U-GAGE® QT50UVR Series Sensors

Datasheet



Figure 1. Standard Model



Figure 2. Teflon-Protected Model

- Fast, easy-to-use TEACH-Mode programming; no potentiometer adjustments
- SPDT electromechanical relay for high-capacity switching
- Universal supply voltage: 85 to 264 V ac / 48 to 250 V dc
- Rugged encapsulated design for harsh environments
- Models available with factory-installed Teflon® flange and film coating bonded over the transducer for protection from harsh environments
- Unique housing design allows for multiple mounting configurations
- Choose models with integral 2 m (6.5 ft) or 9 m (30 ft) cable, or with Mini-style or Micro-style quick-disconnect fitting
- Wide operating range of –20 °C to 70 °C (–4 °F to 158 °F)
- Temperature compensation

Teflon® is a registered trademark of Dupont™

Information about dc-voltage models is available on Banner's website: *www.bannerengineering.com*

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.

Models

Models	Sensing Range	Cable [1]	Operation Model
QT50UVR3W	200 mm to 8 m (8 in to 26 ft)	5-wire, 2 m (6.5 ft) cable	Window-limit (N.O.and N.C.)
QT50UVR3WQ1		5-pin Micro-style Quick Disconnect (QD)	
QT50UVR3WQ		5-pin Mini-style QD	
QT50UVR3F		5-wire, 2 m (6.5 ft) cable	Fill-level control (pump-in and pump out)
QT50UVR3FQ1		5-pin Micro-style QD	
QT50UVR3FQ		5-pin Mini-style QD	

Overview

Ultrasonic sensors excel in position-monitoring applications and in applications involving clear or multi-colored targets.

QT50UVR sensors are available in a variety of models: dc sensors with either analog or two discrete outputs, or universal voltage models that feature an SPDT electromechanical relay for switching larger loads. Programming and setup for the universal voltage models are accomplished using the sensor's two push buttons.

Models are available with Teflon sensor face and hex nut, plus Teflon-coated transducer and special o-rings for use in harsh environments, such as fill-level monitoring in an acidfilled tank.

[1] To order the 9 m cable models, add the suffix W/30 to the model number of a cabled sensor (for example, QT50UVR3W w/30). Models with a QD connector require a mating cable.

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

The speed of sound changes roughly 1% per 6° C (10° F). QT50U series ultrasonic sensors have temperature compensation available; temperature compensation will reduce the error due to temperature by about 90%.

Changes in air temperature affect the speed of sound, which in turn affects the distance reading measured by the sensor. An increase in air temperature shifts both sensing window limits farther away from the sensor. Conversely, a decrease in air temperature shifts both limits closer to the sensor. This shift is approximately 3.5% of the limit distance for a 20° C change in temperature. With temperature compensation enabled, the sensor will maintain the window limits to within 1.8% over the entire -20° to +70° C (−4° to +158° F) range.

NOTE:
- If temperature compensation is enabled, 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.
- With temperature compensation enabled, the temperature warmup drift upon power-up is less than 1.0% of the sensing distance. After 30 minutes, the apparent switchpoint will be within 0.5% of the actual position. After 60 minutes, the apparent switchpoint will be within 0.3% of the actual position.

Configuration

The sensor can be configured for one of three output response times and to enable or disable temperature compensation. Both are accomplished using the sensor's Speed push button, using the procedures described below. A button click is defined as: 0.04 ≤ Click ≤ 0.8 sec.

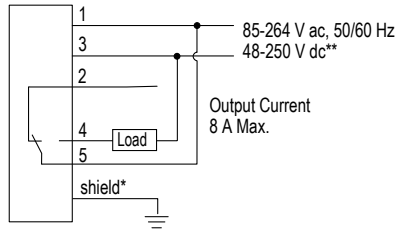
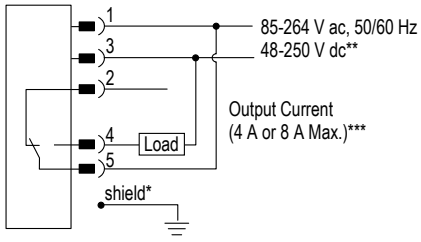
1. Select the output response time.

