Autonics

FIBER OPTIC SENSOR

BF4 SERIES

M A N U A L



Thank you very much for selecting Autonics products.
For your safety, please read the following before using.

■ Caution for your safety

※Please keep these instructions and review them before using this unit.

※Please observe the cautions that follow;

⚠Warning Serious injury may result if instructions are not followed.

⚠Caution Product may be damaged, or injury may result if instructions are not followed.

※The following is an explanation of the symbols used in the operation manual.
⚠ Caution:Injury or danger may occur under special conditions.

⚠ Warning

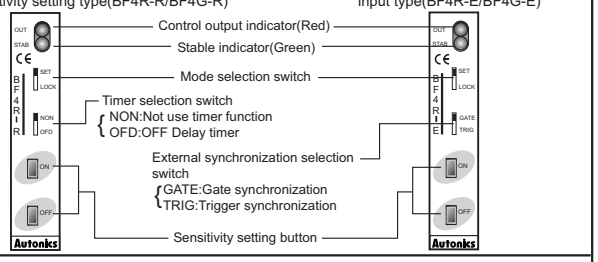
1. **In case of using this unit with machinery (Ex: nuclear power control, medical equipment, ship, vehicle, train, airplane, combustion apparatus, safety device, crime/disaster prevention equipment, etc) which may cause damages to human life or property, it is required to install fail-safe device.**
   It may cause a fire, human injury or damage to property.
2. **Do not disassemble and modify this unit. If needs, please contact us.**
   It may cause an electric shock and cause a fire.

⚠ Caution

1. **This unit shall not be used outdoors.**
   It might shorten the life cycle of the product or give an electric shock. Use this product inside only. Do not use the product outdoors or location subject to temperatures or humidity outside.
   (Ex: rain, dirty, frost, sunlight, condensation, etc.)
2. **Do not use this unit in place where there is flammable or explosive gas.**
   It may cause a fire or explosion.
3. **Please observe the rated voltage and do not supply AC power.**
   It may result in damage to this unit.
4. **Please check the polarity of power and wrong wiring.**
   It may result in damage to this unit.
5. **Do not use this unit in place where there is vibration or impact.**
   It may result in damage to this unit.
6. **In cleaning the unit, do not use water or an oil-based detergent.**
   It may cause an electric shock and cause a fire.

■ Part identification

- Standard type(BF4R/BF4RP/BF4G/BF4GP)/ Remote sensitivity setting type(BF4R-R/BF4G-R)
- External synchronization input type(BF4R-E/BF4G-E)



■ Function

◎ Sensitivity adjustment

- **Adjustment by the sensitivity setting button(All models)**

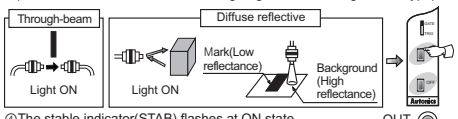
-Light ON Mode

①Mount the fiber optic cable within sensing distance.

②Change the mode selection switch to SET.



③Press ON button in state of installed the sensing target.
(Press ON button without the sensing target for the through-beam type)



④The stable indicator(STAB) flashes at ON state.
(Check the target position)



⑤Press OFF button without the sensing target.
(Press OFF button in state of installed the sensing target for the through-beam type)

⑥When there is enough sensitivity difference between ON state and OFF state, the stable indicator(STAB) flashes one time only at stable sensing area.
When there is not enough sensitivity difference between ON state and OFF state, the stable indicator(STAB) flashes five times at unstable sensing area. (Note)



⑦Change the mode selection switch to LOCK. After this, additional ON/OFF button input is not valid and the set sensitivity shall not be changed.



(Note)The sensitivity can operate at unstable detecting area.
※Setting sensitivity is memorized when power turns off.
※Do not touch the fiber optic cable after adjusting the sensitivity. Stable sensing is not available.

