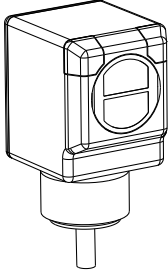


Q40 Sensor: AC Voltage



Instruction Manual

Self-contained, ac-operated sensors



- Featuring EZ-BEAM® technology for reliable sensing without the need for adjustments
- Rectangular 40 mm plastic housing with 30 mm threaded mounting base in opposed, retroreflective or fixed-field modes
- Completely epoxy-encapsulated to provide superior durability, even in harsh sensing environments rated to IP69K
- Innovative dual-indicator system for simple sensor performance monitoring
- 20 to 250 V ac (3-wire hookup); SPST solid-state switch output, maximum load 300 mA



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 ¹	Sensing Mode	Range	LED	Output
Q403E	<p>OPPOSED</p>	60 m (200 ft)	Infrared, 950 nm	-
Q40AW3R				LO
Q40RW3R				DO
Q40AW3LP	<p>POLAR RETRO</p>	6 m (20 ft)	Visible red, 680 nm	LO
Q40RW3LP				DO
Q40AW3FF200	<p>FIXED-FIELD</p>	200 mm (8 in) cutoff	Infrared, 880 nm	LO
Q40RW3FF200		DO		
Q40AW3FF400		400 mm (16 in) cutoff		LO
Q40RW3FF400		DO		
Q40AW3FF600		600 mm (24 in) cutoff		LO
Q40RW3FF600		DO		

Fixed-Field Mode Overview

Q40 self-contained fixed-field sensors are small, powerful, infrared diffuse mode sensors with far-limit cutoff (a type of background suppression). Their high excess gain and fixed-field technology allow detection of objects of low reflectivity, while ignoring background surfaces.

The cutoff distance is fixed. Backgrounds and background objects must always be placed beyond the cutoff distance.

¹ Standard 2 m (6.5 ft) cable models are listed.

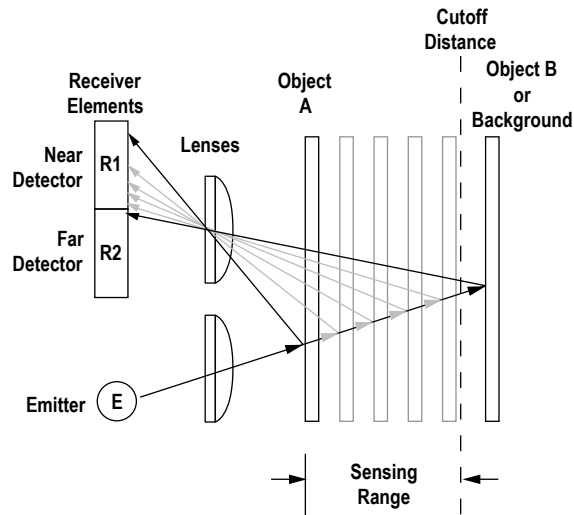
- To order **9 m (30 ft) cable**: add suffix "**W/30**" (for example, **Q403E W/30**).
- To order **4-pin Euro-style QD models**: add suffix "**Q1**" (for example, **Q403EQ1**). A model with a QD connector requires a mating cable.



Fixed-Field Sensing – Theory of Operation

The Q40 compares the reflections of its emitted light beam (E) from an object back to the sensor's two differently aimed detectors, R1 and R2. See [Figure 1](#) on page 2. If the near detector's (R1) light signal is stronger than the far detector's (R2) light signal (see object A in the Figure below, closer than the cutoff distance), the sensor responds to the object. If the far detector's (R2) light signal is stronger than the near detector's (R1) light signal (see object B in the Figure below, beyond the cutoff distance), the sensor ignores the object.

The cutoff distance for the Q40 is fixed at 200, 400 or 600 millimeters (8, 16, or 24 inches). Objects lying beyond the cutoff distance are usually ignored, even if they are highly reflective. However, under certain conditions, it is possible to falsely detect a background object (see [Background Reflectivity and Placement](#) on page 2).