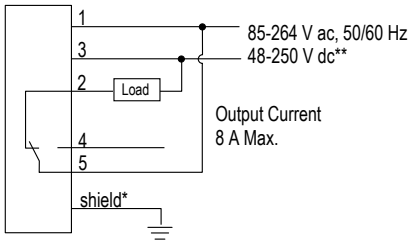
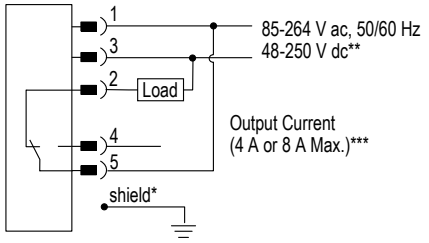
Action	Result
Click the Speed button until the desired output response time is selected.	Response LED cycles throughSolid Red, Solid Amber, and OFF to indicate selected Output Response Time. • Solid Red — Slow Response (1600 ms) • Solid Amber — Medium Response (400 ms) (factory default) • OFF — Fast Response (100 ms)
	No further action required; sensor stores selection and remains in RUN mode.

2. Enable or disable the temperature compensation.

Action	Result
Push and hold the Speed push button for 10 seconds to enter programming mode.	Response LED flashes: • Flashing Amber — Temperature Compensation is enabled (default). • Flashing Red — Temperature Compensation is disabled.
Click the Speed button to toggle between enable and disable.	Response LED flashes: • Flashing Amber — Temperature Compensation is enabled (default). • Flashing Red — Temperature Compensation is disabled.
Push and hold the Speed button for 10 seconds to return to Run mode.	• Sensor stores selection. • Sensor returns to Run mode. • Response LED returns to a solid color or OFF to indicate current Output Response Time setting.

Wiring

Cabled Models	QD Models	
Normally Open/Pump-In	Normally Open/Pump-In	Key
		1 - brown 2 - white 3 - blue 4 - black 5 - yellow

Normally Closed/Pump-Out	Normally Closed/Pump-Out	Key
		1 - brown 2 - white 3 - blue 4 - black 5 - yellow

* Banner recommends that the shield wire be connected to earth ground.

** DC wiring is without regard to polarity

*** 4 A maximum for sensors with Micro-style quick disconnects; 8 A maximum for sensors with Mini-style quick disconnects.

Status Indicators

Power ON/OFF LED (Green) — ON when sensor power is ON.

Signal LED (Red) — indicates incoming signal strength and condition.

Signal LED Status	Indicates
ON Bright	Good signal
ON Dim	Marginal signal strength
OFF	No signal is received [2] or target is beyond the sensor's range limitations

Output LED (Amber or Red) — indicates the target position relative to the window limits, or TEACH mode status.

Output LED Status	Indicates	
RUN Mode	Window-Limit Sensor Models	Fill-Level Control Sensor Models
ON Amber	Target is within window limits	Level has dropped below far limit
OFF	Target is outside window limits	Level has risen above near limit

TEACH Mode	
ON Red	Waiting for first limit to be taught
Flashing Red	Waiting for second limit to be taught

Response LED (Amber or Red) — indicates sensor output response time selection.

Response LED Status	Indicates
ON Red	Slow response (1600 ms)
ON Amber	Medium response (400 ms)
OFF	Fast response (100 ms)

Sensor Programming

Two TEACH methods may be used to program the sensor, using the TEACH button:

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

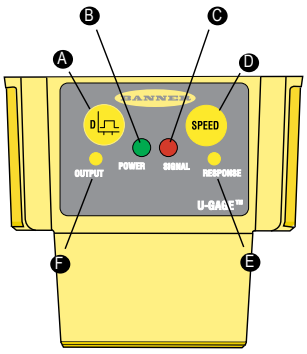


Figure 3. Sensor features

A - TEACH button
B - Sensor power indicator
C - Target signal strength indicator
D - Speed button
E - Output response time indicator
F - Output ON indicator

