


SA1Q Stainless Steel Laser Sensor

Quick Start Guide

Class 1 laser CMOS sensor with a discrete (PNP or NPN) output.

This guide is designed to help you set up and install the SA1Q Sensor. For complete information on programming, performance, troubleshooting, dimensions, and accessories, please refer to the Instruction Manual. Use of this document assumes familiarity with pertinent industry standards and practices.

	<p>WARNING: Not To Be Used for Personnel Protection Never use this device as a sensing device for personnel protection. Doing so could lead to serious injury or death.</p> <p>This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.</p>
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Features

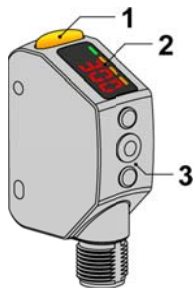


Figure1. Sensor Features

1. Output indicator (Amber)
2. Display
3. Buttons

Display and Indicators

The display is a 4-digit, 7-segment LED. The main screen is the Run mode screen. For 2-pt, BGS, FGS, and DYN TEACH modes, the display shows the current distance to the target in millimeters*¹. For dual TEACH mode, the display shows the percentage matched to the taught reference surface. A display value of **999P** indicates the sensor has not been taught. (*1. The display may differ from the actual distance due to operating environment, target and aging. The distance data is a reference value.)



Figure2. Display in Run Mode

1. Stability indicator (STB-Green)
2. Active TEACH indicators
 - DYN : Dynamic (Amber)
 - FGS : Foreground Suppression (amber)
 - BGS : Background Suppression (Amber)

Output Indicator

- On : Outputs conducting (closed)
- Off : Outputs not conducting (open)

Active TEACH Indicators (DYN, FGS, and BGS)

- DYN, FGS, and BGS all off : Two-point TEACH mode selected (default)
- DYN on : Dynamic TEACH mode selected
- FGS on : Foreground suppression TEACH mode selected
- BGS on : Background suppression TEACH mode selected
- DYN, FGS, and BGS all on : Dual TEACH mode selected

Stability Indicator (STB)

- On : Stable signal within the specified sensing range
- Flashing : Marginal signal, the target is outside the limits of the specified sensing range, or a multiple peak condition exists
- Off : No target detected within the specified sensing range

Buttons

Use the sensor buttons **[SELECT/TEACH]**, **[+/LO/DO]**, and **[-/MODE]** to program the sensor.



[SELECT/TEACH]

- Press to select menu items in Setup mode
- Press and hold for longer than 2 seconds to start the currently selected TEACH mode (the default is two-point TEACH)

[-/MODE]

- Press to navigate the sensor menu in Setup mode
- Press to change setting values; press and hold to decrease numeric values
- Press and hold for longer than 2 seconds to enter Setup mode

[+/LO/DO]

- Press to navigate the sensor menu in Setup mode
- Press to change setting values; press and hold to increase numeric values
- Press and hold for longer than 2 seconds to switch between light operate (LO) and dark operate (DO)

Laser Description and Safety Information

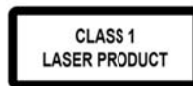


CAUTION: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure. Do not attempt to disassemble this sensor for repair. A defective unit must be returned to the manufacturer.

Class 1 Lasers

Class 1 lasers are lasers that are safe under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing.

COMPLIES WITH 21 CFR 1040.10 AND 1040.11
EXCEPT FOR DEVIATIONS PURSUANT TO
LASER NOTICE No. 50, DATED JUNE 24, 2007.
IDEC CORPORATION
2-6-64 Nishimiyahara, Yodogawa-ku,
Osaka 532-0004, Japan



COMPLIES WITH IEC 60825-1:2007

Laser wavelength: 655 nm


Output: < 0.20 mW

Pulse Duration: 7 μ s to 2 ms

Installation

Install the Safety Label

The safety label must be installed on SA1Q sensors that are used in the United States.

	Note: Position the label on the cable in a location that has minimal chemical exposure.
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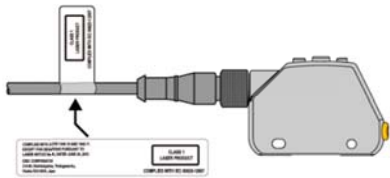


Figure 3. Safety Label Installation

1. Remove the protective cover from the adhesive on the label.
2. Wrap the label around the SA1Q cable, as shown.
3. Press the two halves of the label together.