Object is sensed if amount of light at R1 is greater than the amount of light at R2

Figure 1. Fixed-Field Concept

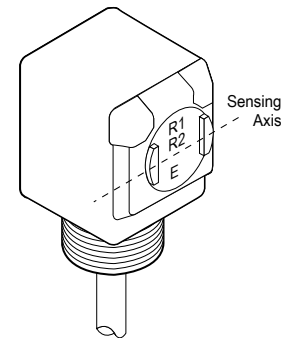


Figure 2. Fixed-Field Sensing Axis

In the drawings and information provided in this document, the letters E, R1, and R2 identify how the sensor's three optical elements (Emitter "E", Near Detector "R1", and Far Detector "R2") line up across the face of the sensor. The location of these elements defines the sensing axis, see [Figure 2](#) on page 2. The sensing axis becomes important in certain situations, such as those illustrated in [Figure 5](#) on page 3 and [Figure 6](#) on page 3.

Installation

Sensing Reliability

For highest sensitivity, position the target for sensing at or near the point of maximum excess gain. Maximum excess gain for all models occurs at a lens-to-object distance of about 40 mm (1.5 in). Sensing at or near this distance makes the maximum use of each sensor's available sensing power. The background must be placed beyond the cutoff distance. Note that the reflectivity of the background surface also may affect the cutoff distance. Following these guidelines improves sensing reliability.

Background Reflectivity and Placement

Avoid mirror-like backgrounds that produce specular reflections. A false sensor response occurs if a background surface reflects the sensor's light more to the near detector (R1) than to the far detector (R2). The result is a false ON condition ([Figure 3](#) on page 3). Correct this problem by using a diffusely reflective (matte) background, or angling either the sensor or the background (in any plane) so the background does not reflect light back to the sensor ([Figure 4](#) on page 3). Position the background as far beyond the cutoff distance as possible.

An object beyond the cutoff distance, either stationary (and when positioned as shown in [Figure 5](#) on page 3), or moving past the face of the sensor in a direction perpendicular to the sensing axis, may cause unwanted triggering of the sensor if more light is reflected to the near detector than to the far detector. Correct the problem by rotating the sensor 90° ([Figure 6](#) on page 3). The object then reflects the R1 and R2 fields equally, resulting in no false triggering. A better solution, if possible, may be to reposition the object or the sensor.

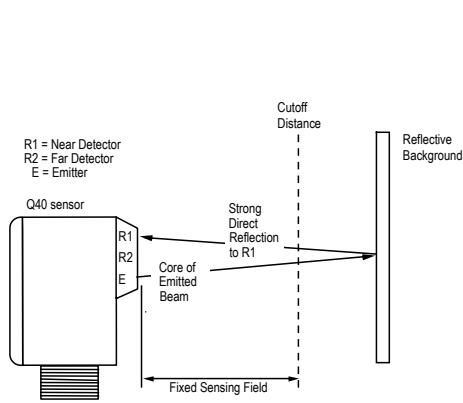


Figure 3. Reflective Background - Problem

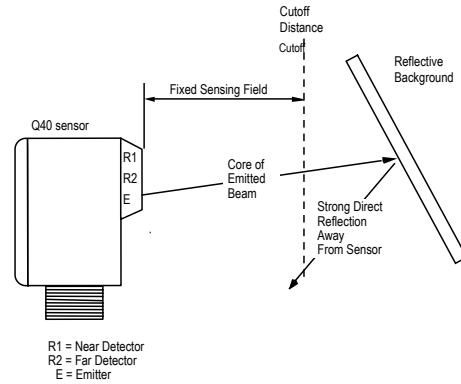
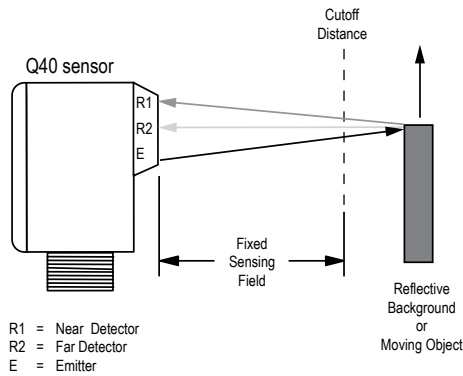
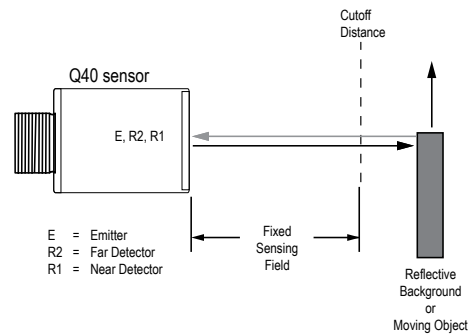


