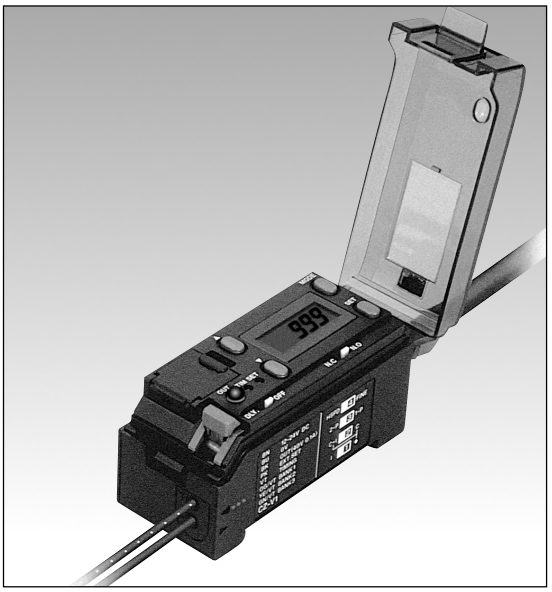
KEYENCE

96M0745

96M0745-7

RGB Digital Fiberoptic Sensor
CZ-K1(P) Series

Instruction Manual



SAFETY PRECAUTIONS

This manual describes the instructions, operating procedures and precautions for using the CZ-K1(P) Series.
Before beginning operation, please read this manual carefully to get the most from your CZ-K1(P) Series.
Keep this manual handy for future reference.

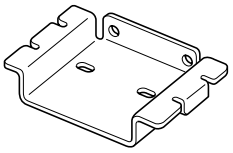
⚠ WARNING

- ***The CZ-K1(P) Series is intended for the detection of target objects. Do not use the CZ-K1(P) Series in a safety circuit to protect the human body.***
- ***The CZ-K1(P) Series does not have an explosion-proof structure. Do not use it in a location where any flammable gases, liquid or powder exist.***

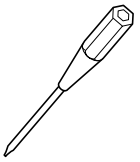
ACCESSORIES

Instruction manual (This manual): 1

Mounting bracket: 1



Resin driver: 1



SPECIFICATIONS

Amplifier

Model	NPN output	CZ-K1
	PNP output	CZ-K1P
Light source		Red LED, Green LED, Blue LED
Response time		300 μs/1 ms (switch selectable)
Indicators		Output: Red LED, Calibration: Orange LED, External synchronization input: Green LED, Matching rate/received light intensity: LCD (Red/Green)
Error indication		Excess light intensity, insufficient light intensity, insufficient color difference
Calibration method		1-point/2-point calibration (switch selectable)
Tolerance value adjustment		Numerical value setting on digital display
Differentiation mode		C mode/C + I mode/I mode (switch selectable)
Timer function		Timer OFF/OFF-delay timer (40 ms) (switch selectable)
Output mode selection		Match output: Turns on when target color matches registered color. Mismatch output: Turns on when target color is different from registered color. (switch selectable)
External synchronization input		Response speed: 500 μs max.
External calibration input		Input response time: 20 ms min.
Registered color selection		8-bank selection (By external input), Input response time: 20 ms min.
Control output		NPN or PNP open-collector: 40 VDC max. (100 mA max.), Residual voltage: 1.0 V max.
Protection circuit		Reverse-polarity protection (power supply), overcurrent protection (output), surge absorber (output)
Power supply		12 to 24 VDC±10%, Ripple (P-P): 10% max.
Current consumption		75 mA max.
Ambient light		Incandescent lamp: 5,000 lux max., Sunlight: 10,000 lux max.
Ambient temperature [1]		-10 to +55°C (14 to 131°F), No condensation
Relative humidity		35 to 85%, No condensation
Vibration		10 to 55 Hz, 1.5 mm double amplitude in X, Y, and Z directions, 2 hours respectively
Shock		500 m/s² in X, Y, and Z directions, 3 times respectively
Housing material		Polycarbonate
Weight (including 2 m cable)		Approx. 115 g

Fiber unit

Type	Reflective	
	Small size adjustable spot	Small size, side-view adjustable spot
Model	**CZ-10**	**CZ-11**
Detection range	10 to 30 mm	3 to 15 mm
Smallest spot diameter	0.9 to 3.5 mm dia.	0.9 to 1.5 mm dia.
Minimum bend radius	R25 mm	
Enclosure rating	IP40	
Ambient temperature	-40 to +70°C (-40 to +158°F), No condensation	
Relative humidity	35 to 85%, No condensation	
Fiber length	2 m (free-cut)	1 m (free-cut)
Housing material	Lens case: Aluminum, Fiber case: Stainless steel	
Weight	Approx. 5 g	Approx. 13 g

Type	Reflective	
	Long detecting distance	Small beam spot
Model	**CZ-40**	**CZ-41**
Detection range	70±20 mm	16±4 mm
Smallest spot diameter	6 mm dia.	1 mm dia.
Minimum bend radius	R25 mm	R15 mm
Enclosure rating	IP67	
Ambient temperature	-40 to +70°C (-40 to +158°F), No condensation	
Relative humidity	35 to 85%, No condensation	
Fiber length	2 m (free-cut)	
Housing material	Polyarylate	
Weight	Approx. 27 g	

