

SA1J: Full Color Recognition Sensors

Introducing a cost-effective solution for full color sensing applications — SA1J full color recognition sensor. Outstanding benefits of the SA1J include an extremely high response speed (0.3ms), high resolution, and a very low cost.

Key features of the SA1J color sensor include:

- Choice of a 3-color version or a 1-color version
- Fast response (0.3ms) — perfect for sensing complex color marks at high speed
- Three LEDs (Red, Green, and Blue) provide a long sensing life
- Easy alignment and targeting using a visible spot
- Set sensor with the touch of a button
- Highly sensitive to variations in color; can distinguish between subtle shades of the same color
- Up to 60mm sensing distance
- IP67 rated



	1-Color Version	3-Color Version	
General Specifications	Power Voltage 12 to 24V DC (ripple 10% maximum) Operating voltage: 10 to 30V DC		
	Current Draw 150mA maximum		
	Dielectric Strength Between live and dead parts: 1,000V AC, 1 minute		
	Insulation Resistance Between live and dead parts: 20MΩ minimum (500V DC megger)		
	Operating Temperature -10 to +50C (performance will be adversely affected if the sensor becomes coated with ice)		
	Operating Humidity 35 to 85% RH (avoid condensation)		
	Storage Temperature -30 to +70C		
	Vibration Resistance Damage limits: 10 to 55Hz Single amplitude: 0.75mm 2 hours in each of 3 axes		
	Shock Resistance Damage limits: 500m/s ² (approximately 50G) 5 shocks in each of 3 axes		
	Extraneous Light Immunity Sunlight: 10,000 lux maximum Halogen lamp: 3,000 lux maximum		
	Material Housing: Aluminum Lens: Glass Cover: Polyarylate		
	Degree of Protection IP67 — IEC Pub 529		
	Cable	Cable type: ø5.4mm 5-core oiltight vinyl cabtyre cable (0.2mm ²) 2m long	Cable type: ø5.4mm 7-core oiltight vinyl cabtyre cable (0.2mm ²) 2m long
	Weight	Approximately 250g	
	Dimensions (HxWxD)	1.97" x 1.18" x 3.15" (50 x 30 x 80mm)	
Accessories	Adjusting screwdriver		

Part Numbers: SA1J Sensors

1-Color Version	3-Color Version	Output	Spot Diameter	Sensing Distance	Inspection Spot
SA1J-C1N1	SA1J-C1N3	NPN	ø 0.157" (ø 4mm)	1.575" (40mm)	Standard
SA1J-C1P1	SA1J-C1P3	PNP	ø 0.236" (ø 6mm) ø 0.315" (ø 8mm)	1.969" (50mm) 2.362" (60mm)	
SA1J-C2N1	SA1J-C2N3	NPN	ø 0.098" (ø 2.5mm) ø 0.118" (ø 3mm)	0.591" (15mm) 0.787" (20mm)	
SA1J-C2P1	SA1J-C2P3	PNP	ø 0.177" (ø 4.5mm)	0.984" (25mm)	Small

