplifiers are mounted in cascade, make sure to mount identical models together.

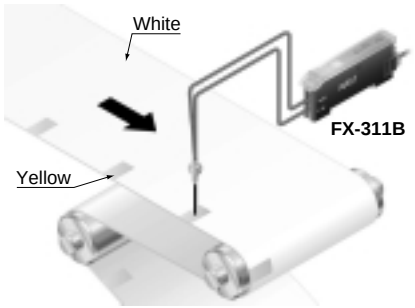
OFF-delay timer with selectable timer period

The **FX-311** series incorporates an OFF-delay timer. It is useful when the connected device has a slow response time or when small objects are being sensed and the output signal width is small. You can select the timer period not only 40 ms but also 10 ms. It is also suitable for increased PLC speeds.

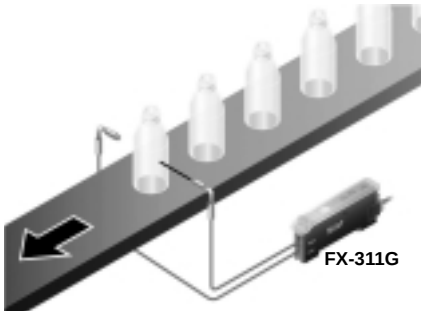
FX-311

APPLICATIONS

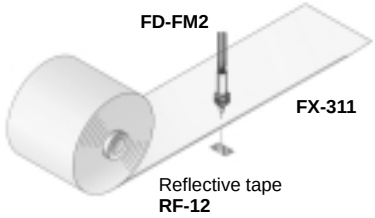
Detecting register marks



Detecting transparent bottles



Sensing the presence of a translucent sheet



ORDER GUIDE

Amplifiers

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

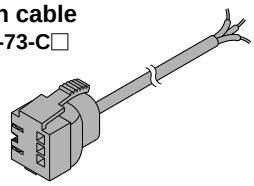
Type		Appearance	Model No.	Emitting element	Output
Manually set	NPN output		**FX-311**	Red LED	NPN open-collector transistor
			FX-311B	Blue LED	
			FX-311G	Green LED	
	PNP output		**FX-311P**	Red LED	PNP open-collector transistor
			FX-311BP	Blue LED	
			FX-311GP	Green LED	

Quick-connection cables

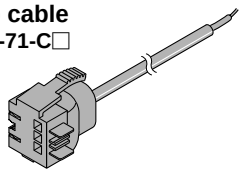
Quick-connection cable is not supplied with the amplifier. Please order it separately.

Type	Model No.	Description
Main cable	**CN-73-C1**	Length: 1 m 3.281 ft; 0.15 mm² 3-core cabtyre cable, with connector on one end. Cable outer diameter: ϕ3 mm ϕ0.118 in
	CN-73-C2	Length: 2 m 6.562 ft
	CN-73-C5	Length: 5 m 16.404 ft
Sub cable	**CN-71-C1**	Length: 1 m 3.281 ft; 0.15 mm² 1-core cabtyre cable, with connector on one end. Cable outer diameter: ϕ3 mm ϕ0.118 in
	CN-71-C2	Length: 2 m 6.562 ft
	CN-71-C5	Length: 5 m 16.404 ft

Main cable
• **CN-73-C□**

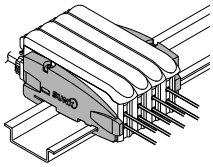


Sub cable
• **CN-71-C□**



End plates

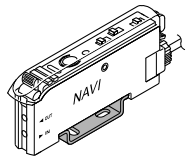
End plates are not supplied with the amplifier. Please order it separately when the amplifiers are mounted in cascade.

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

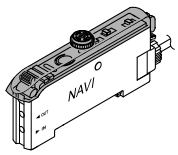
OPTIONS

Designation	Model No.	Description
Amplifier mounting bracket	**MS-DIN-2**	Mounting bracket for amplifier
Hand-turned knob attached cover	**FX-AJ1**	Hand-turned knob allows easy adjustment of sensor sensitivity.
Fiber sensor amplifier protection seal	**FX-MB1**	10 sets of 2 communication window seals and 1 connector seal Communication window seal: It prevents malfunction due to transmission signal from another amplifier, as well as, prevents effect on another amplifier. Connector seal: It prevents contact of any metal, etc., with the pins of the quick-connection cable.

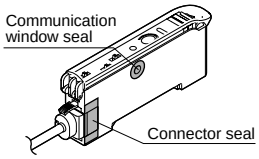
Amplifier mounting bracket
• **MS-DIN-2**



Hand-turned knob attached cover
• **FX-AJ1**



Fiber sensor amplifier protection seal
• **FX-MB1**



FX-311

LIST OF FIBERS

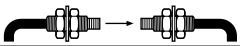
General purpose fibers [Thru-beam type (one pair set)]

Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 1) ■: LONG ■: STD □: FAST □: S-D			Min. sensing object (under the optimum condition (Note 2))	Fiber cable length ✂: Free-cut	Allowable bending radius	Model No.
		Red LED	Blue LED	Green LED				
Standard / Long sensing range	With lens, M14	19,500 767.715 14,000 551.180 Not equipped with FAST mode 3,800 149.606	5,400 212.598 2,700 106.299 1,900 74.803	2,800 110.236 1,400 55.118 1,000 39.370	ϕ0.4 mm ϕ0.016 in opaque object	✂ 10 m 32.808 ft	R25 mm R0.984 in	**FT-FM10L**
	With lens, ϕ2.5 ϕ0.098	1,600 62.992 800 31.496 Not equipped with FAST mode 280 11.024	400 15.748 200 7.874 130 5.118	200 7.874 100 3.937 65 2.559	ϕ0.02 mm ϕ0.0008 in opaque object	✂ 2 m 6.562 ft		**FT-SFM2L**
	Lens mountable, M4	1,100 43.307 530 20.866 Not equipped with FAST mode 180 7.087	220 8.661 110 4.331 75 2.953	110 4.331 55 2.165 40 1.575	ϕ0.04 mm ϕ0.0016 in opaque object	✂ 2 m 6.562 ft		**FT-B8**
	M4	1,000 39.37 480 18.898 Not equipped with FAST mode 168 6.614	200 7.874 100 3.937 70 2.756	100 3.937 50 1.969 35 1.378	ϕ0.03 mm ϕ0.0012 in opaque object	✂ 2 m 6.562 ft (Note 3)		**FT-NB8**
Standard	Lens mountable, M4	780 30.709 400 15.748 Not equipped with FAST mode 130 5.118	150 5.906 75 2.953 40 1.575	70 2.756 35 1.378 24 0.945	ϕ0.03 mm ϕ0.0012 in opaque object	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FT-FM2**
	Sleeve 90 mm 3.543 in, M4, ϕ1.48 ϕ0.058						Fiber R25 mm R0.984 in	**FT-FM2S**
	Sleeve 40 mm 1.575 in, M4, ϕ1.48 ϕ0.058						Sleeve R10 mm R0.394 in	**FT-FM2S4**
	Lens mountable, M3						R25 mm R0.984 in	**FT-T80**
	ϕ2.5 ϕ0.098							**FT-SFM2**
	M4	700 27.559 360 14.173 Not equipped with FAST mode 126 4.961	140 5.512 70 2.756 40 1.575	66 2.598 33 1.299 22 0.866	ϕ0.03 mm ϕ0.0012 in opaque object	✂ 2 m 6.562 ft (Note 3)	R25 mm R0.984 in	**FT-N8**
	M3	270 10.630 140 5.512 Not equipped with FAST mode 49 1.929	50 1.969 25 0.984 16 0.630	24 0.945 12 0.472 8 0.315	ϕ0.025 mm ϕ0.0010 in opaque object	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FT-NFM2**
	Sleeve 90 mm 3.543 in, M3, ϕ0.88 ϕ0.035						Fiber R25 mm R0.984 in	**FT-NFM2S**
	Sleeve 40 mm 1.575 in, M3, ϕ0.88 ϕ0.035						Sleeve R10 mm R0.394 in	**FT-NFM2S4**
	ϕ1.5 ϕ0.059						R25 mm R0.984 in	**FT-SNFM2**
Elbow	Lens mountable, M4	530 20.866 230 9.055 Not equipped with FAST mode 80 3.150	85 3.346 42 1.654 28 1.102	44 1.732 22 0.866 16 0.630	ϕ0.04 mm ϕ0.0016 in opaque object	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FT-R80**
Side-view	3, 0.118, ϕ4 ϕ0.157	2,000 78.740 1,000 39.370 Not equipped with FAST mode 350 13.780	400 15.748 200 7.874 130 5.118	200 7.874 100 3.937 65 2.559	ϕ0.05 mm ϕ0.0020 in opaque object	✂ 2 m 6.562 ft	R25 mm R0.984 in	New **FT-V10**
	0.8, 0.031, ϕ1.5 ϕ0.059, ϕ2.5 ϕ0.098 Sleeve part cannot be bent.	400 15.748 200 7.874 Not equipped with FAST mode 70 2.756	80 3.150 40 1.575 28 1.102	40 1.575 20 0.787 14 0.551	ϕ0.02 mm ϕ0.0008 in opaque object	✂ 2 m 6.562 ft		**FT-SFM2SV2**
	0.6, 0.024, ϕ1 ϕ0.039, ϕ2 ϕ0.079 Sleeve part cannot be bent.	390 15.354 180 7.087 Not equipped with FAST mode 63 2.480	50 1.969 25 0.984 16 0.630	26 1.024 13 0.512 8 0.315		1 m 3.281 ft		**FT-V22**
	0.6, 0.024, ϕ1 ϕ0.039, ϕ2.5 ϕ0.098 Sleeve part cannot be bent.	175 6.890 80 3.150 Not equipped with FAST mode 27 1.063	28 1.102 14 0.551 10 0.394	14 0.551 7 0.276 5 0.197		✂ 2 m 6.562 ft		**FT-V41**

Notes: 1) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
2) The minimum sensing object size is the value for red LED type. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type.
The optimum condition is the condition when the sensitivity is set so that the output just changes to light incident operation in the object absent condition.
3) The fiber cutter is not attached with **FT-NB8** and **FT-N8**. Please order it separately.

