# **KEYENCE**

96M1591

Environment Resistant Digital Photoelectric Sensor PX-10(P)/10C(P) Instruction Manual

# Part Names

# Amplifier Unit



There are two types of amplifier units

PX-10/10P (above): Uses a cable length of 2 m and can handle external input.
 PX-10C/10CP (connector type): Connects to the power source with a socket cable.

# Connecting to the Amplifier Unit and to External Devices

# Input/Output Circuit (Wiring Method)

### PX-10 (NPN output)



### PX-10P (PNP output)



#### ■PX-10C (connector type NPN output)



#### ■PX-10CP (connector type PNP output)





<u>∧</u> Warning		<ul> <li>This product is used to detect targets. Do not apply the product to safety circuits for human protection.</li> </ul>	
		This product is not of explosion-proof construction. Do not use the products in places with flammable gas, liquid, or dust.	
		• This product is a sensor of DC power supply type. Do not apply AC	
		power. Application of the AC power may lead to explosion or fire.	

### Socket Cables for PX-10C/10CP (sold separately)

■OP-75721 (cable lenth 2 m) ■O

OP-75722 (cable length 2 m)



■ Relationship between connector pin numbers and cable core wires Information in the following table is the same for OP-75721 and OP-75722.

Connector pin no.	Wire casing color	Connection
	Brown	12 to 24 V DC
	White	Alarm output
	Blue	0 V
	Black	Detection output

#### Note

When connecting the L-shaped cable (OP-75722) to the amplifier unit, face the connector for the cable towards the amplifier unit in the direction shown in the following diagram and lock it into place. Note that the connector portion cannot be reversed.



# **Precautions on Installation**

### Connecting the Sensor Head to the Amplifier Unit

#### Note

- The sensor is not guaranteed under the conditions of the warranty if the sensor head
   is not connected correctly using the procedure described above.
- The sensor is not guaranteed under the conditions of the warranty if dust or dirt attaches to the packing for the sensor.
- If the sensor head cannot be inserted easily, fully remove any dirt or dust from the amplifier unit and apply silicon grease to the opening.
- Grasp the cap for the sensor head connector and insert the connector straight in the direction shown in the diagram.



 ${f 2}$  Insert the two upper tabs on the mounting fixture into the head installation hole on the amplifier unit and pull the mounting fixture up in the direction shown in the diagram. If the tabs do not slide into place easily, push on the bottom of the mounting fixture.



Installation is complete when the head release lever locks into place as shown in the following diagram.



#### Note

Check that the lower tab on the mounting fixture for the connector fits into the groove on the bottom of the amplifier unit. If the tab does not fit into the groove, remove the sensor head and try connecting it again.





Tab is fitted in the groove

### Mounting the Amplifier Unit

### Mounting on a DIN rail

1 Hook the tab located on the bottom of the amplifier unit to the DIN rail as shown in the figure. While pushing the amplifier unit in the direction of arrow 1, tilt it in the direction of arrow 2



 ${f 2}$  To dismount the sensor, raise the amplifier unit in the direction of arrow 3 while pushing the amplifier unit in the direction of arrow 1.

#### Mounting the amplifier unit sideways (Only for use with a single unit)

Mount the amplifier unit using M3 screws in the two locations as shown in the diagram. Use a maximum torque of 0.6 Nm to tighten the screws.



### Using Multiple Amplifier Units (Interference Protection Function)

Installing multiple amplifier units (up to four) side by side on a DIN rail can protect against interference. Two end units (option item, sold separately: OP-26751 (two units included)) are also

required

1 Install the sensor heads to the connected amplifier units.







Note End units must be used

### Removing the Sensor Head from the **Amplifier Unit**

Note Do not pull on the cable.

1 Grasp the amplifier unit. While pulling the head release lever in the direction of arrow 1, slide the mounting fixture for the connector in the direction of arrow 2. Pull the connector from the amplifier unit in the direction of arrow 3.



