

U-GAGE® Q45U Long-Range Ultrasonic Sensors



Datasheet

Piezoelectric Proximity Mode Sensors with Push Button Programming of Sensing Window Limits – Bipolar Discrete Outputs



- Ultrasonic proximity detection from 250 mm to 3.0 m (9.8 in to 118 in)
- Push button TEACH mode programming of sensing window limits
- Digital filtering for exceptional immunity to electrical and acoustic noise
- 12 to 24 V dc operation
- Bipolar outputs: one NPN (sinking) and one PNP (sourcing)
- ON/OFF presence detection or HIGH/LOW level control are switch-selectable
- Wide operating temperature range of $-25\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$ ($-13\text{ }^{\circ}\text{F}$ to $+158\text{ }^{\circ}\text{F}$); models include temperature compensation
- Rugged design for use in demanding sensing environments; rated IEC IP67, NEMA 6P
- Choose models with integral unterminated 2 m (6.5 ft) or 9 m (30 ft) cable, or with Mini-style or M12/Euro-style quick-disconnect connection
- External enable/disable feature for remote gating control

Analog models are also available
Models with other ranges are also available

Models	Connection ¹	Output Type	Response Time
Q45UBB63BC	2 m (6.5 ft) unterminated cable	Bipolar NPN/PNP	Programmable for 40, 80, 320, or 1280 milliseconds
Q45UBB63BCQ	5-Pin Mini quick disconnect		
Q45UBB63BCQ6	5-Pin M12/Euro-style quick disconnect		



WARNING: Not To Be Used for Personnel Protection

Never use this device as a sensing device for personnel protection. Doing so could lead to serious injury or death. This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.

Temperature Compensation

All models listed above feature temperature compensation. An increase in air temperature shifts both sensing window limits closer to the sensor. Conversely, a decrease in air temperature shifts both limits further away from the sensor. The shift is approximately 3.5% of the limit distance for a $20\text{ }^{\circ}\text{C}$ change in temperature.

Temperature compensated models maintain the position of both sensing window limits to within 1% of each limit distance over the $0\text{ }^{\circ}\text{C}$ to $+50\text{ }^{\circ}\text{C}$ ($+32\text{ }^{\circ}\text{F}$ to $+122\text{ }^{\circ}\text{F}$) range, and to within 2.5% over the full operating range of $-25\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$ ($-13\text{ }^{\circ}\text{F}$ to $+158\text{ }^{\circ}\text{F}$).

¹ To order 9 m (30 ft) cable models, add the suffix "W/30" to the model number of any cabled sensor (for example, Q45UBB63BC W/30). Models with a quick-disconnect connector require an optional mating cable.



Overview

Near and Far Sensing Limit Settings. The Q45U features a single push button for programming of sensing window near and far limits. Refer to [Programming the Window Limit](#) on page 3.

Status Indicators. Status indicator LEDs are visible through the transparent, o-ring sealed polycarbonate top cover. Indicator function in the Run mode is, as follows:

- The green LED is on when power is applied to the sensor and flashes to indicate an overloaded output.
- The red LED flashes when an echo is received; the flash rate is proportional to echo strength.
- The amber LED is on when the outputs are conducting.

The 5-segment moving dot LED indicator displays the relative position of the target within the programmed sensing window. The #1 LED flashes when the target is closer than the near limit. The #5 LED flashes when the target is beyond the far limit.

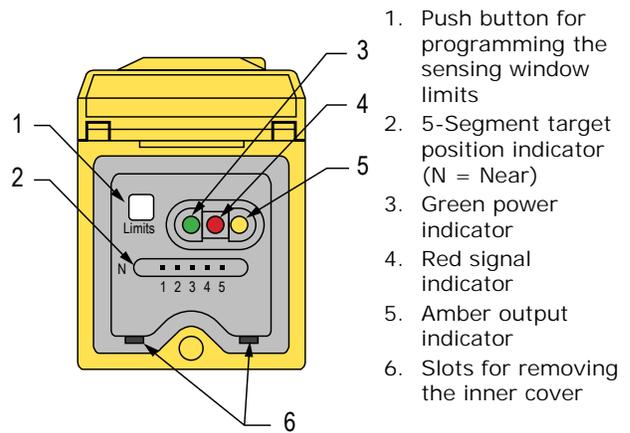


Figure 1. Q45U Long-Range Features

Output Response Settings.