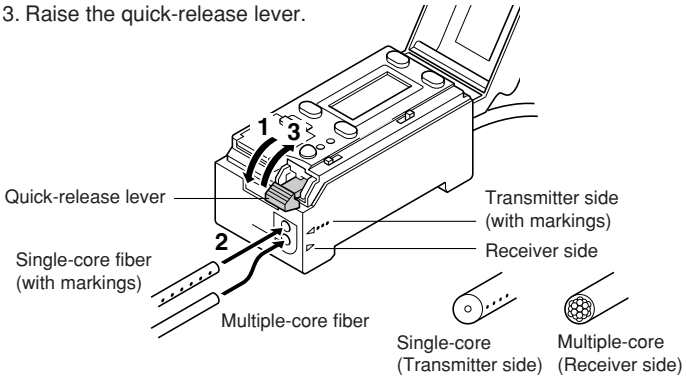
1. When several units are connected, the acceptable ambient temperature varies depending on the conditions given below. To connect several units, be sure to mount them to a DIN rail (metallic plate). Ensure that the output current is 20 mA max.
   • When 3 to 10 units are connected: -10 to +50°C (14 to 122°F)
   • When 11 to 16 units are connected: -10 to +45°C (14 to 113°F)

CONNECTING FIBER UNIT AND AMPLIFIER

1. Tilt the quick-release lever.
2. Push the single-core fiber to the transmitter side, and the multiple-core fiber to the receiver side as far as they will go (Approx. 14 mm of the fiber will be inserted.).

* Inserting the fiber in the wrong side will decrease the original detection performance. Be sure to check the markings on the amplifier's lateral side before inserting the fiber.

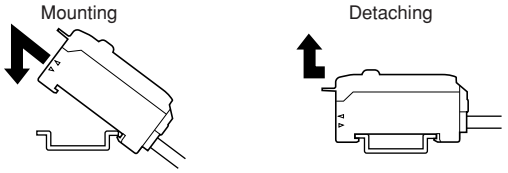
3. Raise the quick-release lever.



MOUNTING AMPLIFIER

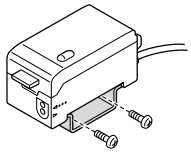
■ Mounting/detaching amplifier to/from DIN rail or mounting bracket

Hook the claw on the rear side of the amplifier onto the DIN rail or the mounting bracket, and then hook the front side claw to the rail or bracket while pressing the amplifier forward. To detach the amplifier, unhook the front claw by lifting the amplifier front side while pressing it forward.



■ Side mounting

Using the side holes of the supplied mounting bracket, secure the amplifier with the screws.

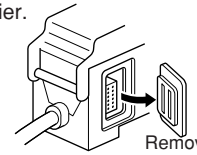


CONNECTING SEVERAL AMPLIFIERS

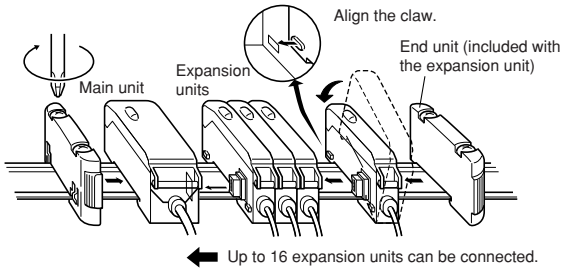
■ Mounting expansion units

Up to 16 expansion units (FS-T2, FS-M2, FS-V12, PS-T2) can be mounted to the side of the CZ-K1(P) amplifier.

1. Remove the protective cover on the side of the amplifier.
2. Mount expansion units to the DIN rail one at a time.



3. Slide one expansion unit toward the main unit or another unit. Align the front claws of the units and push them together until you hear a click.
4. Secure the units together by pushing the end units (included in the expansion unit) from both sides.



The sticker on the right is included with the expansion unit. Attach the sticker close to the sensor units.

■ Detaching expansion units from DIN rail

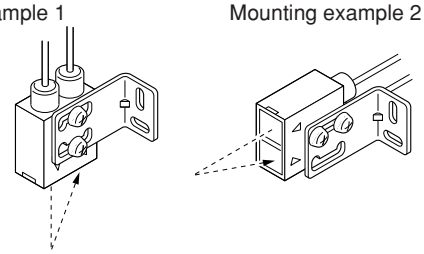
1. Detach the end units.
2. Slide the expansion unit that is to be detached. Detach it individually from the DIN rail.

Note 1: When connecting several amplifiers, be sure to use a DIN rail and the end units.
Note 2: Be sure to turn the power off before connecting/disconnecting amplifiers.
Note 3: Do not remove the protective cover on the expansion connector from the outermost unit.
Note 4: Do not detach several units from the DIN rail while they are connected to each other.
Note 5: When several units are connected, confirm that the ambient temperature is appropriate. (See "Specifications" on page 1.)

