

High Accuracy Fibreoptic Sensors

FS01 Series

Features

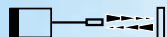
- An Industry-first dual monitoring system
- Auto and manual calibration
- 20-bit concurrent processing chip
- High accuracy and high power
- Wire-saving 0-line or 1-line connection system

Detecting Distance

Thrubeam – Up to 3,600 mm (with lens)



Diffuse-reflective – Up to 300 mm



Definite-reflective – Up to 14 mm



Description

Dual monitoring system

The FS-V10 Series features both a digital LED indicator, which numerically displays the received light intensity, and a bar LED, which shows the level of detection stability (excess gain). The digital LED indicator can be used to align the optical axis and to display operating conditions during sensor mounting. The bar LED indicates detection stability during operation.



The digital LED indicator is a powerful aid for optical axis alignment.

Auto and manual calibration

In addition to the conventional AUTO SET button, the FS-V10 Series features a Manual Calibration button, which enables fine adjustment. You can start detection after a quick calibration using the AUTO SET button, then make fine adjustments to the sensitivity using the Manual button. Using only the automatic calibration or only the manual calibration will provide satisfactory detection. Even an inexperienced person can make very precise adjustments.

Calibration comparisons	Setting procedure	Fine adjustment		Manual adjustment trimmer
By button	Good Just press the button for optimal setting.	No good	Sensitivity is fixed. Fine adjustment is impossible.	
By trimmer	No good Calibration requires experience. Settings vary depending on the operator.	Good	Sensitivity can be set as desired.	Sensitivity UP Sensitivity DOWN
By hybrid calibration	Good Just press the button for fully automatic calibration.	Good	Sensitivity can be finely adjusted.	AUTO SET button

<FS-V10 Series>

NEW 20-bit concurrent processing chip + 12-bit A/D converter
The FS-V10 Series features a newly developed 20-bit concurrent processing chip. This chip can concurrently process 12 types of control including "high-speed calculation of received light intensity", "dual monitor display", and "peak/bottom hold display". Compared to general-purpose CPUs for sequential processing, this chip offers various advantages such as low current consumption, high-speed response, and reduced heat value, resulting in the improvement of overall usability.

Amplifier Variations

Fibreoptic sensors FS01 Series

FS01 Series features

- **High accuracy detection:**
Detects down to 0.01 mm dia wire with thru-beam unit
- **High power intensity:**
Detects target at the industry longest 300 mm distance with reflective unit
- **Wire-saving connection:**
1-line connection system reduces the wiring labour to 1/2 of conventional method
- **Compact size with 9-mm thickness:**
Installing several units requires very small space.

Hybrid Calibration Type: FS-V10 Series

- Dual monitoring function with bar LED and digital display
- Hybrid calibration with Auto SET button and manual adjustment button



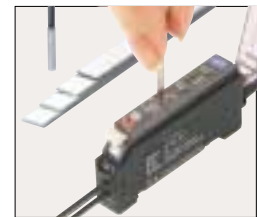
One-touch Calibration Type: FS-T Series

- Fully-automatic calibration by pressing a button
- Green LED light source model FS-T1G is also available



Manual Calibration Type: FS-M Series

- Fine adjustment in calibration by using a multi-turn trimmer
- Ultra-high-speed response model FS-M1H is also available



Digital Calibration Type: FS-V1 Series

- Digital monitor function and 2 independent outputs
- Control and adjustment function for 1-line expansion units



FS01 Series amplifier functional chart

Series		FS-V10	FS-V	FS-T	FS-M
Amplifier model	Main unit	FS-V11	FS-V1	FS-T1	FS-M1
	Expansion unit	FS-V12	—	FS-T2	FS-M2
1-line wire-saving connection system • Main unit supplies power to expansion units, requiring no power supply wire.		✓	✓	✓	✓
Mutual interference suppression • Automatically prevents interference by simply expanding units		✓ ^{1.}	✓ ^{2.}	✓ ^{2.}	✓ ^{3.}
4 Automatic calibration modes with a single button • Fully-automatic • Positioning • 2-point • Maximum sensitivity		✓	✓	✓	—
Digital monitor offering 3 display modes • Intensity monitor: showing current received intensity • Limit value display: showing preset limit value • Limit value adjustment: changing limit value digitally		✓	✓	✓ ^{4.}	—
2 independent outputs • One unit works as two separate amplifiers		—	✓	—	—
Manual calibration adjustment • Sensitivity finely adjustable		✓ ^{5.}	✓ ^{5.}	—	✓ ^{6.}
Versatile performance with one model • One model covers applications from high-accuracy to high-power intensity		✓ ^{7.}	—	—	✓ ^{8.}

1. FINE mode: Up to 4, TURBO/SUPER-TURBO: Up to 8
2. Up to 4
3. FINE mode: Up to 4, TURBO: Up to 8

4. V1 controls T2.
5. Push-button
6. Trimmer

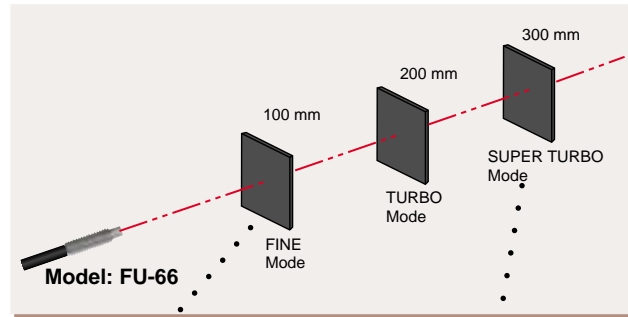
7. 3 modes: FINE/TURBO/SUPER-TURBO
8. 2 modes: FINE/TURBO

- 1 Photoelectric Sensors
- 2 Safety Light Curtains
- 3 Proximity Sensors
- 4 Pressure Sensors
- 5 Programmable Logic Controllers
- 6 Counters, Control Units
- 7 High Precision Sensors
- 8 Vision Systems
- 9 Bar Code Readers
- 10 Displacement Sensors
- 11 Tri-beam Measuring Instruments
- 12 Analog Sensor Controllers
- 13 Video Microscope
- 14 Technical Guide

Functions

From ultra-high precision to ultra-high power: A single unit covers every application

The FS-V10 Series offers three levels of detection to suit the application.



The FS-V10 Series can be used for high-precision detection of wire as thin as 0.01 mm in diameter with a threbeam type fibre unit. It can also be used for detection in harsh environments where oil or dust exists. Because the FS-V10 Series can work in almost all applications, sensor selection is easy.



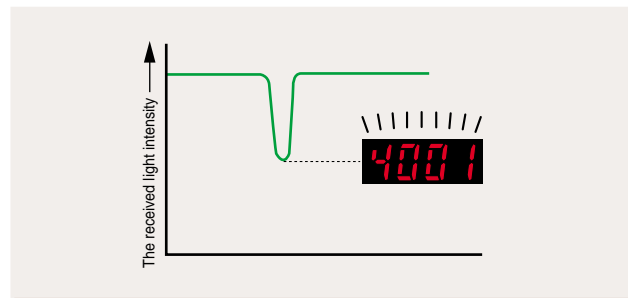
Detection with ultra-high precision



Detection under harsh environment

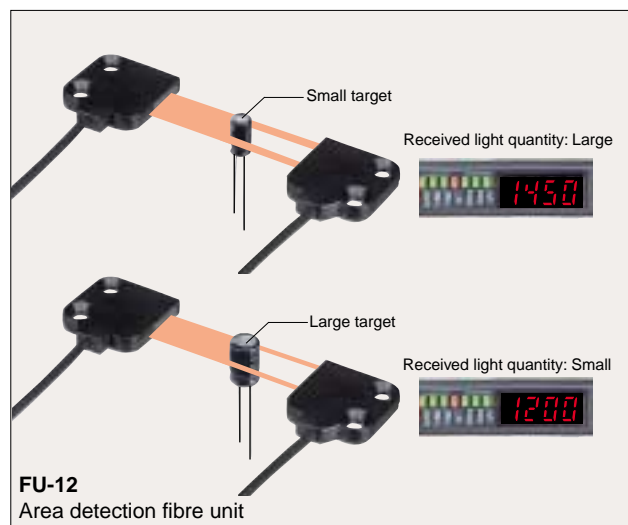
Readable digital display of moving target: Peak/bottom hold display

The digital LED monitor can hold the displayed value. The light intensity value of a moving target can be frozen to control the numerical values easily.



At a glance digital LED monitors interrupted light


The digital LED monitor displays the light quantity at the light-receiving element incrementally from 0 to 4095. This enables you to determine the degree of dust accumulation on the sensor and the deviation in the optical axis. In addition, checking the change in the light quantity with the digital reading ensures an optimal setting value, improving the detection reliability.



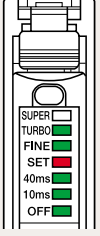
Unstable operating conditions can be discovered at a glance using Bar LED indicators

The bar LED indicates detection stability using a 7-level bar LED.

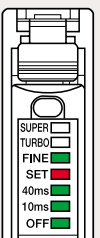
The bar LED shows when maintenance is required at a glance, which is difficult to notice with the digital display.



Low excess gain
One LED does not light during light beam reception. That means the excess gain is +10%.



Inspection required
Two LEDs do not light during light beam reception. That means the excess gain is +5%. An immediate inspection is required.



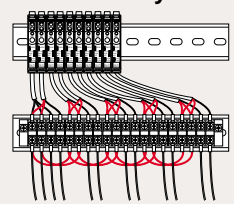
1-line wire-saving connection system significantly reduces wiring time

The FS-V10 Series use the KEYENCE's unique 1-line system.

Power is supplied from the main unit (FS-V11) through the expansion connector so that the expansion units (FS-V12) do not require power cables.

When 10 units are used

Conventional system

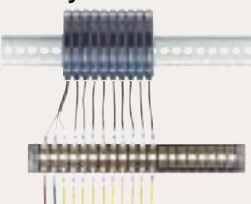


No. of terminal blocks	20 pairs
No. of wires	58
No. of crossover wires	8
Man-hours	120 minutes Approx.

The red wires can be reduced with the 1-line system.



1-line system



No. of terminal blocks	12 pairs
No. of wires	24
No. of crossover wires	0
Man-hours	50 minutes Approx.

Space advantage

Automatic interference prevention

In TURBO/SUPER TURBO mode, up to 8 units can be mounted side-by-side without mutual interference. (In FINE mode, up to 4 units)



- 1 Photoelectric Sensors
- 2 Safety Light Curtains
- 3 Proximity Sensors
- 4 Pressure Sensors
- 5 Programmable Logic Controllers
- 6 Counters, Control Units
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Specifications

Amplifier

FS-V Series

Type		Hybrid calibration (One-touch + manual, digital)			Digital calibration
		Main unit	1-line expansion unit	0-line expansion unit	Main unit
Model	NPN	FS-V11	FS-V12	FS-V10 ¹	FS-V1
	PNP	FS-V11P	FS-V12P	—	FS-V1P
Light source		Red LED			
Response time		250 μs (FINE)/500 μs (TURBO) /1 ms (SUPER TURBO)		410 μs to 1.7 ms ²	250 μs
Operation mode		LIGHT-ON/DARK-ON (switch-selectable)			
Indicators		Output indicator: Red LED Digital LED monitor: Red LED, 7-segment, 4-digit Bar graph LED monitor: Green/Orange LED ³ . Calibration indicator: Orange LED ³ .			Output indicators: 2 Red LEDs Digital LCD monitor: LCD (Red/Green LED back-lit) Calibration indicator: Orange LED
Timer function		OFF-delay: 40 ms/10 ms/ Timer OFF (selectable)			ON-delay: 40 ms/ OFF-delay: 40 ms/ Timer OFF (switch-selectable)
Control output		NPN or PNP open-collector: 100 mA (40 V) max., Residual voltage: 1 V max. ⁴			
Protection circuit		Reverse polarity protection, over-current protection, surge absorber			
Power supply		12 to 24 VDC ±10%			
Current consumption		50 mA max.			
Ambient illumination		Incandescent lamp: 10,000 lux max., Sunlight: 20,000 lux max.			
Ambient temperature		-10 to +55°C ⁵			
Housing material		Body/Cover: Polycarbonate			
Weight (including 2-m cable)		Approx. 80 g	Approx. 45 g	Approx. 20 g	Approx. 80 g

- FS-V10 has no output wire and FS-R0 should be used for issuing output.
- The response time varies depending on the number of expansion units connected.
- The orange LED is normally part of the bar graph LED monitor. It is used as a calibration indicator during the setting of the sensitivity.
- FS-V1 has 2 outputs.
- When several units are connected, the allowable ambient temperature changes depending on the following conditions.
To connect several units, be sure to mount them to a DIN rail (metal DIN rail). Make sure that the output current is 20 mA max.
When 3 to 10 units are connected: -10 to +50°C, When 11 to 16 units are connected: -10 to +45°C

FS-T Series

Type		One-touch calibration			
		Main unit	Colour detection	1-line expansion unit	0-line expansion unit
Model	NPN	FS-T1	FS-T1G	FS-T2	FS-T0
	PNP	FS-T1P	—	FS-T2P	—
Light source		Red LED	Green LED	Red LED	Red LED
Response time		250 μs	250 μs	250 μs	410 μs to 1 ms ¹
Operation mode		LIGHT-ON/DARK-ON (switch-selectable)			
Indicators		Output indicator: Red LED, Stable operation indicator: Green LED, Calibration indicator: Orange LED			
Timer function		ON-delay: 40 ms, OFF-delay: 40 ms, Timer OFF (switch-selectable)			
External calibration input signal		Non-voltage input (contact, solid state)		—	—
Control output		NPN or PNP: 100 mA max. (40 V max.), Residual voltage: 1 V max. ²			
Stability output		NPN or PNP: 50 mA max. (40 V max.), Residual voltage: 1 V max. ³			
Protection circuit		Reversed polarity protection, over-current protection, surge absorber			
Power supply		12 to 24 VDC ±10%	12 to 24 VDC ±10%	12 to 24 VDC ±10% ⁴	12 to 24 VDC ±10% ⁴
Current consumption		35 mA max.	35 mA max.	35 mA max.	35 mA max.
Ambient light		Incandescent lamp: 10,000 lux max., Sunlight: 20,000 lux max.			
Ambient temperature		-10 to +55°C	-10 to +55°C	-10 to +55°C	-10 to +55°C
Housing		Body/Cover: Polycarbonate	Body/Cover: Polycarbonate	Body/Cover: Polycarbonate	Body/Cover: Polycarbonate
Weight (including 2-m cable)		Approx. 75 g	Approx. 75 g	Approx. 40 g	Approx. 20 g

- The response speed varies depending on the number of expansion units connected.
- The FS-T0/M0 have no control output.
- Only the FS-T1/M1 provide stability outputs. Stability outputs for the FS-T2/T0/M2/M0 are output from the FS-T1/M1 or FS-R0.
- Power to the FS-T2/T0/M2/M0 is supplied through the FS-V11/V1/T1/M1 or FS-R0.

