BF4R Series

High reliability of fiber optic amplifier for convenient mounting

▣Features

- High speed response : Under 0.5ms
- Auto sensitivity setting(Button setting) / Remote sensitivity setting.
- External synchronization input function, Mutual interference protection, Self diagnosis function.
- Overcurrent protection and Reverse power polarity protection.
- Timer function : OFF Delay approx. 40ms fixed. (Standard Type, Remote sensitivity setting type only)
- Automatically selectable Light ON / Dark ON mode.
- Able to detect small targets and mount to tiny place.

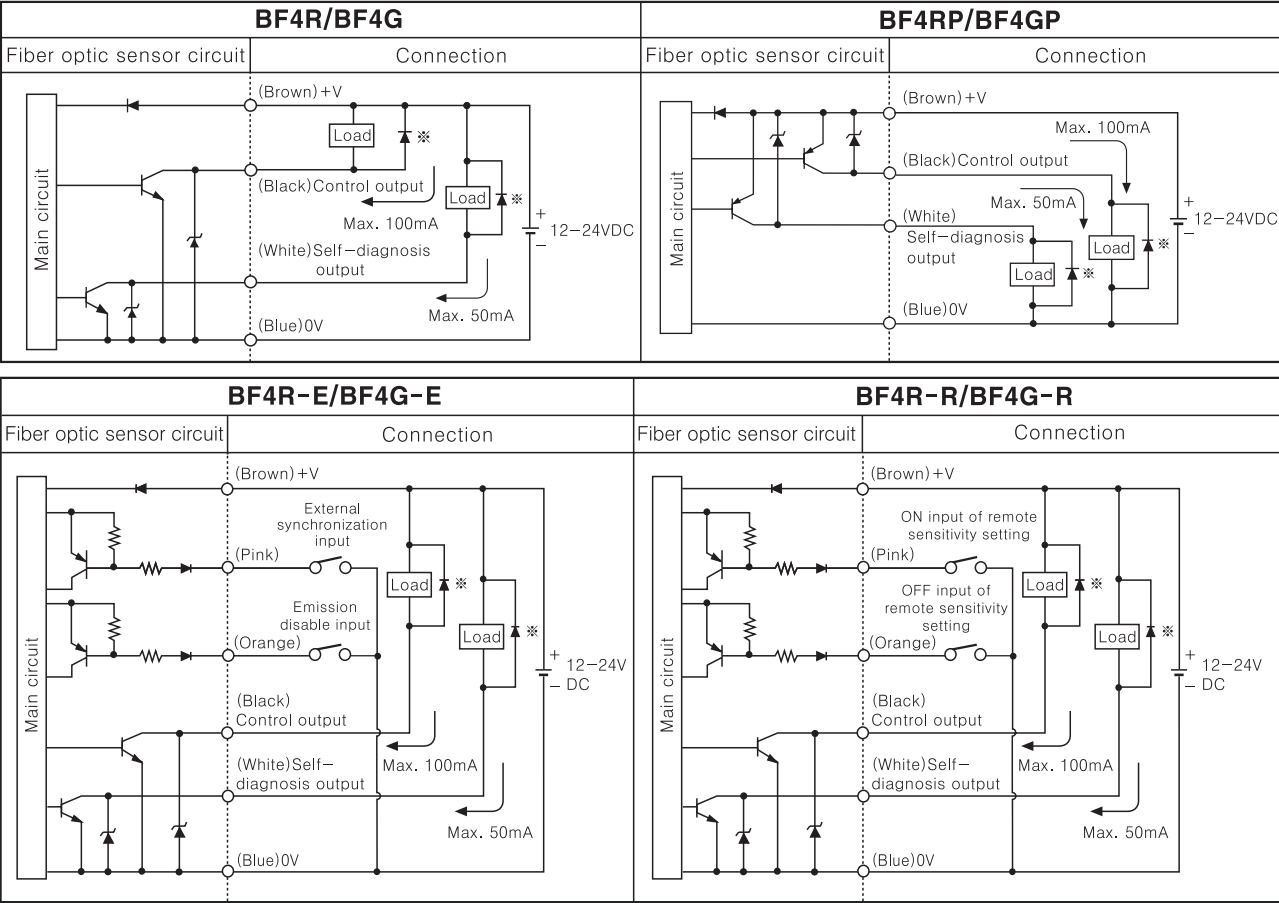⚠ **Please read "Caution for your safety" in operation manual before using.**

