


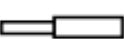
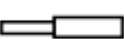


Diffuse-Reflective Fiber Optics

The FD series of diffuse-reflective fiber optics is a wide-ranging family of sensing heads that are suitable for use in all SUNX fiber amplifiers. Fiber types include standard, high flexibility, special use, and environmentally resistant. Each type is broken down further to include various configurations such as side-view, fixed-focus, ultra-small diameter, high precision, and wide beam.

Model Name	Model Pic	Type	Fiber Length (mm)	Bending Radius (mm)	Sensing Range (mm)
Sort ▲ ▼		Sort ▲ ▼	Sort ▲ ▼	Sort ▲ ▼	Sort ▲ ▼
FD-B8		M6 Threaded Type	2000	25	600
FD-FM2		Coaxial M6 Threaded Type	2000	25	410
FD-G4		Coaxial M4 Threaded Type Lens Mountable	2000	25	150
FD-S80		3mm Cylindrical Type	2000	25	370
FD-SNFM2		2.5mm Cylindrical Type	2000	25	140

## LIST OF FIBERS

## FX-300 SERIES



## FX-305 / FX-301 (Red LED type) sensing range (Note 1)

## Reflective type



The FX-305 and FX-301(-HS) have different sensing modes.  
 FX-305: H-SP, FAST, STD, STDF, LONG, U-LG (no S-D mode)  
 FX-301(-HS): S-D, H-SP, FAST, STD, LONG (no STDF or U-LG mode)

