Q45U Ultrasonic Sensors with Analog Outputs (Short Range)

Piezoelectric analog proximity mode sensors with push-button or remote programming of sensing window limits



- Ultrasonic proximity detection from 100 to 1400 mm (4 to 55 inches)
- Push-button TEACH-mode programming of sensing window limits
- Digital filtering for exceptional immunity to electrical and acoustic “noise”
- Selectable 0 to 10V dc voltage sourcing or 4 to 20 mA current sourcing analog outputs
- Selectable output slope: positive or negative with increasing target distance
- Wide operating temperature range of –25 to +70 °C; all models include temperature compensation
- Rugged design for use in demanding sensing environments; rated IEC IP67, NEMA 6P
- Choose models with integral 2 m (6.5 ft) or 9 m (30 ft) cable, or with Mini-style or Euro-style quick-disconnect fitting
- Input for remote TEACH-mode programming of window limits

Models	Temperature Compensation	Cable	Supply Voltage	Output Type	Response Time
Q45ULIU64ACR	Yes	2 m (6.5 ft)	15–24V dc	Selectable 0–10V dc or 4–20 mA sourcing	Adjustable from 40 milliseconds to 1.28 seconds
Q45ULIU64ACRQ		5-Pin Mini-style QD			
Q45ULIU64ACRQ6		5-Pin Euro-style QD			

Standard 2 m (6.5 ft) cable models are listed. To order the 9 m (30 ft) cable model, add suffix "W/30" to the cabled model number. For example, Q45ULIU64ACR W/30. Models with a QD connector require a mating cable.

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 °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 to +50 °C range, and to within 2.5% over the full operating range of from –25 to +70 °C.

Setting the Near and Far Sensing Limits

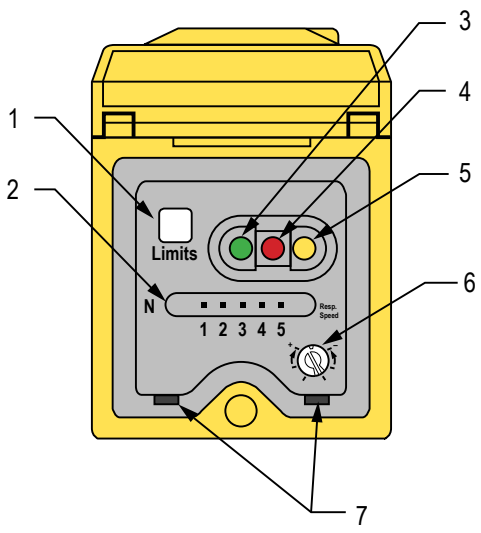
The Q45U features a single push button for programming of sensing window near and far limits. For more information, refer to *Programming the Window Limits* on page 4.

Status Indicators

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

- The green LED is solid when power is applied to the sensor and flashes to indicate a current output fault.
- The red LED is solid when an echo is received and flashes at a rate proportional to echo strength.
- The amber LED is solid when the target is within the operating window limits.

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



1 - Push button for programming sensing window limits
2 - 5-segment target position indicator (N = near)
3 - Green POWER indicator LED
4 - Red SIGNAL indicator LED
5 - Amber OUTPUT indicator LED
6 - Response adjustment
7 - Slots for removing inner cover

Figure 1. Analog Q45U Features

Output Response Settings

Important: Remove power before making any internal adjustments.

Using the two slots shown in *Figure 1* on page 2, a small flat-blade screwdriver may be used to lift up and remove the black inner cover to expose the 4-position DIP switch. Use these DIP switches to program the output slope, output mode, loss of echo, and min./max. output value default.

DIP Switch	Function	Settings
1	Output slope	On = Output value increases with distance Off* = Output value decreases with distance
2	Output mode	On = Current output enabled Off* = Voltage output enabled
3	Loss of echo	On = Min - Max Mode Off* = Hold Mode
4	Min-Max	On* = Default to maximum output value Off = Default to minimum output value

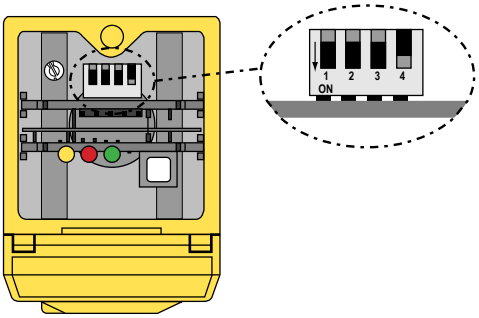


Figure 2. DIP Switches for Q45U Sensors

* Factory default setting.

