

SA1J: Full Color Recognition Sensors

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

Key features of the SA1J color sensor include:

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



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

Part Numbers: SA1J Sensors

1-Color Version	3-Color Version	Output	Spot Diameter	Sensing Distance	Inspection Spot
SA1J-C1N1	SA1J-C1N3	NPN	ø 0.157" (ø 4mm)	1.575" (40mm)	Standard
SA1J-C1P1	SA1J-C1P3	PNP	ø 0.236" (ø 6mm) ø 0.315" (ø 8mm)	1.969" (50mm) 2.362" (60mm)	
SA1J-C2N1	SA1J-C2N3	NPN	ø 0.098" (ø 2.5mm)	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-Color Version	3-Color Version	
Function Specifications	Reference Color Registration	Push SET button (sensor aimed at color target); sensor records reference color in EEPROM memory	Set dial to A: Push SET button (sensor aimed at color target A); sensor records reference color A in EEPROM memory Set dial to B: Push SET button (sensor aimed at color target B); sensor records reference color B in EEPROM memory Set dial to C: Push SET button (sensor aimed at color target C); sensor records reference color C in EEPROM memory
	Tolerance	Digital setting for 5 degrees of inspection sensitivity	Digital setting for 5 degrees of inspection sensitivity (normal run mode only)
	Inspection Mode	Selectable: Color component only (C) or color component plus intensity (C+I) (depth of color)	
	Operation Mode	—	Selectable: S run: Auto select, sensor determines tolerance (no need to set tolerance) Normal run mode: Manually select tolerance (1–5) for each reference color
	Synchronous Mode	Selectable: Internal response mode or synchronized with an external signal	
	Response Mode	High-speed (F): 0.3ms Normal speed (N): 1ms Slow speed (S): 5ms	High-speed (F): 0.8ms Normal speed (N): 1.5ms Slow speed (S): 6ms
	Control Output	On: Detected color matches target color NPN or PNP transistor open collector 30V DC, 100mA maximum Residual: 1.5V maximum, short circuit protection	Control output A on: Detected color corresponds to target color A* Control output B on: Detected color corresponds to target color B* Control output C on: Detected color corresponds to target color C* NPN or PNP transistor open collector 30V DC, 100mA maximum Residual: 1.5V maximum, short circuit protection
	Operation LED	On: When control output is on (yellow LED)	
	Off-Delay Timer	Selectable: Timer ON (T-ON) or Timer OFF (T-OFF)	
	Timer	OFF delay timer 40ms	
	SET Input	NPN: 30V DC maximum/3.6mA (when connected to 0V) Typical operating voltage: (0V) +4V maximum PNP: 30V DC maximum/3mA (when connected to 24V) Typical operating voltage: (+V) –4V maximum	NPN: 30V DC maximum/3.6mA (when connected to 0V) Typical operating voltage: (0V) +4V maximum PNP: 30V DC maximum/3mA (when connected to 24V) Typical operating voltage: (+V) –4V maximum
	External Synchronous Input		
	Light Source	3 LEDs (Red, Green, Blue)	



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



SA1J-F: Full Color Fiber Optic Sensors

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



Key features of the SA1J-F color sensor include:

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

	1-Color Version	3-Color Version
Power Voltage	12 to 24V DC (ripple 10% maximum) Operating voltage: 10 to 30V DC	
Current Draw	150mA maximum	
Dielectric Strength	Between live and dead parts: 1,000V AC, 1 minute	
Insulation Resistance	Between live and dead parts: 20M Ω minimum (500V DC megger)	
Operating Temperature	-10 to +50°C (no freezing)	
Operating Humidity	35 to 85% RH (avoid condensation)	
Storage Temperature	-30 to +70°C	
Vibration Resistance	Damage limits: 10 to 55Hz Single amplitude: 0.75mm 2 hours in each of 3 axes	
Shock Resistance	Damage limits: 500m/s ² (approximately 50G) 5 shocks in each of 3 axes	
Extraneous Light Immunity	Sunlight: 10,000 lux maximum Incandescent lamp: 3,000 lux maximum	
Material	Housing: Aluminum Lens: Glass Cover: Polyarylate	
Degree of Protection	IP65 (when inserting the fiber unit and tightening the cover)	
Cable	0.2mm ² ϕ 5.4mm 5-core vinyl cabtyre cable, 2m long	0.2mm ² ϕ 5.4mm 7-core vinyl cabtyre cable, 2m long
Weight	Approximately 190g	
Dimensions (HxWxD)	47H x 25W x 82.4D mm	
Accessories	Mounting bracket Adjusting screwdriver	