MOUNTING FIBER UNIT

- Use the supplied special mounting bracket to mount the fiber unit in the desired position according to the location.
- Be sure to limit the tightening torque to 0.3 Nm or less.

Mounting example 1 Mounting example 2

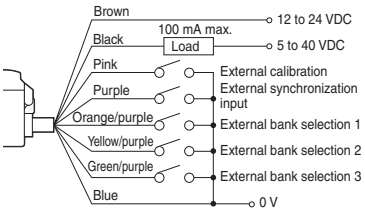


Reference: To cut the fiber to the desired length, use the special cutter included with the fiber unit.

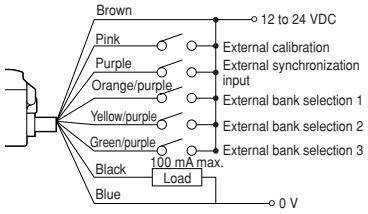
INPUT/OUTPUT CIRCUIT

Connections

NPN

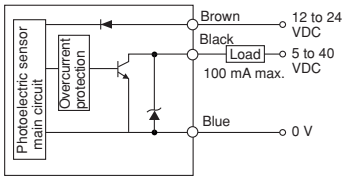


PNP

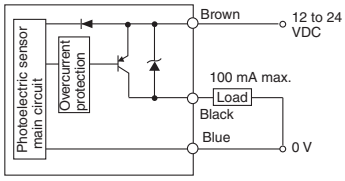


Output circuit

NPN



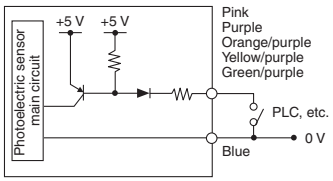
PNP



Input circuit

NPN

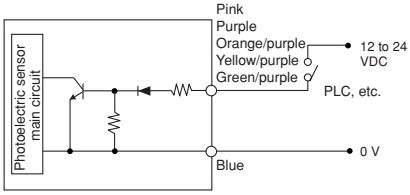
External calibration input
External synchronization input
External bank selection input 1 to 3



Short-circuit current: Approx. 1 mA

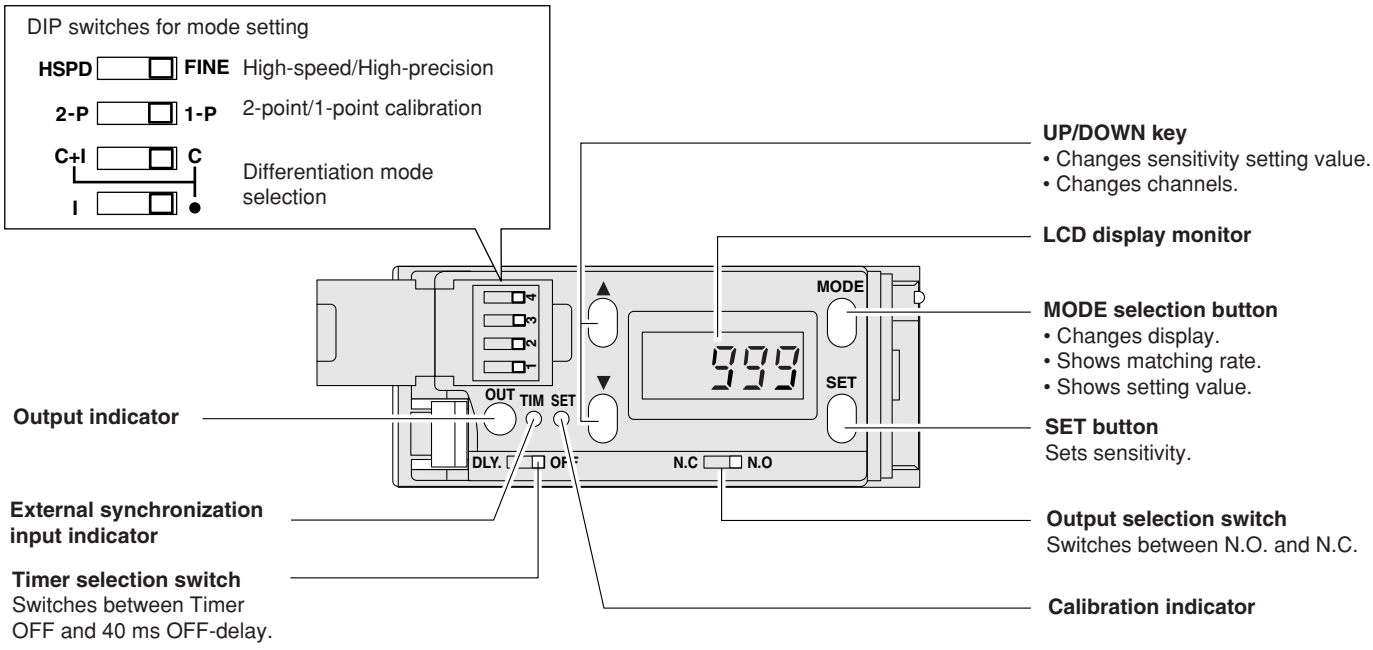
PNP

External calibration input
External synchronization input
External bank selection input 1 to 3