CE

▣Specifications

Model	Standard type		External synchronization input type	Remote sensitivity setting type
	BF4RP/BF4GP	**BF4R/BF4G**	**BF4R-E/BF4G-E**	**BF4R-R/BF4G-R**
Response Frequency	Max. 0.5ms(FREQ.1), Max. 0.7ms(FREQ.2)			
Power voltage	12-24VDC ±10%, Ripple P-P:Max. 10%			
Current consumption	Max. 45mA			
Light source	Red LED/Green LED(Modulated)			
Sensitivity adjustment	Selectable sensitivity adjustment button			
Operation mode	Automatic selection of Light ON/Dark ON accordance with button setting			
Control output	**PNP O·C output**	**NPN O·C output**		
	Load current:Max. 100mA Applied voltage:Max. 30VDC Output voltage: Min. (Power supply -2.5)VDC	Load current:Max. 100mA, Applied voltage:Max. 30VDC Residual voltage:Max. 1V(at 100mA load current), Max. 0.4V(at 16mA load current)		
Self-diagnosis output	ON state under unstable sensing(When the target stays for 300ms in unstable level), ON state when control output short-circuited			
	Load current:Max. 50mA Applied voltage:Max. 30VDC Output voltage:Min. (Power supply -2.5)VDC	Load current:Max. 50mA, Applied voltage:Max. 30VDC Residual voltage:Max. 1V(at 50mA load current), Max. 0.4V(at 16mA load current)		
Protection circuit	Short-circuit protection, Reverse polarity protection circuit			
Indicator	Operation indicator:Red LED, Stable indicator:Green LED flickers when the target stays in stable sensing level			
Input of stop transmission function	————	————	Includes	————
External synchronization function	————	————	Includes(Gate/Trigger)	————
Remote sensitivity setting function	————	————	————	Includes
Interference prevention function	**(Note1)**	Includes(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)
Insulation resistance	Min. 20MΩ(at 500VDC)			
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			
Vibration	1.5mm amplitude at frequency of 10 ~ 55Hz in each of X, Y, Z directions for 2 hours			
Shock	500m/s² (50G) in X, Y, Z direction for 3 times			
Operating temperature	-10 ~ +50℃ (at non-freezing status)			
Storage temperature	-20 ~ +70℃			
Ambient humidity	35 ~ 85%RH			
Material	Case : Heat-resistance ABS, Case cover : Polycarbonate			
Cable	φ4, 4P, Length : 2m		φ4, 6P, Length : 2m	
Approval	CE			
Unit weight	Approx. 65g			

※**(Note1)**Frequency1 (Normal mode) : Max. 0.5ms, Frequency :Max. 0.7ms
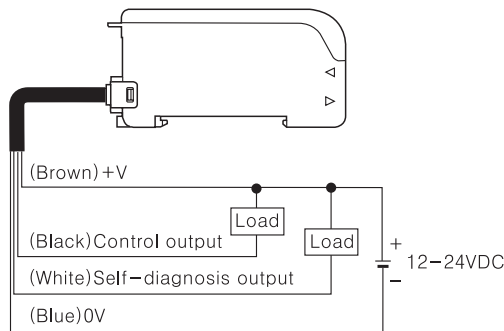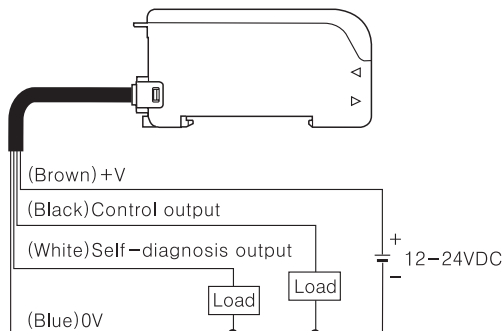
Fiber Optic Amplifier

■Control output diagram

BF4R/BF4G		BF4RP/BF4GP	
Fiber optic sensor circuit	Connection	Fiber optic sensor circuit	Connection

