SA1M: Analog Laser Color 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 inuenced 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 uctuating surface levels — ignores movement while sensing
- Insensitive to vertical movement of material to and from the sensor, as in the case of web utter
- Ideal for use in industrial environments
- Dual analog output (light intensity and distance) and digital output
- IP65 protection rating

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

Sensors

Part Numbers: SA1M Sensors

Part Number	Spot Type	Sensing Range	Digital Output	Analog Output for Light Intensity (color mark)	Analog 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				

|		
Function Specifications	Sensing Range	2.755" to 5.906" (70 to 150mm)

	Digital Output	Output style: NPN open collector: (SA1M-CK4-AC/BC)
		    PNP open collector: (SA1M-CL4-AC/BC)
		    with short circuit protection
		Output type: Window comparator output (in-window ON)
		Response time: 1ms maximum
		Hysteresis: 5% (0.8mA) maximum (over the entire sensing range)
		Applied voltage: 30V DC maximum
		Load current: 100mA maximum
		Voltage drop: 1.0V maximum (SA1M-CK4-AC/BC)
		    1.5V maximum (SA1M-CL4-AC/BC)

	Analog Output for Light Intensity (color mark detection)	Analog current output: 4 to 20mA, 5V maximum
		Reference output current **(Note 1)**: 19.0+/-0.4mA
		Output stability **(Note 2)**:
		    ±5% (±0.8mA) maximum
		    (against reference output current over the entire sensing range)
		Temperature drift **(Note 3)**:
		    ±5% (±0.8mA) maximum
		    (against reference output current over the entire operating temperature)
		Response time: 1ms maximum (10 to 90% response)
		Additional noise **(Note 2)**:
		    0.4mA maximum p-p (Position: 70mm)

	Auxiliary Output (Note 4) (analog output for distance)	Analog current output: 20 to 4mA, 5V maximum
		Linearity error **(Note 2)**:
		    ±1.5% FS (±1.2mm)
		    (over the entire sensing range)
		Resolution **(Note 2)**: 0.008" (200µm); Position: 70mm
		Temperature drift **(Note 3)**:
		    5µA/C maximum
		    (against the entire operating temperature)
		Response time 1ms maximum (10 to 90% response)

	Sensitivity Selections	Selection using the sensitivity selector: L: Low (low sensitivity, 35% of standard sensitivity) M: Middle (Standard sensitivity) H: High (high sensitivity, 3.5 times standard sensitivity)

	Indicators	Analog output for light intensity:
		    Red LED (10-dot level meter, Mode selector: RUN)
		Digital output setting monitor:
		    Red LED (10-dot level meter, Mode selector: SET1, SET2)
		Digital output:
		    Red LED (turns on when output is on)
		Laser diode emission:
		    Green LED (turns on while laser is emitted), laser emits approximately 1 second after power-up

	Accessories	Adjusting screwdriver, resistor (249Ω), operating instructions, warning label, precaution label

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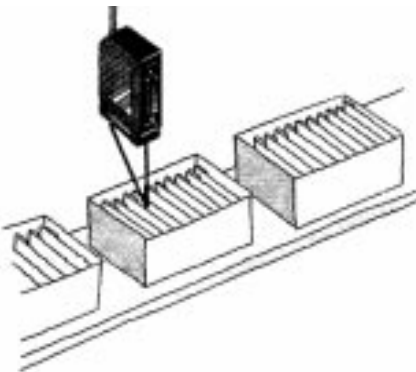
Applications

