L-GAGE™ Q50 Series with Analog Output

LED-Based Linear Displacement Sensor with Analog Output and TEACH-Mode Programming

L-GAGE Q50 Analog Output Sensor Features

- Fast, easy-to-use TEACH-Mode programming; no potentiometer adjustments
- Selectable output response speeds: 4 milliseconds or 64 milliseconds (see hookup)
- Teach a sensing window size and position, or a set-point threshold centered within a 100 mm window
- Two sensing ranges, depending on model: 100 to 300 mm (visible red beam models), and 100 to 400 mm (infrared beam models)
- Sensor linearity is better than 3 mm
- Banner's patented scalable analog output (U.S. patent #6,122,039) automatically distributes the output signal over the width of the programmed sensing window
- Analog output slope can be either positive or negative, depending upon which window limit is programmed first
- Two bicolor Status LEDs
- Choose 2 meter or 9 meter unterminated cable, or swivel 5-pin Euro-style QD connector
- Rugged construction withstands demanding sensing environments; rated IEC IP67, NEMA 6
- Select models with either visible red or infrared beam
- Select models with either a 0-10V or 4-20 mA output

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.

L-GAGE Q50 Analog Output Sensor Models

Model Number	Sensing Range	Cable*	Supply Voltage	Beam	Output
Q50BVI	100 to 300 mm (3.9" to 11.8")	5-wire, 2 m (6.5') cable	15 to 30V dc	Visible Red LED	4 to 20 mA
Q50BVIQ		5-pin Euro-style QD			
Q50BVU		5-wire, 2 m (6.5') cable			0 to 10V
Q50BVUQ		5-pin Euro-style QD			
Q50BI	100 to 400 mm (3.9" to 15.7")	5-wire, 2 m (6.5') cable		Infrared LED	4 to 20 mA
Q50BIQ		5-pin Euro-style QD			
Q50BU		5-wire, 2 m (6.5') cable			0 to 10V
Q50BUQ		5-pin Euro-style QD			

* 9 meter cables are available by adding suffix "**W/30**" to the model number of any cabled sensor (e.g., **Q50BRI W/30**). A model with a QD connector requires a mating cable; see page 8.

L-GAGE Q50 – Analog Output Sensor

L-GAGE Q50 Analog Output Sensor Overview

The Q50 is an easy-to-use triangulation sensor which provides a sophisticated, yet cost-effective solution for demanding measurement applications. Q50 Series sensors feature compact, all-in-one design and require no separate controller.

Near and far sensing window limits are set quickly using simple push-button or remote signal TEACH-mode programming. The analog output has the option of being set with a sensing distance centered within a 100 mm window. The sensor features Banner's patented digital signal processing algorithm (U.S. patent #6,122,039), which automatically distributes the 0 to 10V dc (or 4 to 20 mA) output signal over the width of the programmed window.

Optical Triangulation
The function of the Q50 Sensor is based on optical triangulation (see Figure 1). The emitter circuitry and optics create a light source which is directed toward a target. The light source bounces off the target, scattering some of its light through the sensor's receiver lens to its position-sensitive-device (PSD) receiver element. The target's distance from the receiver determines the light's angle to the receiver element; this angle determines where the returned light will touch the PSD receiver element.

The position of the light on the PSD receiver element is processed through analog and digital electronics and analyzed by the microprocessor, which calculates the appropriate output value. The analog output provides either a current or voltage output proportional to the target's position within the user-programmed analog window limits (see page 4).
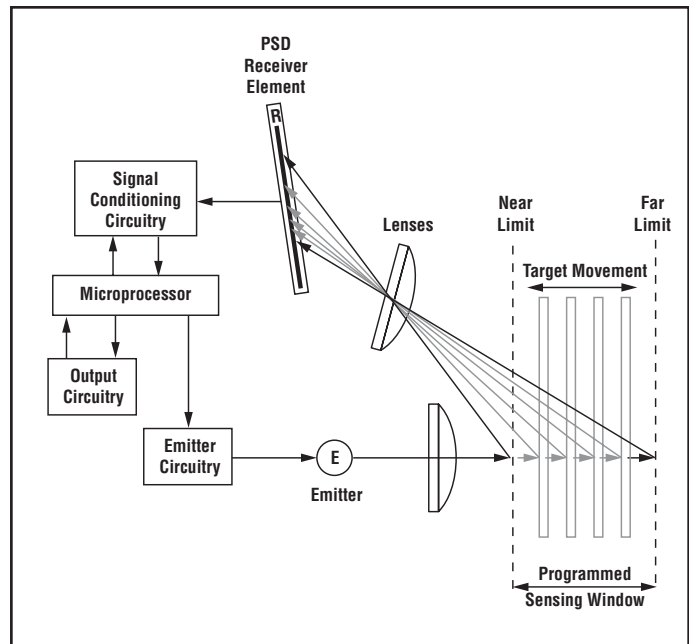