### Precautions for Installing the Sensor Head

Install the sensor head so that it can move at least four degrees in any direction. This allows beam-axis adjustment for the sensor head. Use a mounting fixture especially made for beam-axis adjustment with an elongated hole. Contact Keyence for more information about this item, which is

sold separately.



### Improving Performance against Dust and Stains (Maximum Sensitivity Setting)

Set the sensitivity without a workpiece for a reflective type target, and with a workpiece for a transmission type target. Set the sensitivity slightly higher than the amount of received light at the setting time.

Press the button for at least three seconds in the state as shown in the figure below. Release the button when "SET" flashes on the display.

Reflective type



Transmission type



### Detecting Moving Workpieces (Full Auto Calibration)

In this mode, the set value will be set to the mean value of the maximum and minimum values obtained within a certain period.

Press the Determinant button for at least three seconds while the target workpiece is passing the sensing area of the sensor head.

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



### • Positioning a Target (Positioning Calibration)



Place a workpiece on the position where you want to perform positioning.
 Press the press button for at least three seconds. When the indication flashes, release the button.



# **Fine-adjusting Sensitivity**

The setting value can be changed by pressing the  $\frac{UP/DOWN}{\Delta V}$  buttons.



# Setting a Sensitivity – Advanced –

### Setting Sensitivity with Signals from External Devices (Page 6, No. 6)

By selecting "External calibration" in page 6, No. 6, the signal from an external device can be used to set the sensitivity. See "Using External Input" (page 4).

### Percent (%) Calibration (Page 6, No. 3)

The sensitivity can be set as a percent (%) of received light intensity. For example, when the percentage calibration target value is set to "-10P", pressing the set button sets the value to 10% below the amount of received light.



1 When selecting the sensitivity setting method (page 6, No. 3), select percent calibration, set the target value of calibration, and return to the normal display.

2 Press the set button at the percentage for the desired reference for light intensity.



- While percent calibration is selected, other calibrations (sensitivity setting) cannot be used.
- \* External input (page 4) can still be used (PX-10/10P only).

# **Selecting Detection Mode**

Detection mode can be set for normal detection or for one of the following two modes.

### • Edge Detection Mode (Page 6, No. 5)

This mode detects the change in the received light intensity during a given period of time. This mode can be set to react only to rapid changes in intensity and not slow changes in intensity.

Select "Edge detection mode" in page 6, No. 5.

_Г-д	Rising edge detection	Detects an increase (rising edge) in the received light intensity.	
-L_d	Falling edge detection	Detects a decrease (falling edge) in the received light intensity.	
_N_d	Rising/falling (both-edge) detection	Detects an increase (rising edge) and a decrease (falling edge) in the received light intensity	

#### Sensitivity setting

Quickly press the  $\overset{\text{SET}}{\bigcirc}$  button once to set the maximum sensitivity setting. This completes the setting.



 If the sensitivity is too low, the sensor may sense objects other than the workpiece. In this situation, increase the value by fine-adjusting the sensitivity (see "Fine-adjusting Sensitivity" on page 3).

### Dynamic Sensitivity Correction (DSC) Mode (Page 6, No. 5)

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.

Select "Dynamic Sensitivity Correction" in page 6, No. 5

#### Sensitivity setting

Sensitivity is set in the same way as for the normal detection mode (page 4). The DSC indicator illuminates when DSC mode is set.

DSC indicator



- When L-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 blinks when the L/D-ON settings are inadequate or the amount of light changes drastically with output OFF. Verify the settings again when the indicator blinks.

# **Avoiding Effects of Dust and Stains**

There are two methods for avoiding the effects of dust and stains. One uses external input and the other does not. Keyence recommends using the method with external input.

#### ■Using external input (PX-10/10P only)

Use the external input .to periodically correct the setting value and the display value

When using a transmission type sensor head: See "Percent Calibration" (page 3).

When using a reflective type sensor head: See "Zero Shift Function" (page 5).

#### Not using external input

See "Edge Detection Mode" and "Dynamic Sensitivity Correction Mode" (page 4).