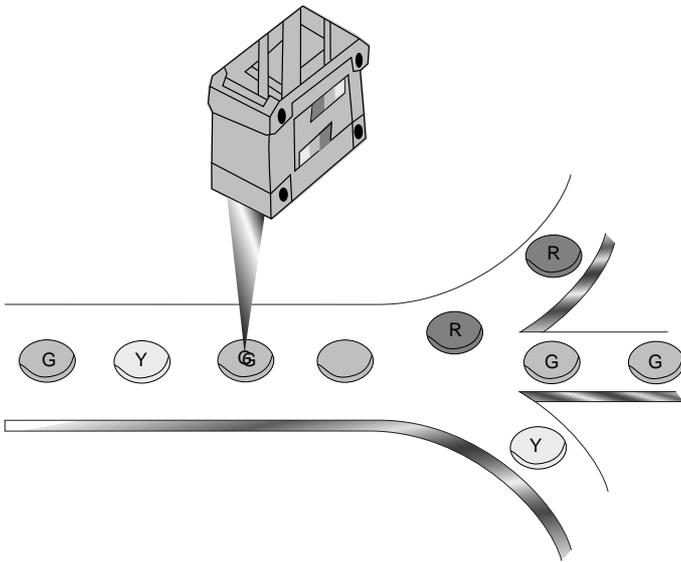
	1-Color Version	3-Color Version	
Function Specifications	Reference Color Registration	Push SET button (sensor aimed at color target); sensor records reference color in EEPROM memory	Set dial to A: Push SET button (sensor aimed at color target A); sensor records reference color A in EEPROM memory Set dial to B: Push SET button (sensor aimed at color target B); sensor records reference color B in EEPROM memory Set dial to C: Push SET button (sensor aimed at color target C); sensor records reference color C in EEPROM memory
	Tolerance	Digital setting for 5 degrees of inspection sensitivity	Digital setting for 5 degrees of inspection sensitivity (normal run mode only)
	Inspection Mode	Selectable: Color component only (C) or color component plus intensity (C+I) (depth of color)	
	Operation Mode	—	Selectable: S run: Auto select, sensor determines tolerance (no need to set tolerance) Normal run mode: Manually select tolerance (1–5) for each reference color
	Synchronous Mode	Selectable: Internal response mode or synchronized with an external signal	
	Response Mode	High-speed (F): 0.3ms Normal speed (N): 1ms Slow speed (S): 5ms	High-speed (F): 0.8ms Normal speed (N): 1.5ms Slow speed (S): 6ms
	Control Output	On: Detected color matches target color NPN or PNP transistor open collector 30V DC, 100mA maximum Residual: 1.5V maximum, short circuit protection	Control output A on: Detected color corresponds to target color A* Control output B on: Detected color corresponds to target color B* Control output C on: Detected color corresponds to target color C* NPN or PNP transistor open collector 30V DC, 100mA maximum Residual: 1.5V maximum, short circuit protection
	Operation LED	On: When control output is on (yellow LED)	
	Off-Delay Timer	Selectable: Timer ON (T-ON) or Timer OFF (T-OFF)	
	Timer	OFF delay timer 40ms	
	SET Input	NPN: 30V DC maximum/3.6mA (when connected to 0V) Typical operating voltage: (0V) +4V maximum PNP: 30V DC maximum/3mA (when connected to 24V) Typical operating voltage: (+V) –4V maximum	NPN: 30V DC maximum/3.6mA (when connected to 0V) Typical operating voltage: (0V) +4V maximum PNP: 30V DC maximum/3mA (when connected to 24V) Typical operating voltage: (+V) –4V maximum
	External Synchronous Input		
Light Source	3 LEDs (Red, Green, Blue)		



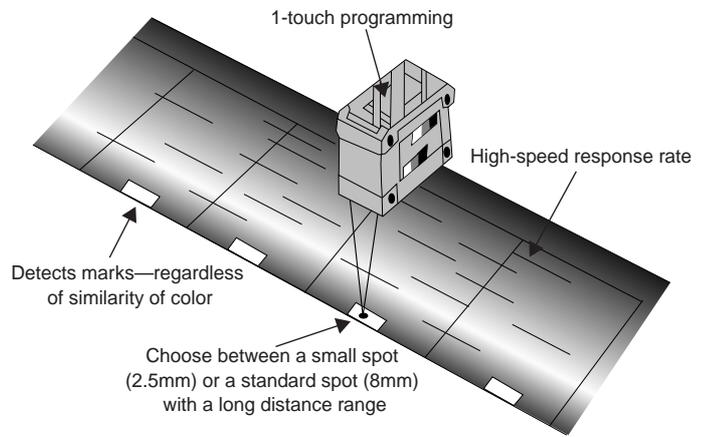
1. Each channel has its own independent short circuit protection.
2. *The target color is denied by the operation mode setting.

