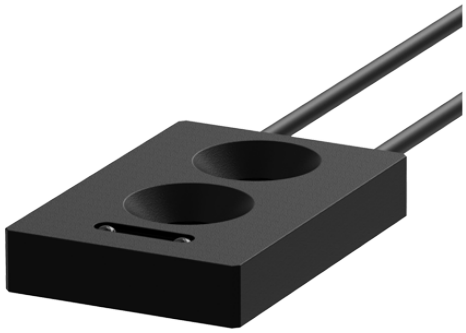


Convergent Reflective Type Lineup

Head Type	Standard	Heat-Resistant	Vacuum-Resistant	Bend-Resistant	Flexible
Flat (Flat View)	✓	✓	✓		✓
Flat (Top View)	✓	✓			

Standard Type	For use in standard environmental conditions
Heat-Resistant Type	For use in high temperatures (-60 to 350 °C)
Vacuum-Resistant Type	For use in vacuum or high temperatures (-60 to 350 °C)
Bend-Resistant Type	(R5) For use in enviroments requiring frequent bends
Flexible Type	(R1, R2) For use in enviroments requiring frequent bends

Product Components

- Fiber optic units
- Cable cutter (FREE CUT type models)
- Adapter (for compatible models)

Sold Separately

- For vacuum-resistant type fiber units
  - Fiber optic coupler: FU-VC□
  - Atmospheric fiber optic unit: FU-VA□
- Cable cutter: FC-3
- Adapter

Convergent Reflective Type Fiber Optic Units

FL/GL Series

PRODUCT MANUAL

Be sure to follow the instructions and precautions in the instruction manual, other manuals, and the Autonics website.

The specifications, dimensions, and other information in this document are subject to change without notice for product improvement. Certain models may be discontinued without notice.

Ordering Information

For reference only. The actual product does not support all combinations. To check all supported models, please refer to the Autonics website.

• Reference model example: FLF-320-10H

F	L	F	-	3	20	-	10	H	□
❶	❷	❸	-	❹	❺	-	❻	❼	❽

❶	**Fiber material**	F	Plastic
		G	Glass
❷	**Sensing type**	D	Diffuse reflective
		L	Convergent reflective
		T	Through-beam
❸	**Head type**		
	· Threaded	No mark	Standard
	· Cylindrical	C	Standard
		CN	Side view
		CS	Cylindrical + stainless steel (stainless steel length 15 mm)
		CSN	Cylindrical + stainless steel (stainless steel length 15 mm, side view)
	· Flat	F	Flat view
		FB	Side view + top view (bending)
		FN	Side view
		FU	Top view (up)
		LU	L-type top view (height 12.2 mm)
		LU1	L-type top view (height 17.2 mm)
		LU2	L-type top view (height 22.2 mm)
	· L-type	L	Standard
	· Molded plastic	P	Standard
		PF	Flat view
	· Perpendicular	R	Standard
		RT	Mounted protection tube
	· Stainless steel	S	Stainless steel length 90 mm
		S1	Stainless steel length 35 mm
		S2	Stainless steel length 45 mm
	· U-shaped	U6	Sensing distance 6 mm
		U10	Sensing distance 10 mm
		U20	Sensing distance 20 mm
	· Wide area	W5	Beam width 5 mm
		W10	Beam width 10 mm
		W10T	Beam width 10 mm, mounted protection tube
		W11	Beam width 11 mm
		W20	Beam width 20 mm
		W40	Beam width 40 mm
		W60	Beam width 60 mm
		W100	Beam width 100 mm
	· Protection tube	H	Fiber cable protection tube (sold spearately)
❹	**Hood diameter**	15	Ø 1.5 mm
		2	Ø 2 mm (M2)
		3	Ø 3 mm (M3)
		4	Ø 4 mm (M4)
		6	Ø 6 mm (M6)

❺	**Cable length**	5	0.5 m
		10	1 m
		20	2 m
		10M	10 m
❻	**Fiber diameter**	2	Ø 0.2 mm
		5	Ø 0.5 mm
		6	Ø 0.6 mm
		10	Ø 1.0 mm
		12	Ø 1.2 mm
		13	Ø 1.3 mm
		14	Ø 1.4 mm
		15	Ø 1.5 mm
		17	Ø 1.7 mm
		20	Ø 2.0 mm
		F	Ø 0.5 mm, Ø 0.25 mm×4 (coaxial type)
		F1	Ø 0.5 mm, Ø 0.25 mm×9 (coaxial type)
		F2	Ø 1.0 mm, Ø 0.265 mm×16 (coaxial type)
❼	**Cable type**	No mark	Standard
		B	Bend-resistant (R5)
		R	Flexible (R1, R2)
		H	Heat-resistant (-40 to 105 °C)
		H1	Heat-resistant (-40 to 150 °C)
		H2	Heat-resistant (-60 to 250 °C)
		H3	Heat-resistant (-60 to 350 °C)
		V	Vacuum-resistant (-60 to 100 °C)
		V1	Vacuum-resistant (-60 to 150 °C)
		V2	Vacuum-resistant (-60 to 250 °C)
		V3	Vacuum-resistant (-60 to 350 °C)
❽	**Misc.**	A	R20 / 12×18×3
		L	Product length: ≥ 30 mm
		LN	Built-in lens
		WP	Water-resistant [01]
		WF	Waterproof [01]

