KEYENCE

NEW **Colour-Differentiating Fibreoptic Sensor**

CZ Series

R · G · B

Three light source, high precision

Sensor for advanced colour differentiation

CZ SERIES

CE

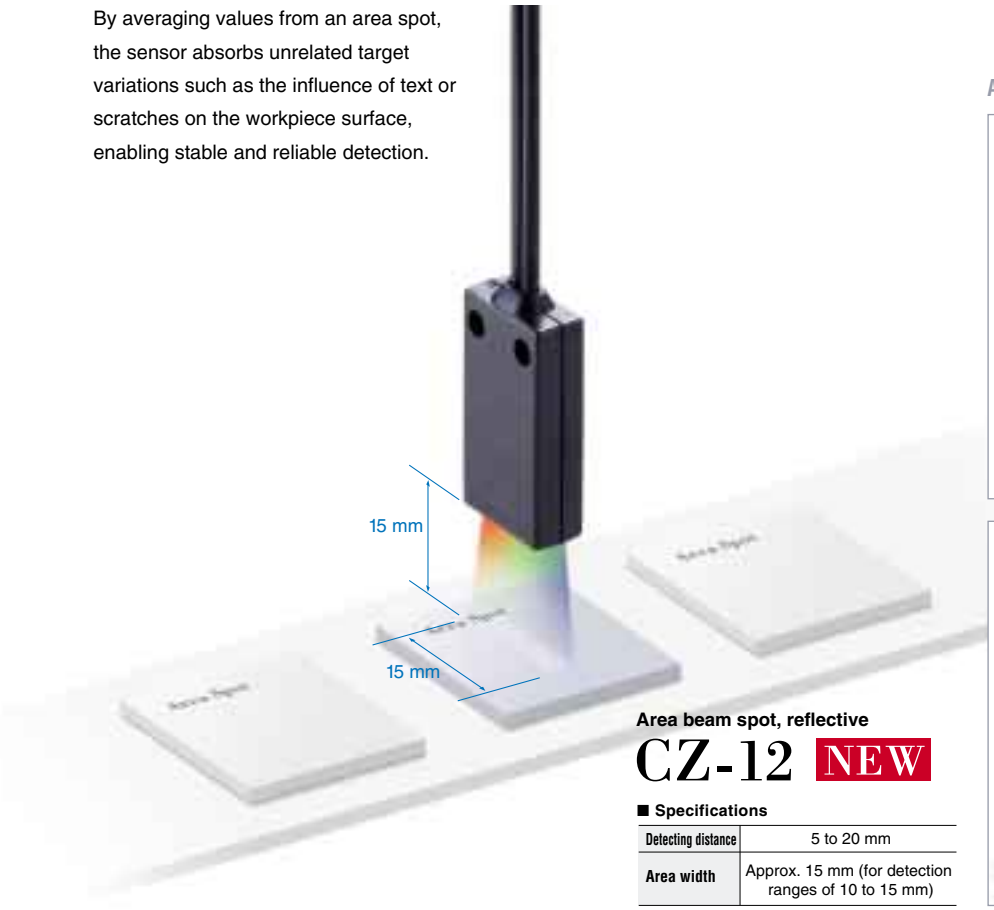
Boasting three separate RGB light sources for high-precision colour detection.

Two new models and a total of six fibre units provide a range suitable for a variety of on-site conditions.

CZ SERIES LINE-UP

Multi-purpose detection ▪ ▪ ▪ area spot type

By averaging values from an area spot, the sensor absorbs unrelated target variations such as the influence of text or scratches on the workpiece surface, enabling stable and reliable detection.



Area beam spot, reflective

CZ-12 NEW

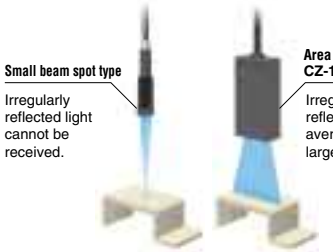
■ **Specifications**

Detecting distance	5 to 20 mm
Area width	Approx. 15 mm (for detection ranges of 10 to 15 mm)

An area beam spot means stable, reliable detection.

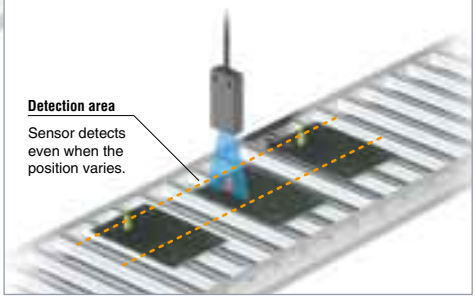
✔ Uneven workpiece surfaces.