Teaching Minimum and Maximum Limits

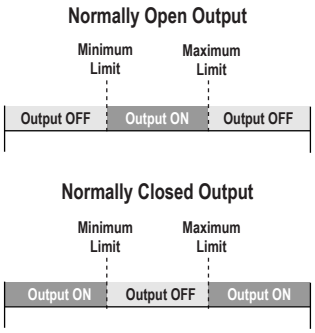


Figure 4. Teaching independent minimum and maximum limits — window limit models

Teach procedures are identical for window-limit and fill-level control models. Window-limit models function as shown in the figure on the right, and fill-level control models function as shown in *Figure 5* on page 5. To readjust minimum or maximum limits, repeat the teach procedure.

A button click is defined as: 0.04 s. ≤ Click ≤ 0.8 s.

1. Enter programming mode.

[2] If no signal is received, the output reacts as if the target is beyond the far limit. The normally open output will be OFF, and the normally closed output will be ON.

Action	Result
Push and hold TEACH button for 2 seconds	Output LED turns solid red and the sensor waits for first limit

2. Teach the first limit.

Action	Result
Position the target for the first limit.	
Click the TEACH button.	The sensor learns the first limit position and the Output LED changes to flashing red

3. Teach the second limit.

Action	Result
Position the target for the second limit.	
Click the TEACH button.	The sensor stores both limits and Output LED turns solid amber. The sensor returns to Run mode.

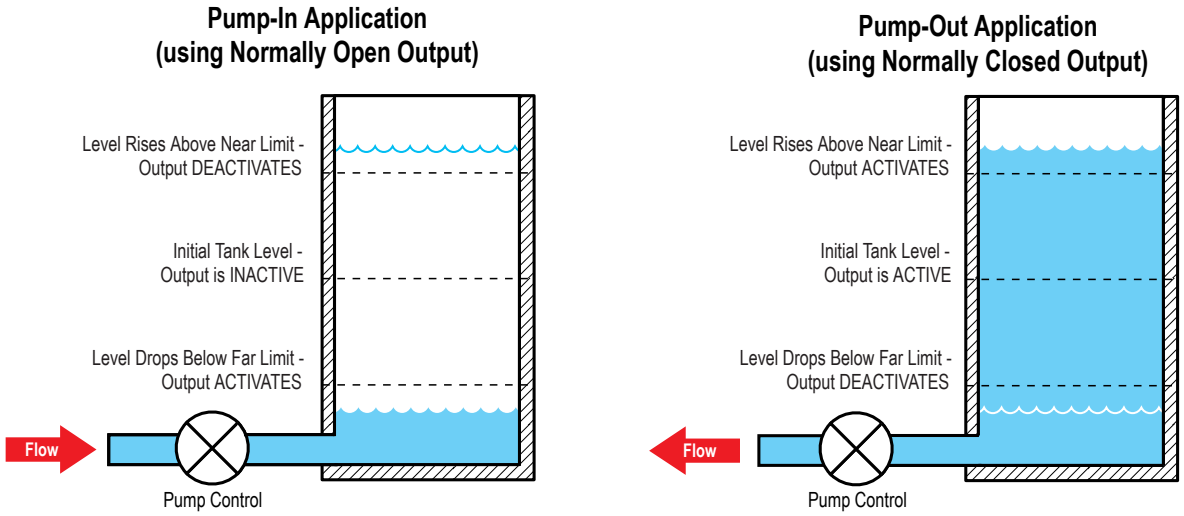


Figure 5. Fill-Level Control

The Fill-Level Control mode provides the switching logic required for fill-level, web tensioning control, and similar applications. In this 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.

