KEYENCE

96M11291

DIGITAL FIBER SENSOR

FS-V30/31(P)/31C(P)/31M/32(P)/32C(P)

Instruction Manual

Read this manual before using the product in order to achieve maximum performance. Keep this manual in a safe place after reading it so that it can be used at any time.

⚠ Warning	• This product is just intended to detect the object(s). Do not use this product for the purpose to protect a human body or a part of human body. • This product is not intended for use as explosion-proof product. Do not use this product in a hazardous location and/or potentially explosive atmosphere. • This product is a sensor of DC power supply type. Do not apply AC power. The product may explode or burn if an AC voltage is applied.

Precautions on Regulations and Standards

■ UL Certificate

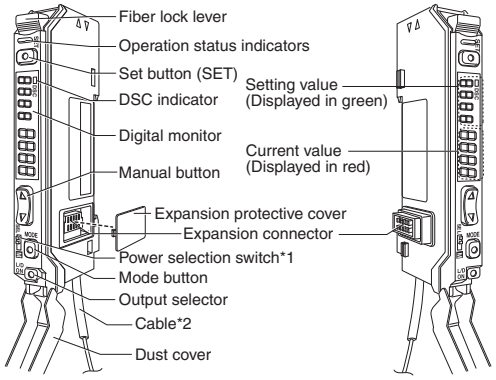
This product is an UL/C-UL Listed product.

- UL File No. E301717
- Category NRKH,NRKH7
- Enclosure Type 1 (Based on UL50)

Be sure to consider the following specifications when using this product as an UL/C-UL Listed Product.

- Use the power supply with Class 2 output defined in NFPA70 (NEC: National Electrical Code).
- Power supply/ Control input/ Control output circuits shall be connected to a single Class 2 source only.
- Use with the over current protection device which is rated 24V or more and not more than 2A.

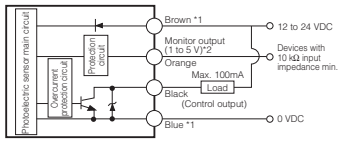
Part Names



*1 When set to "M", the power mode is fixed to Mega Turbo.
*2 FS-V30 does not have the cable. M8 connector for FS-V31C(P)/32C(P)

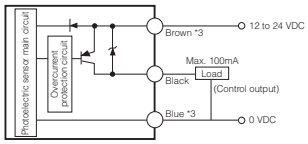
I/O Circuit

■ FS-V31/32/31M



*1 FS-V31/31M only *2 FS-V31M only

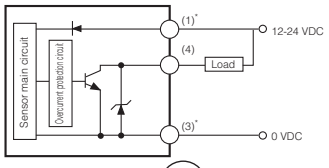
■ FS-V31P/32P



*3 FS-V31P only

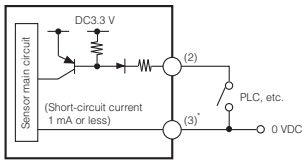
■ FS-V31C/32C

Output Circuit Diagram



Pin assignment

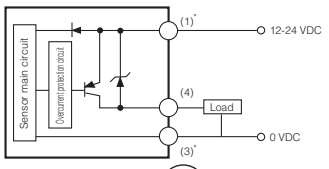
Input Circuit Diagram



* FS-V31C only

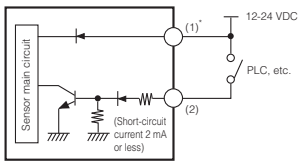
■ FS-V31CP/32CP

Output Circuit Diagram



Pin assignment

Input Circuit Diagram

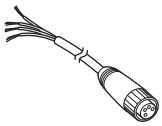


* FS-V31CP only

■ Socket Cable (Sold Separately)

For FS-V31C(P)/32C(P)

OP-73864 (cable length:2 m)
OP-73865 (cable length:10 m)



Pin and wire color table

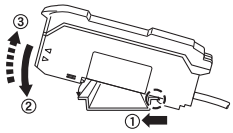
Connected pin No.	Core wire cover color
(1)	Brown
(2)	White
(3)	Blue
(4)	Black

Mounting Unit

■ Mounting on a DIN Rail

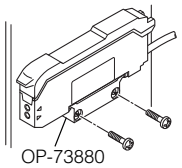
1 Align the claw at the bottom of the main body with the DIN rail. While pushing the main body in the direction of the arrow 1, slant it in the direction of the arrow 2.

2 To dismount the sensor, raise the main body in the direction of the arrow 3 while pushing the main body in the direction of the arrow 1.



■ Installation on a Wall (Main Unit Only)

Attach the unit to the optional mounting bracket (OP-73880), mount them together, and secure them with two M3 screws as shown in the illustration.

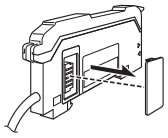


OP-73880

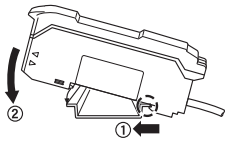
Connecting Multiple Amplifiers

Up to 16 sub units can be connected to one main unit.

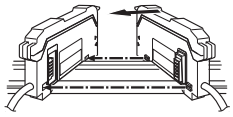
1 Remove the protection cover on the side of the main unit.



