Panasonic **INSTRUCTIONS**

Digital Fiber Sensor Amplifier

FX-501□, FX-502□, FX-505□-C2 Series

Thank you for purchasing products from Panasonic Electric Works SUNX Co., Ltd. Please read this Instruction Manual carefully and thoroughly for the correct and optimum use of this product. Kindly keep this manual in a convenient place for quick reference.

⚠ WARNING

- Never use this product as a sensing device for personnel protection.
- In case of using sensing devices for personnel protection, use products which meet laws and standards, such as OSHA, ANSI or IEC etc., for personnel protection applicable in each region or country.

1 Compliance with standards

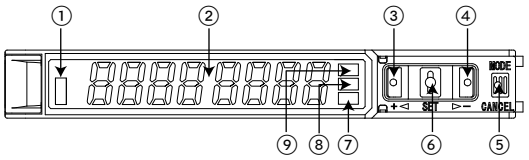
This product complies with the following standards and regulations.

- For the EU: EMC Directive 2004/108/EC
- For the US and Canada: ANSI/UL60947-5-2, CAN/CSA C22.2 No.14
- For Korea: S1-G-1-2009, S2-W-5-2009

☛ **In case you require a UL listing mark or C-UL listing mark, use a class 2 power supply unit.**

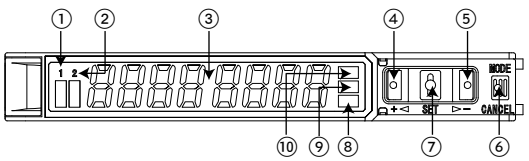
2 Part description

FX-501□



①	Operation indicator for sensing output (orange)	
②	Digital display (green/red)	
③	UP key (+)	Functions: ● Teach ● Fine adjustment of the threshold value ● Select settings
④	DOWN key (–)	
⑤	MODE key	Functions: ● Select modes ● Cancel
⑥	SET key	Functions: ● Teach ● Save selected settings
⑦	Mode indicator PRO mode (yellow), see page 6	
⑧	Mode indicator CUST (custom) mode (yellow), see page 5	
⑨	Mode indicator L /D (Light-ON/Dark-ON) mode (yellow)	

FX-502□ and FX-505□-C2



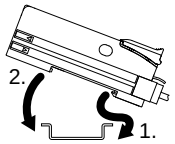
①,	Sensing output 1 (lit if output is active) ● Orange: Sensing output is operating
②	Sensing output 2 (lit if output is active) ● Orange: Sensing output is operating
③	Digital display (green/red)
④	UP key (+) / DOWN key (–): Functions: ● Teach ● Fine adjustment of the threshold value ● Select settings
⑤	MODE key: Functions: ● Select modes ● Cancel
⑦	SET key: Functions: ● Teach ● Save selected settings
⑧	Mode indicator PRO mode (yellow)
⑨	Mode indicator CUST (custom) mode (yellow)
⑩	Mode indicator L /D (Light-ON/Dark-ON) mode (yellow)

☛ **To toggle the key lock function ON/OFF, press the SET and the MODE key together for 3 seconds.**

3 Mounting

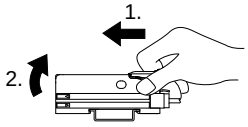
Installation to a DIN rail

1. Attach the railing on the rear of the amplifier to the DIN rail.
2. Push the amplifier in the direction of the arrow as illustrated so that it attaches securely.



Removal from a DIN rail

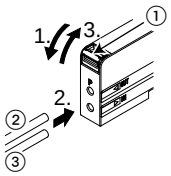
1. Push the amplifier forward.
2. Lift the front part of the amplifier up.



Connecting the fiber cable

☛ **The attachments to the fiber cables need to be fitted BEFORE you insert the fibers into the amplifier. For details, refer to the instruction manual enclosed with the fibers.**

1. Snap the fiber lock lever ① down as far as it will go.
2. Insert the fiber cables slowly into the inlets until they stop (see note).
3. Return the fiber lock lever to the original position.



☛ **With the coaxial reflective type fiber, such as FD-G4 or FD-FM2, insert the single core fiber cable into the inlet for the emitter ② (inlet on the amplifier is labeled "P") and the multi-core fiber cable into the inlet for the receiver ③. If they are inserted the wrong way round, the sensing performance will deteriorate.**

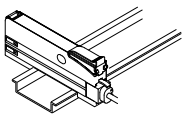
4 Cascading amplifiers of the connector type

☛ **Cascading is not available for FX-505□-C2.**

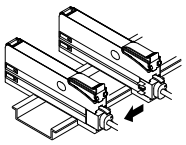
- You can only cascade amplifiers of the connector type, i.e. FX-501□ and FX-502□.
- Make sure that the power supply is OFF while adding or removing amplifiers of the connector type.
- If you cascade 2 or more amplifiers, make sure to mount them on a DIN rail. Refer to “3 Mounting” for details.
- For each amplifier using a main connection cable you can install a maximum of 11 additional amplifiers using sub cables.
- If you connect 2 or more amplifiers of the connector type in cascade, use the sub cable (optional) for the second connector-type-type amplifier and all after.

Cascading amplifiers

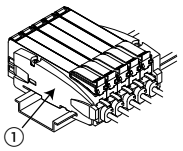
1. Mount the amplifiers one by one on the DIN rail.



2. Slide the amplifiers next to each other and connect the quick-connection cables (main cable for the first amplifier, sub cables for all amplifiers after the first).

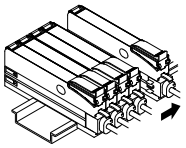


3. Mount the end plates **MS-DIN-E** (①, optional) at both ends of the cascade so that their flat sides hold the amplifiers together.
4. Tighten the screws to fix the end plates.



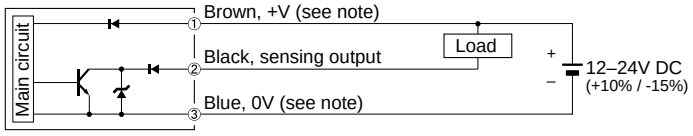
Removing cascaded amplifiers

1. Loosen the screws of the end plates.
2. Remove the end plates.
3. Slide the last amplifier away from the others and remove them one by one.

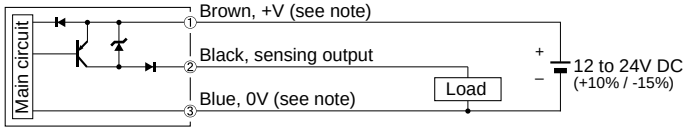


5 I/O circuit diagrams

FX-501 (NPN type)

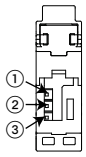


FX-501P (PNP type)



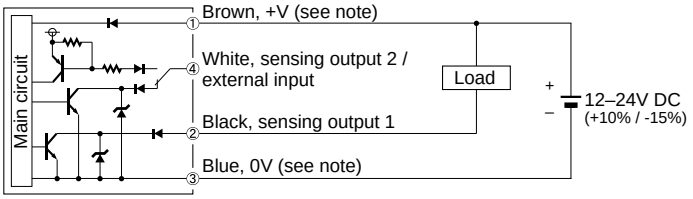
☛ **The quick-connection sub cable does not have +V (brown) and 0V (blue). The power is supplied from the connector of the main cable.**

Terminal arrangement



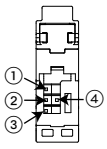
Terminal no.	Function
①	+V
②	Sensing output
③	0V

FX-502 (NPN type)



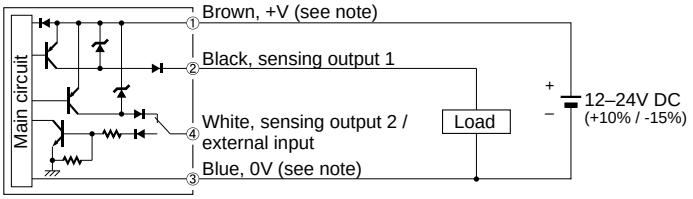
☛ **The quick-connection sub cable does not have +V (brown) and 0V (blue). The power is supplied from the connector of the main cable.**

