# Q2XKLAF Laser Measurement Sensor

Features

- Miniature sensor for installation in the smallest of spaces
- Exceptional optical performance; up to 3 m sensing range in miniature Q2X housing
- Background suppression models for reliable detection of objects when the background condition is not controlled or fixed
- Simple TEACH adjustment of cutoff distance
- Enhanced immunity to fluorescent lights
- Remote configuration and monitoring available over IO-Link
- Class 1 IR laser emitter
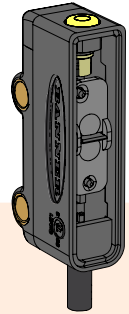
⚠️ **WARNING:**
- **Do not use this device for personnel protection**
- Using this device for personnel protection could result in serious injury or death.
- This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A device failure or malfunction can cause either an energized (on) or de-energized (off) output condition.

Models

Models	Sensing Range	Channel 1	Channel 2	Connections
Q2XKLAF2IR-Q	20 mm to 2000 mm (0.8 in to 78.74 in)	IO-Link, PNP output	User selectable, remote input, PNP output, or PFM Pulse Pro output	150 mm (6 in) PVC-jacketed cable with a 4-pin M8 male quick-disconnect connector
Q2XKLAF2IR-Q5				150 mm (6 in) PVC-jacketed cable with a 4-pin M12 male quick-disconnect connector
Q2XKLAF3IR-Q	20 mm to 3000 mm (0.8 in to 118.1 in)			150 mm (6 in) PVC-jacketed cable with a 4-pin M8 male quick-disconnect connector
Q2XKLAF3IR-Q5				150 mm (6 in) PVC-jacketed cable with a 4-pin M12 male quick-disconnect connector
Q2XNLAF2IR-Q	20 mm to 2000 mm (0.8 in to 78.74 in)	NPN output	Remote input	150 mm (6 in) PVC-jacketed cable with a 4-pin M8 male quick-disconnect connector
Q2XNLAF3IR-Q	20 mm to 3000 mm (0.8 in to 118.1 in)			

Overview

The Q2X Laser Measurement Sensor ignores objects beyond the set cutoff distance.

Background suppression mode can be used in most situations with varying object color and position or with varying background conditions.

1. Green: Power Indicator
2. Amber: Output Indicator
3. TEACH Button
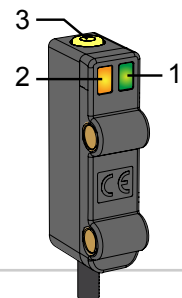
Laser Description and Safety Information

⚠️ **CAUTION:**
- **Return defective units to the manufacturer.**
- 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.

Laser Model - IEC 60825-1:2014 Class 1 Laser

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

Laser Classification

Class 1 laser product; Complies with IEC 60825-1:2014 and 21CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice 56, dated 5-08-19

CLASS 1
LASER PRODUCT

COMPLIES WITH IEC 60825-1:2014

Complies with 21 CFR 1040.10 and 1040.11
Except for conformance with
IEC 60825-1:2014, as described in
Laser Notice 56, dated May 8, 2019.

Laser Wavelength

940 nm

Average Output Power

0.9 mW

Pulse Width

3 ms

Rep Rate

32.8 ms

Installation

Mount the Device

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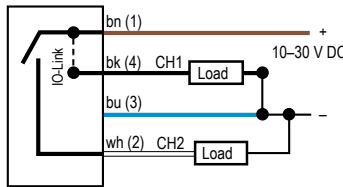
Wiring

> **CAUTION:** Cabled wiring diagrams are shown. Quick disconnect wiring diagrams are functionally identical. Observe proper ESD precautions (grounding) when connecting quick disconnect models.
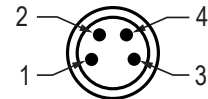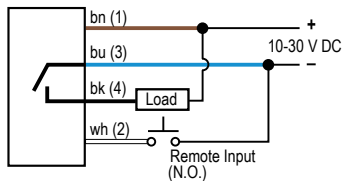
CH1 as PNP/IO-Link and CH2 as the Remote Input
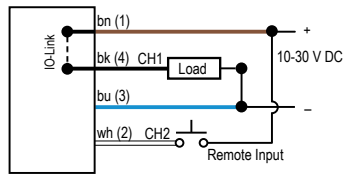
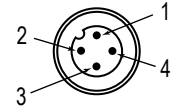

CH1 as PNP/IO-Link and CH2 as PNP Discrete or PFM Output

4-pin male M8 quick disconnect connector

NPN and Remote Input

4-pin male M12 quick disconnect connector

Configuration Instructions

Select the TEACH Mode

Configure the sensor using the TEACH button on the sensor or the remote input (limited programming options).

To select the TEACH mode, follow these steps:

1. Put the sensor into TEACH mode.

Method	Action	Result
TEACH Button	Press and hold the TEACH button for two seconds.	The amber and green LEDs flash.
Remote Input	No action is necessary.	

2. Enter the TEACH mode selection.

Method	Action	Result
TEACH Button	Press the TEACH button three times.	The amber and green LEDs flash three times.
Remote Input	Pulse the remote input wire three times.	

3. Select the TEACH method.

TEACH Method	How to Select
One-Point Object SET	Press the TEACH button once or pulse the remote input once.
Two-Point Static Background Suppression (Default)	Press the TEACH button twice or pulse the remote input twice.
One-Point Window SET (Foreground Suppression)	Press the TEACH button three times or pulse the remote input three times.
One-Point Dual Mode (Intensity + Distance)	Press the TEACH button four times or pulse the remote input four times.
PFM Output	See "Pulse Frequency Modulation (PFM)" on page 7.

After the TEACH method has been selected, the LEDs flash the same number of times as the button press/remote pulse.

Remote Input Wire Menu

Use the remote input wire to program the sensor remotely.

The remote input provides limited programming options. The remote input is either Active High or Active Low depending on the polarity of the sensor. If the polarity is PNP, the remote input is Active High. If polarity is NPN, the remote input is Active Low.