FS-M Series

Type		Manual calibration			
		Main unit	1-line expansion unit	High-speed response	0-line expansion unit
Model	NPN	FS-M1	FS-M2	FS-M1H	FS-M0
	PNP	FS-M1P	FS-M2P	—	—
Light source		Red LED	Red LED	Red LED	Red LED
Sensitivity adjustment/ Mode selection		8-turn trimmer (with indicator), FINE/TURBO (switch-selectable)			
Response time		250 µs (FINE), 500 µs (TURBO)	250 µs (FINE), 500 µs (TURBO)	20 µs (FINE), 50 µs (TURBO)	410 µs to 1.2 ms ¹
Operation mode		LIGHT-ON/DARK-ON (switch-selectable)			
Indicators		Output indicator: Red LED, Stable operation indicator: Green LED			
Timer function		ON-delay: 40 ms, OFF-delay: 40 ms, Timer OFF (switch-selectable)			
Control output		NPN or PNP:100 mA max. (40 V max.), Residual voltage: 1 V max. ²			
Stability output		NPN or PNP: 50 mA max. (40 V max.), Residual voltage: 1 V max. ³			
Protection circuit		Reversed polarity protection, over-current protection, surge absorber			
Power supply		12 to 24 VDC ±10%	12 to 24 VDC ±10% ⁴	12 to 24 VDC ±10%	12 to 24 VDC ±10% ⁴
Current consumption		35 mA max.	35 mA max.	35 mA max.	35 mA max.
Ambient light		Incandescent lamp: 10,000 lux max., Sunlight: 20,000 lux max.			
Ambient temperature		-10 to +55°C	-10 to +55°C	-10 to +55°C	-10 to +55°C
Housing		Body/Cover: Polycarbonate	Body/Cover: Polycarbonate	Body/Cover: Polycarbonate	Body/Cover: Polycarbonate
Weight (including 2-m cable)		Approx. 75 g	Approx. 40 g	Approx. 20 g	Approx. 20 g

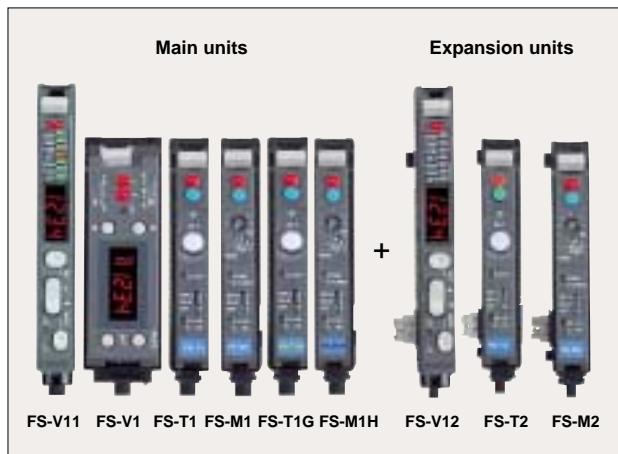
- The response speed varies depending on the number of expansion units connected.
- The FS-T0/M0 have no control output.
- Only the FS-T1/M1 provide stability outputs. Stability outputs for the FS-T2/T0/M2/M0 are output from the FS-T1/M1 or FS-R0.
- Power to the FS-T2/T0/M2/M0 is supplied through the FS-V11/V1/T1/M1 or FS-R0.

Amplifier Function

1-line connection amplifiers reduce wiring and labour

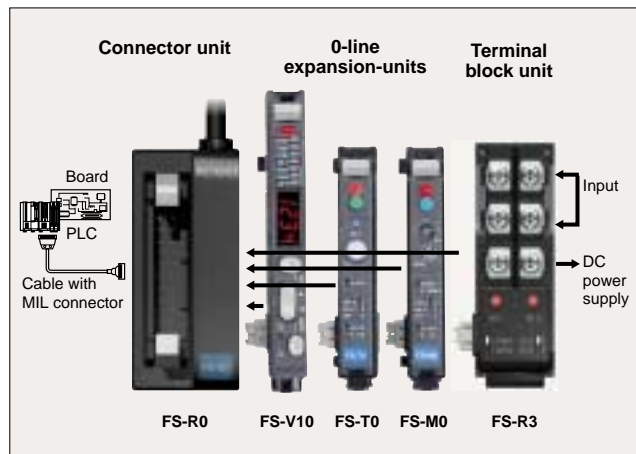
Up to 16 expansion units can be connected to a single main unit and can be freely combined.

FS-V11 :Hybrid calibration	FS-T1G :Green LED light source
FS-V1 :Multi-functions and digital calibration	FS-M1H :High-speed response
FS-T1 :One-touch calibration	FS-V12 :Hybrid calibration
FS-M1 :Manual calibration	FS-T2 :One-touch calibration
	FS-M2 :Manual calibration



0-line connection units eliminate wiring and labour

The innovative 0-line connection system only requires an FS-R0 connector unit and a cable with a MIL connector for wiring. The units can be easily connected to an I/O card of a PLC (programmable controller) or special board. Units can be freely combined to suit the application.



ToughFlex Fibre Principle

Keyence has developed the toughest fibre unit series by bundling multiple core fibres of 66 µm diameter. These fibres will work normally without any malfunction even when they are bent to a minimum radius or when they are hit or pulled suddenly. Keyence has also maintained a long detecting distance while using this unique design. Including focused small spot model, area detection model, ultra-long detecting distance model, and thin sleeve models, every application can be improved with maintenance efficiency. Plus, the latest armoured model is sheathed by a flexible stainless steel jacket to protect the fibre from daily wear and exposure to harsh environmental conditions.

Conventional fibre



A standard fibre will easily break.



A single-core fibre exposed to excessive bending will easily break.

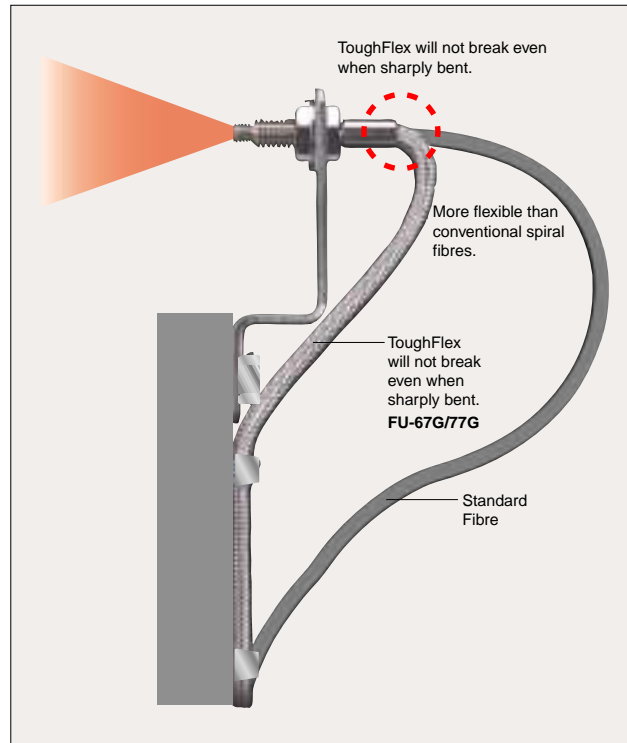
ToughFlex fibre



ToughFlex will not break even when sharply bent.



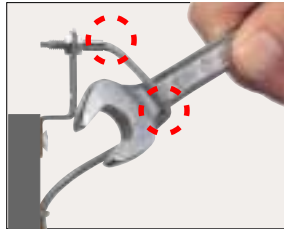
The 217-core fibre is hardly affected by excessive bending.



ToughFlex Fibre Features

Tough even when entangled

Even if the fibre unit becomes entangled, the fibre unit and the base of the head will continue to perform.



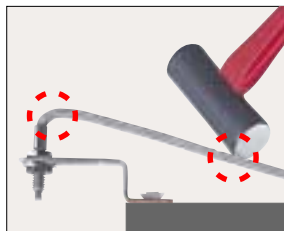
Ready for immediate use

Armoured ToughFlex provides a cost and labour savings by eliminating the need for protective tubing.

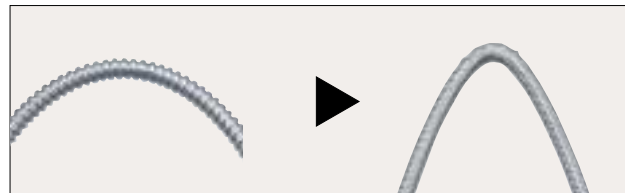


Shock-resistant

The fibre unit and the base of the head will continue to perform even when dropped or struck by a tool.



More flexible than conventional spiral fibres



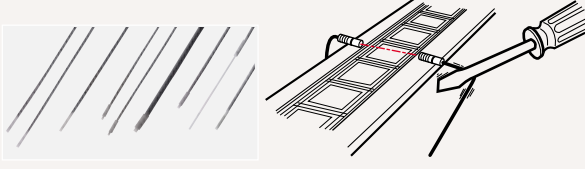
ToughFlex fibre variations

FU-67G	FU-77G	FU-67	FU-77	FU-66Z	FU-63Z	FU-35FZ	FU-12
M6, reflective with armoured tube	M4, thrubeam with armoured tube	M6, reflective	M4, thrubeam	M4, reflective	M4, reflective with sleeve	M3, reflective	Thrubeam Area detection

Fibre Unit Selection Guide (major models only)

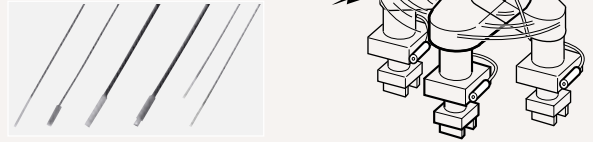
**“Break-free” ToughFlex Fibres [Patent pending]:
FU-67/77/35FZ/4FZ/5FZ/63Z/66Z/12**

Fibres with a minimum bend radius of 2 mm retain light intensity even when folded. These innovative fibres can be routed just like an electric wire, enabling installation anywhere.



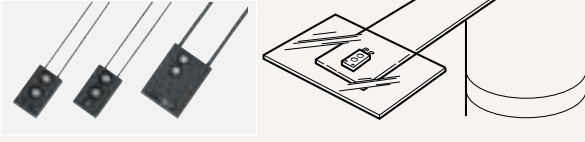
High-flex Fibres: FU-45X/48/49X/59/65X/68/69X/78/79

These fibres, which provide higher flexibility than an electric wire, can endure repeated bends. The bend radius of 4 mm makes fibre routing easier and saves mounting space.



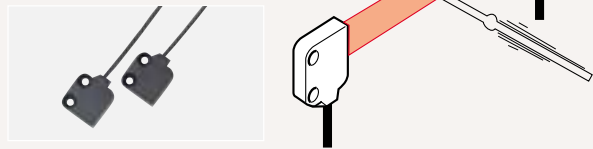
**Compact Definite Reflective Fibres:
FU-38/38V/38R**

These fibres are excellent for detection in tight spaces such as being embedded in a robot arm or on a conveyor. Detection is almost unaffected by target backgrounds.



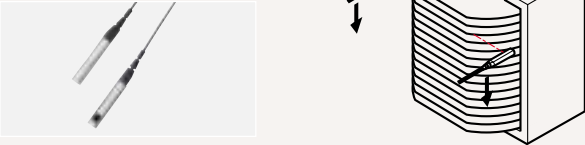
Area Detection Fibre: FU-12

The FU-12, which provides a detecting area 10 mm wide, is suitable for detecting vibrating targets or minute targets. A target as small as 1.2 mm in diameter can be accurately detected.



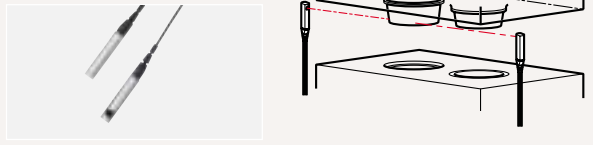
Wafer Mapping Fibre: FU-18

The FU-18 incorporates a special lens and prism and has an aperture angle of 2° enabling ultra-narrow beam emission. This capability is well suited to mapping (positioning) wafers placed at a small pitch.



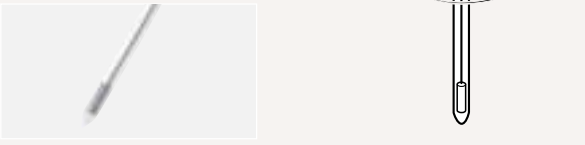
Long Detecting Distance, Side-view Fibre: FU-16

The FU-16 provides a long detecting distance of 1.7 m and an aperture angle of 6°, enabling narrow beam emission. Almost no light reflected by surrounding objects enters the receiver, enabling stable detection.



**Liquid Level Detection Fibre:
FU-93**

The FU-93 is totally encased in a Teflon®-sheath. It is liquid resistant and can be used to reliably detect a liquid surface level.



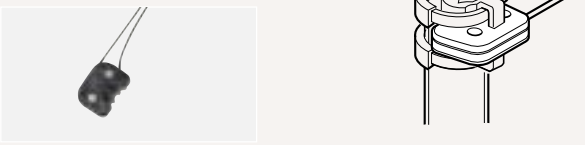
Focused Beam Lens and Fibre: FU-21X + F-2HA

The FU-21X with the F-2HA forms a tiny beam spot 0.2 mm in diameter at a detecting distance of 7 mm. This combination is very useful for detecting minute targets or positioning with high accuracy.



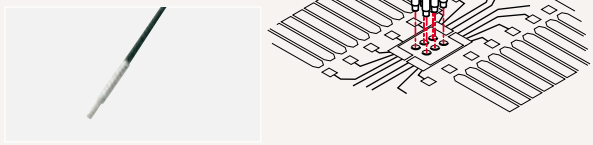
Tube-mountable Liquid Level Detection Fibre: FU-95

The FU-95 is a liquid-level-detection fibre that can be easily mounted to a tube. Because it is lightweight it can be mounted in anywhere.



Narrow-beam Fibre: FU-22X

The light diffusion angle is 10° (1/6 of conventional models), allowing narrow beam emission. This capability is ideal for detecting minute targets.



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Fibre Unit Selection Chart

Type	Shape	Detecting distance ¹ (mm)	Smallest ² detectable object	Minimum bend radius	Features	Weight (Approx.)	Model					
Thru-beam	Standard	3 mm dia. 760 (3600)	ø0.03 mm	R25 mm	Long-detecting distance	19g	FU-5F <i>Free-cut</i>					
		M4 640					Lens F-1, F-2, F-4	21g	FU-7F <i>Free-cut</i>			
		M4 320						9g	FU-78 <i>Free-cut</i>			
	ToughFlex	3 mm dia. 370	ø0.03 mm	R4 mm	A minimum bend radius of 4 mm	9g	FU-78 <i>Free-cut</i>					
		M4 300					Lens F-1, F-2, F-4	21g	FU-77 <i>Free-cut</i>			
		M4 230						R10 mm	Armoured ToughFlex fibre	39g	FU-77G NEW	
	High-flex	1.5 mm dia. 220	ø0.01 mm	R4 mm	High-flex fibre	3g	FU-59 <i>Free-cut</i>					
		M3 100					6g	FU-79 <i>Free-cut</i>				
	Thin-sleeve	0.82 mm dia. M3 150	ø0.01 mm	R10 mm	Thin sleeve	10g	FU-75F <i>Free-cut</i>					
		Do not bend sleeve. 75					1.65 mm dia. M4 760	ø0.03 mm	R25 mm	Long-detecting distance with sleeve	24g	FU-73 <i>Free-cut</i>
		Min. bend radius of sleeve: 10 mm										640
	Side-view	1.65 mm dia. 4 mm dia. 500	ø0.03 mm	R25 mm	Side-view type with thin sleeve	11g	FU-36X					
Min. bend radius of sleeve: 10 mm		400					250	Long-detecting distance side-view type	6g	FU-16 <i>Free-cut</i>		
4 mm dia. 1700		ø0.1 mm					R10 mm			Wafer-mapping type	8g	FU-18 <i>Free-cut</i>
4 mm dia. 1300												1000
Area detection	0.82 mm dia. 2.5 mm dia. 80	ø0.01 mm	R25 mm	Side-view type with thin sleeve	5g	FU-32 <i>Free-cut</i>						
	Do not bend sleeve. 60					ø0.03 mm	R25 mm	Space-saving, side-view type	17g	FU-34 <i>Free-cut</i>		
Diffuse-reflective	1.2 mm dia. 3 mm dia. 250	ø0.03 mm	R25 mm	Space-saving, side-view type	17g					FU-34 <i>Free-cut</i>		
	Min. bend radius of sleeve: 25 mm					200	100					
Area detection	1000	ø1.2 mm ³ ø0.3 mm	R2 mm	Area detection fibre with a detecting width of 10 mm	23g	FU-12 <i>Free-cut</i>						
	800					ø0.01 mm	R25 mm	Long-detecting distance	8g	FU-4F <i>Free-cut</i>		
	600											
Standard	3 mm dia. 300	ø0.01 mm (gold wire)	R25 mm	Long-detecting distance	21g	FU-6F <i>Free-cut</i>						
	M6 200					10g	FU-66 <i>Free-cut</i>					
	M4 100											

SUPER TURBO
 TURBO
 FINE
 SUPER TURBO is for FS-V11/12/10 only. For FS-V1 and FS-T, see FINE.