Terminal arrangement

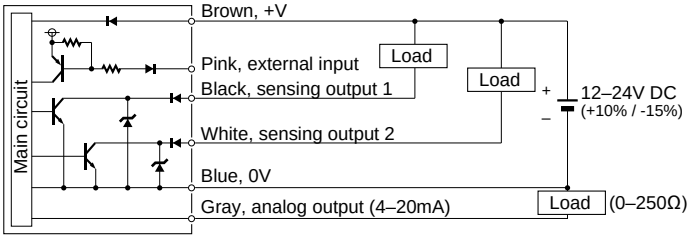


Terminal no.	Function FX-501□	Function FX-502□
①	+V	+V
②	Sensing output	Sensing output 1
③	0V	Sensing output 2/external input
④	—	0V

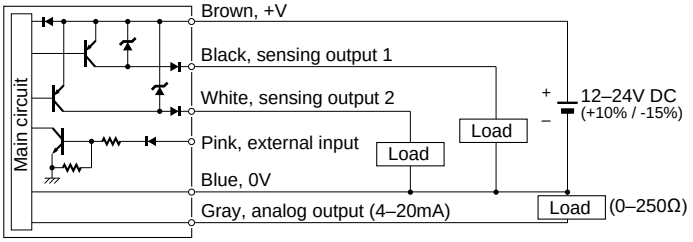
FX-502P (PNP type)



FX-505-C2 (NPN type)



FX-505P-C2 (PNP type)



☛ **Make sure to insulate the ends of all unused lead wires.**

6 Operation procedure

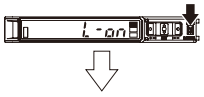
- If you change settings, press the SET key before you turn the power OFF. Otherwise your changes will be lost.
- With FX-502□, press the MODE key for 3 seconds to switch from sensing output 1 to sensing output 2.

When you turn the power ON, the amplifier is in RUN mode. Press the MODE key (indicated by black arrow in the illustrations below) to switch from one mode to the next.

RUN mode

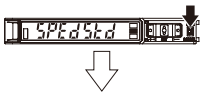
- Displays the threshold value in green and the incident light intensity in red.
- Used for teaching, making fine adjustments to the threshold values (see page 5), and activating the key lock function (see page 5).

Sensing output operation mode



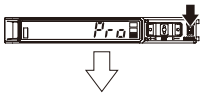
- Select either Light-ON or Dark-ON. The default setting is L-on (Light-ON).
- Refer to sensing output operation mode on page 5 for details.

CUSTOM mode



- Displays one of the three settings available in CUSTOM mode (response time, emission power, hysteresis). The default setting is SPEdStd (response time).
- Refer to CUSTOM mode on page 5 for details.

PRO mode



- Used for advanced settings.
- Refer to PRO mode on page 6 for details.

RUN mode

7 Teaching

- Please note that if the threshold values are very close to each other, objects may not be detected reliably.
- For teaching in Window Comparator mode or Hysteresis mode, you need to set the shift amount in PRO mode first (see “Pro1 menu items” on page 6).
- If you use 1-point teaching, set the shift amount (the initial value is 10% or 100) in PRO mode.

Teaching is performed in RUN mode. There are different teaching methods available. Which teaching method is recommended depends on the sensor type and whether the sensing object is present or not present or moving.

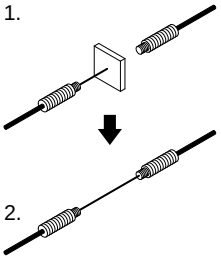
Sensing condition	Recommended teaching method
Sensing object is present and easily detectable.	2-point teaching
Sensing object is very small. Other objects are in the background.	Limit teaching
Production line cannot be stopped and sensing object is moving	Auto teaching

All teaching methods are available for the thru-beam and the reflective type.

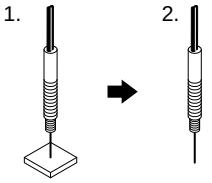
2-point teaching

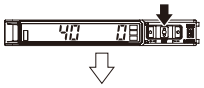
The basic teaching method when the sensing object is present is **2-point teaching**.

Thru-beam type

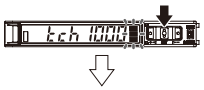


Reflective type





1. Press the SET key when the sensing object is present.



2. Press the SET key when the sensing object is absent.

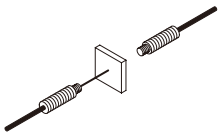
Display when stable sensing is possible.

Display when stable sensing is not possible.

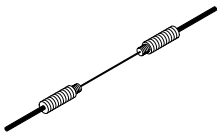
Limit teaching

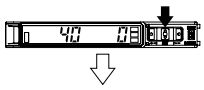
When the sensing object is small or there are objects in the background, use this teaching method. Both the thru-beam type and the reflective type can be used. The procedure only shows the thru-beam type.

Sensing object is present

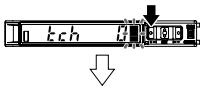


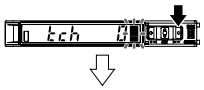
Sensing object is not present





1. Press the SET key when the sensing object is present or not present.
2. Press the UP key to shift the threshold level to a high level (low sensitivity) or press the DOWN key to shift the threshold level to a low level (high sensitivity).

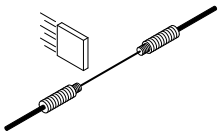




Display when stable sensing is possible.

Display when stable sensing is not possible.

Full auto teaching



When the sensing object is moving, use this teaching method. Both the thru-beam type and the reflective type can be used. The procedure only shows the thru-beam type.

1. Press and hold the SET key for a long time

2. Run the sensing object on the production line and hold down the SET key.

3. The display shows Auto in green. When the sensing object has passed through, release the SET key.

Display when stable sensing is possible.

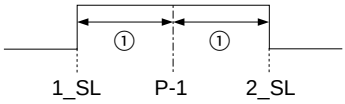
Display when stable sensing is not possible.

1-point teaching in window comparator and hysteresis mode

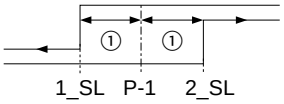
With this method, you set the threshold range by setting the shift amount to the desired value and measuring the incident light intensity once. The shift amount will be added to the incident light intensity to provide the upper threshold respectively subtracted from the incident light intensity to provide the lower threshold.

☛ **For FX-502□, window comparator mode only works for sensing output 1.**

Window comparator mode



Hysteresis mode



1_SL	Lower threshold value
P-1	Teaching point
2_SL	Upper threshold value
①	Shift amount. The shift amount is 10% by default and can be set in PRO mode as a percentage or as the incident light intensity. If you select a incident light intensity setting that exceeds the maximum or minimum, the maximum or minimum sensitivity will be set automatically.

1. Press the SET key when no sensing object is present.
2. Press the SET key when the sensing object is present.
   This sets the lower threshold 1_SL at 10% (the set shift amount) lower than the incident light intensity and the upper threshold 2_SL at 10% higher than the incident light intensity.

Display when stable sensing is possible.

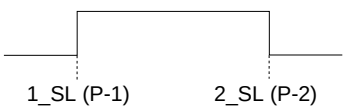
Display when stable sensing is not possible.

2-point teaching in window comparator and hysteresis mode

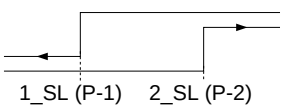
With this method, you set the threshold range by performing teaching the with two sensing objects with different incident light intensities (P-1 and P-2).

☛ **For FX-502□, window comparator mode only works for sensing output 1.**

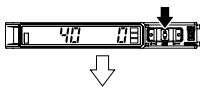
Window comparator mode



Hysteresis mode



1_SL (P-1)	Teaching point 1 serving as the lower threshold value
2_SL (P-2)	Teaching point 2 serving as the upper threshold value



1. Press the SET key when the first sensing object is present.
2. Press the SET key again when the second sensing object is present.

Display when stable sensing is possible.

Display when stable sensing is not possible.

