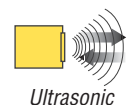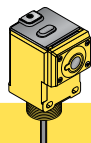# U-GAGE™ Q45UR Remote Ultrasonic Sensors

Piezoelectric Proximity Mode Sensors with Push-Button or Remote Programming of Sensing Windows

M18C2.0 Stainless Steel Barrel

S18C2.0 Molded Barrel

Q13C2.0 Flat-Pak

C E

Q45UR Series Features

- Ultrasonic proximity detection from 50 to 250 mm (2" to 10")
- Precision programmability that can resolve object presence to within 0.6 mm
- Window limits may be set in two ways: by individually setting the near and far window limits, or by programming a set point to be centered within one of four selectable window sizes
- Simple push-button TEACH-mode programming; input for remote programming
- Digital filtering for exceptional immunity to random electrical and acoustic "noise"
- 12 to 24V dc operation; bipolar outputs: sinking (NPN) and sourcing (PNP)
- Wide operating temperature range of -25° to +70°C; temperature compensation circuitry is included
- User-selectable response speeds
- Easy-to-use in-window/out-of-window output; ideal for gauging and similar inspection applications
- Exceptional sensing repeatability: ±0.2% of the measured distance
- Choose from 3 remote sensors: 18 mm threaded-barrel models in either stainless steel or molded PBT polyester, and a molded flat-pak model
- Remote sensors connect to controller via an integral 2 m (6.5') cable
- Kit includes both controller and sensor; components also sold separately

Ultrasonic

Q45UR Series Ultrasonic Sensor Models

Kit Models	Kit Includes Controller Model	Controller Cable*	Controller Output	Supply Voltage	Kit Includes Sensor Model	Sensing Range
Q45UR3BA63CK Q45UR3BA63CQK Q45UR3BA63CQ6K	Q45UR3BA63C Q45UR3BA63CQ Q45UR3BA63CQ6	2 m (6.5') 5-Pin Mini QD 5-Pin Euro QD	Bipolar NPN/PNP	12-24V dc	**M18C2.0 Stainless Steel Barrel**	50 to 250 mm (2" to 10")
Q45UR3BA63CKQ Q45UR3BA63CQKQ Q45UR3BA63CQ6KQ	Q45UR3BA63C Q45UR3BA63CQ Q45UR3BA63CQ6	2 m (6.5') 5-Pin Mini QD 5-Pin Euro QD			**Q13C2.0 Flat-Pak**	
Q45UR3BA63CKS Q45UR3BA63CQKS Q45UR3BA63CQ6KS	Q45UR3BA63C Q45UR3BA63CQ Q45UR3BA63CQ6	2 m (6.5') 5-Pin Mini QD 5-Pin Euro QD			**S18C2.0 Molded Barrel**	

*NOTES:
- 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g., **Q45UR3BA63C W/30**).
- A model with a QD connector requires a mating cable; see page 7.

U-GAGE™ Q45UR Remote Ultrasonic Sensors

Programming the Sensing Window Limits

The Q45UR controller features a single push button for programming the sensing window limits (Figure 1). The window limits may be set in one of two ways: programming two independent window limits, or defining a sensing distance set point, which will be centered within a window whose size is determined by the setting of DIP switches 2 and 3 (specific steps are described on page 3).

Independent Window Limits: The target is placed at the desired position to set the first limit, then the second limit is set using the same procedure. In order to set two independent limits, the window must be at least 5 mm.

Sensing Distance Set Point: The sensor is taught the same set point for both window limits. This set point is centered within an overall window size of 1, 2, 3, or 4 mm (0.04", 0.08", 0.12", or 0.16"), determined by the DIP switch settings. DIP switches are located inside the controller, under the inner cover (Figure 1).

See page 4 for detailed programming instructions.

Status Indicators

Status indicator LEDs are visible through the transparent, o-ring sealed Lexan® top cover. Their function is as follows:

LED	Condition	Description
Green	ON Steady Flashing	Power is applied to the sensor Overloaded output
Red	Flashing	An echo is received; rate is proportional to echo strength
Yellow	ON Steady	Outputs are conducting

The 5-segment moving dot LED indicator tracks the position of the target relative to the programmed window limits.

For Independent Window Limits (> 5 mm windows): LED #1 flashes when the target is closer than the near window limit. LED #5 flashes when the target is beyond the far window limit. LED #3 comes ON when the target is near the center of the two limits.

