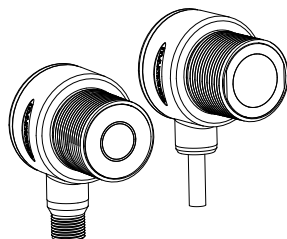


# U-GAGE® T30 Series with Analog and Discrete Outputs



## Datasheet

Ultrasonic Sensors with TEACH-Mode Programming



- Fast, easy-to-use TEACH-Mode programming; no potentiometer adjustments
- Program both outputs together or independently, with either an upward or a downward analog output slope
- Remote TEACH for security and convenience
- Choose models with 150 mm to 1 m range (5.9 in to 39.4 in) or 300 mm to 2 m range (11.8 in to 78.7 in)
- Wide operating range of  $-20^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$  to  $+158^{\circ}\text{F}$ )
- Choose models with NPN or PNP discrete output, plus 0 to 10V dc or 4 to 20 mA sourcing analog output
- LED indicators for Power ON/OFF; Signal Strength; and Analog/Discrete Outputs Conducting
- Choose models with integral unterminated 2 m (6.5 ft) or 9 m (30 ft) cable, or with M12/Euro-style quick-disconnect connection
- Compact, self-contained sensor package
- Rugged design for use in demanding sensing environments; rated IEC IP67, NEMA 6P



### 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—Proximity Mode

| Models   | Range and Frequency                            | Cable <sup>1</sup>          | Supply Voltage     | Discrete Output | Analog Output | Response Time   |
|----------|------------------------------------------------|-----------------------------|--------------------|-----------------|---------------|-----------------|
| T30UINA  | 150 mm to 1 m<br>(5.9 in to 39 in)<br>228 kHz  | 2 m (6.5 ft)                | 12 V dc to 24 V dc | NPN             | 4 mA to 20 mA | 48 milliseconds |
| T30UINAQ |                                                | 5-pin Euro quick-disconnect |                    |                 |               |                 |
| T30UIPA  |                                                | 2 m (6.5 ft)                |                    | PNP             |               |                 |
| T30UIPAQ |                                                | 5-pin Euro quick-disconnect |                    |                 |               |                 |
| T30UUNA  |                                                | 2 m (6.5 ft)                | 15 V dc to 24 V dc | NPN             | 0 to 10 V dc  |                 |
| T30UUNAQ |                                                | 5-pin Euro quick-disconnect |                    |                 |               |                 |
| T30UUPA  |                                                | 2 m (6.5 ft)                |                    | PNP             |               |                 |
| T30UUPAQ |                                                | 5-pin Euro quick-disconnect |                    |                 |               |                 |
| T30UINB  | 300 mm to 2 m<br>(11.8 in to 79 in)<br>128 kHz | 2 m (6.5 ft)                | 12 V dc to 24 V dc | NPN             | 4 mA to 20 mA | 96 milliseconds |
| T30UINBQ |                                                | 5-pin Euro quick-disconnect |                    |                 |               |                 |
| T30UIPB  |                                                | 2 m (6.5 ft)                |                    | PNP             |               |                 |
| T30UIPBQ |                                                | 5-pin Euro quick-disconnect |                    |                 |               |                 |
| T30UUNB  |                                                | 2 m (6.5 ft)                | 15 V dc to 24 V dc | NPN             | 0 to 10 V dc  |                 |
| T30UUNBQ |                                                | 5-pin Euro quick-disconnect |                    |                 |               |                 |
| T30UUPB  |                                                | 2 m (6.5 ft)                |                    | PNP             |               |                 |
| T30UUPBQ |                                                | 5-pin Euro quick-disconnect |                    |                 |               |                 |

## Overview

The U-GAGE is an easy-to-use ultrasonic sensor, ideal for demanding environments. Simple push-button programming provides flexibility for a variety of applications. Excellent for measurement applications such as sensing of liquid levels in a tank or, for example, determining box heights for sorting purposes.

Each sensor includes both an analog and a discrete output, which may be programmed independently with different window limits or together with identical limits. Each output has the option of being set with a sensing distance set point centered within a 10-mm window.

<sup>1</sup>

- To order the 9 m (30 ft) PVC cable model, add the suffix "W/30" to the cabled model number. For example, T30UINA/30.
- Models with a quick disconnect require a mating cordset.