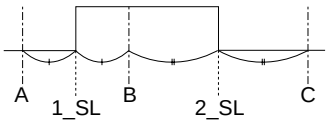
☛ **If you select a value exceeding the maximum/minimum, the sensitivity will be set automatically to the maximum/minimum value.**

3-point teaching in window comparator and hysteresis mode

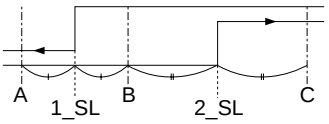
With this method, you set the threshold range by performing teaching with three sensing objects with different incident light intensities (P-1, P-2, and P-3). After you have performed teaching, the three points P-1, P-2, and P-3 will be sorted in ascending order into the values A, B, and C. The threshold range will be calculated from A, B, and C as follows: The lower threshold value 1_SL is the midpoint between A and B and the upper threshold value 2_SL is the midpoint between B and C.

☛ **For FX-502□, window comparator mode only works for sensing output 1.**

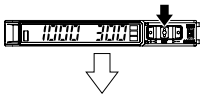
Window comparator mode



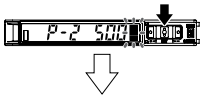
Hysteresis mode



A	Teaching point with the lowest incident light intensity
B	Teaching point with medium incident light intensity
C	Teaching point with the highest incident light intensity
1_SL	Lower threshold value (midpoint between A and B)
2_SL	Higher threshold value (midpoint between B and C)



1. Press the SET key when the first sensing object is present.



2. Press the SET key again when the second sensing object is present.
3. Press the SET key again when the third sensing object is present.

Display when stable sensing is possible.

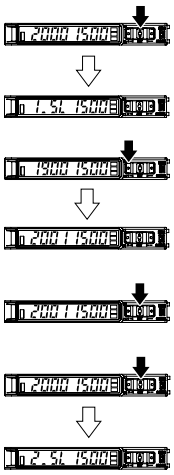
Display when stable sensing is not possible.

☛ **If you select a value exceeding the maximum/minimum, the sensitivity will be set automatically to the maximum/minimum value.**

8 Threshold value fine adjustment function

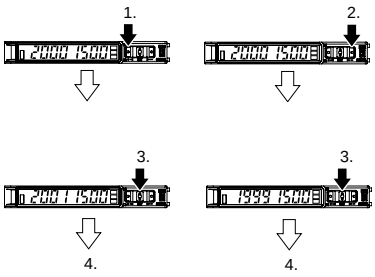
- The fine adjustment of the threshold value can be set in RUN mode, forced ON output mode and forced OFF output mode.
- For the setting procedure, refer to the Pro7 menu in “PRO mode (PRO)” on page 6.

Window comparator and hysteresis mode



1. Press the SET key for 2 seconds to display the threshold level. 1.SL or 2.SL appears in the digital display for a short time, then its threshold value (1900 in the example).
2. Press the UP or DOWN key to change the threshold value. In this example, the threshold value of 1900 is increased to 2001.
3. Press the SET key to save the threshold value. If you do not press the SET key, the value will be saved automatically after 2 seconds.
4. Press the SET key again for 2 seconds to display the other threshold level. Repeat the steps listed above to change and save the value.

All other modes

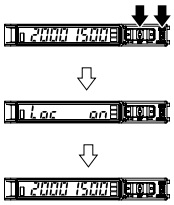


1. Press the UP key to increase the threshold value
2. Press the DOWN key to decrease the threshold value
3. Press the SET key to save the threshold value.
4. The value has been saved. If you do not press the SET key, the value will be saved automatically after 2 seconds.

9 Key lock function

The key lock prevents users from changing settings by accident. When the key lock function is activated and you press any of the keys, the digital display shows Loc on.

Activating the key lock function

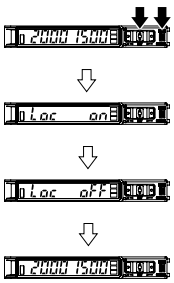


1. Press the SET and the MODE key together for 3 seconds or longer.

   The digital display changes to show the key lock function has been activated.

   Then the digital display returns to show the current values.

Deactivating the key lock function



1. Press the SET and the MODE key together for 3 seconds or longer.

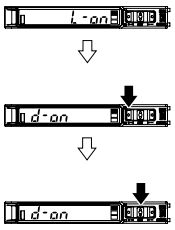
   The digital display changes to show the key lock function is active.

   The digital display changes to show the key lock function has been turned off.

   Then the digital display returns to show the current values.

10 Sensing output operation mode (L/D)

When the mode indicator L /D (yellow) is ON, you can switch from Light-ON mode to Dark-ON mode and vice versa.



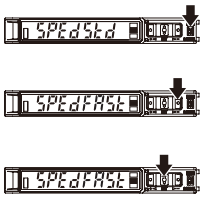
1. Press the MODE key. The L/D indicator lights up and the current mode setting is displayed.
2. Press the UP key to select Dark-ON mode or the DOWN key to select Light-ON mode.
3. Press the SET key to save the setting.

11 Custom mode (CUST)

The custom mode serves as a shortcut to one of the three settings listed in the table and allows you to access a frequently-used setting without having to go through the PRO mode menu:

Setting item	Digital display
Response time (default)	SPEdStd
Emission power	PctL H-P
Hysteresis	HYSH-02

☛ **Use Pro5 in the PRO mode to select which item should be displayed in custom mode (see “PRO mode (PRO)” on page 6).**

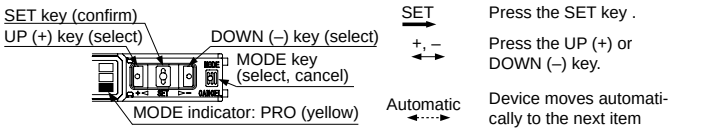


1. Press the MODE key twice. The CUST indicator lights up and the pre-selected setting item is displayed.
2. Press the UP or DOWN key to change the setting.
3. Press the SET key to save the setting.
4. Press the MODE key twice to return to RUN mode.

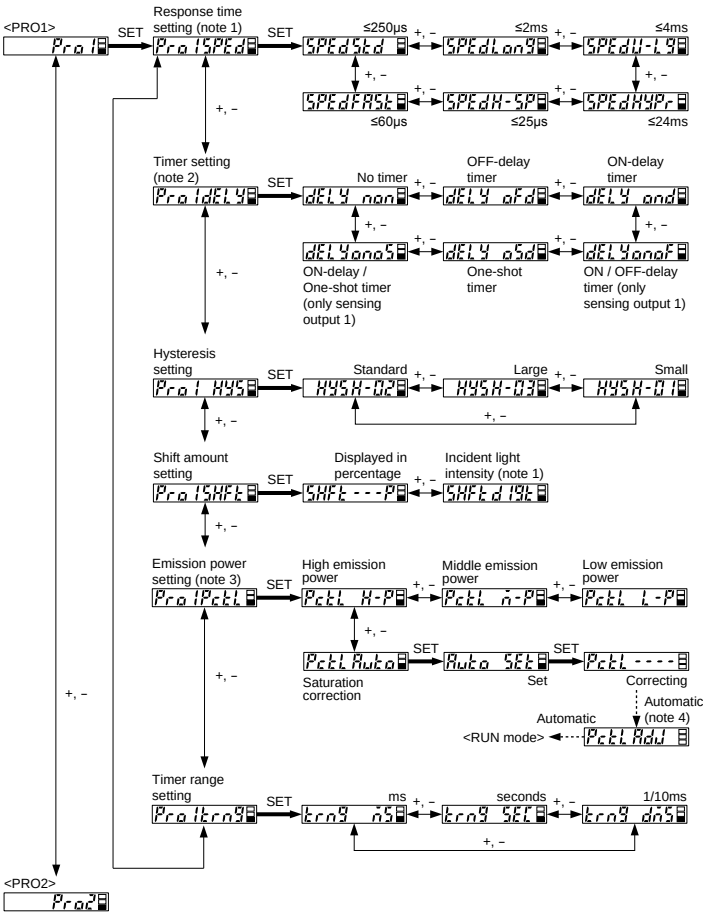
12 PRO mode (PRO)

- When the mode indicator PRO (yellow) is ON, you can scroll through the PRO menu (Pro1 to Pro7) and make advanced settings.
- Note that FX-502□ has additional setting items in Pro3 and Pro4.

