Industrial Automation Catalog Section - U906

Sensors

Full Color Recognition Sensors

SA1J, SA1J-F,
SA1K, SA1K-F

For up-to-date information, or to request a full copy of this catalog, contact us at **www.idec.com** or **800-262-IDEC.**.

Due to continuous product improvements, specifications are subject to change wihtout notice.

Selection Guide

Sensor Type	Series	Page	Appearance	Advantages	Considerations
Full Color Recognition Sensors	**SA1J** **SA1J-F**	M-5		• Use to detect registration marks (regardless of similarity of color) at high-speed (0.3ms). • Use to distinguish between different shades of the same color. • 3 LEDs (red, green, and blue) provide a long life — no need to replace lamps. • Use in wash-down environments. • Use when long distance range, high-speed, and small sensing spots are required for color sensing applications.	• Use the 3-color sensor for multiple outputs for sorting applications. • Use the small spot version to detect small objects. • Replace conventional contrasting sensors with the SA1J for reliable color sensing. • Use the auto-select mode to sort objects, to differentiate fine shades of the same color, or to detect objects moving to and from the sensor.
	SA1K **SA1K-F**	M-16		• Use in complex color detection applications, for precise, flexible results. • Use to detect a combination of colors within one spot. • Use to differentiate fine shades of the same hue. • Output can be selected to detect a match or variance from the reference (target) color. • 9 levels of distinction can be selected to detect even highly-subtle variations or allow tolerance of minor differences in color.	• One output is provided when using the 1-color SA1K. Use the 3-color sensor for multiple outputs. • To detect multiple reference samples, it is necessary to use a corresponding number of sensors. • Halogen ambient lighting results in the most reliable, daylight-like color detection.
Analog Laser Color Mark Sensors	**SA1M**	M-26		• Uses visible red laser for color detection. • Compensates for fluctuations of objects. • Long range: 2.75" to 5.9". • Available in small spot or parallel beam. • Dual analog and digital output.	**IMPORTANT:** Always consider safety when using laser sensors. Make sure laser beam cannot inadvertently shine into the eyes of people passing by or working in the vicinity. See safety information on page H-55.
Water Detection Sensors	**SA1W**	M-34		• Fastest (response time 0.5ms), most reliable light detection photoelectric sensor. • Use to detect any liquid containing water in any translucent, colored container—even clear or dark containers at high-speed. • Eliminate many of the problems associated with other photoelectric sensors, capacitive sensors, ultrasonic sensors, vision systems, or moisture sensors. • Use diffuse reflective fiber optic cables to detect a drop of water, glue, wet tissue, toothpaste, ice cream, chemicals, or any type of liquid containing water molecules. • Use through-beam fiber optic cables to sense precise liquid levels through clear or translucent, colored containers.	• For increased precise liquid level detection, use the lens attachment with a through-beam fiber optic cable. • When long sensing ranges (up to 31") are required, use the lens attachment.
Laser Displacement Sensors	**MX1A** **MX1B**	M-42		• Use in the most precise sensor applications, because of the minute size of the laser beam. • Use the MX1A/B to add or subtract measured values, calculating differences in thickness or levels. • Use the MX1C to achieve precise positioning or alignment, because the visible beam is easy to aim. • All laser sensors provide analog and digital output.	**IMPORTANT:** Always consider safety when using laser sensors. Make sure laser beam cannot inadvertently shine into the eyes of people passing by or working in the vicinity. See safety information on page H-55. • Two MX1A/B sensors must be used together to achieve calculation of measured values.
Self-Contained Laser Sensors	**MX1C**	M-56			

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SA1J: Full Color Recognition Sensors

Introducing a cost-effective solution for full color sensing applications—IDEC's 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

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General Specifications	1-Color Version	3-Color Version
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 +50˚C (performance will be adversely affected if the sensor becomes coated with ice)	
Operating Humidity	35 to 85% RH (avoid condensation)	
Storage Temperature	–30 to +70˚C	
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	

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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) ø 0.236" (ø 6mm) ø 0.315" (ø 8mm)	1.575" (40mm) 1.969" (50mm) 2.362" (60mm)	Standard
SA1J-C1P1	SA1J-C1P3	PNP			
SA1J-C2N1	SA1J-C2N3	NPN	ø 0.098" (ø 2.5mm) ø 0.118" (ø 3mm) ø 0.177" (ø 4.5mm)	0.591" (15mm) 0.787" (20mm) 0.984" (25mm)	Small
SA1J-C2P1	SA1J-C2P3	PNP			

Function Specifications

	1-Color Version	3-Color Version
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 defined by the operation mode setting.*

SA1J-F: Full Color Fiber Optic Sensors

This new line of full color sensors offers IDEC's proven color sensing technology in a fiber optic version. The SA1J-F is ideal for color sorting and quality control applications where space is limited. The SA1J-F utilizes a wide assortment of fiber optic heads to fit in the smallest of mounting areas. This product line offers both 1 and 3-color programmable sensors for multiple color sorting applications. With the touch of a button, the SA1J-F is programmed and ready to work. The SA1J-F also has a remote lead for programming by a remote PLC or switch.

Key features of the SA1J-F color sensor include:

- Choice of a 3-color version or a 1-color version
- Wide assortement of fiber optic heads fit in tight mounting areas
- Three LEDs (Red, Green, and Blue) provide a long sensing life
- High speed response time (0.3 msec)
- Simple one touch button and remote color teach functions
- IP67 rating for use in harsh wet environments

General Specifications	1-Color Version	3-Color Version
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 +50˚C (no freezing)	
Operating Humidity	35 to 85% RH (avoid condensation)	
Storage Temperature	–30 to +70˚C	
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 Incandescent lamp: 3,000 lux maximum	
Material	Housing: Aluminum Lens: Glass Cover: Polyarylate	
Degree of Protection	IP65 (when inserting the fiber unit and tightening the cover)	
Cable	0.2mm^2 ø5.4mm 5-core vinyl cabtyre cable, 2m long	0.2mm^2 ø5.4mm 7-core vinyl cabtyre cable, 2m long
Weight	Approximately 190g	
Dimensions (HxWxD)	47H x 25W x 82.4D mm	
Accessories	Mounting bracket Adjusting screwdriver	

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Subassembled Part Numbers: SA1J-F Sensors

Amplifiers

Part No.	Type	Output Type
SA1J-F1N1	1-color	NPN open collector 30V DC, 100mA
SA1J-F1N3	3-color	
SA1J-F1P1	1-color	PNP open collector 30V DC, 100mA
SA1J-F1P3	3-color	

Diffuse-Reflected Light Fiber Optic Unit

Part No.	Inspection Spot	Sensing Range
SA9F-DA11	ø 2.5 mm	10 mm
SA9F-DA12	ø 5 mm	20 mm
SA9F-DA13	ø 8 mm	30 mm

Lens Attachments

Part No.	Description	Used With	Sensing Range
SA9Z-F11	For long range detection of opaque objects	SA9F-TS21	300 mm
		SA9F-TC21	200 mm
		SA9F-TM21	150 mm
SA9Z-F12	Sideview attachment	SA9F-TS21	25 mm
		SA9F-TC21	20 mm
		SA9F-TM21	20 mm

Accessories

Part No.	Description
SA9Z-F01	Fiber Cutter

Function Specifications

	SA1J-F1N1	SA1J-F1N3	SA1J-F1P1	SA1J-F1P3
Reference Color Set	Teaching system, 1-color	Teaching system, 3-colors	Teaching system, 1-color	Teaching system, 3-colors
Inspection Tolerance	5-step digital setting			
Inspection Mode	Color (C) / Color + Intensity (C+1)			
Operation Mode	Normal Run Mode (1 to 5)	Normal Run Mode (1 to 5) / Select Run Mode	Normal Run Mode (1 to 5)	Normal Run Mode (1 to 5) / Select Run Mode
Synchronous Mode	Internal Synchronous Mode (INT) / External Synchronous Mode (EXT)			
Response Mode	Fast (F) / Normal (N) / Slow (S)			
OFF-delay Timer	Timer On (T-ON) / Timer Off (T-OFF)			
Control Output	NPN open collector 30V DC, 100mA maximum Voltage Drop 1.5V maximum Protected against short cirtcuit		PNP open collector 30V DC, 100mA maximum Voltage Drop 1.5V maximum Protected against short circuit	
SET input **External Synchronous Input**	30V DC maximum / 3.6mA (when connected to 0V) Typical Operating Voltage: (0V) + 4V maximum		30V DC maximum / 3.0mA (when connected to 24V) Typical Operating Voltage: (+V) - 4V maximum	
Operation Indicator	Yellow LED	Yellow LED (3-color individual display)	Yellow LED	Yellow LED (3-color individual display)
Timer	OFF-delay timer 40 msec			
Output Operation	Equivalent Output			
Response Time	FAST (0.3 msec), NORMAL (1 msec), SLOW (5 msec) selectable	FAST (0.8 msec) NORMAL (1.5 msec) SLOW (6 msec) selectable	FAST (0.3 msec), NORMAL (1 msec), SLOW (5 msec) selectable	FAST (0.8 msec) NORMAL (1.5 msec) SLOW (6 msec) selectable
Light Source	Three LEDs (red, green, blue)			

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Fiber Optic Units

			SA9F-DA11	SA9F-DA12	SA9F-DA13
Specifications	Type		Spot-detection	Standard	Long-Range
	Sensing		Diffuse reflex		
	Amplifier Unit		SA1J-F1N1, -F1N3, -F1P1, -F1P3		
	Sensing Range		10 mm	20 mm	30 mm
	Sport Diameter		ø 2.5 mm	ø 5 mm	ø 8 mm
	Material	Sensing Head	Body: PA66, Front Core: PC		
		Fiber Optic	Surface: PE, Core: PMMA		
	Fiber Optic Length		2 m		
	Degree of Protection		IP65		
	Operating Termperature		-10° C to +55° C (no freezing)		
	Operating Humidity		35 to 85% RH (no condensation)		
	Allowable Bending Radius		R40mm minimum		

The following fiber optic units for the SA1C-F photoelectric switches can also be used with the SA1J-F:

Through Beam Fiber Optic Units

Part No.	Type	Sensing Range
SA9F-TS21	M4 • Straight No Sleeve	30 mm
SA9F-TS22	M4 • Straight 90 mm Sleeve	30 mm
SA9F-TS23	M4 • Straight 45 mm Sleeve	30 mm
SA9F-TC21	M6 • Coiled No Sleeve	25 mm
SA9F-TC22	M6 • Coiled 90 mm Sleeve	25 mm
SA9F-TC23	M6 • Coiled 45 mm Sleeve	25 mm
SA9F-TM21	M4 • Multicore	25 mm
SA9F-TM22	M4 • Multicore 90 mm Sleeve	25 mm
SA9F-TM23	M4 • Multicore 45 mm Sleeve	25 mm
SA9FTM74	Multicore 16 fibers in 1 row	25 mm