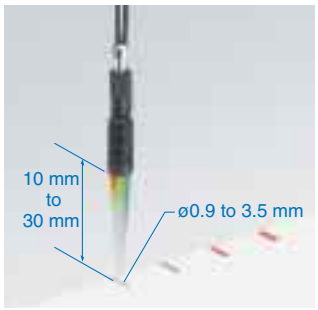
When the beam spot is too small, some workpiece surfaces case emitted light to reflect irregularly, making reflected light impossible to receive by the fibre unit. The CZ-12 eliminates this problem, averaging light from a large area spot to enable stable detection.



✔ Variations in workpiece position.

With the CZ-12's area spot, workpieces can be detected even when there is variation in the position at which they pass the beam spot.





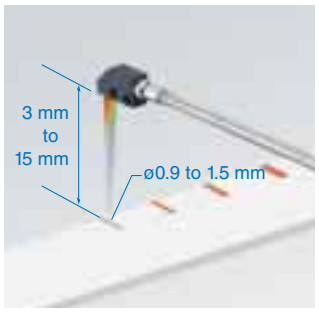
Adjust the size of the beam spot to fit the workpiece.

Variable beam spot, reflective

CZ-10

■ **Specifications**

Detecting distance	10 to 30 mm
Beam spot diameter	ø0.9 to ø3.5 mm



Install in cramped locations.

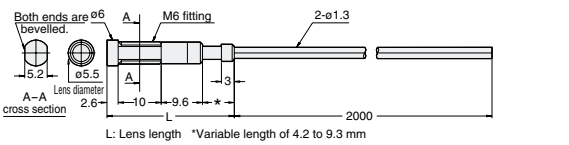
Side-view, reflective

CZ-11

■ **Specifications**

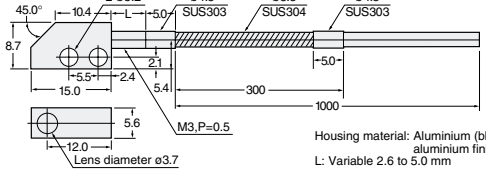
Detecting distance	3 to 15 mm
Beam spot diameter	ø0.9 to ø1.5 mm

■ **Dimensions** Unit : mm



Accessories: 1x mounting bracket (OP-23980), 1x M6 nut set

■ **Dimensions** Unit : mm



Housing material: Aluminium (black anodised aluminium finish)
L: Variable 2.6 to 5.0 mm

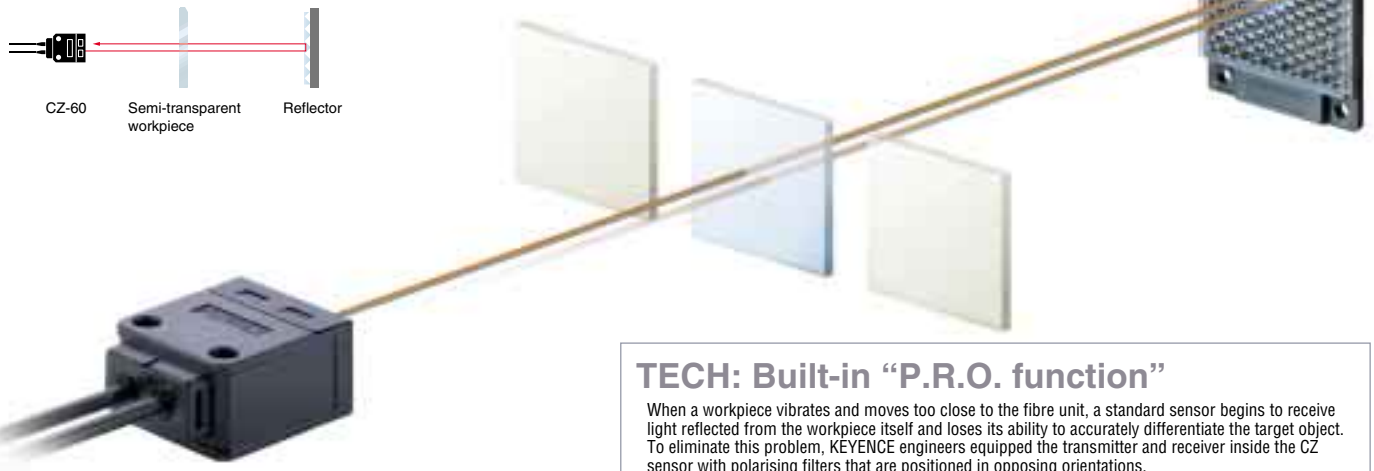
See pages 6 and 7 for information about applications for each type of fibre unit.

Digital amplifier
CZ-V1

CZ
SERIES

Transparent object differentiation ▪ ▪ ▪ retro-reflective type

Transparent objects with only slight colour differences can be differentiated due to its high precision RGB light sources and its retro-reflective operating principle, which sends emitted light through the workpiece twice, increasing light attenuation.



