Q4X Stainless Steel Laser Sensor

Instruction Manual

Original Instructions
181483 Rev. D
6 January 2015

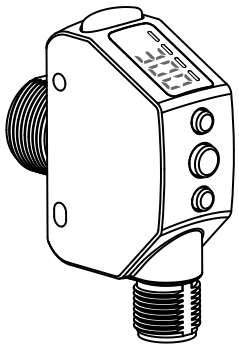
BANNER®

181483

Contents

1 Product Description

Class 1 laser CMOS sensor with a bipolar (1 PNP & 1 NPN) output. Patent pending.



- The ultimate problem solver: reduce sensor inventory with a reliable, durable sensor that solves the most challenging applications
- Solves difficult distance-based applications regardless of target surface reflectivity, including black foam on black plastic, black rubber in front of metal, multicolor packaging and targets of all colors
- Reliable sensing range of 25 mm (0.98 in) to 300 mm (11.81 in) with best in class excess gain
- Angled four-digit display with submillimeter resolution is easily viewed from multiple vantage points
- Display provides clear user feedback for easy setup, and bright output indicator provides high visibility of sensor operation
- Intuitive setup utilizing three tactile buttons conveniently located below the display
- Durable and robust construction resists mechanical impact, over tightening and extreme vibration
- FDA grade stainless steel, chemically-resistant material and laser marked sensor information withstands aggressive cleaning procedures
- Superior resistance to ambient light interference prevents nuisance output trips under changing lighting conditions
- Temperature-compensated design ensures reliable detection during changing temperature conditions

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. 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.

1.1 Models

Model	Sensing Range	Output	Cable
Q4XTBLAF300-Q8	25 mm (0.98 in) to 300 mm (11.81 in)	Bipolar: 1 NPN; 1 PNP	5-pin Euro M12 Integral Connector

1.2 Overview

The Q4X Sensor is a Class 1 laser CMOS sensor with a bipolar output. The normal sensor state is Run mode. From Run mode, the switch point value and LO/DO selection can be changed and the selected TEACH method can be performed. The secondary sensor state is Setup mode. From Setup mode, the TEACH mode can be selected, all standard operating parameters can be adjusted, and a factory reset can be done.

1.3 Features

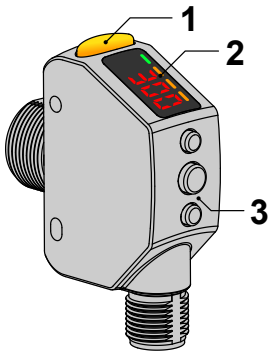


Figure 1. Sensor Features

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

1.3.1 Display and Indicators

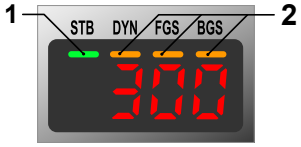


Figure 2. Display in Run Mode

The display is a 4-digit, 7-segment LED. The main screen is the Run Mode screen, which shows the current distance to the target in millimeters.

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)

Stability Indicator (STB)

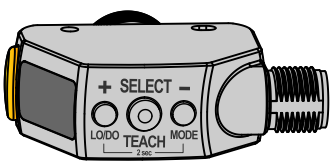
- On—Stable signal within the specified sensing range
- Flashing—Marginal signal, the target is outside the limits of the specified sensing range, or a multiple peak condition exists
- Off—No target detected within the specified sensing range

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

1.3.2 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)

(+)(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)

(-)(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

NOTE: When navigating the menu, the menu items loop.

1.4 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.

Laser wavelength: 655 nm

Output: < 0.20 mW

Pulse Duration: 7 µs to 2 ms

2 Installation

2.1 Install the Safety Label

The safety label must be installed on Q4X sensors that are used in the United States.

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

1. Remove the protective cover from the adhesive on the label.
2. Wrap the label around the Q4X cable, as shown.
3. Press the two halves of the label together.

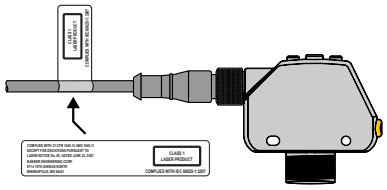


Figure 3. Safety Label Installation

2.2 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.

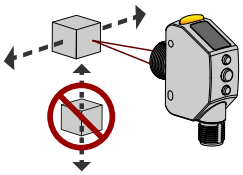


Figure 4. Optimal Orientation of Target to Sensor

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 Q4X can be used in the less preferred orientation and provide reliable detection performance; see *Figure 16* on page 23 for the minimum object separation distance required for each case.

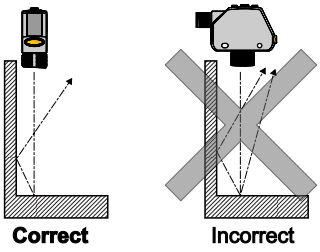


Figure 5. Orientation by a wall

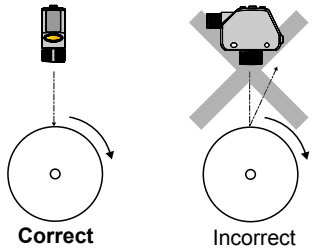


Figure 6. Orientation for a turning object

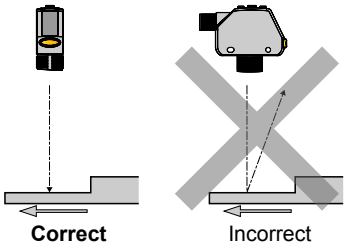


Figure 7. Orientation for a height difference

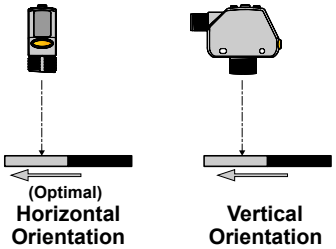
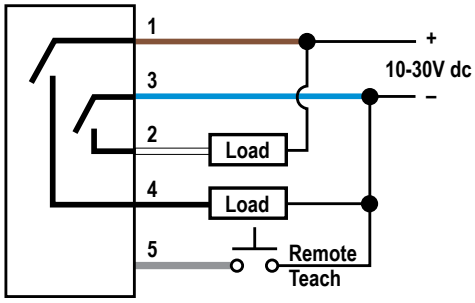


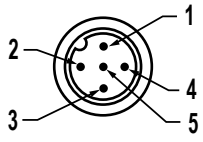
Figure 8. Orientation for a color or luster difference

2.3 Sensor Mounting

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 at this time.
3. Check the sensor alignment.
4. Tighten the screws to secure the sensor (or the sensor and the bracket) in the aligned position.

