



Sensors

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Selection Guide

Sensor Type	Series	Page	Appearance	Advantages	Considerations
Full Colour Recognition Sensors	SA1J SA1J-F	4		• Use to detect registration marks (regardless of similarity of colour) at high-speed (0.3ms). • Use to distinguish between different shades of the same colour. • 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 colour sensing applications.	• Use the 3-colour 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 colour sensing. • Use the auto-select mode to sort objects, to differentiate fine shades of the same colour, or to detect objects moving to and from the sensor.
Analogue Laser Colour Mark Sensors	SA1M	10		• Uses visible red laser for colour detection. • Compensates for fluctuations of objects. • Long range: 2.75" to 5.9". • Available in small spot or parallel beam. • Dual analogue 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 Q-25.
Water Detection Sensors	SA1W	15		• Fastest (response time 0.5ms), most reliable light detection photoelectric sensor. • Use to detect any liquid containing water in any translucent, coloured 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, coloured 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.
Self-Contained Laser Sensors	MX1C	23		• Use in the most precise sensor applications, because of the minute size of the laser beam. • Use the MX1C to achieve precise positioning or alignment, because the visible beam is easy to aim. • All laser sensors provide analogue 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 Q-25.
Ultrasonic Analogue Sensors	SA6A	27		• Ultrasonic sensing (using sound waves) is perfect for sensing applications which cannot be accomplished through the use of light, such as when detecting transparent items, films, and liquid levels. • Ultrasonic sensing is normally disrupted by wave interference, but the SA6A features adjustments for optimal performance, despite the effects of surface turbulence (liquid level sensing), heat waves (blowing hot air), or inductive noise interference.	• Adjustments for tolerating wave interference are not selected simultaneously. One mode is selected when encountering surface turbulence (liquid level sensing) and another mode is used when sensing under the influence of blowing hot air.

Selection Guide con't

Sensor Type	Series	Page	Appearance	Advantages	Considerations
Analogue Distance Sensors	SA1D	30		- The most reliable distance sensing, calculated using the optical triangle between two points and the sensor. - Analogue output and digital output provided.	Maximum analogue output value corresponds to minimum sensing distance and minimum analogue value corresponds to maximum distance.
Photoelectric	SA1E	32		- Through-beam. Long sensing range of 10m max. - Diffuse-reflective can detect light-reflecting transparent objects as well as white matt paper at a distance of 700mm. - Polarized retroreflective mirror-like objects can also be detected easily. - Small-beam reflective. Ideal for detecting small objects with easy recognition of a red LED beam.	- Long sensing ranges. - High-speed response of 1msec max. - Interference prevention allows close mounting of two switches (except for the through-beam type).
Fiber Optic Photoelectric Sensors	SA1C-FK	37		- Optimum performance under adverse conditions including high temperatures, inductive noise, and corrosive exposure. - Maintain integrity of sensing signal over long distances. - Perfect for areas with minimal clearance. Fiber optic leads capable of great flexibility for tight installations.	- It is necessary to consider reduced maintenance expenses when evaluating cost effectiveness. - Fiber optics do not withstand impact well (may shatter).
	SA1C-F	43			
Heavy Duty Photoelectric Sensors	ISF	50		- Universal voltage type (24 to 240V AC/DC). - Built-in 0.1 to 5 second time delay. - Selectable Light ON or Dark ON. - Touch-down terminals.	Available in various modes: Through-beam Diffuse-reflective Retro-reflective Polarized retro-reflective
Magnetic Proximity Switches	DPRI	53		- Lightweight, compact design reduces mounting space requirements. - Sealed reed contact. - Long life and high reliability.	Operating distance range: 0 to 4mm

SA1J: Full Colour Recognition Sensors

Introducing a cost-effective solution for full colour sensing applications—IDEC's SA1J full colour 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 colour sensor include:

- Choice of a 3-colour version or a 1-colour version
- Fast response (0.3ms)— perfect for sensing complex colour 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 colour; can distinguish between subtle shades of the same colour
- Up to 60mm sensing distance
- IP67 rated



General Specifications		1-Colour Version	3-Colour 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: Aluminium 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-Colour Version	3-Colour 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-Colour Version	3-Colour Version
	Reference Colour Registration	Push SET button (sensor aimed at colour target); sensor records reference colour in EEPROM memory	Set dial to A: Push SET button (sensor aimed at colour target A); sensor records reference colour A in EEPROM memory Set dial to B: Push SET button (sensor aimed at colour target B); sensor records reference colour B in EEPROM memory Set dial to C: Push SET button (sensor aimed at colour target C); sensor records reference colour 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: Colour component only (C) or colour component plus intensity (C+I) (depth of colour)	
	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 colour
	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 colour matches target colour NPN or PNP transistor open collector 30V DC, 100mA maximum Residual: 1.5V maximum, short circuit protection	Control output A on: Detected colour corresponds to target colour A* Control output B on: Detected colour corresponds to target colour B* Control output C on: Detected colour corresponds to target colour 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 colour is defined by the operation mode setting.

SA1J-F: Full Colour Fiber Optic Sensors

This new line of full colour sensors offers IDEC's proven colour sensing technology in a fiber optic version. The SA1J-F is ideal for colour 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-colour programmable sensors for multiple colour 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 colour sensor include:

- Choice of a 3-colour version or a 1-colour version
- Wide assortment 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 colour teach functions
- IP67 rating for use in harsh wet environments



General Specifications		1-Colour Version	3-Colour 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: Aluminium 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	

Subassembled Part Numbers: SA1J-F Sensors

Amplifiers

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

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 Colour Set	Teaching system, 1-colour	Teaching system, 3-colours	Teaching system, 1-colour	Teaching system, 3-colours
	Inspection Tolerance	5-step digital setting			
	Inspection Mode	Colour (C) / Colour + Intensity (C+I)			
	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 circuit		PNP open collector 30V DC, 100mA maximum Voltage Drop 1.5V maximum Protected against short circuit	
	SET 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	
	External Synchronous Input				
	Operation Indicator	Yellow LED	Yellow LED (3-colour individual display)	Yellow LED	Yellow LED (3-colour 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)			

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 Temperature	-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

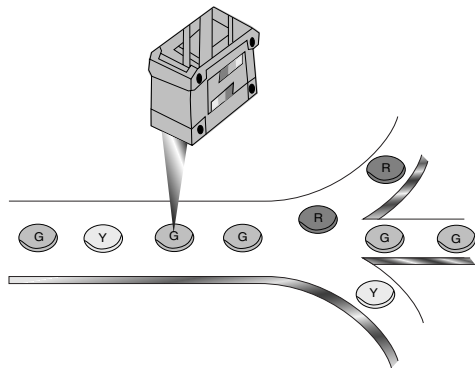
Part No.	Type	Sensing Range
SA9F-TS21	M4 • Straight No Sleeve	30 mm
SA9F-TS22	M4 • Straight 90 mm Sleeve	30 mm
SA9F-TS23	M4 • Straight 45 mm Sleeve	30 mm
SA9F-TC21	M6 • Coiled No Sleeve	25 mm
SA9F-TC22	M6 • Coiled 90 mm Sleeve	25 mm
SA9F-TC23	M6 • Coiled 45 mm Sleeve	25 mm
SA9F-TM21	M4 • Multicore	25 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

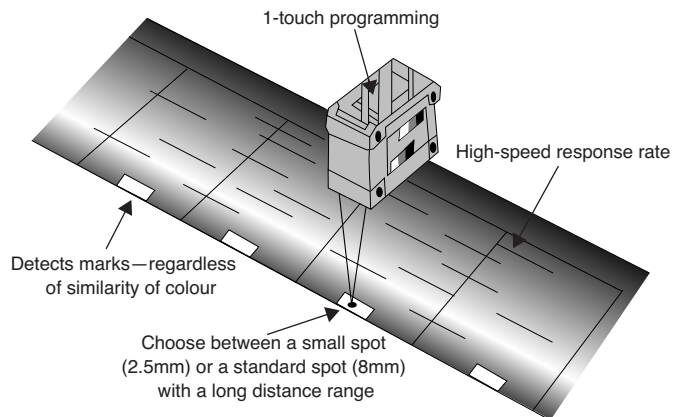
Part No.	Type	Sensing Range
SA9F-DS31	M6 • Straight No Sleeve	6 mm
SA9F-DS32	M6 • Straight 90 mm Sleeve	6 mm
SA9F-DS33	M6 • Straight 45 mm Sleeve	6 mm
SA9F-DD31	M6 • Coaxial	5 mm
SA9F-DM74	1 row = 32 fibers Multicore	2 mm
SA9F-DM75	2 rows = 16 each Multicore	5 mm

Applications

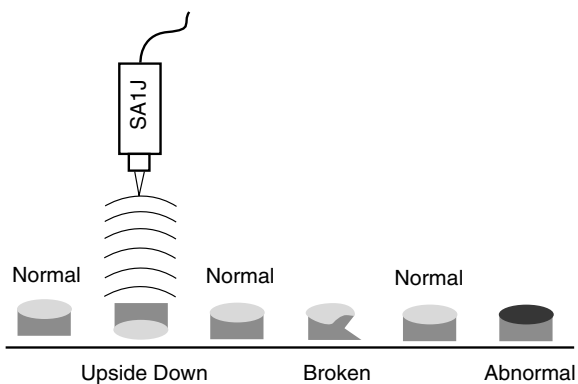
Sorting objects by cap or lid colour



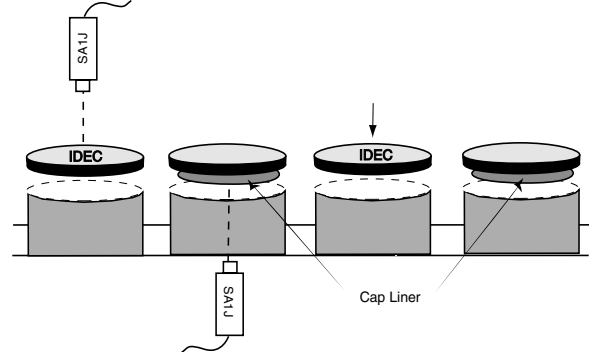
Detecting plastic bagging materials on a web



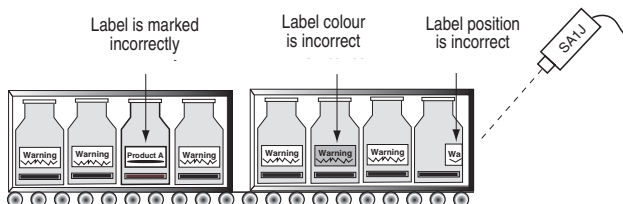
Detecting objects that are the incorrect shape or colour



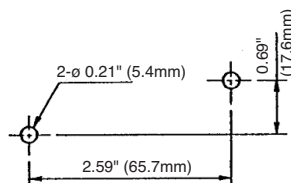
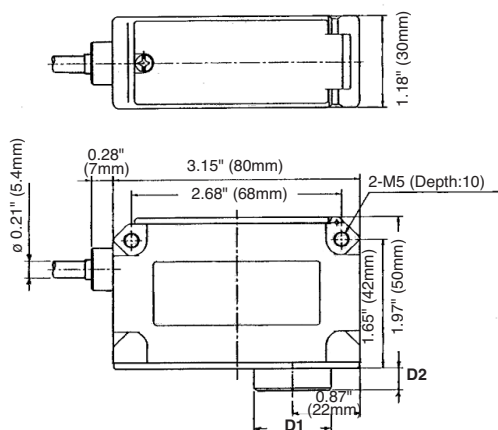
Detecting presence or absence of a logo on a cap or lid



Checking packaging labels for correct position, colour, and content



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)]

SA1M: Analogue Laser Colour Mark Sensors

Using a visible red laser (670nm), the SA1M Laser Mark sensor is excellent for detecting label alignment and different kinds of objects. The small spot version can easily detect tiny objects. The parallel beam version keeps the detection spot size unchanged, regardless of the distance between the sensor and the object. Both versions ensure stable sensing without being influenced by changes in the sensing range and are ideal for use in varying environmental conditions.

Key features of the SA1M include:

- Stable output over a wide sensing range: 2.755" to 5.906" (70 to 150mm)
- Small visible beam enables detection of tiny objects (such as a spot) and thin materials
- High tolerance of fluctuating surface levels — ignores movement while sensing
- Insensitive to vertical movement of material to and from the sensor, as in the case of web flutter
- Ideal for use in industrial environments
- Dual analogue output (light intensity and distance) and digital output
- IP65 protection rating



General Specifications	Power Voltage	24V DC (ripple 10% maximum)
	Current Draw	200mA maximum
	Light Source Element	Laser diode (670nm)
	Receiver Element	PSD (position sensitive device)
	Dielectric Strength	Between live and dead parts: 500V AC, 1 minute
	Insulation Resistance	Between live and dead parts: 20MΩ minimum (500V DC megger)
	Operating Temperature	0 to +45°C (performance will be adversely affected if the sensor becomes coated with ice)
	Storage Temperature	-20 to +70°C
	Operating Humidity	35 to 85% RH (avoid condensation)
	Vibration Resistance	Damage limits: 10 to 55Hz Single amplitude: 0.75mm 2 hours in each of 3 axes (de-energized)
	Shock Resistance	Damage limits: 100 m/s ² (approximately 10G) 5 times in each of 3 axes (when de-energized)
	Extraneous Light Immunity	Incandescent light, 3,000 lux maximum
	Operating Atmosphere	Free from corrosive gasses
	Material	Housing: Zinc diecast Coverplate: Polyarylate Filter: Glass
	Degree of Protection	IP65 IEC Pub 529
	Cable	Cable type: 6-core vinyl cabtyre cable 0.19mm ² : 6' – 6-3/4' (2m) long
	Weight	Approximately 400g
	Dimensions (HxWxD)	1.97" x 0.83" x 3.07" (50 x 21 x 78mm)

Part Numbers: SA1M Sensors

Part Number	Spot Type	Sensing Range	Digital Output	Analogue Output for Light Intensity (colour mark)	Analogue Output for Sensing Distance
SA1M-CK4-AC	Small spot	2.755" to 5.906" (70mm to 150mm)	NPN open collector	4 to 20mA 5V maximum	20 to 4mA 5V maximum
SA1M-CK4-BC	Parallel beam		PNP open collector		
SA1M-CL4-AC	Small spot				
SA1M-CL4-BC	Parallel beam				

Function Specifications	Sensing Range	2.755" to 5.906" (70 to 150mm)
	Digital Output	Output style: NPN open collector: (SA1M-CK4-AC/BC) PNP open collector: (SA1M-CL4-AC/BC) with short circuit protection Output type: Window comparator output (in-window ON) Response time: 1ms maximum Hysteresis: 5% (0.8mA) maximum (over the entire sensing range) Applied voltage: 30V DC maximum Load current: 100mA maximum Voltage drop: 1.0V maximum (SA1M-CK4-AC/BC) 1.5V maximum (SA1M-CL4-AC/BC)
	Analogue Output for Light Intensity (colour mark detection)	Analogue current output: 4 to 20mA, 5V maximum Reference output current (Note 1): 19.0+/-0.4mA Output stability (Note 2): ±5% (±0.8mA) maximum (against reference output current over the entire sensing range) Temperature drift (Note 3): ±5% (±0.8mA) maximum (against reference output current over the entire operating temperature) Response time: 1ms maximum (10 to 90% response) Additional noise (Note 2): 0.4mA maximum p-p (Position: 70mm)
	Auxiliary Output (Note 4) (analogue output for distance)	Analogue current output: 20 to 4mA, 5V maximum Linearity error (Note 2): ±1.5% FS (±1.2mm) (over the entire sensing range) Resolution (Note 2): 0.008" (200µm); Position: 70mm Temperature drift (Note 3): 5µA/°C maximum (against the entire operating temperature) Response time 1ms maximum (10 to 90% response)
	Sensitivity Selections	Selection using the sensitivity selector: L: Low (low sensitivity, 35% of standard sensitivity) M: Middle (Standard sensitivity) H: High (high sensitivity, 3.5 times standard sensitivity)
	Indicators	Analogue output for light intensity: Red LED (10-dot level metre, Mode selector: RUN) Digital output setting monitor: Red LED (10-dot level metre, Mode selector: SET1, SET2) Digital output: Red LED (turns on when output is on) Laser diode emission: Green LED (turns on while laser is emitted), laser emits approximately 1 second after power-up
	Accessories	Adjusting screwdriver, resistor (249Ω), operating instructions, warning label, precaution label

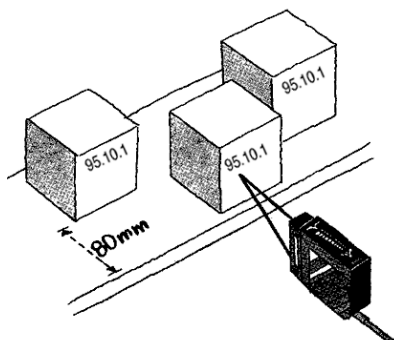


Measuring conditions:

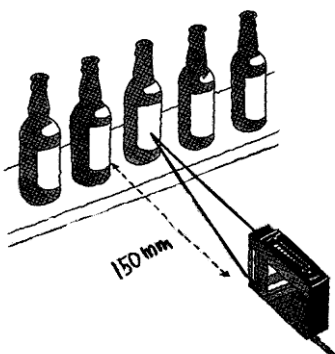
1. Temperature: 25°C, Object: White ceramic (0.6mm thickness), Sensitivity: Middle, Position: 110mm
2. Temperature: 25°C, Object: White ceramic (0.6mm thickness), Sensitivity: Middle
3. Object: White ceramic (0.6mm thickness), Sensitivity: Middle, Position: 110mm
4. Auxiliary output should be used only to monitor distance

Applications

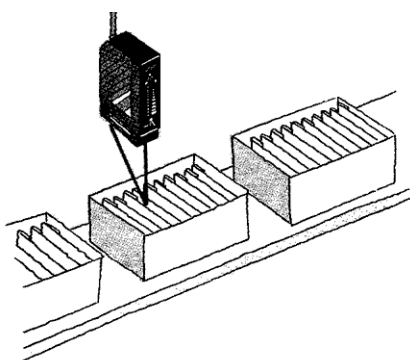
Stable output response over a wide sensing range, detecting the presence of package markings



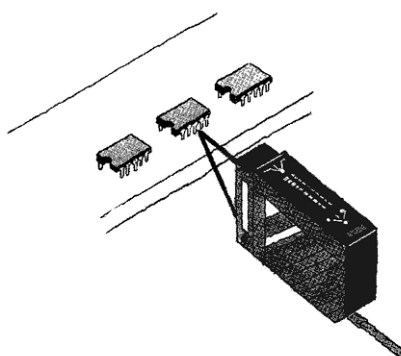
Long sensing distance (150mm maximum)



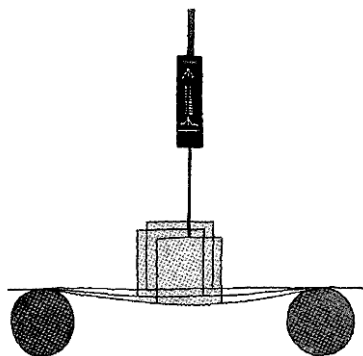
Counting the number of packages in a box



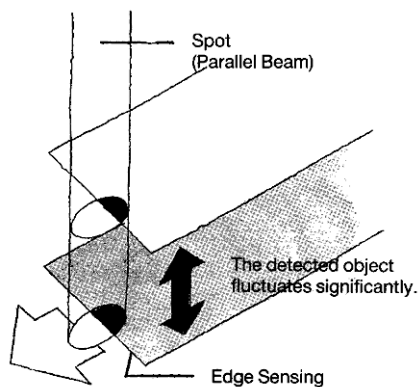
Small beam spot (0.5 x 1mm) (small spot type)



Compensating for fluctuating objects (parallel beam type) ($\pm 40\text{mm}$)



Parallel beam type (beam size: 2 X 4mm)

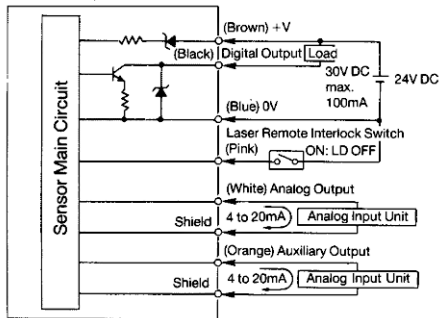


When the distance between the sensor and object varies significantly in positioning and edge sensing, the spot size remains unchanged, thus ensuring stable sensing.

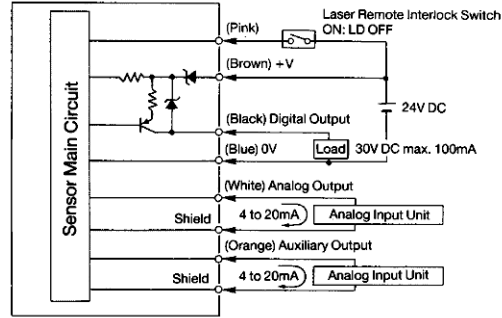
When the output should not be influenced by blurs, taints, fine patterns, or lines in the object surface, stable sensing is ensured by the relatively large spot size.