Sensor Orientation

Optimize detection reliability and minimum object separation performance with correct sensor-to-target orientation. To ensure reliable detection, orient the sensor as shown in relation to the target to be detected.

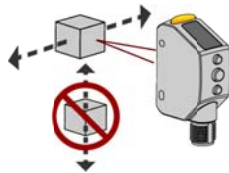


Figure 4. Optimal Orientation of Target to Sensor

See the following figures for examples of correct and incorrect sensor-to-target orientation as certain placements may pose problems for sensing some targets. The SA1Q can be used in the less preferred orientation and provide reliable detection performance; refer to the *Performance Curves* for the minimum object separation distance required for each case.

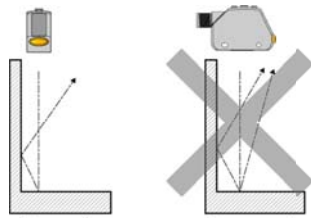


Figure 5. Orientation by a wall

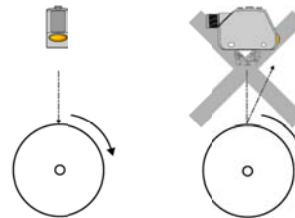


Figure 6. Orientation for a turning object

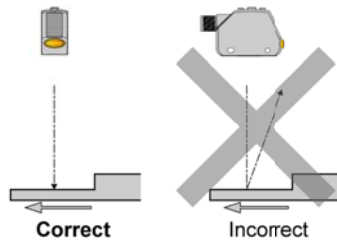


Figure 7. Orientation for a height difference

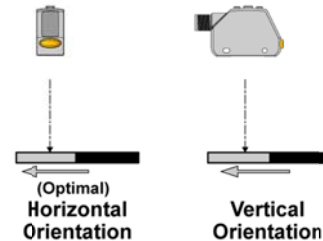
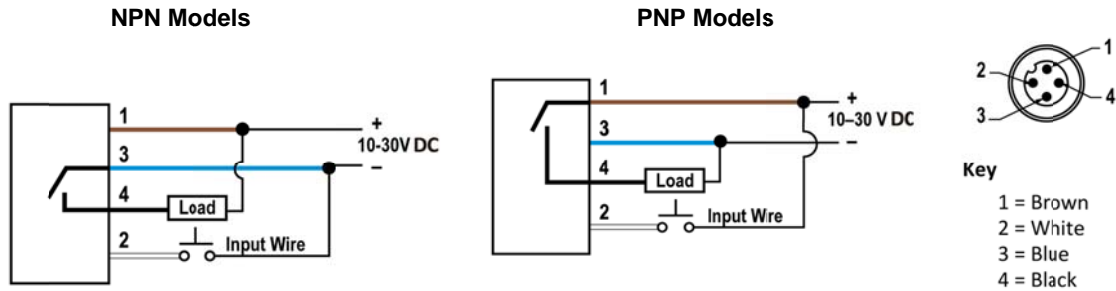


Figure 8. Orientation for a color or luster

Mount the Sensor

1. If a bracket is needed, mount the sensor onto the bracket.
2. Mount the sensor (or the sensor and the bracket) to the machine or equipment at the desired location. Do not tighten the mounting screws at this time.
3. Check the sensor alignment.
4. Tighten the mounting screws to secure the sensor (or the sensor and the bracket) in the aligned position.

Wiring Diagram



Note: Open lead wires must be connected to a terminal block.

Note: The input wire function is user-selectable; see the Instruction Manual for details. The default for the input wire function is off (disabled).

Cleaning and Maintenance

Handle the sensor with care during installation and operation. Sensor windows soiled by fingerprints, dust, water, oil, etc. may create stray light that may degrade the peak performance of the sensor.

As the sensor may cause corrosion, please do not leave moisture adhering. Wipe clean plenty, use it for cleanliness. Blow the window clear using filtered, compressed air, then clean as necessary using water and a lint-free cloth.

Sensor Programming

Program the sensor using the buttons on the sensor or the remote input (limited programming options). In addition to programming the sensor, use the remote input to disable the buttons for security, preventing unauthorized or accidental programming changes. See the Instruction Manual, for more information.