### Using External Input (PX-10/10P only)

Use the following procedure to import a signal from an external device.

- Select an option other than OFF in the external input function selection (page 6, No. 6).
- 2 Short circuiting the pink wire for at least 2 ms as shown below (at least 20 ms for OFF) accepts the signal.



- External input settings (external calibration/display scaling) can be changed up to 1 million times.
- Input is not received while setting each mode
- When external calibration is selected, external input performs the same operations as with the SET button.

#### Sensitivity settings and display scaling settings

Both the sensitivity and the display scaling can be set when using the external input. In external input function selection (page 6, No. 6), select "External calibration". In display value correction function selection (page 7, No. 8), select "Display scaling function".

The following shows an example of use during percent (%) calibration and display scaling.



# **Activating Key Lock**

The key lock function disables the operation of all keys

Press and hold the △ button or the while holding down the MODE button.
button for at least 3 seconds





• During the operations shown above where the display shows "Loc", pressing and holding the ODE button for at least 3 seconds activates key lock mode with PIN number.

Press the DP/DOWN buttons to enter a PIN number between 0 and 9999, then press the DD button to activate the key lock. Use the same procedure to deactivate the function.

#### Note

Write down the PIN number and store it some place safe so that you do not forget it. The lock cannot be released if an incorrect PIN number is entered.

### Display Selection (Page 7, No. 10)

The display selection can be changed in the following manner during detection when "FuLL" is selected in page 7, No. 10. The factory default value is "1" only.



- \* 1 When ULTRA or MEGA modes are selected, the current received light intensity can be displayed up to five digits.
  - The setting value flashes when the  $\square$  button or the  $\square$  button is pressed once
  - The setting can be changed by pressing the Department button or the button again while the display is flashing.
- \* 2 The excess gain is displayed in 5% increments from 85 to 115%
- \* 3 The current light intensity for the setting value is displayed as a percentage.
- \* 4 Holds and displays the peak value and the bottom value.
- \* 5 This value is only displayed when "Limit detection function" is selected for the alarm output settings (page 7, No. 9). The setting value for the alarm output can be changed.

#### Resetting peak and bottom values (displays 4 and 5)

- Press and hold the button and the button at the same time for at least 3 seconds
- Turn off the power

#### ■Useful functions during hold display (4)

During hold display, press and hold the button for three or more seconds to set the following advanced settings.



#### Useful functions during power mode display (6)

Press and hold the vertice button for at least 3 seconds to switch easily between power mode and light emission power



# **Correcting Display Values**

### Shifting Current Light Intensity and Setting Value by a Specific Value (Display Shift Function: Page 7, No. 8)

This function shifts (increases or decreases) the current light intensity and the setting value by a specific value.

- Select "Display Shift Function" on page 7, No. 8 and set a shift value
- This function cannot be used during Dynamic Sensitivity Correction (DSC) mode.

### Forcibly Setting the Current Light Intensity to 0 (PX-10/10P only) (Zero-Shift Function: Page 6, No. 6)

The zero-shift function is used to forcibly set the current light intensity to zero by inputting a signal from the PLC or other external device.

- Select "Zero-shift function" at page 6, No. 6.
- For how to input a signal, see page 4 • The function is reset when the power is turned off.
- Negative values are displayed as 0.

### Changing Current Light Intensity to a **Specific Value** (Display Scaling Function: Page 7, No. 8)

This function reduces or enlarges the current received light intensity to the "scaling target value"

- (The intensity is enlarged or reduced by the same ratio as set in the parameter.)
- It can be used when "Display Scaling Function" is selected on page 7, No. 8. • 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.
- When selecting a display value correction function (page 7, No. 8), select "Display Scaling Function", and set the target value. (The explanation here deals with the case where the target value is set to 2000.)
- $\mathbf{2}$  During the normal display, press the  $\overset{\mathsf{set}}{\bigcirc}$  button while pressing the  $\overset{\mathsf{MODE}}{\Box}$ button

(Scaling is performed for the current light intensity at this time.)