DIP Switch 1: Output Slope Select

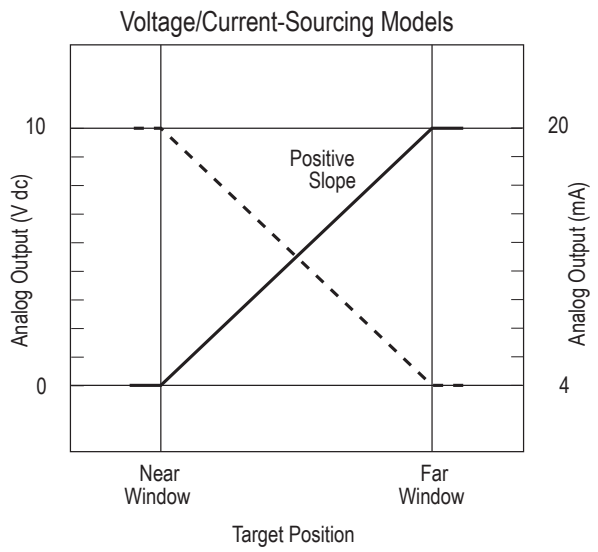


Figure 3. Output as a function of target position

On = Direct = Output value (voltage or current) increases with increasing distance of the target from the sensor

Off* = Inverse = Output value decreases with increasing distance of the target from the sensor

DIP Switch 2: Output Mode Select

On = The 4 to 20 mA current output (white wire) is enabled

Off* = The 0 to 10V dc voltage output (black wire) is enabled

This switch configures the D/A driver to use either the current output or the voltage output driver. This output function can only be set with the power to the sensor turned off.

DIP Switch 3: Loss of Echo Mode Select

On = Min - Max Mode

Off* = Hold Mode

This switch determines the output response to the loss of echo. The “Hold Mode” (Switch 3 Off*) maintains the output at the value present at the time of echo loss. The “Min - Max Mode” (Switch 3 On) drives the output to either the minimum value (0V or 4 mA or the maximum value (10V or 20 mA) when the echo is lost. Minimum or maximum value is selected by DIP switch 4.

DIP Switch 4: Min-Max Default

On* = Default to maximum output value at loss of echo

Off = Default to minimum output value at loss of echo

Switch 4 selects the output response to loss of echo when “Min - Max Mode” is selected by DIP switch 3.

Response Speed Adjustments

The speed of the output response is set using the single-turn potentiometer. There are six values for response speed, which relate directly to the number of sensing cycles over which the output value is averaged. The response value is set by aligning the slot of the potentiometer with one of the marked positions.

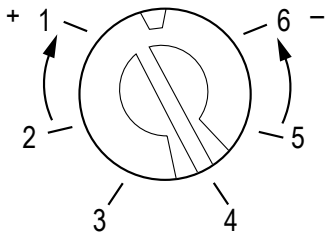
Position	Response Speed	Potentiometer Positions
1	80 milliseconds (2 cycles)	
2	160 milliseconds (4 cycles)	
3	320 milliseconds (8 cycles)	
4	640 milliseconds (16 cycles)	
5	1.28 seconds (32 cycles)	
6	2.56 seconds (64 cycles)	

Figure 4. Response adjustment positions
This example shows the potentiometer set at position number 4. There are no numbers on the actual product label.

Programming the Window Limits

Use the “Limits” push button, located under the transparent top cover, to program the near and the far limits. The near limit may be set as close as 100 mm (4 inches) and the far limit may be set as far as 1400 mm (55 inches) from the transducer face. Minimum window width is 10 mm (0.4 inches). Whenever possible, use the actual target to be sensed when setting the window limits. The following procedure begins with the sensor in Run mode.