Figure 4. Reflective Background - Solution



A reflective background object in this position or moving across the sensor face in this axis and direction may cause a false sensor response.

Figure 5. Object Beyond Cutoff - Problem



A reflective background object in this position or moving across the sensor face in this axis is ignored.

Figure 6. Object Beyond Cutoff - Solution

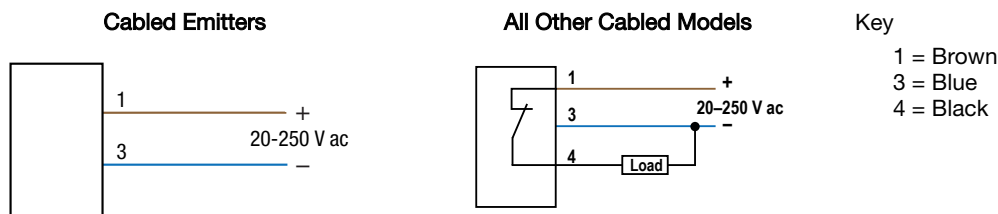
Color Sensitivity

The effects of object reflectivity on cutoff distance, though small, may be important for some applications. It is expected that at any given cutoff setting, the actual cutoff distance for lower reflectance targets is slightly shorter than for higher reflectance targets. This behavior is known as color sensitivity.

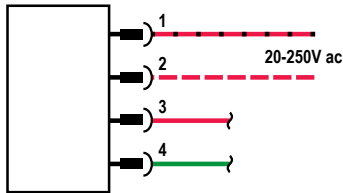
For example, an excess gain of 1 for an object that reflects 1/10 as much light as the 90% white card is represented by the horizontal graph line at excess gain = 10. An object of this reflectivity results in a far limit cutoff of approximately 190 mm (7.5 in) for the 200 mm (8 in) cutoff model, for example; and 190 mm represents the cutoff for this sensor and target.

These excess gain curves were generated using a white test card of 90% reflectance. Objects with reflectivity of less than 90% reflect less light back to the sensor, and thus require proportionately more excess gain in order to be sensed with the same reliability as more reflective objects. When sensing an object of very low reflectivity, it may be especially important to sense it at or near the distance of maximum excess gain.

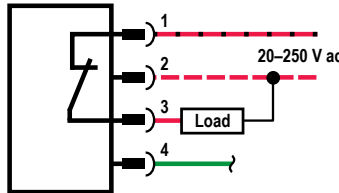
Wiring Diagrams



QD Emitters (4-pin Micro-Style)



All Other QD Models (4-pin Micro-Style) Key



- 1 = Red/Black
- 2 = Red/White
- 3 = Red
- 4 = Green

Specifications

Supply Voltage and Current

20 V ac to 250 V ac (50/60 Hz)
 Average current: 20 mA
 Peak current: 200 mA at 20 V ac, 500 mA at 120 V ac, 750 mA at 250 V ac

Supply Protection Circuitry

Protected against transient voltages

Output Configuration

SPST solid-state ac switch; Three-wire hookup; Choose light operate or dark operate models
Light Operate: N.O. output conducts when sensor sees its own (or the emitter's) modulated light
Dark Operate: Output conducts when the sensor sees dark

Output Rating

300 mA maximum (continuous)
Fixed-Field models: derate 5 mA/°C above +50°C (122°F)
Inrush Capability: 1 amp for 20 milliseconds, non-repetitive
OFF-state leakage current: < 100 microamps
ON-state saturation voltage: 3 V at 300 mA ac; 2 V at 15 mA ac

Required Overcurrent Protection



WARNING: Electrical connections must be made by qualified personnel in accordance with local and national electrical codes and regulations.

