# 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

Continued from page 1

$C_{m/s}$ = 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.<br>• **Solid Red** — Slow Response (1600 ms)<br>• **Solid Amber** — Medium Response (400 ms) (factory default)<br>• **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:<br>• **Flashing Amber** — Temperature Compensation is enabled (default).<br>• **Flashing Red** — Temperature Compensation is disabled. |
| Click the Speed button to toggle between enable and disable. | Response LED flashes:<br>• **Flashing Amber** — Temperature Compensation is enabled (default).<br>• **Flashing Red** — Temperature Compensation is disabled. |
| Push and hold the Speed button for 10 seconds to return to Run mode. | • Sensor stores selection.<br>• Sensor returns to Run mode.<br>• Response LED returns to a solid color or OFF to indicate current Output Response Time setting. |


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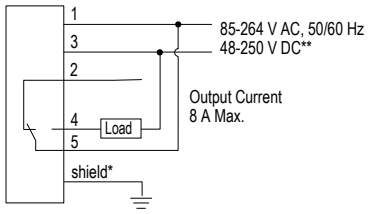
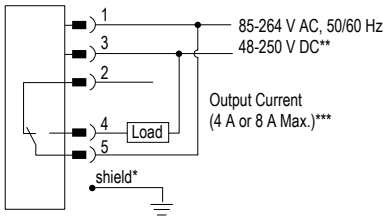
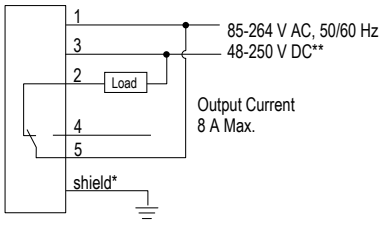
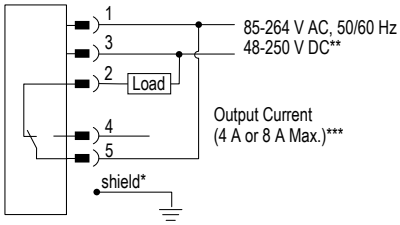
## Wiring

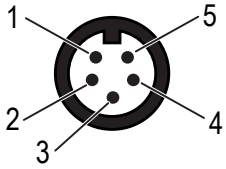
*Normally open/pump-in*

| Cabled Models | QD Models | Key |
|---|---|---|
|  |  | 1 - brown<br>2 - white<br>3 - blue<br>4 - black<br>5 - yellow |

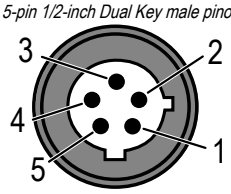
*Normally closed/pump-out*

| Cabled Models | QD Models | Key |
|---|---|---|
|  |  | 1 - brown<br>2 - white<br>3 - blue<br>4 - black<br>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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Continued from page 3

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

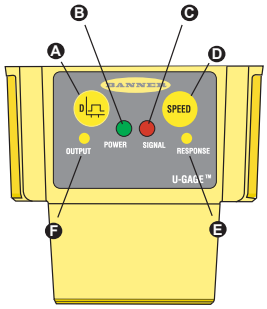
## Sensor Programming

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).

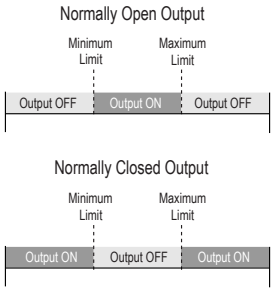
A - TEACH button
B - Sensor power indicator
C - Target signal strength indicator
D - Speed button
E - Output response time indicator
F - Output ON indicator

*Sensor features*




### Teach the Minimum and Maximum Limits

*Teaching independent minimum and maximum limits — window limit models*

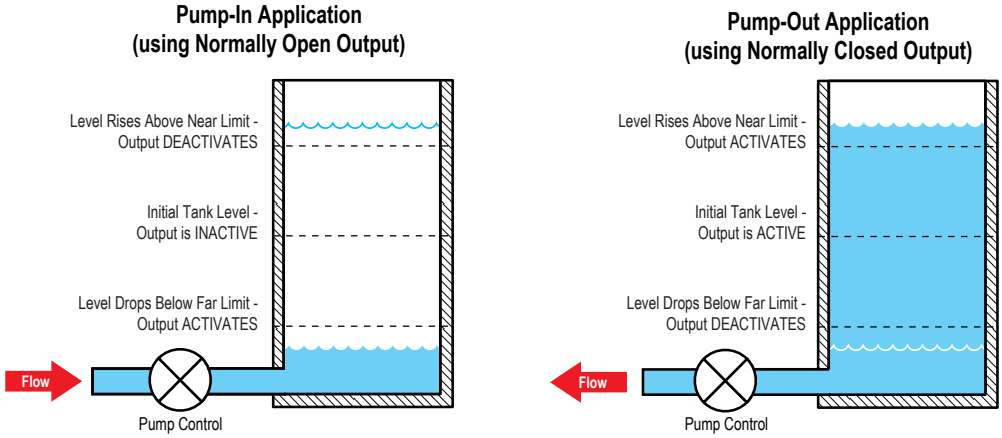



Teach procedures are identical for window-limit and fill-level control models. Window-limit models function as shown in the figure on the right, and fill-level control models function as shown below. To readjust minimum or maximum limits, repeat the teach procedure.