2 Install the amplifier one by one on the DIN rail.

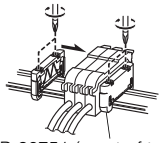


3 Engage the two claws of the child unit with the recesses on the main unit side until you hear a click sound.



4 Attach the end units (option: OP-26751) to the both ends of the connected amplifiers in the same way as in step (2).

5 Sandwich the amplifiers between the end units. Tighten the screws at the top (two screws x two units) with a Phillips screwdriver to fix the end units.



OP-26751 (a set of two)

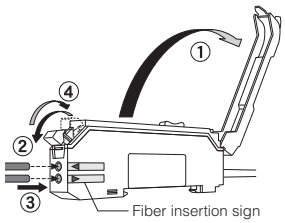
Connecting Fiber Unit

1 Open the dust cover in the direction shown by arrow 1.

2 Move down the fiber lock lever in the direction shown by arrow 2.

3 Insert a fiber unit into the fiber insertion holes to a length of the fiber insertion sign (i.e., approximately 14 mm).

4 Move down the fiber lock lever in the direction shown by arrow 4.

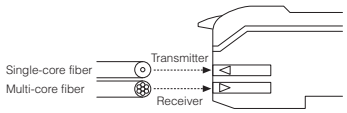


Note

If a thin fiber unit is used, an adapter provided with the thin fiber unit will be required. Unless the right adapter is connected, the thin fiber unit will not detect targets correctly. (The adapter is supplied with the fiber unit.)

Cable outer dia.	Adapter	Appearance
ϕ1.3	Adapter A (OP-26500)	
ϕ1.0	Adapter B (OP-26501)	

- To connect the coaxial reflective type fiber unit to the amplifier, connect the single-core fiber to the transmitter side, and connect the multiple-core fiber to the receiver side.

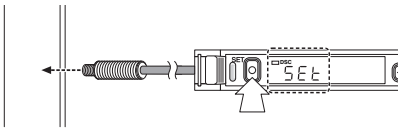


Making Sensitivity Settings

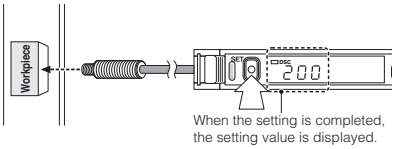
■ Two-point Calibration

In this mode, the PV used will be the mean value of two sensing values obtained with and without a workpiece.

1 Press the SET button without any workpiece placed in front of the fiber unit.



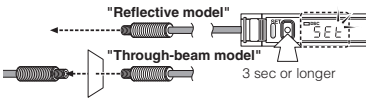
2 Place a workpiece placed in front of the fiber unit, and press the SET button.



If the sensitivity difference does not have enough room, "----" flashes for about two seconds after the calibration is complete. The set value is stored in memory even in that case.

■ Maximum Sensitivity Setting

Set the sensitivity without a workpiece in the case of the reflective type, and with a workpiece in the case of the through-beam or retro-reflective type.



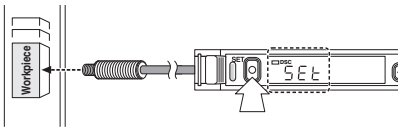
Press the SET button for three seconds in the state as shown in the above figure. (Release the button when SET flashes.)
When setting the sensitivity, set the value slightly higher than the received light intensity.

■ Full Auto Calibration

In this mode, the PV will be set to the mean value of the maximum and minimum incident values obtained within a certain period. Use this mode to detect moving workpieces.

1 Press the set button for a minimum of three seconds while the target workpiece is passing the sensing area of the fiber unit.

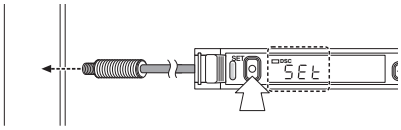
- While the SET button is pressed, the sensitivity of the sensor will be set according to the incident values.



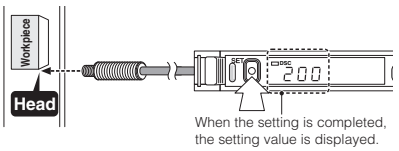
- After the setting is completed, the setting value is displayed on the digital monitor.

■ Positioning Calibration

1 Press the SET button without any workpiece placed in front of the fiber unit.



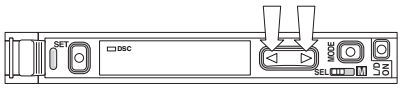
2 Place a workpiece on the position where you want to perform positioning.



Press the SET button for 3 seconds or longer until the display flashes.

Fine-adjusting Sensitivity

The setting value can be directly changed by pressing the manual button.



When extension display (page 5, No.8) is set for the number of digits to be displayed for the received light intensity

1 Press the manual button quickly once, and check that the setting value flashes.

2 While the setting value is flashing, change the setting value with the Manual button.

Percentage (%) Calibration

This is a calibration method that can set the setting value by percentage with reference to the received light intensity at the time of sensitivity setting.
For example, if the target value is set to –10P, the setting value is determined 10% lower than the received light intensity when the SET button is pressed.