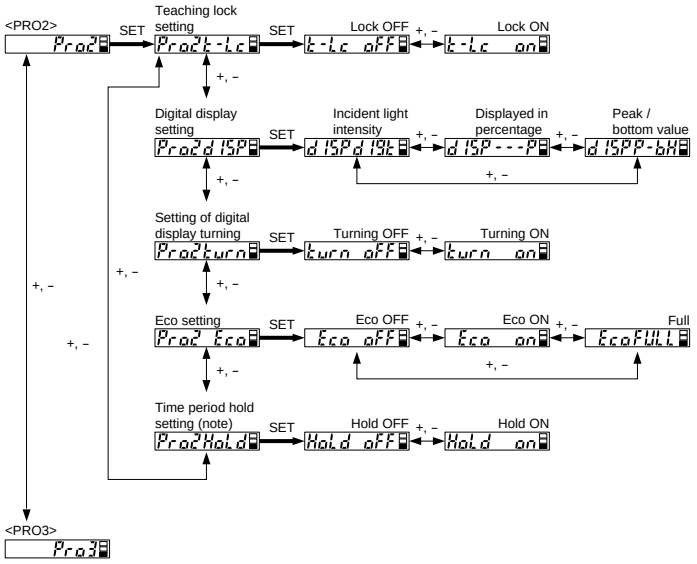
For details, refer to the diagrams for menu items below and the code settings table on page 10.



Pro1 menu items

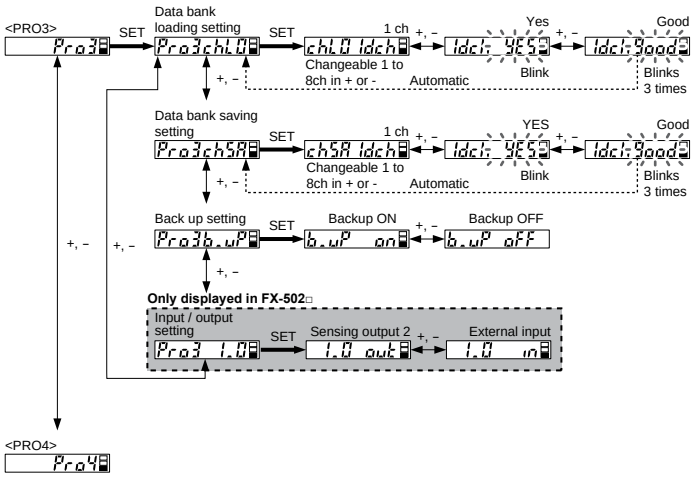


Pro2 menu items



☛ **To clear the held value, set the time period hold function to OFF once or turn the power OFF.**

Pro3 menu items



☛ Notes

1. The incident light intensity displayed depends on the selected response time.

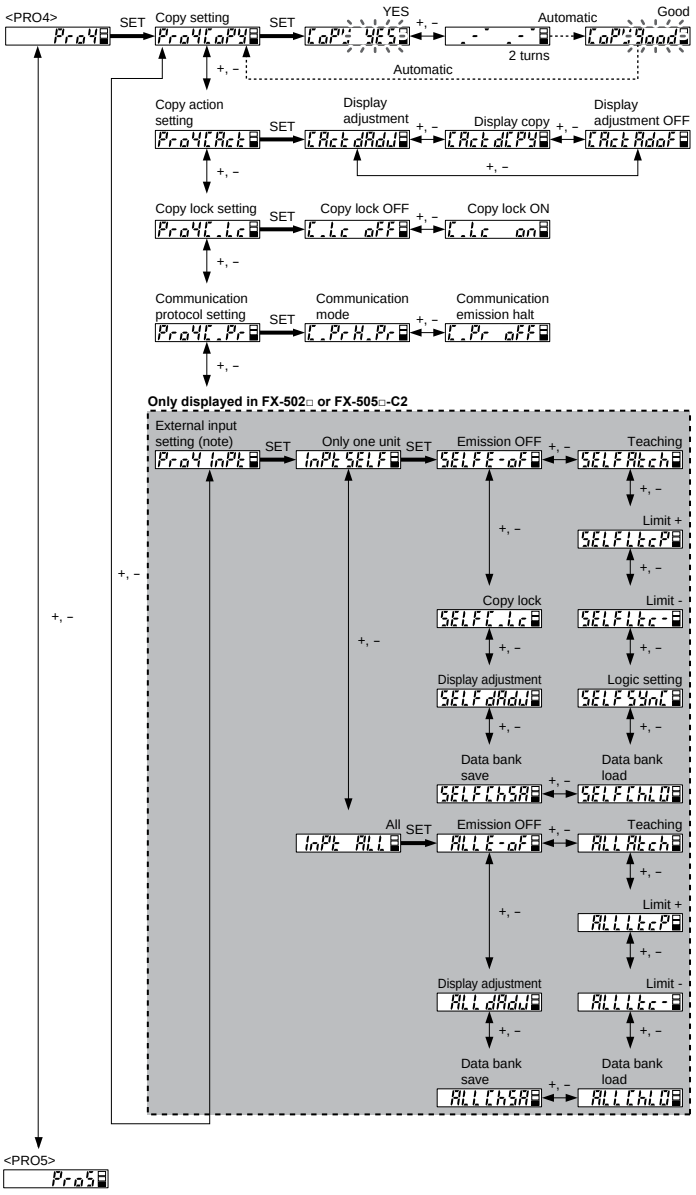
Response time	Incident light intensity
STD, H-SP, FAST	Max. 4,000
LONG	Max. 8,000
U-LG, HYPR	Max. 9,999

2. If you want to use the timer, make sure to select the timer range (last option in the Pro1 menu) first as the timer periods depend on the timer range.

Timer range	Timer period	Timer step
ms	0.5 – 9999ms	1ms
sec	0.5 – 32s	1ms
1/10ms	0.1 – 999.9ms	0.1ms

3. When the response time is set to high speed (H-SP) and the hysteresis is set to small (H-0.1), the emitting power automatically is set to low (L-P) regardless of what you have selected.
4. If the saturation correction is NG, it will not be displayed.

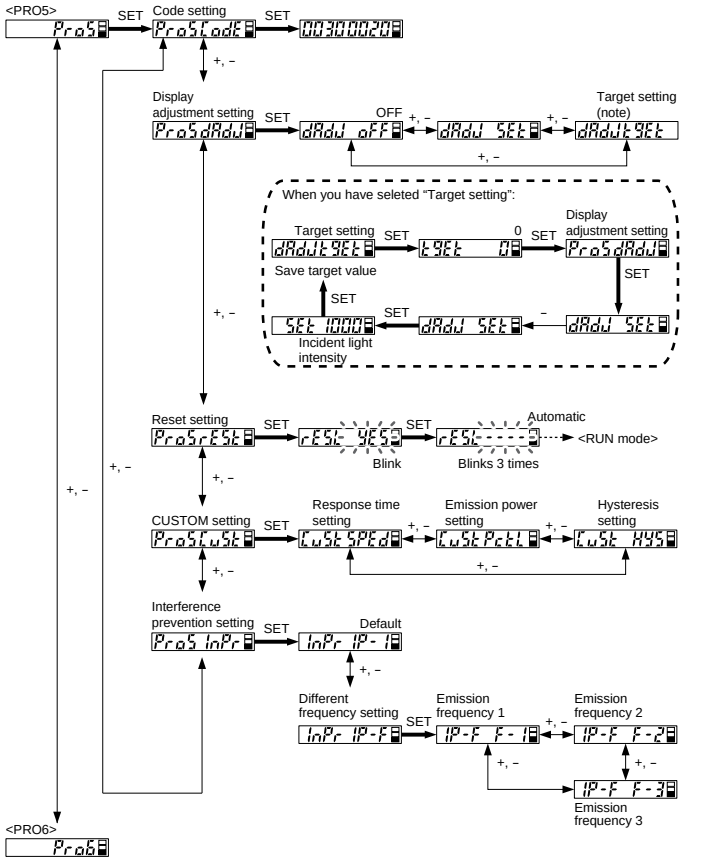
Pro4 menu items



Use the following signal input times:

Purpose	Signal input time
2-point teaching Limit teaching Display adjustment	20 to <500ms
Full auto teaching	≥600ms (sampling during signal input)
Emission OFF, logic setting, copy lock	≥2ms (function will be executed as long as the signal is input)
Data bank loading Data bank saving	Input the channel number by sending the corresponding number of pulses (1 pulse: 16 to 300ms). Note that the time between pulses should be at least 500ms.

