

SA1D: Analog 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 analog output (20 to 4mA) for continuous values; use digital output (on/off); or use both together
- Far and near limits can be dened for detecting objects within a specied zone
- A ten-dot LED level meter provides a dynamic display of detected positions and also shows near and far settings
- Alarm output indicates when sensing conditions may result in inaccurate results



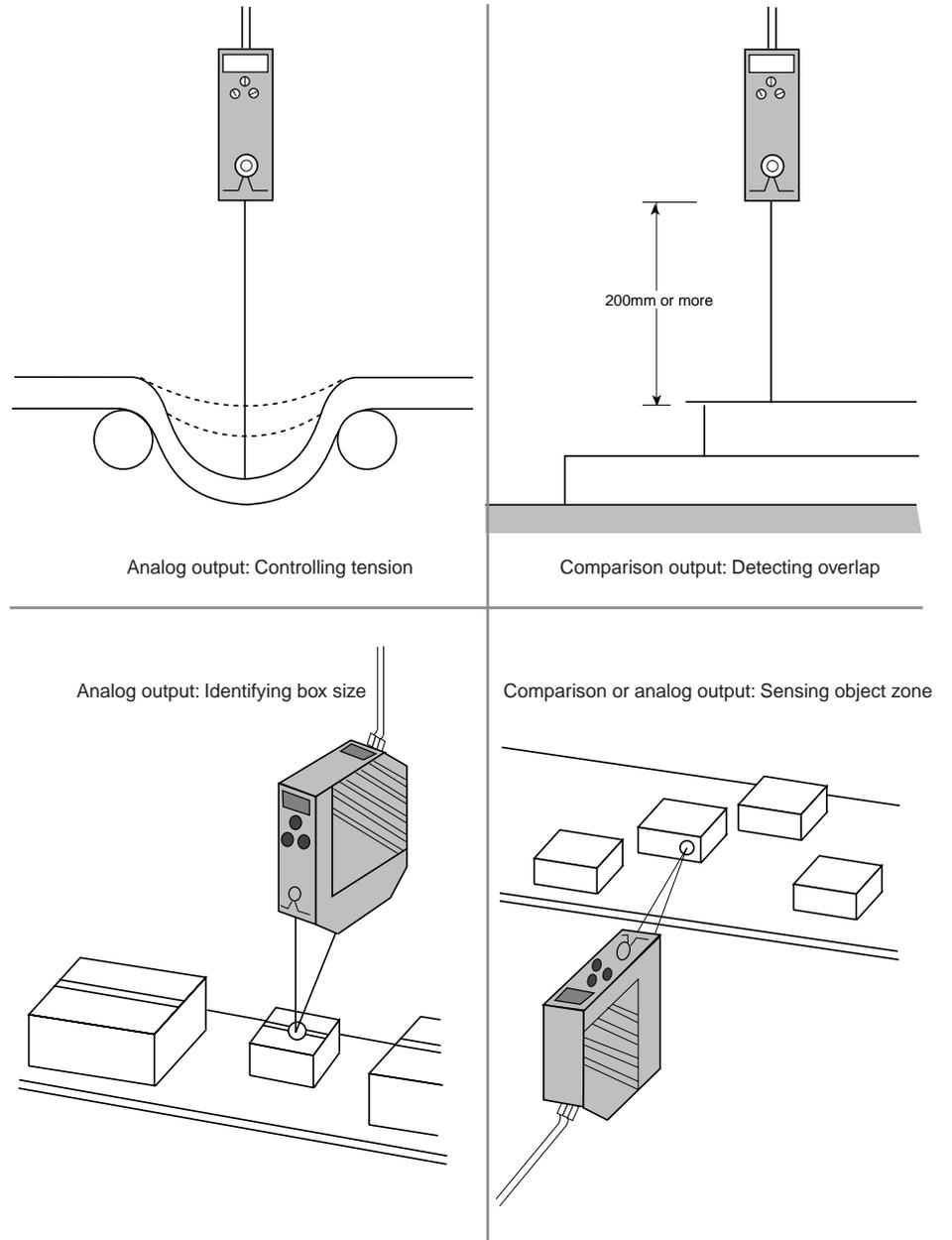
General Specifications	Power Voltage	12 to 24V DC \pm 10% (ripple 10% maximum)
	Current Draw	100mA (maximum)
	Dielectric Strength	Not specied due to capacitor grounding
	Insulation Resistance	Not specied due to capacitor grounding
	Operating Temperature	0 to +55C (performance will be adversely affected if the sensor becomes coated with ice)
	Operating Humidity	35 to 85% RH (avoid condensation)
	Storage Temperature	-20 to +70C
	Vibration Resistance	Damage limits: 10 to 55Hz, amplitude 1.5mm p-p, 2 hours in each of 3 axes (power off)
	Shock Resistance	Damage limits: 500m/sec ² (approximately 50G), 5 shocks in each of 3 axes
	Extraneous Light Immunity	Sunlight: 10,000 lux; Incandescent light: 3,000 lux (maximum) — dened as the incident or unwanted light received by a sensor , unrelated to the presence or absence of the intended object
	Material	Housing: Diecast zinc; Filter and lens: Acrylic
	Degree of Protection	IP65 — IEC Pub 529; sensors rated IP65 are dust-tight, water-resistant, and perform best when not subjected to heavy particle or water blasts
	Cable	Cable type: 5-core cabtyre cable 0.2mm ² , 6'-6-3/4" (2m) long
	Weight	Approximately 350g
Dimensions	2.68"H x 0.83"W x 1.97"D (68mm H x 21mm W x 50mm D)	