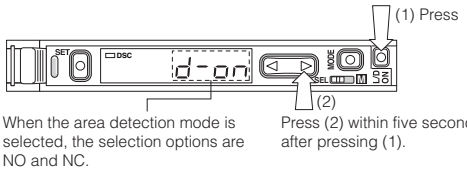
1 When selecting the sensitivity setting method (page 4, No. 2), select the % calibration, and set the target value of calibration.

2 Taking the desired light intensity as a reference (normally without a workpiece), press the SET button.

* While the % calibration is in use, other calibrations (sensitivity setting) cannot be used.
* With FS-V31C(P)/32C(P), by periodically performing external calibration from PLC or other devices, stable detection can be performed even with a small sensitivity difference.

Output Selection

Either light-ON mode or dark-ON mode is selectable.



Dynamic Sensitivity Correction (DSC) Function

DSC automatically corrects the setting value according to the changes in the received light intensity when there is no workpiece (output OFF).
This function is effective when the light intensity difference is small when judging whether or not there is a workpiece.
At Detection mode selection (page 4, No.4), select "Dynamic sensitivity correction mode" beforehand.*
How to set the sensitivity is the same as in the normal mode.

The DSC indicator illuminates when the DSC function is set.

* When Light ON is selected, the upper limit of the correctable range is twice as much as the initial setting value.
* The value is stored in memory even after the power is turned off.
* The DSC indicator flashes when the light intensity during output OFF greatly fluctuates or the L/D ON selection is inappropriate. In such a case, check the setting again.

Edge Detection Mode

This mode detects the change in the received light intensity during a given period of time.

_r-d	Rising edge detection	Detects the increase (rising edge) of the received light intensity
-L_d	Falling edge detection	Detects the decrease (falling edge) of the received light intensity

■ Filter Setting

Basically, leave this setting as its initial value. If the passage interval of workpieces is too short for the unit to respond, strengthen the level and try again.
The selectable filter level differs depending on the power modes.

Filter level	HSP*	FINE	TURBO	SUPER	ULTRA	MEGA
Default state	5	8	9	9	9	9
Setting range	1 to 5	4 to 8	5 to 9	6 to 9	8 to 9	9 only

*HSP: HIGH SPEED
As the number becomes smaller, the filter becomes stronger, which makes the unit difficult to respond to gradual changes in light intensity.

■ Making Sensitivity Settings

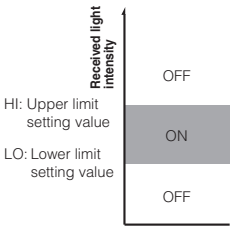
The sensitivity is set to maximum when the SET button is pressed quickly once.
When the setting value is too low and the unit detects objects other than the workpiece, fine-adjust the setting value to a higher number.

■ Operation When Switching Outputs

Setting	Operation
L-ON	Normally OFF. Turns ON only when the light intensity changes.
D-ON	Normally ON. Turns OFF only when the light intensity changes.

Area Detection Mode

This mode is suited to detecting the received light intensity only of a certain range.
To set this mode, select the area detection mode at Detection mode selection (page 4, No.4).



Set the value so that the upper limit setting value is larger than the lower limit setting value.
The unit does not respond when the upper limit setting value is less than or equal to the lower limit setting value.

Even when the above condition is satisfied, the unit may not respond when the HI and LO values are close to each other because of hysteresis. Be sure to operate the unit to check whether the values are valid.

■ How to switch the upper limit setting value (HI) and the lower limit setting value (LO)

When the ◄► button is pressed, "HI" or "LO" and the setting value alternately flash. When the MODE button is pressed while the display alternately flashes, the "HI" or "LO" display changes. How to configure the sensitivity setting is the same as when in the normal detection mode.

Setting the Display Scaling

This is the function to adjust the current received light intensity to the ìscaling target value.

1 When selecting a display value correction function (page 5, No. 6), select the display scaling function, and set the target value.

2 During the normal display, press the SET button while pressing the MODE button. (Scaling is performed for the current light intensity at this time.)

The reference light intensity can be set in the following range in reference with the currently received light intensity:

Power mode	Minimum value	Maximum value
HIGH SPEED/FINE/TURBO	Approx. 1/20 times	Approx. 16 times
SUPER	Approx. 1/40 times	Approx. 8 times
ULTRA	Approx. 1/160 times	Approx. 2 times
MEGA	Approx. 1/320 times	Approx. 1 time

If the value exceeds the range, Err is displayed and scaling is performed up to the possilbe range.

- No value can be set when the Edge detection mode is selected.
- The value is stored in memory even after the power is turned off.
- The value is not reflected to the analog output of the FS-V31M.
- When using FS-V31C(P)/32C(P), external inputs can be used.

Zero-shift Function

The Zero-shift function is used to forcibly set the current light intensity to zero.

1 At Display value correction function selection (page 5, No.6), select "Zero-shift function".

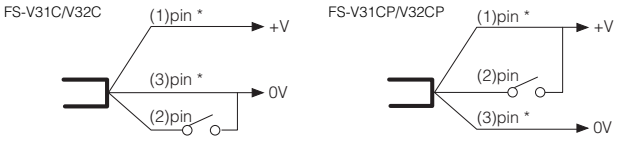
2 When the SET button is pressed while the MODE button is pressed, the current light intensity is forcibly set to zero.