- Detecting range varies depending on detecting distance and target diameter. Refer to "Characteristics". Detecting distance for reflective sensors were obtained using a white paper target (standard target).
- The smallest detectable object was determined at the optimal detecting distance and sensitivity setting.
- Smallest detectable object is ø1.2 mm in TURBO mode and ø0.3 mm in FINE mode.

Type	Shape	Detecting distance ¹ (mm)	Smallest ² detectable object	Minimum bend radius	Features	Weight (Approx.)	Model
Diffuse-reflective	Coaxial	3 mm dia. SUPER TURBO 300 TURBO 200 FINE 100	ø0.01 mm (gold wire)	R25 mm	Suitable for positioning	4g	FU-23X
		M6 SUPER TURBO 240 TURBO 160 FINE 80				18g	FU-25 <i>Free-cut</i>
		M3 SUPER TURBO 28 TURBO 20 FINE 12				4g	FU-21X <i>Lens F-2HA</i>
		M3 SUPER TURBO 110 TURBO 70 FINE 35				6g	FU-35FA <i>Free-cut</i> <i>Lens F-1, F-2, F-4</i>
	ToughFlex	3 mm dia. SUPER TURBO 130 TURBO 80 FINE 45	ø0.01 mm (gold wire)	R2 mm	Break-free fibre	8g	FU-4FZ <i>Free-cut</i>
		M4 SUPER TURBO 180 TURBO 130 FINE 65				10g	FU-66Z <i>Free-cut</i>
		M6 SUPER TURBO 65 TURBO 45 FINE 25				21g	FU-67 <i>Free-cut</i>
		M6 SUPER TURBO 45 TURBO 35 FINE 20				29g	FU-67G <i>Free-cut</i> NEW
		M3 SUPER TURBO 45 TURBO 35 FINE 20				6g	FU-35FZ <i>Free-cut</i> <i>Lens F-2HA, F-3HA, F-4HA</i>
		1.65 mm dia. M4 SUPER TURBO 45 TURBO 35 FINE 20 Min. bend radius of sleeve: 10 mm				10g	FU-63Z <i>Free-cut</i>
	High-flex	3 mm dia. SUPER TURBO 55 TURBO 40 FINE 25	ø0.01 mm (gold wire)	R4 mm	High-flex fibre	7g	FU-48 <i>Free-cut</i>
		M4 SUPER TURBO 25 TURBO 20 FINE 15				8g	FU-68 <i>Free-cut</i>
1.5 mm dia. SUPER TURBO 25 TURBO 20 FINE 15		3g				FU-49x	
M3 SUPER TURBO 15 TURBO 10 FINE 8		3g				FU-69X	
Thin-sleeve	1.77 mm dia. SUPER TURBO 12 TURBO 10 FINE 8 Do not bend sleeve.	ø0.01 mm (gold wire)	R25 mm	Narrow-beam type for small-beam spot	4g	FU-22X	
	0.82 mm dia. SUPER TURBO 14 TURBO 10 FINE 6 Do not bend sleeve.		R4 mm	Flush-mount type with thin-sleeve	4g	FU-45X	
	3 mm dia. SUPER TURBO 14 TURBO 10 FINE 6 Do not bend sleeve.		R4 mm	Screw-mount type with thin-sleeve	5g	FU-65X	
	0.82 mm dia. SUPER TURBO 14 TURBO 10 FINE 6 Do not bend sleeve.		R4 mm	Flush-mount type with sleeve	8g	FU-43 <i>Free-cut</i>	
	1.65 mm dia. SUPER TURBO 70 TURBO 50 FINE 30 Min. bend radius of sleeve: 10 mm		R25 mm	Screw-mount type	10g	FU-63 <i>Free-cut</i>	
	4 mm dia. SUPER TURBO 70 TURBO 50 FINE 30 Do not bend sleeve.		R25 mm	Long-sleeve, Flat type	10g	FU-63T <i>Free-cut</i>	
	1.65 mm dia. SUPER TURBO 70 TURBO 50 FINE 30 Min. bend radius of sleeve: 10 mm		R25 mm	Long-sleeve, Flat type	10g	FU-63T <i>Free-cut</i>	
	1.65 mm dia. SUPER TURBO 70 TURBO 50 FINE 30 Min. bend radius of sleeve: 10 mm		R25 mm	Long-sleeve, Flat type	10g	FU-63T <i>Free-cut</i>	
Side-view	4.8 mm dia. SUPER TURBO 60 TURBO 40 FINE 20 Min. bend radius of sleeve: 25 mm	ø0.03 mm (copper wire)	R25 mm	Long-sleeve	10g	FU-33 <i>Free-cut</i>	
	2.8 mm dia. SUPER TURBO 27 TURBO 20 FINE 13 Do not bend sleeve.		R10 mm	Compact	5g	FU-31 <i>Free-cut</i>	

SUPER TURBO
 TURBO
 FINE
 SUPER TURBO is for FS-V11/12/10 only. For FS-V1 and FS-T, see FINE.

- Detecting distance for reflective sensors were obtained using a white paper target (standard target).
- The smallest detectable object was determined at the optimal detecting distance and sensitivity setting.

Photoelectric Sensors	1
Safety Light Curtains	2
Proximity Sensors	3
Pressure Sensors	4
Programmable Logic Controllers	5
Counters, Control Units	6
High Precision Sensors	7
Vision Systems	8
Bar Code Readers	9
Displacement Sensors	10
Truck Measuring Instruments	11
Analog Sensor Controllers	12
Video Microscope	13
Technical Guide	14

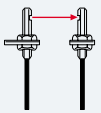





Type	Shape	Detecting distance ¹ (mm)	Smallest detectable object ²	Minimum bend radius	Features	Weight (Approx.)	Model		
Definite-reflective		<ul style="list-style-type: none"> 3 (Centre of detecting distance) 3 (Centre of detecting distance) 3 (Centre of detecting distance) 	ø0.01 mm (gold wire)	R10 mm	Almost unaffected by target colour and background	6g	FU-37 <i>Free-cut</i>		
		<ul style="list-style-type: none"> 6 ±1 6 ±1 6 ±1 				5g	FU-38 <i>Free-cut</i>		
		<ul style="list-style-type: none"> 0 to 4 0 to 4 0 to 4 	ø0.08 mm (copper wire)		Almost unaffected by target background, side-by-side detection available	5g	FU-38V <i>Free-cut</i>		
		<ul style="list-style-type: none"> 0 to 14 (Centre of detecting distance) 0 to 14 (Centre of detecting distance) 	ø0.3 mm (gold wire)	R25 mm	Almost unaffected by target colour and background, long-detecting distance	20g	FU-38R <i>Free-cut</i>		
Liquid-level		Transparent tube of 4 to 26 mm dia.	-	R10 mm	For mounting to a tube	7g	FU-95 <i>Free-cut</i>		
		Liquid (except for milky white liquids)	-	R40 mm (Teflon® part)	Liquid level detection by sensor head immersion. Teflon®-sheathed	78g	FU-93 <i>Free-cut</i>		
			Liquid level detection by sensor head immersion. Teflon® covered for high durability against chemicals. FU-94C heat resistant up to 200°C		90g	FU-94C			
		Heat-resistant		<ul style="list-style-type: none"> 180 120 60 	ø0.01 mm (gold wire)	R25 mm	Heat resistance: 350°C, glass fibre with sleeve	24g	FU-81C
				<ul style="list-style-type: none"> 210 140 70 			Heat resistance: 300°C, glass fibre with sleeve	29g	FU-82C
				<ul style="list-style-type: none"> 300 200 100 			Heat resistance: 300°C, glass fibre	23g	FU-83C
<ul style="list-style-type: none"> 210 140 70 	Heat resistance: 105°C, plastic fibre			21g			FU-85 <i>Free-cut</i>		
<ul style="list-style-type: none"> 210 140 70 	Heat resistance: 180°C, plastic fibre			33g			FU-87 <i>Free-cut</i>		
Oil-proof, Chemical proof	<ul style="list-style-type: none"> 110 85 60 	ø0.01 mm (gold wire)	R40 mm	Teflon® fibre	32g	FU-91 <i>Free-cut</i>			
Thru-beam		<ul style="list-style-type: none"> 370 (3600) 300 150 	ø0.03 mm	R25 mm	Heat resistance: 300°C, glass fibre	66g	FU-84C		
					<ul style="list-style-type: none"> 760 640 320 	Heat resistance: 105°C, plastic fibre	22g	FU-86 <i>Free-cut</i>	
						<ul style="list-style-type: none"> 500 400 200 	Heat resistance: 180°C, plastic fibre	36g	FU-88 <i>Free-cut</i>
		Oil-proof, Chemical proof		<ul style="list-style-type: none"> 2500 2200 1100 	ø0.2 mm	R40 mm	Teflon® fibre	71g	FU-92 <i>Free-cut</i>
				<ul style="list-style-type: none"> 870 700 350 	ø0.1 mm		Teflon® fibre, side-view type	71g	FU-96 <i>Free-cut</i>

■ SUPER TURBO
 ■ TURBO
 ■ FINE
 SUPER TURBO is for FS-V11/12/10 only. For FS-V1 and FS-T, see FINE.

1. Detecting range varies depending on detecting distance and target diameter. Refer to "Characteristics".
 Detecting distance for reflective sensors were obtained using a white paper target (standard target).
 2. The smallest detectable object was determined at the optimal detecting distance and sensitivity setting.

Selection Chart

Lens attachment

Type	Configuration	Applicable fibre units	Detecting distance (mm)			Feature Model	Model	
			FINE	TURBO	SUPER TURBO			
Thru-beam	 Side-view	FU-7F,86	400	800	1000	Space-saving, side-view type	F-1 ¹	
		FU-77, 77G	260	540	670			
		FU-78	220	440	550			
		FU-84C	220	440	550			
	 Long-detecting distance	FU-7F,86	1800	3600	3600 ²	Greatly increases the detecting distance., Aperture angle: 15°	F-2	
		FU-77, 77G	1500	3000	3600			
		FU-84C	1500	3000	3600			
	 Ultra-long detecting distance	FU-7F	3000	3600 ²	3600 ²	Greatly increases the detecting distance. Aperture angle: 8°	NEW F-4	
		FU-77, 77G	2500	3600 ²	3600 ²			
		FU-78	2000	3600 ²	3600 ²			
	Diffuse-reflective	 Focusing lens	FU-35FA(Z)	7 ±2 with beam spot diameter of 0.4 mm			Focuses light beam for precise aiming. Improves the stability for the minute target detection.	F-2HA
			FU-21X	7 ±2 with beam spot diameter of 0.2 mm				
 Long-detecting distance, focusing lens		FU-35FA(Z)	0 to 20 with beam spot diameter of 4 mm			F-3HA		
		 Long-detecting distance, high focusing lens	FU-35FA(Z)	15 ±2 with beam spot diameter of 0.5 mm				NEW F-4HA

1. When using the F-1 at a temperature of 70°C or more, specify the "Heat-resistant F-1".
2. "3600" is assumed as maximum because the fibre cable has the length of 2 m.

Specifications

Fibre unit

Type	Standard	Heat-resistant				Oil proof, Chemical proof
		350°C type	300°C type	180°C type	105°C type	
Ambient temperature	-40 to +70°C (FU-12, 67, 77: -40 to +50°C, FU-39: -30 to +100°C)	-30 to +350°C ¹	-40 to +300°C ¹	-60 to +180°C ¹	-40 to +105°C	-30 to +70°C
Material	Fibre: Plastic, Sheath: Polyethylene (FU-39: glass)	Fibre: Glass, Sheath: Stainless-steel spiral tube		Fibre: Plastic, Sheath: Fluorocarbon polymer coating	Fibre: Plastic, Sheath: Polypropylene	Fibre: Plastic, Sheath: Teflon®

1. Ambient temperature varies depending on the distance from the tip or a fibre unit. Refer to "Dimensions". The ambient temperature for the FU-87 and 88 is in dry condition.

- 1 Photoelectric Sensors
- 2 Safety Light Curtains
- 3 Proximity Sensors
- 4 Pressure Sensors
- 5 Programmable Logic Controllers
- 6 Counters, Control Units
- 7 High Precision Sensors
- 8 Vision Systems
- 9 Bar Code Readers
- 10 Displacement Sensors
- 11 Thru-beam Measuring Instruments
- 12 Analog Sensor Controllers
- 13 Video Microscope
- 14 Technical Guide

Fibre Unit Selection Chart

Detecting distance using FS-T1G/FS-M1H

Fibre unit

Type	Shape	Detecting distance ¹ (mm)	Weight (Approx.)	Model
Thru-beam	Standard 3 mm dia. M4	190	19g	FU-5F <i>Free-cut</i>
		120	21g	FU-7F <i>Free-cut</i>
	ToughFlex 3 mm dia. M4	160	19g	FU-5FZ <i>Free-cut</i>
		100	21g	FU-77, 77G <i>Free-cut</i> (1 m)
	High-flex 1.5 mm dia. M3	65	3g	FU-59 <i>Free-cut</i>
		40	6g	FU-79 <i>Free-cut</i>
	Sleeve 1.65 mm dia. M4 Min. bend radius of sleeve: 10 mm	190	24g	FU-73 <i>Free-cut</i>
		120		
	Side-view 0.82 mm dia. 2.5 mm dia. Do not bend sleeve.	20	5g	FU-32 <i>Free-cut</i>
		12		
Area detection		300	23g	FU-12 <i>Free-cut</i>
Heat-resistant M4	120	66g	FU-84C	
	75			
Diffuse-reflective	Standard 3 mm dia. M6	80	8g	FU-4F <i>Free-cut</i>
		50	21g	FU-6F <i>Free-cut</i>
	ToughFlex M4 M6	36	10g	FU-66Z <i>Free-cut</i>
		20	21g	FU-67, 67G <i>Free-cut</i> (1 m)
	Coaxial M3	28	6g	FU-35FA <i>Free-cut</i>
		17		
	High-flex 1.5 mm dia. M3	12	3g	FU-49X
		8	3g	FU-69X
	Sleeve 1.65 mm dia. 4 mm dia. Do not bend sleeve. 1.65 mm dia. M4 Min. bend radius of sleeve: 10 mm	24	8g	FU-43 <i>Free-cut</i>
		15	10g	FU-63 <i>Free-cut</i>
4		10g	FU-63T <i>Free-cut</i>	
Heat-resistant M4	50	23g	FU-83C	
	30			
Heat-resistant M4	80	21g	FU-85 <i>Free-cut</i>	
	50			
		20		

■ When using the FS-M1H (TURBO mode)
 ■ When using the FS-M1H (FINE mode)
 ■ When using the FS-T1G

1. Detecting range varies depending on detecting distance and target diameter. Refer to "Characteristics".

Detecting distance for reflective sensors were obtained using a white paper target (standard target).

Attachment (with FS-M1H/T1G)

Type		Side-view			Long-detecting distance		
Model		F-1			F-2		
Fibre unit		FU-7F, 86 ¹	FU-77, 77G	FU-84C ¹	FU-7F, 86	FU-77, 77G	FU-84C
Detecting distance (mm)	FS-M1H (FINE)	160	120	100	800	600	500
	FS-M1H (TURBO)	250	220	160	1300	1000	800
	FS-T1G	70	50	45	400	350	250

Type		Ultra-long-detecting distance		Focusing lens	
Model		F-4		F-2HA	F-3HA
Fibre unit		FU-7F, 86	FU-77, 77G	FU-35FA	
Detecting distance (mm)	FS-M1H (FINE)	1300	1000	8	20
	FS-M1H (TURBO)	2100	1600	10	30
	FS-T1G	600	500	8	15

1. To use the F-1 with the FU-84C or FU-86, specify the heat-resistant F-1 when ordering.

Specifications

0-line system

Simple wiring connector unit

Model	NPN	FS-R0
Power supply		12 to 24 VDC ±5%, max. ¹
Current consumption		20 mA or less, plus current consumed by expansion units connected
Expandable inputs		16 (15 when using stability output)
Number of outputs		16
Response time		410 µs to 1.2 ms ²
Control output		NPN 50 mA max. (40 V max.) Residual voltage: 1 V max.