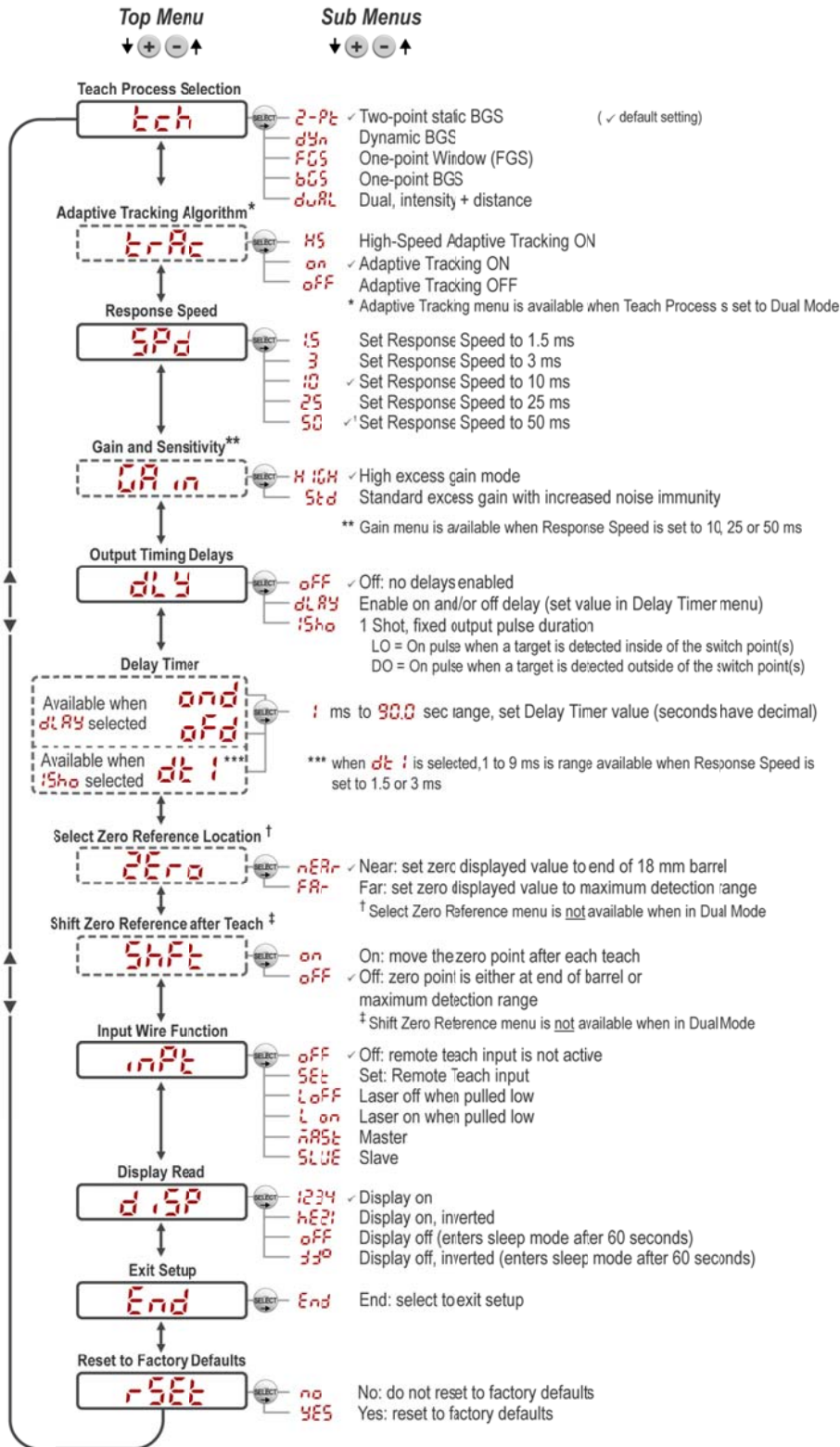
Setup Mode

Access Setup mode and the sensor menu from Run mode by pressing and holding **MODE** for longer than 2 seconds. Use **+** and **-** to navigate through the menu. Press **SELECT** to select a menu option and access the submenus.

Use **+** and **-** to navigate through the submenus. Press **SELECT** to select a submenu option and return to the top menu, or press and hold **SELECT** for longer than 2 seconds to select a submenu option and return immediately to Run mode.

To exit Setup mode and return to Run mode, navigate to **End** and press **SELECT**.

Figure 9. Sensor Menu Map



Basic TEACH Instructions



Use the following instructions to teach the SA1Q sensor. The instructions provided on the sensor display vary depending on the type of TEACH mode selected. Two-point TEACH is the default TEACH mode.