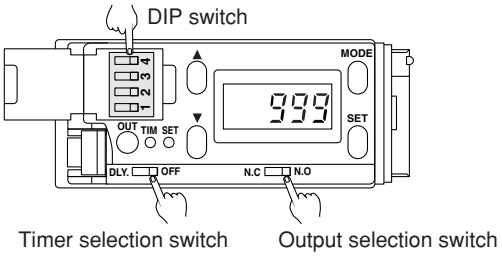


Short-circuit current: Approx. 1 mA

PART NAMES



SETTING EACH MODE



Factory setting
"✳" indicates the factory-set mode. Normally, you should use the CZ-K1(P) with the setting indicated by "✳", and only change the setting if required.

■ Differentiation mode setting (Using DIP switches 1 and 2)

Change the setting according to the detection conditions such as the target color or received light intensity.

	Mode	Switch	Description
✳	**C (Color)**	1 2	Detects color using color components (R, G, and B).
	C + I (Color and intensity)	1 2	Detects color using color components (R, G, and B) and received light intensity (received light quantity).
	I (Intensity)	1 2 or 1 2	Detects color using received light intensity (received light quantity).

Sensitivity setting in C or C + I mode → Go to page 4.
Sensitivity setting in I mode → Go to page 5.

■ 1-point/2-point calibration selection[1.] (Using DIP switch 3)

Change the calibration method.

	Mode	Switch	Description
✳	**1-P (1-point calibration)**	3	Detects one specified color. (The sensitivity is automatically set to detect only the one color selected during calibration.)
	2-P (2-point calibration)	3	Differentiates two specified colors. (The sensitivity is automatically set to the optimal value to differentiate the two colors selected during calibration.)

1. The setting of DIP switch 3 is effective only in the C and C + I modes. The setting is unnecessary in I mode.

■ FINE/HSPD selection (Using DIP switch 4)

Use HSPD when the detection requires a response speed less than 1 ms.

	Mode	Switch	Description
✳	**FINE (Fain)**	4	Differentiates colors with high precision.
	HSPD (High-speed)	4	Differentiates colors with a high-speed response of 300 μs.

■ N.O./N.C. selection

Change the setting to invert the output mode.

	Mode	Switch	Description
✳	**N.O. (Color match output)**	N.C. N.O.	Output is turned on when the target color matches the registered color.
	N.C. (Color mismatch output)	N.C. N.O.	Output is turned on when the target color does not match the registered color.

■ Timer OFF/40 ms OFF-delay selection

Change the setting to delay the output timing.

	Mode	Switch	Description
✳	**Timer OFF**	DLY. OFF	Output is turned on without any delay.
	40 ms OFF-delay	DLY. OFF	Output is delayed for 40 ms.

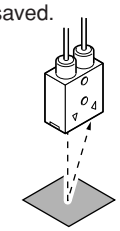
OPERATING PROCEDURE FOR USING C OR C + I MODE

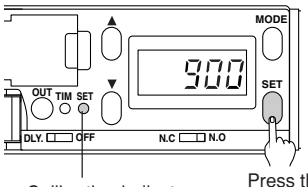
Setting sensitivity

■ 1-point calibration (Detection of one specified color)

Place a target that is the reference color in the detection area of the fiber unit. Press the SET button and then release it.

The calibration indicator illuminates momentarily and the reference color is saved.





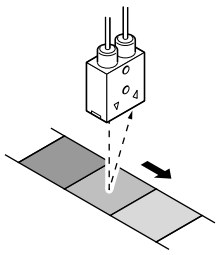
Calibration indicator

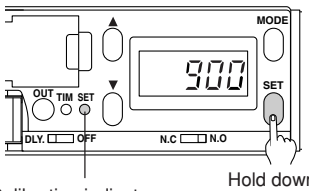
Press this button once.

● To ignore certain color differences

There are two methods for ignoring color differences.

- Perform the sensitivity adjustment after calibration. (→ See the lower right part of page 4.)
- Use the quick color difference cancellation function.
  In 1-point calibration, hold down the SET button and continue the calibration with targets of different colors. The CZ-K1(P) Series ignores the color vibration and saves them as the reference color.





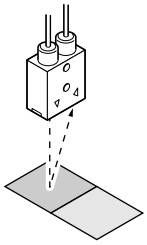
Calibration indicator (Illuminates while the SET button is held down.)

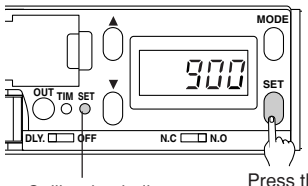
Hold down the SET button.

■ 2-point calibration (Differentiation of two colors)

1. Place a target that is the reference color in the detection area of the fiber unit. Press the SET button and then release it.

   The calibration indicator illuminates and the reference color is saved.



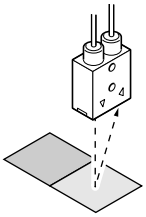


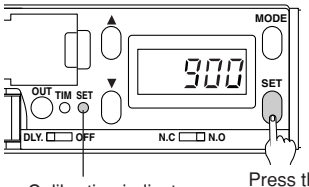
Calibration indicator

Press the SET button once.

