












# Sensors

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**Selection Guide**

Sensor Type	Series	Page	Appearance	Advantages	Considerations
<b>Full Colour Recognition Sensors</b>	<b>SA1J SA1J-F</b>	4		<ul style="list-style-type: none"> <li>• Use to detect registration marks (regardless of similarity of colour) at high-speed (0.3ms).</li> <li>• Use to distinguish between different shades of the same colour.</li> <li>• 3 LEDs (red, green, and blue) provide a long life — no need to replace lamps.</li> <li>• Use in wash-down environments.</li> <li>• Use when long distance range, high-speed, and small sensing spots are required for colour sensing applications.</li> </ul>	<ul style="list-style-type: none"> <li>• Use the 3-colour sensor for multiple outputs for sorting applications.</li> <li>• Use the small spot version to detect small objects.</li> <li>• Replace conventional contrasting sensors with the SA1J for reliable colour sensing.</li> <li>• 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.</li> </ul>
<b>Analogue Laser Colour Mark Sensors</b>	<b>SA1M</b>	10		<ul style="list-style-type: none"> <li>• Uses visible red laser for colour detection.</li> <li>• Compensates for fluctuations of objects.</li> <li>• Long range: 2.75" to 5.9".</li> <li>• Available in small spot or parallel beam.</li> <li>• Dual analogue and digital output.</li> </ul>	<p><b>IMPORTANT:</b> 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.</p>
<b>Water Detection Sensors</b>	<b>SA1W</b>	15		<ul style="list-style-type: none"> <li>• Fastest (response time 0.5ms), most reliable light detection photoelectric sensor.</li> <li>• Use to detect any liquid containing water in any translucent, coloured container—even clear or dark containers at high-speed.</li> <li>• Eliminate many of the problems associated with other photoelectric sensors, capacitive sensors, ultrasonic sensors, vision systems, or moisture sensors.</li> <li>• 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.</li> <li>• Use through-beam fiber optic cables to sense precise liquid levels through clear or translucent, coloured containers.</li> </ul>	<ul style="list-style-type: none"> <li>• For increased precise liquid level detection, use the lens attachment with a through-beam fiber optic cable.</li> <li>• When long sensing ranges (up to 31") are required, use the lens attachment.</li> </ul>
<b>Self-Contained Laser Sensors</b>	<b>MX1C</b>	23		<ul style="list-style-type: none"> <li>• Use in the most precise sensor applications, because of the minute size of the laser beam.</li> <li>• Use the MX1C to achieve precise positioning or alignment, because the visible beam is easy to aim.</li> <li>• All laser sensors provide analogue and digital output.</li> </ul>	<p><b>IMPORTANT:</b> 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.</p>
<b>Ultrasonic Analogue Sensors</b>	<b>SA6A</b>	27		<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> </ul>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>

## Selection Guide con't

Sensor Type	Series	Page	Appearance	Advantages	Considerations
<b>Analogue Distance Sensors</b>	SA1D	30		<ul style="list-style-type: none"> <li>The most reliable distance sensing, calculated using the optical triangle between two points and the sensor.</li> <li>Analogue output and digital output provided.</li> </ul>	<ul style="list-style-type: none"> <li>Maximum analogue output value corresponds to minimum sensing distance and minimum analogue value corresponds to maximum distance.</li> </ul>
<b>Photoelectric</b>	SA1E	32		<ul style="list-style-type: none"> <li>Through-beam. Long sensing range of 10m max.</li> <li>Diffuse-reflective can detect light-reflecting transparent objects as well as white matt paper at a distance of 700mm.</li> <li>Polarized retroreflective mirror-like objects can also be detected easily.</li> <li>Small-beam reflective. Ideal for detecting small objects with easy recognition of a red LED beam.</li> </ul>	<ul style="list-style-type: none"> <li>Long sensing ranges.</li> <li>High-speed response of 1msec max.</li> <li>Interference prevention allows close mounting of two switches (except for the through-beam type).</li> </ul>
<b>Fiber Optic Photoelectric Sensors</b>	SA1C-FK	37		<ul style="list-style-type: none"> <li>Optimum performance under adverse conditions including high temperatures, inductive noise, and corrosive exposure.</li> <li>Maintain integrity of sensing signal over long distances.</li> <li>Perfect for areas with minimal clearance. Fiber optic leads capable of great flexibility for tight installations.</li> </ul>	<ul style="list-style-type: none"> <li>It is necessary to consider reduced maintenance expenses when evaluating cost effectiveness.</li> <li>Fiber optics do not withstand impact well (may shatter).</li> </ul>
	SA1C-F	43			
<b>Heavy Duty Photoelectric Sensors</b>	ISF	50		<ul style="list-style-type: none"> <li>Universal voltage type (24 to 240V AC/DC).</li> <li>Built-in 0.1 to 5 second time delay.</li> <li>Selectable Light ON or Dark ON.</li> <li>Touch-down terminals.</li> </ul>	<ul style="list-style-type: none"> <li>Available in various modes: Through-beam Diffuse-reflective Retro-reflective Polarized retro-reflective</li> </ul>
<b>Magnetic Proximity Switches</b>	DPRI	53		<ul style="list-style-type: none"> <li>Lightweight, compact design reduces mounting space requirements.</li> <li>Sealed reed contact.</li> <li>Long life and high reliability.</li> </ul>	<ul style="list-style-type: none"> <li>Operating distance range: 0 to 4mm</li> </ul>

## 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



	1-Colour Version	3-Colour Version	
<b>General Specifications</b>	<b>Power Voltage</b>	12 to 24V DC (ripple 10% maximum) Operating voltage: 10 to 30V DC	
	<b>Current Draw</b>	150mA maximum	
	<b>Dielectric Strength</b>	Between live and dead parts: 1,000V AC, 1 minute	
	<b>Insulation Resistance</b>	Between live and dead parts: 20MΩ minimum (500V DC megger)	
	<b>Operating Temperature</b>	-10 to +50°C (performance will be adversely affected if the sensor becomes coated with ice)	
	<b>Operating Humidity</b>	35 to 85% RH (avoid condensation)	
	<b>Storage Temperature</b>	-30 to +70°C	
	<b>Vibration Resistance</b>	Damage limits: 10 to 55Hz Single amplitude: 0.75mm 2 hours in each of 3 axes	
	<b>Shock Resistance</b>	Damage limits: 500m/s <sup>2</sup> (approximately 50G) 5 shocks in each of 3 axes	
	<b>Extraneous Light Immunity</b>	Sunlight: 10,000 lux maximum Halogen lamp: 3,000 lux maximum	
	<b>Material</b>	Housing: Aluminium Lens: Glass Cover: Polyarylate	
	<b>Degree of Protection</b>	IP67 — IEC Pub 529	
	<b>Cable</b>	Cable type: ø5.4mm 5-core oiltight vinyl cabtyre cable (0.2mm <sup>2</sup> ) 2m long	Cable type: ø5.4mm 7-core oiltight vinyl cabtyre cable (0.2mm <sup>2</sup> ) 2m long
	<b>Weight</b>	Approximately 250g	
<b>Dimensions (HxWxD)</b>	1.97" x 1.18" x 3.15" (50 x 30 x 80mm)		
<b>Accessories</b>	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)	1.575" (40mm)	Standard
SA1J-C1P1	SA1J-C1P3	PNP	ø 0.236" (ø 6mm) ø 0.315" (ø 8mm)	1.969" (50mm) 2.362" (60mm)	
SA1J-C2N1	SA1J-C2N3	NPN	ø 0.098" (ø 2.5mm)	0.591" (15mm)	
SA1J-C2P1	SA1J-C2P3	PNP	ø 0.118" (ø 3mm) ø 0.177" (ø 4.5mm)	0.787" (20mm) 0.984" (25mm)	Small

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



		1-Colour Version	3-Colour Version
<b>General Specifications</b>	<b>Power Voltage</b>	12 to 24V DC (ripple 10% maximum) Operating voltage: 10 to 30V DC	
	<b>Current Draw</b>	150mA maximum	
	<b>Dielectric Strength</b>	Between live and dead parts: 1,000V AC, 1 minute	
	<b>Insulation Resistance</b>	Between live and dead parts: 20MΩ minimum (500V DC megger)	
	<b>Operating Temperature</b>	-10 to +50°C (no freezing)	
	<b>Operating Humidity</b>	35 to 85% RH (avoid condensation)	
	<b>Storage Temperature</b>	-30 to +70°C	
	<b>Vibration Resistance</b>	Damage limits: 10 to 55Hz Single amplitude: 0.75mm 2 hours in each of 3 axes	
	<b>Shock Resistance</b>	Damage limits: 500m/s <sup>2</sup> (approximately 50G) 5 shocks in each of 3 axes	
	<b>Extraneous Light Immunity</b>	Sunlight: 10,000 lux maximum Incandescent lamp: 3,000 lux maximum	
	<b>Material</b>	Housing: Aluminium Lens: Glass Cover: Polyarylate	
	<b>Degree of Protection</b>	IP65 (when inserting the fiber unit and tightening the cover)	
	<b>Cable</b>	0.2mm <sup>2</sup> ø5.4mm 5-core vinyl cabtyre cable, 2m long	0.2mm <sup>2</sup> ø5.4mm 7-core vinyl cabtyre cable, 2m long
	<b>Weight</b>	Approximately 190g	
<b>Dimensions (HxWxD)</b>	47H x 25W x 82.4D mm		
<b>Accessories</b>	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	

**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

**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

**Accessories**

Part No.	Description
SA9Z-F01	Fiber Cutter

		SA1J-F1N1	SA1J-F1N3	SA1J-F1P1	SA1J-F1P3
<b>Function Specifications</b>	<b>Reference Colour Set</b>	Teaching system, 1-colour	Teaching system, 3-colours	Teaching system, 1-colour	Teaching system, 3-colours
	<b>Inspection Tolerance</b>	5-step digital setting			
	<b>Inspection Mode</b>	Colour (C) / Colour + Intensity (C+1)			
	<b>Operation Mode</b>	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
	<b>Synchronous Mode</b>	Internal Synchronous Mode (INT) / External Synchronous Mode (EXT)			
	<b>Response Mode</b>	Fast (F) / Normal (N) / Slow (S)			
	<b>OFF-delay Timer</b>	Timer On (T-ON) / Timer Off (T-OFF)			
	<b>Control Output</b>	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	
	<b>SET input</b>	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	
	<b>External Synchronous Input</b>				
	<b>Operation Indicator</b>	Yellow LED	Yellow LED (3-colour individual display)	Yellow LED	Yellow LED (3-colour individual display)
	<b>Timer</b>	OFF-delay timer 40 msec			
	<b>Output Operation</b>	Equivalent Output			
<b>Response Time</b>	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	
<b>Light Source</b>	Three LEDs (red, green, blue)				

## Fiber Optic Units

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

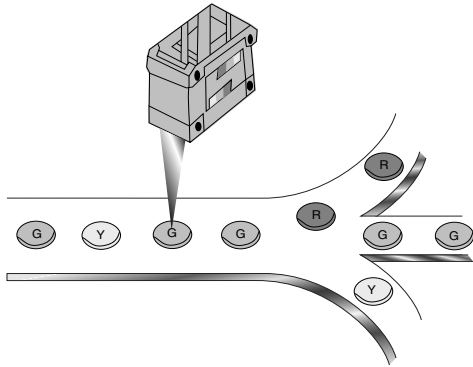
## Diffuse-Reflected Light Fiber Optic Unit

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

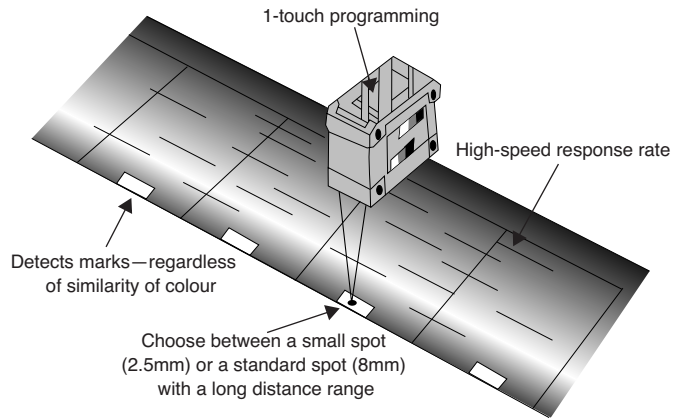


### Applications

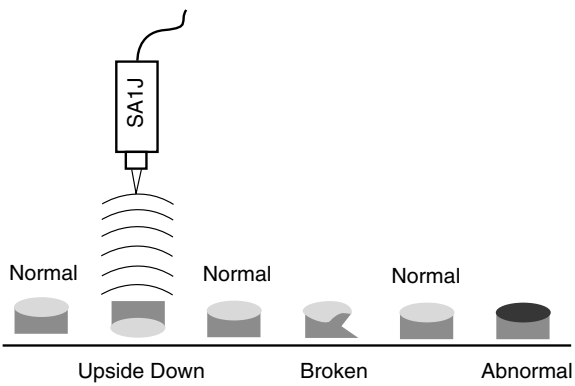
Sorting objects by cap or lid colour



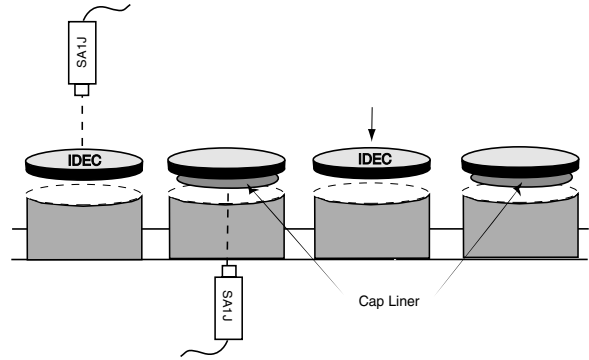
Detecting plastic bagging materials on a web



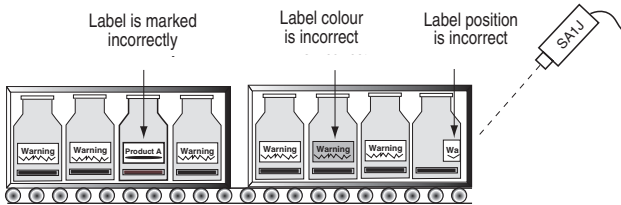
Detecting objects that are the incorrect shape or colour



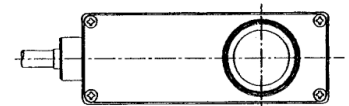
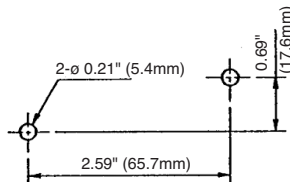
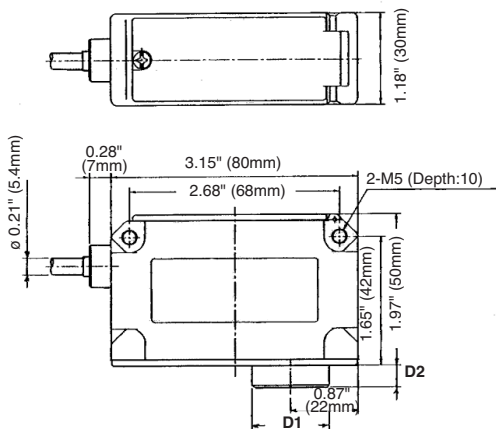
Detecting presence or absence of a logo on a cap or lid



