

# L-GAGE™ Q50A Series with Analog Output



## Datasheet

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



**Note:** Q50B models also available, with 100 to 400 mm range



- 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 50 mm window
- Two sensing ranges, depending on model: 50 mm to 150 mm (visible red beam models) and 50 mm to 200 mm (infrared beam models)
- Sensor linearity is better than 1.5 mm
- Banner's patented scalable analog output<sup>1</sup> 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 <sup>2</sup>	Supply Voltage	Beam	Output	
Q50AVI	50 mm to 150 mm (2 in to 5.9 in)	5-wire, 2 m (6.5 in) cable	15 V DC to 30 V DC	Visible Red LED	4 mA to 20 mA	
Q50AVIQ		5-pin Euro-style quick-disconnect				0 V to 10 V
Q50AVU		5-wire, 2 m (6.5 in) cable			4 mA to 20 mA	
Q50AVUQ		5-pin Euro-style quick-disconnect				0 V to 10 V
Q50AI	50 mm to 200 mm (2 in to 7.9 in)	5-wire, 2 m (6.5 in) cable		15 V DC to 30 V DC	Infrared LED	
Q50AIQ		5-pin Euro-style quick-disconnect				0 V to 10 V
Q50AU		5-wire, 2 m (6.5 in) cable				
Q50AUQ		5-pin Euro-style quick-disconnect				0 V to 10 V

<sup>1</sup> U.S. patent #6,122,039

<sup>2</sup> 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 Q50A sensor features

The Q50A is an easy-to-use triangulation sensor which provides a sophisticated, yet cost-effective solution for demanding measurement applications. Q50A 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 50 mm window. The sensor features Banner's patented digital signal processing algorithm<sup>3</sup>, 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
	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

<sup>3</sup> U.S. patent #6,122,039

## Optical Triangulation

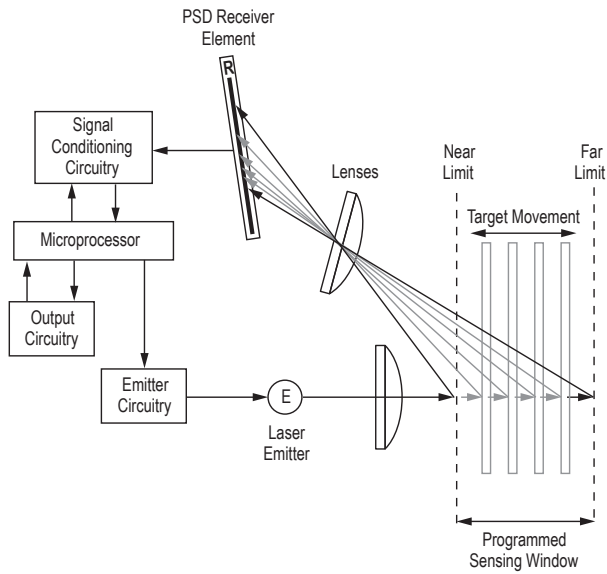


Figure 2. Using optical triangulation to determine sensing distance

The function of the Q50A 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.