Diffuse-Reflected Light Fiber Optic Unit

Part No.	Type	Sensing Range
SA9F-DS31	M6 • Straight No Sleeve	6 mm
SA9F-DS32	M6 • Straight 90 mm Sleeve	6 mm
SA9F-DS33	M6 • Straight 45 mm Sleeve	6 mm
SA9F-DD31	M6 • Coaxial	5 mm
SA9F-DM74	1 row = 32 fibers Multicore	2 mm
SA9F-DM75	2 rows = 16 each Multicore	5 mm

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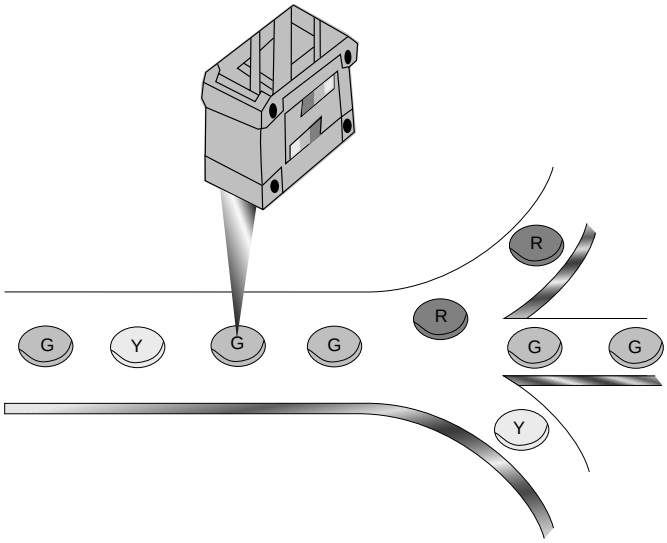
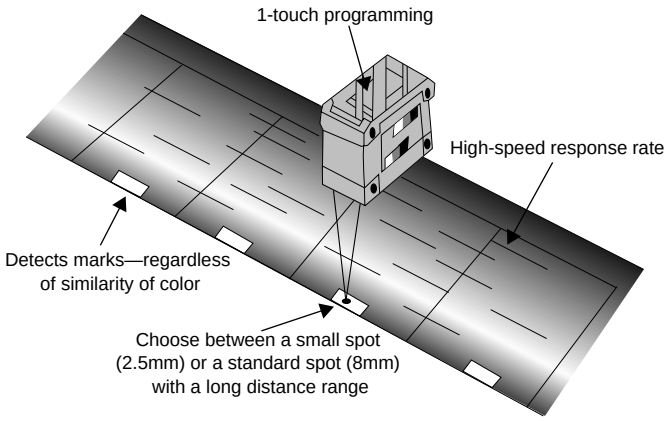
Applications

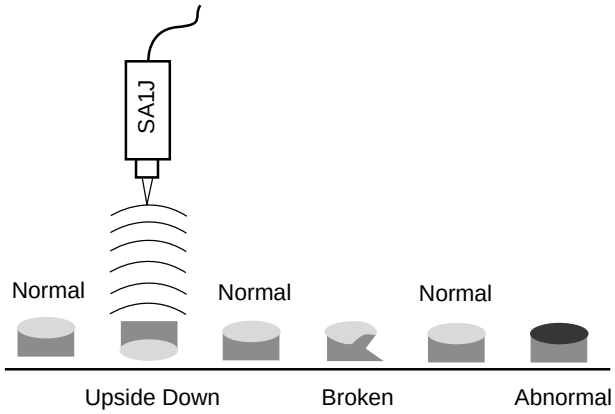
Sorting objects by cap or lid color



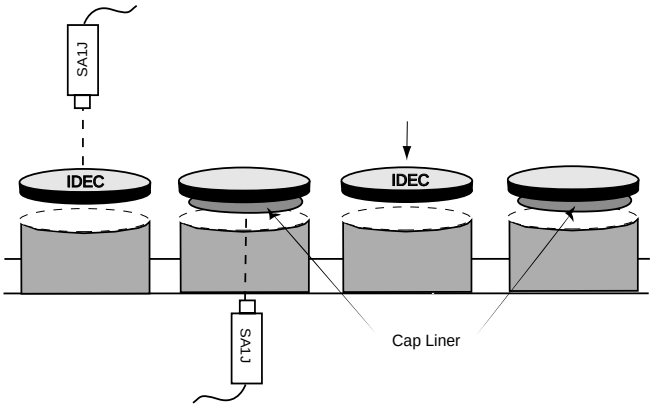
Detecting plastic bagging materials on a web



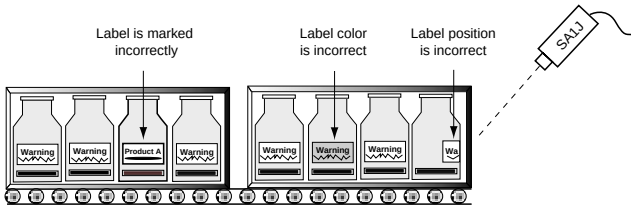
Detecting objects that are the incorrect shape or color



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

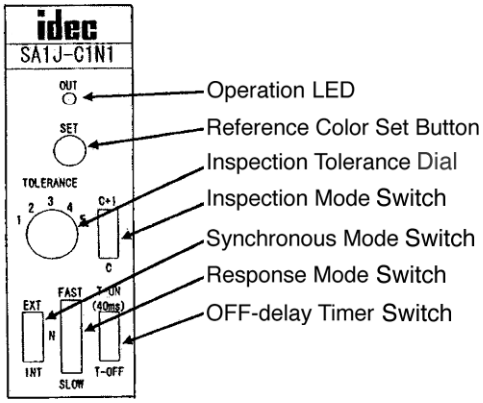


Checking packaging labels for correct position, color, and content



Operation (1-Color Version)

Control Panel



See page M-115 for general sensor instructions. The considerations below are specific to SAIJ sensors.

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).

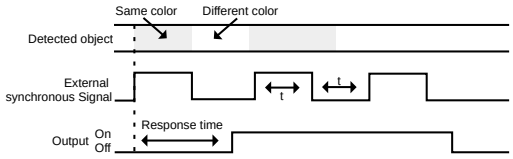
Inspection mode switches:

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:

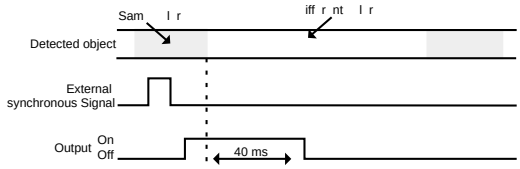
Fast response mode (F): This mode is used for high-speed inspection. Response time is 0.3ms.

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

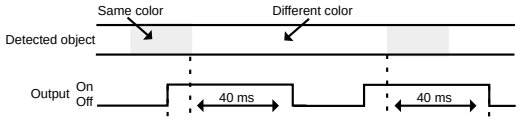
Slow response mode (S): This mode is used for stable inspection. Response time is 5ms.

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.

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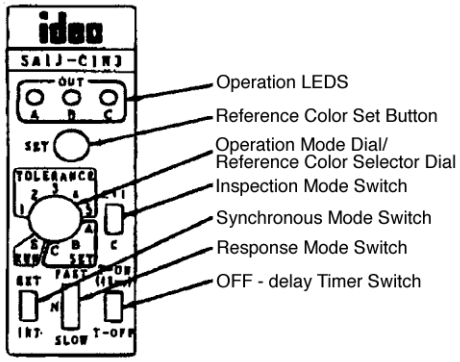
Operation (3-Color Version)

Control Panel



See page M-115 for general sensor instructions. The considerations below are specific to SAIJ sensors.

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.

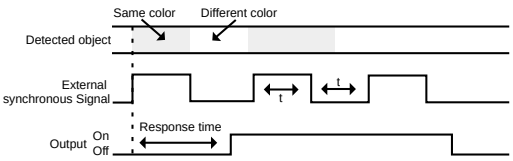
Inspection mode switches:

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:

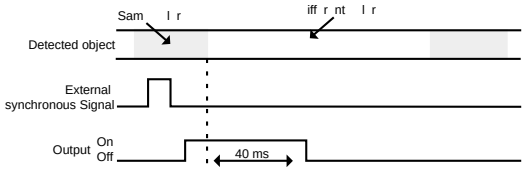
Fast response mode (F): This mode is used for high-speed inspection. Response time is 0.8ms.

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

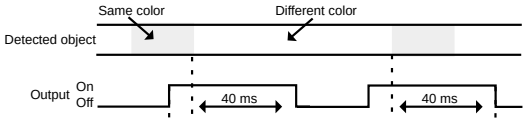
Slow response mode (S): This mode is used for stable inspection. Response time is 6ms.

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

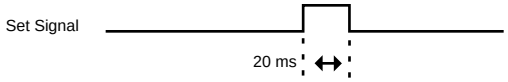
Follow the instructions below to register the reference color using the **Reference Color Set Button**:

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.



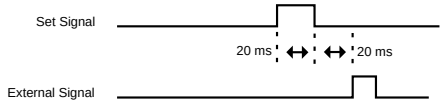
A pulse of 20ms or more should be provided to the SET input.

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

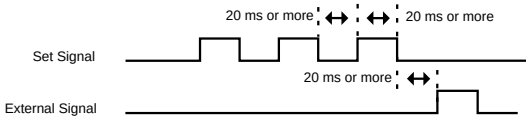
Follow the instructions below to register the reference color using the **Reference Color Set Button**:

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 M-12. 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.

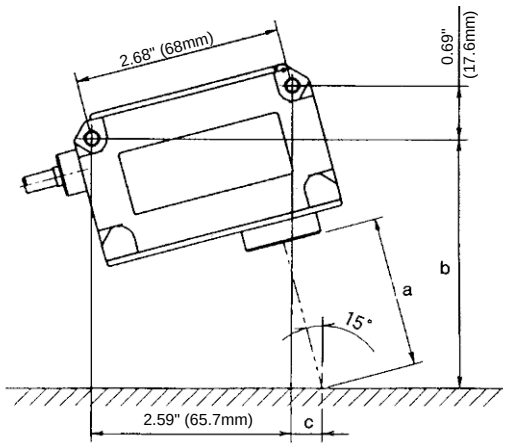
Reference Color Memory
Since reference color memory is stored in EEPROM, no battery back-up is required.

M

Installation

See page M-116 for general sensor installation instructions. The considerations below are specific to the SA1J sensor.

Standard Installation



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.