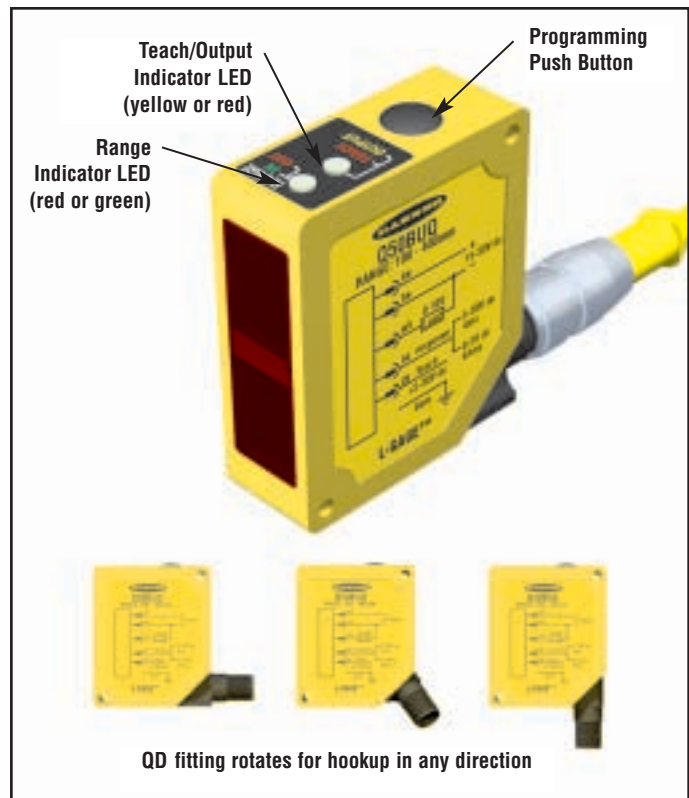**Figure 1. Using optical triangulation to determine sensing distance**

Figure 2. L-GAGE Q50 sensor features

NOTE: Slow response performance shown; with fast response, resolution is 4 times larger.

Figure 3. L-GAGE Q50 resolution

NOTES: Color sensitivity is independent of response time
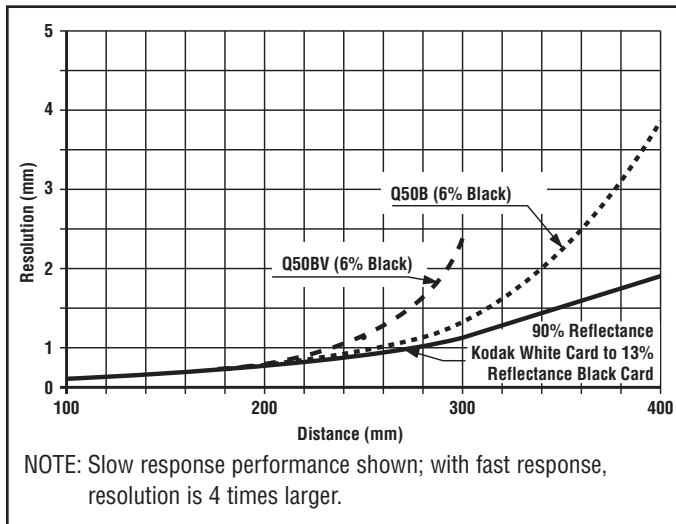Q50B (infrared models) span is 100-400 mm
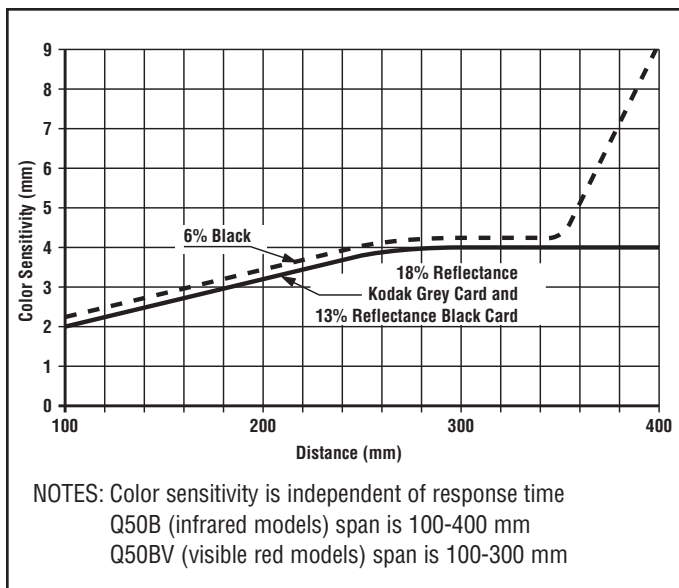Q50BV (visible red models) span is 100-300 mm

