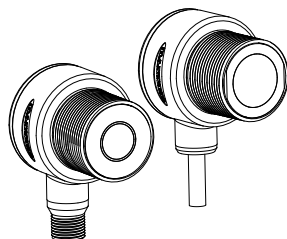


U-GAGE® T30 Series with Analog and Discrete Outputs



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°C to $+70^{\circ}\text{C}$ (-4°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 ¹	Supply Voltage	Discrete Output	Analog Output	Response Time
T30UINA	150 mm to 1 m (5.9 in to 39 in) 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 (11.8 in to 79 in) 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.

¹

- 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

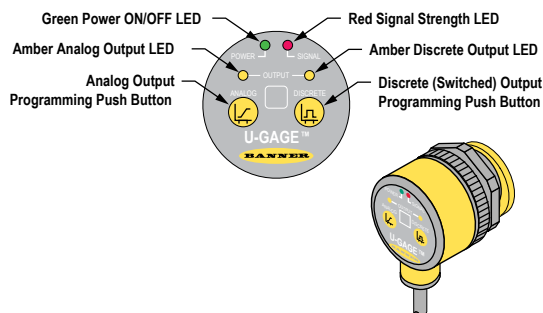


Figure 1. U-GAGE T30 Series sensor programming push buttons and indicators



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:

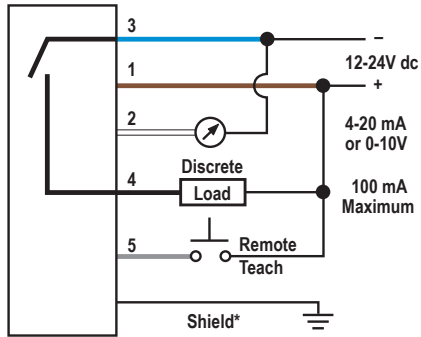
Indicator	Mode	Description
Green Power ON/OFF LED	Off	Power is OFF
	On	Power is ON, sensor is operating normally
	Flashing	Discrete output is overloaded
Red Signal Strength LED	Off	No signal is received, or the target is beyond the range limitations of the sensor (with some tolerance beyond the recommended 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

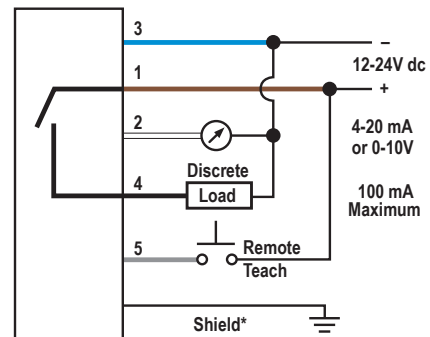
Wiring

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.

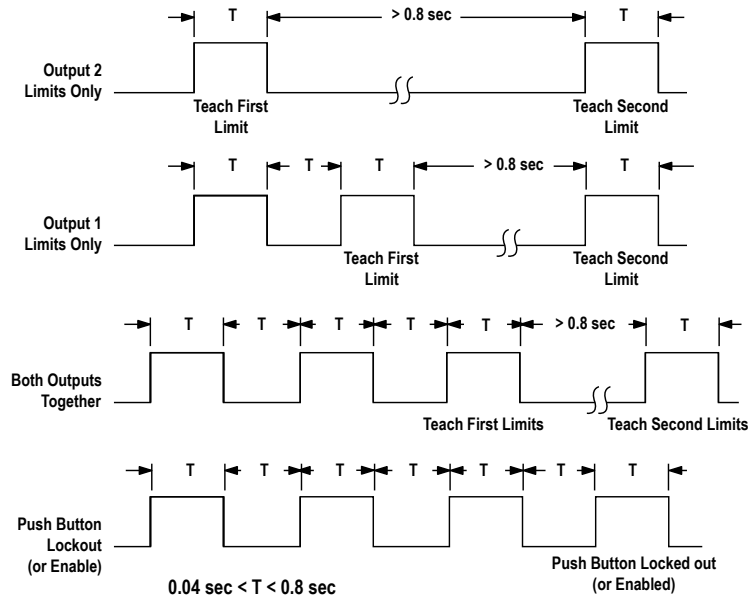


Figure 2. Timing programs for remote TEACH programming

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
Push Button	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 Output LED: On The sensor is waiting for the first limit.
Remote Input²	No action required; sensor is ready for first limit teach.	None

2. Configure the first limit.

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

3. Teach the second limit.

Method	Action	Result
Push Button	a. Position the target for the second limit. b. Press the button again. The second limit is configured.	Power LED: On Output LED: Off The sensor returns to Run mode.
Remote Input	a. Position the target for the second limit (no time out). 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.

² 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 ± 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
Push Button	a. Press and hold either the analog or discrete button until Output LED turns On. b. Press and hold the other button (analog or discrete) until its Output LED turns On.	Both Output LEDs: On The sensor is waiting for the first limit.
Remote Input³	No action required; sensor is ready for first limit teach.	None


2. Configure the first limit.

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

Push Button Lockout

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

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.

³ 0.04 seconds < T < 0.8 seconds

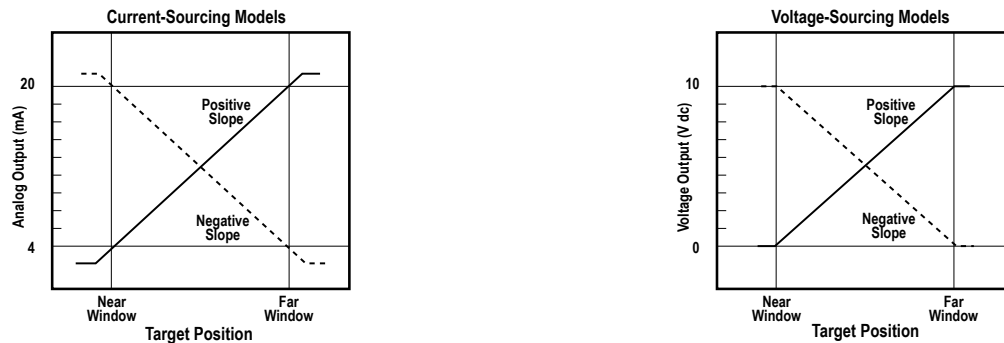


Figure 3. Positive and Negative Output Slopes

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 Ω minimum resistance)
Current sourcing: 4 to 20 mA, 1 Ω 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 \times 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 °C to +70 °C (-4 °F to +158 °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.