## Features and Indicators

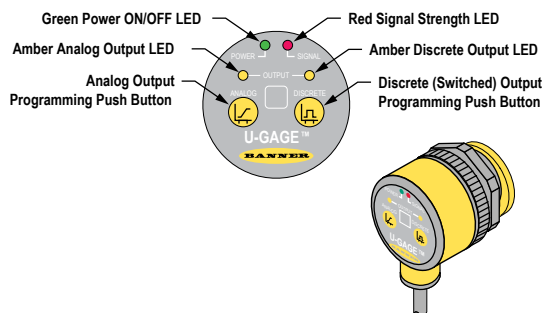


Figure 1. U-GAGE T30 Series sensor programming push buttons and indicators



**Note:** All LED indicators momentarily turn off when the sensor changes state between Program and Run modes.

The U-GAGE sensor has four LED indicators. The red Signal LED indicates the strength and condition of the sensor's incoming signal. Each amber Output LED, whether analog or discrete, turns on when a target is sensed within the programmed window limits. The green Power ON/OFF LED indicates the operating status of the sensor. There are two modes of indication for the LED indicators: Run Mode and Program Mode.

In Run mode:

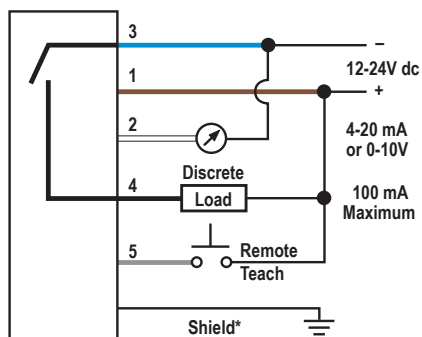
| Indicator                 | Mode     | Description                                                                                                                                                          |
|---------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Green Power ON/OFF LED    | Off      | Power is OFF                                                                                                                                                         |
|                           | On       | Power is ON, sensor is operating normally                                                                                                                            |
|                           | Flashing | Discrete output is overloaded                                                                                                                                        |
| Red Signal Strength LED   | Off      | No signal is received, or the target is beyond the range limitations of the sensor (with some tolerance beyond the recommended minimum and maximum sensing distance) |
|                           | Flashing | Relative received signal strength; the faster the LED flashes, the stronger the signal                                                                               |
| Amber Analog Output LED   | On       | Target is inside window limits                                                                                                                                       |
| Amber Discrete Output LED | On       | Output conducting                                                                                                                                                    |

In Program mode:

| Indicator                  | Mode     | Description                                                                            |
|----------------------------|----------|----------------------------------------------------------------------------------------|
| Green Power ON/OFF LED     | Off      | Sensor is in Program mode, if other LEDs are ON                                        |
| Red Signal Strength LED    | Flashing | Relative received signal strength; the faster the LED flashes, the stronger the signal |
| Amber Analog Output LED    | On       | Ready for first window limit                                                           |
|                            | Flashing | Ready for second window limit                                                          |
|                            | Off      | Not teaching analog limits                                                             |
| Analog Discrete Output LED | On       | Ready for first window limit                                                           |
|                            | Flashing | Ready for second window limit                                                          |
|                            | Off      | Not teaching discrete limits                                                           |

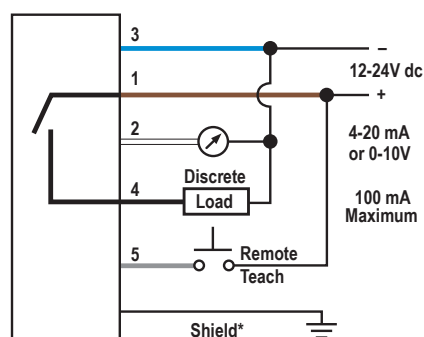
## Wiring

### NPN



\*It is recommended that the shield wire be connected to either earth ground or DC common.

### PNP



\*It is recommended that the shield wire be connected to either earth ground or DC common.

Cabled wiring diagrams are shown. Quick disconnect wiring diagrams are functionally identical.

## Configuring a Sensor

### Window Limits

Window limits can be taught to the sensor in several ways, using either the push buttons on the back of the sensor or remote input.