1. Change the supply voltage to meet the requirement of the input device (PLC, etc.).
2. The response speed varies depending on the number of expansion units connected.

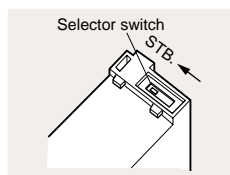
Terminal block unit

Model	FS-R3
Power supply	12 to 24 VDC ±5% max. ¹
Current consumption	50 mA or less, plus current consumed by connected sensor (100 mA max.)
Expandable inputs	2
Input signal	NPN/PNP non-voltage input (contact, solid-state) switching
Response time	350 µs to 1 ms ²
Output mode	N.O./N.C. (switch-selectable)

1. Change the supply voltage to meet the requirement of the input device (PLC, etc.).
2. The response speed varies depending on the number of expansion units connected.

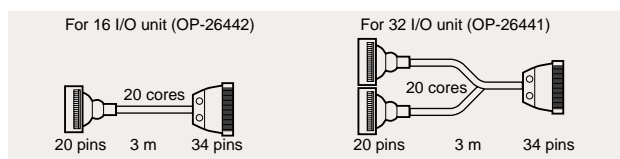
Using stability output

There is a selector switch located on the bottom of the FS-R0. By sliding the selector switch in the direction of the arrow, the stability output of any sensor that runs on will output from OUT 15.



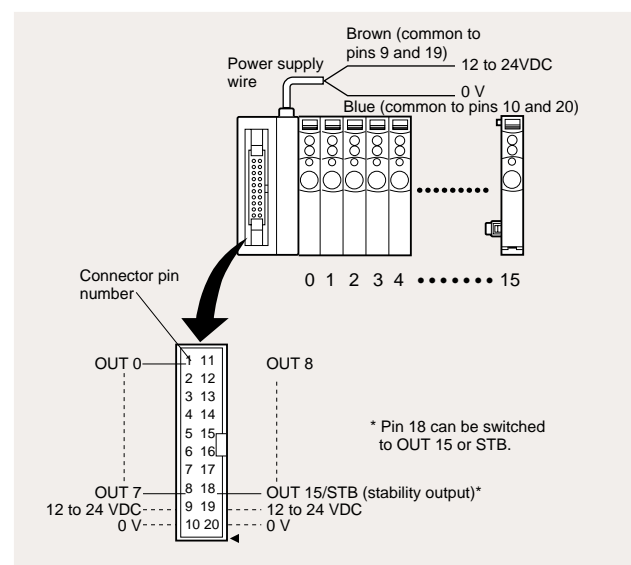
Cable with MIL connector (FS-R0)

(For connecting to the programmable logic controller)



Contact KEYENCE for cables for programmable logic controllers made by other manufacturers.

Connector pin assignment (FS-R0)

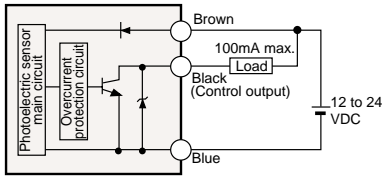


Input/Output Circuits

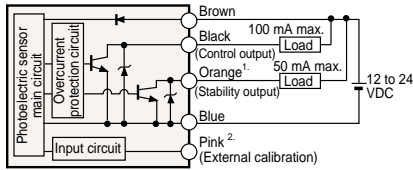
Output circuit

NPN

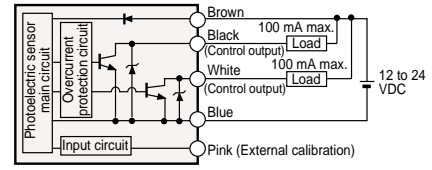
FS-V11



FS-T1/M1/T1G/M1H

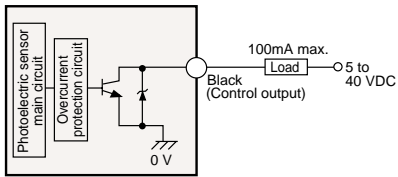


FS-V1



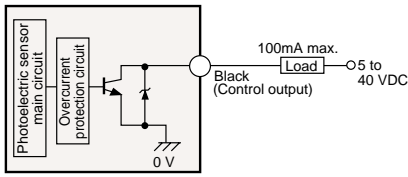
1. When the stability output is not used, cut the orange cable at the base, or connect this cable to the 0 V terminal of the power supply.
2. The FS-M1/M1H does not have a pink cable (for external calibration).

FS-V12



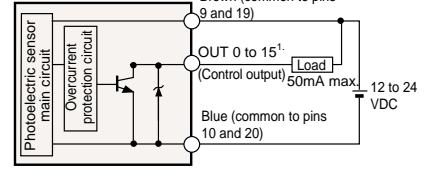
Power is supplied through the main unit.

FS-T2/M2



Power is supplied through the main unit.

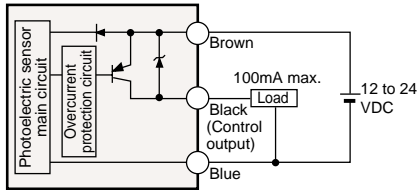
FS-R0



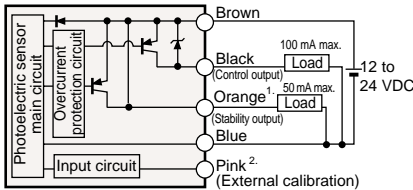
When OUT 15 is switched to STB, an over-current protection circuit is not provided.

PNP

FS-V11P

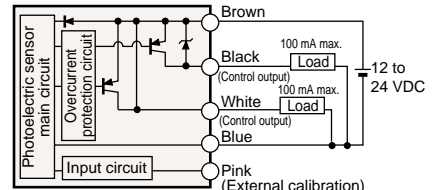


FS-T1P/M1P

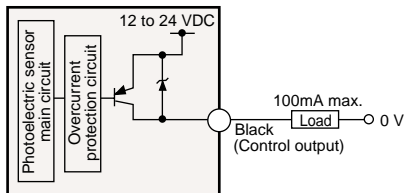


1. When the stability output is not used, cut the orange cable at the base, or connect this cable to the positive terminal of the power supply.
2. The FS-M1P does not have a pink cable.

FS-V1P

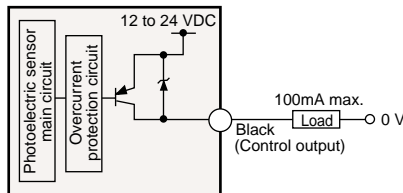


FS-V12P



Power is supplied through the main unit.

FS-T2P/M2P



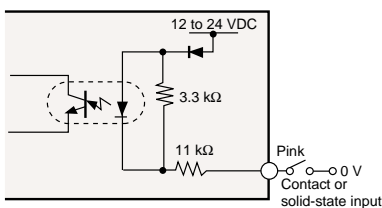
Power is supplied through the main unit.

Input circuit

NPN

FS-T1/T1G/V1

External calibration input circuit

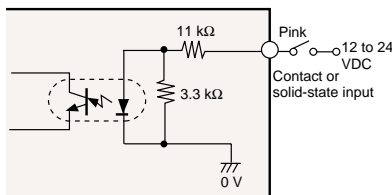


When the external calibration input is not used, cut the pink cable at the root, or connect this cable to the positive terminal of the power supply.

PNP

FS-T1P/V1P

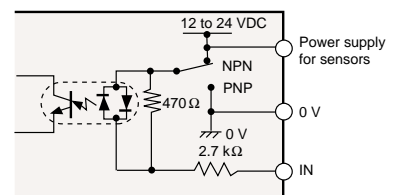
External calibration input circuit



When the external calibration input is not used, cut the pink cable at the root, or connect this cable to the 0 V terminal of the power supply.

NPN/PNP

FS-R3



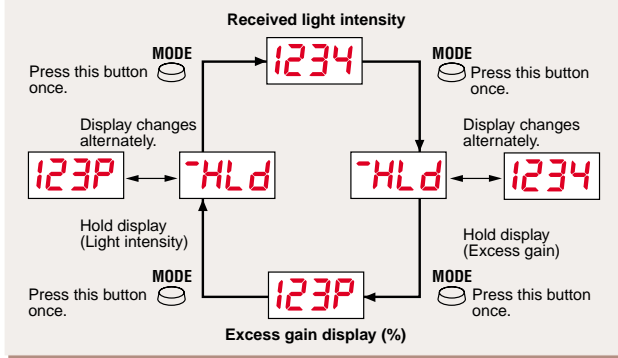
Power is supplied through the main unit.

Adjustment

FS-V10 Series

Selecting displayed data

The display changes every time the MODE button is pressed.



Displaying the setting value

Press or once while the received light intensity is displayed. The setting value flashes for 2 seconds, and then the received light intensity appears once more.

[Note]

To change the setting value, press or while the setting value is flashing.

• Displaying received light intensity

Received light intensity is displayed 4095 max.

[Note]

The MAX and MIN values vary depending on the fibre unit connected.

• Displaying excess gain

Received light intensity is converted by defining the setting value as 100 P (%).

- Stable LIGHT status is obtained with 110 P (%) or more.
- Stable DARK status is obtained with 90 P (%) or less.

• Displaying the hold value

The peak value or the minimum value of the received light intensity or excess gain is displayed.

The setting of the output selector switch determines whether the peak value or the minimum value is displayed.

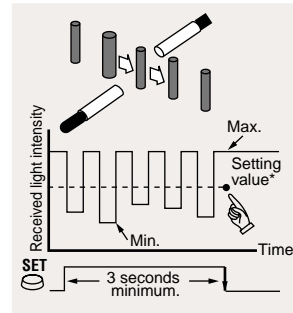
Output selector switch	Display	Hold value
LIGHT-ON	-HLD	Peak-hold value
DARK-ON	-HLD	Bottom-hold value

Setting the sensitivity (Automatic calibration)

Select the sensitivity setting procedure according to the target condition.

When the setting is completed, the setting value flashes twice.

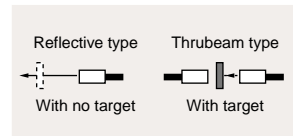
For sensitivity adjustment using a moving target
• Fully-automatic calibration



1. Pass a target through the optical axis while pressing the SET button.
 2. The calibration indicator (orange LED) flashes.
 3. Release the SET button. (The orange LED goes off.)
- *The setting value is adjusted to the midpoint of the difference between the maximum and minimum values of the received light intensity.

If the fully-automatic calibration does not work properly, try the two-point calibration.

• Maximum sensitivity setting

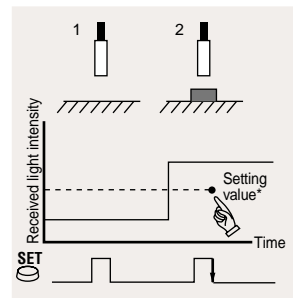


When the reflective type is used to detect a target with some objects in the background, the sensitivity is set to the maximum value at which the background objects are not detected.

1. Under the conditions on the left, press the SET button for 3 seconds or more.
2. The calibration indicator (orange LED) flashes.
3. Release the SET button. (The orange LED goes off.)

If the detecting distance is insufficient, try the two-point calibration.

For sensitivity adjustment using a stationary target
• Two-point calibration

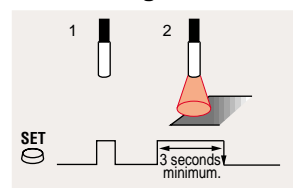


1. With no target in place, press the SET button and release it. (The orange LED lights.)
2. Position a target in place. Press the SET button again and release it. (The orange LED goes off.)

*The setting value is adjusted to the midpoint of the difference in the received light intensity when the target is absent and present.

For target positioning

• Positioning calibration



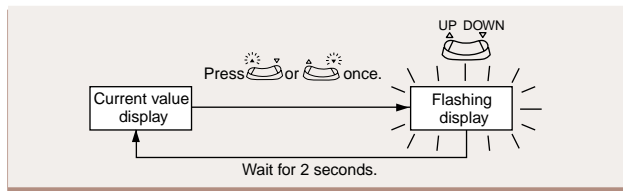
1. With no target, press the SET button and release it. (The orange LED lights.)
2. Place a target in the position where it is to be stopped.
3. Press the SET button for 3 seconds or more until the calibration indicator (orange LED) flashes. Release the SET button. (The orange LED goes off.)

The setting value is adjusted to turn on the sensor when the target comes to the place where it should be stopped.

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Changing the setting value (Manual calibration)

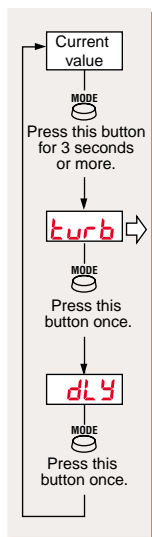
Use only the button.



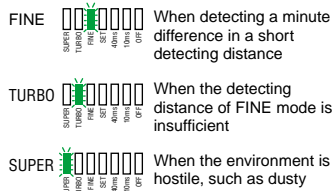
• **When the sensitivity difference is insufficient**
If the sensitivity has no allowance, “- - -” flashes immediately after the completion of the automatic calibration.

[Note]
Sensitivity is set and entered even when the sensitivity difference is insufficient. Be sure to confirm that the detection is properly performed.

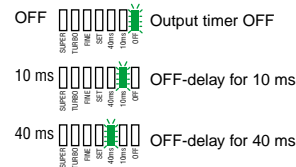
Selecting mode (Power/Timer)



Power selection
One lamp in the bar graph LED monitor flashes to show the currently selected power mode. Press or to choose the desired power mode.



Timer selection
One lamp in the bar graph LED monitor flashes to show the currently selected output timer mode. Press or to choose the desired timer mode.



[Note]
Be sure to readjust the sensitivity after the power mode is changed.

Bar graph LED monitor in normal operation

The LEDs show the received light intensity with respect to the setting value. The monitor shows the stability level of the current detection.

The light is steadily received.	+15% or more
↓	+10% or more
The light is irregularly received.	+5% or more
↓	Setting value
The light is irregularly interrupted.	-5% or less
↓	-10% or less
↑	-15% or less
The light is steadily interrupted.	

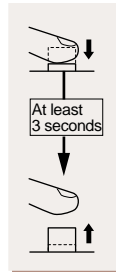
When the detection becomes unstable due to the change in surrounding environment or targets, readjust sensitivity.

FS-V1/FS-T Series

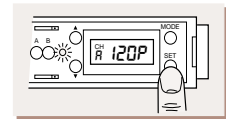
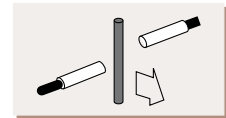
Select the sensitivity setting procedure according to the target condition. (FS-T has no display.)

For sensitivity adjustment using a moving target

• Fully automatic calibration

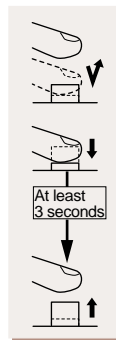


1. Pass a target through the optical axis while pressing the SET button.
2. Confirm that the calibration indicator (yellow LED) flashes.
3. Release the SET button. The calibration indicator goes off.

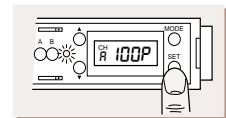
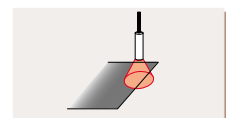


For target positioning

• Positioning calibration



1. With no target, press the SET button and release it. The calibration indicator (yellow LED) lights.
2. Place a target in the position where it is to be stopped.
3. Press the SET button until the calibration indicator flashes.
4. Release the SET button.