01) The waterproof performance is intended to prevent product damage and safety issues caused by external moisture ingress and does not guarantee maintenance of detection performance.
Due to the characteristics of optical sensors, in mist or condensation environments, moisture on the lens surface may cause refraction and scattering of light, resulting in fluctuations in the PV value.
- Water-resistant: Waterproof sealing structure applied to major joints.
- Waterproof: Integrated sealing structure applied using an external protective tube.

Selection Guide

⚠ The installation method of the fiber optic unit may vary depending on the fiber optic amplifier. Be sure to refer to the product manual of the fiber optic amplifier. For details on fiber optic units, refer to 'Fiber Optic Sensor Technical Overview.'

■ Model

- Refer to the Ordering Information for fiber material, sensing type, head type, hood diameter, cable length, fiber diameter, cable type, and other specifications.

■ Cable

- Check the length, bend radius, and FREE CUT compatibility of the cable.
- Use the included cable cutter (FC-3) when cutting FREE CUT compatible models.

■ Ambient Temperature

- Be sure to use the fiber optic sensors within the rated ambient temperature range.
- Physical property changes in the optical fiber and components may occur due to temperature variations (e.g., refractive index, optical loss, thermal expansion, component output/sensitivity, target reflectivity, etc.).

■ Minimum Target Object Size

- The mininum target object size specifications are based on the maximum sensitivity setting of BF4 Series fiber optic amplifiers.

■ Sensing Distance

- The sensing distance data is based on internal testing and for reference only. Performance may vary by installation and usage environment. Product testing prior to use is recommended.
- The sensing distance data is based on measurements using non-glossy white paper.
- The sensing distances may vary depending on the measurement standards of the tested amplifiers and sensing target objects.
- The sensing distances for each amplifier series are from the following models.
  : BFN-□, BFN-D□-□-□-IL3, BFX-D1-□, BF5R-□1-□, BF4R□-□, BF3RX-□
- The response time for each response mode are as shown:

MFST	UFST	FST	STD	LONG	ULOG	MLOG	MAX (BF4 / BF3)
25 µs	50 µs	150 µs	500 µs	4 ms	10 ms	20 ms	0.5 ms / 1 ms

- The sensing distances for BFN series are based on the reponse time setting of the equivalent response mode.
- The sensing mode of BF4/3 are based on maximum sensitivity settings.
- For BF4G□-□ models, apply 10% of the sensing distance of BF4R□-□ models.
- Deviations in sensing distance may occur due to the following conditions.
  - Fiber optic unit properties: cable bend radius, condition of cutting surface, amplifier insertion depth, etc.
  - Sensing target object properties: material, shape, inclination, bending, gloss, etc.
- For detection area characteristics, refer to the product manual of the fiber optic amplifiers.

■ Adapter

- For compatible models, be sure to attach the included adapter before use.
- Check the product components or the symbols below.

●: Supports included adapter or adapters sold separately.
(supports only fiber optic amplifiers BFN, BFX, BF5, BF4 Series. In case of BF3 Series, the adapter needs to be purchased separately.)
○: Only supports the included adapter. Cannot be purchased separately.
- : Adapters are not supported.

Flat Head (Flat View): Standard Type

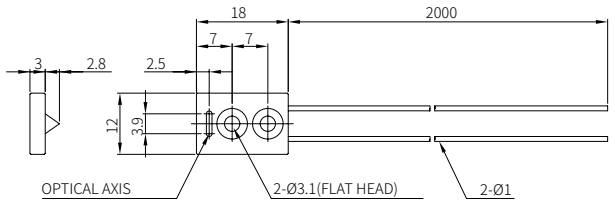
Appearance	Model	Cable		Ambient temperature	Min. size of target object	Sensing distance (Typical, unit: mm)							Adapter
		Length	Bend radius			Mode \ Amp.	BFN	BFN-D	BFX	BF5	BF4	BF3	
	FLF-320-05	2 m (FREE CUT)	R15	-30 to 70 °C	Ø 0.1 mm	MFST	-	30	-	-	-	-	●
						UFST	3	35	2	5	-	-	
						FST	5	45	4	6	-	-	
						STD	8	55	6	8	-	-	
						LONG	-	65	9	9	-	-	
						ULOG	-	80	10	11	-	-	
						MLOG / MAX	-	115	-	-	5	5	
	FLF-320-10	2 m	R25	-40 to 60 °C	Ø 0.0125 mm	MFST	-	20	-	-	-	-	○ 01)
						UFST	5	45	4	4	-	-	
						FST	15	55	8	8	-	-	
						STD	30	120	12	10	-	-	
						LONG	-	155	20	20	-	-	
						ULOG	-	195	25	25	-	-	
						MLOG / MAX	-	245	-	-	10	5	
	FLF-320-10A	2 m (FREE CUT)	R20	-30 to 70 °C	Ø 0.08 mm	MFST	-	185	-	-	-	-	●
						UFST	50	310	25	30	-	-	
						FST	100	620	40	50	-	-	
						STD	180	1120	65	100	-	-	
						LONG	-	1620	130	180	-	-	
						ULOG	-	2160	180	260	-	-	
						MLOG / MAX	-	3140	-	-	70	15	