Checking packaging labels for correct position, colour, and content



### Dimensions



**D1** = SA1J-C1□□ model =  $\phi$  0.99" (25.2mm)  
[SA1J-C2□□ model =  $\phi$  1.06" (27mm)]

**D2** = SA1J-C1□□ model =  $\phi$  0.26" (7mm)  
[SA1J-C2□□ model =  $\phi$  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



<b>General Specifications</b>	<b>Power Voltage</b>	24V DC (ripple 10% maximum)
	<b>Current Draw</b>	200mA maximum
	<b>Light Source Element</b>	Laser diode (670nm)
	<b>Receiver Element</b>	PSD (position sensitive device)
	<b>Dielectric Strength</b>	Between live and dead parts: 500V AC, 1 minute
	<b>Insulation Resistance</b>	Between live and dead parts: 20MΩ minimum (500V DC megger)
	<b>Operating Temperature</b>	0 to +45°C (performance will be adversely affected if the sensor becomes coated with ice)
	<b>Storage Temperature</b>	-20 to +70°C
	<b>Operating Humidity</b>	35 to 85% RH (avoid condensation)
	<b>Vibration Resistance</b>	Damage limits: 10 to 55Hz Single amplitude: 0.75mm 2 hours in each of 3 axes (de-energized)
	<b>Shock Resistance</b>	Damage limits: 100 m/s <sup>2</sup> (approximately 10G) 5 times in each of 3 axes (when de-energized)
	<b>Extraneous Light Immunity</b>	Incandescent light, 3,000 lux maximum
	<b>Operating Atmosphere</b>	Free from corrosive gasses
	<b>Material</b>	Housing: Zinc diecast Coverplate: Polyarylate Filter: Glass
	<b>Degree of Protection</b>	IP65 IEC Pub 529
<b>Cable</b>	Cable type: 6-core vinyl cabtyre cable 0.19mm <sup>2</sup> : 6' – 6-3/4' (2m) long	
<b>Weight</b>	Approximately 400g	
<b>Dimensions (HxWxD)</b>	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				
SA1M-CL4-AC	Small spot		PNP open collector		
SA1M-CL4-BC	Parallel beam				

<b>Function Specifications</b>	<b>Sensing Range</b>	2.755" to 5.906" (70 to 150mm)
	<b>Digital Output</b>	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)
	<b>Analogue Output for Light Intensity (colour mark detection)</b>	Analogue current output: 4 to 20mA, 5V maximum Reference output current ( <b>Note 1</b> ): 19.0+/-0.4mA Output stability ( <b>Note 2</b> ): ±5% (±0.8mA) maximum (against reference output current over the entire sensing range) Temperature drift ( <b>Note 3</b> ): ±5% (±0.8mA) maximum (against reference output current over the entire operating temperature) Response time: 1ms maximum (10 to 90% response) Additional noise ( <b>Note 2</b> ): 0.4mA maximum p-p (Position: 70mm)
	<b>Auxiliary Output (Note 4) (analogue output for distance)</b>	Analogue current output: 20 to 4mA, 5V maximum Linearity error ( <b>Note 2</b> ): ±1.5% FS (±1.2mm) (over the entire sensing range) Resolution ( <b>Note 2</b> ): 0.008" (200µm); Position: 70mm Temperature drift ( <b>Note 3</b> ): 5µA/°C maximum (against the entire operating temperature) Response time 1ms maximum (10 to 90% response)
	<b>Sensitivity Selections</b>	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)
	<b>Indicators</b>	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
	<b>Accessories</b>	Adjusting screwdriver, resistor (249Ω), operating instructions, warning label, precaution label

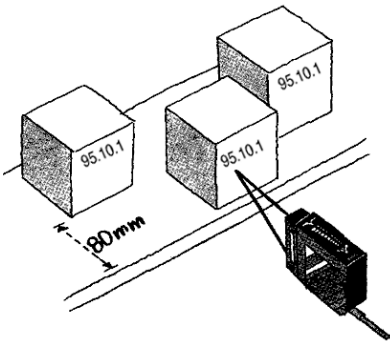


**Measuring conditions:**

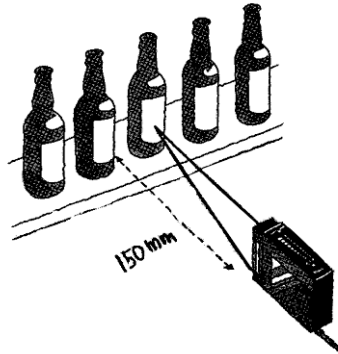
1. Temperature: 25°C, Object: White ceramic (0.6mm thickness), Sensitivity: Middle, Position: 110mm
2. Temperature: 25°C, Object: White ceramic (0.6mm thickness), Sensitivity: Middle
3. Object: White ceramic (0.6mm thickness), Sensitivity: Middle, Position: 110mm
4. Auxiliary output should be used only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

**Applications**

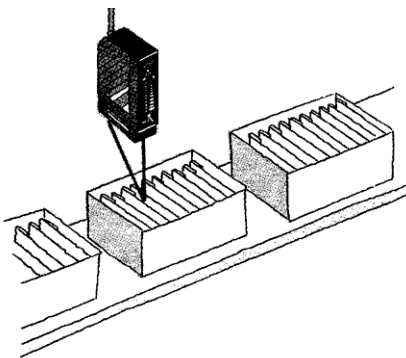
Stable output response over a wide sensing range, detecting the presence of package markings



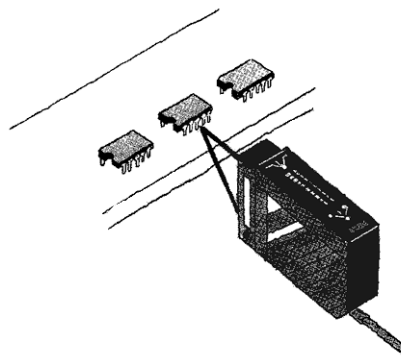
Long sensing distance (150mm maximum)



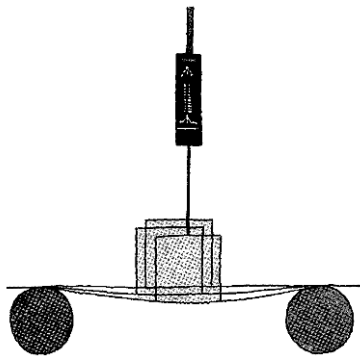
Counting the number of packages in a box



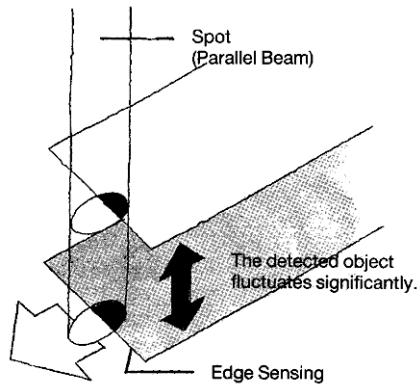
Small beam spot (0.5 x 1mm) (small spot type)



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



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

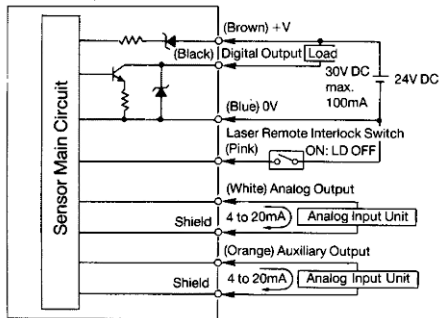


When the distance between the sensor and object varies significantly in positioning and edge sensing, the spot size remains unchanged, thus ensuring stable sensing.

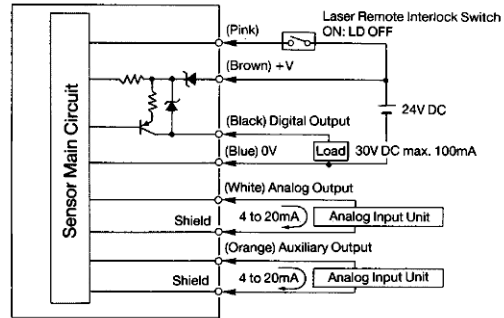
When the output should not be influenced by blurs, taints, fine patterns, or lines in the object surface, stable sensing is ensured by the relatively large spot size.

**Schematics**

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

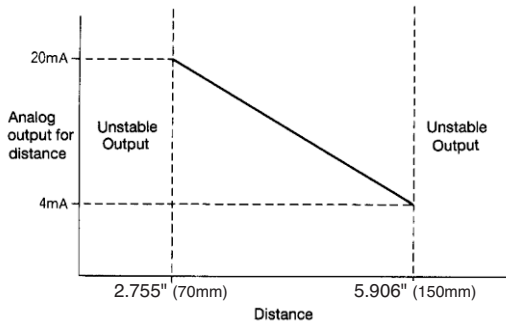


**Connection Example (SA1M-CL4-AC/BC (PNP) Output)**



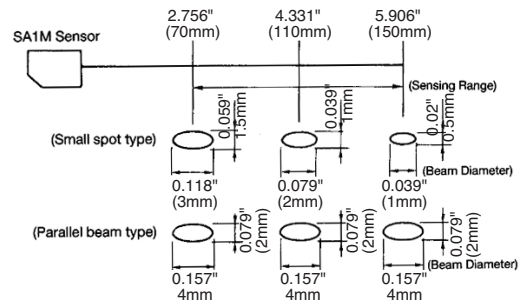
**Auxiliary Output**

**Analogue Output for Distance vs. Distance Characteristics**

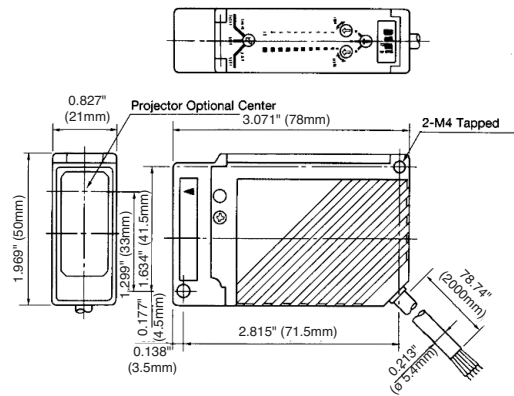


1. When the auxiliary output (analogue output for distance) is used, the sensing distance should range from 70 to 150mm. If the sensing distance exceeds this range, an unstable output occurs.

**Sensing Distance and Beam Distance**

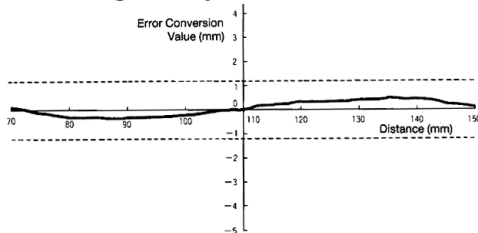


**Dimensions**



**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.

## 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



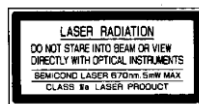
Warning Label (common)



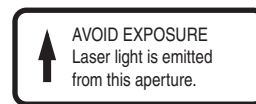
**All Laser Sensors:**  
Identification and Certification

mfd.: **FEBRUARY 1997**  
Product conforms to  
**21 CFR 1040**

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

General Specifications

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

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

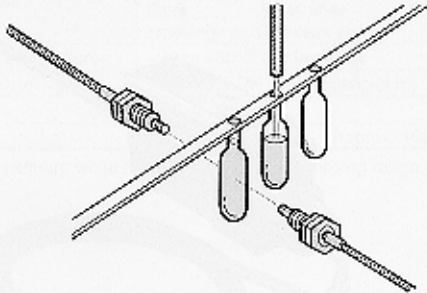
**Lens Attachments (for through-beam type fiber units)**

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

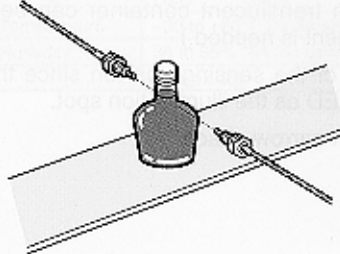


### Applications

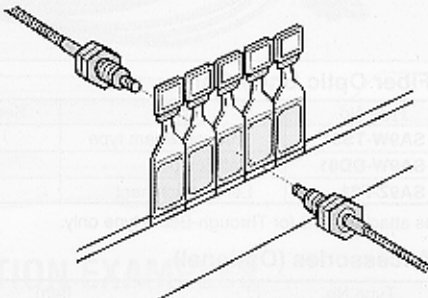
• Checking the Level of Chemicals.



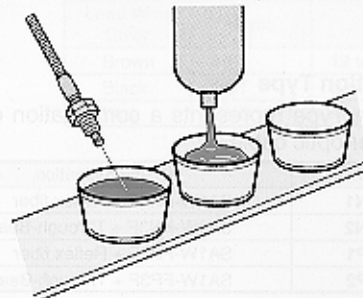
• Checking the Level of Spirits.  
Detection can be performed irrespective of bottle shapes.



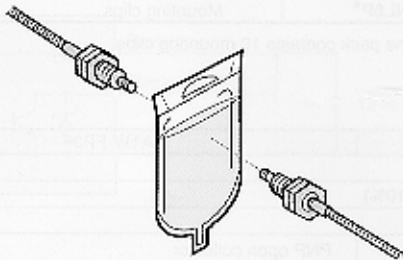
• Checking the Level of Eyewash.



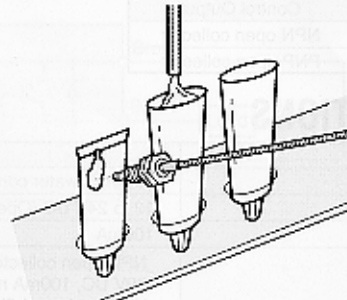
• Checking for the Presence of Jelly (ice cream, pudding, etc).



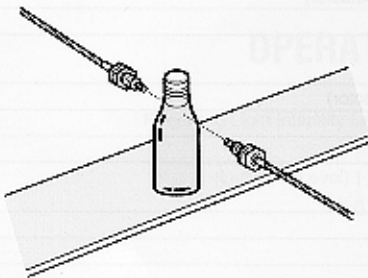
• Checking the Level of Intravenous Drip.



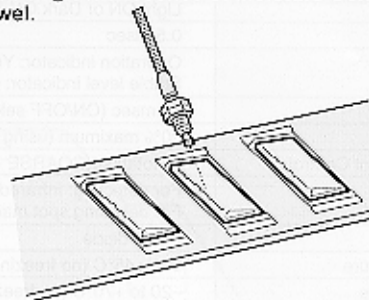
• Checking for Leakage in a Toothpaste Tube.



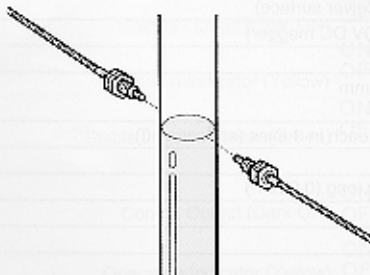
• Checking the Level of Soda or Juice.



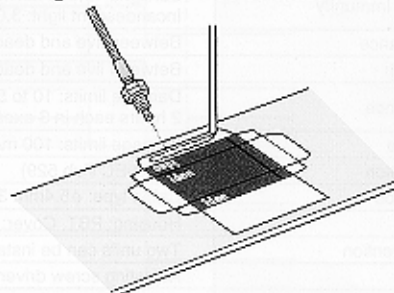
• Checking the Presence of Moisture Content in a Towel.