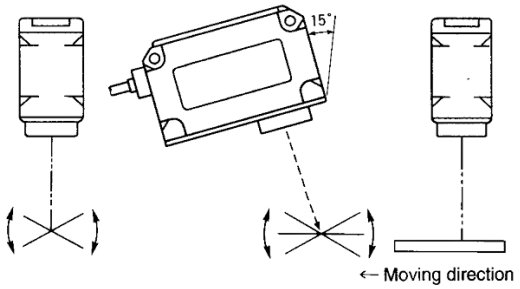


Figure 1. Figure 2. Figure 3.

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 2.0N·m.

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 0.49N·m to 0.69N·m. 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 0.02N·m.

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

M

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.

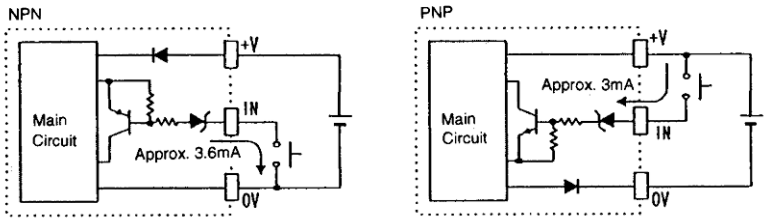
If wires are long, power lines and electromagnetic equipment may interfere with the sensor's operations. Use a separate conduit for wiring.

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

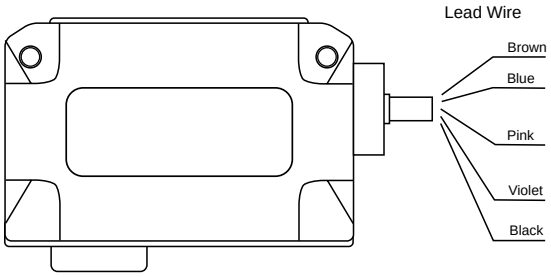
Cable extension is allowed up to 100m using a cabtyre cable with core wires of 22 AWG or more.

1- and 3-Color Types

Input Circuit



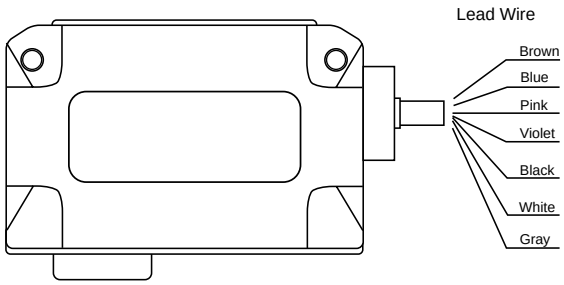
Wiring, continued



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

Connection Diagram (3-color version)

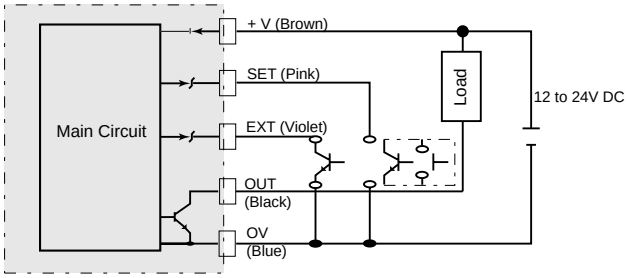


Wiring (3-color version)

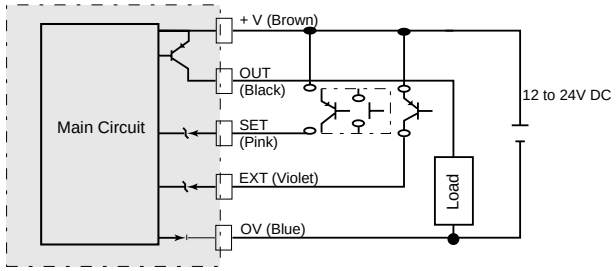
Lead Wire Color	Name	Function
Brown	+V	Power voltage 12 to 24V
Blue	0V	Power ground
Pink	SET	Set input
Violet	EXT	External synchronous input
Black	OUT A	Control output A
White	OUT B	Control output B
Gray	OUT C	Control output C

Connection Example (1-color version)

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

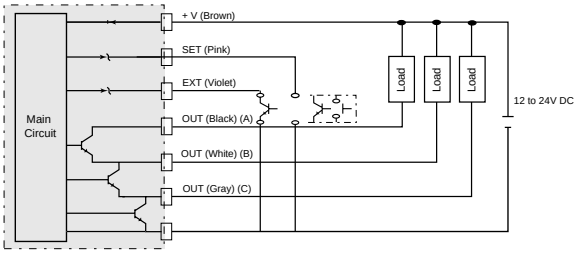


I/O Circuit Example (SA1J-C1P1, -C2P1)

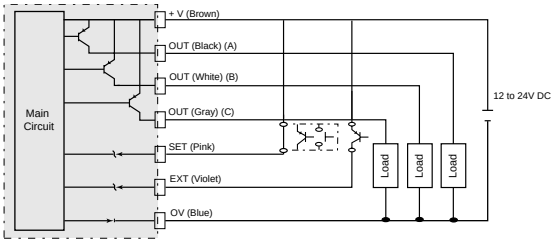


Connection Example (3-color version)

(SA1J-C1N3, -C2N3)



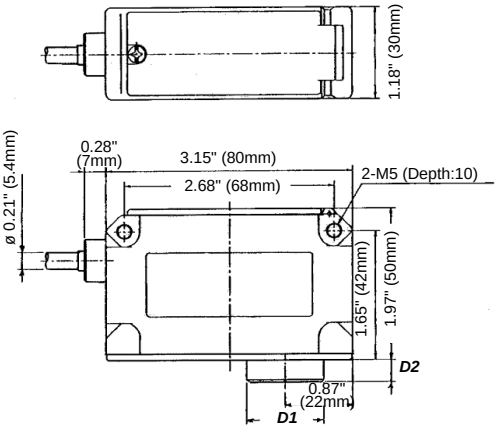
(SA1J-C1P3, -C2P3)

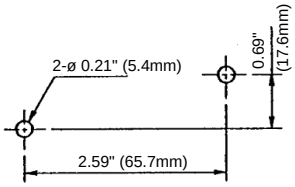


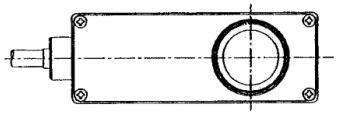
Use a non-contact output sensor for external synchronous input to prevent chattering.

M

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)]

SAIK: Full Color Recognition Sensors

Recognize a specific combination of different colors.

Differentiate between very subtle shades of the same color.

Tolerate a range of hues similar to a reference color.

Memorize three different colors with the three-color SA1K sensor!

Specify separate, interchangeable fiber optic cords: one sensor head, three sensor heads, and heat-resistant.

Programming is simple: aim the sensor at the target color and push the color preset button. The sensor records the reference color in its memory.

Key features of the SA1K include:

- NPN or PNP outputs
- Multiple outputs (three-color sensor) can be used individually or combined to signal five variations of the same color hue
- High-speed: 2ms response for one-color sensors and 3ms response for three-color sensors
- Normal speed (average 10 inspections 1 output): 12ms response (1-color) and 13ms response (3-color) — best for detecting uneven color coverage
- DIN rail (35mm) mount (amplifier for fiber optics) or surface mount
- IP65 protection rating

CE

General Specifications

Power Voltage	12V DC ±5% (ripple 10% maximum)
Current Draw	800mA (maximum)
Dielectric Strength	Between input and output: 1000V AC 50/60Hz, 1 minute
Insulation Resistance	Between input and output: 20MΩ (minimum), with 500V DC megger
Operating Humidity	35 to 85% RH (avoid condensation)
Operating Temperature	Lens style and amplifier (only) of fiber optic units: –10° to +40°C Fiber optic cord (only): –30° to +80°C Heat-resistant fiber optic cord: –30° to +350°C — rating applies to the 66.93" (1.7m) length of cord closest to the sensor head. The full cord is 78.74" (2m) long. (performance will be adversely affected if the sensor becomes coated with ice)
Storage Temperature	Lens style and amplifier (only) of fiber optic units: –30° to +70°C Fiber optic cord (only) (standard and heat-resistant): –30° to +80°C
Vibration Resistance	Damage limits: 10 to 55Hz, amplitude 1.5mm p-p, 2 hours in each of 3 axes
Shock Resistance	Damage limits: 300m/sec^2 (approximately 30G), 3 shocks in each of 3 axes
Extraneous Light Immunity	Lens style, integrated amplifier/fiber optic cord: 500 lux (maximum) from halogen lamp Separate, interchangeable amplifier and cords: 1000 lux (maximum) from halogen lamp — defined as incident or unwanted light received by a sensor, unrelated to the presence or absence of the intended object
Material	Amplifier housing: aluminum with polyarylate rear cover Lens: glass Standard fiber optic: glass fiber with PVC spiral tube and nickel-plated brass sensor head Heat-resistant fiber optic: glass fiber with SUS spiral tube and SUS 303 sensor head
Degree of Protection	IP65 — IEC Pub 529, sensors rated IP65 are dust-tight, water-resistant, and perform best when not subjected to heavy particle or water blasts
Cable	Cable type: 7-core (one-color sensor) or 9-core (three-color sensor) oiltight vinyl cabtyre, 9' 10 1/8" (3m) long
Weight	Lens style, interchangeable amplifier: 550g Integrated amplifier/fiber cord: 750g
Dimensions	Housing, lens style: 2.95"H x 1.33"W x 3.43"D (75mm x 34mm x 87.3mm) Housing, fiber optic: 3.35"H x 1.65"W x 5.12"D (85mm x 42mm x 130mm) Fiber optic cord (only): 3' 3 1/3" (1m); Heat-resistant cord (only): 6' 6 3/4" (2m) long

M

Part Numbers: Self-Contained (Lens) Style

One-Color	Three-Color	Input	Output	Inspection Spot	Stand-Off	Ordering
SA1K-C1N3 **SA1K-C1P3**	**SA1K-C1N7** **SA1K-C1P7**	NPN PNP	NPN PNP	Ø 0.394" (Ø 10mm)	1.38" (35mm)	Lens style: Amplifier and lens are integrated in the same housing; one part number = complete sensor (no mounting bracket included)
SA9Z-L01						Replacement bulb for SA1K

Part Numbers: Separate, Interchangeable Amplifier and Fiber Optic Cords

One-Color	Three-Color	Input	Output	Inspection Spot	Stand-Off	Ordering
SA1K-FAN3 **SA1K-FAP3**	**SA1K-FAN7** **SA1K-FAP7**	NPN PNP	NPN PNP	Depends on fiber optic cord used (see below)		Amplifier only (order separately) — used with separate fiber optic cords only (shown below)
SA1K-TF1 **SA1K-TF2**		Standard fiber optic cord Heat-resistant (–30 to +350°C)		Ø 0.196" (5mm) Ø 0.276" (7mm) Ø 0.394" (10mm)	0.157" (4mm) 0.276" (7mm) 0.394" (10mm)	Separate, interchangeable fiber optic cords (order separately) — used with 1-color or 3-color amplifier only (above) (SA1K-TF1 and-TF2 come with **SA9Z-KF1** and **-KF3** brackets; SA1K-TF3 comes with (3) **SA9Z-KF1** and (3) **SA9Z-KF4** brackets)
SA1K-TF3		Fiber optic cord with three sensor heads (standard high-resolution)		Ø 0.118" (3mm) Ø 0.196" (5mm) Ø 0.276" (7mm)	0.118" (3mm) 0.236" (6mm) 0.354" (9mm)	