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

Part Numbers: SA1D Sensors

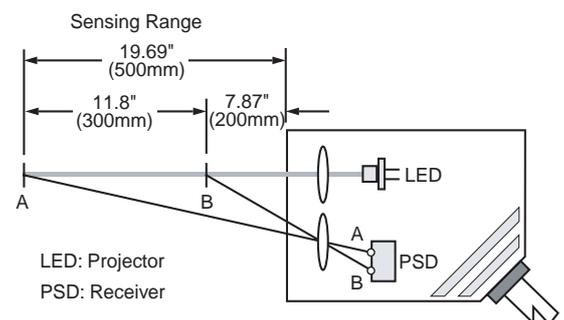
Part Number	Output	Sensing Range	Reference Object
SA1D-LK4	NPN	7.87" to 19.69" (200mm to 500mm)	White: 2.95" x 2.95" (75mm x 75mm)
SA1D-LL4	PNP	7.87" to 19.69" (200mm to 500mm)	

Applications



Operation Principle

The analog distance sensor projects a beam from the infrared LED, through the projection lens, to the object. The diffuse-rected light from the object surface is received as a spot image. This spot image moves from position A to B on the position sensitive device (PSD). The optical triangle is used to determine the distance between the sensor and the object, depending on the displacement.



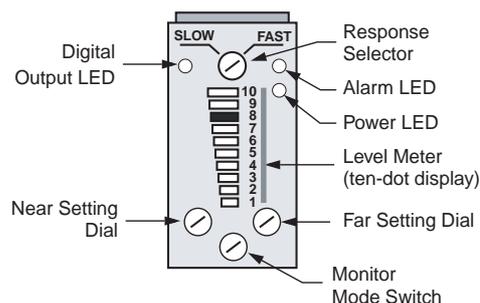
Operation

Digital output: Turns on, along with OUT LED, when the detected object is within near and far limits. (After turning the power on, allow approximately 100ms for output to prevent a transient state.)

Response selector: Specify high-speed ("F" = 5ms) or normal speed ("S" = 50ms). Use normal speed for the most reliable repetition. Also, normal speed is recommended for the best linearity, using analog output.

Alarm output: Turns on, along with ALARM LED, when sensing conditions may result in inaccurate sensing, such as when the sensor head is dirty or when there is insufficient reflected light. The comparison output and OUT indicator are turned off simultaneously.

An internal circuit is provided to turn the output off for 100ms upon power up to prevent a transient state. This delay is normal when turning the power on.



1. Analog sensing of non-reflective, transparent, or liquid objects may not be possible.

Near setting (NS) dial: Move the monitor mode switch to MON. Place the object at the near limit position. Make sure that the object is within the sensing range. One of the LEDs on the ten-dot display will turn on — remember the position of this LED. (It will not stay on if object is moved.) Now, move the monitor mode switch to NS.

2. If the LED in the same position stays on, then the near setting is already in the desired position. There is no need to adjust the near setting.

With the monitor mode switch turned to NS, an LED on the ten-dot display should be lit. If the LED is at a farther position (larger number) than the position noted above, turn the near setting (NS) dial counterclockwise. If the LED is at a nearer position (smaller number) than the position noted above, turn the near setting (NS) dial clockwise.

Adjust the NS dial until the LED turns on — in the same position noted above on the ten-dot display.

3. If the OUT LED is off, turn the NS dial toward "F" until the OUT LED turns on. Make sure that the FS and NS settings are not reversed. If so, the OUT LED will not turn on.