1. Press and hold **TEACH** for longer than 2 seconds to start the selected TEACH mode.
2. Present the target.
3. Press **TEACH** to teach the target. The target is taught and the sensor waits for the second target, if required by the selected TEACH mode, or returns to Run mode.
Complete steps 4 and 5 only if required for the selected TEACH mode:
4. Present the second target.
5. Press **TEACH** to teach the target. The target is taught and the sensor returns to Run mode.





See the Instruction Manual for detailed instructions and other available TEACH modes. The TEACH modes include:

- Two-point static background suppression **2-PT** :
Two-point TEACH sets a single switch point. The sensor sets the switch point between two taught target distances, relative to the shifted origin location.
- Dynamic background suppression **dyn** :
Dynamic TEACH sets a single switch point during machine run conditions. The sensor takes multiple samples and the switch point is set between the minimum and the maximum sampled distances.
- One-point window (foreground suppression) **FGS** :
One-point window sets a window (two switch points) centered around the taught target distance.
- One-point background suppression **BGS** :
One-point background suppression sets a single switch point in front of the taught target distance. Objects beyond the taught switch point are ignored.
- Dual intensity + distance **dual** :
Dual mode records the distance and amount of light received from the reference surface. See [Dual Mode Reference Surface Considerations](#) on page 10 for more information about selecting a reference surface. The output switches when an object passing between the sensor and the reference surface changes the perceived distance or amount of returned light.

Manual Adjustments

Manually adjust the sensor switch point using the  and  buttons.


1. From Run mode, press either  or  one time. The current switch point value flashes slowly.
2. Press  to move the switch point up or  to move the switch point down. After 1 second of inactivity, the new switch point value flashes rapidly, the new setting is accepted, and the sensor returns to Run mode.

	<p>Note: When FGS mode is selected (FGS indicator is on), manual adjustment moves both sides of the symmetrical threshold window simultaneously, expanding and collapsing the window size. Manual adjustment does not move the center point of the window.</p> <p>Note: When dual mode is selected (DYN, FGS, and BGS indicators are on), after the TEACH process is completed, use the manual adjustment  to adjust the sensitivity of the thresholds around the taught reference point. The taught reference point is a combination of the measured distance and returned signal intensity from the reference target.</p> <p>Manual adjustment does not move the taught reference point, but pressing  increases the sensitivity, and pressing  decreases the sensitivity. When re-positioning the sensor or changing the reference target, re-teach the sensor.</p>
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Light Operate/Dark Operate

The default output configuration is light operate. To switch between light operate and dark operate, use the following instructions:

1. Press and hold LO/DO for longer than 2 seconds. The current selection displays.
2. Press LO/DO again. The new selection flashes slowly.
3. Press **SELECT** to change the output configuration and return to Run mode.

	<p>Note: If neither SELECT nor LO/DO are pressed after step 2, the new selection flashes slowly for a few seconds, then flashes quickly and the sensor automatically changes the output configuration and</p>
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	returns to Run mode.
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Locking and Unlocking the Sensor Buttons

Use the lock and unlock feature to prevent unauthorized or accidental programming changes. Three settings are available:

- **wLoc**: The sensor is unlocked and all settings can be modified (default).
- **Loc**: The sensor is locked and no changes can be made.
- **OLoc**: The switch point value can be changed by teaching or manual adjustment, but no sensor settings can be changed through the menu.

When in **Loc** mode, **Loc** displays when the **[SELECT/TEACH]** button is pressed. The switch point displays when **[+/DISP]** or **[-/MODE]** are pressed, but **Loc** displays if the buttons are pressed and held. When in **OLoc** mode, **Loc** displays when **[+/DISP]** or **[-/MODE]** are pressed and held. To access the manual adjust options, briefly press and release **[+/DISP]** or **[-/MODE]**. To enter TEACH mode, press the **[SELECT/TEACH]** button and hold for longer than 2 seconds.

To enter **Loc** mode, hold **+** and press **-** four times. To enter **OLoc** mode, hold **+** and press **-** seven times. Holding **+** and pressing **-** four times unlocks the sensor from either lock mode and the sensor displays **wLoc**.