2.4 Wiring Diagram





Key

1 = Brown
2 = White
3 = Blue
4 = Black
5 = Gray

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

NOTE: The input wire function is user-selectable. The default for the input wire function is off (disabled).

2.5 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. Blow the window clear using filtered, compressed air, then clean as necessary using water and a lint-free cloth.

3 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 *Locking and Unlocking the Sensor Buttons* on page 15 for more information.

3.1 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.

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 returns to Run mode.

3.2 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  and press SELECT.

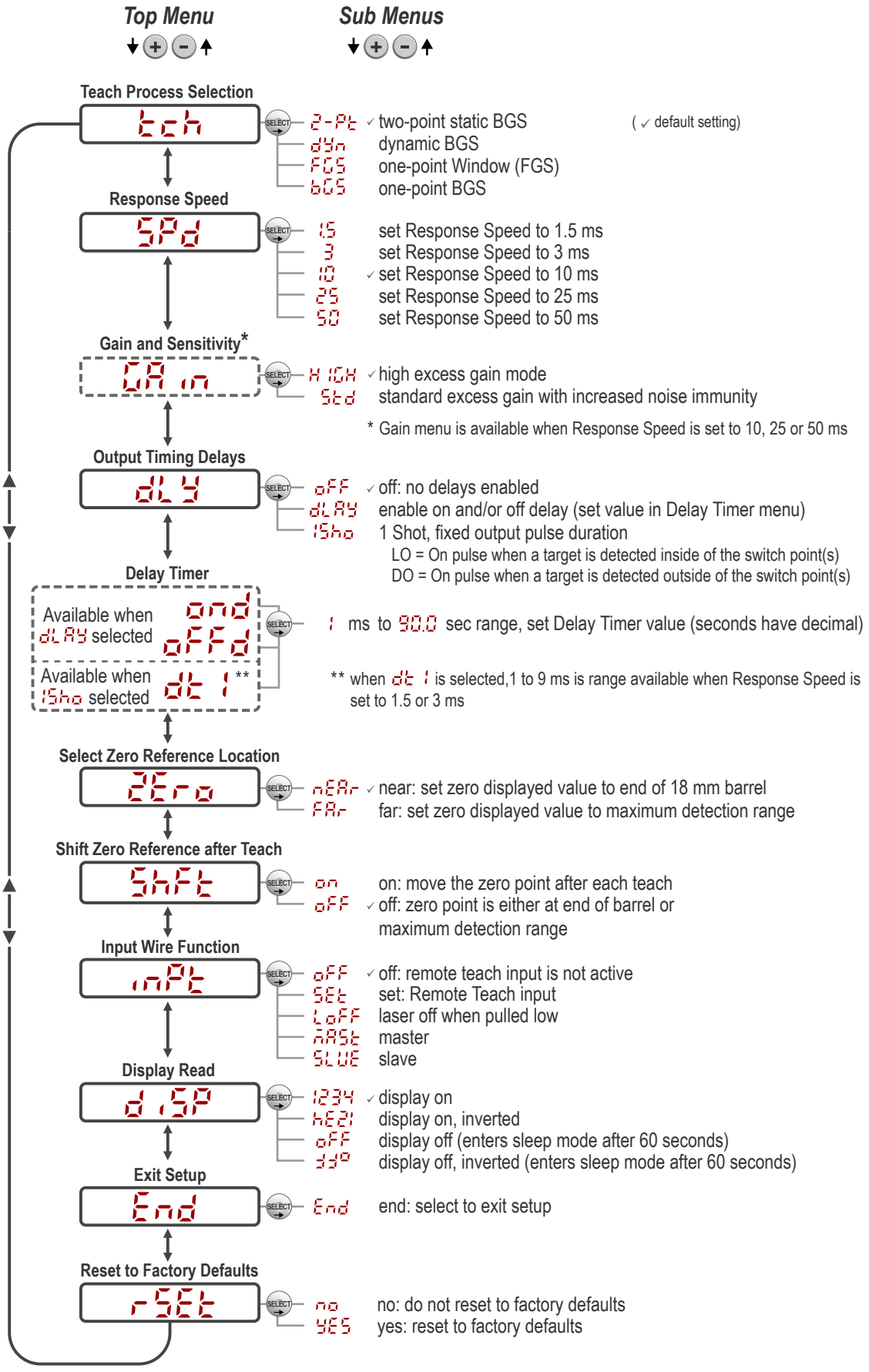


Figure 9. Sensor Menu Map

3.2.1 TEACH Menu tch

Use this menu to select the TEACH mode. The default is two-point TEACH.

- 2-Pt —Two-point static background suppression
- dyn —Dynamic background suppression
- FGS —One-point window (foreground suppression)
- bGS —One-point background suppression

After the TEACH mode is selected, from Run mode, press and hold TEACH for longer than 2 seconds to start the TEACH mode and program the sensor. See *TEACH Procedures* on page 15 for additional information and remote input TEACH instructions.

3.2.2 Response Speed SPd

Use this menu to select the response speed. The default is 10 milliseconds.

- 1.5 —1.5 milliseconds
- 3 —3 milliseconds
- 10 —10 milliseconds
- 25 —25 milliseconds
- 50 —50 milliseconds

Table 1: Tradeoffs

Response Speed	Response Speed in Sync Mode	Repeatability	Ambient Light Rejection	Excess Gain
1.5 ms	3 ms	500 µs	Disabled	See *Table 7* on page 22
3 ms	6 ms	500 µs	Enabled	
10 ms	20 ms	2 ms	Enabled	
25 ms	50 ms	5 ms	Enabled	
50 ms	100 ms	10 ms	Enabled	

Gain and Sensitivity GAin

Use this menu to set the excess gain mode. This menu is only available when a 10, 25, or 50 millisecond response speed is selected. It is not available for 1.5 or 3 millisecond response speeds.

- HIGH —High excess gain mode
- Std —Standard excess gain mode with increased noise immunity

3.2.3 Output Timing Delays dLY

Use this menu to select the output timing delay to be set. On and off delay timers can be used together. The default is no delay.

