B5WC-VB

Color Sensor to Build into Equipment

A New Color Sensor with Built-in Algorithms!
– Easier Use with Built-in Algorithms –

Reliable Detection of Changes and Differences in Color
– Contributes to Automation of Equipment –

- Improves equipment maintenance efficiency by monitoring the changes in liquid color.
- Assists equipment multifunctionality and work automation by an operation based on the color information of the detected object.
- Provides stable operation of equipment by detecting the objects by color.
- Can be built into equipment thanks to its compact form* and high degree of installation flexibility.

* Size: 8.4 [W] × 40 [L] × 15.9 [H] mm

⚠ Be sure to read Safety Precautions on page 7.

Model Number Legend

B5WC-VB □ □ □ □ - □
1. 2. 3. 4. 5.

1. Size
2: Miniature

2. Sensing distance
3: 40 mm

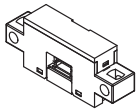
3. Output
2: I^2C

4. Software
3: Built-in algorithms for calculating color index C

5. Minimum number of deliverable units
1: 1 piece

Ordering Information

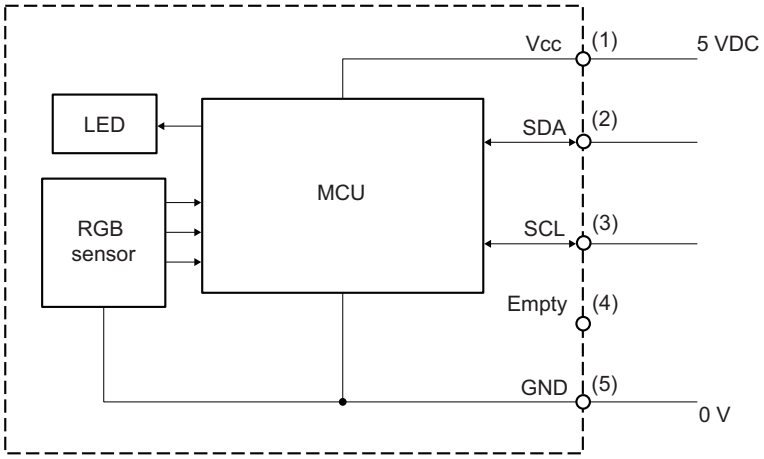
Sensors

Sensing method	Appearance	Size	Connecting method	Output type	Sensing distance	Model	Minimum number of deliverable units (Unit: pieces)
Reflective		Miniature	Connector	I^2C	40 mm	**B5WC-VB2323-1**	1

Ratings and Specifications

Item / Model		B5WC-VB2323-1
Sensing distance		40 mm (white paper)
Light source		White LED
Power supply voltage		5 VDC ±5%
Current consumption		18 mA max. (at 5.25 VDC)
Communication method		I^2C
I^2C output		RED/GREEN/BLUE output voltage: 0.45 V +/- 20% (Diffuse reflection reference plate (Equivalent to Munsell color N 6.5 at a detection distance of 40 mm) Output saturation voltage: Typ. 2.75 V (output voltage range: 0 to 2.75 V) Color index C: 0.00 to 10.00 SCL/SDA input H voltage: 2.54 to 5.4 V, input L voltage: 0.9 V max., SDA output L voltage 0.44 V max. (when output current of 3 mA) RGB output voltage value resolution: 3.2 mV
Sampling period		1 msec
Data update period		Sampling period (1 msec) × average number of times (1 to 50 times)
Ambient temperature range		Operating: -10 to +70°C, Storage: -25 to +80°C (with no icing or condensation)
Vibration resistance		10 to 55 Hz, 1.5-mm double amplitude for 2 h each in X, Y, and Z directions
Shock resistance		150 m/s^2 for 3 times each in X, Y, and Z directions
Degree of protection		IP50 (IEC60529 standard, category 2) (not including terminals)
Connecting method		Connector models (connector: SM05B-SRS made by J.S.T. Mfg. Co., Ltd.)
Weight		Approx 3.4 g
Material	**Case**	Polycarbonate (PC)
	Lens	Acrylic (PMMA)
	Cover	Polycarbonate (PC)