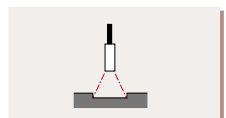
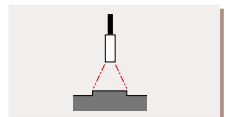


To detect a minute difference

• Two-point calibration

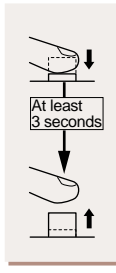


1. With a target in place, press the SET button and release it. The calibration indicator (yellow LED) lights.
2. With the target removed, press the SET button and release it. The calibration indicator goes off.

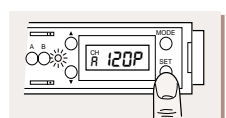
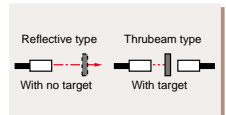


For stable detection unaffected by dust

• Maximum sensitivity setting



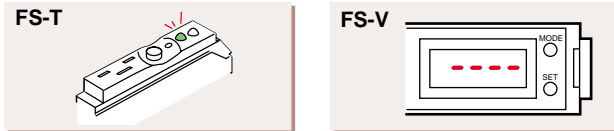
1. Under the following conditions, press the SET button until the calibration indicator (yellow LED) flashes.
2. Release the SET button. The calibration indicator goes off.



Precautions for adjustment

When the sensitivity difference is insufficient:

- After calibration is completed, the stable operation indicator (green LED) flashes if the sensitivity difference is insufficient. The FS-V1 LCD display flashes a row of dashes.



- When the external calibration function is used, the stability output remains on for another 3 seconds after the calibration input is turned off.

[Note]

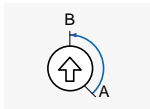
Sensitivity is set and registered even when the sensitivity difference is insufficient. Be sure to confirm that detection is properly performed.

FS-M Series

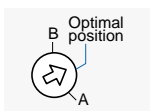
LIGHT-ON mode (When DARK-ON mode is specified, refer to symbols and words in parentheses.)



- With no target, turn the trimmer clockwise until the red LED indicator lights (turns off). – Point A



- With a target in place, turn the trimmer counterclockwise until the green LED turns off (lights). – Point B

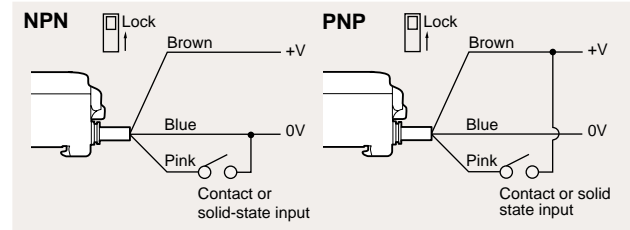


- Set the trimmer midway between points A and B. Confirm sensor operation.

External calibration function

Sensitivity can be set using a signal input from an external device. The input time should be 20 ms or more. For external calibration, set the key-protection switch to LOCK.

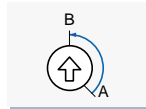
When several units are connected, only the units with the key-protection switch set to LOCK are externally calibrated.



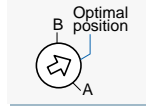
DARK-ON mode (When LIGHT-ON mode is specified, refer to symbols and words in parentheses.)



- With a target in place, turn the trimmer clockwise until the red LED indicator turns off (lights). – Point A



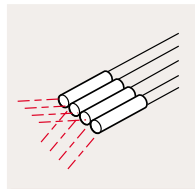
- With no target, turn the trimmer counterclockwise until the green LED lights (turns off). – Point B



- Set the trimmer midway between points A and B. Confirm sensor operation.

Mutual Interference Prevention Function

- Up to four sensors can be connected without being affected by light beams from adjacent units.

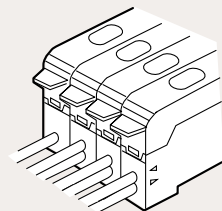


- When several units are connected, the FS01 Series alternates the light emission timing with up to four sensors so that the adjacent sensors' light beams do not affect detection.
- When the TURBO mode is selected with the FS-M Series, up to 8 sensors enable stable detection without mutual interference.

- The FS-V, FS-T Series and FS-M Series can be used together.

[Note]

When only a single unit is used, the mutual-interference prevention function cannot be used.

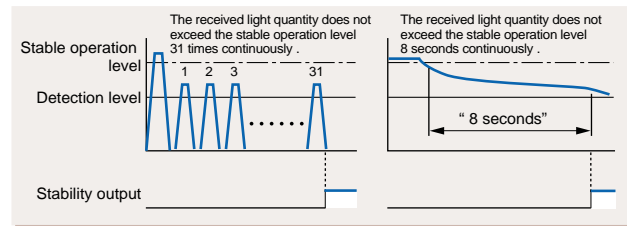


Self-diagnostic Function

When the received light quantity exceeds the detection level but does not exceed the stable operation level "31 times continuously" or "for 8 seconds continuously", the stability output is activated.

Reset: When the stability output is activated, clean the front surface of the fibre unit or realign the optical axis so that the stable operation indicator (green LED) lights again. The stability output is reset when detection is done with the stable operation indicator (green LED) turned on.

Operation chart



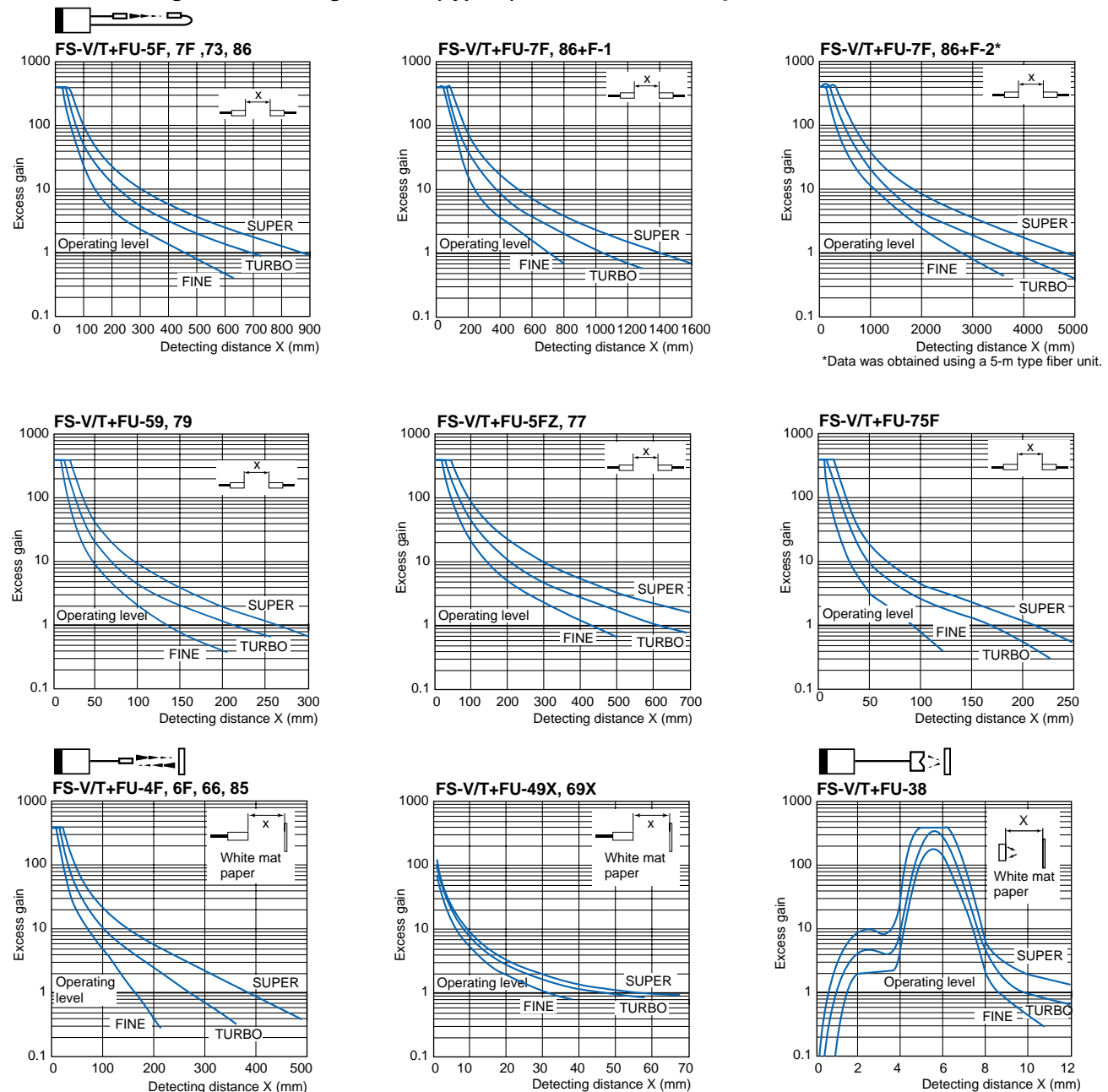
[Note]

When several units are connected, the stability outputs of all the units are output from the main unit based on OR logic.

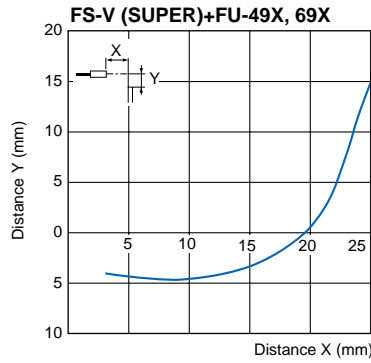
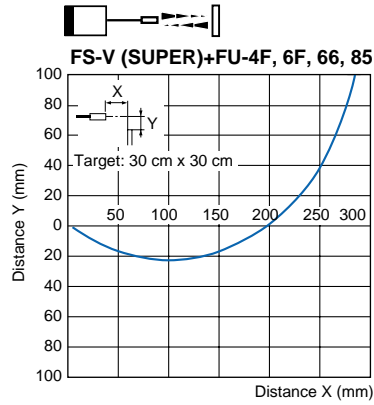
Characteristics

Receiver excess gain vs. detecting distance (Typical)

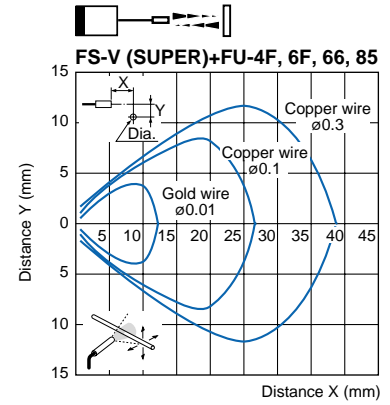
FS-T1/V1 detecting distance is the same as that for FINE mode.



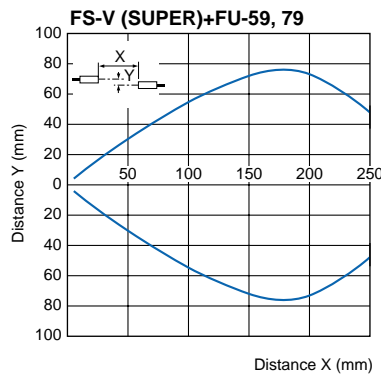
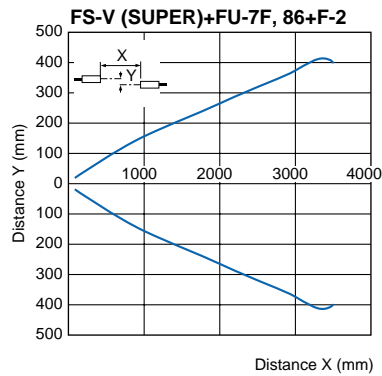
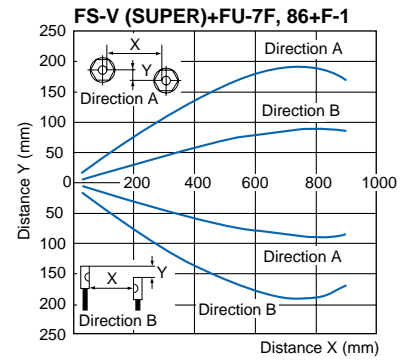
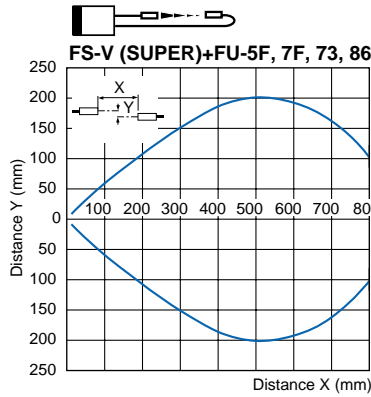
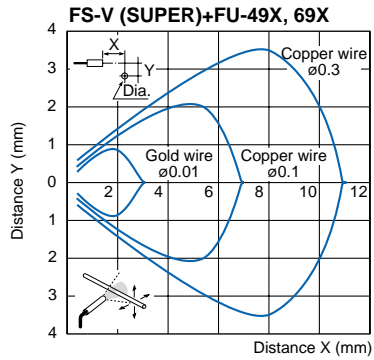
Operating distance vs. detecting distance (Typical)



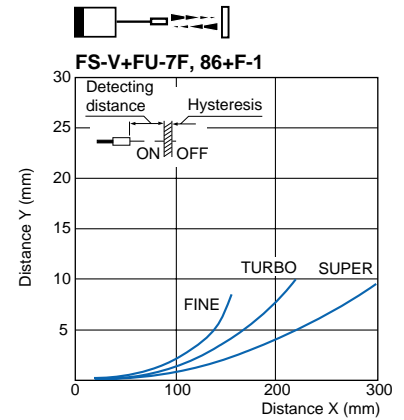
Detecting area (Typical)



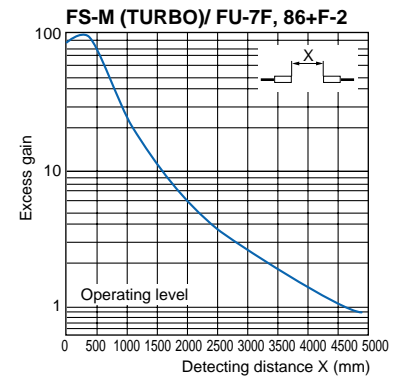
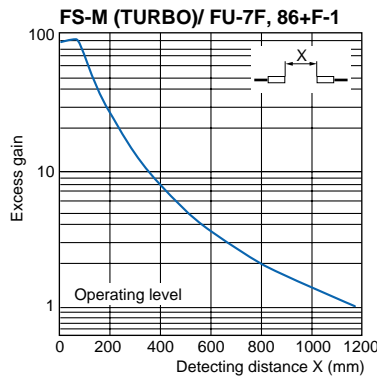
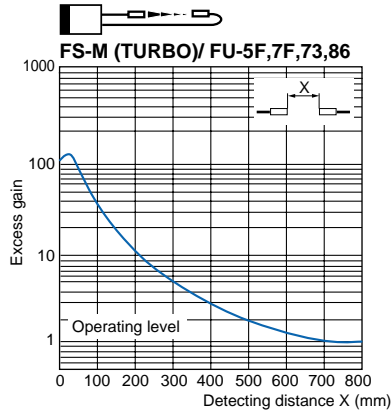
Parallel displacement of optical axis (Typical)



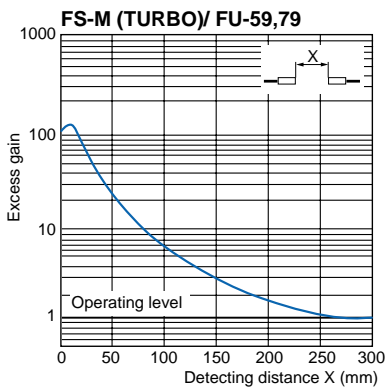
Hysteresis (Typical)