Step	Description	LED Indicator Status
1	Access Limit Programming Mode. Push and hold until the green indicator LED turns off (approximately 2 seconds).	Green: Goes off
		Amber: Solid on to indicate ready for teaching first limit
		Red: Flashes to indicate strength of echo or is off if no target is present
2	Set the First Limit (Near or Far). Place the target at the first limit and press the push button for less than 2 seconds.	Green: Remains off
		Amber: Flashes at 2 Hz to indicate ready for teaching second limit
		Red: Solid on for a moment, then resumes flashing to indicate strength of echo
3	Set the Second Limit (Far or Near). Place the target at the second limit and press the push button for less than 2 seconds	Green: Remains off, then comes on solid (returns to Run mode)
		Amber: Solid on for a moment, then is either on or off to indicate output state (returns to Run mode)
		Red: Solid on for a moment, then resumes flashing to indicate strength of echo (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 time-out for programming of the first limit. The sensor will return to Run mode with the previously programmed limits. There is no time-out between programming of the first and second limit.
3. The programming sequence may be cancelled at any time by pressing and holding the push 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 and 1500 mm (the maximum recommended far limit position is 1400 mm (55 inches)).
5. If the target is positioned between 1400 mm (55 inches) and 1500 mm, the 5th segment of the moving dot indicator flashes to indicate that a valid echo is received, but the target is beyond the recommended 1400 mm (55 inches) maximum far limit.
6. If a limit is rejected during either programming step, the sensor will revert to the first limit programming step (Step 2 in programming chart). This will be indicated by Green - off, Red - flashing to indicate signal strength, and Amber - solid on.
7. If both limits are accepted, the sensor will return to Run mode, which is indicated by the solid on Green LED.

8. If the target is held at the same position for programming of both limits, the sensor will establish a 10 mm-wide sensing window, centered on the target position.

Remote Programming the Window Limits

Connect the yellow wire of the Analog Q45U to a switch or process controller for remote programming of the sensing window limits. The programming procedure is the same as for the push button. A remote programming input is generated when +5 to 24V dc is applied to the yellow wire. The timing diagrams, below, define the required input pulses.

H = +5 to 24V dc

L = <2V dc (or open circuit)

Notes regarding remote window limit programming:

1. The push button is disabled during remote limit programming. (The remote programming input is disabled during push button programming.)
2. Also see the notes regarding window limit programming.

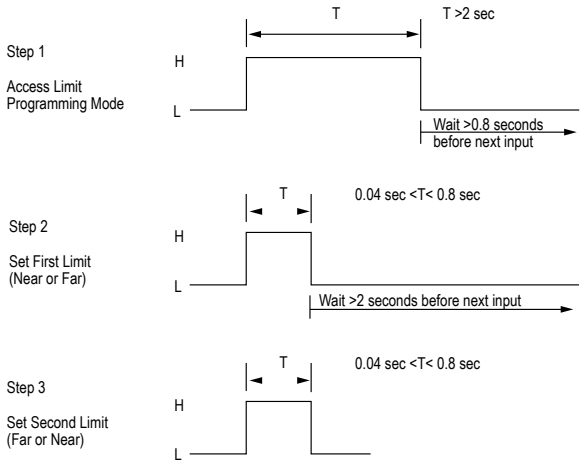


Figure 5. Remote programming the window limits

Specifications

Proximity Mode Range

Near limit: 100 mm (4.0 inches) min

Far limit: 1.4 m (55 inches) max

Supply Voltage and Current

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

Supply Protection Circuitry

Protected against reverse polarity and transient voltages

Indicators

Three status LEDs:

Green solid = power to sensor is ON

Green flashing = current output fault detected (indicates that the 4-20 mA current path to ground has been opened)

Amber solid = target is sensed within the window limits (Amber LED also indicates programming status during 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"-14NPS internal conduit thread

Output Configuration

One voltage sourcing and one current sourcing; one or the other output is enabled by internal programming switch #2. Output function may be programmed by a 4-position DIP switch located on top of the sensor, beneath the transparent o-ring sealed acrylic cover.

Output Rating

Voltage sourcing: 0 to 10V dc, 10 mA maximum

Current sourcing: 4 to 20 mA, 1 to 500 ohm impedance

Output Protection Circuitry

Both outputs are protected against continuous overload and short circuit

Performance Specifications

Sensing Repeatability: ±0.1% of the measured distance (±0.25 mm minimum)

Sensing Resolution: 0.25 mm (0.01 in)