Specifications

Sensing Beam

Visible red Class 1 laser, 655 nm

Supply Voltage (Vcc)

10 to 30 V DC

Power and Current Consumption, exclusive of load
< 675 mW

Sensing Range

SA1Q-110* : 35 to 110 mm (1.38 to 4.33 in)

SA1Q-310* : 35 to 310 mm (1.38 to 12.20 in)

Output Configuration

PNP or NPN output, depending on model

Output Rating

100 mA total maximum

(protected against continuous overload and short circuit)

Off-state leakage current: < 5 µA at 30 V DC

PNP On-state saturation voltage: < 1.5 V DC at 100 mA load

NPN On-state saturation voltage: < 1.0 V DC at 100 mA load

Discrete Output Distance Repeatability

Table 1: SA1Q-110*

Distance (mm)	Repeatability
35 to 110	+/-0.2 mm

Table 2: SA1Q-310*

Distance (mm)	Repeatability
35 to 60	± 0.5 mm
60 to 310	± 1% of range

Remote Input

Allowable Input Voltage Range: 0 to Vcc

Active Low (internal weak pullup-sinking current):

Low State < 2.0 V at 1 mA max.

Supply Protection Circuitry

Protected against reverse polarity and transient overvoltages

excess gain available in 10 ms, 25 ms, and 50 ms response speeds only excess gain provides increased noise immunity

Beam Spot Size :

Table 3: SA1Q-110*

Distance (mm)	Size (Horizontal × Vertical)
35	2.4 × 1.0
60	2.2 × 0.9
110	1.8 × 0.7

Table 4: SA1Q-310*

Distance (mm)	Size (Horizontal × Vertical)
35	2.6 × 1.0
160	2.3 × 0.9
310	2.0 × 0.8

Response Speed

User selectable: 3, 10, 25, 50ms

Delay at Power Up

< 750 ms

Maximum Torque

Side mounting: 1 N · m (9 in · lbs)

Ambient Light Immunity

< 5,000 lux at 300 mm

Construction

Housing: 316 L stainless steel

Lens cover: PMMA acrylic

Lightpipe and display window: polysulfone

Excess Gain

Table 5: **High** Excess Gain (**Std** Excess Gain*1)

Response Speed (ms)	Excess Gain:90% White Card		
	at 35 mm	at 110 mm	at 310 mm
1.5	200	100	20
3	200	100	20
10	1000(500)	500(250)	100(50)
25	2500(1000)	1250(500)	250(100)
50	5000(2500)	2500(1250)	500(250)

*1 **Std** excess gain available in 10ms, and 50ms response speeds only

Std excess gain provides increased noise immunity

Connector

Integral 4-pin M12/Euro-style male quick disconnect

Temperature Effect

0.15 mm/°C at 135 mm

0.6 mm/°C at 310 mm

Chemical Compatibility

Compatible with commonly used acidic or caustic cleaning and disinfecting chemicals used in equipment cleaning and sanitation. ECOLAB® certified.

Compatible with typical cutting fluids and lubricating fluids used in machining centers

Application Note

- For optimum performance, allow 10 minutes for the sensor to warm up
- Since the detection distance may change due to the surrounding environment or aging, please perform correction and maintenance on a regular basis.
- In an operating environment with a temperature change, please set the sensor with sufficient margin.
- After the SA1Q housing, when transporting or storing under high temperature environment, please reconfirm the sensing range at startup.
- Depending on the use environment, the housing may be discolored, but performance of the sensor is not affected.

Environmental Rating

IEC IP67 per IEC60529

IEC IP68 per IEC60529

IEC IP69K per DIN40050-9

Operating Conditions

-10 °C to +50 °C (+14 °F to +122 °F)

35% to 95% relative humidity

Storage Conditions

-10 °C to +50 °C (+14 °F to +122 °F)

Vibration

MIL-STD-202G, Method 201A (10 to 60 Hz, 0.06 inch (1.52 mm) double amplitude, 2 hours each three mutually axes), with sensor operating

Shock

MIL-STD-202G, Method 213B, Condition I (100G 6 shocks on each of three mutually perpendicular axes), with sensor operating

Certifications



Class 1 power
UL Environmental Rating: Type 1



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Required Overcurrent Protection

	WARNING: Electrical connections must be made by qualified personnel in accordance with local and national electrical codes and regulations.
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Overcurrent protection is required to be provided by end product application per the supplied table. Overcurrent protection may be provided with external fusing or via Current Limiting, Class 2 Power Supply. Supply wiring leads < 24 AWG shall not be spliced.

Supply Wiring (AWG)	Required Overcurrent Protection (Amps)
20	5.0
22	3.0
24	2.0
26	1.0
28	0.8
30	0.5

Performance Curves

Minimum Separation Distance Between Target and Background for: Uniform and Non-Uniform Targets.