Output Circuit Diagram

Model	Output circuit
B5WC-VB2323-1	

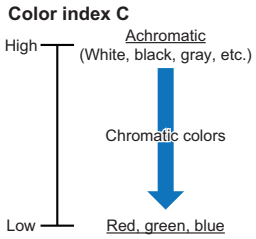
Terminal No.	Name	Function
(1)	Vcc	Power supply voltage
(2)	SDA	I^2C data
(3)	SCL	I^2C clock
(4)	Empty	---
(5)	GND	Power supply ground

Built-in Algorithm

Model B5WC-VB2323-1

Color index C calculation function

This model features an algorithm to calculate the color level referred to as color index C.
Color index C spans a range from 0 to 10, with achromatic colors (white, black, gray, etc.) having higher values, transitioning to lower color index values with the change to chromatic colors (red, blue, green).
Color index C is calculated based on RGB output voltages obtained from color sensors.
The calculation algorithm is constructed to reduce variation in the RGB output voltages that is induced by changes in the external environment, such as power voltages and temperature.



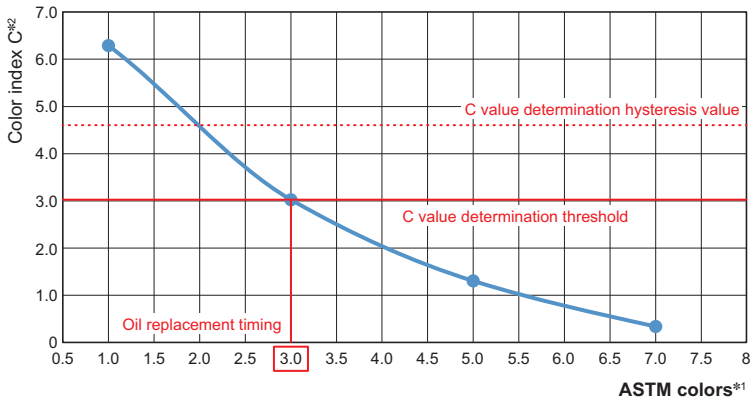
C value determination information

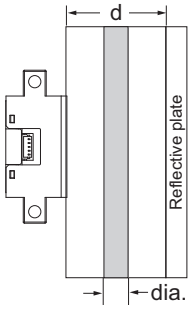
Setting the C value determination threshold and C value determination hysteresis value for color index C determines whether detection of C value determination information is provided or not.
C value determination hysteresis values are effective in preventing chattering.

Example) Oil degradation detection

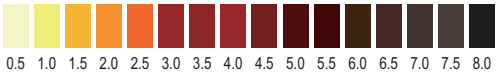
The diagram below illustrates the relationship between color index C and the ASTM color (ASTM D1500), which is known as an indicator of degradation that is based on oil color. Color index C decreases as ASTM color values increase (=oil degrades).
For example, if the oil in a new oil is ASTM 1.0 and the degraded oil is ASTM 3.0, setting the C value determination threshold at around 3.0 in accordance with the following diagram causes the C value determination information to read “Detect” when the oil degrades from new oil.
This allows the timing of oil degradation to be detected using sensors.

Correlation between color index C and ASTM colors





ASTM color



✻1. The color of petroleum products specified in ASTM D1500 is quantified and classified as being from 0.5 for light-colored products to 8.0 for dark ones.
✻2. This test uses a petroleum product color sample to calculate the color index C from color sensor output voltages.

✻ This diagram is for illustration purposes. Colors may appear differently depending on the PC monitor used.