2. Place a target that is the color to be differentiated in the detection area. Press the SET button and then release it.

   The calibration indicator goes off. The CZ-K1(P) Series sets the optimal sensitivity to differentiate the two colors.





Calibration indicator

Press the SET button once.

● When "- - -" is displayed:

When the sensitivity difference is insufficient for proper detection, the LCD display monitor shows "- - -" for 3 seconds after calibration.
In this case, see "When calibration/differentiation fails" on the upper right part of this page and try the calibration again.

● When calibration/differentiation fails

Check the following points.

- Check whether the fiber unit is mounted properly (detection distance and detection angle). (See page 7.)
- Perform the sensitivity adjustment. (See below.)
- Select the other differentiation mode and then perform calibration again. (See page 3.)

LCD display indication

Current value (Matching rate display)

● Matching rate display

Displays the matching degree (matching rate) of the color of the currently detected target to the reference color registered during calibration.

* Displays a value between 0 and 999. (Higher value indicates a better match.)

Press the button once.

Setting value

The setting value flashes on and off.

● Setting value display

Displays the threshold value (criteria) of the matching rate to determine if the color of the currently detected target is the same color as the reference color.

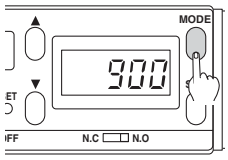
When "ᵒᵒᵒ" or "ᵘᵘᵘ" is displayed

These displays indicate that the received light is insufficient or excessive. → See page 7.

Sensitivity adjustment

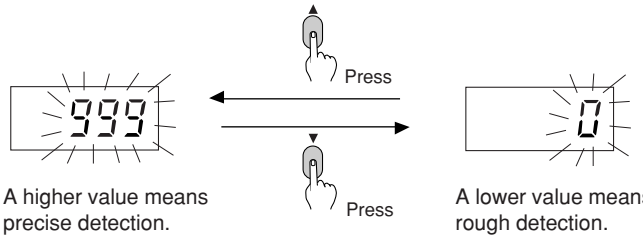
The tolerance of the detection can be adjusted.

1. Press the MODE button to show the setting value.



Press

2. Press the UP/DOWN button to change the setting value.



A higher value means precise detection.

A lower value means rough detection.

Narrow tolerance range

Wide tolerance range

* After the adjustment, press the MODE button to return to the matching rate display.

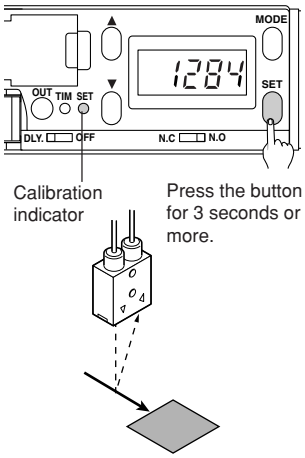
OPERATING PROCEDURE FOR USING I MODE

Setting sensitivity

Select the sensitivity setting procedure according to the target conditions.

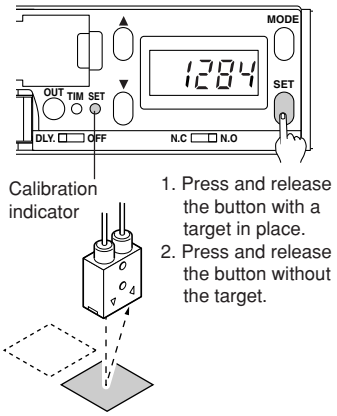
■ To set sensitivity using a moving target (Fully-automatic calibration)

1. Pass a target through the optical axis while pressing the SET button (3 seconds or more).
2. Confirm that the calibration indicator (orange LED) flashes.
3. Release the SET button. The calibration indicator (orange LED) goes off.



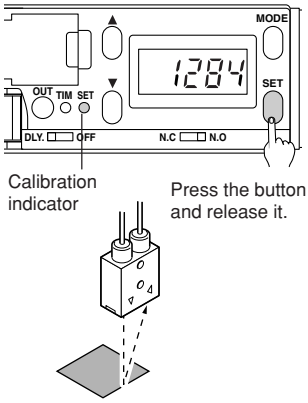
■ To detect a minute color difference (2-point calibration)

1. With a target in place, press the SET button and release it. The calibration indicator (orange LED) illuminates.
2. With the target removed, press the SET button and release it. The calibration indicator (orange LED) goes off.



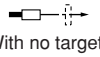
■ For target positioning (Positioning calibration)

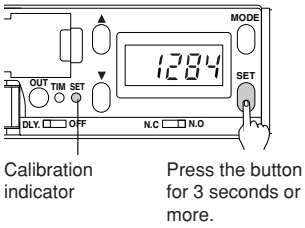
1. With no target, press the SET button and release it. The calibration indicator (orange LED) illuminates.
2. Place a target in the position where it is to be stopped.
3. Press the SET button for 3 seconds or more and confirm that the calibration indicator (orange LED) flashes.
4. Release the SET button.