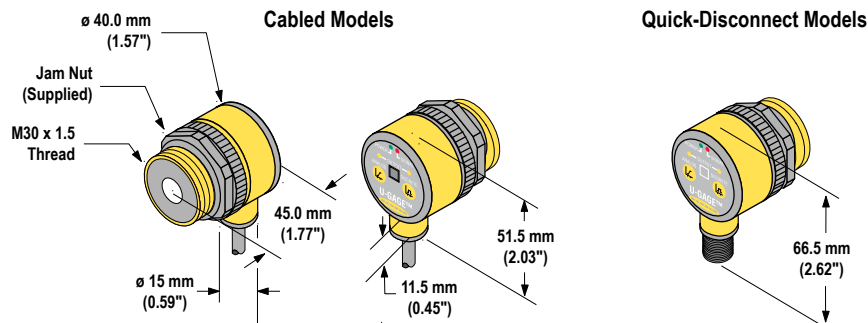
Vibration and Mechanical Shock

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)

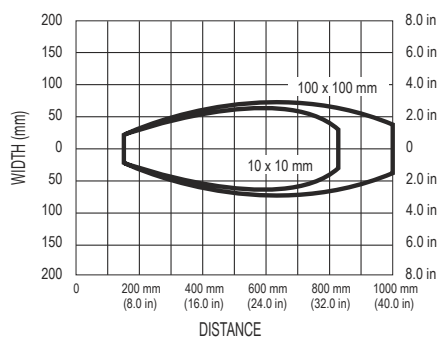


Figure 4. A Models

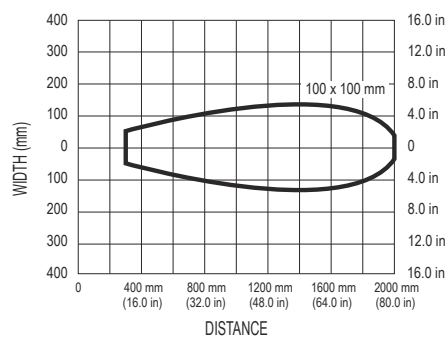


Figure 5. B Models

Effective Beam with Rod Target (Typical)

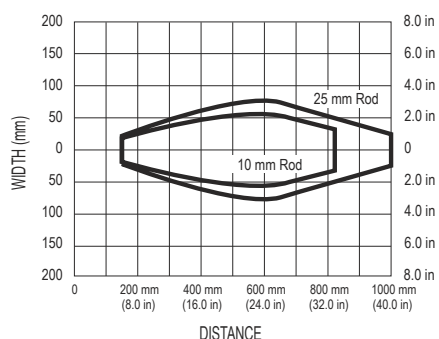


Figure 6. A Models

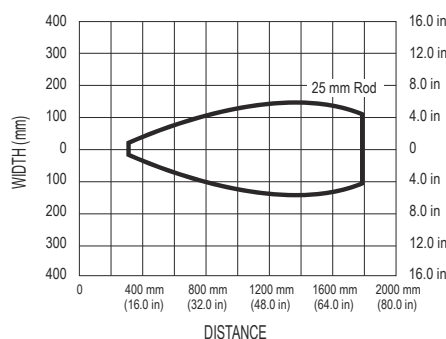
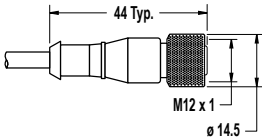
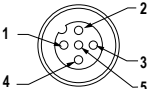
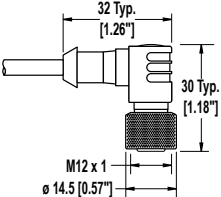


Figure 7. B Models

Accessories

Cordsets

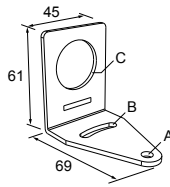
5-Pin Threaded M12/Euro-Style Cordsets—with Shield				
Model	Length	Style	Dimensions	Pinout (Female)
MQDEC2-506	1.83 m (6 ft)	Straight		 1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray
MQDEC2-515	4.57 m (15 ft)			
MQDEC2-530	9.14 m (30 ft)			
MQDEC2-550	15.2 m (50 ft)			
MQDEC2-506RA	1.83 m (6 ft)	Right-Angle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

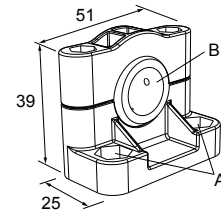
- Right-angle bracket with curved slot for versatile orientation
- Clearance for M6 (¼ in) hardware
- Mounting hole for 30 mm sensor
- 12-ga. stainless steel



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

SMB1815SF

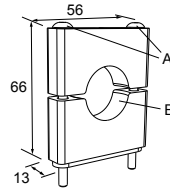
- Swivel with set screws for mounting sensors by the cable hub
- Black reinforced thermoplastic polyester
- Stainless steel swivel locking hardware and hex wrench included



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

SMB30C

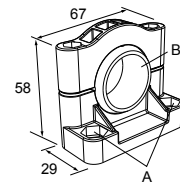
- 30 mm split clamp, black PBT bracket
- Stainless steel mounting hardware included
- Mounting hole for 30 mm sensor



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.

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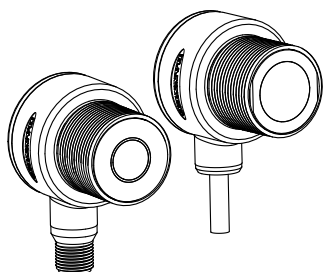
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For patent information, see www.bannerengineering.com/patents.

Datasheet

Ultrasonic Sensors with TEACH-Mode Programming



- Fast, easy-to-use TEACH-Mode programming; no potentiometer adjustments
- Choose to set a specific window size and position, or a set point centered within its own 10 mm window, for either or both outputs
- Program both outputs together or independently. The two outputs may be identical, independent, overlapping, or complementary
- 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 °C to +70 °C (-4 °F to +158 °F)
- Choose models with either NPN or PNP dual discrete outputs
- LED indicators for Power ON/OFF, Signal Strength, and 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

Models	Range and Frequency	Cable ¹	Supply Voltage	Discrete Output	Response Time
T30UDNA	150 mm to 1 m (5.9 in to 39 in) 228 kHz	2 m (6.5 ft)	12 to 24 V DC	NPN (sinking)	48 ms
T30UDNAQ		5-pin M12/Euro-style QD			
T30UDPA		2 m (6.5 ft)		PNP (sourcing)	
T30UDPAQ		5-pin M12/Euro-style QD			
T30UDPAQ	300 mm to 2 m (11.8 in to 79 in) 128 kHz	2 m (6.5 ft)		NPN (sinking)	96 ms
T30UDNB		5-pin M12/Euro-style QD			
T30UDPB		2 m (6.5 ft)		PNP (sourcing)	
T30UDPBQ		5-pin M12/Euro-style QD			

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 gauging applications such as sensing of liquid levels in a tank or for sensing most clear materials.