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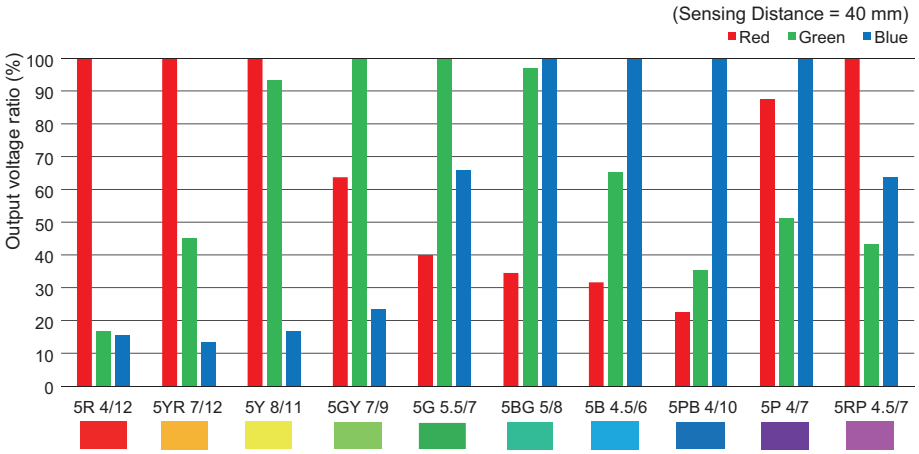
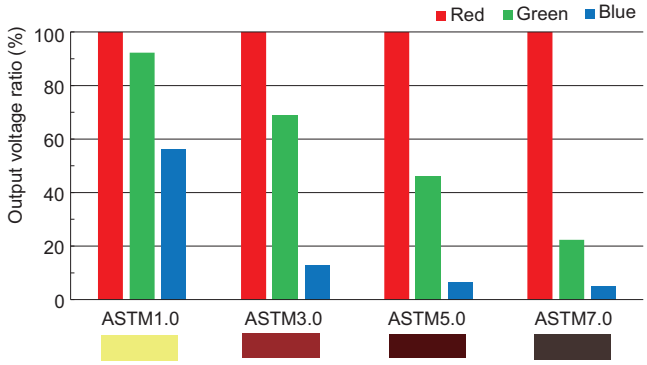
Engineering Data (Reference Value)

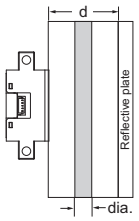
Output voltage ratio: This indicates each RGB output voltage ratio with the highest signal within the RGB output voltages expressed as 100%.
Example: Red = 1.0 V, Green = 0.7 V, Blue = 0.5 V => Red: 100%, Green: 70%, Blue: 50%

B5WC-VB2323-1
Munsell color detection capacity



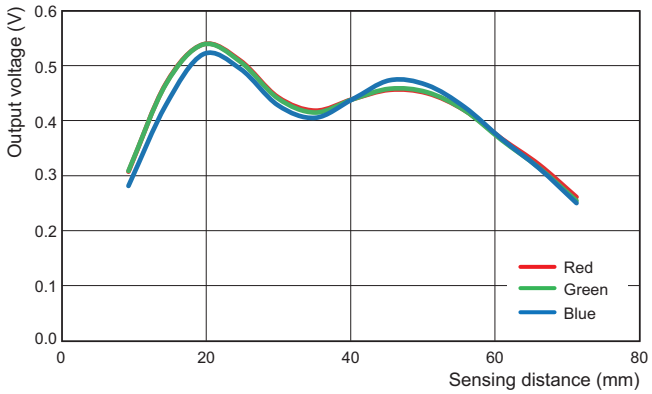
B5WC-VB2323-1
ASTM color detection capacity



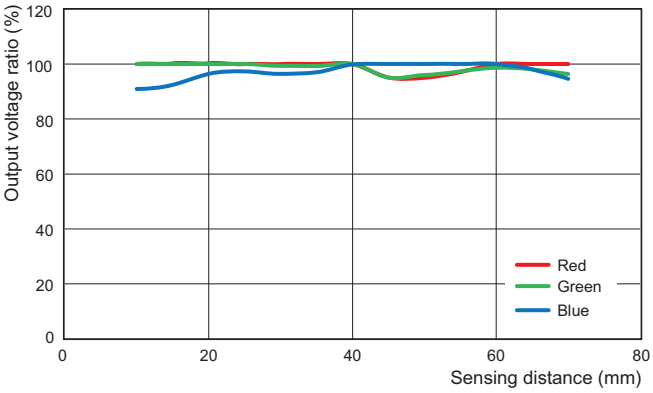


d=22 mm
dia.=7 mm
Reflective plate: Stainless steel 430
Detected object: ASTM reagent

