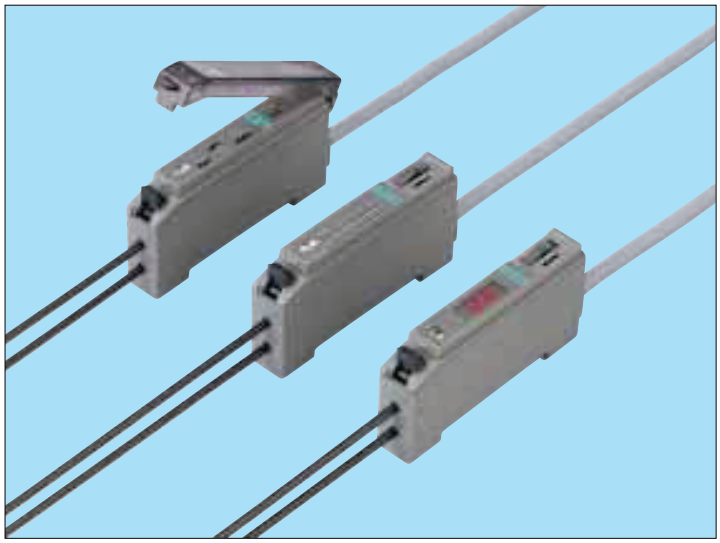
FX-D1/A1/M1 SERIES

NEW

Slim Body Digital/Auto/Manual Setting Fiber Sensor



Simple Operation with Innovative Jog Switch

This series is now **OBSOLETE**

Contact Ramco Innovations for Your Best Replacement Options

CE Marked
Conforming to EMC Directive

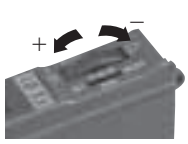
Simple Operation FX-D1/A1 series

Uses an innovative highly operable jog switch.
Anyone can easily do the threshold value (sensitivity in case of the **FX-A1** series) setting or fine adjustment by using a single jog switch.

Press

Threshold value (sensitivity in case of **FX-A1** series) or each mode is set.

Turn



Threshold value (sensitivity in case of **FX-A1** series) setting or fine adjustment, and selection of each mode is done.

Digital Display FX-D1 series

Since the incident light intensity and the threshold value can be confirmed on a digital display (4 digit LCD), the threshold value can be set by seeing the numerical values. Moreover, since the display has a backlight, the values can be read even in a dark place.

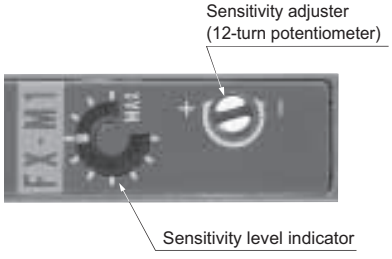
Level Indicators FX-A1 series

Level indicators, comprising of 10 LEDs, enable confirmation of the set sensitivity at one glance.
Setting can be done while confirming the value on the level indicators.

Level indicators

12-turn Potentiometer with Indicator FX-M1 series

12-turn potentiometer has been incorporated for unprecedent fine adjustments. It enables detection of very fine differences.
Moreover, the potentiometer position can be confirmed at a glance on the indicator.



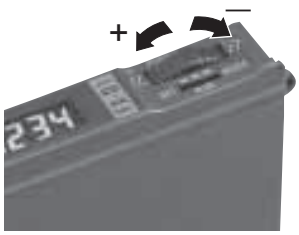
3 Types of Settings Are Possible FX-D1/A1 series

You can select from the following three types of settings:
1) 2-level teaching
2) Limit teaching, which is highly suitable for threshold value (sensitivity in case of the **FX-A1** series) setting in the object absent condition, or in case a background body is present, or for minute difference detection.
3) Full auto-teaching, which is suitable for detecting a moving object, without stopping the production line.

Fine Adjustment Is Possible FX-D1/A1 series

Fine adjustment is possible after setting the threshold value (sensitivity in case of the **FX-A1** series).

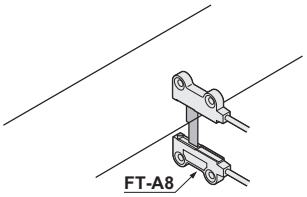
Simply turn the jog switch to the '+' or the '−' side for fine adjustment.



APPLICATIONS

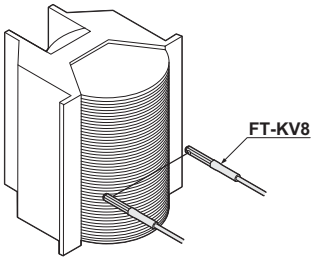
Detection of a sheet's zigzag movement

Since the **FX-D1** series incorporates two independent outputs, the sheet's presence/absence and its zigzag movement can be detected at the same time.



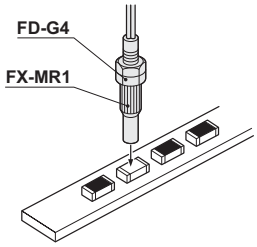
Detection of wafers inside a cassette

Since the aperture angle is only 2° or less and the light beam is very narrow, thin wafers can be individually detected reliably.



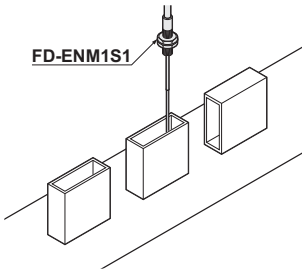
Distinguishing top/bottom surface of a chip component

Due to the small spot size, the top surface can be distinguished from the bottom surface for small components, such as the 1005 chip.



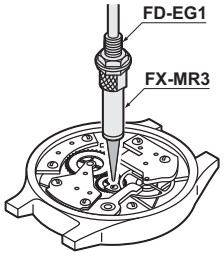
Detection of upright position of a capacitor

Since the **FX-D1** series incorporates two independent outputs, it can detect not only the presence/absence of a capacitor coming from a parts feeder, but also whether it stands upright.



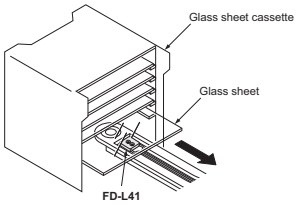
Detection of presence/absence of very small parts

It can reliably detect very small parts in a wrist watch.



Detection of presence/absence of glass sheets

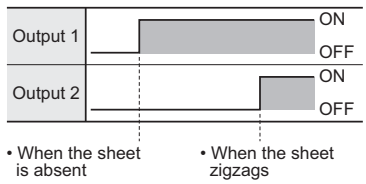
It can reliably detect individual glass sheets which are normally difficult to detect.

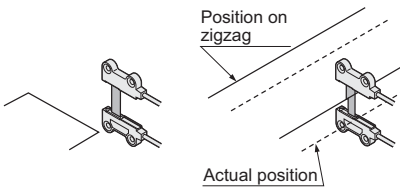


Incorporates Two Independent Outputs FX-D1 series

Since two independent outputs are incorporated, one sensor suffices even in places where, so far, two sensors had to be used.

Detection of a sheet's zigzag movement



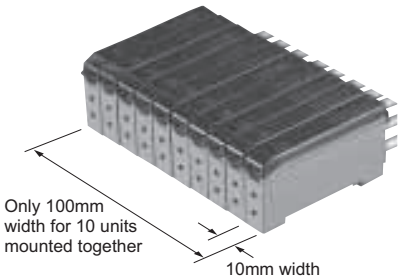


Incorporates a Convenient Timer Function

The **FX-D1** series incorporates an ON-delay timer and an OFF-delay timer. The timer period can be selected from four values — 40ms, 100ms, 200ms and 500ms. Further, the **FX-A1** series and the **FX-M1** series incorporate an approx. 40ms fixed OFF-delay timer.

10mm Width Slim Size

Since the width is merely 10mm, it can be installed in a narrow space.

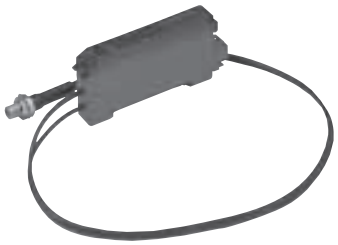


Close Mounting of Three Fibers Is Possible

Three fibers can be mounted closely by selecting three different emission frequencies with the jog switch (frequency selection switch in case of the **FX-M1** series).

Plug-in connector Type Is Available

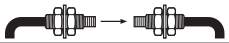
Besides the cable type, plug-in connector type sensors suitable for sensor and wire-saving link system **S-LINK**, or simple wire-saving using a sensor block and a connector attached cable, are available.



FX-D1/A1/M1

ORDER GUIDE

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



Type	Shape of fiber head (mm)	Sensing range (Note 1) (□: Red LED type, □: Green LED type)	Min. sensing object (under the optimum condition (Note 2)) (Ⓡ: Red LED type, Ⓖ: Green LED type)	Features	Fiber cable length	Model No.
Standard — Long sensing range	Lens mountable, M4	650mm / 115mm	Ⓡ ϕ0.16mm opaque object Ⓖ ϕ0.08mm opaque object	• Twice the sensing range as before	Free Cut 2m	**FT-B8**
Standard	Lens mountable, M4		Ⓡ ϕ0.12mm opaque object Ⓖ ϕ0.04mm opaque object	• Free-cut type	Free Cut 2m	**FT-FM2**
Standard	With sleeve, M4, ϕ1.48	380mm / 60mm				**FT-FM2S** With sleeve 90mm **FT-FM2S4** With sleeve 40mm
Standard	ϕ2.5					**FT-SFM2**
Economy — Long sensing range	M4	600mm / 100mm	Ⓡ ϕ0.16mm opaque object Ⓖ ϕ0.08mm opaque object	• Low price & free-cut	Free Cut 2m (Note 3)	NEW **FT-NB8**
Economy — Long sensing range	M4	350mm / 50mm	Ⓡ ϕ0.12mm opaque object Ⓖ ϕ0.04mm opaque object			NEW **FT-N8**
Small fiber head	Lens mountable, M3	380mm / 60mm	Ⓡ ϕ0.12mm opaque object Ⓖ ϕ0.04mm opaque object	• Miniature head but having the same sensing range as the standard type fiber	Free Cut 2m	**FT-T80**
Small diameter	M3		Ⓡ ϕ0.08mm opaque object Ⓖ ϕ0.03mm opaque object	• Suitable for detection in a congested equipment • Free-cut type	Free Cut 2m	**FT-NFM2**
Small diameter	With sleeve, M3, ϕ0.88	100mm / 15mm				**FT-NFM2S** With sleeve 90mm **FT-NFM2S4** With sleeve 40mm
Small diameter	ϕ1.5					**FT-SNFM2**
Sharp bend — Standard	Lens mountable, M4	280mm / 50mm	Ⓡ ϕ0.08mm opaque object Ⓖ ϕ0.03mm opaque object	• The fiber can be bent sharply, like an electric wire, to avoid space wastage in installation because of its small allowable bending radius of R1mm or more.	Free Cut 2m	NEW **FT-W8**
Sharp bend — Standard	ϕ2.5					NEW **FT-WS8**
Sharp bend — Small diameter	M3	60mm / 7mm	Ⓡ ϕ0.04mm opaque object Ⓖ ϕ0.02mm opaque object			NEW **FT-W4**
Sharp bend — Small diameter	ϕ1.5					NEW **FT-WS4**
Sharp bend — With lens	ϕ3	600mm / 90mm	Ⓡ ϕ0.12mm opaque object Ⓖ ϕ0.12mm opaque object			NEW **FT-WS8L**
Flexible	Lens mountable, M4	320mm / 60mm	Ⓡ ϕ0.12mm opaque object Ⓖ ϕ0.05mm opaque object	• Allowable bending radius: R4mm or more • Bending durability: 1,000,000 times or more	Free Cut 2m	**FT-P80**
Flexible — Small diameter	M3	100mm / 10mm	Ⓡ ϕ0.08mm opaque object Ⓖ ϕ0.03mm opaque object			**FT-P40**
Flexible — Small diameter	ϕ1.5	120mm / 18mm	Ⓡ ϕ0.08mm opaque object Ⓖ ϕ0.08mm opaque object		1m	**FT-P2**

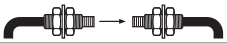
Notes: 1) Please take care that the sensing range of the free-cut type fiber may be reduced by 20% max. depending upon how the fiber is cut.

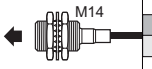
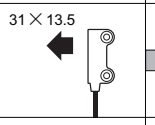
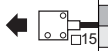
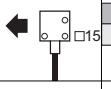
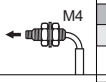
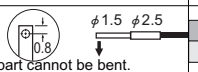
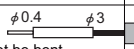
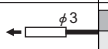
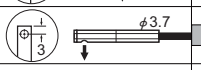
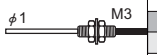
2) The optimum condition is the condition when the sensitivity is set so that the sensing output just changes to light incident operation in the object absent condition.

3) Fiber cutter (**FX-CT1**) is not supplied as accessory along with standard (economy) fibers. Please procure it separately.

ORDER GUIDE

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



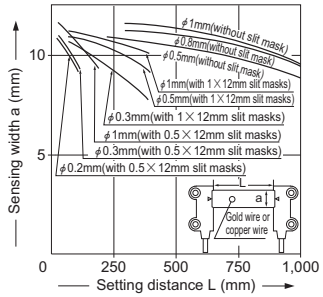
Type	Shape of fiber head (mm)	Sensing range (Note 1) (□: Red LED type, □: Green LED type)	Min. sensing object (under the optimum condition (Note 2)) (Ⓡ: Red LED type, Ⓖ: Green LED type)	Features	Fiber cable length	Model No.
Long sensing range with lens		10,000mm / 2,800mm	Ⓡ ϕ0.5mm opaque object Ⓖ ϕ0.5mm opaque object	• Large lenses on the fiber heads increase the sensing range significantly. • Fiber cable length 10m each	Free Cut 10m	FT-FM10L
		800mm / 130mm	Ⓡ ϕ0.16mm opaque object Ⓖ ϕ0.16mm opaque object	• Long sensing range with small fiber heads of ϕ2.5mm	Free Cut 2m	FT-SFM2L
Wide beam		1,500mm	(Note 3)	• The wide beam detects an object at any place within the range.	Free Cut 2m	NEW FT-A8
Array	Top sensing 	320mm / 50mm	Ⓡ Horizontal ϕ0.05mm opaque object, Vertical ϕ0.7mm opaque object Ⓖ Horizontal ϕ0.04mm opaque object, Vertical ϕ0.2mm opaque object	• The wide beam detects an object at any place within the range.	Free Cut 2m	FT-AFM2
	Side sensing 	290mm / 40mm	Ⓡ Horizontal ϕ0.05mm opaque object, Vertical ϕ0.7mm opaque object Ⓖ Horizontal ϕ0.04mm opaque object, Vertical ϕ0.2mm opaque object			FT-AFM2E
Elbow	Lens mountable 	270mm / 45mm	Ⓡ ϕ0.12mm opaque object Ⓖ ϕ0.08mm opaque object	• The fiber head is bent at a right angle with 5mm bending radius.	Free Cut 2m	FT-R80
Side-view	Small diameter  (ϕ2 for FT-V22) Sleeve part cannot be bent.	175mm / 18mm	Ⓡ ϕ0.08mm opaque object Ⓖ ϕ0.05mm opaque object	• The side-view sensing enables it to be used in a small space.	1m	FT-V22
		70mm / 10mm	Ⓡ ϕ0.08mm opaque object Ⓖ ϕ0.06mm opaque object		Free Cut 2m	FT-V41
	 Sleeve part cannot be bent.	200mm / 35mm	Ⓡ ϕ0.12mm opaque object Ⓖ ϕ0.05mm opaque object			FT-SFM2SV2
Ultra-small diameter	 Sleeve part cannot be bent.	7mm	Ⓡ ϕ0.02mm opaque object	• Ultra-small diameter heads, very narrow beam ϕ0.125mm	500mm	FT-E10
	 Sleeve part cannot be bent.	30mm	Ⓡ ϕ0.02mm opaque object	• Ultra-small diameter heads, very narrow beam ϕ0.25mm	1m	FT-E20
Narrow beam		700mm / 90mm	Ⓡ ϕ0.3mm opaque object Ⓖ ϕ0.1mm opaque object	• Aperture angle 4° or less • Laser beam equivalent detection	1m	FT-K2
		400mm	Ⓡ ϕ0.3mm opaque object	• Aperture angle 4° or less • Side-view type		FT-KV2
		700mm	Ⓡ ϕ0.3mm opaque object	• Aperture angle 2° or less • Side-view type	Free Cut 2m	NEW FT-KV8
	 Sleeve part cannot be bent.	160mm / 18mm	Ⓡ ϕ0.08mm opaque object Ⓖ ϕ0.02mm opaque object	• The narrow aperture angle, 1/6 of a conventional model, reduces interference.	1m	FT-KM1S2

Notes: 1) Please take care that the sensing range of the free-cut type fiber may be reduced by 20% max. depending upon how the fiber is cut.

2) The optimum condition is the condition when the sensitivity is set so that the sensing output just changes to light incident operation in the object absent condition.

3) The sensing width varies with the sensing object size and the sensing distance. Please refer to the graph given below.

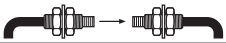
Correlation between sensing width and setting distance with sensing object diameter as a parameter



FX-D1/A1/M1

ORDER GUIDE

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



Type	Shape of fiber head (mm)	Sensing range (Note 1) (□: Red LED type, □: Green LED type)	Min. sensing object (under the optimum condition (Note 2)) (Ⓡ: Red LED type, Ⓖ: Green LED type)	Features	Fiber cable length	Model No.
Heat-resistant	Lens mountable, M4	280mm / 50mm	Ⓡ ϕ0.08mm opaque object Ⓖ ϕ0.05mm opaque object	• Heat-resistant temp.: 350°C Cold-resistant temp.: −60°C	2m	**FT-H35-M2**
	With sleeve, M4, ϕ2.1					**FT-H35-M2S6** With sleeve 60mm
	Lens mountable, M4			• Flexible cable with silicone jacket • Heat-resistant temp.: 200°C Cold-resistant temp.: −60°C	1m	**FT-H20-M1**
	Lens mountable, M4	440mm / 80mm	Ⓡ ϕ0.16mm opaque object Ⓖ ϕ0.12mm opaque object	• Heat-resistant temp.: 130°C Cold-resistant temp.: −60°C • Free-cut type	Free Cut 2m	**FT-H13-FM2**
Chemical-resistant	ϕ5.5	1,500mm / 180mm	Ⓡ ϕ0.5mm opaque object Ⓖ ϕ0.3mm opaque object	• Usable in chemical solvents • Heat-resistant specification (115°C) • Long sensing range with lens	2m (Bending R: 30mm)	**FT-L8Y**
	ϕ5.5	400mm / 70mm	Ⓡ ϕ0.5mm opaque object Ⓖ ϕ0.3mm opaque object	• Usable in chemical solvents • Heat-resistant specification (115°C) • Side-view type		**FT-V8Y**
Vacuum	Lens mountable, M4	230mm	Ⓡ ϕ0.16mm opaque object	• Usable in vacuum chamber • Heat-resistant temp.: 120°C	1m (Bending R: 200mm)	**FT-6V**
		100mm	Ⓡ ϕ0.16mm opaque object		1m (Bending R: 30mm)	**FT-60V**

Notes: 1) Please take care that the sensing range of the free-cut type fiber may be reduced by 20% max. depending upon how the fiber is cut.

2) The optimum condition is the condition when the sensitivity is set so that the sensing output just changes to light incident operation in the object absent condition.

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

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

Semi-standard fibers (Custom-order made)

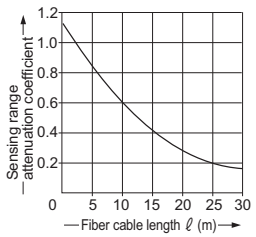
The fiber cable length or sleeve length of the standard fibers can be modified at your request. Select the fiber cable length (symbol ☒) or the sleeve length (symbol △) from the table below.

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

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

• Correlation between sensing range attenuation coefficient and fiber cable length

Longer the fiber cable, shorter is the sensing range.



ORDER GUIDE

General use fibers [Reflective type]

Type	Shape of fiber head (mm)	Sensing range (Note 1, 2) (□: Red LED type, □: Green LED type)	Min. sensing object (at the maximum sensitivity (Note 3)) (Ⓡ: Red LED type, Ⓖ: Green LED type)	Features	Fiber cable length	Model No.
Standard – Long sensing range	M6	210mm / 40mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.05mm copper wire	• Long sensing range • Free-cut type	Free Cut 2m	**FD-B8**
Standard – Coaxial	M6	140mm / 20mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.02mm gold wire	• Suitable for green LED type	500mm	**FD-5**
				• Free-cut type	Free Cut 2m	**FD-FM2**
Standard – With sleeve	M6, ϕ2.5					**FD-FM2S** With sleeve 90mm **FD-FM2S4** With sleeve 40mm
Standard – Economy	M6	120mm / 18mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.12mm copper wire	• Low price & free-cut	Free Cut 2m (Note 4)	NEW **FD-N8**
Standard – Economy – Small diameter	M4	34mm / 3mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.3mm copper wire			NEW **FD-N4**
Small fiber head	M4	140mm / 20mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.02mm gold wire	• Miniature head but having the same sensing range as the standard type fiber	Free Cut 2m	**FD-T80**
Small fiber head – Small diameter	M3	40mm / 5mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.05mm copper wire			**FD-T40**
Small fiber head	ϕ3	140mm / 20mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.02mm gold wire			**FD-S80**
Small diameter	M4		Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.05mm copper wire	• Suitable for detection in a congested equipment • Free-cut type	Free Cut 2m	**FD-NFM2**
Small diameter – With sleeve	M4, ϕ1.48	40mm / 5mm				**FD-NFM2S** With sleeve 90mm **FD-NFM2S4** With sleeve 40mm
Small diameter	ϕ2.5					**FD-SNFM2**
Sharp bend – Standard	M6	90mm / 12mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.03mm gold wire	• The fiber can be bent sharply, like an electric wire, to avoid space wastage in installation because of its small allowable bending radius of R1mm or more (**FD-WG4**, **FD-WSG4**: R2mm or more, sleeve part of **FD-W44**: R10mm or more).	Free Cut 2m	NEW **FD-W8**
Sharp bend – Small diameter with sleeve – With sleeve	M4, ϕ1.48	14mm	Ⓡ ϕ0.01mm gold wire			NEW **FD-W44**
Sharp bend – Small head	M4	90mm / 12mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.03mm gold wire			NEW **FD-WT8**
Sharp bend – Small head	ϕ3					NEW **FD-WS8**
Sharp bend – Small diameter	M3	14mm	Ⓡ ϕ0.01mm gold wire			NEW **FD-WT4**
Sharp bend – High precision – Lens mountable – Coaxial	M4	30mm / 3mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.02mm gold wire			NEW **FD-WG4**
Sharp bend – High precision – Coaxial	ϕ3					NEW **FD-WSG4**
Flexible	M6	100mm / 16mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.05mm copper wire	• Allowable bending radius: R4mm or more • Bending durability: 1,000,000 times or more	Free Cut 2m	**FD-P80**
Flexible – Small diameter	M3	16mm	Ⓡ ϕ0.01mm gold wire			**FD-P40**
Flexible – Small diameter	ϕ1.5	23mm / 2.5mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.02mm gold wire		1m	**FD-P2**

Notes: 1) The sensing range is specified for white non-glossy paper [100 × 100mm (**FD-B8**: 200 × 200mm)] as the object.
2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20% max. depending upon how the fiber is cut.

3) The minimum sensing object is specified for maximum sensitivity. Also, note that the corresponding setting distance is different from the rated sensing distance.

4) Fiber cutter (**FX-CT1**) is not supplied as accessory along with standard (economy) fibers. Please procure it separately.

FX-D1/A1/M1

ORDER GUIDE

Special use fibers [Reflective type]

Type	Shape of fiber head (mm)	Sensing range (Note 1, 2) (□: Red LED type, □: Green LED type)	Min. sensing object at the maximum sensitivity (Note 3) (Ⓡ: Red LED type, Ⓖ: Green LED type)	Features	Fiber cable length	Model No.
Fixed-focus reflective	18×14	4.5 to 12mm (Convergent point: 6mm)	Ⓡ ϕ0.01mm gold wire	• Detection is not affected by object color.	Free Cut 2m	FD-L4
Glass sheet detection	24×21	3 to 14mm (Convergent point: 8mm)	Ⓡ ϕ0.2mm copper wire	• Just 4mm thick • Glass sheet is reliably detected.		FD-L41
Specular object detection	15×19	1.3 to 3mm (Convergent point: 2mm)	Ⓡ ϕ0.2mm copper wire	• Just 3mm thick • Wafer is reliably detected.		FD-L42
High precision	Lens mountable Coaxial M4	50mm / 7.5mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.02mm gold wire	• Precise position sensing with coaxial fiber	Free Cut 2m	FD-G4
	Lens mountable Coaxial•small diameter M3	17mm	Ⓡ ϕ0.01mm gold wire	• Combination with the **FX-MR3** lens gives an extremely small spot diameter of ϕ0.3mm approx.	500mm	FD-EG1
Array	Top sensing □20	110mm	Ⓡ Horizontal ϕ0.01mm gold wire, Vertical ϕ0.1mm copper wire Ⓖ Horizontal ϕ0.01mm gold wire, Vertical ϕ0.06mm copper wire	• Its wide beam meets various needs.	Free Cut 2m	FD-AFM2
	Side sensing □20	17mm				FD-AFM2E
Elbow	M6	85mm / 13mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.2mm copper wire	• The fiber head is bent at a right angle with 5mm bending radius at the neck.	Free Cut 2m	FD-R80
Side-view	Small diameter 0.7 ϕ1.5 ϕ3 Sleeve part cannot be bent.	25mm	Ⓡ ϕ0.01mm gold wire	• The side view sensing enables it to be used in a small space.	Free Cut 2m	FD-V41
	0.8 ϕ2 ϕ5 Sleeve part cannot be bent.	45mm / 5mm	Ⓡ ϕ0.01mm gold wire Ⓖ ϕ0.5mm copper wire			FD-SFM2SV2
Ultra-small diameter	ϕ0.5 M3 Sleeve part cannot be bent.	2mm	Ⓡ ϕ0.01mm gold wire	• Suitable for detection in a very congested equipment	500mm	FD-EN500S1
	Coaxial ϕ0.8 M3 Sleeve part cannot be bent.	17mm	Ⓡ ϕ0.01mm gold wire	• Precise position sensing with coaxial fiber	1m	FD-ENM1S1
Narrow-view	Coaxial ϕ2 M5 Sleeve part cannot be bent.	15mm	Ⓡ ϕ0.01mm gold wire	• The narrow aperture angle, 1/6 of a conventional model, produces a small detecting area.	1m	FD-KM1S2
Liquid level Sensing	ϕ6 ϕ5		Ⓡ (Liquid)	• Reduces malfunction due to liquid drop at the tip.	Free Cut 2m	FD-F8Y
Mountable on pipe Standard	25×20	ϕ6 to ϕ26mm transparent pipe (PVC, fluorine resin, PC, acrylic, glass, wall thickness 1 to 3mm)	Ⓡ (Liquid)	• Liquid surface is reliably detected from outside the pipe.	Free Cut 2m	NEW FD-F41
					Free Cut 5m	NEW FD-F91
For PFA, wall thickness 1mm		ϕ6 to ϕ26mm transparent pipe (PFA (fluorine resin), wall thickness 1mm)			Free Cut 2m	FD-F4
					Free Cut 5m	FD-F9

Notes: 1) The sensing range is specified for white non-glossy paper [100×100mm (**FD-L42** and **FD-V41**: 50×50mm, **FD-KM1S2**: 10×10mm, **FD-L41**: glass sheet 25×25×t1.3mm)] as the object.
2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20% max. depending upon how the fiber is cut.

3) The minimum sensing object is specified for maximum sensitivity. Also, note that the corresponding setting distance is different from the rated sensing distance.

ORDER GUIDE

Environment resistant fibers [Reflective type]

Type	Shape of fiber head (mm)	Sensing range (Note 1, 2) (□: Red LED type, □: Green LED type)	Min. sensing object (at the maximum sensitivity (Note 3)) (Ⓡ: Red LED type, Ⓖ: Green LED type)	Features	Fiber cable length	Model No.
Heat-resistant	Coaxial M6	140mm / 18mm	Ⓡ φ0.01mm gold wire Ⓖ φ0.01mm gold wire	• Heat-resistant temp.: 350°C Cold-resistant temp.: −60°C	2m	**FD-H35-M2**
	With sleeve M6 φ2.8					**FD-H35-M2S6** With sleeve 60mm
	Coaxial M6			• Flexible cable with silicone jacket • Heat-resistant temp.: 200°C Cold-resistant temp.: −60°C	1m	**FD-H20-M1**
	M6	150mm / 26mm	Ⓡ φ0.01mm gold wire Ⓖ φ0.06mm copper wire	• Heat-resistant temp.: 130°C Cold-resistant temp.: −60°C • Free-cut type	Free Cut 2m	**FD-H13-FM2**
Vacuum	M6	75mm	Ⓡ φ0.01mm gold wire	• Usable in vacuum chamber • Heat-resistant temp.: 120°C	1m	**FD-6V**

Notes: 1) The sensing range is specified for white non-glossy paper (100 × 100mm) as the object.
2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20% max. depending upon how the fiber is cut.