Teaching Limits Using the Auto-Window Feature

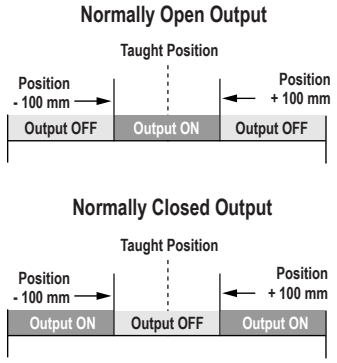


Figure 6. Using the Auto-Window feature for programming

Teach procedures are identical for window-limit and fill-level control models. Teaching the same limit twice automatically centers a 200 mm window on the taught position. To readjust the sensing midpoint, repeat the teach procedure.

A button click is defined as: 0.04 s. ≤ Click ≤ 0.8 s.

1. Enter programming mode.

Action	Result
Push and hold TEACH push button for 2 seconds.	Output LED turns solid red and the sensor waits for first limit.

2. Teach the first limit.

Action	Result
Position the target at the desired midpoint for the sensing window.	
Click the TEACH button.	Output LED changes to flashing red

3. Teach the second limit.

Action	Result
Without moving the target, click the button again.	The sensor stores sensing window and the Output LED turns solid amber. The sensor returns to Run mode.

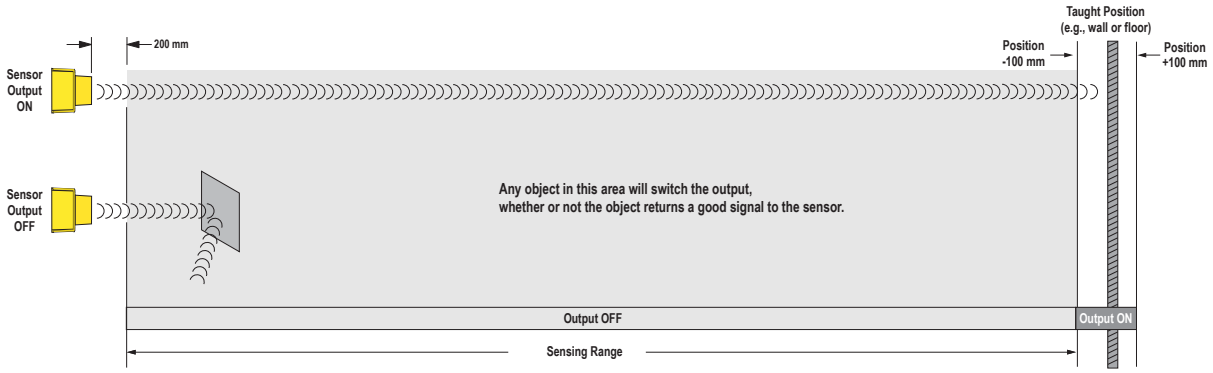


Figure 7. An application for Auto-Window feature (retroreflective mode)

Installing the Chemical-Resistant Models

The sensor may be threaded directly into the side of a tank (see dimensions for hole diameter and thread specifications), or into a non-threaded hole, using the included threaded nut. Recommended through-hole size: 56.5 ± 0.5 mm

For a non-threaded hole, install an o-ring onto the flange, and insert the flange completely into the hole until the sensor's front surface is against the tank's exterior surface. Place the second o-ring into the groove on the PTFE nut. Thread the nut onto the flange and tighten enough to eliminate gaps between the flange and the tank surface. This ensures that the o-rings are fully compressed.

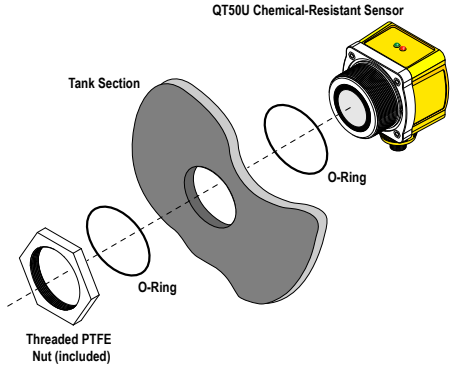


Figure 8. Installing a chemical-resistant sensor model into a non-threaded hole in a tank