Each sensor includes two discrete outputs, 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.

¹ To order the 9 m (30 ft) cable models, add **W/30** to the model number of any cabled sensor (for example, **T30UDNA W/30**). A model with a QD connector requires an optional mating cable; see [Cordsets](#) (p. 7).



Configuration Instructions

Sensor Programming

Window limits may be taught to the sensor in several ways. The following methods describe the programming procedures using the push buttons on the back of the sensor; remote programming (remote TEACH) procedures are described in [Remote Programming](#) (p. 3).



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

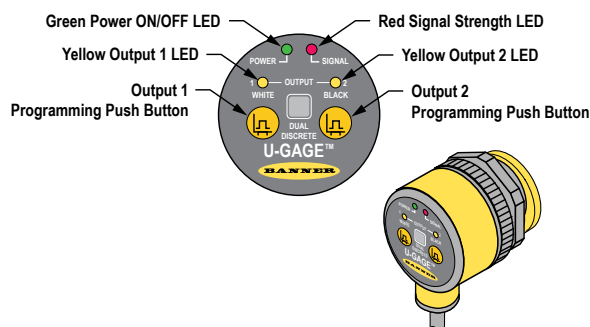


Figure 1. U-GAGE T30 Series sensor programming push buttons and indicators

Program the outputs independently to define separate sensing windows (both their size and placement) or program the outputs simultaneously for complementary or fixed field operation.

Sensing windows may be as large as 0.85 m for 1 m range models, and as large as 1.7 m for 2 m range models. Use the procedures as described, or combine them for specialized applications.



Note: Output 1 = White wire, Output 2 = Black wire

General Notes on Programming:

1. The sensor returns to Run mode if the first TEACH condition is not registered within 120 seconds.
2. After the first limit is taught, the sensor remains in Program mode until the TEACH sequence is finished.
3. Press and hold the programming push button > 2 seconds (before teaching the second limit) to exit Program mode without saving any changes. The sensor will revert to the last saved program.
4. The sensor allows for some forgiveness in the teaching of a set point. If both near and far limits are not exactly the same (but are closer than the minimum 10 mm required to define a window), the sensor will set a 10 mm window with the center at the "average" of the two limits.

To Program Separate Sensing Window Limits

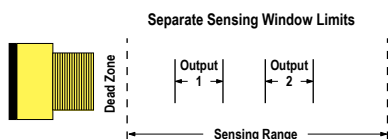


Figure 2. Programming separate sensing window limits

Each output conducts when the target is inside that output's window limits. The two sets of window limits may overlap or be completely independent.

1. Press and hold the push button for the selected output until the green Power LED turns OFF and the yellow LED for the programmed output turns ON.
2. Position the target at the first limit and click the push button. The yellow Output LED flashes.
3. Position the target at the second limit and click the push button. The green Power LED turns ON. The sensor is in Run mode.
4. Repeat the procedure for the second output, if desired.

To Program Separate Sensing Set Point Limits

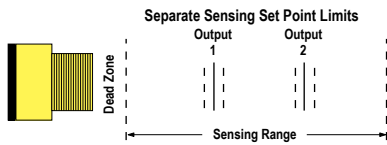


Figure 3. Programming separate sensing set point limits

Each output conducts when the target is inside that output's 10 mm limits (centered on the taught set point, or the average of the two limits). The window limits for the two outputs may overlap or be completely independent.

1. Press and hold the push button for the selected output until the green Power LED turns OFF and the yellow LED for the programmed output turns ON.
2. Position the target at the set point and click the push button. The yellow Output LED flashes.
3. While the target remains at the first limit (or within 10 mm), click the push button once more. The green Power LED turns ON. The sensor is in Run mode.
4. Repeat the procedure for the second output, if desired.

To Program A Single Pair of Sensing Window Limits, with Complementary Outputs

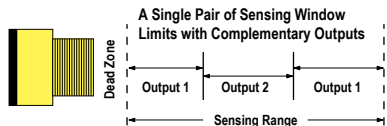


Figure 4. Programming a single pair of sensing window limits, complementary outputs

Output 2 conducts when inside the programmed window limits; Output 1 conducts for all other conditions.

1. Press and hold both push buttons (or press and hold one and then the other) until the green Power LED turns OFF and both yellow Output LEDs turn ON.
2. Position the target at the first limit and click a push button. The yellow Output LED flashes.
3. Position the target at the second limit and click a push button. The green Power LED turns ON. The sensor is in Run mode.



Note: The window limits must be ≥ 10 mm or the sensor will default to fixed-field style.

To Program A Single Sensing Set Point, with Complementary Outputs (Fixed-Field Style)

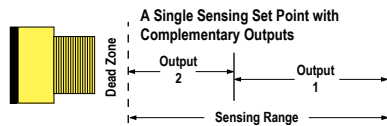


Figure 5. Programming separate sensing set point limits, complementary outputs

Output 2 conducts when inside the programmed set point; Output 1 conducts outside (away) from this point.

1. Press and hold both push buttons (or press and hold one and then the other) until the green Power LED turns OFF and both yellow Output LEDs turn ON.
2. Position the target at the first limit and click a push button. The yellow Output LED flashes.
3. While the target remains at the first limit (or within 10 mm), click the push button once more. The green Power LED turns ON. The sensor is in Run mode.

Remote Programming

Use the Remote Programming function to program the sensor remotely or to disable the keypad. Disabling the keypad prevents anyone from adjusting any of the programming settings directly from the sensor. Connect the gray wire of the sensor to +12 to 24V dc, with a remote programming switch connected between them.



Note: The impedance of the remote teach input is 55 k Ω .

Follow the sequence of input pulses to program the sensor. The duration of each pulse (corresponding to a push button "click"), and the period between multiple pulses, is defined as: 0.04 seconds < T < 0.8 seconds.