The display changes as follows, and the target value (which is 2000) for scaling is displayed.

SET UP/DOWN MODE	ר [	ESCAL 2	000]
		UP/DOWN	MODE



The scaled value is displayed

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1 F	0	יריםםםל	ווממר
2		3676767	<i>ii ii i</i> l
_ L			
L SE	т	UP/DOWN	MODE
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	2	لنغالكا	

The current light intensity can be adjusted in the following range

Power mode	Minimum value	Maximum value
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,  $E_{rr}$  is displayed and a range that can be adjusted (minimum value or maximum value) is set

\* External input (see page 4) can be used. (PX-10/10P only)

# Setting Each Type of Function

Normally, only standard settings can be used

Display each type of menu and change the settings as required.

- Press and hold MODE for at least three seconds to return to the basic menu.
- Select a function with the buttons and press the button to set the value.
- Select END for each menu and press the MODE button to set the value.

Basic Settings Menu	1 2 3	Detection output selection Power mode selection Sensitivity setting method selection
Detection Settings Menu	4 5 6 7	Timer mode selection Detection mode selection External input function selection (PX-10/10P only) Light emission power selection
System Settings Menu	8 9 10 11	Display value correction function selection Alarm output setting Display selection during detection Display reverse selection

12 Power save mode setting

### **Basic Settings Menu**





#### **Detection Settings Menu**



### System Settings Menu



### Initializing, Saving, and Loading Settings

Initializing settings (returns the parameters to the factory default state)

- 1 While pressing the  $\bigcirc$  button, press the  $\bigcirc$  button or the  $\bigcirc$  button five times
- 2 With the  $\square$  button or the  $\square$  button, select "rSt" and press the  $\square$  button.
- **3** With the  $\square$  button or the  $\square$  button, select ":n:L" and press the  $\square$ button to perform initialization
- Saving settings (you can make changes but still return to the saved settings)
- 1 While pressing the  $\bigcirc$  button, press the  $\bigcirc$  button or the  $\bigtriangledown$  button
- 2 With the  $\square$  button or the  $\square$  button, select "5RuE" and press the  $\square$  button.
- 3 With the <sup>UP</sup> button or the <sup>DOWN</sup> button, select "𝒴E5" and press the <sup>MODE</sup> button to save the settings.

\* Saved settings are not cleared even when initialization is performed.

#### Loading saved settings

- While pressing the  $\bigcirc$  button, press the  $\bigcirc$  button or the  $\bigcirc$  button five times.
- 2 With the  $\square$  button or the  $\square$  button, select "r5L" and press the  $\square$  button.

3 With the △ button or the ♥ button, select "Cu5t" and press the ♥ button to load the saved settings.

# **Outputting Alarms**

### Limit Setting Function (Page 7, No. 9)

Limit settings output a warning when the difference in light intensity becomes too small for detecting whether a workpiece is present.
It can be used when "Limit Setting Function" is selected on page 7, No. 9.

There are two types of limit setting functions.

#### Peak value

This function samples the peak value when the light intensity rises above the set value for detection output. The warning outputs when the minimum hold value drops below the setting value for alarm output.

#### Bottom value

This function samples the bottom value when the light intensity falls below the set value for detection output. The warning outputs when the maximum hold value rises above the setting value for alarm output.



#### Resetting peak value and bottom value

Press and hold the button and the button for at least 3 seconds to reset the values

The function is reset when the power is turned off.

# Error Displays and Corrective Actions

Error indication	Cause	Remedy Check whether there is a short circuit in the head cable and whether the amplifier is inserted correctly. Shield the sensor from the extraneous light.	
ErH	Sensor head is not connected. There is a short circuit in the head cable, or strong extraneous light has entered the top of the short head.		
ErC	Overcurrent is flowing through the output wire.	Check the load and reduce the current to be within the rated range.	
	Data write/read error	Perform initialization.	
ErE	Data has been written in the EEPROM over 1 million times.	If you need to write more data, replace the amplifier unit.	
Err	The amplifier unit is broken.	Replace it with a new amplifier unit.	