Figure 4. L-GAGE Q50 color sensitivity (This represents the expected change in output when the target color is changed from a 90% reflectance Kodak White Card to a 6%, 13% or 18% reflectance surface.)

Using the L-GAGE Q50 Analog Output Sensor

Response Speed

To control the response speed, connect the black wire as follows:

Fast Speed (4 ms): Connect black wire to +5 to 30V dc
Slow Speed (64 ms): Connect black wire to 0 to +2V dc (or open connection)

Window Limits

Window limits may be taught to the sensor either remotely (using the gray wire) or by using the sensor's Teach push button.
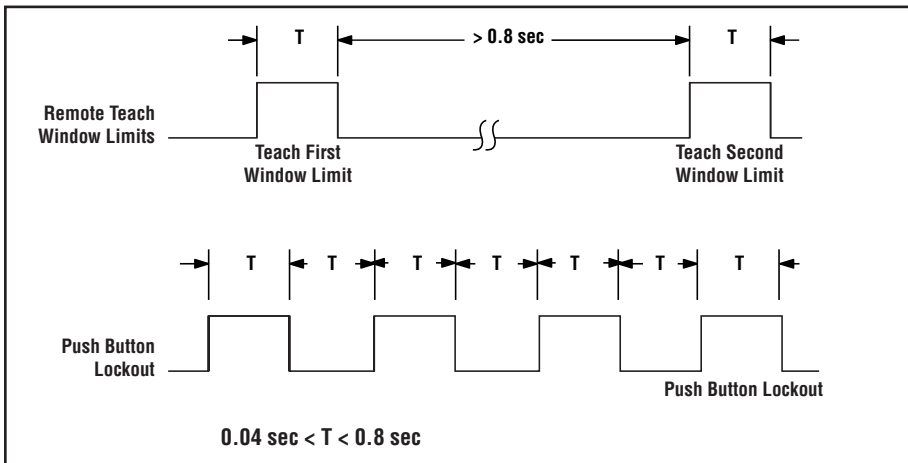
The Q50 sensor operates in two modes: TEACH (or programming) mode and RUN mode.

NOTE: All LED indicators momentarily go OFF when the sensor changes state between RUN and TEACH modes.

Indicator Status Conditions

Indicator	Status
Range LED (green/red)	Green — Target is within sensing range
	Red — Target is outside sensing range
	OFF — Sensor Power OFF
Teach/Output LED (yellow/red)	Yellow — Target is within taught window limits
	OFF — Target is outside taught window limits
	Red — Sensor is in TEACH mode

TEACH-Mode Programming

Push-Button Procedure

1. Press the Teach push button until the Teach LED turns red (hold button in for about 2 seconds). This indicates the sensor is waiting for the first window limit.

2. Position the target for the first limit. The Range LED should be green, indicating a valid target. Briefly "click" the Teach push button. This will teach the sensor the first limit. The Teach LED will flash red at 2 Hz to acknowledge receiving the first window limit; it is now waiting for the second limit.

3. Position the target for the second limit and "click" the Teach push button again to teach the sensor the second limit. The Teach LED will return to either yellow or OFF as the sensor returns to RUN mode.

L-GAGE Q50 – Analog Output Sensor

Teaching Analog Limits Using a Fixed 100 mm Window
For some analog applications, a sensing distance set point centered within a sensing window is required. The TEACH procedure is simple: teaching the same limit twice causes the sensor to program a window centered on the position taught. This window is 100 mm wide (taught position ±50 mm).