- This function cannot be used when the Dynamic sensitivity correction (DSC) or Edge detection mode is selected.
- The value is stored in memory even after the power is turned off.
- The value is not reflected to the analog output of the FS-V31M.
- When using FS-V31C(P)/32C(P), external inputs can be used.

External Input [Function only for FS-V31C(P)/V32C(P)]

1 Signals can be input externally by selecting an external input function (page 4, No. 4-C).

2 The signal can be accepted by short-circuiting the pin (2) for 2 ms or more as shown below for each model (20 ms for OFF).



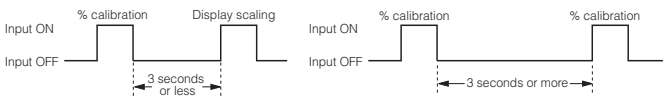
* For FS-V31C/31CP only.

- Setting using an external input is up to 1 million times.
- No inputs are accepted while setting each mode.

When external calibration is selected, the operation is the same as with the SET button.

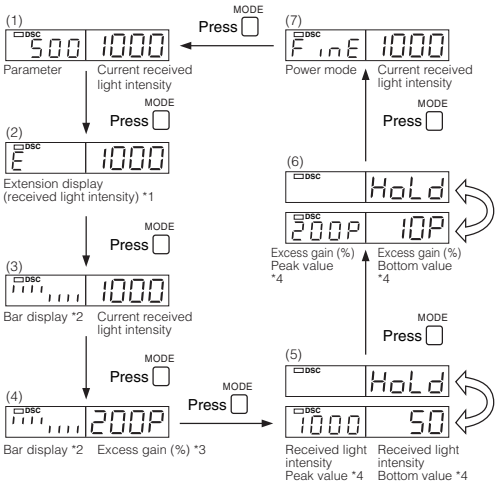
■ Special Function

By performing the following operation, both sensitivity setting and scaling can be performed using external input. Select external calibration (page 4, No. 4-C) and display scaling. The following is the example when using the % calibration.



Display Selection

The factory default value is "1" only. Other items can be displayed only after being selected at Display customization selection (page 5, No.8).



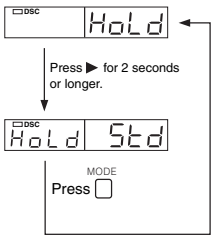
*1 When ULTRA/MEGA mode is selected, the current received light intensity can be displayed up to 5 digits.
The setting value flashes when the ◄► button is pressed once.
The setting can be changed by pressing the ◄► button while flashing.
*2 The excess gain is displayed in a 5% increment from 85 to 115%.
*3 The current light intensity for the setting value is displayed in percentage.
*4 Holds and displays the peak value and the bottom value.

How to reset the peak and bottom values (with the 5/6 display)

While pressing the MODE button, press the SET button for 3 seconds or longer to reset the peak and bottom values. Turning the power off also resets the values.
With FS-V31C(P)/32C(P), the value can be reset externally by selecting Reset at External input function selection (page 4, No.4-C).

■ User-friendly Functions (Direct Access Menu)

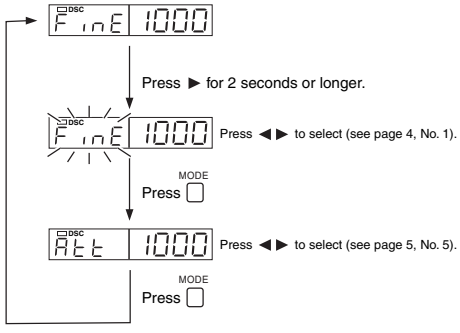
The hold display (5/6) can be set in detail by pressing the ► button for 2 seconds or longer.



Hold display selection
Select the setting by pressing the ◄► button.

- Std Updates every time the current light intensity is less (or more) than the specified peak and bottom values.
- P-P_ Displays the maximum and minimum peak values since the power is turned on (total number).
- b-b_ Displays the maximum and minimum bottom values since the power is turned on (total number).
- P_b- Displays the minimum peak value and the maximum bottom value since the power is turned on (total number).
- P-b_ Displays the maximum peak value and the minimum bottom value since the power is turned on (total number).

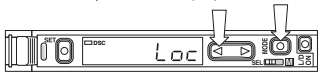
The power mode and attenuation function for the power mode display (3) can be set by pressing the ► button for 2 seconds or longer.



Key Lock Function

The key lock function disables the operation of all keys.

1 While pressing the MODE button, press the ◄ (►) button for at least three seconds.



The same steps can be taken to deactivate key lock.
For more information on the key lock levels and the PIN number key lock function, refer to page 6.

Operation Configuration

Normally, this unit can be used in the basic settings.
Set other functions as necessary.

Pressing MODE for 3 seconds or longer displays the basic menu.

Select a function with the ◄► button, and press MODE to confirm.

The setting for each item is confirmed when selecting END and pressing MODE.