Applications

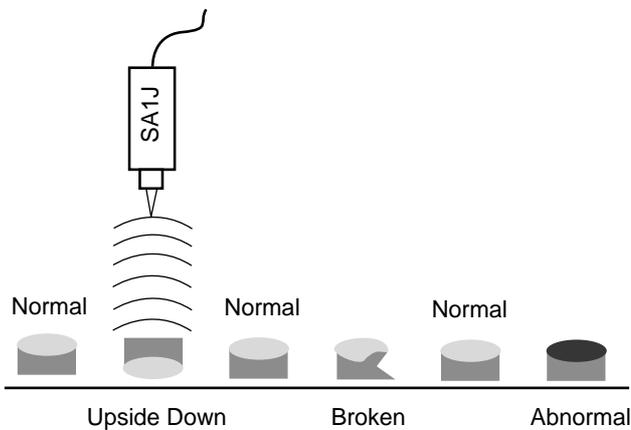
Sorting objects by cap or lid color



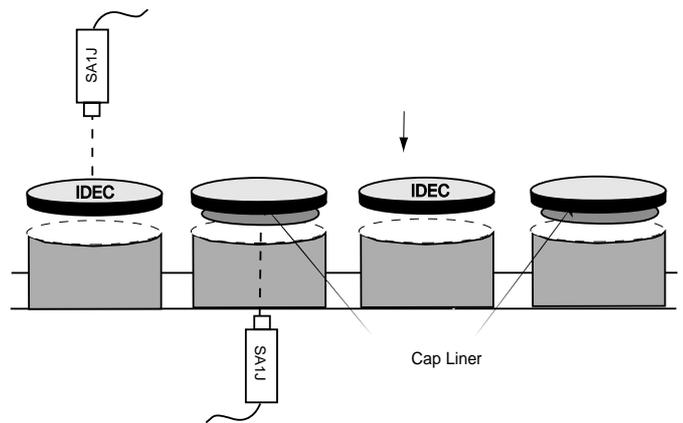
Detecting plastic bagging materials on a web



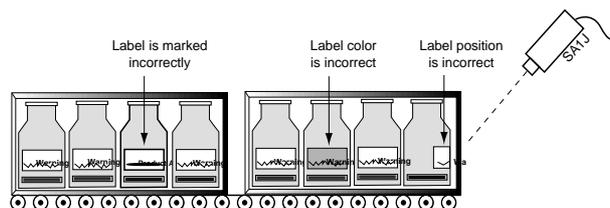
Detecting objects that are the incorrect shape or color



Detecting presence or absence of a logo on a cap or lid

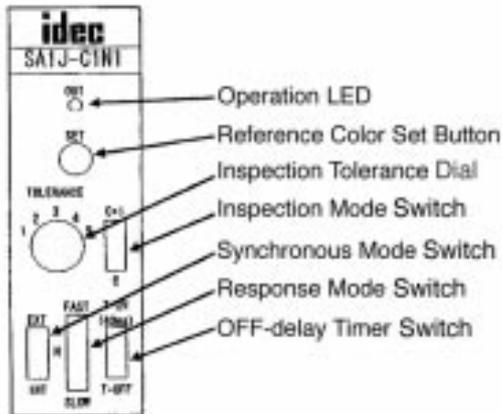


Checking packaging labels for correct position, color, and content



Operation (1-Color Version)

Control Panel



Operation LED: The Operation LED (Yellow) is on when the control output is on.

Reference color set button: This button is used to memorize the reference color when the sensor is aimed at a color target. The reference color can also be registered using an external signal and the set input wire (SET). In either case, the reference color existing in memory is replaced by the new reference color.

Inspection tolerance dial: Turn this dial to program one of five different degrees of sensitivity. Set the dial to 1 to distinguish the slightest variation in reference color (narrow range of tolerance). Set the dial to 5 to tolerate considerable variations in the reference color (wide range of tolerance).

Inspection mode switches:

Color only (C): Color only is used to inspect on the basis of color alone, when surrounding lights influence intensity, or when the inspection spot varies.