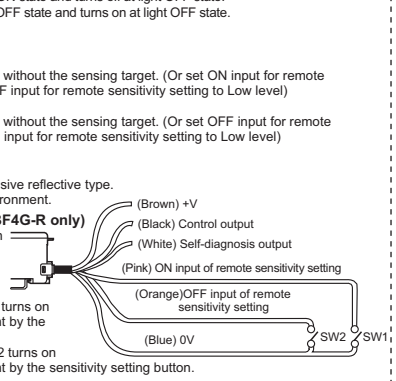
-Dark ON Mode(Diffuse reflective type)
Most of adjustments except ③ & ⑤ are same as Light ON mode.
• Press ON button without the sensing target. (③ state)
• Press OFF button with the sensing target. (⑤ state)
-Light ON mode:The control output turns on at light ON state and turns off at light OFF state.
-Dark ON mode:The control output turns off at light OFF state and turns on at light ON state.

-In case of setting as max. sensitivity
①Set the mode selection switch to SET.
②In case of **Light ON mode**
Press sensitivity setting button from ON to OFF without the sensing target. (Or set ON input for remote sensitivity setting to Low level, and then set OFF input for remote sensitivity setting to Low level)
In case of **Dark ON mode**
Press sensitivity setting button from OFF to ON without the sensing target. (Or set OFF input for remote sensitivity setting to Low level, and then set ON input for remote sensitivity setting to Low level)
③Set the mode selection switch to LOCK.

<Application>
• In case of extending sensing distance as the diffusive reflective type.
• In case of use the through-beam type at bad environment.

- **Remote adjustment of sensitivity(BF4R-R/BF4G-R only)**

BF4R-R/BF4G-R type can adjust the sensitivity with input signal lines without the mode selection switch.



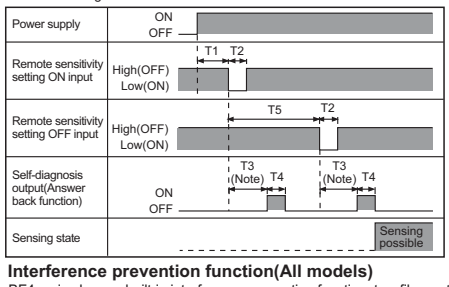
-Adjustment at Light ON Mode
• SW1(ON input of remote sensitivity setting): SW1 turns on and then turns off instead of ③ state of adjustment by the sensitivity setting button.
• SW2(OFF input of remote sensitivity setting): SW2 turns on and then turns off instead of ⑤ state of adjustment by the sensitivity setting button.

-Adjustment at Dark ON Mode
• SW2(OFF input of remote sensitivity setting): SW2 turns on and then turns off instead of ③ state of adjustment by the sensitivity setting button.
• SW1(ON input of remote sensitivity setting): SW1 turns on and then turns off instead of ⑤ state of adjustment by the sensitivity setting button.

- **Answer Back function(BF4R-R/BF4G-R only)**

When ON or OFF input of remote sensitivity setting is applied, after 300ms self-diagnosis output turns on for 40ms and then the sensor keeps normal sensing state. (Refer to below time chart.)
Self-diagnosis output does not turn on if there is no difference of sensitivity between ON input and OFF input and stable sensing is not excuted, but stable sensing operates after 340ms.

<Time Chart:Light ON Mode>



1. T1≥ 1,000ms(After the power turns on, it can be set after 1sec.)
2. T2≥ 5ms(ON or OFF input time of remote sensitivity setting must be min. 5ms)
3. T3≈ 300ms(When ON or OFF input of remote sensitivity setting is applied, self-diagnosis output turns on after 300ms)
4. T4≈ 40ms
   (ON time of self-diagnosis output)
5. T5≥ 500ms(When ON input of remote sensitivity setting is applied, apply OFF input of remote sensitivity setting after 500ms)

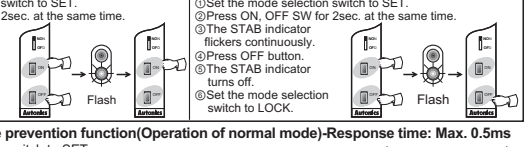
(Note)During period T3(Approx. 300ms), do not change the received light value by moving the object, etc.

◎ Interference prevention function(All models)

BF4 series have a built-in interference prevention function, two fiber optic cables can be mounted very closely by setting different transmission frequencies.