Remote Programming
A function is provided to program the sensor remotely or to disable/enable the push button; this is accomplished via the gray wire. Disabling the push button prevents anyone on the production floor from adjusting any of the programming settings. Connect the gray wire of the Q50 Gauging Sensor to +5 to 30V dc, with a remote programming switch connected between them. NOTE: The impedance of the remote teach input is 15 kΩ

To program, pulse the wire as illustrated in Figure 5. NOTE: The duration of each pulse (corresponding to a push button "click") is 0.04 to 0.8 seconds.

Figure 5. Timing for remote TEACH programming

Run Mode
NOTE: All LED indicators momentarily go OFF when the sensor changes state between RUN and TEACH modes.

Range LED
When the sensor detects a target within its sensing range (either 100 to 300 mm for visible-beam models, or 100 to 400 mm for infrared beam models) the LED will be solid green. In the absence of a target, the Range LED is solid red. Refer to the Indicator Status table on page 3.

Teach/Output LED
In RUN mode, the Output LED is yellow when a target is sensed within the programmed window limits; otherwise the Output LED is red. Refer to the Indicator Status table on page 3.

Analog Output
The Q50 gauging sensor may be programmed for either a positive or a negative output slope (see Figure 6). If the near limit is taught first, the slope will be positive; if the far limit is taught first, the slope will be negative. Banner's patented scalable analog output automatically distributes the output signal over the width of the programmed sensing window. (Output is either 0 to 10V or 4 to 20 mA, depending on model.)
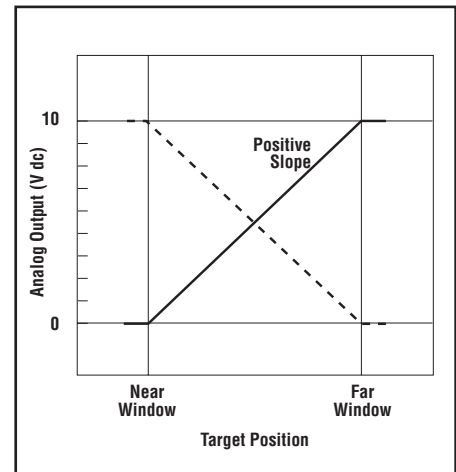

Figure 6. Analog voltage output as a function of target position (loss of signal – 0 Volts)
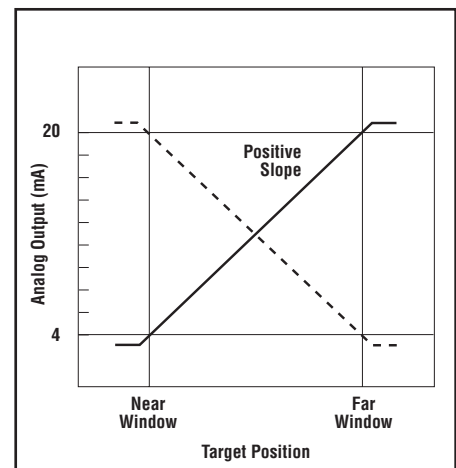

Figure 7. Analog current output as a function of target position (loss of signal – 3.6 mA)