Analog Output Resolutions: 2 mV, 3 µA

Environmental Rating

Leakproof design is rated IEC IP67; NEMA 6P

Operating Temperature

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

Maximum relative humidity: 100%

Vibration and Mechanical Shock

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

Connections

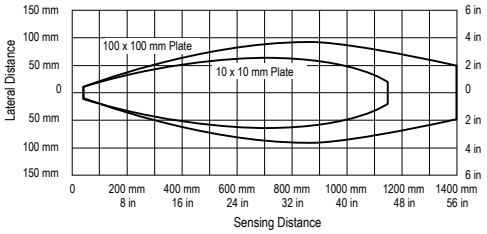
2 m (6.5 ft) or 9 m (30 ft) attached cable, or 5-pin Mini-style or 5-pin Euro-style quick-disconnect fitting

Application Notes

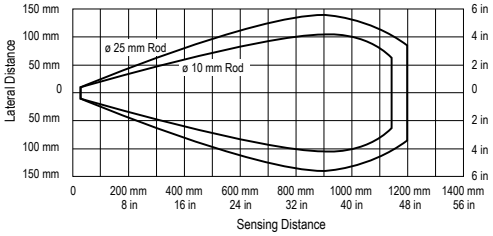
Minimum target size: 10 mm x 10 mm aluminum plate at 500 mm (20")
35 mm x 35 mm aluminum plate at 1.4 m (55")

Performance Curves

Effective Beam with Plate Target (Typical)

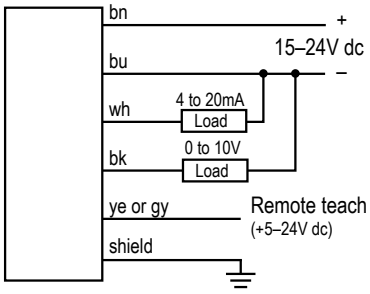


Effective Beam with Rod Target (Typical)



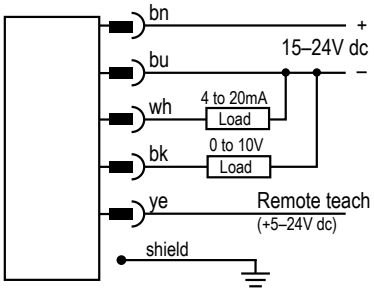
Hookup Diagrams for Q45U Sensors with Analog Outputs

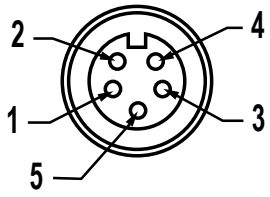
Sensor with Attached Cable



Banner Engineering Corp recommends the shield wire be connected to earth ground or dc common.