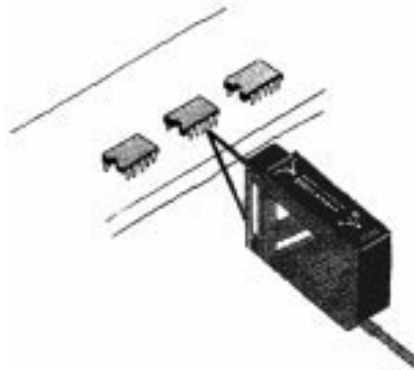Stable output response over a wide sensing range, detecting the presence of package markings
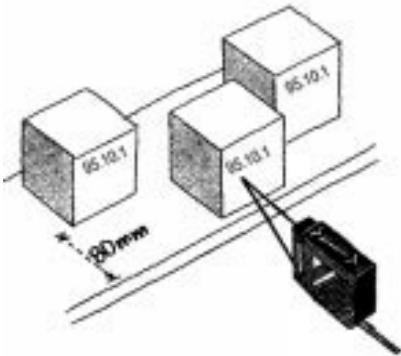
Long sensing distance (150mm maximum)
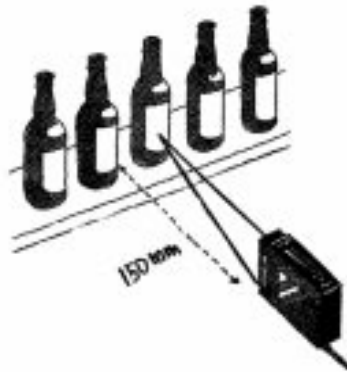
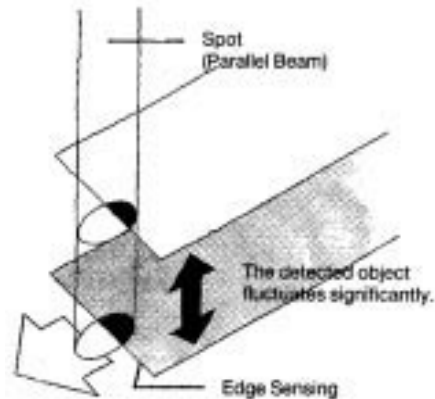Counting the number of packages in a box

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

Compensating for uctuating objects (parallel beam type) (±40mm)

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

Spot (Parallel Beam)

The detected object fluctuates significantly.

Edge Sensing

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

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

Operation
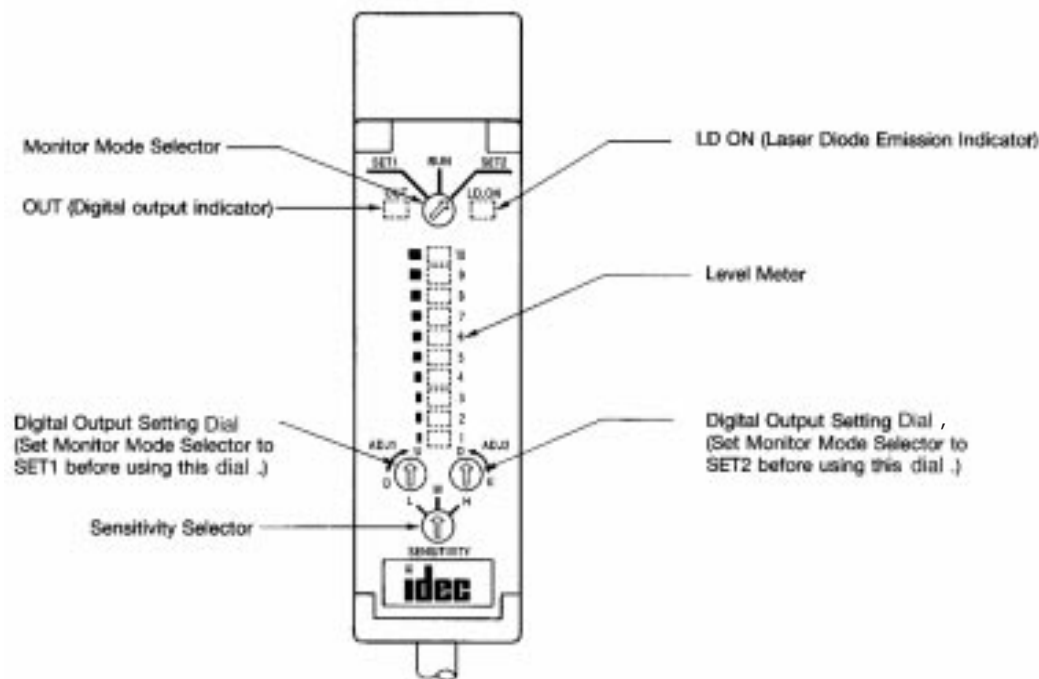
Monitor Mode Selector		
Set Mode	SET1	Displays upper (or lower) limit of sensing window comparator output on the level meter. (For ADJ.1)
	SET2	Displays lower (or upper) limit of sensing window comparator output on level meter. (For ADJ.2)
Run Mode	RUN	Displays analog output for light intensity on the level meter.

OUT (digital output indicator): Red LED when digital output is on.

LD ON (laser diode emission indicator): Green LED when laser light is emitted.

Level meter: Indicates analog output for light intensity and digital output setting level. (The higher the Level Meter in the above gure, the greater the output current value.)