B5WC-VB2323-1
Receiver Output - Sensing Distance Characteristics



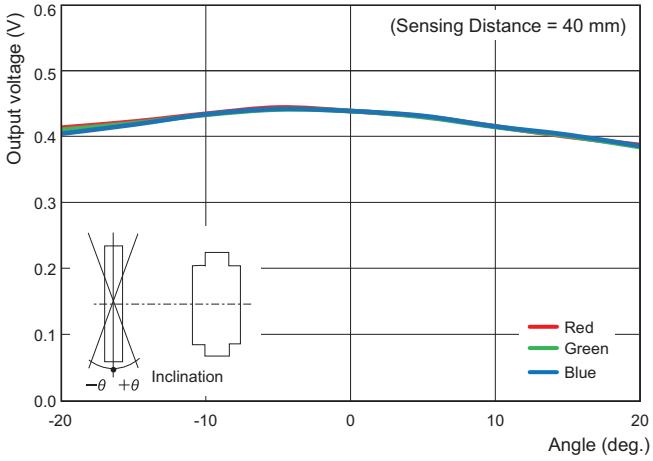
Receiver output ratio - Sensing Distance Characteristics



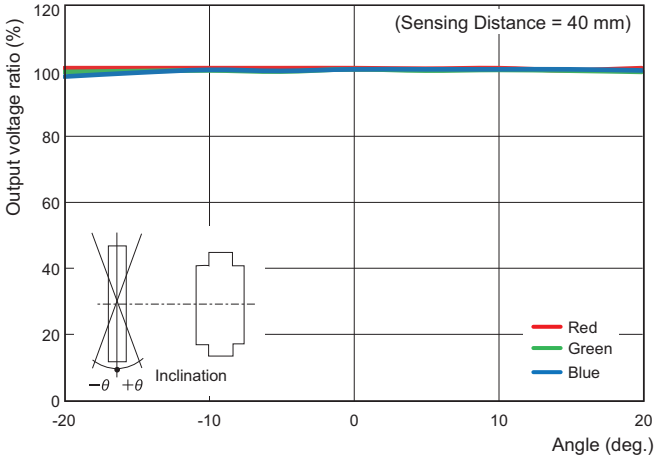
Engineering Data (Reference Value)

Output voltage ratio: This indicates each RGB output voltage ratio with the highest signal within the RGB output voltages expressed as 100%.
Example: Red = 1.0 V, Green = 0.7 V, Blue = 0.5 V => Red: 100%, Green: 70%, Blue: 50%

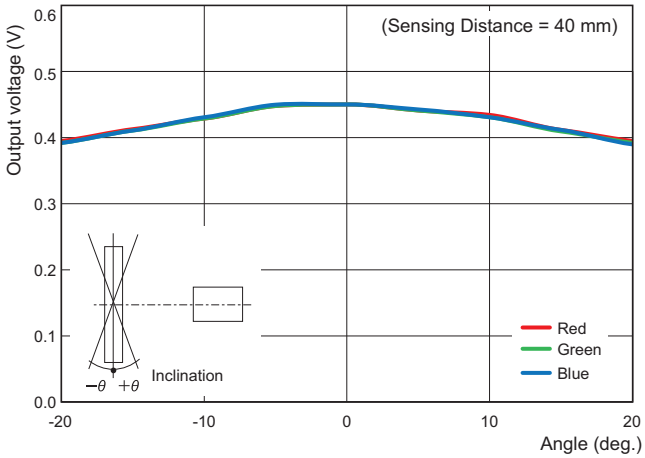
B5WC-VB2323-1
Receiver Output - Angle characteristics (Up and down)