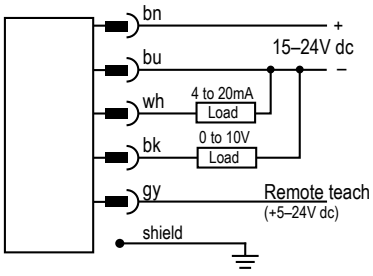
Sensor with 5-pin Mini-style QD

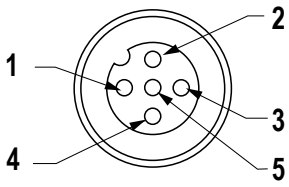




1 = brown
2 = white
3 = blue
4 = black
5 = yellow

Sensor with 5-pin Euro-style QD

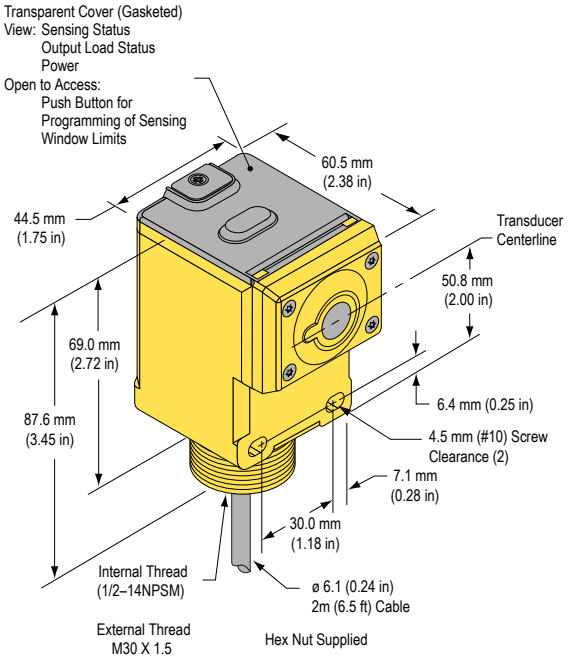


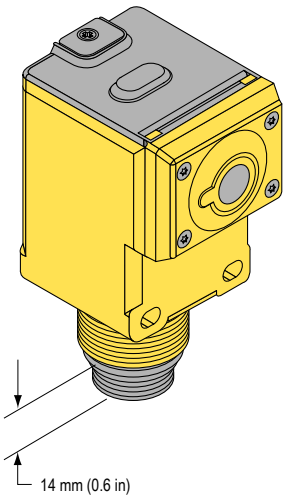


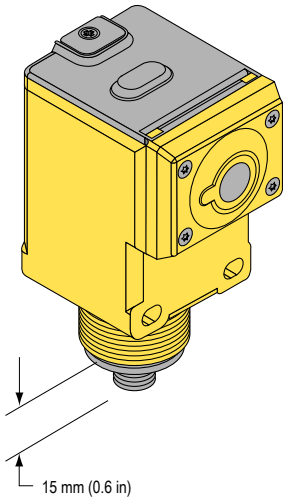
1 = brown
2 = white
3 = blue
4 = black
5 = gray

Dimensions

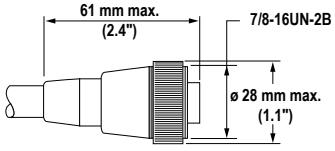
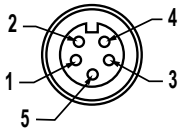
Cabled Models	5-pin Mini-Style QD Models	5-pin Euro-syle QD Models



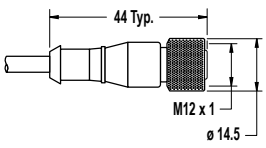
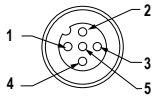




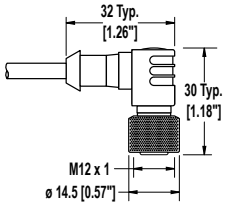
Accessories

5-Pin Mini-Style Cordsets with Shield				
Model	**Length**	**Style**	**Dimensions**	**Pinout (Female)**
MBCC2-506	1.83 m (6 ft)	Straight		
MBCC2-515	4.57 m (15 ft)			
MBCC2-530	9.14 m (30 ft)			

1 = Brown
2 = White
3 = Blue
4 = Black
5 = Yellow

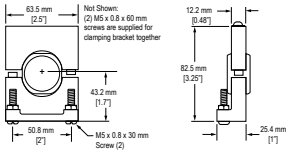
5-Pin Threaded M12/Euro-Style Cordsets with Shield				
Model	**Length**	**Style**	**Dimensions**	**Pinout**
MQDEC2-506	1.83 m (6 ft)	Straight		
MQDEC2-515	4.57 m (15 ft)			
MQDEC2-530	9.14 m (30 ft)			
MQDEC2-550	15.2 m (50 ft)			

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

5-Pin Threaded M12/Euro-Style Cordsets with Shield				
Model	**Length**	**Style**	**Dimensions**	**Pinout**
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)			

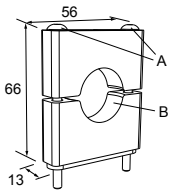
SMB30S

- 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



SMB30C

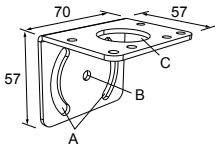
- 30 mm split clamp, black PBT bracket
- Stainless steel mounting hardware included
- Mounting hole for 30 mm sensor



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

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 = ø 6.4, C = ø 30.1

Banner Engineering Corp Limited Warranty

Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product.

THIS LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED (INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), AND WHETHER ARISING UNDER COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE.

This Warranty is exclusive and limited to repair or, at the discretion of Banner Engineering Corp., replacement. **IN NO EVENT SHALL BANNER ENGINEERING CORP. BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR ANY EXTRA COSTS, EXPENSES, LOSSES, LOSS OF PROFITS, OR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES RESULTING FROM ANY PRODUCT DEFECT OR FROM THE USE OR INABILITY TO USE THE PRODUCT, WHETHER ARISING IN CONTRACT OR WARRANTY, STATUTE, TORT, STRICT LIABILITY, NEGLIGENCE, OR OTHERWISE.**

Banner Engineering Corp. reserves the right to change, modify or improve the design of the product without assuming any obligations or liabilities relating to any product previously manufactured by Banner Engineering Corp.