## 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.

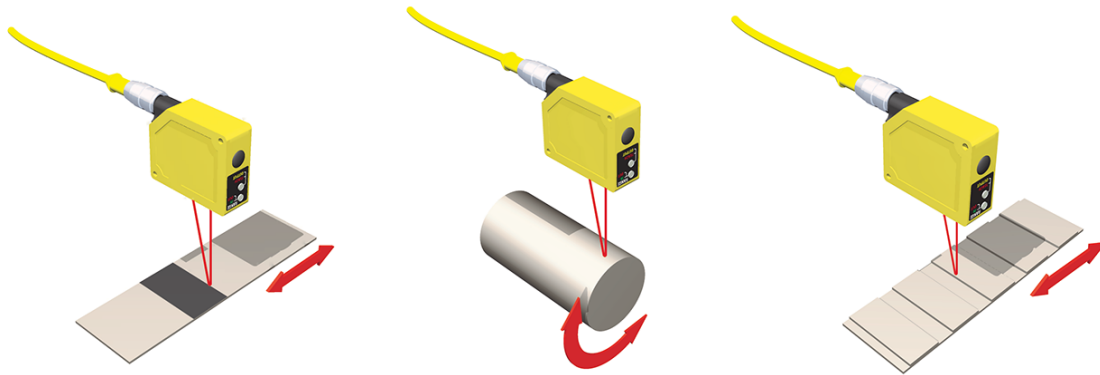


Figure 3. Sensor orientations for typical targets: recommended

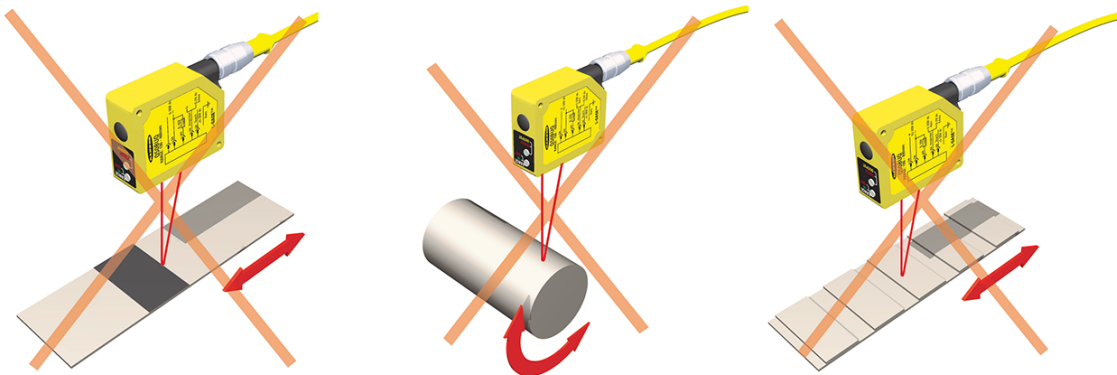


Figure 4. Sensor orientations for typical targets: not recommended

## Using the Q50A 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 Q50A 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 Q50A 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:  $0.04 \text{ s} < T < 0.8 \text{ s}$ .

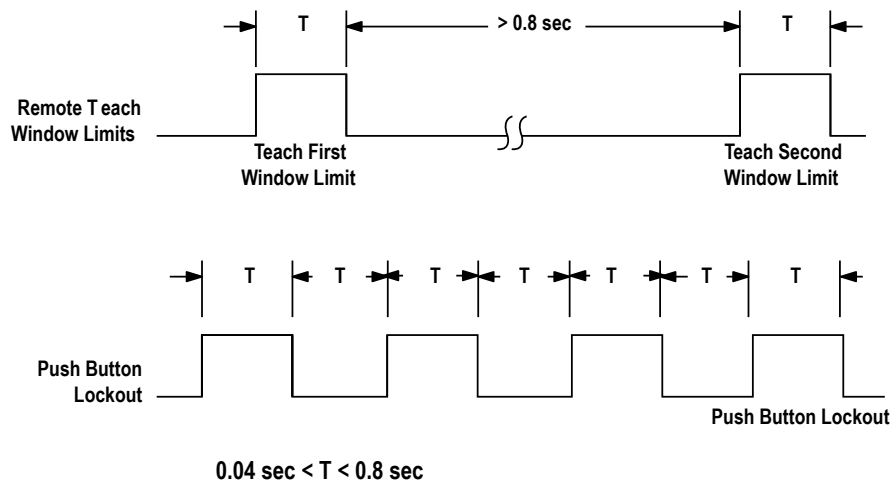


Figure 5. Timing for remote TEACH configuration

## Analog Output

The Q50A 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.)

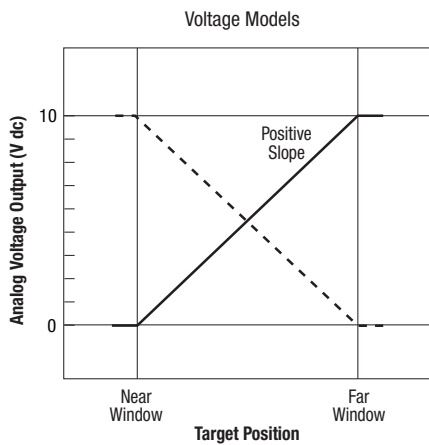


Figure 6. Analog voltage output as a function of target position (loss of signal – 0 V)