Schematics

Connection Example (SA1M-CK4-AC/BC (NPN) Output)

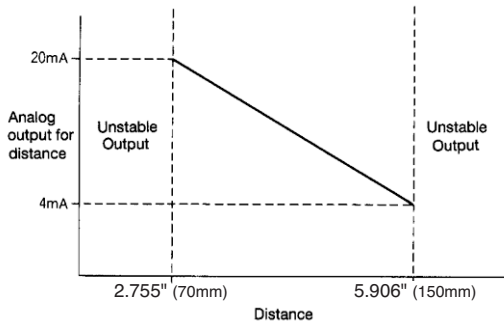


Connection Example (SA1M-CL4-AC/BC (PNP) Output)



Auxiliary Output

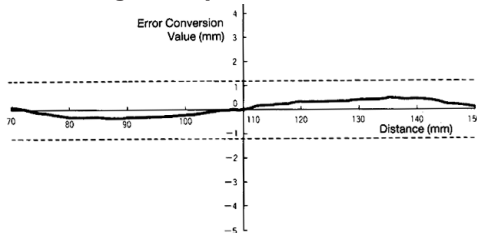
Analogue Output for Distance vs. Distance Characteristics



1. When the auxiliary output (analogue output for distance) is used, the sensing distance should range from 70 to 150mm. If the sensing distance exceeds this range, an unstable output occurs.

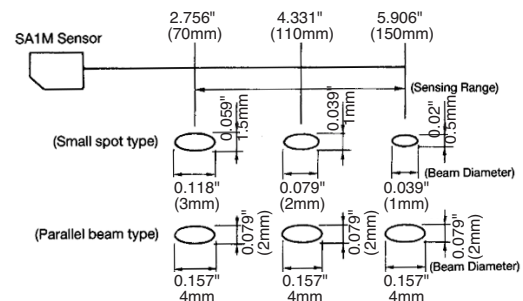
Linearity Error for Auxiliary Output

Analogue Output for Distance

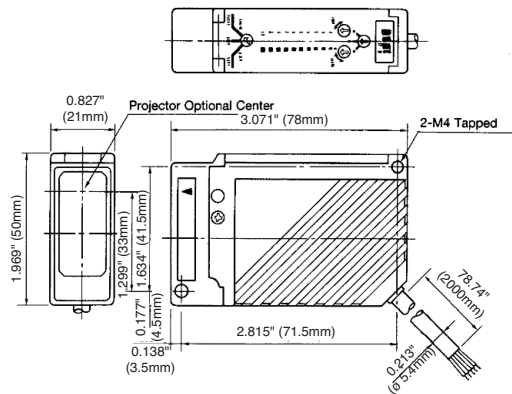


2. IDEC's laser displacement sensor is ideal when highly accurate distance measurement is required. (Sensing range is 60 to 160mm.) Refer to the MX1C section on page M-23.

Sensing Distance and Beam Distance



Dimensions



Laser Safety Information

Installation: If a sensor is installed so that the laser beam may shine or reflect into the eyes of a person passing by or working in the vicinity, place an opaque sheet of material in front of the beam to prevent potential eye injury. For people working near a laser sensor, protective glasses which screen out a significant amount of the harmful radiation are recommended at all times.

All SA1M laser sensors also include a remote interlock terminal which can be used to turn the laser on or off with an external switch, as required, to operate the sensor safely from a remote location. To avoid exposure to harmful radiation, never disassemble a laser sensor.

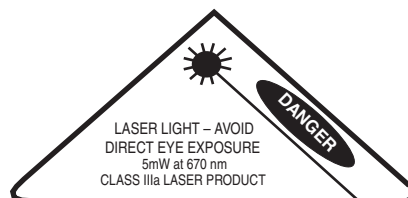
WARNING: Do not allow class IIIa beams to shine directly into the eyes. Do not allow lasers to reflect from a glossy, shiny, or reflective surface into the eyes.



Labelling: IDEC laser sensors include **CDRH-approved** safety warnings shown on the right and below, in compliance with federal regulations of the **Center for Devices and Radiological Health**.



SA1M Laser Mark Sensor:
Class IIIa Laser (670nm) Visible Beam



Warning Label (common)



All Laser Sensors:
Identification and Certification

mfd.: **FEBRUARY 1997**
Product conforms to
21 CFR1040

Precaution Label



SA1M Visible Laser:
Aperture Warning



SA1W: Water Detection Sensors

The SA1W is the fastest, most reliable liquid detection sensor on the market. Using a laser beam tuned to the resonant frequency of an H₂O molecule, the SA1W is able to detect any liquid containing water molecules — without contact! This allows the SA1W to eliminate many of the problems associated with other photoelectric sensors, capacitive sensors, ultrasonic sensors, vision systems, or moisture metres.

The SA1W easily detects liquid in any translucent container — even clear or dark coloured containers. Operation is as simple as a photoelectric switch. Just position the fiber optic cable to the proper level, and apply power to the sensor.

Key features of the SA1W include:

- High-speed response time (0.5ms)
- Long sensing range: up to 31.5" (800mm)
- Small diameter laser beam for precise level detection
- Visible red spot for easy targeting and alignment
- Easy to mount in restricted spaces due to fiber optic cables
- Choice of either through-beam or diffuse-reflected fiber cables
- Capable of detecting liquid levels (including clear water) through clear or translucent coloured containers



	SA1W-FN1	SA1W-FN2	SA1W-FP1	SA1W-FP2	SA1W-MK1229
General Specifications	Detectable Object	Water or water content			
	Power Voltage	12 to 24V DC (operating voltage: 12 to 24V DC ± 10%)			
	Current Draw	100mA			Projector: 30mA max. Receiver: 20mA max.
	Control Output	NPN open collector 30V DC, 100mA (maximum) Voltage drop: 1.5V (maximum) protected against short circuit	PNP open collector 30V DC, 100mA (maximum) Voltage drop: 1.5V (maximum) protected against short circuit		NPN and PNP open collector; NPN 30V DC, 100mA max. Voltage drop 1.5V; PNP 30V DC, 100mA max, Voltage drop 2.0 max., protected against short circuit
	Operation Mode	Light ON or Dark ON (selectable by DIP switch on amplifier)			
	Response Time	0.5ms			10ms
	Indicator	Operation indicator: Yellow LED Stable level indicator: Green LED			Projector: Power ON: green LED Receiver: Operation indicator: Yellow LED, Stable level indicator: Green LED
	Off-Delay Timer	40ms (ON/OFF selectable by DIP switch on amplifier)			—
	Hysteresis	20% (maximum) (using reflex fiber unit, SA9W-DD81)			—
	Sensitivity Adjustment Control	1 rotation (COARSE + FINE)			One turn adjustment
	Light Source Element	For detecting: Infrared laser diode (Class I laser); For alignment: Red LED			Infrared LD (Class I laser)
	Receiver Element	Photo diode			
	Operating Temperature	0 to +45°C (avoid freezing)			
	Storage Temperature	−20 to +70°C			-5 to +50°C (no freezing)
	Operating Humidity	35 to 85% RH (avoid condensation)			
	Extraneous Light Immunity	Sunlight: 10,000 lux (maximum); Incandescent light: 3,000 lux (maximum) on the receiver surface			—
	Insulation Resistance	Between live and dead parts: 20MΩ minimum (500V DC megger)			?
	Dielectric Strength	Between live and dead parts: 500V AC, 1 minute			?
	Vibration Resistance	Damage limits: 10 to 55Hz Single amplitude: 0.75mm 2 hours in each of 3 axes (when de-energized)			?
	Shock Resistance	Damage limits: 100 m/s ² (approximately 10G) 5 times in each of 3 axes (when de-energized)			?
	Degree of Protection	IP66 IEC Pub 529			IP65
	Cable	Cable type: Ø 5.4mm 3-core vinyl cabtyre cable, 6' 6-3/4' (2m) long			Projector: 0.2mm ² , ø4mm2-core vinyl cabtyre cable, 2m Receiver: 0.2mm ² , ø4mm4-core vinyl cabtyre cable, 2m
	Material	Housing: PBT; Cover: Polyarylate			Housing: PBT; Lens: PC
	Interference Prevention	2 units can be installed in close proximity			?
	Accessories	Adjusting screwdriver, mounting bracket			—
Dimensions (WxHxD)	1.10" x 1.89" x 3.70" (28 x 48 x 94mm)			13W x 23H x 46.6D mm	
Weight	Approximately 200g			Projector and Receiver: each approx. 70g	

Assembled Part Number List

Part Numbers: Assembled Units

Part Number	Control Output Description
SA1W-FN1	NPN open collector amplifier + Diffuse-reflex
SA1W-FN2	NPN open collector amplifier + Through-beam
SA1W-FP1	PNP open collector amplifier + Diffuse-reflex
SA1W-FP2	PNP open collector amplifier + Through-beam

Sub-Assembled Part Number List

Part Numbers: Fiber Optic Units

Part Number	Description	Sensing Distance
SA9W-TS31	Through-beam	3.94" (100 mm)
SA9W-DD81	Diffuse-Reflex	1.18" (30 mm)
SA9Z-F21	Lens attachment	31.50" (800 mm)



Lens attachment is for through-beam type only.



Part Numbers: Amplifier Units

Part Number	Control Output
SA1W-FN3F	NPN open collector: 30V DC
SA1W-FP3F	PNP open collector: 30V DC

Specifications

Fiber Optic Units

	SA9W-TS31	SA9W-DD81
Detection Method	Through-beam	Diffuse reflex
Sensing Range	3.94" (100mm)	1.18" (30mm)*
Material	Fiber head: Stainless steel; Fiber: Glass fiber; Housing: Stainless steel	
Operating Temperature	-30 to +80°C (avoid freezing)	
Operating Humidity	35 to 85% RH (avoid condensation)	
Allowable Bending Radius	Armored tube: R25 or more	
Weight	Approximately 200g	Approximately 100g



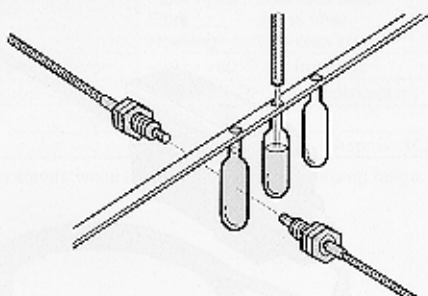
*1.97" (50 mm) square white mat paper is used for sensing range.

Lens Attachments (for through-beam type fiber units)

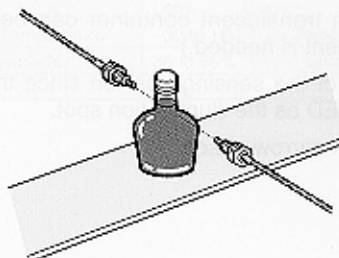
	SA9Z-F21
Applicable Fiber Optics	SA9W-TS31 (through-beam type)
Sensing Range	31.50" (800mm)
Material	Housing: Aluminium; Lens: Optical glass
Operating Temperature	-30 to +80°C (avoid freezing)
Operating Humidity	35 to 85% RH (avoid condensation)
Weight	Approximately 2g

Applications

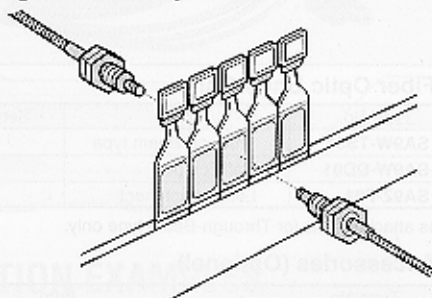
- Checking the Level of Chemicals.



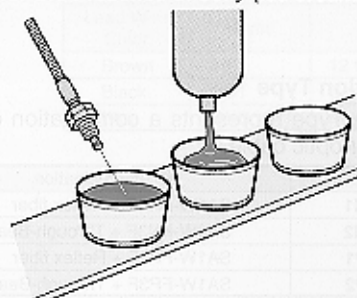
- Checking the Level of Spirits.
Detection can be performed irrespective of bottle shapes.



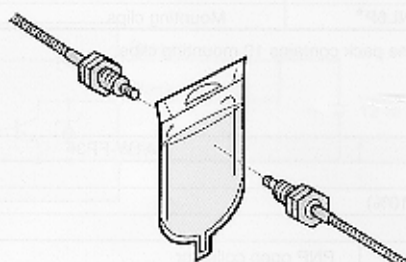
- Checking the Level of Eyewash.



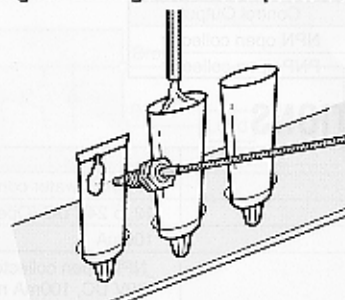
- Checking for the Presence of Jelly (ice cream, pudding, etc).



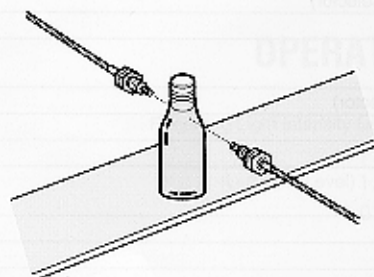
- Checking the Level of Intravenous Drip.



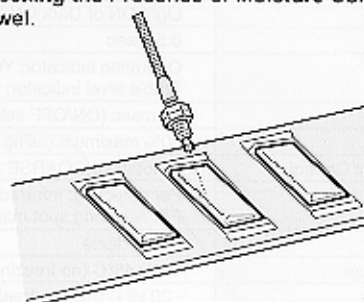
- Checking for Leakage in a Toothpaste Tube.



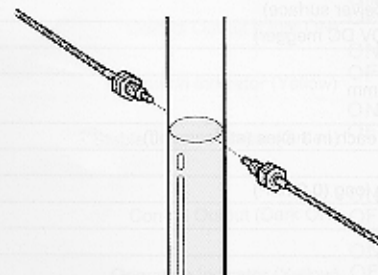
- Checking the Level of Soda or Juice.



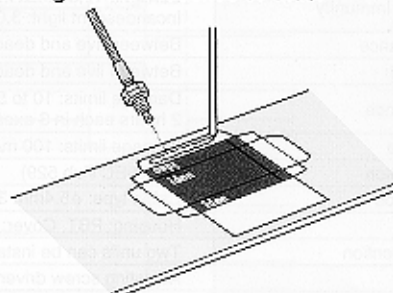
- Checking the Presence of Moisture Content in a Towel.



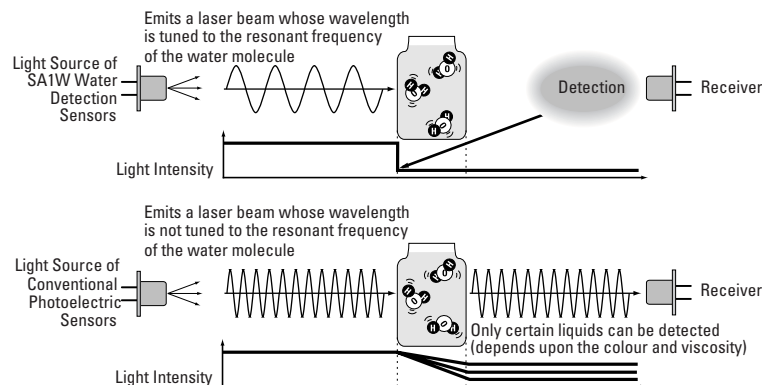
- Checking the Transparency Level in Glass Tube.



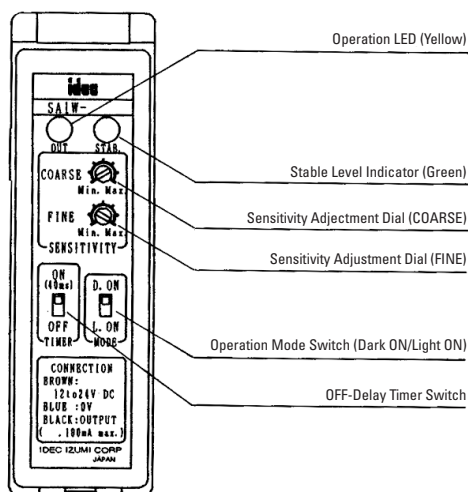
- Checking for the Presence of Glue.



Operation Principle



Operation



Operation LED (yellow) and stable level indicator (green): The operational indicator and stable level indicator operate according to the intensity level of received light described below. Use the sensor in the stable incident or stable interruption mode.

Sensitivity adjustment dial (COARSE and FINE): When the reflex type is affected by the background or when the through-beam type detects water in a thin container, adjust the sensitivity using the COARSE control. If the detection is still unstable, adjust the sensitivity using the FINE control. When sensitivity adjustment is not required, set the adjustment control to Max. The adjustment procedures described below are for Light ON. For Dark ON, the lighting status of the operational indicator is reversed.

Operation mode switch (Dark ON/Light ON): This switch is used to select Light ON or Dark ON.

OFF-delay timer switch: This switch is used to select the off-delay timer (40ms).

Sensitivity Adjustment Procedures

Sensor Status	Sensitivity Adjustment Control	Adjustment Procedures	Remarks
Course Adjustment Incident condition Through-beam: without detected object (water) Reflex: without detected object (water) Interrupt condition Through-beam: with detected object (water) Reflex: with detected object (water)	Coarse	First, at incident condition, turn the COARSE control from the Min. position to the Max. position until the operational indicator (yellow) turns ON (Point A).	When the operational indicator (yellow) turns ON at the Min. position, the Min. position is regarded as Point A.
	Coarse	Second, at interrupt condition (operational indicator is OFF), turn the COARSE control to the Max. position until the operational indicator (yellow) turns ON again (Point B). Then set the COARSE control to the middle between Point A and Point B.	- When the operational indicator (yellow) does not turn ON, the Max. position is regarded as Point B. - When there is not enough adjustment range, use the FINE control.
Fine Adjustment Incident condition Through-beam: without detected object (water) Reflex: without detected object (water) Interrupt condition Through-beam: with detected object (water) Reflex: with detected object (water)	Fine	First, at incident condition, turn the FINE control from the Min. position to the Max. position until the operational indicator (yellow) turns ON (Point A).	When the operational indicator (yellow) does not turn OFF, the Min. position is regarded as Point A.
	Fine	Second, at interrupt condition (operational indicator is OFF), turn the FINE control to the Max. position until the operational indicator (yellow) turns ON again (Point B). Then set the COARSE control to the middle between Point A and Point B.	When the operational indicator (yellow) does not turn ON, the Max. position is regarded as Point B.