Type	Shape of fiber head (mm in)	Sensing range (mm in)(Note 2, 3)	<div> <div> <div>U-LG</div> <div>LONG</div> <div>STDF</div> <div>STD</div> </div> <div> <div>FAST</div> <div>H-SP</div> <div>S-D</div> </div> </div>	Min. sensing object (Note 4)	Fiber cable length Free-cut	Bending radius	Model No.
Threaded type	M4	<div> <div>370 14.567</div> <div>270 10.630</div> <div>170 6.693</div> <div>110 4.331</div> </div>	<div> <div>85 3.346</div> <div>45 1.772</div> <div>39 1.535</div> </div>			R25 mm R0.984 in	FD-T80
	M4						FD-NFM2
	Sleeve 90 mm 3.543 in M4 φ1.48 φ0.058	<div> <div>140 5.512</div> <div>90 3.543</div> <div>60 2.362</div> <div>45 1.772</div> </div>	<div> <div>35 1.378</div> <div>16 0.630</div> <div>16 0.630</div> </div>			Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in	FD-NFM2S
	Sleeve 40 mm 1.575 in M4 φ1.48 φ0.058						FD-NFM2S4
	Sleeve 40 mm 1.575 in M4 φ1.48 φ0.058	<div> <div>40 1.575</div> <div>30 1.181</div> <div>18 0.709</div> <div>15 0.591</div> </div>	<div> <div>12 0.472</div> <div>4.5 0.177</div> <div>5 0.197</div> </div>	φ0.02 mm φ0.0008 in gold wire	2 m 6.562 ft	Fiber R1 mm R0.039 in Sleeve R10 mm R0.394 in	FD-W44
	M4	<div> <div>250 9.843</div> <div>190 7.480</div> <div>110 4.331</div> <div>90 3.543</div> </div>	<div> <div>60 2.362</div> <div>25 0.984</div> <div>32 1.260</div> </div>			R1 mm R0.039 in	FD-WT8
	Coaxial · Lens mountable M4	<div> <div>85 3.346</div> <div>65 2.559</div> <div>37 1.457</div> <div>32 1.260</div> </div>	<div> <div>25 0.984</div> <div>10 0.394</div> <div>11 0.433</div> </div>			R2 mm R0.079 in	FD-WG4
	M4	<div> <div>150 5.906</div> <div>110 4.331</div> <div>65 2.559</div> <div>55 2.165</div> </div>	<div> <div>42 1.654</div> <div>15 0.591</div> <div>19 0.748</div> </div>			R25 mm R0.984 in	FD-G4
	M4	<div> <div>130 5.118</div> <div>90 3.543</div> <div>55 2.165</div> <div>45 1.772</div> </div>	<div> <div>30 1.181</div> <div>13 0.512</div> <div>16 0.630</div> </div>			R4 mm R0.157 in Flexible	FD-P60
	Small diameter M3	<div> <div>140 5.512</div> <div>90 3.543</div> <div>60 2.362</div> <div>45 1.772</div> </div>	<div> <div>35 1.378</div> <div>16 0.630</div> <div>16 0.630</div> </div>			R25 mm R0.984 in	FD-T40
	M3	<div> <div>40 1.575</div> <div>30 1.181</div> <div>18 0.709</div> <div>15 0.591</div> </div>	<div> <div>12 0.472</div> <div>4.5 0.177</div> <div>5 0.197</div> </div>			R1 mm R0.039 in	FD-WT4
	M3	<div> <div>50 1.969</div> <div>36 1.417</div> <div>20 0.787</div> <div>18 0.709</div> </div>	<div> <div>14 0.551</div> <div>5.5 0.217</div> <div>6 0.236</div> </div>	φ0.02 mm φ0.0008 in gold wire	2 m 6.562 ft	R4 mm R0.157 in Flexible	FD-P40
	Lens mountable (FX-MR3, FX-MR6) M3	<div> <div>150 5.906</div> <div>110 4.331</div> <div>65 2.559</div> <div>55 2.165</div> </div>	<div> <div>42 1.654</div> <div>15 0.591</div> <div>19 0.748</div> </div>			R25 mm R0.984 in	FD-G6
M3	Lens mountable (FX-MR3, FX-MR6) M3	<div> <div>150 5.906</div> <div>90 3.543</div> <div>48 1.890</div> <div>45 1.772</div> </div>	<div> <div>35 1.378</div> <div>12 0.472</div> <div>20 0.787</div> </div>		1 m 3.281 ft (Note 5)	R10 mm R0.394 in	FD-G6X
	Coaxial · Tough flexible M3	<div> <div>50 1.969</div> <div>38 1.496</div> <div>25 0.984</div> <div>18 0.709</div> </div>	<div> <div>14 0.551</div> <div>5 0.197</div> <div>6 0.236</div> </div>			R25 mm R0.984 in	FD-EG1
	High precision M3	<div> <div>40 1.575</div> <div>25 0.984</div> <div>14 0.551</div> <div>12 0.472</div> </div>	<div> <div>9 0.354</div> <div>3 0.118</div> <div>5 0.197</div> </div>	φ0.04 mm φ0.0016 in gold wire	500 mm 19.685 in	R10 mm R0.394 in	FD-EG2
	Coaxial · Lens mountable (FX-MR3, FX-MR6) M3	<div> <div>20 0.787</div> <div>15 0.591</div> <div>9 0.354</div> <div>8 0.315</div> </div>	<div> <div>5 0.197</div> <div>2.5 0.098</div> <div>3 0.118</div> </div>				FD-EG3
	High precision M3	<div> <div>6.5 0.256</div> <div>5 0.197</div> <div>3 0.118</div> </div>	<div> <div>2 0.079</div> </div>	φ0.02 mm φ0.0008 in gold wire		R25 mm R0.984 in	FD-EN500S1
	Sleeve part cannot be bent. M3	<div> <div>50 1.969</div> <div>38 1.496</div> <div>20 0.787</div> <div>18 0.709</div> </div>	<div> <div>14 0.551</div> <div>5 0.197</div> <div>6 0.236</div> </div>		1 m 3.281 ft		FD-ENM1S1
	Coaxial M3						
	Sleeve part cannot be bent. M3						

Notes: 1) Refer to p.27 for the sensing ranges for the FX-301-HS in H-SP mode and for the FX-301B/G/H.

2) The sensing range is specified for white non-glossy paper [200×200 mm 7.874×7.874 in (FD-T80, FD-WT8: 400×400 mm 15.748×15.748 in, FD-W44, FD-WT4, FD-P40, FD-G6, FD-EG1, FD-EG2, FD-EG3, FD-EN500S1, FD-ENM1S1: 100×100 mm 3.937×3.937 in)] as the object.