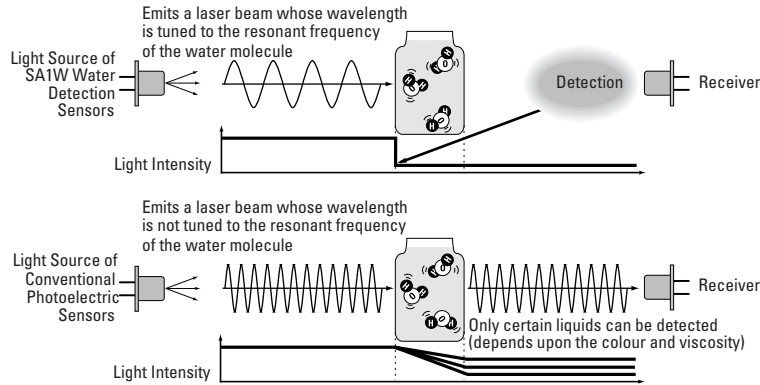
• Checking the Transparency Level in Glass Tube.



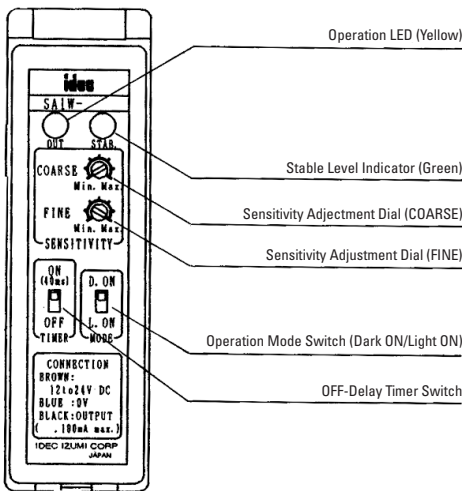
• Checking for the Presence of Glue.



**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	<b>Incident condition</b> Through-beam: without detected object (water) Reflex: without detected object (water)	Coarse	Min. Max.	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.
	<b>Interrupt condition</b> Through-beam: with detected object (water) Reflex: with detected object (water)	Coarse	Min. Max.	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	<b>Incident condition</b> Through-beam: without detected object (water) Reflex: without detected object (water)	Fine	Min. Max.	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.
	<b>Interrupt condition</b> Through-beam: with detected object (water) Reflex: with detected object (water)	Fine	Min. Max.	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.

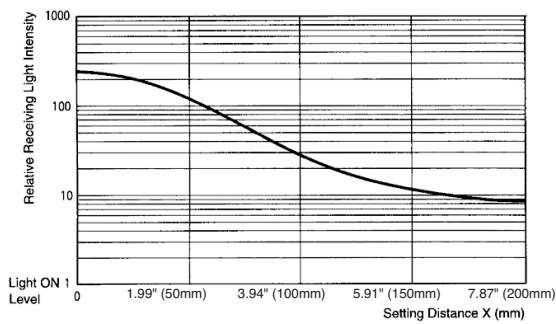
### Operation and Stable Level Indicator

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

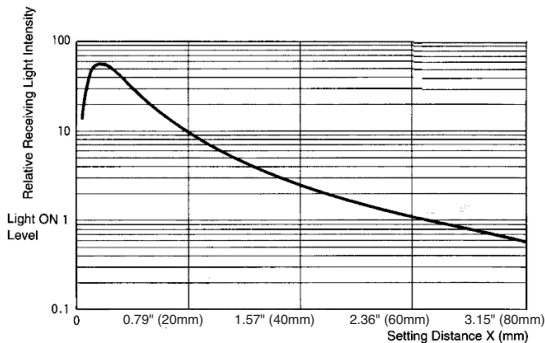
### Sensing Characteristics

#### 1. Relative Receiving Light Intensity vs. Setting Distance

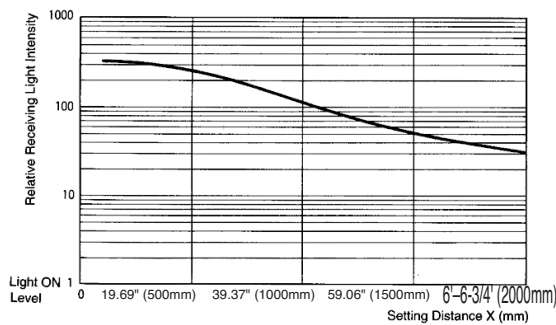
SA9W-TS31 (through-beam type)



SA9W-DD81 (reflex type)

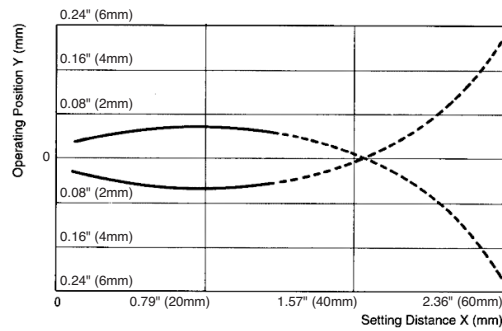


SA9W-TS31 (through-beam type) and SA9Z-F21 (lens attachment)



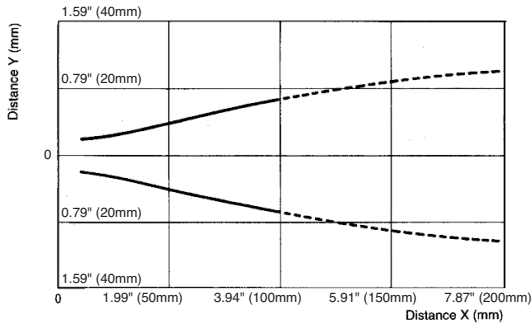
#### 2. Sensing Range Characteristics

SA9W-DD81 (reflex type)

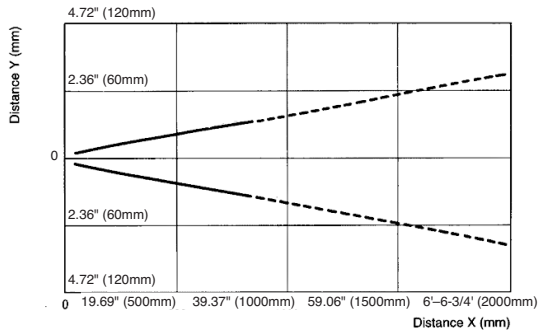


#### 3. Horizontal Transfer Characteristics

SA9W-TS31 (through-beam type)



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



**Installation**

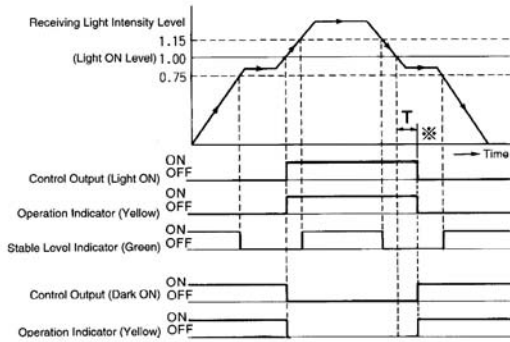
**Notes**

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.

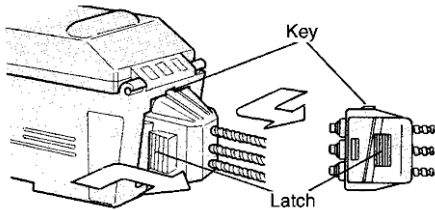
To ensure stable sensing, run a test operation for approximately 15 minutes.

**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.

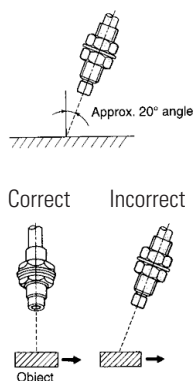


**Installing the fiber optics:** Tighten the fibers with tightening torque less than 2N·m (20kgf·cm) by using the nut on the tip of the fiber cable.

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.

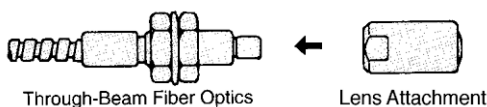
When the surface of the object is not glossy, the mounting angle may be less than 20°.

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**

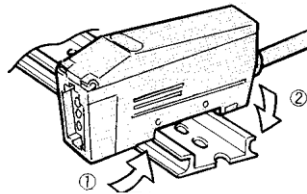
Amplifier units can be snap-mounted onto a 35mm-wide DIN rail or mounted using an attached mounting bracket.

**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.



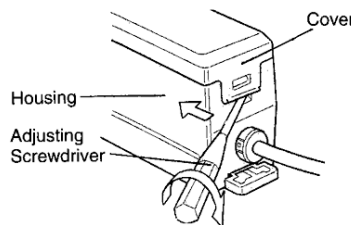
**Removal:** Insert a screwdriver into the hole on the hook and pull the screwdriver toward you. When using a hole for screw mounting, the tightening torque should range from 0.5 to 0.8N·m (5 to 8kgf·cm).

**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.

**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.

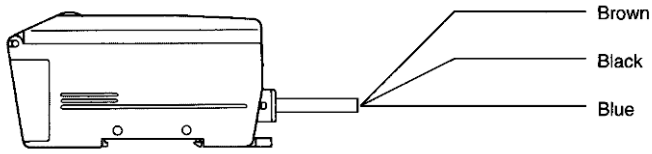
Do not install high-voltages and power lines in the same conduit with input and output lines. Use separate conduits.

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 (0.3mm<sup>2</sup>) or more.

**Schematics**

**Connection Diagram**

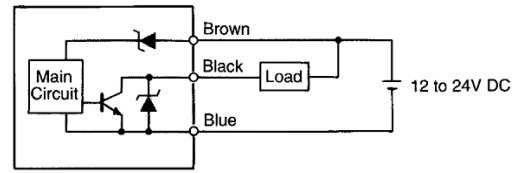


**Wiring**

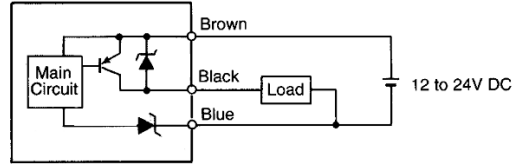
Lead Wire Colour	Name	Function
Brown	+V	12 to 24V DC
Black	OUT	Control Output
Blue	GND (0V)	Power Voltage 0V

**Connection Examples**

**NPN Output**

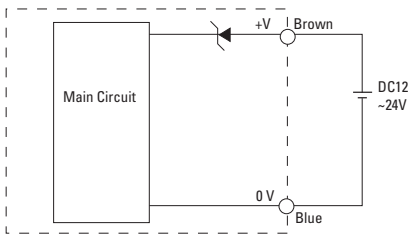


**PNP Output**

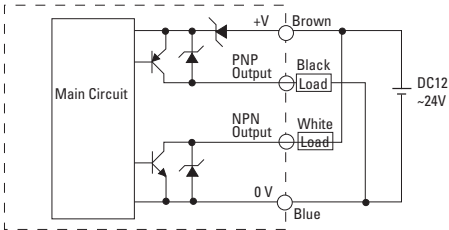


**Connection Diagram for SA1W-MK1229**

**Projector**

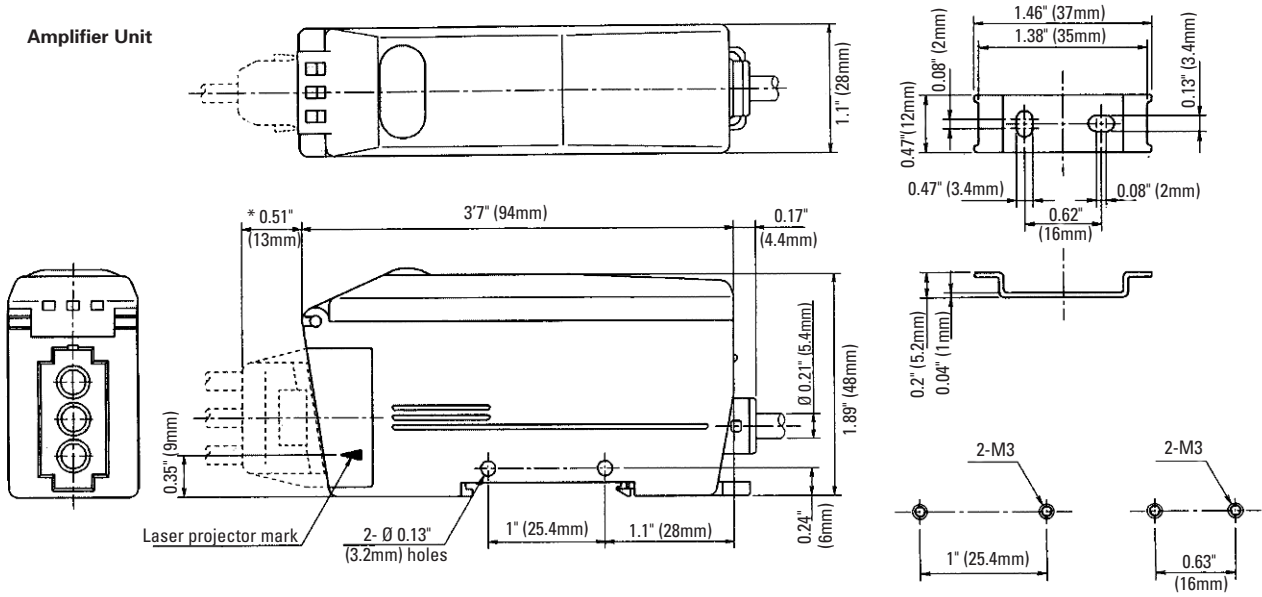


**Receiver**

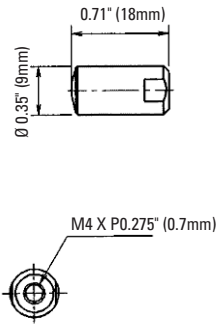


**Dimensions**

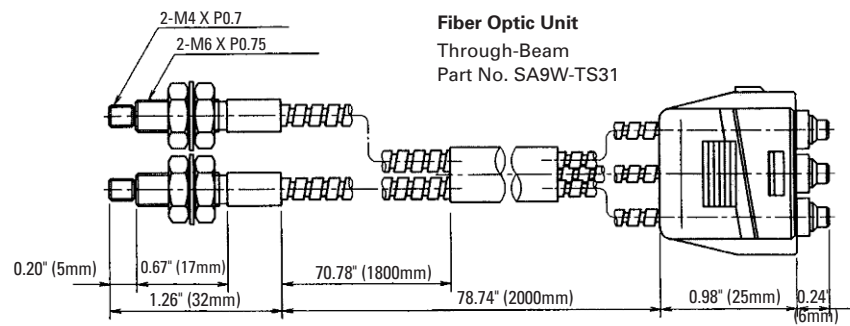
**Amplifier Unit**



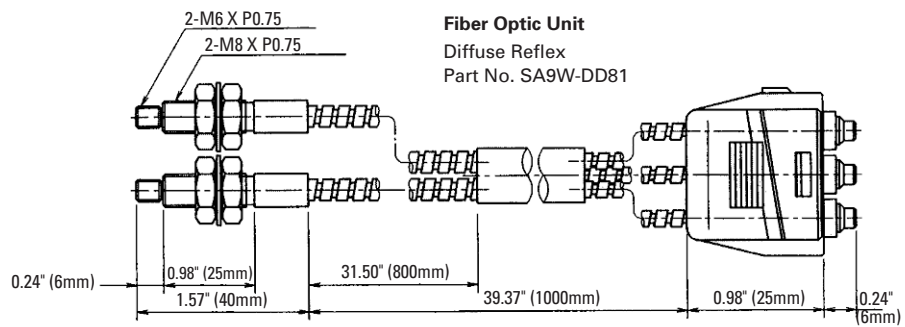
**Lens Attachment**  
Through-Beam  
Part No. SA9Z-F21