**Note:** When the sensor changes state between PROGRAM and RUN modes, all of the LED indicators turn OFF momentarily, before the appropriate LEDs come ON as described below. The sensing window limits expand temporarily to full scale (max range) during PROGRAM mode.

### Remote Input

To program the sensor remotely or to disable the keypad, use the Remote Programming function. In addition to programming the sensor, use the remote input to disable the buttons for security, preventing unauthorized or accidental programming changes. Connect the gray wire of the sensor to +12 V dc to 24 V dc, with a remote programming switch connected between them.



**Note:** The impedance of the remote teach input is 55 kΩ.

Programming is accomplished by following the sequence of input pulses. The duration of each pulse (corresponding to a push button “click”), and the period between multiple pulses, are defined as: 0.04 seconds < T < 0.8 seconds.



**Note:** To exit PROGRAM mode without saving any changes, hold the Remote line high > 2 seconds (before teaching the second limit). The sensor reverts to the last saved program.

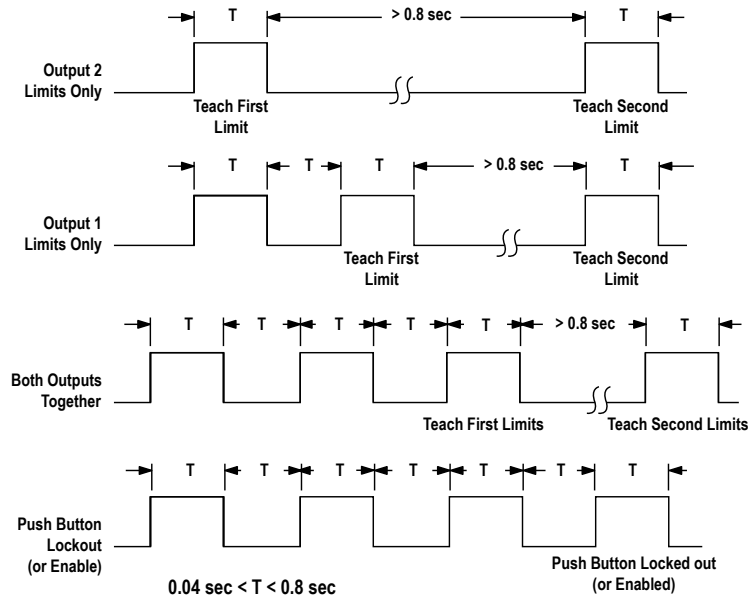


Figure 2. Timing programs for remote TEACH programming

## General Notes on Configuration

- The sensor returns to Run mode if the first TEACH condition is not registered within 120 seconds.
- After the first limit is taught, the sensor remains in Program mode until the TEACH sequence is finished.
- To exit PROGRAM mode without saving any changes, press and hold the programming push button > 2 seconds or hold the Remote line high > 2 seconds (before teaching the second limit). The sensor reverts to the last saved program.

## Configuring Limits for Either Analog or Discrete Output



**Note:** To exit PROGRAM mode without saving any changes, press and hold the programming push button > 2 seconds or hold the Remote line high > 2 seconds (before teaching the second limit). The sensor reverts to the last saved program.

1. Choose the output for the first set of window limits (analog or discrete).

| Method                          | Action                                                                                                                                          | Result                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| <b>Push Button</b>              | Press and hold the corresponding button (analog or discrete) until the green Power LED turns Off and the appropriate amber Output LED turns On. | Power LED: Off<br>Output LED: On<br>The sensor is waiting for the first limit. |
| <b>Remote Input<sup>2</sup></b> | No action required; sensor is ready for first limit teach.                                                                                      | None                                                                           |

2. Configure the first limit.

| Method              | Action                                                                                                                                                                                                                                                                                                               | Result                                                                                                   |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <b>Push Button</b>  | a. Position the target for the first limit.<br>b. Briefly press the same button.                                                                                                                                                                                                                                     | Output LED: On flashing<br>The sensor is waiting for the second limit.<br>The first limit is configured. |
| <b>Remote Input</b> | a. Position the target for the first limit.<br>b. Configure the first limit.<br><ul style="list-style-type: none"> <li>• To configure the first discrete limit, pulse the remote input one time.</li> <li>• To configure the first analog limit, pulse the remote input two times.</li> </ul> c. Wait > 0.8 seconds. | The first limit is configured.                                                                           |