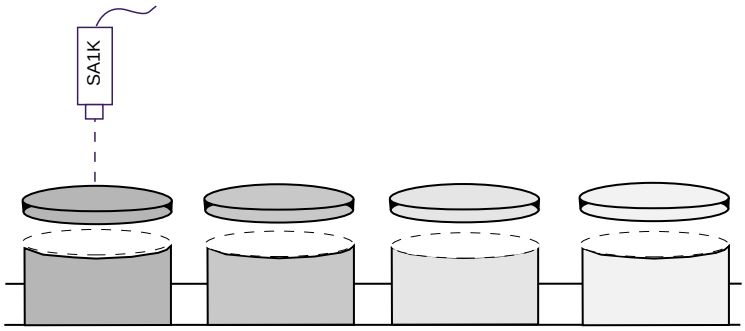
1. Integrated amplifier/fiber optic units are calibrated in pairs — use the same serial numbers together. A separate fiber optic cord cannot be used with an amplifier from an integrated amplifier/fiber optic set. A separate fiber optic cord can be used with an "amplifier only" unit (SA1K-FA ■■).
2. Order SA9Z-L01 separately for one replacement halogen lamp (one spare bulb is included with each unit). All fiber optic units come with a mounting bracket and nut (SA9Z-KF1). Each fiber optic unit also includes the corresponding mounting bracket as noted.

Function Specifications

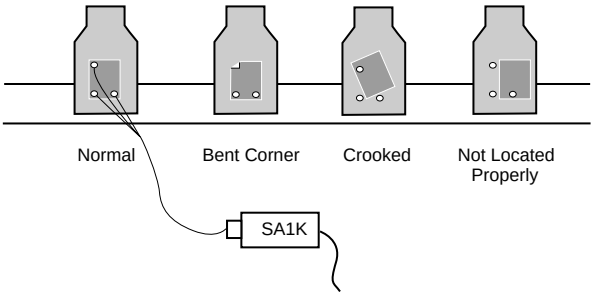
	One-Color Sensors	Three-Color Sensors
Reference Color Registration	Push color preset button (sensor aimed at color target), sensor records reference color in EEPROM memory	**Set dial to A:** push preset button (sensor aimed at color target A); sensor records reference color A in EEPROM memory **Set dial to B:** push preset button (sensor aimed at color target B); sensor records reference color B in EEPROM memory **Set dial to C**: push preset button (sensor aimed at color target C); sensor records reference color C in EEPROM memory
Tolerance	Digital setting for nine degrees of inspection sensitivity	
Inspection Mode	Selectable: color component only or color component plus intensity (depth of color)	
Synchronous Mode	Selectable: internal response mode or synchronize with an external signal	
Operation Mode	Selectable: **Equivalent (=):** output on when detected color matches target color **Different (≠):** output on when detected color differs from target color	Selectable: **S:** auto select, sensor determines tolerance (no need to set tolerance, see explanation under *Three-Color Sensors* on page M-20.) **N:** normal mode, match one of three reference colors — set tolerance LMT: confirm or change tolerance setting for each target color
Response Mode	High-speed (F): 2ms (each inspection = 1 output) Normal speed (S): 12ms (10 inspections averaged = 1 output)	High-speed (F): 3ms (each inspection = 1 output) Normal speed (S): 13ms (10 inspections averaged = 1 output)
Control Output	On: detected color matches target color or differs from target color defined by the operation mode setting NPN or PNP transistor open collector 28V DC, 100mA (maximum); Residual: 2V (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 (*defined by operation mode setting) NPN or PNP transistor open collector 28V DC, 100mA (maximum); Residual: 2V (maximum); Short circuit protection
Alarm Output	On: when halogen lamp is burned out NPN or PNP transistor open collector 28V DC, 100mA (maximum); Residual voltage 2V (maximum); Short circuit protection	
Set Input	12V DC, 10mA, 12V supply (input is not isolated due to common ground connection — photocoupler used)	
Synchronous Input	12V DC, 10mA, 12V supply (input is not isolated due to common ground connection — photocoupler used)	
Operation LED	On: when control output is on (red LED)	
Light Source	Halogen lamp 12V, 5W, life: 2,000 hours; Order SA9Z-L01 separately for one replacement halogen lamp (one spare bulb is included with each unit)	
Receiver Element	RGB color recognition element	
Minimum Bending Radius	Integrated amplifier/fiber optic units: 1.38" (35mm); Separate fiber optic cords: 1" (25mm)	
Detectable Color Difference	Lens style and separate fiber optic cords: $\Delta E \geq 10$; Integrated amplifier/fiber optic units: $\Delta E \geq 15$ — while online, defined by CIE as measurement of color difference (3-variable function: values for light, hue, and chroma, plotted on XYZ axis)	

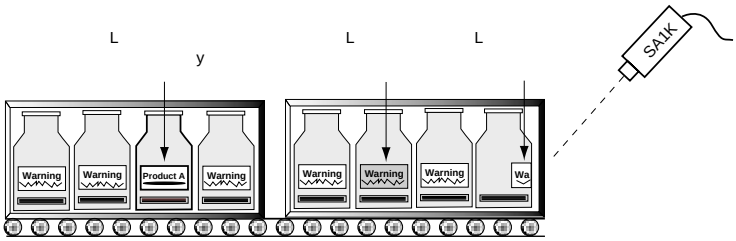
M

Applications

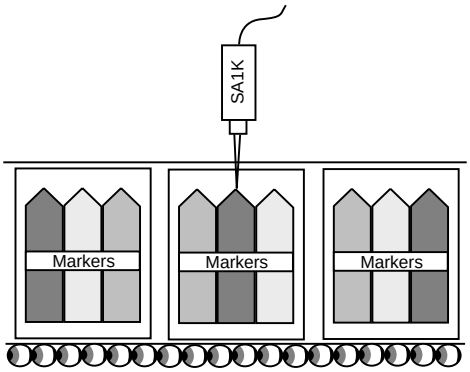


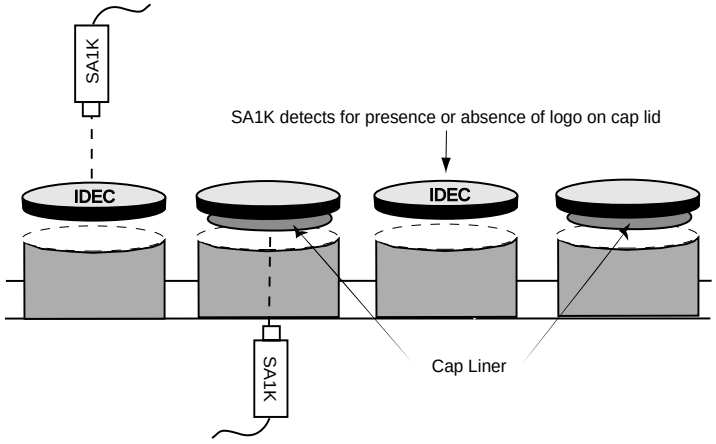
Differentiate subtle variations in shades of color for quality control

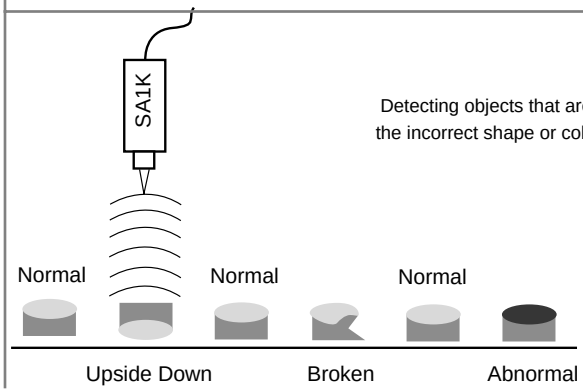




Detects packaging labels for correctness of position, color, and content.
The SA1K can either detect a precise color or a combination of colors.







Beam must be aimed within 12˚ to target surface.

Operation Principle

Using a true light source (the halogen lamp) reflected light is collected into a precise color recognition element. Detected color is separated into RGB components, and the signal is converted (internally) from analog to digital. The digital value is compared to the reference value(s) stored in memory.

Distinguish or Tolerate Variations

Select from nine degrees of sensitivity. Low tolerance distinguishes between slight differences in the shade of a color ("N" = narrow). High tolerance accepts a wide range of similar colors ("W" = wide).

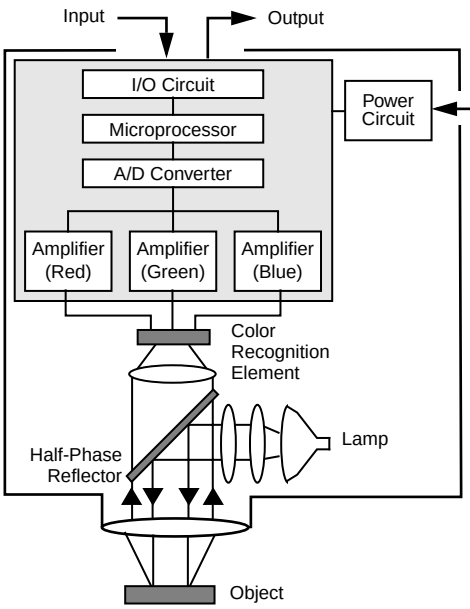
Three-Color Sensors

Set different tolerances for each of the three colors, or let the sensor determine the tolerance! Using auto select, the SA1K defines the color differences existing between the three reference colors. The sensor will detect object color and produce an output, corresponding to the most similar reference color.

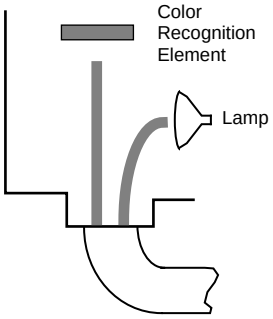
Example:

When each reference color is a different shade of red, the sensor sees subtle differences and picks the most similar reference red. Alternatively, when reference colors are red, green, and blue, the sensor will accept similar shades of red and output according to the reference red.