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

4) The minimum sensing object size is the value for red LED type at maximum sensitivity.

Note that the corresponding setting distance is different from the rated sensing distance.

5) The allowable cutting range is 700 mm 27.559 in from the end that the amplifier inserted.

## LIST OF SENSING RANGE FOR FX-301(P)-HS・FX-301B/G/H

Sensing range for ultra high-speed type FX-301(P)-HS in H-SP mode (35  $\mu$ s)(Typical model)

	Fiber model No.	Sensing range (mm in) (Note)		Fiber model No.	Sensing range (mm in) (Note)
Thru-beam type	<b>FT-B8</b>	160 6.299	Reflective type	<b>FD-B8</b>	60 2.362
	<b>FT-FM2</b>	120 4.724		<b>FD-FM2</b>	35 1.378
	<b>FT-NFM2</b>	40 1.575		<b>FD-NFM2</b>	14 0.551
	<b>FT-E12</b>	2 0.079		<b>FD-E12</b>	1 0.039
	<b>FT-E22</b>	10 0.394		<b>FD-E22</b>	5 0.197

Note: The sensing ranges are in H-SP mode. The sensing ranges in FAST, STD, S-D and LONG modes are the same as for the **FX-301**. (Refer to p.18~)

## Sensing range for FX-301B/G/H (Typical model)

(mm in)

		Thru-beam type										
		FT-B8	FT-FM2	FT-NFM2	FT-V10	FT-W8	FT-Z8	FT-P80	FT-A30	FT-A8	FT-E12	FT-E22
<b>FX-301B</b>	LONG	220 8.661	150 5.906	50 1.969	400 15.748	90 3.543	120 4.724	130 5.118	2,400 94.488	600 23.622	3 0.118	14 0.551
	STD	110 4.331	75 2.953	25 0.984	200 7.874	45 1.772	60 2.362	65 2.559	1,200 47.244	300 11.811	2 0.079	7 0.276
	FAST	75 2.953	40 1.575	16 0.630	130 5.118	30 1.181	40 1.575	45 1.772	700 27.559	220 8.661	1 0.039	4 0.157
<b>FX-301G</b>	LONG	110 4.331	70 2.756	24 0.945	200 7.874	56 2.205	60 2.362	70 2.756	1,200 47.244	300 11.811	1 0.039	6 0.236
	STD	55 2.165	35 1.378	12 0.472	100 3.937	28 1.102	30 1.181	35 1.378	600 23.622	150 5.906	—	3 0.118
	FAST	40 1.575	24 0.945	8 0.315	65 2.559	20 0.787	22 0.866	25 0.984	350 13.780	110 4.331	—	2 0.079
<b>FX-301H</b> (Note)	LONG	100 3.937	50 1.969	16 0.630	150 5.906	42 1.654	46 1.811	56 2.205	800 31.496	220 8.661	4 0.157	10 0.394
	STD	50 1.969	25 0.984	8 0.315	75 2.953	21 0.827	23 0.906	28 1.102	400 15.748	110 4.331	2 0.079	5 0.197
	FAST	30 1.181	18 0.709	5 0.197	40 1.575	15 0.591	16 0.630	20 0.787	240 9.449	80 3.150	1.5 0.059	3 0.118

Note: Infrared types are easily affected by humidity, so if using them in environments with high humidity or where the humidity fluctuates, please contact our office.

(mm in)