Transparent object differentiation, retro-reflective

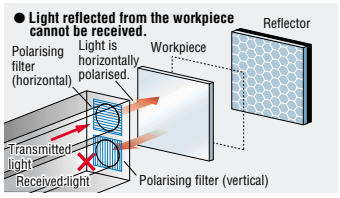
CZ-60 NEW

■ **Specifications**

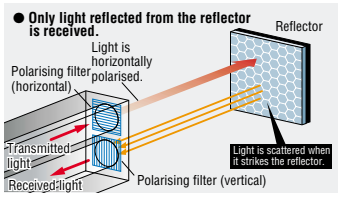
Detecting distance	40 to 1,000 mm (when using the R-2 reflector)
Aperture angle	Approx. 10°

TECH: Built-in "P.R.O. function"

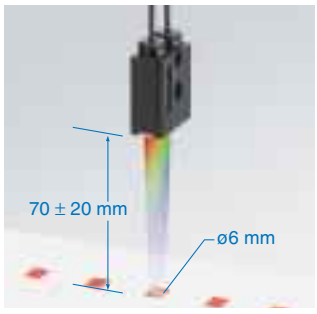
When a workpiece vibrates and moves too close to the fibre unit, a standard sensor begins to receive light reflected from the workpiece itself and loses its ability to accurately differentiate the target object. To eliminate this problem, KEYENCE engineers equipped the transmitter and receiver inside the CZ sensor with polarising filters that are positioned in opposing orientations.



Light that has been horizontally polarised from the transmitter cannot pass through the vertical polarising filters even if it is reflected from the workpiece before reaching the reflector.



Light is scattered as it strikes the reflector, allowing it to be received regardless of the orientation of the polarising filter.



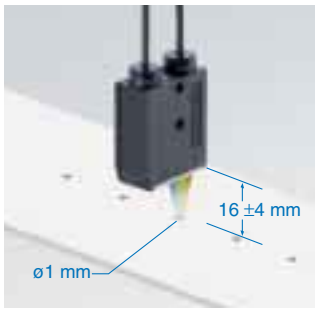
Long-distance waterproof type boasts a 70 mm detection range.

Long distance, waterproof reflective

CZ-40

■ **Specifications**

Detecting distance	70 ±20 mm
Beam spot diameter	ø6 mm
Enclosure rating	IP67



Small beam spot type for locations exposed to water.

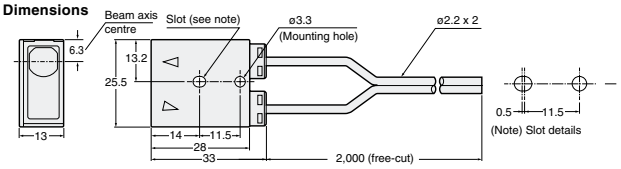
Small beam spot, waterproof reflective

CZ-41

■ **Specifications**

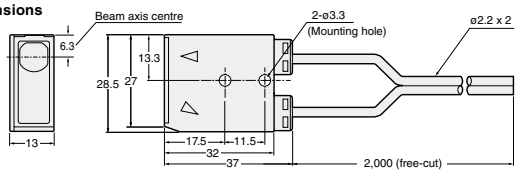
Detecting distance	16 ±4 mm
Beam spot diameter	ø1 mm
Enclosure rating	IP67

■ **Dimensions**



Accessories: 1x mounting bracket, 2x M3 screws, 1x flat nut

■ **Dimensions**



Accessories: 1x mounting bracket, 2x M3 screws, 1x flat nut

*The beam spots portrayed in product photographs are simulated illustrations and differ from actual beam spot appearance.

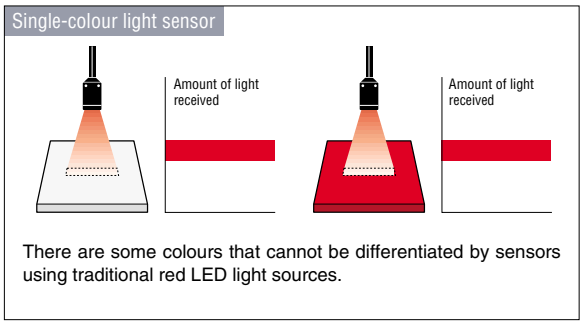
Three light sources enable high amplifier performance.

The CZ Series uses a new detection system that differentiates target objects using 3-colour RGB light. This innovative target offers compatibility with a wide range of applications, including minute detection and colour differentiation.

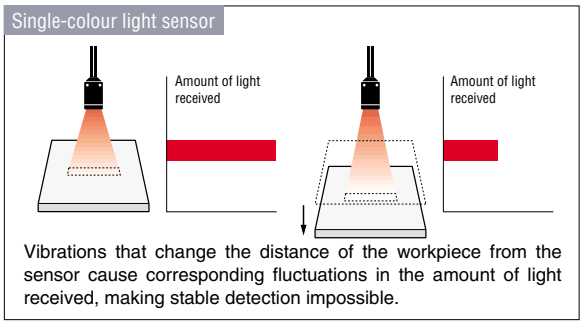
Three colours of light, with differing wavelengths, are transmitted in sequence.

