U-GAGE® T30UX Series with Discrete Output

Datasheet

Ultrasonic sensor with TEACH-mode configuration

- 1, 2, and 3 m (3.28, 6.56, and 9.84 ft) versions with short dead zones (10% of max range)
- Built-in temperature compensation
- Fast, easy-to-use TEACH-Mode programming; no potentiometer adjustments
- Remote TEACH for security and convenience
- Wide operating temperature range of –40 °C to +70 °C (–40 °F to +158 °F)
- Outputs can be set for either NPN or PNP, Normally Open (N.O.) or Normally Closed (N.C.)
- Compact, self-contained, right-angle sensor package with fully encapsulated electronics

Models

Models	Range and Frequency	Cable [1]	Discrete Output	Response Time
T30UXDA	100 mm to 1 m (3.9 in to 39 in) 224 kHz	Standard 2 m (6.5 ft) cable	NPN, PNP, NO, NC, Selectable	45 ms
T30UXDB	200 mm to 2 m (7.8 in to 78 in) 174 kHz			92 ms
T30UXDC	300 mm to 3 m (11.8 in to 118 in) 114 kHz			135 ms

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.

Overview

The U-GAGE® T30UX is an easy-to-use ultrasonic sensor with extended range and built-in temperature compensation. Simple push button configuration provides flexibility for a variety of applications.

Easy-to-see indicator LEDs communicate the status of the sensor. The Green “Power” LED ON indicates that the sensor is in Run Mode (the sensor’s normal operating condition). The Red “Signal” LED indicates the target signal strength. The Amber “Output” LED indicates that the output is enabled and the sensor is receiving a signal within the window limits (depending on NO or NC). The Amber “Mode” LED indicates the currently selected mode.

Figure 1. Features

[1] Only standard 2 m (6.5 ft) cable models are listed. To order the 4-pin M12 integral QD, add the suffix “**Q8**” to the model number (for example, **T30UXDAQ8**). To order the 150 mm (6 in) PUR cable with a 4-pin M12 QD, add the suffix “**QPMA**” to the model number (for example, **T30UXDAQPMA**). To order the 9 m (30 ft) cable, add the suffix “**W/30**” to the model number (for example, **T30UXDA W/30**). A model with a QD connector requires a mating cable. See Accessories on page 11.

Principles of Operation

Ultrasonic sensors emit one or multiple pulses of ultrasonic energy, which travel through the air at the speed of sound. A portion of this energy reflects off the target and travels back to the sensor. The sensor measures the total time required for the energy to reach the target and return to the sensor. The distance to the object is then calculated using the following formula: **D = ct ÷ 2**

D = distance from the sensor to the target
c = speed of sound in air
t = transit time for the ultrasonic pulse

To improve accuracy, an ultrasonic sensor may average the results of several pulses before outputting a new value.

Temperature Effects

The speed of sound is dependent upon the composition, pressure and temperature of the gas in which it is traveling. For most ultrasonic applications, the composition and pressure of the gas are relatively fixed, while the temperature may fluctuate.

In air, the speed of sound varies with temperature according to the following approximation:

In metric units: $C_{m/s} = 20\sqrt{273 + T_C}$

$C_{m/s}$ = speed of sound in meters per second

T_C = temperature in °C

In English units: $C_{ft/s} = 49\sqrt{460 + T_F}$

$C_{ft/s}$ = speed of sound in feet per second

T_F = temperature in °F

Temperature Compensation

Changes in air temperature affect the speed of sound, which in turn affects the total time for the echo measured by the sensor. An increase in air temperature shifts both sensing window limits closer to the sensor. Conversely, a decrease in air temperature shifts both limits farther away from the sensor. This shift is approximately 3.5% of the limit distance for a 20° C change in temperature.

The T30UX series ultrasonic sensors are temperature compensated. This reduces the error due to temperature by about 90%. The sensor will maintain its window limits to within 2.2% over the -40° to +70° C (−40° to +158° F) operating range of the sensor.

Note:

- Exposure to direct sunlight can affect the sensor's ability to accurately compensate for changes in temperature.
- If the sensor is measuring across a temperature gradient, the compensation will be less effective.