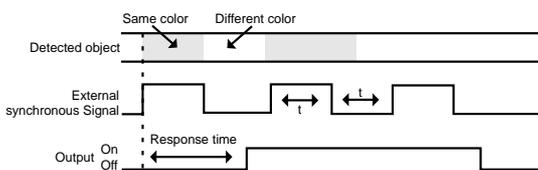
Color plus intensity (C+I): Color plus intensity is used to inspect on the basis of color and depth of color when necessary to distinguish between slight variations in shade.

Synchronous mode switch:

Select external or internal.

External synchronous mode (EXT):

External (EXT) is used to synchronize inspection with an external signal.



1. In the figure above, "t" represents the amount of time the external synchronous signals should remain on in response to the response mode.

F (fast response): 0.2ms or more

N (normal response): 0.5ms or more

S (slow response): 3ms or more

2. To prevent chattering, use a non-contact output sensor as the external synchronous input.

Internal synchronous mode (INT): Internal (INT) is used to perform inspections continuously corresponding to the response mode selection. Internal response is activated when INT is selected and the reference color set button is pressed.

Response mode switch:

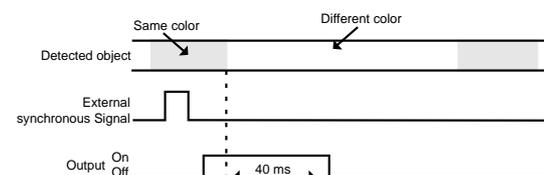
Fast response mode (F): This mode is used for high-speed inspection. Response time is 0.3ms.

Normal response mode (N): This mode is used for normal inspection. Response time is 1ms.

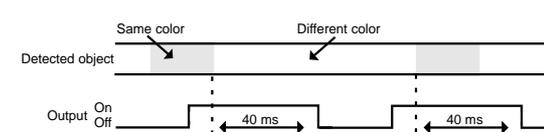
Slow response mode (S): This mode is used for stable inspection. Response time is 5ms.

Off-delay timer (T-ON/T-OFF) switch: This mode is used to select the OFF-delay timer. The timer maintains the output for 40ms.

Using External Synchronization



Using Internal Synchronization

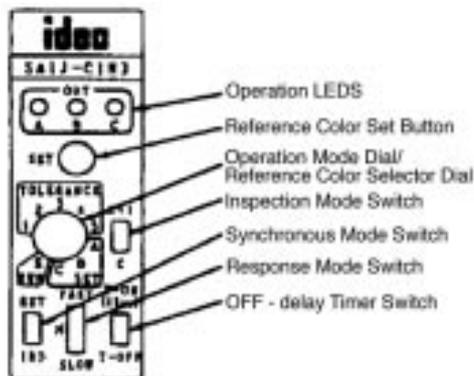


Operation at Power ON

The light source does not go on immediately when power is turned on. The sensor contains a circuit to initially delay the output for two seconds. To ensure stable sensing, run a test operation for approximately 15 minutes.

Operation (3-Color Version)

Control Panel



Operation LEDs: The operation LEDs (yellow) are on when the control output is on.

Reference color set button: With the reference color selector dial set to A and with the sensor is aimed at color target A, press this button to memorize color A. Repeat this procedure to memorize reference colors B and C.

Reference colors can also be registered by inputting an external signal using the set input wire (SET) and the external input wire (EXT). (Refer to *Remote Reference Color Registration* on the following page.) Existing reference colors are replaced by new reference colors.

Operation mode dial/reference color selector dial:

Normal run mode (tolerance 1 to 5): Turn the dial to program one of five different degrees of sensitivity. Set the dial to 1 to distinguish the slightest variation in reference color (narrow range of tolerance). Set the dial to 5 to tolerate considerable variations in the reference color (wide range of tolerance).

Select run mode (S RUN): This mode allows the sensor to define the best tolerance. (No need to set tolerance.) Low tolerance is used to distinguish shades of color that are similar to the reference color. High tolerance is used to distinguish shades of color that vary from the reference color. The output corresponds to the reference color that is most similar to the object detected.