# Shortening the Sensor Head Cable

Be sure to follow the steps carefully in order to waterproof the cable.

#### Sensor head connector



Disassembled diagram (configuration diagram) The connector for the sensor head can be disassembled into the following parts



Note

Do not remove parts other than the IDC connector from the cables.

### **Removing the Connector and Cutting the Cables**





2 Pull the IDC connector gently in the direction of the arrow to remove it from Cap B. Remove the packing from Cap B.



 ${f 3}$  Hold the IDC connector so that the back side (side where the wires can be seen) is facing forwards. Push the upper tab in the direction of arrow 1 and then open the back side in the direction of arrow 2.



4 Remove the cables.





**5** Cut the cable to the required length.



#### Note

If all of the parts are accidentally removed, insert the cable through all of the parts as shown below before starting the procedure under "Connecting the Cables and the IDC Connector" (page 9).

• Thread the gray cable through the hole near the raised portion of Cap B.



### Connecting the Cables and the IDC Connector

- 1 Manipulate the end of the cables as shown in the following figure. • Peel back the insulation 10 mm from the end. (Do not strip the wires in the core.)
  - Twist the base of the shielded wire at least five times so it does not unravel, and bend it 90° to the side.



- \* Be careful not to twist the core wires along with the shielded wire. If the wires become twisted, untwist them slightly and pull the core wires apart from the shielded wires.
- $\mathbf 2$  Align the core wires with the same color as indicated by the sticker on the IDC connector and insert the wires as shown below.
  - . Insert the two wires (one black and one white) for the black cable into the connector completely.
  - The red wire for the gray cable cannot be inserted completely, but insert it as far as it can go.
  - Twist the shielded wires in the direction of the arrow while pulling them into the ditches



3 Close the IDC connector, crimp it tight with pliers or a similar tool, and push down on the top to lock it shut.



#### Note

Be careful not to crush the raised portion shown in the diagram when using pliers.



**4** Use wire cutters or a similar tool to trim off the wires sticking out of the IDC connector.



#### Note

Do not install the connectors more than two times. If the installation exceeds twice, purchase OP-77758 (two connectors) separately.

### Mounting the Connector





 ${f 2}$  Slide the packing and the mounting fixture in the direction of the arrow to combine them.



Insert the packing into the hole in Cap B and combine the parts so that the raised portion on Cap B lines up with the notch on the mounting fixture.



- **3** Push Cap A in the direction of the arrow and turn it clockwise to lock it into place. Tighten Cap A while pushing on the IDC connector as shown in the diagram below.



### Sensor head

Туре		Thru beam type Reflective ty				ive type		
		M8 straight M8 nut M12 straight		M12 straight				
Ca	Cable Normal Spiral Normal Normal Spiral		Spiral	Normal	Spiral			
M	odel	PX-H71	PX-H71G	PX-H71TZ	PX-H72	PX-H72G	PX-H61	PX-H61G
Enclosu	ure rating		IEC: IP68	, JEM: IP68	g, NEMA: 4	4X,6P,13, D	IN: IP69K	
Light	source	4 el (Wav	ement red l elength: 63	LED 5 nm)	Infrared LED (Wavelength: 870 nm)		4 element red LED (Wavelength: 635 nm)	
	TURBO		4 m		10	m	400 mm	
Detection	SUPER	6 m		15 m		600 mm		
distance	ULTRA		12 m		30 m		1200	) mm
	MEGA	20 m		40 m		2000	) mm	
Standard detecting object		φ 4 m	m opaque	object	φ 7.5 mn obj	n opaque ject	Spot size Detection distance 15 mm at 100 mm 65 mm at 500 mm	
	Operating ambient light	Incandescent lamp: 20,000 lx max., Sunlight: 30,000 lx max.						
Environ- ment resistance	Operating ambient temperature	-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					(YZ axes	
	Housing	SUS303 (plastic portions: PMP, POM)						
	Lens	Glass						
Material	Cable	PVC						
	Connector portion	PBT, NBR, POM, SUS304						
Cable length		2 m						
Acce The cor connect ca	Accessory The connector is connected to the cable.		M8 nut x4 Metal washer x2	M8 nut x2 Metal washer x2	M12 nut x4 Metal washer x2	M12 nut x4 Metal washer x2	M13 nut x2 Metal washer x1	M13 nut x2 Metal washer x1
We	eight	Approx. 80 g	Approx. 250 g	Approx. 88 g	Approx. 90 g	Approx. 260 g	Approx. 80 g	Approx. 220 g