Basic setting menu

1. Power mode selection
2. Sensitivity setting method selection

Detection setting menu

3. Timer mode selection
4. Detection mode selection

4-C. External input function selection

5. Light emission power selection

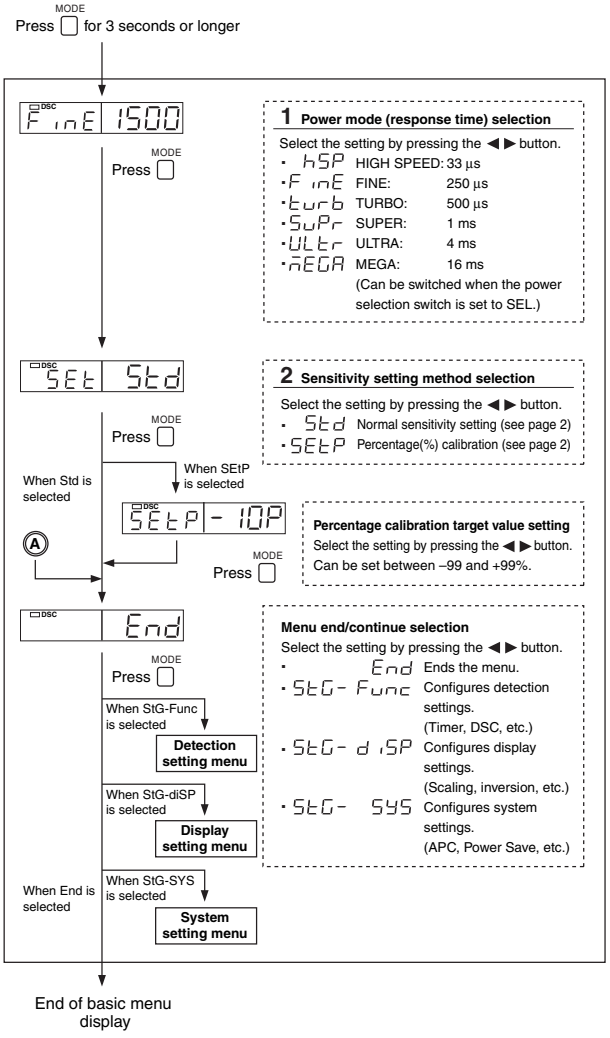
Display setting menu

6. Display value correction function selection
7. Display reverse selection
8. Display customization selection

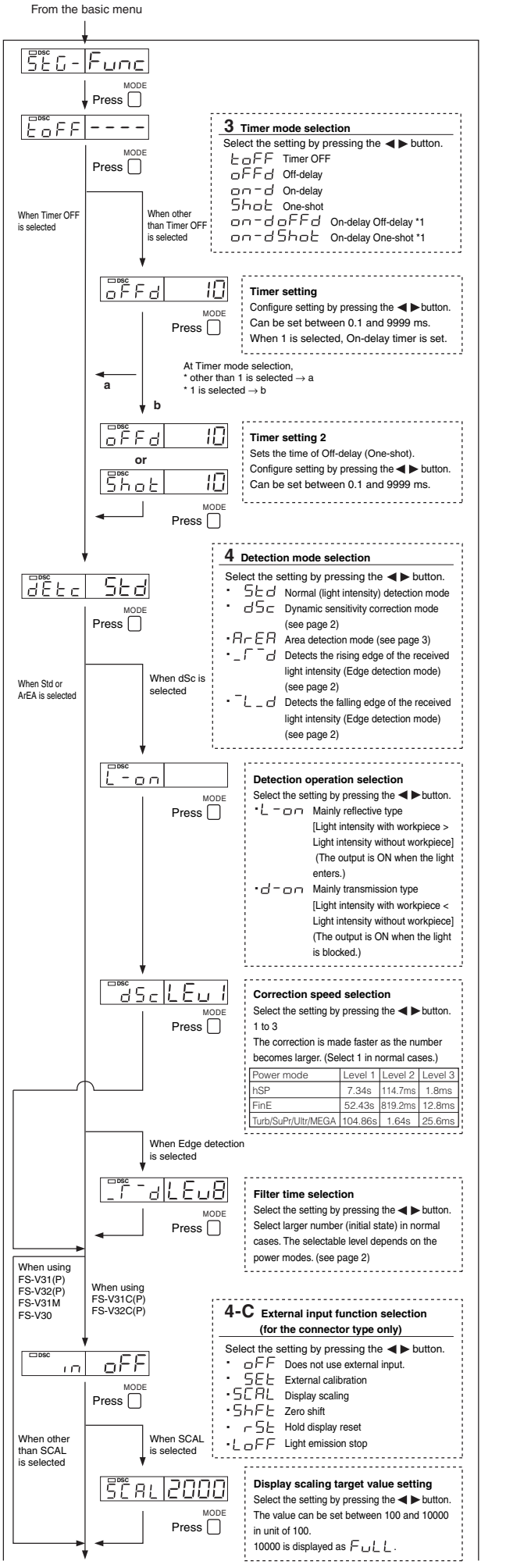
System setting menu

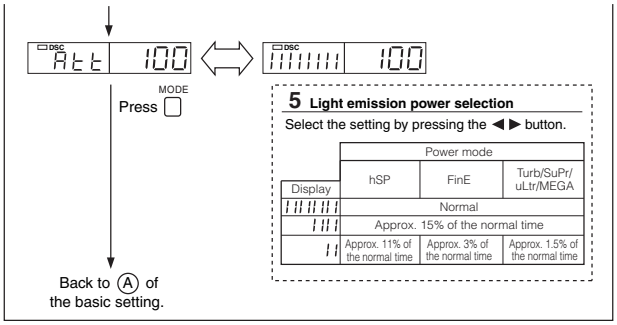
9. APC function setting
10. Power save mode setting
11. Key lock level setting
12. Interference prevention function setting