- **1 pulse:** Programs first Output 2 limit. Wait > 0.8 seconds. Next pulse programs second Output 2 limit.
- **2 pulses:** Programs first Output 1 limit. Wait > 0.8 seconds. Next pulse programs second Output 1 limit.
- **3 pulses:** Programs both outputs together (complementary or fixed-field mode). First 3-pulse programs the first limit; wait > 0.8 sec. Next pulse programs second limit and determines output configuration.
- **4 pulses:** Disables (locks out) or enables the keypad for security.

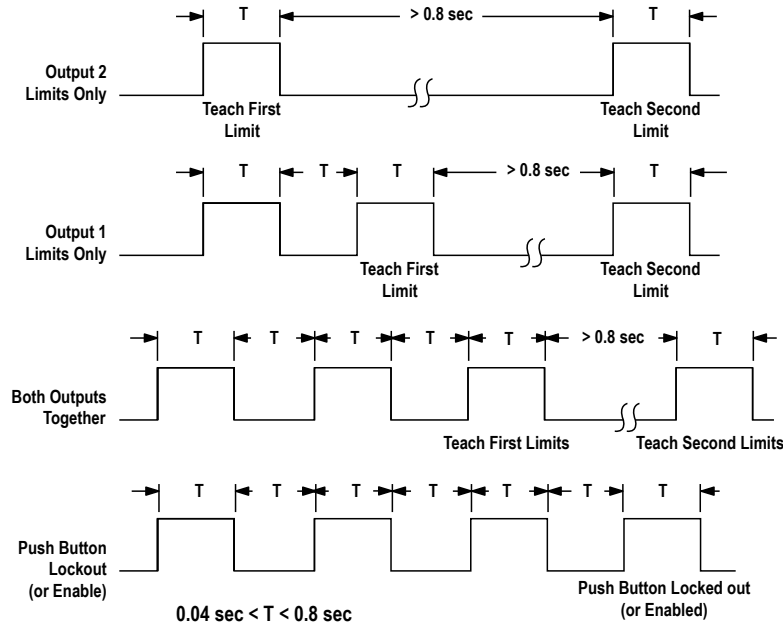


Figure 6. Timing programs for remote TEACH programming

Note: Hold the Remote line high > 2 seconds (before teaching the second limit) to exit Program mode without saving any changes. The sensor will revert to the last saved program.

Wiring Diagrams

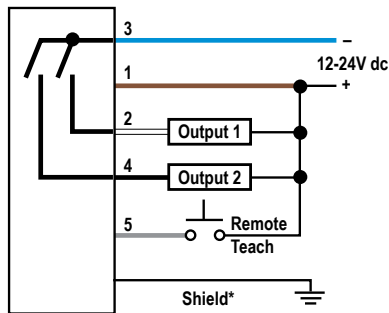


Figure 7. Cabled NPN

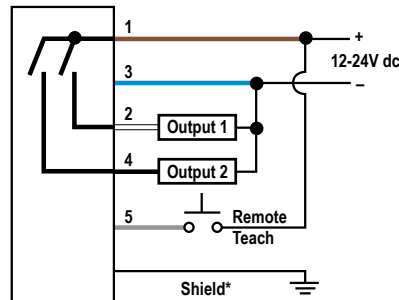
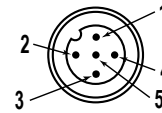


Figure 8. Cabled PNP

5-pin M12/Euro-style
male connector models



Key

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

It is recommended that the shield wire is connected to earth ground or dc common.

Run Mode

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

Signal LED

The red Signal LED indicates the strength and condition of the sensor's incoming signal.

Signal LED Status	Indicates
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

Output LEDs

Each amber Output LED lights when a target is sensed within the programmed window limits.

Power ON/OFF LED

The green Power ON/OFF LED indicates the operating status of the sensor.

Power ON/OFF LED	Indicates
OFF	Power is OFF (or in Program mode, if other LEDs are ON)
ON Solid	Sensor is operating normally (power is ON, Run mode)
Flashing	Discrete output is overloaded (Run mode)

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) min. near limit; 1 m (39 in) max. far limit
"B" suffix models: 300 mm (11.8 in) min. near limit; 2 m (79 in) max. far limit

Supply Voltage

12 to 24 V dc (10% max. ripple) at 90 mA, exclusive of load

Supply Protection Circuitry

Protected against reverse polarity and transient voltages

Output Configurations

SPST solid-state switch; choose NPN (current sinking) or PNP (current sourcing) models

Output Ratings

Dual Discrete Outputs: 100 mA maximum, total – both outputs

OFF-state leakage current: less than 10 microamps

ON-state saturation voltage: less than 1 V at 10 mA and less than 1.5 V at 100 mA

Output Protection

Protected against continuous overload and short-circuit; transient over-voltage; no false pulse on power-up

Output Response Time

"A" suffix models: 48 milliseconds

"B" suffix models: 96 milliseconds

Sensing Performance

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)

Indicators

Status LEDs	Run Mode	Program mode
Green	ON: Power ON, Run mode Flashing: Output is overloaded	OFF: Program Mode
Red	Flashing: Relative received signal strength	Flashing: Relative received signal strength
Amber (2)	ON: Output energized (conducting)	ON: Ready for first window limit
		Flashing: Ready for second limit
		OFF: Not teaching this output

Adjustments

Sensing window limits: TEACH-mode programming of near and far window limits may be set using membrane push buttons on sensor or remotely via TEACH input. Window limits may be programmed separately, or together

Construction

Molded reinforced thermoplastic polyester housing

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°C to $+70^{\circ}\text{C}$ (-4°F to $+158^{\circ}\text{F}$)

Humidity: 100% maximum relative humidity

Vibration and Mechanical Shock

All models meet Mil. Std. 202F requirements. Method 201A (Vibration: 10 to 60 Hz max., double amplitude 0.06 in, maximum acceleration 10G). Also meets IEC 947-5-2 requirements: 30G, 11 ms duration, half sine wave

Certifications



Application Notes

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

Performance Curves

Effective Beam with Plate Target (Typical)