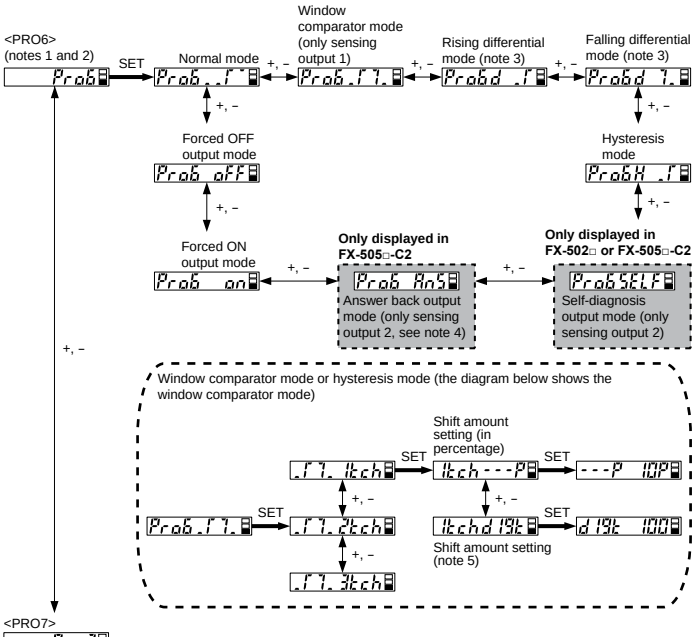
Pro5 menu items



The target setting for the display adjustment depends on the selected response time.

Response time	Incident light intensity
STD, H-SP, FAST	From -1,999 to 4,000
LONG	From -1,999 to 8,000
U-LG, HYPR	From -1,999 to 9,999

Pro6 menu items



Notes

1. With FX-502□, you can select whether terminal 3 should be used as sensing output 2 or as an external input. Activate sensing output 2 in Pro3 before making settings in Pro6.
2. With FX-502□ or FX-505□-C2, you can switch between sensing output 1 or 2 by pressing the MODE key until the display changes to the other output.

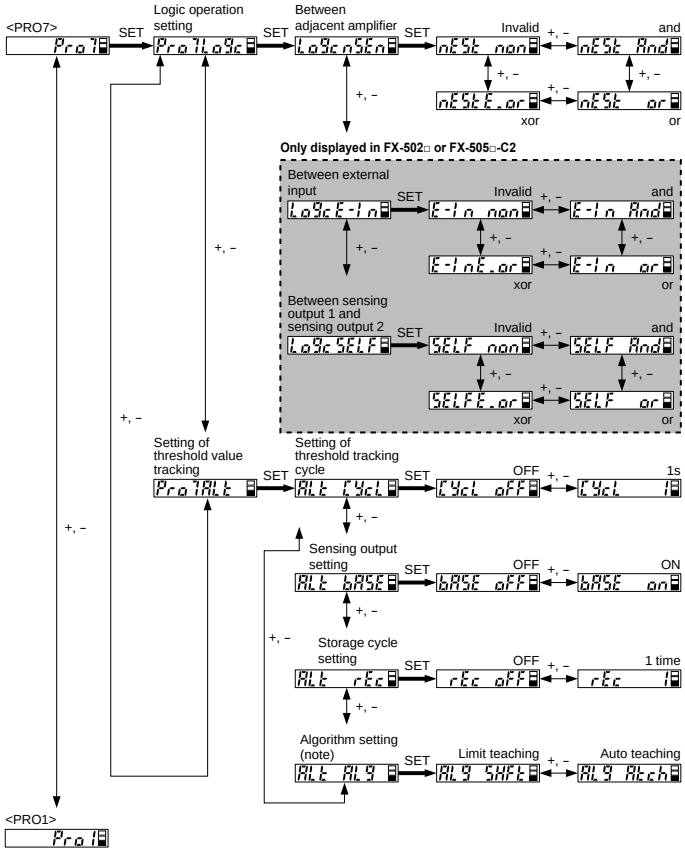
3. If you are using differential mode, combine threshold values and hysteresis settings as follows: If the hysteresis setting is H-01, set a threshold value of ≥20. If the hysteresis setting is to H-02 or H-03, set a threshold value of ≥80.
4. After an external signal has been input, the time until an answer is output is as follows. Please note that if you have set a timer for sensing output 2, different output times apply.

	Time between input signal and answer
2-point teaching Limit teaching Full auto teaching	20ms after the end of the input signal, the answer-back output will switch when the result of teaching is Good.
Display adjustment	20ms after the end of the input signal, the answer-back output will switch.
Data bank loading Data bank saving	520ms after the last rising edge of the input pulse, the answer-back output outputs the number of the data bank channel in pulses.

5. The incident light intensity displayed depends on the selected response time.

Response time	Incident light intensity
STD, H-SP, FAST	Max. 4,000
LONG	Max. 8,000
U-LG, HYPR	Max. 9,999

Pro7 menu items



☛ **If you have selected limit teaching for the changed incident light intensity (Algorithm setting = SHFt), note that the shift direction of the threshold differs depending on the combination of the sensing output status and the sensing output operation.**

Sensing output status	Sensing output operation	Shift direction
ON	Light-ON	–
ON	Dark-ON	+
OFF	Light-ON	+
OFF	Dark-ON	–

Details on the menu items

Pro1 menu		
Menu item	**Default setting**	**Description**
Response time setting	SPEdStd	Set response time.
Timer setting	dELY non	Set operation and delay of the timer.
Hysteresis setting	HYSH-02	Hysteresis can be set in normal mode or window comparator mode. The setting to H-01 results in low sensibility.
Shift amount setting	SHFt ---P	Set the shift amount for the threshold value when you execute limit teaching (see “Limit teaching” on page 3).
Emission power setting	PctL H-P	Set emission power. For all emission power settings but Auto you can select which percentage of the power should be output. Auto The saturated incident light intensity is adjusted automatically. H-P High emission power (25% to 100%) n-P Middle emission power (25% to 100%) L-P Low emission power (25% to 100%)
Timer range setting	trnG nS	Change unit time of timer.

Pro2 menu		
Menu item	**Default setting**	**Description**
Teaching lock setting	t-Lc oFF	Be able to prevent from wrong operation of teaching. oFF The lock is deactivated, teaching can be performed. on The lock is activated, teaching is not possible.
Setting items in the digital display	d ISPd Int	Select what should be displayed in red on the digital display. Choose between the incident light intensity displayed as a percentage or the peak/bottom value.
Digital display turning on setting	turn oFF	When you set this parameter to ON, the digital display will be rotated by 180°.
ECO setting	Eco oFF	The power consumption can be lowered. oFF Power consumption is normal. on If no key is pressed for 20s in RUN mode, the digital display turns OFF. FULL If no key is pressed for 20s in RUN mode or the key lock function has been activated, the digital display and all indicators turn OFF.
Peak/bottom hold function setting	HoLd oFF	oFF Peak/bottom values are refreshed regularly. on Peak/bottom values are held.

Pro3 menu		
Menu item	**Default setting**	**Description**
Data bank loading setting	chLO Idch	Load a setting from the specified data bank (1 to 8 channels).
Data bank saving setting	chSA Idch	Save a setting to the specified data bank (1 to 8 channels).
Back up setting	b.uP on	Select whether the threshold value determined by teaching should be saved in the EEPROM.
Input/output setting (only for FX-502□)	I.O out	Select whether terminal 3 should be used as sensing output 2 or as an external input.

