

# Q4X Stainless Steel Laser Sensor



## Quick Start Guide

*Class 1 laser CMOS sensor with a bipolar (1 PNP & 1 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](http://www.bannerengineering.com). Search for p/n 181483 to view the manual. Use of this document assumes familiarity with pertinent industry standards and practices.



### 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

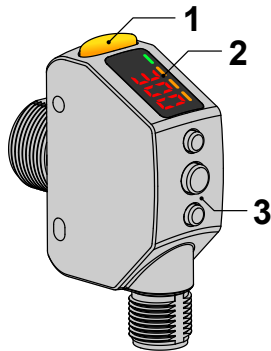


Figure 1. Sensor Features

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

## 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

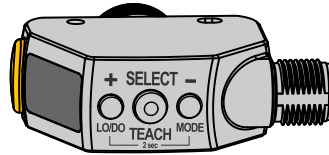


### Active TEACH Indicators (DYN, FGS, and BGS)

- 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

## 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.

## 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.  
BANNER ENGINEERING CORP.  
9714 10TH AVENUE NORTH  
MINNEAPOLIS, MN 55441

CLASS 1  
LASER PRODUCT

COMPLIES WITH IEC 60825-1:2007

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.

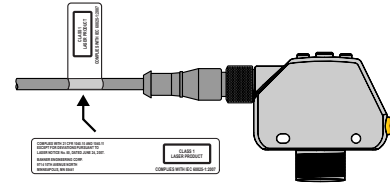


Figure 3. Safety Label Installation

### 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.

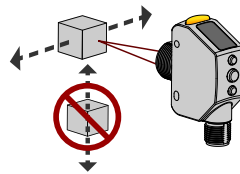


Figure 4. Optimal Orientation of Target to Sensor

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 10](#) on page 8 for the minimum object separation distance required for each case.

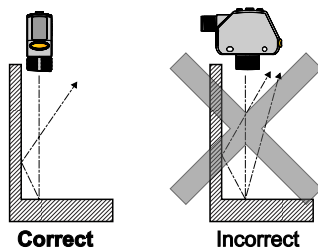


Figure 5. Orientation by a wall

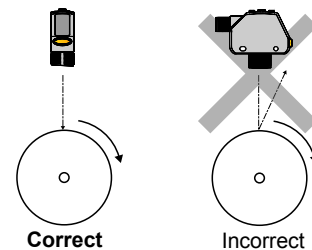


Figure 6. Orientation for a turning object

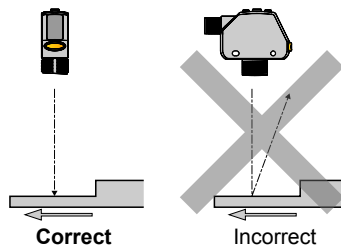


Figure 7. Orientation for a height difference

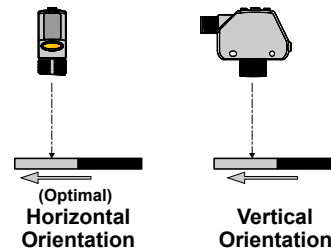
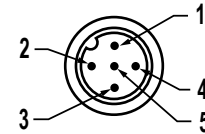
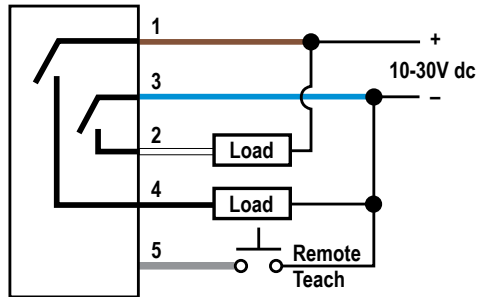


Figure 8. Orientation for a color or luster difference

## 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.

## 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; 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 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.