Important: Disconnect the power before making any internal adjustments.

1. Insert a small flat-blade screwdriver into the slots.
2. Lift up and remove the black inner cover to expose the 4-position DIP switch.
3. Use the DIP switches to program the following functions:

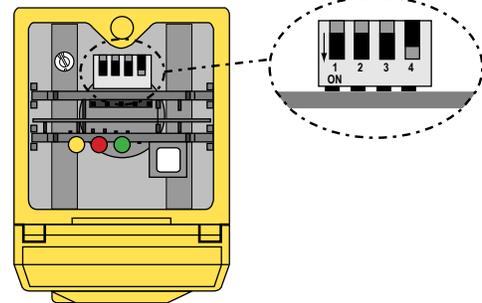


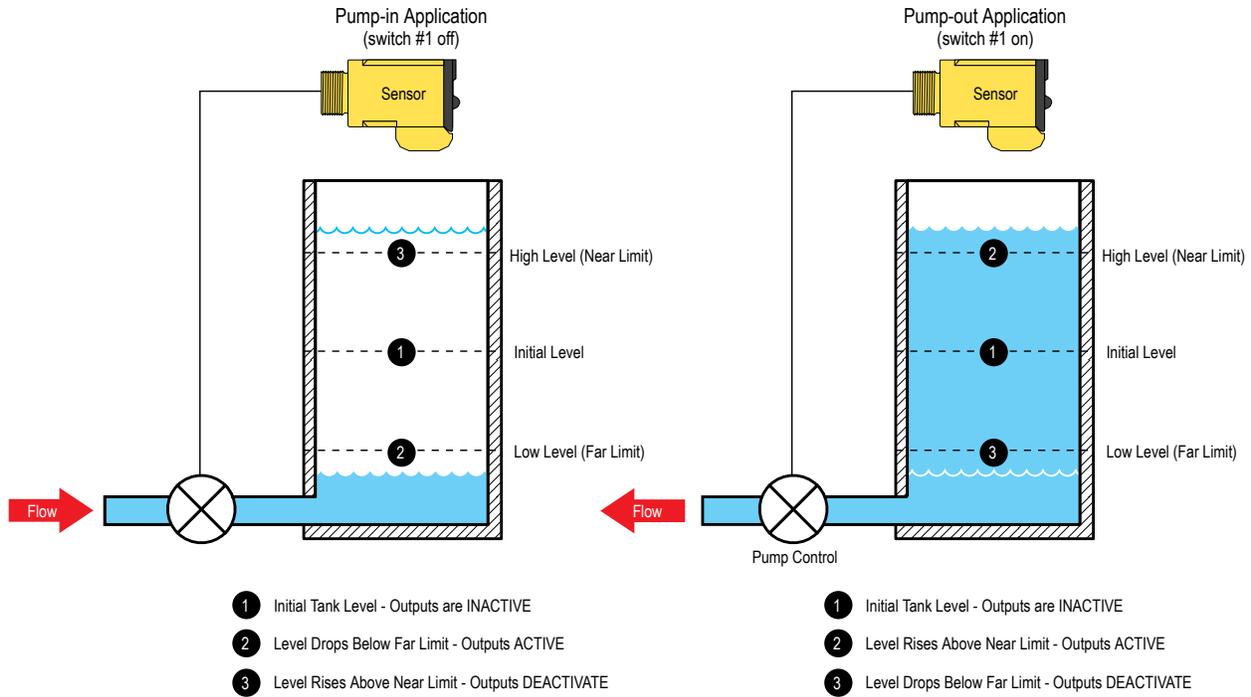
Figure 2. Q45U Programming Switches

DIP Switches	Function		
1	ON/OFF Mode		HIGH/LOW Mode On = Pump Out Off = Pump In
	Output: On = normally closed (output energizes when target is absent) Off ² = normally open (output energizes when target sensed)		
2	Mode: On = HIGH/LOW (fill level control) Off ² = ON/OFF (output follows sensing action)		
	3 and 4	Response (40 ms/cycle)	Switch 3
	1 cycle	OFF	OFF
	2 cycles	ON	OFF
	8 cycles ²	OFF ²	ON ²
	32 cycles	ON	ON

² Factory default settings



Important: A response setting of 2 cycles, or higher, is recommended for optimum sonic and electrical noise immunity. Always use the slowest acceptable response speed for your application. Single cycle update is only recommended for short range (>1.0 m) applications looking for a stationary background target.



