QT50UVR Series Sensor with Universal Supply Voltage

Features

Standard Model



- Fast, easy-to-use TEACH-Mode programming; no potentiometer adjustments
- SPDT electromechanical relay for high-capacity switching
- Universal supply voltage: 85 V AC to 264 V AC / 48 V DC 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 unterminated 2 m (6.5 ft) or 9 m (30 ft) cable, or with Mini or 1/2-in Dual Key quick-disconnect connection
- Wide operating range of –20 °C to +70 °C (–4 °F to +158 °F)
- Temperature compensation

Teflon-Protected Model



Teflon® is a registered trademark of Dupont™

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

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

Models	Sensing Range	Cable	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.)
QT50UVR3W W/30		5-wire, 9 m cable	
QT50UVR3WQ1		5-pin 1/2-in Dual Key Quick Disconnect (QD)	
QT50UVR3WQ		5-pin Mini QD	
QT50UVR3F		5-wire, 2 m (6.5 ft) cable	Fill-level control (pump-in and pump out)
QT50UVR3FQ1		5-pin 1/2-in Dual Key QD	
QT50UVR3FQ		5-pin Mini QD	

Models with a QD connector require a mating cable.

The following models are no longer available for order but are still covered by the information in this document.

- QT50UVR3F W/30 (9 m cable)

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 acid-filled tank.

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

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

Continued on page 2

Original Instructions
10-Jul-26

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117764
p/n: 117764 Rev H

ПРОМЭЛЕКТРОНИКА/ sales@prom-elec.com

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

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

T_C = temperature in °C

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 through **Solid 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.

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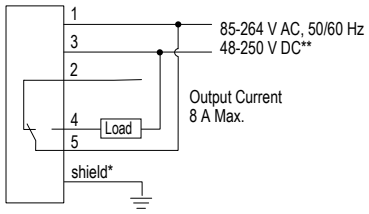
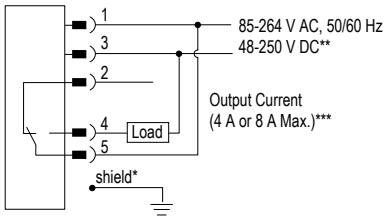
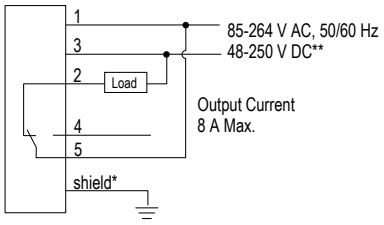
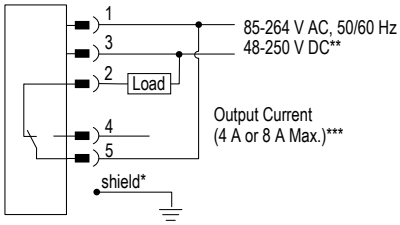
Wiring

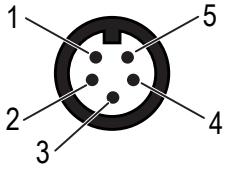
Normally open/pump-in

Cabled Models	QD Models	Key
		1 - brown 2 - white 3 - blue 4 - black 5 - yellow

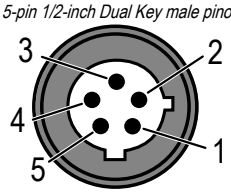
Normally closed/pump-out

Cabled Models	QD Models	Key
		1 - brown 2 - white 3 - blue 4 - black 5 - yellow

5-pin Mini male pinout



5-pin 1/2-inch Dual Key male pinout



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

** DC wiring is without regard to polarity

*** 4 A maximum for sensors with 1/2-inch Dual Key quick disconnects; 8 A maximum for sensors with Mini 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 [1] or the 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 the far limit
OFF	Target is outside the window limits	Level has risen above the near limit

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

Continued on page 4

[1] 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.

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

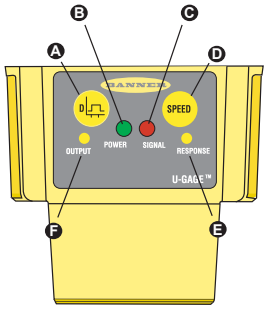
Sensor Programming

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

- Teach individual minimum and maximum limits ("Teach the Minimum and Maximum Limits" on page 4).
- Use the Auto-Window feature to center a sensing window around the taught position)DELETE - Teaching Limits Using the Auto-Window Feature).