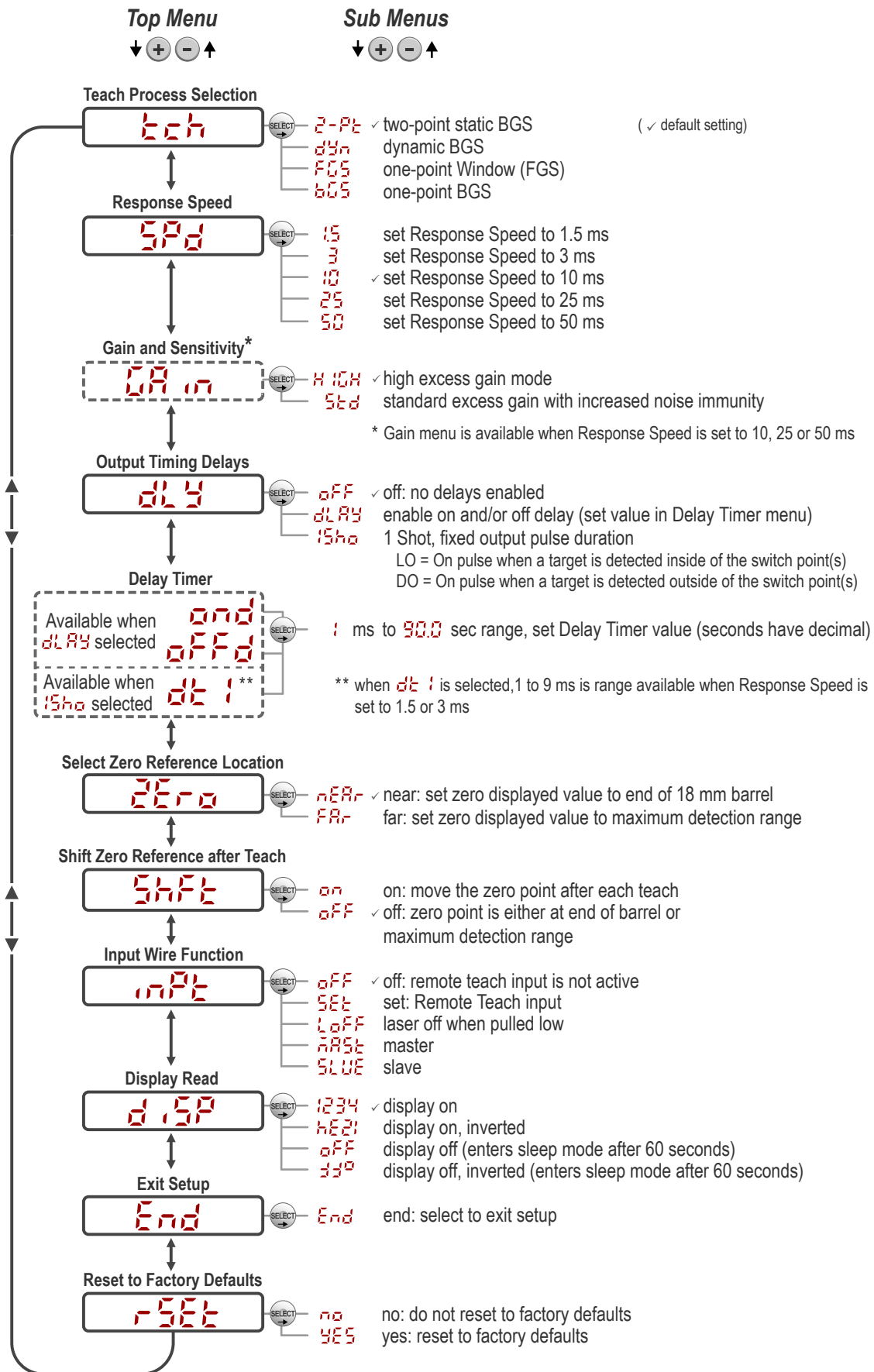


Figure 9. Sensor Menu Map

## Basic TEACH Instructions

Use the following instructions to teach the Q4X 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.

## 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.

## 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.

## 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.

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.

## 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 1: 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 2: ~~High~~ Excess Gain ( ~~5x~~ Excess Gain<sup>1</sup>)

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.

<sup>1</sup>

- ~~5x~~ excess gain available in 10 ms, 25 ms, and 50 ms response speeds only
- ~~5x~~ excess gain provides increased noise immunity

## Performance Curves

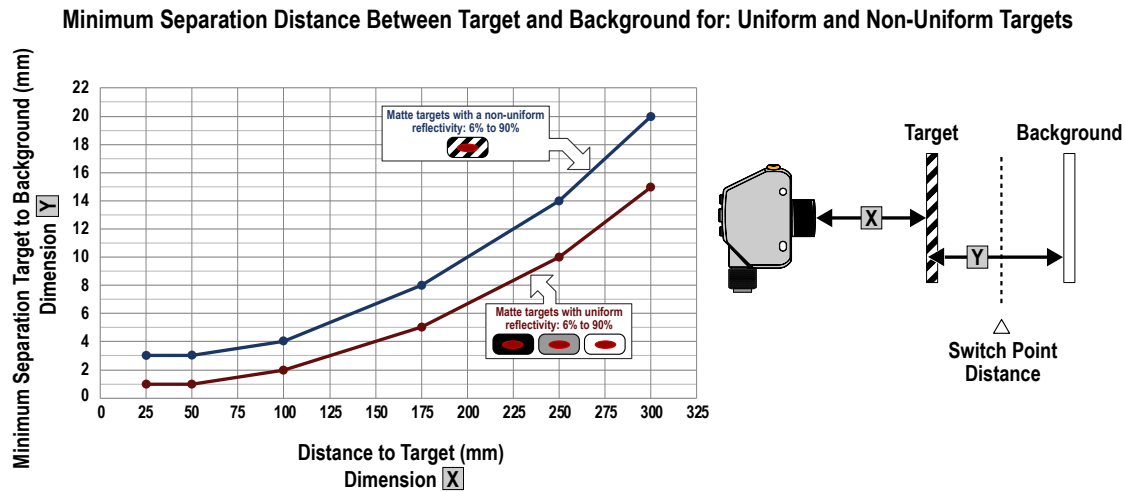


Figure 10. Minimum Object Separation Distance (90% to 6% reflectance)

## Banner Engineering Corp. Limited Warranty

Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product.

THIS LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED (INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), AND WHETHER ARISING UNDER COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE.

This Warranty is exclusive and limited to repair or, at the discretion of Banner Engineering Corp., replacement. IN NO EVENT SHALL BANNER ENGINEERING CORP. BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR ANY EXTRA COSTS, EXPENSES, LOSSES, LOSS OF PROFITS, OR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES RESULTING FROM ANY PRODUCT DEFECT OR FROM THE USE OR INABILITY TO USE THE PRODUCT, WHETHER ARISING IN CONTRACT OR WARRANTY, STATUTE, TORT, STRICT LIABILITY, NEGLIGENCE, OR OTHERWISE.

Banner Engineering Corp. reserves the right to change, modify or improve the design of the product without assuming any obligations or liabilities relating to any product previously manufactured by Banner Engineering Corp.