3) The minimum sensing object is specified for maximum sensitivity. Also, note that the corresponding setting distance is different from the rated sensing range.

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

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

Semi-standard fibers (Custom-order made)

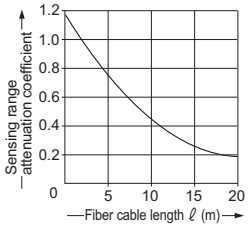
The fiber cable length or sleeve length of the standard fibers can be modified at your request. Select the fiber cable length (symbol ☆) or the sleeve length (symbol △) from the table below.

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

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

• Correlation between sensing range attenuation coefficient and fiber cable length

Longer the fiber cable, shorter is the sensing range.



FX-D1/A1/M1

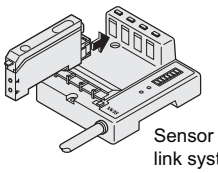
ORDER GUIDE

Amplifiers

Type		Appearance	Model No.	Emitting element	Output
Digital setting	Red LED type		**FX-D1**	Red LED	NPN open-collector transistor (Output 1, Output 2)
			FX-D1P		PNP open-collector transistor (Output 1, Output 2)
Auto-setting	Red LED type		**FX-A1**	Red LED	NPN open-collector transistor (Sensing output, self-diagnosis output)
			FX-A1P		PNP open-collector transistor (Sensing output, self-diagnosis output)
	Green LED type		**FX-A1G**	Green LED	NPN open-collector transistor (Sensing output, self-diagnosis output)
Manual setting	Red LED type		**FX-M1**	Red LED	NPN open-collector transistor (Sensing output, self-diagnosis output)
			FX-M1P		PNP open-collector transistor (Sensing output, self-diagnosis output)
	Green LED type		**FX-M1G**	Green LED	NPN open-collector transistor (Sensing output, self-diagnosis output)

Plug-in connector type

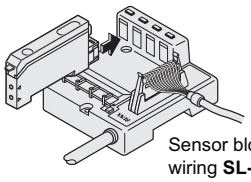
Plug-in connector type is available. (Standard: cable type)
When ordering the plug-in connector type, add suffix '**J**' to the model No.
(e.g.) Plug-in connector type of **FX-A1P** is '**FX-A1PJ**'.
Usable with the sensor & wire-saving link system **S-LINK**, the sensor block for simple wiring **SL-BMW** or **SL-BW**, or with the connector attached cable **CN-54-C2** or **CN-54-C5**.
However, if **FX-D1** series is connected to the sensor & wire-saving link system **S-LINK** or the sensor block for simple wiring, Output 2 cannot be used.



Sensor & wire-saving link system **S-LINK**

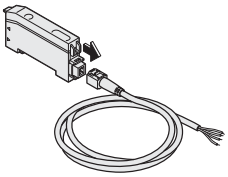
(Refer to P.26〜 for details.)

PNP output type amplifier cannot be connected.



Sensor block for simple wiring **SL-BMW**, **SL-BW**

(Refer to P.54〜 for details.)



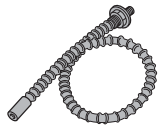
Connector attached cable
CN-54-C2 (2m long)
CN-54-C5 (5m long)

OPTIONS

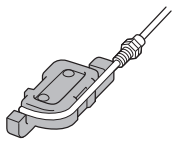
Designation	Model No.	Description				
Protective tube (For thru-beam type fiber)	**FTP-500** (0.5m)	For M4 thread	Applicable fibers	**FT-B8** **FT-FM2** **FT-FM2S** **FT-FM2S4**	**FT-P80** **FT-H13-FM2**	The protective tube, made of non-corrosive stainless steel, protects the inner fiber cable from any external forces.
	FTP-1000 (1m)					
	FTP-1500 (1.5m)					
	FTP-N500 (0.5m)	For M3 thread		**FT-T80** **FT-NFM2** **FT-NFM2S** **FT-NFM2S4**	**FT-P40** **FD-T40** **FD-P40**	
	FTP-N1000 (1m)					
	FTP-N1500 (1.5m)					
Protective tube (For reflective type fiber)	**FDP-500** (0.5m)	For M6 thread		**FD-B8** **FD-FM2** **FD-FM2S** **FD-FM2S4**	**FD-P80** **FD-H13-FM2**	
	FDP-1000 (1m)					
	FDP-1500 (1.5m)					
	FDP-N500 (0.5m)	For M4 thread		**FD-T80** **FD-NFM2** **FD-NFM2S** **FD-NFM2S4**		
	FDP-N1000 (1m)					
	FDP-N1500 (1.5m)					
Fiber bender	**FB-1**	The fiber bender bends the sleeve part of the fiber head at the proper radius. (Note 1)				
Universal sensor mounting stand (Note 2)	**MS-AJ-F**	Mounting stand assembly for fiber (For M3, M4 or M6 threaded head fibers)				
Fiber cutter	**FX-CT1**	The free-cut type fiber can be easily cut.				

Notes: 1) Do not bend the sleeve part of any side-view type fiber, ultra-small diameter head type fiber, narrow beam type fiber, or narrow-view type fiber.
2) Refer to P.310〜 for the universal sensor mounting stand.

Protective tube

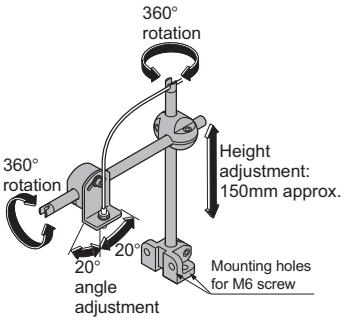


Fiber bender



Universal sensor mounting stand

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



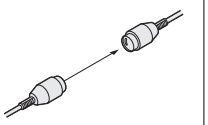
Fiber cutter

FX-D1/A1/M1

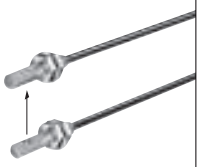
OPTIONS

Designation		Model No.	Description
For thru-beam type fiber	Expansion lens	**FX-LE1**	 Increases the sensing range by 4.5 times or more. • Ambient temperature: −60 to +350°C **Sensing range (mm) [Lens on both sides]**

Fiber \ Applicable amplifier	Red LED type	Green LED type
FT-B8	3,000	650
FT-FM2	3,500 (Note 1)	600
FT-T80	3,500 (Note 1)	600
FT-W8	2,800	500
FT-P80	3,500 (Note 1)	500
FT-H35-M2	2,800	300
FT-H20-M1	1,600 (Note 1)	300
FT-R80	2,400	400

	Super-expansion lens	**FX-LE2**	 Tremendously increases the sensing range with large aperture lenses. • Ambient temperature: −60 to +350°C **Sensing range (mm) [Lens on both sides]**

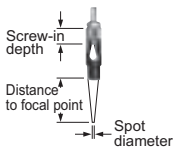
Fiber \ Applicable amplifier	Red LED type (Note 2)	Green LED type
FT-B8	3,500 (Note 1)	3,500 (Note 1)
FT-FM2	3,500 (Note 1)	3,000
FT-W8	3,500 (Note 1)	2,500
FT-P80	3,500 (Note 1)	3,000
FT-H35-M2	3,500 (Note 1)	2,700
FT-H20-M1	1,600 (Note 1)	1,600 (Note 1)
FT-H13-FM2	3,500 (Note 1)	2,400
FT-R80	3,500 (Note 1)	2,400

	Side-view lens	**FX-SV1**	 Beam axis is bent by 90°. • Ambient temperature: −60 to +300°C **Sensing range (mm) [Lens on both sides]**

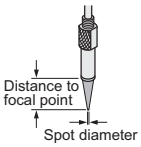
Fiber \ Applicable amplifier	Red LED type	Green LED type
FT-B8	650	120
FT-FM2	600	100
FT-T80	600	100
FT-W8	450	80
FT-P80	600	100
FT-H35-M2	450	75
FT-H20-M1	280	75

	Expansion lens for vacuum fiber	**FV-LE1**	 Sensing range increases by 10 times or more. • Ambient temperature: −40 to +120°C **Sensing range (mm) [Lens on both sides]**

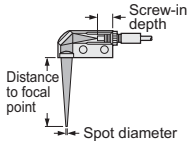
Fiber \ Applicable amplifier	Red LED type	Green LED type
FT-6V	2,700	———
FT-60V	1,400	———

For reflective type fiber	Pinpoint spot lens	**FX-MR1**	 Pinpoint spot of ϕ0.5mm. Enables detection of minute objects or small marks. • Applicable amplifiers: Red LED type • Applicable fibers: **FD-WG4**, **FD-G4** • Distance to focal point: 6 ± 1mm • Ambient temperature: −40 to +70°C
	Zoom lens	**FX-MR2**	 The spot diameter is adjustable from ϕ0.7 to ϕ2mm according to how much the fiber is screwed in. • Applicable amplifiers: Red LED type • Applicable fibers: **FD-WG4**, **FD-G4** • Ambient temperature: −40 to +70°C

Screw-in depth	Distance to focal point	Spot diameter
7mm	18.5mm approx.	ϕ0.7mm
12mm	27mm approx.	ϕ1.2mm
14mm	43mm approx.	ϕ2.0mm

	Finest spot lens	**FX-MR3**	 Extremely fine spot of ϕ0.3mm achieved. • Applicable amplifiers: Red LED type • Applicable fibers: **FD-WG4**, **FD-EG1**, **FD-G4** • Ambient temperature: −40 to +70°C

Screw-in depth	Distance to focal point	Spot diameter
FD-WG4	7.5±0.5mm	ϕ0.5mm approx.
FD-EG1	7.5±0.5mm	ϕ0.3mm approx.
FD-G4	7.5±0.5mm	ϕ0.5mm approx.

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

Screw-in depth	Distance to focal point	Spot diameter
8mm	13mm approx.	ϕ0.5mm
10mm	15mm approx.	ϕ0.8mm
14mm	30mm approx.	ϕ3.0mm

Notes: 1) The fiber cable length practically limits the sensing range to 3,500mm long (**FT-H20-M1**: 1,600mm).
2) A sensing distance of 8m is possible if combined with the semi-standard fiber **FT-FM10**, having a 10m fiber length.

SPECIFICATIONS

Fibers

Item \ Type	Standard, small fiber head, small diameter, sharp bend, flexible, long sensing range with lens, wide beam, array, elbow, high precision, thru-beam type of ultra-small diameter	Fixed-focus reflective	Side-view, narrow beam, narrow-view, reflective type of ultra-small diameter
Allowable bending radius	R25mm or more (Sharp bend: R1mm or more (**FD-WG4**, **FD-WSG4**: R2mm or more), Flexible: R4mm or more, Thru-beam type of ultra-small diameter: R5mm or more	R10mm or more	R25mm or more (**FT-K2** and **FT-KV2**: R10mm or more)
Ambient temperature	−40 to +70°C (Sharp bend: −40 to +60°C, **FD-EG1**: −20 to +60°C)	−40 to +70°C (**FD-L41** and **FD-L42**: −40 to +60°C)	−20 to +60°C (**FT-V41**, **FD-V41**, **FT-KV8**, **FT-K2** and **FT-KV2**: −40 to +60°C)
Ambient humidity	35 to 85% RH (No dew condensation or icing allowed)		
Material: Fiber core	Acrylic		
Material: Sheath	Polyethylene (Thru-beam type of ultra-small diameter and flexible, except for **FD-P2**: Vinyl chloride; Reflective type of narrow-view: Polyurethane)		
Material: Fiber head	Brass (Nickel plated) : Threaded part of standard, threaded part of small diameter, threaded type of sharp bend, threaded part of thru-beam type ultra-small diameter, **FT-P80**, **FD-P80**, high precision, array, threaded part of **FT-R80** Polycarbonate : **FT-A8**, lens of **FT-WS8L** Stainless steel (SUS): **FT-SFM2**, small fiber head, non-threaded type of sharp bend, **FT-SNFM2**, **FD-SNFM2**, **FT-SFM2L**, **FT-P40**, **FT-P2**, **FD-P40**, **FD-P2**, sleeve part of sleeve-attached fiber Polyolefin : Lens of **FT-A8** ABS : **FT-FM10L** Acrylic : Lens of **FT-FM10L** Die-cast zinc alloy : Threaded part of **FD-R80**	ABS: **FD-L4**, **FD-L41** Acrylic: Lens of **FD-L4** Aluminum: **FD-L42**	Stainless steel (SUS) (**FT-KV2**, threaded part of **FD-EN500S1**·**FD-ENM1S1**·**FT-KM1S2** and **FD-KM1S2**: Brass, Lens of **FT-K2**: Glass, Reflector of **FT-KV8**, Prism of **FT-KV2**: Acrylic, Holder of **FT-KV8**: Polycarbonate)
Accessories	Threaded head fiber: 2 Nos. of nuts (thru-beam type: 4 Nos.) and 1 No. of toothed lock washer (thru-beam type: 2 Nos.) Free-cut type fiber (except economy type): 1 No. of **FX-CT1** (Fiber cutter) **FD-N4**, Small diameter free-cut type fiber, high precision free-cut type fiber: **FX-AT10** (φ1mm fiber attachment), **FX-AT13** (φ1.3mm fiber attachment) **FT-WS4**, **FD-W44**, **FD-WT8**, **FD-WS8**, **FD-WT4**, **FD-WG4** or **FD-WSG4**: **FX-AT10** (φ1mm fiber attachment) **FT-A8**: 2 Nos. of 0.5×12mm seal type slit mask and 2 Nos. of 1×12mm seal type slit mask **FD-L4**: **FX-AT10** (φ1mm fiber attachment), **FX-AT13** (φ1.3mm fiber attachment), 2 Nos. of M2.6 (length 12mm) screws with washers and 2 Nos. of nuts Fixed-focus reflective type fiber: **FX-AT10** (φ1mm fiber attachment)		

Fibers

Item \ Type	Liquid level sensing		Vacuum	Heat-resistant			Chemical-resistant
		Mountable on pipe		350°C type	200°C type	130°C type	
Allowable bending radius	Protective tube: R40mm or more Fiber cable: R15mm or more	R10mm or more	R200mm or more (**FT-60V**: R30mm or more)	R25mm or more			R30mm or more
Ambient temperature	−40 to +125°C (Note 1)	−40 to +100°C (Note 1)	−40 to +120°C	−60 to +350°C (Note 2, 3)	−60 to +200°C (Note 3)	−60 to +130°C	−40 to +115°C
Ambient humidity	35 to 85% RH (No dew condensation or icing allowed)						
Material: Fiber core	Acrylic		Quartz glass (Note 4)	Multi-component glass (Note 5)		Acrylic	
Material: Sheath	Protective tube: Fluorine resin Sheath: Polypropylene	Polypropylene	Fluorine resin	Stainless steel (SUS)	Silicone (Inside stainless steel (SUS) spiral tube)	Fluorine resin	Protective tube: Fluorine resin Fiber sheath: Polypropylene
Material: Fiber head		Polyetherimide	Aluminum		Brass (Nickel plated)	Brass (Nickel plated)	
Accessories	Threaded head fiber: 2 Nos. of nuts (thru-beam type: 4 Nos.) and 1 No. of toothed lock washer (thru-beam type: 2 Nos.) Free-cut type fiber, chemical-resistant type fiber: 1 No. of **FX-CT1** (Fiber cutter) **FD-F4**□ and **FD-F9**□: **FX-AT-10** (φ1mm fiber attachment) **FD-F4**□ and **FD-F9**□: 4 Nos. of tying bands and 2 Nos. of anti-slip tubes						

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

FX-D1/A1/M1

SPECIFICATIONS

Amplifiers

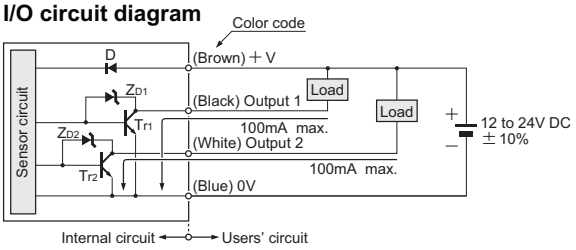
Item \ Type		NPN output					PNP output		
		Digital setting	Auto-setting		Manual setting		Digital setting	Auto-setting	Manual setting
		Red LED type	Red LED type	Green LED type	Red LED type	Green LED type	Red LED type		
Model No.		**FX-D1**	**FX-A1**	**FX-A1G**	**FX-M1**	**FX-M1G**	**FX-D1P**	**FX-A1P**	**FX-M1P**
Supply voltage		12 to 24V DC ± 10% Ripple P-P 10% or less							
Current consumption		45mA or less	50mA or less		45mA or less		45mA or less	50mA or less	45mA or less
Sensing output (Note 1)		NPN open-collector transistor • Maximum sink current: 100mA • Applied voltage: 30V DC or less (between sensing output and 0V) • Residual voltage: 1V or less (at 100mA sink current) 0.4V or less (at 16mA sink current)					PNP open-collector transistor • Maximum source current: 100mA • Applied voltage: 30V DC or less (between sensing output and +V) • Residual voltage: 1V or less (at 100mA source current) 0.4V or less (at 16mA source current)		
	Utilization category	DC-12 or DC-13							
	Output operation	Switchable either Light-ON or Dark-ON, with jog switch			Switchable either Light-ON or Dark-ON, with selection switch		Switchable either Light-ON or Dark-ON, with jog switch		Switchable either Light-ON or Dark-ON, with selection switch
	Short-circuit protection	Incorporated							
Self-diagnosis output		———	NPN open-collector transistor • Maximum sink current: 50mA • Applied voltage: 30V DC or less (between self-diagnosis output and 0V) • Residual voltage: 1V or less (at 50mA sink current) 0.4V or less (at 16mA sink current)				———	PNP open-collector transistor • Maximum source current: 50mA • Applied voltage: 30V DC or less (between self-diagnosis output and +V) • Residual voltage: 1V or less (at 50mA source current) 0.4V or less (at 16mA source current)	
	Output operation	———	ON in unstable sensing condition				———	ON in unstable sensing condition	
	Short-circuit protection	———							
Response time	Emission Frequency 1	0.5ms or less							
	Emission Frequency 2	0.65ms or less							
	Emission Frequency 3	0.75ms or less							
Sensitivity setting		2-level teaching/Limit teaching/ Full auto-teaching			Potentiometer setting		2-level teaching/Limit teaching/ Full auto-teaching		Potentiometer setting
Sensitivity adjuster		———			Incorporated with 12-turn potentiometer with indicator		———		Incorporated with 12-turn potentiometer with indicator
Timer function		Incorporated with ON-delay timer/OFF-delay timer, switchable either effective or ineffective (Note 2)	Incorporated with approx. 40ms fixed OFF-delay timer, switchable either effective or ineffective				Incorporated with ON-delay timer/OFF-delay timer, switchable either effective or ineffective (Note 2)	Incorporated with approx. 40ms fixed OFF-delay timer, switchable either effective or ineffective	
Interference prevention function		Incorporated (Three units of sensors can be mounted closely.)							
Environmental resistance	Pollution degree	3 (Industrial environment)							
	Ambient temperature	0 to +50°C (No dew condensation) Storage: −20 to +70°C	−10 to +50°C (No dew condensation or icing allowed), Storage: −20 to +70°C				0 to +50°C (No dew condensation) Storage: −20 to +70°C	−10 to +50°C (No dew condensation or icing allowed) Storage: −20 to +70°C	
	Ambient humidity	35 to 85% RH, Storage: 35 to 85% RH							
	Ambient illuminance	Sunlight: 10,000ℓx at the light-receiving face, Incandescent light: 3,000ℓx at the light-receiving face							
	EMC	Emission: EN50081-2, Immunity: EN50082-2							
	Voltage withstandability	1,000V AC for one min. between all supply terminals connected together and enclosure (Note 3)							
	Insulation resistance	20MΩ, or more, with 250V DC megger between all supply terminals connected together and enclosure (Note 3)							
	Vibration resistance	10 to 150Hz frequency, 0.75mm amplitude in X, Y and Z directions for two hours each							
	Shock resistance	98m/s² acceleration (10G approx.) in X, Y and Z directions for five times each							
Emitting element		Red LED (modulated)	Red LED (modulated)	Green LED (modulated)	Red LED (modulated)	Green LED (modulated)	Red LED (modulated)		
Material		Enclosure: Heat-resistant ABS, Case cover: Polycarbonate, Fiber lock lever: PES							
Cable		0.2mm² 4-core cabtyre cable, 2m long							
Cable extension		Extension up to total 100m is possible with 0.3mm², or more, cable.							
Weight		70g approx.							
Accessories		**MS-DIN-2** (Amplifier mounting bracket): 1 No. Adjusting screwdriver (Manual setting type only): 1 No.							

Notes: 1) The digital setting type **FX-D1** series is equipped with two independent outputs (Output 1, Output 2).
2) The time period of ON-delay timer and OFF-delay timer can be selected from 40ms, 100ms, 200ms and 500ms. Also, independent settings can be made for Output 1 and Output 2.
3) The voltage withstandability and the insulation resistance values given in the above table are for the amplifier only.

I/O CIRCUIT AND WIRING DIAGRAMS

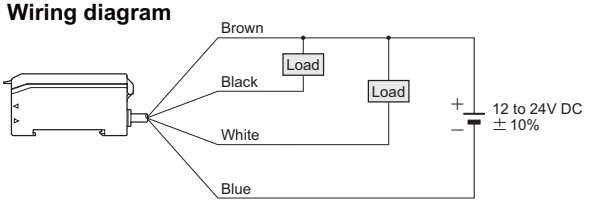
FX-D1□ NPN output

I/O circuit diagram

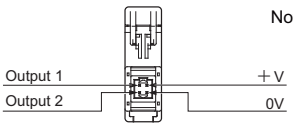


Symbols ... D: Reverse supply polarity protection diode
Z_{D1}, Z_{D2}: Surge absorption zener diode
Tr_1, Tr_2 : NPN output transistor

Wiring diagram



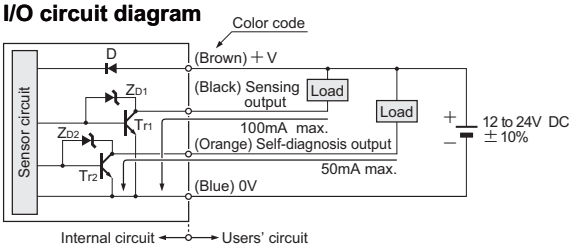
Connector pin position (Plug-in connector type) (Note)



Note: In case the optional connector attached cable **CN-54-C**□ is connected to the plug-in connector type amplifier, the color of Output 2 wire is orange.

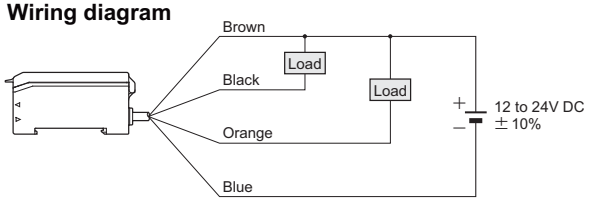
FX-A1□ FX-M1□ NPN output

I/O circuit diagram

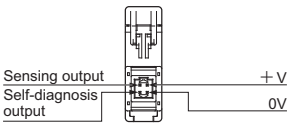


Symbols ... D: Reverse supply polarity protection diode
Z_{D1}, Z_{D2}: Surge absorption zener diode
Tr_1, Tr_2 : NPN output transistor

Wiring diagram

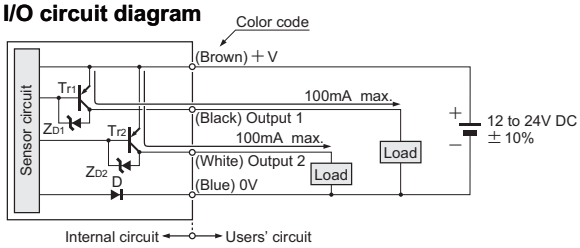


Connector pin position (Plug-in connector type)



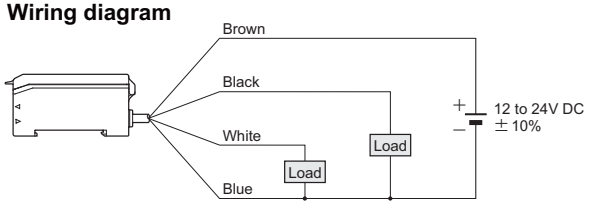
FX-D1P□ PNP output

I/O circuit diagram

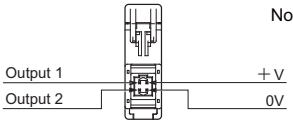


Symbols ... D: Reverse supply polarity protection diode
Z_{D1}, Z_{D2}: Surge absorption zener diode
Tr_1, Tr_2 : PNP output transistor

Wiring diagram



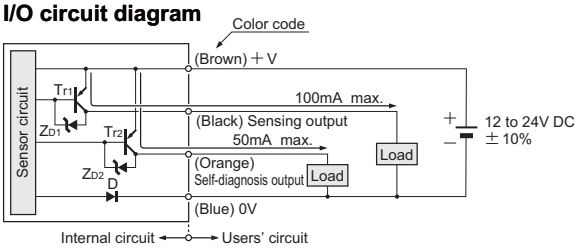
Connector pin position (Plug-in connector type) (Note)



Note: In case the optional connector attached cable **CN-54-C**□ is connected to the plug-in connector type amplifier, the color of Output 2 wire is orange.