Installation Notes

Some targets (those with a stepped plane facing the sensor, a boundary line, or rounded targets) pose specific problems for sensing distances. For such applications, see Figure 8 for suggested mounting orientations.
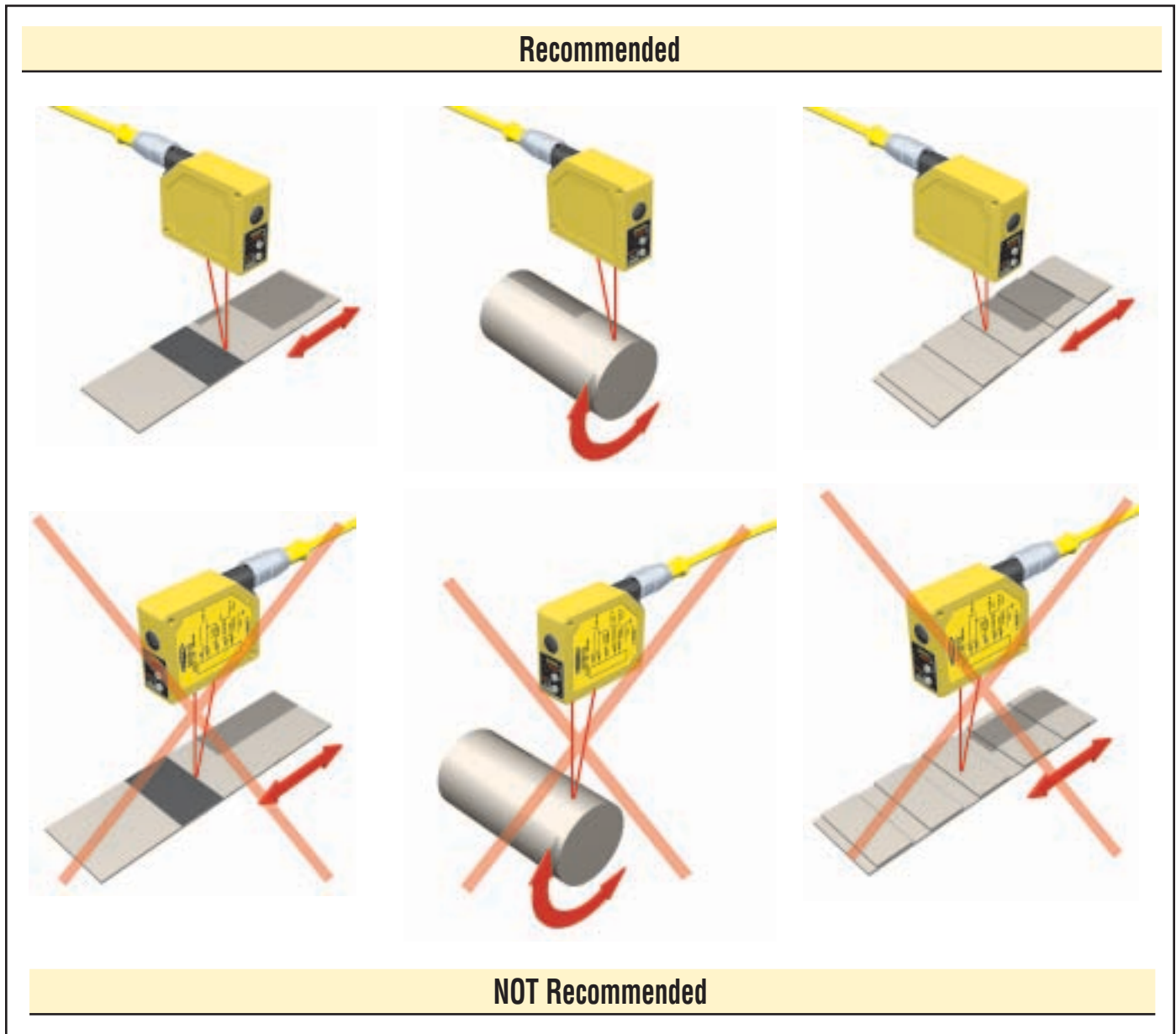
Recommended

NOT Recommended

Figure 8.   Sensor orientations for typical targets

L-GAGE Q50 Analog Output Sensor Specifications

Sensing Range	**Q50BV:** 100 to 300 mm (3.9" to 11.8") **Q50B:** 100 to 400 mm (3.9" to 15.7")
Supply Voltage	15 to 30V dc (10% maximum ripple); 70 mA max. (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient overvoltages
Delay at Power-up	2 seconds
Sensing Beam	**Wave length** **Q50BV:** 685 nm (typical) **Q50B:** 880 nm (typical) **Beam Size** **Q50BV:** 20 mm dia. (max.) **Q50B:** 20 mm dia. (max.)

Output Configuration	**Depending on model**
	    4-20 mA current sourcing models: 1 kΩ max. load @ 24V dc. Max. load = $[(V_{CC} -4.5)/0.02]\Omega$
	                   Loss of signal or target outside of sensor range: 3.6 mA
	    0-10V voltage sourcing models: 15 mA max.
	              Loss of signal or target outside of sensor range: 0V