Basic Setting Menu



Detection Setting Menu



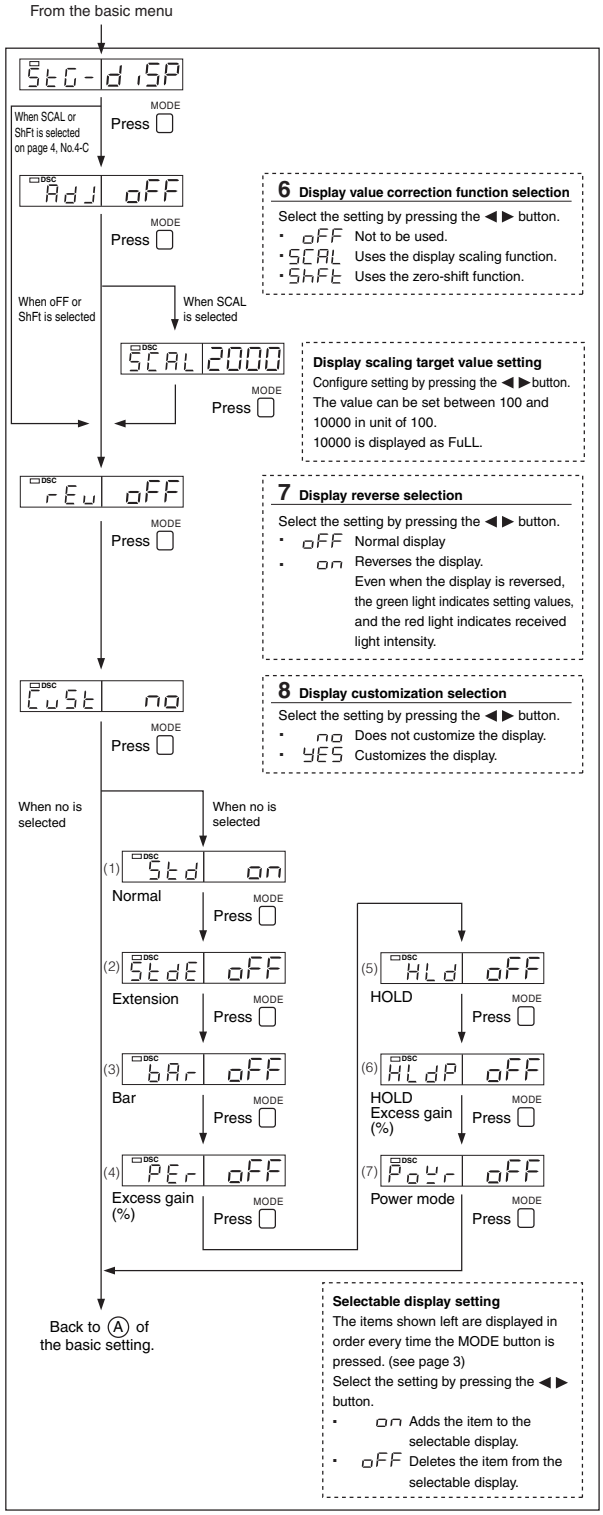


5 Light emission power selection

Select the setting by pressing the ◀ ▶ button.

Display	Power mode		
	hSP	FinE	Turb/SuPr/ uLtr/MEGA
111111	Normal		
111	Approx. 15% of the normal time		
11	Approx. 11% of the normal time	Approx. 3% of the normal time	Approx. 1.5% of the normal time

Display Setting Menu



6 Display value correction function selection

Select the setting by pressing the ◀ ▶ button.

- oFF Not to be used.
- SCAL Uses the display scaling function.
- ShFt Uses the zero-shift function.

Display scaling target value setting

Configure setting by pressing the ◀ ▶ button.
The value can be set between 100 and 10000 in unit of 100.
10000 is displayed as FuLL.

7 Display reverse selection

Select the setting by pressing the ◀ ▶ button.

- oFF Normal display
- on Reverses the display. Even when the display is reversed, the green light indicates setting values, and the red light indicates received light intensity.

8 Display customization selection

Select the setting by pressing the ◀ ▶ button.

- no Does not customize the display.
- YES Customizes the display.