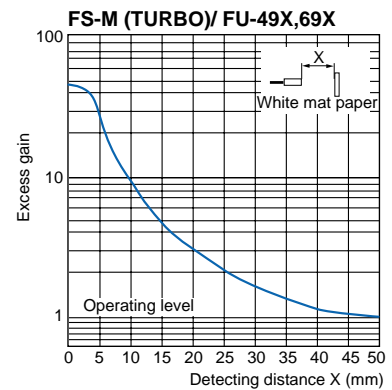
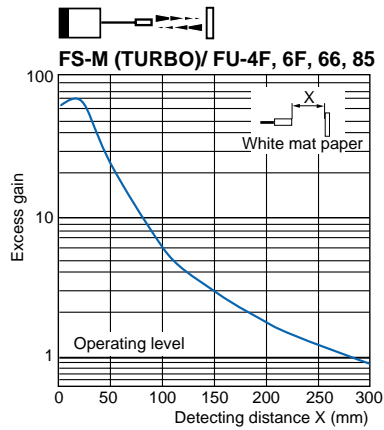
Receiver excess gain vs. detecting distance (Typical)



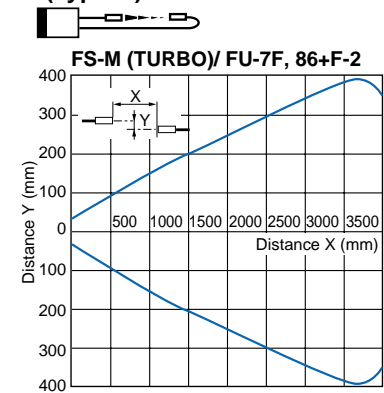
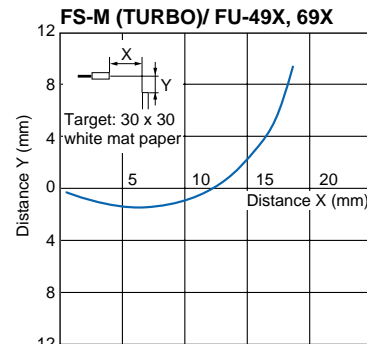
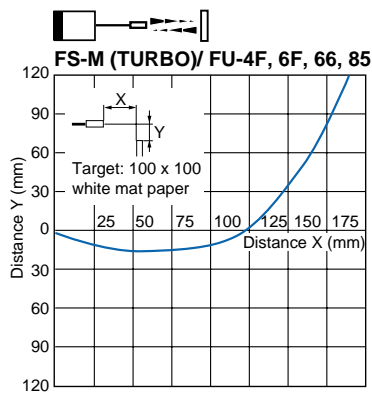
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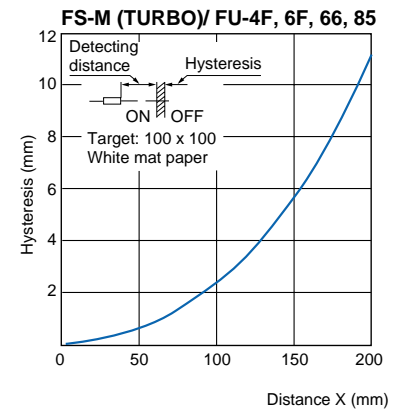
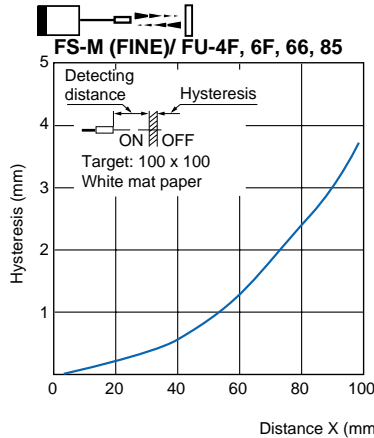
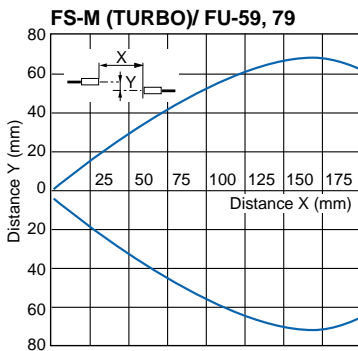
Operating distance vs. detecting distance (Typical)



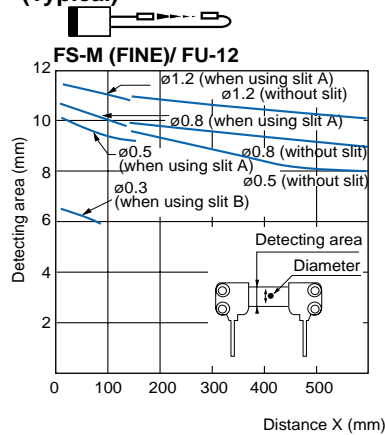
Parallel displacement of optical axis (Typical)



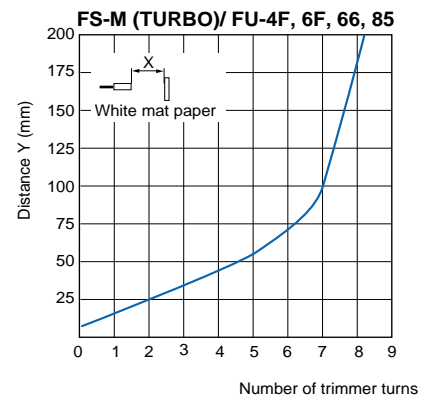
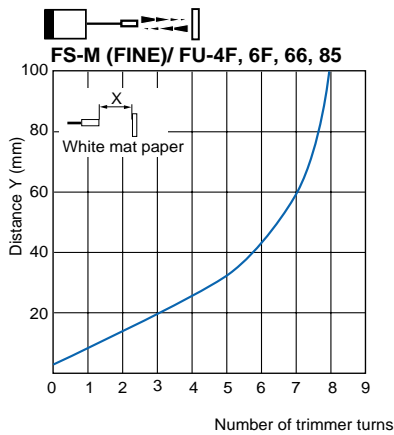
Hysteresis (Typical)



Target diameter vs. detecting area (Typical)



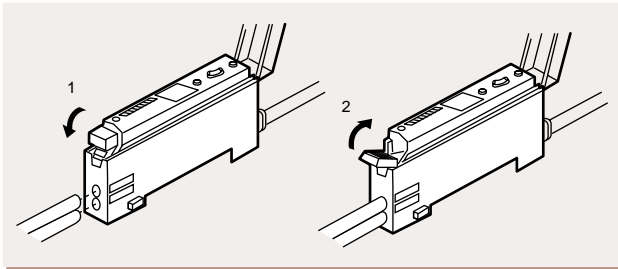
Number of trimmer turns vs. detecting distance (Typical)



Hints on Correct Use

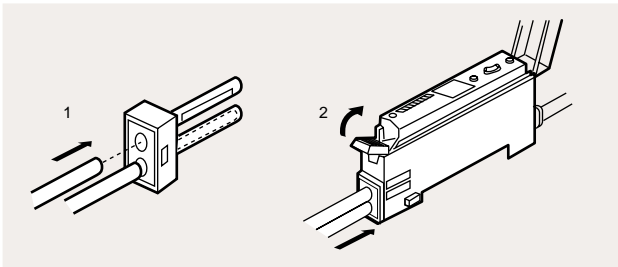
Mounting the fibre unit

Tilt the quick-release lever. Insert the fibre unit until it stops, and then lift the quick-release lever.



- To connect a fibre unit with a small diameter, use the adapter included with the FU Series.

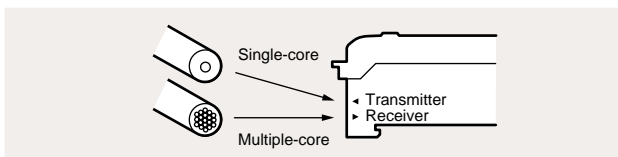
1. Attach the adapter to the fibre unit.
2. Fully insert the adapter into the mounting holes of the amplifier, and then lift the quick-release lever.



- The required adapter is included in each model of the FU Series. If an inadequate adapter is used, the fibre unit cannot be properly installed.

Type	Shape	Applicable fibre unit
Adaptor A (OP-26500)	 For 1.3 mm diameter	FU-32/35FA/35FZ/4F/4FZ/43/63/63Z/63T/66/66Z/78/91/93
Adaptor B (OP-26501)	 For 1 mm diameter	FU-16/18/31/37/38/38V/48/59/68/75F/79/95

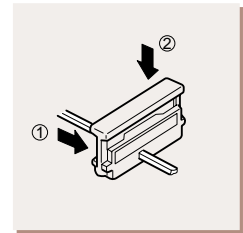
- To connect the coaxial reflective type fibre unit to the amplifier, connect the single-core fibre to the transmitter side, and connect the multiple-core fibre to the receiver side. (Connect the fibres according to the marking on the amplifier lateral side.)



Using the cutter

Cut the free-cut fibre unit to the desired length using the included cutter.

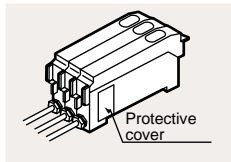
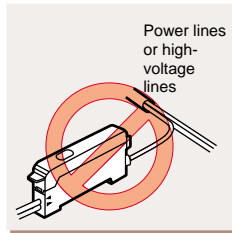
1. Insert the fibre unit into the corresponding cutter hole to the desired length.
2. Cut the fibre by quickly pushing the blade all the way down. Stopping the blade midway will prevent a clean cut, thereby lessening the detecting distance. Do not use a cutter hole more than once.



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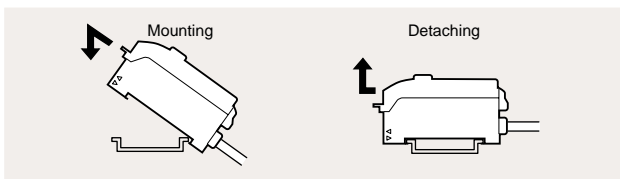
Amplifier

- When extending, use the cable whose sectional area is more than 0.3 mm³. Do not extend the cable more than 100 m. (When using the expansion unit, contact Keyence.)
- If the amplifier cable is placed together with power lines or high-voltage lines in the same conduit, detection error may occur due to noise interference, or the sensor may be damaged. Isolate the amplifier cable from these lines.
- Do not use the FS01 Series outdoors, or in a place where extraneous light can enter the light-receiving surface directly.
- When the external calibration input is not used, cut the pink cable at the base, or connect this cable to the 0 V terminal of the power supply. If the wiring is incorrect, the unit may heat up, or the sensitivity setting may fluctuate.
- Do not remove the protective cover of the expansion connector on the outermost unit.



Mounting/Detaching the amplifier to/from a DIN rail or the mounting bracket

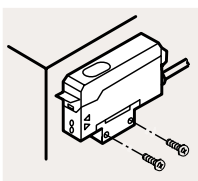
Hook the claw located at the amplifier cable side onto the DIN rail, and then hook the front side claw to the rail while pressing the amplifier forward. To detach the amplifier, unhook the front claw by lifting the amplifier front side while pressing it forward.



Do not detach several units at one time that are connected together.

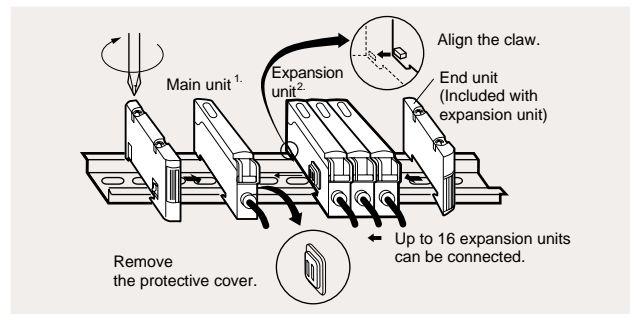
Side mounting (main unit)

Using the side holes of the standard mounting bracket, fix the amplifier with the screws.



Mounting expansion unit

- Mount amplifiers to a DIN rail one at a time.
- Slide one expansion unit toward another. Align the front claws of the amplifiers and push the amplifiers together until they click.
- Fix the amplifiers together by pushing an end unit onto each end (The end units are included in the expansion unit. Be sure to use end units.)



- The FS-V11/V1/T1/M1, PS-T1, CZ-K1 (1-line connection) and FS-R0 (0-line connection) can be used as the main unit.
- The FS-V12/T2/M2, PS-T2 (1-line connection) and FS-T0/M0 (0-line connection) can be used as the expansion unit. (The FS-T Series and FS-M Series can be used together.)

[Notes]

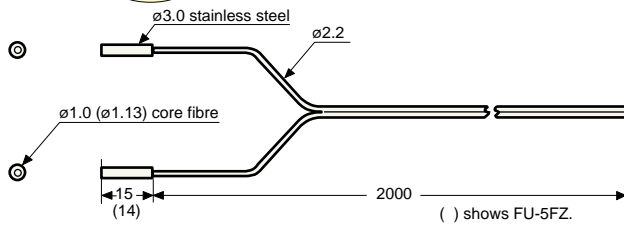
- When several units are connected, confirm the ambient temperature. (See "Specifications".)
- To connect several units, be sure to use a DIN rail and end units.
- When detaching amplifiers from DIN rail, slide the expansion units apart, and detach them individually.

Dimensions

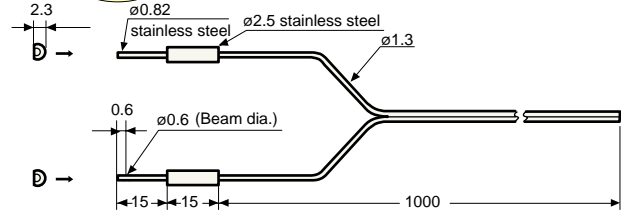
Unit: mm

Thru-beam type

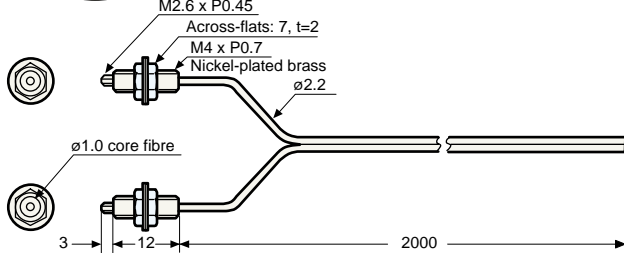
FU-5F/5FZ (Free-cut)



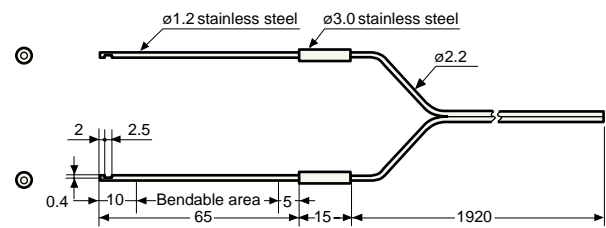
FU-32 (Free-cut)



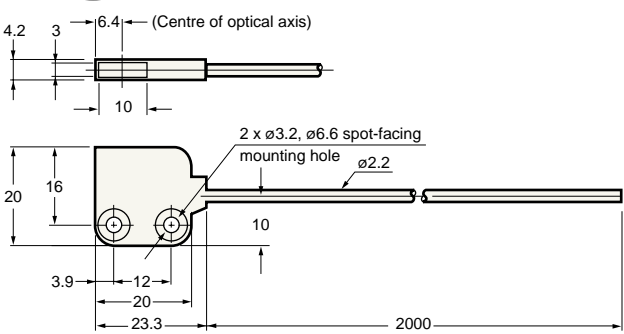
FU-7F (Free-cut)



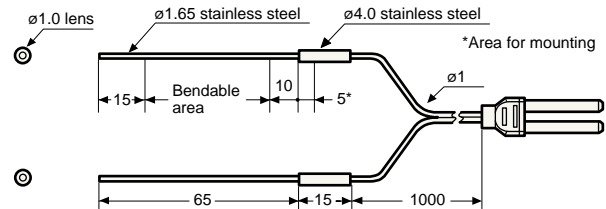
FU-34 (Free-cut)



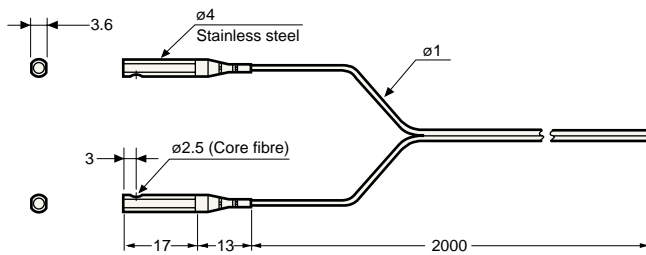
FU-12 (Free-cut)