**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.

<b>General Specifications</b>	<b>Power Voltage</b>	24V DC (ripple 10% maximum)
	<b>Current Draw</b>	200mA (maximum)
	<b>Dielectric Strength</b>	Between live and dead parts: 500V AC, 1 minute
	<b>Insulation Resistance</b>	Between live and dead parts: 100M $\Omega$ (minimum), with 500V DC megger
	<b>Operating Temperature</b>	0 to +45°C (performance will be adversely affected if the sensor becomes coated with ice)
	<b>Storage Temperature</b>	-20°C to +70°C
	<b>Operating Humidity</b>	35% to 85% RH (avoid condensation)
	<b>Vibration Resistance</b>	Damage limits: 10 to 55Hz, amplitude 1.5mm p-p, 2 hours in each of 3 axes (when de-energized)
	<b>Shock Resistance</b>	Damage limits: 100m/sec <sup>2</sup> (approximately 10G), 5 shocks in each of 3 axes
	<b>Extraneous Light Immunity</b>	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
	<b>Material</b>	Housing: diecast zinc; Filter: glass; Lens: acrylic; Rear cover: polyarylate
	<b>Degree of Protection</b>	IP65 — IEC Pub 529; Sensors rated IP65 are dust-tight, water-resistant, and perform best when not subjected to heavy particle or water blasts
	<b>Cable</b>	Cable type: 6-core cabtyre cable 0.3mm <sup>2</sup> , 6' 6 3/4" (2m) long
<b>Weight</b>	Approximately 400g	
<b>Dimensions</b>	1.97"D x 0.83"W x 3.07"D (50mm H x 21mm W x 78mm D)	

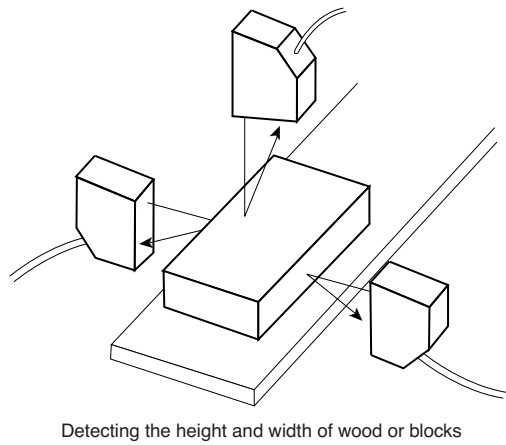
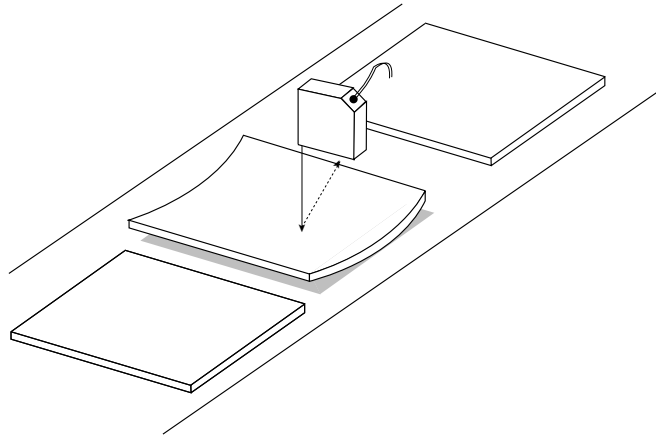
<b>Function Specifications</b>	<b>Resolution</b>	0.002" (50 $\mu$ m) — measuring conditions: sensing a white ceramic object at the reference sensing distance (60mm) using the normal response speed (50ms) at 25°C
	<b>Analogue Output</b>	20 to 4mA, 5V (maximum), fixed range
	<b>Digital Output</b>	NPN or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

**Part Numbers: MX1C Sensors**

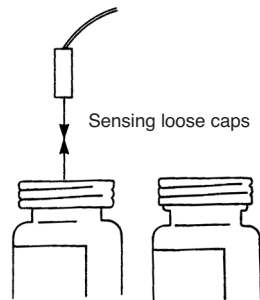
Part Number	Output	Sensing Range	Resolution
<b>MX1C-AK1</b>	NPN	2.36" to 6.30"	0.002" (50µm)
<b>MX1C-AL1</b>	PNP	(60mm to 160mm)	

**Applications**

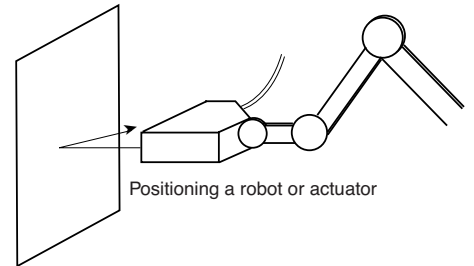
Checking for warped boards



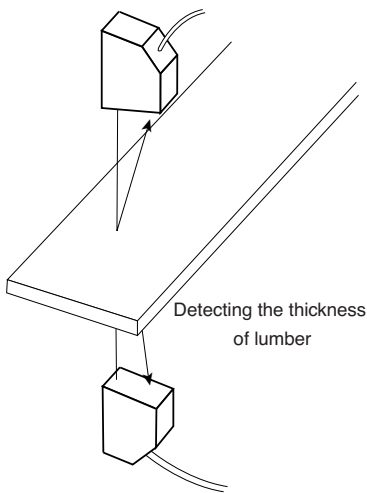
Detecting the height and width of wood or blocks



Sensing loose caps

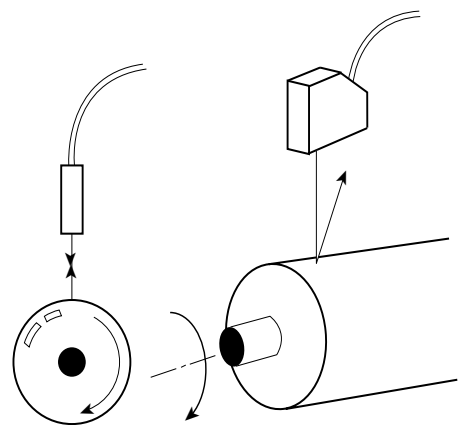
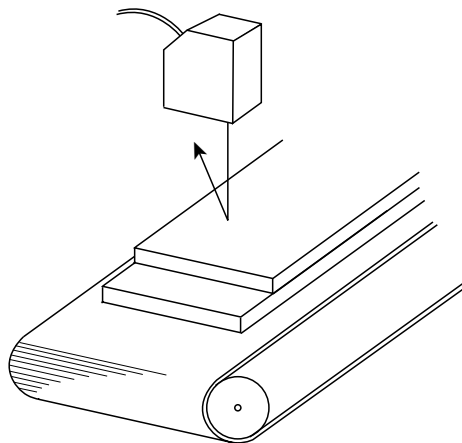


Positioning a robot or actuator



Detecting the thickness of lumber

Detecting overlapping sheets  
Counting sheets of paper



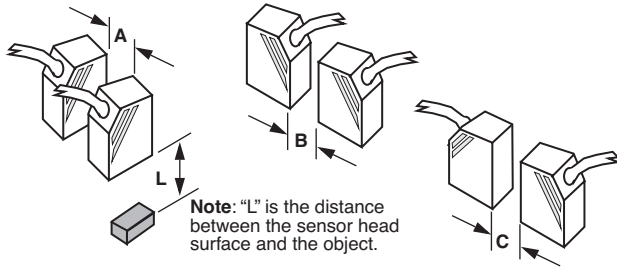
Sensing the roundness of a roller



**Installation**

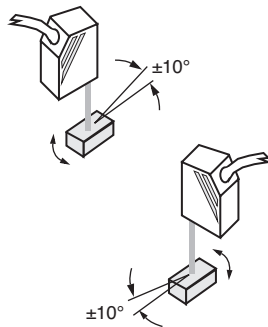
See page Q-56 for general sensor instructions. Below are considerations specific to the MX1C miniature laser sensors.

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)

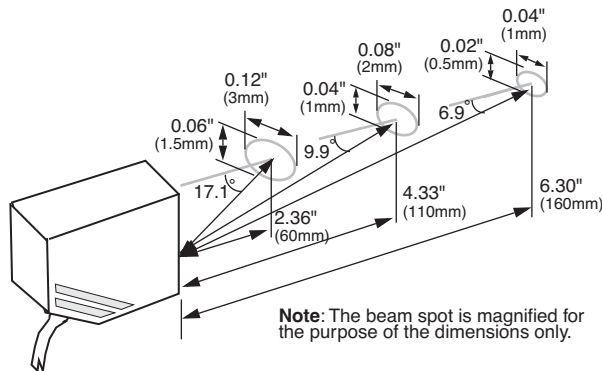
Laser sensing of mirror-like surfaces is not recommended, as the sensor receiver is designed for detecting diffuse-reflected light. Direct laser reflection may result in unreliable results.



For best results detecting reflective surfaces, tilt the sensor to reduce direct laser reflection. Sensing at a small angle (approximately ±10°) 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.

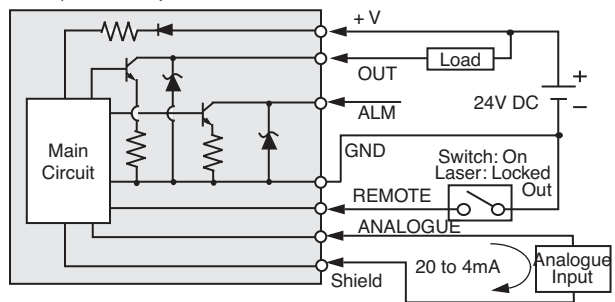
**Wiring**

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

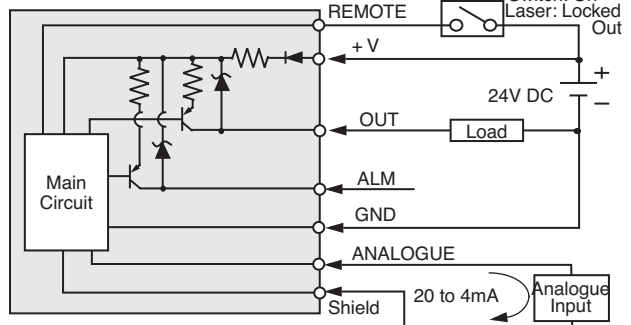
The analogue output line may be extended up to 33' (10m), as long as the cable used is equal to or superior to the cable provided. Other lines may be extended up to 164' (50m), using #22 AWG (0.3mm<sup>2</sup>) wire.

**Schematics**

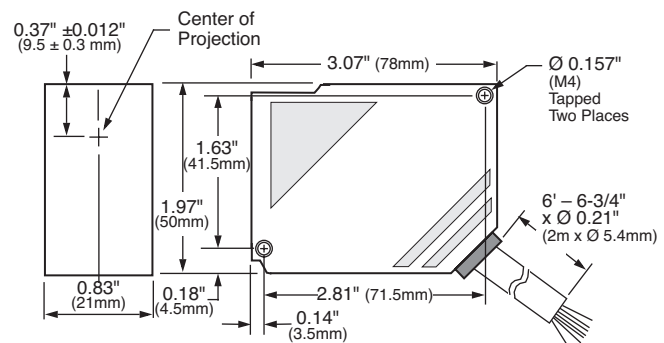
**NPN (MX1C-AK1)**



**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)



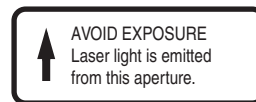
**All Laser Sensors:**  
Identification and Certification

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" ( $\pm 0.04$ ")  
Medium range: 3.94" to 39.37" ( $\pm 0.08$ ")  
Long range: 7.87" to 78.74" ( $\pm 0.19$ ")
- 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	<b>Power Voltage</b>	12 to 24V DC (ripple 10% maximum)
	<b>Current Draw</b>	100mA (maximum)
	<b>Dielectric Strength</b>	Between live and dead parts: 1000V, 50/60Hz, 1 minute
	<b>Insulation Resistance</b>	Between live and dead parts: 100M $\Omega$ (minimum) with 500V DC megger
	<b>Operating Temperature</b>	-10° to +60°C (performance will be adversely affected if the sensor becomes coated with ice)
	<b>Storage Temperature</b>	-30°C to +70°C
	<b>Operating Humidity</b>	35 to 70% RH (avoid condensation)
	<b>Vibration Resistance</b>	Damage limits: 10 to 55Hz, amplitude 1.5mm p-p, 2 hours in each of 3 axes (when de-energized)
	<b>Shock Resistance</b>	Damage limits: 500m/sec <sup>2</sup> (approximately 50G) 3 shocks in each of 3 axes
	<b>Noise Resistance</b>	Power line: 500V; Pulse width: 1 $\mu$ sec, 50/60Hz (using a noise simulator)
	<b>Material</b>	Housing: diecast zinc; Coverplate: polyarylate
	<b>Degree of Protection</b>	IP65 — IEC Pub 529: Sensors rated IP65 are dust-tight, water-resistant, and perform best when not subjected to heavy particle or water blasts
	<b>Cable</b>	Cable type: 6-core cabtyre cable 0.2mm <sup>2</sup> , 6'-6-3/4" (2m) long
	<b>Weight</b>	Short and medium range: 260g; Long range: 270g
<b>Dimensions</b>	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" ± 0.4" (100mm to 300mm ± 10mm)	1.97" to 11.81" ± 0.4" (50mm to 300mm ± 10mm)	± 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" ± 0.8" (200mm to 1m ± 20mm)	3.94" to 39.37" ± 0.8" (100mm to 1m ± 20mm)	± 0.08" (2mm)