For Sensing Distance Set Points (1, 2, 3,or 4 mm windows): LED #1 flashes when the target is closer than the near window limit. LED #3 comes ON steady when the target is within the sensing window. LED #5 flashes when the target is beyond the far sensing window.
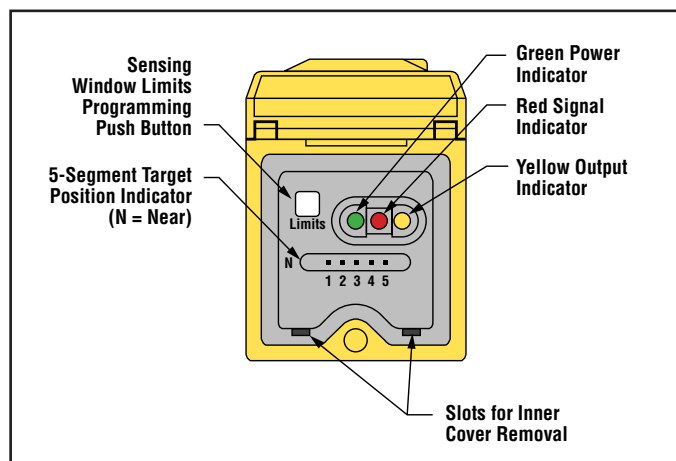

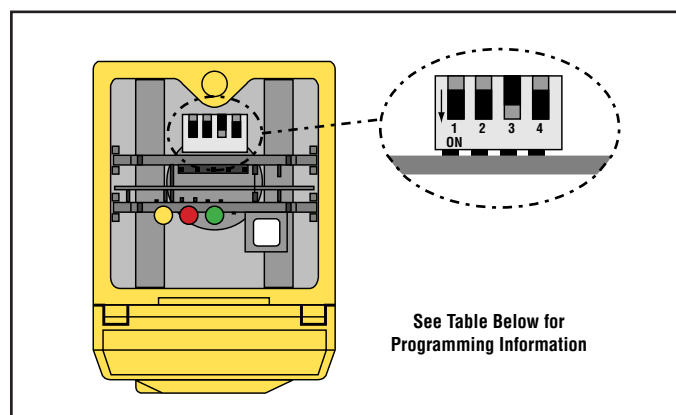**Figure 1.   Q45UR controller features**

Figure 2.   Q45UR controller programming DIP switches (factory default settings)

Setting the Q45UR Programming Switches

Using the two slots shown in Figure 1, a small flat-blade screwdriver may be used to lift up and remove the black inner cover to expose the 4-position programming DIP switch (Figure 2). These switches program the following functions:

Switch	Function		
1	**ON/OFF Mode** **Output:** ON = normally closed (output energizes when target is absent or outside the window limits) OFF* = normally open (output energizes when target is sensed inside the window limits)		
2 - 3	**Window Size (If a Set Point is Programmed)****	**Switch 2**	**Switch 3**
	1 mm (Sensing set point ± 0.5 mm)	OFF	OFF
	2 mm (Sensing set point ± 1 mm)	ON	OFF
	3 mm* (Sensing set point ± 1.5 mm)	OFF	ON
	4 mm (Sensing set point ± 2 mm)	ON	ON
4	**Response:** ON = 40 ms OFF* = 160 ms		

*   Denotes factory settings.

**   If two independent window limits are programmed, these switch settings are disregarded.

NOTE: Hysteresis is 0.5 mm for all window tolerance settings.