3. Teach the second limit.

| Method              | Action                                                                                                                                                        | Result                                                              |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| <b>Push Button</b>  | a. Position the target for the second limit.<br>b. Press the button again. The second limit is configured.                                                    | Power LED: On<br>Output LED: Off<br>The sensor returns to Run mode. |
| <b>Remote Input</b> | a. Position the target for the second limit (no time out).<br>b. Pulse the remote input one time to configure the second limit for either discrete or analog. | The second limit is configured.                                     |

4. Repeat for the other output (analog or discrete) if a second output is desired.

<sup>2</sup> 0.04 seconds < T < 0.8 seconds

## Configure Analog or Discrete Limits Using the Auto-Zero Feature

For some applications, a sensing distance set point centered within a minimum sensing window may be required. The TEACH procedure for this application is simple: configuring the same limit twice causes the sensor to program a 10-mm window centered on the position taught (position  $\pm 5$  mm).



**Note:** The sensor allows for some forgiveness in this procedure. If the two limits are not exactly the same (but closer than the minimum 10-mm window required), the sensor places the set point at the average of the two limits.

## Configuring Identical Limits for Both Analog and Discrete Outputs Simultaneously

To set both the analog and the discrete outputs at exactly the same limits, both may be set simultaneously.

1. Enter PROGRAM mode.

| Method                          | Action                                                                                                                                                                      | Result                                                             |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| <b>Push Button</b>              | a. Press and hold either the analog or discrete button until Output LED turns On.<br>b. Press and hold the other button (analog or discrete) until its Output LED turns On. | Both Output LEDs: On<br>The sensor is waiting for the first limit. |
| <b>Remote Input<sup>3</sup></b> | No action required; sensor is ready for first limit teach.                                                                                                                  | None                                                               |

2. Configure the first limit.

| Method              | Action                                                                                                             | Result                                                                                                         |
|---------------------|--------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| <b>Push Button</b>  | a. Position the target for the first limit.<br>b. Press either the analog or the discrete button.                  | Both Output LEDs: On flashing<br>The sensor is waiting for the second limit.<br>The first limit is configured. |
| <b>Remote Input</b> | a. Position the target for the first limit.<br>b. Pulse the remote input three times to configure the first limit. | The first limit is configured.                                                                                 |

3. Teach the second limit.

| Method              | Action                                                                                                            | Result                                                                                                                                                              |
|---------------------|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Push Button</b>  | a. Position the target for the second limit.<br>b. Press either the analog or the discrete button.                | Power LED: On<br>Both Output LEDs: On, if the outputs are conducting within the window limits<br>The sensor returns to Run mode.<br>The second limit is configured. |
| <b>Remote Input</b> | a. Position the target for the second limit.<br>b. Pulse the remote input one time to configure the second limit. | The second limit is configured.                                                                                                                                     |

## Push Button Lockout

| Push Button                   |                | Remote Wire<br>0.04 sec. < T < 0.8 sec.                                                                                                                          |                                                                                                                                |
|-------------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Procedure                     | Result         | Procedure                                                                                                                                                        | Result                                                                                                                         |
| Not available via push button | Not applicable | <ul style="list-style-type: none"> <li>Four-pulse the remote line</li> </ul>  | <ul style="list-style-type: none"> <li>Push buttons are either enabled or disabled, depending on previous condition</li> </ul> |

## Analog Output

The U-GAGE T30 Series sensor may be configured for either a positive or a negative output slope, based on which condition is taught first (see [Figure 3](#) on page 6). If the near limit is taught first, the slope is positive; if the far limit is taught first, the slope is negative. Banner's scalable analog output automatically distributes the output signal over the width of the programmed sensing window.

The U-GAGE T30 Series also features a 2-second hold upon loss of the received analog signal, which is useful for harsh and unstable applications. In the event of analog signal loss for longer than 2 seconds, the analog output goes to 3.6 mA or 0 V dc, which may be used to trigger an alarm.