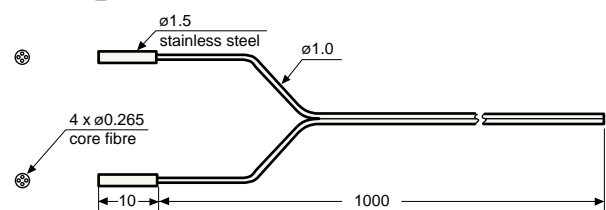
FU-36X



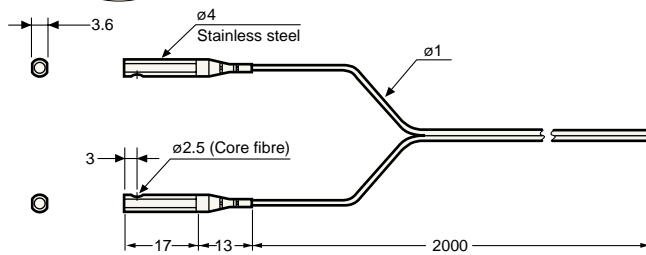
FU-16 (Free-cut)



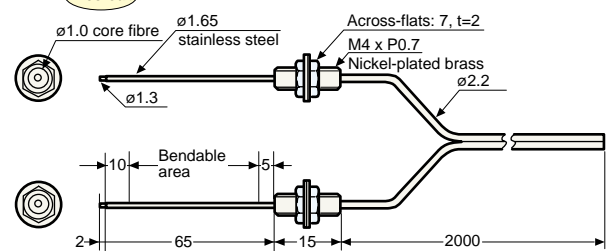
FU-59 (Free-cut)



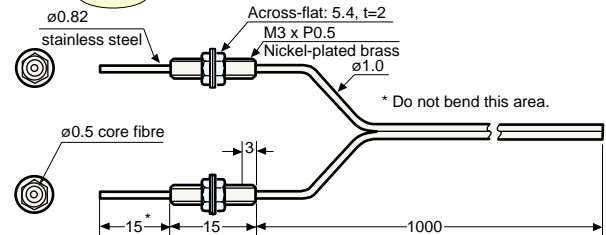
FU-18 (Free-cut)



FU-73 (Free-cut)



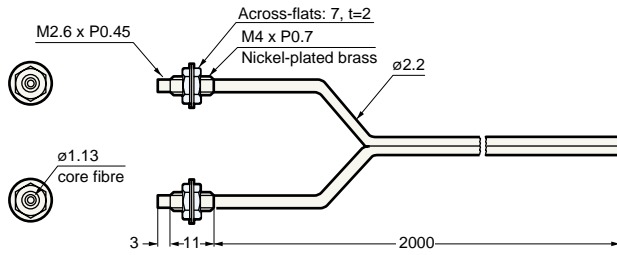
FU-75F (Free-cut)



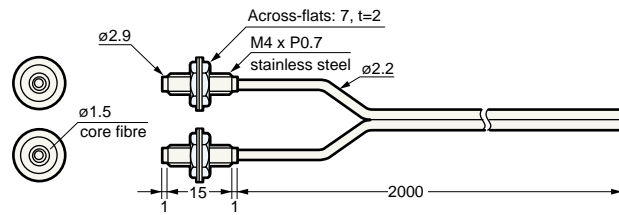
Photoelectric Sensors	1
Safety Light Curtains	2
Proximity Sensors	3
Pressure Sensors	4
Programmable Logic Controllers	5
Counters, Control Units	6
High Precision Sensors	7
Vision Systems	8
Bar Code Readers	9
Displacement Sensors	10
Thru-beam Measuring Instruments	11
Analog Sensor Controllers	12
Video Microscope	13
Technical Guide	14

Unit: mm

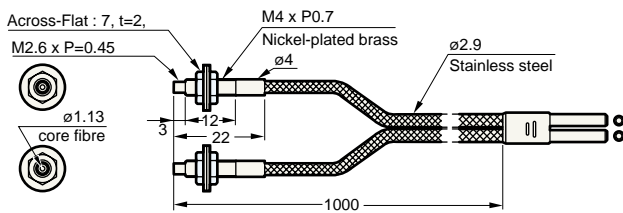
FU-77 *Free-cut*



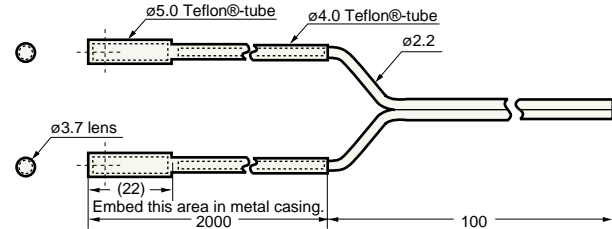
FU-88 *Free-cut*



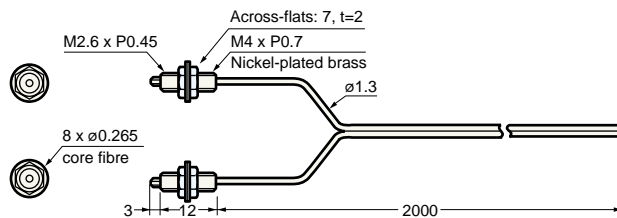
FU-77G



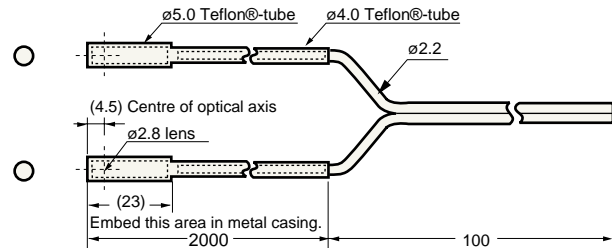
FU-92 *Free-cut*



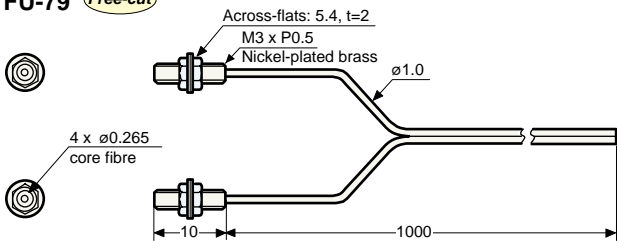
FU-78 *Free-cut*



FU-96 *Free-cut*

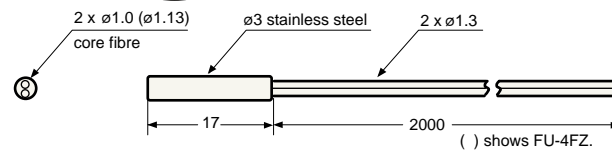


FU-79 *Free-cut*

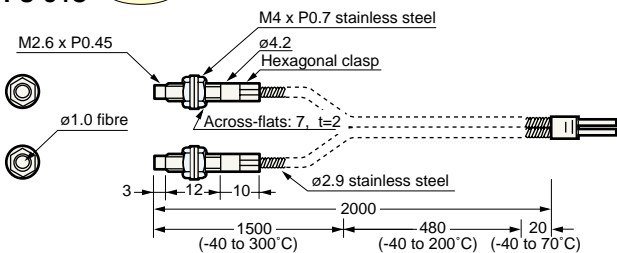


Diffuse-reflective type

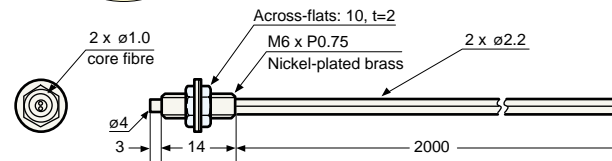
FU-4F/4FZ *Free-cut*



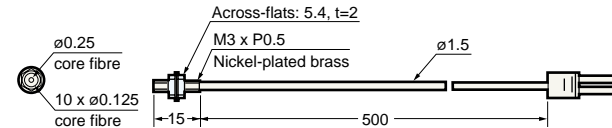
FU-84C *Free-cut*



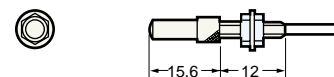
FU-6F *Free-cut*



FU-21X

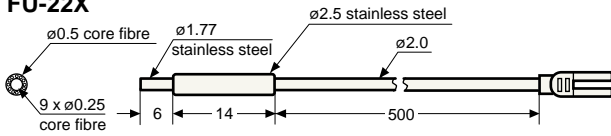


FU-21X+F-2HA

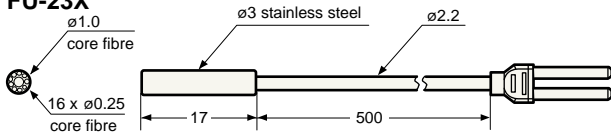


Unit: mm

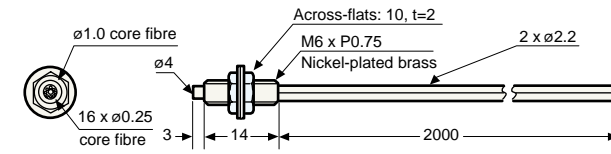
FU-22X



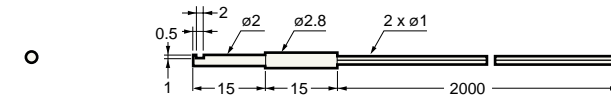
FU-23X



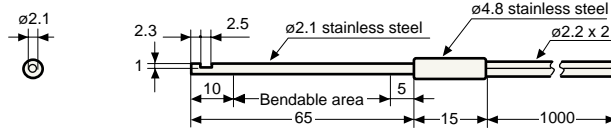
FU-25 (Free-cut)



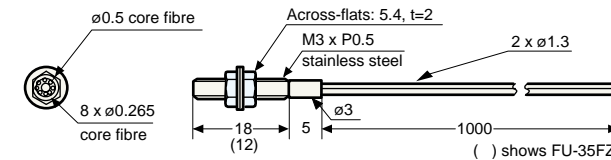
FU-31 (Free-cut)



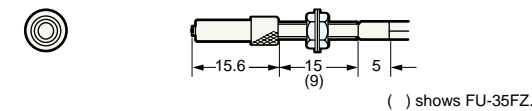
FU-33 (Free-cut)



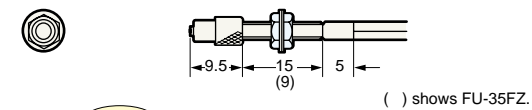
FU-35FA/35FZ (Free-cut)



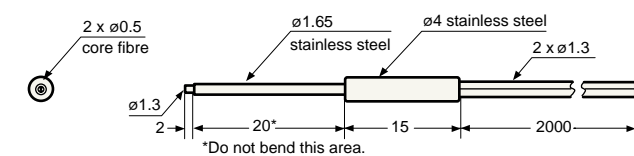
FU-35FA(35FZ)+F-2HA



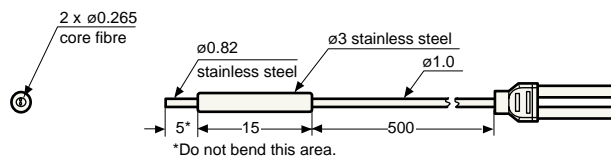
FU-35FA(35FZ)+F-3HA



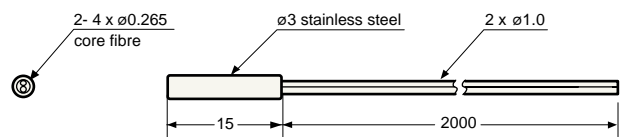
FU-43 (Free-cut)



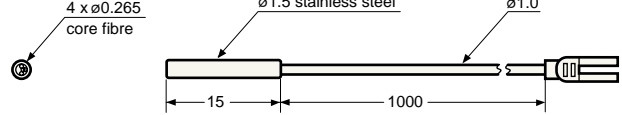
FU-45X



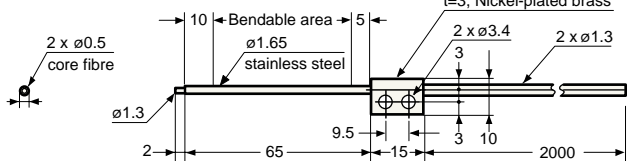
FU-48 (Free-cut)



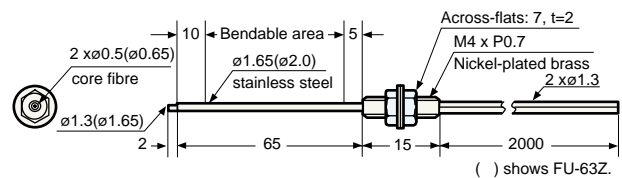
FU-49X



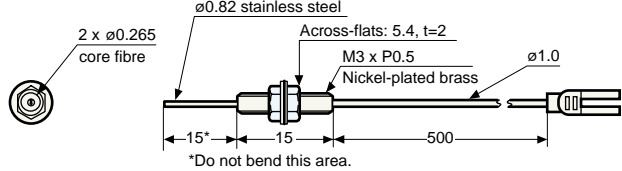
FU-63T (Free-cut)



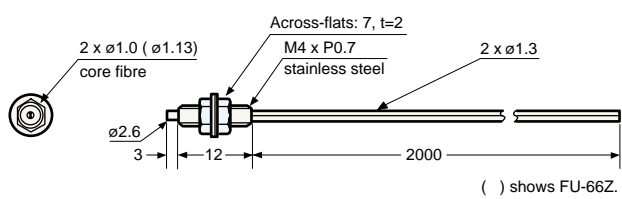
FU-63/63Z (Free-cut)



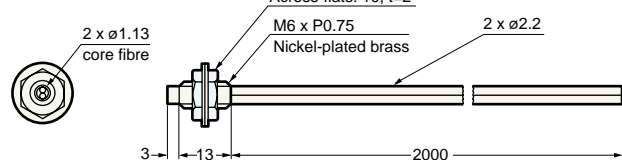
FU-65X



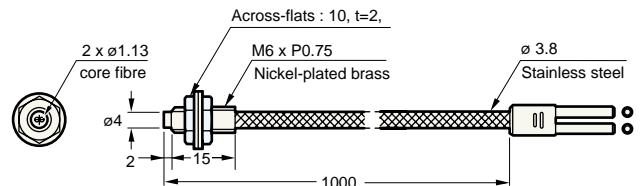
FU-66/66Z (Free-cut)



FU-67 (Free-cut)



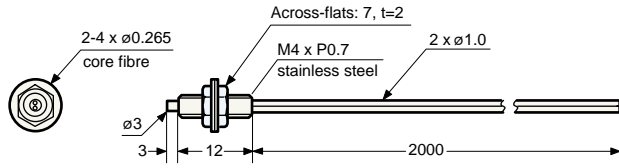
FU-67G



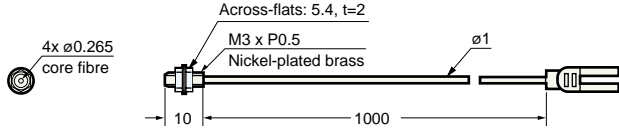
1	Photoelectric Sensors
2	Safety Light Curtains
3	Proximity Sensors
4	Pressure Sensors
5	Programmable Logic Controllers
6	Counters, Control Units
7	High Precision Sensors
8	Vision Systems
9	Bar Code Readers
10	Displacement Sensors
11	Tri-beam Measuring Instruments
12	Analog Sensor Controllers
13	Video Microscope
14	Technical Guide

Unit: mm

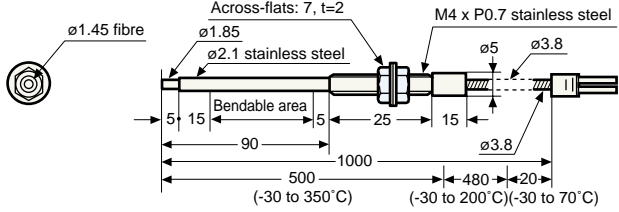
FU-68 (Free-cut)