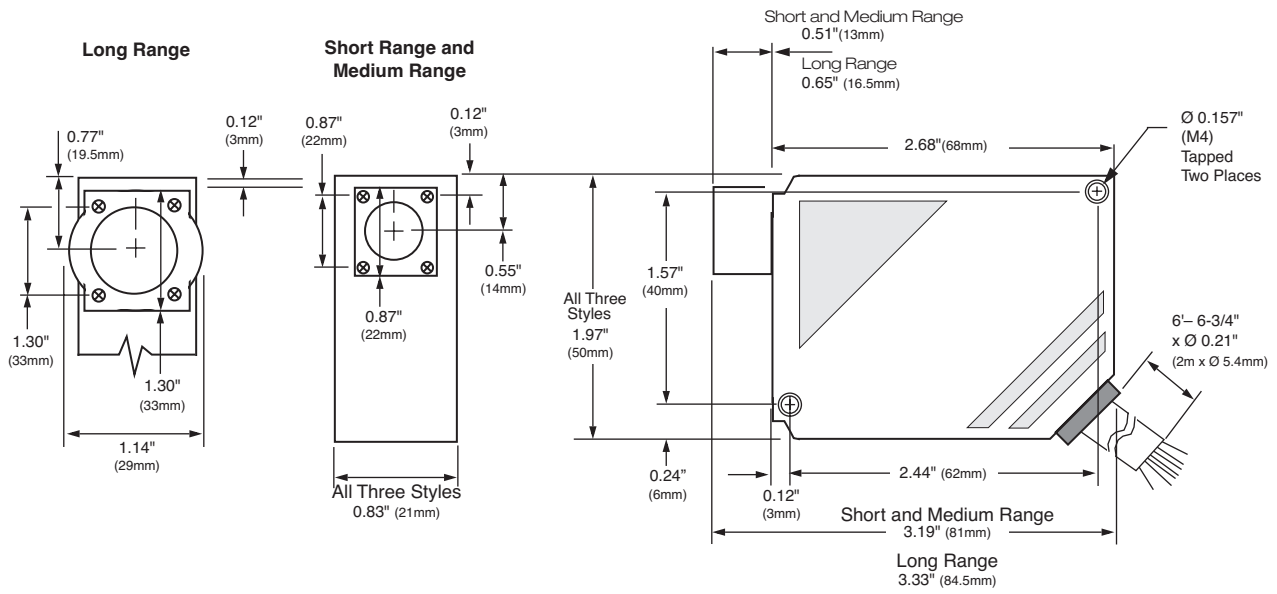
**Part Numbers: Long Sensing Range**

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

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

Function Specifications

### 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



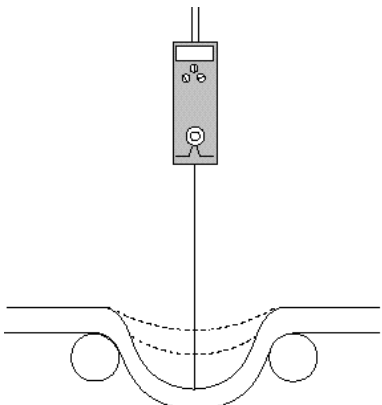
General Specifications	<b>Power Voltage</b>	12 to 24V DC $\pm$ 10% (ripple 10% maximum)
	<b>Current Draw</b>	100mA (maximum)
	<b>Dielectric Strength</b>	Not specified due to capacitor grounding
	<b>Insulation Resistance</b>	Not specified due to capacitor grounding
	<b>Operating Temperature</b>	0° to +55°C (performance will be adversely affected if the sensor becomes coated with ice)
	<b>Operating Humidity</b>	35 to 85% RH (avoid condensation)
	<b>Storage Temperature</b>	-20° to +70°C
	<b>Vibration Resistance</b>	Damage limits: 10 to 55Hz, amplitude 1.5mm p-p, 2 hours in each of 3 axes (power off)
	<b>Shock Resistance</b>	Damage limits: 500m/sec <sup>2</sup> (approximately 50G), 5 shocks in each of 3 axes
	<b>Extraneous Light Immunity</b>	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
	<b>Material</b>	Housing: Diecast zinc; Filter and lens: Acrylic
	<b>Degree of Protection</b>	IP65 — IEC Pub 529; sensors rated IP65 are dust-tight, water-resistant, and perform best when not subjected to heavy particle or water blasts
	<b>Cable</b>	Cable type: 5-core cabtyre cable 0.2mm <sup>2</sup> , 6'-6-3/4" (2m) long
<b>Weight</b>	Approximately 350g	
<b>Dimensions</b>	2.68"H x 0.83"W x 1.97"D (68mm H x 21mm W x 50mm D)	

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

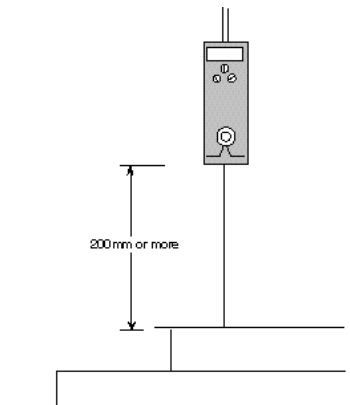
Part Numbers: SA1D Sensors

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)	

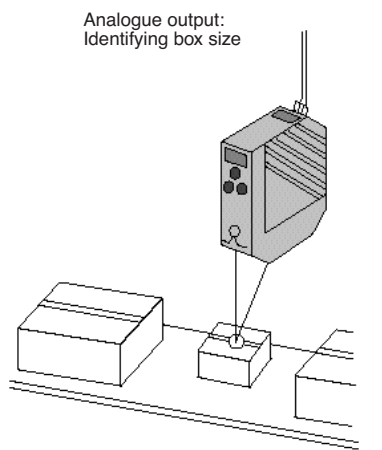
### Applications



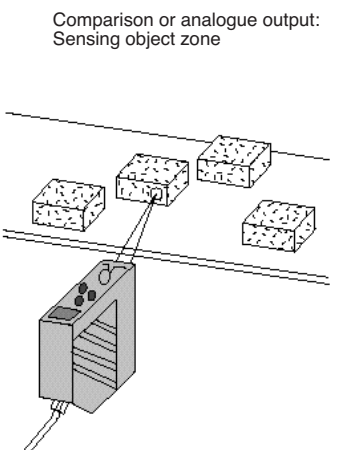
Analogue output: Controlling tension



Comparison output: Detecting overlap

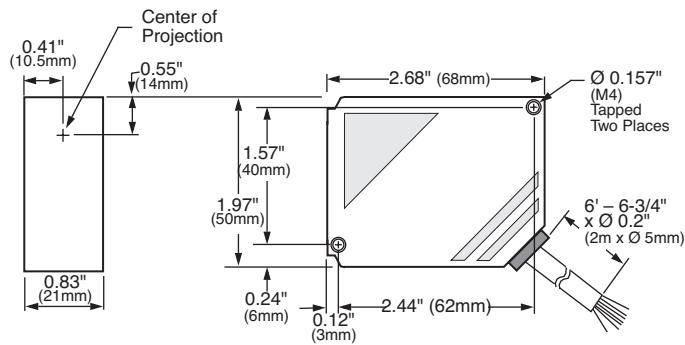


Analogue output: Identifying box size



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 (0.3mm<sup>2</sup>) 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 <sup>2</sup> , 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 <sup>2</sup> , 1-m vinyl cabtyre cable (2-core for the emitter of through-beam type)				
	Connector Type	M8 connector (4-pin)				

## SA1E Accessories

### Mounting Brackets

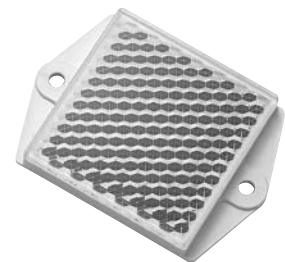
Part Number	Type	Package Quantity
SA9Z-K01	Vertical	1
SA9Z-K02	Horizontal	

### 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	—

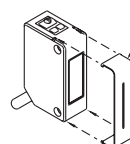


### Slits for through-beam type

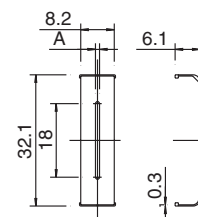
Part Number	Slit Width	Package Quantity	Sensing Range (m)		Maximum Detectable Object Width (mm)	
			One side	Both sides	One side	Both sides
SA9Z-S06	0.5 mm	2	2.5	1.0	7.0	0.5
SA9Z-S07	1.0 mm		3.5	1.5	7.0	1.0
SA9Z-S08	2.0 mm		6.0	3.5	7.0	2.0

Dimensions

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

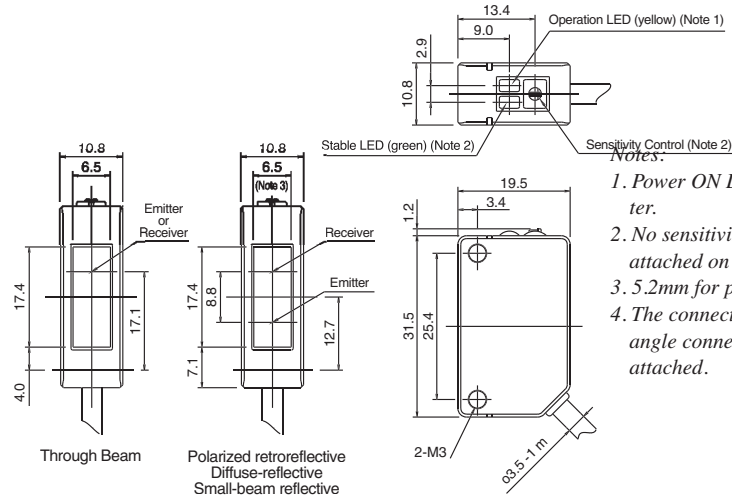


Slit (Stainless Steel)



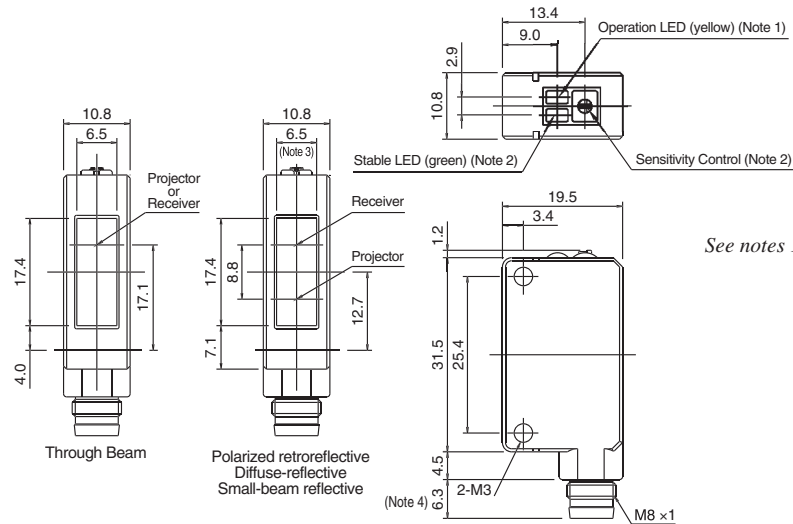
**Dimensions**

**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.

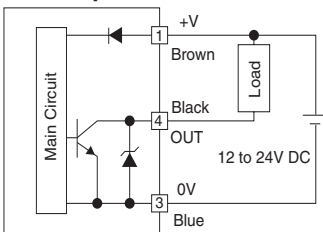
**Connector Type**



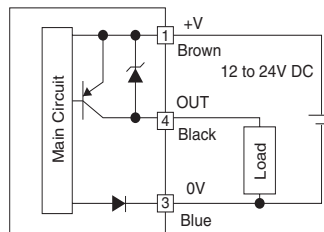
See notes 1 through 4 above.

**Output Circuit and Wiring Diagram**

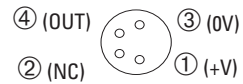
**• NPN Output**



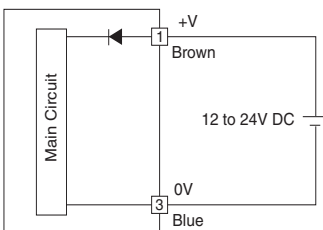
**• PNP Output**



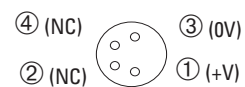
**Connector Pin Assignment**



**• Through-beam Type Emitter**



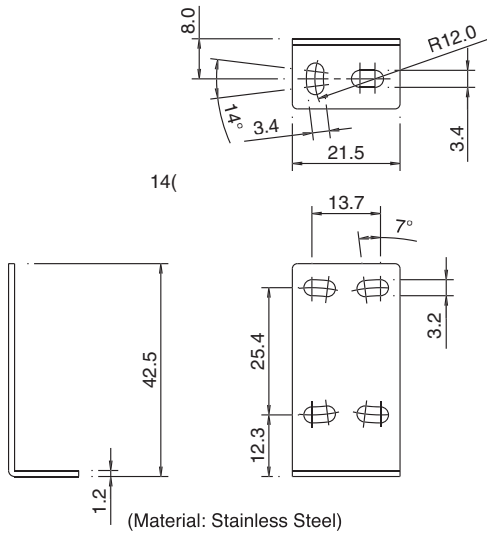
**Connector Pin Assignment**



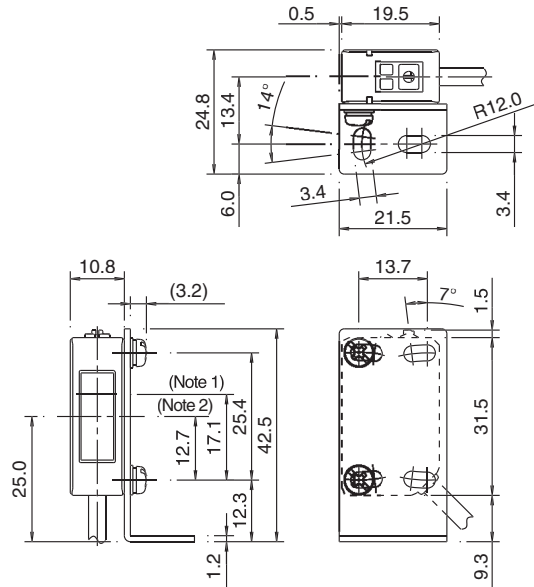
**Dimensions, continued**

**Mounting Bracket**

**SA9Z-K01**

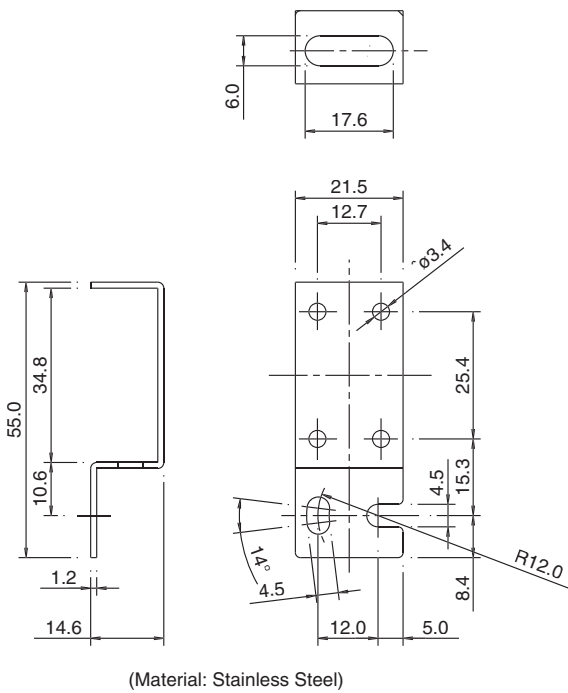


**With Mounting Bracket**

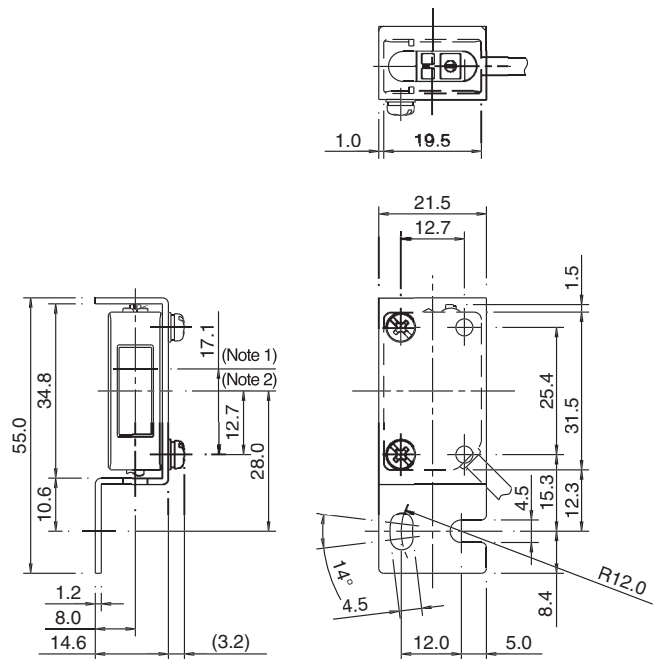


Note 1: Center of optical axis (through-beam type)  
 Note 2: Center of optical axis (polarized retroreflective, diffuse reflective, and small-beam reflective type)