- oFF —No delay
- dLAY —Delay—enables the selection of on and off delay timers
- 1Sho —One-shot—enables a one-shot, fixed output pulse duration

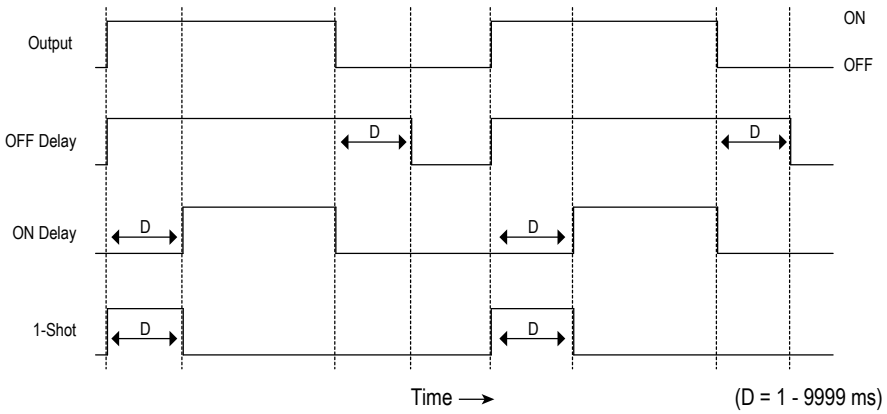


Figure 10. Output Timing Delays

When either dLAY or 1Sho is chosen, the sensor returns to the Setup menu and additional options become available to set the timer(s):

dLAY

- ond —On delay
- oFFd —Off delay

1Sho

- dt 1 —One-shot delay timer

NOTE: For the one-shot delay timer:
- LO = On pulse when a target is detected inside of the switch point(s)
- DO = On pulse when a target is detected outside of the switch point(s)

Delay Timers ond , oFFd , dt 1

Use these menus to set the delay timers. These menus are available only if an output timing delay is selected.

For ond and oFFd, the default is 0.

For dt 1, the default is 10 milliseconds for 10, 25, and 50 millisecond response speeds and 1 millisecond for 1.5 and 3 milliseconds response speeds.

Use + and - to scroll through the values. Values greater than 10 increase or decrease by increments of 10. Millisecond values do not include the decimal point; seconds values include the decimal point.

- 1 to 9 ms (when dt 1 is selected, the 1 to 9 ms range is available for 1.5 and 3 ms response times)
- 10 to 90 ms
- 100 to 900 ms
- 1.0 to 90.0 s

3.2.4 Zero Reference Location 2Ero

Use this menu to select the zero reference location. The default is nEAr, 0 = the end of the sensor barrel.

- nEAr —0 = the end of the sensor barrel; the measurement increases further from the sensor
- FAr —0 = maximum range; the measurement increases closer to the sensor

3.2.5 Shift the Zero Reference Location after a TEACH SHFt

Use this menu to select whether the sensor shifts the zero reference location to the last taught distance. The default is oFF , 0 = the end of barrel or the maximum range.

- on —Shift the zero reference location to one of the taught positions with each TEACH
- oFF —0 = the end of barrel or the maximum range, depending on the zEro setting

3.2.6 Input Wire Function inPt

Use this menu to select the input wire function. The default is off, ignore all remote input pulses.

- oFF —Ignore all remote input pulses
- SEt —Remote TEACH input
- LoFF —Laser off when pulled low
- MASt —Master sync line output for two-sensor cross-talk avoidance
- SLVE —Slave sync line input for two-sensor cross-talk avoidance

To configure sensors for master-slave operation, see *Sync Master/Slave* on page 21.

3.2.7 Display View d.SP

Use this menu to select the display view. The default is right-reading.

- 1234 —Right-reading
- rEVr —Inverted
- oFF —Right-reading and the display enters sleep mode after 60 seconds
- 33o —Inverted and the display enters sleep mode after 60 seconds

When the sensor is in sleep mode, the display wakes with the first button press.

3.2.8 Exit Setup Mode End

Navigate to End and press SELECT to exit Setup mode and return to Run mode.

3.2.9 Reset to Factory Defaults rSEt

Use this menu to restore the sensor to the factory default settings. See *Factory Default Settings* on page 12.

Select no to return to the sensor menu without restoring the defaults. Select YES to apply the factory defaults and return to Run mode.

Factory Default Settings

Setting	Factory Default
Display view (d.SP)	1234 —Right-reading, no sleep mode
Gain and sensitivity (GAin)	HIGH —High excess gain mode
Input wire function (inPt)	oFF —Ignore all remote input pulses If the sensor was reset using the remote input, the sensor remains in SEt mode to allow use of the remote input.
Output configuration	LO—Light Operate

Setting	Factory Default
Output timing delays (dLY)	oFF —No delay
Response speed (SPd)	10 ms
Shift the Zero Reference Location after a TEACH (SHFt)	oFF —0 = the end of barrel
TEACH process selection (tch)	2-Pt —Two-point TEACH
Zero reference location (2Ero)	nEAr —Measurement increases further from sensor

3.3 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.

NOTE: When FGS mode is selected (the 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.

3.4 Remote Input

Use the remote input to program the sensor remotely. The remote input provides limited programming options and is Active Low. For Active Low, connect the gray input wire to ground (0 V dc), with a remote switch connected between the wire and ground. Pulse the remote input according to the diagram and the instructions provided in this manual.

The length of the individual programming pulses is equal to the value T: 0.04 seconds ≤ T ≤ 0.8 seconds.

Exit remote programming modes by setting the remote input low for longer than 2 seconds.