Specifications

Sensing Range
200 mm to 8 m (8 in to 26 ft)

Supply Voltage
Universal Voltage: 85 to 264 V ac, 50/60 Hz / 48 to 250 V dc (1.5 watts maximum, exclusive of load)

Supply Protection Circuitry
Protected against transient overvoltages; DC wiring is without regard to polarity

Ultrasonic Frequency
75 kHz burst, rep. rate 96 ms

Delay at Power-up
1.5 seconds

Output Configuration
SPDT (Single-Pole, Double-Throw) electromechanical relay output

Output Ratings
Max. switching power (resistive load): 2000 VA, 240 W (1000 VA, 120 W for sensors with Micro-style QD)
Max. switching voltage (resistive load): 250 V ac, 125 V dc
Max. switching current (resistive load): 8 A at 250 V ac, 8 A at 30 V dc derated to 200 mA at 125 V dc (4 A max. for sensors with Micro-style QD)
Min. voltage and current: 5 V dc, 10 mA
Mechanical life of relay: 50,000,000 operations
Electrical life of relay at full resistive load: 100,000 operations

Output Response Time
Selectable 1600 ms, 400 ms or 100 ms

Temperature Effect
Uncompensated: 0.2% of distance/°C
Compensated: 0.02% of distance/°C

Hysteresis
Window-Limit Sensor Models: 5 mm
Fill-Level Control Sensor Models: 0 mm

Repeatability
1.0 mm

Minimum Window Size
20 mm

Adjustments
Sensing Limits: TEACH-Mode programming of near and far limits
Sensor Configuration: Output response time and temperature compensation mode
Factory Default Settings: 400 ms output response; Temperature compensation enabled

Indicators
Green Power On LED: Indicates power is ON.
Red Signal LED: Indicates target is within sensing range, and the condition of the received signal.
Output indicator (bicolor amber/red): Indicates output status or TEACH mode.
Response indicator (bicolor amber/red): Indicates output response time selection.

Construction
Transducer: Ceramic/Epoxy composite
Housing: ABS
Membrane Switch: Polyester
CRFV Models: Teflon face, flange, hex nut and transducer coating; Viton® o-ring

Operating Conditions
Temperature: −20 °C to +70 °C (−4 °F to +158 °F)
Maximum Relative Humidity: 100%

Connections
2 m (6.5 ft) or 9 m (30 ft) shielded 5-conductor (with drain) PVC jacketed attached cable or 5-pin Micro-style quick-disconnect or 5-pin Mini-style quick-disconnect fitting.

Environmental Rating
Leakproof design is rated IEC IP67; NEMA 6P

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

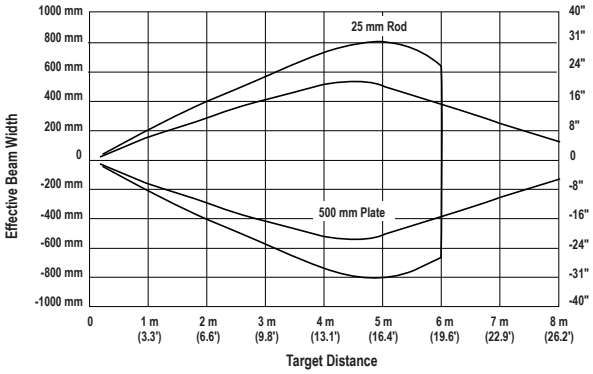
Temperature Warmup Drift
Less than 1.0% of sensing distance upon power-up with Temperature Compensation enabled

Application Notes
Objects passing inside the specified minimum sensing distance (200 mm) may produce a false response.