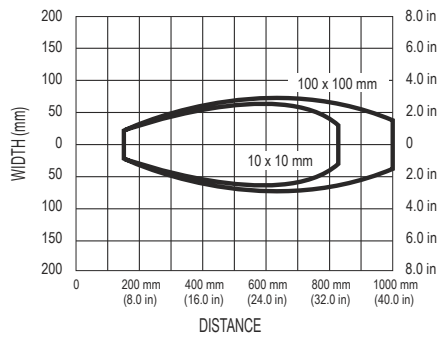


Figure 9. A Models

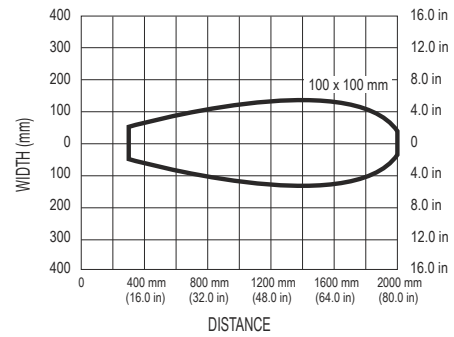


Figure 10. B Models

Effective Beam with Rod Target (Typical)

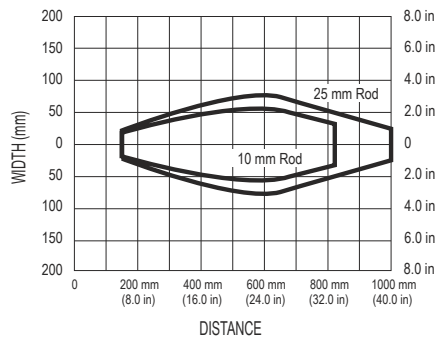


Figure 11. A Models

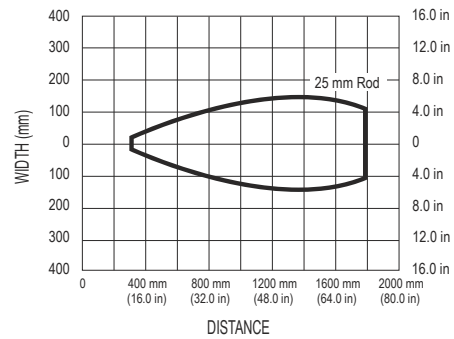
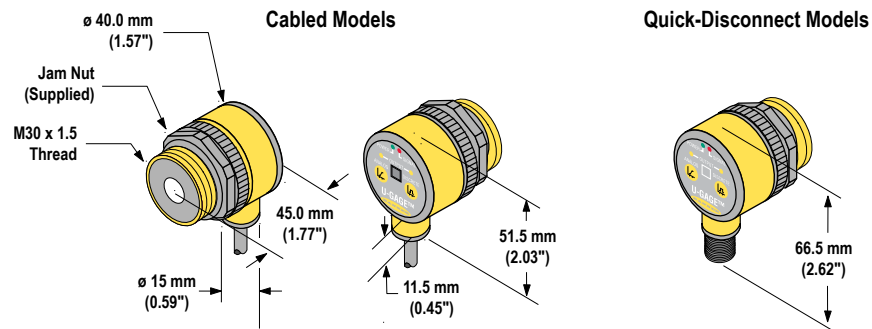


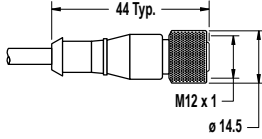
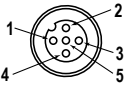
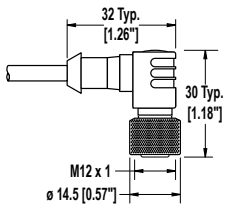
Figure 12. B Models

Dimensions



Accessories

Cordsets

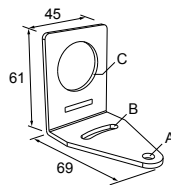
5-Pin Threaded M12/Euro-Style Cordsets with Shield—Single Ended				
Model	Length	Style	Dimensions	Pinout (Female)
MQDEC2-506	1.83 m (6 ft)	Straight		 <p>1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray</p>
MQDEC2-515	4.57 m (15 ft)			
MQDEC2-530	9.14 m (30 ft)			
MQDEC2-550	15.2 m (50 ft)			
MQDEC2-506RA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

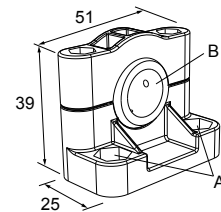


Hole center spacing: A to B=40

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

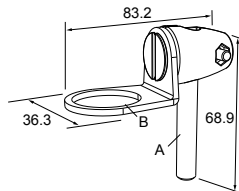


Hole center spacing: A = 36.0

Hole size: A = ø 5.0, B = ø 15.0

SMB30FA

- Swivel bracket with tilt and pan movement for precise adjustment
- Mounting hole for 30 mm sensor
- 12-ga. 304 stainless steel
- Easy sensor mounting to extrude rail T-slot
- Metric and inch size bolt available

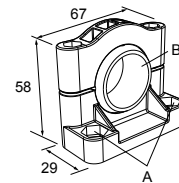


Bolt thread: SMB30FA, A= 3/8 - 16 x 2 in; SMB30FAM10, A= M10 - 1.5 x 50

Hole size: B= ø 30.1

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

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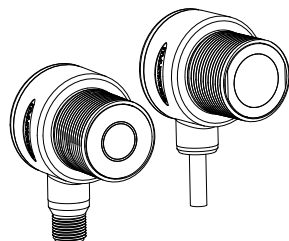
more sensors, more solutions

U-GAGE® T30U Series Sensors - Pump-In/Pump-Out



Datasheet

Ultrasonic Sensors with Pump-In/Pump-Out Switching Logic



- Fast, easy-to-use TEACH-Mode programming; no potentiometer adjustments
- Program both outputs together or independently. The two outputs may be identical, independent, overlapping, or complementary
- 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 °C to +70 °C (-4 °F to +158 °F)
- Choose models with either NPN or PNP dual discrete outputs
- LED indicators for Power ON/OFF, Signal Strength, and 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, right-angle sensor package with fully encapsulated electronics
- 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

Models	Range and Frequency	Cable	Supply Voltage	Discrete Output	Response Time
T30UHNA	150 mm to 1 m (5.9 in to 39 in) 228 kHz	2 m (6.5 ft)	12 to 24 V DC	NPN (sinking)	48 ms
T30UHNAQ		5-pin M12/Euro-style QD		PNP (sourcing)	
T30UHPA		2 m (6.5 ft)			
T30UHPAQ		5-pin M12/Euro-style QD		NPN (sinking)	96 ms
T30UHNB	300 mm to 2 m (11.8 in to 79 in) 128 kHz	2 m (6.5 ft)			
T30UHNBQ		5-pin M12/Euro-style QD			
T30UHPB		2 m (6.5 ft)			
T30UHPBQ		5-pin M12/Euro-style QD			