Overcurrent protection is required to be provided by end product application per the supplied table.
 Overcurrent protection may be provided with external fusing or via Current Limiting, Class 2 Power Supply.
 Supply wiring leads < 24 AWG shall not be spliced.
 For additional product support, go to www.bannerengineering.com.

Supply Wiring (AWG)	Required Overcurrent Protection (Amps)
20	5.0
22	3.0
24	2.0
26	1.0
28	0.8
30	0.5

Output Protection Circuitry

Protected against false pulse on power-up

Output Response Time

Opposed mode: 16 milliseconds ON, 8 milliseconds OFF
Other models: 16 milliseconds ON and OFF



Note: 100 ms delay on power-up

Repeatability

Opposed mode: 2 milliseconds
Other modes: 4 milliseconds
 Repeatability and response are independent of signal strength

Indicators

Two LEDs (Green and Amber)
Green ON steady: power to sensor is ON
Amber ON steady: sensor sees light
Amber flashing: excess gain marginal (1 to 1.5x) in light condition

Construction

PBT polyester housing; polycarbonate (opposed mode) or acrylic lens

Environmental Rating

Leakproof design rated NEMA 6P, DIN 40050 (IP69K per DIN 40050-9)

Connections

2 m (6.5 ft) or 9 m (30 ft) attached cable, or 4-pin Micro-style quick-disconnect fitting

Operating Conditions

Temperature: -40 °C to +70 °C (-40 °F to +158 °F)
 90% at +50 °C maximum relative humidity (non-condensing)

Vibration and Mechanical Shock

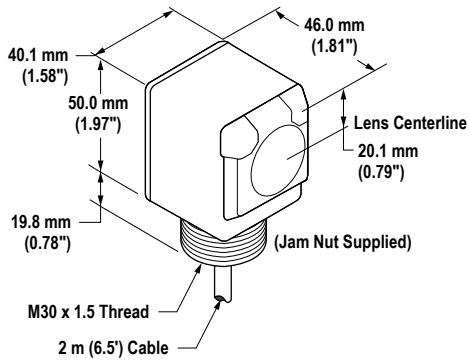
All models meet MIL-STD-202F, Method 201A (Vibration: 10 Hz to 60 Hz maximum, 0.06 inch (1.52 mm) double amplitude, 10G acceleration) requirements. Method 213B conditions H&I. Shock: 75G with device operating; 100G for non-operation

Certifications

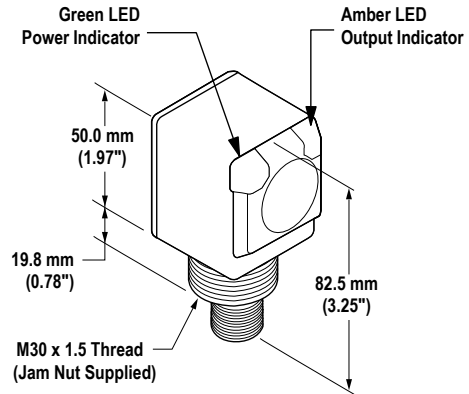


Dimensions

Cabled Models



QD Models

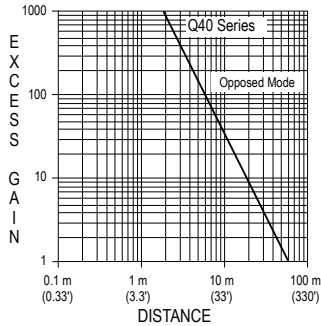


All measurements are listed in millimeters [inches], unless noted otherwise.