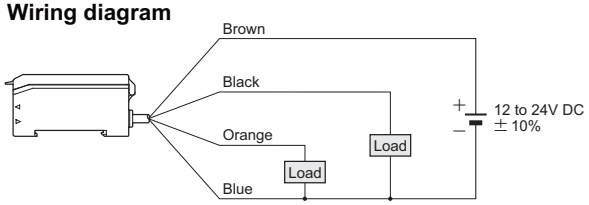
FX-A1P□ FX-M1P□ PNP output

I/O circuit diagram

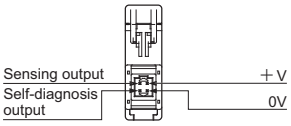


Symbols ... D: Reverse supply polarity protection diode
Z_{D1}, Z_{D2}: Surge absorption zener diode
Tr_1, Tr_2 : PNP output transistor

Wiring diagram



Connector pin position (Plug-in connector type)



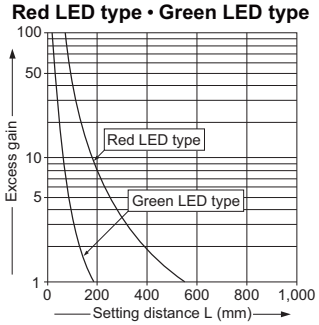
FX-D1/A1/M1

SENSING CHARACTERISTICS (TYPICAL)

Correlation between setting distance and excess gain

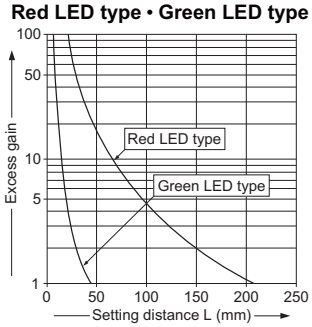
FT-FM2 Thru-beam type

Red LED type • Green LED type



FD-FM2 Reflective type

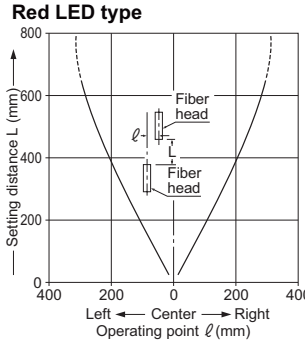
Red LED type • Green LED type



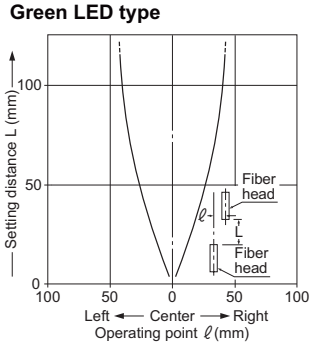
Parallel deviation

FT-B8 Thru-beam type

Red LED type

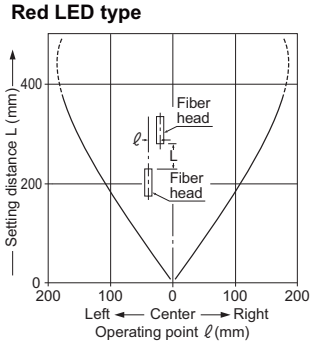


Green LED type

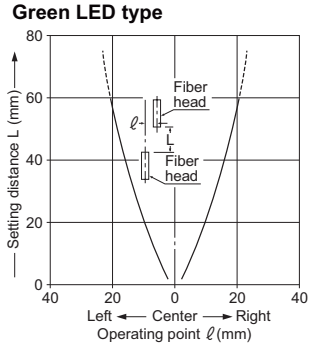


FT-FM2 FT-FM2S FT-FM2S4 FT-SFM2 FT-T80 Thru-beam type

Red LED type

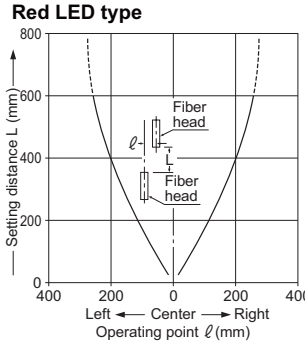


Green LED type

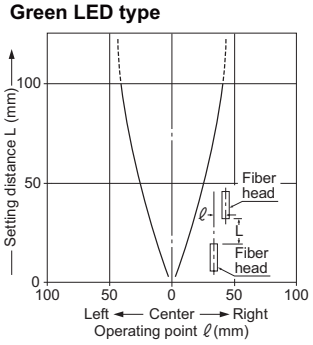


FT-NB8 Thru-beam type

Red LED type

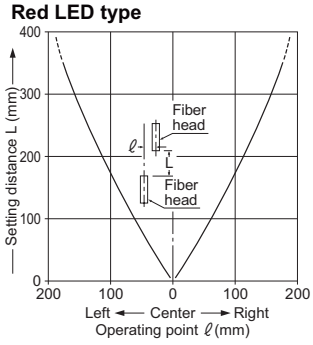


Green LED type

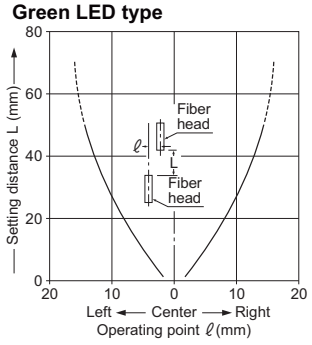


FT-N8 Thru-beam type

Red LED type

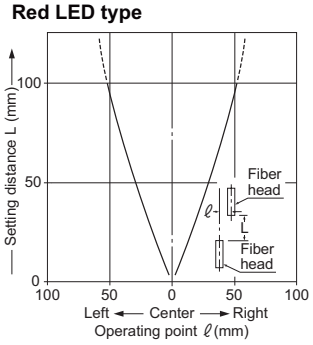


Green LED type

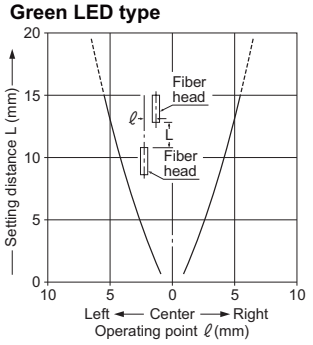


FT-NFM2 FT-NFM2S FT-NFM2S4 FT-SNFM2 Thru-beam type

Red LED type

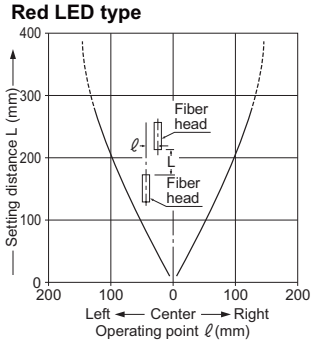


Green LED type

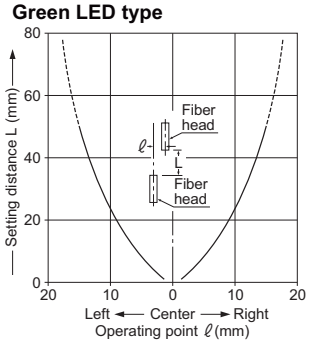


FT-W8 FT-WS8 Thru-beam type

Red LED type



Green LED type

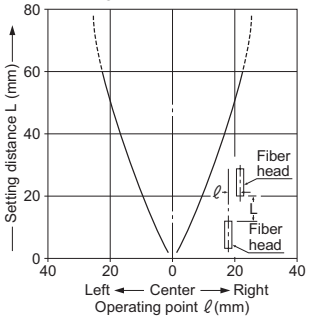


SENSING CHARACTERISTICS (TYPICAL)

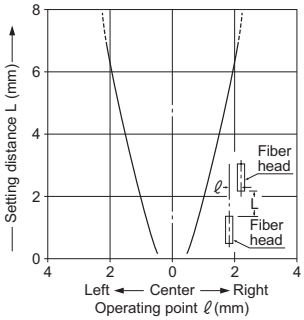
Parallel deviation

FT-W4 FT-WS4 Thru-beam type

Red LED type

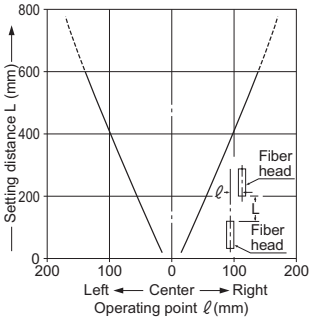


Green LED type

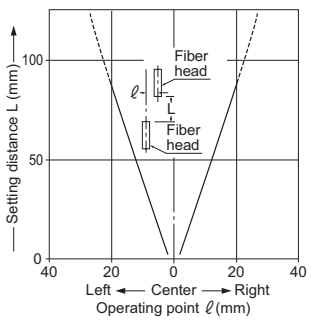


FT-WS8L Thru-beam type

Red LED type

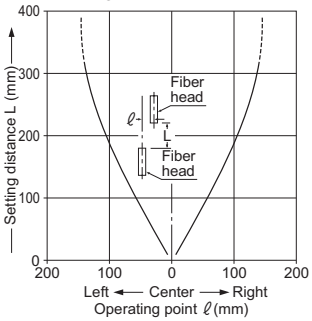


Green LED type

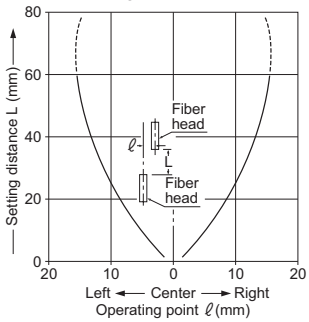


FT-P80 Thru-beam type

Red LED type

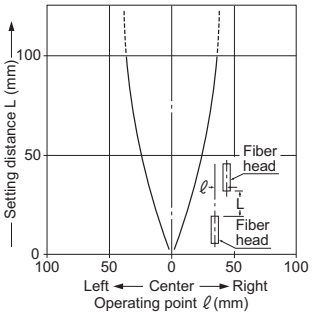


Green LED type

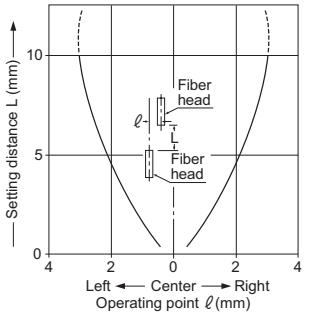


FT-P40 Thru-beam type

Red LED type

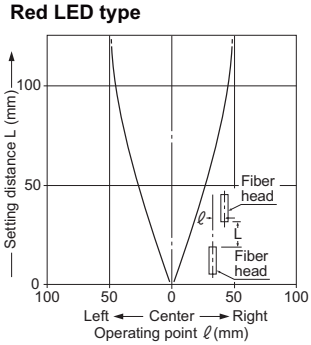


Green LED type

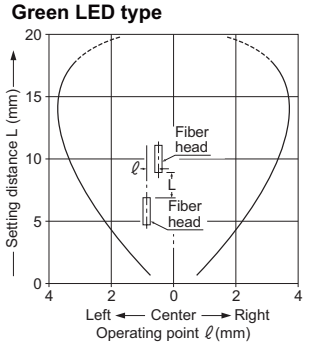


FT-P2 Thru-beam type

Red LED type

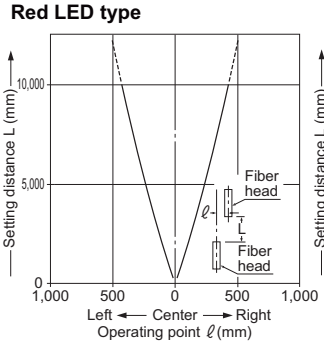


Green LED type

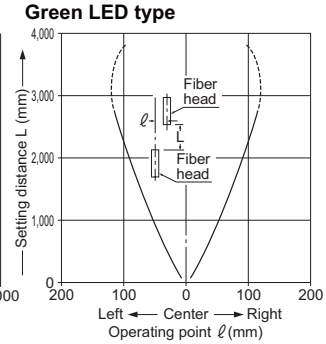


FT-FM10L Thru-beam type

Red LED type

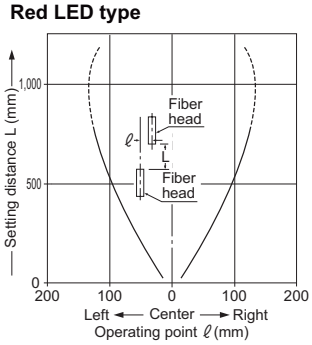


Green LED type

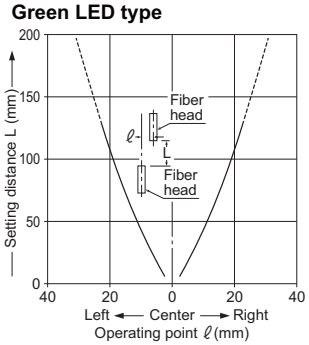


FT-SFM2L Thru-beam type

Red LED type

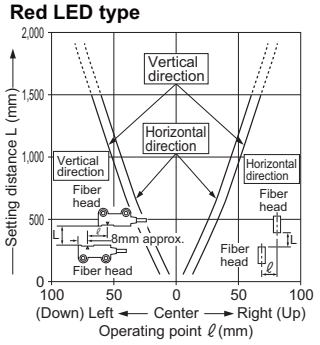


Green LED type



FT-A8 Thru-beam type

Red LED type



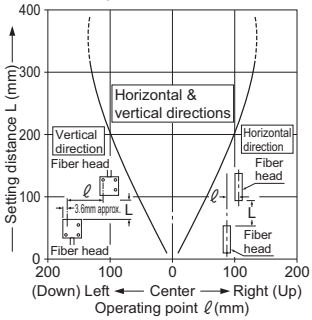
FX-D1/A1/M1

SENSING CHARACTERISTICS (TYPICAL)

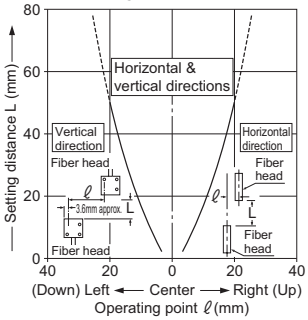
Parallel deviation

FT-AFM2 Thru-beam type

Red LED type

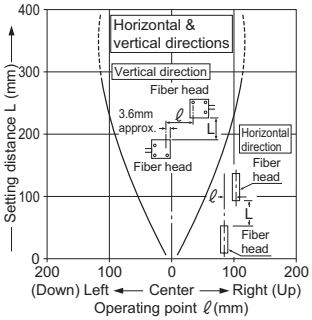


Green LED type

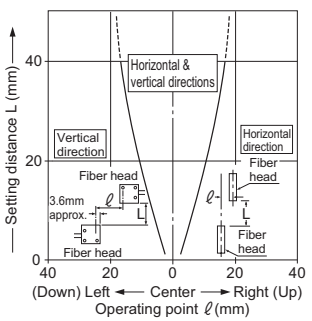


FT-AFM2E Thru-beam type

Red LED type

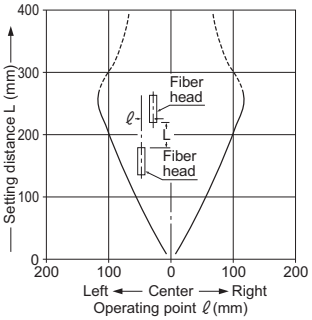


Green LED type

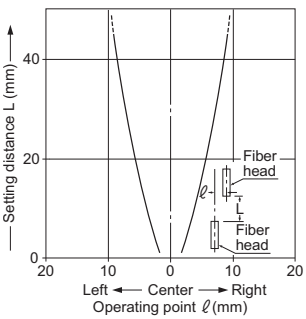


FT-R80 Thru-beam type

Red LED type

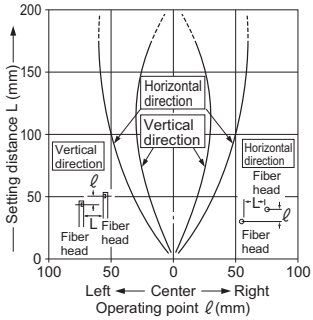


Green LED type

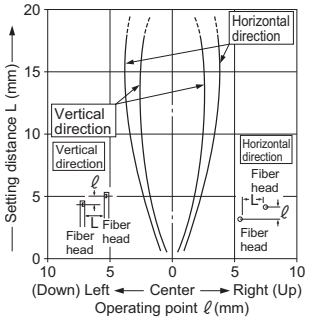


FT-V22 Thru-beam type

Red LED type

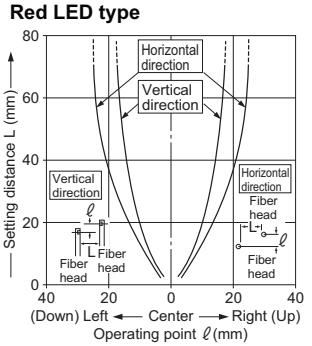


Green LED type

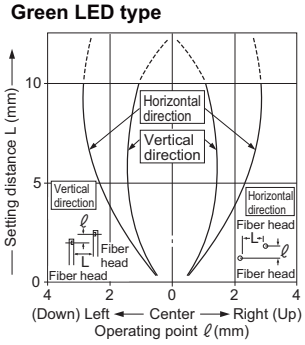


FT-V41 Thru-beam type

Red LED type

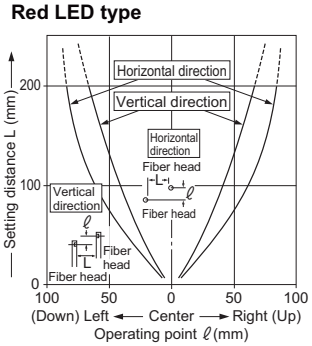


Green LED type

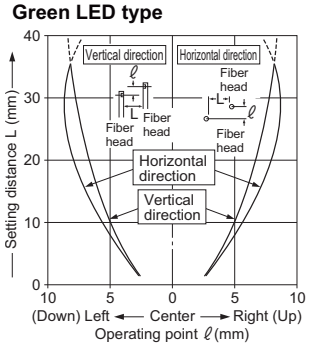


FT-SFM2SV2 Thru-beam type

Red LED type

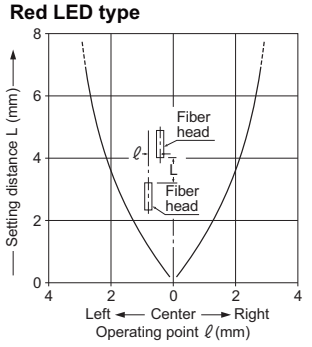


Green LED type



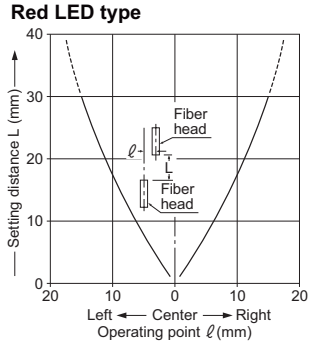
FT-E10 Thru-beam type

Red LED type



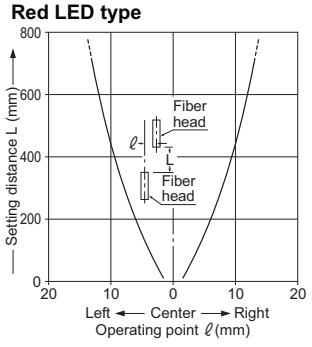
FT-E20 Thru-beam type

Red LED type

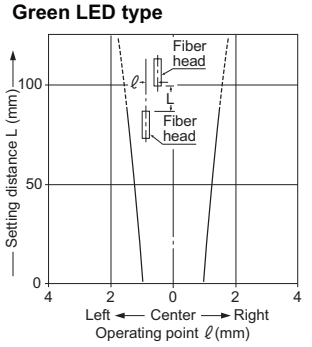


FT-K2 Thru-beam type

Red LED type



Green LED type

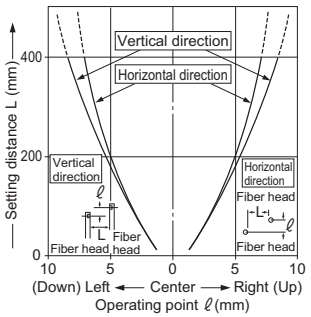


SENSING CHARACTERISTICS (TYPICAL)

Parallel deviation

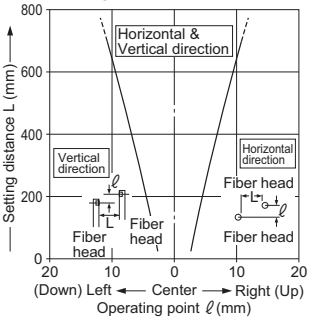
FT-KV2 Thru-beam type

Red LED type



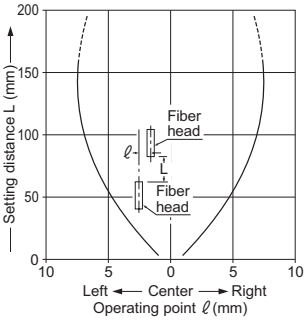
FT-KV8 Thru-beam type

Red LED type

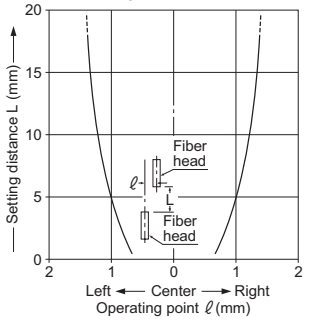


FT-KM1S2 Thru-beam type

Red LED type

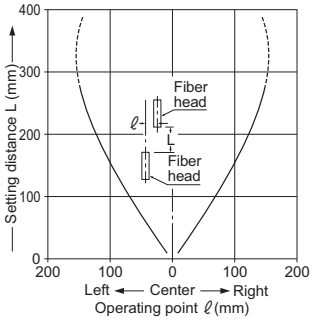


Green LED type

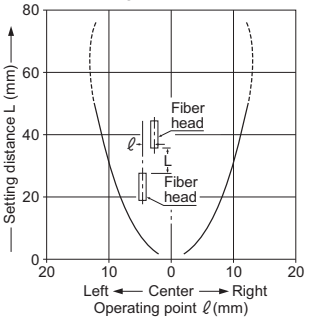


FT-H35-M2 FT-H35-M2S6 FT-H20-M1 Thru-beam type

Red LED type

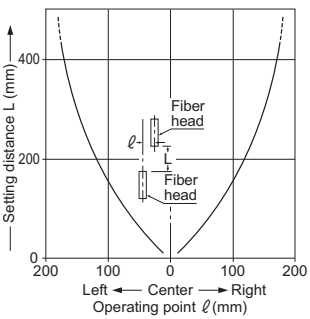


Green LED type

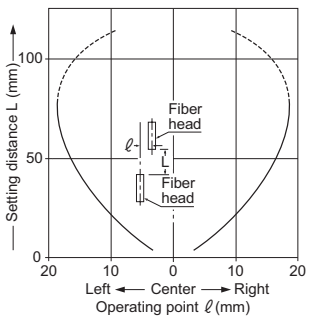


FT-H13-FM2 Thru-beam type

Red LED type

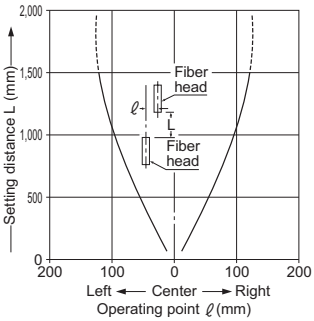


Green LED type

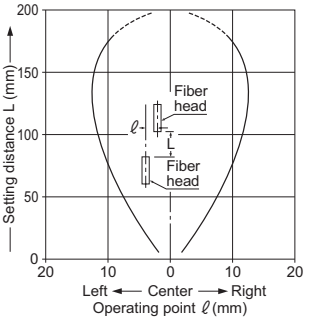


FT-L8Y Thru-beam type

Red LED type

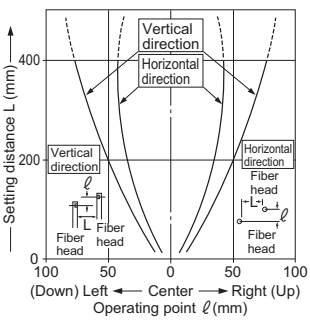


Green LED type

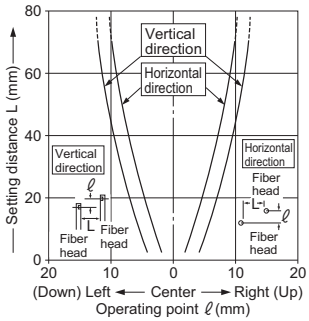


FT-V8Y Thru-beam type

Red LED type

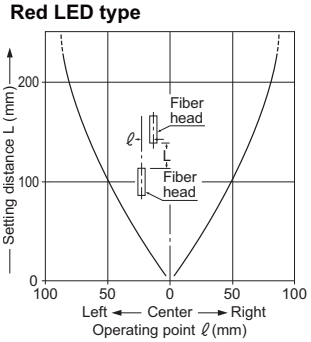


Green LED type



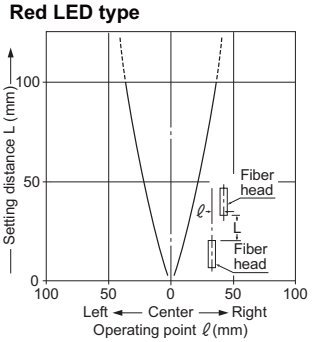
FT-6V Thru-beam type

Red LED type



FT-60V Thru-beam type

Red LED type



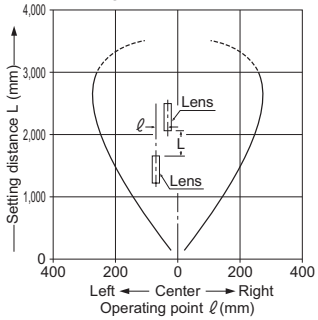
FX-D1/A1/M1

SENSING CHARACTERISTICS (TYPICAL)

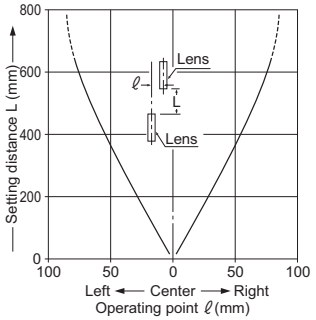
Parallel deviation with FX-LE1 (expansion lens) applied on both sides

FT-B8 Thru-beam type

Red LED type

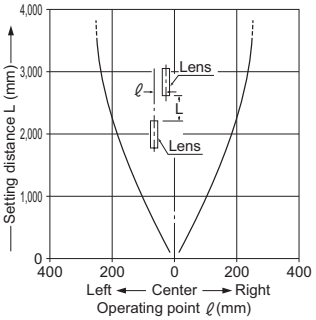


Green LED type

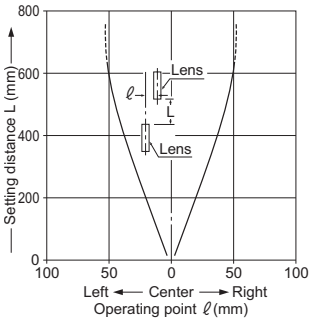


FT-FM2 FT-T80 Thru-beam type

Red LED type

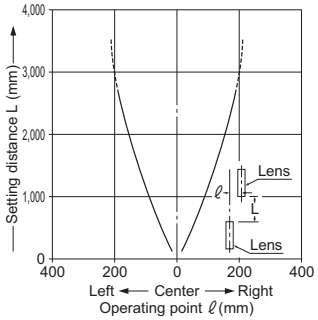


Green LED type

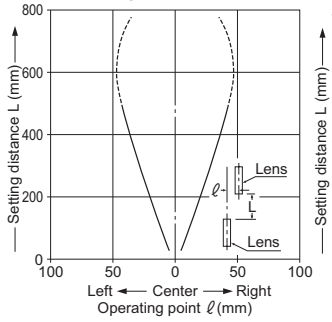


FT-W8 Thru-beam type

Red LED type

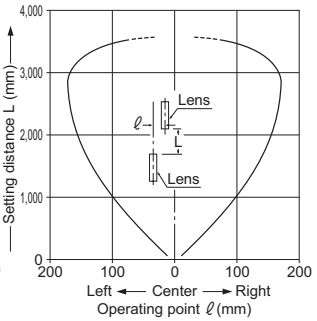


Green LED type

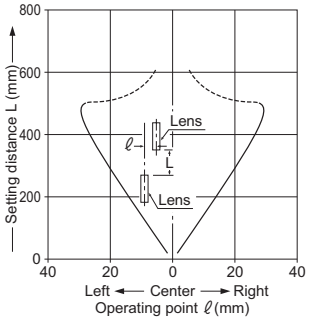


FT-P80 Thru-beam type

Red LED type

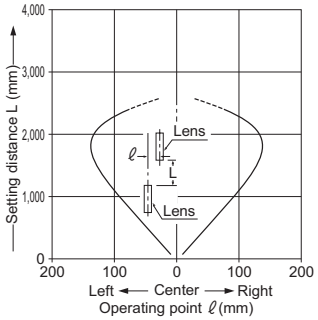


Green LED type

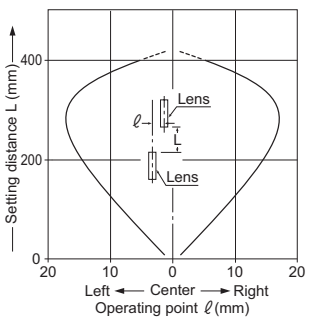


FT-R80 Thru-beam type

Red LED type

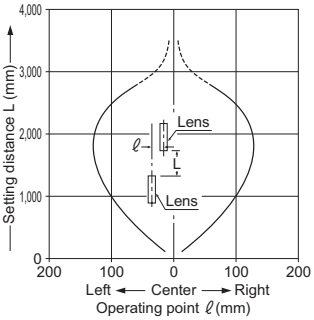


Green LED type

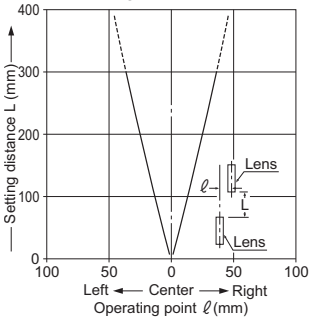


FT-H35-M2 Thru-beam type

Red LED type

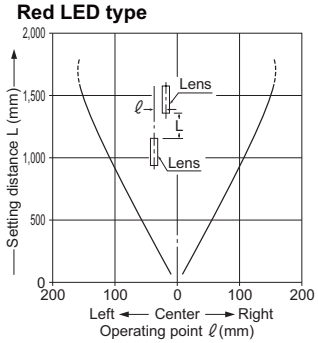


Green LED type

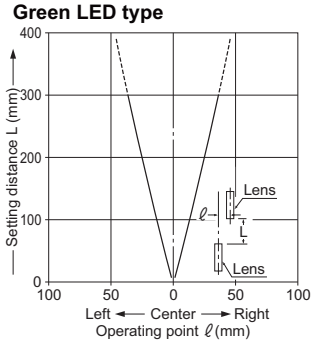


FT-H20-M1 Thru-beam type

Red LED type



Green LED type

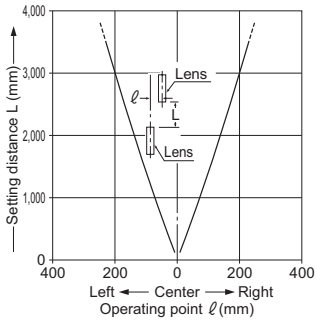


SENSING CHARACTERISTICS (TYPICAL)

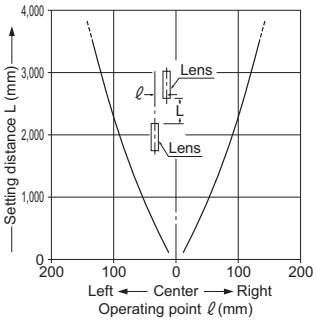
Parallel deviation with FX-LE2 (super-expansion lens) applied on both sides