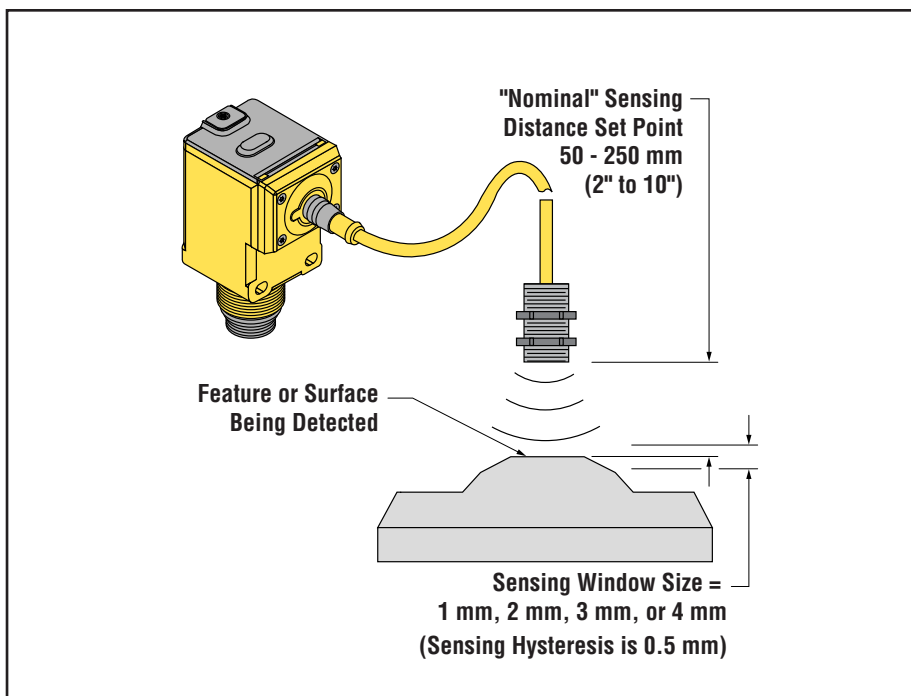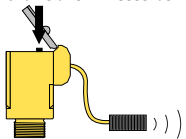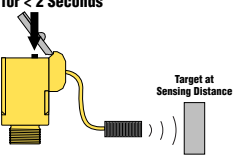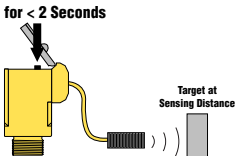**"Nominal" Sensing Distance Set Point 50 - 250 mm (2" to 10")**

Feature or Surface Being Detected

Sensing Window Size = 1 mm, 2 mm, 3 mm, or 4 mm (Sensing Hysteresis is 0.5 mm)

Figure 3.   Sensing distance set point and window size

Programming Procedure

Whenever possible, use the actual target to be sensed when programming the window limits. The following procedures begin with the sensor operating in RUN mode.
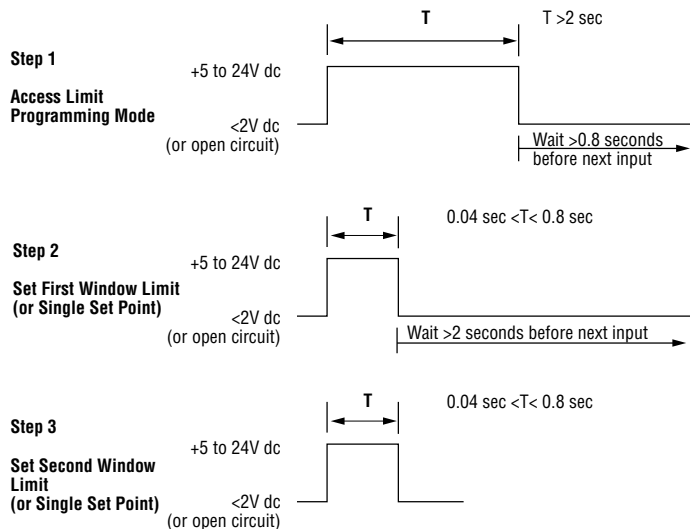
Push Button		Indicator Status
Step 1 **Enter Program Mode** Push and hold until green indicator turns OFF (approximately 2 seconds)	**Push and Hold for ≥ 2 Seconds** 	**Green:** Goes OFF **Yellow:** Is ON steadily to indicate ready for teaching **Red:** Flashes to indicate echo strength; or OFF if no target is present
Step 2 **Set the First Window Limit (or the Set Point)** Place the target at the first window limit or the sensing distance set point and press the push button for less than 2 seconds	**Push for < 2 Seconds** Target at Sensing Distance	**Green:** Remains OFF **Yellow:** Flashes at 2 Hz to indicate ready for teaching **Red:** Comes ON steadily for a moment, then resumes flashing to indicate echo strength
Step 3 **Set the Second Window Limit** Place the target at the second window limit and press the push button for less than 2 seconds. If the target is held at the same position for programming of both limits, the sensor will establish a sensing window centered on the target position.	**Push for < 2 Seconds** Target at Sensing Distance	**Green:** Remains OFF, then comes on steadily (returns to RUN mode) **Yellow:** ON steadily for a moment, then either ON or OFF to indicate output state (returns to RUN mode) **Red:** Comes ON steadily for a moment, then resumes flashing to indicate echo strength (returns to RUN mode)

NOTES:
1) There is a 2-minute timeout for programming the first window limit. After this time, the sensor will return to RUN mode with the previously programmed distance. There is no timeout for programming the second limit.