For Active High, connect the white wire to 24 V DC with a remote switch connected between the wire and 24 V DC. For Active Low, connect the white 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 activating the remote input for longer than 2 seconds.

Remote Input menu

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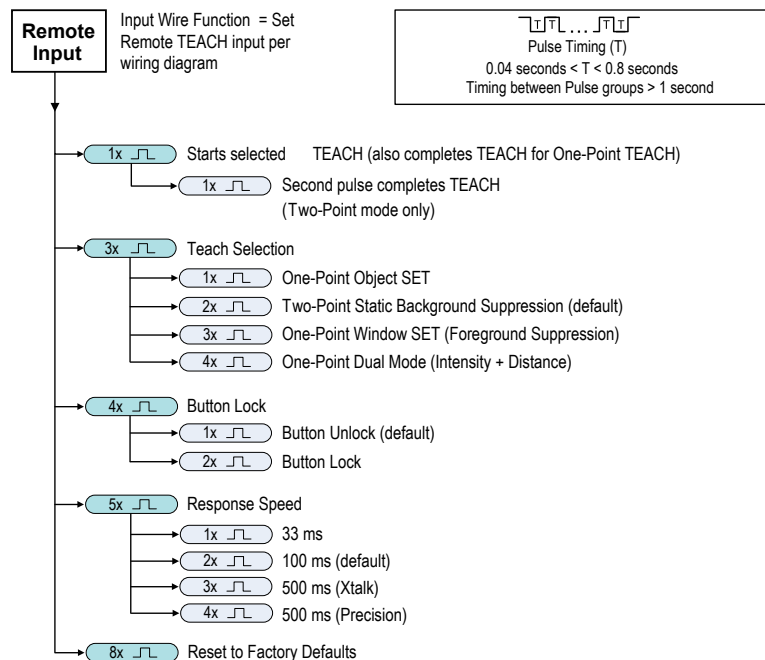
TEACH the Sensor Using Two-Point Static Background Suppression

Two-Point TEACH sets a single switch point between two taught target distances. Use either the TEACH button or the remote line to teach the sensor.

Select the TEACH mode (see).

The duration of each remote input pulse is defined as T, where T is 0.04 s < T < 0.8 s.

TEACH Process for Two-Point Static Background Suppression
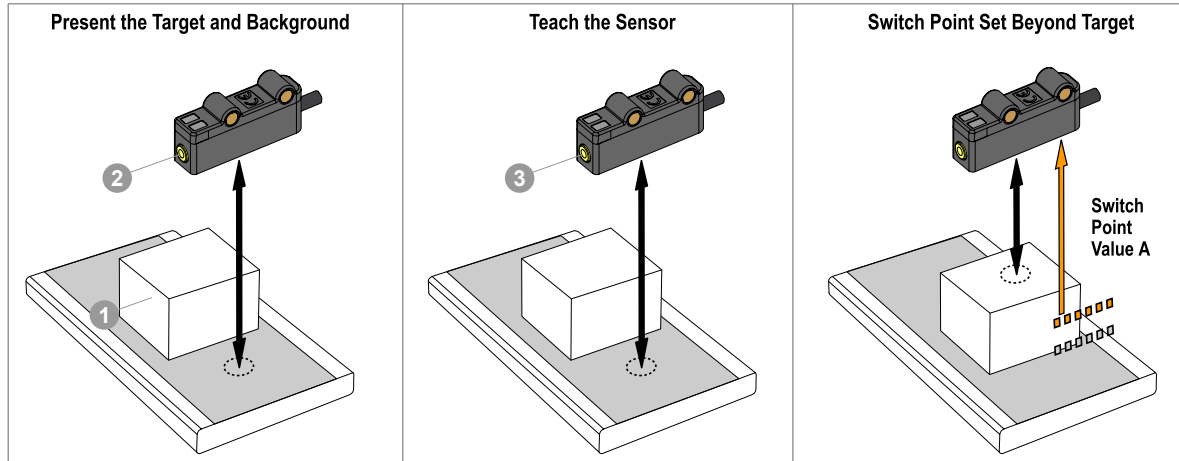
| Present the Target and Background | Teach the Sensor | Switch Point Set Beyond Target |

1. Present the first target.
2. Start the TEACH process.

Method	Action	Result
TEACH Button	Press and hold the TEACH button for two seconds.	The amber and green LEDs flash.
Remote Input	No action is necessary.	

3. Teach the first target location.

Method	Action	Result
TEACH Button	Press the TEACH button once.	The LEDs turn off, then flash twice.
Remote Input	Single pulse the remote input wire.	

4. Present the second target.
5. Teach the second target location.

Method	Action	Result
TEACH Button	Press the TEACH button once.	The LEDs turn off, then flash as shown below.
Remote Input	Single pulse the remote input wire.	

After the sensor is taught the target locations, both LEDs flash with the results code, and then the sensor returns to Run mode.

Results of the two-point static background suppression TEACH

| Condition	TEACH Result	Number of LED Flashes
Two points with different distance values within the sensor's range have been taught.	Sets a switch point between the two taught distance values.	Three
Two points with the same distance value within the sensor's range have been taught.	Sets a switch point in front of taught distance equal to the uniform reflectivity minimum object separation.	Six
Two points with different distance values have been taught; one point is within sensor range and the other is outside sensor range.	Sets a switch point between the taught distance and the maximum range.	Eight
Two points with distance values outside the sensor's range have been taught.	Sets a switch point to 2980 mm.	Ten

TEACH the Sensor Using One-Point Object SET

One-Point Object SET sets a single switch point just behind the taught target distance. Objects beyond the taught switch point are ignored.

Select the TEACH mode (see).

 10-Oct-24

The duration of each remote input pulse is defined as T, where T is 0.04 s < T < 0.8 s.