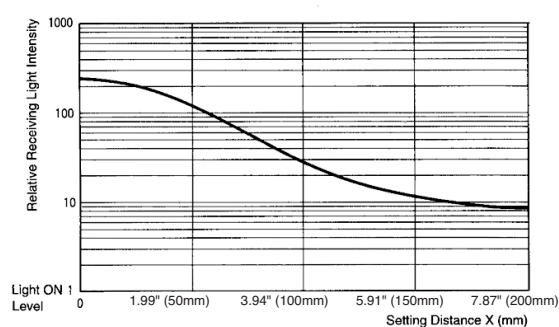
Operation and Stable Level Indicator

					Light ON	Dark On
Receiving Light Intensity Level			Mode	Stable Operation (Green)	Operational (Yellow)	
Light ON Level	1.15	▷	Stable incident	ON	ON	OFF
	1.00	▶	Unstable incident	OFF		
		Unstable interruption				
	0.75	▷	Stable interruption	ON	OFF	ON

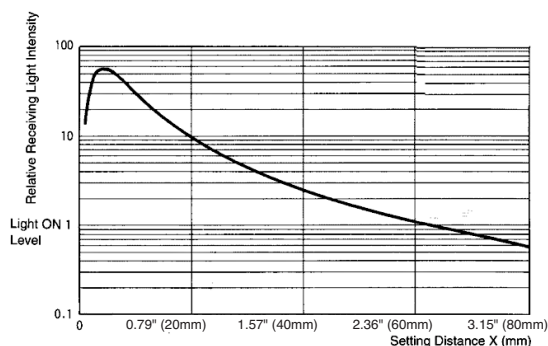
Sensing Characteristics

1. Relative Receiving Light Intensity vs. Setting Distance

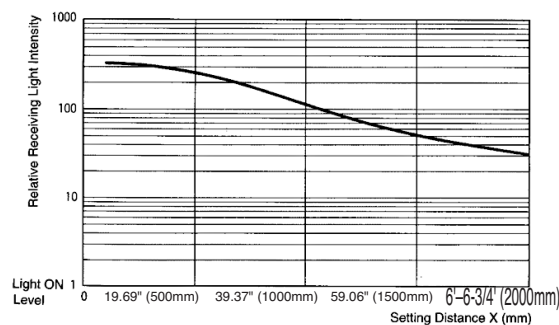
SA9W-TS31 (through-beam type)



SA9W-DD81 (reflex type)

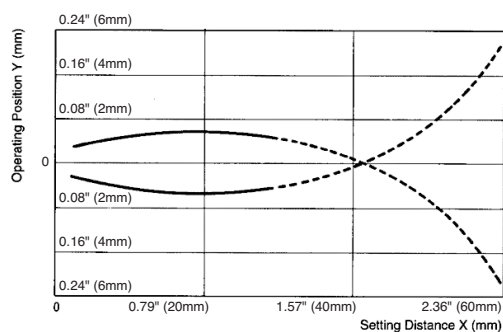


SA9W-TS31 (through-beam type) and
SA9Z-F21 (lens attachment)



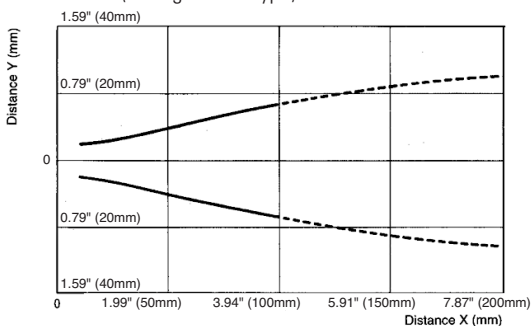
2. Sensing Range Characteristics

SA9W-DD81 (reflex type)

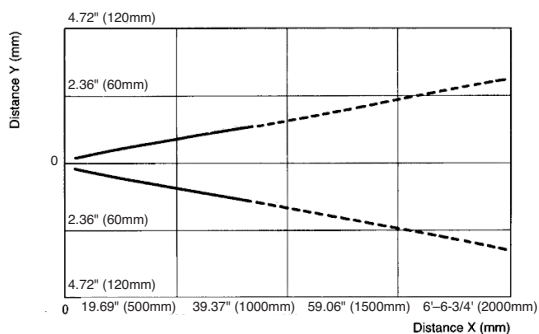


3. Horizontal Transfer Characteristics

SA9W-TS31 (through-beam type)



SA9W-TS31 (through-beam type) and
SA9Z-F21 (lens attachment)



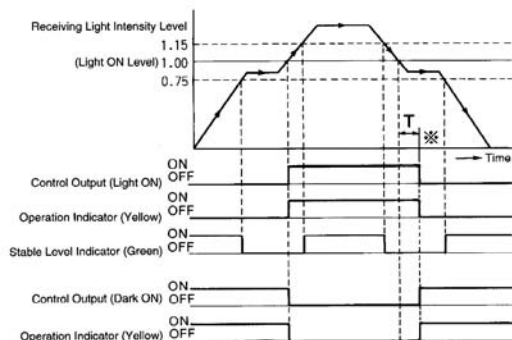
Installation

See page M-56 for general instructions. The information below is specific to the SA1W sensors.

Operation at power ON: The light source does not go on immediately when the power is turned on. The sensor contains a circuit to keep the output off for 20ms.

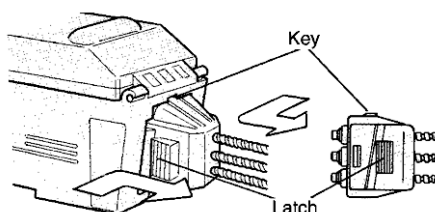
To ensure stable sensing, run a test operation for approximately 15 minutes.

Operation Charts



Connecting fibers to the amplifier: Insert the fibers into the amplifier with the key connector facing up until the head clicks into the body.

For removal, pinch the latches on both sides of the fiber connector and pull the connector toward you.

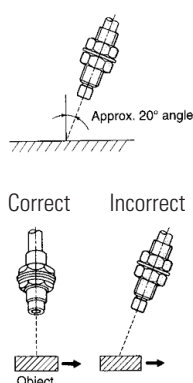


Installing the fiber optics: Tighten the fibers with tightening torque less than 2N·m (20kgf·cm) by using the nut on the tip of the fiber cable.

When using the reflex fiber cable, mount the sensing head with the optical axis angled at 20° from the sensing surface to avoid direct reflective light.

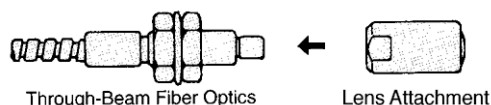
When the surface of the object is not glossy, the mounting angle may be less than 20°.

When the surface of the object is glossy and the changes in the sensing angle are significant, increase the mounting angle to reduce the influence of the changes in the sensing angle.



Connecting the Lens Attachment

Fasten the lens attachment securely to the screw on the tip of the fiber cable. The tightening torque should not exceed 1N·m (10kgf·cm).



Installing the Amplifier Unit

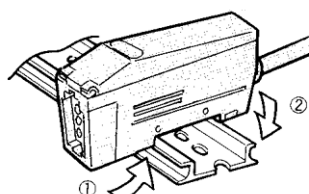
Amplifier units can be snap-mounted onto a 35mm-wide DIN rail or mounted using an attached mounting bracket.

Installation

1. Insert the front of the sensor unit onto the DIN rail or attached mounting bracket.
2. Press the rear of the sensor unit down onto the DIN rail or attached mounting bracket.



1. Do not reverse the above procedures.
2. Do not install the fiber optics onto the amplifier unit before the amplifier is installed onto the DIN rail.



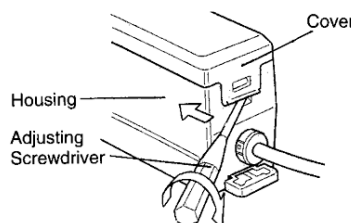
Removal: Insert a screwdriver into the hole on the hook and pull the screwdriver toward you. When using a hole for screw mounting, the tightening torque should range from 0.5 to 0.8N·m (5 to 8kgf·cm).

Cover Opening and Closing

Opening: As shown in the figure at right, insert a screwdriver into the clearance between the cover and the sensor unit. Press the screwdriver toward the sensor unit, and turn the screwdriver clockwise. The cover then can be easily opened.

Caution: To avoid injury, do not use your fingernail to open the cover.

Closing: Press the cover onto the sensor unit until it snaps into place.



Optical alignment: The optical alignment described below is for the Light ON mode.

Through-beam type: Face the projector and receiver fiber optics toward each other. Move the emitter or receiver up, down, left, and right. Then mount them in the middle of the range where the operational indicator (yellow) turns ON. Make sure that the stable level indicator (green) turns on at the incident or interruption.

For Dark ON mode, ON and OFF described above are reversed.

Notes

Installation

See page M-56 for general instructions. The information below is specific to the SA1W sensors.

Do not use sensors near an inductive heat source or where they are subject to strong shocks or vibrations, large amounts of dust, corrosive gases, water for long periods of time, oil, or chemicals.

When the lens of the fiber cable is dusty, dirty, or wet, clean it with a soft cloth dipped in alcohol.

Note that the temperature of the sensor unit may rise depending on the operating environment.

Do not expose the lens to excessive extraneous light.

Do not extend the fiber unit cable.

Do not apply excessive tensile strength to the fiber unit cable; otherwise, malfunction or damage may occur.

Wiring and Power Supplies

Connect according to the output circuit diagram, as mis-wiring will cause damage.

The power voltage should not exceed the rated range.

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

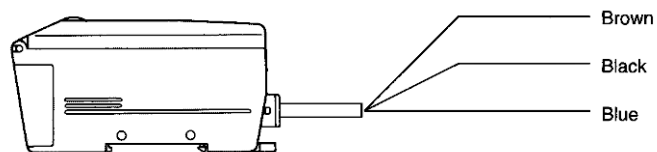
Do not install high-voltages and power lines in the same conduit with input and output lines. Use separate conduits.

When wiring is long or when the influence of the power line and electromagnetic equipment may occur, use a separate conduit for wiring.

Power cable extension is allowed up to 327' (100m) using a cable with core wires of #22 AWG (0.3mm²) or more.

Schematics

Connection Diagram

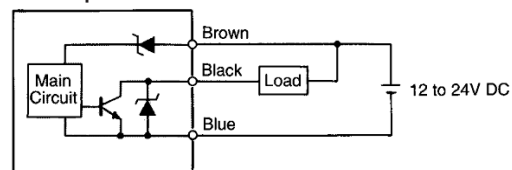


Wiring

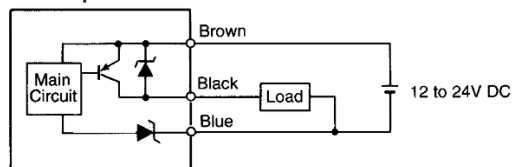
Lead Wire Colour	Name	Function
Brown	+V	12 to 24V DC
Black	OUT	Control Output
Blue	GND (0V)	Power Voltage 0V

Connection Examples

NPN Output

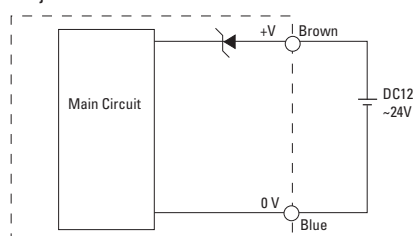


PNP Output

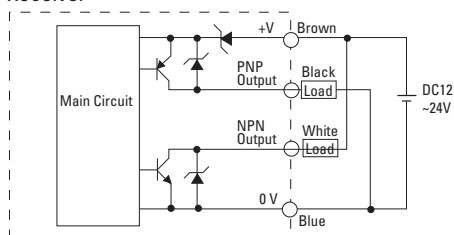


Connection Diagram for SA1W-MK1229

Projector

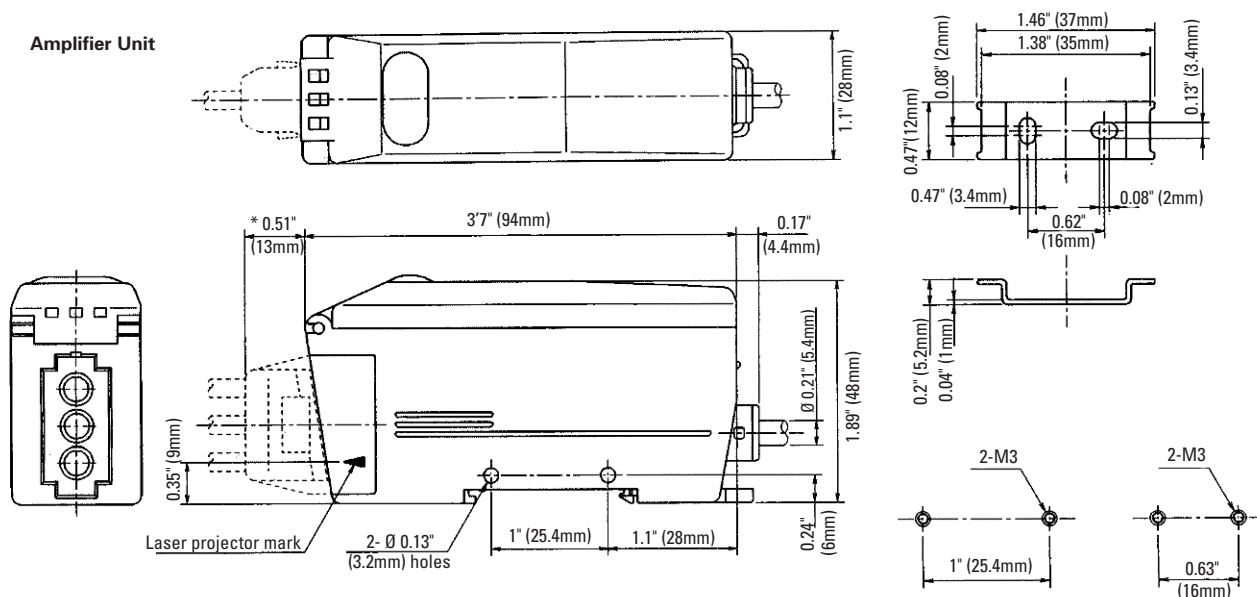


Receiver



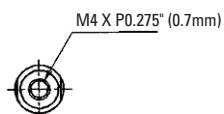
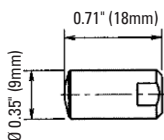
Dimensions

Amplifier Unit



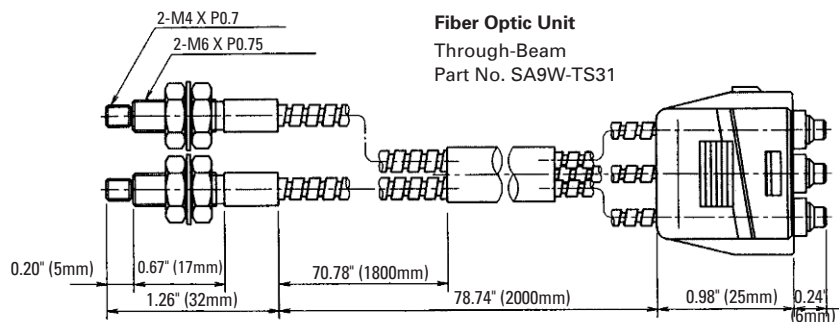
Lens Attachment

Through-Beam
Part No. SA9Z-F21



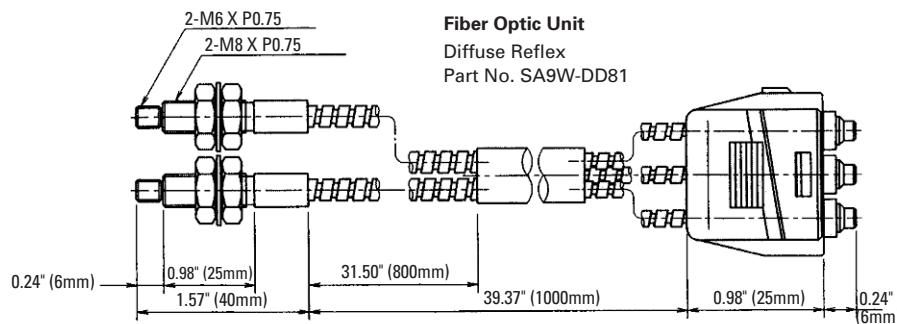
Fiber Optic Unit

Through-Beam
Part No. SA9W-TS31



Fiber Optic Unit

Diffuse Reflex
Part No. SA9W-DD81



MX1C: Self-Contained Laser Displacement Sensors

- Analogue output (20 to 4mA) can be selected for continuous values; digital output (on/off) can be used; or both can be used together
- Miniature sensor head is compact for high-density installations
- Visible beam is easy to align with target
- Adjustable response speed
- Shape, size, colour, and material do not detract from accurate measurement (see note)
- Wide sensing range: 2.36" to 6.30" (60mm to 160mm)
- A ten-dot dynamic display shows detected positions
- Alarm output indicates when sensing conditions may result in inaccurate results



1. *Laser sensing of mirror-like surfaces is not recommended. For best results detecting reflective surfaces, tilt the sensor to reduce direct laser reflection. Sensing at a small angle (approximately $\pm 10^\circ$) does not significantly reduce sensing accuracy or linearity of resulting analogue output.*
2. **WARNING:** *Class IIIa laser. Do not allow the laser to shine directly into the eyes. Always consider eye safety when installing a laser sensor. Make sure that the laser beam cannot inadvertently shine into the eyes of people passing by or working in the vicinity. See laser safety information on page Q-25.*

General Specifications	Power Voltage	24V DC (ripple 10% maximum)
	Current Draw	200mA (maximum)
	Dielectric Strength	Between live and dead parts: 500V AC, 1 minute
	Insulation Resistance	Between live and dead parts: 100M Ω (minimum), with 500V DC megger
	Operating Temperature	0 to +45°C (performance will be adversely affected if the sensor becomes coated with ice)
	Storage Temperature	-20°C to +70°C
	Operating Humidity	35% to 85% RH (avoid condensation)
	Vibration Resistance	Damage limits: 10 to 55Hz, amplitude 1.5mm p-p, 2 hours in each of 3 axes (when de-energized)
	Shock Resistance	Damage limits: 100m/sec ² (approximately 10G), 5 shocks in each of 3 axes
	Extraneous Light Immunity	Incandescent light: 3,000 lux (maximum) — defined as incident or unwanted light received by a sensor, unrelated to the presence or absence of intended object
	Material	Housing: diecast zinc; Filter: glass; Lens: acrylic; Rear cover: polyarylate
	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: 6-core cabtyre cable 0.3mm ² , 6' 6 3/4" (2m) long
	Weight	Approximately 400g
	Dimensions	1.97"D x 0.83"W x 3.07"D (50mm H x 21mm W x 78mm D)

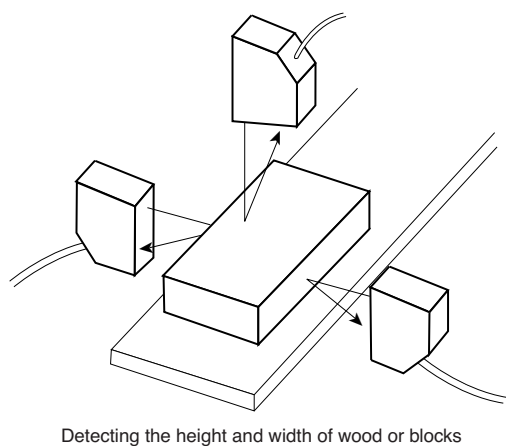
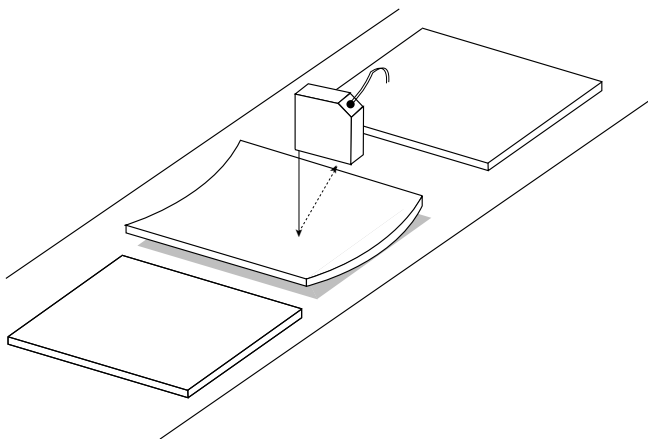
Function Specifications	Resolution	0.002" (50 μ m) — measuring conditions: sensing a white ceramic object at the reference sensing distance (60mm) using the normal response speed (50ms) at 25°C
	Analogue Output	20 to 4mA, 5V (maximum), fixed range
	Digital Output	NPN or PNP transistor open collector: 30V DC, 100mA (maximum); Residual: 1V (NPN), 2V (PNP)
	Alarm Output	NPN or PNP transistor open collector: 30V DC, 100mA (maximum); Residual: 1V (NPN), 2V (PNP)
	Level Metre (ten-dot LED)	Analogue: Represents analogue output level according to the object distance Digital: Indicates preset position for near limit
	Out LED	On: When digital output on
	Laser Diode LED	On: While laser is emitted (LD ON), laser emits approximately 1 second after power-up
	Alarm LED	On: When reflected light is insufficient
	Digital Output	On: When object is within the near limit setting and beyond the close end of the sensing range ($\geq$ 2.36" or 60mm from the sensor)
	Digital Output Setting	Fine-tuning dial for near limit setting
	Response Time	High-speed (F): 5ms (maximum); Normal speed (S): 50ms (maximum)
	Detectable Object	Non-mirror-like surfaces
	Analogue Adjustment	0.20" (5mm) = 0.8mA using multi-turn dial
	Linearity	$\pm 100 \mu$ m $\pm 1\%$ of displacement value, defined as how linear (i.e. accurate) the actual analogue output is, with respect to distance
	Hysteresis	0.039" (1mm), defined as the difference between the operating point and the release point
	Temperature Drift	5 μ A per °C with 1.97" (50mm) square white ceramic
	Light Source Element	Visible laser diode (670nm), 5 mW laser
	Receiver Element	PSD (position sensitive device)

Part Numbers: MX1C Sensors

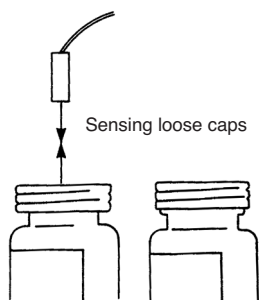
Part Number	Output	Sensing Range	Resolution
MX1C-AK1	NPN	2.36" to 6.30"	0.002" (50μm)
MX1C-AL1	PNP	(60mm to 160mm)	

Applications

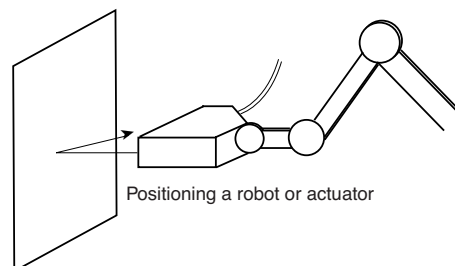
Checking for warped boards



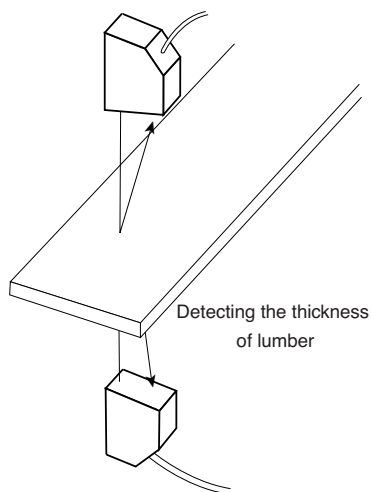
Detecting the height and width of wood or blocks



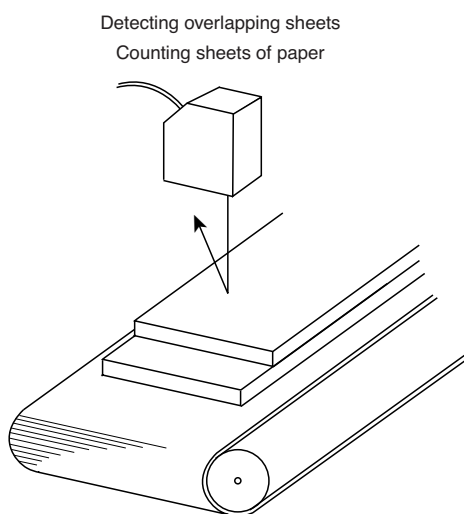
Sensing loose caps



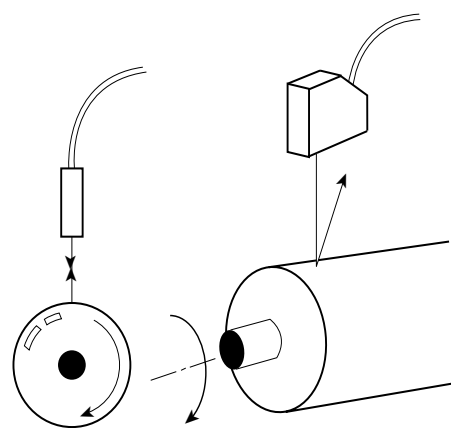
Positioning a robot or actuator



Detecting the thickness of lumber



Detecting overlapping sheets
Counting sheets of paper

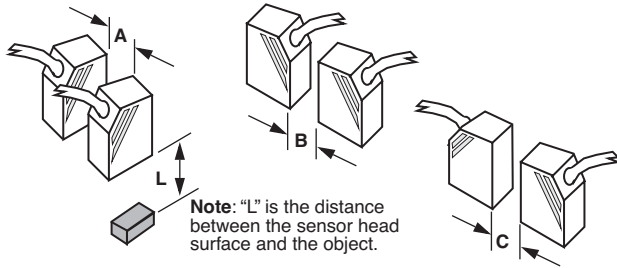


Sensing the roundness of a roller

Installation

See page Q-56 for general sensor instructions. Below are considerations specific to the MX1C miniature laser sensors.