2) The programming sequence may be cancelled at any time by pressing and holding the push button for ≥ 2 seconds. The sensor will return to RUN mode with the previously programmed limits.

3) If programming is rejected during either programming step, the sensor will revert to step 1 above, and wait for programming of the first window limit. This will be indicated by: Green OFF, Red Flashing to indicate signal strength, Yellow ON Steady.

4) If the sensing distance is accepted, the sensor will return to RUN mode, indicated by: Green ON Steady.

5) During limit programming, the 5-segment moving dot indicator displays the relative target position between 50 and 250 mm (the maximum recommended far limit position is 250 mm).

6) If the target is farther than 250 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 250 mm maximum far limit.

Step 1

Access Limit Programming Mode

+5 to 24V dc

<2V dc (or open circuit)

T   T >2 sec

Wait >0.8 seconds before next input

Step 2

Set First Window Limit (or Single Set Point)

+5 to 24V dc

<2V dc (or open circuit)

T   0.04 sec <T< 0.8 sec

Wait >2 seconds before next input

Step 3

Set Second Window Limit (or Single Set Point)

+5 to 24V dc

<2V dc (or open circuit)

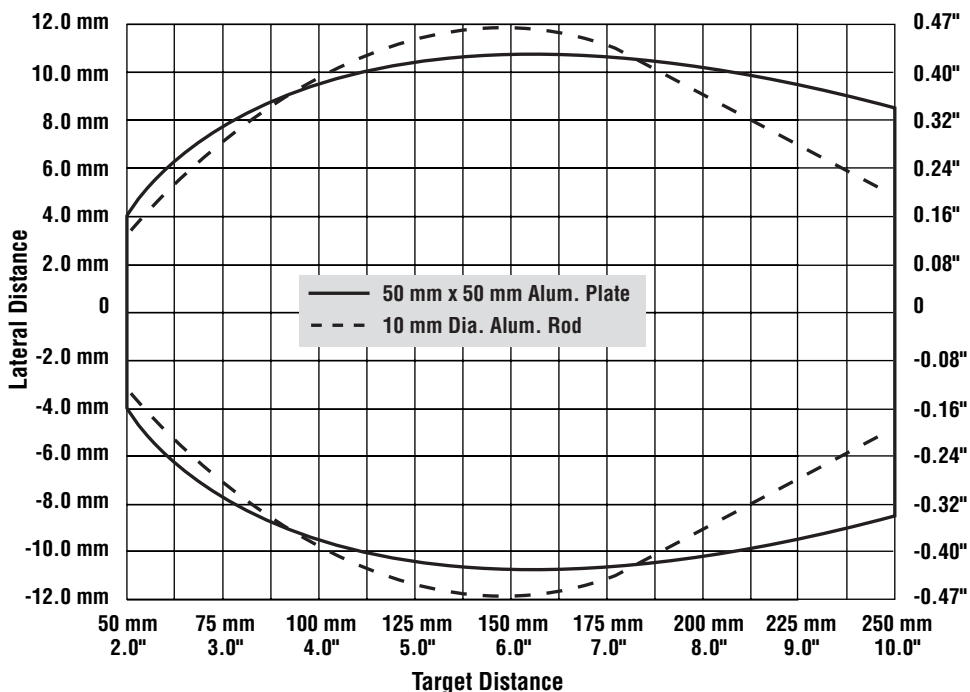T   0.04 sec <T< 0.8 sec

Remote Window Limit Programming

The yellow wire of the Q45UR may be connected 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 (see page 3).

A remote programming input is generated when +5 to 24V dc is applied to the yellow wire. The timing diagrams, right, define the required input pulses.

NOTES:
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 on page 3.

Q45UR Series Response Curves

Lateral Distance vs **Target Distance**

12.0 mm		0.47"
10.0 mm		0.40"
8.0 mm		0.32"
6.0 mm		0.24"
4.0 mm		0.16"
2.0 mm		0.08"
0		0
-2.0 mm		-0.08"
-4.0 mm		-0.16"
-6.0 mm		-0.24"
-8.0 mm		-0.32"
-10.0 mm		-0.40"
-12.0 mm		-0.47"

——— 50 mm x 50 mm Alum. Plate
- - - 10 mm Dia. Alum. Rod

50 mm 2.0" · 75 mm 3.0" · 100 mm 4.0" · 125 mm 5.0" · 150 mm 6.0" · 175 mm 7.0" · 200 mm 8.0" · 225 mm 9.0" · 250 mm 10.0"

NOTE: The pattern displayed for the 50 mm x 50 mm Aluminum plate is referenced to the EDGE of the plate. The pattern displayed for the 10 mm dia. Aluminum rod is referenced to the CENTER of the rod.