\* Note that when using the sensor underwater, the detection distance becomes extremely short.

#### Amplifier

Туре		Cable type	Connector type		
Model NPN output PNP output		PX-10	PX-10C		
		PX-10P	PX-10CP		
Respo	onse time	500 μs (TURBO)/1 ms (SUPER)/ 4 ms (ULTRA)/16 ms (MEGA)			
Control	NPN output	NPN open collector, 40 V, 100 mA max. per output 2 outputs for total 100 mA max., residual voltage 1 V max.			
output	PNP output	PNP open collector, 40 V, 100 mA max. per output 2 outputs for total 100 mA max., residual voltage 1 V ma			
Exter	nal input	Input time, ON: 2 ms, OFF: 20 ms max.			
Number of units required to prevent interference		4 (when all are	in power mode)		
Power voltage <sup>*1</sup>		12-24 VDC, Ripple (P	-P): 10% max, Class2		
Current consumption		Normal: 50 mA max. at 24 V, 55 mA max. at 12 V Power saving: 40 mA max. at 24 V, 45 mA max at 12 V			
Enclosure rating		IEC: IP67 JEM: IP67 NEMA: 4X			
Environment	Operating ambient temperature <sup>*2</sup>	-10 to +55°C (No freezing)			
al resistance	Operating ambient humidity	35 to 85% RH (No condensation)			
	Vibration	10 to 55 Hz Compound amplitude 1.5 mm,			
	resistance	2 hours for each of XYZ axes			
Case	material	Main unit: PBT, display portion: PSU, display cover and connector cover: SUS304, heat sink: SUS304, gasket: NBR			
Acc	essory	Instructio	n Manual		
W	eight	Approx. 100g	Approx. 50 g		

\*1 When the sensor head cable is 3 m or longer, use a power supply voltage of 24 V DC.
 \*2 When using several units in close proximity.

2 to 4 units : 55°C

5+ units : 45°C

# 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 PX 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 sensor head model, the maximum sensing distance or displayed value of all the units are not the same.
- Changing the cable layout can change the light intensity slightly. Reset the sensitivity when changing the layout.
- Even when using the interference prevention function, devices installed and connected to the sensor may have a slight effect on detection. In these cases, fine-adjust the sensitivity (raise the value).
- Infrared light used for communicating with the amplifier unit emits from the back of the amplifier unit. Make sure that the receiving head is not used too close to the amplifier unit.
- Do not use the sensor while it is submerged in oil.
- Performance may be lowered depending on the type of oil.

# **Precautions on UL Certificate**

The PX series complies with the following UL and CSA standards. The PX series has obtained UL and C-UL certificate.

- Applicable standard UL508 Industrial Control Equipment
- CAN/CSA C22.2 No.14-M05 Industrial Control Equipment
- UL File No. E301717
   UL category: NRKH, NRKH7
- Enclosure Type 1 (according to UL50)
- Precautions
  - The PX series must be supplied from the power source defined as Class 2 according to NFPA70 (NEC: National Electrical Code).
- The UL certificate for the PX series is for the sensor head unit and the amplifier unit used in combination. The PX-H series (the sensor head unit) must be used together with the PX-10 series (amplifier unit) exclusively.

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