Detection based on relative RGB ratios means more reliable and stable sensor operation.

[Case 1] ▮ Appropriate with colours where differentiation with single-coloured sensors is impossible.



[Case 2] ▮ Provides stable, reliable detection even when the workpiece moves or vibrates.



KEYENCE's commitment to usability brings you simple, intuitive operation.

▮ One-touch tuning

Set up is a simple process, requiring only that you press the "SET" button once for the workpiece you want to detect. The sensor immediately recognises the target object's signature colour composition. (In 1-point tuning mode)

▮ Understand differentiation status at a glance with the 2-colour display.

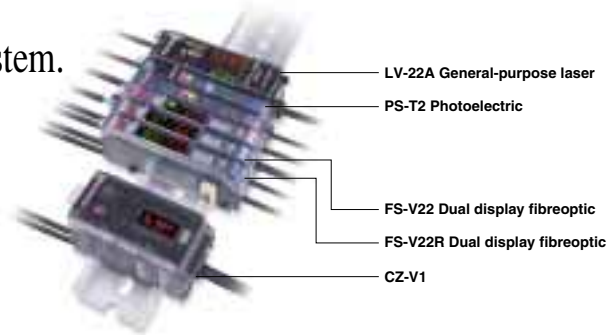
The sensor's display changes colours to indicate ON and OFF status, informing you of its differentiation status at a glance.

On status **Off status**

Compatible with the wire-saving One Line system.

▮ Simple wiring even when using multiple units.

The CZ Series offers compatibility with the popular, wire-saving One Line system. For applications requiring the simultaneous use of multiple amplifiers, power can be supplied to additional amplifiers from the connector on the side of the unit. This convenient system eliminates the need for power lines for other sensors that are used at the same time, providing a dramatic reduction in the amount of labour consumed by configuring device wiring.



■ **Part Names**

1. **DIP switches**
   Settings adjustments
2. **Timer selection switch**
   Select timer-off or 40-ms off-delay
3. **Output indicator**
4. **External synchronous input indicator**
5. **Tuning display light**
6. **UP/DOWN key**
   Adjustment of setting value
7. **LCD display monitor**
   Displays matching rate, received light quantity, and setting value
8. **MODE selection switch**
   Switching settings value and present value
9. **SET button**
   Setting sensitivity
10. **Output selection switch**
    N.O. matching output
    N.C. non-matching output

CZ AMP PERFORMANCE

Built-in high-precision, triple 12 bit A/D converter

12bit
triple A/D

The amount of light received for each of the 3 RGB colours is detected at 12-bit resolution, enabling the amplifier to perform calculations using actual 36-bit data and making it the industry's highest-resolution calculation system. The end result is enhanced stability for previously difficult detection applications.

High-speed 300 μs response

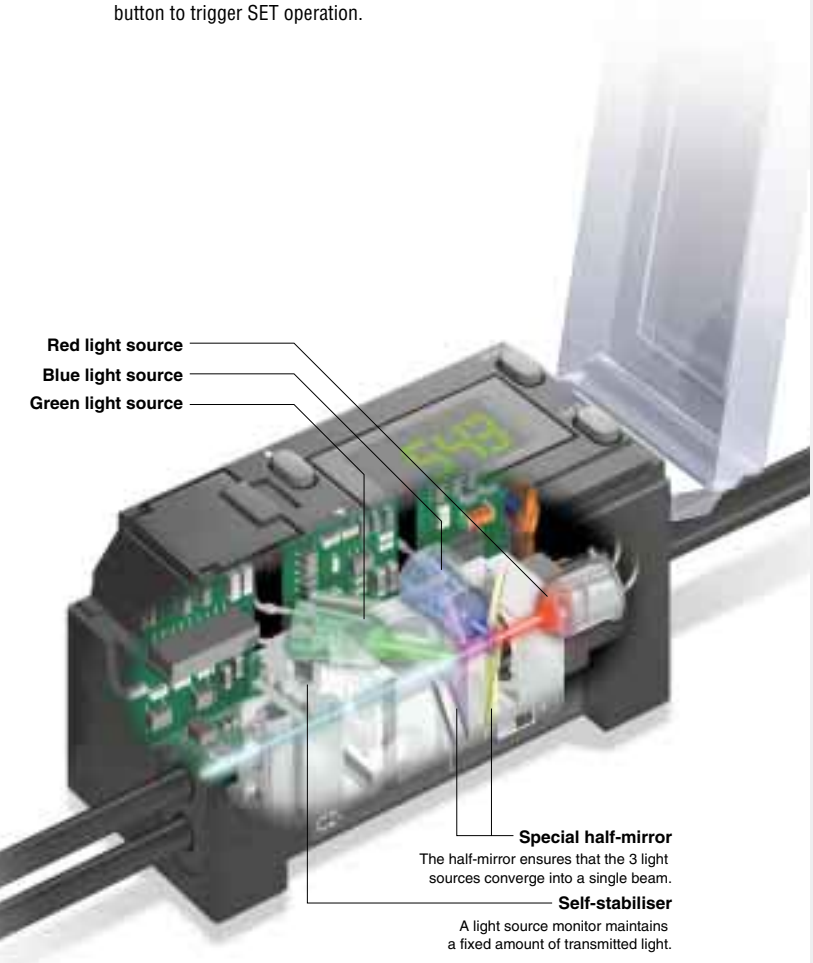
The amplifier includes a 300 μs high-speed response mode. As an example of the speed provided, the system is capable of detecting marks that are 1 mm wide on sheeting being fed at a speed of 3.3 m/s. (HSPD = during high-speed mode operation)