01) The adapter for this model is not compatible with separately sold adapters and cannot be purchased separately. Please take care not to lose it.

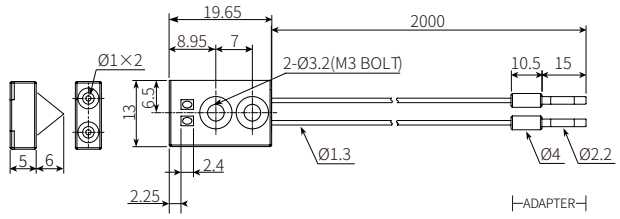
■ Dimensions

• Unit: mm (Refer to the CAD files from the Autonics website for exact dimensions)

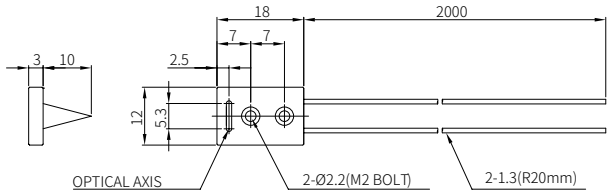
• FLF-320-05



• FLF-320-10



• FLF-320-10A



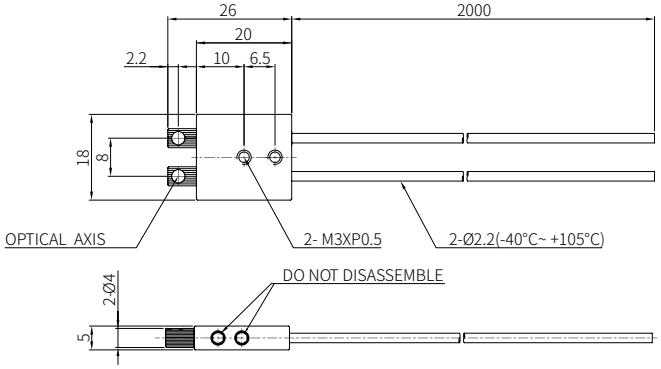
Flat Head (Flat View): Heat-Resistant Type

Appearance	Model	Cable		Ambient temperature	Min. size of target object	Sensing distance (Typical, unit: mm)						Adapter
		Length	Bend radius			Mode \ Amp.	BFN	BFN-D	BFX	BF5	BF4	BF3	
	FLF-320-10H	2 m (FREE CUT)	R25	-40 to 105 °C	Ø 0.08 mm	MFST	-	370	-	-	-	-	-
						UFST	60	495	45	60	-	-	
						FST	100	810	60	80	-	-	
						STD	135	1370	90	130	-	-	
						LONG	-	1995	175	220	-	-	
						ULOG	-	2640	240	320	-	-	
						MLOG / MAX	-	3380	-	-	90	80	
	GLF-320-12H2L	2 m	R25	-60 to 250 °C	Ø 0.6 mm	MFST	-	310	-	-	-	-	-
						UFST	60	435	35	50	-	-	
						FST	100	745	50	70	-	-	
						STD	150	1435	75	120	-	-	
						LONG	-	2120	160	230	-	-	
						ULOG	-	2640	260	340	-	-	
						MLOG / MAX	-	3120	-	-	90	N/A	

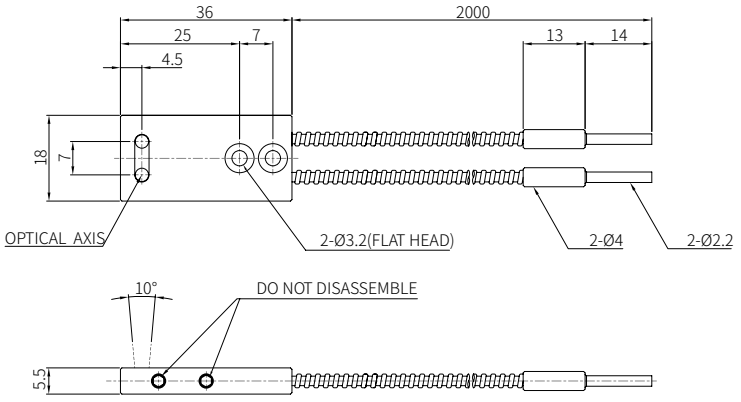
■ Dimensions

- Unit: mm (Refer to the CAD files from the Autonics website for exact dimensions)

