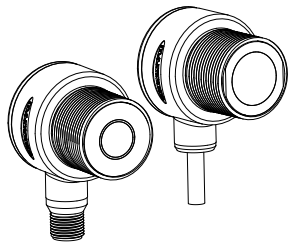
U-GAGE® T30 Series with Analog and Discrete Outputs

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 °C (–4 °F to +158 °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

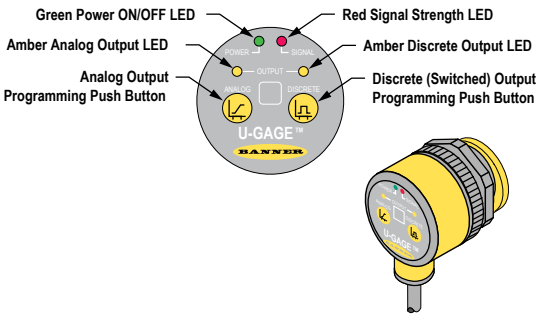


Figure 1. U-GAGE T30 Series sensor programming push buttons and indicators

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:

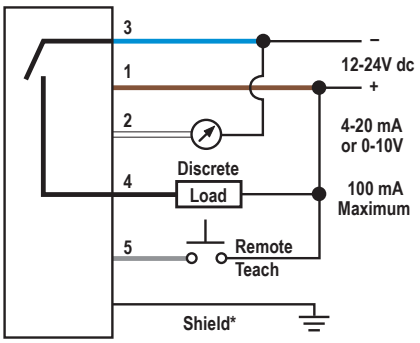
Indicator	Mode	Description
Green Power ON/OFF LED	Off	Power is OFF
	On	Power is ON, sensor is operating normally
	Flashing	Discrete output is overloaded
Red Signal Strength LED	Off	No signal is received, or the target is beyond the range limitations of the sensor (with some tolerance beyond the recommended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

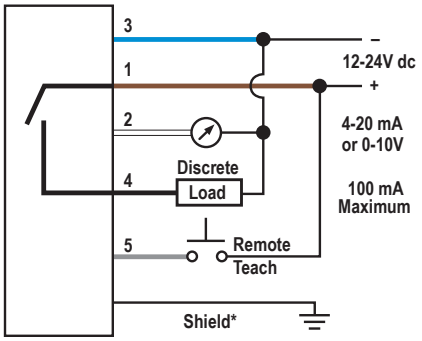
Wiring

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.

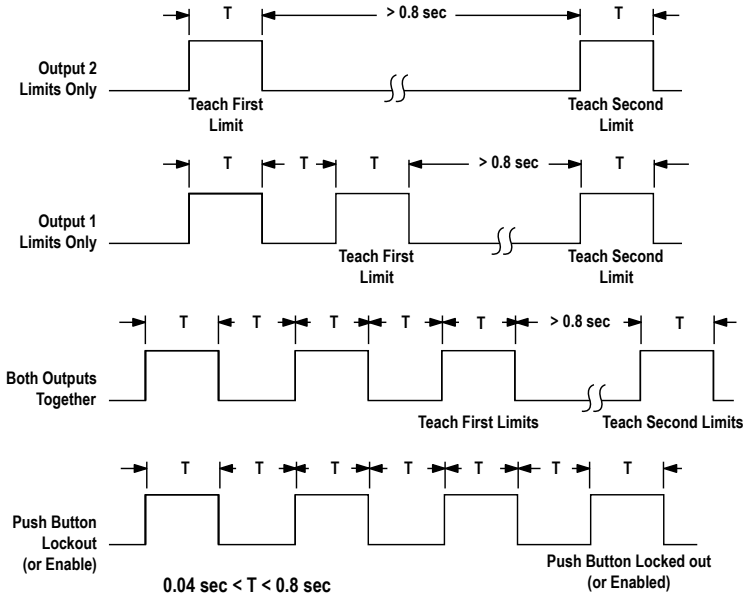


Figure 2. Timing programs for remote TEACH programming

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 Input[2]	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. • 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 Input[3]	No action required; sensor is ready for first limit teach.	None

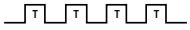
2. Configure the first limit.

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	• Four-pulse the remote line 	• Push buttons are either enabled or disabled, depending on previous condition

Analog Output

The U-GAGE T30 Series 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

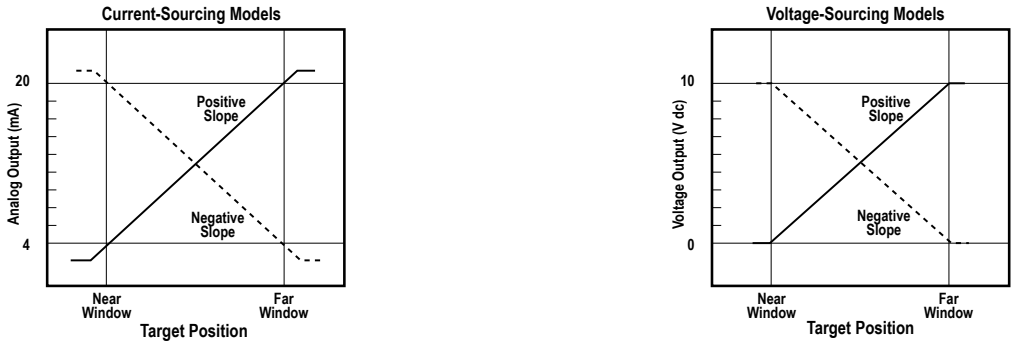


Figure 3. Positive and Negative Output Slopes

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
Rmax = V^{supply} - 7V / 20 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: ±0.25% of measured distance
Analog linearity: ±0.5% of full-scale sensing range
Sensing repeatability: ±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.