- **Interference prevention function(Operation of dual frequency mode)**

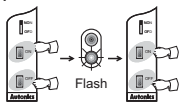
First sensor-FREQ.1(Response time:max. 0.5ms)	Second sensor-FREQ.2(Response time:max. 0.7ms)
①Set the mode selection switch to SET. ②Press ON, OFF SW for 2sec. at the same time. ③The STAB indicator flickers continuously. ④Press ON button ⑤The STAB indicator turns off. ⑥Set the mode selection switch to LOCK.	①Set the mode selection switch to SET. ②Press ON, OFF SW for 2sec. at the same time. ③The STAB indicator flickers continuously. ④Press OFF button. ⑤The STAB indicator turns off. ⑥Set the mode selection switch to LOCK.



- **Release interference prevention function(Operation of normal mode)-Response time: Max. 0.5ms**

①Set the mode selection switch to SET.
②Press ON, OFF buttons for 2 sec. at the same time.
③The STAB indicator flashes continuously.
④Press ON, OFF buttons at the same time.
⑤The STAB indicator turns off.
⑥Set the mode selection switch to LOCK.

※In case of using interference prevention function, hysteresis & response time will be longer than normal mode operation.



※The above specifications are subject to change without notice.

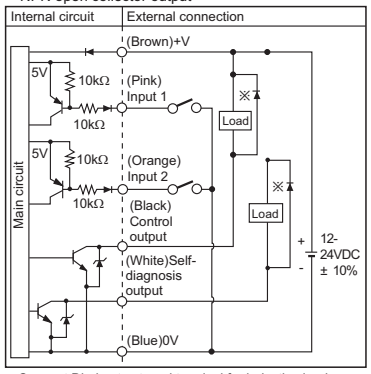
■ Specifications

Type		Standard type	External synchroni-zation input type	Remote sensitivity setting type	Standard type
Model	Red light source	BF4R	BF4R-E	BF4R-R	BF4RP
	Green light source	BF4G	BF4G-E	BF4G-R	BF4GP
Power voltage		12-24VDC ± 10%, Ripple p-p:Max. 10%			
Current consumption		Max. 45mA			
Control output		NPN open collector output			PNP open collector output
		Load current: Min. 100mA, Applied voltage: Max. 30VDC Residual voltage: Max. 1V(at 100mA load current), Max. 0.4V(at 16mA load current)			Load current: Min.100mA, Applied voltage: Max.30VDC Output voltage:Min.power supply -2.5V
Self-diagnosis output		ON state under unstable sensing(When the target stays for 300ms in unstable area) or ON state when control output short-circuited			
		Load current: Min. 50mA, Applied voltage: Max. 30VDC Residual voltage: Max. 1V(at 50mA load current), Max. 0.4V(at 16mA load current)			Load current: Min.50mA, Applied voltage: Max.30VDC Output voltage:Min.power supply -2.5V
Operation mode		Selectable by the sensitivity setting button ON/OFF in front of this unit			
Protection circuit		Short-circuit protection, Reverse polarity protection circuit			
Light source		Red LED/Green LED(Modulated)			
Response time※1		Max. 0.5ms			
Control output indicator(OUT)		Red LED			
Stable indicator(STAB)		Green LED flashes when the target stays in stable sensing area			
Input of stop transmission function		—	Built in	—	—
External synchroni-zation function		—	Built in (Gate/Trigger)	—	—
Remote sensitivity setting function		—	—	Built in	—
Interference prevention function※1		Built-in selectable FREQ.1 or FREQ.2 by ON/OFF button			
Timer function (Selectable)		OFF delay timer (Approx. 40ms fixed)	—	OFF delay timer(Approx. 40ms fixed)	
Ambient illumination		Sunlight : Max. 11,000ℓx, Incandescent lamp : Max. 3,000ℓx			
Noise strength		± 240V the square wave noise(pulse width: 1μs) by the noise simulator			
Dielectric strength		1,000VAC 50/60Hz for 1 minute			
Insulation resistance		Min. 20MΩ (at 500VDC megger)			
Vibration		1.5mm amplitude at frequency of 10 to 55Hz in each of X, Y, Z directions for 2 hours			
Shock		500m/s² (50G) X, Y, Z directions for 3 times			
Environ-ment	Ambient temperature	-10 to 50℃, Storage: -20 to 70℃			
	Ambient humidity	35 to 85%RH, Storage: 35 to 85%RH			
Material		Case : Heat-resistant ABS, Case cover : Polycarbonate			
Cable		ø 4, 4P, Length: 2m, AWG 22, Insulation diameter: ø 1.2	ø 4, 6P, Length : 2m, AWG 24, Insulation diameter: ø 1.0		ø 4, 4P, Length: 2m, AWG 22, Insulation diameter: ø 1.2
Accessory		Mounting bracket, Bolts/nuts			
Weight		Approx. 65g			