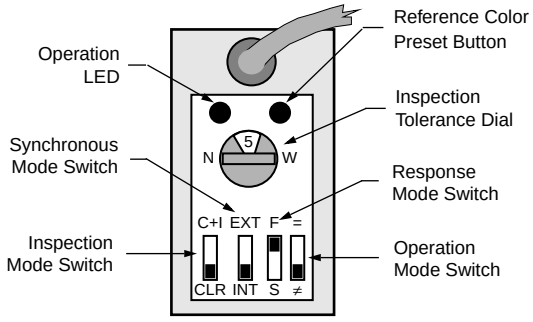
Self-Contained (Lens) Style



Fiber Optic Units



Operation: One-Color Sensors



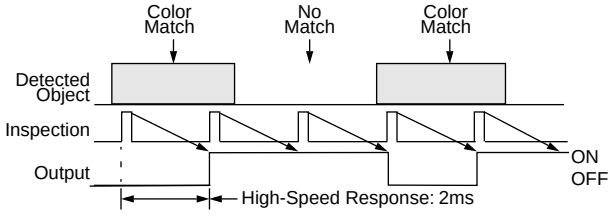
See page M-115 for general sensor instructions. Below are considerations specific to SA1K and SA1K-F full color sensors.

After turning the power on, allow approximately one second for output. The sensor does not instantly emit light upon powering on.

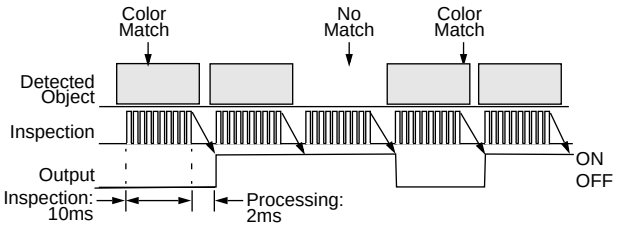
Reference color preset button: Press to memorize the reference color when sensor is aimed at color target. Reference color can also be registered using an external signal and the set input wire (SET). In either case, a reference color existing in memory is replaced by the new reference color.

Response mode switch: Select high-speed ("F" = 2ms response) or normal speed ("S" = 12ms response).

High-speed (F): Set synchronous mode to internal; set operation mode to equivalent (=). Each inspection = one output.



Normal Speed (S): Ten inspections averaged ➜ one output (best for detecting uneven color coverage). Set synchronous mode to internal; set operation mode to equivalent (=).



Operation mode switch: Select output on when the detected color is equivalent or different. For equivalent (=), the output turns on when the inspected color is the same as the reference color. For different (≠), the output turns on when the inspected color differs from the reference color.

Inspection tolerance selection dial: Turn the dial to program one of nine different degrees of sensitivity. Set the dial to 1 to distinguish the slightest variation in the reference color ("N" = narrow range of tolerance). Set dial to 9 to tolerate considerable variations in the reference color ("W" = wide range of tolerance).

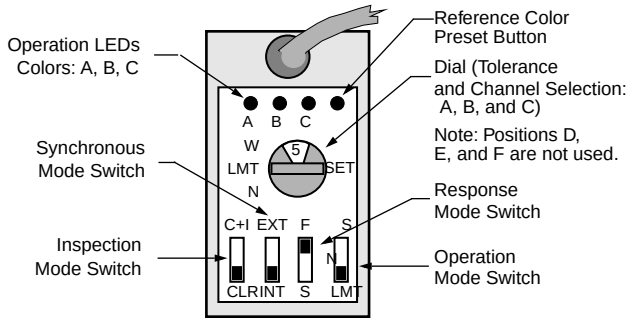
Inspection mode switch: Select color only (CLR) or color plus intensity (C + I). Color only is used to inspect on the basis of color alone, when surrounding lights influence intensity, or when inspection spot varies. Color plus intensity is used to inspect color *and* depth of color when necessary to distinguish between slight variations in shade.

Control output: Turns on, along with operation LED, when inspected color matches or doesn't match reference color, depending on operation mode setting.

Alarm output: Turns on when the lamp is burned out. (See page M-21 for more details.)

M

Operation: Three-Color Sensors

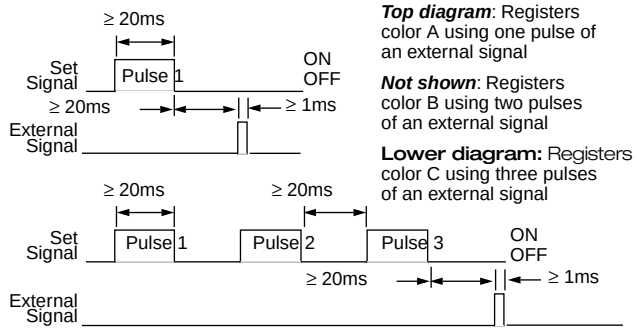


See page M-115 for general sensor instructions. Below are considerations specific to the SA1K and SA1K-F full color sensors.

After turning the power on, allow approximately one second for output. The sensor does not instantly emit light upon powering on.

IMPORTANT: If it is necessary to change one or more target color(s) along with tolerance setting(s) and/or inspection mode(s), for best results it is recommended to clear the memory of all tolerance settings and inspection modes and to enter all settings for each color starting with cleared settings.

Reference color preset button: With the operation mode switch set to the S or N mode and the tolerance/color dial set to A, press this button to memorize color A when sensor is aimed at color target A. Repeat this procedure to memorize reference colors B and C.
Reference colors can also be registered when an external signal is input using the set input wire (SET) and the external input wire (EXT). Existing reference colors can be replaced by new reference colors.



Top diagram: Registers color A using one pulse of an external signal

Not shown: Registers color B using two pulses of an external signal

Lower diagram: Registers color C using three pulses of an external signal

Response mode switch: Select high-speed ("F" = 3ms response) or normal speed ("S" = 13ms response). For high-speed (F), each inspection ➜ one output. For normal speed (S), ten inspections averaged ➜ one output (best for detecting uneven color coverage).

Operation mode switch: Select one of two operation (RUN) modes — auto select (S) or normal (N) mode. Or use LMT to confirm or change the tolerance setting and/or inspection mode. (The sensor does not operate when LMT is selected.)

Auto select (S): 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.

Normal (N): Matches any one of the three reference colors and ignores all other colors. A unique setting for the tolerance and inspection mode can be used for each reference color.

LMT: Sets a unique tolerance level for each color (see *Inspection tolerance selection dial*), or selects color only (CLR) or color plus intensity (C + I) for each color (see *Inspection mode switch*).

Individual tolerances and inspection modes: Setting the inspection tolerance and inspection mode individually for each of the three reference colors is a three-step procedure —

For each color:
(1) Clear the memory for the inspection tolerance and mode (not target color memory)
(2a) Set the inspection tolerance
(2b) Set the inspection mode

IMPORTANT: The individual inspection tolerance and inspection mode must be set at the same time for each color, in the order described below (steps 2a and 2b together). To use the individual tolerance settings, the operation mode must be set to LMT.

1. *If individual tolerance and inspection mode settings are not required for each color, then skip the three-step procedure below. Make sure that the memory is cleared of the individual settings for each color, and then set the tolerance and inspection mode as described for a one-color sensor.*
2. *Individual tolerance and inspection mode settings are not required when using auto select (S) for the operation mode.*

(1) Clear memory for tolerance and inspection mode:
(This procedure will not clear the reference color(s) from memory.)
With operation mode set to LMT, turn the dial to A and press the preset button (doesn't change the reference color). Turn the dial to zero (0), and press the preset button again to program zero tolerance for reference color A. This erases previous presets. Repeat this clearing procedure for colors B and C.

3. *Make sure all settings are cleared by selecting LMT using the operation mode switch. All operation LEDs (A, B, and C) should stay lit. If the LEDs are not lit, repeat the clearing procedure.*
4. *To use one reference color only on the three-color sensor, clear the other two colors (along with tolerance and mode settings) from memory. To use two reference colors, clear the third reference color from memory.*

(2a) Inspection tolerance selection dial: With the operation mode set to LMT, turn the dial to A, and press the color preset button (doesn't change the reference color). Now, program one of nine different degrees of sensitivity for reference color A.

Set the dial to 1 to distinguish the slightest variation in the reference color ("N" = narrow range of tolerance). Set the dial to 9 to tolerate considerable variations in the reference color ("W" = wide range of tolerance). With the dial set to the desired tolerance, press the preset button again (doesn't change the reference color).

IMPORTANT: Continue setting the inspection mode for color A (described below in step 2b) before repeating the entire three-step procedure for colors B and C.

(2b) Inspection mode switch: Set the desired tolerance for color A, as described above; then, select color (CLR) only or color plus intensity (C+I) for reference color A. Press preset again.

CLR inspects on the basis of color alone, when surrounding lights influence intensity or when the inspection spot varies. C+I inspects color *and* depth of color to distinguish between slight variations in shade.

5. *Check the inspection mode setting by selecting LMT using the operation mode switch after tolerance is set (not cleared). The operation LED (corresponding to color A, B, or C) is lit continuously for color only (CLR) or and blinks for color plus intensity (C + I).*
6. *Although the color only (CLR) setting is designed to minimize the influence of surrounding incident light, it may also be necessary to shield the sensor from extraneous light.*

Set the desired tolerance for color B as described above; then select CLR or C+I for reference color B. Press preset again. Repeat this procedure for color C.

Control output: Turns on along with the corresponding operation LED (A, B, or C) when the inspected color corresponds to one of three reference colors, as specified by the operation mode setting.

Alarm output: Turns on when the lamp is burned out (see the following page for more details).

Operation: One- and Three-Color Sensors

Operation LED: The LED turns on when the control output turns on, according to the inspection results (one-color sensors). The LED turns on when the A, B, or C control output turns on (three-color sensors).

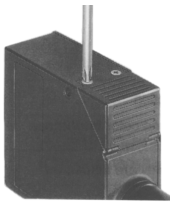
1. Check inspection mode setting by selecting LMT using the operation mode switch after tolerance is set (not cleared). Operation LED corresponding to color A, B, or C will be blinking for color plus intensity (C + I) or will be lit continuously for color only (CLR).

Alarm output: Turns on when lamp is burned out.

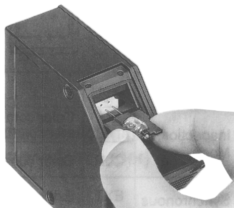
2. The lamp does not turn on immediately upon power-up; the output is delayed for one second. When the lamp is burned out, the alarm output goes on, and operation is stopped.

Replacing a halogen lamp: When the lamp is burned out, the alarm output goes on and operation is stopped. Be sure to turn the power off before replacing lamp.

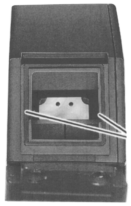
Remove two screws; open the cover.



Pull the lamp, together with the lamp holder, straight out through the back of sensor.