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

Figure 3. High/Low Control (DIP Switch 2 in ON)

The HIGH/LOW mode (DIP switch 2 is ON) provides the switching logic required for fill-level, web tensioning control, and similar applications. In the HIGH/LOW mode, the output energizes when the target reaches the first sensing window limit, and stays energized until the target moves to the second limit. The output then de-energizes at the second limit and does not re-energize until the target moves, again, to the first limit. Figure 3 on page 3 shows how pumping action might be controlled, directly, by the sensor in a fill-level application.

Programming the Window Limit

Use the Limits button, located under the transparent top cover, to program the near and the far limits.

The near limit may be set as close as 250 mm (9.8 in) and the far limit may be set as far as 3.0 m (118 in) from the transducer face. The minimum window width is 25 mm (1.0 in). When possible, use the actual target to be sensed when setting the window limits. Programming the window limit begins with the sensor in Run mode.

1. Push and hold the Limits button until the green LED turns off (approximately 2 seconds).

Green LED	Amber LED	Red LED
Off	On to indicate the sensor is ready to program the first limit	Flashes to indicate the strength of the echo; Off if no target is present

2. Set the first limit (near or far) by placing the target at the first limit and pressing the Limits button for less than 2 seconds.

Green LED	Amber LED	Red LED
Off	Flashes at 2 Hz to indicate the sensor is ready to program the second limit	On for a moment, then resumes flashing to indicate the strength of the echo

3. Set the second limit (far or near) by placing the target at the second limit and pressing the Limits button for less than 2 seconds.

Green LED	Amber LED	Red LED
Off, then turns on when the sensor returns to Run mode	On for a moment, then is either on or off to indicate the output state when the sensor returns to Run mode	On for a moment, then resumes flashing to indicate the strength of the echo when the sensor returns to Run mode

Notes regarding window limit programming:

1. Either the near or far limit may be programmed first.
2. There is a 2-minute timeout for programming of the first limit. The sensor returns to Run mode with the previously programmed limits. There is no timeout between the programming of the first and second limit.
3. Cancel the programming sequence at any time by pressing and holding the Limits button for ≥ 2 seconds. The sensor returns to Run mode with the previously programmed limits.
4. During limit programming, the 5-segment moving dot indicator displays the relative target position between 0 m and 4.0 m (0 ft and 13.1 ft). The maximum recommended far limit position is 3.0 m (9.84 ft).
5. If the target is positioned between 3.0 and 4.0 m (9.84 ft to 13.1 ft), the 5th segment of the moving dot indicator flashes to indicate that a valid echo is received, but the target is beyond the recommended 3.0 m (9.84 ft) maximum far limit.
6. If a limit is rejected during either programming step, the sensor reverts to the first limit programming step. This is indicated by the green LED (OFF), red LED (flashing to indicate signal strength), and the amber LED (ON).
7. If both limits are accepted, the sensor returns to Run mode, which is indicated by the green LED (ON).
8. If the target is held at the same position for programming of both limits, the sensor establishes a 50 mm wide sensing window, centered on the target position.