TEACH Process for One-Point Object SET
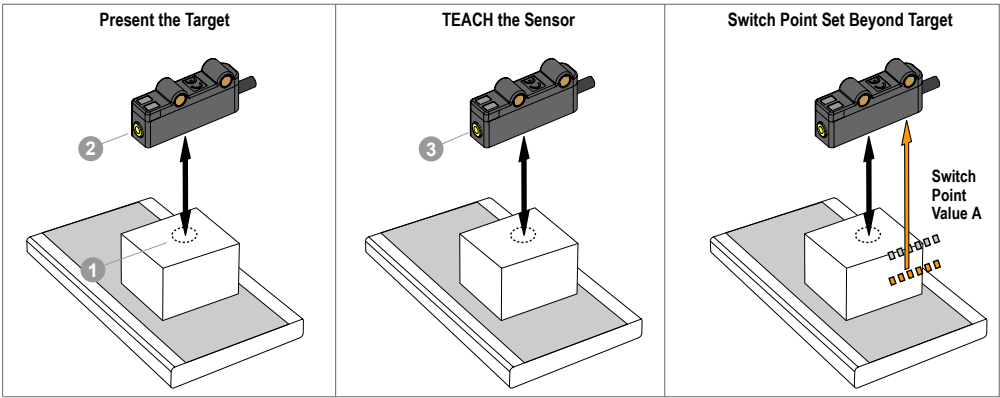
1. Present the first target.
2. Start the TEACH process.

Method	Action	Result
TEACH Button	Press and hold the TEACH button for two seconds.	The amber and green LEDs flash.
Remote Input	No action is necessary.	

3. Teach the target location.

Method	Action	Result
TEACH Button	Press the TEACH button once.	The LEDs turn off, then flash three times.
Remote Input	Single pulse the remote input wire.	

After the sensor is taught the target location, both LEDs flash with the results code, and then the sensor returns to Run mode.
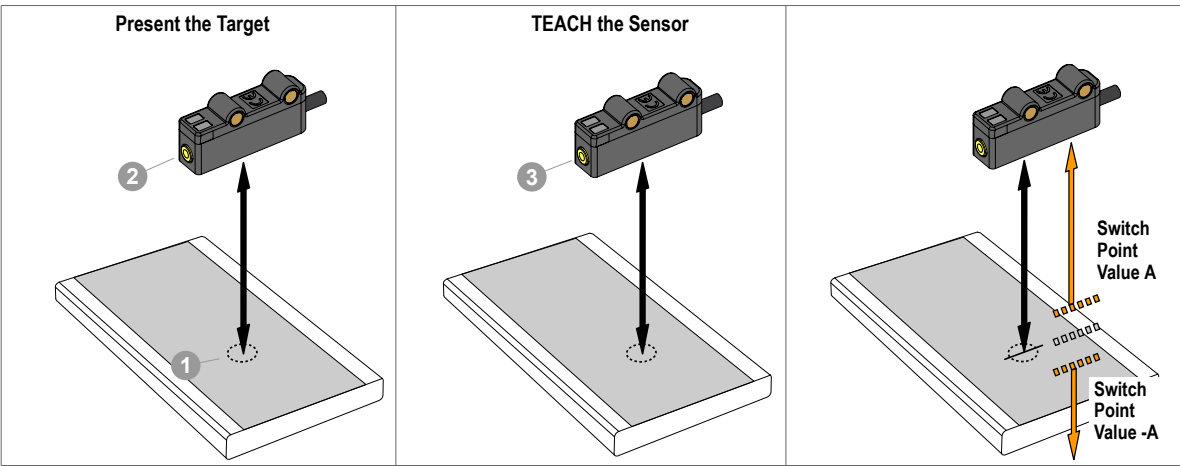
TEACH the Sensor Using One-Point Window SET (Foreground Suppression)

One-Point Window SET defines a window (two switch points) centered around the taught target distance.

Select the TEACH mode (see "Select the TEACH Mode" on page 2).

The duration of each remote input pulse is defined as T, where T is 0.04 s < T < 0.8 s.

TEACH Process for One-Point Window SET (FGS)

1. Present the target.
2. Start the TEACH process.

Method	Action	Result
TEACH Button	Press and hold the TEACH button for two seconds.	The amber and green LEDs flash.
Remote Input	No action is required.	

3. Teach the target.

Method	Action	Result
TEACH Button	Press the TEACH button once.	The LEDs turn off, then flash three times.
Remote Input	Single pulse the remote input.	

After the sensor is taught the target location, both LEDs flash with the results code, and then the sensor returns to Run mode.
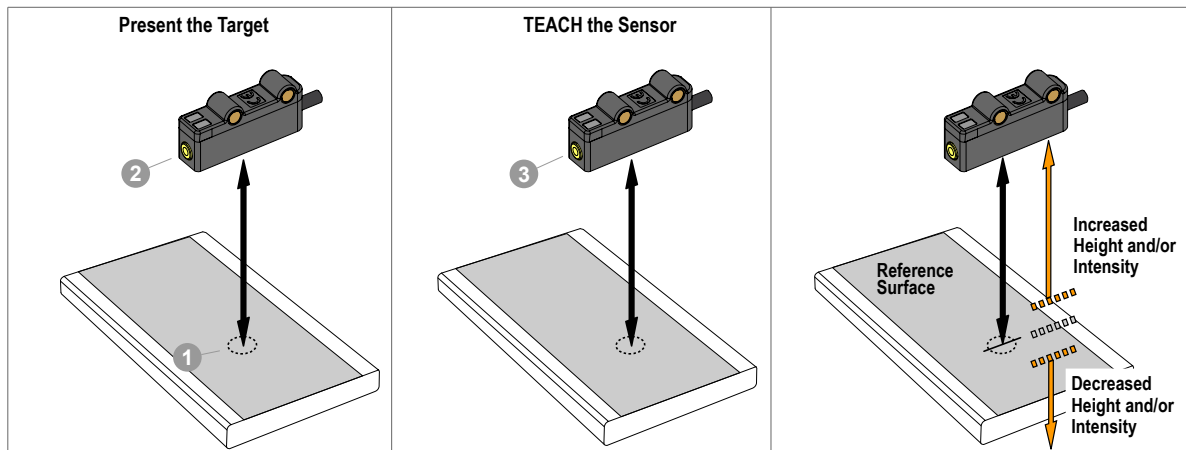
TEACH the Sensor Using One-Point Dual Mode (Intensity + Distance)

Dual (Intensity + Distance) TEACH records the distance and amount of light received from the 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.