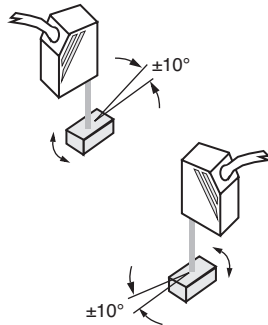
When installing multiple sensors, provide the recommended clearance as shown below, to prevent the interference of signals.



L	A	B	C
2.36" (60mm)	0	0	0
4.33" (110mm)	0	0.79" (20mm)	1.97" (50mm)
6.30" (160mm)	0.79" (20mm)	2.36" (60mm)	3.94" (100mm)

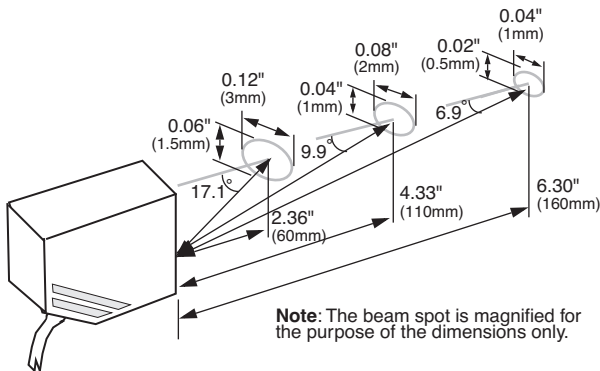
Laser sensing of mirror-like surfaces is not recommended, as the sensor receiver is designed for detecting diffuse-reflected light. Direct laser reflection may result in unreliable results.

For best results detecting reflective surfaces, tilt the sensor to reduce direct laser reflection. Sensing at a small angle (approximately $\pm 10^\circ$) does not significantly reduce the sensing accuracy or linearity of the resulting analogue output.



WARNING: Class IIIa laser. Do not allow the laser to shine directly into the eyes. Always consider eye safety when installing a laser sensor. Make sure laser beam cannot inadvertently shine into the eyes of people passing by or working in the vicinity. See laser safety information on page Q-25.

Projected Beam Characteristics



Due to the focusing characteristics of the lens, the projected beam of a laser sensor gets smaller (converges) from the near end to the far end of the sensing range. The beam gets larger (diverges) beyond the far end of the sensing range.

MX1C: Self-Contained Laser Displacement Sensors

Wiring

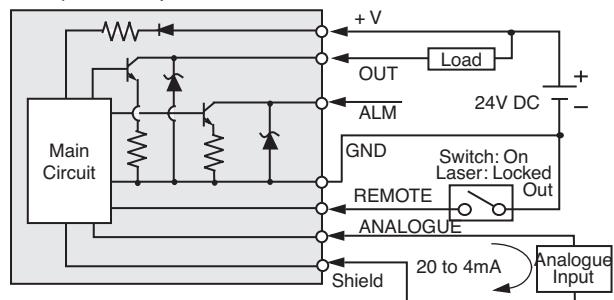
Wire Colour	Name	Function
Brown	+V	24V DC, 200mA (maximum)
Black	OUT	Digital Output, 30V DC, 100mA
Orange	ALM	Alarm Output, 30V DC, 100mA
Blue	GND	Power Ground (0 V)
White	ANALOGUE	Analogue Output, 20 to 4mA
Peach	LD RMT	Remote Interlock On/Off Switch
Shield	A. GND	Analogue Ground



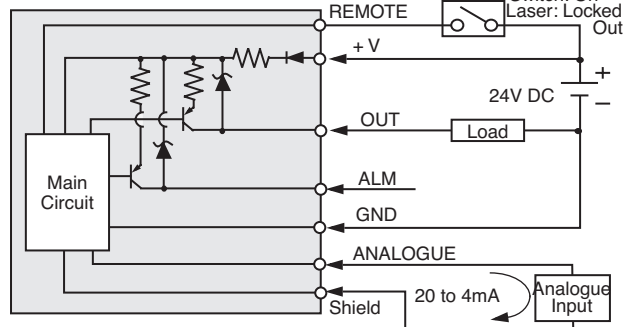
The analogue output line may be extended up to 33' (10m), as long as the cable used is equal to or superior to the cable provided. Other lines may be extended up to 164' (50m), using #22 AWG (0.3mm²) wire.

Schematics

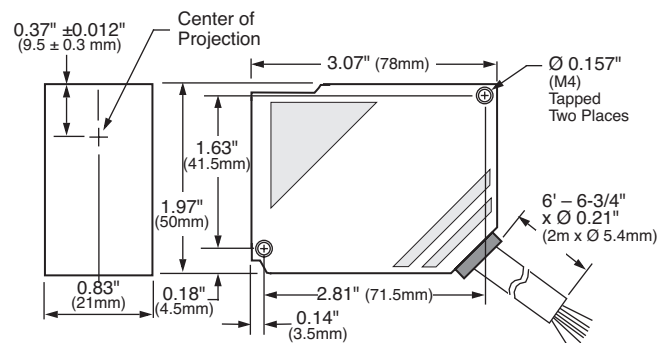
NPN (MX1C-AK1)



PNP (MX1C-AL1)



Dimensions



Laser Safety Information

Installation: If a sensor is installed so that the laser beam may shine or reflect into the eyes of a person passing by or working in the vicinity, place an opaque sheet of material in front of the beam to prevent potential eye injury. For people working near a laser sensor, protective glasses which screen out a significant amount of the harmful radiation are recommended at all times.

All SA1M laser sensors also include a remote interlock terminal which can be used to turn the laser on or off with an external switch, as required, to operate the sensor safely from a remote location. To avoid exposure to harmful radiation, never disassemble a laser sensor.

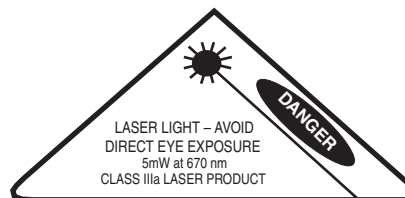
WARNING: Do not allow class IIIa beams to shine directly into the eyes. Do not allow lasers to reflect from a glossy, shiny, or reflective surface into the eyes.



Labelling: IDEC laser sensors include **CDRH-approved** safety warnings shown on the right and below, in compliance with federal regulations of the **Center for Devices and Radiological Health**.



SA1M Laser Mark Sensor:
Class IIIa Laser (670Nm) Visible Beam



Warning Label (common)



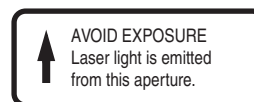
All Laser Sensors:
Identification and Certification

mfd.: **FEBRUARY 1997**
Product conforms to
21 CFR1040

Precaution Label



SA1M Visible Laser:
Aperture Warning



SA6A: Ultrasonic Analogue Distance Detection Sensors

Key features of the SA6A include:

- Noise protection is available in two modes of operation
- Fuzzy logic eliminates the adverse effects of temperature fluctuation and air turbulence
- Hold mode is ideal for sensing liquid levels without the chatter often caused by surface ripples
- Three sensing ranges optimize resolution:
Short range: 1.97" to 11.81" (± 0.04 ")
Medium range: 3.94" to 39.37" (± 0.08 ")
Long range: 7.87" to 78.74" (± 0.19 ")
- Shape, size, colour, and material do not impair high-precision measurement
- Select analogue output (4 to 20mA) for continuous values; use digital output (on/off); or use both
- An eight-dot LED metre provides a dynamic display of detected positions



General Specifications	Power Voltage	12 to 24V DC (ripple 10% maximum)
	Current Draw	100mA (maximum)
	Dielectric Strength	Between live and dead parts: 1000V, 50/60Hz, 1 minute
	Insulation Resistance	Between live and dead parts: 100M Ω (minimum) with 500V DC megger
	Operating Temperature	-10° to +60°C (performance will be adversely affected if the sensor becomes coated with ice)
	Storage Temperature	-30°C to +70°C
	Operating Humidity	35 to 70% RH (avoid condensation)
	Vibration Resistance	Damage limits: 10 to 55Hz, amplitude 1.5mm p-p, 2 hours in each of 3 axes (when de-energized)
	Shock Resistance	Damage limits: 500m/sec ² (approximately 50G) 3 shocks in each of 3 axes
	Noise Resistance	Power line: 500V; Pulse width: 1 μ sec, 50/60Hz (using a noise simulator)
	Material	Housing: diecast zinc; Coverplate: polyarylate
	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: 6-core cabtyre cable 0.2mm ² , 6'-6-3/4" (2m) long
	Weight	Short and medium range: 260g; Long range: 270g
	Dimensions	Short and medium range: 1.96"H x 0.82"W x 3.19"D (50mm H x 21mm W x 81mm D) Long range: 3.19"H x 1.14"W x 3.33"D (50mm H x 29mm W x 84.5mm D)

Part Numbers: Short Sensing Range

Part Number	Output	Sensing Range (A Mode)	Sensing Range (B Mode)	Linearity/Resolution
SA6A-L1K4S SA6A-L1L4S	NPN PNP	3.94" to 11.81" $\pm$ 0.4" (100mm to 300mm $\pm$ 10mm)	1.97" to 11.81" $\pm$ 0.4" (50mm to 300mm $\pm$ 10mm)	$\pm$ 0.04" (1mm)

Part Numbers: Medium Sensing Range

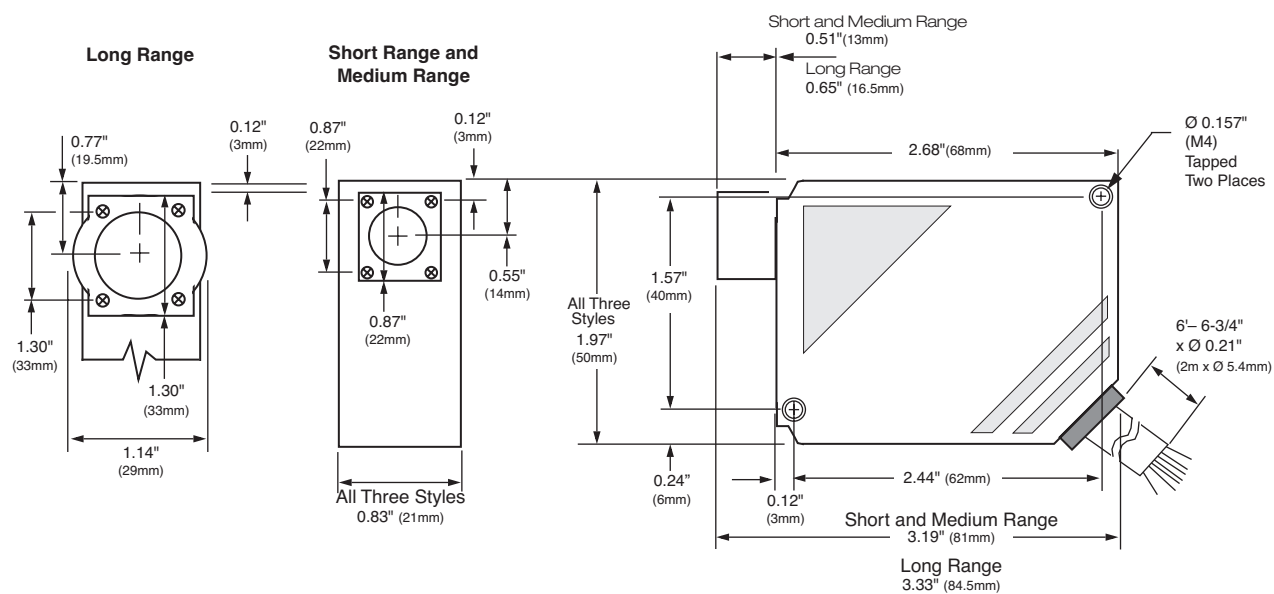
Part Number	Output	Sensing Range (A Mode)	Sensing Range (B Mode)	Linearity/Resolution
SA6A-LK4S SA6A-LL4S	NPN PNP	7.87" to 39.37" $\pm$ 0.8" (200mm to 1m $\pm$ 20mm)	3.94" to 39.37" $\pm$ 0.8" (100mm to 1m $\pm$ 20mm)	$\pm$ 0.08" (2mm)

Part Numbers: Long Sensing Range

Part Number	Output	Sensing Range (A Mode)	Sensing Range (B Mode)	Linearity/Resolution
SA6A-L2K4S SA6A-L2L4S	NPN PNP	15.75" to 78.74" $\pm$ 1.6" (400mm to 2m $\pm$ 40mm)	7.87" to 78.74" $\pm$ 1.6" (200mm to 2m $\pm$ 40mm)	$\pm$ 0.19" (5mm)

Function Specifications		SA6A-L1K4S, -L1L4S	SA6A-LK4S, -LL4S	SA6A-L2K4S, -L2L4S
	Analogue Output	4 to 20mA (fixed range)	4 to 20mA (fixed range)	4 to 20mA (fixed range)
	Error	$\pm$ 0.08mA	$\pm$ 0.04mA	$\pm$ 0.05mA
		Defined as how accurate the actual analogue output is, with respect to distance		
	Resolution	$\pm$ 0.04" (1mm)	$\pm$ 0.08" (2mm)	$\pm$ 0.19" (5mm)
		Defined as the smallest object or the shortest distance that can be detected with reliability		
	Digital Output	NPN or PNP transistor open collector, 100mA, 30V DC (maximum); Residual: 1.5V (NPN), 2.5V (PNP)		
	Alarm Output	NPN or PNP transistor open collector, 100mA, 30V DC (maximum); Residual: 1.5V (NPN), 2.5V (PNP)		
	Level Metre	A or B mode: Represents analogue output level on an 8-dot LED display, corresponding to object distance		
	Out LED	On: When digital output is on (red LED)		
	Power LED	On: When power is on (red LED)		
	Alarm LED	On: When environment change occurs (red LED)		
	Stable LED	On: When stable operation is ensured (green LED)		
	Response: Normal Mode	Analogue: 12Hz Digital (A mode): 22Hz Digital (B mode): 15Hz	Analogue: 8Hz Digital (A mode): 15Hz Digital (B mode): 10Hz	Analogue: 5Hz Digital (A mode): 10Hz Digital (B mode): 7Hz
	Response: Fuzzy Mode	Analogue/Digital: 4Hz	Analogue/Digital: 3Hz	Analogue/Digital: 2Hz
	Response: Hold Mode	Analogue/Digital: 4Hz	Analogue/Digital: 3Hz	Analogue/Digital: 2Hz
	Response Time	Analogue: 48ms Digital (A mode): 16ms Digital (B mode): 24ms	Analogue: 70ms Digital (A mode): 24ms Digital (B mode): 36ms	Analogue: 90ms Digital (A mode): 30ms Digital (B mode): 45ms
	Internal Synchronous Mode	Two sensors synchronized, alternate oscillations prevent interference; response time is doubled		
	External Synchronous Mode	Three or more sensors synchronized with timing pulse signal: On/Off (A mode) $\geq$ 15ms On/Off (B mode) $\geq$ 20ms		
	Oscillation Frequency	Approximately 290kHz	Approximately 200kHz	Approximately 130kHz
	Directivity	$\pm$ 10° (half wave: -6 dB)	$\pm$ 7° (half wave: -6 dB)	$\pm$ 7° (half wave: -6 dB)
	Temperature Characteristics	$\pm$ 0.06% per °C ($\pm$ 12 μ A per °C)		
	Hysteresis	0.24" (6mm)	0.39" (10mm)	0.79" (20mm)
		Defined as the difference between the operating point and the release point		

Dimensions



SA1D: Analogue Distance Detection Sensors

Key features of the SA1D include:

- Triangulation ensures high-precision when sensing the presence or position of objects
- Wide sensing range: 7.87" to 19.69" (200 to 500mm)
- Select analogue output (20 to 4mA) for continuous values; use digital output (on/off); or use both together
- Far and near limits can be defined for detecting objects within a specified zone
- A ten-dot LED level metre provides a dynamic display of detected positions and also shows near and far settings
- Alarm output indicates when sensing conditions may result in inaccurate results



General Specifications	Power Voltage	12 to 24V DC $\pm$ 10% (ripple 10% maximum)
	Current Draw	100mA (maximum)
	Dielectric Strength	Not specified due to capacitor grounding
	Insulation Resistance	Not specified due to capacitor grounding
	Operating Temperature	0° to +55°C (performance will be adversely affected if the sensor becomes coated with ice)
	Operating Humidity	35 to 85% RH (avoid condensation)
	Storage Temperature	-20° to +70°C
	Vibration Resistance	Damage limits: 10 to 55Hz, amplitude 1.5mm p-p, 2 hours in each of 3 axes (power off)
	Shock Resistance	Damage limits: 500m/sec ² (approximately 50G), 5 shocks in each of 3 axes
	Extraneous Light Immunity	Sunlight: 10,000 lux; Incandescent light: 3,000 lux (maximum) — defined as the incident or unwanted light received by a sensor, unrelated to the presence or absence of the intended object
	Material	Housing: Diecast zinc; Filter and lens: Acrylic
	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: 5-core cabtyre cable 0.2mm ² , 6'-6-3/4" (2m) long
	Weight	Approximately 350g
	Dimensions	2.68"H x 0.83"W x 1.97"D (68mm H x 21mm W x 50mm D)

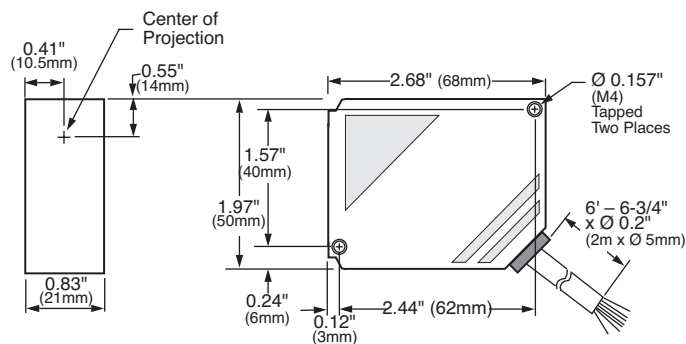
Function Specifications	Analogue Output	20 to 4mA, 5V (maximum), fixed range
	Digital Output	NPN or PNP transistor open collector, 30V DC, 100mA (maximum), Residual: 1V (NPN), 2V (PNP)
	Alarm Output	NPN or PNP transistor open collector, 30V DC, 100mA (maximum), Residual: 1V (NPN), 2V (PNP)
	Level Metre (10-dot LED display)	Analogue: Represents object distance corresponding to analogue output on a 10-dot LED display Digital: Indicates near or far limit settings
	Out LED	On: When digital output is on
	Power LED	On: When power is on
	Alarm LED	On: When reflected light is excessive or insufficient
	Digital Output	Digital output and OUT LED turns on when object is within near and far limits
	Digital Output Setting	14-turn control for far/near setting (far and near limits can be set separately)
	Response Time	High-speed (F): 5ms (maximum) Normal speed (S): 50ms (maximum)
	Repeat Error	High-speed: 4% (maximum) Normal speed: 2% (maximum)
	Hysteresis	10% (maximum), defined as the difference between the operating point and the release point
	Light Source Element	Infrared LED (modulation mode)
	Wavelength	880 nm (infrared LED)
	Receiver Element	Position sensitive device (PSD)
	Detectable Object	Opaque

Part Numbers: SA1D Sensors

Part Number	Output	Sensing Range	Reference Object
SA1D-LK4	NPN	7.87" to 19.69" (200mm to 500mm)	White: 2.95" x 2.95" (75mm x 75mm)
SA1D-LL4	PNP	7.87" to 19.69" (200mm to 500mm)	

Applications	
Analogue output: Controlling tension	Comparison output: Detecting overlap
Analogue output: Identifying box size	Comparison or analogue output: Sensing object zone

Dimensions



Wiring

Wire Colour	Name	Function
Brown	+V	12 to 24V DC, 100mA (maximum)
Black	OUT	Digital Output, 30V DC, 100mA
Orange	ALM	Alarm Output, 30V DC, 100mA
Blue	GND	Power Ground (0 V)
White	ANALOGUE	Analogue Output, 20 to 4mA
Shield	GND	Shield



An analogue output line may be extended up to 33' (10m), as long as the cable used is equal to or superior to the cable provided. Other lines may be extended up to 164' (50m), using #22 AWG (0.3mm²) wire.