U-GAGE™ Q45UR Remote Ultrasonic Sensors

Q45UR Series Specifications

Sensing Distance Range	50 to 250 mm (2" to 10")
Supply Voltage and Current	12 to 24V dc (10% maximum ripple) at 100mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar: one current sourcing (PNP) and one current sinking (NPN) open collector transistor

Output Rating	150mA maximum (each output)
	     OFF-state leakage current: <25 microamps at 24V dc
	     ON-state saturation voltage: <1.5V at 10mA; <2.0V at 150mA

Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short-circuit of outputs
Performance Specifications * Repeatablility is specified using a 50 mm x 50 mm (2" x 2") aluminum plate at 22ºC under fixed sensing conditions.	**Response speed:** 40 or 160 milliseconds (switch selectable) **Repeatability*:** ±0.2% of measured distance **Temperature stability:** ±0.03% of the window limit positions per °C from 0° to 50°C (±0.05% per °C over remainder of operating temperature range) **Sensing window width:** 5 mm to 200 mm, when independent near and far limits are taught; 1, 2, 3, or 4 mm (switch selectable), when a sensing distance set point is taught **Hysteresis:** 0.5 mm **Ultrasonic beam angle:** ±3.5° Also see Response Curve, page 4

Adjustments	The following may be selected by a 4-position DIP switch located on top of the controller, beneath a transparent o-ring sealed acrylic cover and beneath the black inner cover (see page 2):
	     Switch 1: Output normally open (output is energized when target is within sensing window limits), or normally closed (output is energized when target is outside sensing window limits)
	     Switches 2 & 3: Sensing window size (1 mm, 2 mm, 3 mm or 4 mm; see Application Notes, page 5)
	     Switch 4: Response speed selection (40 or 160ms)

Indicators	**Three status LEDs:**
	     Green ON steadily = power to controller is ON
	     Green flashing = output is overloaded
	     Yellow glowing steadily = outputs are conducting (yellow also indicates programming status during setup; see page 3)
	     Red flashing = relative strength of received echo
	5-segment red LED indicates the following:
	     #3 ON steadily = Target within sensing window
	     #1 flashing = Target closer than near window limit
	     #5 flashing = Target further than far window limit
	     All OFF = No target present

Construction	**Controller:** Molded thermoplastic polyester housing, o-ring sealed transparent acrylic top cover, and stainless steel hardware
	Sensors: **M18C2.0:** Stainless steel M18 threaded barrel housing and jam nuts, ULTEM® polyetherimide front cover, ceramic transducer, TEXIN® polyurethane rear cover
	     S18C2.0: Thermoplastic polyester S18 threaded barrel housing and jam nuts, ULTEM® polyetherimide front cover, ceramic transducer, TEXIN® polyurethane rear cover
	     Q13C2.0: Molded 30% glass reinforced thermoplastic polyester housing, ceramic transducer, fully epoxy-encapsulated

Environmental Rating	**Controller:** IEC IP67; NEMA 6P **Sensor:** IEC IP65; NEMA 4
Connections	**Controller:** 2m (6.5') or 9 m (30') attached cable, or 5-pin Mini-style or Euro-style quick-disconnect fitting **Sensor:** 2m (6.5') attached PVC cable terminated with 4-pin Euro-style quick-disconnect fitting for connection to controller

ULTEM® is a registered trademark of General Electric
TEXIN® is a registered trademark of Bayer Corporation