• FLF-320-10H



• GLF-320-12H2L



Flat Head (Flat View): Vacuum-Resistant Type

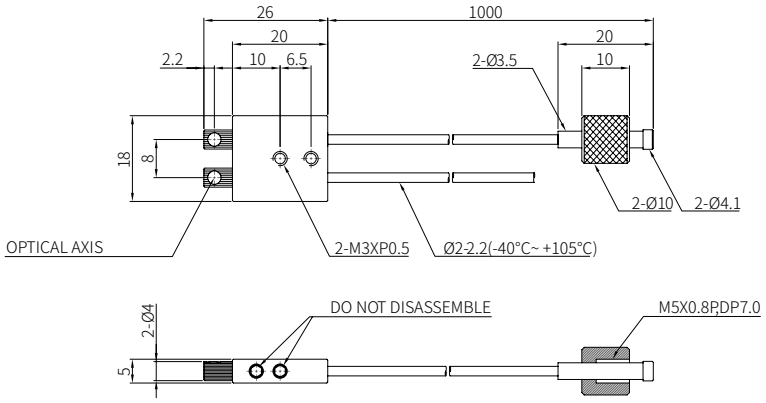
- Vaccum-resistant fiber optic units must be used in combination with fiber optic couplers and atmospheric fiber optic units.
- The sensing distances of vacuum-resistant fiber optic units are specified based on installation with atmospheric fiber optic units. (FU-VA0□, sold separately)

Appearance	Model	Cable		Ambient temperature	Min. size of target object	Sensing distance (Typical, unit: mm)							Adapter
		Length	Bend radius			Mode \ Amp.	BFN	BFN-D	BFX	BF5	BF4	BF3	
	FLF-310-10V	1 m (FREE CUT)	R25	-30 to 105 °C	Ø 3.4 mm (+ FU-VA01)	MFST	-	185	-	-	-	-	-
						UFST	30	310	15	30	-	-	
						FST	45	435	20	50	-	-	
						STD	60	745	30	70	-	-	
						LONG	-	1060	55	120	-	-	
						ULOG	-	1580	75	170	-	-	
						MLOG / MAX	-	2325	-	-	35	25	
					Ø 3.9 mm (+ FU-VA02)	MFST	-	185	-	-	-	-	
						UFST	40	245	10	30	-	-	
						FST	60	370	15	40	-	-	
						STD	80	620	20	60	-	-	
						LONG	-	870	45	100	-	-	
						ULOG	-	1415	60	140	-	-	
						MLOG / MAX	-	2160	-	-	25	25	
	GLF-310-12V2	1 m	R25	-60 to 250 °C	Ø 1.8 mm (+ FU-VA01)	MFST	-	185	-	-	-	-	-
						UFST	35	310	25	30	-	-	
						FST	55	495	40	50	-	-	
						STD	75	870	55	80	-	-	
						LONG	-	1245	95	140	-	-	
						ULOG	-	1680	130	200	-	-	
						MLOG / MAX	-	2400	-	-	40	35	
					Ø 2.0 mm (+ FU-VA02)	MFST	-	185	-	-	-	-	
						UFST	45	245	20	30	-	-	
						FST	80	370	30	40	-	-	
						STD	100	620	45	60	-	-	
						LONG	-	935	80	100	-	-	
						ULOG	-	1460	105	150	-	-	
						MLOG / MAX	-	2110	-	-	30	35	
	GLF-310-12V2L	1 m	R25	-60 to 250 °C	Ø 0.6 mm (+ FU-VA01)	MFST	-	185	-	-	-	-	-
						UFST	30	310	20	30	-	-	
						FST	45	495	30	50	-	-	
						STD	60	870	45	80	-	-	
						LONG	-	1245	85	140	-	-	
						ULOG	-	1700	120	200	-	-	
						MLOG / MAX	-	2375	-	-	45	45	
					Ø 2.0 mm (+ FU-VA02)	MFST	-	185	-	-	-	-	
						UFST	40	245	20	30	-	-	
						FST	60	370	25	40	-	-	
						STD	95	620	40	60	-	-	
						LONG	-	935	60	100	-	-	
						ULOG	-	1245	80	150	-	-	
						MLOG / MAX	-	1680	-	-	35	35	
	GLF-310-12V3L	1 m	R25	-60 to 350 °C	Ø 0.6 mm (+ FU-VA01)	MFST	-	185	-	-	-	-	-
						UFST	30	310	25	30	-	-	
						FST	45	495	35	50	-	-	
						STD	60	870	50	80	-	-	
						LONG	-	1245	85	140	-	-	
						ULOG	-	1655	120	200	-	-	
						MLOG / MAX	-	2110	-	-	50	40	
					Ø 1.5 mm (+ FU-VA02)	MFST	-	185	-	-	-	-	
						UFST	45	245	20	30	-	-	
						FST	80	370	25	40	-	-	
						STD	100	620	40	60	-	-	
						LONG	-	870	65	100	-	-	
						ULOG	-	1175	85	140	-	-	
						MLOG / MAX	-	1700	-	-	40	35	