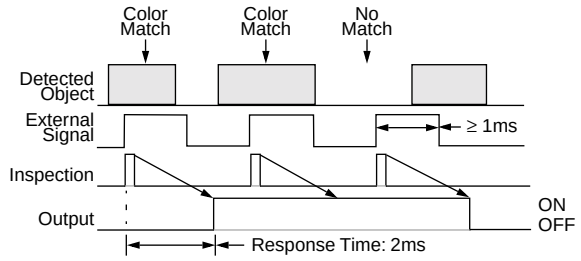
Insert the lamp along the guides.



3. Avoid touching the lamp directly. Remove all fingerprints and smudges from the lamp using alcohol (isopropyl) and a clean cloth. To avoid damaging the sensor, do not use organic solvents for cleaning.

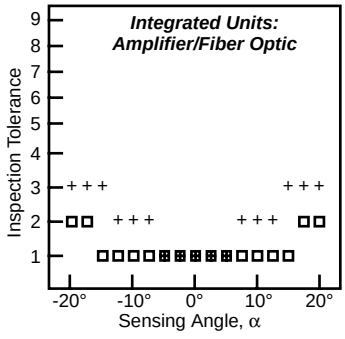
Synchronous mode switch: Select external (EXT) or internal (INT). EXT is used to synchronize the inspection with an external signal. INT is used to perform inspections continuously corresponding to the response mode selection. The internal response is activated when INT is selected *and* the reference color preset button has been pressed.

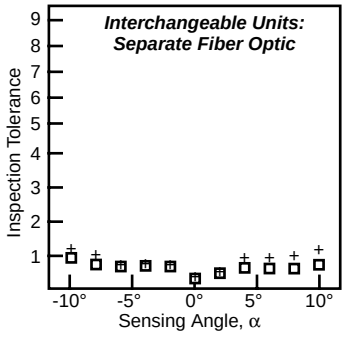
External synchronous input: Receives synchronous inputs from an external source (synchronous mode = EXT), used to synchronize inspection with an external signal.
Example below: one-color sensor with operation mode set to equivalent (=).

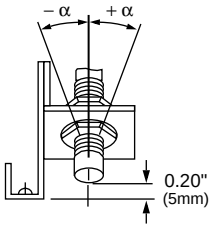


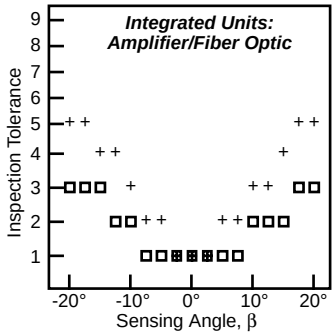
4. The inspection is performed on the rising edge of external signals only. The external signal must be on for 1ms or more.

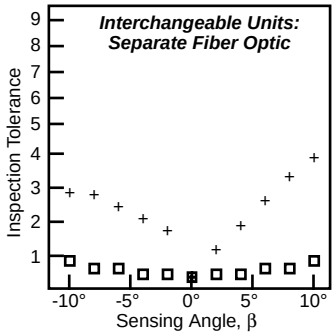
Sensing Angle Characteristics: SA1K-F Fiber Optic Units

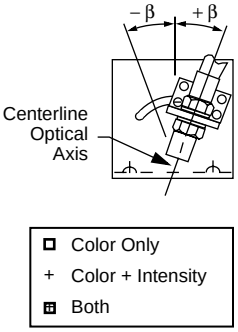












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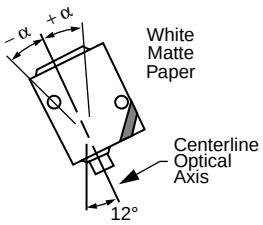
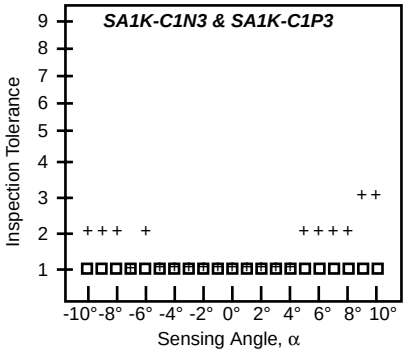
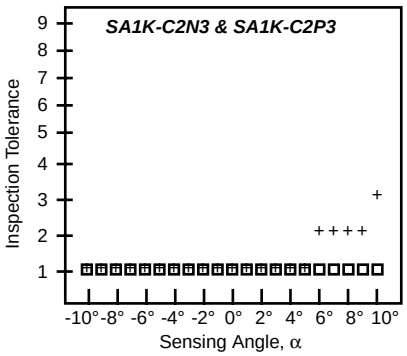
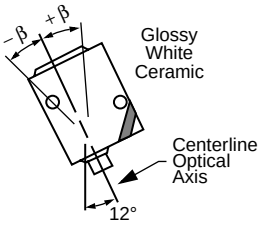
Sensing Angle Characteristics: SA1K Self-Contained (Lens) Type

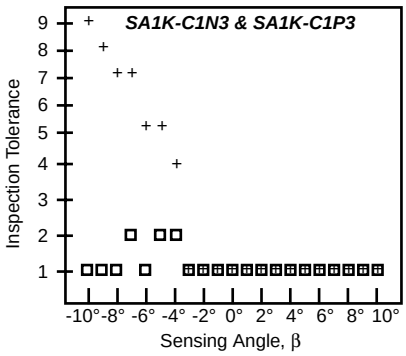
□ Color Only
\+ Color + Intensity
⊞ Both

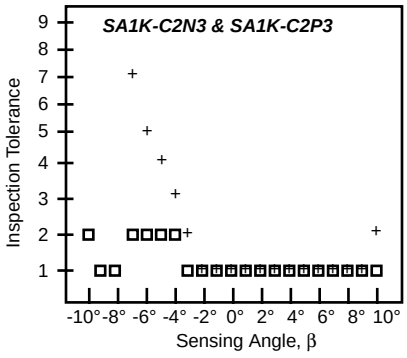












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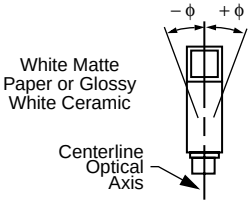
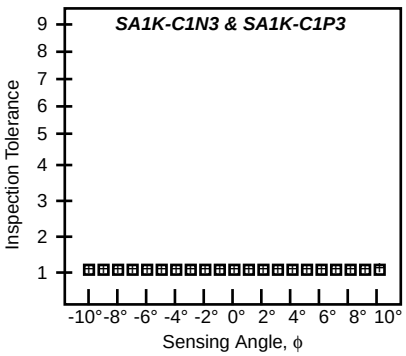
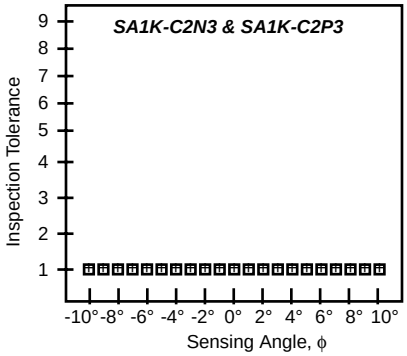
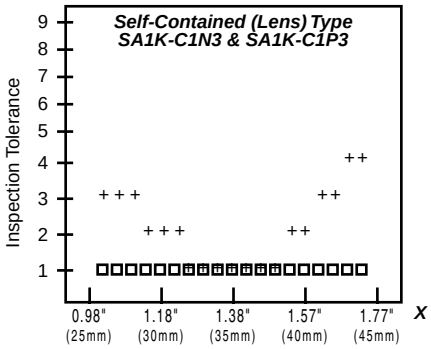


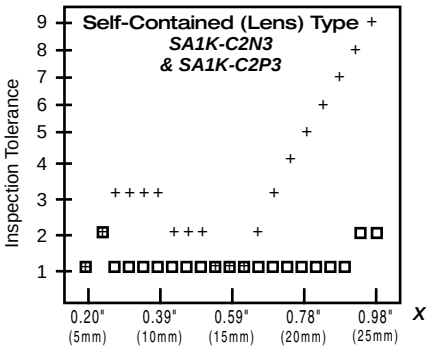


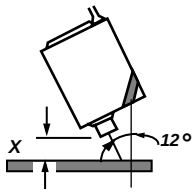


Sensing Range Characteristics: SA1K Self-Contained (Lens) Type

□ Color Only
\+ Color + Intensity
⊞ Both

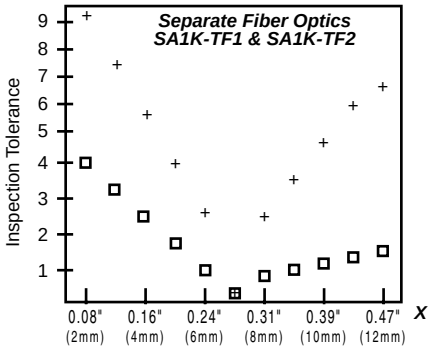


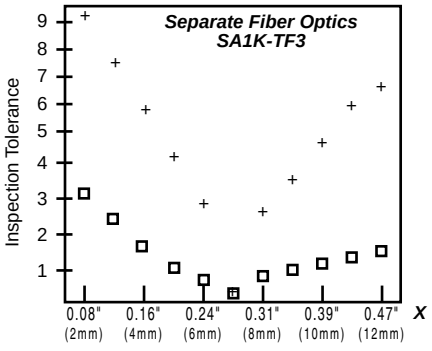


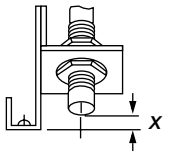


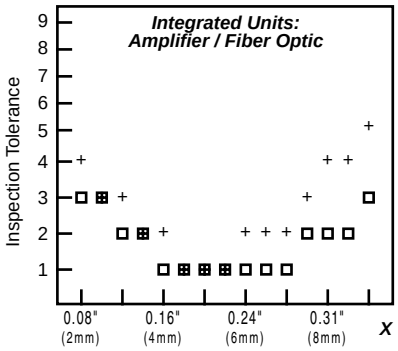
Sensing Range Characteristics: SA1K-F Fiber Optic Units

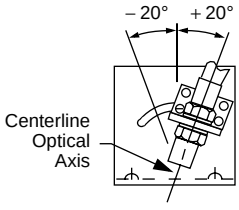
□ Color Only
\+ Color + Intensity
⊞ Both

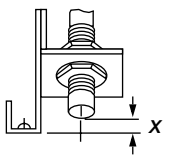












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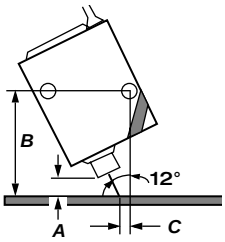
Installation

See page M-116 for general sensor instructions. Below are considerations specific to SA1K and SA1K-F full color sensors.

SA1K Self-Contained (Lens) Style

Mounting Position: Install the sensor so that distance **A** (between the lens and the object) and distance **B** (between the mounting hole and the object) are within parameters shown in the table below.The center of the inspection spot is dimension **C**.