<sup>3</sup> 0.04 seconds < T < 0.8 seconds

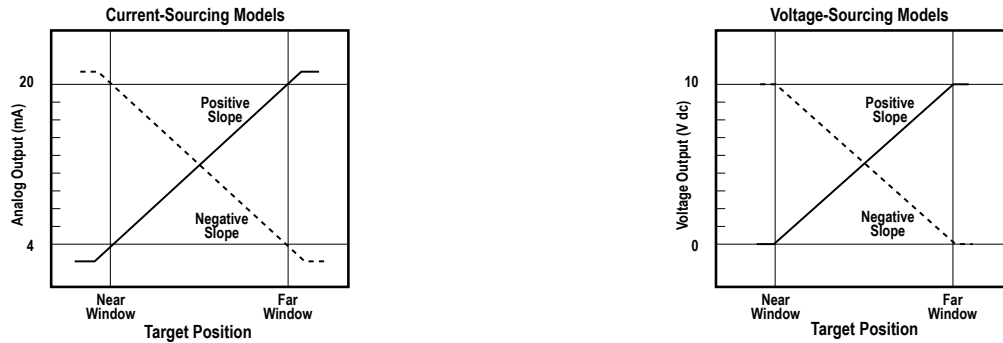


Figure 3. Positive and Negative Output Slopes

**Note:** The analog current output tracks slightly past each window limit (from 3.8 to 20.5 mA).

## Self-Diagnostic Error Mode

In the unlikely event of a microprocessor memory error, all of the LEDs will flash in sequence. If this occurs, the setup parameters have been lost and the sensor may be corrupt. Contact Banner Engineering for further information.

## Specifications

### Proximity Mode Range

A suffix models: 150 mm (5.9 in) minimum near limit; 1 m (39 in) maximum far limit  
B suffix models: 300 mm (11.8 in) minimum near limit; 2 m (79 in) maximum far limit

### Supply Voltage

Current-sourcing analog output models: 12 V dc to 24 V dc (10% maximum ripple) at 90 mA, exclusive of load  
Voltage-sourcing analog output models: 15 V dc to 24V dc (10% maximum ripple) at 90 mA, exclusive of load

### Supply Protection Circuitry

Protected against reverse polarity and transient voltages

### Output Configurations

Discrete (switched) output: SPST solid-state switch conducts when target is sensed within sensing window; choose NPN or PNP models  
Analog output: Choose 0 V dc to 10 V dc sourcing or 4 mA to 20 mA sourcing output models; output slope may be selected via TEACH sequence (see [Window Limits](#) on page 3)

### Output Ratings

Discrete (switched) output: 100 mA maximum  
Off-state leakage current: less than 5 microamps  
On-state saturation voltage: less than 1 V at 10 mA and less than 1.5 V at 100 mA  
Analog output:  
Voltage sourcing: 0 V dc to 10 V dc (at 1K  $\Omega$  minimum resistance)  
Current sourcing: 4 to 20 mA, 1  $\Omega$  to Rmax  
 $R_{max} = V_{supply} - 7V / 20 \text{ mA}$

### Output Protection Circuitry

Protected against output short-circuit, continuous overload, transient overvoltages, and false pulse on power-up

### Output Response Time

Discrete output:  
"A" suffix models: 48 milliseconds  
"B" suffix models: 96 milliseconds

Analog output:

"A" suffix models: 48 milliseconds average, 16-millisecond update  
"B" suffix models: 96 milliseconds average, 32-millisecond update

### Construction

Molded reinforced thermoplastic polyester housing

### Sensing Performance

**Note:** Specified using a 10 cm × 10 cm aluminum target at 25 °C under fixed sensing conditions.

Analog sensing resolution:  $\pm 0.25\%$  of measured distance  
Analog linearity:  $\pm 0.5\%$  of full-scale sensing range  
Sensing repeatability:  $\pm 0.25\%$  of distance  
Minimum window size: 10 mm (0.4 in)  
Hysteresis of discrete output: 2.5 mm (0.10 in)

### Adjustments

Sensing window limits (analog or discrete): TEACH-mode programming of near and far window limits may be set using the push buttons on the sensor or remotely via TEACH input (see [Configuring a Sensor](#) on page 3). Discrete and analog window limits may be programmed separately, or together.  
Analog output slope: the first limit taught is assigned to the minimum output value (4 mA or 0V)

### Environmental Rating

Leakproof design is rated IEC IP67; NEMA 6P

### Connections

2 m (6.5 ft) or 9 m (30 ft) 5-conductor PVC-covered attached cable, or 5-pin Euro-style quick-disconnect fitting

### Operating Conditions

Temperature:  $-20^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$  to  $+158^{\circ}\text{F}$ )  
100% maximum relative humidity

### Application Notes

Objects passing inside the specified near limit will produce a false response.