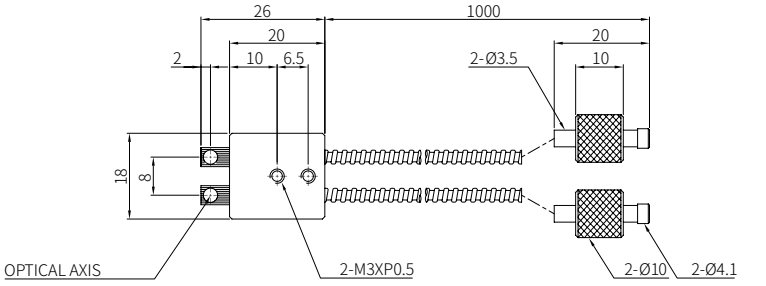
■ Dimensions

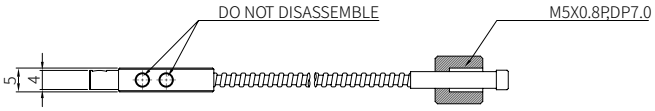
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• FLF-310-10V

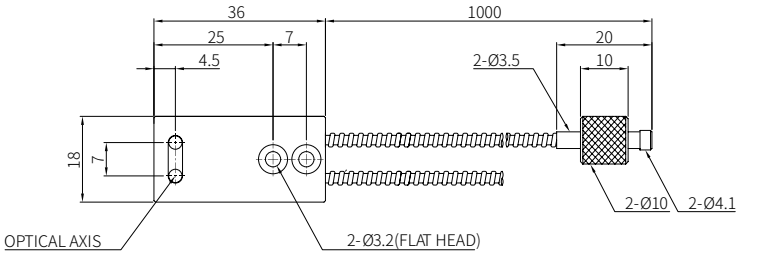


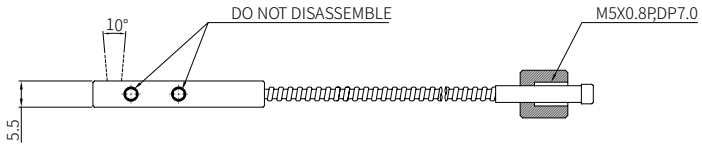
• GLF-310-12V2



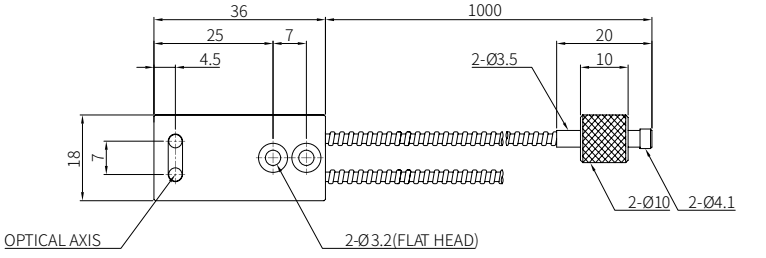


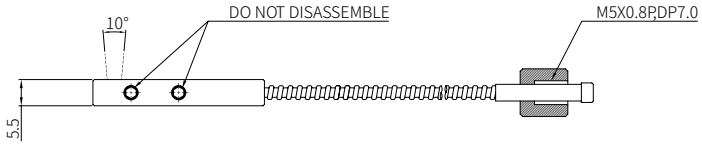
• GLF-310-12V2L





• GLF-310-12V3L





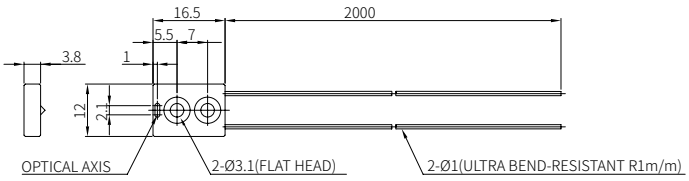
Flat Head (Flat View): Flexible Type

Appearance	Model	Cable		Ambient temperature	Min. size of target object	Sensing distance (Typical, unit: mm)						Adapter
		Length	Bend radius			Mode \ Amp.	BFN	BFN-D	BFX	BF5	BF4	BF3	
	FLF-320-05R	2 m (FREE CUT)	R1	-30 to 70 °C	Ø 0.08 mm	MFST	-	15	-	-	-	-	●
						UFST	3	30	4	3	-	-	
						FST	5	40	4	5	-	-	
						STD	15	65	5	7	-	-	
						LONG	-	105	7	11	-	-	
						ULOG	-	160	12	17	-	-	
						MLOG / MAX	-	230	-	-	5	5	