Reference color selector (SET): This dial selects the reference color (A, B, or C) for the reference color registration.

Inspection mode switches:

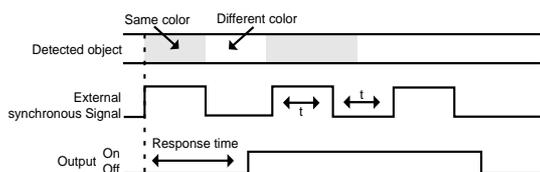
Color only (C): Color only is used to inspect on the basis of color alone, when surrounding lights influence intensity, or when the inspection spot varies.

Color plus intensity (C+I): Color plus intensity is used to inspect on the basis of color and depth of color when necessary to distinguish between slight variations in shade.

Synchronous mode switch:

Select external or internal.

External synchronous mode (EXT): External (EXT) is used to synchronize inspection with an external signal.



1. In the previous figure, "t" represents the amount of time the external synchronous signals should remain on in response to the response mode.

F (fast response): 0.5ms or more

N (normal response): 0.8ms or more

S (slow response): 3ms or more

2. To prevent chattering, use a non-contact output sensor as the external synchronous input.

Internal synchronous mode (INT): Internal (INT) is used to perform inspections continuously corresponding to the response mode selection. Internal response is activated when INT is selected and the reference color set button is pressed.

Response mode switches:

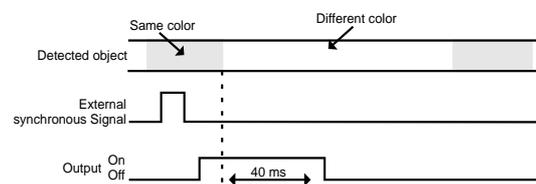
Fast response mode (F): This mode is used for high-speed inspection. Response time is 0.8ms.

Normal response mode (N): This mode is used for normal inspection. Response time is 1.5ms.

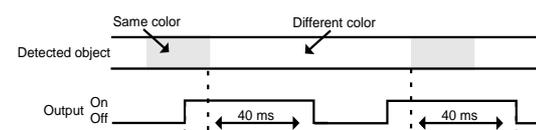
Slow response mode (S): This mode is used for stable inspection. Response time is 6ms.

Off-delay timer (T-ON/T-OFF) switch: This mode is used to select the OFF-delay timer. The timer will maintain the output for 40ms.

Using External Synchronization



Using Internal Synchronization



Operation at Power ON

The light source does not go on immediately when power is turned on. The sensor contains a circuit to initially delay the output for two seconds. To ensure stable sensing, run a test operation for approximately 15 minutes.

Reference Color Registration

1-Color Version

Manual Reference Color Registration

Follow the instructions below to register the reference color using the **Reference Color Set Button**:

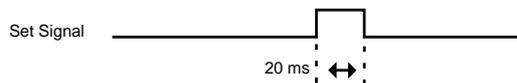
1. Set the synchronous mode to INT.
2. Aim the sensor at the color target, and press the button to memorize the reference color.
3. Set the desired inspection tolerance, inspection mode, response mode, and off-delay timer.

Remote Reference Color Registration

External Signal

Follow the instructions below to register the reference color using an **external signal**:

1. Set the synchronous mode to INT.
2. When the sensor is aimed at the color target, input signals to the SET input as shown below to memorize a reference color.



A pulse of 20ms or more should be provided to the SET input.

The interval between the SET signal and the external synchronous signal should be 20ms or more.

3. Set the desired inspection tolerance, inspection mode, response mode, and off-delay timer.

Input Set Wire/External Input Wire

Reference color can also be registered using the set input wire (SET) and the external input wire (EXT) as shown in the instructions below.

1. Set the synchronous mode to EXT.
2. Set the desired inspection tolerance, inspection mode, response mode, and off-delay timer.
3. Input signals are transmitted as shown below.



A pulse of 20ms or more should be provided to the SET input.

The interval between SET signal and external synchronous signal should be 20ms or more.

Registration can be timed by the external synchronous signal only.