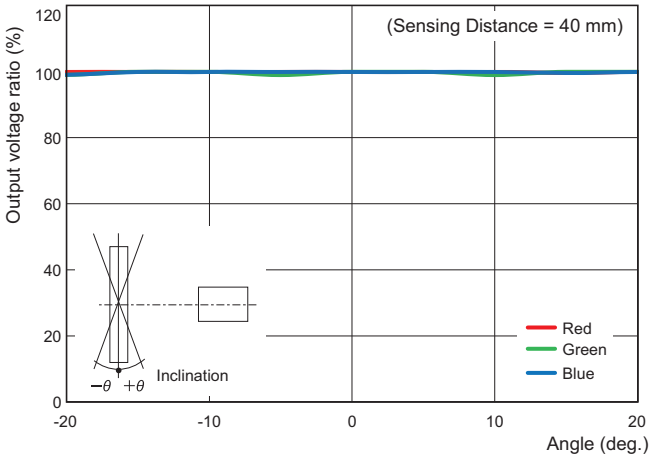
Receiver output ratio - Angle characteristics (Up and down)



B5WC-VB2323-1
Receiver Output - Angle characteristics (Left and right)



Receiver output ratio - Angle characteristics (Up and down)



B5WC-VB

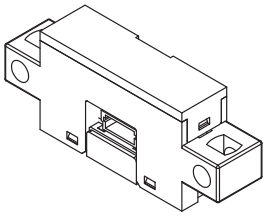
Dimensions

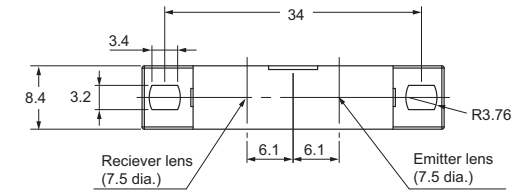
CAD Data marked products, 2D drawings and 3D CAD models are available.
For CAD information, please visit our website, which is noted on the last page.

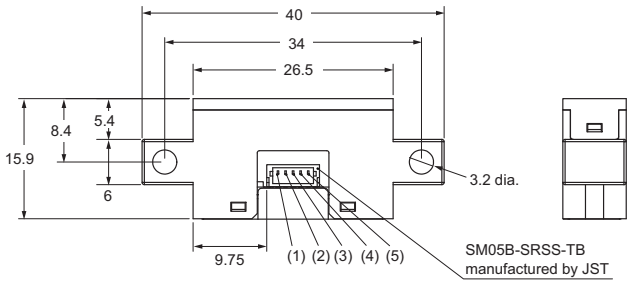
(Unit: mm)

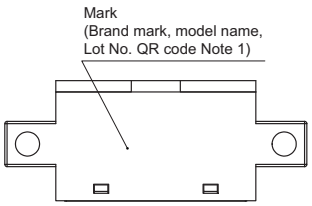
B5WC-VB2323-1

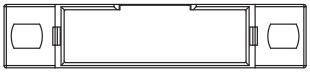
CAD Data











Terminal No.	Name
(1)	Vcc
(2)	SDA
(3)	SCL
(4)	Empty
(5)	GND

Note: Tolerance class IT16 applies to dimensions in this data sheet unless otherwise specified.
Note: 1. The QR Code trademark is a registered trademark of DENSO WAVE INCORPORATED.

Safety Precautions

To ensure safe operation, be sure to read and follow the Terms and Conditions Agreement.

⚠ WARNING

These products cannot be used in safety devices for presses or other safety devices used to protect human life. This product is designed for use in applications for sensing workpieces and workers that will not affect levels of safety.

⚠ CAUTION

This product is not designed or rated for ensuring safety of persons either directly or indirectly. Do not use it for such purposes.

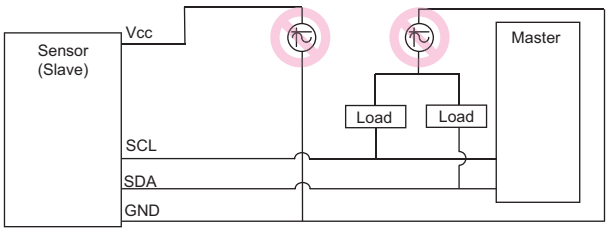
Precautions for Safe Use

To ensure safety, observe the following precautions.