Output Protection	Protected against short circuit conditions
Output Response Time	<table><tr><td>**Analog Output**</td><td>**Average Interval**</td><td>**Update Rate**</td><td>**-3 dB Frequency Response**</td></tr><tr><td>**Fast:**</td><td>4 ms</td><td>1 ms</td><td>112 Hz</td></tr><tr><td>**Slow:**</td><td>64 ms</td><td>4 ms</td><td>7 Hz</td></tr></table>
Resolution	See Figure 3 for typical values **Target Distance:** 200 mm **Slow Response:** 1 mm max. **Fast Response:** 4 mm max.
Linearity	±3 mm
Color Sensitivity (typical)	See Figure 4
Temperature Drift	**From 0° to 50°C:** -0.25 mm/°C **From -10° to 55°C:** -0.35 mm/°C
Remote and Speed Input Impedance	15 kΩ
Remote Teach Input	**To Teach:** Connect gray wire to +5 to 30V dc **To Disable:** Connect gray wire to 0 to +2V dc (or open connection)
Adjustments	**Response Speed:** **Fast Speed:** Connect black wire to +5 to 30V dc **Slow Speed:** Connect black wire to 0 to +2V dc (or open connection)
Indicators	**Range LED** Green — Target is within sensing range **Indicator** Red — Target is outside sensing range **(green/red)** OFF — Sensor Power OFF **Teach/Output** Yellow — Target is within taught window limits **LED Indicator** OFF — Target is outside taught window limits **(yellow/red)** Red — Sensor is in TEACH mode
Minimum Taught Window	**Target distance at 300 mm:** 50 mm window **Target distance at 125 mm:** 10 mm window
Ambient Light Immunity	<10,000 Lux

L-GAGE Q50 Analog Output Sensor Specifications (continued)

Construction	**Housing:** Molded ABS/Polycarbonate **Window Lens:** Acrylic
Environmental Rating	IEC IP67, NEMA 6
Connections	2 m or 9 m 5-conductor PVC-covered attached cable or 5-pin Euro-style quick disconnect
Operating Conditions	**Temperature:** -10° to +55°C (+14° to +131°F) **Max. Rel. Humidity:** 90% at +50°C (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). Also meets IEC 947-5-2 requirements: 30G, 11 ms duration, half sine wave.
Application Notes	Allow 15-minute warm-up for maximum linearity.
Hardware	M3 hardware is included.

L-GAGE Q50 Dimensions
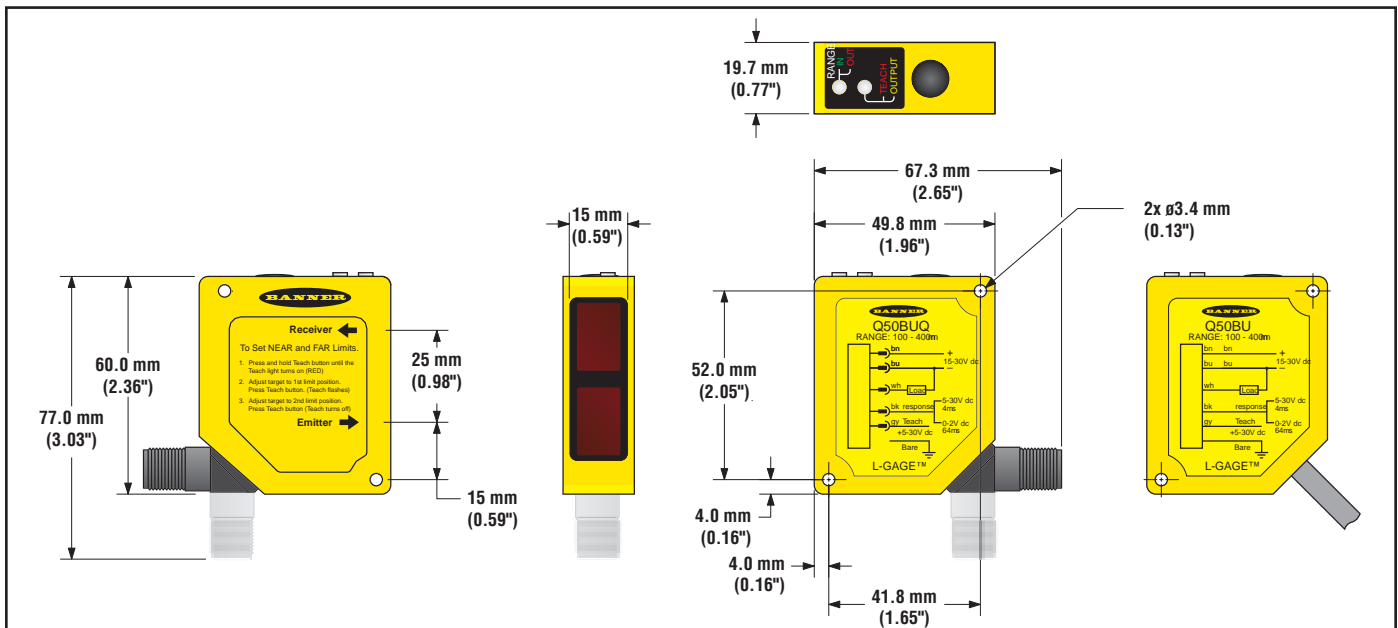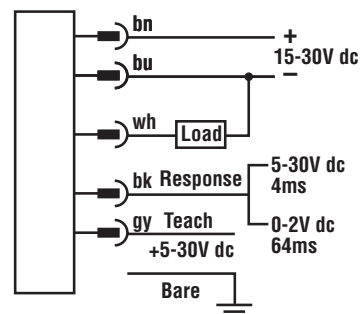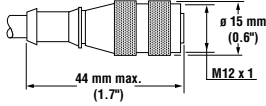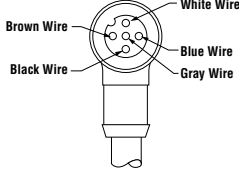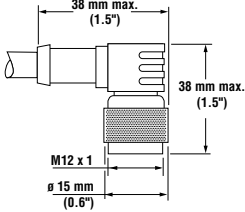