Part #	A	B	C	Spot Ø
SA1K-C1N3 **SA1K-C1N7**	1.37" (35mm)	4.33" (110mm)	1.06" (27mm)	Ø 0.39" (10mm)
SA1K-C1P3 **SA1K-C1P7**	1.37" (35mm)	4.33" (110mm)	1.06" (27mm)	Ø 0.39" (10mm)
SA1K-C2N3 **SA1K-C2N7**	0.59" (15mm)	3.34" (85mm)	1.25" (32mm)	Ø 0.19" (5mm)
SA1K-C2P3 **SA1K-C2P7**	0.59" (15mm)	3.34" (85mm)	1.25" (32mm)	Ø 0.19" (5mm)

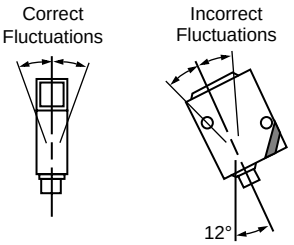
Mount the sensor where vibration and shock will be minimized. Make sure that the sensing range and angle remain reasonably constant.

To minimize the adverse effects of sensing an object with a glossy surface or when the sensing angle fluctuates, make sure that the mounting angle is at least 12°. When the object surface is not glossy, the mounting angle may be less than 12°.

For a 12° mounting angle, draw an imaginary line between the mounting holes, and make sure it is horizontal.

If it is not possible to avoid fluctuations in the sensing angle, minimize adverse effects by mounting the sensor so changes in the sensing angle are NOT in the same plane as the 12° mounting angle (see below).

Make sure the illumination spot lands on the object to be sensed, in the desired location (the illumination spot is slightly larger than the inspection spot).



SA1K-F Fiber Optic Units

Since integrated amplifier/fiber optic units are calibrated in pairs, it is important to always install the same serial numbers together. A separate fiber optic cord cannot be installed with an amplifier from an integrated amplifier/fiber optic set.

A separate interchangeable fiber optic cord can be installed with a separate interchangeable amplifier of any serial number, but make sure to use an "amplifier only" unit (SA1K-FA■■).

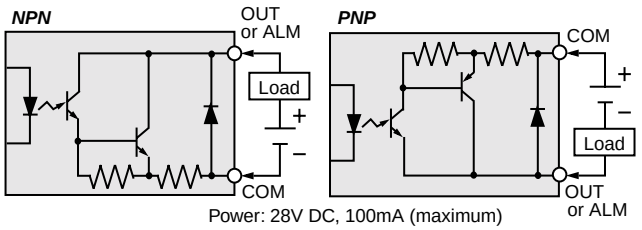
Integrated amplifier/fiber optic units and separate fiber optic cords are shipped with a bracket to easily mount the sensing head with the optical axis at a 20° angle (see diagram on the right). Do not tighten the mounting nut in excess of 8 N·m (80kgf·cm).

Wiring

Wire Color	Name	Function
Brown (Thick)	+12V	Power Voltage 12V DC
Blue (Thick)	0V	Power Ground
Pink (Thin)	SET	Set Input
Purple (Thin)	EXT	External Synchronous Input
Black (Thin)	OUT OUT A	Control Output (1-color sensors) Control Output A (3-color sensors)
White (Thin)	OUT B	Control Output B (3-color sensors only)
Gray (Thin)	OUT C	Control Output C (3-color sensors only)
Orange (Thin)	ALM	Alarm Output
Blk/Wht (Thin)	COM	Common Output
Blue (Thin)	GND	Ground (0V)

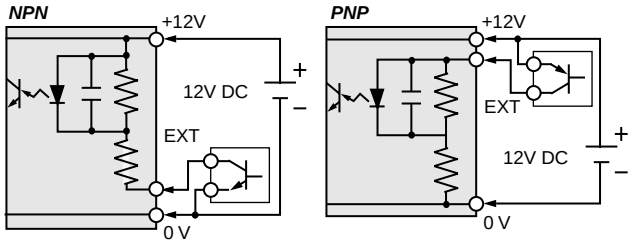
Schematics

Control and Alarm Outputs

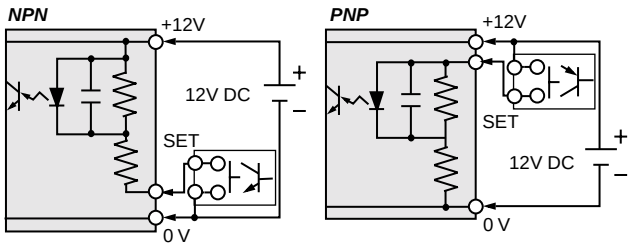


Power: 28V DC, 100mA (maximum)

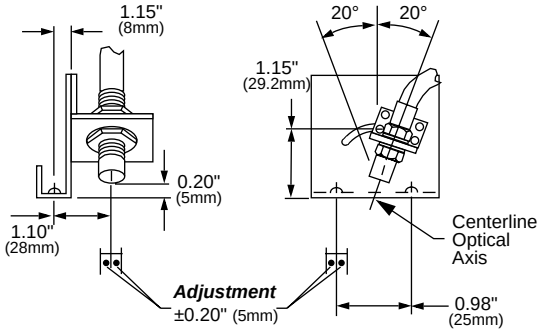
External Synchronous Input



Set Input



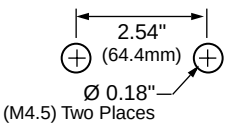
Mounting: Fiber Optic Units



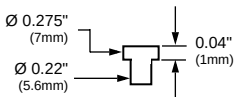
Dimensions

Dimensions	A	B	C
SA1K-C2N3, 7 SA1K-C2P3, 7	4.81" (122.3mm)	2.30" (58.5mm)	1.06" (27mm)
All Other Units (Lens and Fiber)	5.01" (127.3mm)	2.50" (63.5mm)	1.26" (32mm)

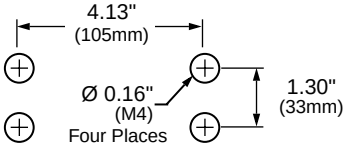
Panel Cut-Out: Lens Style



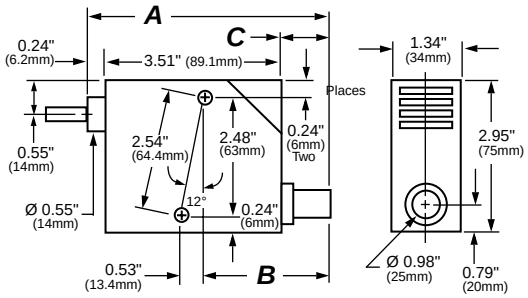
Typical Countersink: Two Holes



Panel Cut-Out: Fiber Optic

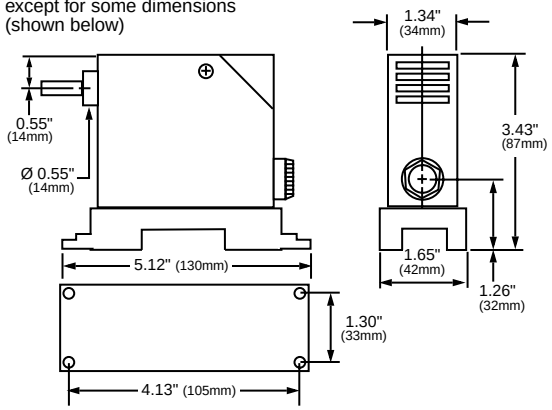


Self-Contained (Lens) Style



Fiber Optic Amplifiers

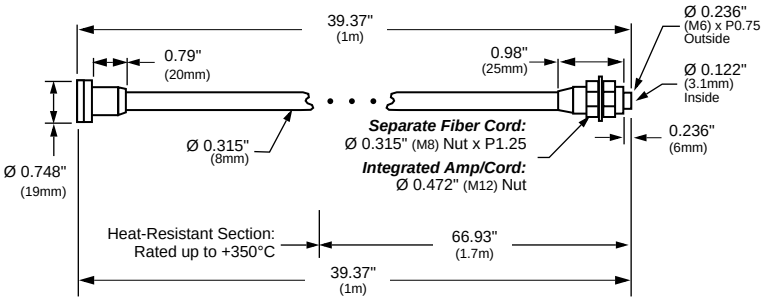
Same as lens style (above) except for some dimensions (shown below)



Fiber Optic Cords

Minimum bending radius =
1.38" (35mm) for integrated amplifier/fiber optic units
1" (25mm) for separate fiber optic cords

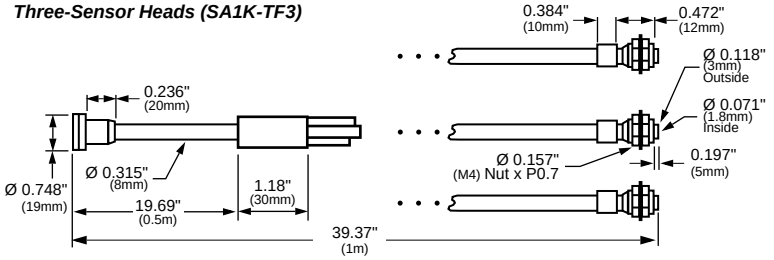
Standard (SA1K-TF1)



Heat-Resistant (SA1K-TF2)

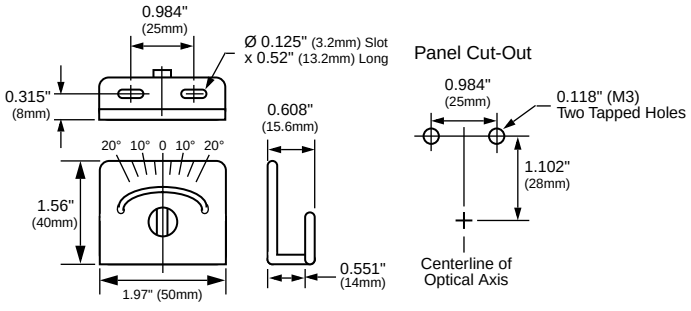
Same as standard (SA1K-TF1) except length = 78.74" (2m).

Three-Sensor Heads (SA1K-TF3)

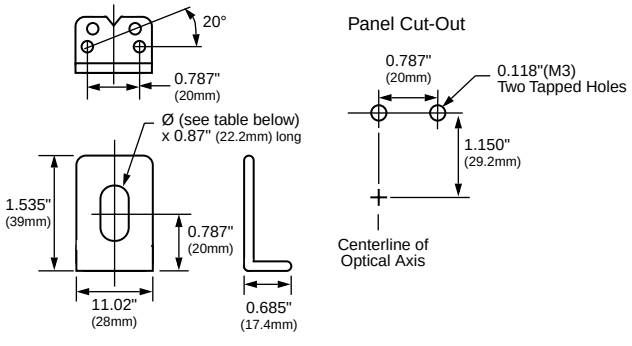


Accessories

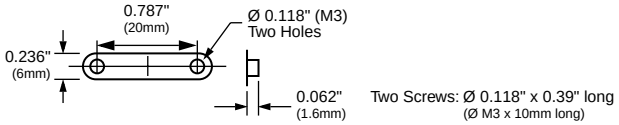
SA9Z-KF1: Fiber Optic Mounting Bracket
Comes with all fiber optic units (integrated amplifier/fiber optic and separate fiber optics). Can be ordered separately. Comes with nut (below).