FT-B8 Thru-beam type

Red LED type

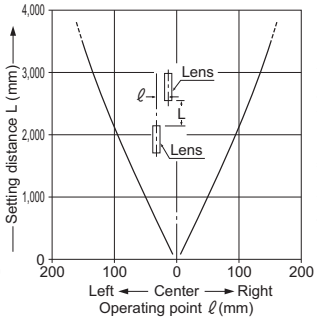


Green LED type

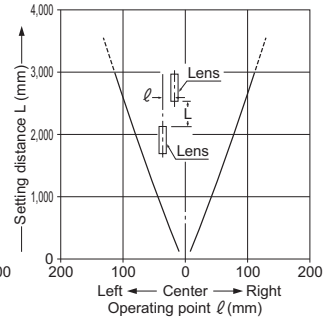


FT-FM2 Thru-beam type

Red LED type

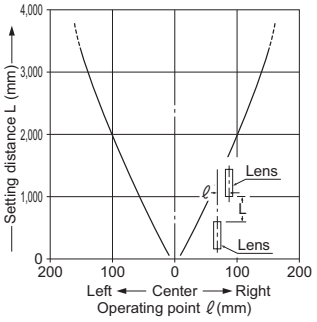


Green LED type

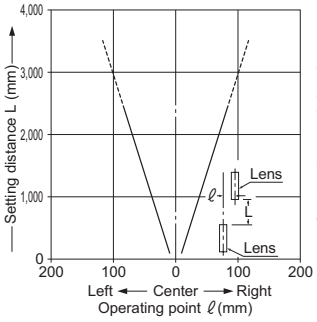


FT-W8 Thru-beam type

Red LED type

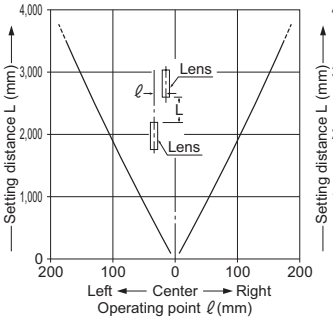


Green LED type

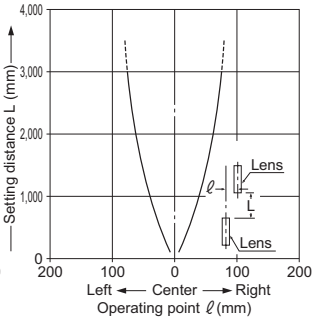


FT-P80 Thru-beam type

Red LED type

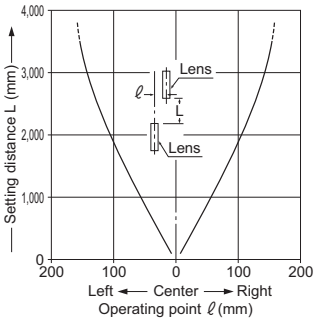


Green LED type

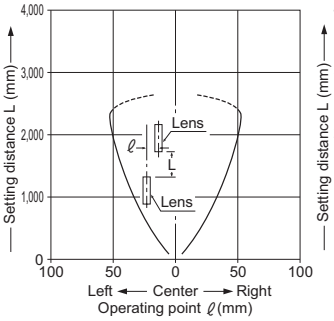


FT-R80 Thru-beam type

Red LED type

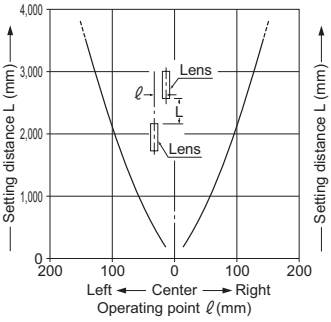


Green LED type

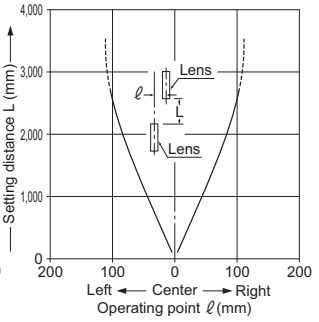


FT-H35-M2 Thru-beam type

Red LED type

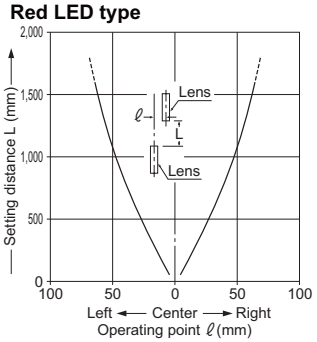


Green LED type

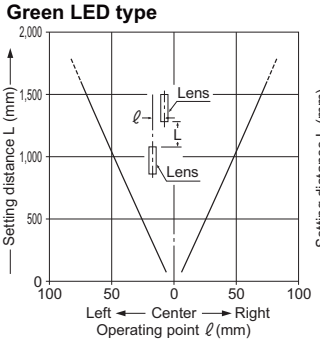


FT-H20-M1 Thru-beam type

Red LED type

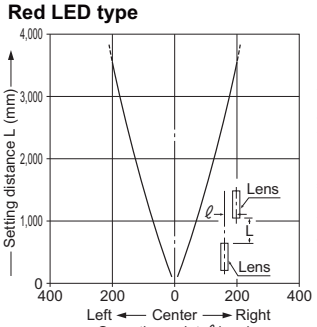


Green LED type

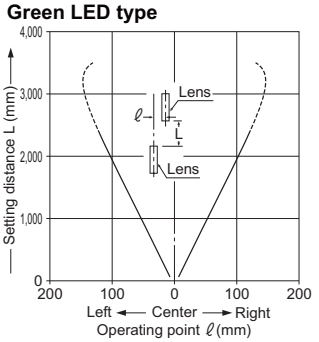


FT-H13-FM2 Thru-beam type

Red LED type



Green LED type



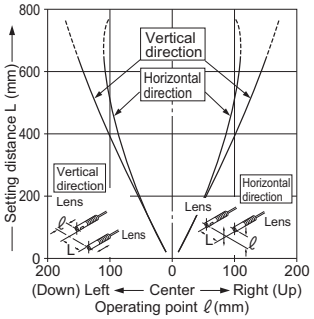
FX-D1/A1/M1

SENSING CHARACTERISTICS (TYPICAL)

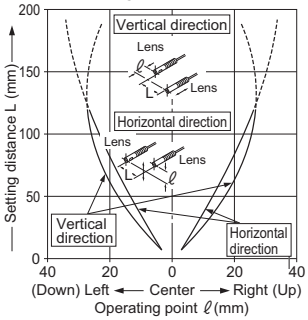
Parallel deviation with FX-SV1 (side-view lens) applied on both sides

FT-B8 Thru-beam type

Red LED type

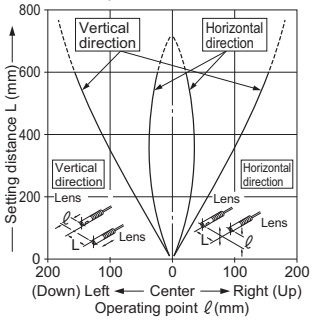


Green LED type

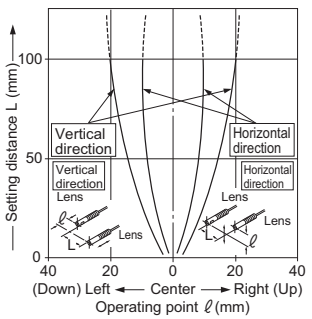


FT-FM2 FT-T80 Thru-beam type

Red LED type

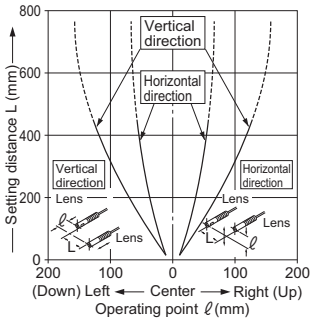


Green LED type

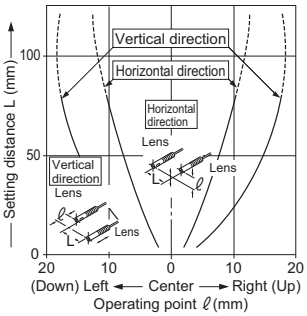


FT-W8 Thru-beam type

Red LED type

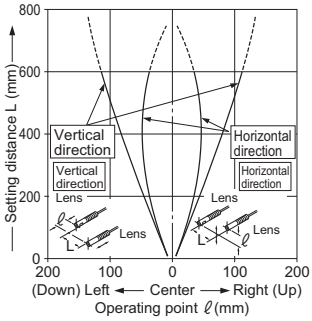


Green LED type

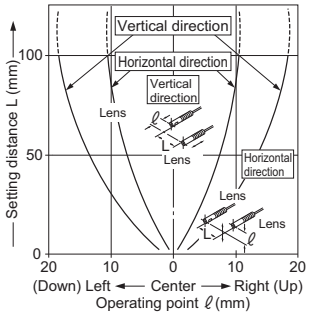


FT-P80 Thru-beam type

Red LED type

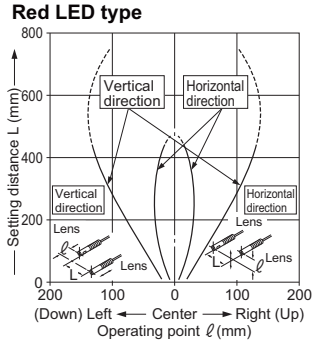


Green LED type

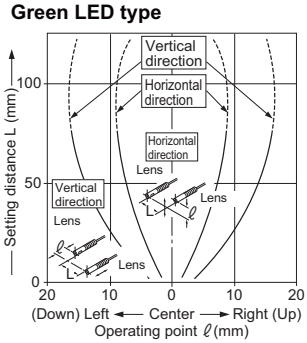


FT-H35-M2 Thru-beam type

Red LED type

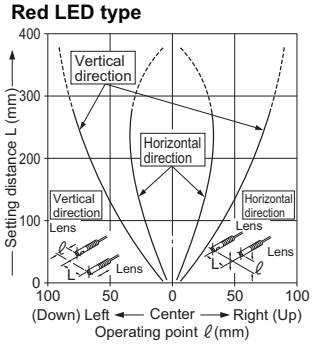


Green LED type

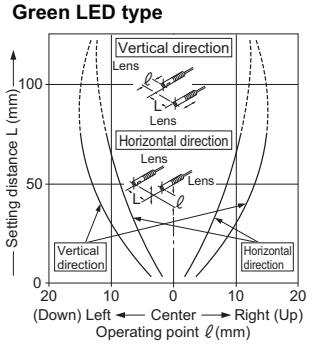


FT-H20-M1 Thru-beam type

Red LED type



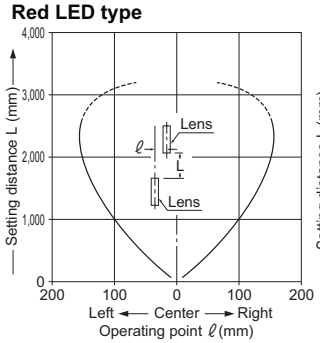
Green LED type



Parallel deviation with FV-LE1 (vacuum • expansion lens) applied on both sides

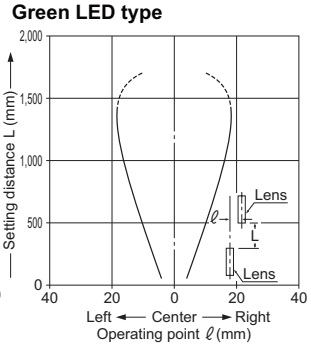
FT-6V Thru-beam type

Red LED type



FT-60V Thru-beam type

Green LED type

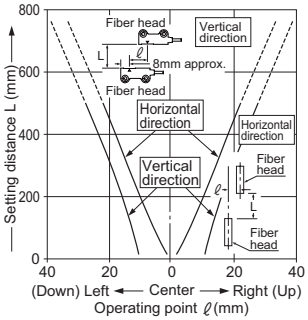


SENSING CHARACTERISTICS (TYPICAL)

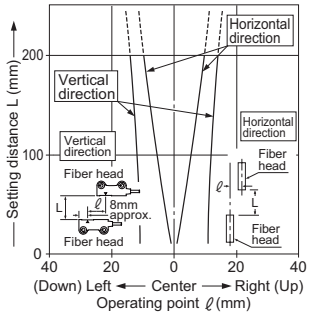
Parallel deviation with seal type slit masks

FT-A8 Thru-beam type

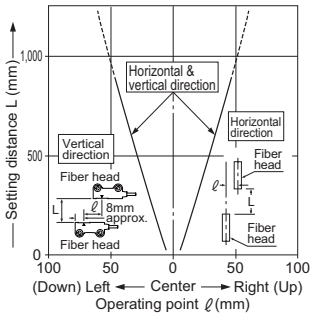
With slit mask (0.5 × 12mm) on one side



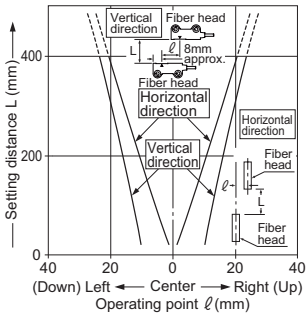
With slit masks (0.5 × 12mm) on both sides



With slit mask (1 × 12mm) on one side



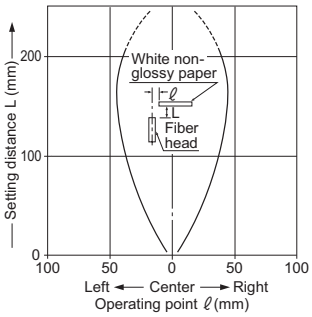
With slit masks (1 × 12mm) on both sides



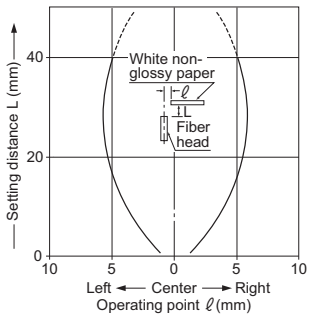
Sensing fields

FD-B8 Reflective type

Red LED type

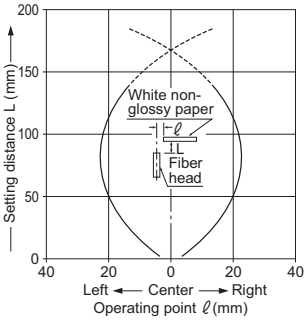


Green LED type

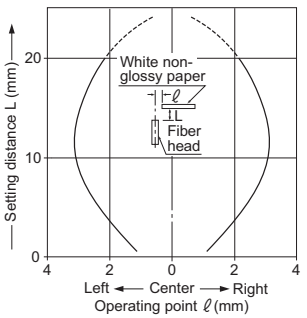


FD-5 FD-FM2 FD-FM2S FD-FM2S4 FD-T80 FD-S80 Reflective type

Red LED type

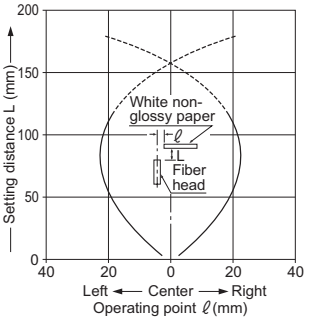


Green LED type

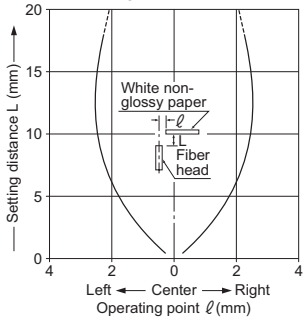


FD-N8 Reflective type

Red LED type

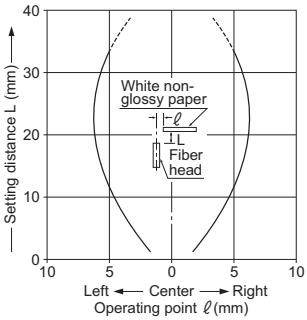


Green LED type

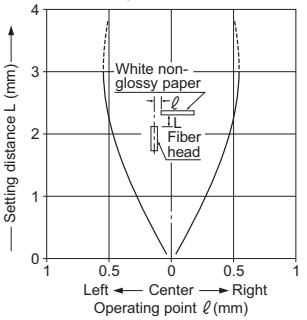


FD-N4 Reflective type

Red LED type

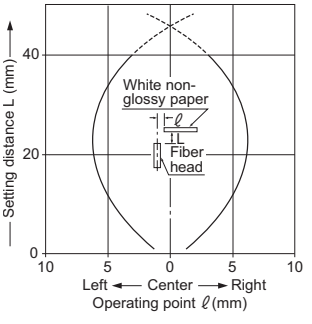


Green LED type

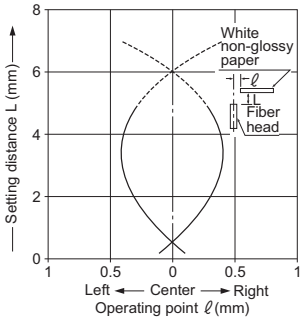


FD-T40 FD-NFM2 FD-NFM2S FD-NFM2S4 FD-SNFM2 Reflective type

Red LED type

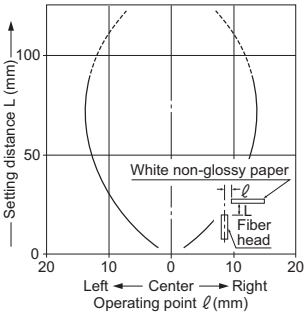


Green LED type

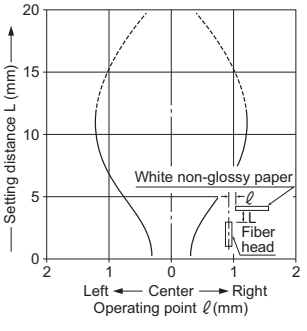


FD-W8 FD-WT8 FD-WS8 Reflective type

Red LED type



Green LED type

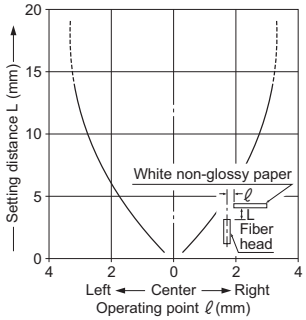


FX-D1/A1/M1

SENSING CHARACTERISTICS (TYPICAL)

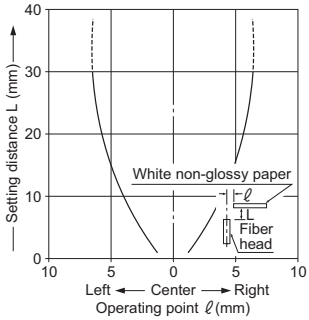
FD-W44 FD-WT4 Reflective type

Red LED type

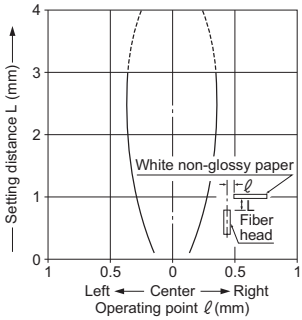


FD-WG4 FD-WSG4 Reflective type

Red LED type

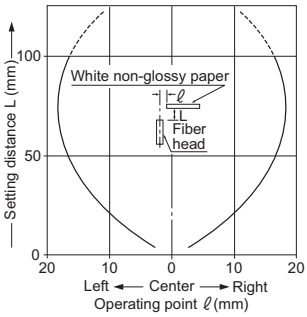


Green LED type

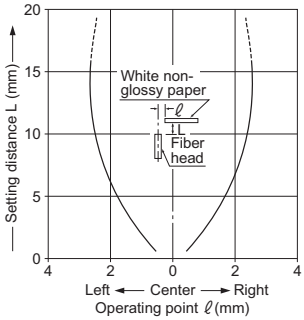


FD-P80 Reflective type

Red LED type

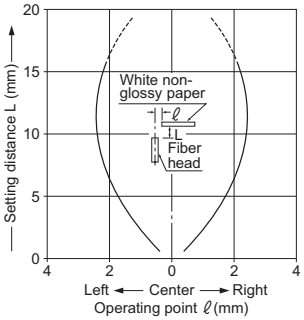


Green LED type



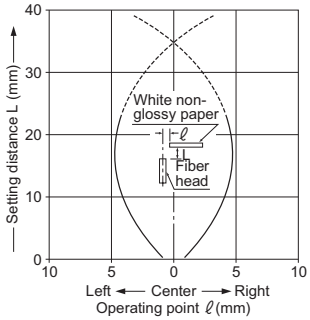
FD-P40 Reflective type

Red LED type

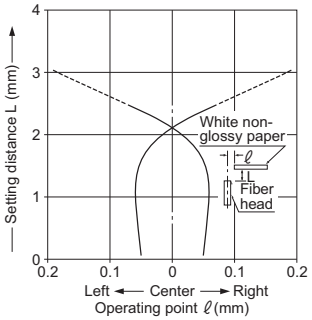


FD-P2 Reflective type

Red LED type

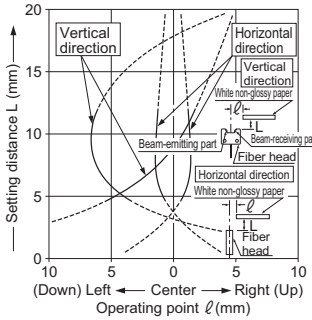


Green LED type



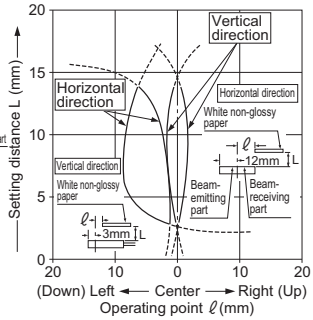
FD-L4 Reflective type

Red LED type



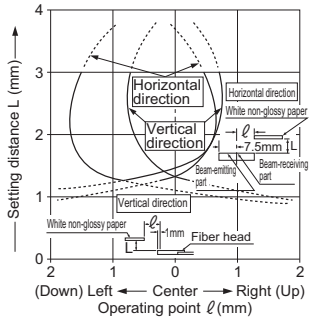
FD-L41 Reflective type

Red LED type



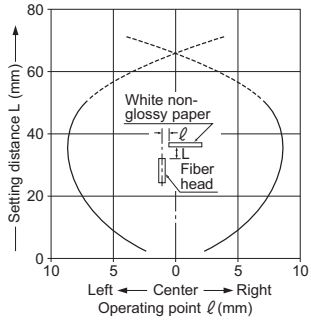
FD-L42 Reflective type

Red LED type

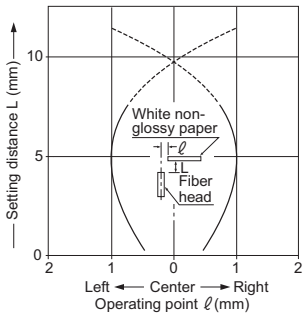


FD-G4 Reflective type

Red LED type



Green LED type

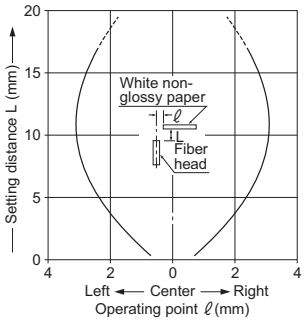


SENSING CHARACTERISTICS (TYPICAL)

Sensing fields

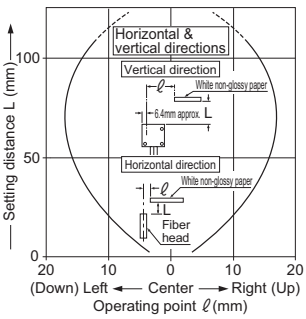
FD-EG1 Reflective type

Red LED type

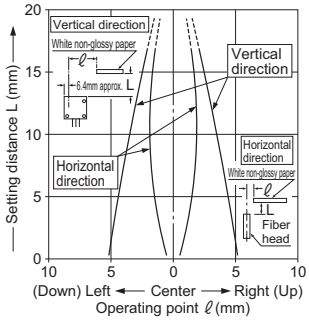


FD-AFM2 FD-AFM2E Reflective type

Red LED type

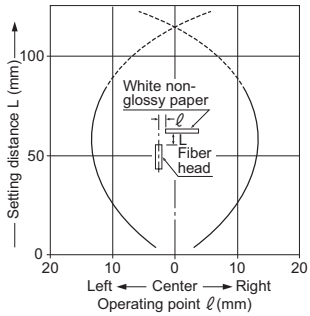


Green LED type

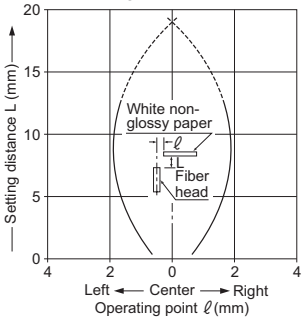


FD-R80 Reflective type

Red LED type

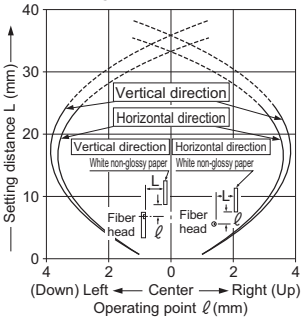


Green LED type



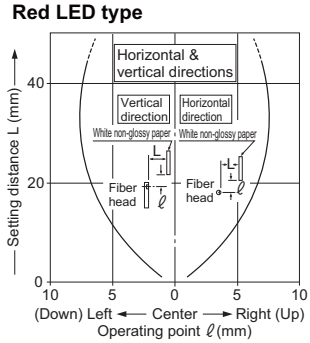
FD-V41 Reflective type

Red LED type

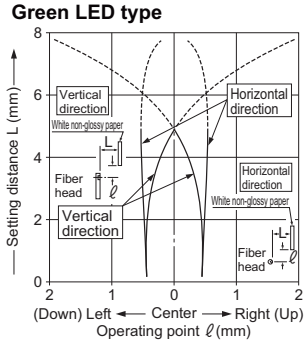


FD-SFM2SV2 Reflective type

Red LED type

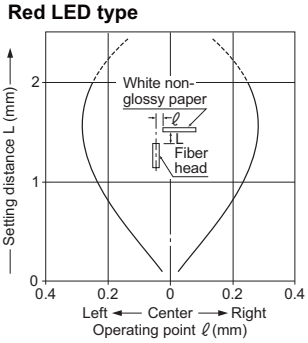


Green LED type



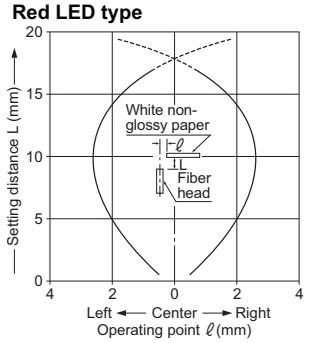
FD-EN500S1 Reflective type

Red LED type



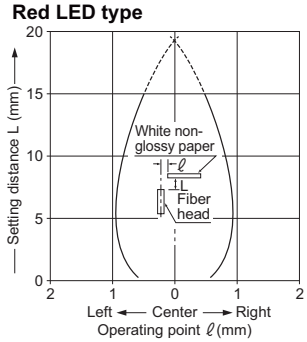
FD-ENM1S1

Red LED type



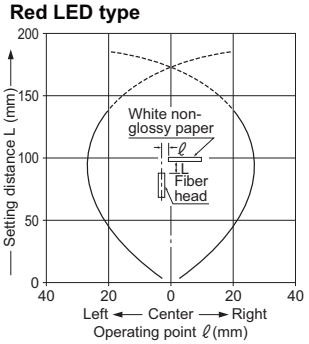
FD-KM1S2 Reflective type

Red LED type

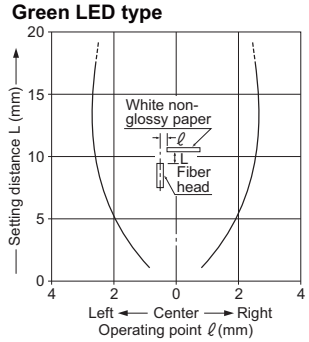


FD-H35-M2 FD-H35-M2S6 FD-H20-M1 Reflective type

Red LED type



Green LED type



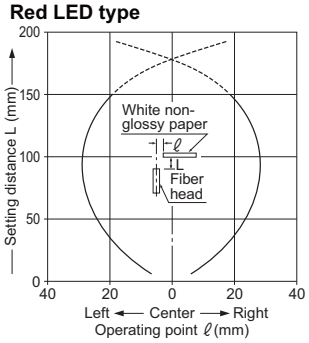
FX-D1/A1/M1

SENSING CHARACTERISTICS (TYPICAL)

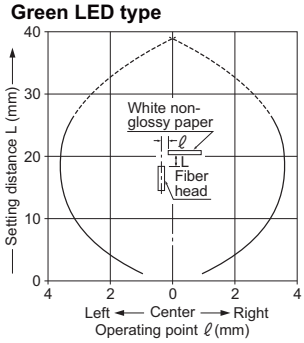
Sensing fields

FD-H13-FM2 Reflective type

Red LED type

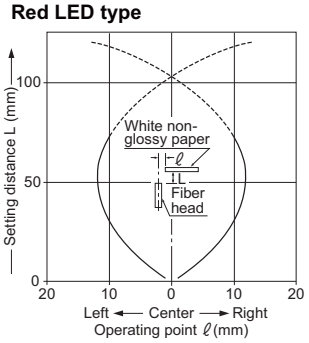


Green LED type



FD-6V Reflective type

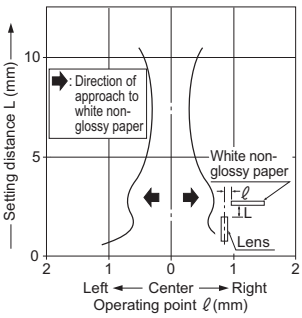
Red LED type



Sensing fields with FX-MR1 (pinpoint spot lens) applied

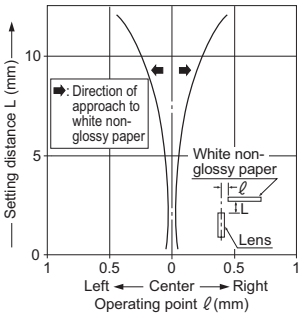
FD-WG4 Reflective type

Red LED type



FD-G4 Reflective type

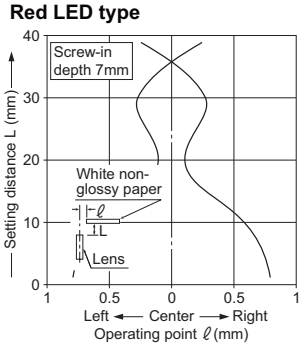
Red LED type



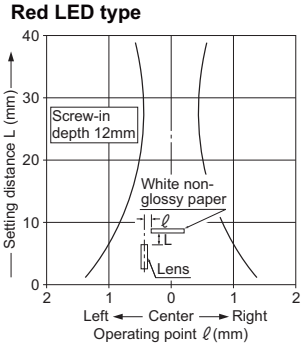
Sensing fields with FX-MR2 (zoom lens) applied