Select the TEACH mode (see "Select the TEACH Mode" on page 2).

The duration of each remote input pulse is defined as T, where T is 0.04 s < T < 0.8 s.

TEACH Process for One-Point Dual Mode

1. Present the target.
2. Start the TEACH process.

Method	Action	Result
TEACH Button	Press and hold the TEACH button for two seconds.	The amber and green LEDs flash.
Remote Input	No action is required.	

3. Teach the target.

Method	Action	Result
TEACH Button	Press the TEACH button once.	The LEDs turn off, then flash three times.
Remote Input	Single pulse the remote input line.	

After the sensor is taught the target locations, both LEDs flash with the results code, and then the sensor returns to Run mode.

Cancel the TEACH Process

1. When the LED indicators are flashing, press and hold the TEACH button for two seconds.
   The amber and green LEDs flash alternately.
2. Release the TEACH button.
   The sensor returns to Run mode.

The TEACH process cannot be canceled using the remote input wire.

Change the Response Speed

Follow these steps to change the response speed.

1. Put the sensor into TEACH mode.

Method	Action	Result
TEACH Button	Press and hold the TEACH button for two seconds.	The amber and green LEDs flash.
Remote Input	No action is necessary.	

2. Select Response Speed.

Method	Action	Result
TEACH Button	Press the TEACH button five times.	The amber and green LEDs flash five times.
Remote Input	Pulse the remote input wire five times.	

3. Choose the response speed.

Response Speed	How to Select
33 ms	Press the TEACH button once or pulse the remote input once.
100 ms (default setting)	Press the TEACH button twice or pulse the remote input twice.
500 ms (Xtalk mode)	Press the TEACH button three times or pulse the remote input three times.
500 ms (Precision mode)	Press the TEACH button four times or pulse the remote input four times.

In Xtalk mode, the Q2X is more resistant to crosstalk. In Precision mode, the Q2X has the best repeatability.

Lock and Unlock the Button

Follow these steps to lock or unlock the TEACH button.

1. Initiate the button locking or unlocking procedure.

Method	Action	Result
TEACH Button	No action.	The LEDs flash four times.
Remote Input	Pulse the wire four times.	

2. Lock or unlock the button.

Method	Action	Result
TEACH Button	Press the TEACH button four times.	The green LED flashes four times.
Remote Input	To lock the button: Single-pulse the remote input wire. To unlock the button: Double-pulse the remote input wire.	

Pulse Frequency Modulation (PFM)

The Q2X Laser Measurement Sensor can be configured to generate pulses on the white wire (pin 2).

The pulse frequency is proportional to the sensor's measured distance to represent an analog signal with only a discrete counter. The sensing range of the sensor is scaled from 100 Hz to 600 Hz, where 100 Hz represents the sensor's near-range limit (20 mm) and 600 Hz represents the sensor's far-range limit (3000 mm).

An output of 50 Hz represents a loss of signal condition where there is no target or the target is out of the sensor's range. There is a two-second delay before the sensor sets the output to 50 Hz to indicate loss of signal. During the two seconds, the output holds the last PFM value.

The white wire (pin 2) can be configured as a PFM output using either the TEACH button or by sending a parameter via IO-Link. While PFM is enabled, the remote input is disabled.

Enable the PFM Output

Follow these steps to enable the PFM output. This changes the white wire (pin 2) from a remote TEACH input to a PFM output.

1. Press and hold the TEACH button for two seconds.
   The amber and green LEDs flash.
2. Press the TEACH button three times.
   The amber and green LEDs flash three times.
3. Press the TEACH button six times.

The amber and green LEDs flash six times and the PFM output is enabled.

Disable the PFM Output

Follow these steps to disable the PFM output. This changes the white wire (pin 2) from a PFM output to a remote TEACH input.

1. Press and hold the TEACH button for two seconds.
   The amber and green LEDs flash.
2. Press the TEACH button three times.
   The amber and green LEDs flash three times.
3. Press the TEACH button five times.
   The LEDs flash five times and the PFM output is disabled.

Specifications

Supply Voltage
10 V DC to 30 V DC (10% maximum ripple within specified limits) at less than 35 mA, exclusive of load

Sensing Beam
Infrared Class 1 laser, 940 nm

Sensing Range
20 mm to 3000 mm

Delay at Power Up
2 s

Supply Protection Circuitry
Protected against reverse polarity and transient overvoltages

Output Configuration
PNP with IO-Link Model:
- Channel 1: PNP discrete output and IO-Link
- Channel 2: PNP discrete output, PFM output or Remote input

NPN Model:
- Channel 1: NPN discrete output
- Channel 2: Remote input

Output Rating
50 mA total output current

Off-State Leakage Current
< 10 µA at 30 V DC

On-State Saturation Voltage
< 2.5 V at 50 mA

IO-Link Interface
IO-Link Revision V1.1
Smart Sensor Profile: Yes
Baud Rate: 38400 bps
Process Data In Length: 32 bits
Process Data Out Length: 8 bits
Minimum Cycle Time: 2.6 ms
IODD files: Provides all programming options of the display, plus additional functionality

Connections
150 mm (6 in) PVC-jacketed cable with a 4-pin M8 male quick-disconnect connector, or 150 mm (6 in) PVC-jacketed cable with a 4-pin M12 male quick-disconnect connector, depending on the model.