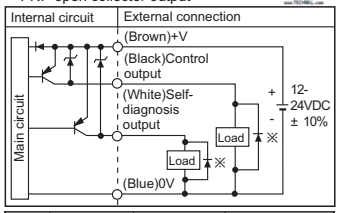
※1: Frequency 1(Normal mode): Max. 0.5ms, Frequency 2: Max. 0.7ms
※The temperature or humidity mentioned in Environment indicates a non freezing or condensation environment.

■ Control output circuit diagram

- NPN open collector output



- PNP open collector output

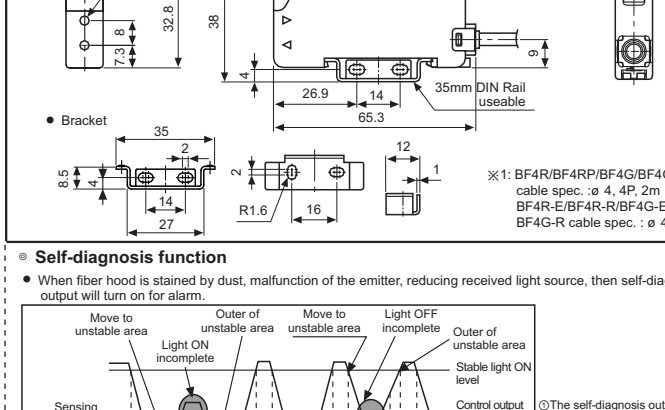


Model / Input cable	BF4R/BF4RP BF4G/BF4GP (Standard type)	BF4R-E BF4G-E (External synchronization input type)	BF4R-R BF4G-R (Remote sensitivity setting type)
Input1	———	External synchronization input	ON input of external sensitivity setting
Input2	———	Emission disable input	OFF input of external sensitivity setting

※Connect Diode at external terminal for inductive load.

■ Dimensions

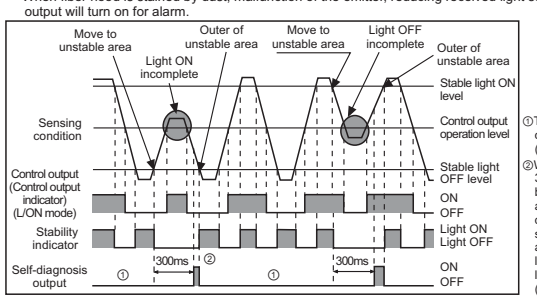
(Unit:mm)



※1: BF4R/BF4RP/BF4G/BF4GP cable spec. :ø 4, 4P, 2m
BF4R-E/BF4R-R/BF4G-E/ BF4G-R cable spec. : ø 4, 6P, 2m

◎ Self-diagnosis function

- When fiber hood is stained by dust, malfunction of the emitter, reducing received light source, then self-diagnosis output will turn on for alarm.



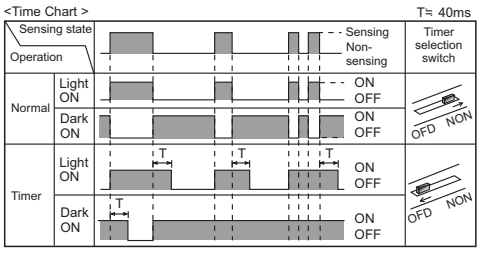
①The self-diagnosis output turns off during stable sensing. (① position)
②When sensing state keeps for 300ms at unstable area between stable light OFF level and stable light ON level, self-diagnosis output turns on, self-diagnosis output turns off at lower than stable light OFF light level or upper than stable light ON level. (② position)

- Under the control output turns on, if the over-current supplied in control output, then self-diagnosis output turns on.