4. If no LED on the ten-dot display turns on when the NS or FS dial is turned to any dial setting, then the position of the object may be outside the range — closer than the near limit, 7.87" (200mm), or farther than the far limit, 19.69" (500mm).

Far setting (FS) dial: Move the monitor mode switch to MON. Place the object at the far limit position. Make sure that the object is within the sensing range. One of the LEDs on the ten-dot display will turn on — remember the position of this LED. (It will not stay on if object is moved.) Now move the monitor mode switch to FS.

5. If the LED in the same position stays on, then the far setting is already in the desired position. There is no need to adjust the far setting.

With monitor mode switch turned to FS, an LED on the ten-dot display should be lit. If the LED is at a farther position (larger number) than the position noted above, turn the near setting (NS) dial counterclockwise. If the LED is at a nearer position (smaller number) than the position noted above, turn the near setting (NS) dial clockwise.

Adjust the FS dial until the LED turns on — in the same position as noted above on the ten-dot display.

6. If the OUT LED is off, turn the FS dial toward "F" until it turns on. Make sure that the FS and NS settings are not reversed. If so, the OUT LED will not turn on.

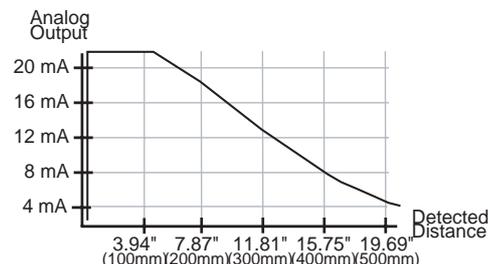
Monitor mode switch: Set the near limit (NS) or far limit (FS) (to be used with digital output—see below), or select MON to monitor object distance (corresponding to analog value) on the ten-dot display while operating the sensor.

Analog output: Provides current output ranging from 20 to 4mA in response to object distance, as monitored on the ten-dot display. The relationship between analog output and distance is not exactly linear. Test output characteristics for each application.

7. The sensor will hold an analog output of 4mA or less, only when the incident light is sufficient.

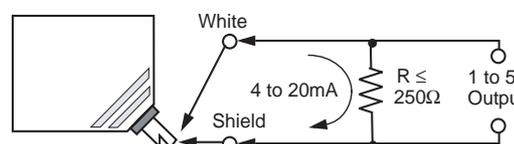
Analog Output Characteristics

Set-Up Distance (mm)		200mm	300mm	400mm	500mm
White Drawing Paper: Normal Response Speed	Noise Voltage	15mV	20mV	30mV	50mV
	Fluctuation Percentage	0.6%	0.7%	0.8%	0.9%
	Distance Conversion	1.2mm	2.1mm	3.2mm	4.5mm
White Drawing Paper: High Response Speed	Noise Voltage	20mV	40mV	70mV	130mV
	Fluctuation Percentage	0.9%	1.4%	1.86%	2.34%
	Distance Conversion	1.8mm	4.2mm	7.4mm	12mm
Black Drawing Paper: Normal Response Speed	Noise Voltage	15mV	30mV	40mV	60mV
	Fluctuation Percentage	0.6%	1.05%	1.06%	1.08%
	Distance Conversion	1.2mm	3.1mm	4.2mm	5.4mm
Black Drawing Paper: High Response Speed	Noise Voltage	20mV	50mV	100mV	180mV
	Fluctuation Percentage	0.9%	1.75%	2.7%	3.24%
	Distance Conversion	1.8mm	5.2mm	8.3mm	16mm



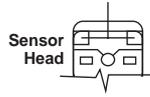
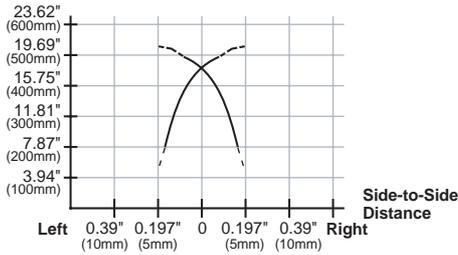
Reference Object: White: 2.95" x 2.95" (75mm x 75mm)

Conversion to voltage output: Analog current output can be converted to voltage output ranging from 1 to 5V by connecting a resistor (supplied, or any $R \leq 250\Omega$) as shown below.