● Wiring

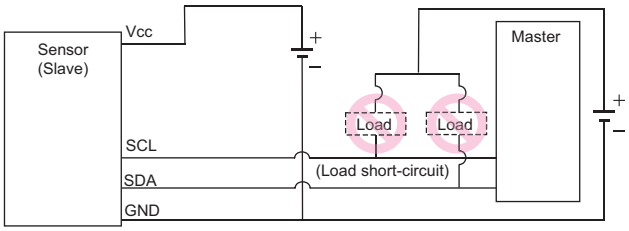
Power supply voltage

Do not use the product with a voltage or current that will even momentarily exceed the specified voltage or current range. Applying a voltage or current exceeding the specified voltage or current range or using an AC power supply may result in rupture or burning.



Load Short-circuit

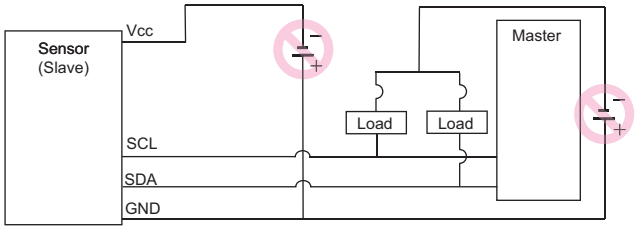
Do not short-circuit the load. Rupture or burning may occur.



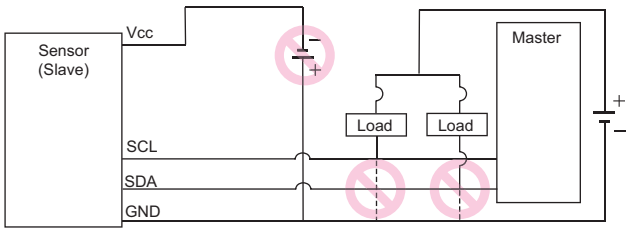
Faulty Wiring

Do not miswire such as the polarity of the power supply voltage. Rupture or burning may occur.

Example 1. Wrong polarity

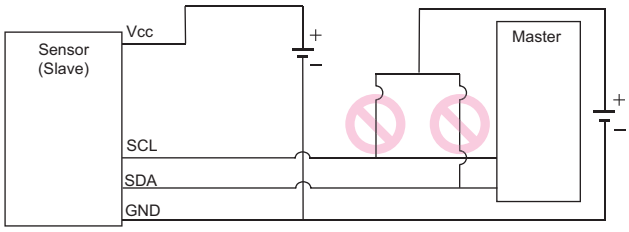


Example 2. Wrong polarity and faulty wiring



Connection without Load

If the power supply is connected directly without a load, rupture or burning of the internal elements may occur. Connect a load when wiring.



Storage and Operating Environment

1. Places where the product is not exposed to corrosive gases, such as hydrogen sulfide gas, or salty wind.
2. Places where it is not exposed to direct sunlight.
3. Make sure that flux, oil, or other chemicals do not adhere to the surface of the emitter and receiver.
4. Do not apply a load that may deform or deteriorate the product in any circumstances.
5. Store the product in a normal temperature, humidity, and pressure environment.
6. The product should be used without freezing or condensation.
7. Do not use the product in atmospheres or environments that exceed product ratings.
8. This product does not have a water-proof and oil-proof structure. Therefore, do not use the product in an application or environment where it will be subject to water, oil, chemicals, or any other liquid getting directly on it.

Precautions for Correct Use

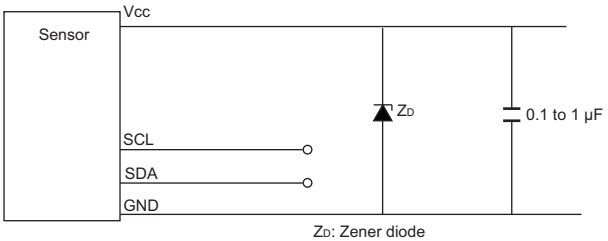
● Mounting

1. This sensor is designed to be built into equipment.
   Design the equipment structure so that ambient light does not enter into the sensor. When using the equipment where the sensor will be influenced by ambient light, install it so that the sensor will not be affected by ambient light.
2. Mount the sensor securely on a flat surface. To retain the sensor with screws, use M3 screws (to prevent the screws from loosening, use a spring washer and a flat washer with a diameter of 6 mm). Use a tightening torque of 0.54 N•m max.
3. Take care that nothing comes into contact with the detected part of the sensor. Damage to the sensing element will result in poor performance.
4. Before using the sensor, check to make sure that it has not become loose due to vibration or shock.
5. When using the sensor with a moving part, secure the part of the cable that is pulled out so that stress will not be directly applied to it.