FD-WG4 Reflective type

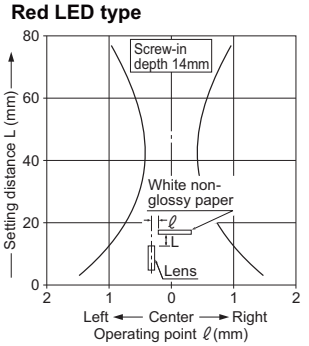
Red LED type



Red LED type

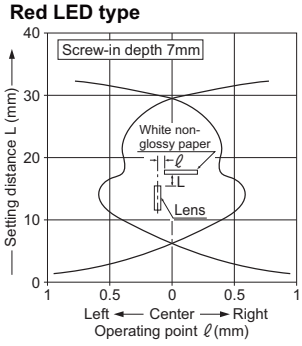


Red LED type

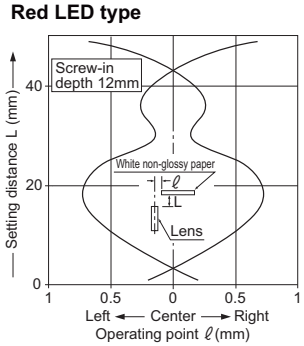


FD-G4 Reflective type

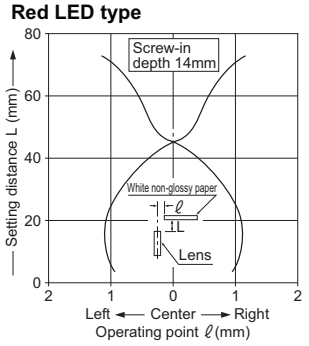
Red LED type



Red LED type



Red LED type

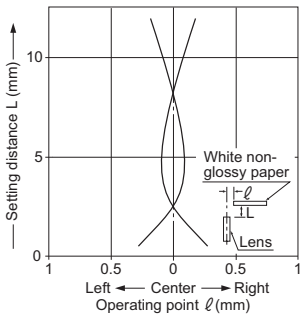


SENSING CHARACTERISTICS (TYPICAL)

Sensing fields with FX-MR3 (finest spot lens) applied

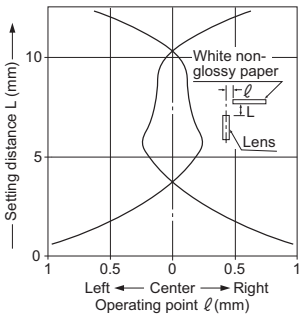
FD-WG4 Reflective type

Red LED type



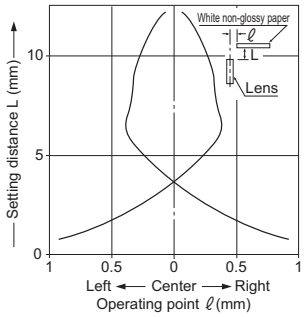
FD-G4 Reflective type

Red LED type



FD-EG1 Reflective type

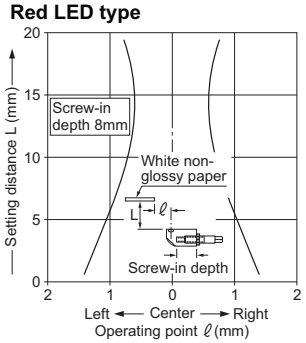
Red LED type



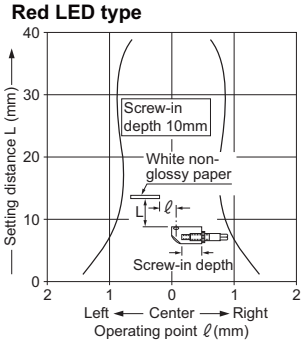
Sensing fields with FX-MR5 (side-view type zoom lens) applied

FD-WG4 Reflective type

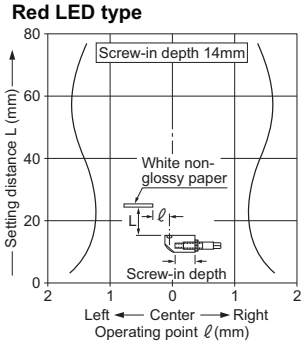
Red LED type



Red LED type

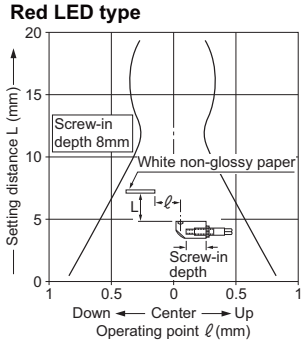


Red LED type

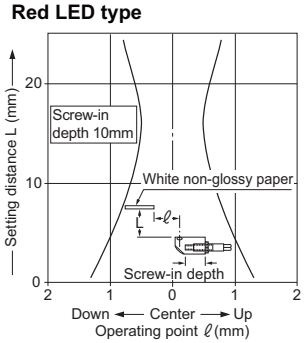


FD-G4 Reflective type

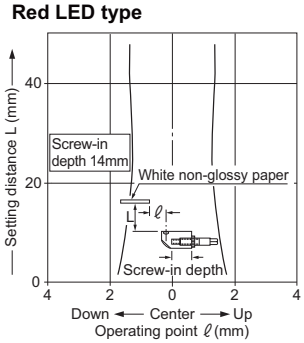
Red LED type



Red LED type



Red LED type



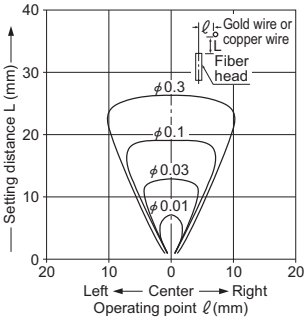
FX-D1/A1/M1

SENSING CHARACTERISTICS (TYPICAL)

Correlation between sensing object diameter and sensing field

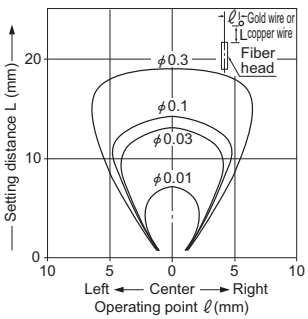
FD-B8 Reflective type

Red LED type



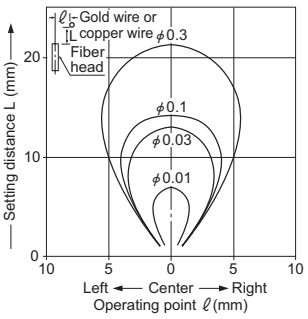
FD-5 FD-FM2 FD-T80 FD-S80 Reflective type

Red LED type



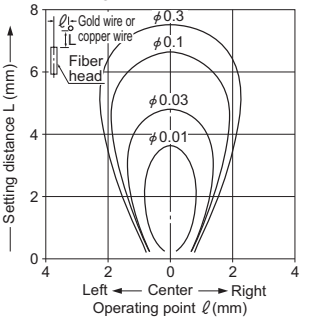
FD-N8 Reflective type

Red LED type



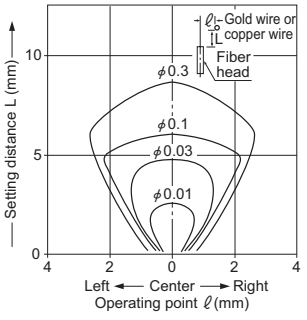
FD-N4 Reflective type

Red LED type



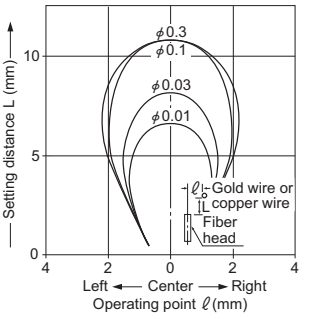
FD-T40 FD-NFM2 Reflective type

Red LED type



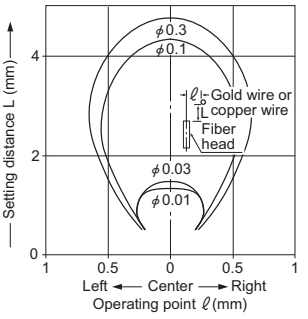
FD-W8 FD-WT8 FD-WS8 Reflective type

Red LED type



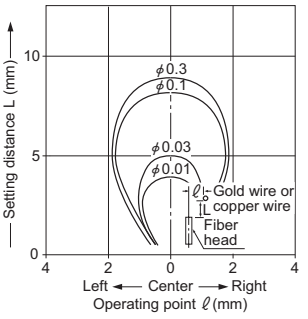
FD-WT4 FD-W44 Reflective type

Red LED type



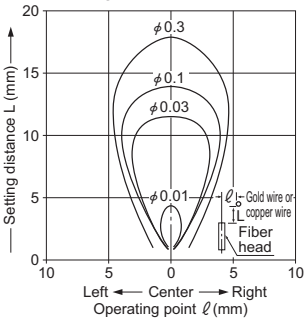
FD-WG4 FD-WSG4 Reflective type

Red LED type



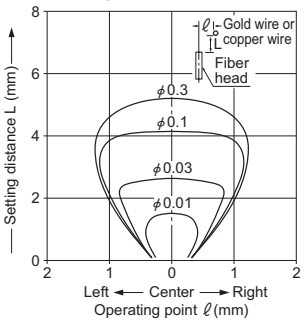
FD-P80 Reflective type

Red LED type



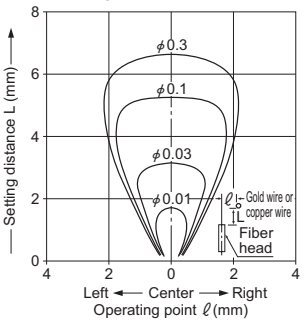
FD-P40 Reflective type

Red LED type



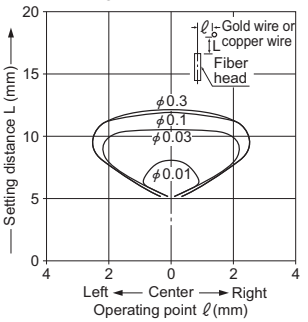
FD-P2 Reflective type

Red LED type



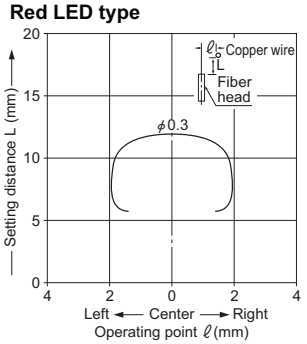
FD-L4 Reflective type

Red LED type



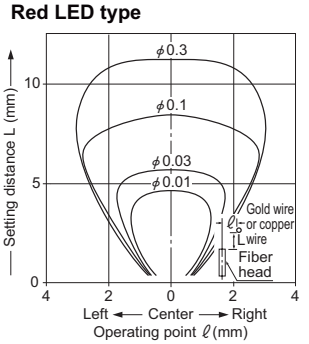
FD-L41 Reflective type

Red LED type



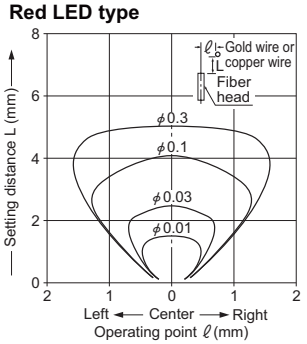
FD-G4 Reflective type

Red LED type



FD-EG1 Reflective type

Red LED type

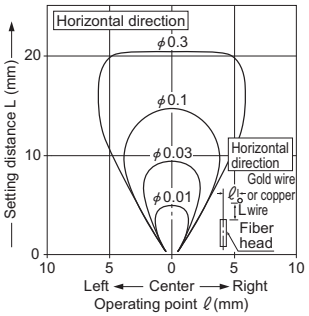


SENSING CHARACTERISTICS (TYPICAL)

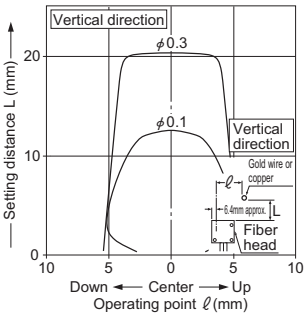
Correlation between sensing object diameter and sensing field

FD-AFM2 Reflective type

Red LED type

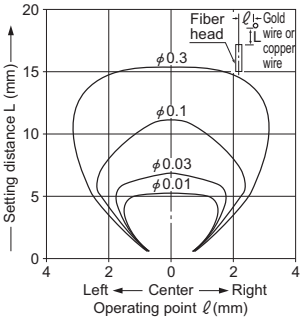


Red LED type



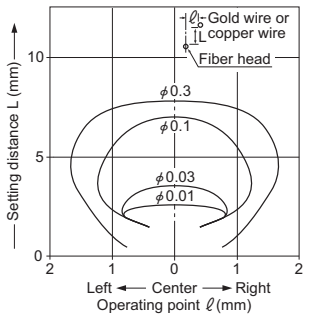
FD-R80 Reflective type

Red LED type



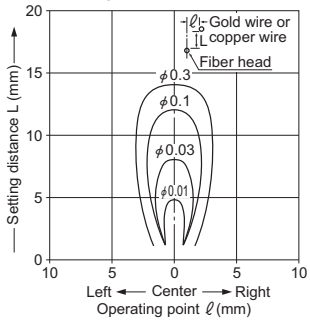
FD-V41 Reflective type

Red LED type



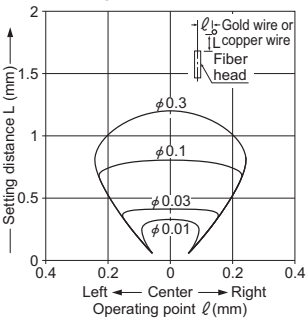
FD-SFM2SV2 Reflective type

Red LED type



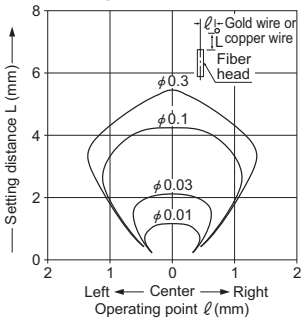
FD-EN500S1 Reflective type

Red LED type



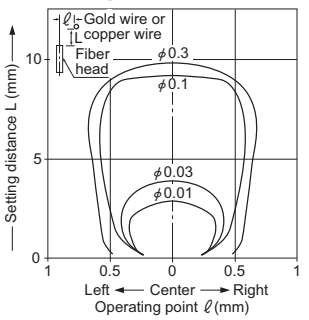
FD-ENM1S1 Reflective type

Red LED type



FD-KM1S2 Reflective type

Red LED type



FX-D1/A1/M1

PRECAUTIONS FOR PROPER USE

Refer to P.820 ～ for general precautions.

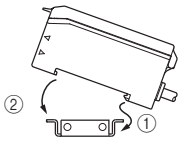
Amplifier

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

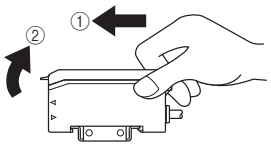
① Fit the rear part of the amplifier on the attached amplifier mounting bracket (**MS-DIN-2**) or a 35mm width DIN rail.
② Press down the front part of the amplifier on the amplifier mounting bracket (**MS-DIN-2**) or the DIN rail to fit it.



Attached amplifier mounting bracket or 35mm width DIN rail

How to remove the amplifier

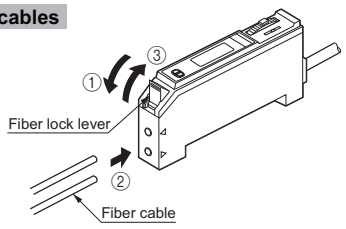
① Push the amplifier forward.
② Lift up the front part of the amplifier to remove it.



Note: Please take care that if the front part is lifted without pushing the amplifier forwards, the hooks on the rear portion of the mounting section are likely to break.

How to connect the fiber cables

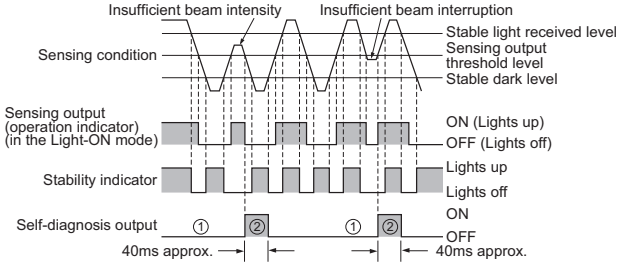
① Snap the fiber lock lever down.
② Insert fiber cables slowly into the inlets until they stop. (Note)
③ Lock the fiber lock lever in the original position, till you feel a click.



Note: In case the fiber cables are not inserted to a position where they stop, the sensing range reduces.

Self-diagnosis function

• The **FX-A1**/**M1** series incorporate a self-diagnosis function. This is a function which diagnoses a decrease in the incident light intensity due to dirt or dust, or optical misalignment, and gives an output.



① The self-diagnosis output transistor stays in the 'OFF' state during stable sensing.
② When the sensing output changes, if the incident light intensity does not reach the stable light received level or the stable dark level, the self-diagnosis output becomes ON. It automatically turns OFF after 40ms approx. (Emission Frequency 2 of the **FX-A1** series: 50ms approx., Emission Frequency 3 of the **FX-A1** series: 60ms approx.)
Further, the self-diagnosis output is generated at the time when the sensing output changes from ON to OFF or from OFF to ON.
(The operation of the sensing output is not affected.)

Interference prevention function

• Since the **FX-D1**/**A1**/**M1** series is equipped with an interference prevention function, up to 3 Nos. of fiber sensors can be mounted close to each other by setting different emission frequencies. Please refer to '**Setting of each mode**' for the setting method in case of the **FX-D1**/**A1** series. For the **FX-M1** series, the emission frequency can be set by the frequency selection switch.
However, note that the response time varies with the emission frequency as given below.

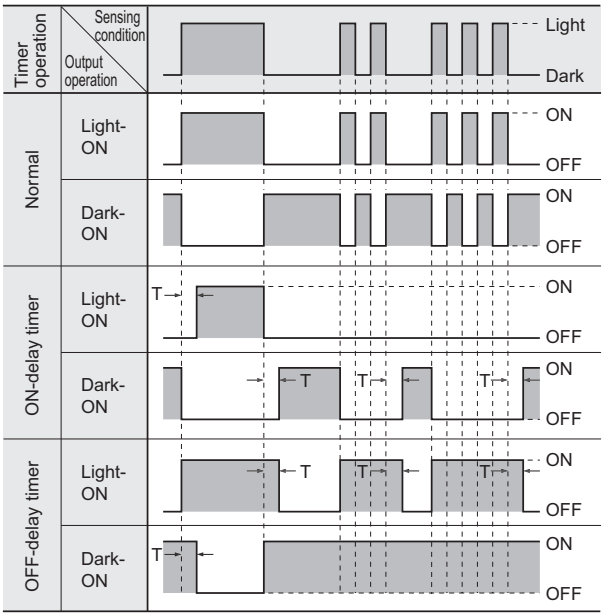
Emission frequency	Response time
1	0.5ms or less
2	0.65ms or less
3	0.75ms or less

Note: Do not set the sensitivity when interfering light is incident.
Correct incident light intensity cannot be taught in this condition.

Timer function

• The **FX-D1** series incorporates an ON-delay timer, which is useful when sensing only objects with a long passage time, and an OFF-delay timer, which is useful when the sensor is connected to devices having a slow response time. The timer period can be selected from four values: 40ms, 100ms, 200ms and 500ms.
The **FX-A1**/**M1** series incorporate approx. 40ms fixed OFF-delay timer. Please refer to '**Setting of each mode**' for the setting method in case of the **FX-D1**/**A1** series. For the **FX-M1** series, selection is by the mode switch.

<Time chart>



Timer period: T = 40ms, 100ms, 200ms, 500ms (selectable at the time of MODE setting)

Timer period of **FX-A1**/**M1** series: T = 40ms (OFF-delay timer)

Wiring

• The self-diagnosis output is not incorporated with a short-circuit protection circuit. Do not connect it directly to a power supply or a capacitive load.

Others

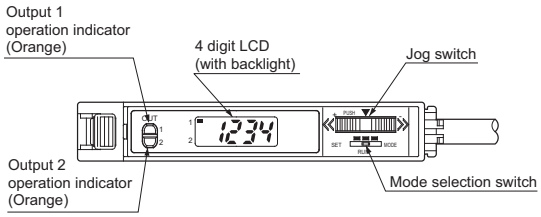
• Do not use during the initial transient time (0.5 sec.) after the power supply is switched on.

PRECAUTIONS FOR PROPER USE

Refer to P.820～ for general precautions.

Amplifier (FX-D1□)

Part description



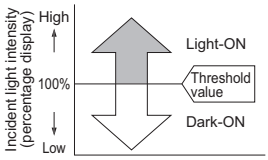
Percentage display

- After setting the threshold value, the current incident light intensity can be expressed as a percentage of the threshold value so that the degree of margin can be confirmed at a glance. If the jog switch is pressed when the mode selection switch is set on 'RUN', the display changes from absolute value to percentage value, and 0 to 999% is displayed. However, % (percent) is expressed by ' P ' and fractions are rounded off.
  If the jog switch is pressed once again, the display returns to absolute value.
  Further, in case percentage display is desired when the power supply is switched off, and then, on again, change the mode selection switch once to 'SET' or 'MODE', and then, set it back to 'RUN'.

<Current incident light intensity> <Percentage display>

Percentage display = Current incident light intensity ÷ Threshold value × 100 (%)

- The larger the difference between the numerical values in the Light state and the Dark state, more stable is the sensing.



Two outputs

- Since the **FX-D1** series is equipped with two independent outputs, threshold value, output operation and timer can be set for each of the two outputs.
  Please refer to '**Setting of threshold value**' for the method of setting the threshold value.
  Further, please refer to '**Setting of each mode**' for the output selection and the method of setting the output operation and the timer.

Output	LCD display	Description
Output 1	1 ■ 2	Threshold value, output operation and timer can be set for Output 1.
Output 2	1 2 ■	Threshold value, output operation and timer can be set for Output 2.

Setting of threshold value

In case of 2-level teaching

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

Step	Operation	LCD display
①	Set the fiber within the sensing range.	———
②	Set the mode selection switch to either 'RUN' or 'MODE'. SET MODE RUN	———
③	Set to either Output 1 or Output 2 by turning the jog switch to the '+' or the '−' side.	Output 1 Output 2
④	Set the mode selection switch to 'SET'. The present threshold value is displayed. SET MODE RUN	1234
⑤	Press the jog switch in the object present condition and release it within 3 sec. (Note 1) **Thru-beam type** **Reflective type** Beam blocked condition, Mark, Background	———
⑥	If teaching is accepted, the read incident light intensity is displayed for 0.5 sec. approx. Subsequently, '2nd' is displayed on the LCD display. (Note 2)	Incident light intensity display ⇩ 2nd
⑦	The jog switch is pressed in the object absent condition and released. **Thru-beam type** **Reflective type** Beam incident condition, Mark, Background	———
⑧	If teaching is accepted, the read incident light intensity is displayed for 0.5 sec. approx., and the threshold value is set to the middle value of the incident light intensity levels in the object present and object absent conditions. After that, the judgment on the stability of sensing is displayed for 2.5 sec. approx. • 'Good' is displayed on the LCD display if there is sufficient difference between the incident light intensities in the object present and object absent conditions and stable sensing is possible. • 'HArd' is displayed on the LCD display if there is a small difference between the incident light intensities in the object present and object absent conditions and stable sensing is not possible. After this, the threshold value is displayed.	Incident light intensity display ⇩ Good or HArd ⇩ Threshold value display
⑨	Set the mode selection switch to 'RUN'. The threshold value does not change even if the jog switch is operated. SET MODE RUN	———

Notes: 1) If the jog switch is pressed continuously for 3 sec., or more, full auto-teaching is done.
2) If the mode selection switch is changed to 'RUN' when '2nd' is being displayed on the LCD display, the incident light intensity taught at Step ⑤ is not recorded.
3) When the mode selection switch is changed from 'SET' to 'RUN' or from 'MODE' to 'RUN', the set threshold value or the contents of each mode setting are stored in an EEPROM. However, since the EEPROM has a lifetime, the threshold value setting cannot be done for more than 100,000 times.
4) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

<Procedure for maximum sensitivity setting>

① Set the mode selection switch to either 'RUN' or 'MODE'.
② Set to either Output 1 or Output 2 by turning the jog switch to the '+' or the '−' side.
③ Set the mode selection switch to 'SET'.
④ Press the jog switch in the condition when there is no object or background body.
⑤ If teaching is accepted, '2nd' is displayed on the LCD display.
⑥ Once again, press the jog switch in the condition when there is no object or background body.
⑦ Set the mode selection switch to 'RUN'.

Note: Please take care that, if the sensor is set to max. sensitivity, it becomes weak against extraneous light, noise and optical interference.

FX-D1/A1/M1

PRECAUTIONS FOR PROPER USE

Refer to P.820～ for general precautions.

Amplifier (FX-D1□)

In case of limit teaching

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

Step	Operation	LCD display
①	Set the fiber within the sensing range.	———
②	Set the mode selection switch to either 'RUN' or 'MODE'. SET MODE RUN	———
③	Set to either Output 1 or Output 2 by turning the jog switch to the '＋' or the '－' side.	Output 1 Output 2
④	Set the mode selection switch to 'SET'. The present threshold value is displayed. SET MODE RUN	1234
⑤	Press the jog switch in the object absent condition and release it within 3 sec. (Note 1) **Thru-beam type** **Reflective type** Background body. Beam incident condition	———
⑥	If teaching is accepted, the read incident light intensity is displayed for 0.5 sec. approx. Subsequently, '2nd' is displayed on the LCD display. (Note 2)	Incident light intensity display 2nd
⑦	Turn the jog switch to either the '＋' or the '－' side. **'＋' side** The threshold value is shifted to a value approx. 15% lower (higher sensitivity) than that set at step ⑤. Used in case of thru-beam type fiber. **'－' side** The threshold value is shifted to a value approx. 15% higher (lower sensitivity) than that set at step ⑤. Used in case of reflective type fiber. High Threshold value 100% Low 15% 15% OFF ON ON OFF Threshold value Incident light intensity with object absent Threshold value 0 Turn to '－' side Turn to '＋' side	———
⑧	'Good' is displayed on the LCD display. After that, the threshold value is shown.	Good Threshold value display
⑨	Set the mode selection switch to 'RUN'. The threshold value does not change even if the jog switch is operated. SET MODE RUN	———

Notes: 1) If the jog switch is pressed continuously for 3 sec., or more, full auto-teaching is done.
2) If the mode selection switch is changed to 'RUN' when '2nd' is being displayed on the LCD display, the incident light intensity taught at Step ⑤ is not recorded.
3) When the mode selection switch is changed from 'SET' to 'RUN' or from 'MODE' to 'RUN', the set threshold value or the contents of each mode setting are stored in an EEPROM. However, since the EEPROM has a lifetime, the threshold value setting cannot be done for more than 100,000 times.
4) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

Please refer to P.511 for setting of threshold value when used in combination with liquid level sensing fiber **FD-F8Y** and to P.504 for setting of threshold value when used in combination with pipe-mountable liquid level sensing fiber **FD-F4□**, **FD-F9□**.