Construction
PC/ABS housing, acrylic lens cover; PVC cable, PBT adjustment switch

Adjustments
One TEACH push button, remote input wire

Indicators
Two LED indicators on the sensor top:
- Green on: Power is on
- Amber on: Output is on

Response Speed
Fast: 33 ms[1]
Medium: 100 ms (default)
Slow: 500 ms in Xtalk or Precision Mode

Environmental Rating
IP67

Operating Conditions
–20 °C to +50 °C (–4 °F to +122 °F)
95% at +50 °C maximum relative humidity (non-condensing)

Application Notes
For mirror-like objects, minimize the sensor-to-object mounting distance and tilt the sensor so reflected light is directed away from the sensor when the object is present

Certifications

CE
Banner Engineering BV
Park Lane, Culliganlaan 2F bus 3
1831 Diegem, BELGIUM

UKCA
Turck Banner LTD Blenheim House
Blenheim Court
Wickford, Essex SS11 8YT
GREAT BRITAIN

c(UL)us
LISTED

Required Overcurrent Protection

⚠️ **WARNING:** Electrical connections must be made by qualified personnel in accordance with local and national electrical codes and regulations.

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.

For additional product support, go to www.bannerengineering.com.

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

[1] The range when using a 6% black card is 2 m in fast mode.

 10-Oct-24

FCC Part 15 Class B for Unintentional Radiators

(Part 15.105(b)) This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

(Part 15.21) Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

## Industry Canada ICES-003(B)

This device complies with CAN ICES-3 (B)/NMB-3(B). Operation is subject to the following two conditions: 1) This device may not cause harmful interference; and 2) This device must accept any interference received, including interference that may cause undesired operation.

Cet appareil est conforme à la norme NMB-3(B). Le fonctionnement est soumis aux deux conditions suivantes : (1) ce dispositif ne peut pas occasionner d'interférences, et (2) il doit tolérer toute interférence, y compris celles susceptibles de provoquer un fonctionnement non souhaité du dispositif.

Dimensions

All measurements are listed in millimeters [inches], unless noted otherwise. The measurements provided are subject to change.
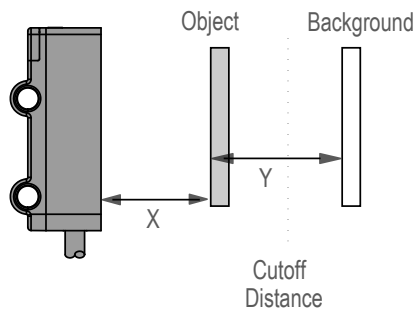

Dimensions
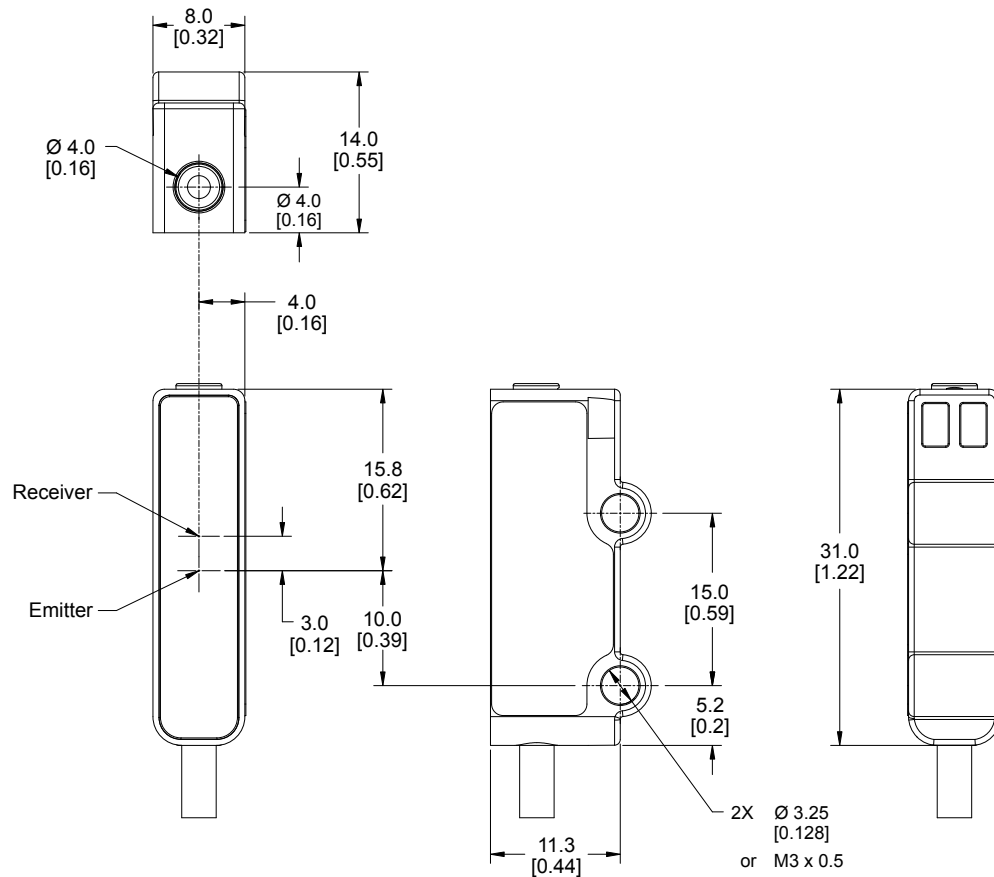
Hardware Included:

- Two M3 x 0.5 - 6g x 16 mm SS Screws
- Two M3 x 0.5 - 6H SS Nuts
- Two M3 flat SS Washers
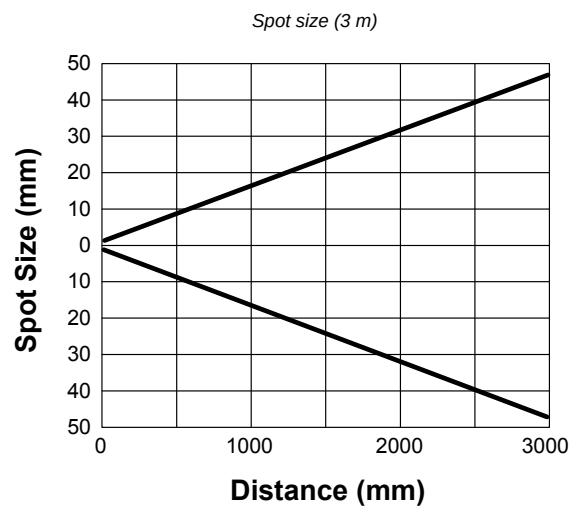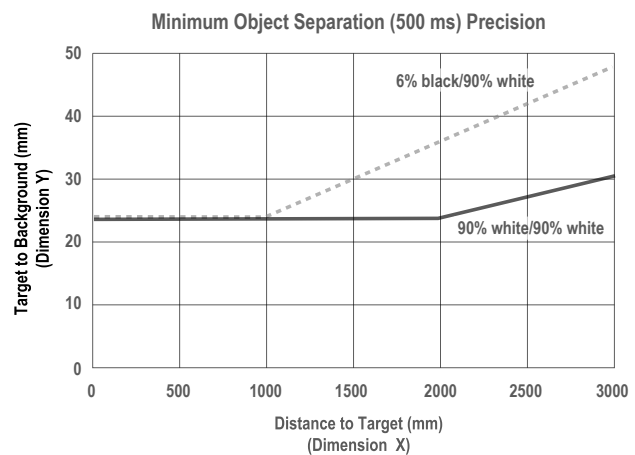- Two M3 internal tooth SS Lock Washers

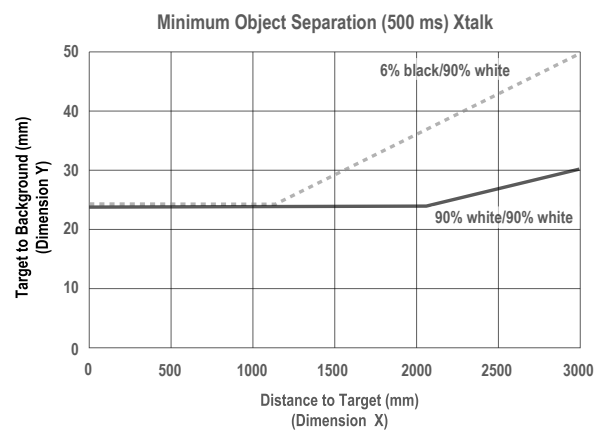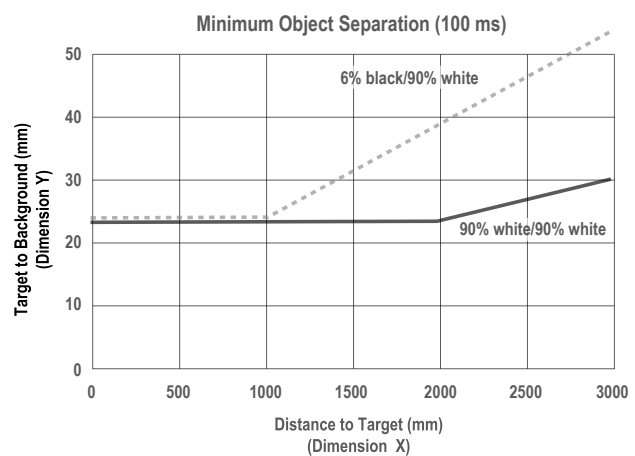Maximum torque 0.9 Nm (8 in-lbf)

Performance Curves

X: Distance to Object (mm)

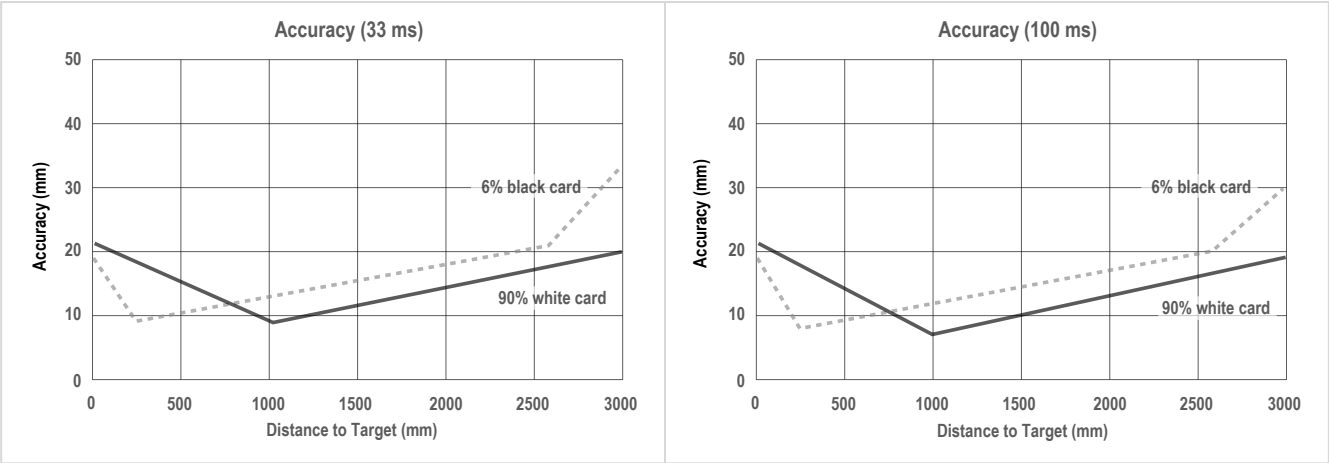Y: Minimum Separation Between Object and Background (mm)

Spot size (3 m)

Minimum Object Separation

Minimum Object Separation (33 ms)

6% black/90% white

90% white/90% white

Minimum Object Separation (100 ms)