		Reflective type										
		FD-B8	FD-FM2	FD-NFM2	FD-W8	FD-P80	FD-AFM2	FD-G4	FD-EG1	FD-E12	FD-E22	FD-G6X
<b>FX-301B</b>	LONG	80 3.150	46 1.811	16 0.630	23 0.906	40 1.575	40 1.575	22 0.866	6 0.236	2 0.079	6 0.236	22 0.866
	STD	40 1.575	23 0.906	8 0.315	11 0.433	20 0.787	20 0.787	11 0.433	3 0.118	1 0.039	3 0.118	11 0.433
	FAST	26 1.024	15 0.591	5 0.197	8 0.315	13 0.512	13 0.512	8 0.315	2 0.079	—	2 0.079	6 0.236
<b>FX-301G</b>	LONG	42 1.654	24 0.945	8 0.315	14 0.551	20 0.787	18 0.709	12 0.472	3 0.118	1 0.039	3 0.118	12 0.472
	STD	21 0.827	12 0.472	4 0.157	7 0.276	10 0.394	9 0.354	6 0.236	1.5 0.059	—	1.5 0.059	6 0.236
	FAST	14 0.551	8 0.315	2 0.079	4 0.157	7 0.276	5 0.197	4 0.157	1 0.039	—	1 0.039	4 0.157
<b>FX-301H</b> (Note)	LONG	26 1.024	20 0.787	6 0.236	11 0.433	18 0.709	12 0.472	7 0.276	10 0.394	1 0.039	6 0.236	18 0.709
	STD	13 0.512	10 0.394	3 0.118	5.5 0.217	9 0.354	6 0.236	3.5 0.138	5 0.197	—	3 0.118	9 0.354
	FAST	9 0.354	7 0.276	2 0.079	3 0.118	6 0.236	4 0.157	2 0.079	3 0.118	—	2 0.079	5 0.197

Note: Infrared types are easily affected by humidity, so if using them in environments with high humidity or where the humidity fluctuates, please contact our office.

## Sensing range when using in combination with FR-WKZ11 reflector (optional)

The sensing ranges are the values for **FX-305** / **FX-301** infrared types.

(mm in)


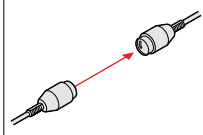
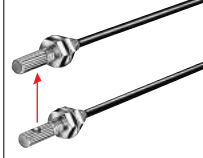
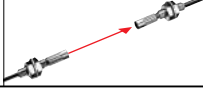
<b>RF-230</b>	100 to 3,200 3.937 to 125.984 (LONG), 100 to 2,000 3.937 to 78.740 (STD), 100 to 1,600 3.937 to 62.992 (FAST), 100 to 1,000 3.937 to 39.370 (S-D)
<b>RF-220</b>	100 to 2,400 3.937 to 94.488 (LONG), 100 to 1,300 3.937 to 51.181 (STD), 100 to 1,000 3.937 to 39.370 (FAST), 100 to 600 3.937 to 23.622 (S-D)
<b>RF-210</b>	100 to 1,100 3.937 to 43.307 (LONG), 100 to 700 3.937 to 27.559 (STD), 100 to 550 3.937 to 21.654 (FAST), 100 to 300 3.937 to 11.811 (S-D)

Note: The sensing range indicates the allowable setting range for the reflector. The fiber head can detect objects at distances of 100 mm 3.937 in or less.

However, note that if there are any white or highly-reflective surfaces near the fiber head, reflected incident light may affect the fiber head. If this occurs, adjust the threshold value of the amplifier before use.

## FIBER OPTIONS

## Lens (For thru-beam type fiber)

Designation	Model No.	Description	
For thru-beam type fiber	Expansion lens (Note 1)	<b>FX-LE1</b>	 <p>Increases the sensing range by 5 times or more.</p> <ul style="list-style-type: none"> <li>Ambient temperature: - 60 to +350 °C - 76 to +662 °F</li> </ul>
	Super-expansion lens (Note 1)	<b>FX-LE2</b>	 <p>Tremendously increases the sensing range with large diameter lenses.</p> <ul style="list-style-type: none"> <li>Ambient temperature: - 60 to +350 °C - 76 to +662 °F</li> </ul>
	Side-view lens	<b>FX-SV1</b>	 <p>Beam axis is bent by 90 °.</p> <ul style="list-style-type: none"> <li>Ambient temperature: - 60 to +300 °C - 76 to +572 °F</li> </ul>
	Expansion lens for vacuum fiber (Note 1)	<b>FV-LE1</b>	 <p>Sensing range increases by 10 times or more.</p> <ul style="list-style-type: none"> <li>Ambient temperature: - 40 to +120 °C - 40 to +248 °F</li> </ul>