SA9Z-KF2, -KF3, and -KF4: Fiber Optic Mounting Bracket
Comes with corresponding fiber optic unit (see table below). Also can be ordered separately.



Mounting Nut (comes with SA9Z-KF1)



Accessories

Part #	Comes With	Slot Ø
SA9Z-KF2	Integrated Amplifier/Fiber Optic Units	Ø 0.48" (12.2mm)
SA9Z-KF3	Separate Fiber Optics SA1K-TF1, -TF2	Ø 0.32" (8.2mm)
SA9Z-KF4	Separate Fiber Optics SA1K-TF3	Ø 0.17" (4.2mm)

M

General Information

Specifications

Do not operate a sensor under any conditions exceeding these specifications.

Do not operate a sensor under current and voltage conditions other than those for which the individual sensor is rated.

Do not exceed the recommended operating temperature and humidity. Although sensors are rated for operation below 0°C, this specification does not imply that performance characteristics will remain constant under prolonged freezing conditions. Continued exposure and the accompanying frost, ice, dew, and condensation which accumulate on the optical surface will adversely affect sensor performance.

To maintain superior performance characteristics, do not exceed vibration and shock resistance ratings while operating a sensor. In addition, avoid isolated impacts to the sensor housing which are severe enough to adversely affect the waterproof characteristics.

IEC (International Electrotechnical Commission) Ratings

Sensors rated IP67 are resistant to moisture when occasionally immersed in still water. Sensors rated IP64 through IP66 are resistant to moisture when occasionally subjected to splashing or when located in the vicinity of turbulent waters. These ratings do not imply that a sensor is intended for use under continual high-pressure water spray. Avoid such applications to maintain optimal sensor performance.

Sensors rated IP64 through IP67 are dust-tight and water-tight. For best performance, avoid using any sensor in an area where it will be subjected to heavy particle blasts and where dust, water, or steam will accumulate on the optical surface.

Start-up

Do not test the housing for dielectric strength and insulation resistance, since the housing is connected to the electronic circuit ground of a sensor. Do not perform dielectric strength and insulation resistance tests on electrical systems without disconnecting photoelectric sensors, as such testing may result in damage to the sensor.

Several lines of sensors, as noted in the individual *operation* sections, are provided with an internal circuit to turn an output off for a specified amount of time upon power-up. This delay is normal; it prevents a transient state when turning power on.

Optimum Performance

The optical surface of each sensor must be cleaned on a regular basis for continual superior performance. Use a soft cloth dipped in isopropyl alcohol to remove dust and moisture build-up.

IMPORTANT: Do not use organic solvents (such as thinner, ammonia, caustic soda, or benzene) to clean any part of a sensor.

All sensors experience signal inconsistencies under the influence of inductive noise. Do not use sensors in close proximity to transformers, large inductive motors, or generators. Avoid using sensors in direct contact with sources of excessive heat. Also avoid operation in close proximity to welding equipment.

1. Even though the SA6A ultrasonic sensor features protection against noise, there may be adverse effects from strong noise.

2. It is strongly recommended to avoid using any sensor where it will be continually subjected to elements which impair performance or cause corrosive damage to the sensor. In particular, avoid strong vibrations and shocks, corrosive gases, oils, and chemicals, as well as blasts of water, steam, dust, or other particles.

Extraneous Light

Bright, extraneous light such as sunlight, incandescent lights, or fluorescent lights may impair the performance of sensors in detecting color or light.

3. SA6A ultrasonic sensors are not affected by extraneous light.

Make sure that extraneous light does not exceed recommended levels found in the individual *specifications* sections. When 500 lux is specified, this is equal to 50 footcandles. The average factory illumination is ordinarily below this level, except in areas where visual inspection is being performed. Only in such brightly lit areas is incident light of particular concern.

Unwanted light interference can often be avoided simply by making sure that the optical receiver is not aimed directly toward a strong light source. When mounting direction cannot be adjusted, place a light barrier between all nearby light sources and the receiver.

Reflected-Light Sensors

When installing sensors which detect reflected light, make sure that unwanted light reflections from nearby surfaces, such as the floor, walls, reflective machinery, or stainless steel, do not reach the optical receiver.

Also, make sure that reflected-light sensors mounted in close proximity do not cause interfering reflections. When it is not possible to maintain the recommended clearance between sensors, as noted in the individual *installation* sections, provide light barriers between sensors.

Through-Beam Sensors

A slit attachment is available to modify the beam size of through-beam sensors. This option is recommended for detecting very small objects (near the size of the smallest object which a sensor can detect) or for eliminating light interference when sensors are mounted in close proximity.

Laser Sensors

IMPORTANT: Always consider safety when installing a laser sensor of any kind. Make sure that the laser beam cannot inadvertently shine into the eyes of people passing by or working in the vicinity. See safety information on page H-55.

Mounting

The mounting bracket and hardware are included with sensors, where applicable. Use the appropriate hardware for mounting, along with washers and spring washers or lock nuts. Do not overtighten attachment hardware. Overtightening causes damage to the housing and will adversely affect the waterproof characteristics of the sensor.

Best results can be obtained when the sensor is mounted so that the object sensed is in the center of the beam, rather than when the object is located near the edges of the sensing window. In addition, the most reliable sensing occurs when the majority of the objects being sensed are well within the sensing range, rather than at the extreme near and far limits.

Wiring

Avoid running high-voltages or power lines in the same conduit with sensor signal lines. This prevents inaccurate results or damage from induced noise. Use a separate conduit when the influence of power lines or electromagnetic equipment may occur, particularly when the distance of the wiring is extended.

IMPORTANT: Connect the sensor cables and wires as noted in the individual *Wiring* sections. Failure to connect as shown in wiring diagrams will result in damage to the internal circuit.

When extending sensor cables and wires, make sure to use cables equal or superior to that recommended in the individual *specifications* sections.

When wiring terminals, be sure to prevent contact between adjoining terminals. When using ring or fork lug terminals, use the insulated sleeve style only. Each sensor terminal can accept only one ring of fork lug terminal.

On ISF series photoelectric sensors, use recommended cable, along with the attached packing gland and washer, when wiring the terminals. This ensures waterproof and dustproof characteristics.

Power Supply

Noise resistance characteristics are improved when a sensor is grounded to the 0V power terminal. If the 0V power terminal is not at ground potential, use a ceramic 0.01µF capacitor which can withstand 250V AC minimum.

When using a switching power supply, be sure to ground the FG terminal to eliminate high-frequency noise. The power supply should include an insulating transformer, not an autotransformer.

On ISF series photoelectric sensors, the power supply should be sized according to the voltage drop through the lead wire when using a long extension for the DC type (328' or 100m maximum extension).

Power Supply

The compact PS5R-A power supply is the perfect companion item for most IDEC sensors (except the SA1K—see note below). This power supply is only 1.77" (45mm) wide, 3.15" (80mm) tall, and 2.76" (70mm) deep. Call an IDEC representative for more details.

Part Number	Output Ratings
PS5R-A12	12V DC, 0.62A
PS5R-A24	24V DC, 0.32A

The SA1K full color recognition sensor requires a different power supply, such as IDEC's PS5R-B12. Call an IDEC representative for more details.

Miscellaneous

Strong magnetic fields may detract from the accuracy of the sensing measurement. Avoid mounting a sensor directly to machinery, since the housing is connected to the electronic circuit ground of the sensor. If it is necessary to mount a sensor on machinery, use the insulating plate and sleeve provided.

M

Glossary

Attenuation: Reduction of beam intensity as a result of environmental factors such as dust, humidity, steam, etc.

Dark on: Output energized when light is *not* detected by the receiving element. For through-beam sensors, light from the projector is not detected by the receiver when an object is present. For reflected light sensors, light is not detected when it is not reflected from an object surface.

Diffuse-reflected light sensors: Sensors that detect all scattered, reflected light. Light reflected from nearby surfaces, as well as intended object surface, is detected. Diffuse-reflected light sensors are often called "proximity switches," since they switch when any object is near. Also use to detect color contrast when colors reflect light intensity differently (green LED recommended for this application).

EEPROM: Acronym which stands for electronically erasable, programmable, read only memory.

Excess gain: Ratio of optical power available at a given projector-to-receiver range divided by the minimum optical power required to trigger the receiver.

Extraneous light: Incident light received by a sensor, irrelated to the presence or absence of object being detected. Extraneous light is usually unwanted background light such as sunlight and incandescent lamps in close proximity.

∆E: The measurement of color difference as a three-variable function, located on an XYZ axis of light, hue, and chroma values.

Hysteresis: Operating point and release point at different levels. For solid state sensors, this is accomplished electrically. For mechanical switches, it results from storing potential energy before the transition occurs.

Light on: Output energized when light is detected by receiving element. For through-beam sensors, light from the projector is detected by the receiver when an object is not present. For reflected light sensors, light is detected when it is reflected from an object surface.

Linearity: Measurement of how nearly linear, that is, how accurate actual analog output is, with respect to distance.

NPN/PNP: Types of open collector transistors. NPN is a sink transistor; output on establishes negative potential difference. PNP is a source transistor; output on establishes positive potential difference.

Polarizing: Filtering out all reflected light except that which is projected in one plane only. Polarized retro-reflected light sensors detect the light from corner-cube type reflectors when an object is not present.

Reflected-light sensors: Sensors with the projector and receiver in one housing. Light is projected by the light source, and reflected light is received by the optical surface. Includes diffuse-reflected, retro-reflected, limited-reflected, and spot-reflected sensors as explained on page H-98.

Repeatability: Ability of a sensor to reproduce output readings consistently when the same value is applied consecutively, in the same direction, for a specified number of cycles, or for a specified time duration.

Resolution: Overall dimension of the smallest object which can be detected (when sensing the presence of an object) or smallest increment of distance which can be distinguished with reliable results (when sensing the position of an object).

Response time: Time elapsed between input and output. Total response time is the sum of object detection, amplifier response, and output response times.

Retro-reflective scan: This type of reflected light sensor uses a special reflector to return projected light when an object is not present. Sensor detects the presence of an object when the light is reflected differently.

Through-beam sensors: Sensors with a separate projector and receiver. The light source from the projector is detected by the receiver, except when an object is present.

Transient: Undesirable surge of current (many times larger than normal current) for a very short period, such as during the start-up of an inductive motor.