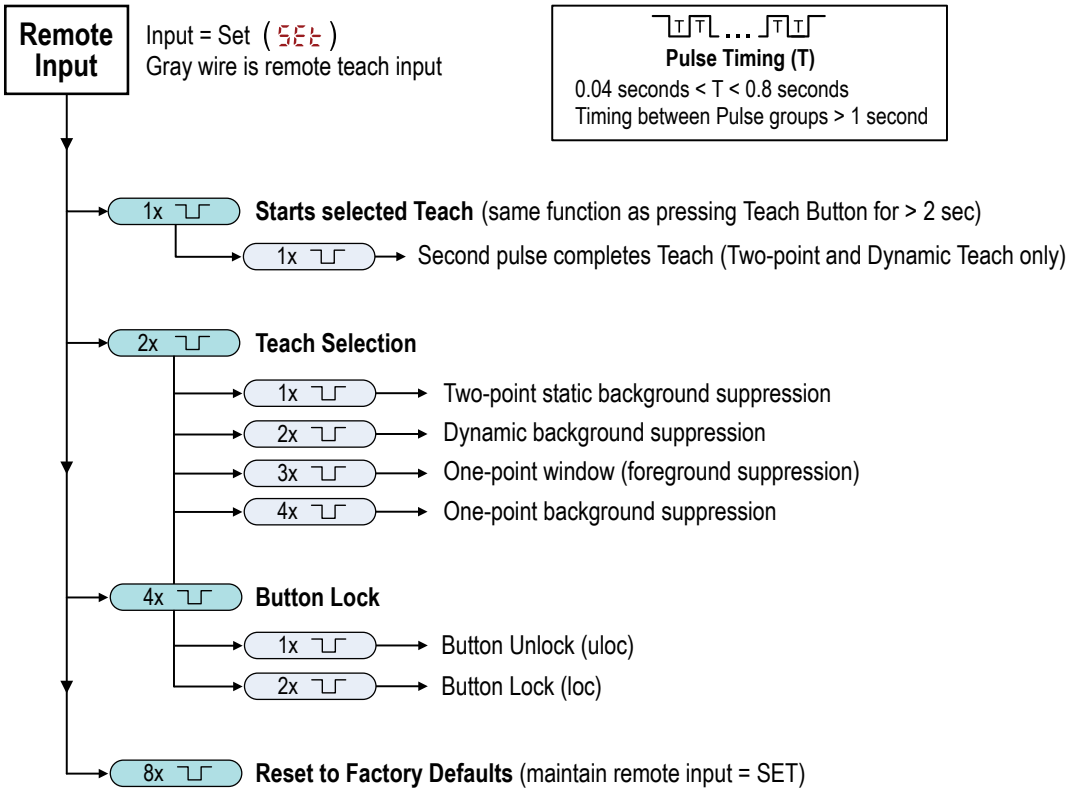
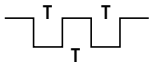


Figure 11. Remote Input Map

3.4.1 Select the TEACH Mode Using the Remote Input

1. Access the TEACH selection.

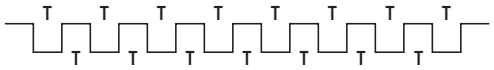
Action	Result
Double-pulse the remote input. 	tch displays.

2. Select the desired TEACH mode.

Action	Result
Pulses / **TEACH Mode** 1 — Two-point static background suppression 2 — Dynamic background suppression 3 — One-point window (foreground suppression) 4 — One-point background suppression	The selected TEACH method displays for a few seconds and the sensor returns to Run mode.

3.4.2 Reset to Factory Defaults Using the Remote Input

Eight-pulse the remote input to apply the factory defaults and return to Run mode.



NOTE: The input wire function remains at remote teach input (SEt).

3.5 Locking and Unlocking the Sensor Buttons

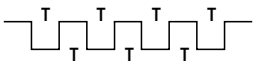
Use the lock and unlock feature to prevent unauthorized or accidental programming changes. When locked, Loc displays when the (SELECT)(TEACH) button is pressed. The switch point displays when (+)(LO/DO) or (-)(MODE) are pressed, but Loc displays if the buttons are pressed and held.

Button Instructions

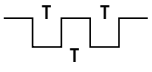
To lock or unlock the sensor using the buttons, press and hold (+) and press (-) four times. Loc or uLoc flashes, depending on the previous status.

Remote Input Instructions

1. Access the remote input.

Action	Result
Four-pulse the remote input. 	The sensor is ready to have the button state defined and btn displays.

2. Lock or unlock the sensor buttons.

Action	Result
Single-pulse the remote input to unlock the sensor. 	uLoc displays and the sensor returns to Run mode.
Double-pulse the remote input to lock the sensor. 	Loc displays and the sensor returns to Run mode.

3.6 TEACH Procedures

Use the following procedures to teach the sensor.

To cancel a TEACH procedure, press TEACH for longer than 2 seconds, or hold the remote input low for longer than 2 seconds. CnCL momentarily displays when a TEACH procedure is canceled.

3.6.1 Two-Point Static Background Suppression TEACH 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.

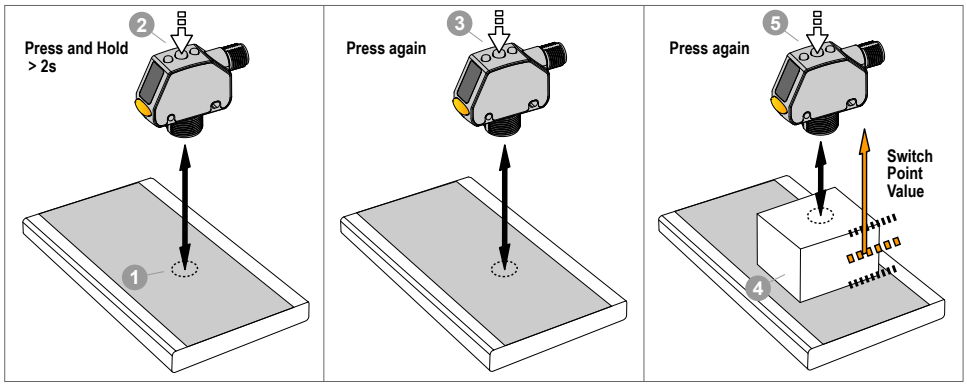


Figure 12. Two-Point Static Background Suppression (Light Operate shown)

NOTE: The sensor must be set to tCH = 2-Pt to use the following instructions.

NOTE: To program the sensor using remote input, remote input must be enabled (rmPt = SEt).

1. Present the target.

Method	Action	Result
Push Button	Present the first target. The sensor-to-target distance must be within the sensor's range.	The target's measurement value displays.
Remote Input		

2. Start the TEACH mode.

Method	Action	Result
Push Button	Press and hold TEACH for longer than 2 seconds.	SEt and 1St flash alternately on the display. The DYN, FGS, and BGS indicators flash.
Remote Input	No action required.	N/A

3. Teach the sensor.

Method	Action	Result
Push Button	Press TEACH to teach the target.	The sensor is taught the first target. SEt , 2nd , and the current distance measurement flash alternately on the display. The DYN, FGS, and BGS indicators flash.
Remote Input	Single-pulse the remote input. 	