In case of full auto-teaching

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

Step	Operation	LCD display
①	Set the fiber within the sensing range.	———
②	Set the mode selection switch to either 'RUN' or 'MODE'. SET MODE RUN	———
③	Set to either Output 1 or Output 2 by turning the jog switch to the '＋' or the '－' side.	Output 1 Output 2
④	Set the mode selection switch to 'SET'. The present threshold value is displayed. SET MODE RUN	1234
⑤	Press the jog switch continuously for 3 sec. or more with the object moving on the assembly line. **Thru-beam type** **Reflective type** Back-ground. Beam blocked condition. Mark	- - - -
⑥	'Auto' is displayed on the LCD display. Release the jog switch when the object has passed.	Auto
⑦	If teaching is accepted, the read incident light intensity is displayed for 0.5 sec. approx., and the threshold value is set to the middle value of the incident light intensity levels in the object present and object absent conditions. After that, the judgment on the stability of sensing is displayed for 2.5 sec. approx. • 'Good' is displayed on the LCD display if there is sufficient difference between the incident light intensities in the object present and object absent conditions and stable sensing is possible. • 'HArd' is displayed on the LCD display if there is a small difference between the incident light intensities in the object present and object absent conditions and stable sensing is not possible. After this, the threshold value is displayed.	Incident light intensity display Good or HArd Threshold value display
⑧	Set the mode selection switch to 'RUN'. The threshold value does not change even if the jog switch is operated. SET MODE RUN	———

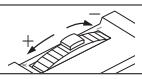
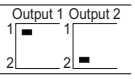
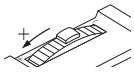
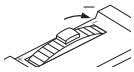
Notes: 1) When the mode selection switch is changed from 'SET' to 'RUN' or from 'MODE' to 'RUN', the set threshold value or the contents of each mode setting are stored in an EEPROM. However, since the EEPROM has a lifetime, the threshold value setting cannot be done for more than 100,000 times.
2) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

PRECAUTIONS FOR PROPER USE

Refer to P.820～ for general precautions.

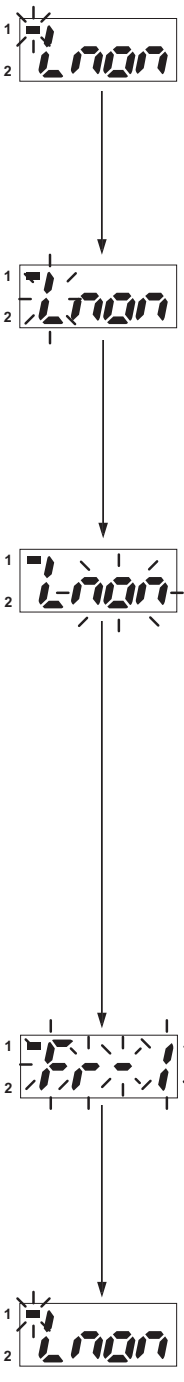
Amplifier (FX-D1□)

In case of fine adjustment

Step	Operation	LCD display
①	Set the mode selection switch to either 'RUN' or 'MODE'. 	———
②	Set to either Output 1 or Output 2 by turning the jog switch to the '＋' or the '－' side. 	Output 1 Output 2 
③	Set the mode selection switch to 'SET'. The present threshold value is displayed. 	
④	In case the threshold value is to be increased (sensitivity to be reduced), turn the jog switch a little to the '＋' side to increase the threshold value slowly. If the jog switch is turned fully to the '＋' side, the threshold value increases rapidly.  In case the threshold value is to be decreased (sensitivity to be increased), turn the jog switch a little to the '－' side to decrease the threshold value slowly. If the jog switch is turned fully to the '－' side, the threshold value decreases rapidly. 	 or
⑤	Set the mode selection switch to 'RUN'. The threshold value does not change even if the jog switch is operated. 	———

Notes: 1) When the mode selection switch is changed from 'SET' to 'RUN' or from 'MODE' to 'RUN', the set threshold value or the contents of each mode setting are stored in an EEPROM. However, since the EEPROM has a lifetime, the threshold value setting cannot be done for more than 100,000 times.
2) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

Setting of each mode



① Set the mode selection switch to 'MODE'.

Output setting

(The bar display on the extreme left blinks.)

② Turn the jog switch to either the '＋' or the '－' side.

- The bar display alternates between Output 1 and Output 2.

③ Press the jog switch at the output desired to be set.

Output operation setting

('L' or 'd' blinks.)

④ Turn the jog switch to either the '＋' or the '－' side.

- 'L' and 'd' are displayed alternately.
  L : Light-ON
  d : Dark-ON

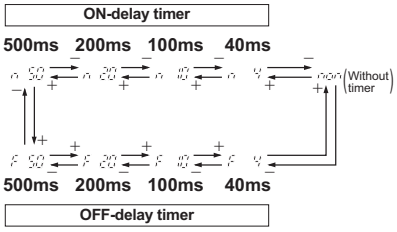
⑤ Press the jog switch at the output operation desired to be set.

Timer operation setting

(3 digits from the right side blink.)

⑥ Turn the jog switch to either the '＋' or the '－' side.

- The display of timer operation changes as given below.



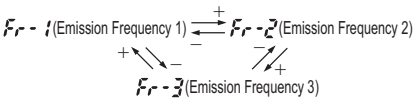
⑦ Press the jog switch at the timer operation desired to be set.

Emission frequency setting

(The display changes and all digits blink.)

⑧ Turn the jog switch to either the '＋' or the '－' side.

- The display of emission frequency changes as given below.



⑨ Press the jog switch at the emission frequency desired to be set.

⑩ After the modification of settings, the display returns to the initial display.

⑪ Set the mode selection switch to 'RUN' after finishing the settings.

In case only a part of the settings are to be changed, set the mode selection switch to 'RUN', at the appropriate time, in the middle of the above procedure to make only the required changes.

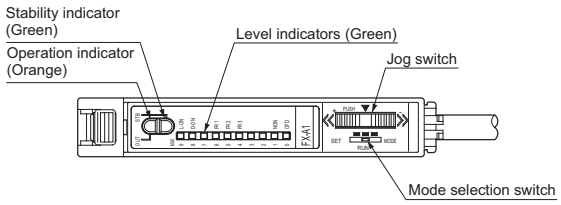
FX-D1/A1/M1

PRECAUTIONS FOR PROPER USE

Refer to P.820～ for general precautions.

Amplifier (FX-A1□)

Part description



Functions of level indicators

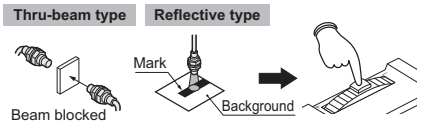
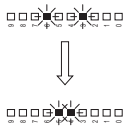
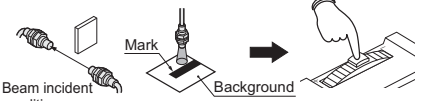
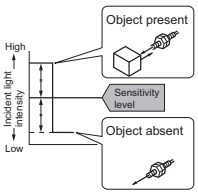
• If the mode selection switch is set to 'SET' or 'RUN', the level indicators show the position of the set sensitivity level. However, if the mode selection switch is set to 'MODE', the level indicators show the output operation/emission frequency/timer settings.

Mode selection switch	Level indicators
SET / RUN / MODE	Hundreds position, Tens position L-ON D-ON FR1 FR2 FR3 NON OFD 9 8 7 6 5 4 3 2 1 0 ← Set sensitivity Sensitivity level is displayed. • Hundreds position: lights up continuously • Tens position : blinks • Units position : not shown ※ The sensitivity level is changed in the range 0 to 999 within the sensor.
SET / RUN / MODE	Hundreds position L-ON D-ON FR1 FR2 FR3 NON OFD 9 8 7 6 5 4 3 2 1 0 ← Set sensitivity Sensitivity level is displayed. • Hundreds position: lights up continuously • Tens position : not shown • Units position : not shown
SET / RUN / MODE	Output operation, Emission frequency, Timer L-ON D-ON FR1 FR2 FR3 NON OFD ← Each mode 9 8 7 6 5 4 3 2 1 0 Each mode is displayed. • Item being set : blinks • Remaining 2 items: light up continuously

Sensitivity setting

In case of 2-level teaching

• This is the method of setting the sensitivity by teaching two levels, corresponding to the object present and object absent conditions. Normally, setting is done as given below.

Step	Operation	Level indicators
①	Set the fiber within the sensing range.	———
②	Set the mode selection switch to 'SET'. The present sensitivity setting is displayed. 	
③	Press the jog switch in the object present condition. The level indicators '3' and '6' blink. Release the jog switch within 3 sec. The level indicators '4' and '5' blink and the incident light intensity in the object present condition is read. (Note 1) **Thru-beam type** **Reflective type** 	
④	The jog switch is pressed in the object absent condition. **Thru-beam type** **Reflective type** 	———
⑤	The stability indicator (green) lights up and the sensitivity level is set at the middle value of the incident light intensity levels in the object present and object absent conditions. The sensitivity level is then displayed on the level indicators.  • Hundreds position: lights up continuously • Tens position : blinks • Units position : not shown (e.g.) The level indicators in the figure on the right show that the sensitivity level is in the range 720 to 729.	
⑥	Set the mode selection switch to 'RUN'. (Note 2) The sensitivity level does not change even if the jog switch is operated. 	———

Notes: 1) If the jog switch is pressed continuously for 3 sec., or more, full auto-teaching is done. Also, if the mode selection switch is changed to 'RUN' while level indicators '4' and '5' are blinking, the incident light intensity taught at Step ③ is not recorded.
2) When the mode selection switch is set to 'SET' or 'MODE', the sensor is more susceptible to extraneous light. Hence, when sensing objects, ensure to set the mode selection switch to 'RUN'.
3) When the mode selection switch is changed from 'SET' to 'RUN' or from 'MODE' to 'RUN', the set sensitivity or the contents of each mode setting are stored in an EEPROM. However, since the EEPROM has a lifetime, the sensitivity setting cannot be done for more than 100,000 times.
4) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

<Procedure for maximum sensitivity setting>

① Set the mode selection switch to 'SET'.
② Press the jog switch in the condition when there is no object or background body.
③ The level indicators '4' and '5' blink after receiving the teaching.
④ Once again, press the jog switch in the condition when there is no object or background body.
⑤ The level indicator '9' blinks.
⑥ Set the mode selection switch to 'RUN'.

Note: Please take care that, if the sensor is set to max. sensitivity, it becomes weak against extraneous light, noise and optical interference.

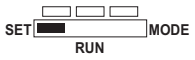
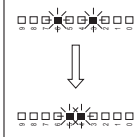
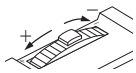
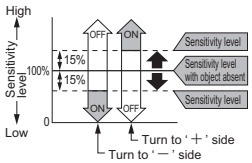
PRECAUTIONS FOR PROPER USE

Refer to P.820～ for general precautions.

Amplifier (FX-A1□)

In case of limit teaching

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

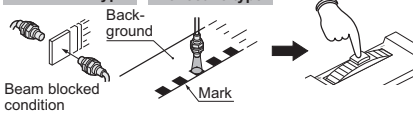
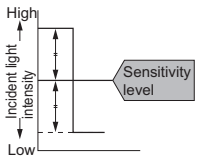
Step	Operation	Level indicators
①	Set the fiber within the sensing range.	———
②	Set the mode selection switch to 'SET'. The present sensitivity setting is displayed. 	
③	Press the jog switch in the object absent condition. The level indicators '3' and '6' blink. Release the jog switch within 3 sec. The level indicators '4' and '5' blink and the incident light intensity in the object absent condition is read. (Note1) **Thru-beam type** **Reflective type** 	
④	Turn the jog switch to either the '＋' or the '－' side. **'＋' side** The sensitivity is increased by 15% approx. with respect to that set at step ③. Used in case of thru-beam type fiber.  **'－' side** The sensitivity is decreased by 15% approx. with respect to that set at step ③. Used in case of reflective type fiber.  (e.g.) The level indicators in the figure on the right show that the sensitivity level is in the range 720 to 729.	
⑤	Set the mode selection switch to 'RUN'. (Note 2) The sensitivity level does not change even if the jog switch is operated. 	———

Notes: 1) If the jog switch is pressed continuously for 3 sec., or more, full auto-teaching is done. Also, if the mode selection switch is changed to 'RUN' while level indicators '4' and '5' are blinking, the incident light intensity taught at Step ③ is not recorded.
2) When the mode selection switch is set to 'SET' or 'MODE', the sensor is more susceptible to extraneous light. Hence, when sensing objects, ensure to set the mode selection switch to 'RUN'.
3) When the mode selection switch is changed from 'SET' to 'RUN' or from 'MODE' to 'RUN', the set sensitivity or the contents of each mode setting are stored in an EEPROM. However, since the EEPROM has a lifetime, the sensitivity setting cannot be done for more than 100,000 times.
4) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

Please refer to P.512 for sensitivity setting when used in combination with liquid level sensing fiber **FD-F8Y** and to P.505 for sensitivity setting when used in combination with pipe-mountable liquid level sensing fiber **FD-F4**□, **FD-F9**□.

In case of full auto-teaching

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

Step	Operation	Level indicators
①	Set the fiber within the sensing range.	———
②	Set the mode selection switch to 'SET'. The present sensitivity setting is displayed. 	
③	Press the jog switch continuously for 3 sec., or more, with the object moving on the assembly line. When the jog switch is pressed, the level indicators '3' and '6' blink and when it is pressed continuously for 3 sec., or more, they start blinking rapidly. Then, release the jog switch when the object has passed. **Thru-beam type** **Reflective type** 	
④	The stability indicator (green) lights up and the sensitivity level is set at the middle value of the incident light intensity levels in the object present and object absent conditions. The sensitivity level is then displayed on the level indicators.  • Hundreds position : lights up continuously • Tens position : blinks • Units position : not shown (e.g.) The level indicators in the figure on the right show that the sensitivity level is in the range 720 to 729.	
⑤	Set the mode selection switch to 'RUN'. (Note 1) The sensitivity level does not change even if the jog switch is operated. 	———

Notes: 1) When the mode selection switch is set to 'SET' or 'MODE', the sensor is more susceptible to extraneous light. Hence, when sensing objects, ensure to set the mode selection switch to 'RUN'.
2) When the mode selection switch is changed from 'SET' to 'RUN' or from 'MODE' to 'RUN', the set sensitivity or the contents of each mode setting are stored in an EEPROM. However, since the EEPROM has a lifetime, the sensitivity setting cannot be done for more than 100,000 times.
3) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

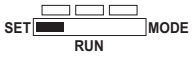
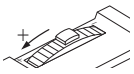
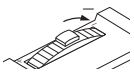
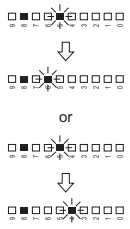
FX-D1/A1/M1

PRECAUTIONS FOR PROPER USE

Refer to P.820～ for general precautions.

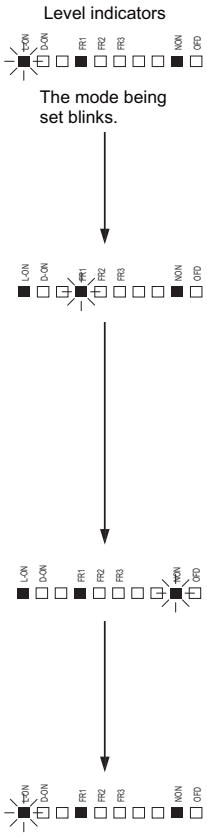
Amplifier (FX-A1□)

In case of fine adjustment

Step	Operation	Level indicators
①	Set the mode selection switch to 'SET'. The present sensitivity setting is displayed. 	
②	• In case the sensitivity is to be increased, turn the jog switch a little to the '＋' side to increase the sensitivity slowly. If the jog switch is turned fully to the '＋' side, the sensitivity increases rapidly.  • In case the sensitivity is to be decreased, turn the jog switch a little to the '－' side to decrease the sensitivity slowly. If the jog switch is turned fully to the '－' side, the sensitivity decreases rapidly. 	
③	Set the mode selection switch to 'RUN'. (Note 1) The sensitivity level does not change even if the jog switch is operated. 	———

Notes: 1) When the mode selection switch is set to 'SET' or 'MODE', the sensor is more susceptible to extraneous light. Hence, when sensing objects, ensure to set the mode selection switch to 'RUN'.
2) When the mode selection switch is changed from 'SET' to 'RUN' or from 'MODE' to 'RUN', the set sensitivity or the contents of each mode setting are stored in an EEPROM. However, since the EEPROM has a lifetime, the sensitivity setting cannot be done for more than 100,000 times.
3) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

Setting of each mode



① Set the mode selection switch to 'MODE'.

Output operation setting

② Turn the jog switch to either the '＋' or the '－' side.
L-ON (Light-ON)
－ ↕ ＋
D-ON (Dark-ON)

③ Press the jog switch at the output operation desired to be set.

Emission frequency setting

④ Turn the jog switch to either the '＋' or the '－' side.

• The display of emission frequency changes as given below.

FR1 (Emission Frequency 1) ⇄ FR2 (Emission Frequency 2)
FR3 (Emission Frequency 3)

⑤ Press the jog switch at the emission frequency desired to be set.

Timer operation setting

⑥ Turn the jog switch to either the '＋' or the '－' side.
NON (without timer)
－ ↕ ＋
OFD (approx. 40ms fixed OFF-delay timer)

⑦ Press the jog switch at the timer operation desired to be set.

⑧ Back to ②.

⑨ Set the mode selection switch to 'RUN' after finishing the settings.

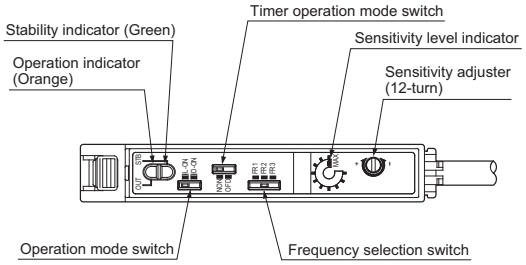
In case only a part of the settings are to be changed, set the mode selection switch to 'RUN', at the appropriate time, in the middle of the above procedure to make only the required changes.

PRECAUTIONS FOR PROPER USE

Refer to P.820～ for general precautions.

Amplifier (FX-M1□)

Part description



Sensitivity adjustment

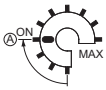
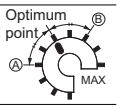
- Adjust the sensitivity while observing the operation indicator (Orange). However, since the lighting up of the operation indicator depends upon the combination of the sensing condition and the selected MODE, verify it from the table on the right.

☼: Lights up ●: Lights off

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

- The sensitivity adjuster is a 12-turn potentiometer. The maximum sensitivity is obtained by turning it fully clockwise.

- The sensitivity level indicator shows the present sensitivity level.

Step	Sensing method: Reflective	Sensing method: Thru-beam	Operation	Sensitivity level indicator
①	Set the operation mode switch to Light-ON mode. (Initial setting)		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.	
③	Beam not received	Beam not received	In the beam not received condition, 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. (If the sensor does not go into the ON state, MAX is the point Ⓑ.)	
④	———	———	Set the adjuster at the center of points Ⓐ and Ⓑ. This is regarded as the optimum sensitivity point.	
⑤	Select the mode either Light-ON or Dark-ON according to your application. (L-ON: ON when the beam is received, D-ON: ON when the beam is not received)			

Notes: 1) In order to protect the mechanism, the sensitivity adjuster idles when over turned, which may result in a backlash of 1 to 2 divisions.
2) Depending upon the sensing conditions, stable sensing may be possible at a position which is slightly shifted from the center point of points Ⓐ and Ⓑ.
3) Do not move or bend the fiber cable after the sensitivity adjustment. Detection may become unstable.

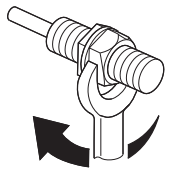
Please refer to P.513 for sensitivity adjustment when used in combination with liquid level sensing fiber **FD-F8Y** and to P.506 for sensitivity adjustment when used in combination with pipe-mountable liquid level sensing fiber **FD-F4**□, **FD-F9**□.

Fiber

Mounting

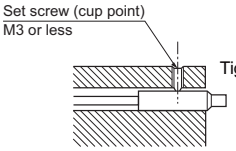
- The tightening torque must not exceed the values given below.

Mounting with a nut (threaded head type)

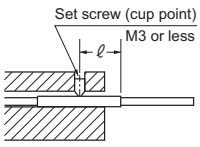


	Tightening torque
M3	0.39N·m
M4	0.58N·m (350°C heat-resistant fiber: 0.98N·m)
M5 M6	0.98N·m (350°C heat-resistant fiber: 1.96N·m)
M14	1.47N·m

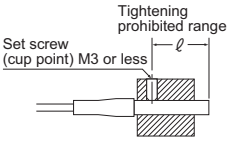
Mounting with a set screw



- Fibers for which the tightening section has been specified should be fixed at ℓmm from the tightening section tip. (However, for **FT-K2**, **FT-KV2** and **FT-KV8** 'ℓ' indicates the range over which tightening cannot be done.)



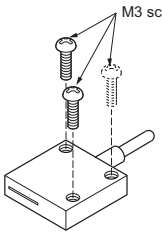
<FT-K2, FT-KV2, FT-KV8>



	ℓ (mm)	Tightening torque
FT-WS4, FT-WS8 FT-WS8L	2.5	0.29N·m
FT-V22 FT-V41, FD-V41 FT-SFM2SV2	10	0.19N·m
FD-EG1	10	0.29N·m
FD-SFM2SV2	7	0.34N·m
FT-K2	10	0.3N·m
FT-KV2, FT-KV8	13	

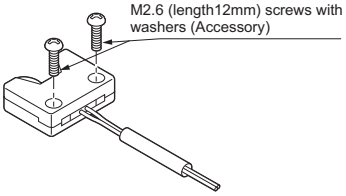
Mounting array fiber

- Using M3 screws, the tightening torque should be 0.58N·m or less.



Mounting FD-L4

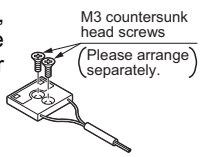
- Using M2.6 (length 12mm) screws with washers (accessory), the tightening torque should be 0.3N·m or less.



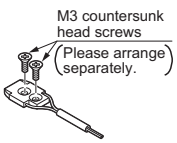
Mounting FD-L41 and FD-L42

- Using M3 countersunk head screws, the tightening torque should be 0.3N·m or less.

<FD-L41>



<FD-L42>



FX-D1/A1/M1

PRECAUTIONS FOR PROPER USE

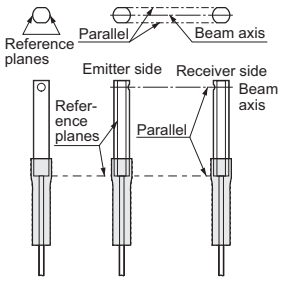
Refer to P.820～ for general precautions.

Fiber

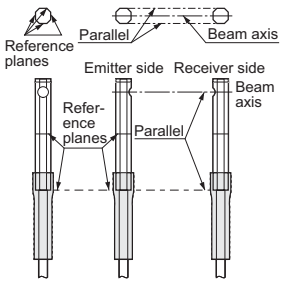
Mounting FT-KV2 and FT-KV8

- Take care that, since the aperture angle of this product is very narrow, the beam may not be received depending upon the setting.
  At the time of installation, determine a reference plane, as shown in the figure below, and taking sufficient care against beam misalignment or tilt, install the emitting and receiving fibers so that they are parallel.

<FT-KV2>

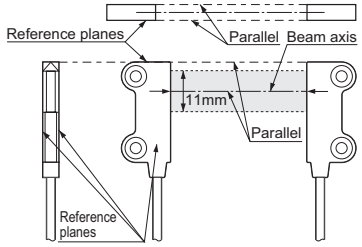


<FT-KV8>

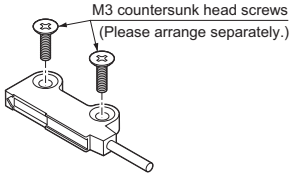


Mounting FT-A8

- Take care that, since the aperture angle of this product is very narrow, the beam may not be received depending upon the setting.
  At the time of installation, determine a reference plane, as shown in the figure below, and taking sufficient care against beam misalignment or tilt, install the emitting and receiving fibers so that they are parallel.



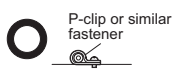
- Install the fiber using M3 countersunk head screws. The tightening torque should be 0.3N·m or less. Further, when using the fiber at places having intense vibrations, use a screw-locking adhesive, etc.



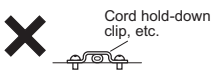
Method of fixing fiber cable

- If fixing the fiber cable in position, make sure that it is set in a manner as shown below, so that no load is applied on the fiber. (Excluding **FT-H35-M2**, **FT-H35-M2S6**, **FD-H35-M2** and **FD-H35-M2S6**)

GOOD



NO GOOD



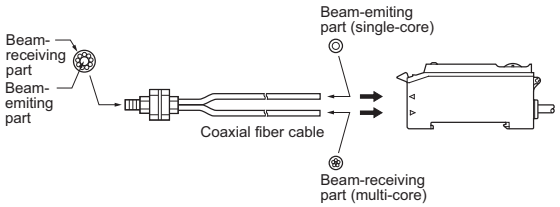
Connection with reflective coaxial type fiber

- With **FD-5**, **FD-FM2**, **FD-WG4**, **FD-WSG4**, **FD-G4**, **FD-EG1**, **FD-ENM1S1** or **FD-KM1S2**, **FD-H35-M2**, **FD-H20-M1**, insert the center fiber cable (single-core) into the beam-emitting inlet and the outer fiber cable (multi-core) into the beam-receiving inlet.

FD-H35-M2 or **FD-H20-M1** is marked 'P' on the beam-emitting cable and 'D' on the beam-receiving cable.

FD-WG4, **FD-WSG4** and **FD-G4** are composed of beam-emitting and beam-receiving cables that are different in diameter.

FD-EG1, **FD-ENM1S1** is marked P on the beam-emitting fiber cable.



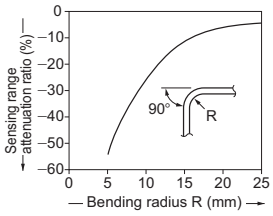
Notes: 1) In case the fiber cables are not inserted to a position where they stop, the sensing range reduces.
2) Before connecting fiber cables of **FD-WG4**, **FD-WSG4** or **FD-G4** to the amplifier, mount the fiber attachments on their ends.

Fiber cable bending radius

- Bending radius of fiber cable must be R25mm or more.

Sharp bend type: R1mm or more (**FD-WG4**, **FD-WSG4**: R2mm or more), Flexible type: R4mm or more, Thru-beam of ultra-small diameter type: R5mm or more, Convergent reflective type, **FD-F4**□, **FD-F9**□, **FT-K2** and **FT-KV2**: R10mm or more, Chemical-resistant type: R30mm or more, **FD-F8Y**: R40mm or more (on protected part, but R15mm or more on unprotected part), Vacuum type: R200mm or more (**FT-60V**: R30mm or more)

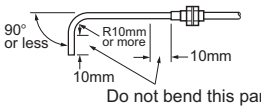
If the fiber cable is bent at a smaller bending radius than that specified above, the sensing range decreases due to beam attenuation.



Note: The 350°C heat-resistant fiber cable is not bendable below R25mm. Neither the vacuum fiber cable nor the chemical-resistant cable must be bent below the values specified above.

How to bend sleeve

- The bending radius must be R10mm or more. Please bend gradually using the fiber bender (**FB-1**) or a round bar of ϕ20mm or more.



Note: Do not bend the sleeve of side-view type, narrow beam type, narrow-view type and ultra-small diameter type fiber.

PRECAUTIONS FOR PROPER USE

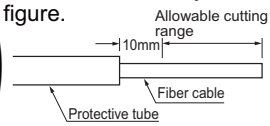
Refer to P.820～ for general precautions.

Fiber

How to cut fiber cable

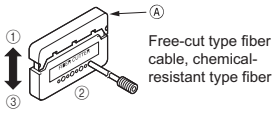
- The free-cut type fiber cable can be cut off at any length with the attached fiber cutter.
  The chemical-resistant type fiber can be cut only within the range illustrated in the right figure.

(Retain 10mm or more of the cable for insertion into the amplifier.)



<How to use fiber cutter>

① Slide the blade Ⓐ of fiber cutter **FX-CT1** upward fully.
② Insert a fiber cable into the hole which matches its diameter and set at prescribed length.
③ Slide the blade Ⓐ down to cut the fiber cable.

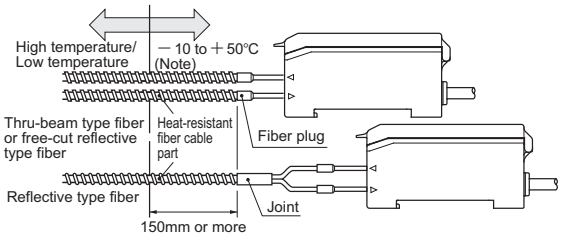


The free-cut type fiber cables must be cut with a fiber cutter before insertion into the amplifier.

Notes: 1) The fiber cable should be cut in one stroke.
2) After it is cut off, mount the fiber attachment immediately and connect it to the amplifier.
3) Cut only one fiber cable at a time. Do not cut two or more fiber cables simultaneously.
4) Once a fiber cable is cut off at a hole, do not use the hole again. If used, it degrades the cut surface quality and the detectability may deteriorate.
5) The blade cannot be replaced. Please purchase an additional fiber cutter, if required.
6) Note that the sensing range may be reduced up to 20% depending on the cut condition.

Use of heat-resistant type fiber

- Use by keeping 150mm, or more, of the heat-resistant fiber cable part at normal temperature.



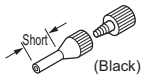
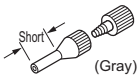
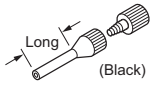
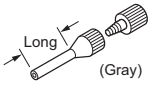
Note: 0 to ＋50°C for **FX-D1**□.