L-GAGE Q50 Hookups

Cable Models
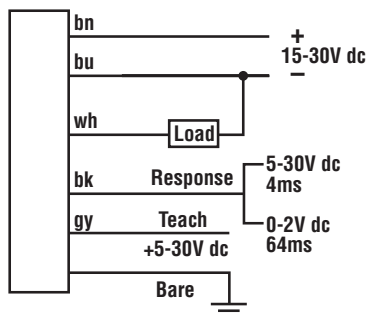
Quick-Disconnect Models
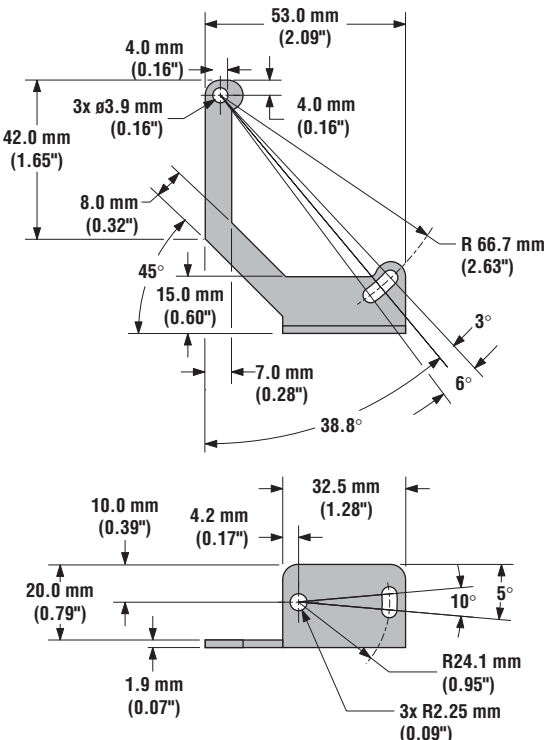
L-GAGE Q50 – Analog Output Sensor

Accessories

Euro-Style Quick-Disconnect Cables

Style	Model	Length	Connector	Pin-out
5-Pin Euro Straight	**MQDEC2-506** **MQDEC2-515** **MQDEC2-530**	2 m (6.5') 5 m (15') 9 m (30')	ø 15 mm (0.6") M12 x 1 44 mm max. (1.7")	White Wire Brown Wire Blue Wire Black Wire Gray Wire
5-Pin Euro Right-angle	**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 ø 15 mm (0.6")	

Mounting Brackets

SMBQ50	• Right-angle bracket • 14-ga., 304 Stainless Steel

53.0 mm (2.09")
4.0 mm (0.16")
3x ø3.9 mm (0.16")
4.0 mm (0.16")
42.0 mm (1.65")
8.0 mm (0.32")
R 66.7 mm (2.63")
45°
15.0 mm (0.60")
3°
7.0 mm (0.28")
6°
38.8°

10.0 mm (0.39")
4.2 mm (0.17")
32.5 mm (1.28")
20.0 mm (0.79")
10°
5°
1.9 mm (0.07")
R24.1 mm (0.95")
3x R2.25 mm (0.09")

BANNER ®

more sensors, more solutions