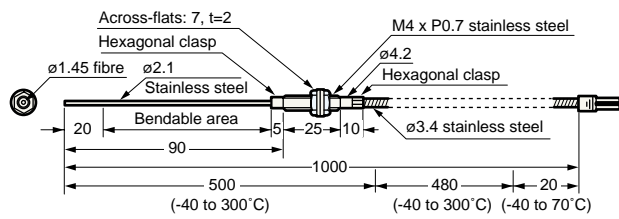
FU-69X



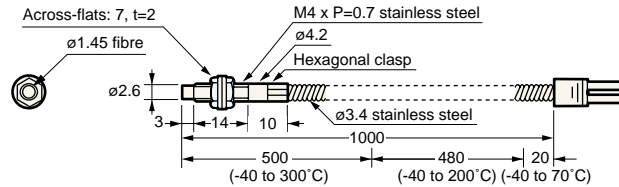
FU-81C



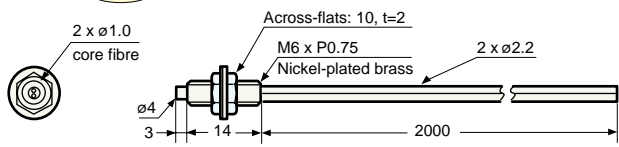
FU-82C



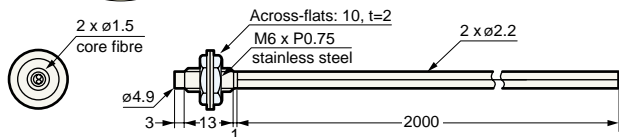
FU-83C



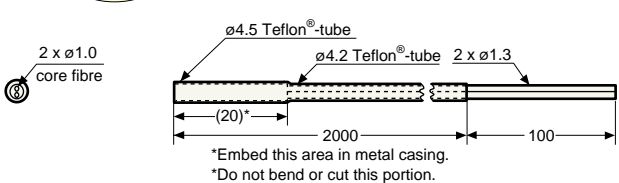
FU-85 (Free-cut)



FU-87 (Free-cut)

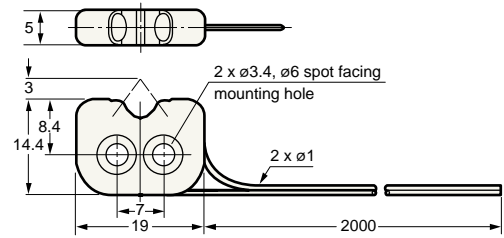


FU-91 (Free-cut)

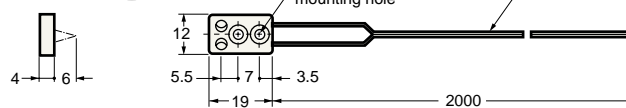


Definite-reflective type

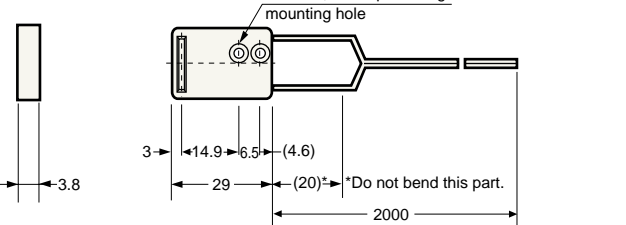
FU-37 (Free-cut)



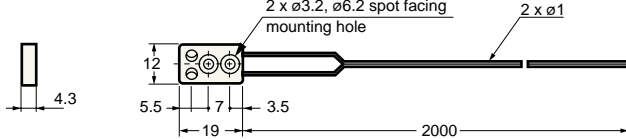
FU-38 (Free-cut)



FU-38R (Free-cut)

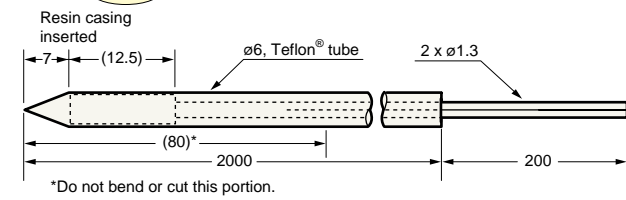


FU-38V (Free-cut)

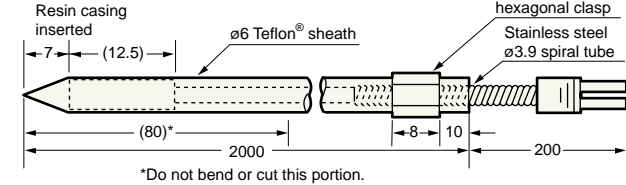


Liquid-level type

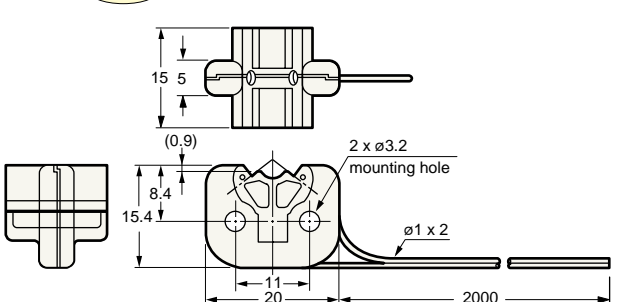
FU-93 (Free-cut)



FU-94C



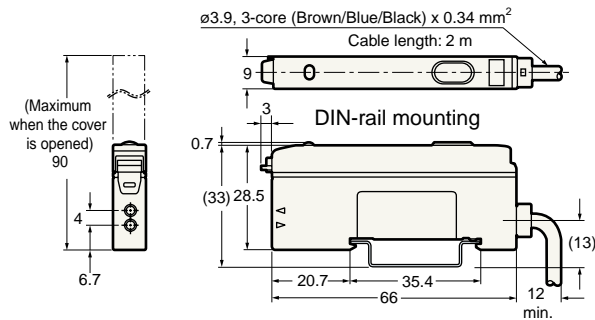
FU-95 (Free-cut)



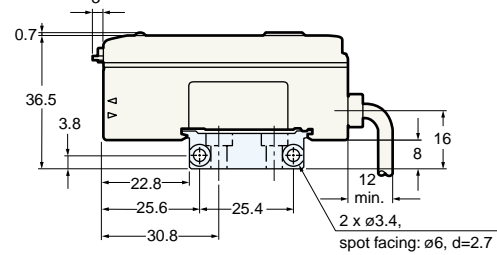
Unit: mm

Amplifier

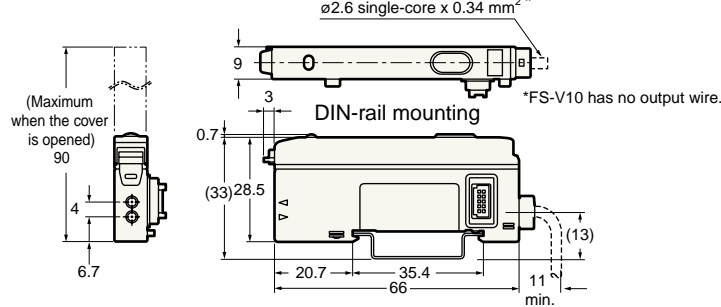
FS-V11(P)



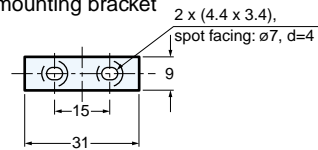
When the mounting bracket (supplied with FS-V11) is attached:



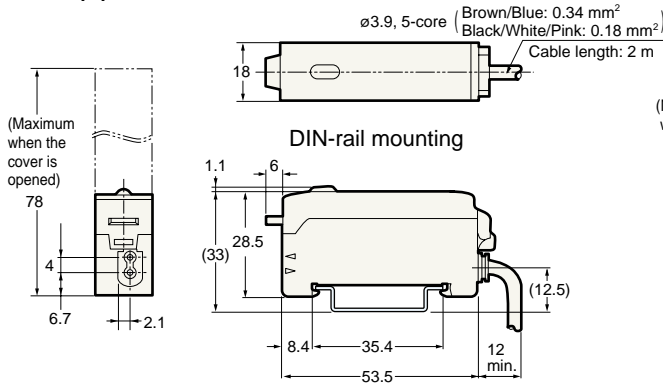
FS-V10/V12(P)



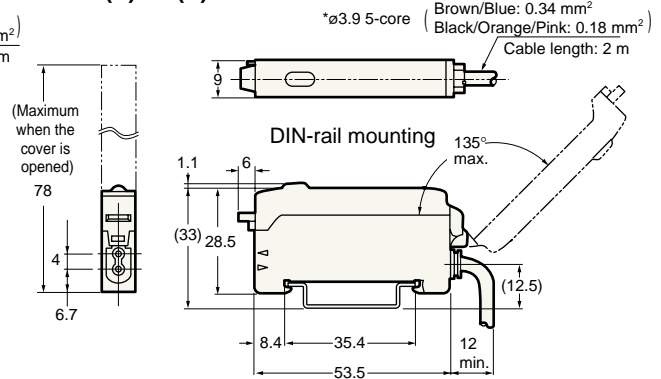
Rear of mounting bracket



FS-V1(P)

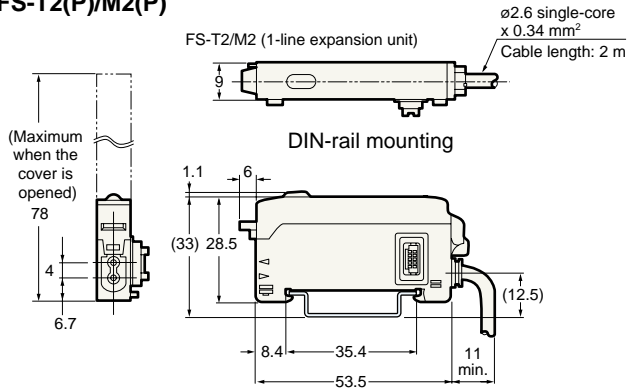


FS-T1(P)/M1(P)/T1G/M1H

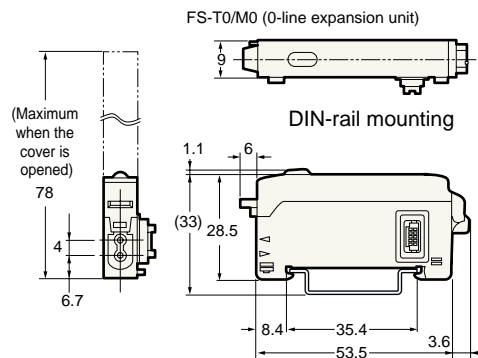


* FS-M1: $\phi 3.9$ 4-core x Brown/Blue: 0.34 mm^2 Black/Orange: 0.18 mm^2

FS-T2(P)/M2(P)



FS-T0/M0

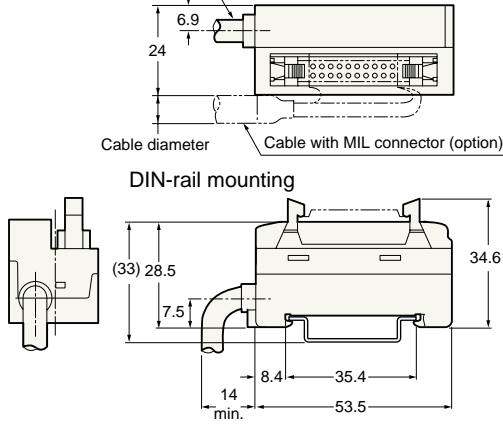


The FS-T0/M0 do not have connecting cables.

1	Photoelectric Sensors
2	Safety Light Curtains
3	Proximity Sensors
4	Pressure Sensors
5	Programmable Logic Controllers
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9	Bar Code Readers
10	Displacement Sensors
11	Tran-beam Measuring Instruments
12	Analog Sensor Controllers
13	Video Microscope
14	Technical Guide

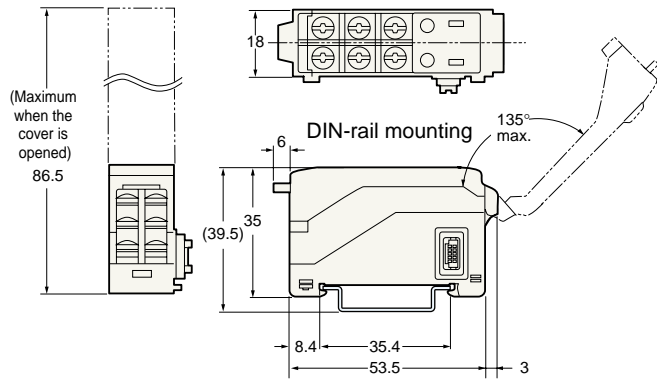
FS-R0

ø5.8 2-core x 0.5 mm²
Cable length: 2 m

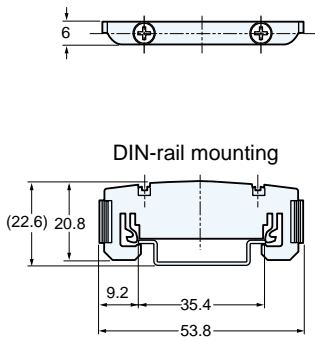


FS-R3

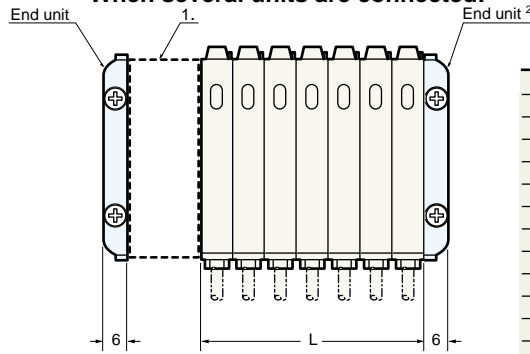
Unit: mm




End unit (included in the FS-R0,T2,M2)



When several units are connected:

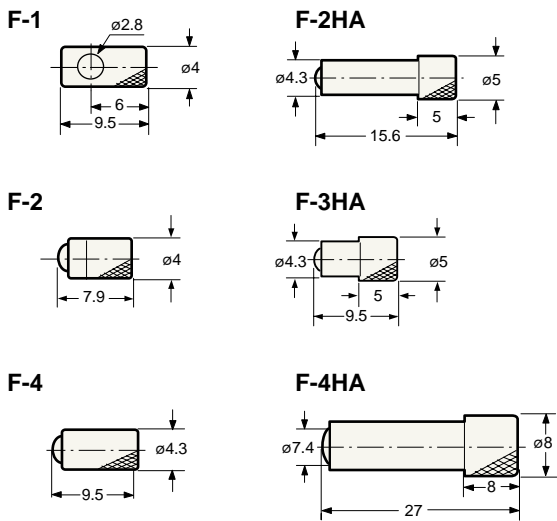


No. of units	L
1	9
2	18
3	27
4	36
5	45
6	54
7	63
8	72
9	81
10	90
11	99
12	108
13	117
14	126
15	135
16	144

1. The FS-V11/V1/T1/M1/R0, PS-T1, CZ-K1 is mounted in .
2. When using expansion units, be sure to use the end unit (accessory to the FS-R0, T2, M2).

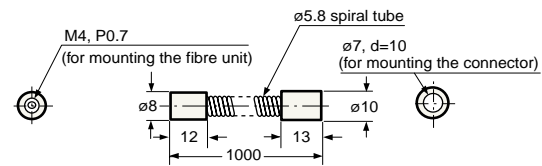
When expanding an FS-R3, refer to the FS-R3 dimensional drawing.

Attachment (optional)

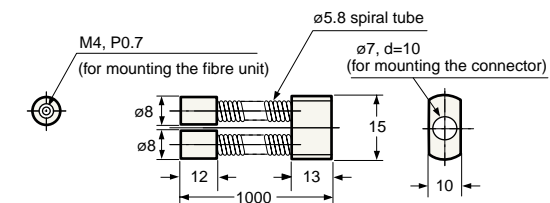


Protective tube (optional)

OP-6630



OP-6631



MEMO

Photoelectric Sensors	1
Safety Light Curtains	2
Proximity Sensors	3
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