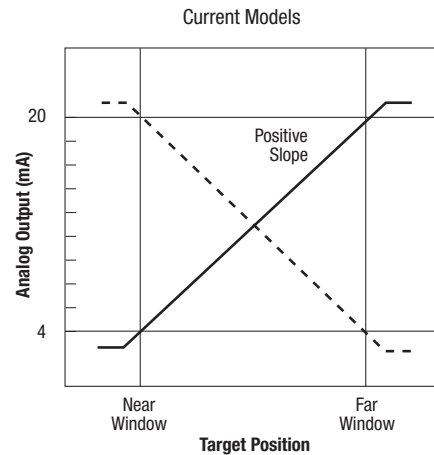


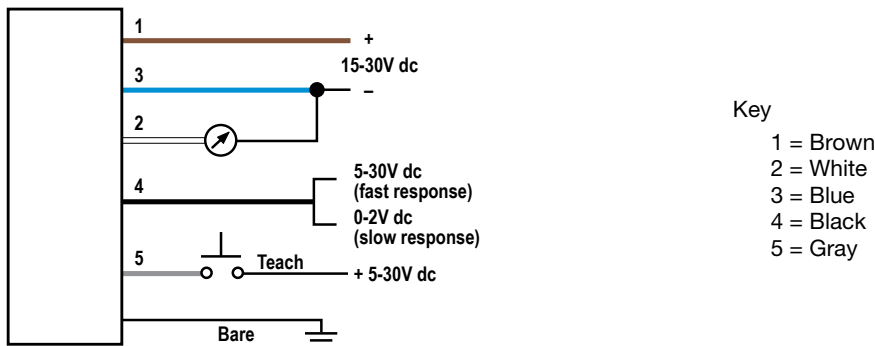
Figure 7. Analog current output as a function of target position (loss of signal – 3.6 mA)

## Teaching Analog Limits Using a Fixed 50 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 Q50A mm wide (taught position  $\pm 25$  mm).

## Wiring Diagrams

Quick disconnect wiring diagrams are functionally identical.



# Specifications

### Sensing Range

Q50AV: 50 mm to 150 mm (2 in to 5.9 in)  
 Q50A: 50 mm to 200 mm (2 in to 7.9 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

Q50AV: Visible red, 685 nm (typical); 20 mm dia. (max.) beam size  
 Q50A: Infrared, 880 nm (typical); 20 mm dia. (max.) 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

### Remote and Speed Input Impedance

15 kΩ

### Output Protection Circuitry

Protected against output short-circuit

### Output Response Time

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

### Linearity

±1.5 mm

### Temperature Drift

From 0 °C to 50 °C: 0.08 mm/°C  
 From -10 °C to 55 °C: 0.11 mm/°C

### Certifications



### 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

Model	Distance						
	50 mm	75 mm	100 mm	125 mm	150 mm	175 mm	200 mm
<b>Q50AV</b>	5 mm	10 mm	15 mm	20 mm	25 mm	-	-
<b>Q50A</b>	5 mm	10 mm	15 mm	20 mm	25 mm	35 mm	50 mm

### Ambient Light Immunity

<10,000 Lux

### Construction

Housing: Molded ABS/Polycarbonate  
 Window Lens: Acrylic

### Environmental Rating

IEC IP67, NEMA 6

### Connections

2 m (6.5 ft) or 9 m (30 ft) 5-conductor PVC-covered attached cable or Integral 5-pin M12/Euro-style male 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

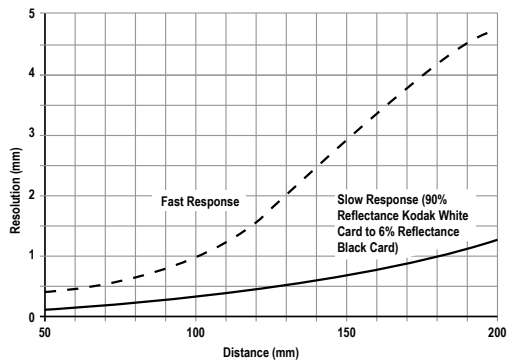
Allow 15-minute warm-up for maximum linearity