4. Present the target.

Method	Action	Result
Push Button	Present the second target. The sensor-to-target distance must be within the sensor's range.	SEt , 2nd , and the distance measurement flash alternately on the display. The DYN, FGS, and BGS indicators flash.
Remote Input		

5. Teach the sensor.

Method	Action	Result
Push Button	Press TEACH to teach the target.	The new switch point flashes rapidly and the sensor returns to Run mode.
Remote Input	Single-pulse the remote input. 	

Table 2: Expected TEACH Behavior for Two-Point Static Background Suppression

See *Figure 16* on page 23 for the minimum object separation.

Condition	TEACH Result	Display
Two valid distances that are greater than or equal to the horizontal minimum object separation	Sets a switch point between the two taught distances	The switch point distance flashes on the display
Two valid distances that are less than the horizontal minimum object separation	Sets a switch point in front of the furthest taught distance by the horizontal minimum object separation	bOS and the switch point distance flash alternately on the display
One valid distance with one invalid TEACH point	Sets a switch point between the one taught distance and 300 mm	obJt and the switch point distance flash alternately on the display
Two invalid TEACH points	Sets a switch point at 290 mm	FuLL and the switch point distance flash alternately on the display

3.6.2 Dynamic Background Suppression TEACH dyn

Dynamic TEACH sets a single switch point during machine run conditions. Dynamic TEACH is recommended for applications where a machine or process may not be stopped for teaching. The sensor takes multiple samples and the switch point is set between the minimum and the maximum sampled distances.

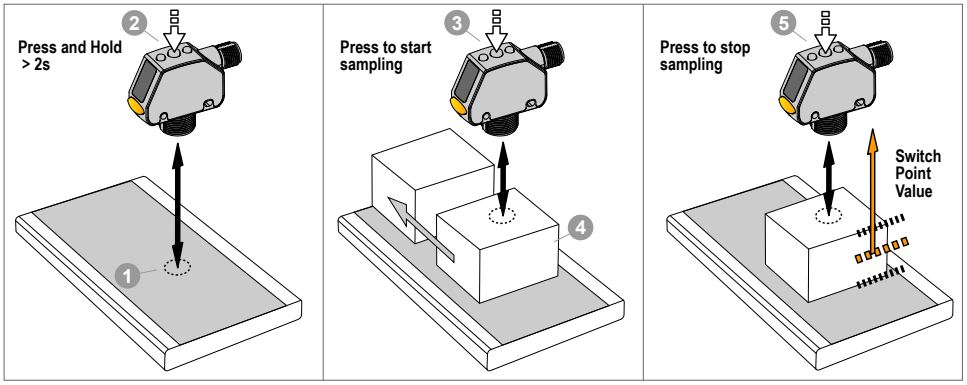


Figure 13. Dynamic Background Suppression

NOTE: The sensor must be set to tch = dyn to use the following instructions. The DYN indicator is amber to indicate Dynamic TEACH mode.

NOTE: To program the sensor using remote input, remote input must be enabled (rmt = SEt).

1. Present the target.

Method	Action	Result
Push Button	Present the first target. The sensor-to-target distance must be within the sensor's range.	The target's measurement value displays.
Remote Input		

2. Start the TEACH mode.

Method	Action	Result
Push Button	Press and hold TEACH for longer than 2 seconds.	dyn and Strt flash alternately on the display. The DYN indicator flashes.

Method	Action	Result
Remote Input	No action required.	N/A

3. Teach the sensor.

Method	Action	Result
Push Button	Press TEACH to teach the target.	The sensor begins sampling target distance information and dyn and StoP flash alternately on the display. The DYN indicator flashes.
Remote Input	Single-pulse the remote input. 	

4. Present the targets.

Method	Action	Result
Push Button	Present additional targets. The sensor-to-target distance must be within the sensor's range.	The sensor continues to sample target distance information and dyn and StoP flash alternately on the display. The DYN indicator flashes.
Remote Input		

5. Teach the sensor.

Method	Action	Result
Push Button	Press TEACH to stop teaching the sensor.	The new switch point flashes rapidly and the sensor returns to Run mode.
Remote Input	Single-pulse the remote input. 	

Table 3: Expected TEACH Behavior for Dynamic Background Suppression

See *Figure 16* on page 23 for the minimum object separation.

Condition	TEACH Result	Display
Two valid distances that are greater than or equal to the horizontal minimum object separation	Sets a switch point between the two taught distances	The switch point distance flashes on the display
Two valid distances that are less than the horizontal minimum object separation	Sets a switch point in front of the furthest taught distance by the horizontal minimum object separation	bGS and the switch point distance flash alternately on the display
One valid distance with one invalid TEACH point	Sets a switch point between the one taught distance and 300 mm	obJt and the switch point distance flash alternately on the display
Two invalid TEACH points	Sets a switch point at 200 mm	bGS and the switch point distance flash alternately on the display

3.6.3 One-Point Window (Foreground Suppression) FGS

One-point window sets a window (two switch points) centered around the taught target distance. Loss of signal is treated as a detection in One-Point Window mode. The size of the taught window is the vertical minimum object separation. See *Figure 16* on page 23.

Manually adjust the window size from Run mode using + and -.

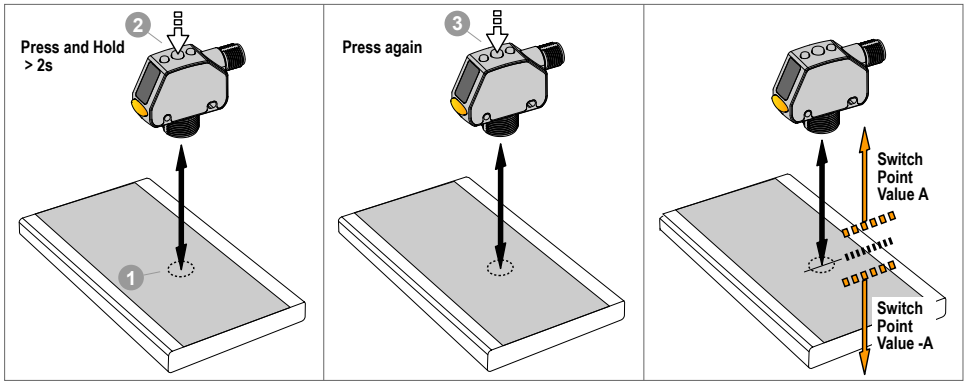


Figure 14. One-Point Window (Foreground Suppression)

NOTE: The sensor must be set to tch = FGS to use the following instructions. The FGS indicator is amber to indicate One-Point Window (Foreground Suppression) mode.