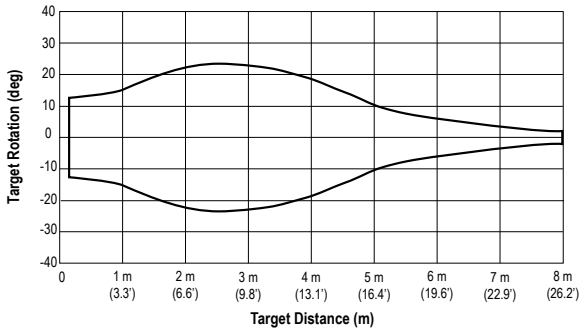
Certifications
CE

Performance Curves

QT50U Effective Beam Pattern

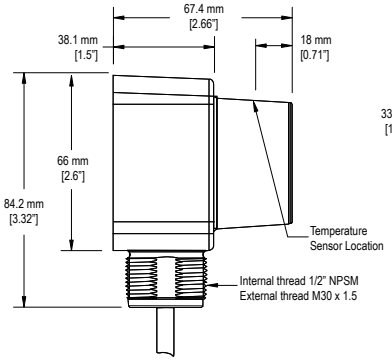


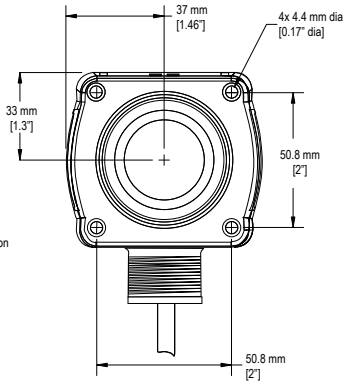
QT50U (with 500 mm Plate) Maximum Target Rotation Angle



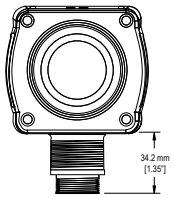
Dimensions

Cabled Models

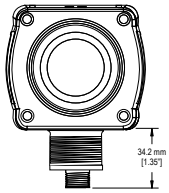




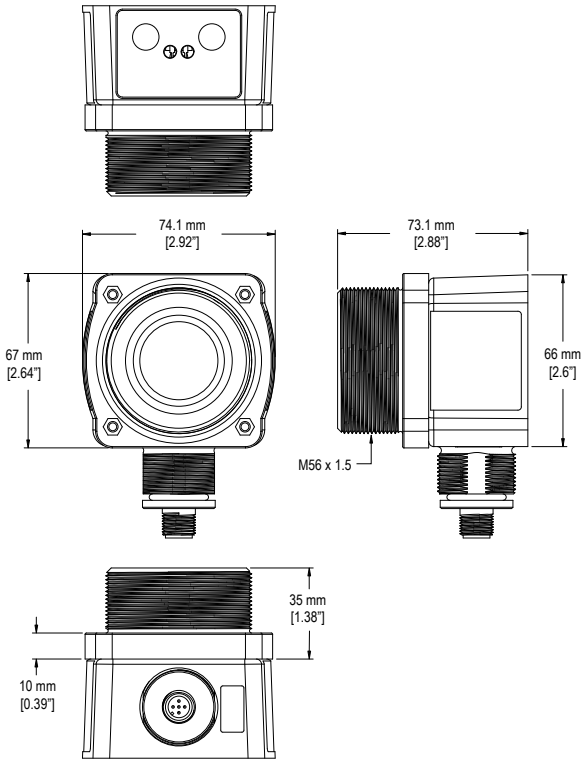
5-pin Mini-style Models



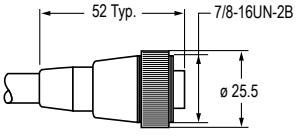
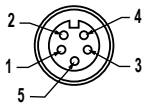
5-pin Euro-style Models



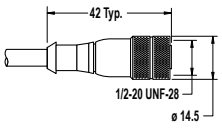
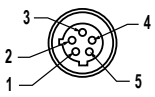
Chemical-Resistant Models



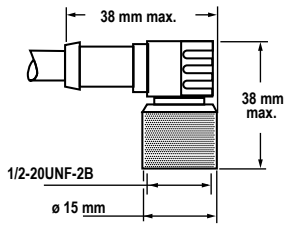
Accessories

5-Pin Mini-Style Cordsets—with Shield				
Model	Length	Style	Dimensions	Pinout (Female)
MBCC2-506	1.83 m (6 ft)	Straight		
MBCC2-512	3.66 m (12 ft)			
MBCC2-530	9.14 m (30 ft)			