■ Dimensions

- Unit: mm (Refer to the CAD files from the Autonics website for exact dimensions)

• FLF-320-05R



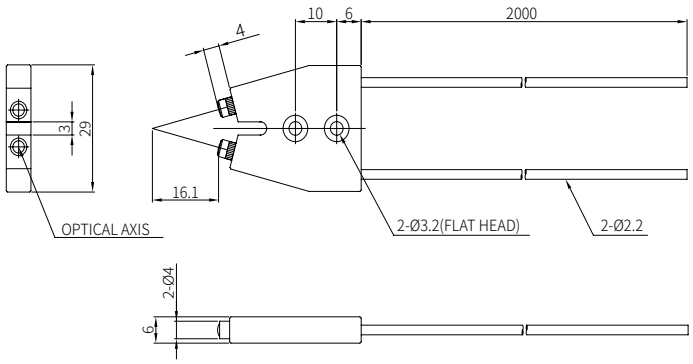
Flat Head (Top View): Standard Type

Appearance	Model	Cable		Ambient temperature	Min. size of target object	Sensing distance (Typical, unit: mm)						Adapter
		Length	Bend radius			Mode \ Amp.	BFN	BFN-D	BFX	BF5	BF4	BF3	
	FLFU-320-10WP (Water-resistant)	2 m (FREE CUT)	R20	-30 to 70 °C	Ø 0.08 mm	MFST	-	155	-	-	-	-	-
						UFST	30	185	20	25	-	-	
						FST	55	495	25	30	-	-	
						STD	85	1245	40	80	-	-	
						LONG	-	1930	115	200	-	-	
						ULOG	-	2470	190	310	-	-	
						MLOG / MAX	-	3215	-	-	40	20	

■ Dimensions

- Unit: mm (Refer to the CAD files from the Autonics website for exact dimensions)

• FLFU-320-10WP



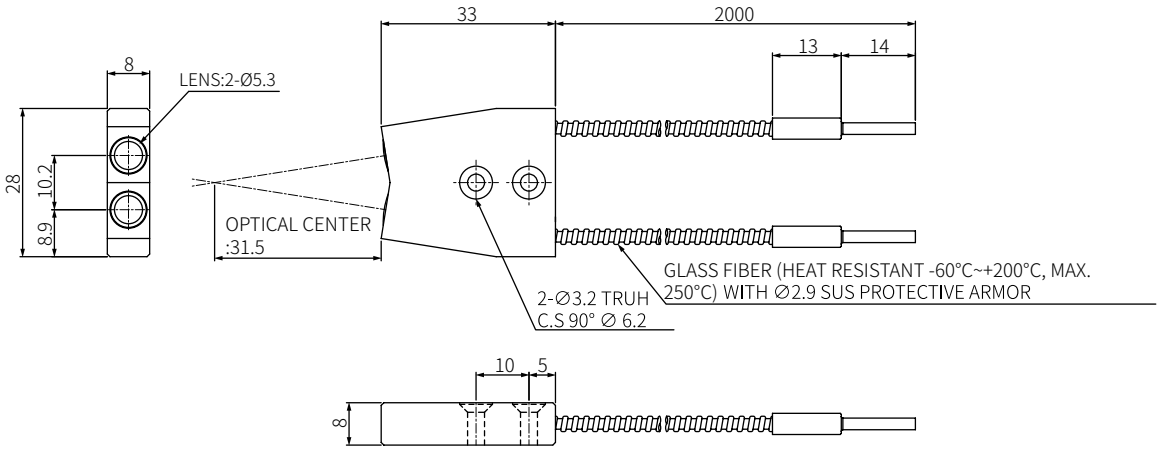
Flat Head (Top View): Heat-Resistant Type