Effective Beam Characteristics

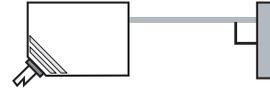
Stand-Off Distance



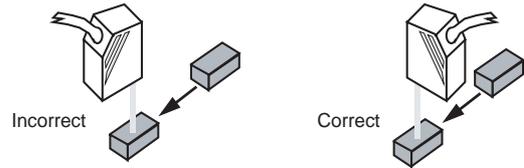
Reference Object:
White: 2.95" x 2.95"
(75mm x 75mm)

Installation

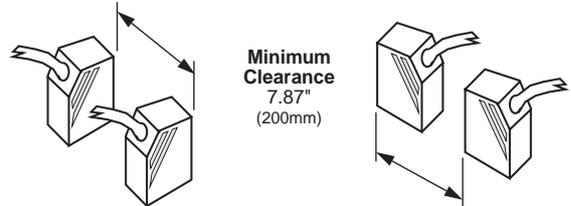
Install the sensor so that the optical window on the front of the sensor and the surface of the object are as parallel as possible.



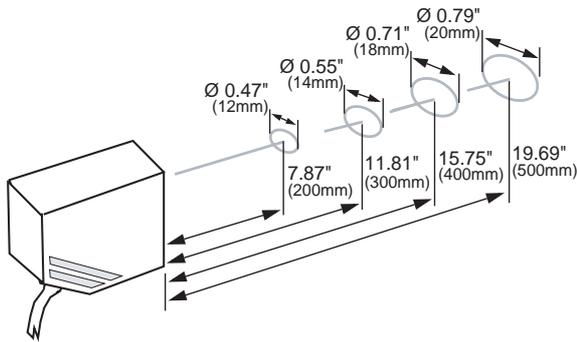
To minimize vibrations resulting from motion, make sure that the sensor is mounted with the longitudinal axis perpendicular to the path of travel (as shown in the correct figure to the right). Sensor output should be taken when the projection beam falls exactly on the object.



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



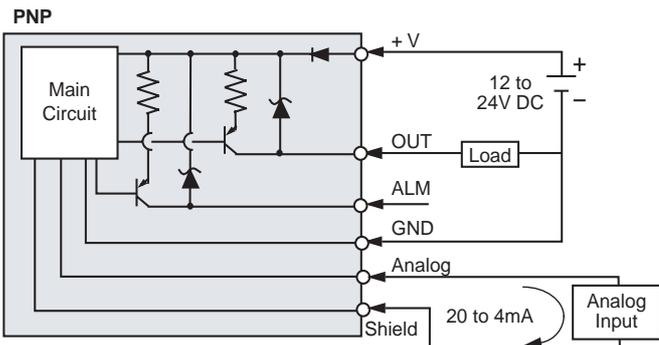
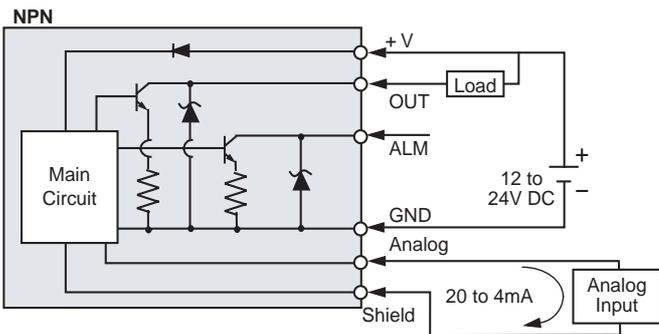
Projected Beam Characteristics



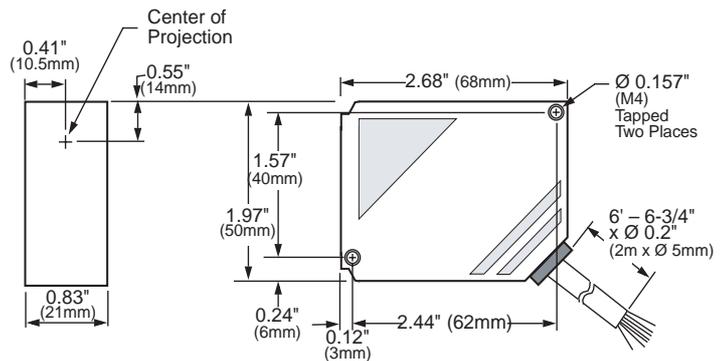
1. The beam spot is magnified for the purpose of these dimensions only.

2. Bright light and strong magnetic fields may detract from the sensing accuracy. Avoid using the analog distance sensor in close proximity to bright light or strong magnetic fields.

Schematics



Dimensions



Wiring

Wire Color	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	ANALOG	Analog Output, 20 to 4mA
Shield	GND	Shield

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