Q45UR Series Specifications, continued

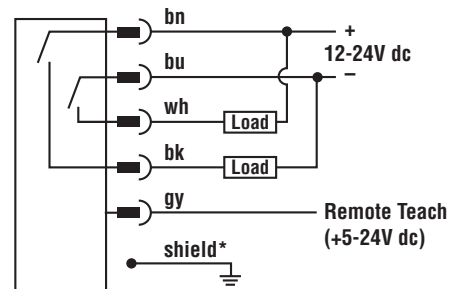|	
Operating Temperature	**Controller and sensor:** -25 to +70°C (-13 to +158°F) **Maximum relative humidity:** 85% (non-condensing)
Vibration and Mechanical Shock	All models meet Mil. Std. 202F requirements. Method 201A Vibration: 10 to 60Hz max., double amplitude 0.06" (maximum acceleration 10G). Method 213B conditions H & I (Shock: 75G with unit operating; 100G for non-operation). Also meets IEC 947-5-2 requirements: 30G, 11 ms duration, half sine wave.
Certifications	C E
Application Notes	The Teach-mode function of the controller (see page 2) is used to set the sensing distance set point. The sensing window size is set using DIP switches #2 and #3 (page 3). The sensing distance set point is centered within the sensing window. The size of the sensing window may be adjusted at any time, with or without power applied, and without re-teaching the sensing distance set point. If the sensor is taught a window larger than 5 mm, the size of the window remains "fixed," disabling switches 2 and 3. The controller has non-volatile memory which remembers the last sensing distance set point setting if power is removed and later reapplied. The sensing distance set point may be programmed via the Remote Teach input (see hookup diagrams). Minimum target size is specified as a 10 x 10 mm aluminum plate (at any point within the 50 to 150 mm sensing range). Acceptable target angle is within ±5° of normal for a smooth, flat target; target rotation does affect the apparent target location with respect to the sensor.

Q45UR Series Controller Hookups

Q45UR Controller with Attached Cable

*Shield wire must be connected to ground
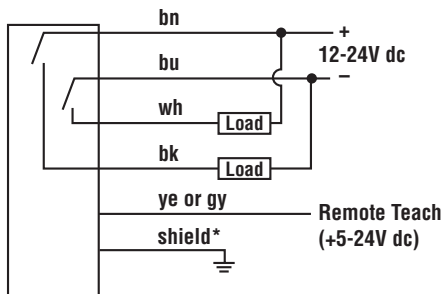
Q45UR Controller with Quick-Disconnect (5-Pin Mini-Style) ("Q" model Suffix)

5-Pin Mini-Style Pin-out (Cable Connector Shown)
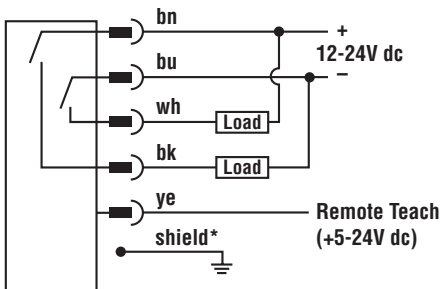
Q45UR Controller with Quick-Disconnect (5-Pin Euro-Style) ("Q6" model Suffix)
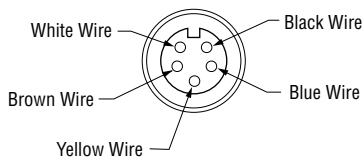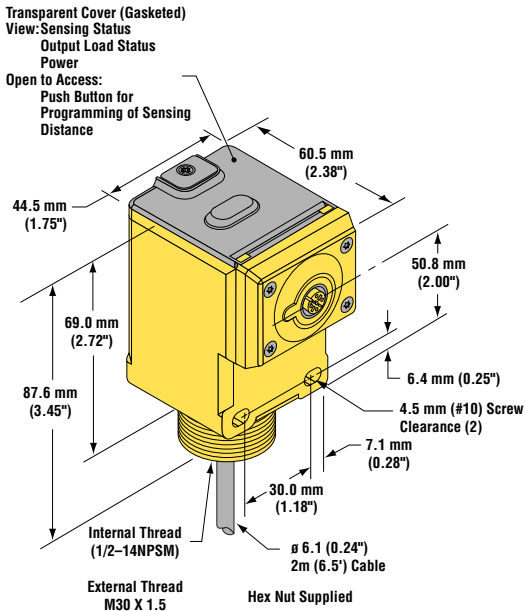

5-Pin Euro-Style Pin-out (Cable Connector Shown)
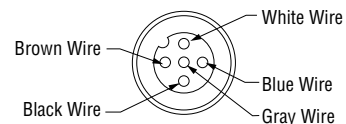
U-GAGE™ Q45UR Remote Ultrasonic Sensors
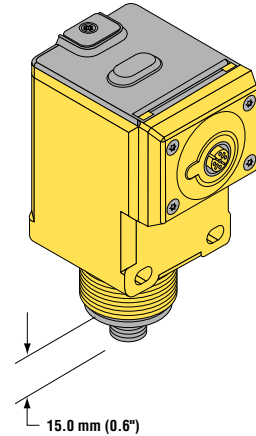
Q45UR Series Controller Dimensions