Pro4 menu			
Menu item	**Default setting**	**Description**	
Copy setting	–	With optical communication it is possible to copy settings from the main amplifier to all sub amplifiers cascaded to the right of the main amplifier. ☛ During the copy process, the FX-502□ cannot send or receive threshold values.	
Copy action setting	CRctdRdJ	With optical communication it is possible to copy or cancel settings for the display adjustment or the incident light intensity. If the incident light intensity does not have enough margin, an optimum value is set automatically.	
		dRdJ	The display of the main and sub amplifiers can be adjusted. Set the target value in each amplifier.
		dCPY	The incident light intensity of the main amplifier can be copied to the sub amplifiers. However, when the difference between the main amplifier and sub amplifier is big, the value will not be copied.
		RdoF	The display adjustment of the main and sub amplifiers can be set to OFF.
Copy lock setting	C.Lc oFF	Individual sub amplifiers in a cascade can be prevented from receiving settings via optical communications by activating the copy lock (C.Lc on). The “locked” sub amplifier will not block the optical communication so that all amplifiers installed behind it will receive the copied settings.	
Communication protocol setting	C.PrH.Pr	This parameter is used to control optical communication from the main amplifier to sub amplifiers. If one of the sub amplifiers is set to halt communication (C.Pr oFF), all amplifiers installed behind it will not receive any data via optical communication.	
External input setting (only for FX-502□ and FX-505□-C2)	InPt SELF	Set the function of the external input.	

Pro5 menu			
Menu item	**Default setting**	**Description**	
Code setting	00300020	To make exactly the same setting on several amplifiers, use the 8-digit code instead of manual setting. The code is also helpful if you wish to confirm the current setting of an amplifier. Refer to the “Code setting tables” on page 10 for details.	
Display adjustment setting	dRdJ oFF	Set the incident light intensity to the target value. When you set the display adjustment while the incident light intensity does not have enough margin, the display shows a blinking OVEr.	
		oFF	Display adjustment OFF
		SEt	Set the display to 0. This redefines the initially displayed value as zero.
		tSEt	Set to any value within the valid range for incident light intensity (negative or positive).
Reset setting	–	If you select the setting YES, the amplifier returns to the factory settings.	
CUSTOM setting	CuSt SPEd	Select which item should be displayed in CUSTOM mode: Response time, emission power, or hysteresis.	
Interference prevention setting	InPr IP-1	Interference can be prevented only for a limited number of amplifiers when you have selected the default setting IP-1 (optical communication). The number of amplifiers depends on the response time you have selected, see details on page 12.	
		IP-1	Use optical communication to prevent interference. A maximum of 12 sensor heads can be cascaded.
		IP-F	Use up to 3 different emitting frequencies. A maximum of 3 sensor heads can be cascaded per frequency setting.

Pro6 menu			
Menu item	**Default setting**	**Description**	
Sensing output mode	Pro6..r-	Set the mode for sensing output 1 and 2.	
		..r-	Normal mode. Sets a threshold value for ON / OFF operation.
		.r7.	Window comparator mode (only for sensing output 1 of **FX-502**□, **FX-505**□**-C2**). Sets two threshold values and judges whether they are within the required range or not. The threshold values can be selected in 1 / 2 / 3-point teaching (see page 3).
		d.r	Rising differential mode. Only drastic rises in the incident light intensity are detected.
		d.7.	Falling differential mode. Only drastic drops in the incident light intensity are detected.
		H.r	Hysteresis mode. Changes hysteresis to ignore small changes to the incident light intensity. The threshold range can be selected in 1 / 2 / 3-point teaching (see page 3).
		SELF	Self diagnosis mode. Only displayed in FX-502□, FX-505□-C2 and only available for sensing output 2. The self-diagnosis output can serve as an alarm output.
		AnS	Answer back output mode. Only displayed in **FX-505**□**-C2** and only available for sensing output 2. In this mode, the amplifier answers all external signals by outputting the same signal for confirmation after a certain time (see note).
		on	Forced ON output mode. Sets the output forcibly to ON.
		oFF	Forced OFF output mode. Sets the output forcibly to OFF.

☛ After an external signal has been input, the time until an answer is output is as follows. Please note that if you have set a timer for sensing output 2, different output times apply.

	Time between input signal and answer
2-point teaching Limit teaching Full auto teaching	20ms after the end of the input signal, the answer-back output will switch when the result of teaching is Good.
Display adjustment	20ms after the end of the input signal, the answer-back output will switch.
Data bank loading Data bank saving	520ms after the last rising edge of the input pulse, the answer-back output outputs the number of the data bank channel in pulses.

Pro7 menu		
Menu item	**Default setting**	**Description**
Logic operation setting	LoGcnSEn	Select how two signals should be logically connected (and, or, xor). For details, refer to the table in note 1. nSEn: The sensing output 1 of an amplifier mounted to the left of this amplifier is logically connected with the sensing output 1 of this amplifier using the logical operator selected with this menu item. The result is output from the sensing output 1 of this amplifier. E - In: Only for **FX-502**□, **FX-505**□**-C2**. An input signal from a device mounted to the left of this amplifier is logically connected with the sensing output 1 of this amplifier using the logical operator selected with this menu item. SELF: Only for **FX-502**□, **FX-505**□**-C2**. The logical connection takes place within this amplifier. The external input is logically connected to the sensing output 1 using the logical operator selected with this menu item.
Threshold value follow-up cycle	CYcL oFF	The incident light intensity can be monitored for the cycle (1 to 9,999s) specified, for example when variations in incident light intensity are expected. When the threshold value follow-up cycle is set, the threshold value is adjusted according to the shift based on the incident light intensity detected. However, the threshold value is not stored.
Sensing output setting	bASE oFF	Select whether the threshold value should be followed when the output is ON or when the output is OFF.
Storage cycle setting	rEc oFF	Select the cycle for storing threshold values in the EEPROM. The valid range is 1 to 250 times.
Algorithm setting	ALG SHFt	SHFt: When limit teaching is used, the threshold value is modified by the shift amount. The direction of the threshold shift differs depending on the combination of the sensing output status and the sensing output operation, see note 2. AtCh: When auto teaching is used, the threshold value will be followed up when the base condition set in “Sensing output setting” is TRUE.

☛ **Notes**

1. The following logic applies:

Signal from other amplifier or device	Sensing output 1 of this device	Logical operator		
		and	or	xor
ON	ON	ON	ON	OFF
ON	OFF	OFF	ON	ON
OFF	ON	OFF	ON	ON
OFF	OFF	OFF	OFF	OFF

2. The direction of the threshold shift differs depending on the combination of the sensing output status and the sensing output operation.

Sensing output status	Sensing output operation	Shift direction
ON	Light-ON	–
ON	Dark-ON	+
OFF	Light-ON	+
OFF	Dark-ON	–

13 Code setting tables

The code tables list the codes for the green and the red display for each sensor type. Note that the digit on the right side is always the first digit. The following abbreviations are used:

OFD	OFF-delay timer	OND	ON-delay timer
ONOF	ON/OFF-delay timer	OSD	One-shot timer
ONOS	On-delay/One-shot timer		
WC	Window comparator mode	HYS	Hysteresis mode

FX-501□

Green digital display							
Code	Forth digit: Sensing output operation mode	Code	Third digit: Timer operation	Code	Second digit: Time delay	Code	First digit: CUSTOM setting
0	Light-ON	0	No timer	0	0.5ms	0	Response time setting
1	Dark-ON	1	OFD	1	1ms	1	Emission power setting
2	–	2	OND	2	3ms	2	Hysteresis setting
3	–	3	ONOF	3	5ms	3	–
4	–	4	OSD	4	10ms	4	–
5	–	5	ONOS	5	30ms	5	–
6	–	6	–	6	50ms	6	–
7	–	7	–	7	100ms	7	–
8	–	8	–	8	300ms	8	–
9	–	9	–	9	500ms	9	–
A	–	A	–	A	1s	A	–
b	–	b	–	b	2s	b	–
C	–	C	–	C	3s	C	–
d	–	d	–	d	4s	d	–
E	–	E	–	E	5s	E	–