SA1E: Photoelectric Switches

Simple, compact design for world-wide usage.

Key features of the SA1E photoelectric sensor include:

- Four sensing methods
- Cable types and M8 connector types available
- NPN output, PNP output, light ON, dark ON options
- Long sensing ranges, high speed response
- CE marked



			Through-beam Type	Polarized Retroreflective Type	Diffuse-reflective Type	Small-beam Reflective Type
Cable Type	NPN output	Light ON	SA1E-TN1	SA1E-PN1	SA1E-DN1	SA1E-NN1
		Dark ON	SA1E-TN2	SA1E-PN2	SA1E-DN2	SA1E-NN2
	PNP output	Light ON	SA1E-TP1	SA1E-PP1	SA1E-DP1	SA1E-NP1
		Dark ON	SA1E-TP2	SA1E-PP2	SA1E-DP2	SA1E-NP2
Connector Type	NPN output	Light ON	SA1E-TN1C	SA1E-PN1C	SA1E-DN1C	SA1E-NN1C
		Dark ON	SA1E-TN2C	SA1E-PN2C	SA1E-DN2C	SA1E-NN2C
	PNP output	Light ON	SA1E-TP1C	SA1E-PP1C	SA1E-DP1C	SA1E-NP1C
		Dark ON	SA1E-TP2C	SA1E-PP2C	SA1E-DP2C	SA1E-NP2C
Applicable Standard			IEC606947-5-2			
Rated Operational Voltage			12 to 24V DC			
Operating Limits			10 to 30V DC			
Rated Insulation Voltage			30V DC			
Power Consumption / Current Draw			Emitter: 15 mA Receiver: 20 mA	30 mA		
Sensing Range			10 m	2.5 m (IAC-R5) 1.5 m (IAC-R6) (Note) 1 m (IAC-RS1)	700 mm (using 200 × 200 mm white matt paper)	50 to 150 mm (using 100 × 100 mm white matt paper)
Detectable Object			Opaque		Opaque/Transparent	
Hysteresis			—		20% maximum	
Response Time			1 ms maximum			
Sensitivity Control			Adjustable using a potentiometer (approx. 260°)			
Light Source Element			Infrared LED	Red LED	Infrared LED	Red LED
Operation Mode			Light ON/Dark ON			
Control Output			NPN open collector/PNP open collector 30V DC, 100 mA maximum Voltage drop: 1.2V maximum Short-circuit protection			
LED Indicators			Operation LED: Yellow Stable LED: Green Power LED: Green (Through-beam type emitter)			
Interference Prevention			—	Two units can be mounted close together		
Degree of Protection			IP67 (IEC60529)			



1. Maintain at least 100 mm clearance between the SA1E photoelectric switch and reflector. Reflectors are not attached to the photoelectric switch and must be ordered separately.
2. Standard cable length for cable type is 1 metre. Contact IDEC for longer cable lengths.

		Through-beam Type	Polarized Retroreflective Type	Diffuse-reflective Type	Small-beam Reflective Type
General Specifications con't	Extraneous Light Immunity		Sunlight: 10,000 lux maximum, Incandescent lamp: 3,000 lux maximum (at receiver)		
	Operating Temperature		−25 to + 55°C (no freezing)		
	Operating Humidity		35 to 85% RH (no condensation)		
	Storage Temperature		−40 to +70°C (no freezing)		
	Insulation Resistance		Between live and dead parts: 20 MΩ maximum (500V DC megger)		
	Dielectric Strength		Between live and dead parts: 1000V AC, 50/60 Hz, 1 minute		
	Vibration Resistance		Damage limits: 10 to 55 Hz, Amplitude 0.75 mm p-p, 20 cycles in each of 3 axes		
	Shock Resistance		Damage limits: 500 m/s ² , 10 shocks in each of 3 axes		
	Material		Housing: PC/PBT, Lens: PC (Polarized retroreflective type: PMMA), Indicator cover: PC		
	Accessories Included		Instruction sheet, Sensitivity control screwdriver		
	Weight (approx)	Cable Type	Emitter: 30g Receiver: 30g	30 g	
		Connector Type	Emitter: 10g Receiver: 10g	10 g	
	Connection Method	Cable Type	ø3.5 mm, 3-core, 0.2 mm ² , 1-m vinyl cabtyre cable (2-core for the emitter of through-beam type)		
		Connector Type	M8 connector (4-pin)		

SA1E Accessories

Mounting Brackets

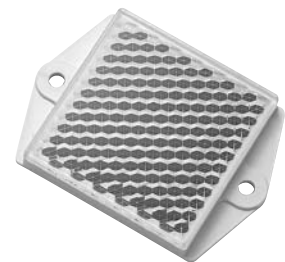
Part Number	Type	Package Quantity
SA9Z-K01	Vertical	1
SA9Z-K02	Horizontal	

Connector Cable for connector type

Part Number	Core Wires	Type & Length	Package Quantity
SA9Z-CM8K-4S2	4	Straight, 2m	1
SA9Z-CM8K-4L2		Right angle, 2m	
SA9Z-CM8K-4S5		Straight, 5m	
SA9Z-CM8K-4L5		Right angle, 5m	

Reflectors for polarized retroreflective type

Part Number	Type	Package Quantity	Type & Length	Applicable Mounting Bracket
IAC-R5	Standard	1	Straight, 2m	IAC-L2
IAC-R6	Small		Right angle, 2m	IAC-L3
IAC-RS1	Tape type		Straight, 5m	—

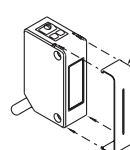


Slits for through-beam type

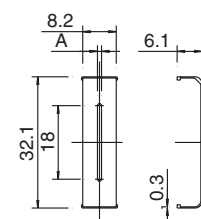
Part Number	Slit Width	Package Quantity	Sensing Range (m)		Maximum Detectable Object Width (mm)	
			One side	Both sides	One side	Both sides
SA9Z-S06	0.5 mm	2	2.5	1.0	7.0	0.5
SA9Z-S07	1.0 mm		3.5	1.5	7.0	1.0
SA9Z-S08	2.0 mm		6.0	3.5	7.0	2.0

Dimensions

The slit can be pressed to fit on the front easily in one touch.

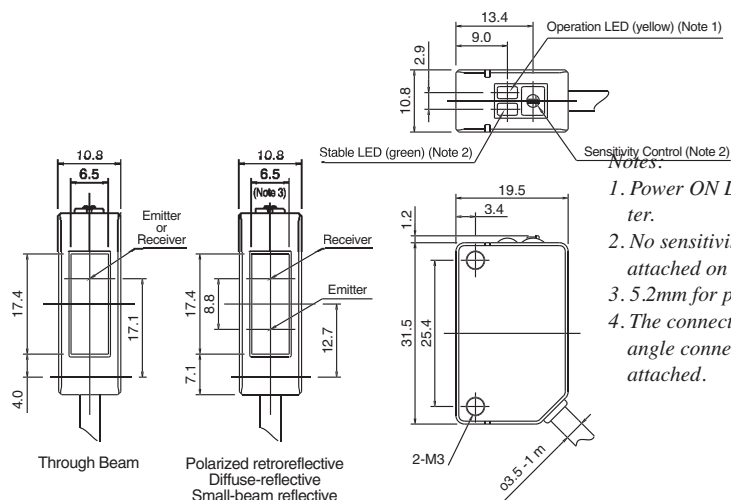


Slit (Stainless Steel)



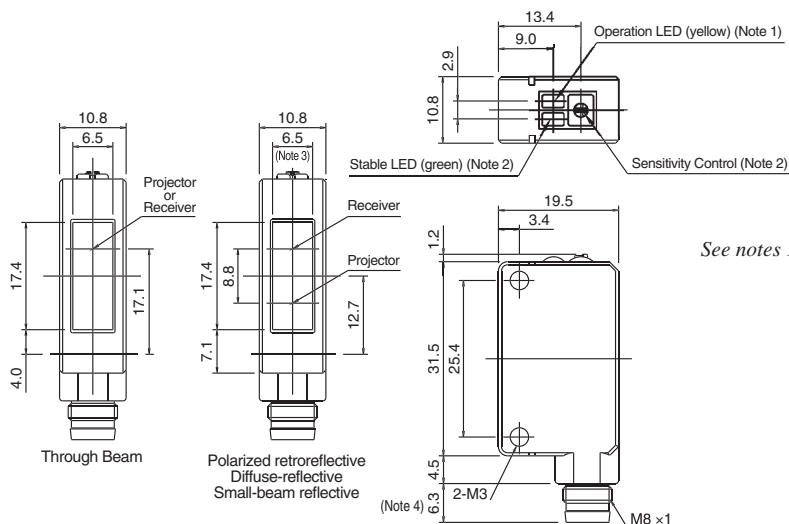
Dimensions

Cable Type



- Notes:**
1. Power ON LED (green) for through-beam emitter.
 2. No sensitivity control and stable LED are attached on the through-beam emitter.
 3. 5.2mm for polarized retroreflective type.
 4. The connector length is 18mm when a right-angle connector cable (SA9Z-CM8K-4L) is attached.

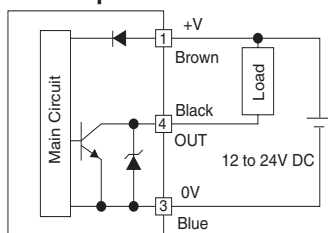
Connector Type



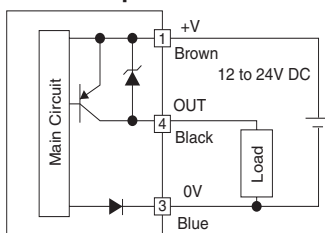
See notes 1 through 4 above.

Output Circuit and Wiring Diagram

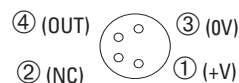
• NPN Output



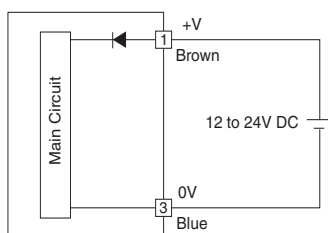
• PNP Output



Connector Pin Assignment



• Through-beam Type Emitter



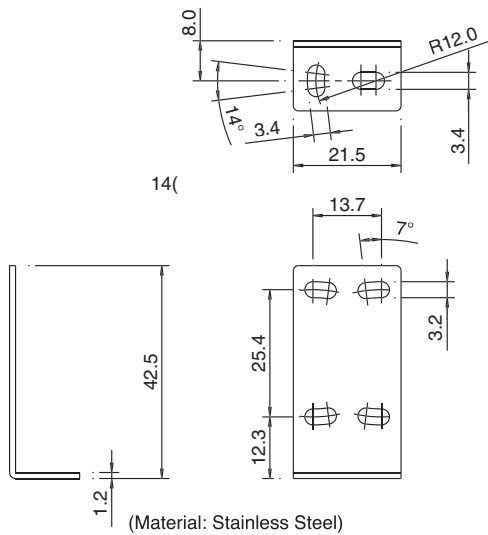
Connector Pin Assignment



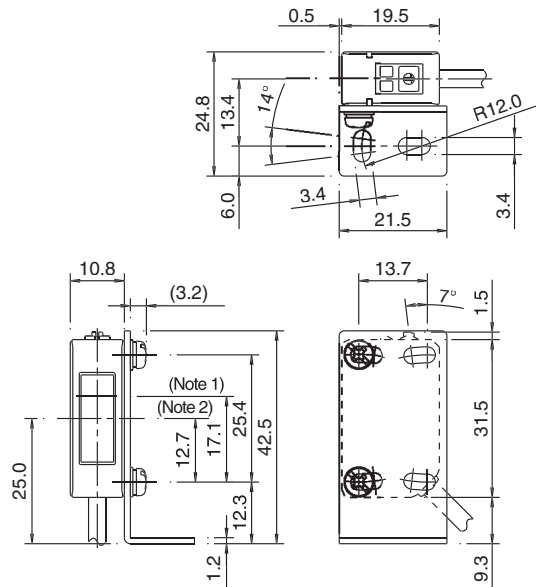
Dimensions, continued

Mounting Bracket

SA9Z-K01

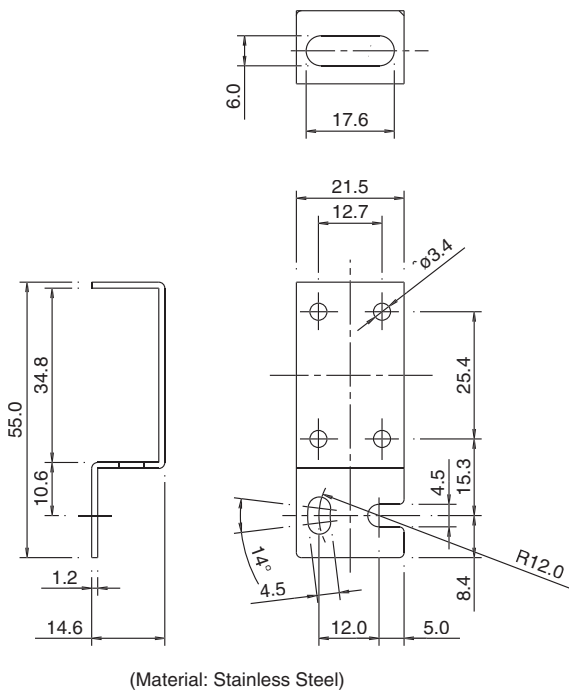


With Mounting Bracket

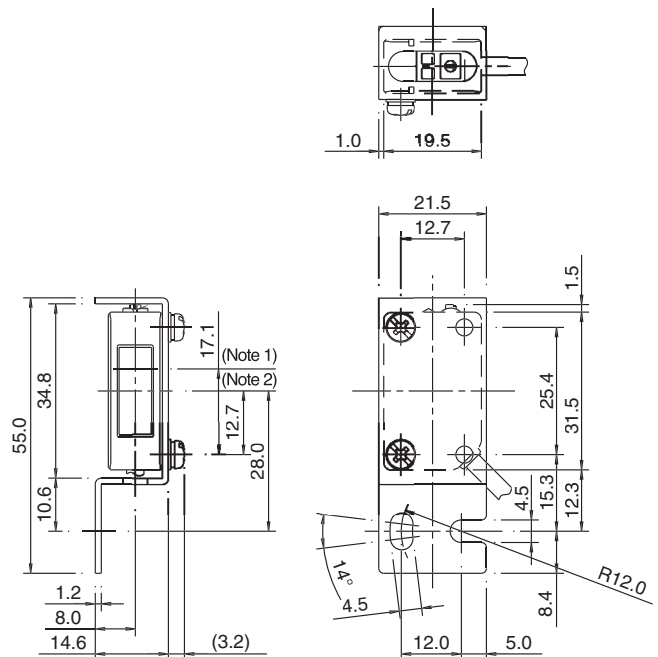


Note 1: Center of optical axis (through-beam type)
 Note 2: Center of optical axis (polarized retroreflective, diffuse reflective, and small-beam reflective type)

SA9Z-K02



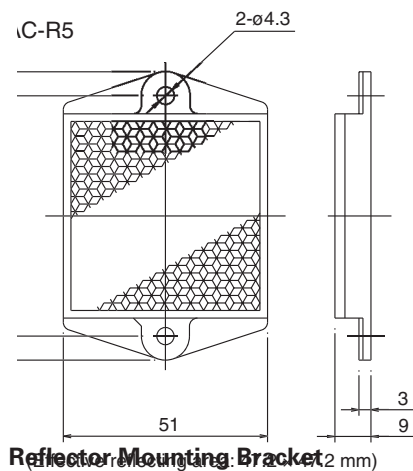
With Mounting Bracket



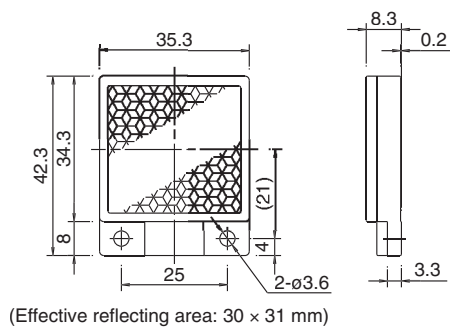
Note 1: Center of optical axis (through-beam type)
 Note 2: Center of optical axis (polarized retroreflective, diffuse reflective, and small-beam reflective type)

Dimensions, continued

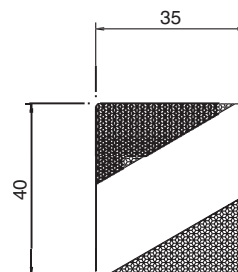
Reflector



IAC-R6

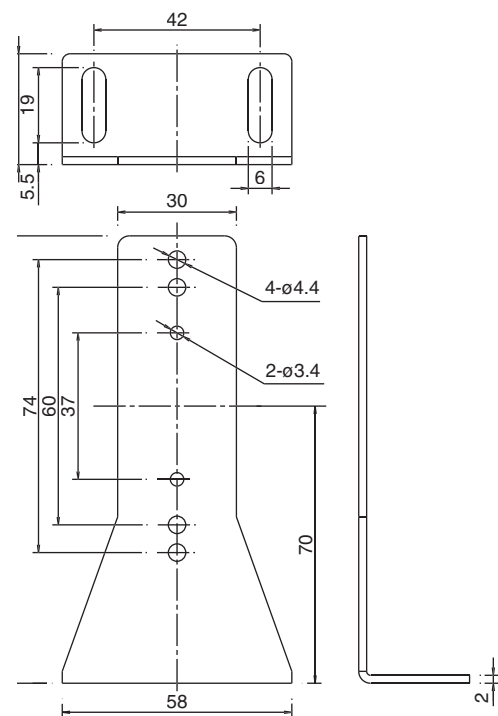


IAC-RS1



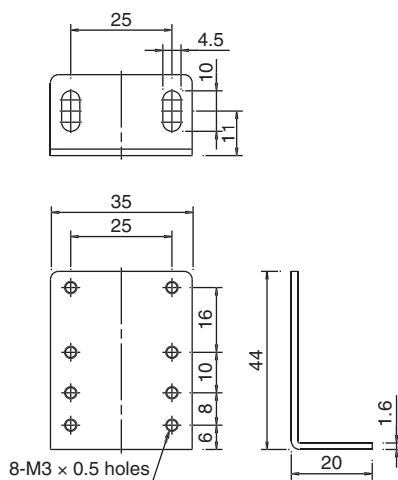
Reflector Mounting Bracket

AC-L2



Material: SPCC (zinc chromate plating, black)

IAC-L3



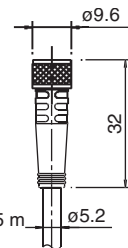
Material: SPCC (zinc plating)

Connector Cable
(one-side connector)

Straight Type

SA9Z-CM8K-4S□

- ① Black ③ White
② Blue ④ Brown



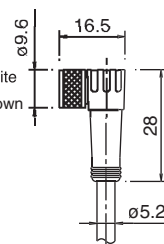
Cable length: 2 or 5 m

Note: Dielectric strength when installed on the switch
Between live part and mounting bracket:
1000V AC (except between live part and clamping ring)