LIST OF FIBERS

Sharp bending fibers / Flexible fibers [Thru-beam type (one pair set)]



Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 1) ■: LONG ■: STD □: FAST □: S-D			Min. sensing object (under the optimum condition (Note 2))	Fiber cable length ✂: Free-cut	Allowable bending radius	Model No.
		Red LED	Blue LED	Green LED				
Sharp bending / Wide beam	Wide area sensing Sensing width 32 mm 1.260 in W5 × H69 × D20 W0.197 × H2.717 × D0.787	3,500 137.795 3,500 137.795 Not equipped with FAST mode 3,500 137.795 (Note 3)	2,400 94.488 1,200 47.244 700 27.559	1,200 47.244 600 23.622 350 13.780	ϕ0.3 mm ϕ0.012 in opaque object	✂ 2 m 6.562 ft	R1 mm R0.039 in	New FT-WA30
Sharp bending / Wide beam	Wide area sensing Sensing width 11 mm 0.433 in W4.2 × H31 × D13.5 W0.165 × H1.22 × D0.531	3,500 137.795 1,500 59.055 Not equipped with FAST mode 750 29.528	600 23.622 300 11.811 220 8.661	300 1.811 150 5.906 110 4.331	ϕ0.25 mm ϕ0.010 in opaque object	✂ 2 m 6.562 ft	R1 mm R0.039 in	New FT-WA8
Sharp bending / Rectangular head	Easy mounting · Top sensing W3 × H8 × D12 W0.118 × H0.315 × D0.472	2,500 98.425 1,200 47.244 Not equipped with FAST mode 410 16.142	400 15.748 200 7.874 140 5.512	200 7.874 100 3.937 70 2.756	ϕ0.08 mm ϕ0.003 in opaque object	✂ 2 m 6.562 ft	R1 mm R0.039 in	New FT-WZ8H
Sharp bending / Rectangular head	Easy mounting · Side sensing W3 × H12 × D8 W0.118 × H0.472 × D0.315	1,500 59.055 700 27.559 Not equipped with FAST mode 210 8.268	240 9.449 120 4.724 80 3.150	120 4.724 60 2.362 40 1.575	ϕ0.05 mm ϕ0.0020 in opaque object	✂ 2 m 6.562 ft	R1 mm R0.039 in	New FT-WZ8E
Sharp bending / Rectangular head	Easy mounting · Front sensing W8.5 × H12 × D3 W0.335 × H0.472 × D0.118	700 27.559 330 12.992 Not equipped with FAST mode 120 4.724	80 3.150 40 1.575 25 0.984	40 1.575 20 0.787 13 0.512	ϕ0.04 mm ϕ0.0016 in opaque object	✂ 2 m 6.562 ft	R1 mm R0.039 in	New FT-WZ8
Sharp bending / Narrow beam	Side-view type with small light dispersion ϕ4 ϕ0.157 3 0.118	1,700 66.929 700 27.559 Not equipped with FAST mode 300 11.811	300 11.811 150 5.906 100 3.937	160 6.299 80 3.150 60 2.362	ϕ0.06 mm ϕ0.0024 in opaque object	✂ 2 m 6.562 ft	R1 mm R0.039 in	New FT-WKV8
Sharp bending / Long sensing range	Long sensing range · With lens ϕ3 ϕ0.118	1,200 47.244 600 23.622 Not equipped with FAST mode 210 8.268	240 9.449 120 4.724 90 3.543	120 4.724 60 2.362 40 1.575	ϕ0.02 mm ϕ0.0008 in opaque object	✂ 2 m 6.562 ft	R1 mm R0.039 in	FT-WS8L
Sharp bending / Standard	Lens mountable M4				ϕ0.03 mm ϕ0.0012 in opaque object			FT-W8
Sharp bending / Standard	ϕ3 ϕ0.118	570 22.441 290 11.417 Not equipped with FAST mode 100 3.937	90 3.543 45 1.575 30 1.181	56 2.205 28 1.102 20 0.787	ϕ0.05 mm ϕ0.0020 in opaque object	✂ 2 m 6.562 ft	R1 mm R0.039 in	New FT-WS3
Sharp bending / Standard	ϕ2.5 ϕ0.098				ϕ0.03 mm ϕ0.0012 in opaque object			FT-WS8
Sharp bending / Small diameter	M3	160 6.299 80 3.15	16 0.630 8 0.315	10 0.394 5 0.197	ϕ0.02 mm ϕ0.0008 in opaque object	✂ 2 m 6.562 ft	R1 mm R0.039 in	FT-W4
Sharp bending / Small diameter	ϕ1.5 ϕ0.059	Not equipped with FAST mode 28 1.102	5 0.197	3 0.118				FT-WS4
Sharp bending / Side-view	ϕ1 ϕ0.039 1 0.039 ϕ2 ϕ0.079 Sleeve part cannot be bent.	90 3.543 40 1.575 Not equipped with FAST mode 15 0.591	– – –	– – –	ϕ0.02 mm ϕ0.0008 in opaque object	✂ 2 m 6.562 ft	R1 mm R0.039 in	New FT-WV42
Flexible / Rectangular head	Easy mounting · Top sensing W3 × H8 × D12 W0.118 × H0.315 × D0.472	2,700 106.299 1,400 55.118 Not equipped with FAST mode 490 19.291	560 22.047 280 11.024 200 7.874	200 7.874 100 3.937 65 2.559	ϕ0.03 mm ϕ0.0012 in opaque object	✂ 2 m 6.562 ft	R4 mm R0.157 in	FT-Z8H
Flexible / Rectangular head	Easy mounting · Side sensing W3 × H12 × D8 W0.118 × H0.472 × D0.315	1,600 62.992 800 31.496 Not equipped with FAST mode 280 11.024	400 15.748 200 7.874 140 5.512	200 7.874 100 3.937 65 2.559				FT-Z8E
Flexible / Rectangular head	Easy mounting · Front sensing W8.5 × H12 × D3 W0.335 × H0.472 × D0.118	800 31.496 400 15.748 Not equipped with FAST mode 140 5.512	120 4.724 60 2.362 40 1.575	60 2.362 30 1.181 22 0.866				FT-Z8
Flexible / Standard	Lens mountable M4	650 25.591 320 12.598 Not equipped with FAST mode 110 4.331	130 5.118 65 2.559 45 1.772	70 2.756 35 1.378 25 0.984	ϕ0.04 mm ϕ0.0016 in opaque object	✂ 2 m 6.562 ft	R4 mm R0.157 in	FT-P80
Flexible / Standard	Lens mountable M4	400 15.748 190 7.48 Not equipped with FAST mode 80 3.15	50 1.969 25 0.984 18 0.709	26 1.024 13 0.512 8 0.315				New FT-P60
Flexible / Small diameter	M3	250 9.843 100 3.937 Not equipped with FAST mode 35 1.378	32 1.260 16 0.630 12 0.472	18 0.709 9 0.354 7 0.276	ϕ0.02 mm ϕ0.0008 in opaque object	✂ 2 m 6.562 ft	R4 mm R0.157 in	FT-P40
Flexible / Small diameter	ϕ1.5 ϕ0.059	280 11.024 120 4.724 Not equipped with FAST mode 42 1.654	36 1.417 18 0.709 14 0.551	20 0.787 10 0.394 8 0.315		1 m 3.281 ft		FT-P2
Flexible / Small diameter	ϕ1 ϕ0.039	80 3.15 40 1.575 Not equipped with FAST mode 17 0.669	14 0.551 7 0.276 4 0.157	6 0.236 3 0.118 2 0.079		500 mm 19.685 in		New FT-PS1

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

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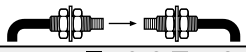
LIST OF FIBERS

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



Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 1) ■: LONG ■: STD □: FAST □: S-D			Min. sensing object (under the optimum condition (Note 2))	Fiber cable length ✂: Free-cut	Allowable bending radius	Model No.
		Red LED	Blue LED	Green LED				
Special use – Wide beam	Wide area sensing Sensing width 32 mm 1.260 in W5 × H69 × D20 W0.197 × H2.717 × D0.787	■ 3,500 137.795 ■ 3,500 137.795 Not equipped with FAST mode □ 3,500 137.795 (Note 3)	2,400 94.488 1,200 47.244 700 27.559 –	1,200 47.244 600 23.622 350 13.780 –	ϕ0.3 mm ϕ0.012 in opaque object	✂ 2 m 6.562 ft	R10 mm R0.394 in	New **FT-A30**
Wide beam	Wide area sensing Sensing width 11 mm 0.433 in W4.2 × H31 × D13.5 W0.165 × H1.22 × D0.531	■ 3,500 137.795 ■ 1,500 59.055 Not equipped with FAST mode □ 750 29.528	600 23.622 300 11.811 220 8.661 –	300 11.811 150 5.906 110 4.331 –	ϕ0.25 mm ϕ0.010 in opaque object	✂ 2 m 6.562 ft	R10 mm R0.394 in	**FT-A8**
Array	Top sensing W5 × H15 × D15 W0.197 × H0.591 × D0.591	■ 650 25.591 ■ 330 12.992 Not equipped with FAST mode □ 115 4.528	120 4.724 60 2.362 40 1.575 –	60 2.362 30 1.181 20 0.787 –	Horizontal: ϕ0.025 mm ϕ0.001 in opaque object Vertical: ϕ0.45 mm ϕ0.018 in opaque object	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FT-AFM2**
	Side sensing W5 × H15 × D15 W0.197 × H0.591 × D0.591	■ 590 23.228 ■ 290 11.417 Not equipped with FAST mode □ 100 3.937	120 4.724 60 2.362 40 1.575 –	60 2.362 30 1.181 20 0.787 –				**FT-AFM2E**
Narrow beam	ϕ3.5 ϕ0.138 ϕ3.7 ϕ0.146	■ 2,000 78.740 ■ 1,000 39.370 Not equipped with FAST mode □ 350 13.780	400 15.748 200 7.874 130 5.118 –	200 7.874 100 3.937 65 2.559 –	ϕ0.06 mm ϕ0.0024 in opaque object	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FT-K8**
	Side-view ϕ4 ϕ0.157 0.118							**FT-KV8**
	Side-view W2 × H1.5 × D20 W0.079 × H0.059 × D0.787 0.079	■ 500 19.685 ■ 250 9.843 Not equipped with FAST mode □ 100 3.937	80 3.150 35 1.378 10 0.394 –	– – – –	ϕ0.02 mm ϕ0.0008 in opaque object	✂ 2 m 6.562 ft	R10 mm R0.394 in	New **FT-KV1**
Ultra-small diameter	Beam diameter: ϕ0.125 mm ϕ0.005 in ϕ0.25 ϕ0.010 ϕ3 ϕ0.118 Sleeve part cannot be bent.	■ 18 0.709 ■ 10 0.394 Not equipped with FAST mode □ 3 0.118	3 0.118 2 0.079 1 0.039 –	1 0.039 – – –	ϕ0.02 mm ϕ0.0008 in opaque object	500 mm 19.685 in	R5 mm R0.197 in	**FT-E12**
	Beam diameter: ϕ0.25 mm ϕ0.010 in ϕ0.4 ϕ0.016 ϕ3 ϕ0.118 Sleeve part cannot be bent.	■ 80 3.150 ■ 50 1.969 Not equipped with FAST mode □ 15 0.591	14 0.551 7 0.276 4 0.157 –	6 0.236 3 0.118 2 0.079 –		✂ 1 m 3.281 ft		**FT-E22**
Tough flexible	Lens mountable M4	■ 650 25.591 ■ 320 12.598 Not equipped with FAST mode □ 110 4.331	130 5.118 64 2.520 45 1.772 –	64 2.520 32 1.206 22 0.866 –	ϕ0.05 mm ϕ0.0020 in opaque object	1 m 3.281 ft	R10 mm R0.394 in	New **FT-P81X**