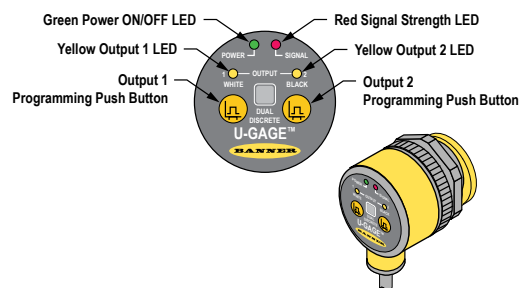
Overview

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 gauging applications such as sensing liquid levels in a tank or for sensing most clear materials.

Each sensor includes two discrete outputs, which may be programmed independently with different window limits or together with identical limits.

Pump-In/Pump-Out Switching Function

Pump-in/pump-out operation provides the switching logic required for fill-level control, web tensioning control, and similar applications. In this mode, Output 2 energizes when the target reaches the farthest sensing window limit, and stays energized until the target moves to the nearest limit. Output 1 de-energizes at the farthest limit and does not re-energize until the target moves to the nearest limit. Figure 2 shows how pumping action might be controlled directly by the sensor in a fill-level-control application.

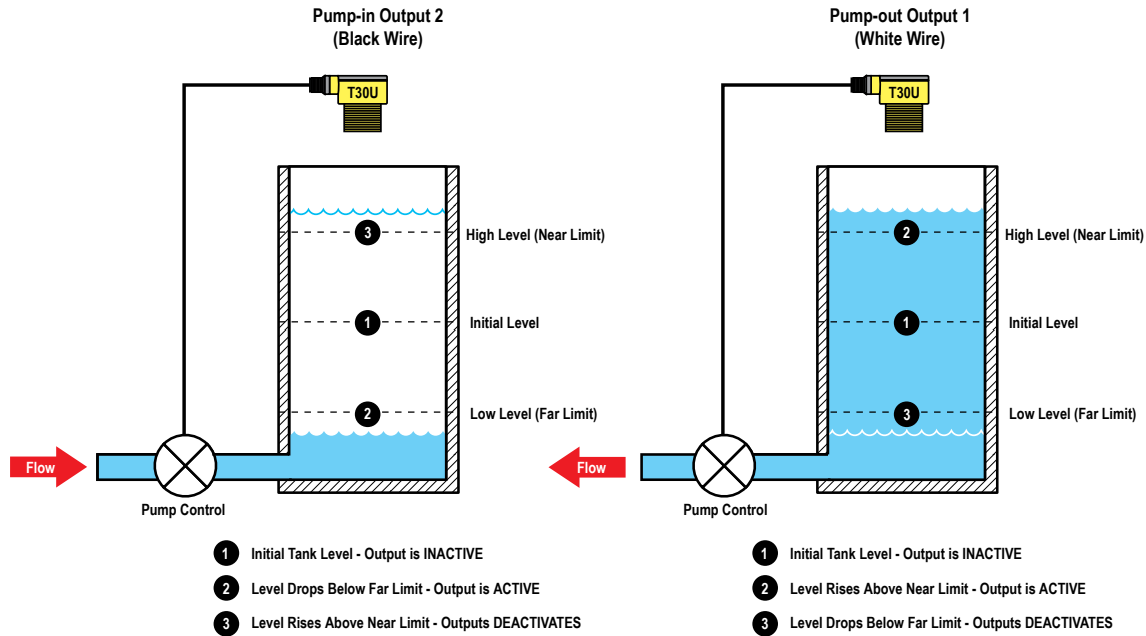


Output 1 = Pump-Out
Output 2 = Pump-In

Figure 1. Sensor features

To order the 9 m (30 ft) cable models, add **W/30** to the model number of any cabled sensor (for example, **T30UHNA W/30**). A model with a QD connector requires an optional mating cable; see [Cordsets](#) (p. 7)





If no echo is received by the sensor, the target is assumed to be beyond the far window limit.

Figure 2. Fill-level-control application

Configuration Instructions

Sensor Programming

Window limits may be taught to the sensor using the push buttons on the back of the sensor or using remote programming.



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

Program the outputs independently to define separate sensing windows (both their size and placement) or program the outputs simultaneously for complementary operation. Sensing windows may be as large as 0.85 m for 1 m range models, and 1.7 m for 2 m range models. **Note:** Output 1 = White wire (Pump-Out), Output 2 = Black wire (Pump-In).

General Notes on Programming:

1. The sensor returns to Run mode if the first TEACH condition is not registered within 120 seconds.
2. After the first limit is taught, the sensor remains in Program mode until the TEACH sequence is finished.
3. Press and hold the programming push button > 2 seconds (before teaching the second limit) to exit Program mode without saving any changes. The sensor will revert to the last saved program.

Remote Programming

Use the Remote Programming function to program the sensor remotely or to disable the keypad. Disabling the keypad prevents anyone from adjusting any of the programming settings directly from the sensor. Connect the gray wire of the sensor to +12 to 24V dc, with a remote programming switch connected between them.



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

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



Note: Hold the Remote line high > 2 seconds (before teaching the second limit) to exit Program mode without saving any changes. The sensor will revert to the last saved program.

Teaching Separate Window Limits for Each Output

Each output conducts in its respective manner (either pump-in or pump-out) independently, in response to the target distance. The two outputs may overlap or may be completely independent. For fill-level applications, set the window limits for Output 2 (pump-in) farther from the sensor than for Output 1 (pump-out); see figure on the right.

The distance between the taught near and far limits for each output must be at least 10 mm.

To readjust window limits for either output, follow the teach procedure for that output only.