Right-angle Type

SA9Z-CM8K-4L□

- ① Black ③ White
② Blue ④ Brown

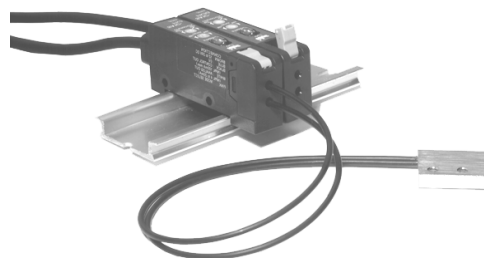


Cable length: 2 or 5 m

Note: Dielectric strength when installed on the switch
Between live part and mounting bracket:
1000V AC (except between live part and clamping ring)

SA1C-FK: Fiber Optic Analogue Photoelectric Sensors

- High-speed, miniature photoelectric sensors with analogue (4mA to 20mA) and digital output
- Senses gradual colour changes
- Available in both red and green LEDs
- Through-beam and reflected-light sensing available
- Ideal for either colour mark applications or simple presence and absence applications requiring analogue output
- Compact size allows for DIN rail mounting
- Dozens of coordinating fiber optic units available to address specific application needs
- Simple to install and program
- IP66 protection rating



General Specifications

	SA1C-FK3	SA1C-FK3G
Light Source Element	Red LED	Green LED
Sensing Distance	Depends on the fiber unit (see pages 38–40)	
Power Voltage	12 to 24V DC (Operating voltage: 10 to 30V DC) ripple 10% maximum	
Current Draw	80mA maximum	
Analogue Current Output	4 to 20mA, 5V DC maximum	
Digital Output	NPN open collector 30V DC, 100mA maximum, 1.5V maximum with short circuit protection	
Operation Mode	Dark ON (connect MODE line to GND line); Light ON (connect MODE line to power line)	
Response	0.5ms maximum	
Indicator	Operation LED: Red, Stable LED: Green	
Detectable Object	Translucent object, opaque object	
Hysteresis	20% maximum (using reflex fiber unit)	
Sensitivity	4-turn adjustment	
Operation Point Control	1 turn	
Receiver Element	Photo diode	
Operating Temperature	–25 to +55°C (performance will be adversely affected if the sensor becomes coated with ice)	
Storage Temperature	–30 to +70°C (performance will be adversely affected if the sensor becomes coated with ice)	
Operating Humidity	35 to 85% RH (avoid condensation)	
Extraneous Light Immunity	Sunlight: 10,000 lux maximum; Incandescent light: 3,000 lux (at the receiver)	
Noise Resistance	Normal mode: 500V (50ns to 1µs, 100Hz: Using a noise simulator) Common mode: 300V (50ns to 1µs, 100Hz: Using a noise simulator)	
Insulation Resistance	Between live and dead parts: 20MΩ minimum, with 500V DC megger	
Dielectric Strength	Between live and dead parts: 1,000V, 1 minute	
Vibration Resistance	Damage limits: 10 to 55Hz; Single amplitude: 0.75mm 20 cycles in each of 3 axes	
Shock Resistance	Damage limits: 500 m/sec ² 10 cycles in each of 3 axes	
Degree of Protection	IP66 — IEC Pub 529	
Cable	Cable type: Ø4.4mm 5-core vinyl cabtyre cable 0.2mm ² , 6'–6-3/4" (2m) long	
Material	Housing: Polybutylenterephthalate (PBT)	
Accessories	Mounting bracket, adjusting screwdriver, load resistor (249Ω) for converting analogue amperage to voltage (1 to 5V)	
Interference Prevention	Up to 2 units can be installed in close proximity. For analogue output, interference prevention is not possible.	
Weight	Approximately 75g	



1. Analogue current output specification is based on the power voltage range from 12 to 24V DC (±10%).
2. Use the attached resistor (249Ω, 1/4W) as a load resistance for converting analogue output to voltage.
3. Response time for analogue current output is between 10% and 90% of the rise or fall of the voltage signal when using a 249Ω resistor.

Part Numbers: SA1C-FK Sensors

Part Number	Light Source Element	Output
SA1C-FK3	Red LED	Analogue output + NPN output (with short-circuit)
SA1C-FK3G	Green LED	

Ordering Details

The SA1C-FK series consists of the amplifier/receiver only. Fiber optic units must be ordered separately using part numbers beginning with SA9F. SA1C-FK amplifier/receivers can be used with either through-beam or diffuse-reflected fiber optic units.

The fiber optic cord is 6'-6-3/4" (2m) long. Fiber optic cords can be cut to the desired length using a fiber cutter, except for heat-resistant glass fiber cords. A fiber cutter is included with fiber optic units (order SA9Z-F01 separately for replacement). A set of two easy-insert adaptors is included with the following fiber optic units: SA9F-TT, SA9F-TL, SA9F-DT, and SA9F-DL (order SA9Z-F02 for replacement set).

Part Numbers: SA9F Diffuse-Reflected Light Fiber Optic Units

Part Number	Description	Amplifier	Range	Dimensions
SA9F-DS31 No sleeve SA9F-DS32 3.54" (90mm) sleeve SA9F-DS33 1.77" (45mm) sleeve	Straight: Two fibers $\varnothing 0.04"$ (1mm) Threaded mount: $\varnothing 0.24"$ (M6) Detects: $\varnothing 0.0012"$ (0.03mm) minimum object	SA1C-FK3 SA1C-FK3G	2.36" (60mm) 0.28" (7mm)	$\varnothing 0.45"$ (11.5mm) $\varnothing 0.20"$ (5.2mm) $\varnothing 0.04"$ (1mm) Two Fibers $\varnothing 0.16"$ (4mm) $\varnothing 0.24"$ (M6) $\varnothing 0.087"$ (2.2mm) 0.12" (3mm) 0.59" (15mm) 0.09" (2.4mm) 6' - 6-3/4" (2m) DS32: 3.54" (90mm) DS33: 1.77" (45mm)
SA9F-DC31 No sleeve SA9F-DC32 3.54" (90mm) sleeve SA9F-DC33 1.77" (45mm) sleeve (All three not compatible with green LED)	Coiled: Two fibers $\varnothing 0.04"$ (1mm) Threaded mount: $\varnothing 0.24"$ (M6) Detects: $\varnothing 0.0012"$ (0.03mm) minimum object	SA1C-FK3 SA1C-FK3G	0.98" (25mm) —	$\varnothing 0.10"$ (2.5mm) DC32: 3.54" (90mm) DC33: 1.77" (45mm) $\varnothing 0.45"$ (11.5mm) $\varnothing 0.20"$ (5.2mm) $\varnothing 0.04"$ (1mm) Two Fibers $\varnothing 0.24"$ (M6) 3.54" (90mm) 6' - 6-3/4" (2m) 15.75" (400mm) Note: All dimensions, except those shown, are the same as straight fiber (DS31/32/33, above)
SA9F-DT11 No sleeve SA9F-DT12 3.54" (90mm) sleeve SA9F-DT13 1.77" (45mm) sleeve (All three not compatible with green LED)	Straight: Two fibers $\varnothing 0.02"$ (0.5mm) Threaded mount: $\varnothing 0.12"$ (M3) Detects: $\varnothing 0.0012"$ (0.03mm) minimum object	SA1C-FK3 SA1C-FK3G	0.78" (20mm) —	$\varnothing 0.25"$ (6.4mm) $\varnothing 0.10"$ (2.5mm) $\varnothing 0.02"$ (0.5mm) Two Fibers $\varnothing 0.09"$ (2.3mm) $\varnothing 0.12"$ (M3) $\varnothing 0.04"$ (1.0mm) 0.12" (3mm) 0.39" (10mm) 0.20" (5mm) 6' - 6-3/4" (2m) DT12: 3.54" (90mm) DT13: 1.77" (45mm)
SA9F-DD31	Coaxial: Core $\varnothing 0.04"$ (1mm) + 16 fibers: $\varnothing 0.01"$ (0.26mm) Threaded mount: $\varnothing 0.24"$ (M6) Detects: $\varnothing 0.0012"$ (0.03mm) minimum object	SA1C-FK3 SA1C-FK3G	2.36" (60mm) 0.28" (7mm)	$\varnothing 0.45"$ (11.5mm) $\varnothing 0.20"$ (5.2mm) $\varnothing 0.010"$ (0.26mm) $\varnothing 0.04"$ (1mm) 16 Fibers One Fiber $\varnothing 0.16"$ (4mm) $\varnothing 0.24"$ (M6) $\varnothing 0.087"$ (2.2mm) 0.12" (3mm) 0.59" (15mm) 0.09" (2.4mm) 6' - 6-3/4" (2m) DS32: 3.54" (90mm) DS33: 1.77" (45mm)

(continued on following page)

Part Numbers: SA9F Diffuse-Reflected Light Fiber Optic Units, continued

Part Number	Description	Amplifier	Range	Dimensions
SA9F-DM74 1 row = 32 fibers SA9F-DM75 2 rows = 16 each (Not compatible with green LED) SA9F-DM76 3 rows = 16 center + 8 fibers each side (Not compatible with green LED)	Multicore: 32 fibers $\varnothing 0.010"$ (0.26mm) Detects: $\varnothing 0.0024"$ (0.06mm) minimum object	SA1C-FK SA1C-FK3G (not compatible with SA9F-DM75, SA9F-DM76)	2.36" (60mm) 0.16" (4mm)	
SA9F-DH21 No sleeve SA9F-DH22 3.54" (90mm) sleeve (Both not compatible with green LED)	Heat-resistant glass: Two fibers $\varnothing 0.03"$ (0.7mm) Threaded mount: $\varnothing 0.16"$ (M4) Detects: $\varnothing 0.0012"$ (0.03mm) minimum object	SA1C-FK3 SA1C-FK3G	1.06" (27mm) —	

Measuring Conditions

Amplifier = Applicable Amplifier

Range = Sensing Range
 Sensing a 50 x 50mm piece of white paper

Minimum detectable object:
 Sensing a copper-stranded wire with the SA1C-FK3

The sensing range varies depending upon the sensing conditions.

Part Numbers: SA9F Through-Beam Fiber Optic Units

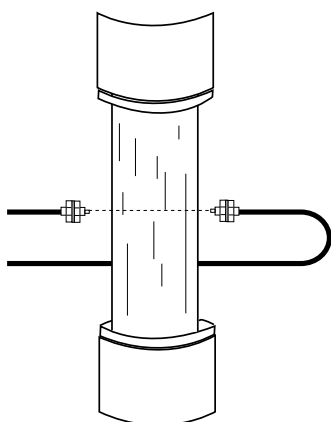
Part Number	Description	Amplifier	Range	Dimensions
SA9F-TS21 No sleeve SA9F-TS22 3.54" (90mm) sleeve SA9F-TS23 1.77" (45mm) sleeve	Straight fiber: $\varnothing 0.04"$ (1mm) Threaded mount: $\varnothing 0.16"$ (M4) Detects: $\varnothing 0.012"$ (0.3mm) minimum object	SA1C-FK3 SA1C-FK3G	7.09" (180mm) 0.63" (16mm)	$\varnothing 0.32"$ (8.1mm), 0.12" (3mm), 0.12" (3mm), 0.47" (12mm), 6' - 6-3/4" (2m), 0.09" (2.4mm), $\varnothing 0.10"$ (M2.6), $\varnothing 0.16"$ (M4), $\varnothing 0.087"$ (2.2mm), $\varnothing 0.06"$ (1.5mm), TS22: 3.54" (90mm), TS23: 1.77" (45mm)
SA9F-TC21 No sleeve SA9F-TC22 3.54" (90mm) sleeve SA9F-TC23 1.77" (45mm) sleeve	Coiled fiber: $\varnothing 0.04"$ (1mm) Threaded mount: $\varnothing 0.16"$ (M4) Detects: $\varnothing 0.012"$ (0.3mm) minimum object	SA1C-FK3 SA1C-FK3G	5.91" (150mm) 0.55" (14mm)	$\varnothing 0.06"$ (1.5mm), TC22: 3.54" (90mm), TC23: 1.77" (45mm), 15.75" (400mm), 3.54" (90mm), 6' - 6-3/4" (2m), 1.77" (45mm) Note: All dimensions, except those shown, are the same as straight fiber (TS21/22/23, above).
SA9F-TT11 No sleeve SA9F-TT12 3.54" (90mm) sleeve SA9F-TT13 1.77" (45mm) sleeve	Straight fiber: $\varnothing 0.02"$ (0.5mm) Threaded mount: $\varnothing 0.12"$ (M3) Detects: $\varnothing 0.006"$ (0.15mm) minimum object	SA1C-FK3 SA1C-FK3G	1.97" (50mm) 0.2" (5mm)	$\varnothing 0.25"$ (6.4mm), 0.10" (2.5mm), 0.12" (3mm), 0.47" (12mm), 6' - 6-3/4" (2m), 0.07" (1.8mm), $\varnothing 0.09"$ (M2.2), $\varnothing 0.12"$ (M3), $\varnothing 0.04"$ (1mm), $\varnothing 0.035"$ (0.9mm), TT12: 3.54" (90mm), TT13: 1.77" (45mm)
SA9F-TM21 No sleeve SA9F-TM22 3.54" (90mm) sleeve SA9F-TM23 1.77" (45mm) sleeve	Multicore: 16 fibers (cluster) $\varnothing 0.010"$ (0.26mm) Threaded mount: $\varnothing 0.16"$ (M4) Detects: $\varnothing 0.012"$ (0.3mm) minimum object	SA1C-FK3 SA1C-FK3G	5.91" (150mm) 0.55" (14mm)	$\varnothing 0.32"$ (8.1mm), 0.12" (3mm), 0.12" (3mm), 0.47" (12mm), 6' - 6-3/4" (2m), 0.09" (2.4mm), $\varnothing 0.10"$ (M2.6), $\varnothing 0.16"$ (M4), $\varnothing 0.087"$ (2.2mm), $\varnothing 0.06"$ (1.5mm), TM22: 3.54" (90mm), TM23: 1.77" (45mm)
SA9F-TM74 16 fibers in one row	Multicore: 16 fibers (one row) $\varnothing 0.010"$ (0.26mm) Detects: $\varnothing 0.0024"$ (0.06mm) minimum object	SA1C-FK3 SA1C-FK3G	5.91" (150mm) 0.55" (14mm)	$\varnothing 0.39"$ (10mm), 0.04" (1mm), 0.21" (5.25mm), 0.79" (20mm), 6' - 6-3/4" (2m), 0.126" (3.2mm), Two Places, 0.16" (4mm), 0.09" (2.2mm), 0.20" (5mm), 0.59" (15mm), 0.12" (3mm)
SA9F-TH21 No sleeve SA9F-TH22 3.54" (90mm) sleeve	Heat-resistant glass fiber: $\varnothing 0.04"$ (1mm) Threaded mount: $\varnothing 0.16"$ (M4) Detects: $\varnothing 0.012"$ (0.3mm) minimum object	SA1C-FK3 SA1C-FK3G	3.94" (100mm) 0.31" (8mm)	$\varnothing 0.102"$ (M2.6), 1.30" (33mm), 6' - 6-3/4" (2m), 0.63" (16mm), 0.55" (14mm), $\varnothing 0.083"$ (2.1mm), 0.12" (3mm), 0.086" (2.2mm), 0.16" (4mm), 0.45" (11mm), 0.24" (6mm), 0.12" (3mm), 0.79" (20mm), 0.16" (M4), 0.16" (4mm), TH22: 3.54" (90mm)
SA9F-TL53 (Not compatible with green LED)	Side view: one fiber $\varnothing 0.02"$ (0.5mm) Optical axis at 90° Detects: $\varnothing 0.0024"$ (0.06mm) minimum object	SA1C-FK3 SA1C-FK3G	1.57" (40mm)	1.77" (45mm), 6' - 6-3/4" (2m), 0.02" (0.5mm), 0.59" (15mm), 0.04" (1mm), 0.033" (0.85mm), $\varnothing 0.08"$ (2mm), $\varnothing 0.04"$ (1mm)



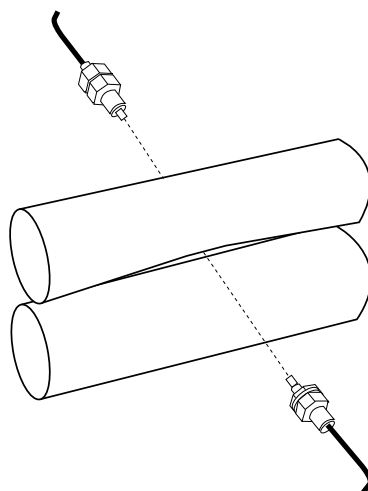
Refer to page Q-39 for the measuring conditions.

Applications

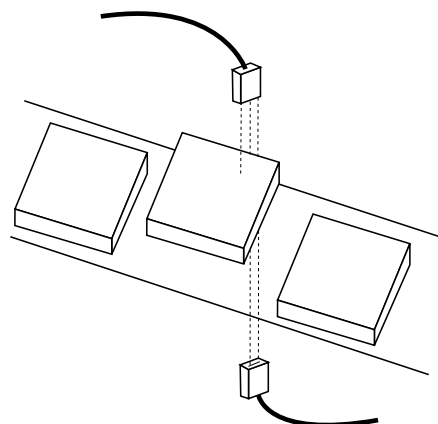
Monitoring the gradual change in liquid densities



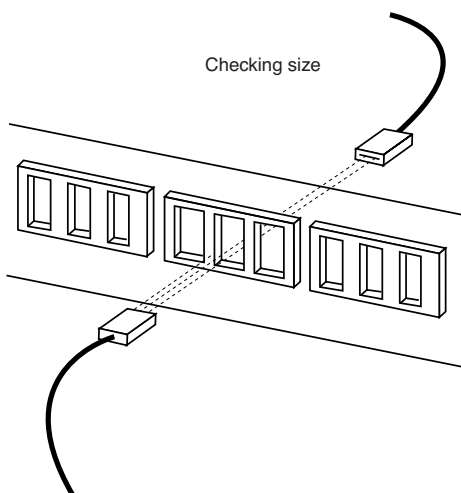
Detecting the roundness of rollers



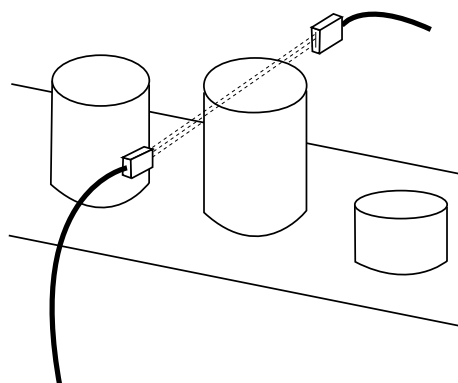
Sensing position or alignment



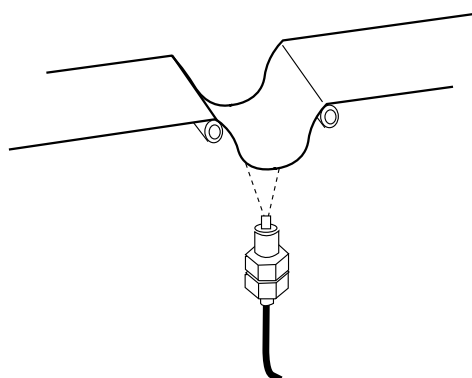
Checking size



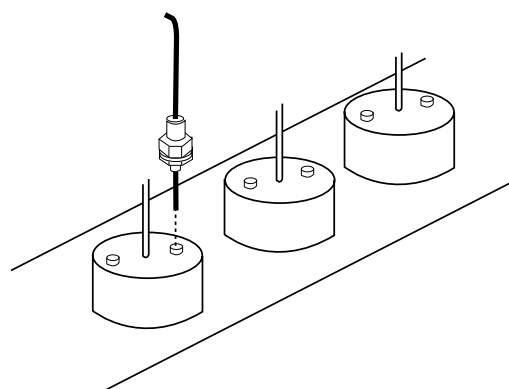
Checking height



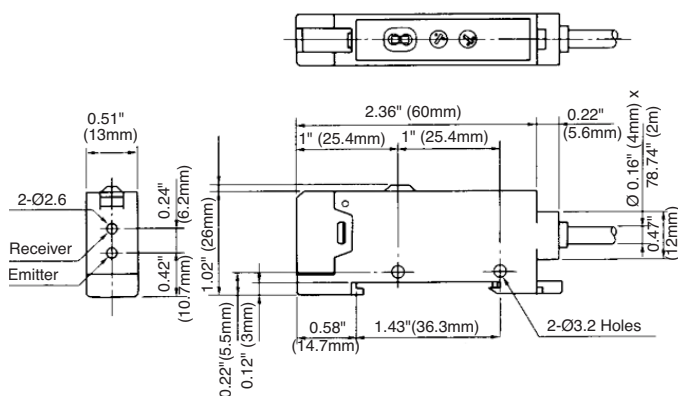
Controlling web tension



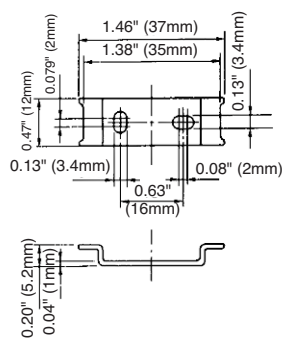
Sensing colour marks



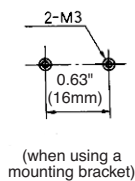
Dimensions



**Mounting Bracket (attachment)
Not Required for DIN Rail Mounting**

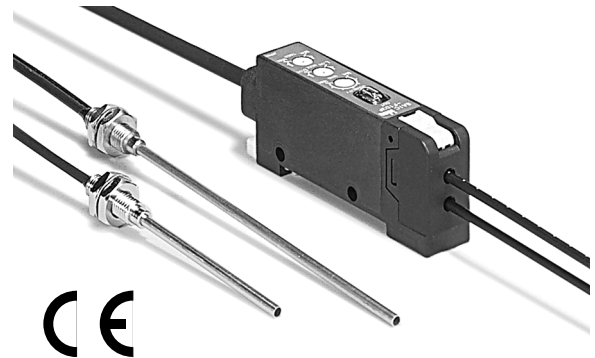


Mounting Hole Layout



SA1C-F: High-Speed, Miniature Photoelectric Sensors with Fiber Optics

- Ideal for remote sensing applications
- Featuring quick-connect cable and easy-insert fiber optic units for simple installation
- Through-beam and reflected-light sensing available
- Sensing range up to 7.09" (180mm) for through-beam sensors
- Dual outputs: Select NPN and PNP transistor outputs or NPN transistor output combined with a self-diagnostic output
- Outputs selectable for light on or dark on
- High-speed, 50µs response time
- Featuring variable off-delay (0 to 100 ms) and fine-tune sensitivity adjustment
- Stable LED makes alignment easy
- Red or green LEDs available for detecting colour marks
- Mount on a 1.378" (35mm) DIN rail
- Protection rated IP66