BF4R/BF4G:
- (Brown)+V
- Load ※
- (Black)Control output
- Load ※
- Max. 100mA
- (White)Self−diagnosis output
- Max. 50mA
- (Blue)0V
- 12−24VDC
- Main circuit

BF4RP/BF4GP:
- (Brown)+V
- (Black)Control output
- Max. 100mA
- (White)Self−diagnosis output
- Max. 50mA
- Load ※
- Load ※
- (Blue)0V
- 12−24VDC
- Main circuit

BF4R-E/BF4G-E		BF4R-R/BF4G-R	
Fiber optic sensor circuit	Connection	Fiber optic sensor circuit	Connection

BF4R-E/BF4G-E:
- (Brown)+V
- External synchronization input
- (Pink)
- Load ※
- Emission disable input
- (Orange)
- Load ※
- (Black) Control output
- (White)Self−diagnosis output
- Max. 100mA
- Max. 50mA
- (Blue)0V
- 12−24V DC
- Main circuit

BF4R-R/BF4G-R:
- (Brown)+V
- ON input of remote sensitivity setting
- (Pink)
- OFF input of remote sensitivity setting
- (Orange)
- Load ※
- Load ※
- (Black) Control output
- (White)Self−diagnosis output
- Max. 100mA
- Max. 50mA
- (Blue)0V
- 12−24V DC
- Main circuit

※Connect Diode at external terminal for inductive load.

■Connections

●BF4R/BF4G

- (Brown)+V
- (Black)Control output
- (White)Self−diagnosis output
- (Blue)0V
- Load
- Load
- 12−24VDC
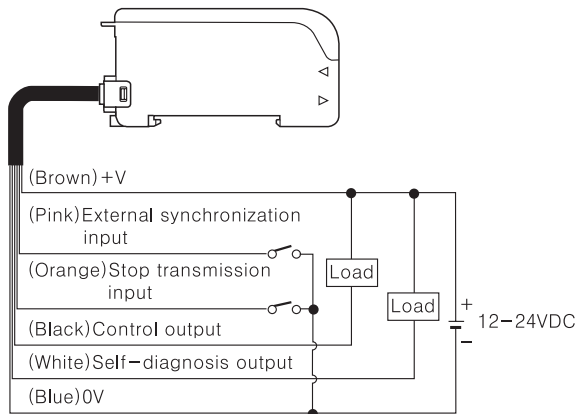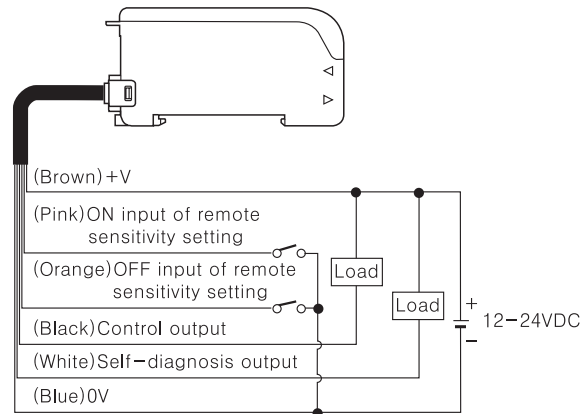
●BF4RP/BF4GP

- (Brown)+V
- (Black)Control output
- (White)Self−diagnosis output
- (Blue)0V
- Load
- Load
- 12−24VDC

●BF4R-E/BF4G-E

- (Brown)+V
- (Pink)External synchronization input
- (Orange)Stop transmission input
- (Black)Control output
- (White)Self−diagnosis output
- (Blue)0V
- Load
- Load
- 12−24VDC

●BF4R-R/BF4G-R

- (Brown)+V
- (Pink)ON input of remote sensitivity setting
- (Orange)OFF input of remote sensitivity setting
- (Black)Control output
- (White)Self−diagnosis output
- (Blue)0V
- Load
- Load
- 12−24VDC