■ For stable detection unaffected by dust or dirt (Maximum sensitivity setting)

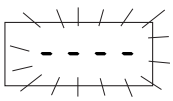
1. Under the conditions shown in the figure, press the SET button for 3 seconds or more until the calibration indicator (orange LED) flashes.





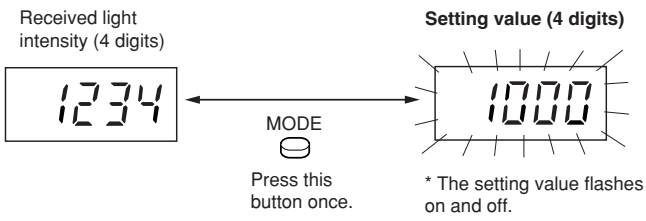
2. Release the SET button.

● **When the sensitivity difference is insufficient:**
"- - - - -" flashes for 3 seconds on the LCD display monitor after calibration.



LCD display indication

The display is factory-set to show the received light intensity.



■ Received light intensity display

Received light intensity is displayed in 4 digit numbers by defining the maximum value as approximately 4000.

The maximum/minimum values vary depending on the fiber unit characteristics.

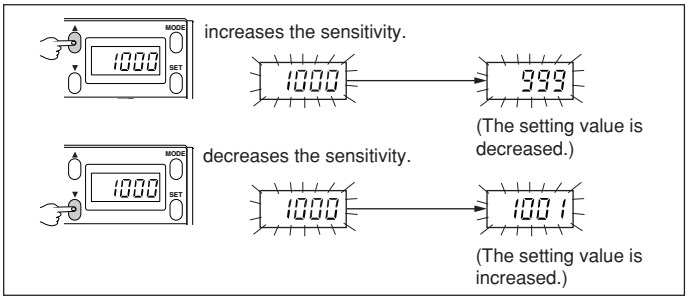
■ Setting value display

The current setting value is displayed. This display enables sensitivity adjustment using the UP/DOWN button.

Changing the setting value

You can change the setting value in the "Setting value display".

In setting value display mode



Reference: Holding down the UP/DOWN button quickly changes displayed values.

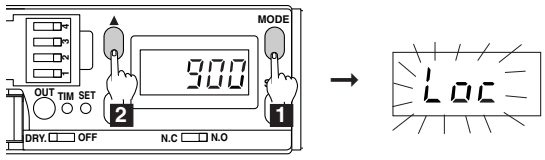
OTHER FUNCTIONS (COMMON TO C, C + I, AND I MODES)

Locking the sensitivity setting

*** Be sure to hold down the MODE button first when operating the MODE and UP/DOWN buttons.**

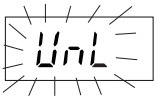
Hold down the MODE button and press the UP button for 3 seconds. This locks the operation buttons.

- "Loc" flashes on and off on the LCD display monitor.
- You can still change the display mode and channel when in setting locked status.



● To cancel the locked status

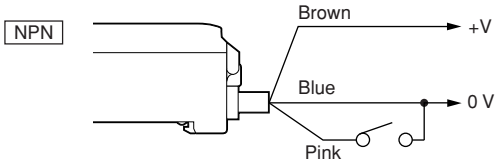
Repeat the procedure above while in setting locked status. "UnL" flashes on and off on the LCD display monitor.

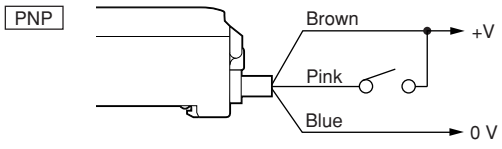


Setting sensitivity using an external input (External calibration function)

1. Lock the sensitivity setting using the procedure above. (If "UnL" is displayed, repeat the same procedure.)

2. Connect the pink cable to a switch or a PLC.
   The minimum input time is 20 ms.





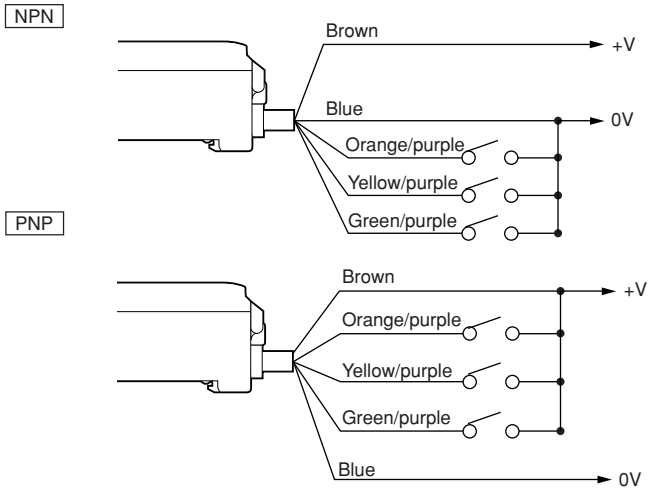
3. The external calibration procedure is the same as using the SET button. (→ All the setting procedures on pages 4 and 5 are available with the external input.)