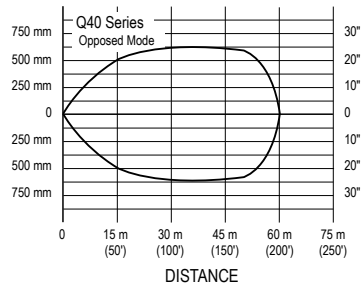
Performance Curves

Opposed Mode

Excess Gain



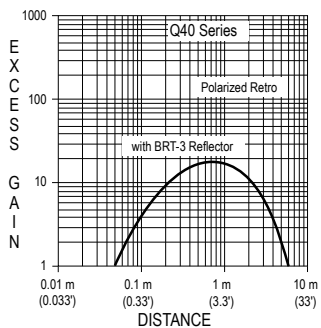
Beam Pattern



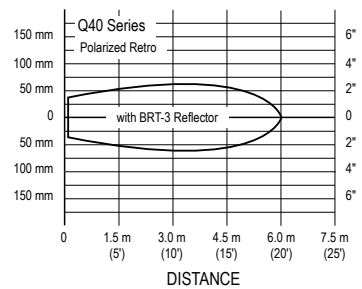
Polarized Retroreflective

Performance based on use of a model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending on the efficiency and reflective area of the retroreflector used.

Excess Gain



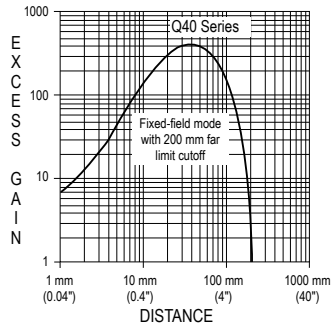
Beam Pattern



Fixed Field

Performance based on use of a 90% reflectance white test card. † Focus and spot sizes are typical.

Fixed-Field—200 mm

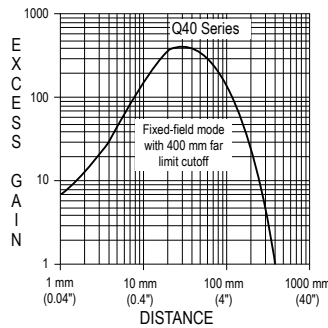


Ø 16 mm spot size @ 35 mm focus
 Ø 20 mm spot size @ 200 mm cutoff

† Using 18% gray test card: Cutoff distance will be 95% of value shown.

† Using 6% black test card: Cutoff distance will be 90% of value shown.

Fixed-Field—400 mm

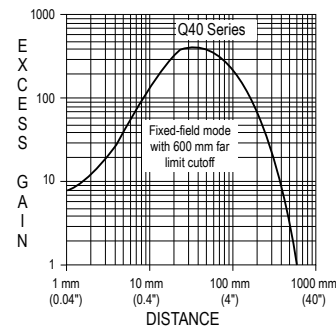


Ø 17 mm spot size @ 35 mm focus
 Ø 25 mm spot size @ 400 mm cutoff

† Using 18% gray test card: Cutoff distance will be 90% of value shown.

† Using 6% black test card: Cutoff distance will be 85% of value shown.

Fixed-Field—600 mm Excess Gain



Ø 17 mm spot size @ 35 mm focus
 Ø 30 mm spot size @ 600 mm cutoff

† Using 18% gray test card: Cutoff distance will be 85% of value shown.

† Using 6% black test card: Cutoff distance will be 75% of value shown.

Quick-Disconnect (QD) Cables

4-Pin Micro-Style Cordsets—Single Ended				
Model	Length	Style	Dimensions	Pinout (Female)
MQAC-406	1.83 m (6 ft)	Straight		<p>1 = Red/Black 2 = Red/White 3 = Red 4 = Green</p>
MQAC-415	4.57 m (15 ft)			
MQAC-430	9.14 m (30 ft)			
MQAC-406RA	1.83 m (6 ft)	Right-Angle		
MQAC-415RA	4.57 m (15 ft)			
MQAC-430RA	9.14 m (30 ft)			

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