

L-GAGE® Q50 Series with Analog Output



Datasheet

LED-Based Linear Displacement Sensor with Analog Output and TEACH-Method Configuration



- Fast, easy-to-use integrated push button TEACH-method configuration; no potentiometer adjustments
- Selectable output response speeds: 4 milliseconds or 64 milliseconds
- Teach a sensing window size and position, or set-point threshold centered within a 100 mm window
- Two sensing ranges, depending on model: 100 mm to 300 mm (visible red beam models) and 100 mm to 400 mm (infrared beam models)
- Sensor linearity is better than 3 mm
- Banner's patented scalable analog output¹ automatically distributes the output signal over the width of configured sensing window
- Analog output slope is either positive or negative, depending upon which window limit is configured first
- Two bicolor Status LEDs
- Choose 2 m (6.6 ft) or 9 m (29.5 ft) unterminated cable, or swivel 5-pin Euro-style quick-disconnect 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 V to 10 V or 4 mA to 20 mA output



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

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

¹ U.S. patent #6,122,039

² To order the 9 m (30 ft) PVC cable model, add the suffix "W/30" to the cabled model number. Models with a quick disconnect require a mating cordset.



Overview

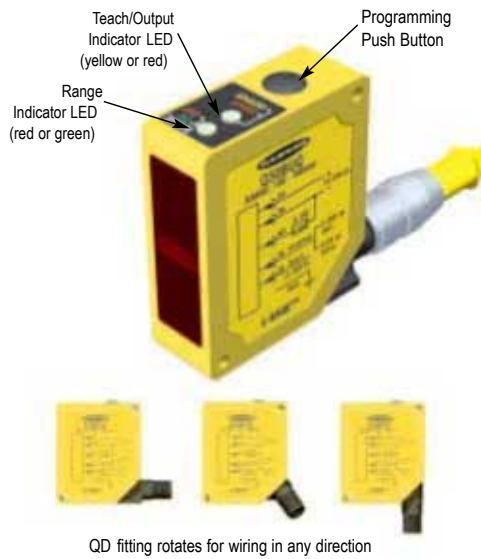


Figure 1. L-GAGE Q50 sensor features

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.

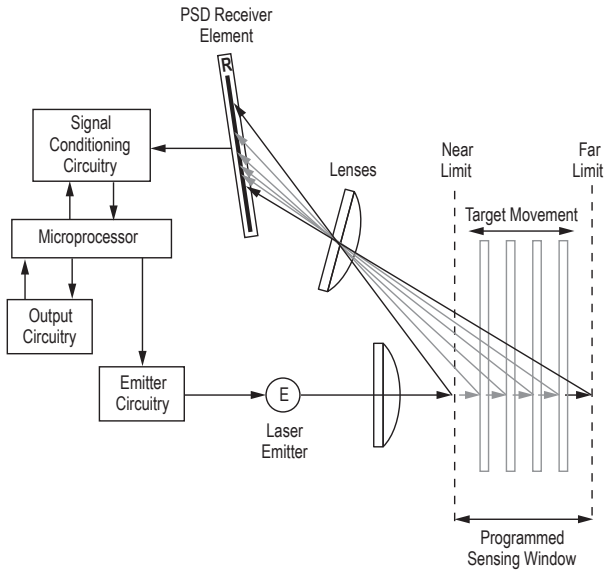
Near and far sensing window limits are set quickly using simple push-button or remote signal TEACH-method configuration. The analog output has the option of being set with a sensing distance centered within a 100 mm window. The sensor features Banner's patented digital signal processing algorithm³, which automatically distributes the 0 V DC to 10 V DC (or 4 mA to 20 mA) output signal over the width of the configured window.

Indicator Status Conditions

Indicator	Status
Range LED (green/red)	Green – Target is within sensing range (either 100 mm to 300 mm for visible-beam models, or 100 mm to 400 mm for infrared beam models)
	Red – Target is outside sensing range
	OFF – Sensor Power OFF
Teach/Output LED (amber/red)	Amber – Target is within taught window limits
	OFF – Target is outside taught window limits
	Red – Sensor is in TEACH configuration

³ U.S. patent #6,122,039

Optical Triangulation



The function of the Q50 sensor is based on optical triangulation. 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 another lens to the sensor's 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 fall along 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, or a variable signal proportional to the target's position within the user-configured analog window limits.