General Specifications	Power Voltage	12V to 24V DC
	Operating Voltage	10V to 30V DC, ripple 10% (maximum)
	Current Draw	Standard speed: 30mA (maximum) High-speed: 40mA (maximum)
	Operating Temperature	Amplifier only: -25° to +55°C Fiber optic cords (except heat-resistant types): -40° to +70°C Heat-resistant fiber optic cords: -40°C to +350°C (avoid ice coating)
	Operating Humidity	35 to 85% RH (avoid condensation)
	Extraneous Light Immunity	Sunlight: 10,000 lux (maximum); Incandescent light: 3,000 lux (maximum) on receiver surface— defined as incident or unwanted light received by a sensor, unrelated to the presence or absence of the intended object
	Material	Amplifier only: PBT resin (housing) with polycarbonate lens Fiber optic cords (except heat-resistant types): Nickel-plated brass (sensing head), polyethylene-covered PMMA (cord), and SUS304 stainless (sleeve) Heat-resistant fiber optic cords: SUS 304 stainless (sensing head) and SUS spiral tube around glass fiber cord
	Degree of Protection	IP66 — IEC Pub 529, sensors rated IP66 are dust-tight, water-resistant, and perform best when not subjected to heavy particle or water blasts
	Cable	Cable type: 0.2mm ² ; Vinyl cabtyre cable #24 AWG, 6'-6-3/4' (2m) long Connector type: Ø 0.31" (8mm) 3- or 4-pin connector (cable ordered separately for quick connect sensors)
	Light Source	Red or green LED (pulse-modulated)
	Output	NPN transistor: 30V DC (1.2V residual), 100mA (maximum) PNP transistor: 30V DC (2.0V residual), 200mA (maximum) Self-diagnostic: 30V DC (1.2V residual), 50mA (maximum)
	Response	Standard-speed: 0.5ms (maximum) High-speed: 50µs (maximum)
	Off Delay	0 to 100 ms (adjustable)
	Sensitivity	4-turn adjustment
	Minimum Bending Radius	Fiber optic cord (except SA9F-TT, -DT, -TL, and -DL): 1"R (25mm); Sleeve: 0.39"R (10mm) SA9F-TT and -DT: 0.59"R (15mm); Sleeve: 0.39"R (10mm) SA9F-TL and DL: 0.59"R (15mm); Sleeve: Unbendable

Function Specifications	SA1C-FN, -FD (standard speed)		SA1C-F1N, -F1D (high-speed)
	Operation Mode	Light on or dark on (selectable by switch on amplifier)	
	Indicator	Operation indicator: Red LED (out) Stable level indicator: Green LED (stable)	
	Noise Resistance	Normal mode: 500V Common mode: 300V Pulse width: 50ns –1µs, 100Hz (using a noise simulator)	Normal mode: 300V Common mode: 150V Pulse width: 50ns –1µs, 100Hz (using a noise simulator)
	Storage Temperature	-30 to +70°C (avoid freezing)	
	Insulation Resistance	20M minimum with 500V DC megger (between live and dead parts)	
	Dielectric Strength	1000V, 1 minute (between live and dead parts)	
	Vibration Resistance	Damage limits: 10 – 55Hz Amplitude: 1.5mm p-p, 20 cycles in each of 3 axes crossed (one cycle = 5 minutes)	
	Shock Resistance	Damage limits: 500m/S ² (approximately 49G), 10 shocks in each of 3 axes	
	Weight	Cable type: Approximately 75g Quick-connect type: Approximately 30g	

Part Numbers: SA1C-F Fiber Optic Sensors

Amplifier Part Number	Output	Light Source	Response	Through-Beam Units Part Number	Range	Diffuse-Reflected Units Part Number	Range
SA1C-FN3E (Cable) SA1C-FN3EC (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) Self-diagnostic: 50mA (maximum)	Red LED	Standard speed: 0.5 ms	SA9F-TS : Ø 0.16" (M4) Straight SA9F-TC : Ø 0.16" (M4) Coiled SA9F-TT : Ø 0.12" (M3) Straight SA9F-TM : Ø 0.16" (M4) Multicore SA9F-TH : Heat-resistant glass fiber SA9F-TL : Side view	7.09" (180mm)	SA9F-DS : Ø 0.24" (M6) Straight SA9F-DC : Ø 0.24" (M6) Coiled SA9F-DD : Ø 0.24" (M6) Coaxial SA9F-DT : Ø 0.12" (M3) Straight SA9F-DM : Ø 0.01" (0.26mm) Multicore SA9F-DH : Heat-resistant glass fiber SA9F-DL : Side view	2.36" (60mm)
SA1C-FD3F (Cable) SA1C-FD3FC (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) PNP transistor: 200mA (maximum)				5.91" (150mm)		0.98" (25mm)
					1.97" (50mm)		2.36" (60mm)
					5.91" (150mm)		0.79" (20mm)
SA1C-FD3F (Cable) SA1C-FD3FC (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) PNP transistor: 200mA (maximum)	Red LED	Standard speed: 0.5 ms	SA9F-TS : Ø 0.16" (M4) Straight SA9F-TC : Ø 0.16" (M4) Coiled SA9F-TT : Ø 0.12" (M3) Straight SA9F-TM : Ø 0.16" (M4) Multicore SA9F-TH : Heat-resistant glass fiber SA9F-TL : Side view	3.94" (100mm)	2.36" (60mm)	2.36" (60mm)
					1.57" (40mm)		1.06" (27mm)
							0.39" (10mm)
SA1C-FN3EG (Cable) SA1C-FN3EGC (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) Self-diagnostic: 50mA (maximum)	Green LED	Standard speed: 0.5 ms	SA9F-TS : Ø 0.16" (M4) Straight SA9F-TC : Ø 0.16" (M4) Coiled SA9F-TT : Ø 0.12" (M3) Straight SA9F-TM : Ø 0.16" (M4) Multicore SA9F-TH : Heat-resistant glass fiber SA9F-TL : Incompatible with green LED	0.63" (16mm)	SA9F-DS : Ø 0.24" (M6) Straight SA9F-DC : Incompatible with green LED SA9F-DD : Ø 0.24" (M6) Coaxial SA9F-DT : Incompatible with green LED SA9F-DM : Ø 0.01" (0.26mm) Multicore SA9F-DH : Incompatible with green LED SA9F-DL : Incompatible with green LED	0.28" (7mm)
SA1C-FD3FG (Cable) SA1C-FD3FGC (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) PNP transistor: 200mA (maximum)				0.55" (14mm)		N/A
					0.20" (5mm)		0.28" (7mm)
					0.55" (14mm)		0.16" (4mm)
SA1C-FD3FG (Cable) SA1C-FD3FGC (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) PNP transistor: 200mA (maximum)	Green LED	Standard speed: 0.5 ms	SA9F-TS : Ø 0.16" (M4) Straight SA9F-TC : Ø 0.16" (M4) Coiled SA9F-TT : Ø 0.12" (M3) Straight SA9F-TM : Ø 0.16" (M4) Multicore SA9F-TH : Heat-resistant glass fiber SA9F-TL : Incompatible with green LED	0.31" (8mm)	N/A	N/A
					N/A		N/A
							N/A
SA1C-F1N3E (Cable) SA1C-F1N3EC (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) Self-diagnostic: 50mA (maximum)	Red LED	High-speed: 50 µs	SA9F-TS : Ø 0.16" (M4) Straight SA9F-TC : Ø 0.16" (M4) Coiled SA9F-TT : Ø 0.12" (M3) Straight SA9F-TM : Ø 0.16" (M4) Multicore SA9F-TH : Heat-resistant glass fiber SA9F-TL : Side view	1.97" (50mm)	SA9F-DS : Ø 0.24" (M6) Straight SA9F-DC : Ø 0.24" (M6) Coiled SA9F-DD : Ø 0.24" (M6) Coaxial SA9F-DT : Ø 0.12" (M3) Straight SA9F-DM : Ø 0.01" (0.26mm) Multicore SA9F-DH : Heat-resistant glass fiber SA9F-DL : Side view	0.79" (20mm)
SA1C-F1D3F (Cable) SA1C-F1D3FC (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) PNP transistor: 200mA (maximum)				1.57" (40mm)		0.28" (7mm)
					0.59" (15mm)		0.79" (20mm)
					1.57" (40mm)		0.24" (6mm)
SA1C-F1D3F (Cable) SA1C-F1D3FC (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) PNP transistor: 200mA (maximum)	Red LED	High-speed: 50 µs	SA9F-TS : Ø 0.16" (M4) Straight SA9F-TC : Ø 0.16" (M4) Coiled SA9F-TT : Ø 0.12" (M3) Straight SA9F-TM : Ø 0.16" (M4) Multicore SA9F-TH : Heat-resistant glass fiber SA9F-TL : Side view	1.18" (30mm)	0.71" (18mm)	0.71" (18mm)
					0.51" (13mm)		0.28" (7mm)
							0.12" (3mm)

Ordering Details

The SA1C-F series consists of the amplifier/receiver only. Fiber optic units must be ordered separately using part numbers beginning with SA9F. SA1C-F amplifier/receivers can be used with either the through-beam or diffuse-reflected fiber optic units.

Amplifier/receiver units include a mounting bracket, screws, and a screwdriver. Cables for quick-connect sensors are ordered separately. Optional attachments, available for modifying beam size of through-beam sensors, are also ordered separately (see pages Q-47 through Q-48).

The fiber optic cord is 6' – 6-3/4" (2m) long. The fiber optic cord can be cut to desired length using a fiber cutter, except for the heat-resistant glass fiber. A fiber cutter is included with fiber optic units (order SA9Z-F01 separately for replacement). A set of two easy-insert adaptors is included with the following fiber optic units: SA9F-TT, SA9F-TL, SA9F-DT, and SA9F-DL (order SA9Z-F02 for replacement set).

Part Numbers: SA9F Through-Beam Fiber Optic Units

Part Number	Description	Dimensions	Appearance
SA9F-TS21 No sleeve SA9F-TS22 3.54" (90mm) sleeve SA9F-TS23 1.77" (45mm) sleeve	Straight fiber: Ø 0.04" (1mm) Threaded mount: Ø 0.16" (M4) Detects: Ø 0.012" (0.3mm) minimum object		
SA9F-TC21 No sleeve SA9F-TC22 3.54" (90mm) sleeve SA9F-TC23 1.77" (45mm) sleeve	Coiled fiber: Ø 0.04" (1mm) Threaded mount: Ø 0.16" (M4) Detects: Ø 0.012" (0.3mm) minimum object		
SA9F-TT11 No sleeve SA9F-TT12 3.54" (90mm) sleeve SA9F-TT13 1.77" (45mm) sleeve	Straight fiber: Ø 0.02" (0.5mm) Threaded mount: Ø 0.12" (M3) Detects: Ø 0.006" (0.15mm) minimum object		
SA9F-TM21 No sleeve SA9F-TM22 3.54" (90mm) sleeve SA9F-TM23 1.77" (45mm) sleeve	Multicore: 16 fibers (cluster) Ø 0.010" (0.26mm) Threaded mount: Ø 0.16" (M4) Detects: Ø 0.012" (0.3mm) minimum object		
SA9F-TM74 16 fibers in one row	Multicore: 16 fibers (one row) Ø 0.010" (0.26mm) Detects: Ø 0.0024" (0.06mm) minimum object		
SA9F-TH21 No sleeve SA9F-TH22 3.54" (90mm) sleeve	Heat-resistant glass fiber: Ø 0.04" (1mm) Threaded mount: Ø 0.16" (M4) Detects: Ø 0.012" (0.3mm) minimum object		
SA9F-TL53 (not compatible with green LED)	Side view: One fiber 0.02" (0.5mm) Optical axis at 90° Detects: Ø 0.0024" (0.06mm) minimum object		

Part Numbers: SA9F Diffuse-Reflected Light Fiber Optic Units

Part Number	DESCRIPTION	Dimensions	Appearance
SA9F-DS31 No sleeve SA9F-DS32 3.54" (90mm) sleeve SA9F-DS33 1.77" (45mm) sleeve	Straight: Two fibers $\varnothing 0.04"$ (1mm) Threaded mount: $\varnothing 0.24"$ (M6) Detects: $\varnothing 0.0012"$ (0.03mm) minimum object	$\varnothing 0.45"$ (11.5mm) $\varnothing 0.20"$ (5.2mm) $\varnothing 0.04"$ (1mm) two fibers $\varnothing 0.12"$ (3mm) $\varnothing 0.59"$ (15mm) $\varnothing 0.09"$ (2.4mm) $\varnothing 0.16"$ (4mm) $\varnothing 0.24"$ (M6) $\varnothing 0.087"$ (2.2mm) $\varnothing 0.10"$ (2.5mm) DS32: 3.54" (90mm) DS33: 1.77" (45mm)	
SA9F-DC31 No sleeve SA9F-DC32 3.54" (90mm) sleeve SA9F-DC33 1.77" (45mm) sleeve (all three not compatible with green LED)	Coiled: Two fibers $\varnothing 0.04"$ (1mm) Threaded mount: $\varnothing 0.24"$ (M6) Detects: $\varnothing 0.0012"$ (0.03mm) minimum object	$\varnothing 0.10"$ (2.5mm) DC32: 3.54" (90mm) DC33: 1.77" (45mm) $\varnothing 0.45"$ (11.5mm) $\varnothing 0.20"$ (5.2mm) $\varnothing 0.04"$ (1mm) two fibers $\varnothing 0.24"$ (M6) 3.54" (90mm) 15.75" (400mm) All dimensions, except those shown, are the same as straight fiber (DS31/32/33, above).	
SA9F-DT11 No sleeve SA9F-DT12 3.54" (90mm) sleeve SA9F-DT13 1.77" (45mm) sleeve (all three not compatible with green LED)	Straight: Two fibers $\varnothing 0.02"$ (0.5mm) Threaded mount: $\varnothing 0.12"$ (M3) Detects: $\varnothing 0.0012"$ (0.03mm) minimum object	$\varnothing 0.25"$ (6.4mm) $\varnothing 0.10"$ (2.5mm) $\varnothing 0.02"$ (0.5mm) Two Fibers $\varnothing 0.09"$ (2.3mm) $\varnothing 0.39"$ (10mm) $\varnothing 0.07"$ (1.8mm) $\varnothing 0.12"$ (M3) $\varnothing 0.04"$ (1.0mm) $\varnothing 0.06"$ (1.5mm) DT12: 3.54" (90mm) DT13: 1.77" (45mm)	
SA9F-DD31	Coaxial: Core $\varnothing 0.04"$ (1mm) + 16 fibers: $\varnothing 0.01"$ (0.26mm) Threaded mount: $\varnothing 0.24"$ (M6) Detects: $\varnothing 0.0012"$ (0.03mm) minimum object	$\varnothing 0.45"$ (11.5mm) $\varnothing 0.20"$ (5.2mm) $\varnothing 0.04"$ (1mm) Core $\varnothing 0.010"$ (0.26mm) 16 Fibers $\varnothing 0.04"$ (1mm) One Fiber $\varnothing 0.12"$ (3mm) $\varnothing 0.59"$ (15mm) $\varnothing 0.09"$ (2.4mm) $\varnothing 0.16"$ (4mm) $\varnothing 0.24"$ (M6) $\varnothing 0.087"$ (2.2mm) $\varnothing 0.10"$ (2.5mm) DS32: 3.54" (90mm) DS33: 1.77" (45mm)	
SA9F-DM74 1 row = 32 fibers SA9F-DM75 2 rows = 16 each (Not compatible with green LED) SA9F-DM76 3 rows = 16 center + 8 fibers each side (not compatible with green LED)	Multicore: 32 fibers $\varnothing 0.010"$ (0.26mm) Detects: $\varnothing 0.0024"$ (0.06mm) minimum object	One Row (DM74) $\varnothing 0.04"$ (1mm) $\varnothing 0.20"$ (5mm) $\varnothing 0.43"$ (10.9mm) $\varnothing 0.75"$ (19mm) $\varnothing 0.126"$ (3.2mm) Two Places $\varnothing 0.16"$ (4mm) $\varnothing 0.98"$ (25mm) $\varnothing 0.39"$ (10mm) $\varnothing 0.20"$ (5mm) $\varnothing 0.087"$ (2.2mm) Two and Three Rows (DM75/76) $\varnothing 0.21"$ (5.25mm) $\varnothing 0.59"$ (15mm) $\varnothing 0.20"$ (5mm) $\varnothing 0.126"$ (3.2mm) two places $\varnothing 0.16"$ (4mm) $\varnothing 0.98"$ (25mm) $\varnothing 0.39"$ (10mm) $\varnothing 0.20"$ (5mm) $\varnothing 0.087"$ (2.2mm)	

(continued on following page)

Part Numbers: SA9F Diffuse-Reflected Light Fiber Optic Units, continued

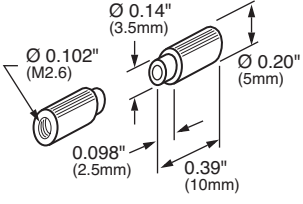
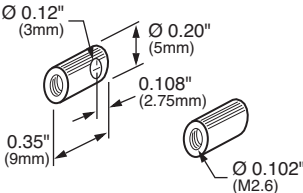
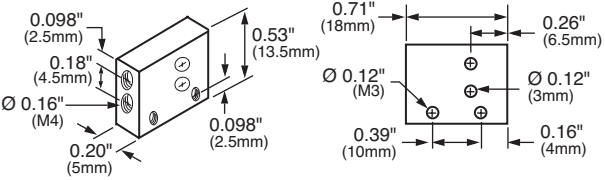
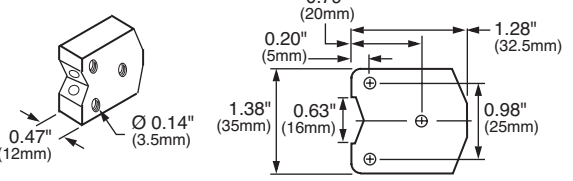
Part Number	Description	Dimensions	Appearance
SA9F-DH21 No sleeve SA9F-DH22 3.54" (90mm) sleeve (both not compatible with green LED)	Heat-resistant glass: Two fibers $\varnothing 0.03"$ (0.7mm) Threaded mount: $\varnothing 0.16"$ (M4) Detects: $\varnothing 0.0012"$ (0.03mm) minimum object		
SA9F-DL63 (not compatible with green LED)	Side view: Two fibers $\varnothing 0.02"$ (0.5mm) Optical axis at 90° Detects: $\varnothing 0.0012"$ (0.03mm) minimum object		