● Wiring

Surge Prevention

1. If there is a surge in the power supply, try connecting a Zener diode or a capacitor (with a capacitance of 0.1 to 1 μF), depending on the operating environment. Use the sensor only after confirming that the surge has been eliminated.



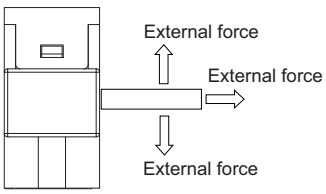
ZD: Zener diode

2. Do not use a small inductive load, such as a relay.
3. Separate the wiring for sensors from high-voltage lines or power lines. If the wiring is routed in the same conduit or duct as such lines, the sensors may malfunction or may be damaged by inductive interference.
4. When attaching the connectors, make sure that they are inserted into the housing properly.

● Handling during Wiring

Surge Prevention

1. If a force is applied to the connection area between the terminal and connector by bending or pulling the cable after the wiring is completed, the connector contact part or connection area with the cable may be damaged, resulting in contact failure.
   Make sure that a stress (external force) as shown in the figure below is not applied to the connection area between the terminal and connector when routing and connecting cables or harnesses.
2. Do not perform cord wiring when power supply voltage is applied. Doing so may result in breakage.



● Design

Modulated-light sensors

When designing, give proper consideration to the influence of the power supply and cable length.
Since this sensor is a modulated-light sensor, it is more easily affected than non-modulated light sensors.

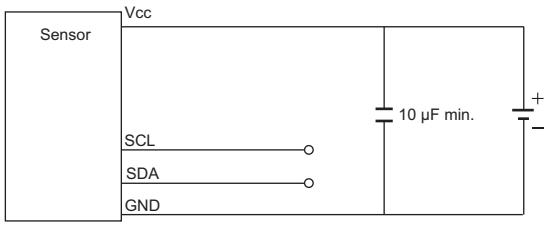
Reasons for Interference from Power and Cable Length on the sensors with Modulated Light

An LED emitter is pulse-lighted to produce modulated light.
A large current momentarily flows to the sensor in sync with this pulse timing. This causes a pulsating consumption current. A photoelectric sensor incorporates a capacitor with sufficient capacity, and is virtually unaffected by the pulse of the consumption current. With a small sensor, however, it is difficult to have a capacitor with a sufficient capacity. Accordingly, when the cable length is long or depending on the type of power source, it may become impossible to keep up with the pulse of the consumption current and operation may become unstable.

Countermeasures

Adding a Capacitor

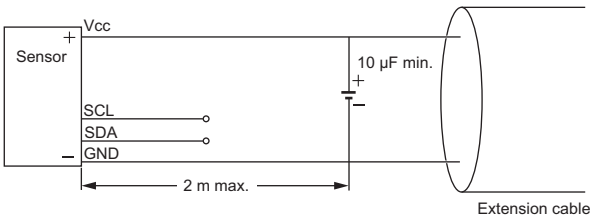
Attach a capacitor of 10 μF min. as close as possible to the sensor when wiring.
(Use a capacitor with a dielectric strength that is at least twice the sensor's power supply voltage. Do not use tantalum capacitors. A short-circuit may cause the capacitor to ignite due to the large current flow.)



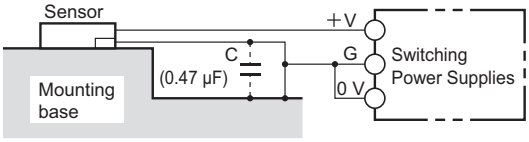
Countermeasures for Switching Power Supplies

Take either of the following countermeasures as required if connecting a modulated-light sensor to a switching power supply.