Specifications

Supply Voltage and Current

12 to 24 V dc (10% maximum ripple) at 100 mA, exclusive of load

Proximity Mode Range

Near limit: 250 mm (9.8 in) minimum

Far limit: 3.0 m (118 in)

Note: The far limit may be extended as far as 3.9 m (12.79 ft) for good acoustical targets (hard surfaces with an area $> 100 \text{ cm}^2$)

Supply Protection Circuitry

Protected against reverse polarity and transient voltages

Output Configuration

Bipolar: one current sourcing (PNP) and one current sinking (NPN) open-collector transistor

Use the 4-position DIP switch to select the following:

Switch 1: Output normally open/normally closed (pump in/pump out)

Switch 2: High/Low level control mode or on/off presence sensing mode

Switch 3 & 4: Response speed selection (digital filter)

Output Rating

150 mA maximum (each)

Off-state leakage current: < 25 microamp at 24 V dc

On-state saturation voltage: < 1.5 V at 10 mA; < 2.0 V at 150 mA

Output Protection Circuitry

Protected against false pulse on power-up and continuous overload or short-circuit of outputs

Hysteresis

ON/OFF mode: 10 mm

HIGH/LOW mode: 0 mm

Performance Specifications

Repeatability: $\pm 0.1\%$ of measured distance (± 0.50 mm min)

Minimum Window Width: 25 mm (1.0 in)

Hysteresis: 10 mm (0.4 in)

Indicators

Three status LEDs:

Green ON = power to sensor is ON

Green flashing = output is overloaded

Amber ON = outputs are conducting (in Run mode); or programming status (in Setup mode)

Red flashing = indicates relative strength of received echo

5-segment moving dot LED indicates the position of the target within the sensing window

Construction

Molded PBT thermoplastic polyester housing, o-ring sealed transparent acrylic top cover, and stainless steel hardware.

Q45U sensors are designed to withstand 1200 psi washdown.

The base of cabled models has a 1/2"-14 NPS internal conduit thread

Connections

2 m (6.5 ft) or 9 m (30 ft) attached cable, or 5-pin Mini-style or 5-pin M12/Euro-style quick disconnect fitting

Environmental Rating

Leakproof design is rated IEC IP67; NEMA 6P

Operating Conditions

Temperature: -25 °C to $+70$ °C (-13 °F to $+158$ °F)

Maximum relative humidity: 100%

Vibration and Mechanical Shock

All models meet Mil Std. 202F requirements. Method 201A (vibration: 10 to 60 Hz max., double amplitude 0.06", maximum acceleration 10G). Also meets IEC 947-5-2 requirements: 30G 11 ms duration, half sine wave. Method 213B conditions H & I (Shock: 75G with unit operating; 100G for non-operation).

Application Notes

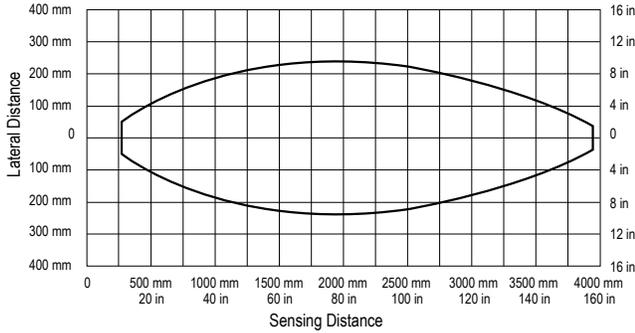
Minimum target size: 50 mm \times 50 mm aluminum plate at 3.0 m (118 in)

Enable/Disable: Connect the yellow wire to +5 to 24 V dc to enable the sensor and 0 to +2 V dc to disable the sensor. When the sensor is disabled, the last output state is held until the sensor is re-enabled.

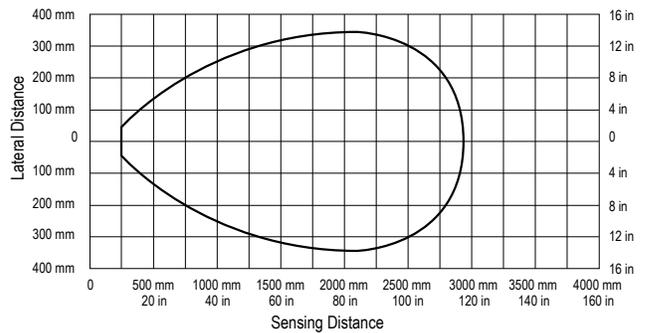
Hold the wire to the appropriate voltage for at least 40 ms to enable or disable the sensor.