◎ OFF Delay timer function(BF4R/BF4G/BF4RP/BF4GP/BF4R-R/BF4G-R only)

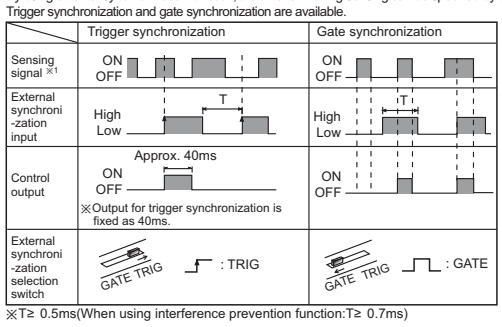
Standard type(BF4R/BF4G/ BF4RP/BF4GP), Remote sensitivity setting type(BF4R-R/ BF4G-R) have built-in approx. 40ms fixed OFF-delay timer.
The timer works when the timer selection switch is set to 'OFD'.
The output turns off after turning on for 40ms at OFF position of the sensing output.
It is useful when the response time of the connected device is slow or when the sensing signal from a tiny object is too short.

<Time Chart >



◎ External synchronization input function(BF4R-E/BF4G-E only)

By using external synchronization function, the time for making sensing can be specified by external synchronization.
Trigger synchronization and gate synchronization are available.



<Input signal condition for External synchronization>

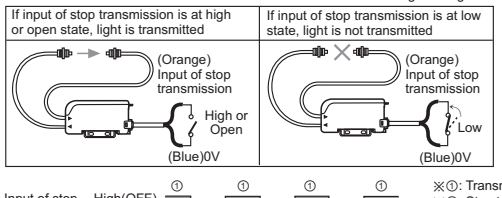
State	Signal condition
High	4.5-30VDC or Open
Low	0-1VDC

※1: Inner signal state before sending as control output for sensing signal which the sensor detects.

※T≥ 0.5ms(When using interference prevention function:T≥ 0.7ms)

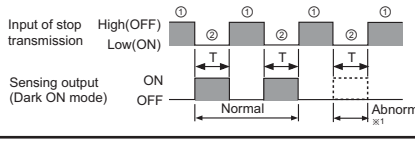
◎ Stop transmission function(BF4R-E/BF4G-E only)-Operation Test

- Below test is available under light ON state only.
- If input of stop transmission is at Low state, transmission light will be disable.
- It can check normal or abnormal state of the sensor without moving the target.



<Input signal condition for stop transmission disable>

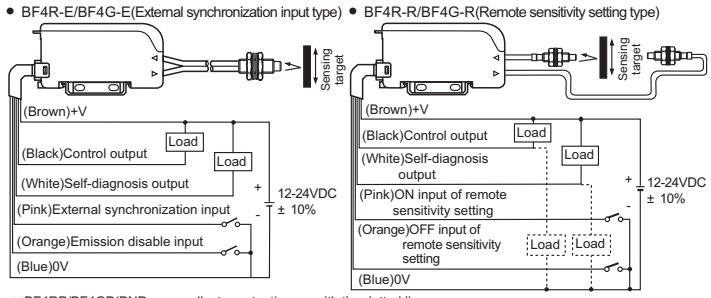
State	Signal condition
High	4.5-30VDC or Open
Low	0-1VDC



※①: Transmission area
※②: Stop transmission area
※1: If transmission is stopped, control output must turn on, but if control output does not turn on, it processes that sensor has error.
※T≥ 0.5ms(When using interference prevention function T≥ 0.7ms)

■ Connection

- BF4R-E/BF4G-E(External synchronization input type)
- BF4R-R/BF4G-R(Remote sensitivity setting type)

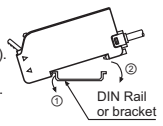


※BF4RP/BF4GP(PNP open collector output) goes with the dotted line.
※There are no pink & orange wires at Standard type(BF4R/BF4RP/BF4G/BF4GP).
※This connection is for diffuse reflective type fiber cable. It also can be used with through-beam type one.