Selecting CH display

The CZ-K1(P) can internally store 8 colors (banks). The banks can be selected using an external input.

● Selecting registered colors (banks) using an external input

The external bank selection cable allows the selection of 8 registered colors from A through H.

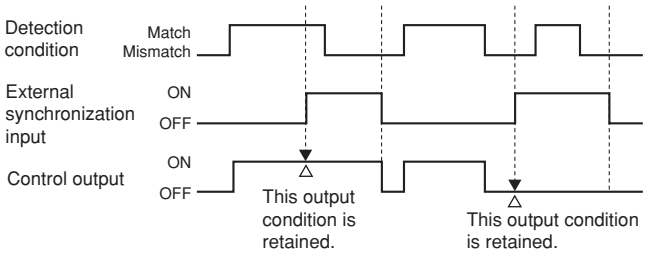


Cable color / Bank	Orange/ purple	Yellow/ purple	Green/ purple
A	X	X	X
B	●	X	X
C	X	●	X
D	●	●	X
E	X	X	●
F	●	X	●
G	X	●	●
H	●	●	●

●: —○ ○—
X: —○ ○—

External synchronization function

When the external synchronization input cable (purple) receives a signal (connected to 0 V), the control output retains the condition at that exact moment.



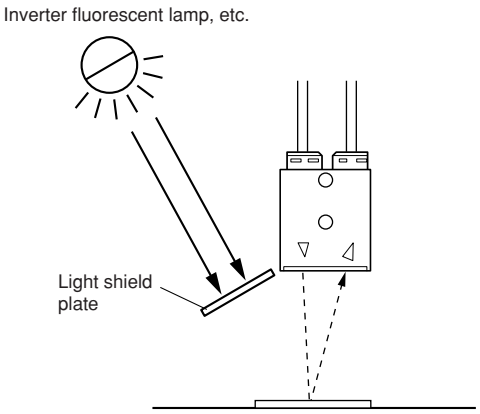
HINTS ON CORRECT USE

Mounting amplifier

- If the amplifier cable is placed together with power lines or high voltage lines in the same conduit, detection errors may occur due to noise interference. Isolate the amplifier cable from these lines.
- If there are several colors in a single beam spot, the CZ-K1(P) determines the color by averaging those colors. Therefore, it may produce an output even though the color is different from the registered color.
- To extend the cable length, use a cable with at least a 0.3 mm^2 nominal cross-section area. Limit the length of cable extension to 100 m or less. (To connect several units, contact Keyence for further information.)
- When using a commercially available switching regulator, ground the frame ground terminal and ground terminal.
- Do not use the CZ-K1(P) outdoors.
- Even when the same color is detected, the displayed value may vary depending on the characteristics of each amplifier, the length of the fiber cable and the location.
- When any of the external inputs (calibration, synchronization or bank selection) are not used, cut the appropriate input cables (pink, purple, orange/purple, yellow/purple or green/purple) at the root or connect them to the "+" (CZ-K1) / "–"(CZ-K1P) terminal of the power supply.

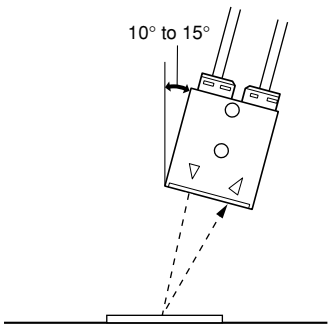
Mounting fiber unit

- A detection error may occur when the target is subjected to direct or reflected light from high-frequency lighting equipment such as an inverter fluorescent lamp. In such a case, apply a light shield plate or change the location of the fiber unit.



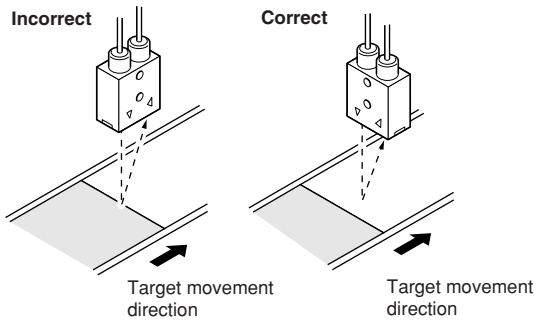
• When detecting a metal surface or glossy target

When a target has a metal or glossy surface, the calibration/differentiation may fail. To detect such a target, tilt the fiber unit by approximately 10 to 15 degrees.



• Target movement and fiber unit orientation

To stabilize the sensor output at a border, mount the fiber unit parallel to the border line as much as possible.



Fiber unit

- Prevent any objects from bumping the sensing surface.
- Do not pull the fiber cable of the CZ-40 and 41 using a strength of greater than 20 N, 3 seconds.