Selectable display setting

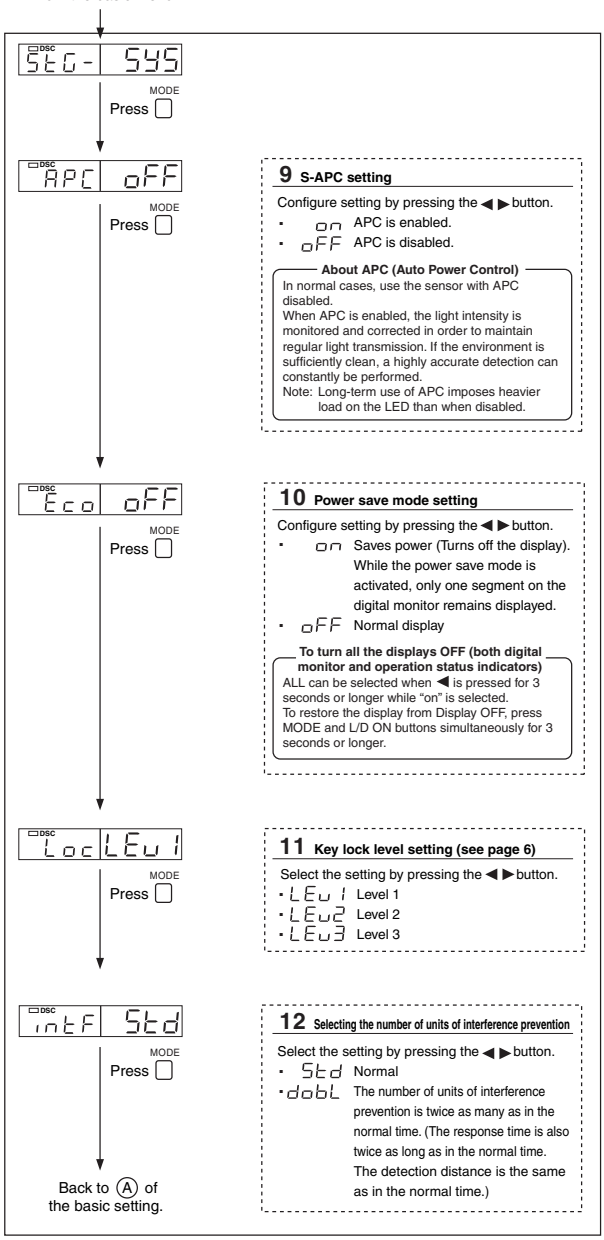
The items shown left are displayed in order every time the MODE button is pressed. (see page 3)
Select the setting by pressing the ◀ ▶ button.

- on Adds the item to the selectable display.
- oFF Deletes the item from the selectable display.

Reference

When setting each mode, the display returns normal by pressing the MODE button for 3 seconds or longer.

System Setting Menu



9 S-APC setting

Configure setting by pressing the ◀ ▶ button.

- on APC is enabled.
- oFF APC is disabled.

About APC (Auto Power Control)

In normal cases, use the sensor with APC disabled.
When APC is enabled, the light intensity is monitored and corrected in order to maintain regular light transmission. If the environment is sufficiently clean, a highly accurate detection can constantly be performed.
Note: Long-term use of APC imposes heavier load on the LED than when disabled.

10 Power save mode setting

Configure setting by pressing the ◀ ▶ button.

- on Saves power (Turns off the display). While the power save mode is activated, only one segment on the digital monitor remains displayed.
- oFF Normal display

To turn all the displays OFF (both digital monitor and operation status indicators)

ALL can be selected when ◀ is pressed for 3 seconds or longer while "on" is selected.
To restore the display from Display OFF, press MODE and L/D ON buttons simultaneously for 3 seconds or longer.

11 Key lock level setting (see page 6)

Select the setting by pressing the ◀ ▶ button.

- LEv1 Level 1
- LEv2 Level 2
- LEv3 Level 3

12 Selecting the number of units of interference prevention

Select the setting by pressing the ◀ ▶ button.

- Std Normal
- dobL The number of units of interference prevention is twice as many as in the normal time. (The response time is also twice as long as in the normal time. The detection distance is the same as in the normal time.)

Initializing, Saving and Loading the Settings

■ Initializing the settings

1 While pressing L/D ON, press SET for 5 seconds or longer.

2 Select "rSt "with the ◀ ▶ button, and press MODE.

3 Select " in it" with the ◀ ▶ button, and press MODE to initialize.

Default setting

Power mode: FINE
Detection mode: Normal
Setting value: 50
Output selection: L ON

■ Saving the settings

1 While pressing L/D ON, press SET for 5 seconds or longer.

2 Select "SAvE" with the ◀ ▶ button, and press MODE.

3 Select "YES" with the ◀ ▶ button, and press MODE to save.

■ Loading the setting

1 While pressing L/D ON, press SET for 5 seconds or longer.

2 Select "rSt" with the ◀ ▶ button, and press MODE.

3 Select "CuSt" with the ◀ ▶ button, and press MODE to load.

Key Lock Level Details

By selecting the key lock (page 5, No.11) level (1-3), key operations to be disabled can be changed.
(The default value is level 1.)

Basic Operations	Button	Level 1	Level 2	Level 3
Sensitivity settings (p.2)	SET	×	○	○
Sensitivity fine-adjustment (p.2)	◄►	△	○	○
Power selection (p.1)	Power selection switch	×	×	×
Output selection (p.2)	L/D ON	×	×	×
Menu selection (p.4)	Press and hold MODE	×	×	△

Advanced Operations	Button	Level 1	Level 2	Level 3
Initialization (p.3)	L/D ON + press and hold SET	×	×	×
Display scaling (p.3)	MODE + quickly press SET	×	○	○
Zero shift (p.3)	MODE + quickly press SET	×	○	○
Direct access menu (p.3)	Press and hold ◄	×	×	△
Display OFF/ ON (p.5, No.10)	L/D.ON + press and hold MODE	○	○	○

○: Normal operation is possible. ×: Operation is not possible.
△: The settings can be checked but cannot be changed.