Figure 2. Using optical triangulation to determine sensing distance

Installation Notes

Some targets pose specific problems for sensing distances. Examples include those with a stepped plan facing the sensor, a boundary line, or rounded targets. For such applications see [Figure 3](#) on p. 3 and [Figure 4](#) on p. 3 for suggested mounting orientations.

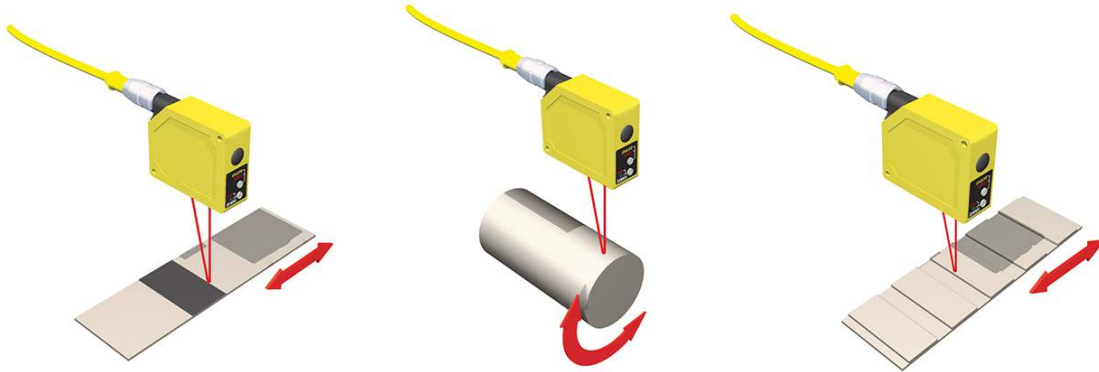


Figure 3. Sensor orientations for typical targets: recommended

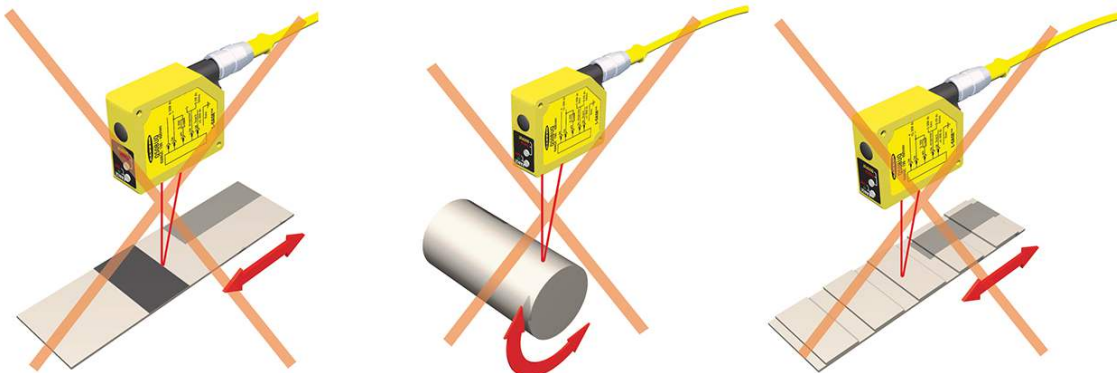


Figure 4. Sensor orientations for typical targets: not recommended

Using the 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 V DC to 30 V DC
- **Slow Speed (64 ms):** Connect black wire to 0 V DC to +2 V 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 button.

The Q50 sensor operates in two modes: TEACH (or configuration mode) and Run mode.



Note: All LED indicators momentarily turn OFF when the sensor changes state between Run mode and TEACH configuration.