6% black/90% white

90% white/90% white

Minimum Object Separation (500 ms) Xtalk

6% black/90% white

90% white/90% white

Minimum Object Separation (500 ms) Precision

6% black/90% white

90% white/90% white

10-Oct-24
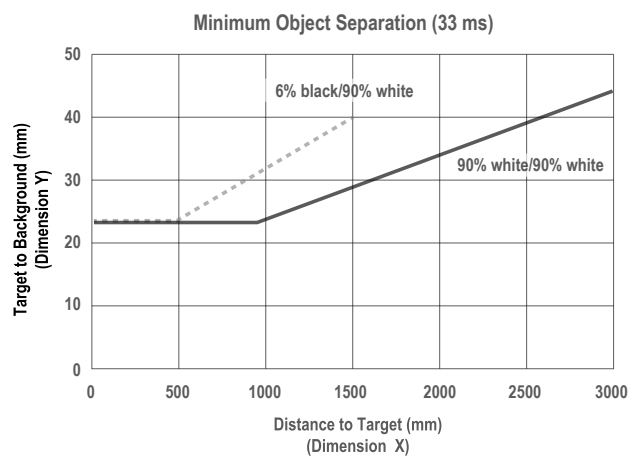
Repeatability

Accuracy

Accuracy (500 ms) Xtalk

Accuracy (500 ms) Precision
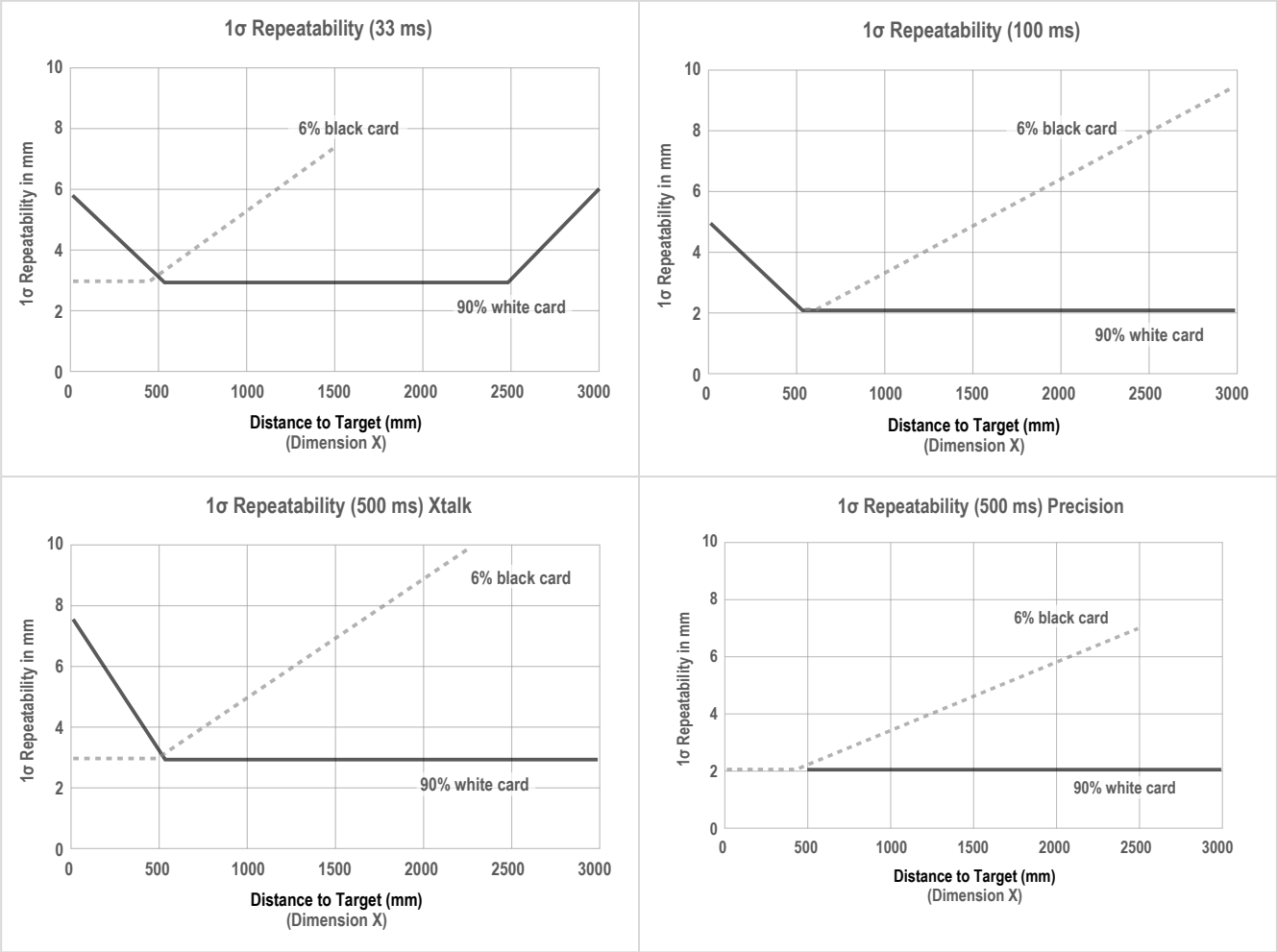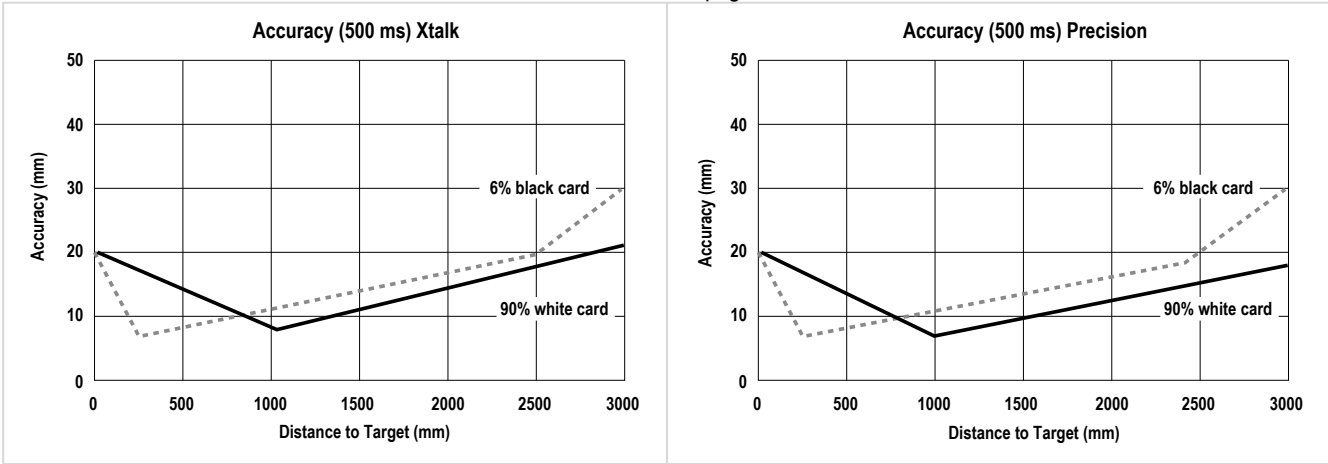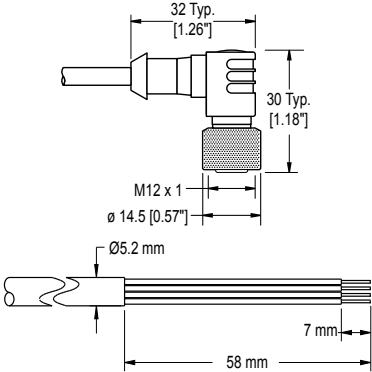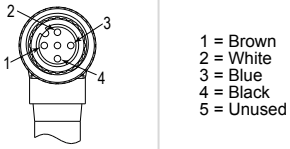
Accessories