NOTE: To program the sensor using remote input, remote input must be enabled (rMt = SEt).

1. Present the target.

Method	Action	Result
Push Button	Present the target. The sensor-to-target distance must be within the sensor's range.	The target's measurement value displays.
Remote Input		

2. Start the TEACH mode.

Method	Action	Result
Push Button	Press and hold TEACH for longer than 2 seconds.	Light Operate SEt and on flash alternately on the display. The FGS indicator flashes. Dark Operate SEt and oFF flash alternately on the display. The FGS indicator flashes.
Remote Input	No action required.	N/A

3. Teach the sensor.

Method	Action	Result
Push Button	Press TEACH to teach the target.	The ± window size flashes rapidly and the sensor returns to Run mode.
Remote Input	Single-pulse the remote input. 	

Table 4: Expected TEACH Behavior for One-Point Window (Foreground Suppression)

See *Figure 16* on page 23 for the minimum object separation.

Condition	TEACH Result	Display
One valid distance	Sets a window (two switch points) centered around the taught distance. The ± window size is the vertical minimum object separation. The two switch points always stay within the specified sensing range.	The ± window size flashes on the display.
One invalid TEACH Point	Sets a window (two switch points) centered around 250 mm. The window size is ± 25 mm.	---- and the window center point distance flash alternately on the display.

3.6.4 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. The switch point is set in front of the taught target distance by the vertical minimum object separation. See *Figure 16* on page 23.

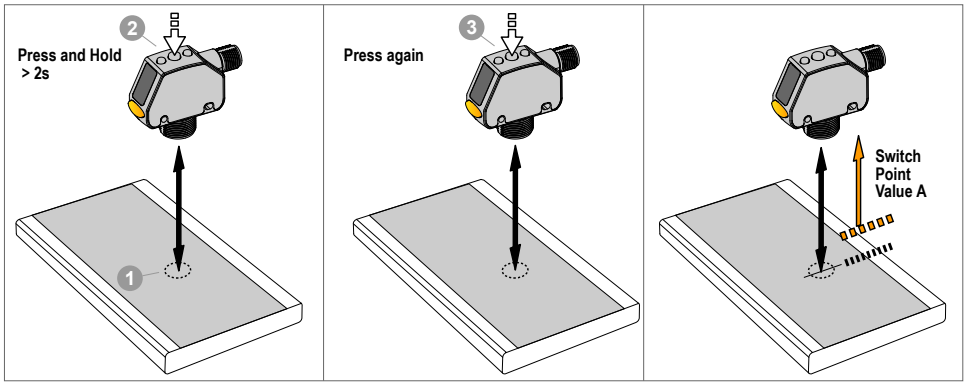


Figure 15. One-Point Background Suppression

NOTE: The sensor must be set to tCH = bGS to use the following instructions. The BGS indicator is amber to indicate Background Suppression mode.

NOTE: To program the sensor using remote input, remote input must be enabled (rmPt = SEt).

1. Present the target.

Method	Action	Result
Push Button	Present the target. The sensor-to-target distance must be within the sensor's range.	The target's measurement value displays.
Remote Input		

2. Start the TEACH mode.

Method	Action	Result
Push Button	Press and hold TEACH for longer than 2 seconds.	Light Operate SEt and oFF flash alternately on the display. The BGS indicator flashes. Dark Operate SEt and on flash alternately on the display. The BGS indicator flashes.
Remote Input	No action required.	N/A

3. Teach the sensor.

Method	Action	Result
Push Button	Press TEACH to teach the target.	The new switch point flashes rapidly and the sensor returns to Run mode.
Remote Input	Single-pulse the remote input. 	

Table 5: Expected TEACH Behavior for One-Point Background Suppression

See *Figure 16* on page 23 for the minimum object separation.

Condition	TEACH Result	Display
One valid distance	Sets a switch point in front of the taught distance by the vertical minimum object separation.	The switch point distance flashes on the display.
One invalid TEACH point	Sets a switch point at 200 mm.	bCS and the switch point distance flash alternately on the display.

3.7 Sync Master/Slave

Two Q4X sensors may be used together in a single sensing application. To eliminate crosstalk between the two sensors, configure one sensor to be the master and one to be the slave. In this mode, the sensors alternate taking measurements and the response speed doubles.

Important: The Master sensor and the Slave sensor must be programmed for the same Response Speed and Gain mode settings. The Master sensor and Slave sensor must share a common power source.

1. Configure the first sensor as the master; navigate: mPt > MASt .
2. Configure the second sensor as the slave; navigate: mPt > SLVE .
3. Connect the gray (input) wires of the two sensors together.

4 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
25 mm (0.98 in) to 300 mm (11.81 in)

Output Configuration
Bipolar (1 PNP & 1 NPN) output

Output Rating
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

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, over-voltage, and transient voltages

Beam Spot Size

Table 6: Beam Spot Size

Distance (mm)	Size (Horizontal × Vertical)
25	2.6 mm × 1.0 mm
150	2.3 mm × 0.9 mm
300	2.0 mm × 0.8 mm

Temperature Effect
0.05 mm/°C at 125 mm
0.35 mm/°C at 300 mm

Excess Gain

Table 7: HIGH Excess Gain (Std Excess Gain[1])

Response Speed (ms)	Excess Gain (90% White Card at 25 mm)	Excess Gain (90% White Card at 300 mm)
1.5	200	20
3	200	20
10	1000 (500)	100 (50)
25	2500 (1000)	250 (100)
50	5000 (2500)	500 (250)

Response Speed
User selectable:

- 1.5—1.5 milliseconds
- 3—3 milliseconds
- 10—10 milliseconds
- 25—25 milliseconds
- 50—50 milliseconds