Q45UR Controller with Attached Cable

Transparent Cover (Gasketed)
View: Sensing Status
　　　Output Load Status
　　　Power
Open to Access:
　　Push Button for
　　Programming of Sensing
　　Distance

60.5 mm (2.38")
44.5 mm (1.75")
50.8 mm (2.00")
69.0 mm (2.72")
87.6 mm (3.45")
6.4 mm (0.25")
4.5 mm (#10) Screw Clearance (2)
7.1 mm (0.28")
30.0 mm (1.18")
Internal Thread (1/2–14NPSM)
ø 6.1 (0.24")
2m (6.5') Cable
External Thread M30 X 1.5
Hex Nut Supplied

Q45UR Controller with 5-Pin Mini-Style QD ("Q" model Suffix)

14.0 mm (0.6")
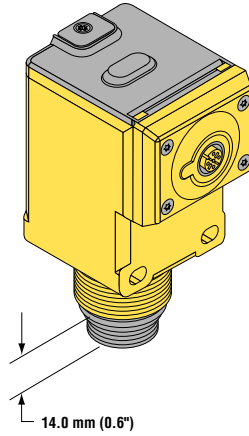
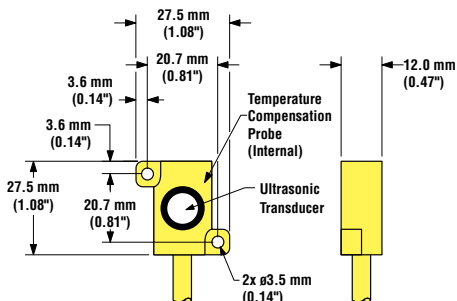### Q45UR Controller with 5-Pin Euro-Style QD ("Q6" model Suffix)

15.0 mm (0.6")

Remote Sensor Dimensions

M18C2.0 and S18C2.0 Sensors

Temperature Compensation Probe
Jam Nuts (2 Provided)
18 x 1 mm Thread
2 m (6.5') Cable
Ultrasonic Transducer
37.0 mm (1.46")
45.0 mm (1.14")

Q13C2.0 Sensors

27.5 mm (1.08")
20.7 mm (0.81")
3.6 mm (0.14")
3.6 mm (0.14")
27.5 mm (1.08")
20.7 mm (0.81")
12.0 mm (0.47")
Temperature Compensation Probe (Internal)
Ultrasonic Transducer
2x ø3.5 mm (0.14")
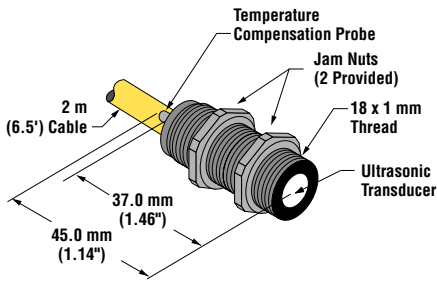
Accessories

Quick-disconnect (QD) Cables

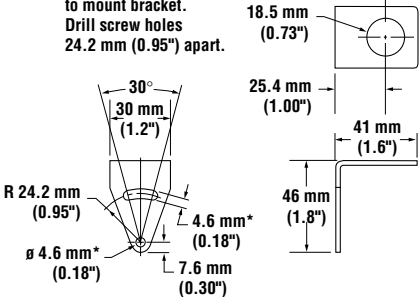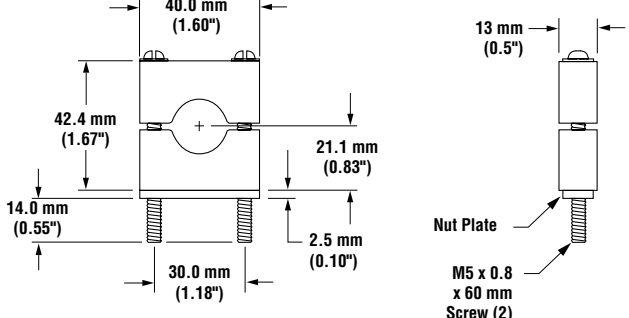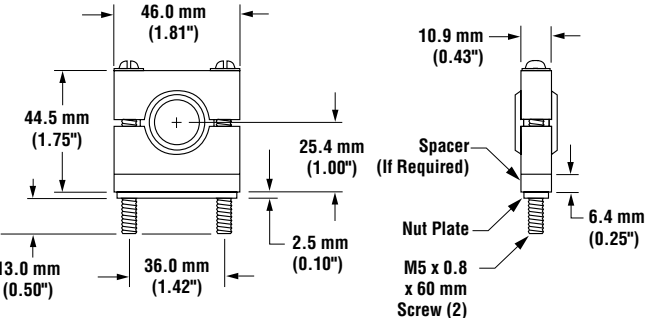| Style	Model	Length	Connector
5-Pin Mini-style with shield	MBCC2-506 MBCC2-512 MBCC2-530	2 m (6.5') 4 m (12') 9 m (30')	61 mm max. (2.4")　7/8-16UN-2B　ø28 mm (1.1")
5-Pin Euro-style Straight with shield	MQDEC2-506 MQDEC2-515 MQDEC2-530	2 m (6.5') 5 m (15') 9 m (30')	ø15 mm (0.6")　44 mm max. (1.7")　M12 x 1
5-Pin Euro-style Right-angle with shield	MQDEC2-506RA MQDEC2-515RA MQDEC2-530RA	2 m (6.5') 5 m (15') 9 m (30')	38 mm max. (1.5")　38 mm max. (1.5")　M12 x 1　ø15 mm (0.6")

