Quick Start Guide

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

This guide is designed to help you set up and install the Q4X Sensor. For complete information on programming, performance, troubleshooting, dimensions, and accessories, please refer to the Instruction Manual at www.bannerengineering.com. Search for p/n 181483 to view the Instruction Manual. Use of this document assumes familiarity with pertinent industry standards and practices.

For illustration purposes, the threaded barrel model Q4X images are used throughout this document.

**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.

**Features**

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

**Figure 1. Sensor Features—Threaded Barrel Models**

**Figure 2. Sensor Features—Flush Mount Models**

**Display and Indicators**

The display is a 4-digit, 7-segment LED. The main screen is the Run Mode screen, which shows the percentage matched to the taught reference surface. A display value of 999P indicates the sensor has not been taught.

1. Stability Indicator (STB = Green)
2. Active TEACH Indicators
   - COD = Intensity and distance windows for clear object detection

**Output Indicator**

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

**Active TEACH Indicators (COD)**

- COD all on = Intensity and distance windows for clear object detection enabled

**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.
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

Installation

**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 4. Safety Label Installation](image-url)
Sensor Orientation and Mounting Considerations for Transparent and Clear Object Detection

Optimize the reliable detection of transparent and clear objects 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 Q4X will allow successful detection even under non-ideal conditions in many cases.

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 and 300 mm (threaded barrel models) or 60 mm and 310 mm (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.

![Figure 5. Mounting considerations](image)

![Figure 6. Common problems and solutions for detecting clear objects](image)
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—Threaded Barrel Models

![Wiring Diagram](image)

**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).

Wiring Diagram—Flush Mount Models

**NPN Models**

![Wiring Diagram](image)

**PNP Models**

![Wiring Diagram](image)

**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. 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, p/n 181483 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.

Basic TEACH Instructions

Use the following instructions to teach the Q4X sensor.

1. Align the sensor to a stable reference surface.
2. Rigidly mount the sensor in this alignment.
3. Press and hold TEACH for longer than 2 seconds to start the TEACH mode.
4. Press TEACH to teach the reference surface. The reference surface is taught, the currently selected switch point value is displayed, and the sensor returns to run mode.
The Q4X sensor records the distance to the reference surface and the amount of laser light returned by the reference surface. The output is switched when an object passing between the sensor and the reference surface changes the perceived distance or amount of returned light. The Q4X is able to detect the very small changes caused by transparent and clear objects. Typical reference surfaces are metal machine frame, conveyor side rail, or mounted plastic targets. Please contact Banner Engineering if you require assistance setting up a stable reference surface in your application.

The Q4X sensor can be taught non-ideal reference surfaces, such as surfaces outside of the sensor range or very dark surfaces. Teaching non-ideal reference surfaces may enable applications other than transparent or clear object detection, but best results for transparent or clear object detection require a stable reference surface as described above in Sensor Orientation and Mounting Considerations for Transparent and Clear Object Detection on page 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.

After the TEACH process is completed, the taught reference point, a combination of the measured distance and returned signal intensity from the reference target, is recorded by the sensor. Use the push buttons to manually adjust the switch point. Manual adjustment changes the sensitivity of the thresholds around the taught reference point but does not move the taught reference point. Press to increase the sensitivity and press to decrease the sensitivity. After re-positioning the sensor or changing the reference target, re-teach the sensor.

The display shows the current match percentage relative to the taught reference point. The switch point defines the sensitivity; the output switches when the current match percentage crosses the switch point.

Your specific application may require some adjustment of the switch point, but these values are recommended starting switch points for common applications.

<table>
<thead>
<tr>
<th>Switch point (%)</th>
<th>Typical Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 (default)</td>
<td>Default, recommended for PET bottles and Trays</td>
</tr>
<tr>
<td>88</td>
<td>Recommended for thin films</td>
</tr>
<tr>
<td>50</td>
<td>Recommended for tinted brown, tinted green, or water-filled containers</td>
</tr>
</tbody>
</table>

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.
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.

Locking and Unlocking the Sensor Buttons

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

- uloc —The sensor is unlocked and all settings can be modified (default).
- loc — The sensor is locked and no changes can be made.
- dloc —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 (+)(LO/DO) or (-)(MODE) are pressed, but loc displays if the buttons are pressed and held.
When in **LOC** mode, **LOC** displays when (+)(LO/DO) or (-)(MODE) are pressed and held. To access the manual adjust options, briefly press and release (+)(LO/DO) 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 **LOC** mode, hold + and press - seven times. Holding + and pressing - four times unlocks the sensor from either lock mode and the sensor displays **LOC**.

### 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 to 300 mm (0.98 in to 11.81 in)

**Output Configuration**
Bipolar (1 PNP and 1 NPN) output

**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

**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

**Response Speed**
User selectable:
- 15 — 1.5 milliseconds
- 3 — 3 milliseconds
- 10 — 10 milliseconds
- 25 — 25 milliseconds
- 50 — 50 milliseconds

**Beam Spot Size**

<table>
<thead>
<tr>
<th>Distance (mm)</th>
<th>Threaded Barrel Models</th>
<th>Flush Mount Models</th>
<th>Size (Horizontal × Vertical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>35</td>
<td>2.6 mm × 1.0 mm</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>160</td>
<td>2.3 mm × 0.9 mm</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>310</td>
<td>2.0 mm × 0.8 mm</td>
<td></td>
</tr>
</tbody>
</table>

**Excess Gain**—Flush Mount Models

<table>
<thead>
<tr>
<th>Response Speed (ms)</th>
<th>Excess Gain—90% White Card at 25 mm</th>
<th>Excess Gain—90% White Card at 30 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>200</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>200</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>1000 (500)</td>
<td>100 (50)</td>
</tr>
<tr>
<td>25</td>
<td>2500 (1000)</td>
<td>250 (100)</td>
</tr>
<tr>
<td>50</td>
<td>5000 (2500)</td>
<td>500 (250)</td>
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<td>200</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>200</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>1000 (500)</td>
<td>100 (50)</td>
</tr>
<tr>
<td>25</td>
<td>2500 (1000)</td>
<td>250 (100)</td>
</tr>
<tr>
<td>50</td>
<td>5000 (2500)</td>
<td>500 (250)</td>
</tr>
</tbody>
</table>

1. **std** excess gain available in 10 ms, 25 ms, and 50 ms response speeds only
2. **std** excess gain provides increased noise immunity

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Delay at Power Up
< 750 ms

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

Ambient Light Immunity
> 5,000 lux

Connector
Integral 5-pin M12/Euro-style male quick disconnect (QD)

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

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

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

Vibration
MIL-STD-202G, Method 201A (10 Hz to 60 Hz, 0.06 inch (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

Operating Conditions
−10 °C to +50 °C (+14 °F to +122 °F)
35% to 95% relative humidity

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

Required Overcurrent Protection

<table>
<thead>
<tr>
<th>Supply Wiring (AWG)</th>
<th>Required Overcurrent Protection (Amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>5.0</td>
</tr>
<tr>
<td>22</td>
<td>3.0</td>
</tr>
<tr>
<td>24</td>
<td>2.0</td>
</tr>
<tr>
<td>26</td>
<td>1.0</td>
</tr>
<tr>
<td>28</td>
<td>0.8</td>
</tr>
<tr>
<td>30</td>
<td>0.5</td>
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</table>

Certifications

<table>
<thead>
<tr>
<th>UL Listed</th>
<th>Class 2 power</th>
</tr>
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<tbody>
<tr>
<td>IEC60529</td>
<td>UL Environmental Rating: Type 1</td>
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</table>

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