Built in self-stabiliser

The self-stabiliser monitors variations in the amount of light produced by each LED and operates to maintain light is transmitted at a constant and uniform level, cancelling the effects of temperature fluctuations and the passage of time on the efficiency of transmitter light.

Eight-colour registration and external tuning

The "8-bank switching" feature allows you to store 8 settings in the amplifier's memory and switch among them using an external signal generated by a device such as a PLC. There is also an "external tuning" feature that lets you use an external device such as a push-button to trigger SET operation.



Basic settings

Tuning

When the sensor is required to differentiate between 2 colours, use 2-point tuning; use 1-point tuning for all other applications.

DIP switch

11. **Detection mode switch**
    Fine (high accuracy) mode
    HSPD (high speed) mode
12. **Calibration mode switch**
    One-point or two-point tuning
13. **Differentiation mode switch (C/C+I/I)**

Differentiation mode

1. Angle the sensor head by 10 to 15° for reflective type setups in order to avoid the influence of glossy surfaces. For retro-reflective setups, install the sensor and its reflector so that the amount of light received in I mode is as high as possible.
2. Set the sensor to C mode and adjust its sensitivity.
3. If you cannot achieve stable detection using C mode, set the sensor to C+I mode and adjust its sensitivity.
4. Reinstall the sensor so that the amount of light received in I mode falls within the range of 2,000 to 3,000 if the display reads "UUU". Reinstall the sensor so that the amount of light received in I mode increases if the display reads "nnn" or if you are experiencing unstable detection.

I mode

C, C+I mode

Mode	Switch	Description
C (Colour)	ON / OFF	Detects colour using RGB colour components.
C + I (Colour and intensity)	ON / OFF	Detects colour using RGB colour components and received light intensity.
I (Intensity)	ON / OFF	Detects colour using received light intensity only.

When workpiece colour varies

1. First perform 1-point tuning using the background and adjust the sensor's sensitivity. (In the example detection application to the right, the bottom of the part feeder serves as the background.)
2. Set the output selection switch to "N.C.".
   (This configuration will detect all objects that differ from the background, including parts whose colour varies.)

<Detection of parts in a part feeder>

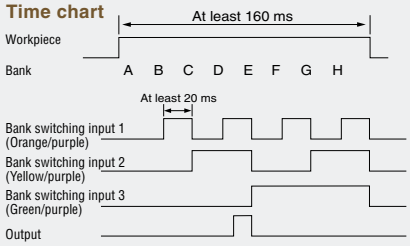
When differentiating multiple colours

Bank switching allows settings for up to 8 colours to be registered.

1. Perform 1-point tuning for each bank for the colour that you want it to detect.
2. Use a PLC to implement high-speed bank switching as the workpieces pass the fibre unit and use the output timing to differentiate workpiece colour.

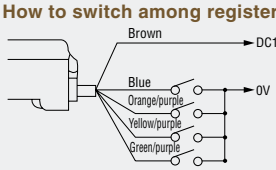
<Differentiation of cap colour>

Time chart



* An interval of 20 ms is necessary between bank switching and output.
* The usage of 8 banks requires a total time of at least 20 X 8 = 160 ms for differentiation.

How to switch among registered colours using external input



Bank switching input can be used to switch among the 8 banks "A" to "H".

Wire colours \ Bank	A	B	C	D	E	F	G	H
Orange/purple	×	○	×	○	×	○	×	○
Yellow/purple	×	×	○	○	×	×	○	○
Green/purple	×	×	×	×	○	○	○	○

A variety of fibre units provides compatibility with a range of applications.