Specifications

Type			Main unit	Sub unit (one line)	Analog output (main unit)	Sub unit (zero line)
Model	Cable	NPN output	FS-V31	FS-V32	FS-V31M	FS-V30
		PNP output	FS-V31P	FS-V32P	–	–
	Connector	NPN output	FS-V31C	FS-V32C	–	–
		PNP output	FS-V31CP	FS-V32CP	–	–
Light source			Red 4-element LED (peak wave length: 640 nm typ.)			
Control output*1	NPN output		NPN open collector 24 V 100 mA max.			–
	PNP output		PNP open collector 24 V 100 mA max.			–
	Analog output (FS-V31M only)		1-5 V voltage output: 1-5 V for the display 0-4095 of HSP/FINE/ TURBO, load resistance 10 kΩ or more, response time 1 ms			
Control input (connector type only)			Calibration/scaling/zero shift/ reset/light emission stop (input time: ON: 2 ms, OFF: 20 ms)		–	
Response time	ON/OFF Output		33 µs (HIGH SPEED)/250 µs (FINE)/ 500 µs (TURBO)/1 ms (SUPER)/ 4 ms (ULTRA)/16 ms (MEGA)			193 µs to 16.7 ms
Number of interference prevention units	Normal time		Power mode: HIGH SPEED / FINE / TURBO/SUPER/ULTRA/MEGA Number of units required to prevent interference: 0 units / 4 units / 8 units			
	When double is set *2		Power mode: HIGH SPEED / FINE / TURBO/SUPER/ULTRA/MEGA Number of units required to prevent interference: 0 units / 8 units / 16 units			
Power voltage			12-24 VDC, Ripple (P-P): 10% max, Class2			
Power consumption*3	NPN output		Normal: 710 mW max. (Using 24 V, 29 mA max., using 12 V, 40 mA max.) Power saving: 540 mW max. (Using 24 V, 22 mA max., using 12 V, 28 mA max.)			
	PNP output		750 mW max. (Using 24 V, 31 mA max., using 12 V, 40 mA max.)/ Power saving 580 mW max. (Using 24 V, 24 mA max., using 12 V, 28 mA max.)		–	
Operating ambient luminance	Incandescent lamp		20,000 lx max.			
	Sun light		30,000 lx max.			
Operating ambient temperature*1			-10 to +55 °C (No freezing)			
Operating ambient humidity			35 to 85% RH (No condensation)			
Vibration resistance			10 to 55 Hz Compound amplitude 1.5 mm, 2 hours for each of XYZ axes			
Shock resistance			500 m/s² 3 times for each of XYZ axes			
Material			Main unit, housing material: Polycarbonate			
Weight (including cable)			Approx. 80g	Approx. 45g	Approx. 80g	Approx. 25g

*1 When several units are connected, the operating ambient temperature varies depending on the number of units to be connected.When connecting several units, be sure to mount the units on the DIN rail (mounted on a metal plate), and keep the output current within 20mA.
When 1 to 2 units are connected : -10 to +55 °C,
When 3 to 10 units are connected : -10 to +50 °C,
When 11 to 16 units are connected : -10 to 45 °C
*2 When double is set, the response time is twice as long as the normal response time.
*3 When using the HIGH SPEED mode, the power consumption increases by 160 mW (7 mA).

The accessory of this unit is this instruction manual only.

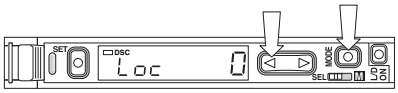
Error Displays and Corrective Actions

Error display	Cause	Corrective action
ErC	Overcurrent is flowing in the control output.	Check the load and return the current within the rated value.
ErE	Failed to write/read the internal data.	Perform initialization (p.5).
End APC	The load on the light source is large.	Replace the sensor if high-accuracy detection is required.

PIN Number Key Lock Function

The unit can be locked using a PIN number to ensure securer locking effect.

1 While pressing the MODE button, press the ◄ (►) button 10 times.



2 Select a PIN number between 0 and 9999 using the button.

3 Press the MODE button to activate key lock.

Follow the same step to disable the key lock. Use the same PIN number used for locking.

Note
Write down the PIN number in case it is forgotten.
The key lock cannot be disabled unless the correct PIN number is used.

Hints On Correct Use

- Do not wire the amplifier line along with power lines or high-tension lines, otherwise the sensor may malfunction or receive damage due to noise.
- When using a commercially available switching regulator, ground the frame ground terminal and ground terminal.
- Do not use the FS series outdoors, or in a place where extraneous light can enter the light receiving surface directly.
- Due to the individual dispersion of characteristics and the difference in fiber unit model, the maximum sensing distance or displayed value of all the units are not the same.
- If the sensor is used in S-APC mode for a long time, the LED indicators will be imposed with a heavy load. In that case, the sensor will be automatically set to ACC mode where the current consumption of the sensor for light emission will be constant, and “END APC” will be displayed. The sensor can be continuously used in this case. Replace the sensor, however, if highly precise detection is required.

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