This product is used to detect targets. Do not apply the product to places with flammable gas, liquid, or dust. 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.

**Warning**

- *1* FS-V31/31M only
- *2* FS-V31C(P)/32C(P)
- *3* FS-V31P only
- *4* FS-V33 only
- *5* FS-V31CP/32CP
- *6* FS-V31C/32C
- *7* FS-V31/32/31M

---

**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)**
  1. 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.

---

**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.

---

**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.)

---

**Part Names**

- Fibre lock lever
- Operation status indicators
- Setting value (Displayed in green)
- Current value (Displayed in red)
- Setting value (Displayed in red)
- Expansion protective cover
- Expansion connector
- Power selection switch*1
- Mode button
- Output selector
- Cable*2
- Dust cover

---

**I/O Circuit**

- **FS-V31/32/31M**
  - Output Circuit Diagram
  - Pin assignment

- **FS-V31C/32C**
  - Output Circuit Diagram
  - Pin assignment

- **FS-V31CP/32CP**
  - Output Circuit Diagram
  - Pin assignment

---

**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**

<table>
<thead>
<tr>
<th>Connected pin No.</th>
<th>Core wire cover color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Brown</td>
</tr>
<tr>
<td>2</td>
<td>White</td>
</tr>
<tr>
<td>3</td>
<td>Blue</td>
</tr>
<tr>
<td>4</td>
<td>Black</td>
</tr>
</tbody>
</table>

---

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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.)

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

- **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.

- **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 \(-10\)\% 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.

- **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).

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.

- **Edge Detection Mode**
  This mode detects the change in the received light intensity during a given period of time.

- **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.

- **Making Sensitivity Settings**
  The setting 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**
<table>
<thead>
<tr>
<th>Setting</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-ON</td>
<td>Normally OFF. Turns ON only when the light intensity changes.</td>
</tr>
<tr>
<td>D-ON</td>
<td>Normally ON. Turns OFF only when the light intensity changes.</td>
</tr>
</tbody>
</table>
**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.

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

When the \( \text{<-} \) 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 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:

<table>
<thead>
<tr>
<th>Power mode</th>
<th>Minimum value</th>
<th>Maximum value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH SPEED/FINE/TURBO</td>
<td>Approx. 1/320 times</td>
<td>Approx. 1/160 times</td>
</tr>
<tr>
<td>SUPER</td>
<td>Approx. 1/140 times</td>
<td>Approx. 7 times</td>
</tr>
<tr>
<td>ULTRA</td>
<td>Approx. 1/160 times</td>
<td>Approx. 2 times</td>
</tr>
<tr>
<td>MEGA</td>
<td>Approx. 1/320 times</td>
<td>Approx. 1 time</td>
</tr>
</tbody>
</table>

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

3. 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).

   - FS-V31C/32C
     - 1 pin * +V
     - 3 pin * OV
     - 2 pin *

   - FS-V31C/P/32C/P
     - 1 pin * +V
     - 3 pin * +V
     - 1 pin * OV
     - 2 pin *

   * For FS-V31C/32C 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 % 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).

- For display selection: Press the \( \text{<-} \) button for 2 seconds or longer.

- Hold display selection
  - Select the setting by pressing the \( \text{<-} \) button. Changes the display selection every time the button is pressed.
  - \( \text{P} \) \( \text{P} \) \( \text{P} \) Displays the maximum and minimum peak values since the power is turned on (total number).
  - \( \text{P} \) \( \text{P} \) \( \text{P} \) Displays the maximum and minimum bottom values since the power is turned on (total number).
  - \( \text{P} \) \( \text{P} \) \( \text{P} \) Displays the maximum peak value and the minimum bottom value since the power is turned on (total number).
  - \( \text{P} \) \( \text{P} \) \( \text{P} \) 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 \( \text{<-} \) 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 \( \text{<-} \) ( \( \text{<-} \) ) button for at least three seconds.

The same steps can be taken to de-activate key lock. For more information on the key lock levels and the PIN number key lock function, refer to page 6.
**Operation Configuration**

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

Pressing for 3 seconds or longer displays the basic menu.

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

### Basic setting menu
1. Power mode selection
2. Sensitivity setting method selection
3. Timer mode selection
4. Detection mode selection
4-C. External input function selection
5. Light emission power selection
6. Display value correction function selection
7. Display reverse selection
8. Display customization selection
9. APC function setting
10. Power save mode setting
11. Key lock level setting
12. Interference prevention function setting

### Detection Setting Menu
- Press for 3 seconds or longer
- Select the setting by pressing the button.
- Can be set between –99 and +99%.
- Can be switched when the power selection switch is set to SEL.

### Display setting menu
- Press when Sel is selected
- Press when Sel is selected

### System setting menu
- Press when Sig-Func is selected
- Press when Sig-DcSP is selected
- Press when Sig-Sys is selected

### Basic Setting Menu
- Press for 3 seconds or longer
- Menu and continue selection
- Ends the menu.
- Configures display settings.
- Configures system settings.