<The automotive and metals industries>

Detection of die inserts

The CZ Series provides reliable differentiation of minute colour variations such as the difference between gold and silver that are difficult to detect with traditional sensors that operate based on the amount of light received, making it suitable for applications such as the detection of brass die inserts. Since long-distance detection is available, the sensor can be positioned at distance from the die itself.

[Recommended fibre unit]

CZ-40 (70±20 mm long-range type)

Differentiation of tail lamp type

The sensor differentiates among different product types, overseas versions, etc., by recognising differences in their colour compositions. This setup adapts easily to changes in production line configuration thanks to the external tuning feature, which allows 8-colour registration and SET operation to be controlled by external inputs. Thanks to a 70±20 mm detection range, stable detection is not compromised by variations in the distance between the sensor and the workpiece.

[Recommended fibre unit]

CZ-40 (70±20 mm long-range type)

<The food and pharmaceutical industries>

Differentiation of transparent bottle types

In a retro-reflective type configuration, the beam of light passes through the workpiece twice, differentiating between even slight differences in colour. Because the sensor includes a P.R.O. feature that eliminates the influence of light reflected from the workpiece surface, the system provides stable and reliable detection even when there are variations in workpiece position. The use of bank switching for 8 colour registrations simplifies production line configuration changes.

[Recommended fibre unit]

CZ-60 (Retro-reflective type)

Differentiation of can orientation

The sensor recognises the point you want to detect by its colour composition, differentiating the difference in colour when workpiece orientation is reversed. Because detection is based on colour composition, the system is insulated from the influence of the curved surface. In addition, the sensor's high-speed 300-µs response in HSPD mode makes it capable of detecting fast-moving workpieces.

[Recommended fibre unit]

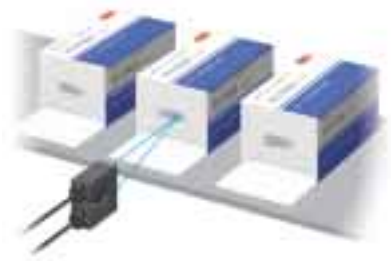
CZ-40 (70±20 mm long-range type)

Detection of bottle cap liners

The sensor can detect whether a bottle cap liner is present by differentiating between the colour of the cap and that of the cap liner. The long-range CZ-40 can be installed up to 70 mm away from the target objects and features an IP-67-rated waterproof construction.

[Recommended fibre unit]

CZ-40 (70±20 mm long-range type)



Detection of adhesive application

Because it detects target objects based on their colour composition, the sensor also provides stable and reliable detection of adhesives, which are difficult to detect with traditional sensors that operate based on the amount of light received. Detection stability is not compromised by slight variations in distance caused by the flexibility of the paper boxes.

[Recommended fibre unit]

CZ-40 (70±20 mm long-range type)

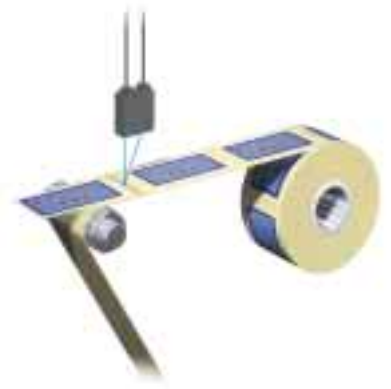
<The printing and packaging industries>

Detection of stickers on cardboard boxes

The sensor detects the difference between the cardboard box and the sticker. Once the sensor has been configured for the cardboard box with 1-point tuning, it differentiates all other objects that differ in colour. The CZ-40's detection range of 70±20 mm also makes it suitable for use with workpieces that are subject to vibration.

[Recommended fibre unit]

CZ-40 (70±20 mm long-range type)



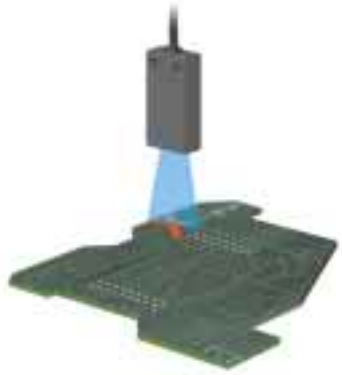
Detection of sticker label tape seams

By recognising only the tape seam by its colour composition, the sensor is able to detect the seam while ignoring the stickers' colours. Because the sensor is not easily affected by variations in distance, the setup is also compatible with applications where the stickers are subject to vertical vibration.

[Recommended fibre unit]

CZ-41 (Small 1.0-diameter beam spot type)
For long range applications: CZ-40

<The semiconductor and electronics industries>



Detection of reject marks on circuit boards

The area spot provides stable, reliable detection even if the position and shape of the reject marks varies. To adjust the sensor's sensitivity, align the sensor with the board's colour and press the "SET" button once. The sensor will recognise the colour composition instantly and automatically adjust its sensitivity (1-point tuning).