Configuration Instructions

Push-Button Procedure

1. Press the Teach 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. Configure the first limit.
 - a) Position the target for the first limit
The Range LED should be green, indicating a valid target.
 - b) Briefly press the Teach button.
The first limit is configured. The Teach LED flashes red at 2 Hz to acknowledge receiving the first window limit. It is now waiting for the second limit.
3. Configure the second limit.
 - a) Position the target for the second limit.
The Range LED should be green, indicating a valid target.
 - b) Press the Teach button again.
The second limit is configured. The Teach LED will turn either amber or OFF as the sensor returns to RUN mode.

Remote Configuration

Configure the sensor remotely or disable/enable the push button using the gray wire. This is accomplished via the gray wire. Disabling the push button prevents unauthorized or accidental changes to the configuration settings. Connect the gray wire of the Q50 Gauging Sensor to +5 V DC to 30 V DC, with a remote configuration switch connected between them.



Note: The impedance of the remote teach input is 15 kΩ.

To configure, pulse the wire as illustrated in Figure 5 on p. 4. The duration of each button click or remote input pulse is defined as T, where T is: $0.04 \text{ s} < T < 0.8 \text{ s}$.

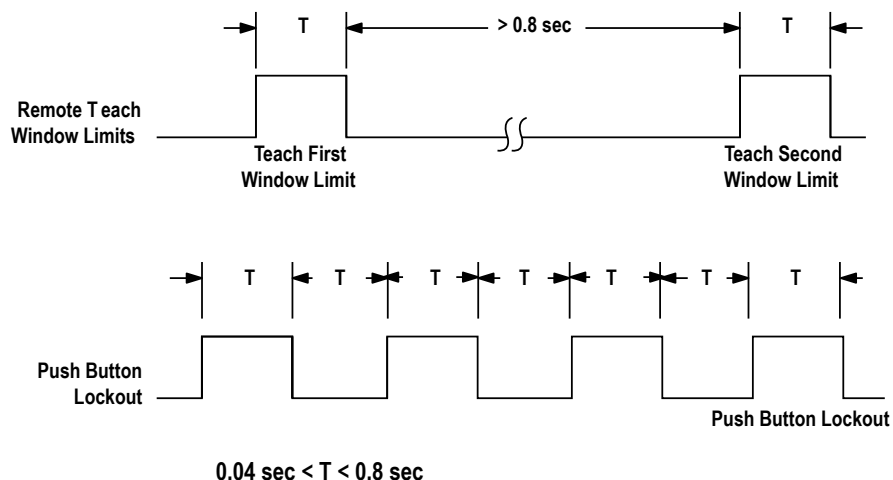


Figure 5. Timing for remote TEACH configuration

Analog Output

The Q50 gauging sensor may be configured for either a positive or a negative output slope; see [Figure 6](#) on p. 5. 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 V to 10 V or 4 mA to 20 mA, depending on the model.)

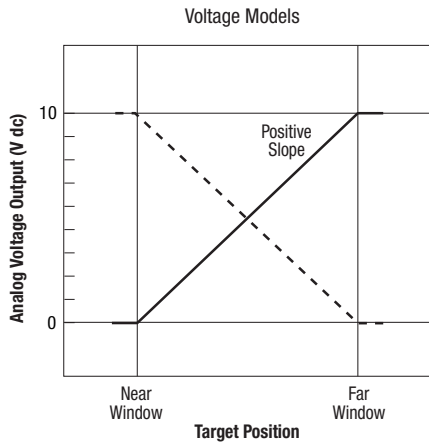


Figure 6. Analog voltage output as a function of target position (loss of signal – 0 V)