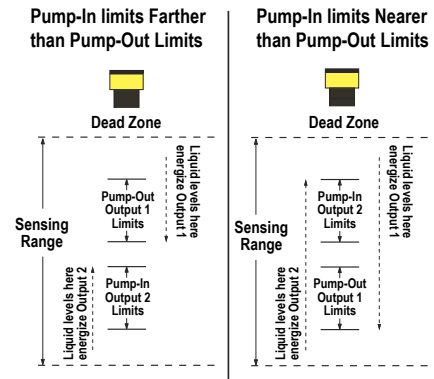








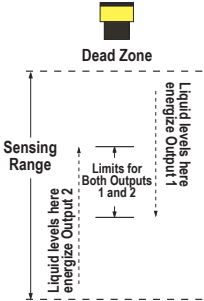
Figure 3. Programming separate sensing window limits for each output

Push Button		Remote Wire 0.04 sec. < T < 0.8 sec.	
Procedure	Result	Procedure	Result
Programming Mode			
<ul style="list-style-type: none"> Push and hold push button for selected output² <p>>2 sec.</p> 	<ul style="list-style-type: none"> Green Power LED turns OFF Corresponding Output LED turns ON Yellow Sensor waits for first limit 	<ul style="list-style-type: none"> No action required 	
Teach First Limit			
<ul style="list-style-type: none"> Position the target for the first limit “Click” the same push button 	<ul style="list-style-type: none"> After a short delay, the Yellow LED flashes Sensor learns first limit and waits for second limit 	<div> <div> Output 1 (Pump-Out) <ul style="list-style-type: none"> Double-pulse the remote line  </div> <div> Output 2 (Pump-In) <ul style="list-style-type: none"> Single-pulse the remote line  </div> </div>	<ul style="list-style-type: none"> Green Power LED turns OFF Corresponding Output LED turns ON Yellow After a short delay, the Yellow LED flashes
Teach Second Limit			
<ul style="list-style-type: none"> Position the target for the second limit “Click” the same push button 	<ul style="list-style-type: none"> After a short delay, the Green Power LED goes ON Sensor learns second limit and returns automatically to Run mode 	<ul style="list-style-type: none"> Position the target for the second limit Single-pulse the remote line 	<ul style="list-style-type: none"> After a short delay, the Green Power LED turns ON Sensor learns second limit and returns automatically to Run mode
Program Second Output			
Repeat as needed for other output.			

² Sensor will return to RUN mode if first TEACH condition is not registered within 120 seconds.

Teaching Identical (Complementary) Window Limits for Both Outputs

A Single Pair of Sensing Window Limits is taught; only one output is on at any time



Only one output conducts at any time in response to the target distance. Under no conditions will both outputs conduct at the same time; see [Overview](#) (p. 1) and the figure on the left.


The distance between the taught near and far limits must be at least 10 mm in this complementary mode for proper sensor operation.

Figure 4. Programming one pair of sensing window limits, complementary outputs

Push Button		Remote Wire 0.04 sec. < T < 0.8 sec.	
Procedure	Result	Procedure	Result
Programming Mode			
<ul style="list-style-type: none">Press and hold both push buttons (or press and hold one and then the other)⁸ <p>>2 sec.</p>	<ul style="list-style-type: none">Green Power LED turns OFFBoth Output LEDs turn ON YellowSensor waits for first limit	<ul style="list-style-type: none">No action required	
Teach First Limit			
<ul style="list-style-type: none">Position the target for the first limit“Click” either push button	<ul style="list-style-type: none">After a short delay, the Yellow LEDs flashesSensor learns first limit and waits for second limit	<ul style="list-style-type: none">Position the target for the first limitTriple-pulse the remote line	<ul style="list-style-type: none">Green Power LED turns OFFBoth Output LEDs turn ON YellowAfter a short delay, the Yellow LEDs flash
Teach Second Limit			
<ul style="list-style-type: none">Position the target for the second limit“Click” either push button	<ul style="list-style-type: none">After a short delay, the Green Power LED goes ONSensor learns second limit and returns automatically to Run mode	<ul style="list-style-type: none">Position the target for the second limitSingle-pulse the remote line	<ul style="list-style-type: none">After a short delay, the Green Power LED turns ONSensor learns second limit and returns automatically to Run mode

⁸ Sensor will return to RUN mode if first TEACH condition is not registered within 120 seconds.

Push Button Lockout

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

Wiring Diagrams

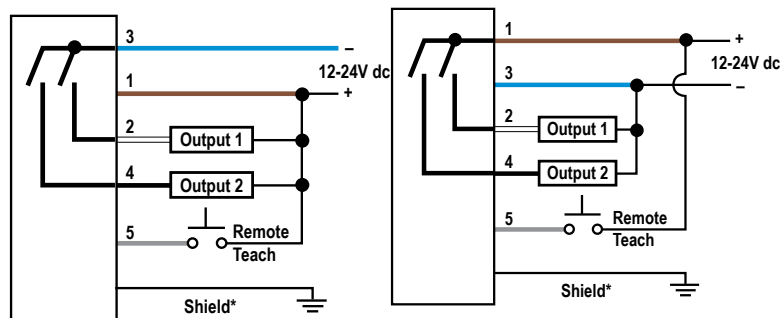


Figure 5. Cabled NPN

Figure 6. Cabled PNP

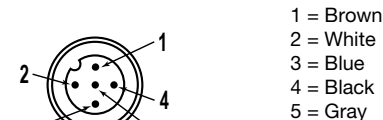


Figure 7. 5-pin M12/Euro-style male connector

It is recommended that the shield wire is connected to earth ground or dc common.

Run Mode



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

Signal LED

The Red Signal LED indicates the strength and condition of the sensor's incoming signal.

Signal LED Status	Indicates
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

Output LEDs

Each Yellow Output LED lights when the corresponding output (pump-in or pump-out) is energized.

Power ON/OFF LED

The Green Power ON/OFF LED indicates the operating status of the sensor.