- Protect the amplifier from heat radiation or hot air.
- With the 350°C heat-resistant type fiber, the surface of the fiber head or the spiral may be discolored by heat. However, this does not affect its performance.

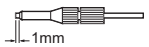
Fiber attachments for free-cut small-diameter type fiber cable

- The fiber attachments should be fixed at the ends of fiber cables to connect them with the amplifier. There are two sets of attachments, one is for **FX-D1**/**FX-A1**/**FX-M1**/**FX-7**/**FX-10** series and the other is for **BFX4N**/**FX4E**/**FX4N** series. They are different in length.

(However, **FT-WS4**, **FD-N4**, **FD-W44**, **FD-WT8**, **FD-WS8**, **FD-WT4**, **FD-WG4**, **FD-WSG4**, **FD-L41** and **FD-L42** have fiber attachments only for **FX-D1**/**FX-A1**/**FX-M1**/**FX-7**/**FX-10** series.)

Used amplifier	Fiber diameter ϕ1.0 mm	Fiber diameter ϕ1.3 mm
FX-D1 series **FX-A1** series **FX-M1** series **FX-7** series **FX-10** series		
BFX4N series **FX4E**/**FX4N** series		

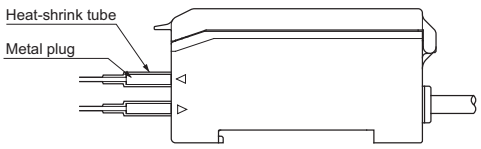
Note: The fiber cable end should protrude from the holder by 1mm approx.



Fiber with metal plug

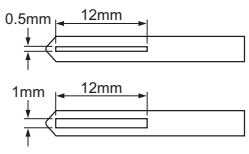
- In **FT-KV2**, **FT-KM1S2** the construction is such that the metal plug is at the same electric potential as the sensor earth (0V) . If it is used at a place where the metal plug may come in contact with a charged body, insulate it with a heat-shrink tube, etc.

(**FT-H35-M2**, **FT-H35-M2S6**, **FD-H35-M2** and **FD-H35-M2S6** are already insulated.)

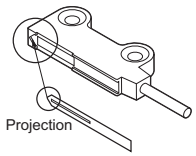


Seal type slit mask for FT-A8

- Two types of slit masks are enclosed. Apply the enclosed slit mask when detecting small objects or for increasing the accuracy of sensing position.
  However, the sensing range is reduced when the slit mask is mounted as shown in the table below.
  As the slit mask is seal type, stick it by aligning the projection of the slit mask with the upper portion of the fiber, as shown in the figure below.



Mounting



Sensing range when mounting slit mask

	0.5×12mm slit mask	1×12mm slit mask
Slit on one side	500mm	900mm
Slit on both sides	200mm	400mm

FX-D1/A1/M1

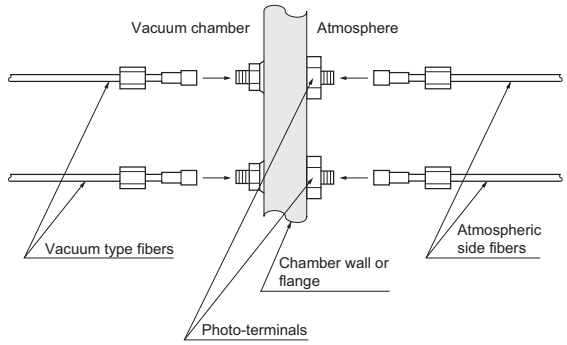
PRECAUTIONS FOR PROPER USE

Refer to P.820～ for general precautions.

Fiber

Vacuum type fiber

Configuration

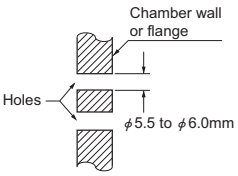


Leakage: 1.33×10^{-10} Pa·m³/sec. [He] or less

Mounting

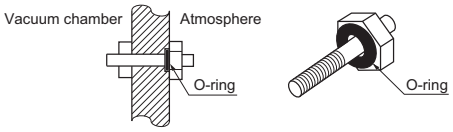
① Make two holes on the vacuum tank wall (chamber wall or flange).

Note: The hole diameter must be from ϕ5.5 to ϕ6.0mm.



② Mount the **FV-BR1** photo-terminal on the vacuum tank wall.

Notes: 1) The attached O-ring must be mounted.
2) The O-ring must be used at the atmospheric side.
3) The tightening torque should be 0.58N·m or less.



③ Mount the **FT-J6** atmospheric side fibers on the atmospheric side of the **FV-BR1** photo-terminals.

Notes: 1) The fixing nuts must be tightened securely. If not, the sensing range may decrease.
2) The tightening torque should be 0.58N·m or less.

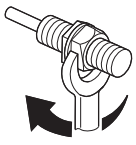
④ Mount the vacuum type fibers on the vacuum side of the **FV-BR1** photo-terminals.

Notes: 1) The fixings rings of the vacuum type fibers must be tightened securely. If not, the sensing range may decrease.
2) The tightening torque should be 0.58N·m or less.

⑤ Fix the fiber head of the vacuum type fiber.

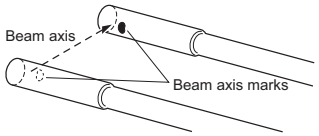
Note: The maximum tightening torque should be as given below.

	Tightening torque
M2.6	0.29N·m
M4 M6	0.58N·m

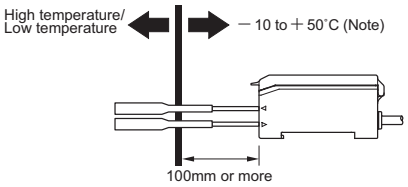


Chemical-resistant type fiber

- Do not use it in the following chemicals:
  Dissolved alkali metals (Natrium, Potassium or Lithium), Fluorine gas (F_2), ClF_3, OF_2 (including gaseous state).
- The beam axis mark is indicated on the side-view fiber. Perform the beam alignment with the beam axis marks, on the receiver and the emitter, facing each other.



- Although the chemical-resistant type fiber is rated for use up to ＋115°C, place 100mm or more of the fiber in the normal temperature area to protect the amplifier.

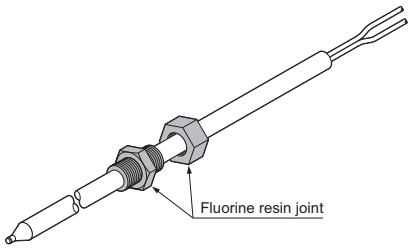


Note: 0 to ＋50°C for **FX-D1**□.

FD-F8Y liquid level sensing fiber

Mounting

- Use a commercially available fluorine resin joint, etc., to install **FD-F8Y**.



Cautions

- Take care that unclear liquid may not be sensed stably.
- Take care that the tube may stretch by maximum 2% of the total length if it is used at a high temperature.
- Do not scratch the fiber jacket while cutting the fluorine resin tube.

PRECAUTIONS FOR PROPER USE

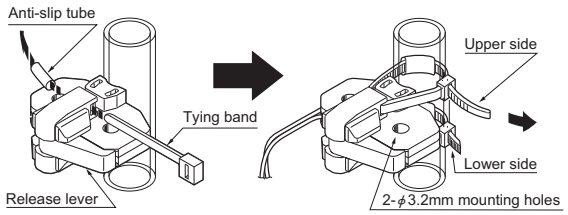
Refer to P.820～ for general precautions.

Fiber

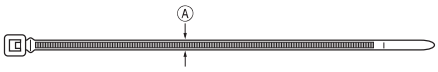
FD-F4□ and FD-F9□ liquid level sensing fiber

Mounting

- Mount the fiber head on a pipe with the attached tying bands and anti-slip tubes as shown in the figure below.
  Make sure that the release lever is retracted (position as in the fig.) before mounting.
  Fasten two tying bands, as shown, and cut off the excess portions.



- If other tying bands are to be used, the dimension Ⓐ shown in the figure below should be 2.5mm or less.

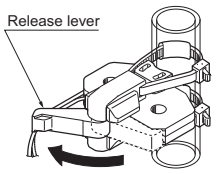


- In case of mounting using the two mounting holes, use M3 screws, plain washers, and spring washers.
  The tightening torque should be 0.5N·m or less.
  (Please arrange the M3 screws, plain washers, and spring washers separately.)

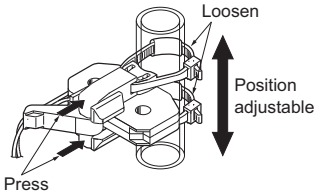
- In case of mounting on the pipe with tying bands, the fiber position can be easily adjusted.

Adjustment

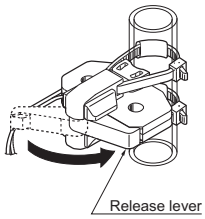
① Unlock the release lever (in the direction of the arrow).



② Press the movable center holders forward to loosen the tying bands and adjust the position.



③ Lock the release lever to its original place.



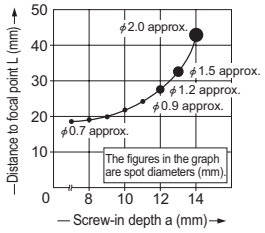
Notes: 1) Whenever the mounting position is changed, adjust the sensitivity again.
2) The lever mechanism must be used only to adjust the position, and not for tightening the tying bands. If tying bands are tightened while the lever is open, and then the lever is locked, the fiber may be damaged.

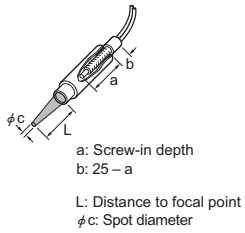
Cautions

- Liquid in a pipe which is not transparent cannot be sensed correctly.
- Unclear or viscous liquid may not be sensed.
- Fit the fiber head to the pipe securely, otherwise the operation may be erroneous.
- Take care that no dew condenses on the pipe's sensing surface or the pipe's inside wall and no bubble attaches on the pipe's inside wall, since it can affect the operation.
- Neither the **FD-F4**□ or the **FD-F9**□ is waterproof or chemical-resistant. Installation should be avoided at any place where it could come in direct contact with water or chemicals.
- Do not apply excessive tensile force to the fiber cable.

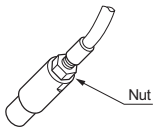
Cautions for FX-MR2 zoom lens usage

- The spot diameter and the sensing range are adjustable by the screw-in depth as follows.

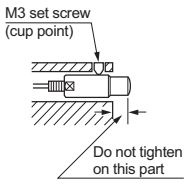




- After **FX-MR2** is set on the fiber head at the desired depth, tighten the attached nut securely.

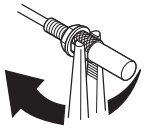


- To mount **FX-MR2** with a set screw, use a M3 set screw. The tightening torque should be 0.29N·m or less.



Caution for FX-MR3 finest spot lens usage

- Screw **FX-MR3** on the fiber head until the fiber is fully inserted.
  The tightening torque should be 0.29N·m or less.



FX-D1/A1/M1

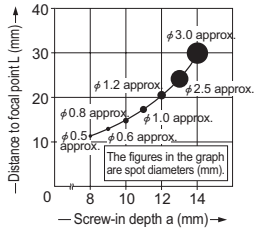
PRECAUTIONS FOR PROPER USE

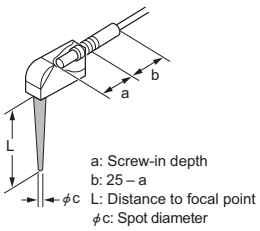
Refer to P.820～ for general precautions.

Fiber

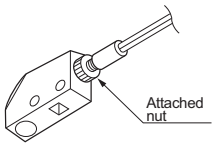
Cautions for FX-MR5 side-view zoom lens usage

- The spot diameter and the sensing range are adjustable by the screw-in depth as follows.





- After **FX-MR5** is set on the fiber head at the desired depth, tighten the attached nut **NT-FX-MR5** securely.



- The tightening torque should be 0.5N·m or less when tightening **FX-MR5** with a screw.

Fitting protective tube

- The threaded head fiber cable can be fitted with a protective tube.

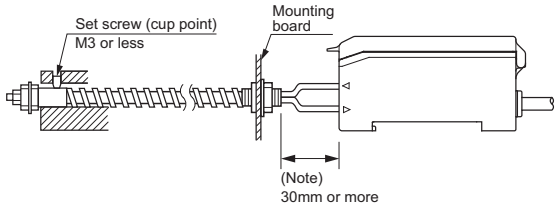
Fitting

① Insert the fiber cable into the protective tube from the sleeve side.

② Turn the fiber head to screw it on the inner thread of the sleeve.

Mounting

- The maximum tightening torque should be as given below.



<Sleeve part>
Tightening torque:
0.58N·m or less

<Threaded part>
Tightening torque:
3.43N·m or less

Note: The fiber cable must be longer than the protective tube by 30mm or more to connect it to the amplifier. Make sure to measure the length required before cutting.

Others

- Do not use the fiber at places having intense vibrations, as this can cause malfunction.
- Keep the fiber head surface intact. If it is scratched or spoiled, the detectability will deteriorate.

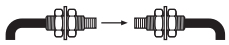
- Do not expose the fiber cable to any organic solvents. (Excluding chemical-resistant type fiber)

- Do not use the fiber head in places where it may come in direct contact with water. A water drop on the fiber head deteriorates the sensing.
- Ensure that any strong extraneous light is not incident on the receiving face of the fiber head.

- Do not apply excessive tensile force to the fiber cable.
- 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.
- Since the sensing portion of **FT-A8**, **FT-K2**, **FT-KV2**, **FT-KV8**, is concave shaped, take care that dust or dirt does not collect on it. In case it does collect, wipe it with a dry soft cloth.

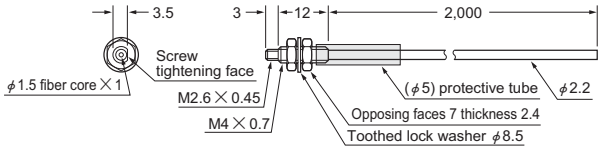
DIMENSIONS (Unit: mm)

Thru-beam type fibers



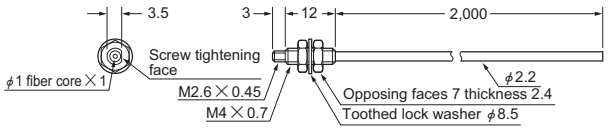
FT-B8

Free-cut



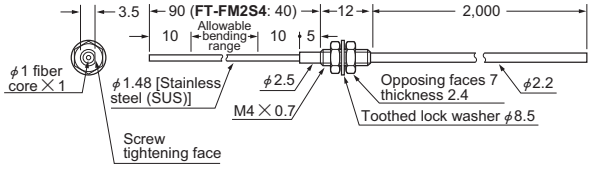
FT-FM2

Free-cut



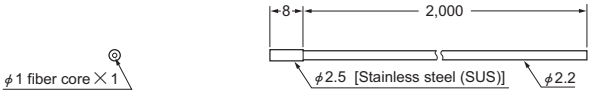
FT-FM2S
FT-FM2S4

Free-cut



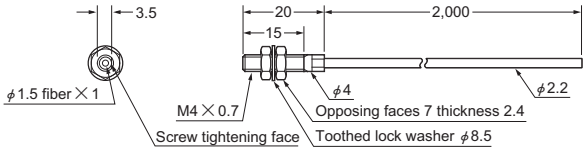
FT-SFM2

Free-cut



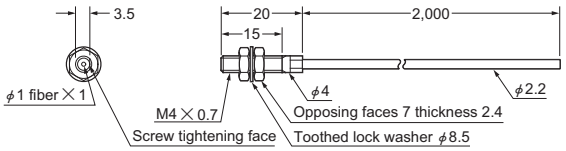
FT-NB8

Free-cut



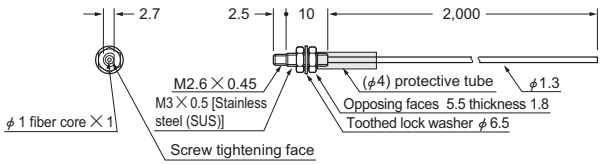
FT-N8

Free-cut



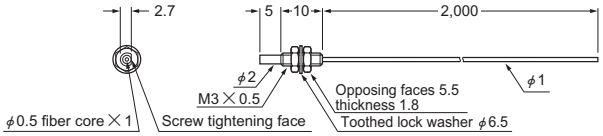
FT-T80

Free-cut With attachment



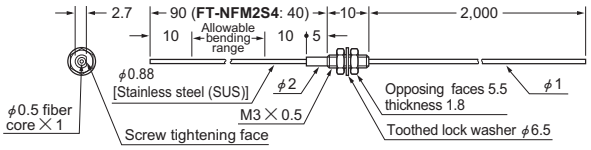
FT-NFM2

Free-cut With attachment



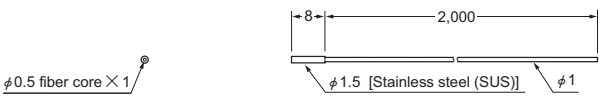
FT-NFM2S
FT-NFM2S4

Free-cut With attachment



FT-SNFM2

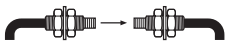
Free-cut With attachment



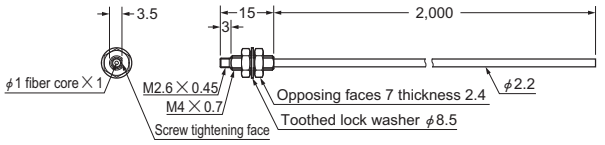
FX-D1/A1/M1

DIMENSIONS (Unit: mm)

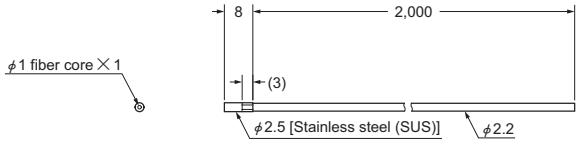
Thru-beam type fibers



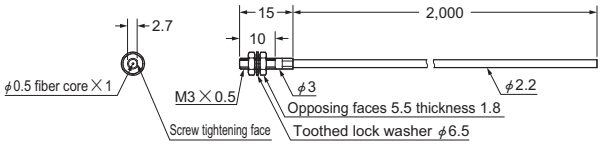
FT-W8 Free-cut



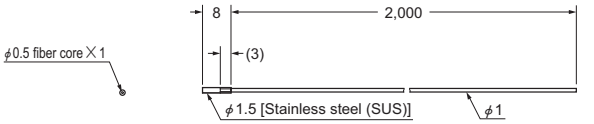
FT-WS8 Free-cut



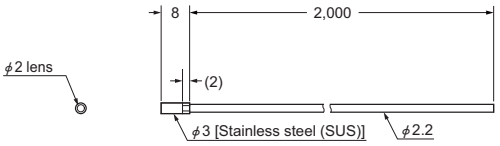
FT-W4 Free-cut



FT-WS4 Free-cut With attachment

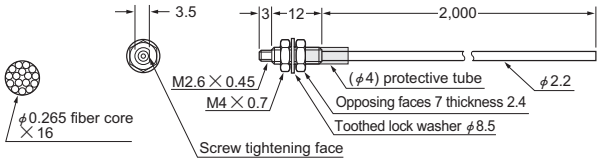


FT-WS8L Free-cut



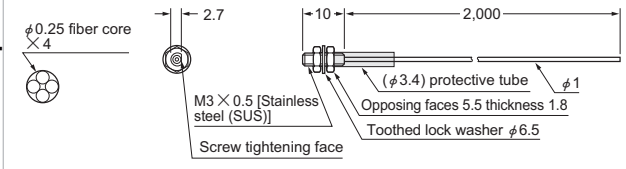
FT-P80 Free-cut

Details of sensing part



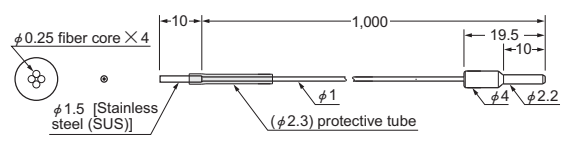
FT-P40 Free-cut With attachment

Details of sensing part

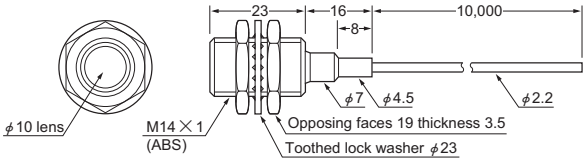


FT-P2

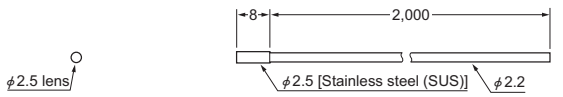
Details of sensing part



FT-FM10L Free-cut

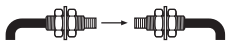


FT-SFM2L Free-cut

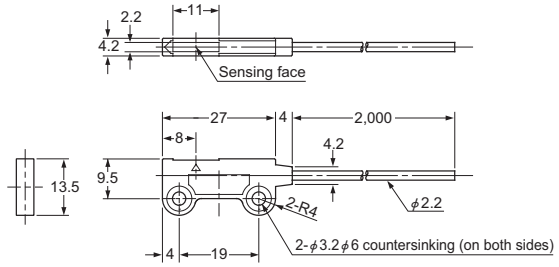


DIMENSIONS (Unit: mm)

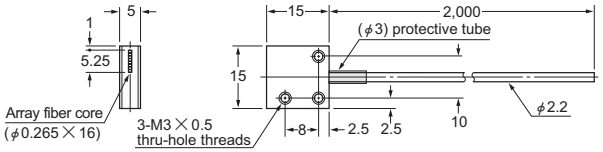
Thru-beam type fibers



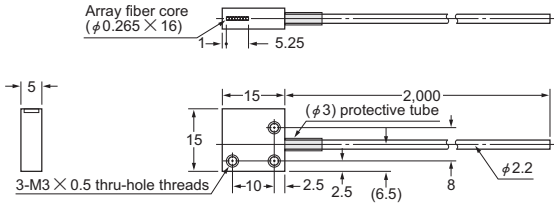
FT-A8 Free-cut



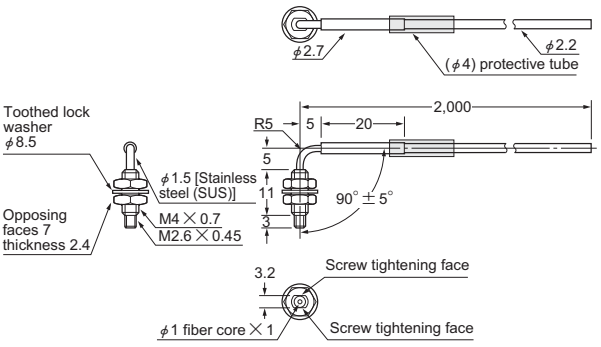
FT-AFM2 Free-cut



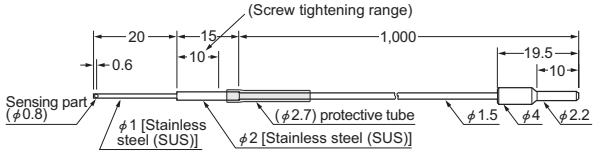
FT-AFM2E Free-cut



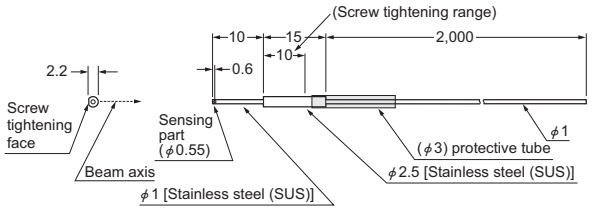
FT-R80 Free-cut



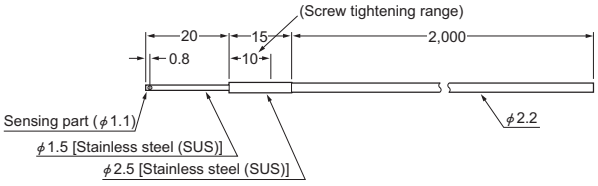
FT-V22



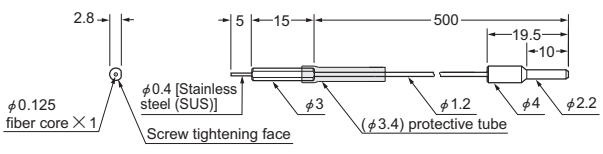
FT-V41 Free-cut With attachment



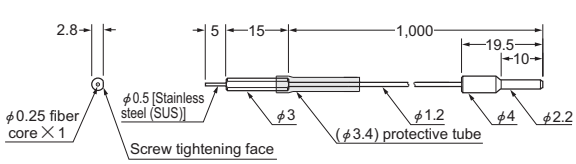
FT-SFM2SV2 Free-cut



FT-E10



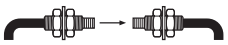
FT-E20



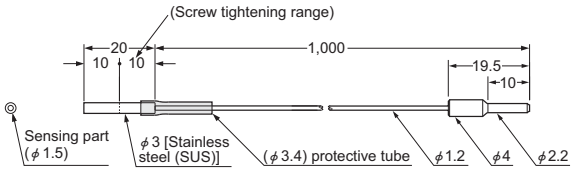
FX-D1/A1/M1

DIMENSIONS (Unit: mm)

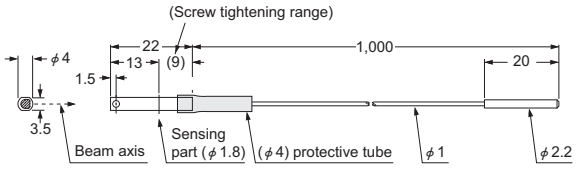
Thru-beam type fibers



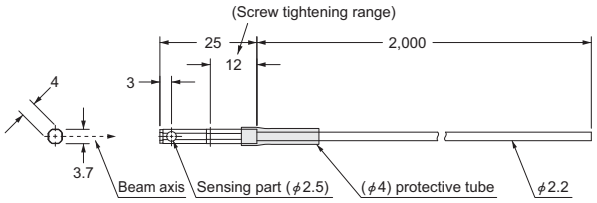
FT-K2



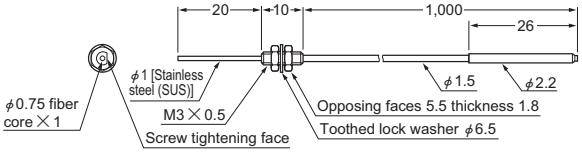
FT-KV2



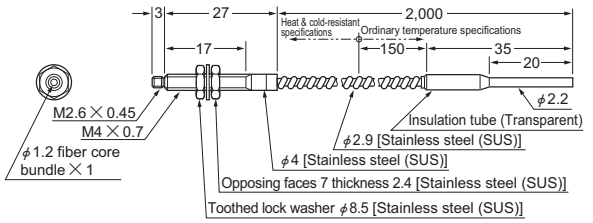
FT-KV8



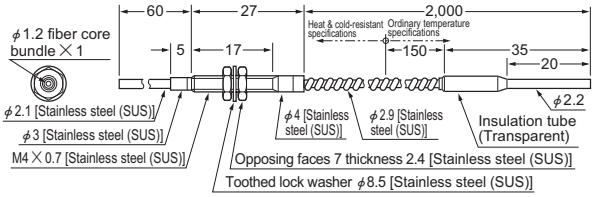
FT-KM1S2



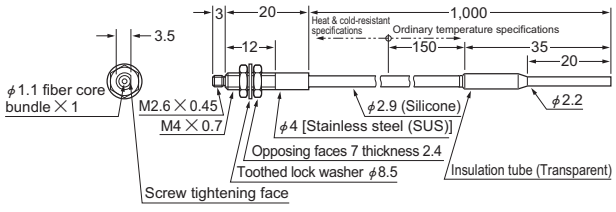
FT-H35-M2



FT-H35-M2S6

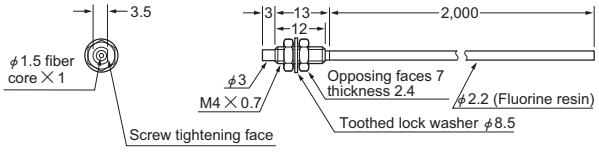


FT-H20-M1

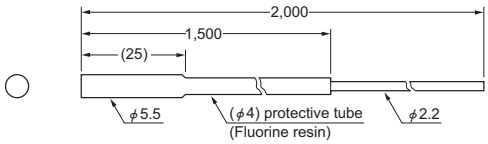


FT-H13-FM2

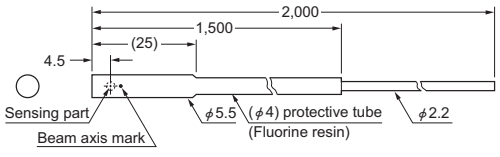
Free-cut



FT-L8Y

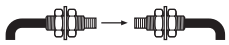


FT-V8Y

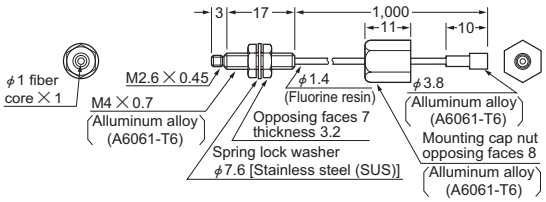


DIMENSIONS (Unit: mm)