Delay at Power Up
< 750 ms

Ambient Light Immunity
> 5,000 lux

Maximum Torque
Side mounting: 1 N·m (9 in·lbs)
Nose mounting: 20 N·m (177 in·lbs)

Connector
5-pin Euro M12 Integral Connector

Construction
Housing: 316 L stainless steel
Lens cover: PMMA acrylic
Lightpipe and display window: polysulfone

Vibration
MIL-STD-202G, Method 201A (10 to 60 Hz, 0.06 in (1.52 mm) double amplitude, 2 hours each along X, Y and Z axes), with sensor operating

Shock
MIL-STD-202G, Method 213B, Condition I (100G 6x along X, Y and Z axes, 18 total shocks), with sensor operating

Environmental Rating
IEC IP67 per IEC60529
IEC IP68 per IEC60529
IEC IP69K per DIN40050-9

Chemical Compatibility
Compatible with commonly used acidic or caustic cleaning and disinfecting chemicals used in equipment cleaning and sanitation.
Compatible with typical cutting fluids and lubricating fluids used in machining centers

Operating Conditions
Temperature: –10 °C to +55 °C (+14 °F to +131 °F)
Humidity: 35% to 95% relative humidity

Storage Temperature
–25 °C to +75 °C (–13 °F to +167 °F)

Application Note
For optimum performance, allow 10 minutes for the sensor to warm up

Certifications

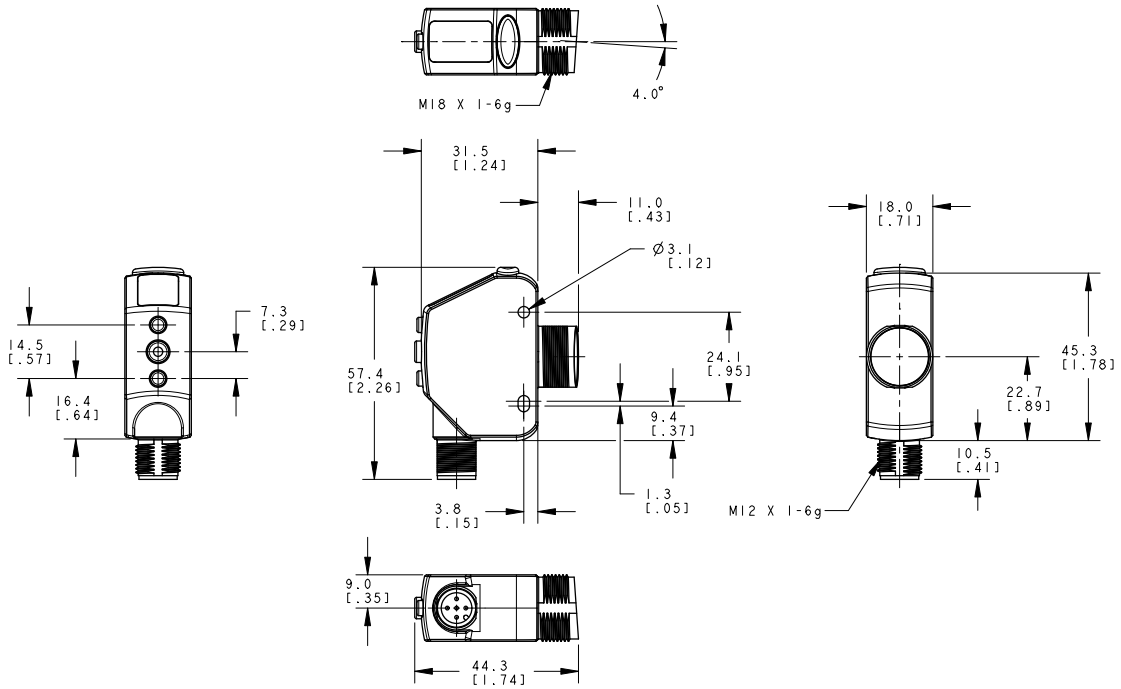
Class 2 power
Ind. Cont. Eq.
3TJJ

ECOLAB® chemical compatibility pending on some models; contact Banner Engineering for details.

[1]
- Std *excess gain available in 10 ms, 25 ms, and 50 ms response speeds only*
- Std *excess gain provides increased noise immunity*

4.1 Dimensions

All measurements are listed in millimeters (inches), unless noted otherwise.



4.2 Performance Curves

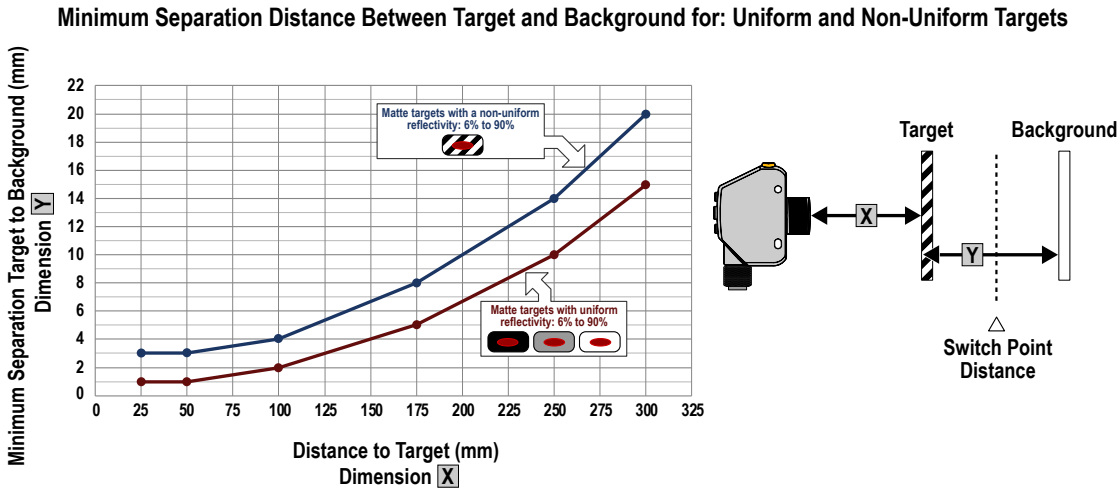


Figure 16. Minimum Object Separation Distance (90% to 6% reflectance)

5 Abbreviations

The following table describes the abbreviations used on the sensor display and in this manual.