**Note:** For more information about out-of-range and signal loss response of the analog output, see [Analog Output](#) on page 5.

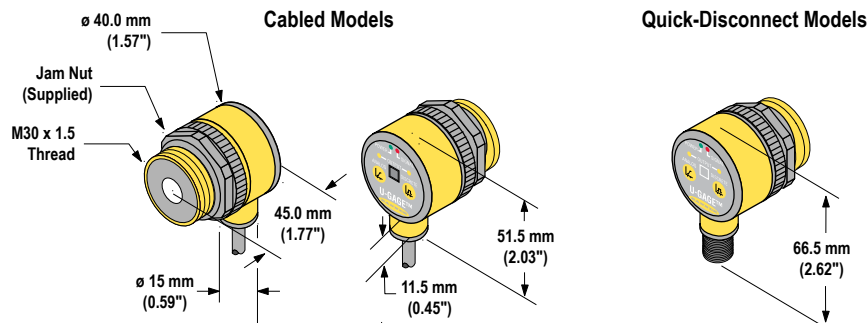
### Vibration and Mechanical Shock

All models meet MIL-STD-202F, Method 201A (Vibration: 10 Hz to 60 Hz maximum, 0.06 inch (1.52 mm) double amplitude, 10G maximum acceleration) requirements. Also meets IEC 60947-5-2 (Shock: 30G 11 ms duration, half sine wave) requirements.

### Certifications



## Dimensions



## Performance Curves

## Effective Beam with Plate Target (Typical)

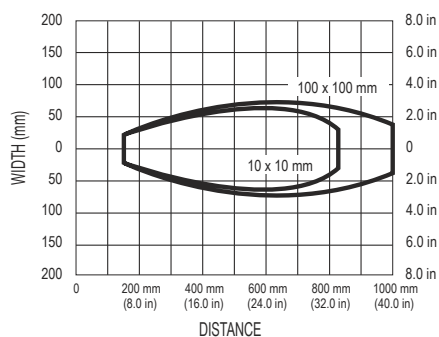


Figure 4. A Models

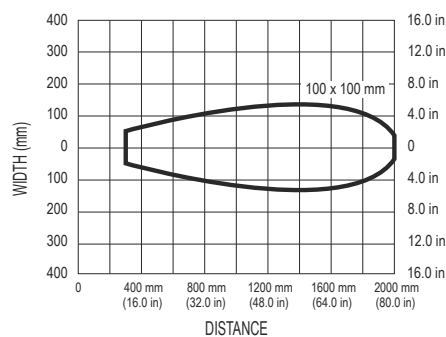


Figure 5. B Models

## Effective Beam with Rod Target (Typical)

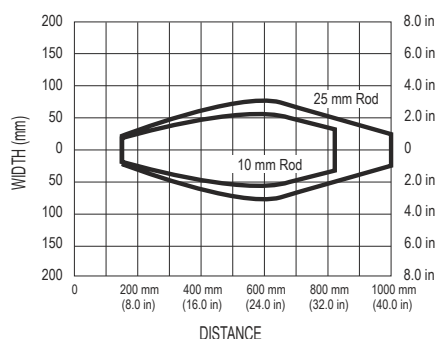


Figure 6. A Models

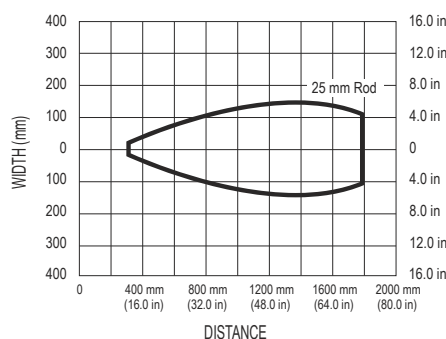
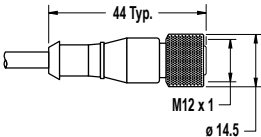
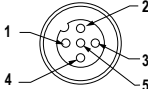
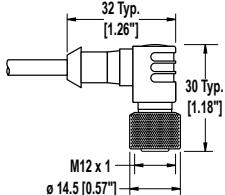