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

LIST OF FIBERS

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

Type		Shape of fiber head (mm in)	Sensing range (mm in) (Note 1) ■: LONG ■: FAST ■: STD □: S-D			Min. sensing object (under the optimum condition (Note 2))	Fiber cable length ✂: Free-cut	Allowable bending radius	Model No.
			Red LED	Blue LED	Green LED				
Environment resistant	Heat-resistant	350 °C 662 °F Lens mountable M4	550 21.654 280 11.024 Not equipped with FAST mode 90 3.543	100 3.937 50 1.969 35 1.378 –	50 1.969 25 0.984 18 0.709 –	ϕ0.04 mm ϕ0.0016 in opaque object	2 m 6.562 ft	R25 mm R0.984 in	FT-H35-M2
		350 °C 662 °F Sleeve 60 mm 2.362 in M4 ϕ2.1 ϕ0.083						Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in	FT-H35-M2S6
		Allows flexible wiring 200 °C 392 °F Lens mountable M4	310 12.205 140 5.512 Not equipped with FAST mode 50 1.969	44 1.732 22 0.866 14 0.551 –	22 0.866 11 0.433 7 0.276 –	ϕ0.02 mm ϕ0.0008 in opaque object	1 m 3.281 ft	R10 mm R0.394 in	FT-H20W-M1
							2 m 6.562 ft		FT-H20W-M2
		200 °C 392 °F Lens mountable M4	550 21.654 280 11.024 Not equipped with FAST mode 90 3.543	100 3.937 50 1.969 35 1.378 –	50 1.969 25 0.984 18 0.709 –	ϕ0.04 mm ϕ0.0016 in opaque object	1 m 3.281 ft	R25 mm R0.984 in	FT-H20-M1
		130 °C 266 °F Lens mountable M4	880 34.646 440 17.323 Not equipped with FAST mode 155 6.102	72 2.835 36 1.417 26 1.024 –	32 1.260 16 0.630 10 0.394 –	ϕ0.06 mm ϕ0.0024 in opaque object	✂ 2 m 6.562 ft		FT-H13-FM2
	Chemical-resistant	Easy mounting · Rectangular head SEMI S2 compliant W7 X H15 X D13 W0.276 X H0.591 X D0.512	3,500 137.795 1,500 59.055 Not equipped with FAST mode 530 20.866	320 12.598 160 6.299 120 4.724 –	160 6.299 80 3.150 60 2.362 –	ϕ4 mm ϕ0.157 in opaque object	✂ 2 m 6.562 ft	R25 mm R0.984 in	FT-Z802Y
		ϕ5.5 ϕ0.217	3,500 137.795 1,500 59.055 Not equipped with FAST mode 530 20.866	160 6.299 80 3.150 50 1.969 –	160 6.299 80 3.150 50 1.969 –	ϕ0.08 mm ϕ0.003 in opaque object	✂ 2 m 6.562 ft (Note 3)	R30 mm R1.181 in	FT-L8Y
		Side-view ϕ5.5 ϕ0.217	800 31.496 400 15.748 Not equipped with FAST mode 140 5.512	120 4.724 60 2.362 35 1.378 –	80 3.150 40 1.575 25 0.984 –				FT-V8Y
	Vacuum	Lens mountable M4	470 18.504 230 9.055 Not equipped with FAST mode 80 3.150	100 3.937 50 1.969 30 1.181 –	46 1.811 23 0.906 16 0.630 –	ϕ0.02 mm ϕ0.0008 in opaque object	1 m 3.281 ft	R200 mm R7.874 in	FT-6V
			220 8.661 100 3.937 Not equipped with FAST mode 35 1.378	36 1.417 18 0.709 12 0.472 –	18 0.709 9 0.354 6 0.236 –			R30 mm R1.181 in	FT-60V

Notes: 1) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
2) The minimum sensing object size is the value for red LED type. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type.
The optimum condition is the condition when the sensitivity is set so that the sensing output just changes to light incident operation in the object absent condition.
3) The allowable cutting range is 500 mm 19.685 in from the end that the amplifier inserted.

The vacuum type fiber must be used with the following products as a set.

FT-J6: Fiber at atmospheric side (one pair set)
FV-BR1: Photo-terminal (one pair set)

Semi-standard fibers (Custom made per order)

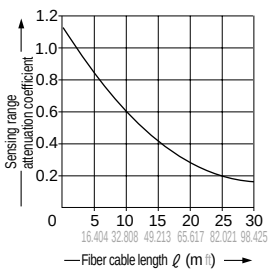
The fiber cable length or sleeve length of the standard fibers can be modified at your request. Select the fiber cable length (symbol ☆) or the sleeve length (symbol △) from the table below.

Type		Basic model No.	☆ Fiber cable length (Unit: m ft)	△ Sleeve length (Unit: cm in)
Standard threaded head (free-cut)		FT-FM ☆	3 9.843, 4 13.123, 5 16.404, 10 32.808, 15 49.213, 20 65.617,25 82.021, 30 98.425	———
	With sleeve	FT-FM ☆ -S △	2 6.562 (Note), 3 9.843, 4 13.123, 5 16.404, 10 32.808, 15 49.213, 20 65.617, 25 82.021, 30 98.425	1 0.394, 2 0.787, 3 1.181, 4 1.575, 5 1.969, 6 2.362, 7 2.756, 8 3.15, 9 3.543, 10 3.937, 11 4.331, 12 4.724
With large diameter lens		FT-FM ☆ L	20 65.617, 30 98.425	———
Small diameter threaded head with sleeve (free-cut)		FT-NFM2-S △	———	1 0.394, 2 0.787, 3 1.181, 4 1.575, 5 1.969, 6 2.362, 7 2.756, 8 3.15, 9 3.543, 10 3.937, 11 4.331, 12 4.724
Wide beam		FT-WA30- ☆ FT-A30- ☆ FT-WA8- ☆ FT-A8- ☆	5 16.404	———
200°C 392°F heat-resistant		FT-H20-M ☆	2 0.079, 3 0.118	———
350°C 662°F heat-resistant		FT-H35-M ☆	3 0.118	———
Chemical-resistant		FT-Z80 ☆ Y	5 0.197, 7 0.276	———

Note: The standard fiber has a 2 m 6.562 ft fiber cable length and a 4 cm 1.575 in or 9 cm 3.543 in sleeve length.

Correlation between sensing range attenuation coefficient and fiber cable length

The longer the fiber cable, the shorter the sensing range.



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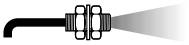
LIST OF FIBERS

General purpose fibers [Reflective type]



Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 1, 2) ■: LONG ■: STD ■: FAST □: S-D			Min. sensing object (at the maximum sensitivity (Note 3))	Fiber cable length ✂: Free-cut	Allowable bending radius	Model No.
		Red LED	Blue LED	Green LED				
Standard — Long sensing range	M6	480 18.898 220 8.661 Not equipped with FAST mode 75 2.953	80 3.150 40 1.575 26 1.024 –	42 1.654 21 0.827 14 0.551 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FD-B8**
Standard	Coaxial M6	310 12.205 140 5.512 Not equipped with FAST mode 47 1.850	46 1.811 23 0.906 15 0.591 –	24 0.945 12 0.472 8 0.315 –	ϕ0.02 mm ϕ0.0008 in gold wire	500 mm 19.685 ft	R25 mm R0.984 in	**FD-5**
Standard	Coaxial M6	310 12.205 140 5.512 Not equipped with FAST mode 47 1.850	46 1.811 23 0.906 15 0.591 –	24 0.945 12 0.472 8 0.315 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft		**FD-FM2**
Standard	Sleeve 90 mm 3.543 in M6 ϕ2.5 ϕ0.098	270 10.630 110 4.331 Not equipped with FAST mode 39 1.535	46 1.811 23 0.906 15 0.591 –	24 0.945 12 0.472 8 0.315 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	Fiber R25 mm R0.984 in	**FD-FM2S**
Standard	Sleeve 40 mm 1.575 in M6 ϕ2.5 ϕ0.098	270 10.630 110 4.331 Not equipped with FAST mode 39 1.535	46 1.811 23 0.906 15 0.591 –	24 0.945 12 0.472 8 0.315 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	Sleeve R10 mm R0.394 in	**FD-FM2S4**
Standard	M4	270 10.630 110 4.331 Not equipped with FAST mode 39 1.535	46 1.811 23 0.906 15 0.591 –	24 0.945 12 0.472 8 0.315 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FD-T80**
Standard	Small diameter M3	90 3.543 45 1.772 Not equipped with FAST mode 16 0.630	16 0.630 8 0.315 5 0.197 –	8 0.315 4 0.157 2 0.079 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FD-T40**
Standard	ϕ3 ϕ0.118	270 10.630 110 4.331 Not equipped with FAST mode 39 1.535	46 1.811 23 0.906 15 0.591 –	24 0.945 12 0.472 8 0.315 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FD-S80**
Standard	M6	260 10.236 120 4.724 Not equipped with FAST mode 42 1.654	46 1.811 23 0.906 15 0.591 –	24 0.945 12 0.472 8 0.315 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FD-N8**
Standard	M4	75 2.953 38 1.496 Not equipped with FAST mode 13 0.512	16 0.630 8 0.315 5 0.197 –	8 0.315 4 0.157 2 0.079 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft (Note 4)	R25 mm R0.984 in	**FD-N4**
Standard	M4	90 3.543 45 1.772 Not equipped with FAST mode 16 0.630	16 0.630 8 0.315 5 0.197 –	8 0.315 4 0.157 2 0.079 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FD-NFM2**
Standard	Sleeve 90 mm 3.543 in M4 ϕ1.48 ϕ0.058	90 3.543 45 1.772 Not equipped with FAST mode 16 0.630	16 0.630 8 0.315 5 0.197 –	8 0.315 4 0.157 2 0.079 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	Fiber R25 mm R0.984 in	**FD-NFM2S**
Standard	Sleeve 40 mm 1.575 in M4 ϕ1.48 ϕ0.058	90 3.543 45 1.772 Not equipped with FAST mode 16 0.630	16 0.630 8 0.315 5 0.197 –	8 0.315 4 0.157 2 0.079 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	Sleeve R10 mm R0.394 in	**FD-NFM2S4**
Standard	ϕ2.5 ϕ0.098	90 3.543 45 1.772 Not equipped with FAST mode 16 0.630	16 0.630 8 0.315 5 0.197 –	8 0.315 4 0.157 2 0.079 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FD-SNFM2**
Elbow	M6	185 7.283 85 3.346 Not equipped with FAST mode 30 1.181	32 1.260 16 0.630 10 0.394 –	16 0.630 8 0.315 5 0.197 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FD-R80**
Side-view	ϕ2 ϕ0.079 ϕ5 ϕ0.197 0.8 0.031 Sleeve part cannot be bent.	100 3.937 45 1.772 Not equipped with FAST mode 16 0.630	14 0.551 7 0.276 4 0.157 –	7 0.276 3.5 0.138 – –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FD-SFM2SV2**
Side-view	Small diameter ϕ1.5 ϕ0.059 ϕ3 ϕ0.118 0.7 0.028 Sleeve part cannot be bent.	55 2.165 25 0.984 Not equipped with FAST mode 9 0.354	6 0.236 3 0.118 – –	3 0.118 – – –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FD-V41**

Notes: 1) The sensing range is specified for white non-glossy paper (**FD-B8**, **FD-5**, **FD-FM2**, **FD-FM2S**, **FD-FM2S4**, **FD-N8**, **FD-T80**, **FD-S80** and **FD-R80**: 400 × 400 mm 15.748 × 15.748 in, **FD-T40**, **FD-N4**, **FD-NFM2**, **FD-NFM2S**, **FD-NFM2S4**, **FD-SNFM2**, **FD-SFM2SV2** and **FD-V41**: 200 × 200 mm 7.874 × 7.874 in) as the object.
2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
3) The minimum sensing object size is the value for red LED type at maximum sensitivity. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type.
Also, note that the corresponding setting distance is different from the rated sensing distance.
4) The fiber cutter is not attached with **FD-N8** and **FD-N4**. Please order it separately.