Sensing range for red LED type (mm) [Lens on both sides] (Note 3)								
Fiber	Mode	U-LG	LONG	STDF	STD	FAST	S-D	H-SP
FT-B8		3,500	3,500	3,000	2,500	2,000	1,000	1,000
FT-FM2		3,500	3,500	3,500	3,500	2,500	1,300	1,000
FT-T80		3,500	3,500	3,500	3,500	2,500	1,300	1,000
FT-R80		3,500	3,500	3,500	2,300	1,600	800	750
FT-W8		3,500	3,500	3,500	2,900	2,000	1,000	900
FT-P80		3,500	3,500	3,500	3,500	2,500	1,100	1,000
FT-P60		3,500	3,500	3,500	3,500	1,500	900	800
FT-P81X		1,600	1,600	1,600	1,600	1,600	1,100	950
FT-H35-M2		3,500	3,500	2,500	2,000	1,500	750	700
FT-H20W-M1		1,600	1,600	1,600	1,300	900	500	400
FT-H20-M1		1,600	1,600	1,600	1,600	1,100	900	600

Sensing range for red LED type (mm) [Lens on both sides] (Note 3)								
Fiber	Mode	U-LG	LONG	STDF	STD	FAST	S-D	H-SP
FT-B8		3,500	3,500	3,500	3,500	3,500	3,500	3,500
FT-FM2		3,500	3,500	3,500	3,500	3,500	3,500	3,500
FT-R80		3,500	3,500	3,500	3,500	3,500	3,500	3,500
FT-W8		3,500	3,500	3,500	3,500	3,500	3,500	3,500
FT-P80		3,500	3,500	3,500	3,500	3,500	3,500	3,500
FT-P60		3,500	3,500	3,500	3,500	3,500	3,500	3,500
FT-P81X		1,600	1,600	1,600	1,600	1,600	1,600	1,600
FT-H35-M2		3,500	3,500	3,500	3,500	3,500	3,500	3,500
FT-H20W-M1		1,600	1,600	1,600	1,600	1,600	1,500	1,600
FT-H20-M1		1,600	1,600	1,600	1,600	1,600	1,600	1,600
FT-H13-FM2		3,500	3,500	3,500	3,500	3,500	3,500	3,500


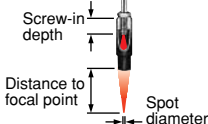
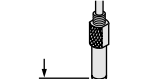
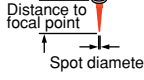
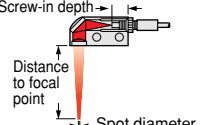
Sensing range for red LED type (mm) [Lens on both sides] (Note 3)				
Fiber	Mode	LONG	STD	FAST
FT-B8		1,100	530	400
FT-FM2		1,200	600	440
FT-T80		1,200	600	440
FT-W8		900	450	330
FT-P80		1,200	600	440
FT-P60		650	300	200
FT-P81X		1,200	600	440
FT-H35-M2		550	280	200
FT-H20W-M1		310	140	100
FT-H20-M1		550	280	200

Sensing range for red LED type (mm) [Lens on both sides] (Note 3, 4)								
Fiber	Mode	U-LG	LONG	STDF	STD	FAST	S-D	H-SP
FT-H30-M1V		1,600	1,200	650	450	300	150	200

Notes: 1) Be careful when installing the thru-beam type fiber equipped with the expansion lens, as the beam envelope becomes narrow and alignment is difficult. Especially when installing a fiber with many cores (sharp bending fibers and heat-resistant glass fiber), please be sure to use it only after you have adjusted it sufficiently.  
2) The fiber cable length practically limits the sensing range to 3,500 mm [137.795 in](#) long (FT-H20W-M1, FT-P81X and FT-H20-M1: 1,600 mm [62.992 in](#)).  
3) The sensing ranges are the values for red LED type amplifier. Please contact our office for details on sensing ranges for other types of amplifiers.  
4) The fiber cable length for the FT-H30-M1V is 1 m [3.281 ft](#). The sensing ranges in U-LG and LONG modes take into account the length of the FT-J8 atmospheric side fiber.