Part Numbers: Accessories

Part Number	Description	Used With	Dimensions
SA9C-CA4D2	4-core cable with connector 6'-6-3/4" (2m)	SA1C-F quick-connect only, NPN and PNP outputs	
SA9C-CA4D5	4-core cable with connector 16'-4-7/8" (5m)		
SA9C-CA4D2S	4-core cable with connector 6'-6-3/4" (2m)	SA1C-F quick-connect only, NPN and self-diagnostic outputs	
SA9C-CA4D5S	4-core cable with connector 16'-4-7/8" (5m)		
SA9Z-F01	Fiber cutter	All fiber units except heat resistant	HxLxD: 0.91" x 1.77" x 0.31" (23x 45 x 8Dmm) Included with fiber units; order replacement only
SA9Z-F02	Set of 2 easy-insert adaptors	SA9F-TT, SA9F-TL, SA9F-DT, and SA9F-DL	$\varnothing 0.087"$ (OD) x 0.945" long ($\varnothing 2.2\text{mm}$ x 24mm) Included with applicable fiber optic units; order replacement set only

(continued on following page)

Part Numbers: Accessories, continued

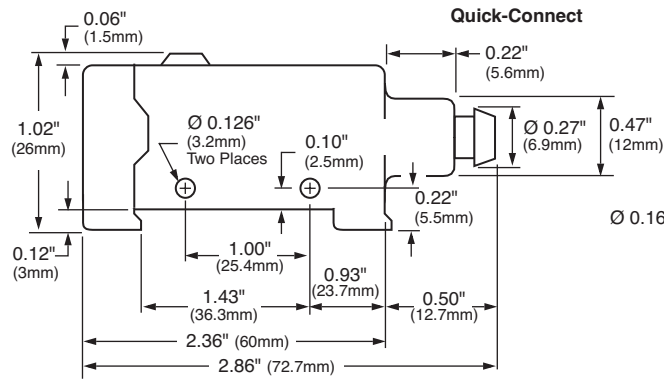
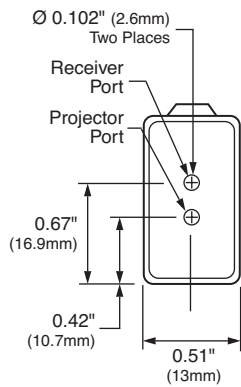
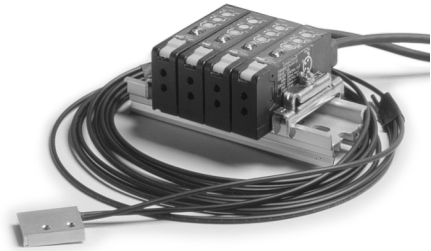
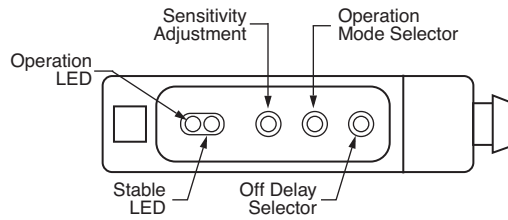
Part Number	Description	Used With	Dimensions
SA9Z-F11	Lens attachment for long-range detection of opaque objects, minimum size: Ø 0.14" (3.5mm)	SA1C-F through-beam fiber unit only Sensing ranges: Standard speed red LED: SA9F-TS21: 4' – 3-3/16" (1.3m) 5.31" (0.135m) SA9F-TC21: 3' – 3-3/8" (1m) 3.94" (0.1m) SA9F-TM21: 3' – 5-3/8" (1.05m) 5.12" (0.13m) Sensing ranges: Standard speed green LED: SA9F-TS21: 5.31" (0.135m) SA9F-TC21: 3.94" (0.1m) SA9F-TM21: 5.12" (0.13m) Sensing ranges: High-speed red LED: SA9F-TS21: 5.75" (0.4m) SA9F-TC21: 1.81" (0.3m) SA9F-TM21: 4.96" (0.38m)	
SA9Z-F12	Side view attachment to rotate axis by 90° for detection of opaque objects, minimum size: Ø 0.14" (3.5mm)	SA1C-F through-beam fiber unit only Sensing ranges: Standard speed red LED: SA9F-TS21: 7.87" (200mm) SA9F-TC21: 5.12" (130mm) SA9F-TM21: 6.30" (160mm) Sensing ranges: High-speed red LED: SA9F-TS21: 1.97" (50mm) SA9F-TC21: 1.38" (35mm) SA9F-TM21: 1.57" (40mm)	
SA9Z-F13	Side-on attachment for narrow clearance, Range: 1.26" (32mm), for detection of transparent or opaque objects	SA1C-F diffuse-reflected light fiber unit only Sensing ranges: Standard speed red LED: SA9F-TS21: 1.38" (35mm) SA9F-TC21: 1.81" (30mm) SA9F-TM21: 1.38" (35mm)	
SA9Z-F14	Attachment for high-accuracy: Range: 0.4" ± 0.04" (10mm ± 1mm), for detection of transparent or opaque objects	SA1C-F through-beam fiber unit only Sensing ranges: Standard speed red LED: SA9F-TS21: 0.394" ± 0.039" (10mm ± 1mm) SA9F-TC21: 0.394" ± 0.039" (10mm ± 1mm) SA9F-TM21: 0.394" ± 0.039" (10mm ± 1mm)	

Detecting Colour Marks

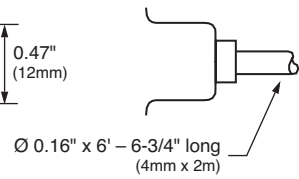
Colour of Mark	Background Colour										
	White	Yellow	Chartreuse	Orange	Red	Magenta	Turquoise	Blue	Violet	Green	Black
□ = Use Red LED ★ = Use Green LED ◆ = Use Red or Green LED — = Not Detectable											
White	—	★	◆	★	★	◆	◆	◆	◆	◆	◆
Yellow	★	—	◆	★	★	★	◆	◆	◆	◆	◆
Chartreuse	◆	◆	—	□	□	★	□	◆	★	◆	◆
Orange	★	★	□	—	—	★	□	◆	◆	◆	◆
Red	★	★	□	—	—	□	□	◆	◆	◆	◆
Magenta	◆	★	★	★	□	—	□	□	—	□	◆
Turquoise	◆	◆	□	□	□	□	—	□	◆	★	◆
Blue	◆	◆	◆	◆	◆	□	□	—	□	□	□
Violet	◆	◆	★	◆	◆	—	◆	□	—	□	□
Green	◆	◆	◆	◆	◆	□	★	□	□	—	□
Black	◆	◆	◆	◆	◆	◆	◆	□	□	□	—

Dimensions

**SA1C-F Series
Amplifier Unit**



Cable Style



For dimensions on fiber optic units, see page Q-45 (through-beam)
or pages Q-46 through Q-47 (diffuse-reflected light).

ISF: Heavy Duty Photoelectric Sensors

Key features of the ISF include:

- Rugged, waterproof photoelectric sensors with universal voltages
- 24–240V AC/24–240V DC or 10–30V DC; both available with time delay
- Featuring through-beam sensing between the projector and receiver, with sensing range of 32' – 9-3/4" (10m)
- Diffuse-reflected light sensing, as well as retro-reflected — with or without polarization
- All sensors are available with three time delay modes (one-shot, on-delay, or off-delay) selectable from 0.1 to 5 seconds
- DC sensors have dual NPN/PNP transistor outputs
- Universal-voltage sensors have one NO relay contact
- Diffuse-reflected light sensors feature a sensitivity adjustment control
- All units are selectable: light on or dark on
- Unique touch-down terminals reduce wiring time
- Protection rated IP66



UL Recognized
File No. E55996



CSA Certified
File No. LR21451



General Specifications	Power Voltage	Universal voltage type: 24V to 240V AC (24V to 240V DC compatible) DC type: 10V to 30V DC (ripple 10% maximum)
	Operating Voltage	Universal voltage: 21.6V to 264V AC, 50/60Hz (21.6V to 264V DC compatible)
	Dielectric Strength	Between power and output terminals: 1,500V AC, 1 minute (universal-voltage type) Between output terminals: 1,000V AC, 1 minute (universal-voltage type) Between live and dead parts: 1,000V AC, 1 minute (DC type)
	Insulation Resistance	Between power and output terminals: 20 MΩ (minimum) with 500V DC megger (universal-voltage) Between live and dead parts: 20 MΩ (minimum) with 500V DC megger (DC type)
	Operating Temperature	–10° to +60°C (avoid freezing)
	Operating Humidity	35 to 85% RH (avoid condensation)
	Storage Temperature	–20° to +70°C
	Vibration Resistance	Damage limits: 10 to 55Hz, amplitude 1.5mm p-p, 2 hours in each of 3 axes
	Shock Resistance	Damage limits: 500m/s ² (approximately 50G), 3 shocks in each of 3 axes
	Extraneous Light Immunity	Sunlight: 10,000 lux at receiver, Incandescent light: 3,000 lux at receiver — defined as incident or unwanted light received by a sensor, unrelated to the presence or absence of the intended object
	Material	Housing: PBT; Lens: acrylic resin; Cover: polycarbonate
	Degree of Protection	IP66 — IEC Pub 529, sensors rated IP66 are dust-tight, water-resistant, and perform best when not subjected to heavy particle or water blasts (JIS C 0920 watertight)
	Applicable Cable (not included)	Cable: Ø 0.31" to 0.39" (8 to 10mm), Core: #18 to #24 AWG (0.25 to 0.75mm ²); Extension: 328' (100m) maximum using #22 AWG (0.3mm ²) cabtyre cable or better (not included or offered by IDEC — must be purchased separately)
	Weight	Through-beam: 75g (projector), 100g (universal voltage receiver), 90g (DC receiver) Reflected light: 100g (universal voltage), 90g (DC)
	Dimensions (HxWxD)	2.66" x 1.02" x 3.62" (67.5 x 26 x 92mm)

Part Numbers: Universal Voltage Types

Part Number	Time Delay	Detects by	Sensing Range	Detects	Power Voltage
ISF-T10MU	No	Through-Beam	32' – 9-3/4" (10m)	Opaque Objects Ø 0.63" (16mm) Minimum	24 to 240V AC (50/60Hz), 24 to 240V DC Compatible
ISF-T10MTU	Yes				
ISF-R05MU	No	Retro-Reflected Light	16' – 4-7/8" (5m)	Opaque Objects Ø 2.36" (60mm) Minimum	
ISF-R05MTU	Yes				
ISF-P03MU	No	Polarized Retro-Reflected Light	9' – 10-1/8" (3m)	Opaque or Mirror-Like Objects Ø 2.36" (60mm) Minimum	
ISF-P03MTU	Yes				
ISF-D500U	No	Diffuse-Reflected Light with Sensitivity Adjustment	19.69" (0.5m)	Opaque or Transparent Objects	
ISF-D500TU	Yes				

Part Numbers: DC Types

Part Number	Time Delay	Detects by	Sensing Range	Detects	Power Voltage
ISF-T10MW	No	Through-Beam	32' – 9-3/4" (10m)	Opaque Objects Ø 0.63" (16mm) Minimum	10 to 30V DC with 10% ripple (maximum)
ISF-T10MWT	Yes				
ISF-R05MW	No	Retro-Reflected Light	16' – 4-7/8" (5m)	Opaque Objects Ø 2.36" (60mm) Minimum	
ISF-R05MWT	Yes				
ISF-P03MW	No	Polarized Retro-Reflected Light	9' – 10-1/8" (3m)	Opaque or Mirror-Like Objects Ø 2.36" (60mm) Minimum	
ISF-P03MWT	Yes				
ISF-D500W	No	Diffuse-Reflected Light with Sensitivity Adjustment	19.69" (0.5m)	Opaque or Transparent Objects	
ISF-D500WT	Yes				



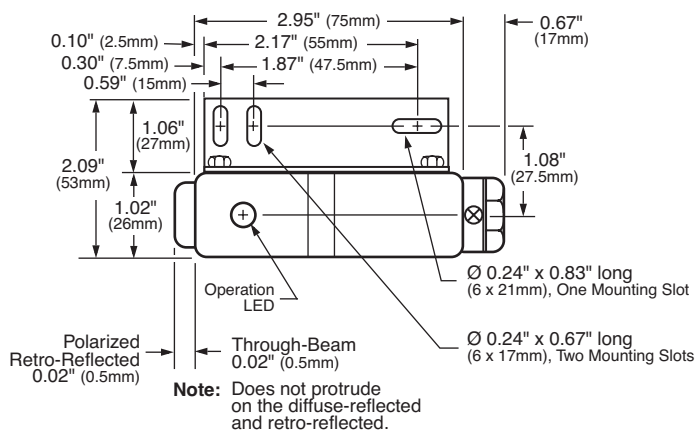
1. All sensors come with mounting brackets. Retro-reflected light sensors (with or without polarization) come with a rectangular reflective backplate. Diffuse-reflected light sensors and sensors with time delay include a screwdriver for the adjustment dial.

Function Specifications	Output	Universal voltage: One NO contact, electromechanical relay, 250V AC/1A, 30V DC/2A (resistive load) DC: NPN/PNP transistor open collector, 100mA (maximum) with short circuit protection Maximum residual voltage: 1.0V (NPN), 2.4V (PNP)
	Light Source	Diffuse and retro-reflected sensors: Infrared LED Polarized retro-reflected sensors: Red LED
	Indicator	On: Turns on when output is on (red LED)
	Response	Universal voltage: 20ms (maximum); DC: 3ms (maximum)
	Hysteresis	Universal voltage and DC diffuse-reflected sensors: 15% at 19.69" (0.5m)
	Power Consumption	Universal voltage: 3VA (maximum); Through-beam: 3VA <i>each</i> for the projector and the receiver DC: 30 mA (maximum); Through-beam: 15 mA (projector), 20 mA (receiver)
	Time Delay	0.1 to 5.0 seconds (adjustable)
	Time Delay Modes	Selectable: One-shot, on-delay, or off-delay, using DIP switches
	Temperature Error	±10% (maximum) over –10 to +60°C (reference temperature: +20°C)
	Repeat Error	±1.0% (maximum) for repeat inputs at intervals of 10 seconds or more

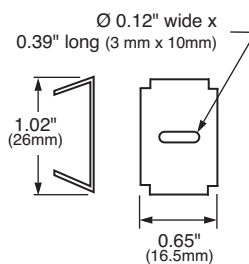


2. Delay time is decreased by 5% when another object is detected during timedown.

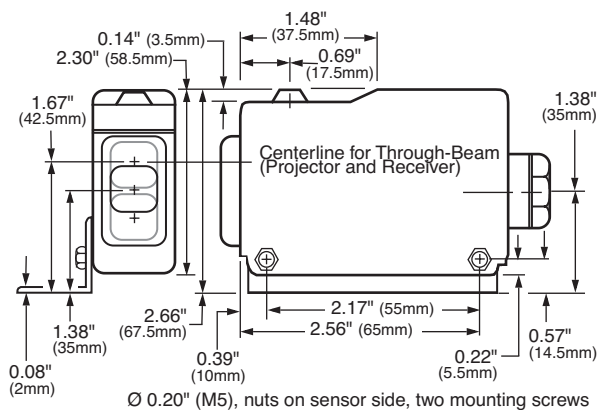
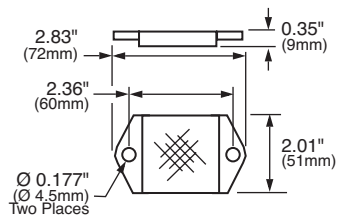
Dimensions



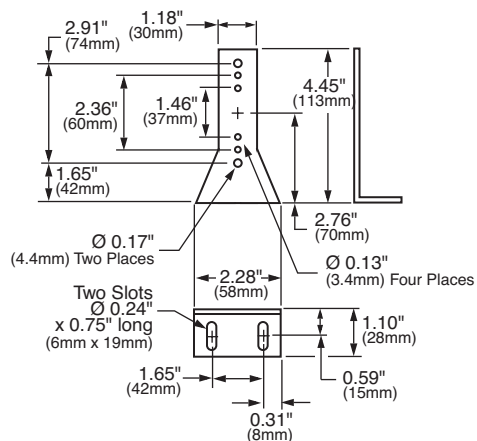
Slit for Through-Beam
(option) Part Number IAC-S1



Square Reflective Backplate
(replacement) Part Number IAC-R5



Reflector Bracket
(option) Part Number IAC-L2

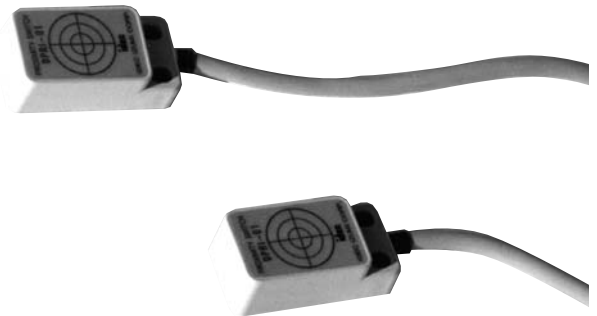


DPRI: Magnetic Proximity Switches

The DPRI magnetic proximity switch incorporates a sealed reed switch and four magnets inside a compact housing. This self-contained proximity switch requires no external power supply and can detect the presence of magnetic objects without contact.

Key features of the DPRI include:

- Lightweight, compact design reduces mounting space requirements
- Compact size allows units to be mounted in close proximity to each other
- Sealed reed contact can be used in dusty locations
- Long life and high reliability



General Specifications	Normal Switching Distance	5mm ±10%
	Operating Distance	0 to 4mm
	Release Distance	Over switching distance, 9mm (maximum)
	Repeat Error ON	0.05mm (maximum)
	Repeat Error OFF	0.15mm (maximum)
	Temperature Error (–10 to 50°C)	±0.5mm or less (20°C as standard)
	Response Speed	300Hz or less (bounce 0.4ms or less)
	Output	
	Contact Configuration	1NO
	Switching Capacity	AC: 10VA (maximum) DC: 10W (maximum)
	Operating Voltage	AC: 100V (maximum) DC: 100V (maximum)
	Operating Current	AC: 0.25A (maximum) DC: 0.25A (maximum)
	Initial Contact Resistance	0.35Ω (maximum)
	Shock Resistance	20G or less
	Ambient Temperature Range	–10 to +50°C
	Sensing Object	Magnetic materials: Fe, Ni, Cu, Ferrite, etc.
	Standard Sensing Object	30 x 20 x 1mm, Ferromagnetic soft iron plate
Life Expectancy	Electrical	Contact resistance 1.5Ω or less after 20,000,000 operations
	Mechanical	1,000,000,000 operations
	Lead Wire	Cable type: 5mm 2-core vinyl cabtyre cable, 3-1/3' (1m) long
Weight		Approximately 40g

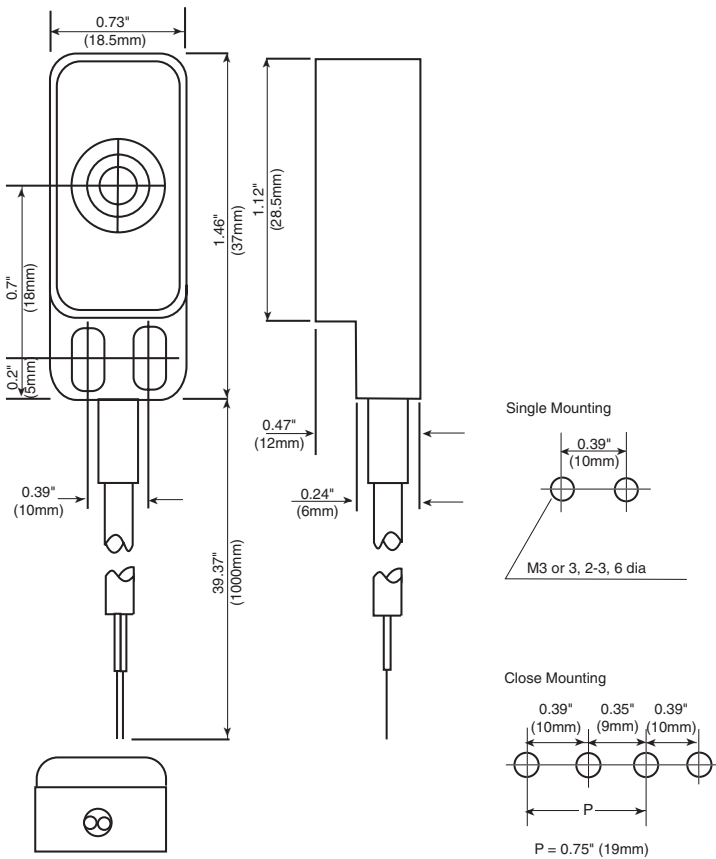
Part Number: DPRI Switches

Part Number	Description
DPRI-01	Magnetic Proximity Switch

Operation Principle

The DPRI incorporates four magnets and a sealed reed switch. The contacts of the reed switch are held normally open by the magnetic field of the four magnets. When a metallic object is within the sensing range, the magnetic field is neutralized, closing the contacts of the reed switch. When the object is removed beyond the sensing distance, the magnetic field is restored and the contacts of the reed switch open.

Dimensions



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 colour 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 Q-25.

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 or 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. 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

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.

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 colour contrast when colours 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, unrelated 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.

ΔE: The measurement of colour 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 analogue 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.

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.

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