LIST OF FIBERS

Sharp bending fibers / Flexible fibers [Reflective type]

■ : LONG ■ : FAST ■ : STD □ : S-D

Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 1, 2) Red LED	Blue LED	Green LED	Min. sensing object (at the maximum sensitivity (Note 3))	Fiber cable length ✂ : Free-cut	Allowable bending radius	Model No.
Sharp bending / Long sensing range	Rectangular head W5.2×H9.5×D15 W0.205×H0.374×D0.591	20 to 480 0.787 to 18.898 20 to 230 0.787 to 9.055 Not equipped with FAST mode 25 to 100 0.984 to 3.937	– – – –	– – – –	ϕ0.3 mm ϕ0.012 in copper wire	✂ 2 m 6.562 ft	R1 mm R0.039 in	New FD-WKZ1
Sharp bending / Standard	M6	190 7.480 90 3.543 Not equipped with FAST mode 32 1.260	23 0.906 11 0.433 8 0.315 –	14 0.551 7 0.276 4 0.157 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R1 mm R0.039 in	FD-W8
Sharp bending / Standard	Sleeve 40 mm 1.575 in M4 ϕ1.48 ϕ0.058	30 1.181 15 0.591 Not equipped with FAST mode 5 0.197	5 0.197 2.5 0.098 1.5 0.059 –	3 0.118 1.5 0.059 1 0.039 –			Fiber R1 mm R0.039 in Sleeve R10 mm R0.394 in	FD-W44
Sharp bending / Standard	M4	190 7.480 90 3.543 Not equipped with FAST mode 32 1.260	23 0.906 11 0.433 8 0.315 –	14 0.551 7 0.276 4 0.157 –				FD-WT8
Sharp bending / Standard	ϕ3 ϕ0.118						R1 mm R0.039 in	FD-WS8
Sharp bending / Standard	M3	30 1.181 15 0.591 Not equipped with FAST mode 5 0.197	5 0.197 2.5 0.098 1.5 0.059 –	3 0.118 1.5 0.059 1 0.039 –				FD-WT4
Sharp bending / High precision	Small spot for sensing minute objects Coaxial · Lens mountable M4	65 2.559 32 1.260 Not equipped with FAST mode 11 0.433	11 0.433 5 0.197 3 0.118 –	6 0.236 3 0.118 2 0.079 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R2 mm R0.079 in	FD-WG4
Sharp bending / High precision	For sensing minute objects Coaxial ϕ3 ϕ0.118							FD-WSG4
Sharp bending / Fixed-focus reflective	Glass substrate detection W24×H21×D4 W0.945×H0.827×0.157	6.5 to 14 0.256 to 0.551 (Convergent point 8 0.315) 7 to 12 0.276 to 0.472 (Convergent point 8 0.315) Not equipped with FAST mode Cannot use	– – – –	– – – –	ϕ1.9 mm ϕ0.075 in metal pipe (gray)	✂ 2 m 6.562 ft	R1 mm R0.039 in	New FD-WL41
Sharp bending / Fixed-focus reflective	Specular object detection W15×H19×D3 W0.591×H0.748×0.118	0.6 to 3.5 0.024 to 0.138 (Convergent point 2 0.079) 0.9 to 2.7 0.035 to 0.106 (Convergent point 2 0.079) Not equipped with FAST mode Cannot use	– – – –	– – – –	ϕ0.08 mm ϕ0.003 in gold wire			New FD-WL42
Sharp bending / Side view	ϕ2 ϕ0.079 ϕ3 ϕ0.118 0.039 Sleeve part cannot be bent.	15 0.591 7 0.276 Not equipped with FAST mode Cannot use	– – – –	– – – –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R1 mm R0.039 in	New FD-WV42
Flexible / Standard	M6	220 8.661 100 3.937 Not equipped with FAST mode 35 1.378	40 1.575 20 0.787 13 0.512 –	20 0.787 10 0.394 7 0.276 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R4 mm R0.157 in	FD-P80
Flexible / Standard	M4	90 3.543 45 1.772 Not equipped with FAST mode 16 0.630	20 0.787 10 0.394 6 0.236 –	10 0.394 5 0.197 3 0.118 –				FD-P60
Flexible / Standard	ϕ3 ϕ0.118							FD-P50
Flexible / Small diameter	M3	36 1.417 18 0.709 Not equipped with FAST mode 6 0.236	5 0.197 2.5 0.098 1.5 0.059 –	3 0.118 1.5 0.059 1 0.039 –				FD-P40
Flexible / Small diameter	ϕ1.5 ϕ0.059	50 1.969 25 0.984 Not equipped with FAST mode 9 0.354	8 0.315 4 0.157 2.5 0.098 –	4 0.157 2 0.079 1.5 0.059 –		1 m 3.281 ft		FD-P2

Notes: 1) The sensing range is specified for white non-glossy paper [100×100 mm 3.937×3.937 in (**FD-WKZ1**, **FD-W8**, **FD-WT8**, **FD-WS8**, and **FD-P80**: 400×400 mm 15.748×15.748 in, **FD-WG4**, **FD-WSG4**, **FD-P60**, and **FD-P50**: 200×200 mm 7.874×7.874 in, **FD-WL41**: glass substrate 100×100×t 2 mm 3.937×3.937×t 0.079 in)] as the object.

2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.

3) The minimum sensing object size is the value for red LED type at maximum sensitivity. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type.
Also, note that the corresponding setting distance is different from the rated sensing distance. However, with the fixed-focus reflective type, when the sensitivity is at MAX., it is only possible to detect the minimum size of the sensing object at a distance corresponding to the convergent point.

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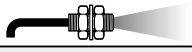
LIST OF FIBERS

Special use fibers [Reflective type]



Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 1, 2) ■: LONG ■: STD □: FAST □: S-D			Min. sensing object (at the maximum sensitivity (Note 3))	Fiber cable length ✂: Free-cut	Allowable bending radius	Model No.
		Red LED	Blue LED	Green LED				
Special use – Wide beam	W7 × H15 × D30 W0.276 × H0.591 × D1.181	200 7.874 150 5.906 Not equipped with FAST mode 50 1.969	25 0.984 15 0.591 – –	– – – –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FD-A15** New
Array	Top sensing W5 × H20 × D20 W0.197 × H0.787 × D0.787	220 8.661 110 4.331 Not equipped with FAST mode 39 1.535	40 1.575 20 0.787 13 0.512 –	18 0.709 9 0.197 5 0.354 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FD-AFM2**
Array	Side sensing W5 × H20 × D20 W0.197 × H0.787 × D0.787							**FD-AFM2E**
High precision	Coaxial · Lens mountable M4	110 4.331 55 2.165 Not equipped with FAST mode 19 0.748	22 0.866 11 0.433 8 0.315 –	12 0.472 6 0.236 4 0.157 –	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FD-G4**
High precision	Coaxial · Lens mountable M3							**FD-G6** New
High precision	Coaxial · Lens mountable M3	38 1.496 18 0.709 Not equipped with FAST mode 6 0.236	6 0.236 3 0.118 2 0.079 –	3 0.118 1.5 0.059 1 0.039 –		500 mm 19.685 in		**FD-EG1**
High precision	Coaxial · Lens mountable M3	25 0.984 12 0.472 Not equipped with FAST mode 5 0.197	5 0.197 2 0.079 1 0.039 –	2 0.079 1 0.039 – –	ϕ0.04 mm ϕ0.0016 in gold wire		R10 mm R0.394 in	**FD-EG2** New
High precision	Coaxial · Lens mountable M3	15 0.591 8 0.315 Not equipped with FAST mode 3 0.118	2 0.079 1 0.039 – –	1 0.039 – – –				**FD-EG3** New
Ultra-small diameter	ϕ0.5 ϕ0.020 ϕ1.5 ϕ0.059 Sleeve part cannot be bent.	11 0.433 6 0.236 Not equipped with FAST mode 1 0.039	2 0.079 1 0.039 – –	1 0.039 – – –	ϕ0.02 mm ϕ0.0008 in gold wire	1 m 3.281 ft	R10 mm R0.394 in	**FD-E12**
Ultra-small diameter	Coaxial ϕ0.65 ϕ0.026 ϕ3 ϕ0.118 Sleeve part cannot be bent.	45 1.772 23 0.906 Not equipped with FAST mode 7 0.276	6 0.236 3 0.118 2 0.079 –	3 0.118 1.5 0.059 1 0.039 –			R25 mm R0.984 in	**FD-E22**
Ultra-small diameter	M3 ϕ0.5 ϕ0.020 Sleeve part cannot be bent.	5 0.197 3 0.118 Not equipped with FAST mode Cannot use	– – – –	– – – –		500 mm 19.685 in		**FD-EN500S1**
Ultra-small diameter	Coaxial M3 ϕ0.8 ϕ0.031 Sleeve part cannot be bent.	38 1.496 18 0.709 Not equipped with FAST mode 6 0.236	6 0.236 3 0.118 2 0.079 –	3 0.118 1.5 0.059 1 0.039 –		1 m 3.281 ft		**FD-ENM1S1**
Fixed-focus reflective	Glass substrate detection SEMI S2 compliant W17 × H29 × D3.8 W0.669 × H1.142 × D0.150	0 to 20 0 to 0.787	–	–	(LCD glass)	✂ 2 m 6.562 ft	R4 mm R0.157 in	**FD-L43**
Fixed-focus reflective	Glass substrate detection W24 × H21 × D4 W0.945 × H0.827 × D0.157	2.5 to 18 0.098 to 0.709 (Convergent point 8 0.315) 3 to 16 0.118 to 0.630 (Convergent point 8 0.315) Not equipped with FAST mode Cannot use	– – – –	– – – –	ϕ0.06 mm ϕ0.0024 in gold wire		R10 mm R0.394 in	**FD-L41**
Fixed-focus reflective	Specular object detection W15 × H19 × D3 W0.591 × H0.748 × D0.118	0.5 to 4 0.020 to 0.157 (Convergent point 2 0.079) 1 to 3.8 0.039 to 0.150 (Convergent point 2 0.079) Not equipped with FAST mode Cannot use	– – – –	– – – –	ϕ0.03 mm ϕ0.0012 in gold wire			**FD-L42**
Fixed-focus reflective	W6 × H18 × D14 W0.236 × H0.709 × D0.551	2.5 to 18 0.098 to 0.709 (Convergent point 6 0.236) 4 to 12 0.157 to 0.472 (Convergent point 6 0.236) Not equipped with FAST mode 4.8 to 9.5 0.189 to 0.374 (Convergent point 6 0.236)	4.5 to 9.5 0.177 to 0.374 5 to 9 0.197 to 0.354 5.5 to 8 0.217 to 0.315 –	5 to 9 0.197 to 0.354 5.5 to 8 0.217 to 0.315 – –	ϕ0.02 mm ϕ0.0008 in gold wire			**FD-L4**
Liquid level sensing	Contact type ϕ6 ϕ0.236	———			(Liquid)	✂ 2 m 6.562 ft (Note 4)	Protective tube R40 mm R1.575 in Fiber R15 mm R0.591 in	**FD-F8Y**
Liquid level sensing	Mountable on pipe Standard W25 × H13 × D20 W0.984 × H0.512 × D0.787	Applicable pipe diameter: Outer dia. ϕ6 to ϕ26 mm ϕ0.236 to ϕ1.024 in transparent pipe [PVC, fluorine resin, Polycarbonate, acrylic, glass, wall thickness 1 to 3 mm 0.039 to 0.118 in]			(Liquid)	✂ 2 m 6.562 ft ✂ 5 m 16.404 ft	R10 mm R0.394 in	**FD-F41** **FD-F91**
Liquid level sensing	Mountable on pipe for 1 mm 0.039 in thick PFA pipe W25 × H13 × D20 W0.984 × H0.512 × D0.787	Applicable pipe diameter: Outer dia. ϕ6 to ϕ26 mm ϕ0.236 to ϕ1.024 in transparent pipe [PFA (fluorine resin) or equivalently transparent pipe, wall thickness 1 mm 0.039 in]				✂ 2 m 6.562 ft ✂ 5 m 16.404 ft		**FD-F4** **FD-F9**
Tough flexible	M6	185 7.283 80 3.150 Not equipped with FAST mode 35 1.378	32 1.260 16 0.630 10 0.394 –	16 0.630 8 0.315 5 0.197 –	ϕ0.02 mm ϕ0.0008 in gold wire	1 m 3.281 ft	R10 mm R0.394 in	**FD-P81X** New
Tough flexible	Small spot for sensing minute objects M3 Coaxial · Lens mountable	90 3.543 45 1.772 Not equipped with FAST mode 20 0.787	22 0.866 11 0.433 6 0.236 –	12 0.472 6 0.236 4 0.157 –		✂ 1 m 3.281 ft (Note 4)		**FD-G6X** New

Notes: 1) The sensing range is specified for white non-glossy paper [100 × 100 mm 3.937 × 3.937 in (**FD-G4**, **FD-G6X** and **FD-A15**: 200 × 200 mm 7.874 × 7.874 in, **FD-AFM2**, **FD-AFM2E** and **FD-P81X**: 400 × 400 mm 15.748 × 15.748 in, **FD-L43**: glass substrate 76 × 52 × t 1.1 mm 2.992 × 2.047 × t 0.043 in, **FD-L41**: glass substrate 100 × 100 × t 2 mm 3.937 × 3.937 × t 0.079 in)] as the object.