Mounting Brackets for Q45UR Series Controllers

SMB30S	• 30 mm swivel, black PBT polyester bracket • Stainless steel mounting hardware included	**SMB30C**	• 30 mm split clamp, black PBT polyester bracket • Stainless steel mounting hardware included

63.5 mm (2.50")
Not Shown:
(2) M5 x 0.8 x 60 mm screws are supplied for clamping bracket together
12.2 mm (0.48")
82.5 mm (3.25")
43.2 mm (1.70")
50.8 mm (2.00")
M5 x 0.8 x 30 mm Screw (2)
25.4 mm (1.00")

56.0 mm (2.20")
13 mm (0.5")
63.0 mm (2.48")
31.5 mm (1.24")
13.5 mm (0.53")
45.0 mm (1.77")
2.5 mm (0.10")
Nut Plate
M5 x 0.8 x 80 mm Screw (2)

SMB30MM	• 30 mm, 11-gauge stainless steel bracket • Curved mounting slots for versatility and orientation		

25.4 mm (1.00")
Clearance for M6 hardware
ø30.1 mm (1.19")
35.1 mm (1.38")
7.1 mm 0.28 x 90° (2 Slots)
ø 6.4 mm (0.25" dia.)
57.2 mm (2.25")
25.4 mm (1.00")
R 25.4 mm (1.00")
35.1 mm (1.38")
69.9 mm (2.75")
57.2 mm (2.25")

Mounting Brackets for M18C2.0 and S18C2.0 Sensors

SMB18A	• 11-gauge, stainless steel right-angle bracket • Curved mounting slot for versatility and orientation	SMB18C	• 18 mm split clamp black PBT polyester bracket • Stainless steel mounting hardware included

SMB18A

* Use 4 mm (#8) screws to mount bracket. Drill screw holes 24.2 mm (0.95") apart.

18.5 mm (0.73")
25.4 mm (1.00")
41 mm (1.6")
46 mm (1.8")
30°
30 mm (1.2")
R 24.2 mm (0.95")
ø 4.6 mm* (0.18")
4.6 mm* (0.18")
7.6 mm (0.30")

SMB18C

40.0 mm (1.60")
42.4 mm (1.67")
14.0 mm (0.55")
21.1 mm (0.83")
2.5 mm (0.10")
30.0 mm (1.18")
13 mm (0.5")
Nut Plate
M5 x 0.8 x 60 mm Screw (2)

SMB18S	• 18 mm swivel, black PBT polyester bracket • Stainless steel mounting hardware included		

SMB18S

46.0 mm (1.81")
44.5 mm (1.75")
25.4 mm (1.00")
2.5 mm (0.10")
13.0 mm (0.50")
36.0 mm (1.42")
10.9 mm (0.43")
6.4 mm (0.25")
Spacer (If Required)
Nut Plate
M5 x 0.8 x 60 mm Screw (2)

NOTES

U-GAGE™ Q45UR Remote Ultrasonic Sensors

BANNER ®

more sensors, more solutions

⚠ **WARNING . . . Not To Be Used for Personnel Protection**

Never use these products as sensing devices for personnel protection. Doing so could lead to serious injury or death.

These sensors do NOT include the self-checking redundant circuitry necessary to allow their use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition. Consult your current Banner Safety Products catalog for safety products which meet OSHA, ANSI and IEC standards for personnel protection.