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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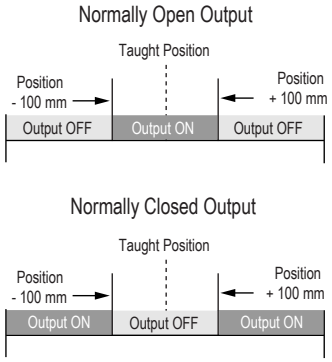
The **Fill-Level Control** mode provides the switching logic required for fill-level, web tensioning control, and similar applications. In this mode, the output energizes when the target reaches the first sensing window limit, and stays energized until the target moves to the second limit. The output 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*

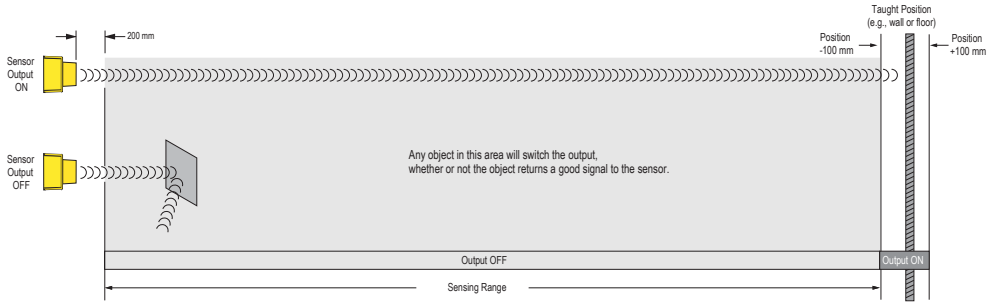



Teach procedures are identical for window-limit and fill-level control models. Teaching the same limit twice automatically centers a 200 mm window on the taught position. To readjust the sensing midpoint, repeat the teach procedure.

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)*

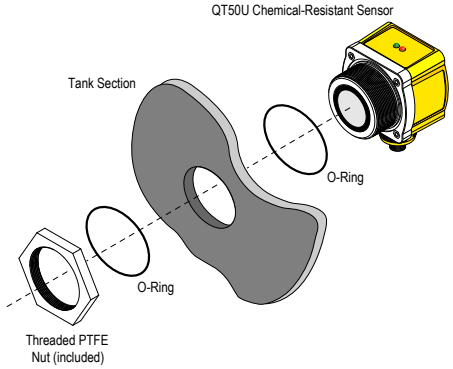



## Installing the Chemical-Resistant Models

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

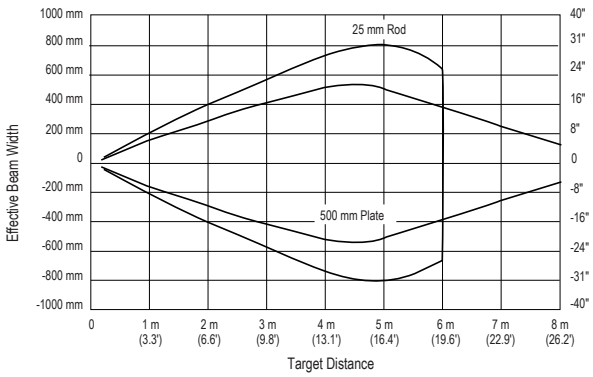
**Application Notes**

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

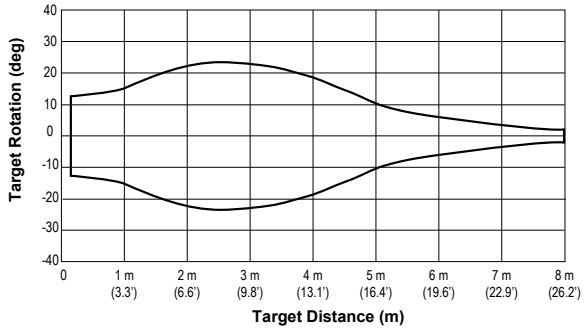
**Certifications**

## Performance Curves

*QT50U effective beam pattern*




*QT50U (with 500 mm plate) maximum target rotation angle*





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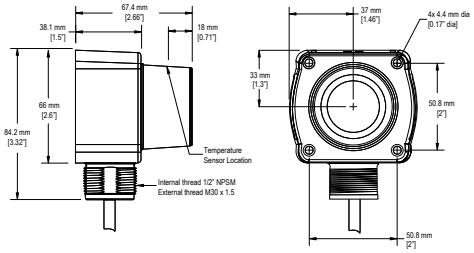
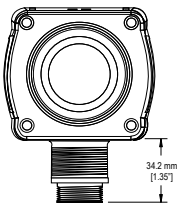
## Dimensions