Digital output setting dial: & , : Set the Monitor Mode Selector to SET1 and SET2, and then turn ADJ.1 and ADJ.2 respectively to set the digital output setting level. (14 turns)

**Sensitivity selector:** The analog sensitivity can be selected from L (Low), M (Middle), or H (High).

Standard for Sensitivity Selection	
L (Low)	Set the sensitivity to L if the light intensity level is too great when sensitivity is set to M.
M (Middle)	Set the sensitivity to M for normal use.
H (High)	Set the sensitivity to H if the light intensity is too low when sensitivity is set to M.

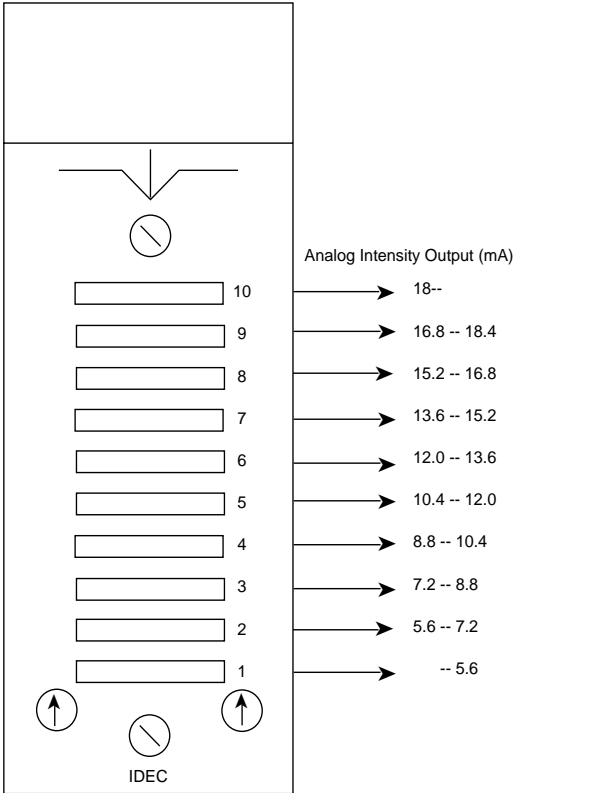| Digital Output Setting Example	
1.	Using the standard sensitivity selection, set the sensitivity selector to the suitable level (L, M, or H).
2.	Set the Monitor Mode Selector to RUN.
3.	Place the object to be detected in position (sensing range: 70 to 150mm) and position the sensor so that the laser projects on the object. Simultaneously read the Level Meter. For the purposes of this example, assume level is 4. **Color Mark Level = 4**
4.	Next, position the sensor so that the laser projects on the background. Simultaneously read the Level Meter. For the purposes of this example, assume the level is 8. **Background Color Level = 8**
5.	Set the Monitor Mode Selector to SET1.
6.	Turn the Digital Output Setting Dial to adjust the level meter to 2 or less for stable sensing. **ADJ.1 = 2**
7.	Set Monitor Mode Selector to SET2.
8.	Turn the Digital Output Setting Dial , to adjust the level meter to 6 (between 4 and 8). Or ne-tune the level depending on the application. **ADJ.2=6**
9.	Set Monitor Mode Selector to RUN.

You can reverse the values of ADJ.1 and ADJ.2.

Example of the Above Digital Output Setting
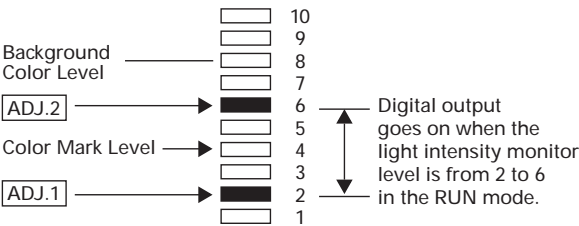
Mark Discrimination Capability

Color of Mark	Background Color											
❏ = Stable Sensing ☆ = Sensing Possible ◆ = Unstable Sensing ✕ = Sensing Impossible	White	Red	Yellow	Light Brown	Brown	Light Blue	Light Green	Gray	Purple	Green	Blue	Black
White	—	✕	✕	❏	❏	❏	❏	❏	❏	❏	❏	❏
Red	✕	—	✕	❏	❏	❏	❏	❏	❏	❏	❏	❏
Yellow	✕	✕	—	❏	❏	❏	❏	❏	❏	❏	❏	❏
Light Brown	❏	❏	❏	—	❏	❏	❏	❏	❏	❏	❏	❏
Brown	❏	❏	❏	❏	—	✕	✕	◆	☆	❏	❏	❏
Light Blue	❏	❏	❏	❏	✕	—	✕	◆	☆	❏	❏	❏
Light Green	❏	❏	❏	❏	✕	✕	—	✕	☆	❏	❏	❏
Gray	❏	❏	❏	❏	◆	◆	✕	—	◆	❏	❏	❏
Purple	❏	❏	❏	❏	☆	☆	☆	◆	—	❏	❏	❏
Green	❏	❏	❏	❏	❏	❏	❏	❏	❏	—	✕	✕
Blue	❏	❏	❏	❏	❏	❏	❏	❏	❏	✕	—	✕
Black	❏	❏	❏	❏	❏	❏	❏	❏	❏	✕	✕	—