Configuration Instructions

Sensor Configuration

Two TEACH methods may be used to configure the sensor:

- Teach individual minimum and maximum limits, or
- Use Auto-Window feature to center a sensing window around the taught position.

The sensor may be configured either via its push button, or via a remote switch. Remote configuration also may be used to disable the push button, preventing unauthorized personnel from adjusting the configuration settings. To access this feature, connect the white wire of the sensor to 0V dc, with a remote configuration switch between the sensor and the voltage.

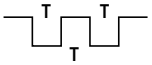
Configuration is accomplished by following the sequence of input pulses. The duration of each pulse (corresponding to a push button "click"), and the period between multiple pulses, are as "T": **0.04 seconds < T < 0.8 seconds**

Remote line configuration requires a greater than 1 second pause between pulse sequences.

Mode Setup - Output Configuration

Sensors can be set up for either NPN (sinking) or PNP (sourcing). In addition, the user can select between Normally Open (N.O.) and Normally Closed (N.C.) operation. Normally Open is defined as the output energizing when the target is present. Normally Closed is defined as the output energizing when the target is absent (see Teaching Minimum and Maximum Limits on page 3). A button click or pulse on the remote line is: 0.04 s < T < 0.8 s.

1. Enter Output Configuration setup mode.

Method	Action	Result
Push Button	Push and hold the MODE button for more than 2 seconds.	Power LED: OFF Mode LED: Flashing Amber shows previously selected mode
Remote Input	 Double-pulse the remote line.	Power LED: OFF Mode LED: Flashing Amber shows previously selected mode

2. Select the output.

Method	Action	Result
Push Button	Click the MODE button to cycle to select the output configuration: • NPN - Normally Open • NPN - Normally Closed • PNP - Normally Open • PNP - Normally Closed	Power LED: OFF Mode LED: Flashes to indicate currently selected mode (120 second time out [2])
Remote Input	• Single-pulse for NPN - Normally Open • Double-pulse for NPN - Normally Closed • Triple-pulse for PNP - Normally Open • Quad-pulse for PNP - Normally Closed	Power LED: ON Green Mode LED: ON to indicate currently selected mode (Sensor returns to RUN mode)

3. Save and return to Run mode.

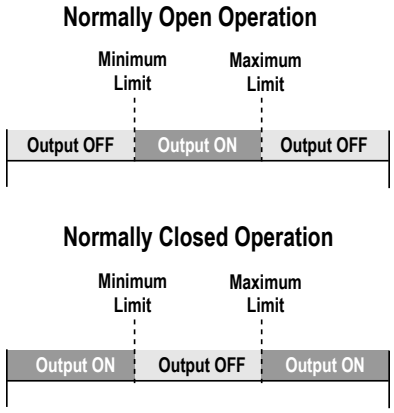
Method	Action	Result
Push Button	Push and hold the MODE button for more than 2 seconds.	Power LED: ON Green Mode LED: ON Amber for selected mode
Remote Input	No action required; the sensor returns to Run Mode automatically.	None

Teaching Minimum and Maximum Limits

General Notes on Teaching

- The sensor returns to RUN mode if the first TEACH condition is not registered within 120 seconds after the initial 2 second hold on the Discrete button.
- To exit TEACH mode without saving any changes, press and hold the Discrete button or remote line longer than 2 seconds (before teaching the second limit). The sensor reverts to the last saved limits.
- After the first limit is taught, the sensor remains in TEACH mode until the TEACH sequence is finished or exited by a 2 second hold on the Discrete button or remote line.
- A button click or pulse on the remote line is: 0.04 s < T < 0.8 s.

Figure 2. Teaching independent minimum and maximum limits



1. Enter TEACH mode.

Method	Action	Result
Push Button	Push and hold the Discrete push button longer than 2 seconds.	Power LED: OFF Output LED: ON
Remote Input	No action required; sensor is ready for first limit teach.	None

[2] The sensor will revert to previously saved configuration and return to RUN mode if TEACH is inactive for 120 seconds after the initial 2 second hold on push button