Figure 7. B Models

## Accessories

## Cordsets

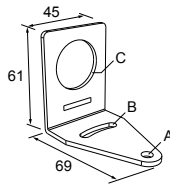
| 5-Pin Threaded M12/Euro-Style Cordsets—with Shield |                |             |                                                                                                                                                                                                                              |                                                                                                                                                              |
|----------------------------------------------------|----------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Model                                              | Length         | Style       | Dimensions                                                                                                                                                                                                                   | Pinout (Female)                                                                                                                                              |
| MQDEC2-506                                         | 1.83 m (6 ft)  | Straight    |                                                                                                                                          |  <p>1 = Brown<br/>2 = White<br/>3 = Blue<br/>4 = Black<br/>5 = Gray</p> |
| MQDEC2-515                                         | 4.57 m (15 ft) |             |                                                                                                                                                                                                                              |                                                                                                                                                              |
| MQDEC2-530                                         | 9.14 m (30 ft) |             |                                                                                                                                                                                                                              |                                                                                                                                                              |
| MQDEC2-550                                         | 15.2 m (50 ft) | Right-Angle |  |                                                                                                                                                              |
| MQDEC2-506RA                                       | 1.83 m (6 ft)  |             |                                                                                                                                                                                                                              |                                                                                                                                                              |
| MQDEC2-515RA                                       | 4.57 m (15 ft) |             |                                                                                                                                                                                                                              |                                                                                                                                                              |
| MQDEC2-530RA                                       | 9.14 m (30 ft) |             |                                                                                                                                                                                                                              |                                                                                                                                                              |
| MQDEC2-550RA                                       | 15.2 m (50 ft) |             |                                                                                                                                                                                                                              |                                                                                                                                                              |

## Brackets

All measurements are in mm.

### SMB30A

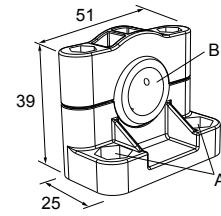
- Right-angle bracket with curved slot for versatile orientation
- Clearance for M6 (¼ in) hardware
- Mounting hole for 30 mm sensor
- 12-ga. stainless steel



**Hole center spacing:** A to B=40  
**Hole size:** A=ø 6.3, B= 27.1 x 6.3, C=ø 30.5

### SMB1815SF

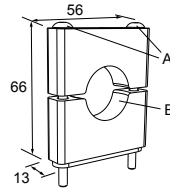
- Swivel with set screws for mounting sensors by the cable hub
- Black reinforced thermoplastic polyester
- Stainless steel swivel locking hardware and hex wrench included



**Hole center spacing:** A = 36.0  
**Hole size:** A = ø 5.0, B = ø 15.0

### SMB30C

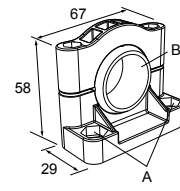
- 30 mm split clamp, black PBT bracket
- Stainless steel mounting hardware included
- Mounting hole for 30 mm sensor



**Hole center spacing:** A=ø 45  
**Hole size:** B=ø 27.2

### SMB30SC

- Swivel bracket with 30 mm mounting hole for sensor
- Black reinforced thermoplastic polyester
- Stainless steel mounting and swivel locking hardware included



**Hole center spacing:** A=ø 50.8  
**Hole size:** A=ø 7.0, B=ø 30.0

## 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. Any misuse, abuse, or improper application or installation of this product or use of the product for personal protection applications when the product is identified as not intended for such purposes will void the product warranty. Any modifications to this product without prior express approval by Banner Engineering Corp will void the product warranties. All specifications published in this document are subject to change; Banner reserves the right to modify product specifications or update documentation at any time. Specifications and product information in English supersede that which is provided in any other language. For the most recent version of any documentation, refer to: [www.bannerengineering.com](http://www.bannerengineering.com).

For patent information, see [www.bannerengineering.com/patents](http://www.bannerengineering.com/patents).