Relative Analog Output Levels

|	Analog Intensity Output (mA)
10	18--
9	16.8 -- 18.4
8	15.2 -- 16.8
7	13.6 -- 15.2
6	12.0 -- 13.6
5	10.4 -- 12.0
4	8.8 -- 10.4
3	7.2 -- 8.8
2	5.6 -- 7.2
1	-- 5.6

IDEC

Installation

Operating environment: Make sure that anything which distorts the laser light, such as water or oil, does not accumulate on the lens of the projector/receiver window. The sensor head can be cleaned with warm water.

Do not expose the receiver to excessive extraneous light.

Mounting direction: When sensing a long, narrow mark, install the sensor in the direction shown in gure (a) below . When ignoring a long, narrow mark or scratches, install the sensor in the direction shown in gure (b) below .
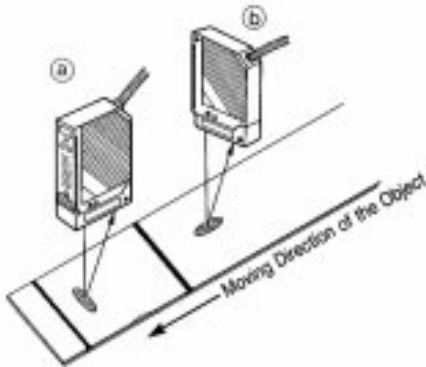
(a): Mark direction is parallel to the beam direction.
(b): Mark direction is perpendicular to the beam direction.

Wiring: Do not install high-voltage and power lines in the same conduit with input and output lines. Use separate conduits.
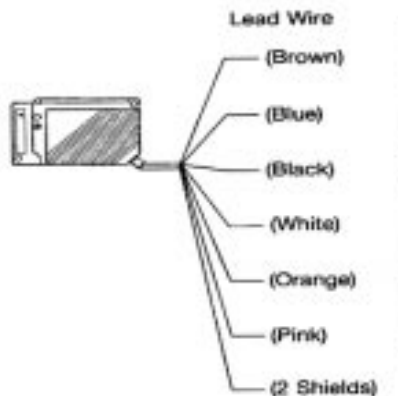
Interference: When using two or more sensors, provide spacing between sensors as shown below to prevent interference.
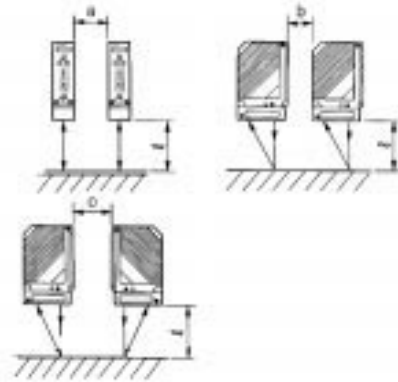
Mounting Dimensions

| l	a	b	c
2.756" (70mm)	0" (0mm)	0" (0mm)	0" (0mm)
4.331" (110mm)	0" (0mm)	0.787" (20mm)	1.969" (50mm)
5.906" (150mm)	0.787" (20mm)	2.362" (60mm)	3.937" (100mm)

Wiring

Lead Wire	Name	Function
Brown	+V	Power 24V DC
Blue	GND(0V)	Power Ground
Black	OUT	Digital Output
White	ANALOG	Analog Output
Orange	SUB	Auxiliary Output (analog output for distance)
Pink	LD RMT	Laser Remote Interlock Input
Shields (x2)	GND(0V)	GND(0V)