Abbreviation	Description
----	No valid signal in range
1Sho	One-shot
1St	First
2nd	Second
2-Pt	Two-point TEACH (static background suppression)
bGS	One-point background suppression
btn	Button
CnCL	Cancel
d.SP	Display read
dLY	Output timing delay
dLAY	Delay
dt 1	Delay timer for one-shot
dyn	Dynamic background suppression
End	End—exit the sensor menu
FAr	Far zero reference location—the maximum range is 0 and the measurement increase as the target moves closer to the sensor
FGS	One-point window (foreground suppression)
FuLL	Full range
GA in	Excess gain
HIGH	High excess gain mode
inPt	Input wire function
Loc	Lock/locked
LoFF	Laser off
MASt	Master
nEAr	Near zero reference location—the end of the barrel is 0 and the measurement increase as the target moves further away from the sensor
obut	Object
oFFd	Off delay timer
ond	On delay timer
rSEt	Reset to factory defaults
SEt	Input wire = remote teach function

Abbreviation	Description
SHFt	Shift the Zero Reference Location after a TEACH
SLVE	Slave
SPd	Response speed
Std	Standard excess gain mode
Strt	Start
StoP	Stop
tch	TEACH process selection
uLoc	Unlock/unlocked
uuuu	Saturated signal (too much light)
ZEro	Zero—select the zero reference location

6 Troubleshooting

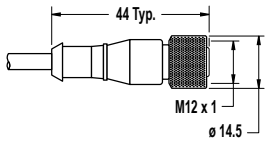
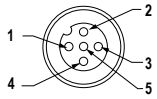
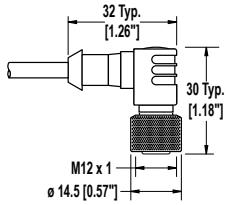
Table 8: Error Codes

Error Code	Description	Resolution
----	No valid signal in range	Reposition the sensor or the target
uuuu	The signal is saturated (too much light)	Reposition the sensor or the target to increase the detection distance, or increase the angle of incidence between the sensor and the target
Err E	EEPROM fault	Contact Banner Engineering to resolve
Err L	Laser fault	Contact Banner Engineering to resolve
Err O	Output short-circuited	Check the wiring for an electrical short circuit and to ensure that the wiring is correct
Err S	System fault	Contact Banner Engineering to resolve

7 Accessories

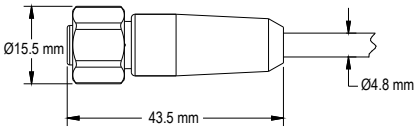
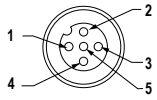
7.1 Cordsets

All measurements are listed in millimeters, unless noted otherwise.

5-Pin Threaded M12/Euro-Style Cordsets (Single Ended)				
Model	Length	Style	Dimensions	Pinout (Female)
MQDC1-501.5	0.50 m (1.5 ft)	Straight		 1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray
MQDC1-506	1.83 m (6 ft)			
MQDC1-515	4.57 m (15 ft)			
MQDC1-530	9.14 m (30 ft)			
MQDC1-506RA	1.83 m (6 ft)	Right-Angle		
MQDC1-515RA	4.57 m (15 ft)			
MQDC1-530RA	9.14 m (30 ft)			

5-Pin Threaded M12/Euro-Style Cordsets—Washdown Stainless Steel

Cable: PVC jacket and over-mold, EPDM o-ring, 316L coupling nut
Environmental Rating: IEC IP69K

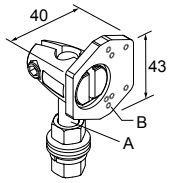
5-Pin Threaded M12/Euro-Style Cordsets—Washdown Stainless Steel				
Model	Length	Style	Dimensions	Pinout (Female)
MQDC-WDSS-0506	1.83 m (6 ft)	Straight		 1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray
MQDC-WDSS-0515	4.57 m (15 ft)			
MQDC-WDSS-0530	9.14 m (30 ft)			

7.2 Brackets

All measurements are listed in millimeters, unless noted otherwise.

SMBQ4X..

- Swivel bracket with tilt and pan movement for precision adjustment
- Easy sensor mounting to extruded rail T-slots
- Metric and inch size bolts available
- Side mounting of some sensors with the 3 mm screws included with the sensor

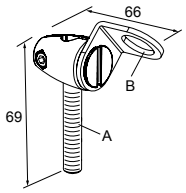


B = 7 × M3 × 0.5

Model	Bolt Thread (A)
SMBQ4XFA	3/8 - 16 × 2¼ in
SMBQ4XFAM10	M10 - 1.5 × 50
SMBQ4XFAM12	n/a; no bolt included. Mounts directly to 12 mm (½ in) rods

SMB18FA..

- Swivel bracket with tilt and pan movement for precision adjustment
- Easy sensor mounting to extruded rail T-slots
- Metric and inch size bolts available
- 18 mm sensor mounting hole

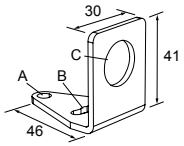


Hole size: B=ø 18.1

Model	Bolt Thread (A)
SMB18FA	3/8 - 16 × 2 in
SMB18FAM10	M10 - 1.5 × 50
SMB18FAM12	n/a; no bolt included. Mounts directly to 12 mm (½ in) rods

SMB18A

- Right-angle mounting bracket with a curved slot for versatile orientation
- 12-ga. stainless steel
- 18 mm sensor mounting hole
- Clearance for M4 (#8) hardware



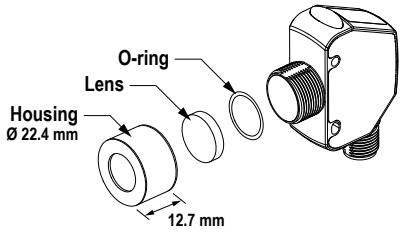
Hole center spacing: A to B = 24.2
Hole size: A = ø 4.6, B = 17.0 × 4.6, C = ø 18.5

7.3 Aperture Kits

APG18S

Kit with glass lens to protect plastic sensor lens from chemical environments and weld splatter damage.

Used with S18, M18, T18, TM18, and Q4X



Additional Information

- Borosilicate glass window protects the PMMA window from weld splatter and chemicals
- Adds 4.8 mm to the length of the threaded barrel
- Reduces excess gain by 30%; increase the response time to restore excess gain

8 Contact Us

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