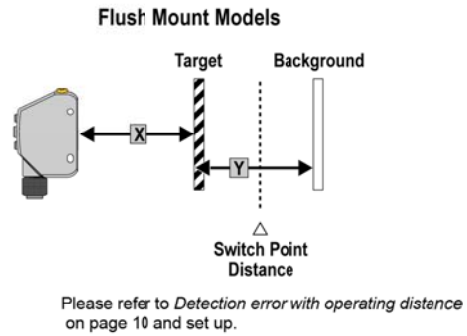
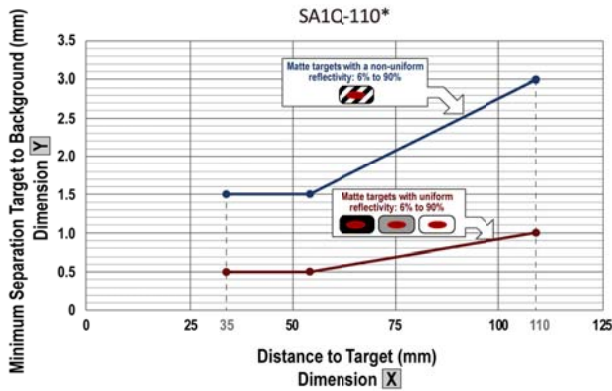
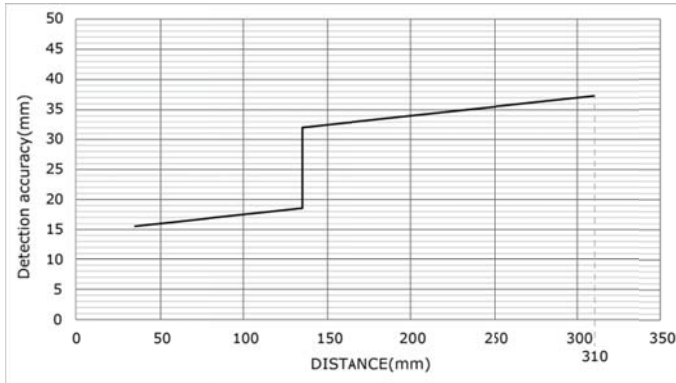


Figure 10. Minimum Object Separation Distance (90 to 6% reflectance)

Detection error with operating distance

Due to the operating environment and accuracy of SA1Q, errors may occur in detection distance. Please make a setting with sufficient margin with reference to [Detection error with operating Distance](#) on page 10* when programming SA1Q.

* Temperature change at 30°C
 0.15mm/°C <135mm
 0.6 mm/°C <310mm

Figure 11. Detection error with operating distance

Dual Mode Reference Surface Considerations

Optimize reliable detection by applying these principals when selecting your reference surface, positioning your sensor relative to the reference surface, and presenting your target. The robust detection capabilities of the SA1Q allows successful detection even under non-ideal conditions in many cases. Typical reference surfaces are metal machine frames, conveyor side rails, or mounted plastic targets.

Contact IDEC if you require assistance setting up a stable reference surface in your application. For detailed instructions for detecting clear or transparent objects, refer to the Instruction Manual.

1. Select a reference surface with these characteristics where possible:
 - Matte or diffuse surface finish
 - Fixed surface with no vibration
 - Dry surface with no build-up of oil, water, or dust
2. Position the reference surface between 50 mm and the maximum sensing range for threaded barrel models or between 60 mm and the maximum sensing range for flush mount models.
3. Position the target to be detected as close to the sensor as possible, and as far away from the reference surface as possible.
4. Angle the sensing beam relative to the target and relative to the reference surface 10 degrees or more.

IDEC Warranty

IDEC warrants its merchandise to be free from defects in material and workmanship under normal and proper use for a Period of one (1) year from date of shipment. Buyer's exclusive remedy for a nonconformity in any item shall be repair or Replacement at seller's option. This warranty is in lieu of all other warranties whether expressed, implied or statutory, including implied warranties of merchantability and of fitness. IDEC shall not be liable for claims based on breach of warranty or negligence or any other damages including consequential, contingent or incidental damages. Warranty does not apply if the merchandise is altered or modified in any way after delivery by IDEC.

Exclusion

- The SA1Q is for general electronic equipment. Do not use SA1Q for the purpose that malfunction or failure may directly threaten the human body and life.
- The SA1Q is not intended to be used for applications which require high reliability and safety, such as medical equipment, nuclear equipment, railways, aircraft, and vehicles. The SA1Q cannot be used for these applications.
- Use the product within the environmental limits given in the Catalog and Quick Start Guide.