[Recommended fibre unit]

CZ-12 (Area spot type)
For long range applications: CZ-40

Detection of solder bridges on circuit boards

The sensor differentiates between the colour of the circuit board and the colour of the solder. For best results, position the sensor at a point that is particularly prone to this defect. Because the beam spot diameter can be adjusted between 0.9 and 1.5 mm in diameter by changing how far the fibre is inserted, the sensor's sensitivity can be fine-tuned after installation.

[Recommended fibre unit]

CZ-11 (Variable beam spot/side-view type)
For larger beam spot diameter: CZ-10

Detection of wafer surface finish

The sensor recognises colour composition variations to detect the minute difference in the surface conditions of wafers before and after film coating. Since the sensor is compatible with long-range detection at up to 70±20 mm, space surrounding the wafers can be kept free.

[Recommended fibre unit]

CZ-40 (70±20 mm long-range type)

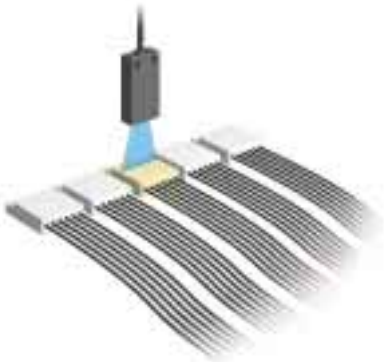
Differentiation of the orientation of tiny chips

The sensor can be made to detect differences in the orientation of tiny chips by adjusting the beam spot so that it falls in the centre of the embossed area of the chips. Since the beam spot size can be varied between 0.9 and 1.5 mm in diameter, the sensor can be adjusted to match workpiece conditions. The setup is compatible with slight changes in target object position and even with workpiece vibration.

[Recommended fibre unit]

CZ-11 (Variable beam spot/side-view type)
For detection ranges of 15 mm and greater: CZ-10

<The electrical and precision equipment industries>

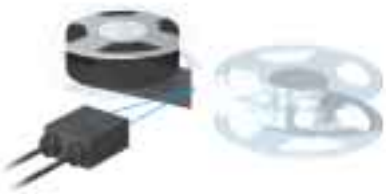


Differentiation of connector type

Because it recognises the target area by its colour, the sensor is capable of minute colour differentiation even if there is some warpage in the housing case. This setup adapts easily to changes in production line configuration thanks to the external tuning feature, which allows 8-colour registration and SET operation to be controlled by external inputs.

[Recommended fibre unit]

CZ-12 (Area spot type)
For long range applications: CZ-40



Detection of tape leader

Because the CZ-40 is capable of long-range detection of 70±20 mm and is resistant to vibration, it can provide stable detection of tape leaders even when the tape reel diameter changes. This setup offers reliable differentiation because it recognises the minute difference in colour composition between the transparent leader and the end of the tape.

[Recommended fibre unit]

CZ-40 (70±20 mm long-range type)

Detection of insulating caps on batteries

The variable beam spot of 0.9 to 3.5 mm diameter can be fine-tuned, allowing it to be reliably aimed at the tiny gap into which the insulating caps fit. Since the sensor recognises target objects using their colour composition, minute differentiation is also possible. The sensor's 300-µs response also provides compatibility with high-speed production lines.

[Recommended fibre unit]

CZ-10 (Variable small beam spot/straight type)

Detection of remaining wire on a bobbin

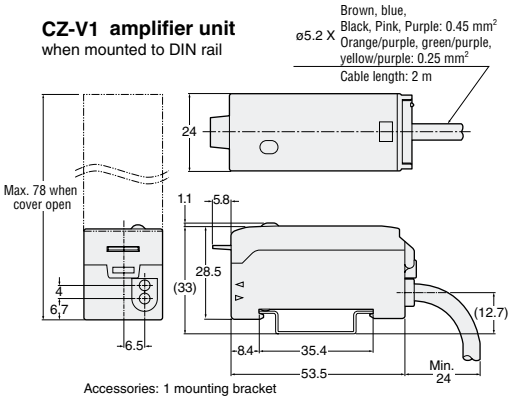
Once the sensor has been programmed with the bobbin's colour, it can detect the part of the bobbin that has become visible. Since the sensor recognises only the bobbin by its colour composition, the setup provides stable and reliable detection even during vibration.