Appearance	Model	Cable		Ambient temperature	Min. size of target object	Sensing distance (Typical, unit: mm)							Adapter
		Length	Bend radius			Mode \ Amp.	BFN	BFN-D	BFX	BF5	BF4	BF3	
	GLFU-320-12H2	2 m	R25	-60 to 250 °C	Ø 0.08 mm	MFST	-	285	-	-	-	-	-
						UFST	125	415	70	80	-	-	
						FST	175	645	110	120	-	-	
						STD	215	1100	215	230	-	-	
						LONG	-	2005	380	405	-	-	
						ULOG	-	>3600	655	685	-	-	
						MLOG / MAX	-	>3600	-	-	190	N/A	
	GLFU-320-12H3	2 m	R25	-60 to 350 °C	Ø 0.08 mm	MFST	-	335	-	-	-	-	-
						UFST	125	460	80	95	-	-	
						FST	160	720	125	140	-	-	
						STD	285	1205	235	255	-	-	
						LONG	-	2240	420	445	-	-	
						ULOG	-	>3600	695	725	-	-	
						MLOG / MAX	-	>3600	-	-	205	N/A	

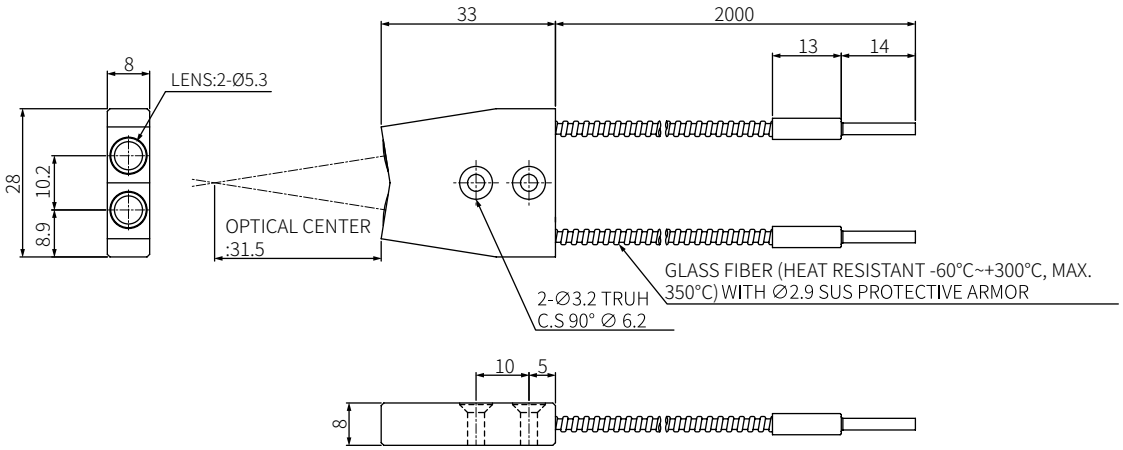
■ Dimensions

- Unit: mm (Refer to the CAD files from the Autonics website for exact dimensions)

• GLFU-320-12H2



• GLFU-320-12H3



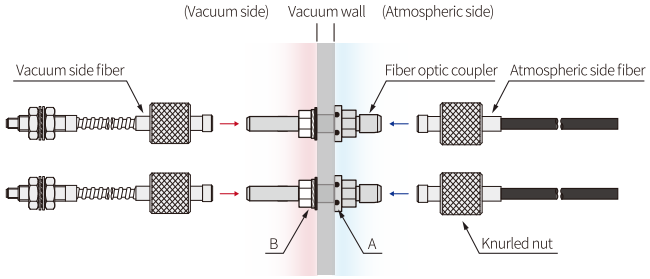
Sold Separately: Fiber Optic Coupler, Atmospheric Fiber Optic Units

■ Cautions During Installation

- When using vacuum-resistant type fiber units, be sure to use it in combination with fiber optic couplers and atmospheric fiber optic units.
- The fiber optic coupler is a device that transmits light while sealing the vacuum side from the atmospheric side. It is equipped with an O-ring. Take care when welding the vacuum chamber wall, as this may cause the internal glass rod to become cloudy.
- Consider the following conditions when installing fiber optic couplers.
  - Applicable chamber wall thickness: 8 to 10 mm
  - Mounting hole diameter: Ø 5.0 + 0.1, - 0.1 mm
  - O-ring contact surface roughness: 1.6 Ry
- Install the fiber optic coupler and fiber optic units to the connection points below. Failure to do so may result in product damage.
  - Vacuum-resistant fiber optic unit → Long end of the fiber optic coupler
  - Atmospheric fiber optic unit → Short end of the fiber optic coupler

■ Example Configuration

01. Insert the fiber optic coupler in the installation hole of the vacuum chamber wall.
02. From the long side of the fiber optic coupler towards the vacuum wall, place the flat washer, spring washer in order, then tighten the nut to secure the coupler.
03. Connect the vacuum-side and atmosphere-side fiber optic units to the coupler by turning the knurled nuts.