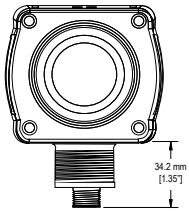
*Cabled models*



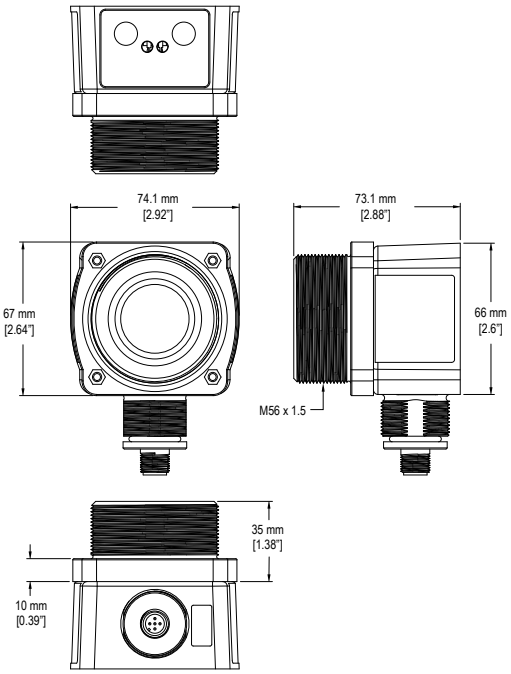

*5-pin Mini Models*



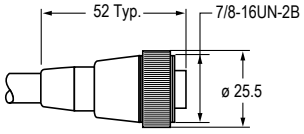
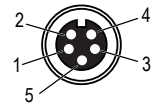

*5-pin M12 Models*

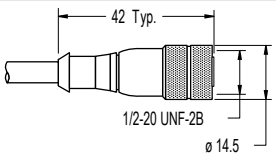
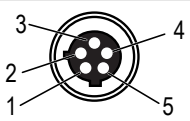



*Chemical-resistant models*




## 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<br>2 = White<br>3 = Blue<br>4 = Black<br>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<br>2 = White<br>3 = Yellow<br>4 = Black<br>5 = Blue |
| **MQVR3S-515** | 5 m (16.4 ft) | | | |
| **MQVR3S-530** | 10 m (32.8 ft) | | | |

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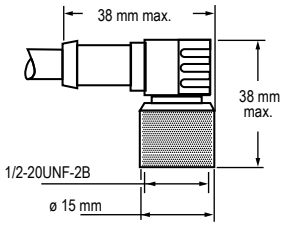
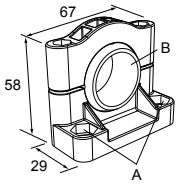
| 5-Pin Single-Ended 1/2-in Dual Key Female Shielded Cordsets | | | | |
|---|---|---|---|---|
| **Model** | **Length** | **Style** | **Dimensions** | **Pinout (Female)** |
| **MQVR3S-506RA** | 2 m (6.56 ft) | Right Angle |  | |
| **MQVR3S-515RA** | 5 m (16.4 ft) | | | |
| **MQVR3S-530RA** | 10 m (32.8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

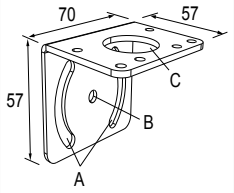
**Hole center spacing:** A=ø 50.8
**Hole size:** A=ø 7.0, B=ø 30.0




**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

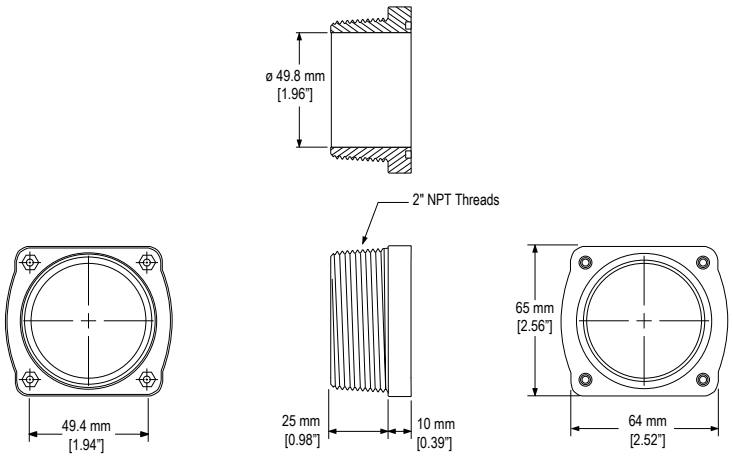
**Hole center spacing:** A=51, A to B=25.4
**Hole size:** A=42.6 × 7, B=ø 6.4, C=ø 30.1

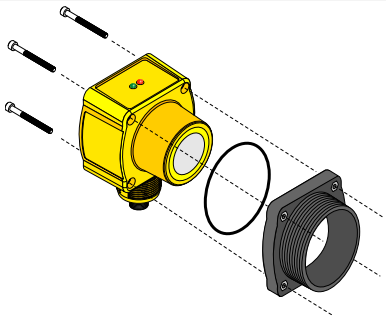



**SAFQT50U**

- **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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