Red digital display									
Code	Forth digit: Copy lock setting	Forth digit: Hysteresis setting	Code	Third digit: Setting items in the digital display	Third digit: Backup setting	Code	Second digit: Response time setting	Code	First digit: Sensing output setting
0	Copy lock OFF	H-02	0	Incident light intensity	Backup ON	0	H-SP	0	Normal mode
1	Copy lock ON	H-02	1	Incident light intensity	Backup OFF	1	FAST	1	WC
2	Copy lock OFF	H-03	2	Displayed as a percentage	Backup ON	2	STD	2	Rising differential mode
3	Copy lock ON	H-03	3	Displayed as a percentage	Backup OFF	3	LONG	3	Falling differential mode
4	Copy lock OFF	H-01	4	Peak / bottom value	Backup ON	4	U-LG	4	HYS
5	Copy lock ON	H-01	5	Peak / bottom value	Backup OFF	5	HYPR	5	-

FX-502□

Green digital display								
Code	Forth digit: Sensing output operation mode: Sensing output 1	Forth digit: Sensing output operation mode: Sensing output 2	Code	Third digit: Timer operation: Sensing output 1	Third digit: Timer operation: Sensing output 2	Code	Second digit: Timer period	Code	First digit: CUSTOM setting
0	Light-ON	Light-ON	0	No timer	No timer	0	0.5ms	0	Response time setting
1	Light-ON	Dark-ON	1	OFD	No timer	1	1ms	1	Emission power setting
2	Dark-ON	Light-ON	2	OND	No timer	2	3ms	2	Hysteresis setting
3	Dark-ON	Dark-ON	3	ONOF	No timer	3	5ms	3	–
4	–	–	4	OSD	No timer	4	10ms	4	–
5	–	–	5	ONOS	No timer	5	30ms	5	–
6	–	–	6	No timer	OFD	6	50ms	6	–
7	–	–	7	No timer	OND	7	100ms	7	–
8	–	–	8	No timer	OSD	8	300ms	8	–
9	–	–	9	–	–	9	500ms	9	–
A	–	–	A	–	–	A	1s	A	–
b	–	–	b	–	–	b	2s	b	–
C	–	–	C	–	–	C	3s	C	–
d	–	–	d	–	–	d	4s	d	–
E	–	–	E	–	–	E	5s	E	–

Red digital display									
Code	Forth digit		Code	Third digit		Code	Second digit	Code	First digit
	Copy lock setting	Hys-teresis setting		Setting items in the digital display	Backup setting		Response time set-ting		Sensing output setting (see note)
0	Copy lock OFF	H-02	0	Incident light intensity	Backup ON	0	H-SP	0	Normal mode
1	Copy lock ON	H-02	1	Incident light intensity	Backup OFF	1	FAST	1	WC
2	Copy lock OFF	H-03	2	Displayed as a percentage	Backup ON	2	STD	2	Rising differential mode
3	Copy lock ON	H-03	3	Displayed as a percentage	Backup OFF	3	LONG	3	Falling differential mode
4	Copy lock OFF	H-01	4	Peak / bottom value	Backup ON	4	U-LG	4	HYS
5	Copy lock ON	H-01	5	Peak / bottom value	Backup OFF	5	HYPR	5	–

☛ **Note that you can only make settings for sensing output 1. Sensing output 2 cannot be set.**

FX-505□-C2

Green digital display									
Code	Forth digit		Code	Third digit		Code	Second digit	Code	First digit
	Sensing output operation mode			Timer operation			Time delay		CUSTOM setting
	Sensing output 1	Sensing output 2		Sensing output 1	Sensing output 2				
0	Light-ON	Light-ON	0	No timer	No timer	0	0.5ms	0	Response time setting
1	Light-ON	Dark-ON	1	OFD	No timer	1	1ms	1	Emission power setting
2	Dark-ON	Light-ON	2	OND	No timer	2	3ms	2	Hysteresis setting
3	Dark-ON	Dark-ON	3	ONOF	No timer	3	5ms	3	–
4	–	–	4	OSD	No timer	4	10ms	4	–
5	–	–	5	ONOS	No timer	5	30ms	5	–
6	–	–	6	No timer	OFD	6	50ms	6	–
7	–	–	7	No timer	OND	7	100ms	7	–
8	–	–	8	No timer	OSD	8	300ms	8	–
9	–	–	9	–	–	9	500ms	9	–
A	–	–	A	–	–	A	1s	A	–
b	–	–	b	–	–	b	2s	b	–
C	–	–	C	–	–	C	3s	C	–
d	–	–	d	–	–	d	4s	d	–
E	–	–	E	–	–	E	5s	E	–

Red digital display									
Code	Forth digit		Code	Third digit		Code	Second digit	Code	First digit
	Copy lock setting	Hys-teresis setting		Setting items in the digital display	Backup setting		Re-sponse time setting		Sensing output setting
								Sensing output 1	Sensing output 2
0	Copy lock OFF	H-02	0	Incident light intensity	Backup ON	0	H-SP	0	Normal mode	Normal mode
1	Copy lock ON	H-02	1	Incident light intensity	Backup OFF	1	FAST	1	Normal mode	Rising differential mode
2	Copy lock OFF	H-03	2	Displayed as a percentage	Backup ON	2	STD	2	Normal mode	Falling differential mode
3	Copy lock ON	H-03	3	Displayed as a percentage	Backup OFF	3	LONG	3	Normal mode	HYS
4	Copy lock OFF	H-01	4	Peak / bottom value	Backup ON	4	U-LG	4	Normal mode	Self-diagnosis output mode
5	Copy lock ON	H-01	5	Peak / bottom value	Backup OFF	5	HYPR	5	Normal mode	Answer back mode
6	–	–	6	–	–	6	–	6	WC	Normal mode
7	-	-	7	-	-	7	-	7	WC	HYS
8	-	-	8	-	-	8	-	8	Rising differential mode	Falling differential mode
9	-	-	9	-	-	9	-	9	HYS	Normal mode

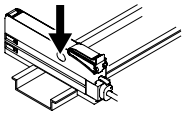
14 Optical communication

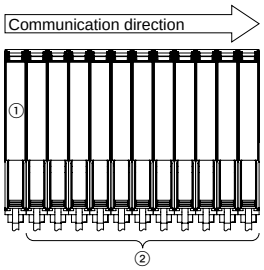
It is possible to use optical communication for the following functions.

- Data bank loading/saving (use **FX-502**□ or **FX-505**□**-C2** as the main amplifier)
- Copy settings

Notes on mounting

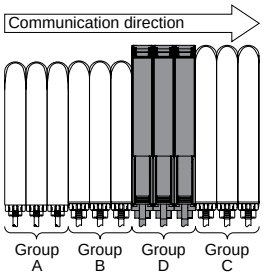
Communication is performed via the communication window of the amplifier (marked with an arrow).





For optical communication to work, you need to cascade the sub amplifiers (②) to the right of the main amplifier (①).

- Make sure to mount the amplifiers closely when the interference prevention function is controlled by optical communication (default setting, refer to “Pro5 menu items” on page 7).
- When you cascade this product together with other products (e.g. fiber sensor amplifiers, pressure sensor controllers, etc.), install the products so that they are in order of group A, B, D and C as shown in the figure below. This product is included in group D. Within each group, identical models should be mounted next to each other.



Group	Model number
A	**FX-301**□ (conventional version unit) **FX-301B**□**/G**□**/H**□**, LS-401**□
B	**FX-301**□ (modified version unit) **FX-305**□**, FX-301**□**-C1**
C	**LS-403**□, DPS series
D	**FX-500** series

- If products of different groups are mounted together, cover the communication window on the products at both ends of each group with the amplifier protection seal **FX-MB1** (optional).
- If you use copy setting for a cascade of different products from the FX-500 series, each product will only accept the settings that it supports and ignore settings for unsupported functions.

Notes on optical communication

- Optical communication is not possible if an amplifier is in one of the following states:
  - The copy lock has been activated (setting C.Lc on).
  - The digital display is blinking.
  - The external input setting of the main amplifier is set to InPt SELF (only for databank loading/saving).
- When the communication protocol of a sub amplifier is set to halt communication (setting C.Pr oFF), it is not possible to communicate with any of the sub amplifiers mounted to the right of said sub amplifier.

15 Interference prevention function

There are 2 options available for interference prevention:

- Interference prevention by optical communication (IP-1, default).
- Interference prevention by different emitting frequency.

For the setting procedure, see “Pro5 menu items” on page 7.