## Lens (For reflective type fiber)

Designation	Model No.	Description	
Pinpoint spot lens	<b>FX-MR1</b>		<p>Pinpoint spot of <math>\phi 0.5</math> mm <math>\phi 0.020</math> in. Enables detection of minute objects or small marks.</p> <ul style="list-style-type: none"> <li>Distance to focal point: <math>6 \pm 1</math> mm <math>0.236 \pm 0.039</math> in</li> <li>Ambient temperature: - 40 to +70 °C - 40 to +158 °F</li> </ul>
Zoom lens	<b>FX-MR2</b>	 <p>Screw-in depth Distance to focal point Spot diameter</p>	<p>The spot diameter is adjustable from <math>\phi 0.7</math> mm to <math>\phi 2</math> mm <math>\phi 0.028</math> in to <math>\phi 0.079</math> in according to how much the fiber is screwed in.</p> <ul style="list-style-type: none"> <li>Applicable fibers: <b>FD-WG4, FD-G4</b></li> <li>Ambient temperature: - 40 to +70 °C - 40 to +158 °F</li> <li>Accessory: <b>MS-EX-3</b> (mounting bracket)</li> </ul>
Finest spot lens	<b>FX-MR3</b>		<p>Extremely fine spot of <math>\phi 0.3</math> mm <math>\phi 0.012</math> in approx. achieved.</p> <ul style="list-style-type: none"> <li>Applicable fibers: <b>FD-WG4, FD-G4, FD-EG1, FD-EG2, FD-EG3, FD-G6X, FD-G6</b></li> <li>Ambient temperature: - 40 to +70 °C - 40 to +158 °F</li> </ul>
Finest spot lens	<b>FX-MR6</b>	 <p>Distance to focal point Spot diameter</p>	<p>Extremely fine spot of <math>\phi 0.1</math> mm <math>\phi 0.004</math> in approx. achieved.</p> <ul style="list-style-type: none"> <li>Applicable fibers: <b>FD-WG4, FD-G4, FD-EG1, FD-EG2, FD-EG3, FD-G6X, FD-G6</b></li> <li>Ambient temperature: - 20 to +60 °C - 4 to +140 °F</li> </ul>
Zoom lens (Side-view type)	<b>FX-MR5</b>	 <p>Screw-in depth Distance to focal point Spot diameter</p>	<p><b>FX-MR2</b> is converted into a side-view type and can be mounted in a very small space.</p> <ul style="list-style-type: none"> <li>Applicable fibers: <b>FD-WG4, FD-G4</b></li> <li>Ambient temperature: - 40 to +70 °C - 40 to +158 °F</li> </ul>

Sensing range for red LED type (Note)		
Screw-in depth	Distance to focal point	Spot diameter
7 mm	18.5 mm approx.	$\phi 0.7$ mm
12 mm	27 mm approx.	$\phi 1.2$ mm
14 mm	43 mm approx.	$\phi 2.0$ mm

Sensing range for red LED type (Note)		
Fiber model No.	Distance to focal point	Spot diameter
FD-EG3	$7.5 \pm 0.5$ mm	$\phi 0.15$ mm approx.
FD-EG2	$7.5 \pm 0.5$ mm	$\phi 0.2$ mm approx.
FD-EG1	$7.5 \pm 0.5$ mm	$\phi 0.3$ mm approx.
FD-WG4/G4/G6X/G6	$7.5 \pm 0.5$ mm	$\phi 0.5$ mm approx.

Sensing range for red LED type (Note)		
Fiber model No.	Distance to focal point	Spot diameter
FD-EG3	$7 \pm 0.5$ mm	$\phi 0.1$ mm approx.
FD-EG2	$7 \pm 0.5$ mm	$\phi 0.15$ mm approx.
FD-EG1	$7 \pm 0.5$ mm	$\phi 0.2$ mm approx.
FD-WG4/G4/G6X/G6	$7 \pm 0.5$ mm	$\phi 0.4$ mm approx.

Sensing range for red LED type (Note)		
Screw-in depth	Distance to focal point	Spot diameter
8 mm	13 mm approx.	$\phi 0.5$ mm
10 mm	15 mm approx.	$\phi 0.8$ mm
14 mm	30 mm approx.	$\phi 3.0$ mm

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