**SA9Z-K02**



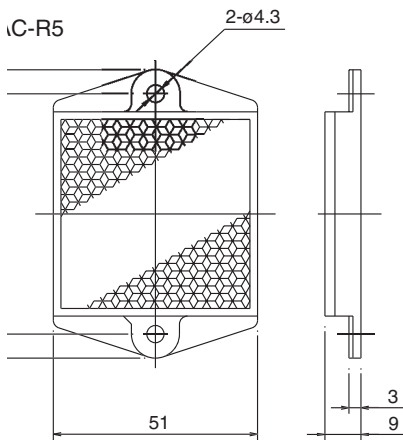
**With Mounting Bracket**



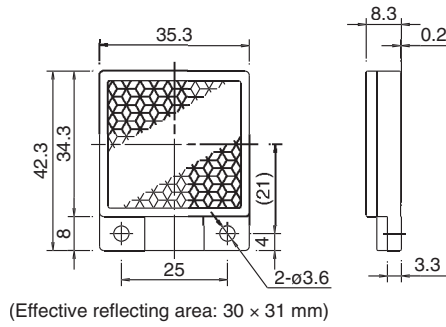
Note 1: Center of optical axis (through-beam type)  
 Note 2: Center of optical axis (polarized retroreflective, diffuse reflective, and small-beam reflective type)

Dimensions, continued

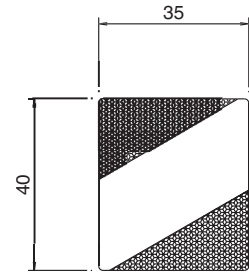
**Reflector**



IAC-R6

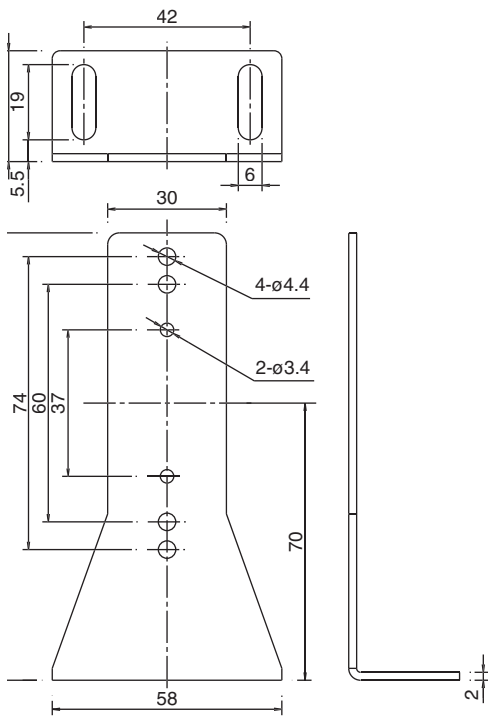


IAC-RS1



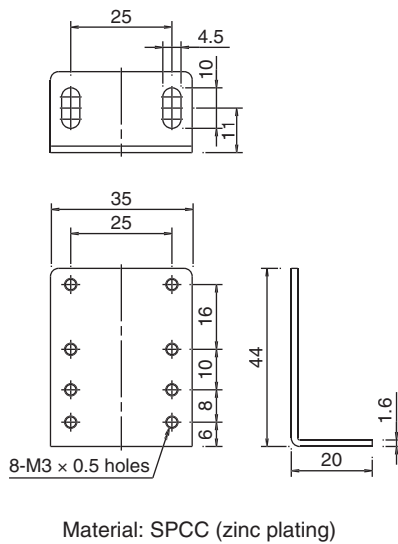
**Reflector Mounting Bracket**

AC-L2



Material: SPCC (zinc chromate plating, black)

IAC-L3

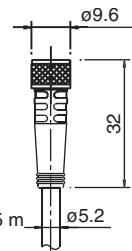


**Connector Cable (one-side connector)**

Straight Type

SA9Z-CM8K-4S□

- ① Black
- ② Blue
- ③ White
- ④ Brown



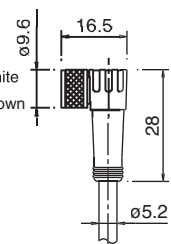
Cable length: 2 or 5 m

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
- ② Blue
- ③ White
- ④ Brown

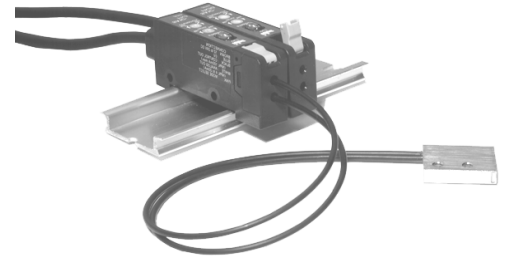


Cable length: 2 or 5 m

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



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

General Specifications



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
<b>SA9F-DS31</b> No sleeve <b>SA9F-DC32</b> 3.54" (90mm) sleeve <b>SA9F-DS33</b> 1.77" (45mm) sleeve	Straight: Two fibers Ø 0.04" (1mm) Threaded mount: Ø 0.24" (M6) Detects: Ø 0.0012" (0.03mm) minimum object	SA1C-FK3 SA1C-FK3G	2.36" (60mm) 0.28" (7mm)	
<b>SA9F-DC31</b> No sleeve <b>SA9F-DC32</b> 3.54" (90mm) sleeve <b>SA9F-DC33</b> 1.77" (45mm) sleeve (All three not compatible with green LED)	Coiled: Two fibers Ø 0.04" (1mm) Threaded mount: Ø 0.24" (M6) Detects: Ø 0.0012" (0.03mm) minimum object	SA1C-FK3 SA1C-FK3G	0.98" (25mm) —	
<b>SA9F-DT11</b> No sleeve <b>SA9F-DT12</b> 3.54" (90mm) sleeve <b>SA9F-DT13</b> 1.77" (45mm) sleeve (All three not compatible with green LED)	Straight: Two fibers Ø 0.02" (0.5mm) Threaded mount: Ø 0.12" (M3) Detects: Ø 0.0012" (0.03mm) minimum object	SA1C-FK3 SA1C-FK3G	0.78" (20mm) —	
<b>SA9F-DD31</b>	Coaxial: Core Ø 0.04" (1mm) + 16 fibers: Ø 0.01" (0.26mm) Threaded mount: Ø 0.24" (M6) Detects: Ø 0.0012" (0.03mm) minimum object	SA1C-FK3 SA1C-FK3G	2.36" (60mm) 0.28" (7mm)	

(continued on following page)

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

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

### Measuring Conditions

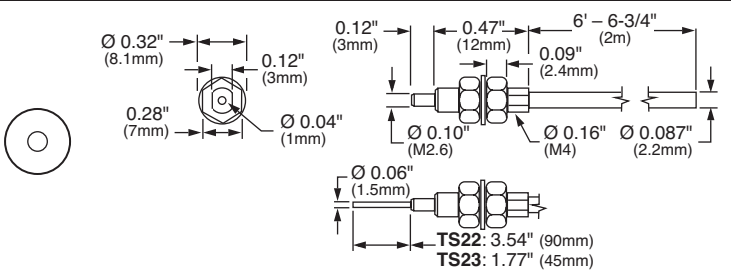
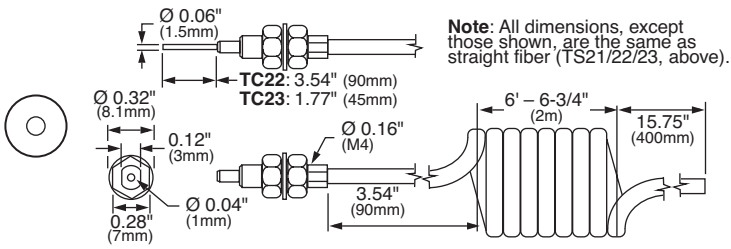
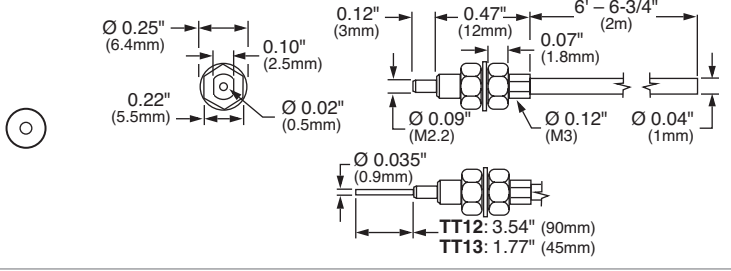
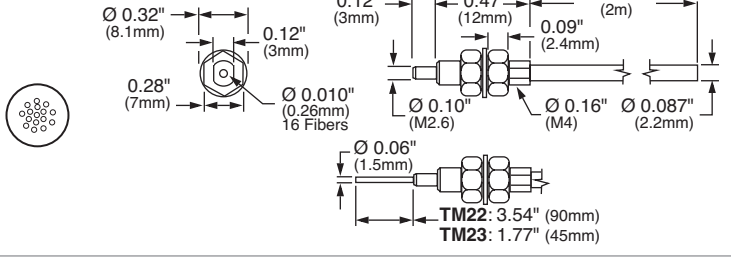
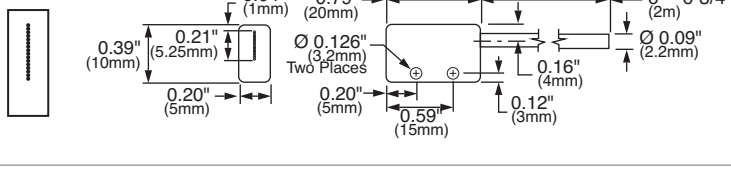
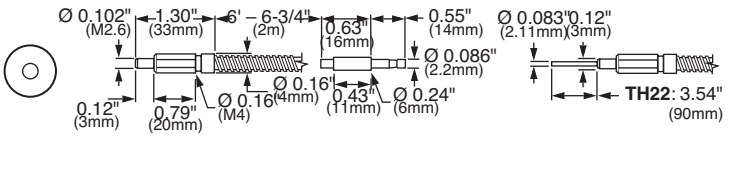
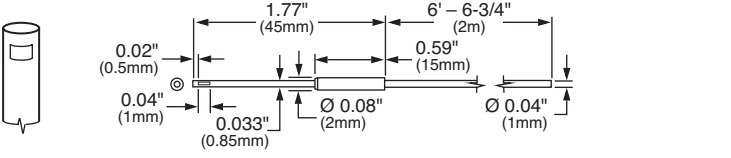
Amplifier = Applicable Amplifier

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
<b>SA9F-TS21</b> No sleeve <b>SA9F-TS22</b> 3.54" (90mm) sleeve <b>SA9F-TS23</b> 1.77" (45mm) sleeve	Straight fiber: Ø 0.04" (1mm) Threaded mount: Ø 0.16" (M4) Detects: Ø 0.012" (0.3mm) minimum object	SA1C-FK3 SA1C-FK3G	7.09" (180mm) 0.63" (16mm)	
<b>SA9F-TC21</b> No sleeve <b>SA9F-TC22</b> 3.54" (90mm) sleeve <b>SA9F-TC23</b> 1.77" (45mm) sleeve	Coiled fiber: Ø 0.04" (1mm) Threaded mount: Ø 0.16" (M4) Detects: Ø 0.012" (0.3mm) minimum object	SA1C-FK3 SA1C-FK3G	5.91" (150mm) 0.55" (14mm)	
<b>SA9F-TT11</b> No sleeve <b>SA9F-TT12</b> 3.54" (90mm) sleeve <b>SA9F-TT13</b> 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	SA1C-FK3 SA1C-FK3G	1.97" (50mm) 0.2" (5mm)	
<b>SA9F-TM21</b> No sleeve <b>SA9F-TM22</b> 3.54" (90mm) sleeve <b>SA9F-TM23</b> 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	SA1C-FK3 SA1C-FK3G	5.91" (150mm) 0.55" (14mm)	
<b>SA9F-TM74</b> 16 fibers in one row	Multicore: 16 fibers (one row) Ø 0.010" (0.26mm) Detects: Ø 0.0024" (0.06mm) minimum object	SA1C-FK3 SA1C-FK3G	5.91" (150mm) 0.55" (14mm)	
<b>SA9F-TH21</b> No sleeve <b>SA9F-TH22</b> 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	SA1C-FK3 SA1C-FK3G	3.94" (100mm) 0.31" (8mm)	
<b>SA9F-TL53</b> (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	SA1C-FK3 SA1C-FK3G	1.57" (40mm)	

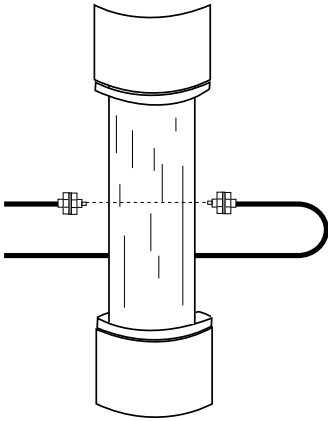


Refer to page Q-39 for the measuring conditions.