Performance Curves

Effective Beam with 100 × 100 mm Plate Target (Typical)



Effective Beam with 2.5 cm Rod Target (Typical)

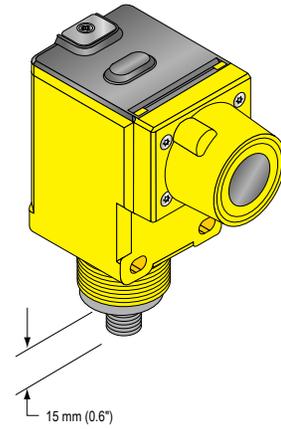
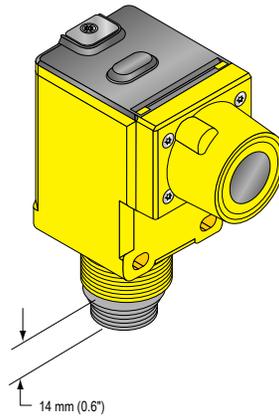
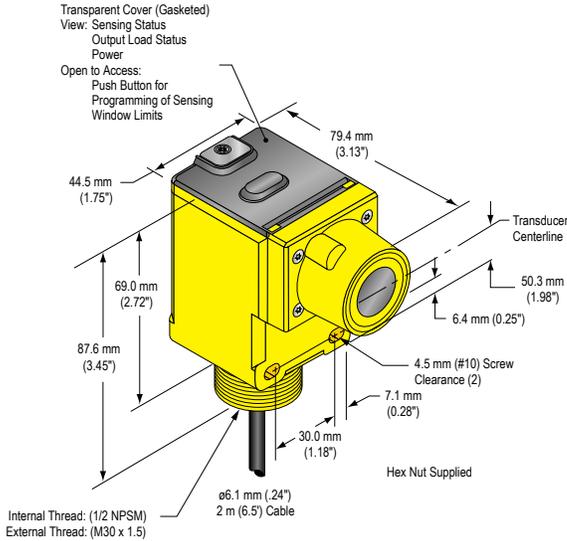


Dimensions

Cabled Models

5-pin Mini-style QD Models

5-pin Euro-style QD Models



Wiring Diagrams

Q45U Sensor with Attached Cable	Q45U Sensor with 5-pin Mini-style or Euro-style QD	Key
		<p>1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray (Euro-style) or yellow (Mini-style)</p> <p>Banner Engineering Corp. recommends that the shield wire be connected to earth ground or dc common.</p>

Accessories

Cordsets

5-Pin Mini-Style Cordsets with Shield				
Model	Length	Style	Dimensions	Pinout (Female)
MBCC2-506	1.83 m (6 ft)	Straight		<p>1 = Brown 2 = White 3 = Blue 4 = Black 5 = Yellow</p>
MBCC2-512	3.66 m (12 ft)			
MBCC2-530	9.14 m (30 ft)			

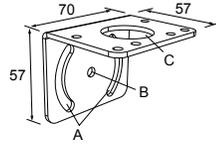
5-Pin Threaded M12/Euro-Style Cordsets with Shield				
Model	Length	Style	Dimensions	Pinout
MQDEC2-506	1.83 m (6 ft)	Straight		<p>1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray</p>
MQDEC2-515	4.57 m (15 ft)			
MQDEC2-530	9.14 m (30 ft)			
MQDEC2-550	15.2 m (50 ft)			
MQDEC2-506RA	1.83 m (6 ft)	Right-Angle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

Brackets

<p>SMB30S</p> <ul style="list-style-type: none"> Swivel bracket with 30 mm mounting hole for sensor Adjustable captive swivel ball Black reinforced thermoplastic polyester Stainless steel mounting and swivel locking hardware included 		<p>SMB30C</p> <ul style="list-style-type: none"> 30 mm split clamp, black PBT bracket Stainless steel mounting hardware included Mounting hole for 30 mm sensor <p>Hole center spacing: A=∅ 45 Hole size: B=∅ 27.2</p>	
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SMB30MM

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



Hole center spacing: A = 51, A to B = 25.4
 Hole size: A = 42.6 x 7, B = \varnothing 6.4, C = \varnothing 30.1

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