2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.

3) The minimum sensing object size is the value for red LED type at maximum sensitivity. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type.
Also, note that the corresponding setting distance is different from the rated sensing distance. However, with the fixed-focus reflective type, when the sensitivity is at MAX., it is only possible to detect the minimum size of the sensing object at a distance corresponding to the convergent point.

4) Following is the allowable cutting range from the end that the amplifier is inserted **FD-F8Y**: 1,000 mm 39.370 in, **FD-G6X**: 700 mm 27.559 in.

LIST OF FIBERS

Environment resistant fibers [Reflective type]

Type		Shape of fiber head (mm in)	Sensing range (mm in) (Note 1, 2) ■: LONG ■: STD □: FAST □: S-D Red LED	Blue LED	Green LED	Min. sensing object (at the maximum sensitivity (Note 3))	Fiber cable length ✂: Free-cut	Allowable bending radius	Model No.
Environment resistant	Heat-resistant	350 °C 662 °F · Coaxial M6	270 10.630 140 5.512 Not equipped with FAST mode 47 1.850	36 1.417 18 0.709 12 0.472	20 0.787 10 0.394 7 0.276	ϕ0.02 mm ϕ0.0008 in gold wire	2 m 6.562 ft	R25 mm R0.984 in	**FD-H35-M2**
		350 °C 662 °F Sleeve 60 mm 2.362 in M6 ϕ2.8 ϕ0.110 in						Fiber R25 R0.984 Sleeve **R10 mm R0.394 in**	**FD-H35-M2S6**
		200 °C 392 °F · Coaxial M6					1 m 3,281 ft	R25 mm R0.984 in	**FD-H20-M1**
		350 °C 662 °F Sleeve 90 mm 3.543 in M4 ϕ2.1 ϕ0.083 in	160 6.299 80 3.150 Not equipped with FAST mode 26 1.024	22 0.866 11 0.433 7 0.276	12 0.472 6 0.236 4 0.157	ϕ0.02 mm ϕ0.0008 in gold wire	1 m 3,281 ft	Fiber R25 R0.984 Sleeve **R10 mm R0.394 in**	***New*** **FD-H35-20S**
		200 °C 392 °F · Coaxial M4	270 10.630 140 5.512 Not equipped with FAST mode 47 1.850	36 1.417 18 0.709 12 0.472	20 0.787 10 0.394 7 0.276	ϕ0.02 mm ϕ0.0008 in gold wire	1 m 3,281 ft	R25 mm R0.984 in	***New*** **FD-H20-21**
		300 °C 572 °F · Glass substrate detection Fixed-focus reflective W19 × H27 × D5 W0.748 × H1.063 × D0.197	0 to 15 0 to 0.591 0 to 10 0 to 0.394 Not equipped with FAST mode 2 to 6 0.079 to 0.236	–	–	ϕ0.02 mm ϕ0.0008 in gold wire	2 m 6.562 ft	R25 mm R0.984 in	***New*** **FD-H30-L32**
		180 °C 356 °F · Glass substrate detection Fixed-focus reflective W19 × H27 × D5 W0.748 × H1.063 × D0.197					✂ 2 m 6.562 ft		***New*** **FD-H18-L31**
		130 °C 266 °F M6	310 12.205 140 5.512 Not equipped with FAST mode 47 1.850	20 0.787 11 0.433 7 0.276	20 0.787 11 0.433 7 0.276	ϕ0.02 mm ϕ0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	**FD-H13-FM2**
	Vacuum	M6	165 6.496 75 2.953 Not equipped with FAST mode 26 1.024	26 1.024 13 0.512 9 0.354	14 0.551 7 0.276 4 0.157	ϕ0.02 mm ϕ0.0008 in gold wire	1 m 3,281 ft	R200 mm R7.874 in	**FD-6V**

Notes: 1) The sensing range is specified for white non-glossy paper [400 × 400 mm 15.748 × 15.748 in (**FD-H30-L32**, **FD-H18-L31**: glass substrate 50 × 50 mm 1.969 × 1.969 in)] as the object.
2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut.
3) The minimum sensing object size is the value for red LED type at maximum sensitivity. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type. Also, note that the corresponding setting distance is different from the rated sensing distance.

The vacuum type fiber must be used with the following products as a set.

FT-J6: Fiber at atmospheric side (one pair set)
FV-BR1: Photo-terminal (one pair set)

Semi-standard fibers (Custom made per order)

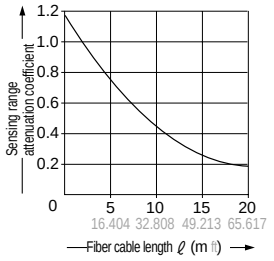
The fiber cable length or sleeve length of the standard fibers can be modified at your request. Select the fiber cable length (symbol ☆) or the sleeve length (symbol △) from the table below.

Type		Basic model No.	☆ Fiber cable length (Unit: m ft)	△ Sleeve length (Unit: cm in)
Standard threaded head (free-cut)		**FD-FM** ☆	3 9.843, 4 13.123, 5 16.404, 10 32.808, 15 49.213, 20 65.617	———
	With sleeve	**FD-FM** ☆ **-S** △	2 6.562 (Note), 3 9.843, 4 13.123, 5 16.404, 10 32.808, 15 49.213, 20 65.617	1 0.394, 2 0.787, 3 1.181, 4 1.575, 5 1.969, 6 2.362, 7 2.756, 8 3.15, 9 3.543, 10 3.937, 11 4.331, 12 4.724
Small diameter threaded head with sleeve (free-cut)		**FD-NFM2-S** △	———	1 0.394, 2 0.787, 3 1.181, 4 1.575, 5 1.969, 6 2.362, 7 2.756, 8 3.15, 9 3.543, 10 3.937, 11 4.331, 12 4.724
200°C 392°F heat-resistant		**FD-H20-M** ☆	2 6.562, 3 9.843	———
350°C 662°F heat-resistant		**FD-H35-M** ☆	3 9.843	———

Note: The standard fiber has a 2 m 6.562 ft fiber cable length and a 4 cm 1.575 in or 9 cm 3.543 in sleeve length.

Correlation between sensing range attenuation coefficient and fiber cable length

The longer the fiber cable, the shorter the sensing range.

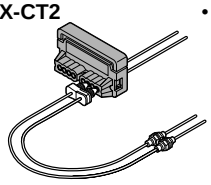


Accessories (attached with fibers)

Fiber cutter

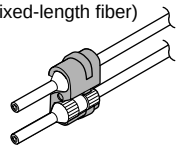
• **FX-CT1**

• **FX-CT2**

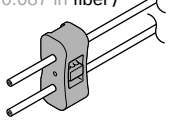


Fiber attachment

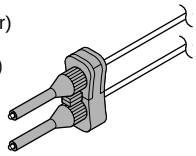
• **FX-AT2**
(for fixed-length fiber)



• **FX-AT3**
(for ϕ2.2 mm ϕ0.087 in fiber)



• **FX-AT4**
(for ϕ1 mm ϕ0.039 in fiber)
• **FX-AT5**
(for ϕ1.3 mm ϕ0.051 in fiber)
• **FX-AT6**
(for ϕ1 mm ϕ0.039 in and ϕ1.3 mm ϕ0.051 in mixed fiber)



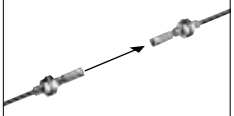
Notes: 1) Fiber cutter is not supplied as accessory along with **FT-NB8**, **FT-N8**, **FD-N8** and **FD-N4**. Please order it separately.
2) The fiber attachment is not attached with **FT-N8/NB8**, **FT/FD-P80** and **FD-N8**. The previous **FX-AT10** attachment is included with **FD-N4**.

FX-311

FIBER OPTIONS

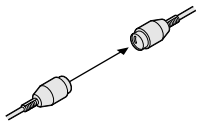
Lens (For thru-beam type fiber)

For thru-beam type fiber

Designation	Model No.		Description
Expansion lens (Note 1)	**FX-LE1**		Increases the sensing range by 5 times or more. • Ambient temperature: −60 to +350 °C −76 to +662 °F

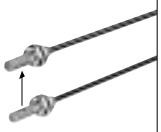
Sensing range (mm in) [Lens on both sides] (Note 2)

Fiber \ Mode	LONG	STD	S-D
FT-B8	3,500 137.759 (Note 3)	2,500 98.425	1,000 39.370
FT-FM2	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	1,300 51.181
FT-T80	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	1,300 51.181
FT-R80	3,500 137.759 (Note 3)	2,300 90.551	800 31.496
FT-W8	3,500 137.759 (Note 3)	2,900 114.173	1,000 39.370
FT-P80	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	1,100 43.307
FT-P60	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	900 35.433
FT-P81X	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	1,100 43.307
FT-H35-M2	3,500 137.759 (Note 3)	2,000 78.740	750 29.528
FT-H20W-M1	1,600 62.992 (Note 3)	1,300 51.181	500 19.685
FT-H20W-M2	2,600 102.362	1,300 51.181	500 19.685
FT-H20-M1	1,600 62.992 (Note 3)	1,600 62.992 (Note 3)	900 35.433

Super-expansion lens (Note 1)	**FX-LE2**		Tremendously increases the sensing range with large diameter lenses. • Ambient temperature: −60 to +350 °C −76 to +662 °F

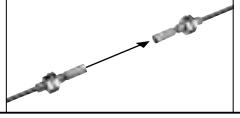
Sensing range (mm in) [Lens on both sides] (Note 2)