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

5-Pin Micro-Style Cordsets—with Shield				
Model	Length	Style	Dimensions	Pinout (Female)
MQVR3S-506	1.83 m (6 ft)	Straight		
MQVR3S-515	4.57 m (15 ft)			
MQVR3S-530	9.14 m (30 ft)			

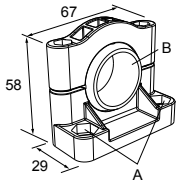
1 = Brown
2 = White
3 = Yellow
4 = Black
5 = Blue

5-Pin Micro-Style Cordsets—with Shield				
Model	Length	Style	Dimensions	Pinout (Female)
MQVR3S-506RA	1.83 m (6 ft)	Right Angle		
MQVR3S-515RA	4.57 m (15 ft)			
MQVR3S-530RA	9.14 m (30 ft)			

Brackets

SMB30SC

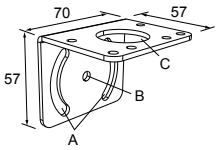
- Swivel bracket with 30 mm mounting hole for sensor
- Black reinforced thermoplastic polyester
- Stainless steel mounting and swivel locking hardware included



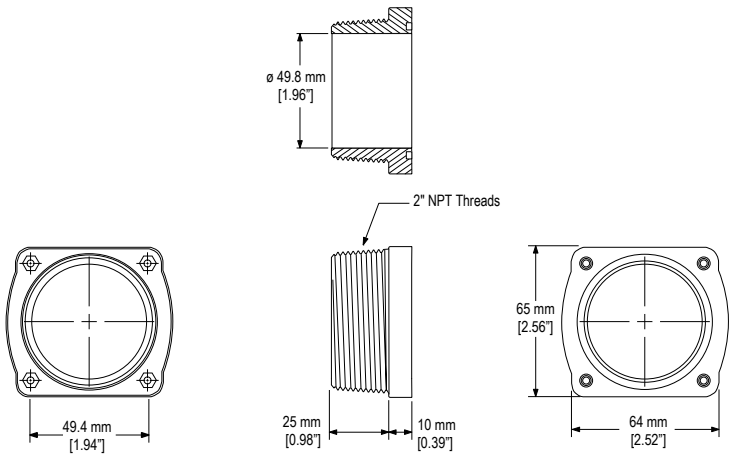
Hole center spacing: A=ø 50.8
Hole size: A=ø 7.0, B=ø 30.0

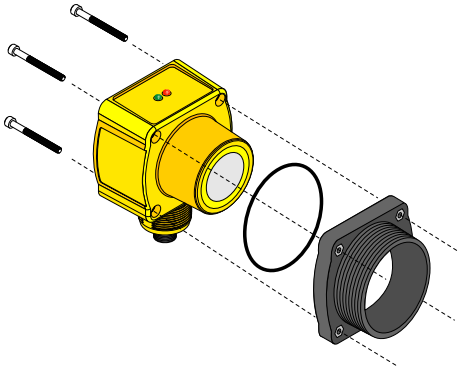
SMB30MM

- 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

SAFQT50U	• PVC mounting flange mounts to the front of a QT50U sensor (not for use with chemical-resistant models). • Adapts sensor to thread into standard 50.8 mm (2 in) NPT female threads
	

SAFQT50U	• PVC mounting flange mounts to the front of a QT50U sensor (not for use with chemical-resistant models). • Adapts sensor to thread into standard 50.8 mm (2 in) NPT female threads
	1. Place o-ring in flange groove. 2. Assemble sensor onto threaded flange as shown, using the M4 screws supplied with the QT50U sensor. 3. Using the supplied hex wrench, torque screws to approximately 1.1 kg/m (10 in/lbs). 4. Mount sensor/flange assembly into the 50.8 mm (2 in) NPT fitting.

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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