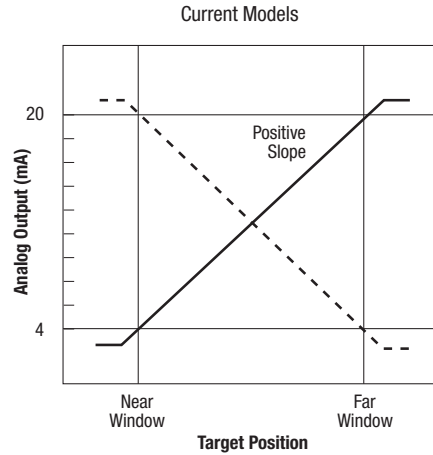


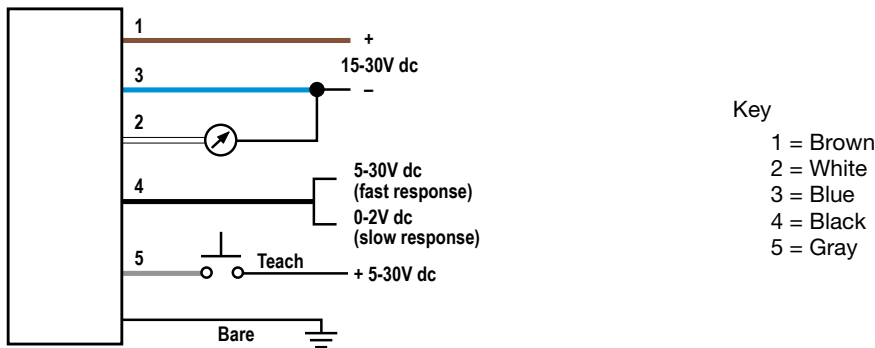
Figure 7. Analog current output as a function of target position (loss of signal – 3.6 mA)

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 configure a window centered on the position taught. This window is 100 mm wide (taught position ± 50 mm).

Wiring Diagrams

Quick disconnect wiring diagrams are functionally identical.



Specifications

Sensing Range

Q50BV: 100 mm to 300 mm (3.9 in to 11.8 in)
 Q50B: 100 mm to 400 mm (3.9 in to 15.7 in)

Supply Voltage

15 V DC to 30 V 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

Q50BV: Visible red, 685 nm (typical); 20 mm dia. (max.) beam size
 Q50B: Infrared, 880 nm (typical); 20 mm diameter (maximum) beam size

Output Configuration

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

Output Protection Circuitry

Protected against output short-circuit

Output Response Time

Analog Output	Average Interval	Update Rate	-3 dB Frequency Response
Fast:	4 ms	1 ms	112 Hz
Slow:	64 ms	4 ms	7 Hz

Linearity

±3 mm

Temperature Drift

From 0 °C to 50 °C: -0.25 mm/°C
 From -10 °C to 55 °C: -0.35 mm/°C

Certifications



Remote and Speed Input Impedance

15 kΩ

Remote Teach Input

To Teach: Connect gray wire to +5 V DC to 30 V DC
 To Disable: Connect gray wire to 0 V DC to +2 V DC (or open connection)

Response Speed

Fast Speed: Connect black wire to +5 V DC to 30 V DC
 Slow Speed: Connect black wire to 0 V DC to +2 V DC (or open connection)

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

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 integral 5-pin M12/ Euro-style quick disconnect

Operating Conditions

Temperature: -10 °C to +55 °C (+14 °F to +131 °F)
 90% at +50 °C maximum relative humidity (non-condensing)

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.

Application Notes

Allow 15-minute warm-up for maximum linearity

Hardware

M3 hardware is included

Resolution⁴

Target Distance: 200 mm
 Slow Response: 1 mm maximum
 Fast Response: 4 mm maximum