Fiber \ Mode	LONG	STD	S-D
FT-B8	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)
FT-FM2	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)
FT-R80	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)
FT-W8	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)
FT-P80	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)
FT-P60	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)
FT-P81X	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)
FT-H35-M2	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)
FT-H20W-M1	1,600 62.992 (Note 3)	1,600 62.992 (Note 3)	1,500 59.055
FT-H20W-M2	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	1,500 59.055
FT-H20-M1	1,600 62.992 (Note 3)	1,600 62.992 (Note 3)	1,600 62.992 (Note 3)
FT-H13-FM2	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)	3,500 137.759 (Note 3)

Side-view lens	**FX-SV1**		Beam axis is bent by 90 °. • Ambient temperature: −60 to +300 °C −76 to +572 °F

Sensing range (mm in) [Lens on both sides] (Note 2)

Fiber \ Mode	LONG	STD	S-D
FT-B8	1,100 43.307	530 20.866	186 7.323
FT-FM2	1,200 47.244	600 23.622	210 8.268
FT-T80	1,200 47.244	600 23.622	210 8.268
FT-W8	900 35.433	450 17.717	160 6.299
FT-P80	1,200 47.244	600 23.622	210 8.268
FT-P60	650 25.591	300 11.811	130 5.118
FT-P81X	1,200 47.244	600 23.622	200 7.874
FT-H35-M2	550 21.654	280 11.024	90 3.543
FT-H20W-M1	310 12.205	140 5.512	50 1.969
FT-H20W-M2	310 2.205	140 5.512	50 1.969
FT-H20-M1	550 21.654	280 11.024	90 3.543

Expansion lens for vacuum fiber (Note 1)	**FV-LE1**		Sensing range increases by 15 times or more. • Ambient temperature: −40 to +120 °C −40 to +248 °F

Sensing range (mm in) [Lens on both sides] (Note 2)

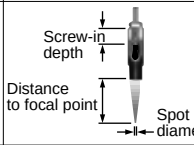
Fiber \ Mode	LONG	STD	S-D
FT-6V	3,500 137.759 (Note 3)	2,700 106.299	940 37.008
FT-60V	2,800 110.236	1,450 57.087	490 19.291

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

Lens (For reflective type fiber)

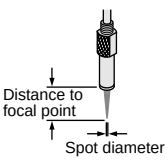
For reflective type fiber

Designation	Model No.		Description
Pinpoint spot lens	**FX-MR1**		Pinpoint spot of ϕ0.5 mm ϕ0.020 in. Enables detection of minute objects or small marks. • Distance to focal point: 6 ± 1 mm 0.236 ± 0.039 in • Applicable fibers: **FD-WG4**, **FD-G4** • Ambient temperature: −40 to +70 °C −40 to +158 °F

Zoom lens	**FX-MR2**		The spot diameter is adjustable from ϕ0.7 to ϕ2 mm ϕ0.028 to 0.079 in according to how much the fiber is screwed in. • Applicable fibers: **FD-WG4**, **FD-G4** • Ambient temperature: −40 to +70 °C −40 to +158 °F • Accessory: **MS-EX3** (Mounting bracket)

Sensing range (Note 1)

Screw-in depth	Distance to focal point	Spot diameter
7 mm 0.276 in	ϕ18.5 mm ϕ0.728 in approx.	ϕ0.7 mm ϕ0.028 in
12 mm 0.472 in	ϕ27 mm ϕ1.063 in approx.	ϕ1.2 mm ϕ0.047 in
14 mm 0.551 in	ϕ43 mm ϕ1.693 in approx.	ϕ2.0 mm ϕ0.079 in

Finest spot lens	**FX-MR3**		Extremely fine spot of ϕ0.3 mm ϕ0.012 in approx. achieved. • Applicable fibers: **FD-WG4**, **FD-G4**, **FD-EG1**, **FD-EG2**, **FD-EG3**, **FD-G6X**, **FD-G6** • Ambient temperature: −40 to +70 °C −40 to +158 °F

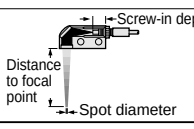
Sensing range (Note 1)

Fiber	Distance to focal point	Spot diameter
FD-EG3	7.5 ± 0.5 mm 0.295 ± 0.020 in	ϕ0.15 mm ϕ0.006 in
FD-EG2	7.5 ± 0.5 mm 0.295 ± 0.020 in	ϕ0.2 mm ϕ0.008 in
FD-EG1	7.5 ± 0.5 mm 0.295 ± 0.020 in	ϕ0.3 mm ϕ0.012 in
FD-WG4/G4/G6X/G6	7.5 ± 0.5 mm 0.295 ± 0.020 in	ϕ0.5 mm ϕ0.020 in

Finest spot lens	**FX-MR6**		Extremely fine spot of ϕ0.1 mm ϕ0.040 in approx. achieved. • Applicable fibers: **FD-WG4**, **FD-G4**, **FD-EG1**, **FD-EG2**, **FD-EG3**, **FD-G6X**, **FD-G6** • Ambient temperature: −20 to +60 °C −4 to +140 °F

Sensing range (Note 1)

Fiber	Distance to focal point	Spot diameter
FD-EG3	7 ± 0.5 mm 0.276 ± 0.020 in	ϕ0.1 mm ϕ0.004 in
FD-EG2	7 ± 0.5 mm 0.276 ± 0.020 in	ϕ0.15 mm ϕ0.006 in
FD-EG1	7 ± 0.5 mm 0.276 ± 0.020 in	ϕ0.2 mm ϕ0.008 in
FD-WG4/G4/G6X/G6	7 ± 0.5 mm 0.276 ± 0.020 in	ϕ0.4 mm ϕ0.016 in

Zoom lens (Side-view type)	**FX-MR5**		**FX-MR2** is converted into a side-view type and can be mounted in a very small space. • Applicable fibers: **FD-WG4**, **FD-G4** • Ambient temperature: −40 to +70 °C −40 to +158 °F

Sensing range (Note 1)

Screw-in depth	Distance to focal point	Spot diameter
8 mm 0.315 in	13 mm 0.512 in approx.	ϕ0.5 mm ϕ0.020 in
10 mm 0.394 in	15 mm 0.591 in approx.	ϕ0.8 mm ϕ0.031 in
14 mm 0.551 in	30 mm 1.181 in approx.	ϕ3.0 mm ϕ0.118 in

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

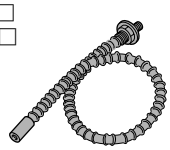
FIBER OPTIONS

Others

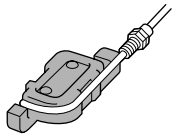
Designation	Model No.	Description				
Protective tube (For thru-beam type fiber)	**FTP-500** (0.5 m 1.640 ft)	For M4 thread	Applicable fibers	**FT-B8** **FT-FM2** **FT-FM2S** **FT-FM2S4** **FT-P80**	**FT-P60** **FT-H13-FM2**	The protective tube, made of non-corrosive stainless steel, protects the inner 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-T80** **FT-NFM2** **FT-NFM2S** **FT-NFM2S4**	**FT-P40** **FD-T40** **FD-P40**	
	FTP-N1000 (1 m 3.281 ft)					
	FTP-N1500 (1.5 m 4.921 ft)					
Protective tube (For reflective type fiber)	**FDP-500** (0.5 m 1.640 ft)	For M6 thread		**FD-B8** **FD-FM2** **FD-FM2S** **FD-FM2S4** **FD-P80**	**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-T80** **FD-N4** **FD-NFM2** **FD-NFM2S** **FD-NFM2S4**		
	FDP-N1000 (1 m 3.281 ft)					
	FDP-N1500 (1.5 m 4.921 ft)					
Fiber bender	**FB-1**	The fiber bender bends the sleeve part of the fiber head at the proper radius. (Note 1)				
Universal sensor mounting stand (Note 3)	**MS-AJ1-F**	Horizontal mounting type	Fiber assemblies (For M3, M4 or M6 threaded head fiber)			
	MS-AJ2-F	Vertical mounting type				
Fiber cutter	**FX-CT1**	The free-cut type fiber can be easily cut. (Accessory for **FT/FD-P80** only)				
	FX-CT2	The free-cut type fiber can be easily cut. (Accessory for the free-cut type fiber. Not attached with the **FT-N8/NB8/P80** and **FD-N8/N4/P80**)				
Fixed-length fiber attachment	**FX-AT2**	Fixed-length fiber attachment (Attached with fiber)				
ϕ2.2 mm ϕ0.087 in fiber attachment	**FX-AT3**	ϕ2.2 mm ϕ0.087 in fiber attachment (Accessory for the fiber. Not attached with the **FT-N8/NB8/P80** and **FD-N8/P80**)				
ϕ1 mm ϕ0.039 in fiber attachment	**FX-AT4**	ϕ1 mm ϕ0.039 in fiber attachment (Accessory for the fiber. Not attached with the **FT-N4**) (Note 2)				
ϕ1.3 mm ϕ0.051 in fiber attachment	**FX-AT5**	ϕ1.3 mm ϕ0.051 in fiber attachment (Accessory for the fiber)				
ϕ1 mm ϕ0.039 in and ϕ1.3 mm ϕ0.051 in mixed fiber attachment	**FX-AT6**	ϕ1 mm ϕ0.039 in and ϕ1.3 mm ϕ0.051 in mixed fiber attachment (Accessory for the fiber)				

Notes: 1) The end sleeve of the side-view and ultra-small diameter head fibers cannot be bent.
2) The conventional **FX-AT10** fiber attachment is attached with the **FD-N4**.
3) Refer to p.332〜 for details of the universal sensor mounting stand.

Protective tube
• **FTP-□**
• **FDP-□**



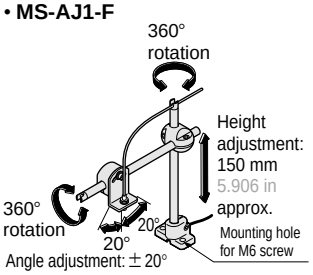
Fiber bender
• **FB-1**



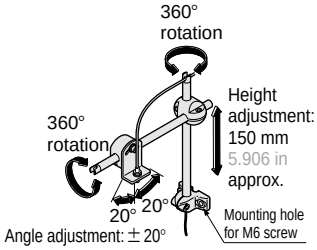
Universal sensor mounting stand

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

• **MS-AJ1-F**

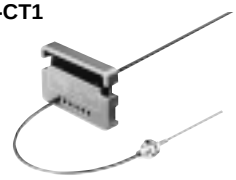


• **MS-AJ2-F**

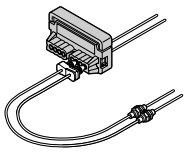


Fiber cutter

• **FX-CT1**



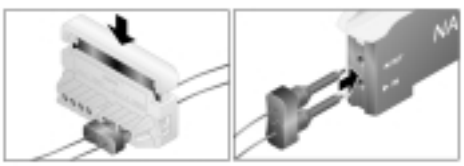
• **FX-CT2**



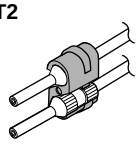
Fiber attachment

Now it's possible to simultaneously cut two fibers to the same length

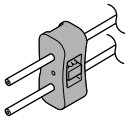
Each fiber (with some exceptions) has a newly developed two-in-one fiber attachment (**FX-AT3/AT4/AT5/AT6**) which enables two fibers to be cut simultaneously to the same length with the new fiber cutter (**FX-CT2**). Also, since the fibers can be attached to the amplifier while being fixed in position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



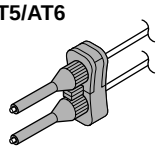
FX-AT2



FX-AT3



FX-AT4/AT5/AT6



FX-311

SPECIFICATIONS

Refer to p.78 ～ for fiber specifications.