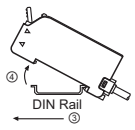
■ Installations

1. Mounting amplifier unit

- When mounting the amplifier.
  ①Hook the front part of the amplifier on DIN Rail(or bracket).
  ②Press the rear part of the amplifier on DIN Rail(or bracket).

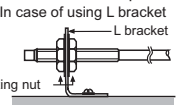


- When releasing the amplifier
  Push the back of amplifier toward ③ and lift the hole for fiber toward ④ up then simply take it out without tools.

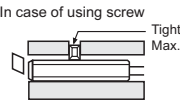


2. Installation of fiber optic cable

- In case of using L bracket

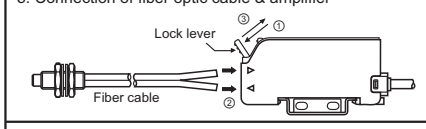


- In case of using screw



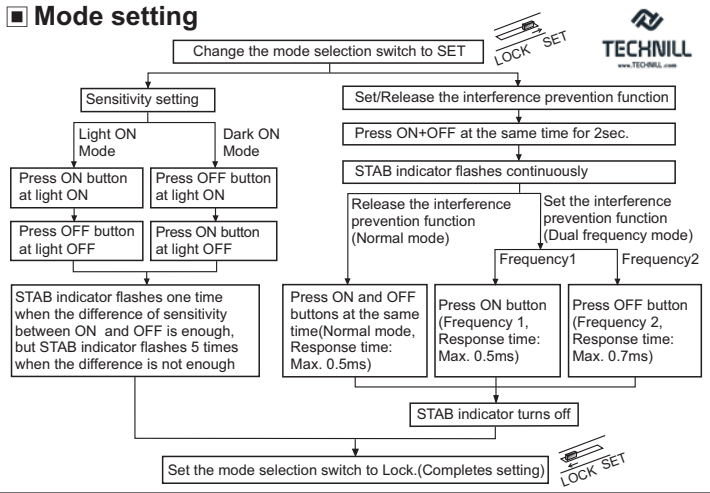
※Notice: If setting bolt is tightened with over specified tightening torque, hood of fiber optic cable may be damaged.

3. Connection of fiber optic cable & amplifier



①Open the lock lever to "↘" direction.
②Insert the fiber optic cable in the amplifier slowly. (Depth: 10mm)
③Close the lock lever to "↗" direction.

■ Mode setting



■ Fiber optic cable model

◎ Fiber optic cable model name(All models)

●FD-310-05	●FDCS-320-05	●FD-420-06B	●FTS2-320-05	●FT-420-10R
●FD-320-05	●FDS-420-05	●FD-620-10R	●FTS-420-10	●FT-420-13B
●FD-320-10	●FDS2-420-05	●FD-620-13B	●FTS2-420-10	●FTC-1520-05
●FD-620-10	●FD-320-F	●FDC-320-06B	●FT-420-10C	●FTC-1520-06B
●FD-610M-10	●FD-320-F1	●FT-310-05	●FTC-220-05	●FTC-220-05R
●FDS-310-05	●FD-320-F2	●FT-320-05	●FTC-320-10	●GT-420-13H2
●FDS-320-05	●FD-620-10H	●FT-420-10	●FTCS-220-05	●GD-420-20H2
●FDS2-320-05	●FD-620-15H1	●FT-430M-10	●FTS1-320-05	●GD-620-20H2
●FDS-620-10	●FDC-320-F	●FTP-320-10	●FT-420-10H	●GD-620-20H2S
●FDS2-620-10	●FD-320-05R	●FTS-310-05	●FT-420-15H1	●GD-420-20H2S
●FD-420-05	●FD-320-06B	●FTS2-310-05	●FT-320-05R	
●FDC-320-05	●FD-420-05R	●FTS-320-05	●FT-320-06B	

◎ Specification(Example) (Unit:mm)