(A) Counter
(B) Timer
(C) Temp. controller
(D) Power controller
(E) Panel meter
(F) Tacho/ Speed/ Pulse meter
(G) Display unit
(H) Sensor controller
(I) Switching power supply
(J) Proximity sensor
(K) Photo electric sensor
(L) Pressure sensor
(M) Rotary encoder
(N) Stepping motor & Driver & Controller
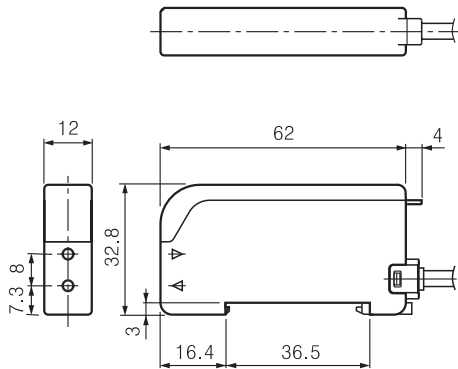(O) Graphic panel
(P) Production stoppage models & replacement
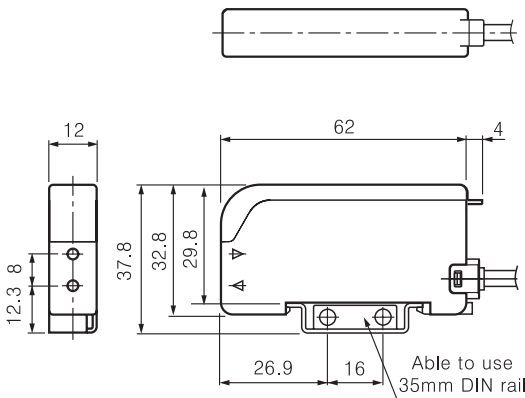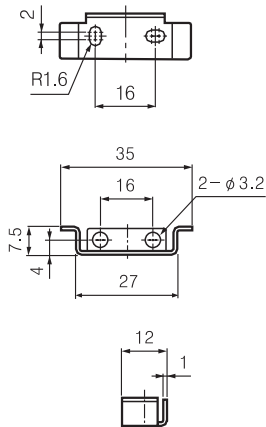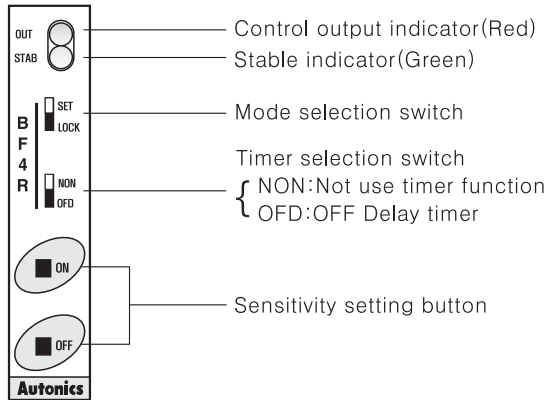
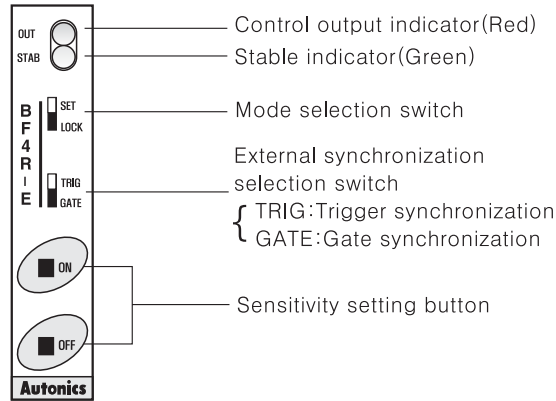# BF4R Series

▣ Dimensions

● Product

● Bracket

● Bracket

Able to use 35mm DIN rail

▣ Panel identification

● BF4R / BF4G / BF4RP / BF4GP / BF4R-R / BF4G-R

- OUT / STAB —— Control output indicator(Red)
- —— Stable indicator(Green)
- SET / LOCK —— Mode selection switch
- NON / OFD —— Timer selection switch
  { NON：Not use timer function
  { OFD：OFF Delay timer
- ON / OFF —— Sensitivity setting button

● BF4R-E / BF4G-E

- OUT / STAB —— Control output indicator(Red)
- —— Stable indicator(Green)
- SET / LOCK —— Mode selection switch
- TRIG / GATE —— External synchronization selection switch
  { TRIG：Trigger synchronization
  { GATE：Gate synchronization
- ON / OFF —— Sensitivity setting button

▣ Setting mode

Change the mode switch as Set.