Amplifiers

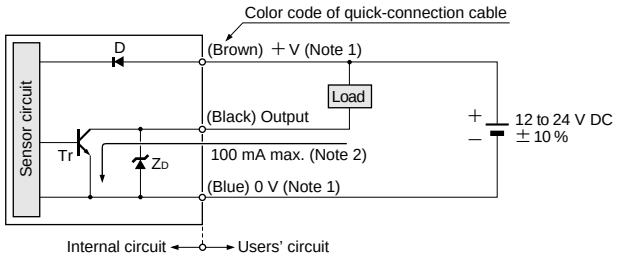
Item \ Type		NPN output			PNP output		
		Red LED	Blue LED	Green LED	Red LED	Blue LED	Green LED
Model No.		**FX-311**	**FX-311B**	**FX-311G**	**FX-311P**	**FX-311BP**	**FX-311GP**
Supply voltage		12 to 24 V DC ± 10 % Ripple P-P 10 % or less					
Power consumption		840 mW or less (Current consumption 35 mA or less at 24 V supply voltage)					
Output		NPN open-collector transistor • Maximum sink current: 100 mA (50 mA, if five, or more, amplifiers are connected in cascade) • Applied voltage: 30 V DC or less (between output and 0 V) • Residual voltage: 1.5 V or less (at 100 mA sink current / 50 mA, if five, or more, amplifiers are connected in cascade)			PNP open-collector transistor • Maximum source current: 100 mA (50 mA, if five, or more, amplifiers are connected in cascade) • Applied voltage: 30 V DC or less (between output and + V) • Residual voltage: 1.5 V or less (at 100 mA source current / 50 mA, if five, or more, amplifiers are connected in cascade)		
	Utilization category	DC-12 or DC-13					
	Output operation	Selectable either Light-ON or Dark-ON, with selection switch					
	Short-circuit protection	Incorporated					
Response time		<Red LED type> 250 μs or less (STD / S-D), 2 ms or less (LONG) selectable with selection switch			<Blue LED type / Green LED type> 150 μs or less (FAST), 250 μs or less (STD), 2 ms or less (LONG) selectable with selection switch		
Operation indicator		Orange LED (lights up when the output is ON)					
Stability indicator		Green LED (lights up under stable light received condition or stable dark condition)					
Sensitivity adjuster		12-turn potentiometer with indicator (Pointer part: red backlight) (Note 1)					
Timer function		Incorporated with OFF-delay timer, selectable either effective (approx. 10 ms or 40 ms) or ineffective					
Automatic interference prevention function		Incorporated (Up to 4 sets of fiber heads can be mounted close together.) (Note 2)					
Environmental resistance	Pollution degree	3 (Industrial environment)					
	Ambient temperature	− 10 to + 55 °C − 14 to + 131 °F (If 4 to 7 units are connected in cascade: − 10 to + 50 °C + 14 to + 122 °F, if 8 to 16 units are connected in cascade: − 10 to + 45 °C + 14 to + 113 °F) (No dew condensation or icing allowed), Storage: − 20 to + 70 °C − 4 to + 158 °F					
	Ambient humidity	35 to 85 % RH, Storage: 35 to 85 % RH					
	Ambient illuminance	Sunlight: 10,000 ℓx at the light-receiving face, Incandescent light: 3,000 ℓx at the light-receiving face					
	EMC	EN 50081-2, EN 50082-2, EN 60947-5-2					
	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 0.03 in amplitude in X, Y and Z directions for two hours each					
	Shock resistance	98 m/s² acceleration (10 G approx.) in X, Y and Z directions for five times each					
Emitting element (modulated)		Red LED	Blue LED	Green LED	Red LED	Blue LED	Green LED
Material		Enclosure: Heat-resistant ABS, Case cover: Polycarbonate					
Connecting method		Connector (Note 4)					
Cable extension		Extension up to total 100 m 328.084 ft is possible with 0.3 mm², or more, cable					
Weight		15 g approx.					

Notes: 1) The red backlight of the pointer part lights up more brightly when the power is turned ON and when the sensitivity is adjusted.
2) When the power supply is switched on, the emission timing are automatically set for interference prevention.
3) The voltage withstandability and the insulation resistance values given in the above table are for the amplifier only.
4) The cable for amplifier connection is not supplied as an accessory. Make sure to use the optional quick-connection cable given below.
Main cable (3-core): **CN-73-C1** (cable length 1 m 3.281 ft), **CN-73-C2** (cable length 2 m 6.562 ft), **CN-73-C5** (cable length 5 m 16.404 ft)
Sub cable (1-core): **CN-71-C1** (cable length 1 m 3.281 ft), **CN-71-C2** (cable length 2 m 6.562 ft), **CN-71-C5** (cable length 5 m 16.404 ft)

I/O CIRCUIT AND WIRING DIAGRAMS

NPN output type

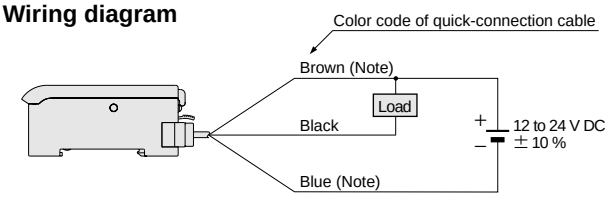
I/O circuit diagram



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

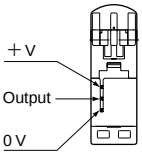
Symbols ... D : Reverse supply polarity protection diode
ZD: Surge absorption zener diode
Tr : NPN output transistor

Wiring diagram



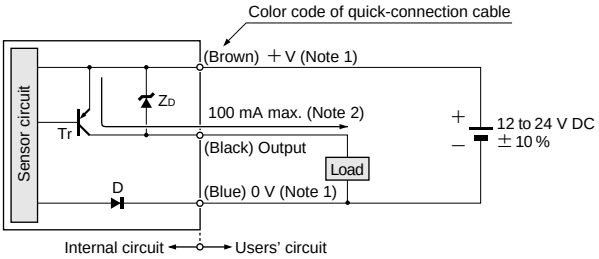
Note: The quick-connection sub cable does not have brown lead wire and blue cable.

Terminal arrangement diagram



PNP output type

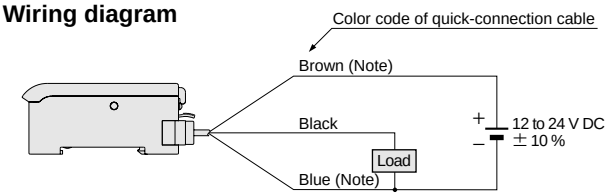
I/O circuit diagram



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

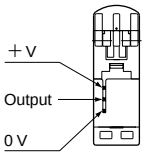
Symbols ... D : Reverse supply polarity protection diode
ZD: Surge absorption zener diode
Tr : PNP output transistor

Wiring diagram



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

Terminal arrangement diagram



SENSING CHARACTERISTICS (TYPICAL)

Refer to p.81 ~ for sensing characteristics.

FX-311

PRECAUTIONS FOR PROPER USE

Refer to p.1135～ for general precautions and p.94～ for fiber precautions.

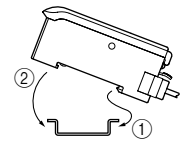
Amplifier

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

Mounting

How to mount the amplifier

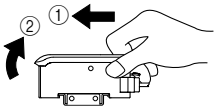
① Fit the rear part of the mounting section of the amplifier on a 35 mm 1.378 in width DIN rail.
② Press down the front part of the mounting section of the amplifier on the 35 mm 1.378 in width DIN rail.



35 mm 1.378 in width DIN rail

How to remove the amplifier

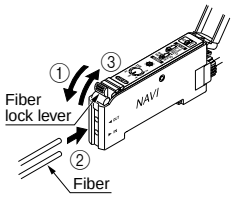
① Push the amplifier forward.
② Lift up the front part of the amplifier to remove it.



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

How to connect the fiber cables

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



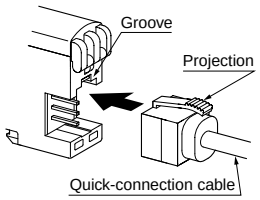
Notes: 1) In case the fiber cables are not inserted to a position where they stop, the sensing range reduces.
2) With the coaxial reflective type fiber, such as, **FD-G4** or **FD-FM2**, insert the single-core fiber cable into the beam-emitting inlet and the multi-core fiber cable into the beam-receiving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

Connection

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

Connection method

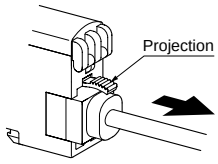
① Holding the connector of the quick-connection cable, align its projection with the groove at the top portion of the amplifier connector.
② Insert the connector till a click is felt.



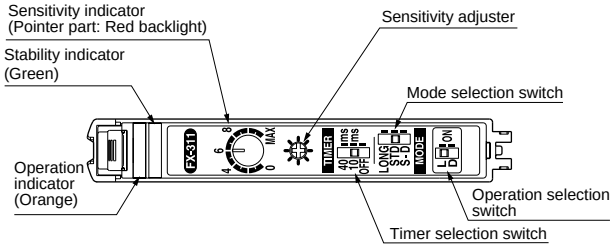
Disconnection method

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

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



Part description

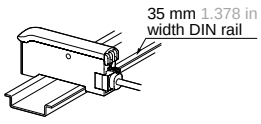


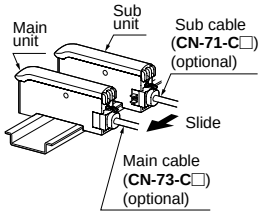
Cascading amplifiers

- Make sure that the power supply is off while cascading or removing the amplifiers.
- Make sure to check the allowable ambient temperature, as it depends on the number of amplifiers connected in cascade.
- In case two, or more, amplifiers are connected in cascade, make sure to mount them on a DIN rail.
- When connecting in cascade, mount the amplifiers close to each other, fitting them between the optional end plates (**MS-DIN-E**) mounted at the two ends.
- When the amplifiers move on the DIN rail depending on the attaching condition, fitting them between the optional end plates (**MS-DIN-E**) mounted at the two ends.
- Up to maximum 15 amplifiers can be added (total 16 amplifiers connected in cascade.)
- When connecting more than two amplifiers in cascade, use the sub cable (**CN-71-C**□) as the quick-connection cable for the second amplifier onwards.

Cascading method

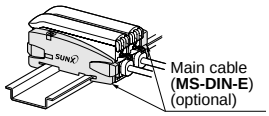
① Mount the amplifiers, one by one, on the 35 mm 1.378 in width DIN rail.
(For details, refer to '**Mounting**'.)
② Slide the sub units next to the main unit, and connect the quick-connection cables.
③ Mount the optional end plates (**MS-DIN-E**) at both the ends to hold the amplifiers between their flat sides.
④ Tighten the screws to fix the end plates (**MS-DIN-E**).

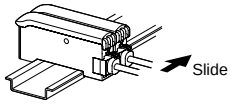




Dismantling

① Loosen the screws of the end plates (**MS-DIN-E**).
② Remove the end plates (**MS-DIN-E**).
③ Slide the sub units and remove them one by one.
(For details, refer to '**Mounting**'.)





Operation method

• The most suitable sensing mode can be selected according to the application from LONG (long-range), STD (standard), FAST (high-speed) or S-D (reduced intensity).