1. Remote registration cannot be performed when the sensor is set in the FAST mode.

Reference Color Memory

Since reference color memory is stored in EEPROM, no battery back-up is required.

3-Color Version

Manual Reference Color Registration

Follow the instructions below to register the reference color using the **Reference Color Set Button**:

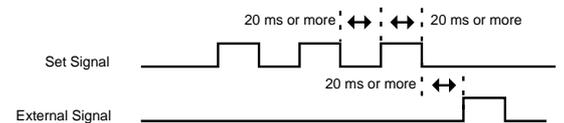
1. Set the synchronous mode to INT.
2. Set the reference color selector dial to A. Aim the sensor at color target A, and then press the reference color set button to memorize color A. Repeat this procedure to memorize reference colors B and C.
3. Set the desired inspection tolerance, inspection mode, response mode, and off-delay timer.

Remote Reference Color Registration

External Signal

Follow the instructions below to register the reference color using an **external signal**.

1. Set the desired inspection tolerance, inspection mode, response mode, and off-delay timer.
2. Input signals are transmitted as shown below.



2. The example above illustrates registering color C using three pulses of an external signal.

SET Signal	One Pulse	Two Pulses	Three Pulses
Registration	A	B	C

Reference colors A, B, and C are registered when an external synchronous signal is on (immediately after the set signal turns on). The number of impulses determines the reference color.

A pulse of 20ms or more should be provided to the SET input. The interval between the SET signal and the external synchronous signal should be 20ms or more.

For an external synchronous signal, refer to External Synchronous Mode (EXT) on page H-9. Registration can be timed by the external synchronous signal only.

When remote registration is used, color inspection can be timed by the external synchronous signal. Whether synchronous mode is INT or EXT does not affect the time of color inspection.

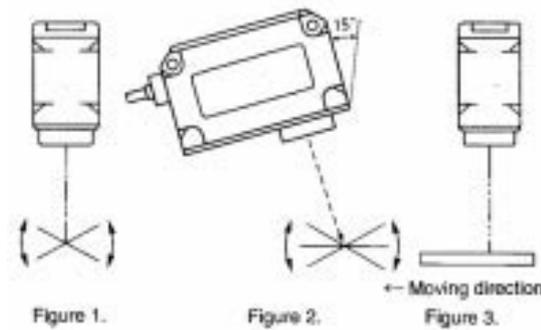
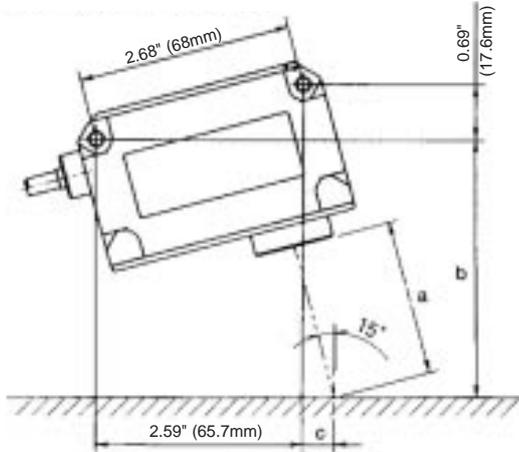
3. Remote registration cannot be performed when the sensor is set in the FAST mode.

Reference Color Memory

Since reference color memory is stored in EEPROM, no battery back-up is required.

Installation

Standard Installation



Installation Notes

Do not use the sensor in extremely dusty areas or areas subject to strong shocks or vibrations. In addition, do not use the sensor near the following:

- Induction machines and heat sources
- Oil and chemicals
- Corrosive gasses
- Water (for a long period of time)

Do not expose the receiver to excessive extraneous light.

Use a soft cloth dipped in alcohol to remove dust from the sensing area on the front of the sensor. To avoid damaging the sensor, do not use organic solvents for cleaning.

To avoid damaging the sensor, do not tighten the mounting screws excessively. The maximum tightening torque for the mounting screws should be less than 2.0Nm.

Do not apply excess voltage between the power supply and the housing.