[Recommended fibre unit]

CZ-40 (70±20 mm long-range type)

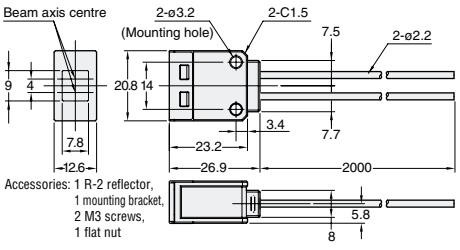
Dimensions

CZ-V1 amplifier unit
when mounted to DIN rail



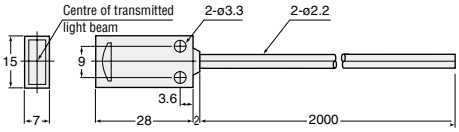
Accessories: 1 mounting bracket

CZ-60 fibre unit

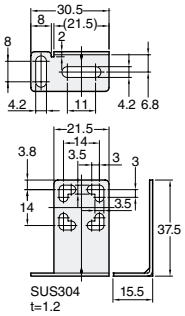


Accessories: 1 R-2 reflector,
1 mounting bracket,
2 M3 screws,
1 flat nut

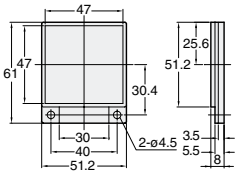
CZ-12 fibre unit



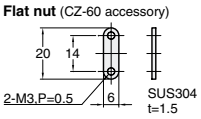
Mounting bracket (CZ-60 accessory)



R-2 reflector (CZ-60 accessory)

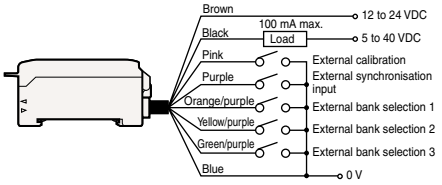


Flat nut (CZ-60 accessory)



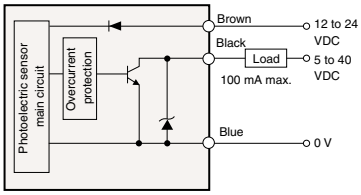
Connections

NPN
CZ-V1

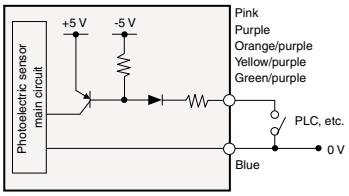


Input/Output Circuits

Output circuit
NPN
CZ-V1



Input circuit
External calibration input
External synchronisation input
External bank selection input 1 to 3



Short-circuit current: Approx. 1 mA

Specifications

Model	NPN	CZ-V1
Light source		Red LED, Green LED, Blue LED
Response time		300 µs/1 ms (switch-selectable)
Indicators		Output: Red LED, Calibration: Orange LED, External synchronisation input: Green LED, Matching rate/received light intensity: LCD (Red/Green)
Error indication		Excess light intensity, insufficient light intensity, insufficient colour 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		OFF-delay timer (40 ms)/Timer OFF (switch-selectable)
Output selection		Match output: Turns on when target colour matches registered colour. Mismatch output: Turns on when target colour is different from registered colour. (switch-selectable)
External synchronisation input		Non-voltage input, Response speed: 500 µs max.
External calibration input		Non-voltage input, Input response time: 20 ms min.
Registered colour selection		8-bank selection (By external input or key operation), Non-voltage input, Input response time: 20 ms min.
Control output		NPN: 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		-10 to +55°C, No condensation
Relative humidity[1]		35 to 85%, No condensation
Housing material		Polycarbonate
Weight (including 2-m cable)		Approx. 115 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
• When 11 to 16 units are connected: -10 to +45˚C

Specifications are subject to change without notice.

KEYENCE

KEYENCE CORPORATION
1-3-14, Higashi-Nakajima, Higashi-Yodogawa-ku,
Osaka, 533-8555, Japan
PHONE: 81-6-6379-2211 FAX: 81-6-6379-2131

Affiliated companies

KEYENCE CORPORATION OF AMERICA
PHONE: 201-930-0100 FAX: 201-930-0099

KEYENCE DEUTSCHLAND GmbH
PHONE: 06102-36 89-0 FAX: 06102-36 89-100

KEYENCE (UK) LIMITED
PHONE: 01908-696900 FAX: 01908-696777

KEYENCE FRANCE S.A.
PHONE: 01 47 92 76 76 FAX: 01 47 92 76 77

KEYENCE SINGAPORE PTE LTD.
PHONE: 6392-1011 FAX: 6392-5055

KEYENCE (MALAYSIA) SDN BHD
PHONE: 03-2092-2211 FAX: 03-2092-2131

KEYENCE (THAILAND) CO., LTD.
PHONE: 02-369-2777 FAX: 02-369-2775

KEYENCE TAIWAN CO., LTD.
PHONE: 02-2627-3100 FAX: 02-2798-8925

KEYENCE (HONG KONG) CO., LTD.
PHONE: 3104-1010 FAX: 3104-1080

KEYENCE INTERNATIONAL TRADING (SHANGHAI) CO., LTD.
PHONE: 021-68757500
FAX: 021-68757550

KEYENCE KOREA CORPORATION
PHONE: 02-563-1270
FAX: 02-563-1271