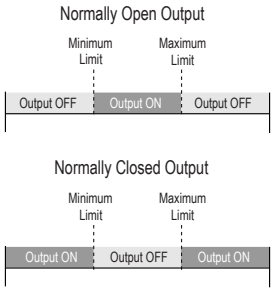
A - TEACH button
B - Sensor power indicator
C - Target signal strength indicator
D - Speed button
E - Output response time indicator
F - Output ON indicator

Sensor features



Teach the Minimum and Maximum Limits

Teaching independent minimum and maximum limits — window limit models

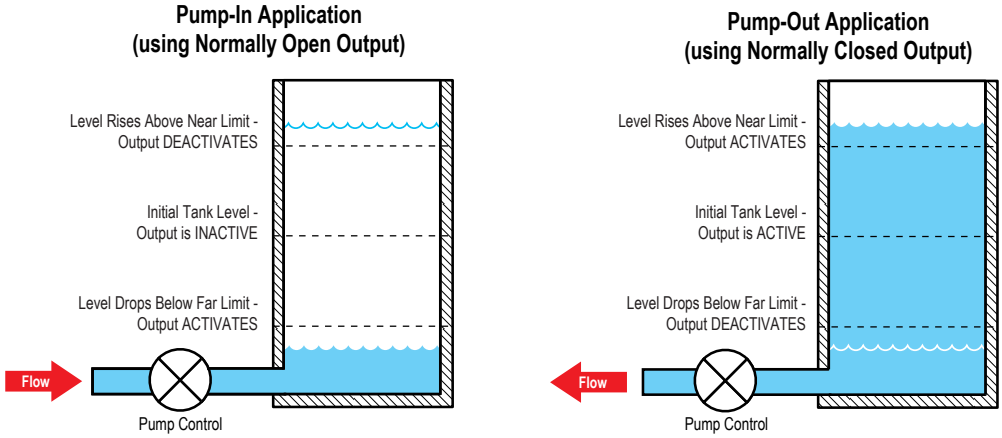


Teach procedures are identical for window-limit and fill-level control models. Window-limit models function as shown in the figure on the right, and fill-level control models function as shown below. To readjust minimum or maximum limits, repeat the teach procedure.

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

1. To enter programming mode, push and hold the TEACH button for 2 seconds.
   The Output LED turns solid red, and the sensor waits for the first limit.
2. Teach the first limit.
   a. Position the target for the first limit.
   b. Click the TEACH button.
   The sensor learns the first limit position, and the Output LED changes to flashing red.
3. Teach the second limit.
   a. Position the target for the second limit.
   b. Click the TEACH button.
   The sensor stores both limits, and the Output LED turns solid amber. The sensor returns to Run mode.

Fill-Level Control



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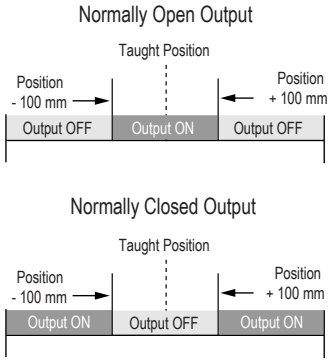
The **Fill-Level Control** mode provides the switching logic required for fill-level, web tensioning control, and similar applications. In this mode, the output energizes when the target reaches the first sensing window limit, and stays energized until the target moves to the second limit. The output then de-energizes at the second limit and does not re-energize until the target moves, again, to the first limit.

Teach Limits Using the Auto-Window Feature

Using the Auto-Window feature for programming

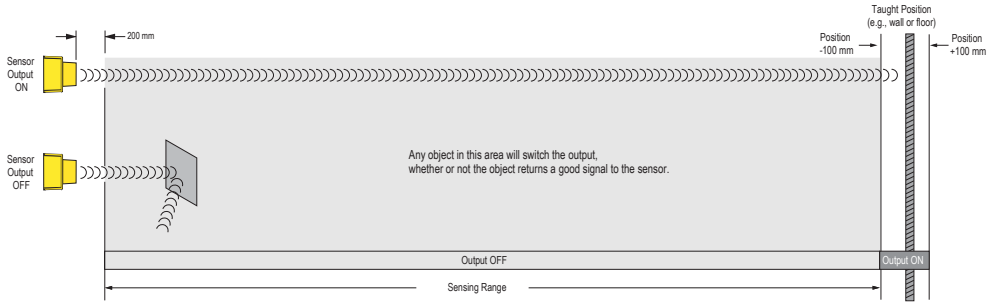


Teach procedures are identical for window-limit and fill-level control models. Teaching the same limit twice automatically centers a 200 mm window on the taught position. To readjust the sensing midpoint, repeat the teach procedure.

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

1. To enter programming mode, push and hold TEACH push button for 2 seconds.
   The Output LED turns solid red and the sensor waits for first limit.
2. Teach the first limit.
   a. Position the target at the desired midpoint for the sensing window.
   b. Click the TEACH button.
   The Output LED changes to flashing red.
3. Teach the second limit.
   a. Do not move the target.
   b. Click the TEACH button again.
   The sensor stores the sensing window and the Output LED turns solid amber. The sensor returns to Run mode.