**Detection operation selection**
- Select the setting by pressing the button.
- Normal light intensity detection mode
- Area detection mode
- Dynamic sensitivity correction mode
- Percentage calibration target value setting
- Select the setting by pressing the button.
- Can be set between 0.1 and 9999 ms.
- The correction is made faster as the number becomes larger (select 1 in normal cases).}

**Correction speed selection**
- Select the setting by pressing the button.
- The correction is made faster as the number becomes larger (select 1 in normal cases).

**Filter time selection**
- Select the setting by pressing the button.
- Select the setting by pressing the button.
- Select larger number (initial state) in normal cases.

**External input function selection**
- Select the setting by pressing the button.
- Does not use external input.
Display Setting Menu

From the basic menu

5 Display value correction function selection

Select the setting by pressing the button.

- off: Not to be used.
- on: Displays the display scaling function. Uses the zero-shift function.

6 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.

- on: Reverses the display.
- off: Normal display.

8 Display customization selection

Select the setting by pressing the button.

- off: Does not customize the display.
- on: Customizes the display.

9 Light emission power selection

Select the setting by pressing the button.

- 100: Normal
- FINE
- Turbo/MEGA

10 Power save mode setting

Configure setting by pressing the button.

- on: Saves power (Turns off the display).
- off: Normal display.

11 Key lock level setting (see page 6)

Select the setting by pressing the button.

- Level 3
- Level 2
- Level 1

12 Selecting the number of units of interference prevention

Select the setting by pressing the button.

- s/L: Normal
- s/L: s/L

Initializing, Saving and Loading the Settings

Initializing the settings

1. While pressing , press for 5 seconds or longer.
2. Select "Y" with the button, and press .
3. Select "on" with the button, and press to initialize.

Default setting

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

Saving the settings

1. While pressing , press for 5 seconds or longer.
2. Select "5r" with the button, and press .
3. Select "s" with the button, and press to save.

Loading the settings

1. While pressing , press for 5 seconds or longer.
2. Select "5r" with the button, and press .
3. Select "5r" with the button, and press to load.

DSC: DSC

<5r><b>0D</b>

<5r><b>12</b>

<5r><b>0D</b>

<5r><b>12</b>

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.

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### 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.)

<table>
<thead>
<tr>
<th>Setting</th>
<th>Button</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity settings (p.2)</td>
<td>SET</td>
<td>X</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>Sensitivity line adjustment (p.2)</td>
<td></td>
<td>X</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Power selection (1)</td>
<td>Power selection switch</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Output selection (2)</td>
<td>LED-ON</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

| PIN Number Key Lock Function |

The unit can be locked using a PIN number to ensure secure 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.

### Error Displays and Corrective Actions

<table>
<thead>
<tr>
<th>Error display</th>
<th>Cause</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error C</td>
<td>Overcurrent is flowing in the control output.</td>
<td>Check the load and return the current within the rated value.</td>
</tr>
<tr>
<td>Error E</td>
<td>Failed to write/read the internal data.</td>
<td>Perform initialization (p.5).</td>
</tr>
<tr>
<td>End RPC</td>
<td>The load on the light source is large.</td>
<td>Replace the sensor if high-accuracy detection is required.</td>
</tr>
</tbody>
</table>

### Specifications

#### Cable
- NPN output: FS-V31, FS-V32, FS-V31M, FS-V30
- PNP output: FS-V31P, FS-V32P
- Control output: FS-V31C, FS-V32C
- Light source: Red 4-element LED (peak wave length: 640 nm typ.)

#### Control output
- NPN output: NPN open collector 40 V 100 mA max.
- PNP output: PNP open collector 30 V 100 mA max.

#### Response time
- Normal: 33 μs (HIGH SPEED)/250 μs (FINE)
- 0.5 μs for the display 0-4095 of HSP/FINE/TURBO, load resistance 10 kΩ or more, response time 1 ms.

#### Number of interference prevention units
- Double is set

#### Voltage
- Power voltage: 12-24 VDC, Ripple (P-P): 10% max. Class 2
- Current consumption
  - Normal: 990 mA (42 mA max. at 24 V, 83 mA max. at 12 V)
  - Power save: 820 mA (34 mA max. at 24 V, 68 mA max. at 12 V)
- Operating ambient temperature
  - Normal: -10 to 55 °C (No freezing)
  - Humidity: 35 to 85% RH (No condensation)

#### Shock resistance
- 500 m/s² for each of XYZ axes

#### Material
- Main unit: Polycarbonate

#### Weight (including cable)
- Approx. 80 g

### 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 when 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 mode. Replace the sensor, however, if highly precise detection is required.

### Warranties and Disclaimers

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- 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 when 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 mode. Replace the sensor, however, if highly precise detection is required.

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### PIN Number Key Lock Function

The unit can be locked using a PIN number to ensure secure 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.

### 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 when 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 mode. Replace the sensor, however, if highly precise detection is required.

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