Sensitivity adjustment

Light ON mode

Dark ON mode

Press ON button in Light ON status

Press OFF button in Light ON status

Press OFF button in non Light ON status

Press ON button in non Light ON status

STAB LED is flashed 1 time when the sensitivity difference is enough. (Or it is flickered 5 times)

Setting and cancellation of interference protection function

Press ON+OFF button together for 2 sec

STAB LED is flashing continuously.

Cancellation of interference protection function (Normal mode)

Setting of interference protection function (Differential frequency mode)

Select the frequency 1

Select the frequency 2

Press ON+OFF button together (Normal mode, Response time : Max. 0.5ms)

Press ON button (Frequency 1, Response time : Max. 0.5ms)

Press OFF button (Frequency 2, Response time : Max. 0.7ms)

STAB LED is out

Change the mode switch as Lock (Setting is completed.)

■Sensitivity adjustment

◎Adjustment by the sensitivity setting button(All models)

●Light ON Mode

The control output turns on at Light ON status and turns off at Light OFF status.

Order	Setting method	
①	Mount the fiber optic cable within sensing distance.	
②	Change the mode selection switch to [**SET**].	
③	Diffuse reflective:Press [**ON**] button with the sensing target in place. Transmitted beam:Press [**ON**] button without the sensing target.	
④	The stable indicator flashes at ON state. (Check the target position)	OUT STAB
⑤	Diffuse reflective:Press [**OFF**] button with the sensing target removed. Transmitted beam:Press [**OFF**] button with the sensing target in place.	
⑥	• When there is enough sensitivity difference between ON state and OFF state, the STAB indicator flashes one time only at stable sensing level. • When there is not enough sensitivity difference between ON state and OFF state, the STAB indicator flashes five times at unstable sensing level. **(Note)**	
⑦	Change the mode selection switch to [**LOCK**], even though the sensitivity setting button is touched, setting sensitivity shall not be changed.	

(Note) The sensitivity can be set at unstable sensing area.

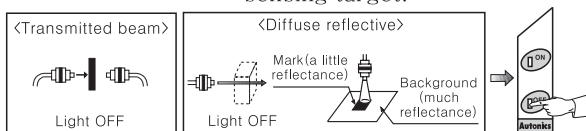#### ●Dark ON Mode

The control output turns off at Light ON status and turns on at Light OFF status.

<How to set sensitivity>

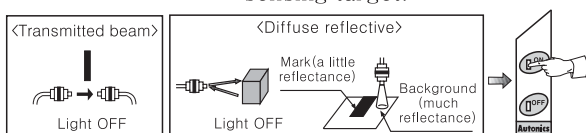Most of adjustments except ③ & ⑤ are same as Light ON mode.

☞ ③ state
 • Diffuse reflective : Press [**ON**] button without the sensing target.
 • Transmitted beam : Press [**ON**] button with the sensing target.

☞ ⑤ state
 • Diffuse reflective : Press [**OFF**]button with the sensing target.
 • Transmitted beam : Press [**OFF**]button without the sensing target.

◎In case of setting as max. sensitivity

①Set the mode selection switch to [**SET**] mode.
②In case of **Light ON mode** : Press ON/OFF 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 ON/OFF 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**] mode.

※External sensitivity setting

●**Light ON Mode**(From above ③)
 External sensitivity setting **ON** input(High→Low→High),
 External sensitivity setting **OFF** input(High→Low→High)

●**Dark ON Mode**(From above ③)
 External sensitivity setting **OFF** input(High→Low→High),
 External sensitivity setting **ON** input(High→Low → High)

< Application >

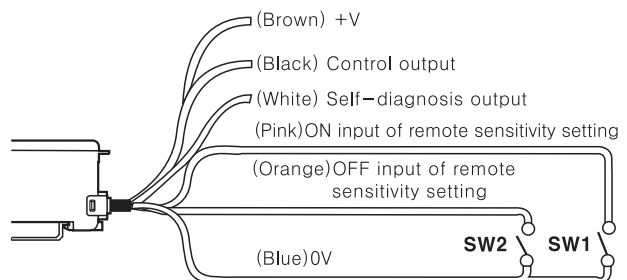 ●In case of extend sensing distance as the diffusive reflective type :
 If using one fiber optic sensor in place where there are targets with high reflectivity and low reflectivity, able to get stable detection by adjusting max. sensitivity.