A. O-ring
B. M5 nut + spring washer + flat washer

■ Fiber Optic Coupler

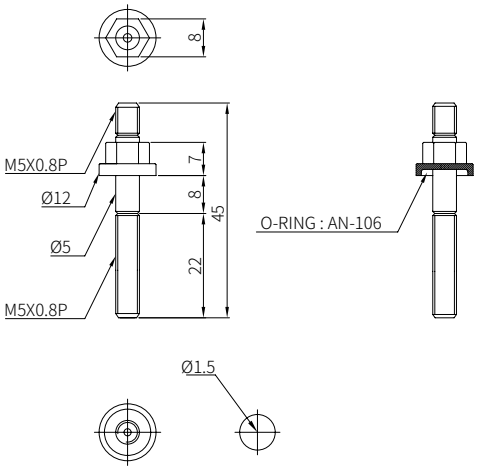
Appearance	Ambient temperature	Compatible cable types	Model
	-60 to 200 °C	Vaccum-resistant, Atmospheric	FU-VC01
	-60 to 300 °C	Vaccum-resistant, Atmospheric	FU-VC02

- Helium leak test: ≤ 10^{-11} Pa · m³/s
- Product components: Fiber optic coupler, M5 nut, spring washer, flat washer (2 each)

■ Dimensions

Unit: mm (Refer to the CAD files from the Autonics website for exact dimensions)

• FU-VC01, FU-VC02



■ Atmospheric Fiber Optic Units

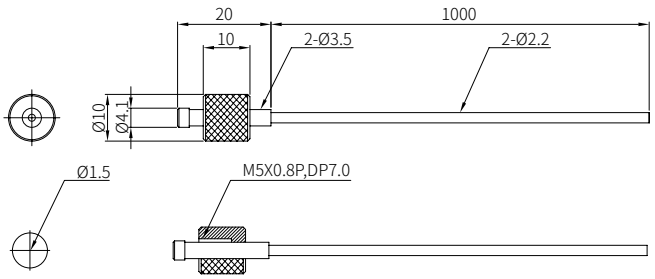
Appearance	Bend radius	Ambient temperature	FREE CUT	Model
	R30	-30 to 70 °C	FREE CUT	FU-VA01
	R20	-30 to 70 °C	FREE CUT	FU-VA02

- Product components: Atmospheric fiber optic units × 2, cable cutter (FC-3) × 1

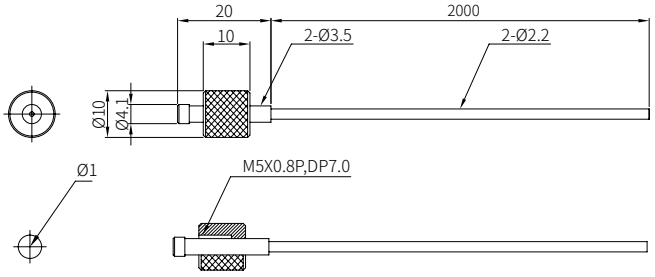
■ Dimensions

Unit: mm (Refer to the CAD files from the Autonics website for exact dimensions)

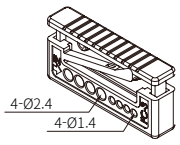
• FU-VA01



• FU-VA02



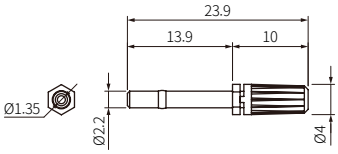
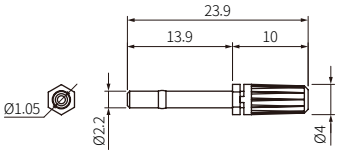
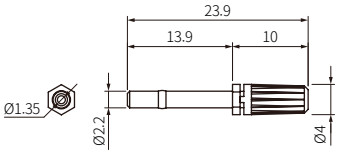
Sold Separately: Cable Cutter

Model	Hole diameter	Appearance
FC-3	Ø2.4 X 4 Ø1.4 X 4	

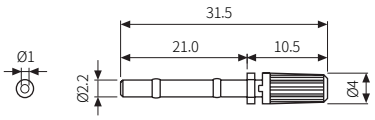
Sold Separately: Adapter

For adapter-compatible models (●), the adapter is supported only with the BFN, BFX, BF5, and BF4 Series fiber optic amplifiers.
The adapter can be purchased separately through our authorized distributors.
For the BF3 series, the adapter needs to be purchased separately.

■ Adapter compatible with BFN, BFX, BF5, and BF4 Series

Model	Features	Qty	Dimensions (unit: mm)
BFN-ADAPTER-13	Inner diameter: Ø1.3 Color: Dark gray	2	
BFN-ADAPTER -1013	Inner diameter: Ø1 Color: Black	1	
	Inner diameter: Ø1.3 Color: Dark gray	1	

■ Adapter compatible with BF3 Series

Model	Features	Dimensions (unit: mm)
H1750000134	Inner diameter: Ø1 Color: Black	
B1700000046	Inner diameter: Ø1.3 Color: Dark gray	