General Specifications

Q

Sensors

Subassembled Part Numbers: SA1J-F Sensors

Amplifiers

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

Diffuse-Reflected Light Fiber Optic Unit

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

Lens Attachments

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

Accessories

Part No.	Description
SA9Z-F01	Fiber Cutter

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

Function Specifications

Fiber Optic Units

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

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

Through Beam Fiber Optic Units

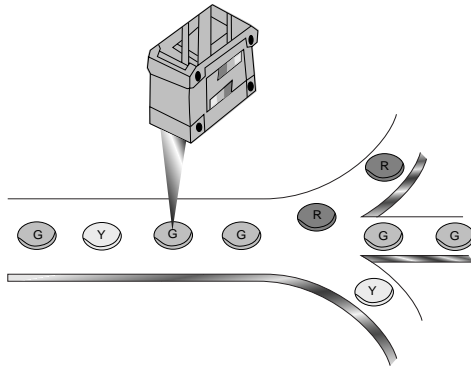
Part No.	Type	Sensing Range
SA9F-TS21	M4 • Straight No Sleeve	30 mm
SA9F-TS22	M4 • Straight 90 mm Sleeve	30 mm
SA9F-TS23	M4 • Straight 45 mm Sleeve	30 mm
SA9F-TC21	M6 • Coiled No Sleeve	25 mm
SA9F-TC22	M6 • Coiled 90 mm Sleeve	25 mm
SA9F-TC23	M6 • Coiled 45 mm Sleeve	25 mm
SA9F-TM21	M4 • Multicore	25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

Diffuse-Reflected Light Fiber Optic Unit

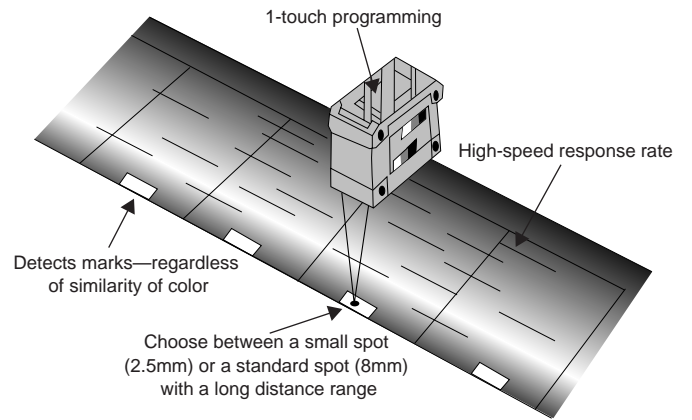
Part No.	Type	Sensing Range
SA9F-DS31	M6 • Straight No Sleeve	6 mm
SA9F-DS32	M6 • Straight 90 mm Sleeve	6 mm
SA9F-DS33	M6 • Straight 45 mm Sleeve	6 mm
SA9F-DD31	M6 • Coaxial	5 mm
SA9F-DM74	1 row = 32 fibers Multicore	2 mm
SA9F-DM75	2 rows = 16 each Multicore	5 mm