An application for the Auto-Window feature (retroreflective mode)

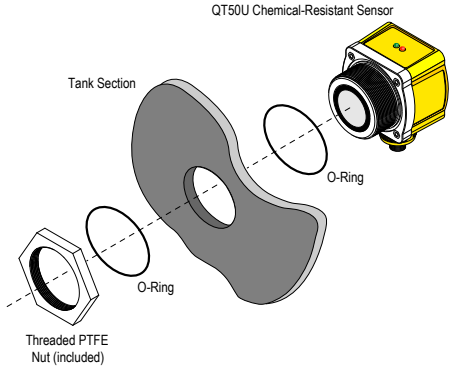


Installing the Chemical-Resistant Models

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.

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

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Universal Voltage: 85 V AC to 264 V AC, 50/60 Hz / 48 V DC 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, repeat 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 1/2-in Dual Key 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 1/2-in Dual Key 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 the 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 1/2-in Dual Key quick-disconnect or 5-pin 7/8 in-16UNF quick-disconnect fitting.

Environmental Rating

Leakproof design is rated IP67; NEMA 6P

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.

Temperature Warmup Drift

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

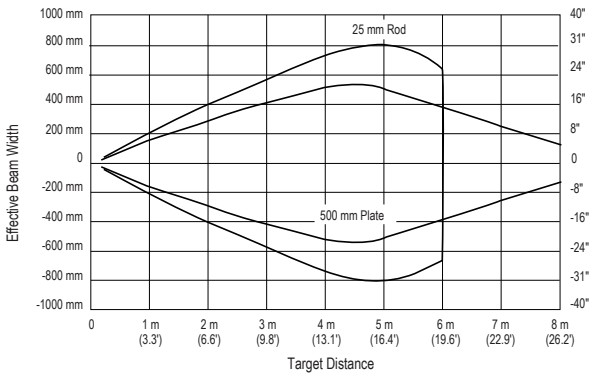
Application Notes

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

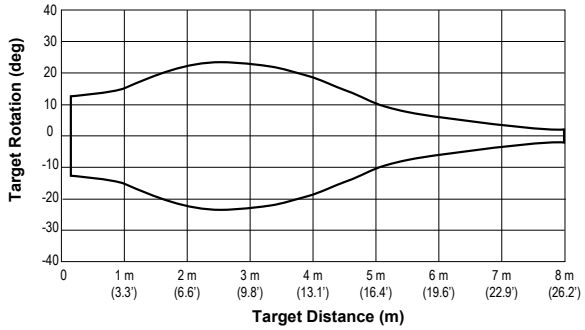
Certifications

Performance Curves

QT50U effective beam pattern



QT50U (with 500 mm plate) maximum target rotation angle



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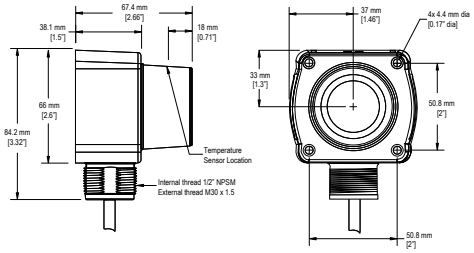
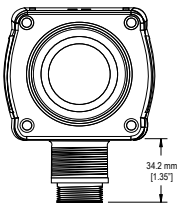
Dimensions

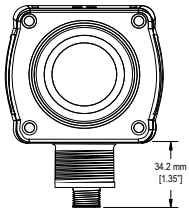
Cabled models



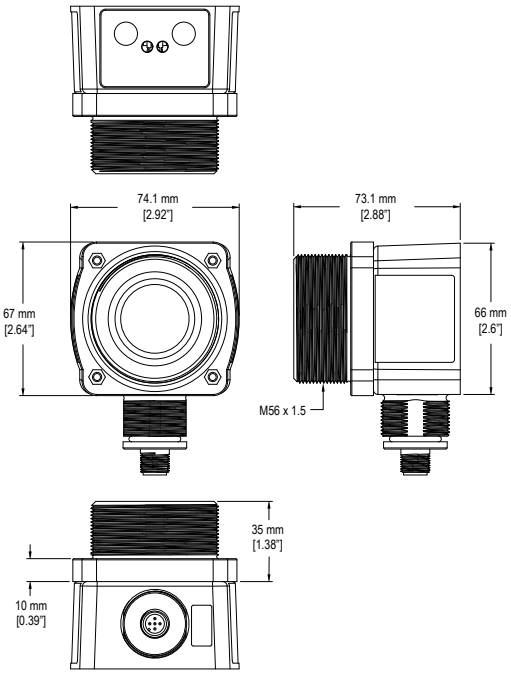
5-pin Mini Models



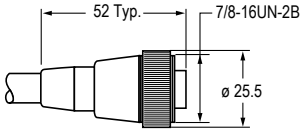
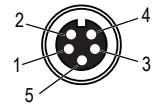
5-pin M12 Models