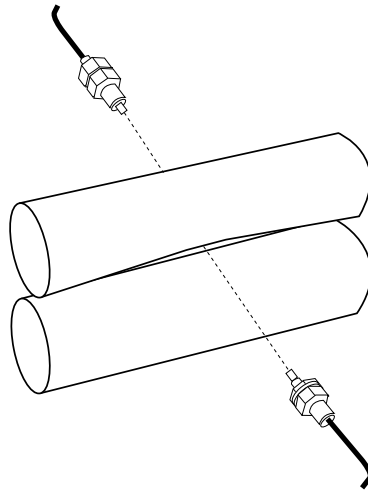


**Applications**

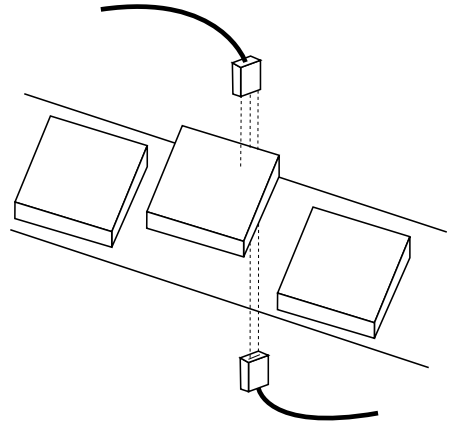
Monitoring the gradual change in liquid densities



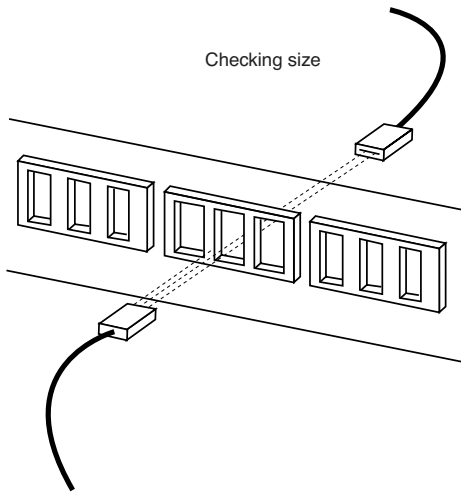
Detecting the roundness of rollers



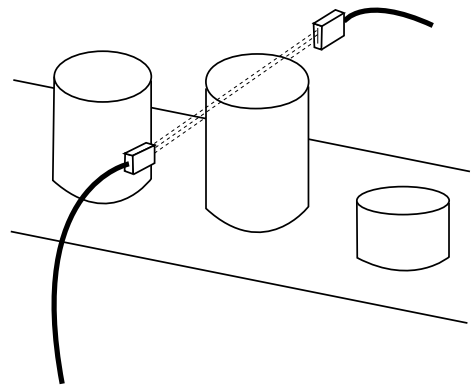
Sensing position or alignment



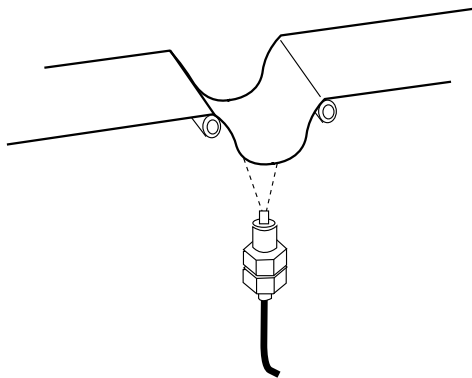
Checking size



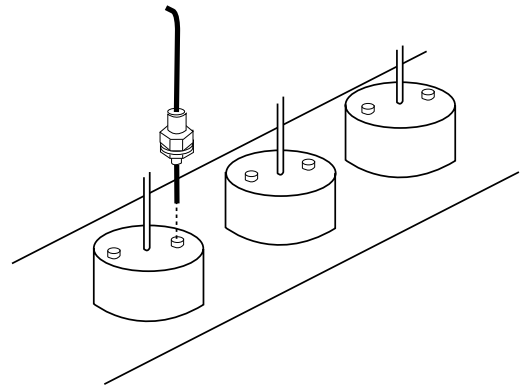
Checking height



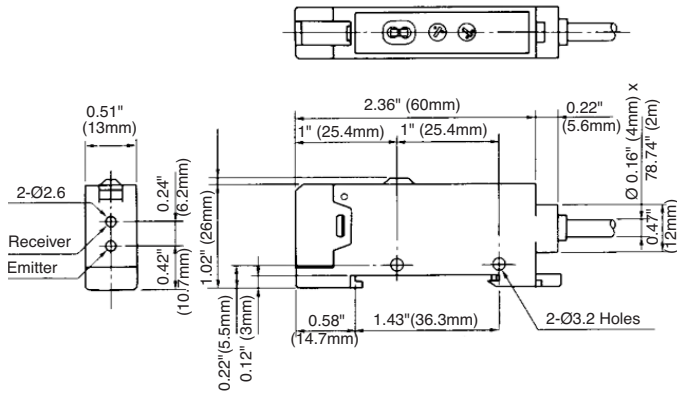
Controlling web tension



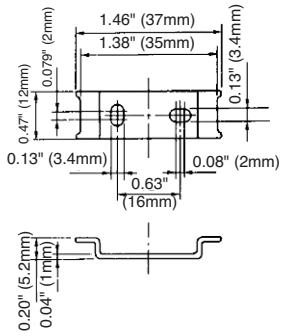
Sensing colour marks



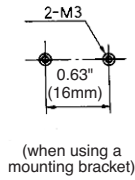
Dimensions



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

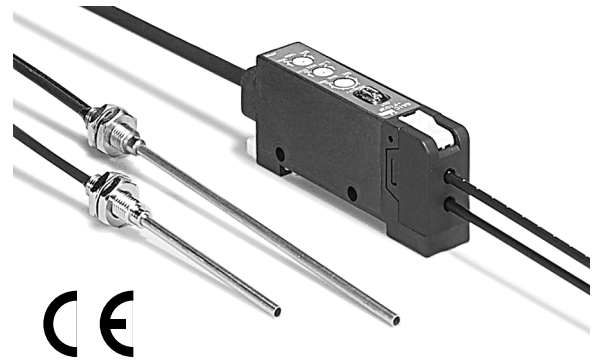


**Mounting Hole Layout**



### 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



<b>General Specifications</b>	<b>Power Voltage</b>	12V to 24V DC
	<b>Operating Voltage</b>	10V to 30V DC, ripple 10% (maximum)
	<b>Current Draw</b>	Standard speed: 30mA (maximum) High-speed: 40mA (maximum)
	<b>Operating Temperature</b>	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)
	<b>Operating Humidity</b>	35 to 85% RH (avoid condensation)
	<b>Extraneous Light Immunity</b>	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
	<b>Material</b>	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
	<b>Degree of Protection</b>	IP66 — IEC Pub 529, sensors rated IP66 are dust-tight, water-resistant, and perform best when not subjected to heavy particle or water blasts
	<b>Cable</b>	Cable type: 0.2mm <sup>2</sup> ; 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)
	<b>Light Source</b>	Red or green LED (pulse-modulated)
	<b>Output</b>	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)
	<b>Response</b>	Standard-speed: 0.5ms (maximum) High-speed: 50µs (maximum)
	<b>Off Delay</b>	0 to 100 ms (adjustable)
	<b>Sensitivity</b>	4-turn adjustment
<b>Minimum Bending Radius</b>	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	

		SA1C-FN, -FD (standard speed)	SA1C-F1N, -F1D (high-speed)
<b>Function Specifications</b>	<b>Operation Mode</b>	Light on or dark on (selectable by switch on amplifier)	
	<b>Indicator</b>	Operation indicator: Red LED (out) Stable level indicator: Green LED (stable)	
	<b>Noise Resistance</b>	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)
	<b>Storage Temperature</b>	-30 to +70°C (avoid freezing)	
	<b>Insulation Resistance</b>	20M minimum with 500V DC megger (between live and dead parts)	
	<b>Dielectric Strength</b>	1000V, 1 minute (between live and dead parts)	
	<b>Vibration Resistance</b>	Damage limits: 10 – 55Hz Amplitude: 1.5mm p-p, 20 cycles in each of 3 axes crossed (one cycle = 5 minutes)	
	<b>Shock Resistance</b>	Damage limits: 500m/S <sup>2</sup> (approximately 49G), 10 shocks in each of 3 axes	
<b>Weight</b>	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
<b>SA1C-FN3E</b> (Cable) <b>SA1C-FN3EC</b> (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) Self-diagnostic: 50mA (maximum)	Red LED	Standard speed: 0.5 ms	<b>SA9F-TS: Ø 0.16"</b> (M4) Straight <b>SA9F-TC: Ø 0.16"</b> (M4) Coiled <b>SA9F-TT: Ø 0.12"</b> (M3) Straight <b>SA9F-TM: Ø 0.16"</b> (M4) Multicore <b>SA9F-TH:</b> Heat-resistant glass fiber <b>SA9F-TL:</b> Side view	7.09" (180mm)	<b>SA9F-DS: Ø 0.24"</b> (M6) Straight <b>SA9F-DC: Ø 0.24"</b> (M6) Coiled <b>SA9F-DD: Ø 0.24"</b> (M6) Coaxial <b>SA9F-DT: Ø 0.12"</b> (M3) Straight <b>SA9F-DM: Ø 0.01"</b> (0.26mm) Multicore <b>SA9F-DH:</b> Heat-resistant glass fiber <b>SA9F-DL:</b> Side view	2.36" (60mm)
	<b>SA1C-FD3F</b> (Cable) <b>SA1C-FD3FC</b> (Quick-Connect)				30V DC NPN transistor: 100mA (maximum) PNP transistor: 200mA (maximum)		5.91" (150mm)
<b>SA1C-FN3EG</b> (Cable) <b>SA1C-FN3EGC</b> (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) Self-diagnostic: 50mA (maximum)	Green LED	Standard speed: 0.5 ms	<b>SA9F-TS: Ø 0.16"</b> (M4) Straight <b>SA9F-TC: Ø 0.16"</b> (M4) Coiled <b>SA9F-TT: Ø 0.12"</b> (M3) Straight <b>SA9F-TM: Ø 0.16"</b> (M4) Multicore <b>SA9F-TH:</b> Heat-resistant glass fiber <b>SA9F-TL:</b> Incompatible with green LED	0.63" (16mm)	<b>SA9F-DS: Ø 0.24"</b> (M6) Straight <b>SA9F-DC:</b> Incompatible with green LED <b>SA9F-DD: Ø 0.24"</b> (M6) Coaxial <b>SA9F-DT:</b> Incompatible with green LED <b>SA9F-DM: Ø 0.01"</b> (0.26mm) Multicore <b>SA9F-DH:</b> Incompatible with green LED <b>SA9F-DL:</b> Incompatible with green LED	0.28" (7mm)
	<b>SA1C-FD3FG</b> (Cable) <b>SA1C-FD3FGC</b> (Quick-Connect)				30V DC NPN transistor: 100mA (maximum) PNP transistor: 200mA (maximum)		0.55" (14mm)
<b>SA1C-F1N3E</b> (Cable) <b>SA1C-F1N3EC</b> (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) Self-diagnostic: 50mA (maximum)	Red LED	High-speed: 50 µs	<b>SA9F-TS: Ø 0.16"</b> (M4) Straight <b>SA9F-TC: Ø 0.16"</b> (M4) Coiled <b>SA9F-TT: Ø 0.12"</b> (M3) Straight <b>SA9F-TM: Ø 0.16"</b> (M4) Multicore <b>SA9F-TH:</b> Heat-resistant glass fiber <b>SA9F-TL:</b> Side view	1.97" (50mm)	<b>SA9F-DS: Ø 0.24"</b> (M6) Straight <b>SA9F-DC: Ø 0.24"</b> (M6) Coiled <b>SA9F-DD: Ø 0.24"</b> (M6) Coaxial <b>SA9F-DT: Ø 0.12"</b> (M3) Straight <b>SA9F-DM: Ø 0.01"</b> (0.26mm) Multicore <b>SA9F-DH:</b> Heat-resistant glass fiber <b>SA9F-DL:</b> Side view	0.79" (20mm)
	<b>SA1C-F1D3F</b> (Cable) <b>SA1C-F1D3FC</b> (Quick-Connect)				30V DC NPN transistor: 100mA (maximum) PNP transistor: 200mA (maximum)		1.57" (40mm)
<b>SA1C-F1N3E</b> (Cable) <b>SA1C-F1N3EC</b> (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) Self-diagnostic: 50mA (maximum)	Red LED	High-speed: 50 µs	<b>SA9F-TS: Ø 0.16"</b> (M4) Straight <b>SA9F-TC: Ø 0.16"</b> (M4) Coiled <b>SA9F-TT: Ø 0.12"</b> (M3) Straight <b>SA9F-TM: Ø 0.16"</b> (M4) Multicore <b>SA9F-TH:</b> Heat-resistant glass fiber <b>SA9F-TL:</b> Side view	0.59" (15mm)	<b>SA9F-DS: Ø 0.24"</b> (M6) Straight <b>SA9F-DC: Ø 0.24"</b> (M6) Coiled <b>SA9F-DD: Ø 0.24"</b> (M6) Coaxial <b>SA9F-DT: Ø 0.12"</b> (M3) Straight <b>SA9F-DM: Ø 0.01"</b> (0.26mm) Multicore <b>SA9F-DH:</b> Heat-resistant glass fiber <b>SA9F-DL:</b> Side view	0.79" (20mm)
	<b>SA1C-F1D3F</b> (Cable) <b>SA1C-F1D3FC</b> (Quick-Connect)				30V DC NPN transistor: 100mA (maximum) PNP transistor: 200mA (maximum)		1.57" (40mm)
<b>SA1C-F1N3E</b> (Cable) <b>SA1C-F1N3EC</b> (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) Self-diagnostic: 50mA (maximum)	Red LED	High-speed: 50 µs	<b>SA9F-TS: Ø 0.16"</b> (M4) Straight <b>SA9F-TC: Ø 0.16"</b> (M4) Coiled <b>SA9F-TT: Ø 0.12"</b> (M3) Straight <b>SA9F-TM: Ø 0.16"</b> (M4) Multicore <b>SA9F-TH:</b> Heat-resistant glass fiber <b>SA9F-TL:</b> Side view	1.18" (30mm)	<b>SA9F-DS: Ø 0.24"</b> (M6) Straight <b>SA9F-DC: Ø 0.24"</b> (M6) Coiled <b>SA9F-DD: Ø 0.24"</b> (M6) Coaxial <b>SA9F-DT: Ø 0.12"</b> (M3) Straight <b>SA9F-DM: Ø 0.01"</b> (0.26mm) Multicore <b>SA9F-DH:</b> Heat-resistant glass fiber <b>SA9F-DL:</b> Side view	0.71" (18mm)
	<b>SA1C-F1D3F</b> (Cable) <b>SA1C-F1D3FC</b> (Quick-Connect)				30V DC NPN transistor: 100mA (maximum) PNP transistor: 200mA (maximum)		0.51" (13mm)
<b>SA1C-F1N3E</b> (Cable) <b>SA1C-F1N3EC</b> (Quick-Connect)	30V DC NPN transistor: 100mA (maximum) Self-diagnostic: 50mA (maximum)	Red LED	High-speed: 50 µs	<b>SA9F-TS: Ø 0.16"</b> (M4) Straight <b>SA9F-TC: Ø 0.16"</b> (M4) Coiled <b>SA9F-TT: Ø 0.12"</b> (M3) Straight <b>SA9F-TM: Ø 0.16"</b> (M4) Multicore <b>SA9F-TH:</b> Heat-resistant glass fiber <b>SA9F-TL:</b> Side view	0.51" (13mm)	<b>SA9F-DS: Ø 0.24"</b> (M6) Straight <b>SA9F-DC: Ø 0.24"</b> (M6) Coiled <b>SA9F-DD: Ø 0.24"</b> (M6) Coaxial <b>SA9F-DT: Ø 0.12"</b> (M3) Straight <b>SA9F-DM: Ø 0.01"</b> (0.26mm) Multicore <b>SA9F-DH:</b> Heat-resistant glass fiber <b>SA9F-DL:</b> Side view	0.12" (3mm)
	<b>SA1C-F1D3F</b> (Cable) <b>SA1C-F1D3FC</b> (Quick-Connect)				30V DC NPN transistor: 100mA (maximum) PNP transistor: 200mA (maximum)		0.51" (13mm)