Cordsets

4-Pin Threaded M8 Cordsets—Single Ended					
Model	Length	Style	Dimensions	Pinout (Female)	
PKG4M-2	2.04 m (6.68 ft)	Straight	35 Typ. ø 9.5 M8 x 1	4 2 3 1	
PKG4M-5	5 m (16.4 ft)				
PKG4M-9	9.04 m (29.6 ft)				1 = Brown 2 = White 3 = Blue 4 = Black
PKW4M-2	2 m (6.56 ft)	Right Angle	28 Typ. 20 Typ. M8 x 1 ø 9.5	4 2 3 1	
PKW4M-5	5 m (16.4 ft)				
PKW4M-9	9 m (29.5 ft)				

4-pin Single-Ended M12 Female Cordsets				
Model	Length	Dimensions (mm)	Pinout (Female)	
BC-M12F4-22-1	1 m (3.28 ft)	44 Typ. M12 x 1 ø 14.5 Ø5.2 mm 7 mm 58 mm	1 2 4 3 5	1 = Brown 2 = White 3 = Blue 4 = Black 5 = Unused
BC-M12F4-22-2	2 m (6.56 ft)			
BC-M12F4-22-5	5 m (16.4 ft)			
BC-M12F4-22-8	8 m (26.25 ft)			
BC-M12F4-22-10	10 m (30.81 ft)			
BC-M12F4-22-15	15 m (49.2 ft)			

 10-Oct-24

4-pin Single-Ended M12 Female Right-Angle Cordsets				
Model	Length	Dimensions (mm)	Pinout (Female)	
BC-M12F4A-22-1	1 m (3.28 ft)			
BC-M12F4A-22-2	2 m (6.56 ft)			
BC-M12F4A-22-5	5 m (16.4 ft)			1 = Brown 2 = White 3 = Blue 4 = Black 5 = Unused
BC-M12F4A-22-8	8 m (26.25 ft)			
BC-M12F4A-22-10	10 m (30.81 ft)			
BC-M12F4A-22-15	15 m (49.2 ft)			

Brackets

All measurements are listed in millimeters, unless noted otherwise. The measurements provided are subject to change.
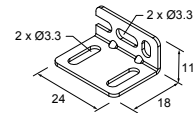
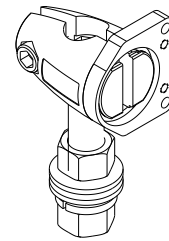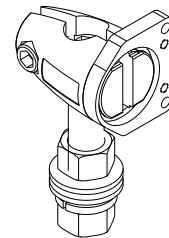|	
SMBQ2XA • Vertical L-shaped bracket • 20-ga stainless steel	
SMBQ2XB • Rear L-shaped bracket • 20-ga stainless steel	
SMBQ20FA • Includes 3/8-16 × 2 in socket head cap screw (SHCS) • 304 stainless steel	
SMBQ20FAM10 • Kit for 10 mm (3/8 in) Rod Bracket Systems for Q2X, Q20, Q12, VS1, VS3, VS8 • Includes M10-1.5 x 50 mm Socket Head Cap Screw (SHCS)	
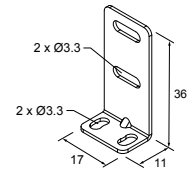
SMBQ20FAM12
- Kit for 12 mm (1/2 in) Rod Bracket Systems for Q2X, Q20, Q12, VS1, VS3, VS8
- No socket head cap screw (SHCS) included
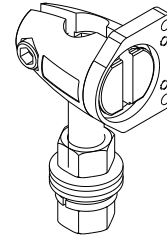
Product Support and Maintenance

Restoring Factory Defaults

To restore factory default settings:
- 8-pulse the remote wire, or
- Press the TEACH button eight times.

After the factory default settings are restored, both LEDs flash eight times.

Cleaning the Q2X Sensors

Handle the sensor with care during installation and operation. Sensor windows that are soiled by dust, water, oil, etc. should be cleaned as necessary using water and a soft cloth.

Wipe down the polycarbonate enclosure and the display with a soft cloth that has been dampened with a mild detergent and warm water solution.

Repairs

Contact Banner Engineering for troubleshooting of this device. **Do not attempt any repairs to this Banner device; it contains no field-replaceable parts or components.** If the device, device part, or device component is determined to be defective by a Banner Applications Engineer, they will advise you of Banner's RMA (Return Merchandise Authorization) procedure.

> **IMPORTANT:** If instructed to return the device, pack it with care. Damage that occurs in return shipping is not covered by warranty.

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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.

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