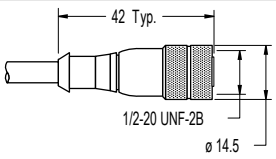
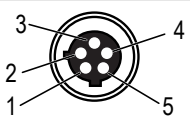


Chemical-resistant models



Accessories

5-Pin Single-Ended Mini Female Shielded Cordsets				
Model	**Length**	**Style**	**Dimensions**	**Pinout (Female)**
MBCC2-506	2 m (6.56 ft)	Straight		 1 = Brown 2 = White 3 = Blue 4 = Black 5 = Yellow
MBCC2-512	4 m (13.1 ft)			
MBCC2-530	9 m (29.5 ft)			

5-Pin Single-Ended 1/2-in Dual Key Female Shielded Cordsets				
Model	**Length**	**Style**	**Dimensions**	**Pinout (Female)**
MQVR3S-506	2 m (6.56 ft)	Straight		 1 = Brown 2 = White 3 = Yellow 4 = Black 5 = Blue
MQVR3S-515	5 m (16.4 ft)			
MQVR3S-530	10 m (32.8 ft)			

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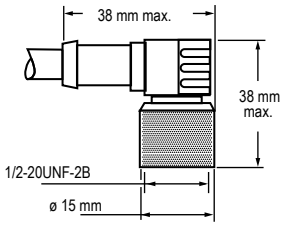
Continued from page 7

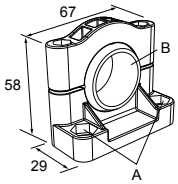
5-Pin Single-Ended 1/2-in Dual Key Female Shielded Cordsets				
Model	**Length**	**Style**	**Dimensions**	**Pinout (Female)**
MQVR3S-506RA	2 m (6.56 ft)	Right Angle		
MQVR3S-515RA	5 m (16.4 ft)			
MQVR3S-530RA	10 m (32.8 ft)			

Brackets

SMB30SC

- Swivel bracket with 30 mm mounting hole for sensor
- Black reinforced thermoplastic polyester
- Stainless steel mounting and swivel locking hardware included
- CAD Files: DXF, PDF, IGS, STP

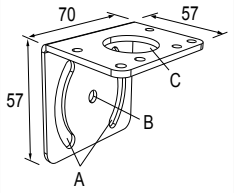
Hole center spacing: A=ø 50.8
Hole size: A=ø 7.0, B=ø 30.0



SMB30MM

- 12-gauge stainless steel bracket with curved mounting slots for versatile orientation
- Clearance for M6 (¼ in) hardware
- Mounting hole for 30 mm sensor
- CAD Files: DXF, PDF, IGS, STP

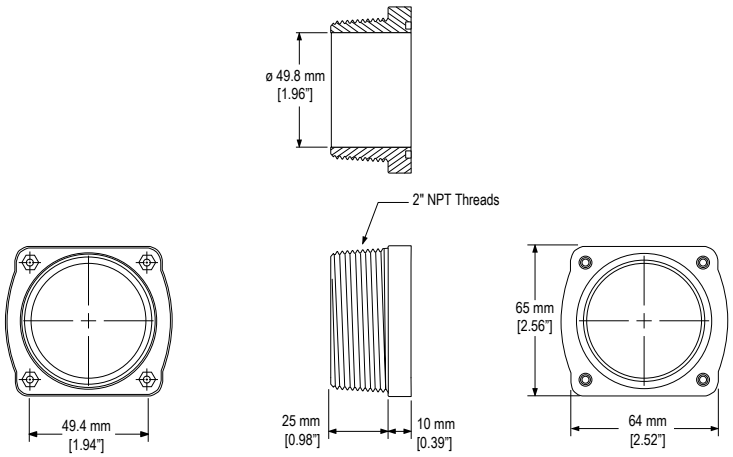
Hole center spacing: A=51, A to B=25.4
Hole size: A=42.6 × 7, B=ø 6.4, C=ø 30.1

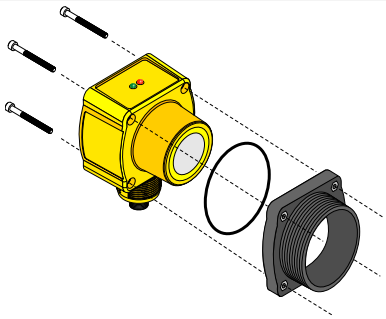


SAFQT50U

- **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**







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.

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