Sensing type	Model	Allowable band radius	Min. sensing object	Sensing distance(mm)	Dimension
Through-beam type	FT-320-05	15R	ø 0.5	150	Adapter, 12, 2000, ø 0.5, M3X0.5, ø 1
	FT-420-10	30R	ø 1	500	20, 2000, 3, 12, 2.6, ø 1, M4X0.7, ø 2.2
Diffuse reflective type	FD-320-05	15R	ø 0.03	40	Adapter, 12, 2000, 2-ø 0.5, M3X0.5, 2-ø 1
	FD-620-10	30R	ø 0.03	120	18, 2000, 3, 15, ø 4, 2-ø 1, M6X0.75, 2-ø 2.2

※Specification of other models is indicated in total catalogue.
※ Adapter marked fiber optic cable should be used with adapter.
※Above sensing distance is for red light. (Green light : 10% of distance of red light)

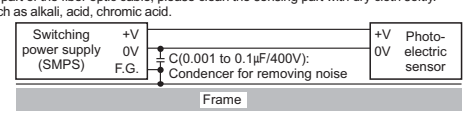
■ Accessories

(Unit:mm)

Model	Dimension	Features
FTH-310	M3X0.5, ø 4.6, ø 3, ø 6, ø 6, 12, 8, 1000	Fiber optic cable protection pipe (Shock, Vibration, Cable cut)
FTH-410	M4X0.7, ø 5.8, ø 4, ø 7, ø 7, 12, 8, 1000	
FDH-610	M6X0.75, ø 7, ø 5.5, ø 9, ø 9, 11, 8, 1000	

■ Caution for using

1. Do not scratch the section of fiber optic cable.
2. Intercept a strong source of light as like sunlight, spotlight within inclination angle range of photoelectric sensor.
3. Do not apply a strong tensile force to fiber optic cable.
4. In case of installing the fiber optic cable, be sure not to curve the fiber optic cable over tolerance that mentioned in total catalog.
5. When wire the fiber optic sensor with high voltage line, power line in the same conduit, it may cause malfunction or mechanical trouble. Therefore please wire separately or use different conduit.
6. Avoid installing the unit where there is severe corrosive gas, or dust, etc.
7. In case of connecting inductive load such as DC relay at load, use shielded cable, diode and varistor in order to remove noise.
8. The amplifier cable shall be used shortly, because it may cause malfunction by surge through the long cable.
9. When it is stained by dirt at a detecting part of the fiber optic cable, please clean the sensing part with dry cloth softly. But do not use an organic materials such as alkali, acid, chromic acid.
10. When the unit is supplied by switching power supply unit, as a power source, please earth Frame Ground(F.G.) terminal, and connect condenser between 0V and F.G. terminals to remove noise.



11. Installation environment
    ① It shall be used indoor
    ② Altitude Max. 2,000m
    ③ Pollution Degree 2
    ④ Installation Category III

※It may cause malfunction if above instructions are not followed.

■ Major products

- Proximity sensors
- Area sensors
- Door/Door side sensors
- Counters
- Rotary encoders
- Power controllers
- Panel meters
- Temperature controllers
- Tachometer/Pulse(Rate) meters
- Temperature/Humidity transducers
- Switching power supplies
- Stepping motors/drivers/motion controllers
- Field network devices
- Laser marking system(CO2, Nd:YAG)
- Laser welding/soldering system
- Photoelectric sensors
- Fiber optic sensors
- Pressure sensors
- Timers
- Display units
- Sensor controllers
- Graphic/Logic panels

Autonics Corporation
http://www.autonics.com
Satisfiable Partner For Factory Automation

■ HEAD QUARTERS :
41-5, Yongdang-dong, Yangsan-si, Gyeongnam, 626-847, Korea
■ OVERSEAS SALES :
Bldg. 402 3rd Fl., Bucheon Techno Park, 193, Yakdae-dong, Wonmi-gu, Bucheon-si, Gyeonggi-do, 420-734, Korea
TEL:82-32-610-2730 / FAX:82-32-329-0728
■ E-mail : sales@autonics.com

The proposal of a product improvement and development : product@autonics.com

EP-KE-08-0240K