1. Attach a capacitor (e.g., aluminum electrolytic capacitor) of 10 μF min. as close as possible to the sensor when wiring.
   (Use a capacitor with a dielectric strength that is at least twice the sensor's power supply voltage. Do not use tantalum capacitors. A short-circuit may cause the capacitor to ignite due to the large current flow.)

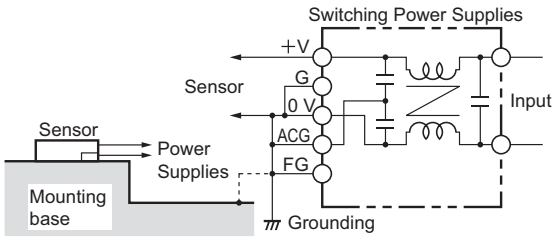


2. Connect to the 0-V line of the power source or connect by way of a capacitor (approx. 0.47 μF) at the point closest to the sensor to reduce the impedance of the sensor mounting base so that it is difficult for inductive noise to enter the mounting base.



3. Connect the noise filter terminal (neutral terminal to ACG) of the switching power supply to the case (FG) and 0-V terminal of the power supply.
   The line connected as mentioned above should be grounded or connected to the mounting base to ensure stable operation.
   (Recommended by power supply manufacturers.)

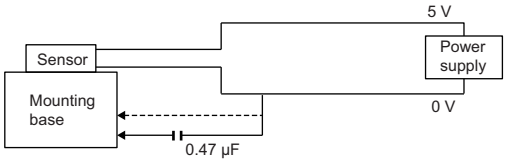
Countermeasures to Handle Inductive Noise



Insert a plastic insulator of approximately 10 mm between the sensor and the mounting base.

Effects of Inductive Noise

When there is inductive noise in the sensor mounting frame (metal), the output of the sensor may be affected.
In this case, ensure that there is no electrical potential difference between the sensor 0-V terminal and the sensor mounting frame (metal).
Or, put a 0.47-μF capacitor between the 0-V terminal and the frame.



● Other precautions

1. Avoid use in the following installation locations or conditions, as they may cause malfunctions or damage.
   1) In locations where there are large amounts of dust, powder, or oil mist. Also, in conditions where a product is constantly subjected to these substances, or where they are adhering to it.
   2) In locations subject to large amounts of corrosive gases.
   3) In locations whether water, oil, or chemicals are dispersed directly or indirectly. Also, in conditions where a product is constantly subjected to these substances, or where they are adhering to it.
   4) Outdoors or in locations subjected to strong sunlight.
2. The sensor may be dissolved by exposure to organic solvents, acid, alkali, aromatic hydrocarbon, and chlorinated aliphatic hydrocarbon. This dissolving may causing deterioration in characteristics. Do not bring the sensor in contact with these substances.
3. Factors such as the power environment may cause an output pulse when the power is turned on.
   Use the sensor in the stable ready-for-detection state reached in 100 ms after turning on the power supply
4. Using a low number of averaging times may result in a larger swing range in RGB output values due to factors such as A/D conversion errors and conversion noise.
   We recommend checking the RGB output values multiple times.
5. If the sensor is used outside the power supply voltage range, set the power to OFF (0 V) once.
   There is the possibility of unexpected operation.
6. If foreign matter has adhered to the lens, the output voltage may vary.
   When removing foreign matter from the lens, take care not to touch the lens with a hand, etc. so as to prevent it from getting scratched or dirty.
7. This sensor does not include a safety device in its internal circuitry. Connect a power supply of less than 15 W to the sensor.
8. The dustproof performance of the sensor may deteriorate depending on the usage environment.
   The protection structure has been confirmed as having undergone and passed a test conducted in a laboratory under controlled conditions in accordance with IEC60529 and JIS C0920 test methods.
9. In order to ensure safe use in your application, please perform validation of protective structures such as dustproofing as appropriate to your usage environment.

Please check each region's Terms & Conditions by region website.

OMRON Corporation
Device & Module Solutions Company

Regional Contact

Americas
https://components.omron.com/us

Europe
https://components.omron.com/eu

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