 ●In case of using the transmitted beam type at bad environment :
 If using fiber optic sensor in place where there is lots of dust or moisture it might cause malfunction.
 Please max. sensitivity then it can perform stable detection.

◎Remote adjustment of sensitivity (BF4R-R/BF4G-R)

BF4R-R/BF4G-R type can adjust the sensitivity with input signal lines regardless of the mode selection switch as following diagram;

(Brown) +V
(Black) Control output
(White) Self-diagnosis output
(Pink)ON input of remote sensitivity setting
(Orange)OFF input of remote sensitivity setting
(Blue)0V
SW2 SW1

①SW1(ON input of remote sensitivity setting) :
 SW1 turns on and then turns off instead of ③ method by the sensitivity setting button.
②SW2(OFF input of remote sensitivity setting) :
 SW2 turns on and then turns off instead of ⑤ method by the sensitivity setting button.

<External sensitivity setting input signal condition>

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

*Input impedance:10kΩ

BF4R Series

◎Prohibition of inputting External sensitivity setting(BF4R-R/BF4G-R)

Even though mode switch is at Lock position, it is able to input external sensitivity setting when SW1 and SW2 are ON. Therefore please install SW3 in order to prevent from malfunction as below.
※SW3 – OFF : Disable to set external sensitivity
※SW3 – ON : Enable to set external sensitivity

- (Brown)+V
- (Black)Control output
- (White)Self−diagnosis output
- (Pink)ON input of remote sensitivity setting
- (Orange)OFF input of remote sensitivity setting
- (Blue)0V

SW3 SW2 SW1

◎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. (Note: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 executed, but stable sensing operates after 340ms.

<Time Chart : Light ON Mode >

Power supply	ON / OFF	
Remote sensitivity setting ON input	HIGH(OFF) / LOW(ON)	T1 T2
Remote sensitivity setting OFF input	HIGH(OFF) / LOW(ON)	T5 T2
Self− diagnosis output (Answer back function)	ON / OFF	T3 ※ T4 / T3 ※ T4
Sensing output		Sensing possible

※During period T3(Approx. 300ms), do not change the light ON value by moving the object, etc.
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 and then apply OFF input of remote sensitivity setting after 500ms)

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

Standard type and Remote sensitivity setting type both contain a built−in approx. 40ms fixed OFF−delay timer. The timer works when the timer selection switch is set to 'OFD'. The output is turned off after remaining on for additional 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>   T≒40ms

Output operation	Sensing state	Sensing Non−Sensing	Timer selection switch
Normal	Light ON	ON / OFF	LOCK NON OFD
Normal	Dark ON	ON / OFF	
Timer	Light ON	ON / OFF T T T	LOCK NON OFD
Timer	Dark ON	ON / OFF T	

■External synchronization input function(BF4R-E/BF4G-E)

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

	Trigger synchronization	Gate synchronization
(Note) Sensing signal	ON / OFF	ON / OFF
External synchroni −zation input	HIGH / LOW T	HIGH / LOW T
Control output	ON / OFF 40ms Approx. ※Control output is fixed as 40ms.	ON / OFF
External synchroni −zation selection switch	LOCK TRIG GATE TRIG	LOCK TRIG GATE GATE

※T≥0.5ms(When using interference prevention function : T≥0.7ms)
(Note)Actual signal detected by sensor.