Mode selection switch		Application	Response time
Red LED type	Blue LED type / Green LED type		
LONG STD S-D	LONG STD FAST	Used in case long distance sensing is required. (However, the response time is longer than in STD mode.)	2 ms
LONG STD S-D	LONG STD FAST	Used for general sensing application.	250 μs
——	LONG STD FAST	Used in case high-speed sensing is required.	150 μs
LONG STD S-D	——	Since the emitted light amount is restricted in this mode, it is suitable for delicate sensing, such as when the received light is saturated due to too short a sensing distance or when detecting translucent objects, etc.	250 μs

Note: Make sure to carry out sensitivity adjustment after mode setting.

PRECAUTIONS FOR PROPER USE

Refer to p.1135～ for general precautions and p.94～ for fiber precautions.

Amplifiers

Sensitivity adjustment

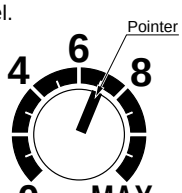
☼: Lights up ●: Lights off

Sensing condition	Operation	Operation indicator
Light	L-ON (Light-ON)	☼
	D-ON (Dark-ON)	●
Dark	L-ON (Light-ON)	●
	D-ON (Dark-ON)	☼

- Adjust the sensitivity, observing the operation indicator (orange). However, since the condition for lighting up of the indicator depends on the combination of the sensing condition and selected operation for L/D-ON, verify it from the table on the right.
- The sensitivity adjuster is a 12-turn potentiometer. The maximum sensitivity is obtained by turning it fully clockwise.
- The pointer shows the present sensitivity level.

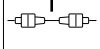
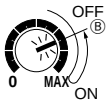
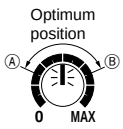
Assist function

- This product incorporates an 'assist function', which helps to easily search the optimum sensitivity position by blinking of the pointer. In order to make 'assist function' effective, switch the operation selection switch in the order L-ON (Light-ON) → D-ON (Dark-ON) → L-ON (Light-ON).



<Sensitivity indicator>

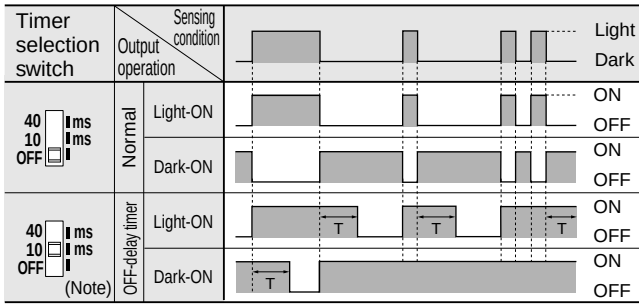
Notes: 1) 'Assist function' cannot be used when adjusting sensitivity for moving objects.
2) 'Assist function' turns off automatically once the sensitivity adjustment has been completed.
3) In case 'assist function' is not to be used, set the operation selection switch to D-ON (Dark-ON) and wait for 2 sec., or more, to make 'assist function' ineffective.

Step	Sensing method		Operation	Sensitivity indicator
	Reflective type	Thru-beam type		
①	★Make sure that the operation mode switch is set to L-ON (Light-ON).In case 'assist function' is to be used, switch the operation mode switch in the order of L-ON (Light-ON) → D-ON (Dark-ON) → L-ON (Light-ON).		Turn the sensitivity adjuster fully counterclockwise. (Minimum sensitivity)	
②	 Beam received	 Beam received	In the beam received condition, slowly turn the adjuster clockwise and find the point Ⓐ where the sensor is switched ON. The pointer blinks once at the point Ⓐ. (Note 1)	
③	 Beam not received	 Beam not received	In the beam not received condition, slowly turn the adjuster further clockwise until the sensor goes into the ON state again. Once it is switched on, turn the adjuster counterclockwise a little and find the point Ⓑ where it is switched OFF. The pointer blinks twice at the point Ⓑ. (Note 2) (If the sensor does not go into the ON state, MAX is the point Ⓑ.)	
④	———	———	Turn the adjuster towards the point Ⓐ from the point Ⓑ slowly. The pointer starts blinking when it approaches the optimum sensitivity point and blinks faster at the optimum sensitivity point for 3 sec. This point is the optimum sensitivity point. (Note 2)	
⑤	Select either L-ON (Light-ON) or D-ON (Dark-ON) according to your application.			

Notes: 1) When 'assist function' is not used, the pointer does not blink.
2) When 'assist function' is not used, the middle point of Ⓐ and Ⓑ is regarded as the optimum sensitivity position.
3) In order to protect the mechanism, the sensitivity adjuster idles when over turned, which may result in a backlash of 1 to 2 divisions.
4) Depending upon the sensing conditions, stable sensing may be possible at a position which is slightly shifted from the optimum sensitivity position.
5) Do not move or bend the fiber cable after the sensitivity adjustment. Detection may become unstable.

Timer function

- This product incorporates OFF-delay timer function. The timer period can be selected as either 10 ms approx. or 40 ms approx. with the timer selection switch. Since the output is extended by a fixed period, it is useful when the connected device has a slow response time or when small objects are being sensed and the output signal width is small.



Timer period T: 10 ms approx. (when set to 10 ms)
40 ms approx. (when set to 40 ms)
Note: The diagram shows the case when 10 ms time period is selected.

Interference prevention function

- This product incorporates an automatic interference prevention function. If the amplifiers are mounted in cascade, since a different emission timing is automatically set for up to 4 amplifiers, up to 4 sets of fiber heads can be mounted close together. Further, even if the amplifiers are mounted close together along with digital fiber sensor **FX-301** series, **FX-302**(**P**), the interference prevention function works. However, in case both models of amplifiers are mounted in cascade, mount identical models together.

Wiring

- Make sure that the power supply is off while wiring and cascading work.
- Verify that the supply voltage variation is within the rating.
- Take care that if a voltage exceeding the rated range is applied, or if an AC power supply is directly connected, the sensor may get burnt or damaged.
- If power is supplied from a commercial switching regulator, ensure that the frame ground (F.G.) terminal of the power supply is connected to an actual ground.
- In case noise generating equipment (switching regulator, inverter motor, etc.) is used in the vicinity of this product, connect the frame ground (F.G.) terminal of the equipment to an actual ground.
- Take care that short-circuit or wrong wiring of the load may burn or damage the sensor.
- Do not run the wires together with high-voltage lines or power lines or put them in the same raceway. This can cause malfunction due to induction.
- Ensure that an isolation transformer is utilized for the DC power supply. If an autotransformer is utilized, the main amplifier or power supply may be damaged.
- Make sure to use the optional quick-connection cable for the connection of the amplifier. Extension up to total 100 m 328.084 ft is possible with 0.3 mm^2, or more, cable. However, in order to reduce noise, make the wiring as short as possible.

Others

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

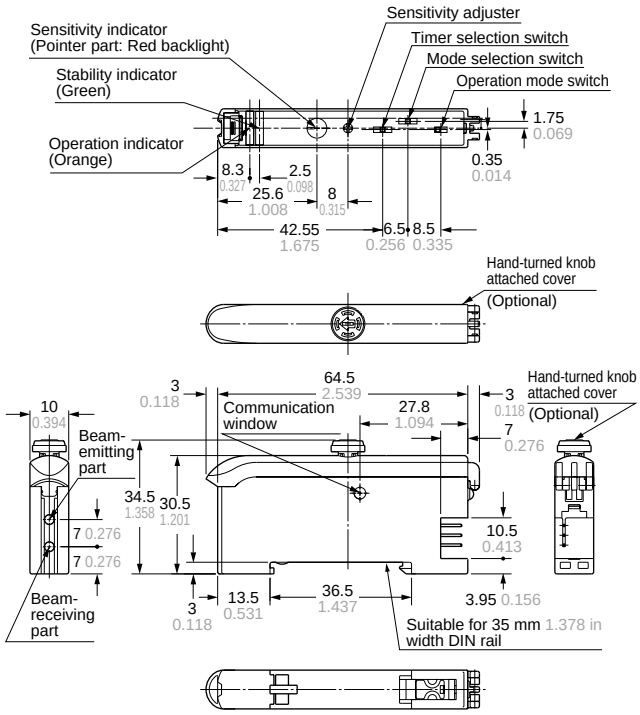
FX-311

DIMENSIONS (Unit: mm in)

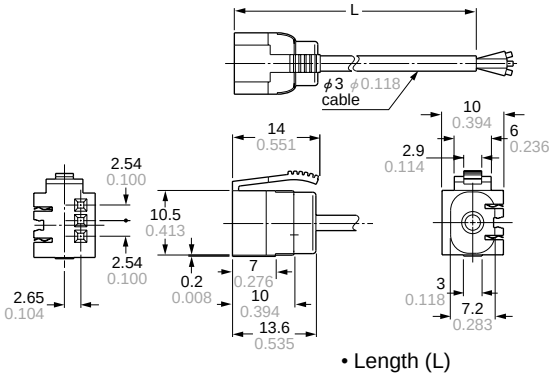
The CAD data in the dimensions can be downloaded from the 'SUNX fiber sensor home page': http://www.fiber-sensor.com/
Refer to p.103～ for dimensions other than those given below.

FX-311□ FX-311□P Amplifier

Mounting drawing with a hand-turned knob attached cover **FX-AJ1** (Optional)



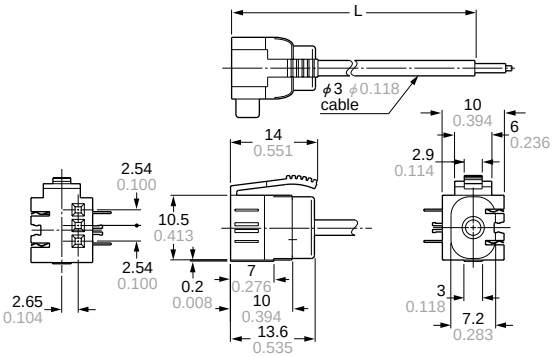
CN-73-C1 CN-73-C2 CN-73-C5 Main cable (Optional)



• Length (L)

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

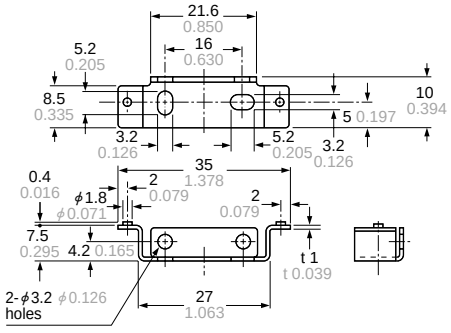
CN-71-C1 CN-71-C2 CN-71-C5 Sub cable (Optional)



• Length (L)

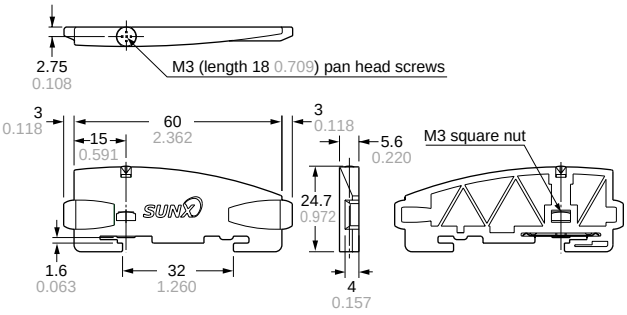
Model No.	Length (mm in)
CN-71-C1	1,000 39.370
CN-71-C2	2,000 78.740
CN-71-C5	5,000 196.850

MS-DIN-2 Amplifier mounting bracket (Optional)



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

MS-DIN-E End plate (Optional)



Material: Polycarbonate