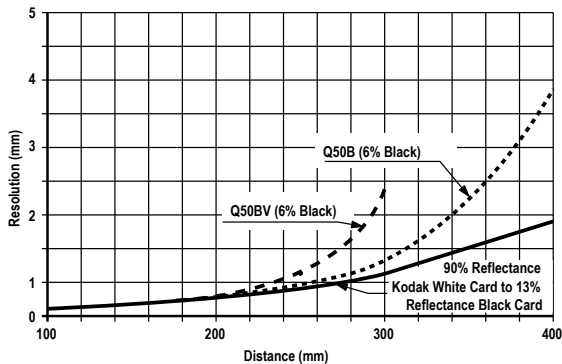


Figure 8. Q50 Resolution

Color Sensitivity (typical)⁵

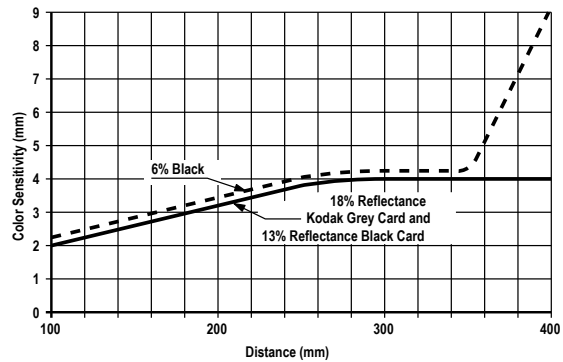


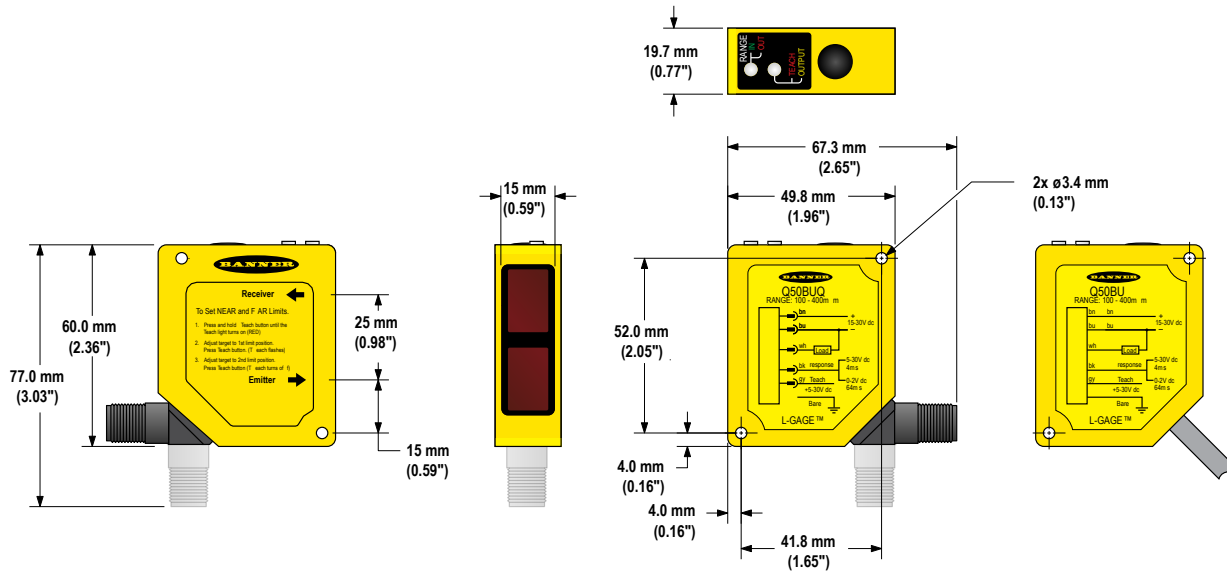
Figure 9. Q50 color sensitivity (This represents the expected change in output when the target color is changed from a 90% reflectance Kodak White Card to a 6%, 13%, or 18% reflectance surface.)

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

⁵ Color sensitivity is independent of response time. Q50B (infrared models) span is 100 mm to 400 mm. Q50BV (visible red models) span is 100 mm to 300 mm.

Dimensions

All measurements are listed in millimeters [inches], unless noted otherwise.



Accessories

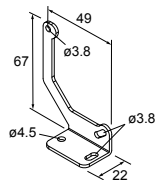
Cordsets

5-Pin Threaded M12/Euro-Style Cordsets with Shield				
Model	Length	Style	Dimensions	Pinout (Female)
MQDEC2-506	2 m (6.5 ft)	Straight		<p>1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray</p>
MQDEC2-515	5 m (15 ft)			
MQDEC2-530	9 m (30 ft)			
MQDEC2-506RA	2 m (6.5 ft)	Right-Angle		
MQDEC2-515RA	5 m (15 ft)			
MQDEC2-530RA	9 m (30 ft)			

Brackets

SMBQ50

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



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