<Input signal condition for External synchronization>

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

Fiber Optic Amplifier

(A)
Counter

(B)
Timer

(C)
Temp.
controller

(D)
Power
controller

(E)
Panel
meter

(F)
Tacho/
Speed/
Pulse
meter

(G)
Display
unit

(H)
Sensor
controller

(I)
Switching
power
supply

(J)
Proximity
sensor

(K)
Photo
electric
sensor

(L)
Pressure
sensor

(M)
Rotary
encoder

(N)
Stepping
motor &
Driver &
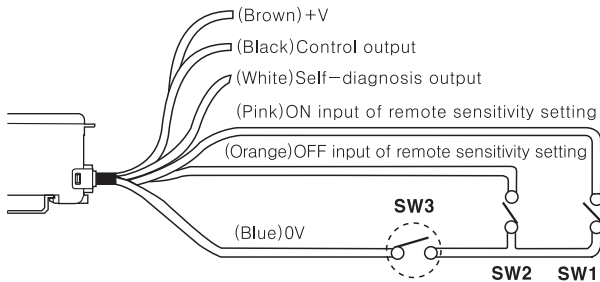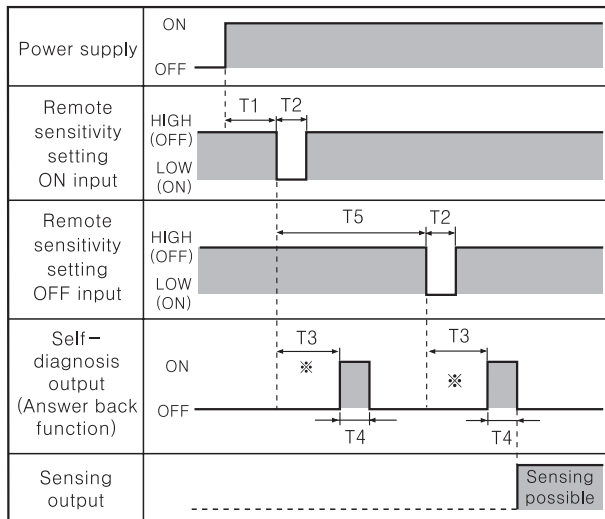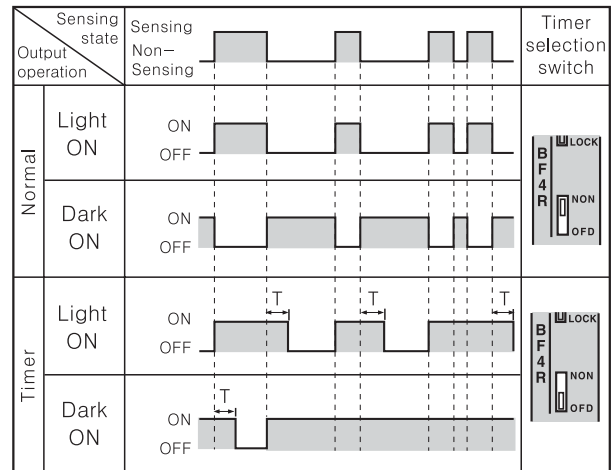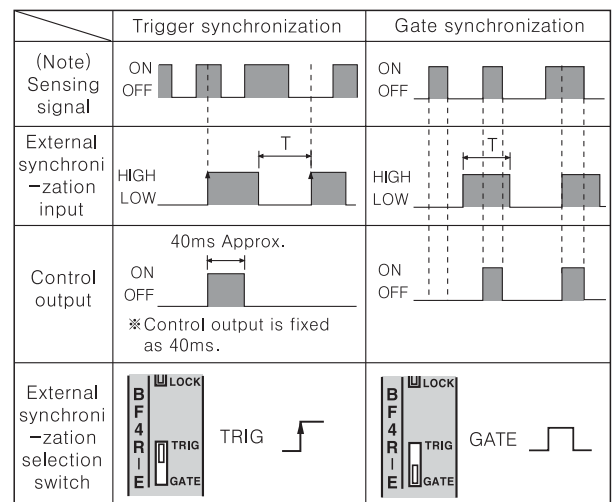Controller

(O)
Graphic
panel

(P)
Production
stoppage
models &
replacement

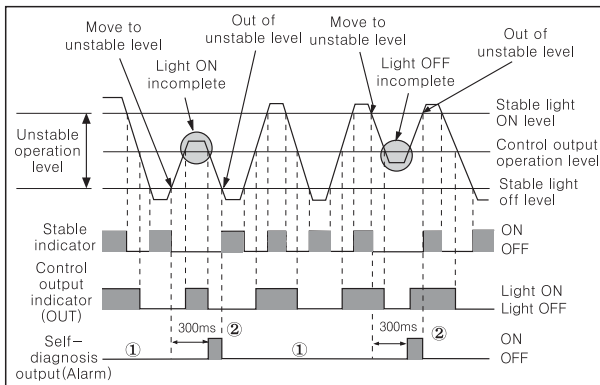## ■Stop transmission function (BF4R-E/BF4G-E)-Operation Test

●Below test is available under Light ON state only.
●If input of stop transmission is at low state, trans－mission light will be stopped.
●It can check normal or abnormal state of the sensor without moving the target.