When installing SA1J sensors in parallel, maintain at least 30mm spacing between units.

When closing the cover, the tightening torque should range from 0.49Nm to 0.69Nm. Do not allow dust to accumulate inside the operation cover, because the degree of protection (IP67) may be impaired.

Safety Information

The turning torque for the inspection tolerance dial should not exceed 0.02Nm.

The operating force for the reference color set button should not exceed 30N.

Installation Requirements

Part Number	a	b	c
SA1J-C1...	1.97" (50mm)	3.25" (82.5mm)	0.40" (10.2mm)
SA1J-C2...	0.79" (20mm)	2.11" (53.5mm)	0.10" (2.5mm)

Install the sensor so that distance "a" between the lens and the object complies with the values shown in the table above.

Tilt the optical axis by approximately 15° to the vertical direction of the object surface.

Position the spot center away from the mounting hole. Refer to the horizontal distance represented by "c."

Determine the best installation position to ensure stable sensing. (Refer to the table above.) The best installation position depends on the object to be detected.

Figure 1 illustrates the correct way to install the SA1J. The sensing direction in Figure 1 is less affected by changes in the sensing angle than the sensing direction in Figure 2. The sensor should be oriented so that the object moves in the direction shown in Figure 3.

Wiring

Connect wiring according to the diagrams on the following page. Miswiring will cause damage.

The power voltage should not exceed the rated range.

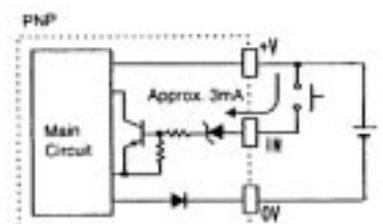
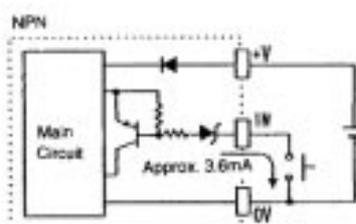
Do not install high-voltage and power lines in the same conduit as the input and output lines. Use separate conduits.

If wires are long, power lines and electromagnetic equipment may interfere with the sensor's operations. Use a separate conduit for wiring.

When using a switching power supply, be sure to ground the FG (frame ground) terminal.

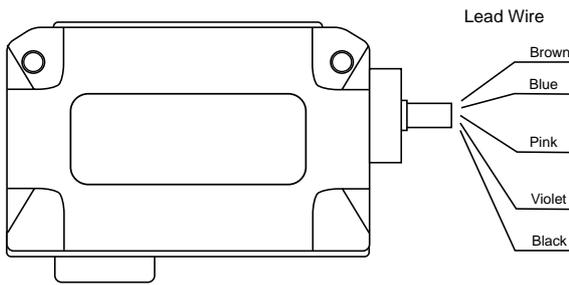
Cable extension is allowed up to 100m using a cat5 cable with core wires of 22 AWG or more.

1- and 3-Color Types Input Circuit

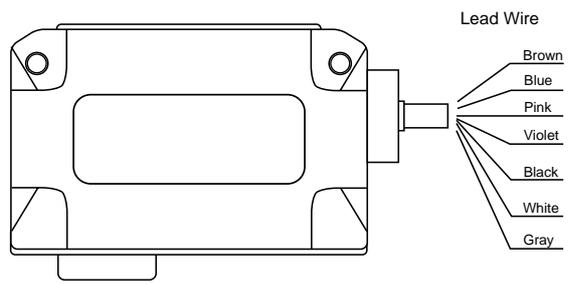


Wiring, continued

Connection Diagram (1-color version)



Connection Diagram (3-color version)



Wiring (1-color version)