Schematics

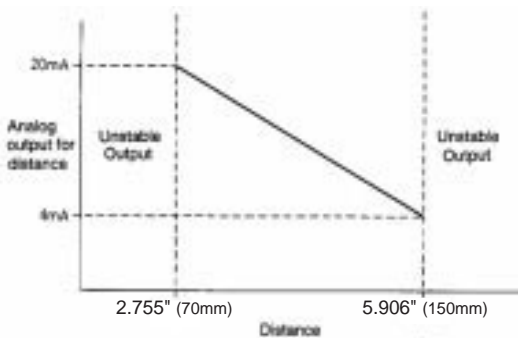**Connection Example** (SA1M-CK4-AC/BC (NPN) Output)
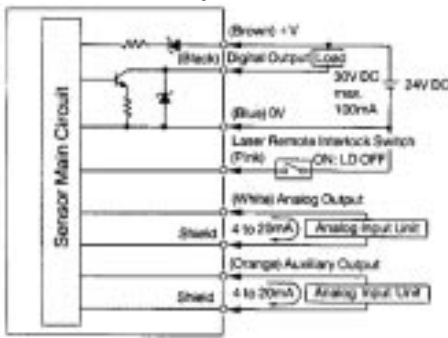
Connection Example (SA1M-CL4-AC/BC (PNP) Output)
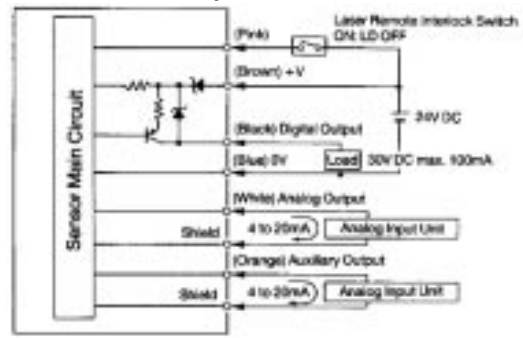
Auxiliary Output

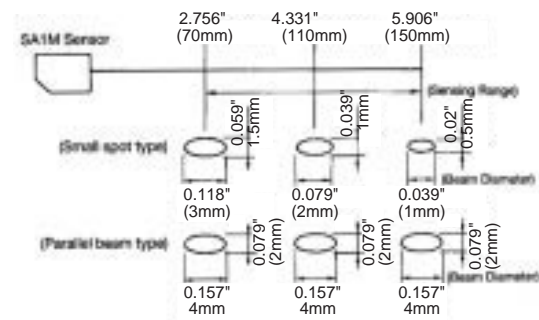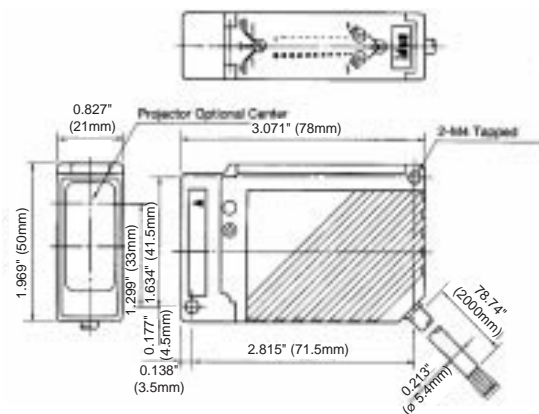### Analog Output for Distance vs. Distance Characteristics

✋ *1. When the auxiliary output (analog output for distance) is used, the sensing distance should range from 70 to 150mm. If the sensing distance exceeds this range, an unstable output occurs.*
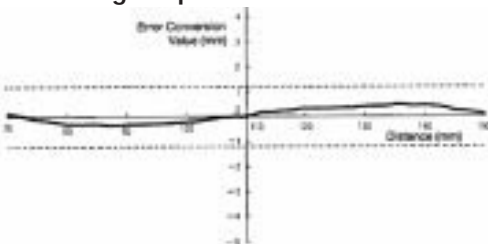
Linearity Error for Auxiliary Output

Analog Output for Distance

✋ *2. Laser displacement sensor is ideal when highly accurate distance measurement is required. (Sensing range is 60 to 160mm.)*

Sensing Distance and Beam Distance

Dimensions

Laser Saefty Information

Installation: If a sensor is installed so that the laser beam may shine or reect 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 signicant 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 reect from a glossy , shiny, or reective surface into the eyes.

Labelling: The 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

LASER LIGHT – AVOID
DIRECT EYE EXPOSURE
5mW at 670 nm
CLASS IIIa LASER PRODUCT

DANGER

Warning Label (common)

All Laser Sensors:
Identication and Certication

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

Precaution Label

LASER RADIATION

SA1M Visible Laser:
Aperture Warning

AVOID EXPOSURE
Laser light is emitted
from this aperture.