Applications

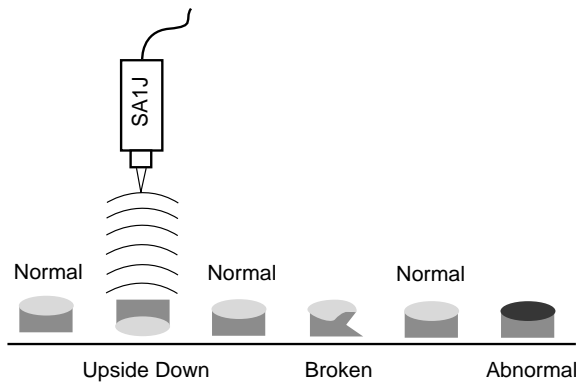
Sorting objects by cap or lid color



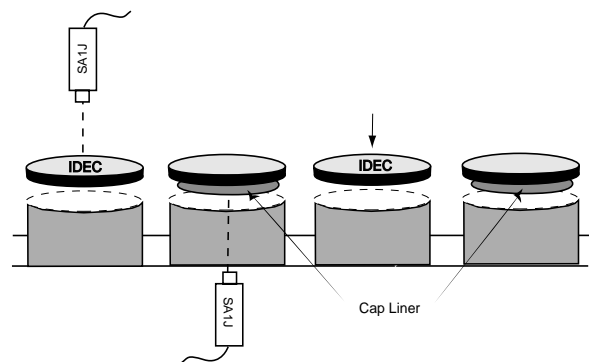
Detecting plastic bagging materials on a web



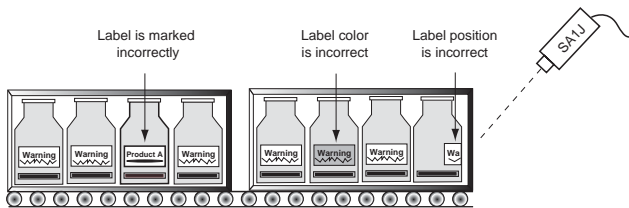
Detecting objects that are the incorrect shape or color



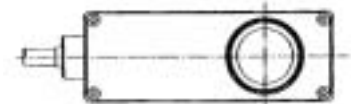
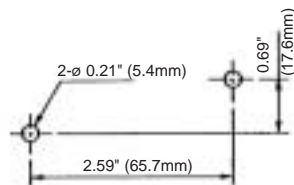
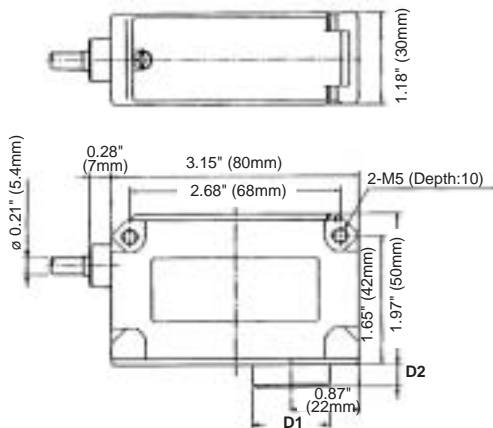
Detecting presence or absence of a logo on a cap or lid



Checking packaging labels for correct position, color, and content



Dimensions



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

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

General Information

Specifications

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

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

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

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

IEC (International Electrotechnical Commission) Ratings

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

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

Start-up

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

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

Optimum Performance

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

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

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



1. Even though the SA6A ultrasonic sensor features protection against noise, there may be adverse effects from strong noise.
2. It is strongly recommended to avoid using any sensor where it will be continually subjected to elements which impair performance or cause corrosive damage to the sensor. In particular, avoid strong vibrations and shocks, corrosive gases, oils, and chemicals, as well as blasts of water, steam, dust, or other particles.

Extraneous Light

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



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

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

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

Reflected-Light Sensors

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

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

Through-Beam Sensors

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

Laser Sensors

IMPORTANT: Always consider safety when installing a laser sensor of any kind. Make sure that the laser beam cannot inadvertently shine into the eyes of people passing by or working in the vicinity. See safety information on page Q-20.

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 color contrast when colors reflect light intensity differently (green LED recommended for this application).

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

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

Extraneous light: Incident light received by a sensor, 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 color difference as a three-variable function, located on an XYZ axis of light, hue, and chroma values.

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

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

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

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

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

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

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.