Power ON/OFF LED	Indicates
OFF	Power is OFF (or in Program mode, if other LEDs are ON)
ON Solid	Sensor is operating normally (power is ON, Run mode)
Flashing	Discrete output is overloaded (Run mode)

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) min. near limit; 1 m (39 in) max. far limit
"B" suffix models: 300 mm (11.8 in) min. near limit; 2 m (79 in) max. far limit

Supply Voltage
12 to 24 V dc (10% max. ripple) at 90 mA, exclusive of load

Supply Protection Circuitry
Protected against reverse polarity and transient voltages

Output Ratings
Dual Discrete Outputs: 100 mA maximum, total – both outputs
OFF-state leakage current: less than 10 microamps
ON-state saturation voltage: less than 1 V at 10 mA and less than 1.5 V at 100 mA

Output Configurations
SPST solid-state switch; choose NPN (current sinking) or PNP (current sourcing) models

Output Protection
Protected against continuous overload and short-circuit; transient over-voltage; no false pulse on power-up

Output Response Time
"A" suffix models: 48 milliseconds
"B" suffix models: 96 milliseconds

Sensing Performance
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: TEACH-mode programming of near and far window limits may be set using membrane push buttons on sensor or remotely via TEACH input. Window limits may be programmed separately, or together

Construction
Molded reinforced thermoplastic polyester housing

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 °C to +70 °C (-4 °F to +158 °F)
Humidity: 100% maximum relative humidity

Vibration and Mechanical Shock
All models meet Mil. Std. 202F requirements. Method 201A (Vibration: 10 to 60 Hz max., double amplitude 0.06 in, maximum acceleration 10G). Also meets IEC 947-5-2 requirements: 30G, 11 ms duration, half sine wave

Certifications



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

Indicators

Status LEDs	Run Mode	Program mode
Green	ON: Power ON, Run mode Flashing: Output is overloaded	OFF: Program Mode
Red	Flashing: Relative received signal strength	Flashing: Relative received signal strength
Amber (2)	ON: Output energized (conducting)	ON: Ready for first window limit Flashing: Ready for second limit OFF: Not teaching this output

Performance Curves

Effective Beam with Plate Target (Typical)

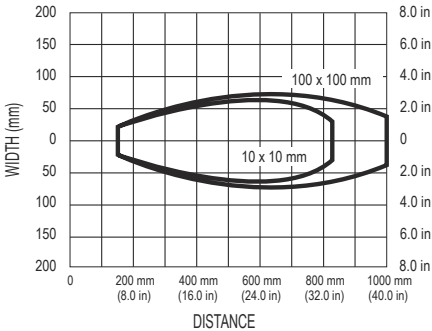


Figure 8. A Models

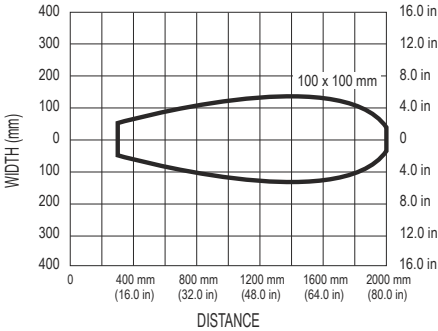


Figure 9. B Models

Effective Beam with Rod Target (Typical)

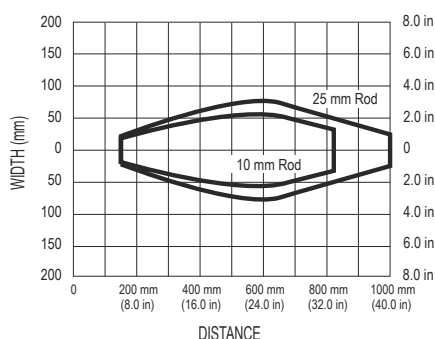


Figure 10. A Models

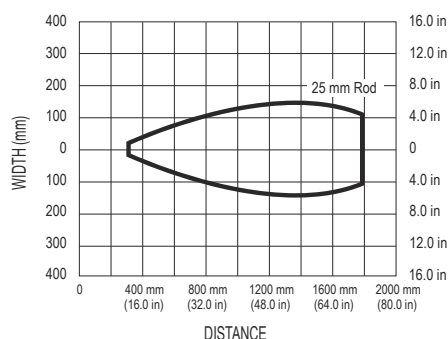
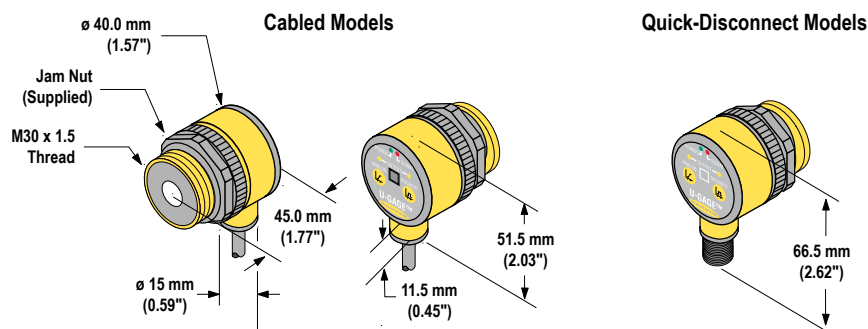


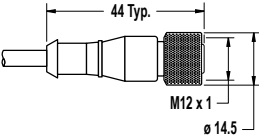
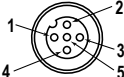
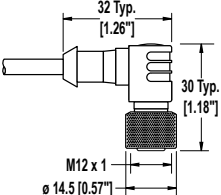
Figure 11. B Models

Dimensions



Accessories

Cordsets

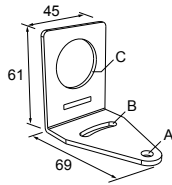
5-Pin Threaded M12/Euro-Style Cordsets with Shield—Single Ended				
Model	Length	Style	Dimensions	Pinout (Female)
MQDEC2-506	1.83 m (6 ft)	Straight		 1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray
MQDEC2-515	4.57 m (15 ft)			
MQDEC2-530	9.14 m (30 ft)			
MQDEC2-550	15.2 m (50 ft)	Right-Angle		
MQDEC2-506RA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

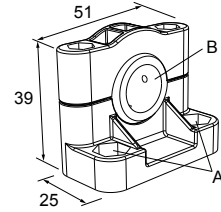


Hole center spacing: A to B=40

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

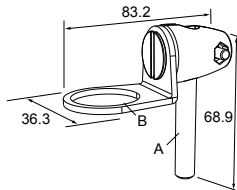


Hole center spacing: A = 36.0

Hole size: A = ø 5.0, B = ø 15.0

SMB30FA

- Swivel bracket with tilt and pan movement for precise adjustment
- Mounting hole for 30 mm sensor
- 12-ga. 304 stainless steel
- Easy sensor mounting to extrude rail T-slot
- Metric and inch size bolt available

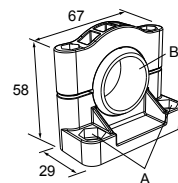


Bolt thread: SMB30FA, A= 3/8 - 16 x 2 in; SMB30FAM10, A= M10 - 1.5 x 50

Hole size: B= ø 30.1

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

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