(Orange)Input of stop transmission
(Blue)0V
High or Open

[If input of stop transmission is at High or Open state, light is transmitted.]

(Orange)Emission disable input
(Blue) 0V
Low

[If input of stop transmission is at Low state, light is transmitted.]

Input of stop transmission　High(OFF)／Low(ON)
Sensing output (If it is in ON state when light is not received)　ON／OFF

① : Transmission area, ② : Stop transmission area
Normal　Abnormal

※① : Transmission area, ② : Stop transmission area
※(Note1)If transmission is stopped control output must turn on, but if control output does not turn on, it seems that sensor has some problems.
※T≧0.5ms
 (When using interference prevention function T≧0.7ms)
※Input of stop transmission ☞ High: 4.5－30VDC or Open
　　　　　　　　　　　　　　　Low : 0－1VDC

■Self-diagnosis function(All models)

When fiber tip is covered with dust, there will be reduction in emitted or received light which will cause the self－diagnosis output to turn on.

※**Light ON mode**

Move to unstable level / Out of unstable level / Move to unstable level / Out of unstable level
Light ON incomplete / Light OFF incomplete
Unstable operation level
Stable light ON level
Control output operation level
Stable light off level
Stable indicator　ON／OFF
Control output indicator (OUT)　Light ON／Light OFF
Self－diagnosis output(Alarm)　ON／OFF
300ms ② / 300ms ②

①The self－diagnosis output turns off during stable detection. (① position)
②When detecting state remains for 300ms at unstable level 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 level and upper than stable light ON level. (② position)
③When the control output turns on, if an over－current condition exists in control output, then self－diagnosis output turns on.

■Interference prevention function (All models)

BF4R 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 differential frequency mode)**
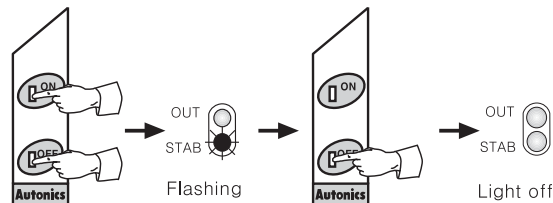
First sensor－FREQ.1(Response time:Max. 0.5ms)

①Set the mode selection switch to [**SET**].
②Press [**ON**] & [**OFF**] buttons for 2sec. at the same time.
③The [**STAB**] indicator flashes continuously.
④**Press [ON] button**
⑤The [**STAB**] indicator turns off.

OUT / STAB / Flashing
OUT / STAB / Light off
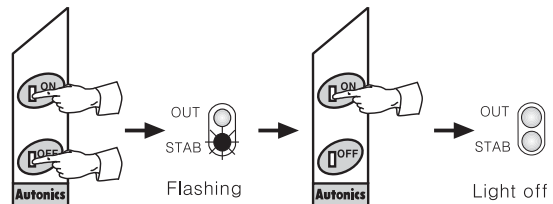
⑥Set the mode selection switch to [**LOCk**].

Second sensor－FREQ.2(Response time:Max. 0.7ms)

①Set the mode selection switch to [**SET**].
②Press [**ON**] & [**OFF**] buttons for 2sec. at the same time.
③The [**STAB**] indicator flashes continuously.
④**Press [OFF] button**
⑤The [**STAB**] indicator turns off.

OUT / STAB / Flashing
OUT / STAB / Light off

⑥Set the mode selection switch to [**LOCk**].

●**Interference prevention function(Operation of normal mode)**

①Set the mode selection switch to [SET].
②Press [ON] & [OFF] buttons for 2 sec. at the same time.
③The stable indicator flashes continuously.
④**Press [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 operation(Response time:Max. 0.5ms).