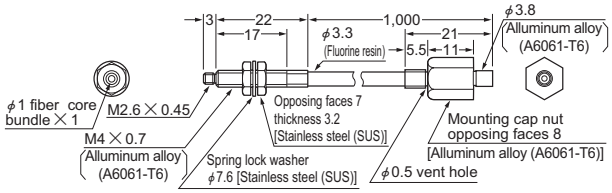
Thru-beam type fibers



FT-6V



FT-60V



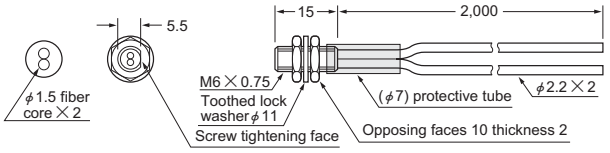
FX-D1/A1/M1

DIMENSIONS (Unit: mm)

Reflective type fibers

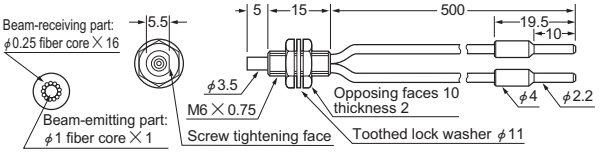
FD-B8 — Free-cut

Details of sensing part



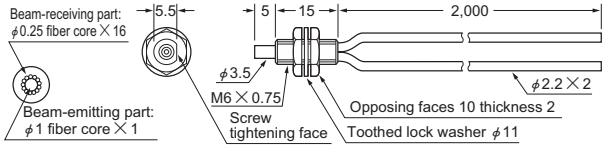
FD-5 — Free-cut

Details of sensing part



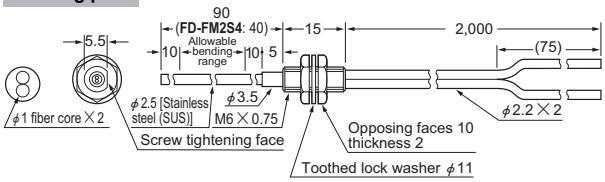
FD-FM2 — Free-cut

Details of sensing part



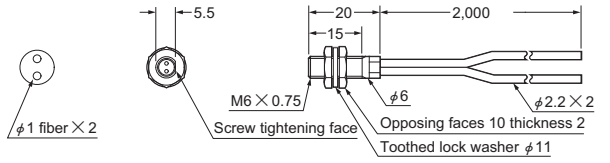
FD-FM2S / FD-FM2S4 — Free-cut

Details of sensing part



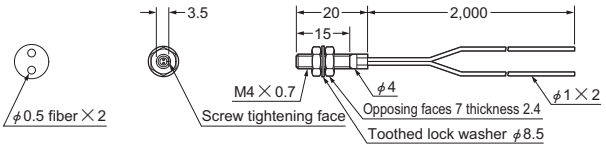
FD-N8 — Free-cut

Details of sensing part



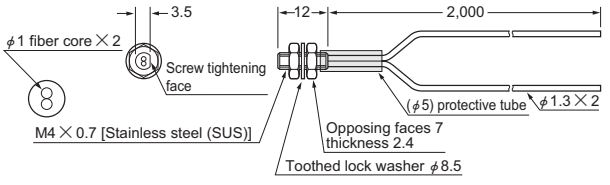
FD-N4 — Free-cut — With attachment

Details of sensing part



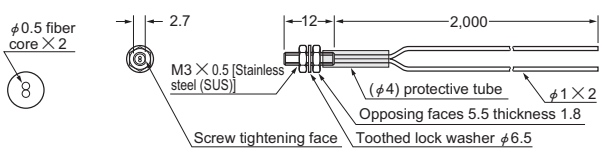
FD-T80 — Free-cut — With attachment

Details of sensing part



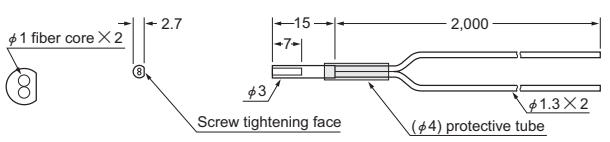
FD-T40 — Free-cut — With attachment

Details of sensing part



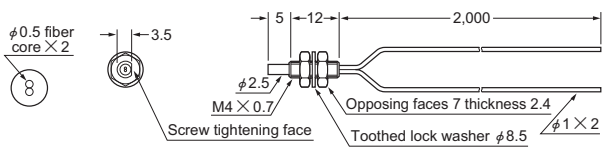
FD-S80 — Free-cut — With attachment

Details of sensing part



FD-NFM2 — Free-cut — With attachment

Details of sensing part

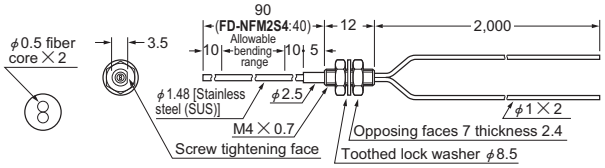


DIMENSIONS (Unit: mm)

Reflective type fibers

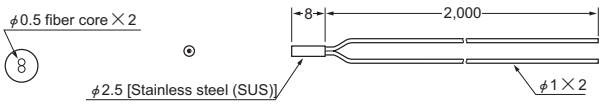
FD-NFM2S FD-NFM2S4 — Free-cut / With attachment

Details of sensing part



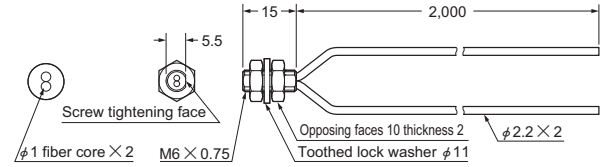
FD-SNFM2 — Free-cut / With attachment

Details of sensing part



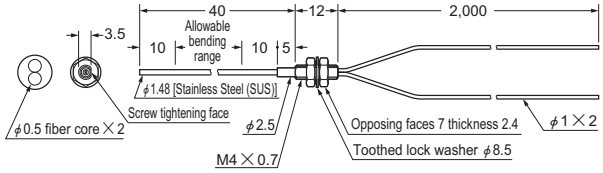
FD-W8 — Free-cut

Details of sensing part



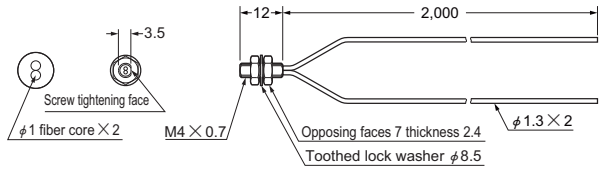
FD-W44 — Free-cut / With attachment

Details of sensing part



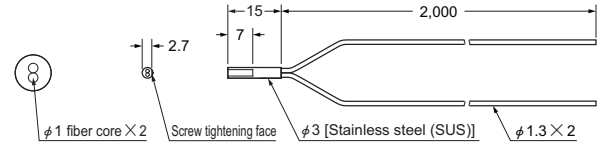
FD-WT8 — Free-cut / With attachment

Details of sensing part



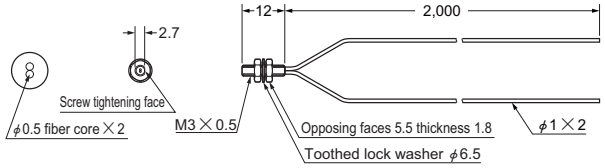
FD-WS8 — Free-cut / With attachment

Details of sensing part



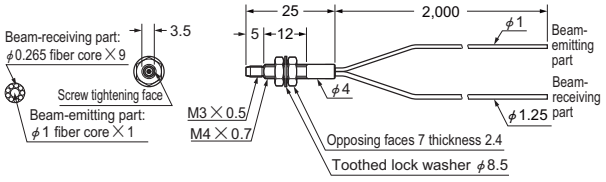
FD-WT4 — Free-cut / With attachment

Details of sensing part



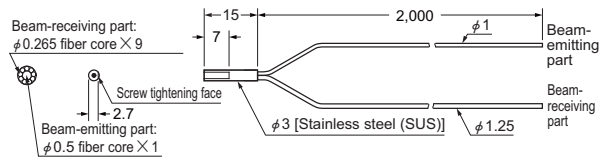
FD-WG4 — Free-cut / With attachment

Details of sensing part



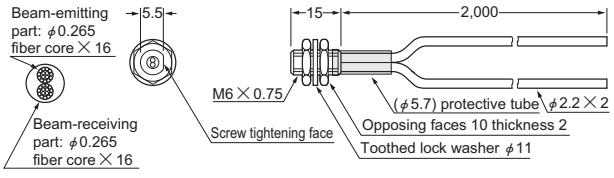
FD-WSG4 — Free-cut / With attachment

Details of sensing part



FD-P80 — Free-cut

Details of sensing part



FX-D1/A1/M1

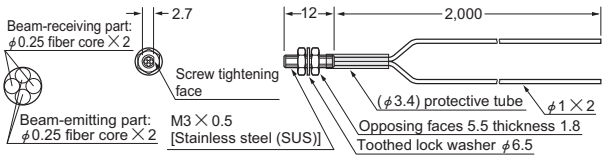
DIMENSIONS (Unit: mm)

Reflective type fibers

FD-P40

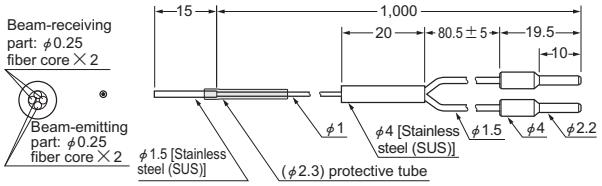
Free-cut With attachment

Details of sensing part



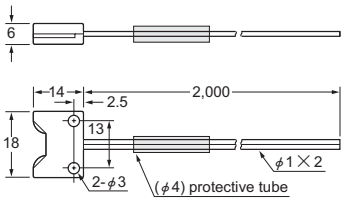
FD-P2

Details of sensing part



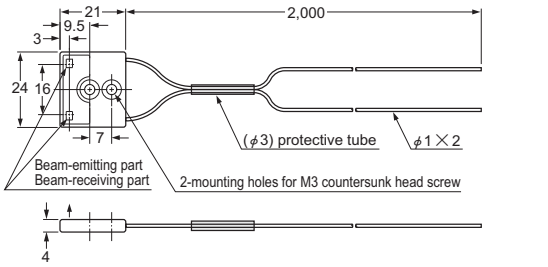
FD-L4

Free-cut With attachment



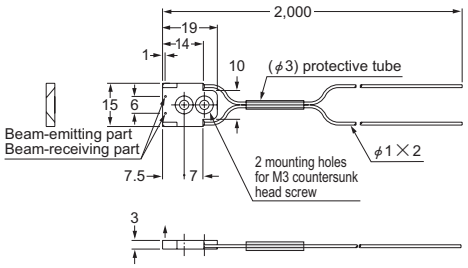
FD-L41

Free-cut With attachment



FD-L42

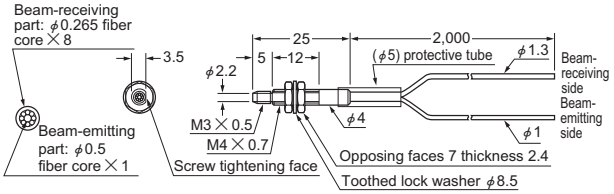
Free-cut With attachment



FD-G4

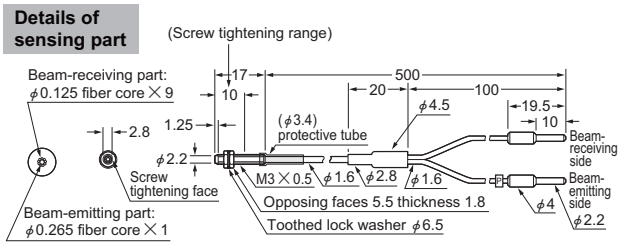
Free-cut With attachment

Details of sensing part



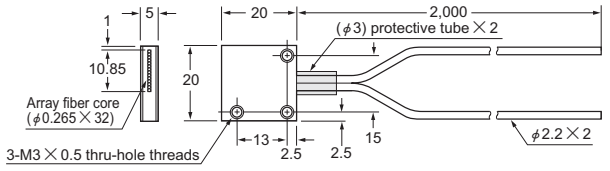
FD-EG1

Details of sensing part



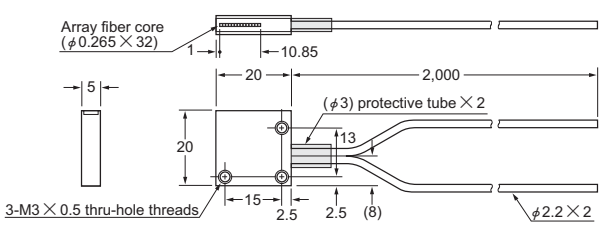
FD-AFM2

Free-cut



FD-AFM2E

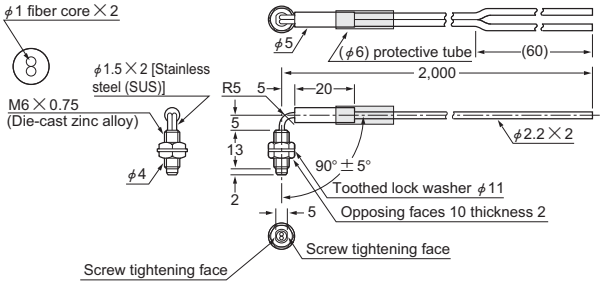
Free-cut



FD-R80

Free-cut

Details of sensing part



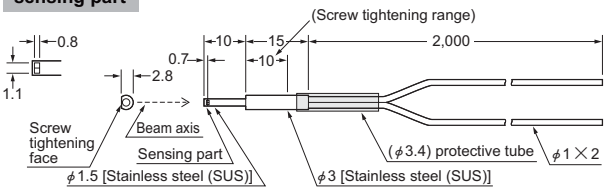
DIMENSIONS (Unit: mm)

Reflective type fibers

FD-V41

Free-cut With attachment

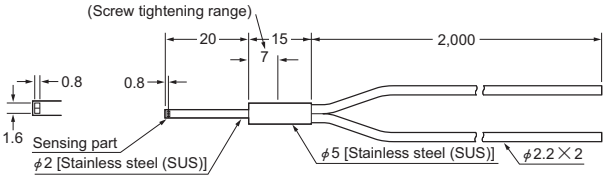
Details of sensing part



FD-SFM2SV2

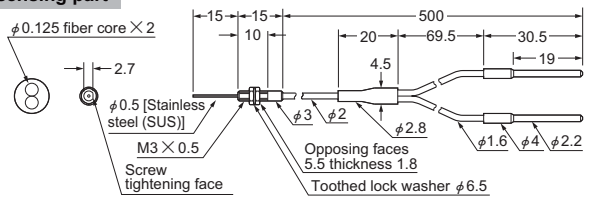
Free-cut

Details of sensing part



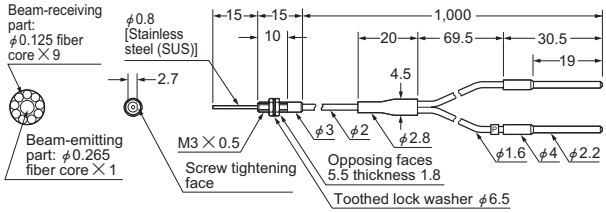
FD-EN500S1

Details of sensing part



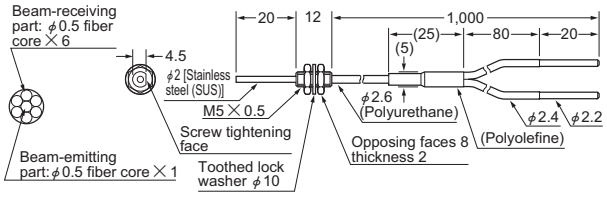
FD-ENM1S1

Details of sensing part



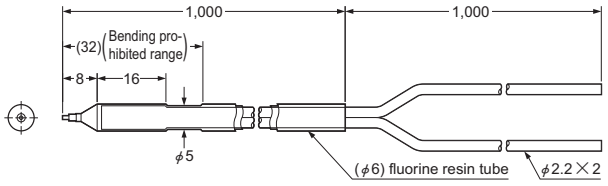
FD-KM1S2

Details of sensing part



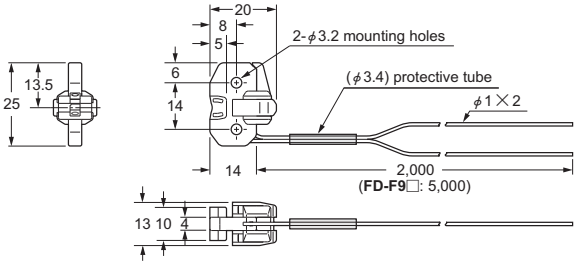
FD-F8Y

Free-cut



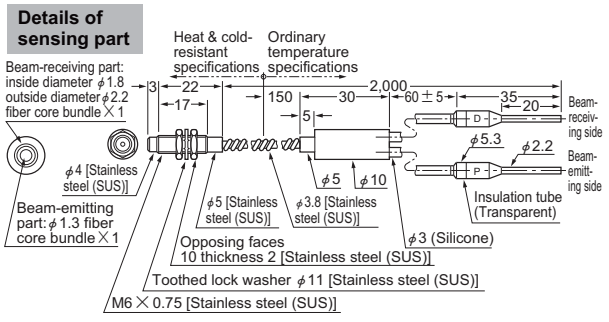
FD-F4□ FD-F9□

Free-cut With attachment



FD-H35-M2

Details of sensing part



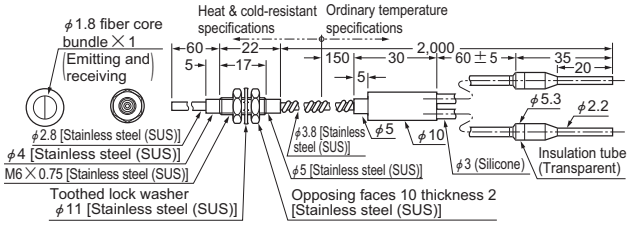
FX-D1/A1/M1

DIMENSIONS (Unit: mm)

Reflective type fibers

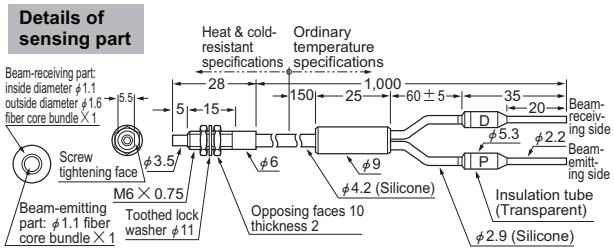
FD-H35-M2S6

Details of sensing part



FD-H20-M1

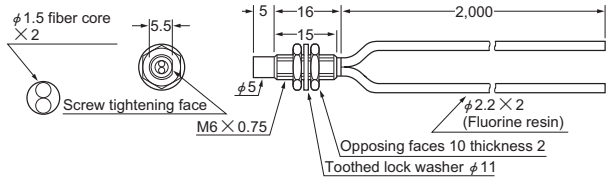
Details of sensing part



FD-H13-FM2

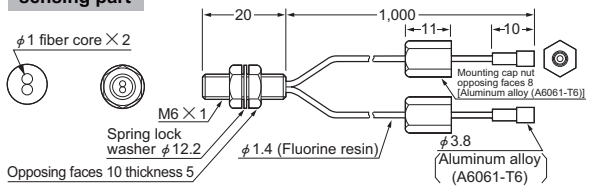
Free-cut

Details of sensing part



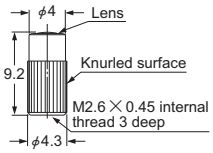
FD-6V

Details of sensing part



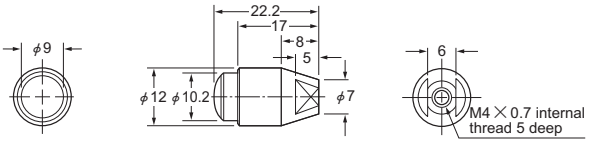
DIMENSIONS (Unit: mm)

FX-LE1 Expansion lens (Optional)



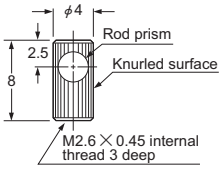
Material: Enclosure .....Brass (Nickel plated)
Lens .....Glass

FX-LE2 Super-expansion lens (Optional)



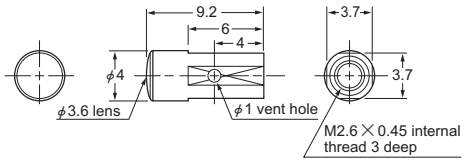
Material: Enclosure .....Stainless steel (SUS303)
Lens .....Glass

FX-SV1 Side-view lens (Optional)



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

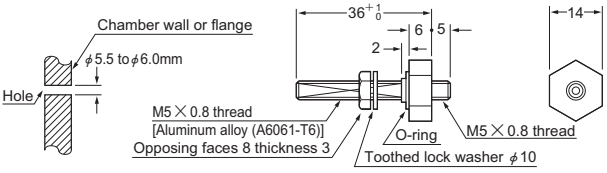
FV-LE1 Expansion lens (For vacuum type fiber)



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

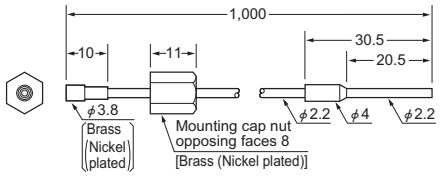
FV-BR1 Photo-terminal (For vacuum type fiber)

Mounting hole

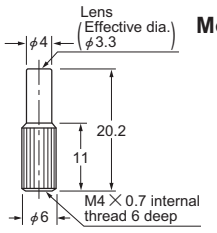


FT-J6 Fiber at atmospheric side (For vacuum type fiber)

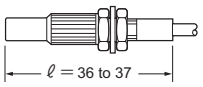
Photo-terminal side **Amplifier side**



FX-MR1 Pinpoint spot lens (Optional)



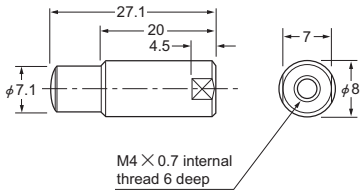
Mounting drawing with FD-G4



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

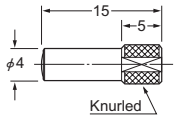
Material: Enclosure .....Aluminum (Black ALMITE)
Lens .....Glass

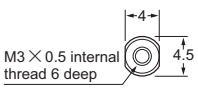
FX-MR2 Zoom lens (Optional)



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

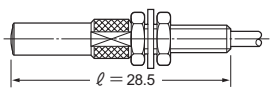
FX-MR3 Finest spot lens (Optional)





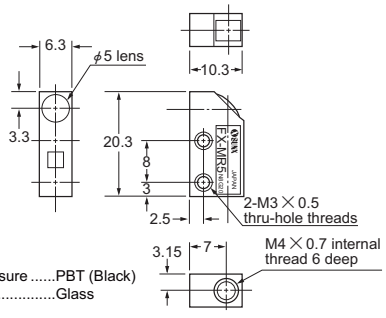
Material: Enclosure .....Aluminum (Black ALMITE)
Lens .....Glass

Mounting drawing with FD-EG1



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

FX-MR5 Zoom lens (Optional)



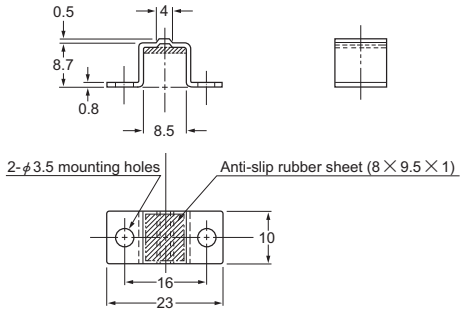
Material: Enclosure .....PBT (Black)
Lens .....Glass

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

FX-D1/A1/M1

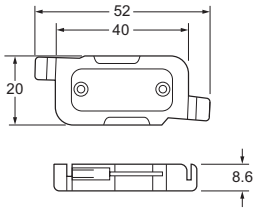
DIMENSIONS (Unit: mm)

MS-EX-3 Mounting bracket for **FX-MR2** (Accessory with **FX-MR2**)



Material: Brass (Nickel plated)

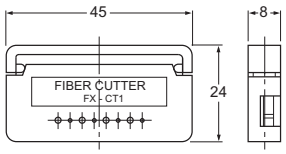
FB-1 Fiber bender (Optional)



Material: PP (containing steel blade)

FX-CT1 Fiber cutter (Optional)

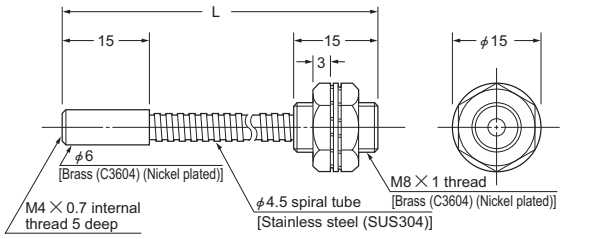
Accessory with free-cut type fiber (except economy type), chemical-resistant type fiber



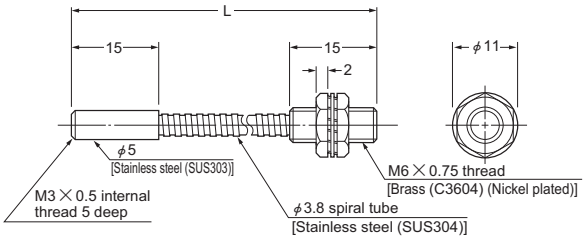
Material: ABS

FTP-□ FDP-□ Protective tube (Optional)

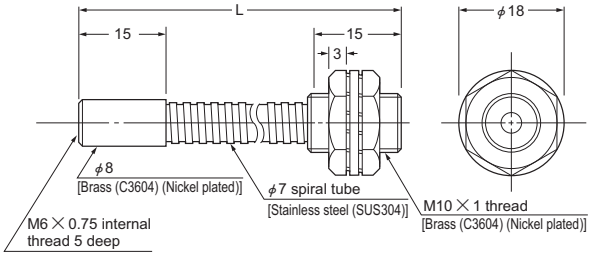
FTP-□, FDP-N□



FTP-N□



FDP-□

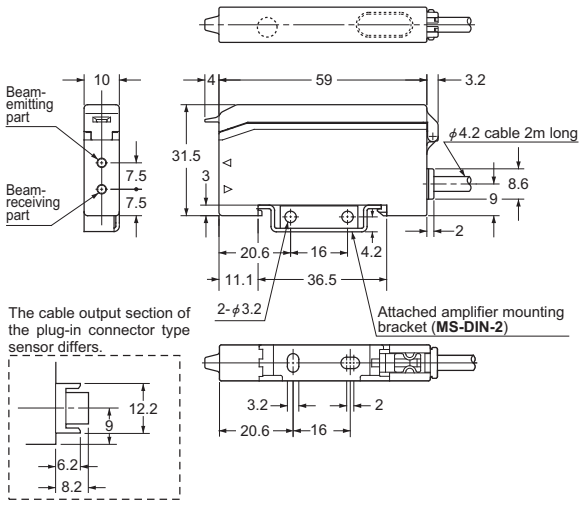


Model No.	Length L (mm)
FTP-500, FTP-N500, FDP-N500, FDP-500	500^{+10}_{0}
FTP-1000, FTP-N1000, FDP-N1000, FDP-1000	$1{,}000^{+10}_{0}$
FTP-1500, FTP-N1500, FDP-N1500, FDP-1500	$1{,}500^{+10}_{0}$

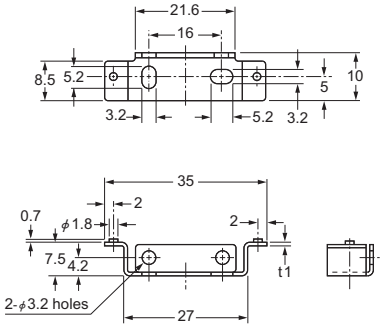
DIMENSIONS (Unit: mm)

FX-D1□ FX-A1□ FX-M1□ Amplifier

Assembly dimensions with attached amplifier mounting bracket



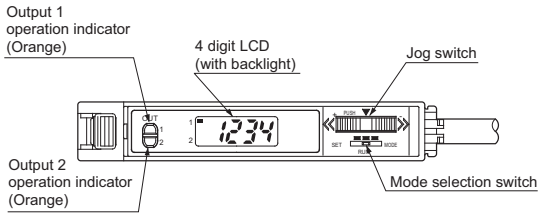
MS-DIN-2 Amplifier mounting bracket (Accessory for amplifier)



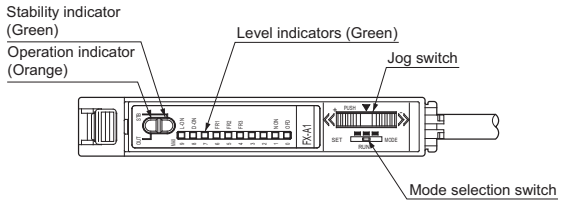
Material: Cold rolled carbon steel (SPCC)
(Uni-chrome plated)

Display part

FX-D1□



FX-A1□



FX-M1□