**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
<b>SA9F-TS21</b> No sleeve <b>SA9F-TS22</b> 3.54" (90mm) sleeve <b>SA9F-TS23</b> 1.77" (45mm) sleeve	Straight fiber: Ø 0.04" (1mm)  Threaded mount: Ø 0.16" (M4)  Detects: Ø 0.012" (0.3mm) minimum object		
<b>SA9F-TC21</b> No sleeve <b>SA9F-TC22</b> 3.54" (90mm) sleeve <b>SA9F-TC23</b> 1.77" (45mm) sleeve	Coiled fiber: Ø 0.04" (1mm)  Threaded mount: Ø 0.16" (M4)  Detects: Ø 0.012" (0.3mm) minimum object		
<b>SA9F-TT11</b> No sleeve <b>SA9F-TT12</b> 3.54" (90mm) sleeve <b>SA9F-TT13</b> 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		
<b>SA9F-TM21</b> No sleeve <b>SA9F-TM22</b> 3.54" (90mm) sleeve <b>SA9F-TM23</b> 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		
<b>SA9F-TM74</b> 16 fibers in one row	Multicore: 16 fibers (one row) Ø 0.010" (0.26mm)  Detects: Ø 0.0024" (0.06mm) minimum object		
<b>SA9F-TH21</b> No sleeve <b>SA9F-TH22</b> 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		
<b>SA9F-TL53</b> (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
<p><b>SA9F-DS31</b> No sleeve <b>SA9F-DS32</b> 3.54" (90mm) sleeve <b>SA9F-DS33</b> 1.77" (45mm) sleeve</p>	<p>Straight: Two fibers Ø 0.04" (1mm) Threaded mount: Ø 0.24" (M6) Detects: Ø 0.0012" (0.03mm) minimum object</p>		
<p><b>SA9F-DC31</b> No sleeve <b>SA9F-DC32</b> 3.54" (90mm) sleeve <b>SA9F-DC33</b> 1.77" (45mm) sleeve (all three not compatible with green LED)</p>	<p>Coiled: Two fibers Ø 0.04" (1mm) Threaded mount: Ø 0.24" (M6) Detects: Ø 0.0012" (0.03mm) minimum object</p>		
<p><b>SA9F-DT11</b> No sleeve <b>SA9F-DT12</b> 3.54" (90mm) sleeve <b>SA9F-DT13</b> 1.77" (45mm) sleeve (all three not compatible with green LED)</p>	<p>Straight: Two fibers Ø 0.02" (0.5mm) Threaded mount: Ø 0.12" (M3) Detects: Ø 0.0012" (0.03mm) minimum object</p>		
<p><b>SA9F-DD31</b></p>	<p>Coaxial: Core Ø 0.04" (1mm) + 16 fibers: Ø 0.01" (0.26mm) Threaded mount: Ø 0.24" (M6) Detects: Ø 0.0012" (0.03mm) minimum object</p>		
<p><b>SA9F-DM74</b> 1 row = 32 fibers <b>SA9F-DM75</b> 2 rows = 16 each (Not compatible with green LED) <b>SA9F-DM76</b> 3 rows = 16 center + 8 fibers each side (not compatible with green LED)</p>	<p>Multicore: 32 fibers Ø 0.010" (0.26mm) Detects: Ø 0.0024" (0.06mm) minimum object</p>		

(continued on following page)

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

Part Number	Description	Dimensions	Appearance
<b>SA9F-DH21</b> No sleeve <b>SA9F-DH22</b> 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		
<b>SA9F-DL63</b> (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
<b>SA9C-CA4D2</b>  <b>SA9C-CA4D5</b>	4-core cable with connector 6'-6-3/4" (2m)  4-core cable with connector 16'-4-7/8" (5m)	SA1C-F quick-connect only, NPN and PNP outputs	
<b>SA9C-CA4D2S</b>  <b>SA9C-CA4D5S</b>	4-core cable with connector 6'-6-3/4" (2m)  4-core cable with connector 16'-4-7/8" (5m)	SA1C-F quick-connect only, NPN and self-diagnostic outputs	
<b>SA9Z-F01</b>	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
<b>SA9Z-F02</b>	Set of 2 easy-insert adaptors	SA9F-TT, SA9F-TL, SA9F-DT, and SA9F-DL	$\varnothing$ 0.087" (OD) x 0.945" long ( $\varnothing$ 2.2mm 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
<b>SA9Z-F11</b>	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)	
<b>SA9Z-F12</b>	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)	
<b>SA9Z-F13</b>	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)	
<b>SA9Z-F14</b>	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: (10mm ± 1mm) SA9F-TM21: (10mm ± 1mm)	

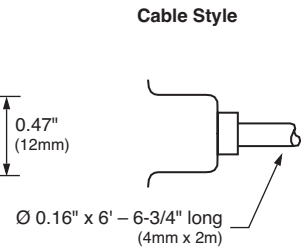
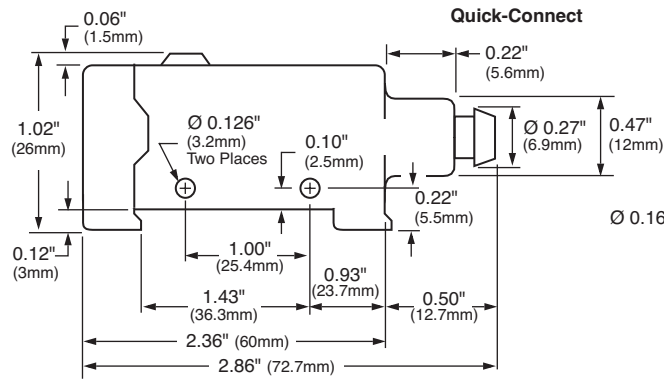
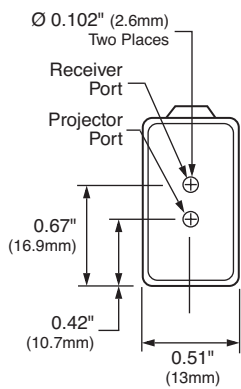
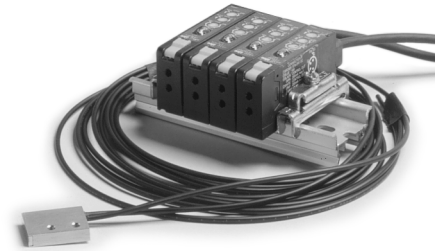
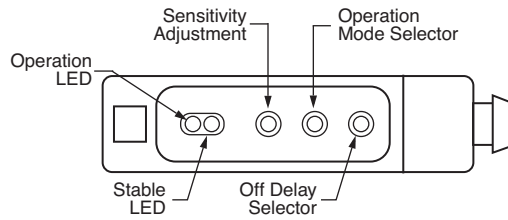
**Detecting Colour Marks**

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												
<b>White</b>	—	★	◆	★	★	◆	◆	◆	◆	◆	◆	
<b>Yellow</b>	★	—	◆	★	★	★	◆	◆	◆	◆	◆	
<b>Chartreuse</b>	◆	◆	—	□	□	★	□	◆	★	◆	◆	
<b>Orange</b>	★	★	□	—	—	★	□	◆	◆	◆	◆	
<b>Red</b>	★	★	□	—	—	□	□	◆	◆	◆	◆	
<b>Magenta</b>	◆	★	★	★	□	—	□	—	—	□	◆	
<b>Turquoise</b>	◆	◆	□	□	□	□	—	□	◆	★	◆	
<b>Blue</b>	◆	◆	◆	◆	◆	□	□	—	□	□	□	
<b>Violet</b>	◆	◆	★	◆	◆	—	◆	□	—	□	□	
<b>Green</b>	◆	◆	◆	◆	◆	□	★	□	□	—	□	
<b>Black</b>	◆	◆	◆	◆	◆	◆	◆	□	□	□	—	



### Dimensions

#### SA1C-F Series Amplifier Unit



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



<b>General Specifications</b>	<b>Power Voltage</b>	Universal voltage type: 24V to 240V AC (24V to 240V DC compatible) DC type: 10V to 30V DC (ripple 10% maximum)
	<b>Operating Voltage</b>	Universal voltage: 21.6V to 264V AC, 50/60Hz (21.6V to 264V DC compatible)
	<b>Dielectric Strength</b>	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)
	<b>Insulation Resistance</b>	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)
	<b>Operating Temperature</b>	–10° to +60°C (avoid freezing)
	<b>Operating Humidity</b>	35 to 85% RH (avoid condensation)
	<b>Storage Temperature</b>	–20° to +70°C
	<b>Vibration Resistance</b>	Damage limits: 10 to 55Hz, amplitude 1.5mm p-p, 2 hours in each of 3 axes
	<b>Shock Resistance</b>	Damage limits: 500m/s <sup>2</sup> (approximately 50G), 3 shocks in each of 3 axes
	<b>Extraneous Light Immunity</b>	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
	<b>Material</b>	Housing: PBT; Lens: acrylic resin; Cover: polycarbonate
	<b>Degree of Protection</b>	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)
	<b>Applicable Cable (not included)</b>	Cable: Ø 0.31" to 0.39" (8 to 10mm), Core: #18 to #24 AWG (0.25 to 0.75mm <sup>2</sup> ); Extension: 328' (100m) maximum using #22 AWG (0.3mm <sup>2</sup> ) cabtyre cable or better (not included or offered by IDEC — must be purchased separately)
<b>Weight</b>	Through-beam: 75g (projector), 100g (universal voltage receiver), 90g (DC receiver) Reflected light: 100g (universal voltage), 90g (DC)	
<b>Dimensions (HxWxD)</b>	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				



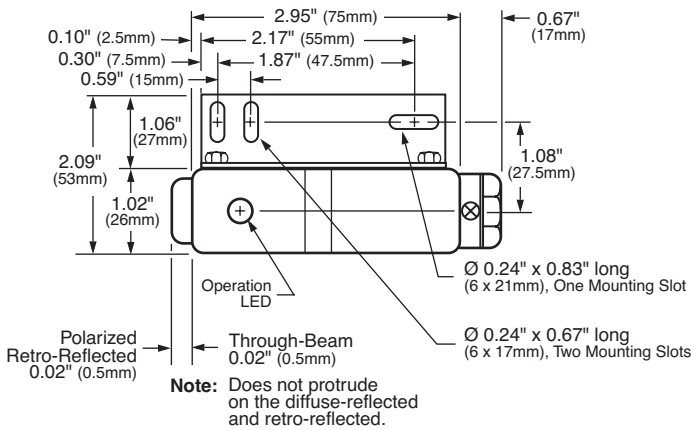
1. All sensors come with mounting brackets. Retro-reflected light sensors (with or without polarization) come with a rectangular reflective backplate. Diffuse-reflected light sensors and sensors with time delay include a screwdriver for the adjustment dial.

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	

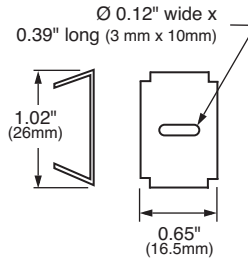


2. Delay time is decreased by 5% when another object is detected during timedown.

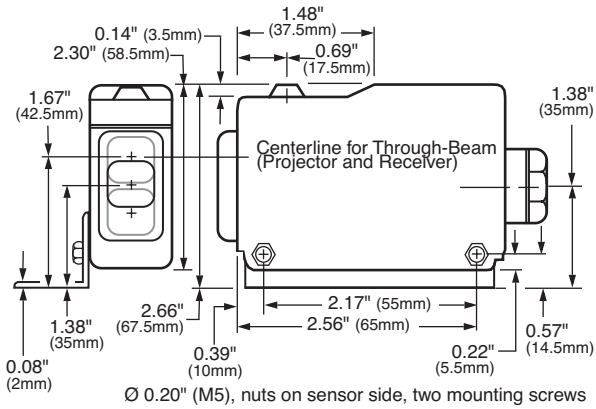
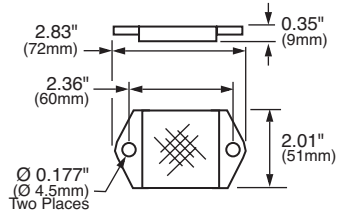
**Dimensions**



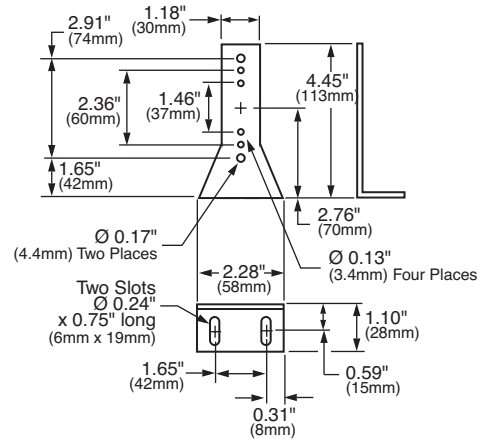
**Slit for Through-Beam**  
 (option) Part Number IAC-S1



**Square Reflective Backplate**  
 (replacement) Part Number IAC-R5



**Reflector Bracket**  
 (option) Part Number IAC-L2

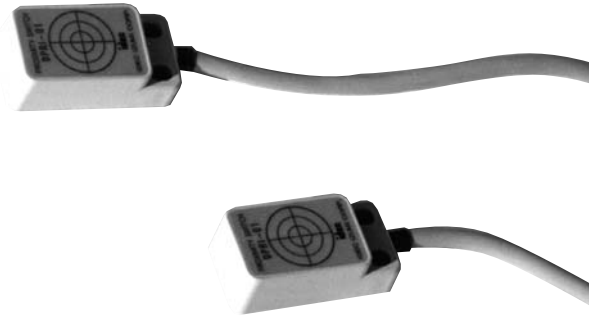


**DPRI: Magnetic Proximity Switches**

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



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

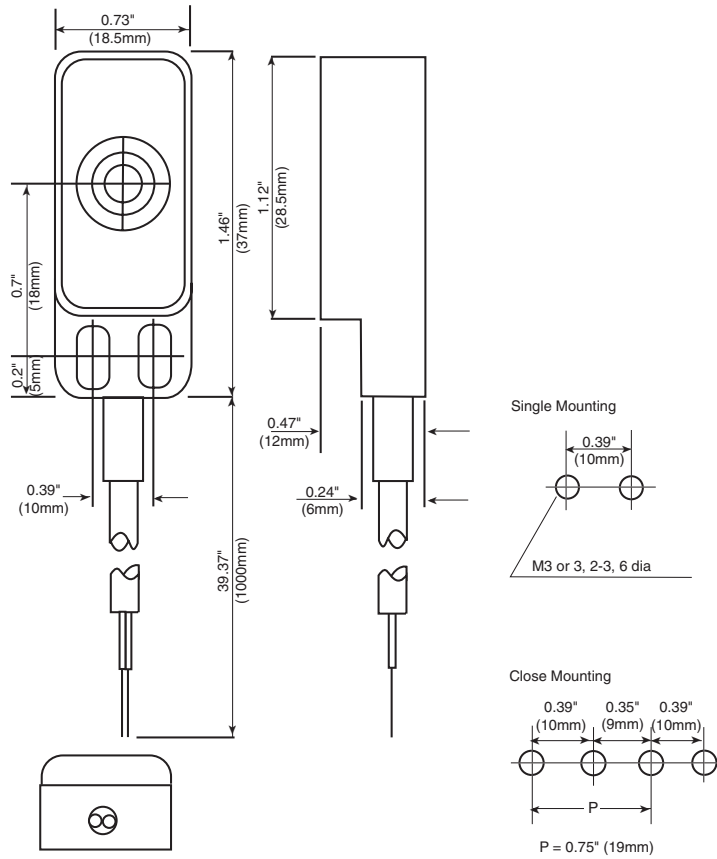
**Part Number: DPRI Switches**

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 of fork lug terminal.

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

**Power Supply**

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

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

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

**Power Supply**

The compact PS5R-A power supply is the perfect companion item for most IDEC sensors. 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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