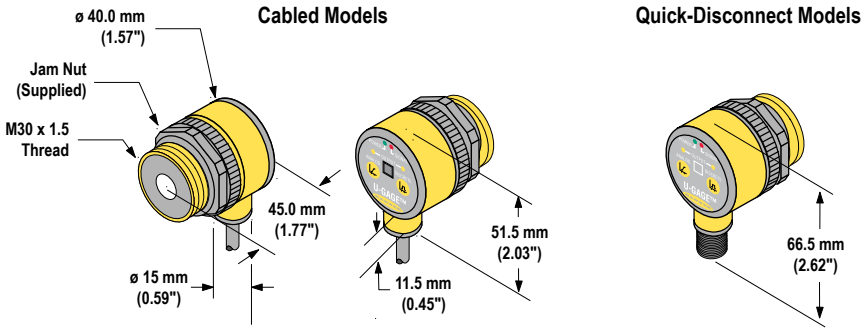
Note: For more information about out-of-range and signal loss response of the analog output, see *Analog Output* on page 5.

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

CE

Dimensions



Performance Curves

Effective Beam with Plate Target (Typical)

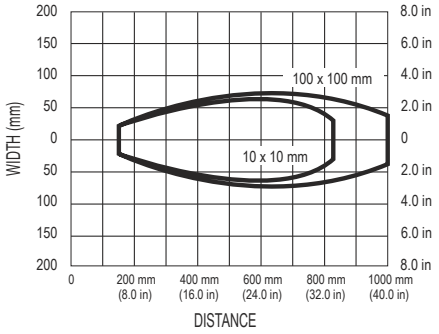


Figure 4. A Models

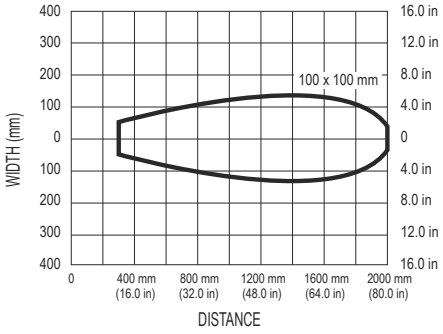


Figure 5. B Models

Effective Beam with Rod Target (Typical)

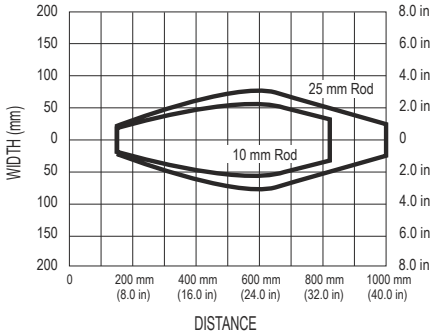


Figure 6. A Models

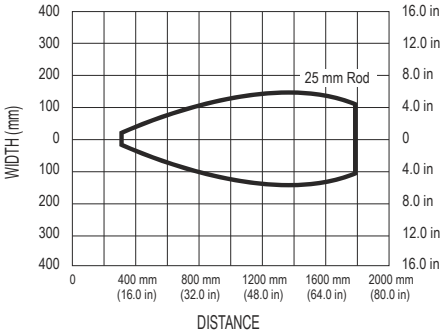
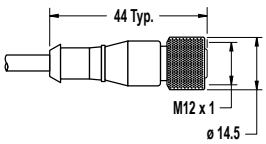
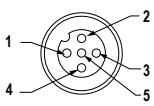
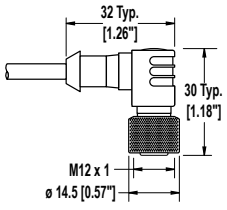


Figure 7. B Models

Accessories

Cordsets

5-Pin Threaded M12/Euro-Style Cordsets—with Shield

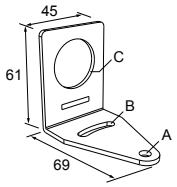
Model	Length	Style	Dimensions	Pinout (Female)
MQDEC2-506	1.83 m (6 ft)	Straight		 1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray
MQDEC2-515	4.57 m (15 ft)			
MQDEC2-530	9.14 m (30 ft)			
MQDEC2-550	15.2 m (50 ft)			
MQDEC2-506RA	1.83 m (6 ft)	Right-Angle		
MQDEC2-515RA	4.57 m (15 ft)			
MQDEC2-530RA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

Brackets

All measurements are in mm.

SMB30A

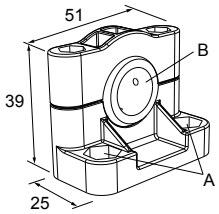
- Right-angle bracket with curved slot for versatile orientation
- Clearance for M6 (¼ in) hardware
- Mounting hole for 30 mm sensor
- 12-ga. stainless steel



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

SMB1815SF

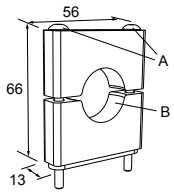
- Swivel with set screws for mounting sensors by the cable hub
- Black reinforced thermoplastic polyester
- Stainless steel swivel locking hardware and hex wrench included



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

SMB30C

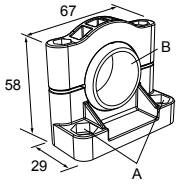
- 30 mm split clamp, black PBT bracket
- Stainless steel mounting hardware included
- Mounting hole for 30 mm sensor



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

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