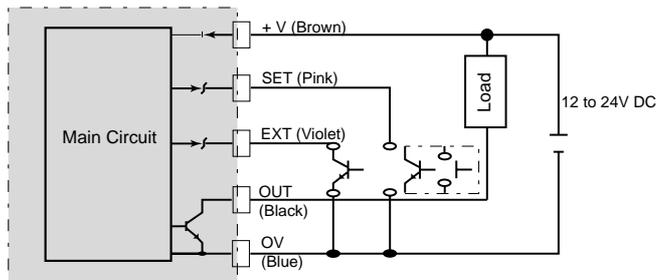
Lead Wire Color	Name	Function
Brown	+V	Power voltage 12 to 24V
Blue	0V	Power ground
Pink	SET	Set input
Violet	EXT	External synchronous input
Black	OUT	Control output

Wiring (3-color version)

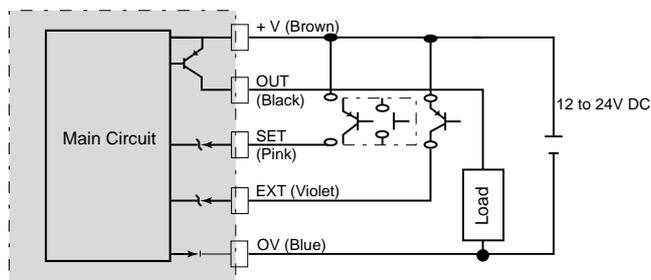
Lead Wire Color	Name	Function
Brown	+V	Power voltage 12 to 24V
Blue	0V	Power ground
Pink	SET	Set input
Violet	EXT	External synchronous input
Black	OUT A	Control output A
White	OUT B	Control output B
Gray	OUT C	Control output C

Connection Example (1-color version)

I/O Circuit Example (SA1J-C1N1, -C2N1)

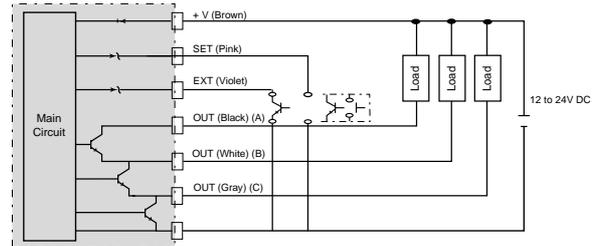


I/O Circuit Example (SA1J-C1P1, -C2P1)

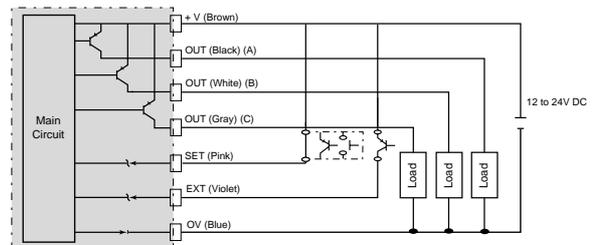


Connection Example (3-color version)

(SA1J-C1N3, -C2N3)

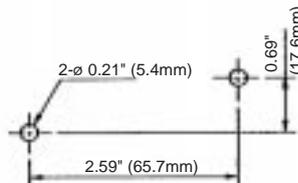
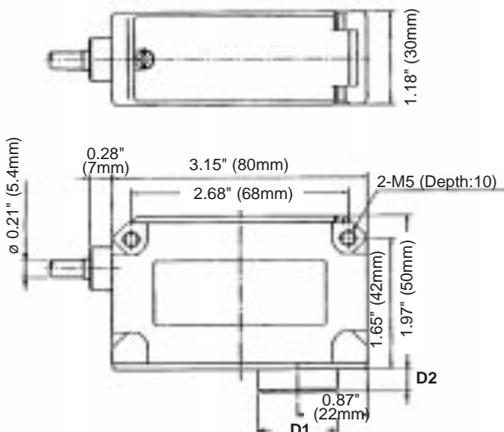


(SA1J-C1P3, -C2P3)



Use a non-contact output sensor for external synchronous input to prevent chattering.

Dimensions



D1 = SA1J-C1□□ model = ø 0.99" (25.2mm)
[SA1J-C2□□ model = ø 1.06" (27mm)]

D2 = SA1J-C1□□ model = ø 0.26" (7mm)
[SA1J-C2□□ model = ø 0.50" (12.8mm)]