ERROR INDICATIONS

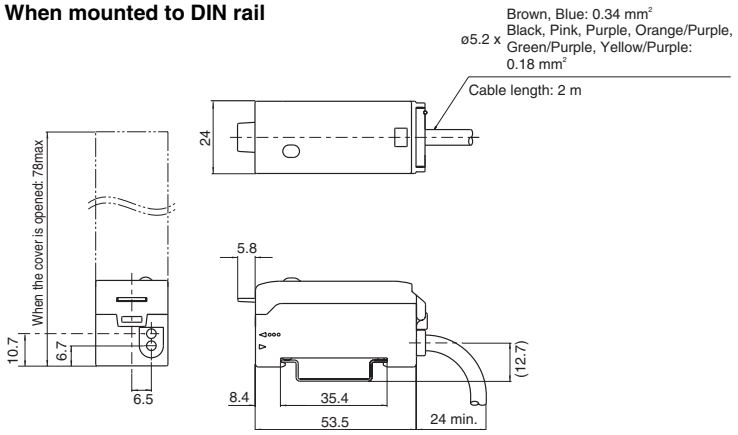
The following indications on the LCD display show the error events. Correct the problem using the following countermeasures.

Error indication	Cause	Countermeasures
⊓⊓⊓	Received light intensity is insufficient.	Check whether the fiber unit is installed at the specified detecting distance. Insert the fiber cable into the fiber unit as far as it will go (approx. 14 mm).
⊔⊔⊔	Received light intensity is excessive.	Tilt the fiber unit by approx. 10 to 15 degrees. (→ See “Mounting fiber unit” on the left part of this page.)
- - - -	Color difference (in I mode, “difference in light intensity”) is too small to differentiate colors during 2-point calibration.	→ See “When calibration/ differentiation fails” on page 4 and retry the sensitivity adjustment.

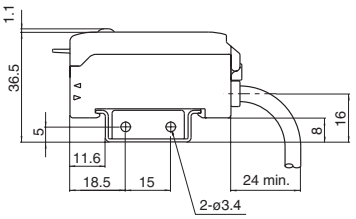
DIMENSIONS

CZ-K1(P)

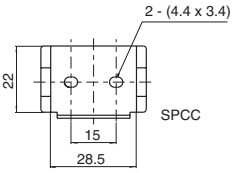
When mounted to DIN rail



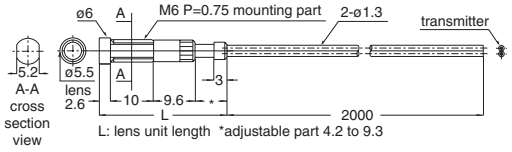
When mounting bracket is attached



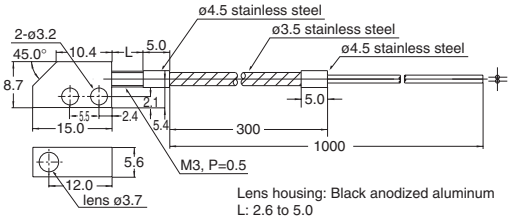
Amplifier mounting bracket (accessory)



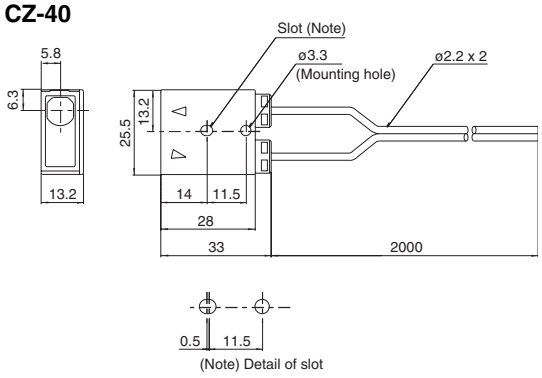
CZ-10



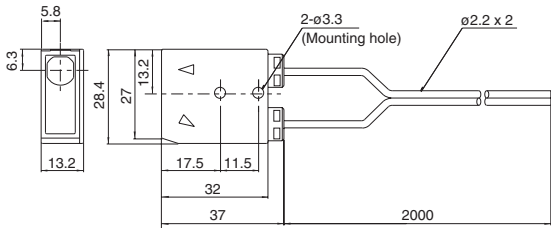
CZ-11



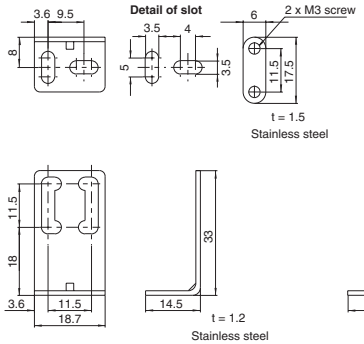
CZ-40



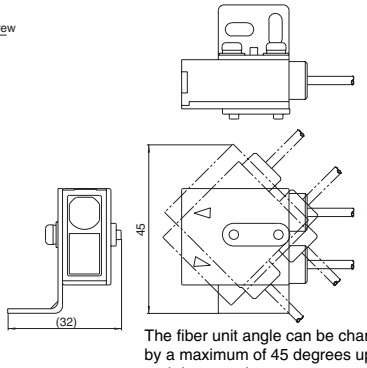
CZ-41



Fiber unit mounting bracket (accessory)



When mounting bracket is attached to CZ-40



The fiber unit angle can be changed by a maximum of 45 degrees upward and downward.

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