Interference can be prevented only for a limited number of amplifiers when you have selected the default setting IP-1 (optical communication). The number of amplifiers depends on the response time you have selected, see table below.

H-SP ≤25µs	FAST ≤60µs	STD ≤250µs	LONG ≤2ms	U-LG ≤4ms	HYPR ≤24ms
—	2	4	8	8	12

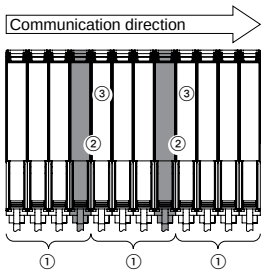
If you have mounted more amplifiers than the interference prevention function can cover, you need to prevent interference manually with one of the two following methods:

- Attach the amplifier protection seal **FX-MB1** to the communication window between the last amplifier in the valid range and the first amplifier of the next range (see example below).
- Turn the communication function OFF (I.Pr oFF) for the amplifier **after** the valid range (see example below).
- If you have mounted more than the valid range of amplifiers and the amplifiers use different response times, cover the communication window between two amplifiers with different response times with a protection seal or turn the communication function OFF for the amplifier in the master position.

Example

You have mounted 12 amplifiers and the response time is STD. This means, the valid range for the interference prevention function is 4 amplifiers (①). The last amplifier in the valid range is highlighted in gray.

To make sure that there is no interference between the 12 amplifiers, use one of the two following methods:



- Cover the communication window between the 4th and the 5th amplifier (②) with the protection seal.
- Turn the communication function OFF (I.Pr oFF) for the amplifier marked with ③ (for details, see “Pro4 menu items” on page 7).

16 Error codes and troubleshooting

The following error codes may appear in the digital display

Error code	Description	Remedy
Er01	EEPROM is broken or reached the end of its working life.	Please contact our office.
Er02	Error writing on the EEPROM	
Er11	Load of the sensing output 1 is short-circuited causing an over-current to flow.	Turn OFF the power and check the load.
Er12 (only FX-502□)	Load of the sensing output 2 is short-circuited causing an over-current to flow.	
Er52	Communication error when the amplifiers are mounted in cascade.	Check that all amplifiers are firmly attached and that there is no gap between amplifiers.
Er53	Communication error between the “master” communication unit and the subordinated amplifiers.	Check that all amplifiers are firmly attached and that there is no gap between the “master” communication unit and the subordinated amplifiers.

17 Cautions

- This product has been developed/produced for industrial use only.
- This product is suitable for indoor use only.
- Make sure to add or remove amplifiers with the power OFF.
- If you apply a voltage exceeding the rated range or if an AC power supply is connected directly, the product may get burnt or damaged.
- Shortcircuiting the load or wrong wiring may burn or damage the product.
- Do not run the wires together with high-voltage lines or power lines or put them in the same raceway. This can cause malfunction due to induction.
- Avoid using the product where there are strong magnetic fields as they may prevent the product from working according to the specification.
- Verify that the supply voltage including the ripple is within the rating.
- If power is supplied from a commercial switching regulator, ensure that the frame ground (F.G.) terminal of the power supply is connected to an actual ground.
- In case noise generating equipment (switching regulator, inverter motor, etc.) is used in the vicinity of this product, connect the frame ground (F.G.) terminal of the equipment to an actual ground.
- Do not apply stress directly to the sensor cable joint or the fiber cable by forcibly bending or pulling.
- The ultra long response time settings U-LG and HYPR are more likely to be affected by extraneous noise since the sensitivity is higher than with other response times. Test the behavior of the product before use.
- Do not use during the initial transient time (H-SP, FAST, STD: 0.5 seconds, LONG, U-LG, HYPR: 1 second) after the power supply is switched ON.
- Use the quick-connection cable (see Specifications on page 13). You can extend the cable up to 100m max. with 0.3mm^2 or more cable. However, in order to reduce noise, make the wiring as short as possible.
- Do not use the product in dusty or dirty places or in places that are exposed to steam.
- Protect the sensor from water, oil, grease, organic solvents such as thinner, etc., strong acid, and alkaline.
- This product cannot be used in an environment containing inflammable or explosive gasses.
- Never disassemble or modify the product.
- This product uses an EEPROM. Due to the EEPROM’s lifetime, do not expect to make settings more than 100 thousand times.

17 Specifications

Type		Standard type	2-output type	Cable type
Model number	NPN output	**FX-501**	**FX-502**	**FX-505-C2**
	PNP output	**FX-501P**	**FX-502P**	**FX-505P-C2**
Supply voltage		12 to 24V DC % (+10%/-10%), ripple P-P10% or less		
Power consumption		Normal operation: 960mW or less (current consumption 40mA or less at 24V supply voltage) Eco mode: 680mW or less (current consumption 28mA or less at 24V supply voltage)		
Output (**FX-502**□ and **FX-505**□**-C2** only: output 1, output 2)		**NPN open-collector transistor** ● Maximum sink current (see note 2): **FX-501**: 100mA **FX-502, FX-505**: 50mA ● Applied voltage: 30V DC or less between sensing output and 0V ● Residual voltage: 2V or less (see note 3) at maximum sink current **PNP open-collector transistor** ● Maximum source current (see note 2): **FX-501P**: 100mA **FX-502P, FX-505P**: 50mA ● Applied voltage: 30V DC or less between sensing output and +V ● Residual voltage: 2V or less (see note 3) at maximum source current		
	Number of outputs	1	2	
	Output operation	Switchable either Light-ON or Dark-ON		
	Short-circuit protection	Incorporated		
Response time		H-SP: 25µs or less, FAST: 60µs or less, STD: 250µs or less, LONG: 2ms or less, U-LG: 4ms or less, HYPR: 24ms or less		
Analog output (**FX-505**□**-C2** only)		—	—	● Output current: approx. 4 to 20mA (display in H-SP, FAST, STD: 0 to 4,000, display in LONG: 0 to 8,000 (see note 4)) ● Response time: 2ms or less ● Zero point: within 4mA ±1%F.S. ● Span: within 16mA ±5%F.S. ● Linearity: within ±3%F.S. ● Load resistance: 0 to 250Ω
External input (switchable with output 2 for **FX-502**□)		—	**Signal condition of NPN non-contact input:** ● High: +8V to +V DC or Open ● Low: 0 to +1.2V DC (at 0.5mA source current) ● Input impedance: Approx. 10kΩ **Signal condition of PNP non-contact input:** ● High: +4V to +V DC (at 3mA sink current) ● Low: 0 to +0.6V DC or Open ● Input impedance: Approx. 10kΩ	
Protection		IP40 (IEC)		
Ambient temperature		-10 to +55°C (no dew condensation or icing allowed) ● For 4 to 7 units mounted in cascade: -10 to +50°C ● For 8 to 12 units mounted in cascade: -10 to +45°C) Storage: -20 to +70°C		
Ambient humidity		35 to 85% RH, Storage: 35 to 85% RH		
Material		Enclosure: polycarbonate, switch: TPEE, protective cover: polycarbonate		
Cable		Cables are not supplied with the product. Select cables from the table below,		0.2 mm² 6-core cab tire cable, 2m
Weight (main body only)		Approx. 15g		Approx. 60g
Accessory		FX-MB1 (Amplifier protection seal): 1 set.		

Notes:

1. Where measurement conditions have not been specified precisely, the conditions used were an ambient temperature of +23°C.
2. **FX-501**□: 50mA max. if 5 or more connector types are connected together (25mA for **FX-502**□)
3. Only if you are using the quick-connection cable (optional, cable length 5m).
4. If the digital display has been adjusted manually, the figures displayed may be outside the range.

Cable / Amplifier	Cable length 1m		Cable length 2m		Cable length 5m	
	Main cable	Sub cable	Main cable	Sub cable	Main cable	Sub cable
FX-501□	CN-73-C1	CN-71-C1	CN-73-C2	CN-71-C2	CN-73-C5	CN-71-C5
FX-502□	CN-74-C1	CN-72-C1	CN-74-C2	CN-72-C2	CN-74-C5	CN-72-C5

☛ You can extend the cable up to 100m max. with 0.3mm² or more cable. However, in order to reduce noise, make the wiring as short as possible.