### Hardware

M3 hardware is included

### Resolution<sup>4</sup>

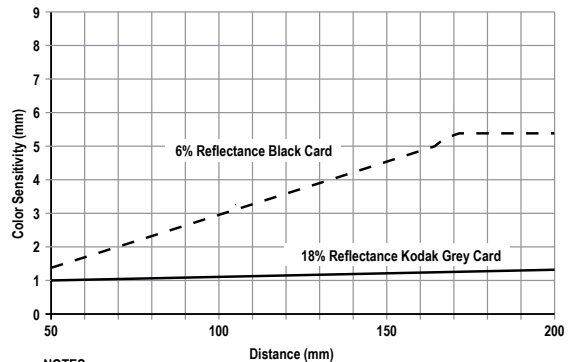
Target Distance: 100 mm  
 Slow Response: 0.5 mm maximum  
 Fast Response: 2 mm maximum



NOTE: Resolution is independent of color (90% Kodak White Card to 6% Black)

Figure 8. Q50A Resolution

### Color Sensitivity (typical)



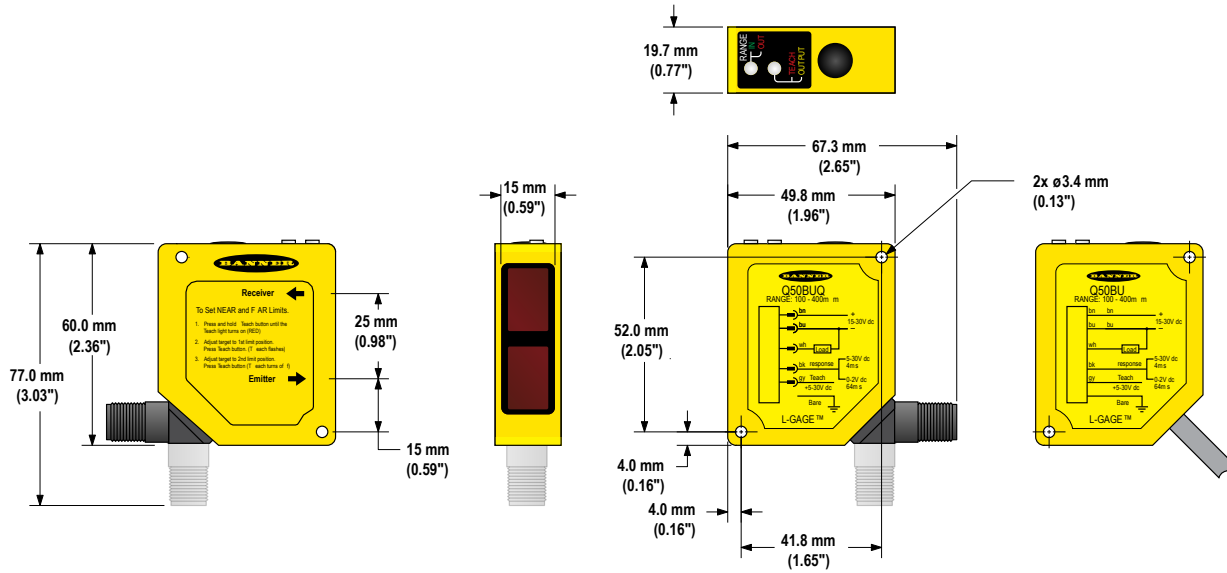
NOTES:  
 Color sensitivity is independent of response time  
 Q50A (infrared models) span is 50-200 mm  
 Q50AV (visible models) span is 50-150 mm

Figure 9. Q50A 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% or 18% reflectance surface.)

<sup>4</sup> Slow performance shown; with fast response, resolution is four times larger.

## Dimensions

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



## Accessories

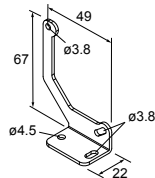
### Cordsets

5-Pin Threaded M12/Euro-Style Cordsets with Shield—Single Ended				
Model	Length	Style	Dimensions	Pinout (Female)
MQDEC2-506	2 m (6.56 ft)	Straight		<p>1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray</p>
MQDEC2-515	5 m (16.4 ft)			
MQDEC2-530	9 m (29.5 ft)			
MQDEC2-550	15 m (49.2 ft)			
MQDEC2-506RA	2 m (6.56 ft)	Right-Angle		
MQDEC2-515RA	5 m (16.4 ft)			
MQDEC2-530RA	9 m (29.5 ft)			
MQDEC2-550RA	15 m (49.2 ft)			

### Brackets

#### SMBQ50

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



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